

# 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.

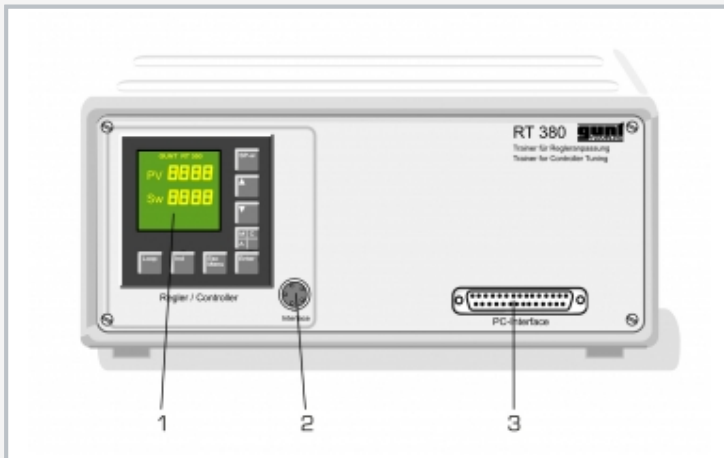
The controller that is used can be easily configured from the PC across an interface using the software provided.

### Learning objectives/experiments

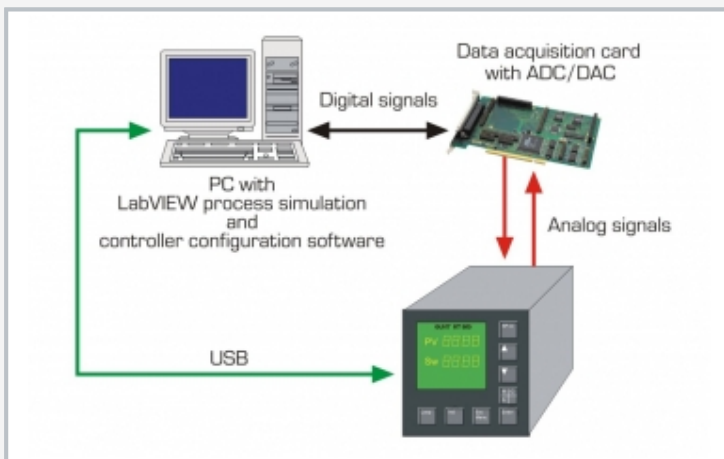
- learning basic terminology and methods involved in process control
  - ▶ control loop comprising controller and controlled system
  - ▶ difference between open and closed loop control
- adapting the controller to different controlled systems
  - ▶ determining the controlled system parameters
  - ▶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

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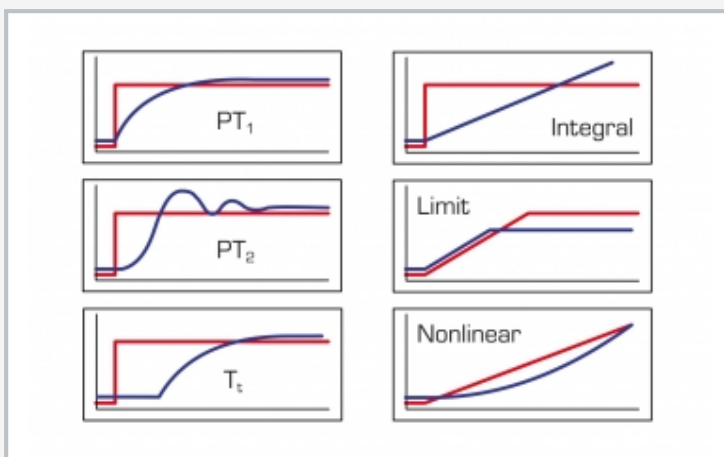
## Optimization of control loops



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