RT 350

Operation of industrial controllers

Description

- **familiarisation with an industrial controller**
- **digital controller with freely selectable parameters**
- **simulation of controlled systems**
- **configuration software**

This experimental unit familiarises students with the operation and function of a state-of-the-art industrial controller.

The controller has freely accessible inputs and outputs. Defined input levels and step signals can be produced with a signal generator. A digital voltmeter is used to measure the input and output signals. A simple first order lag is simulated to allow the response and stability of a closed control loop to be investigated.

All signals are accessible via lab jacks so a standard x/y plotter or line recorder can be used. It is also possible to control external controlled system models with this controller. As well as manual configuration and parameter setting with keys, the controller can be configured (configuration software supplied) from a PC via USB.

Learning objectives/experiments

- basic concept of an industrial controller
  - operator control levels
  - parameter level
  - configuration level
- learning about basic terminology and methods of process control
  - static and dynamic transfer function
  - step response
  - reference variable step
  - closed control loop
- setting controller parameters
  - setting input and output channels
  - scaling displays
  - using PC-based configuration tools

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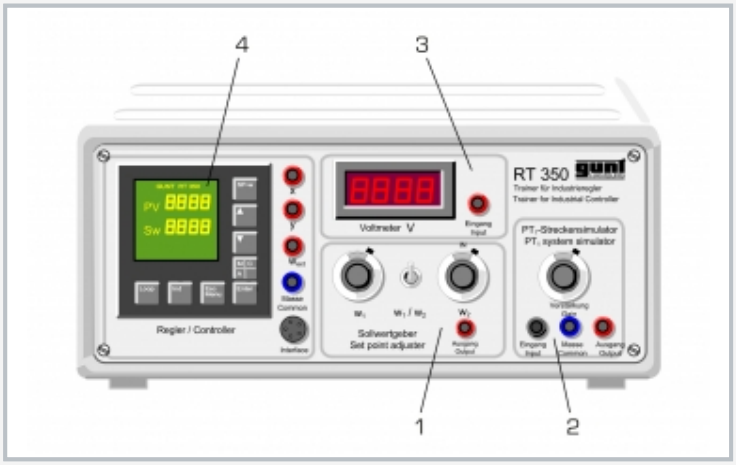
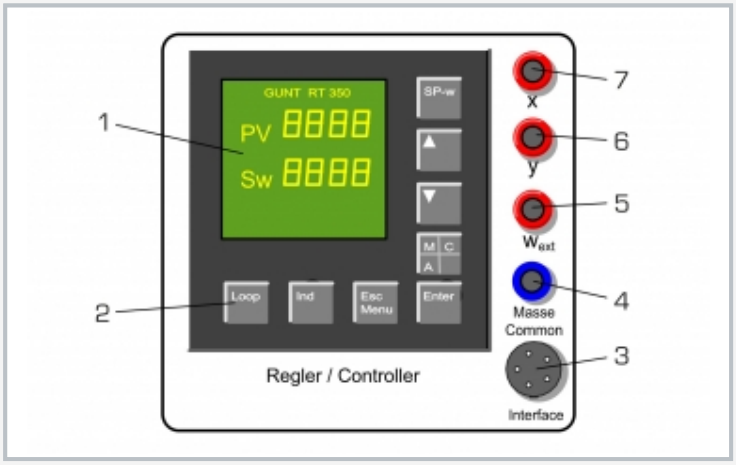
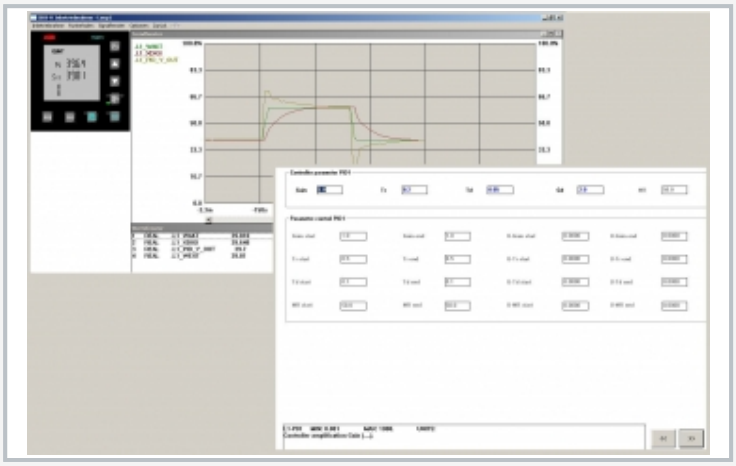


1 signal generator with switch between two pre-defined levels, 2 first order lag controlled system simulator with adjustable gain, 3 digital voltmeter, 4 controller



Controller: 1 LC display, 2 operating buttons, 3 configuration interface, 4 earth connection, 5 reference variable input, 6 manipulating variable output, 7 controlled variable input



Configuration software with time log window and parameter selection

Specification

[1] experimental unit for industrial controllers
[2] digital controller, configurable
[3] signal generator with potentiometer
[4] digital voltmeter
[5] first order lag controlled system simulator
[6] all variables accessible as analogue signals at lab jacks
[7] configuration software; software via USB under Windows 7, 8.1, 10

Technical data

Controller
- configurable as P, PI or PID controller
- proportional gain X_p: 0...999,9%
- integral action time T_n: 0...3600s
- derivative time T_v: 0...1200s
- 2 inputs, 1 output

Voltmeter
- measuring range: 0...20V
- resolution: 10mV

Reference variables generator
- 2 voltages selectable
- output voltage: 0...10V

Controlled system simulator
- controlled system type: first order lag
- time constant: 20s
- controlled system gain: 1...10
- process variables as analogue signals: 0...10V

Connection of external instruments (e.g. oscilloscope, line recorder) via lab jacks

230V, 50Hz, 1 phase
230V, 60Hz, 1 phase
120V, 60Hz, 1 phase
UL/CSA optional
LxWxH: 370x330x150mm
Weight: approx. 5kg

Required for operation

PC with Windows recommended

Scope of delivery

1 experimental unit
1 configuration software + USB cable
1 set of laboratory cables
1 set of instructional material

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Operation of industrial controllers

Optional accessories

020.30009	WP 300.09	Laboratory trolley

RT 380
Optimization of control loops

Description

- **closed-loop control system response**
- **choice of optimum controller parameters**
- **tuning rules such as Ziegler-Nichols**
- **stability and transient response**
- **software simulation of controlled systems**

This experimental unit with the interaction between controller and controlled system, the objective being for the closed control loop, comprising the controller and the controlled system, to exhibit the desired optimum response. The setting of controller parameters – a key practical aspect – can be practised safely and intensively using simulation software. Concepts such as open and closed loop control, stability, step response, disturbance and control response are clearly demonstrated.

The particular feature of this experimental unit is that no real controlled systems are used; the controlled system is simulated on a PC by a simulation program developed by GUNT. This principle is in widespread application in product development in industry and is known as Hardware in Loop (HIL).

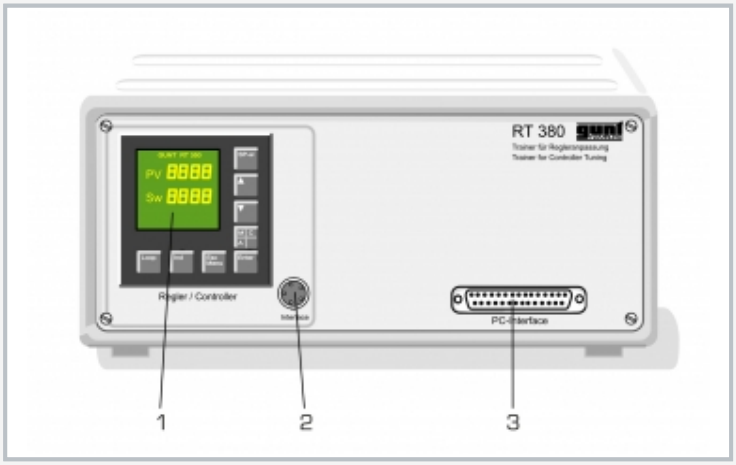
All major types of controlled systems can be selected in the program. The controlled system parameters can be set within broad limits so that – unlike actual controlled systems – extreme parameter situations can be investigated. The time response can be recorded and analysed using the software. The controller and the PC are connected by a data acquisition card with AD and DA converters.

The controller that is used can be easily configured from the PC across an interface using the software provided.

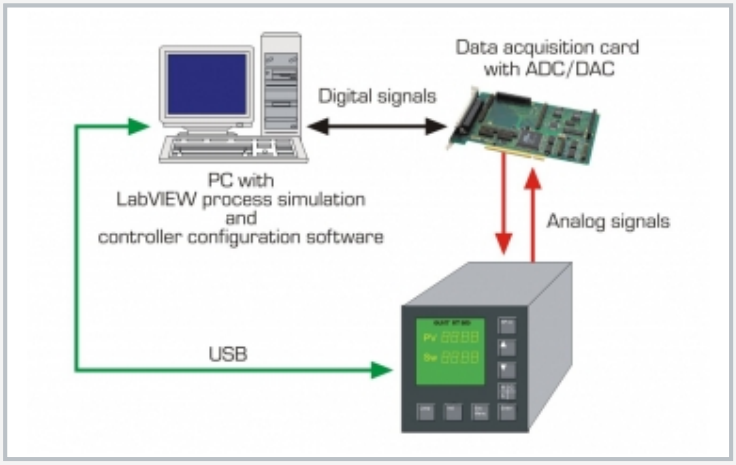
Learning objectives/experiments

- learning basic terminology and methods involved in process control
  - control loop comprising controller and controlled system
  - difference between open and closed loop control
- adapting the controller to different controlled systems
  - determining the controlled system parameters
  - choosing optimum controller parameters
  - using commonly applied tuning rules
  - investigating control and disturbance response
  - investigating the stability of the closed control loop

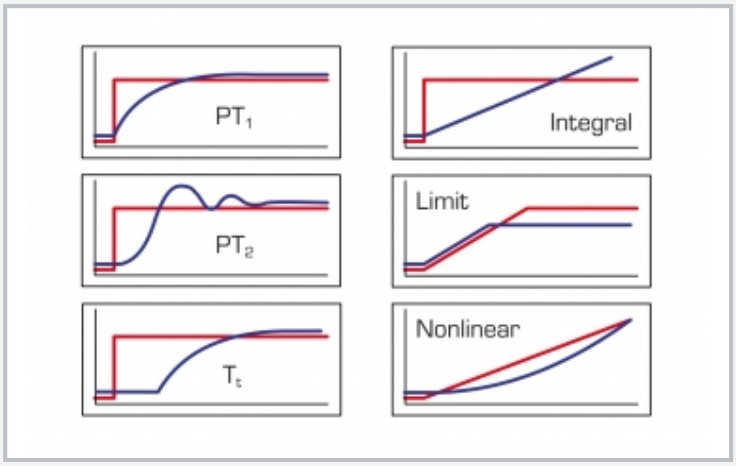
RT 380
Optimization of control loops



1 controller, 2 interface for controller parameter setting, 3 interface with analogue signals for data acquisition card



The real controller works together with a simulated controlled system (HIL: Hardware in Loop)



A wide range of controlled system characteristics can be simulated: PT_1 first order lag; PT_2 second order lag; T_t time-delayed process

Specification

[1] experimental unit for controller tuning
[2] digital controller, configurable as a P, PI or PID controller with interface
[3] interface for PC
[4] data acquisition card for PC
[5] GUNT simulation software for different controlled system types, such as first and second order lags, time-delayed systems etc.
[6] recording and evaluation of time response on PC
[7] configuration software for process controller
[8] software via PCI under Windows 7, 8.1, 10

Technical data

Controller
- configurable as P, PI or PID controller
- proportional gain X_p: 0...999,9%
- integral action time T_n: 0...3600s
- derivative time T_v: 0...1200s

Process variables as analogue signals: 0...10V
Controlled system simulation models with proportional, integral, first-order lag, second-order lag
Time-delayed response, non-linearity and limitation possible

230V, 50Hz, 1 phase
230V, 60Hz, 1 phase
120V, 60Hz, 1 phase
UL/CSA optional
LxWxH: 370x330x150mm
Weight: approx. 5kg

Required for operation

PC with Windows

Scope of delivery

1 experimental unit
1 data acquisition card
1 software CD with GUNT simulation software for controlled systems
1 configuration software CD for the controller
1 set of cables
1 set of instructional material