Control Engineering / Power Electronics

5120	PID Board
5125	Power Board
5130	Motor Board
5131	Servo Board
5132	Stepping Board
3891	PC Control Board PCI

9500	**Series** Modulsystem Control Engineering

Software

007035-XXXX	MESSwin
000000 B	WinFACT
007004	WinErs Process Control Training
007004 B	WinErs-Practical Training on Measurement Techniques
005012EVXX	CASPOC

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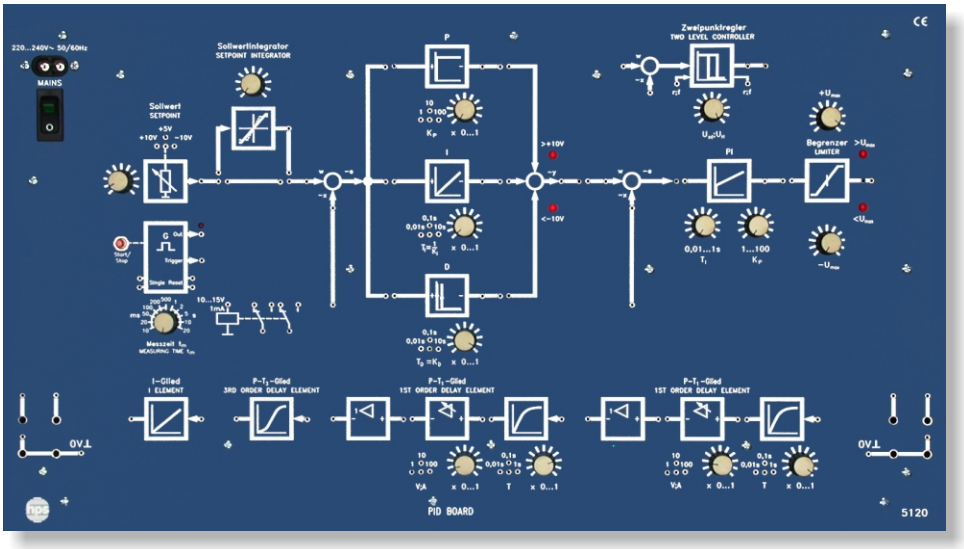
Control Engineering

PID BOARD
Type 5120



Front view of the PID BOARD

- **Universal training unit for control engineering**
- **Built-in power supply unit (short-circuit-proof)**
- **All fundamental experiments possible without storage oscilloscope**
- **A pre-trigger circuit guarantees complete display of the signal**
- **As a test object in computer-aided teaching**
- **With detailed experiment descriptions**

The PID BOARD has been developed by hps System Technik especially for basic and further experimentation in control engineering.

The unit can also be used as a controller for the following hps systems:

- POWER BOARD (Type 5125)
- MOTOR BOARD (Type 5130)
- SERVO BOARD (Type 5131)
- Temperature and Brightness Controlled System (Type 5125.5)

The characteristic data of all the controllers are settable within a wide range by connectors and potentiometers.

The polarity of the signals can be adapted to the requirements of the overall circuit or the wishes of the experiment leader by various summers, comparators and inverters.

Limit value sensors at the output of the controllers report exceeding of the range clearly with LEDs.

One I-element, several delay elements and P-elements are available for the electronic simulation of controlled systems.

With a few exceptions, all the elements of the control circuit with a time-dependent behaviour are designed so that their jump reply can be Measured with a normal oscilloscope and a storage oscilloscope as well as with a Y-t recorder.

Repetition frequencies up to 100 Hz are possible for operation with an oscilloscope. Measurements with a recorder can be conducted as a one-time procedure at times in the seconds range.

The decisive factor in the reproducibility and comfort for the measurements is the clock generator which hps SystemTechnik has developed especially for this Board.

When an oscilloscope is used, this generator enables the measuring process to be repeated cyclically, whereby all the participating capacitors are discharged before each cycle. A pre-trigger circuit guarantees an optimum display of the signal on the oscilloscope.

For measurements with a recorder, every measuring cycle can be triggered individually. The trigger output is available in connection with a relay for controlling the stylus.

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PID BOARD
Type 5120

The process control can also be controlled by a computer or a PLC through an additional RESET input.

To conduct the experiments, the PID BOARD is placed on a table or suspended in an hps rack for demonstration purposes.

The PID BOARD can be converted into a portable training unit by simply screwing it into a Box: All the experiments can be conducted directly in the Box. Dust-free storage and protection against transport damages are further advantages of the Box version.

Function Groups on the PID BOARD

Setpoint potentiometer:
voltage: 0 ... +10 V;
0 ... -10 V; 0 ... +5 V

Sequence control:
voltage: 0 ... +10 V
frequency:
approx. 0 ... 100 Hz; can be replugged to single operation

Relay:
with 2 change-over contacts for setpoint jumps and recorder control

Setpoint integrator:
continuously adjustable time constant

Comparator 1:
forms the control difference
e = w - x

P-controller:
proportional correction value K_P adjustable by connectors and potentiometers in the range of approx. 0.1 ... 100

I-controller:
integral action time T_n adjustable by connectors and potentiometers in the range of approx. 1 ms ...10 s

D-controller:
derivative action time adjustable by connectors and potentiometers of approx.
1 ms ... 10 s

Summer:
sums the controller output voltages

Comparator 2:
as additional comparator for setting up a cascade control. Forms the control difference
e = w - x

Two-point controller:
threshold switch with adjustable switching difference

PI controller:
controller for setting up a cascade control

Limiter:
conceived for matching to external control circuit elements and as a level detector for troubleshooting on the PID BOARD. The upper and lower reaction thresholds are separately adjustable.

1st order delay element:
two 1st order delay elements, for simulation of controlled systems, for matching of the feedback signal and the actual value of true controlled systems.

3rd order delay element:
for simulating a controlled system with delay time, e. g. a temperature control. By connecting it in series with the first order delay element, it can be further extended up to 5th order elements.

I-element:
for simulating a controlled system with I-behaviour, for example a filling level or position controlled system

Technical Data

Mains connection
- Voltage: 230 V AC / 115 V AC (110 V AC);
  50 ... 60 Hz; 8 VA

Mechanical data
- The front panel of the PID BOARD is made of 5 mm thick laminate, matt blue in colour with white engraving representing the built-in function groups.
- The rear of the Board is protected with a grey plastic cover. Its shape allows the Board to be placed at an ergonomically favourable angle for example on a table.

Dimensions and weights
- Board version (Type 5120):
  532 x 297 x 110 mm (w x h x d)
  weight: ca. 3.35 kg
- Box version, consisting of:
  PID BOARD (Type 5120) and
  Box (Type 5120.20): 580 x 450 x 155 mm
  total weight: approx. 6.1 kg

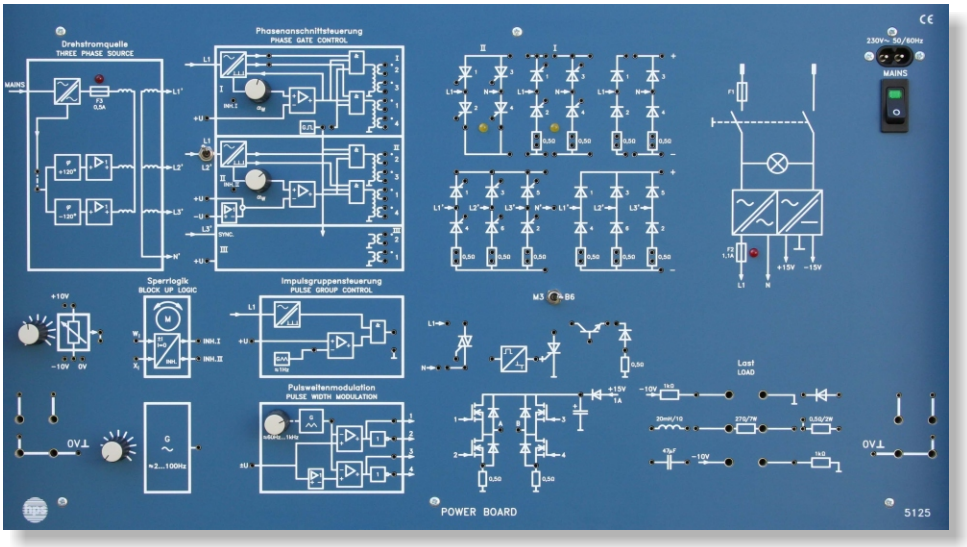
Accessories Recommended

- Experiment manual:
  „Introduction to Control Engineering“
  (Type V 0120)

- Set of Accessories
  (Type 5120.1), consisting of connecting leads and plugs

Subject to technical modification.

Power Electronics / Control Engineering



POWER BOARD (Type 5125)

- **The whole power electronics on one Board**
- **With built-in three-phase source**
- **Connection field for Temperature and Brightness Controlled System**
- **All experiments with protective low voltage (12 V)**
- **Four-quadrant operation with H-circuit (MOS-FET) or antiparallel thyristor bridges**
- **Can be combined with PID BOARD, MOTOR BOARD and STEPPING BOARD**

With the POWER BOARD, hps SystemTechnik offers a demonstration and training system with which experiments covering the whole field of power electronics can be conducted.

Experiments on the single-phase AC supply

- The uncontrolled half-wave rectifier
- The uncontrolled bridge rectifier
- The half-controlled bridge rectifier
- The fully controlled bridge rectifier
- The line-commutated inverter
- Two fully controlled bridge rectifiers, antiparallel with circulating current-free wiring and optical indication by 2 LEDs
- Pulse group control

Experiments on the three-phase supply

- The uncontrolled rectifier (M3)
- The uncontrolled rectifier (B6)
- The controlled rectifier (M3)
- The controlled rectifier (B6)

Experiments on the DC supply

- Basic pulse width modulation (PWM) circuits
- PWM with H-circuit, DC-evaluated
- PWM with H-circuit, sine-evaluated

POWER BOARD

Type 5125

Experiments with the GTO (Gate-Turn-Off)

- Firing pulse conditioning for the GTO
- The GTO as a DC actuator

The POWER BOARD contains ohmic, inductive and capacitive loads for conducting the experiments mentioned above.

Bridgeable shunts are integrated in all the important load current branches for measuring the currents.

In the phase gate control no. I, all the important test points in the circuit are accessible at jacks. This circuit can be used both in single-pulse and multi-pulse mode.

Phase gate control no. II has an additional input for operation with negative setpoint.

This makes it possible to simulate a four-quadrant drive in conjunction with the controlled system MOTOR BOARD (Type 5130).

All firing pulse outputs of the phase gate controls are electrically isolated with firing transformers. In this way,

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POWER BOARD

Type 5125

ground- or potential-free measurements can be carried out.

The basic frequency of the PWM control can be varied for investigation of the smoothing with uniform inductance.

The POWER BOARD is connected to the single-phase mains, the required three-phase voltage is generated internally.

Mechanical Data

The front panel of the POWER BOARD is made of 5 mm thick laminate, matt blue in colour with white engraving. The rear of the Board is protected with a grey plastic cover.

hps SystemTechnik also offers the POWER BOARD in a Box version in addition to the Board version.

Temperature and Brightness Controlled System (Type 5125.5)

This plug-in module is included in the delivery scope of the POWER BOARD and contains:

Type 5125.5

- Actual value acquisition of temperature: by PTC resistor
- Actual value acquisition of brightness: by LDR resistor
- Heat and light source: filament lamp 12 V / 5 W

A connection field wired with the necessary voltage dividers for the measuring resistances is built in the POWER BOARD for accommodating the Temperature and Brightness Controlled System (Type 5125.5).

Accessories Recommended

- Experiment manual: „Introduction to Power Electronics" (Type V 0121)
- Set of Accessories: consisting of connecting plugs and leads (Type 5125.1)

Technical Data

Mains connection
- Voltage: 230 V AC / 115 V AC (110 V AC); 50 ... 60 Hz; 80 VA

Integrated power supplies
- DC voltage: +/- 15 V DC / 2.5 A
- AC voltage (L1): 12 V AC / 1 A
- Three-phase source: switchable for M3 or B6 circuit; $U_{O\ rms}$ = 12 V DC

All power supplies are electrically isolated from each other.

Controls
- Phase gate control I, II and III
- Pulse group control
- Pulse width modulation
- Block-up logic for circulating current-free four-quadrant drive
- GTO pulse shaper
- Signal generator: f = 2 ... 100 Hz (for sine-evaluated PWM)

Rectifiers
- Uncontrolled rectifiers
- Controlled rectifiers (thyristors)
- H-circuit (Power MOS-FET)

Additional semiconductor components
- 1 diode, transistor, GTO thyristor, TRIAC

Load components
- Ohmic load (27)
- Inductive load (20 mH)
- Capacitive load (47 µF)

Adapter field

Serves to adapt 4 mm plugs to 2 mm plugs and for plugging in four adapters (BNC socket ®two 4 mm plugs).

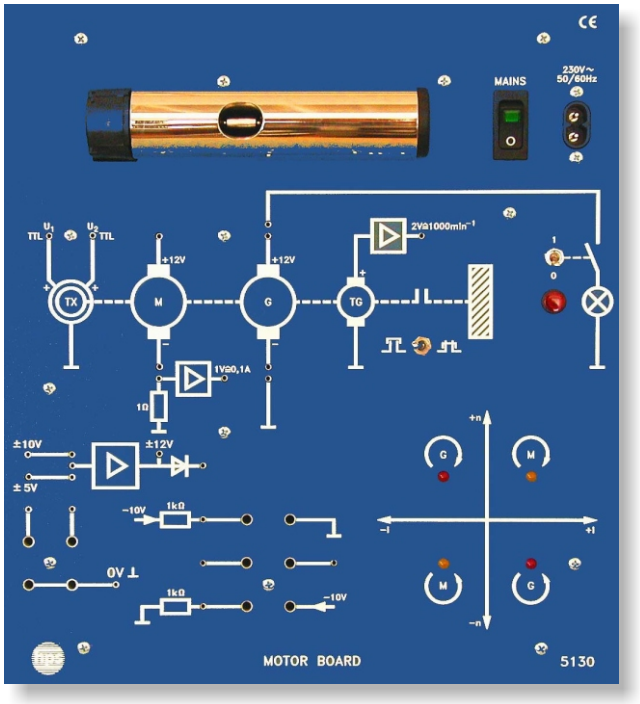
Dimensions and weights
- Board version (Type 5125): 532 x 297 x 130 mm (w x d x h); weights: approx. 5.4 kg
- Box version, consisting of: POWER BOARD (Type 5125) and Box (Type 5125.20) 585 x 425 x 155 mm; weight: approx. 8.8 kg
- Temperature and Brightness Controlled System (Type 5125.5): 37 x 56 x 35 mm (w x d x h), dimensions without plugs; weight: approx. 65 g

Subject to technical modifications.

Control Engineering / Power Electronics

MOTOR BOARD

Type 5130



- **Universal speed control system**
- **Extendable with plug-in module for temperature and brightness control**
- **With integrated four-quadrant display**
- **With variable centrifugal mass**
- **Dual-channel encoder**
- **Built-in four-quadrant Amplifier**

MOTOR BOARD
(Type 5130)

With the MOTOR BOARD hps SystemTechnik offers a controlled system which can be used either in power electronics (e. g. POWER BOARD), in control engineering (e. g. PID BOARD) or in communications technology (PLL, Type 4250).

The MOTOR BOARD contains a machine set comprising:

- DC motor with current actual value acquisition
- DC generator with connectable load
- Tachogenerator with decoupling amplifier
- Connectable mechanical centrifugal mass, realised electronically
- Dual-channel encoder for direct acquisition of speed and direction of rotation
- Built-in sight window for optical recognition of speed and direction of rotation and stroboscopic scanning

A DC power amplifier is built into the MOTOR BOARD for direct connection to a controller or a PLL circuit.

It is possible to plug this amplifier for positive current direction only or for both current directions.

In this way the machine set can be accelerated and decelerated in both directions. Four-quadrant drive is therefore possible.

The momentary operating state of the machine set can be optically monitored.

For this, a four-quadrant indicator is integrated in the MOTOR BOARD which links the current and direction of rotation via a logical circuit and then indicates them on 4 LEDs.

A combined plug-in module „Temperature and Brightness Controlled System" (Type 5125.5) is offered for temperature and brightness control.
A connection field is provided on the MOTOR BOARD which is wired with voltage dividers for actual value acquisition of temperature and brightness.

The MOTOR BOARD has a built-in power supply unit which guarantees electrical isolation from other connected devices.

The following disturbance variables can be applied on the MOTOR BOARD:

- Variation of the mechanical centrifugal mass and the related time constant fluctuation
- Connectable load on the generator

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MOTOR BOARD

Type 5130

Control Engineering / Power Electronics

Mechanical Data

The front panel of the MOTOR BOARD is made of 5 mm thick laminate, matt blue in colour with white engraving representing the built-in function groups.

The rear of the Board is protected with a grey plastic cover. Its shape allows the Board to be placed at an ergonomically favourable angle for example on a table.

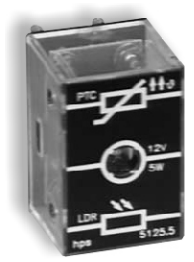
Adapter field
Serves for adapting 4 mm to 2 mm connections and for plugging in two adapters (BNC socket two 4 mm connectors)

Centrifugal mass
Connectable, for altering the time constants, realised electronically

Connection field
For plugging the Temperature and Brightness Controlled System and adapting it to 2 mm jacks. Two resistors serve as voltage dividers for the actual value acquisition of temperature and brightness.

Accessories Recommended

- Experiment manual: „Controlled Systems/Control Circuits" (Type V 0122)
- Temperature and Brightness Controlled System (Type 5125.5)



Type 5125.5

▲ **Temperature and Brightness Controlled System**

Plug-in module consisting of:
actual value acquisition of temperature by PTC resistor; actual value acquisition of brightness by LDR resistor; heat and light source: filament lamp 12 V/5 W

The Temperature and Brightness Controlled System is not part of the delivery scope of the MOTOR BOARD (Type 5130).

Subject to technical modifications.

Technical Data

Mains connection
- Voltages: 230 V AC / 115 V AC (110 V AC); 50 ... 60 Hz; 20 VA;

Motor
- Rated voltage: 12 V
- Rated speed: 5900 min^{-1}
- Speed: max. 8000 min^{-1}
- Current: max. 0.5 A

Generator
- Rated voltage: 12 V
- Maximum current: 0.5 A

Tachogenerator
- Output voltage: 2 V ≙ 1000 min^{-1}; decoupled by amplifier
- R_i = 200

Encoder
- Resolution: 100 lines / rev.
- Output channels: 2
- Output voltage: TTL (decoupled by TTL module)

Load
- Connectable load resistance: 33 / 5 W ; with parallel-circuited lamp

Current actual value acquisition
- Measuring resistance: 1

Series-connected amplifier
- Gain factor: 10
- Internal resistance: 200

DC amplifier
- Input I: 0 ... +/- 10 V
- Gain factor: V = 1.2
- Input II: 0 ... +/- 5 V
- Gain factor: V = 2.4
- Output voltage in four-quadrant operation: 0 ... +/-12 V
- Output current: max. 0.5 A

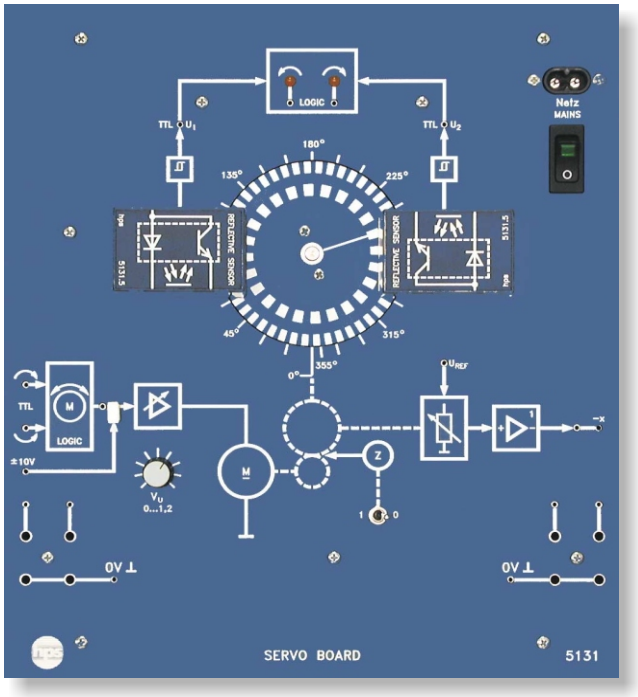
Four-quadrant indicator
4 LEDs in two colours, to distinguish between motor and generator quadrants

Dimensions and weights
- MOTOR BOARD (Type 5130): 266 x 297 x 90 mm (w x h x d); weight: approx. 2.2 kg
- Temperature and Brightness Controlled System (Type 5125.5): 37 x 56 x 35 mm (w x d x h), dimensions without plugs; weight: approx. 65 g

Control Engineering

SERVO BOARD

Type 5131



SERVO BOARD (Type 5131)

- **Universal positioning controlled system**
- **Analog angle acquisition**
- **With switchable disturbance variable (gear play)**
- **With reflective sensors for digital angle acquisition (incremental)**
- **Acquisition of digital speed and direction of rotation**
- **Digital control inputs for both directions of rotation**

With the SERVO BOARD, hps SystemTechnik offers a controlled system which can be used both in analog control engineering (PID BOARD) and in digital control engineering.

The SERVO BOARD contains a DC motor which is coupled to a potentiometer by a gear.

The potentiometer is used for analog position location. To protect the potentiometer, the wiper is decoupled through an amplifier. The actual value is inverted at the output.

The motor of the SERVO BOARD can be controlled digitally in both directions of rotation by TTL inputs and a series-circuited logic.

This makes digital control of the SERVO BOARD possible.

A pre-circuited amplifier is used to match the input signal of -10 V ... +10 V to the 12 V motor voltage.

The unit also has a digital encoder.
This consists among other things of an encoder disk which contains two encoder tracks with a different resolution for digital data acquisition and further processing of speed, angle of rotation and direction of rotation.

A reflective sensor is plugged in to measure the speed and angle of rotation (incremental). Its output signal is fed through a Schmitt trigger.

The reflective sensor can be plugged in two positions in order to examine different resolutions.

An additional reflective sensor can be plugged for digital data acquisition of the direction of rotation. Its output signal has a phase shift of 90°.

If the encoder disk turns to the right, the left-hand reflective sensor is always switched first in relation to the right-hand one because it is reached first by a marker (U_1 before U_2). If the encoder disk turns to the left, the opposite procedure is the case (U_2 before U_1).

A digital logical circuit evaluates the chronologically different signals and provides them to U_1 and U_2 as TTL signals. The states are indicated additionally by LEDs.

A disturbance variable can also be switched to the controlled system. This is the mechanical play of the drive (dead time) which is realised electronically in the SERVO BOARD.

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SERVO BOARD

Type 5131

Control Engineering

Reflective Sensor (Type 5131.5)

Plug-in module with built-in LED photo Darlington transistor.

- Dimensions without plugs: 37 x 56 x 35 mm (w x d x h)
- Weight: approx. 50 g

2 Connection Fields

(4 mm jacks)

For inserting the reflective sensors (Type 5131.5) via the encoder disk.
Two plugging positions each are possible for acquiring the different resolutions.

Adapter Fields

Are used for adapting 4 mm plugging in adapters to 2 mm connectors and for (BNC jacks → 4 mm plugs).

Mechanical Data

The front panel of the SERVO BOARD is made of 5 mm thick laminate, matt blue in colour with white printing representing the built-in function groups.

The rear of the Board is protected with a grey plastic cover. Its shape allows the Board to be placed at an ergonomically favourable angle for example on a table.

Accessories Included

- 2 Reflective Sensors (Type 5131.5)

Technical Data

Mains connection
- Voltage: 230 V AC / 115 V AC (110 V AC); 50 ... 60 Hz; 20 VA;

Motor
- Rated voltage: 12 V
- Current consumption: max. 0.4 A

Encoder disk
- Speed: 125 min^{-1}
- Resolution 1: 24 lines / rev.
- Resolution 2: 48 lines / rev.

DC amplifier
- Input voltage: 0 ... +/-10 V
- Amplification factor: v = 1.2
- Output current: max. 0.5 A

Motor control logic
- Input above: TTL level, log. 1 ≙ right-hand rotation
- Input below: TTL level, log. 1 ≙ left-hand rotation

Disturbance variable (switchable)
Mechanical play in the drive (realised electronically)

Actual value measurement (By potentiometer)
- Resistance: 5 k (+/-15 %)
- Mechanical range of rotation: 320° without stop
- Linearity tolerance: +/-1.5 %

Actual value output
Decoupled through amplifier and inverted for protection of motor Potentiometer
- Output voltage: 0 ... 10 V
- Output resistance: 200

2 outputs (U_1 / U_2)
Output voltage:
TTL, 90° offset, decoupled by TTL component. The output signals are incremental and only available when the reflective sensors are plugged in (Type 5131.5).

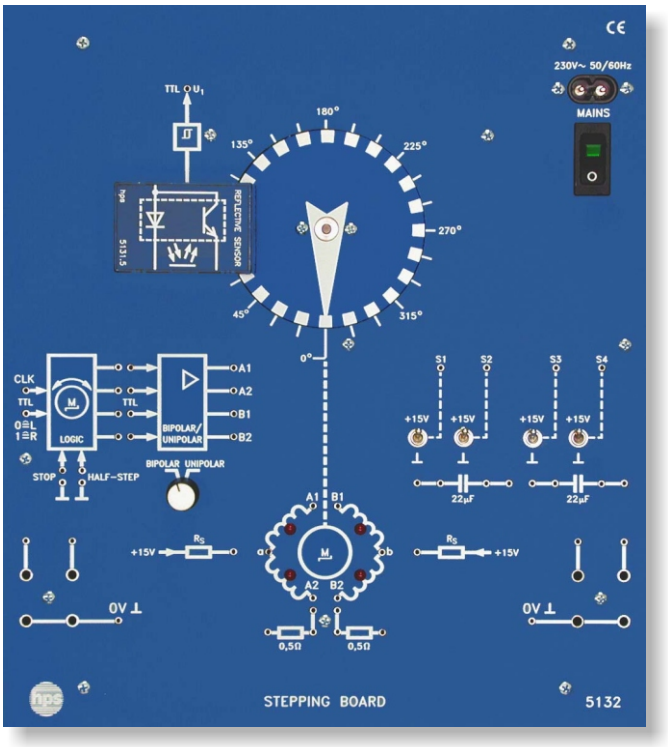
Decoding logic
Indicated by two LEDs for right- and left-hand rotation.
The logical 1 or 0 states can be tapped additionally at 2 mm jacks; TTL signal; decoupled by TTL component.
The signals are available when both reflective sensors are plugged (Type 5131.5).

Dimensions / weight
- 266 x 297 x 95 mm (w x d x h) / approx. 2.1 kg

Subject to technical modification.

STEPPING BOARD

Type 5132



STEPPING BOARD
(Type 5132)

- **Universal controlled system for digital technology and power electronics**
- **Use as synchronous motor and stepping motor**
- **Digital recording of the angle and number of revolutions by a plug-in reflective sensor**
- **Digital control inputs for both senses of rotation**
- **With built-in phase shifter and control logic**
- **Bipolar and unipolar function of the stepping motor**

With the STEPPING BOARD hps SystemTechnik offers a controlled system which can be used in power electronics as well as in digital automatic control engineering.

The STEPPING BOARD in Power Electronics

The STEPPING BOARD can be directly connected to the sine modulated pulse-width modulation (PWM) of the hps POWER BOARD through a built-in phase shifter. This allows to examine the function of a frequency converter in connection with a motor.

The STEPPING BOARD used as a Stepping Motor

The stepping motor used in the STEPPING BOARD can be manually examined in half and full stepping operation (unipolar) by means of 4 switches.

A control logic with downstream amplifier allows operation with a square-wave generator (TTL level), for example with the hps DIGI BOARD 2 or a PC interface.

The direction of rotation can be preselected by logic 0 ≙ L or logic 1 ≙ R.

Without the control logic level the amplifier can be actuated with a digital pulse sequence via four inputs (TTL level), for example with the hps DIGI BOARD 2, the hps PC CONTROL BOARD or a PC interface.

Two built-in amplifiers allow to select unipolar or bipolar drive.

The stepping motor of the STEPPING BOARD is equipped with an encoder disk on which 24 lines are printed. These lines are incrementally registered with a plug-in reflective sensor and converted into the according digital pulses.

The digital pulses are lead over a Schmitt trigger and can be used as TTL signals for determining the number of revolutions and the angle of rotation.

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Digital Technoloy

STEPPING BOARD

Type 5132

To conduct the experiments, the STEPPING BOARD is placed on a table or suspended in an hps bench rack for demonstration purposes.

Mechanical Data

The front panel of the STEPPING BOARD is made of 5 mm Thick laminate, matt blue in colour with white engraving representing the built-in function groups.

The rear of the Board is protected with a grey plastic cover. Its shape allows the Board to be placed at an ergonomically favourable angle for example on a table.

Accessories Included

- Reflective Sensor (Type 5131.5)

with built-in LED photo darlington transistor.
Dimensions (without plugs): 37 x 56 x 35 mm (w x d x h), weight: approx. 50 g

- 4 Connecting plugs, 2 mm

Accessories Recommended

- Experiment manual:
  „Experiments with the STEPPING BOARD"
  (Type V 0123)

- Software:
  DIGIWIN (Type 002035)

Technical Data

Mains connection
- Voltage: 230 V AC / 115 V AC (110 V AC); 20 VA; 50 ... 60 Hz

Motor
- Stepping motor, 2-phase
- Rated voltage: 12 V
- Current consumption: max. 0.4 A per phase
- Resonant frequency: 15 Hz ... 35 Hz

Voltage supply
- +15 V in unipolar mode, for each phase

Encoder disk
- Speed: 300 min^{-1}
- Resolution: 24 pulses (lines) / revolution

Plug-in field (4 mm jacks)
for the use of the Reflective Sensor (Type 5131.5) with the encoder disk

Output (U_1)
Output voltage: TTL, decoupled through TTL module.
The output signal is incremental and only existing with plugged Reflective Sensor.

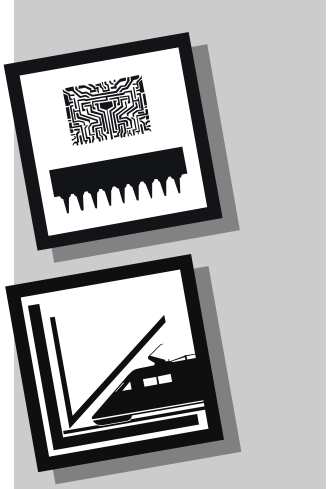
Adapter fields
The adapter fields serve for change-over from 4 mm to 2 mm plug connections and to plug-in adapters (BNC jack → 4 mm plugs).

Amplifier
- All inputs: TTL level

Control logic
- CLK input: TTL level
- Input below: TTL level
  logic 1 ≙ clockwise
  logic 0 ≙ anticlockwise

Dimensions and weight
- 266 x 297 x 90 mm (w x h x d); weight: approx. 1.2 kg

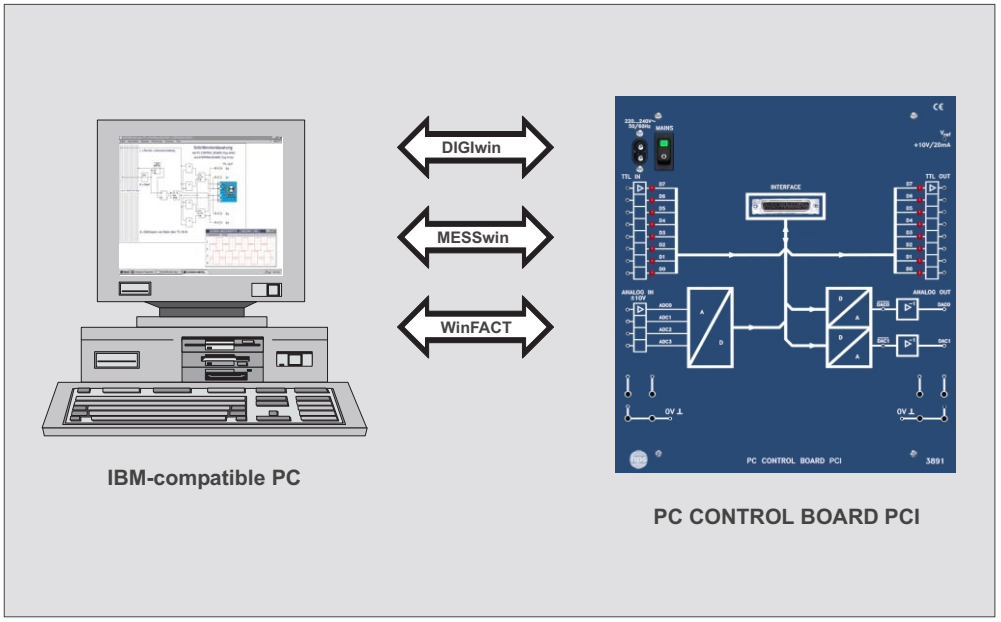
Subject to technical modifications.



Digital Technology / Control Engineering / Measuring

PC CONTROL BOARD PCI

Type 3891



- **Universal interface for digital technology, control engineering and measuring**
- **Software programs for digital technology, control engineering and measuring**
- **Direct connection of hps Boards possible:**
  DIGI BOARD 2, MOTOR BOARD, SERVO BOARD, STEPPING BOARD, and PID BOARD
- **4 analog inputs, 2 analog outputs / 8 digital inputs and outputs**

The PC CONTROL BOARD PCI serves as an interface between a commercially available PC (IBM-compatible) and the Boards for digital technology, control engineering and measuring contained in the hps program.

Three software programs are offered for the PC CONTROL BOARD PCI:

- **DIGIwin**
- **MESSwin**
- **WinFACT**

DIGIWINcan be used to design, simulate and analyse any digital circuits. The program provides numerous components for this purpose.

External devices such as the hps DIGI BOARD 2 can be included in the simulation in connection with the PC CONTROL BOARD PCI.

MESSwinis an object-oriented programming environment for tasks in the field of measuring, controlling and regulating.

MESSwin can be used for example in connection with the PC CONTROL BOARD PCI for position control with the hps SERVO BOARD or for speed control with the hps MOTOR BOARD.

WinFACT is an innovative modular software program for analysis, synthesis and simulation in control engineering with the simulation system BORIS as its basic module.
It can be expanded by a fuzzy shell for analyzing fuzzy systems. The fuzzy systems generated with FLOP can be integrated in the block oriented simulation of BORIS.

WinFACT was especially designed for use in vocational, technical and academic schools, but is also appropriate for use in industry and research.

13 / 14 V02 Technical changes without prior notice!

hps SystemTechnik
Competence in Training

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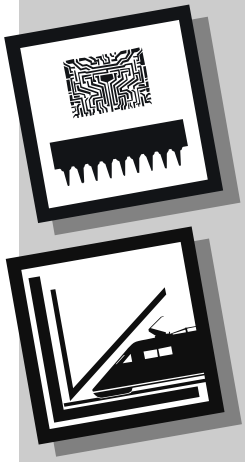


PC CONTROL BOARD PCI

Type 3891

Digital Technology / Control Engineering / Measuring

Mechanical Data

The front panel of the PC CONTROL BOARD PCI is made of 5 mm thick laminate, matt blue in colour with white engraving representing the built-in function groups.

The rear of the Board is protected with a grey plastic cover. Its shape allows the Board to be placed at an ergonomically favourable angle for example on a table.

Accessories Required

- IBM-compatible PC with Windows 95 / 98 / NT 4.0 / 2000 / ME oder XP, free slot for PC Plug-in Card (5 V)
- PCI-I/O Card (hps Type 2736) with Connecting lead

Available Software

- **DIGIwin:**
  Simulation software for digital technology
- **MESSwin:**
  Object-oriented programming environment for tasks in the field of measuring, controlling and regulating.
- **WinFACT:**
  Software for analysis, synthesis und simulation in the control engineering

Technical Data

Mains connection
- 220 V AC ... 240 V AC / 115 V AC (110 V AC); approx. 15 VA; 50 ... 60 Hz

INTERFACE CONNECTION
To the Slot Card in the PC via a 25-pin Sub-D plug

TTL IN
- Inputs: 8 (D0 ... D7)
- Input voltage: TTL level (5 V)
- Display: LED

ANALOG IN
- +/-10 V
- Inputs: 4 (ADC0 ... ADC3); multiplex mode
- Input voltage: -10 V ... +10 V (tolerance: +/-200 mV)
- Input resistance: 1 M

TTL OUT
- Outputs 8 (D0 ... D7)
- Output voltage: TTL level (5 V)
- Display: LED

ANALOG OUT
- 2 Outputs: inverted / not inverted, over digital to analog converters
- Output voltage: -10 V ... +10 V; (tolerance: +/-200 mV)

V_{ref}
- Output voltage: +10 V; 20 mA
  e. g. for SERVO BOARD (Type 5131)

PCI-I/O Card (hps Type 2736)
- PCI slot (5 V)

Adapter fields
The adapter fields serve for change-over from 4 mm to 2 mm plug connections and to plugin adapters (BNC jack 4 mm plugs). Wiring of the inputs and outputs of the PC CONTROL BOARD PCI via 2 mm jacks.

Dimensions and weight
- 266 x 297 x 90 mm (w x h x d); weight: approx. 1.5 kg

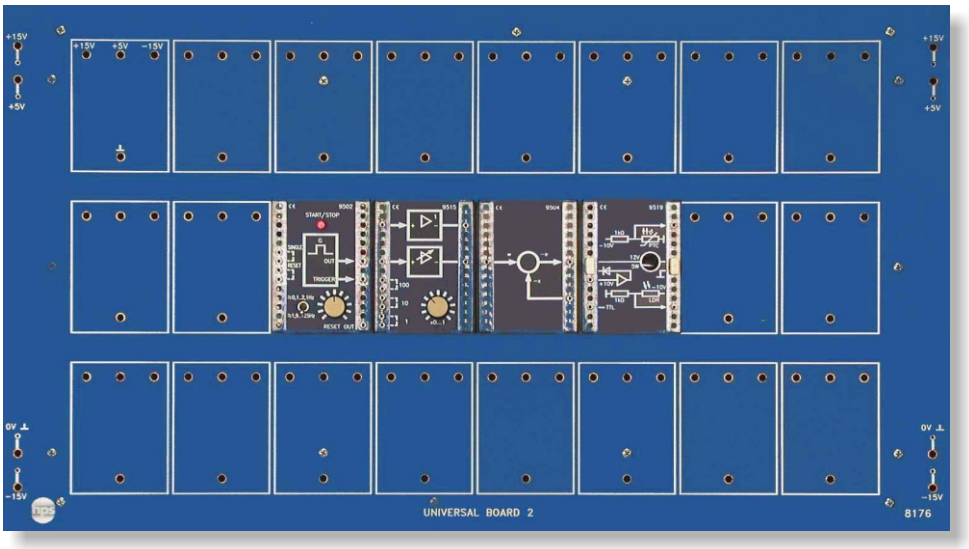
To conduct the experiments, the PC CONTROL BOARD PCI is placed on a table or suspended in an hps bench rack for demon-Stration purposes.

Subject to technical modifications.

Control Engineering

Modulsystem Control Engineering

Series 9500



UNIVERSAL BOARD 2 (Type 8176)

- **Modular training system for fundamental control engineering**
- **Clear experiment set-up because only the modules required for the experiment are plugged in**
- **Short experiment set-up times due to central operating voltage supply**
- **Individual combination possibilities**
- **Extendible with MOTOR BOARD, SERVO BOARD and Temperature and Brightness Controlled System**
- **Detailed experiment descriptions**

hps SystemTechnik has designed the Module System for Control Engineering specially for basic and further experiments in control engineering.

It consists of plug-in modules which are plugged into the

- UNIVERSAL BOARD 1 (Type 8175) or the
- UNIVERSAL BOARD 2 (Type 8176)

for conducting experiments.

- UNIVERSAL ASSEMBLY BOARD (Type 1012.1) or
- UNIVERSAL ASSEMBLY BOARD (Type 1012.2)

can be used to set up the experiments instead of the UNIVERSAL BOARDs.

The Module System for Control Engineering can also be used in connection with other hps systems such as:

- POWER BOARD (Type 5125)
- MOTOR BOARD (Type 5130)
- Temperature and Brightness Controlled System (Type 5125.5)
- SERVO BOARD (Type 5131)

To conduct the experiments, the Boards or Assembly Boards can be placed at an ergonomically favourable angle on the table or suspended in a demonstration rack.

The modules are wired with 2 mm connecting leads and plugs.

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Control Engineering

Modulsystem Control Engineering

Series 9500

General Technical Data

Apart from a few exceptions, all the modules are designed with time-dependent behaviour so that their jump reply can be measured with a standard oscilloscope, a storage oscilloscope and with a y-t recorder.

Repetition frequencies up to about 125 Hz are possible. Measurements with a recorder can be made as a single process at times in the seconds range.

The process control developed by hps SystemTechnik specially for the Module System for Control Engineering is decisive for the reproducibility and comfort of the measurements.

When using an oscilloscope, this control system allows the measuring process to be repeated cyclically, whereby all the capacitors involved are discharged before every cycle.

A pre-trigger circuit provides an optimum signal representation on the oscilloscope.

Every measuring cycle can be triggered singly for measurements with a recorder. The trigger output is available in connection with the Relay (Type 9131.2) for controlling the nib.
The process control can also be controlled by a PC or PLC through an additional RESET input.

Technical Data of the Modules for Control Engineering (Types 9501 ... 9519)

Mechanical construction

The module housings consist of a top section made of unbreakable transparent plastic and a sturdy bottom section made of black, glass-fibre reinforced plastic. The top and bottom sections are held together by two snap-action catches; these enable the housing to be opened quickly and easily.
There are three gold-plated laminated plugs in the base of the housing to plug the modules into the Boards or Assembly Boards. The power supply is fed to the modules through these plugs also. The circuit symbol of the function group contained in the module is printed in white on the front.

Other technical data

- Plug diameter: 4 mm (arrangement in 19 mm grid)
- Operating voltage: +/-15 V DC
- All modules with reverse polarity protection
- All IC components inserted in sockets
- Housing dimensions: 75 x 56 x 35 mm (w x d x h)
- Weight: approx. 0.1 kg

hps SystemTechnik offers 16 modules for conducting experiments in control engineering.

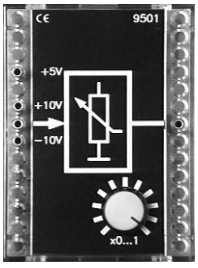
These are illustrated below with designation, technical data and type number.

Control Engineering

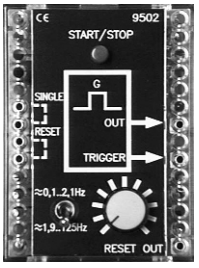
Modules for Control Engineering

Modulsystem Control Engineering

Series 9500



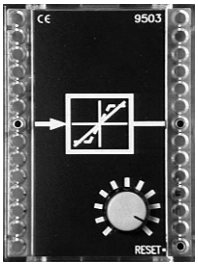
Type 9501



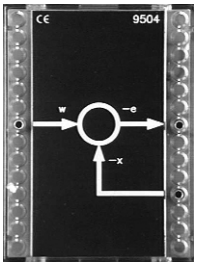
Type 9502

Setpoint Potentiometer **Type 9501**
Setpoint voltage (convertible): 0 ... +5 V; 0 ... +10 V; 0 ... -10 V;
current consumption: max. approx. 25 mA

Sequence Control **Type 9502**
Output voltage: +12 V (squarewave); frequency: 0.1 ... 2.1 Hz/1.9 ... 125 Hz;
with single trigger and repetitive trigger;
current consumption: max. approx. 80 mA



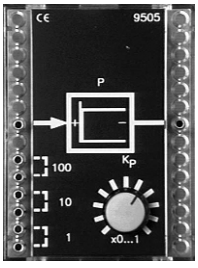
Type 9503



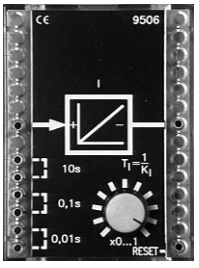
Type 9504

Setpoint Integrator **Type 9503**
The setpoint integrator enables an adjustable integral action factor K_I of
approx. 10 mV/ms ... approx. 1 V/ms
current consumption: max. approx. 16 mA

Comparator **Type 9504**
The comparator is structured as an inverting adder. It forms the difference of
both input signals, the result is inverted.
current consumption: max. 20 mA



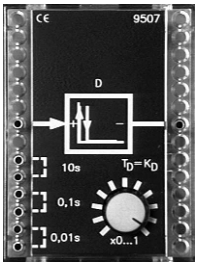
Type 9505



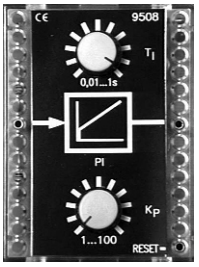
Type 9506

P-Controller **Type 9505**
Proportional action factors K_P: 0 ... 1; 0 ... 10; 0 ... 100;
current consumption: max. approx. 20 mA

I-Controller **Type 9506**
Integration times T_I: 0 ... 0.01 s; 0 ... 0.1 s; 0 ... 10 s;
current consumption: max. approx. 15 mA



Type 9507



Type 9508

D-Controller **Type 9507**
Differentiation times T_D: 0 ... 0.01 s; 0 ... 0.1 s; 0 ... 10 s;
current consumption: max. approx. 10 mA

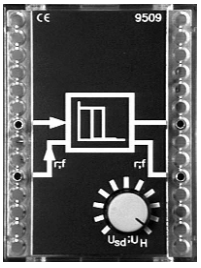
PI-Controller **Type 9508**
Proportional action factor K_P: approx. 1 ... 100;
integration time T_I: approx. 0.01 s ... 1s;
current consumption: max. approx. 30 mA

Control Engineering

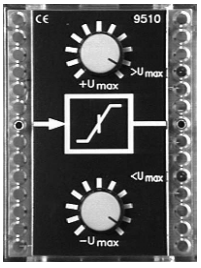
Modules for Control Engineering

Modulsystem Control Engineering

Series 9500



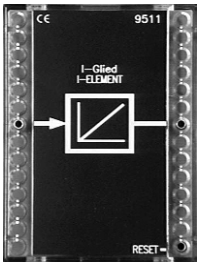
Type 9509



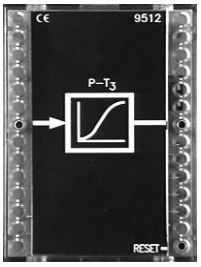
Type 9510

Two-Level Controller **Type 9509**
Threshold value switch with adjustable switching difference and additionally wirable control feedback:
current consumption: max. approx. 20 mA

Limiter **Type 9510**
Upper and lower limit separately adjustable;
upper limit: approx. 0 V ... +10 V; lower limit: approx. 0 V ... -10 V;
respectively with overload indicator; current consumption: max. approx. 65 mA



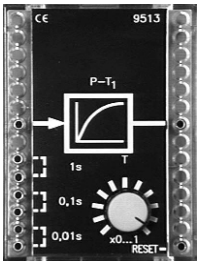
Type 9511



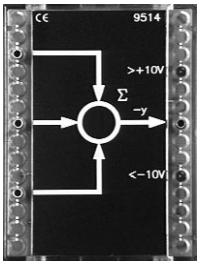
Type 9512

I-Element **Type 9511**
Integral action factor K_I: approx. 400 mV/ms;
current consumption: max. approx. 15 mA

P-T_3-Element **Type 9512**
3rd order delay element; compensation time T_g: approx. 2 ms;
current consumption: max. approx. 15 mA



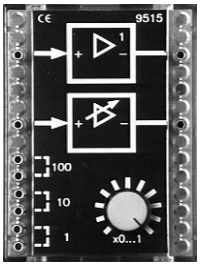
Type 9513



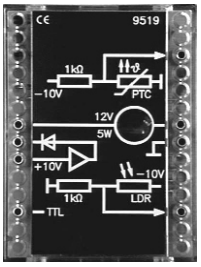
Type 9514

P-T_1-Element **Type 9513**
1st order delay element;
time constant T (adjustable in 3 ranges): 0 ... 1 s; 0 ... 0.1 s; 0 ... 0.01 s;
current consumption: max. approx. 15 mA

Summer **Type 9514**
The adder forms the sum of the input voltages and inverts them;
max. output voltage: -10 V ... +10 V; with 2 overload indicators;
current consumption: max. approx. 25 mA



Type 9515



Type 9519

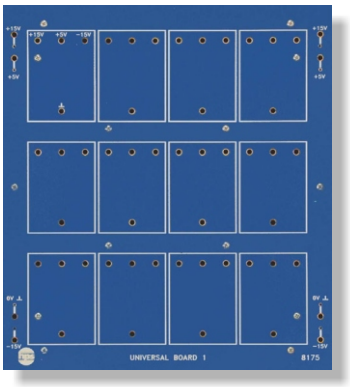
Amplifier/Inverter **Type 9515**
Inverter: for inverting an analog input signal;
amplifier (adjustable): V = 0 ... 1; 0 ... 10; 0 ... 100; inverting;
current consumption: max. approx. 30 mA

Temperature and Brightness Controlled Module **Type 9519**
Double control circuit; with PC resistor for actual value acquisition of the temperature and LDR resistance for actual value acquisition of the light; with built-in amplifier; current consumption: max. approx. 350 mA

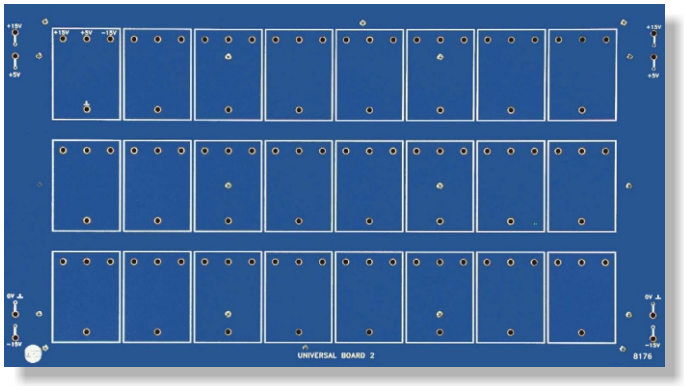
Modulsystem
Control
Engineering

Series 9500

UNIVERSAL BOARD 1 / UNIVERSAL BOARD 2



Front view of the
UNIVERSAL BOARD 1
(Type 8175)



Front view of the
UNIVERSAL BOARD 2
(Type 8176)

With these two Boards, which differ in size only, hps SystemTechnik offers a low-cost introduction for conducting experiments in connection with the Modules for Control Engineering.

The front panel of the Board is divided into 12 or 24 slots. The slots are used for plugging in the modules and are equipped with four 4 mm jacks each.

The operating voltage is also fed to the modules through three of these jacks (+15 V DC/-15 V DC/ ground).

The fourth jack is provided for +5 V, e. g. for use of digital modules.

On the right and left hand side of the Boards, 2 and 4 mm jacks are installed for the external operating voltage supply.

To conduct the experiments, the Boards can be placed at an ergonomically favourable angle on the table or suspended in a demonstration rack.

Technical Data

Operating voltage supply for the Modules
+15 V DC/-15 V DC, by external power supply units.
It is fed centrally through 2 mm or 4 mm jacks which are electrically connected to the jacks of the individual locations.

Front panel
5 mm thick laminate, matt blue in colour, white printing

Plug-in locations
- UNIVERSAL BOARD 1 (Type 8175): 12, with 4 jacks each
- UNIVERSAL BOARD 2 (Type 8176): 24, with 4 jacks each

Dimension/weight
- UNIVERSAL BOARD 1 (Type 8175):
  266 x 297 x 90 mm (w x h x d)/1.33 kg
- UNIVERSAL BOARD 2 (Type 8176):
  532 x 297 x 90 mm (w x h x d)/2.65 kg

Modulsystem Control Engineering

Series 9500

Control Engineering

Recommended Accessories

- Set of Accessories (Type 5125.1), consisting of 2 mm connecting leads and plugs
- Manual:
  „Introduction to Control Engineering“ (Type V 0120)
- Power supply:
  DC SUPPLY BOARD (Type 1002.1)

Extension Possibilities

The Module System for Control Engineering can be extended with the control systems listed below.

- MOTOR BOARD (Type 5130)
- Temperature and Brightness Controlled System (Type 5125.5),
  in connection with the MOTOR BOARD (Type 5130)
- SERVO BOARD (Type 5131)
- Manual:
  „Controlled Systems/Control Circuits“ (Type V 0122)
- Relay (with driver), Type 9131.2
- Assembly kit (for making your own plug-in modules), consisting of:
  Empty Housing (Type 9152.7)
  Universal PCB with dot grid (Type 9167)
  Universal PCB with line grid (Type 9167.1)
  Set of Jacks (Type 9168)
  Sticker (Type 9162.5-6)

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MESSwin

Simple programming environment for control engineering

(Type 007035 xxxx)

MESSwin is a graphic program generator to solve any problems in measuring technique and control engineering.

With MESSwin you can ...

... solve all measuring and automatic control engineering problems quickly and easily with the PC.

... create measuring programs without programming experience.

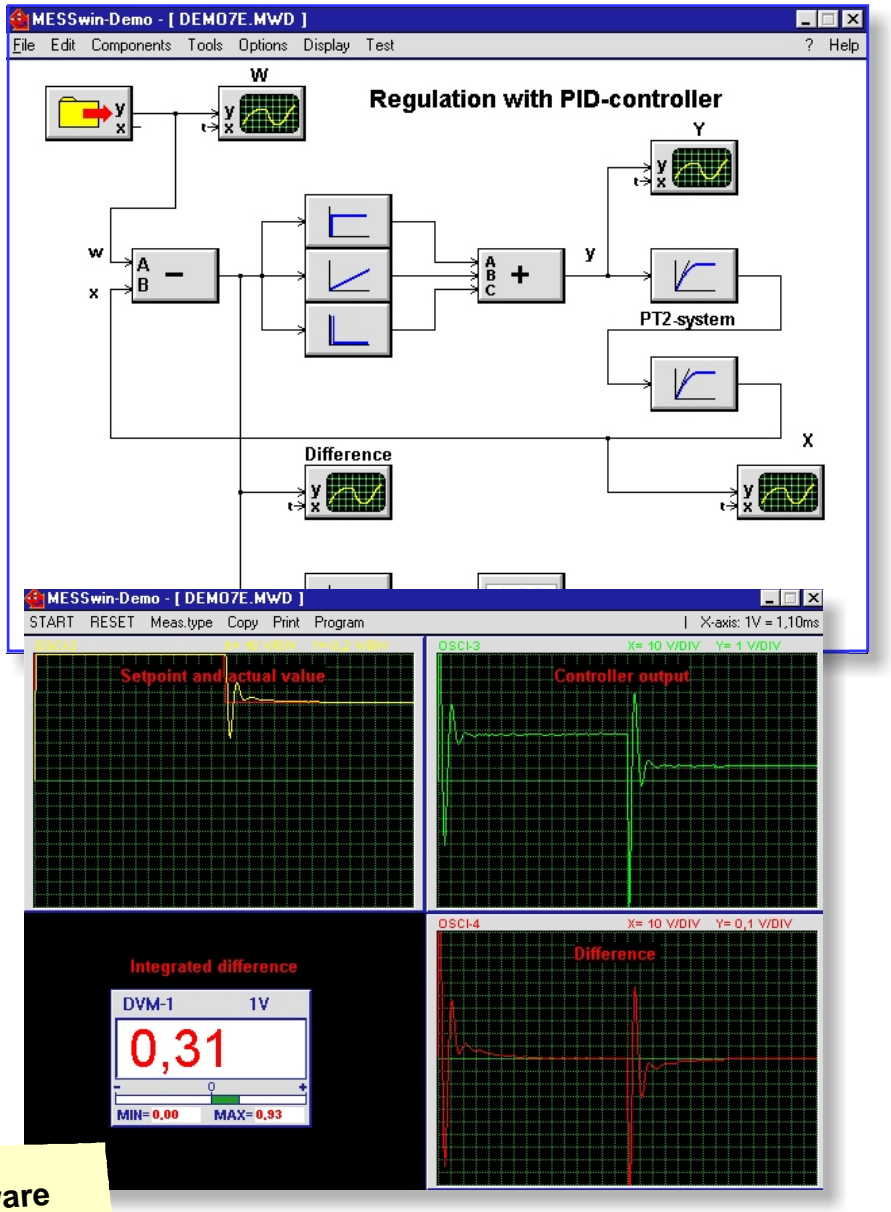
... solve a measuring problem by drawing the block diagram.

... display measuring results graphically, save them and print them.

... use the I/O functions of an interface in the simplest way possible.

... set or change all component parameters easily.

... simulate any control circuits without an interface.



System Requirements:

- PC with Windows® Software
- Hard disk: 10 MB free
- RAM: 4 MB
- CD ROM drive
- SVGA graphic card (800 x 600)

Hardware connection by hps plug & play card

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CONTROL ENGINEERING
COMPUTER-PROCESS SYSTEMS

SystemTechnik

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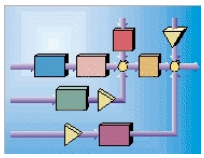


(Type 000000 B)

WinFACT

Control Engineering, modular in one system

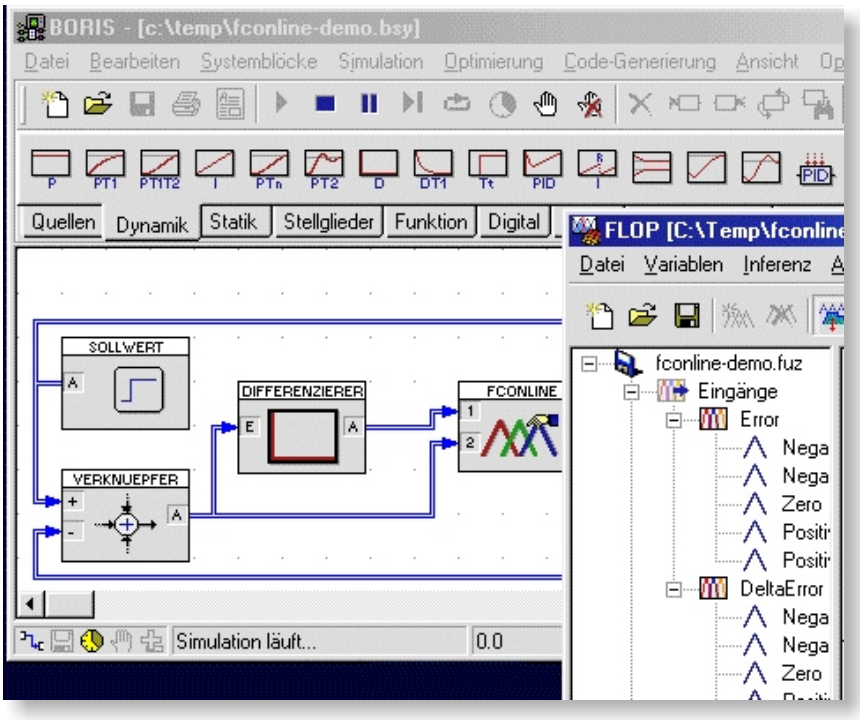
WinFACT is an innovative, modularely expandable program system for analysis, synthesis and simulation in control engineering. The main module is the BORIS simulation system. WinFACT is especially useful for vocational training and technical colleges but also in industry and research. WinFACT is a supplement or alternative to conventional practical experiments in training.

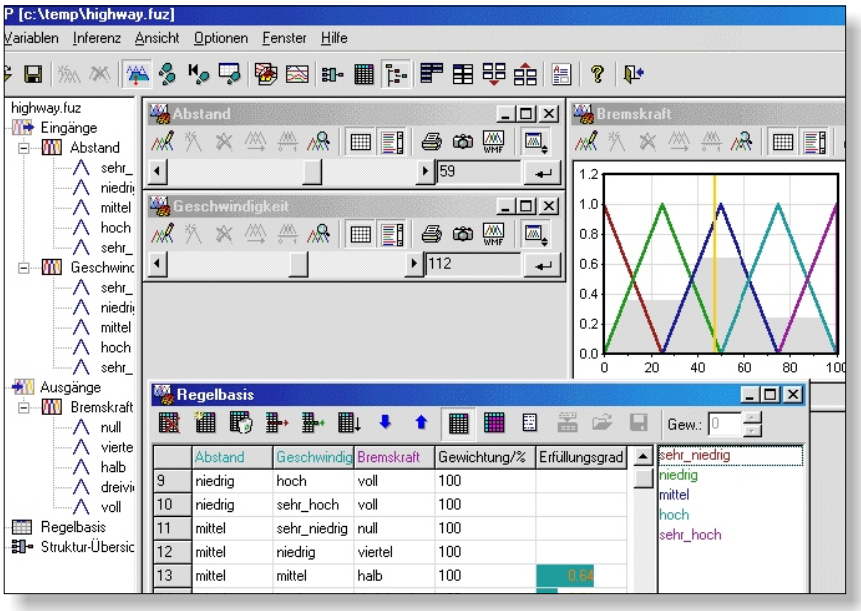
BORIS: Block-orientated simulation system for all exercises in the field of measuring and controlling. Numerous possibilities for integration of hardware (e.g. A/D-D/A cards). Virtual instruments and process visualisation (FAB module) are concise and easy to understand. Various system models including visualisation are available as an ideal supplement to BORIS for conducting practical training in control engineering.

INGO: Graphic representation module. Enables comfortable and high quality output (printing, export in BMP and WMF format) of the files created by other modules (e.g. simulation results, frequency responses, characteristic fields, etc.).

FLOP: Fuzzy Shell for designing and analysing fuzzy systems. FLOP can be integrated in the block-orientated simulation BORIS.

LISA: Module for analysing linear systems: Calculation and graphic output of transient responses, Bode diagrams, locus and locus of the roots.





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CONTROL ENGINEERING
COMPUTER-PROCESS SYSTEMS

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IDA: Identificationof linear systems based on measured curves of input and output variables.

RESY: Design of controllers (e.g. PID controllers) in the frequency range. Frequency response and time behaviour of system, controller, open circuit and closed control circuit can be represented graphically parallel to this and the influence of the individual control parameters examined.

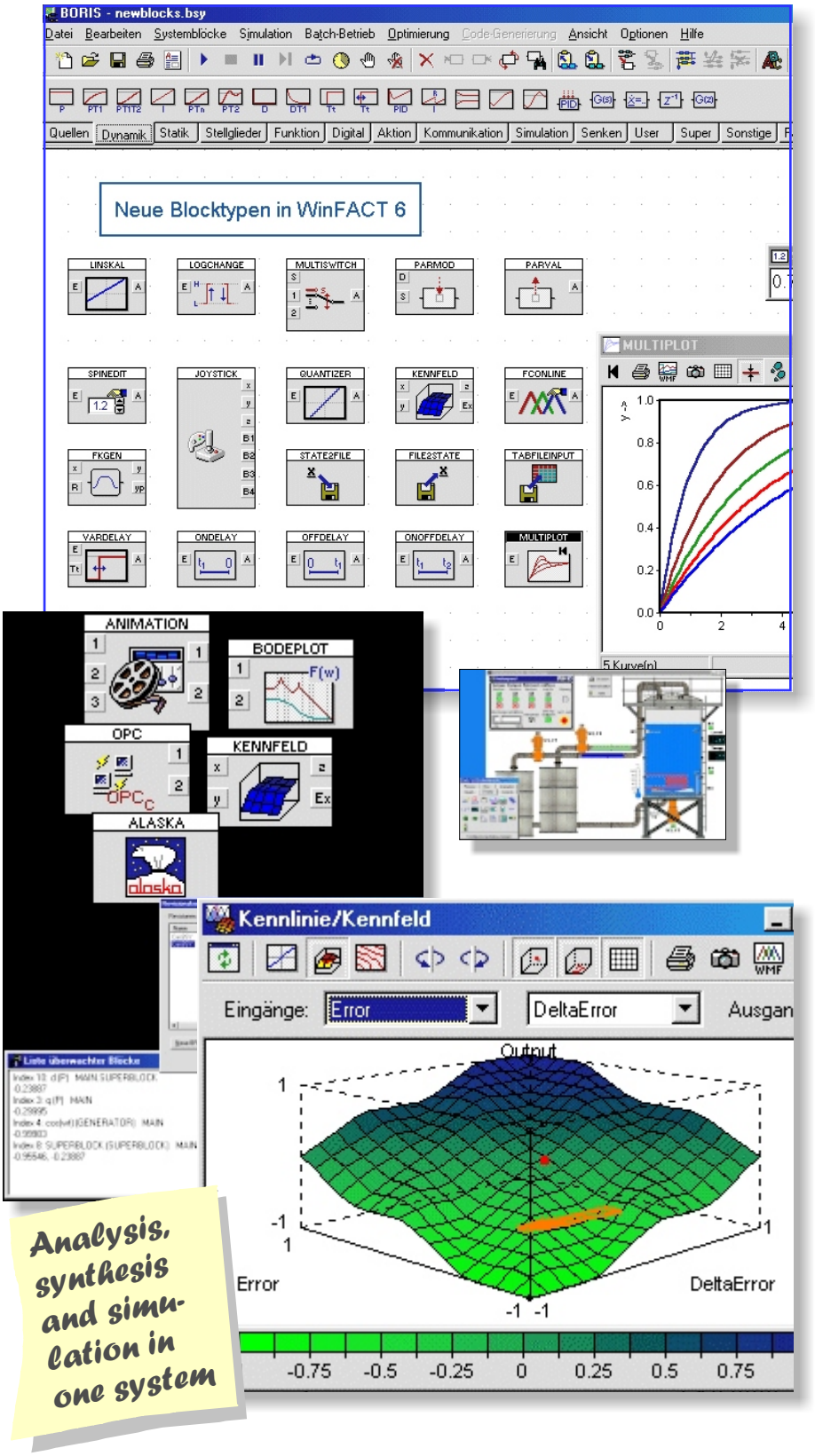
FALCO: C-code generation for fuzzy systems. FALCO generates an Ansi-C code from the fuzzy system designed with the FLOP module which can be ported to any target hardware (e.g. microcontroller).

SUSY: Simulation and design of status control circuits.

FUZZYPID: Program for easy introduction to basic fuzzy control engineering.

System Models: Collection of systems models of various kinds (temperature system, motor-generator set, agitated boiler reactor) for BORIS.

FAB: *Flexible Animation Builder*. Extra tool for block-orientated simulation system BORIS which enables a comfortable creation of any process visualisations (animation etc.) and user interfaces which can then be integrated in BORIS as „normal“ system blocks (demo available).



System Requirements:

- PC with Windows® Software
- Hard disk: 250 MB free
- RAM: 32 MB
- CD ROM drive
- SVGA graphic card (800 x 600)
- 16 bit sound card

CONTROL ENGINEERING
PROCESS CONTROL SYSTEM

SystemTechnik

hps SystemTechnik
Lehr- + Lernmittel GmbH
Altdorfer Straße 16
88276 Berg (Germany)

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Web: www.hps-systemtechnik.com
E-Mail: export@hps-systemtechnik.com

WinErs
Process Control Training

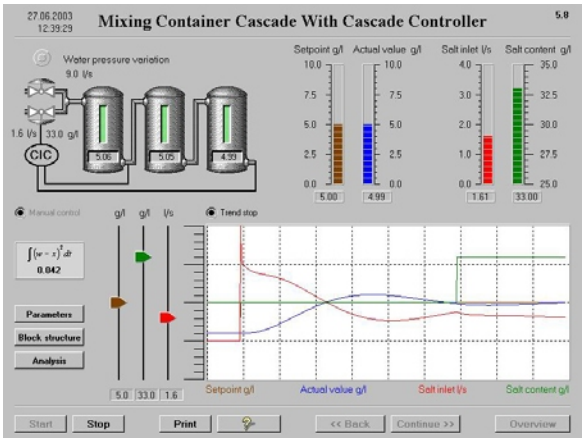
(Type 007004 EVDE)

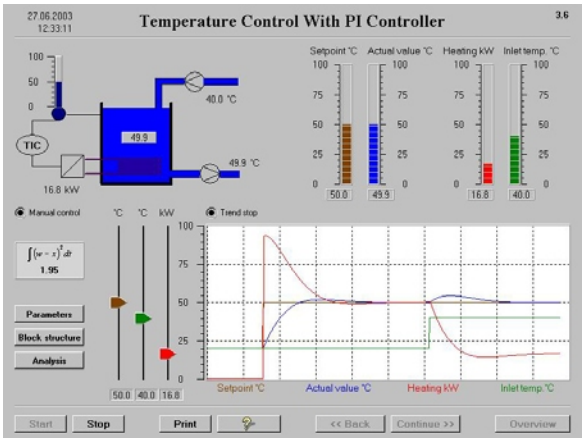
Use this special training version of the process control system WinErs for education in control engineering and to obtain experiences handling a process control system.

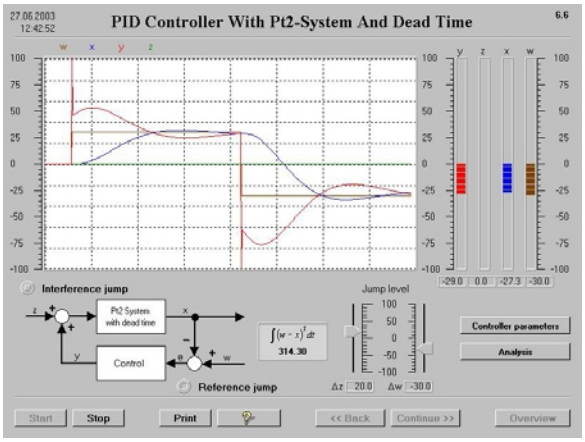
Explore the behavior of controlled systems, controllers, and control loops.

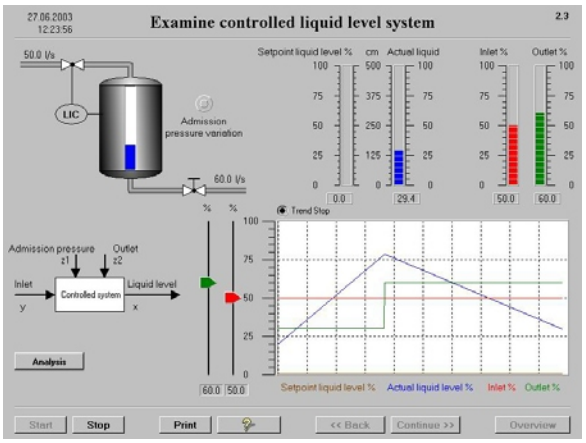
Obtain the fundamentals of process control engineering with these four complete process simulations.

- control of a continuous-flow water heater
- water level control
- control of a stirring tank cascade
- examination of PT_n controlled systems with P-, I-, PI- and PID-controllers





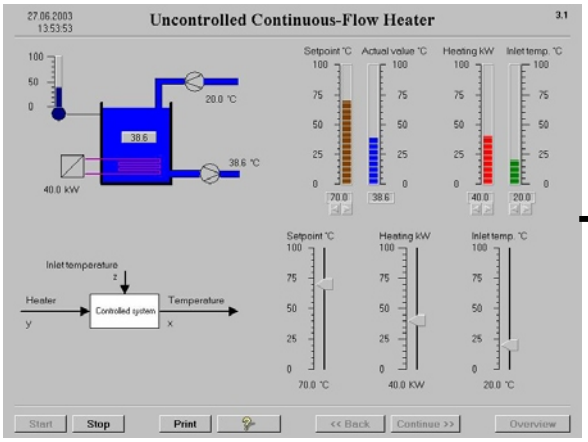




13 / 14 V02 Technical changes without prior notice!

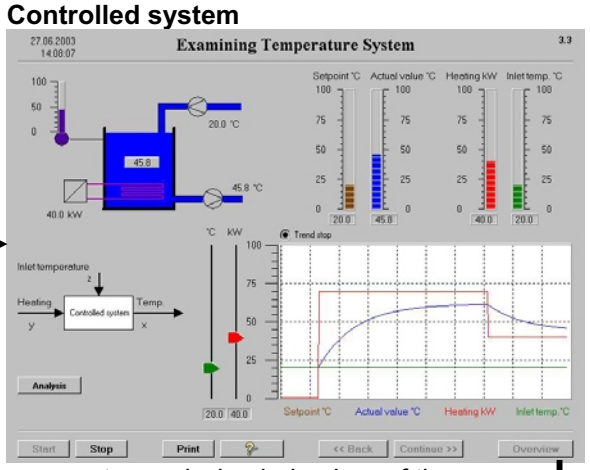
Didactic structure

Introduction



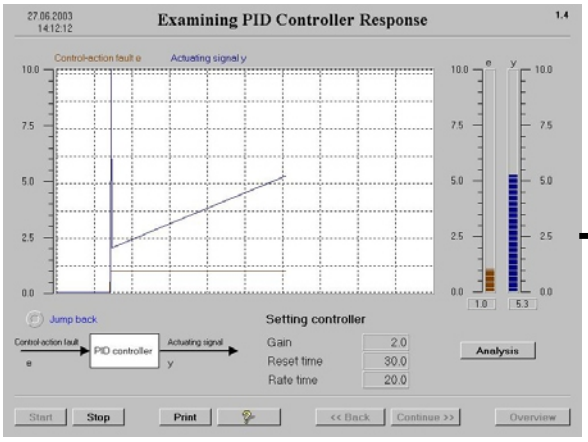
- controlled system
- uncontrolled system

Controlled system



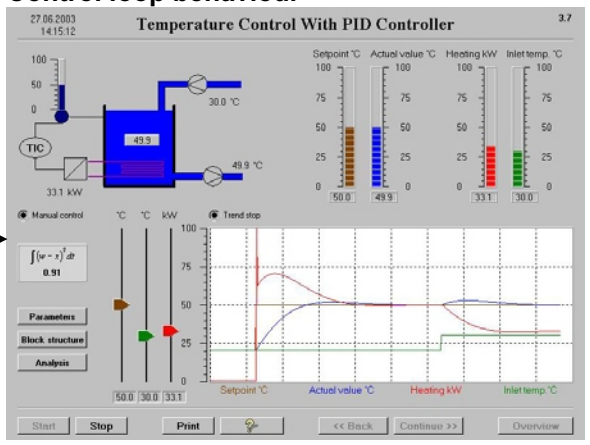
- transmission behaviour of the process
- response to changing set-points

Controller behaviour



- I-/O-behaviour of controllers
- controller types: P, I, PI, PID

Control loop behaviour

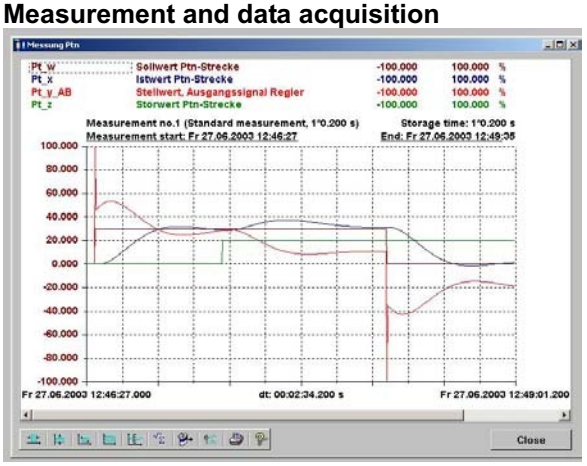


- leading and disturbing behaviour of control loops
- controller types

CONTROL ENGINEERING
PROCESS CONTROL SYSTEM

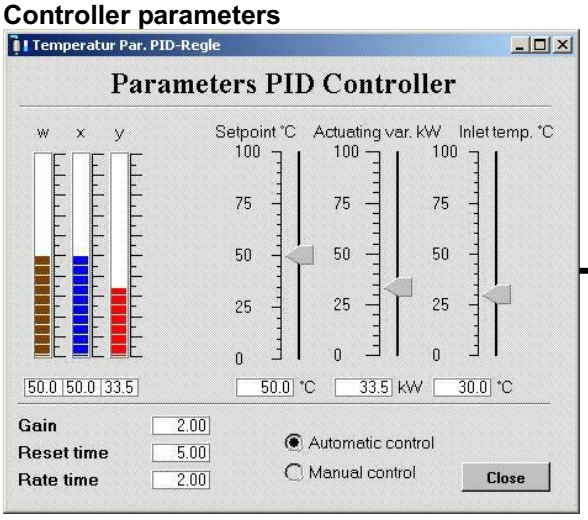
SystemTechnik

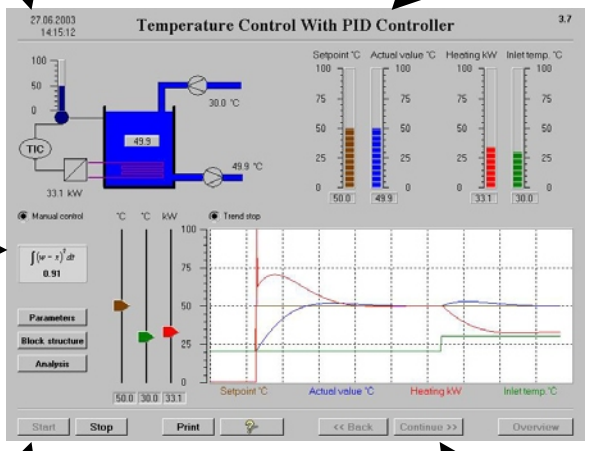
Measurement and data acquisition



Bar graphs for signal representation

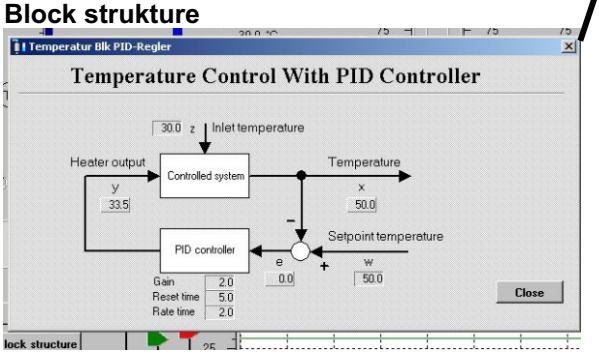
Controller parameters





Online trend chart

Block strukture



CONTROL ENGINEERING
PRACTICAL TRAINING

SystemTechnik

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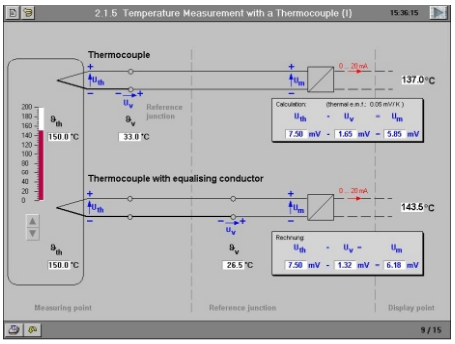
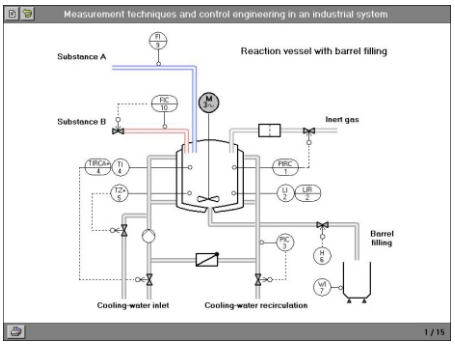
WinErs

Practical Training on Measurement Techniques

(Type 007004B EVDE)

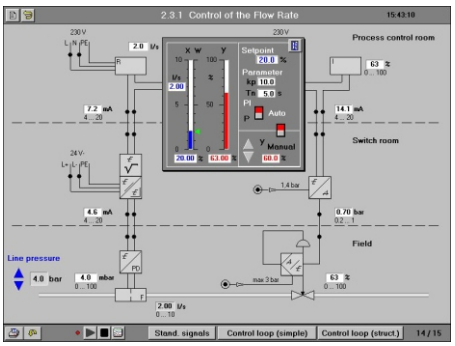
The measurement techniques training was developed for hands-on learning in the subject automation engineering. To simulate various measurement techniques the example in this program is based on a typical industrial process.



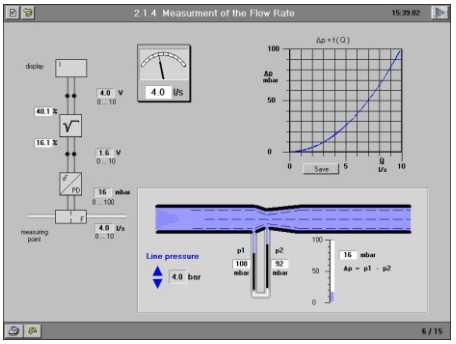


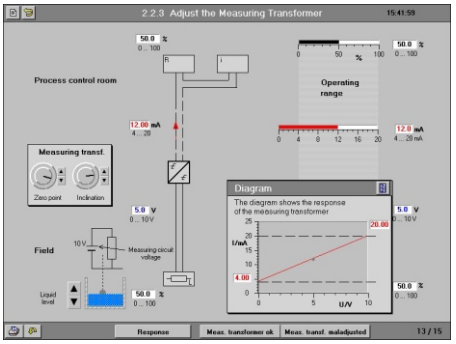
The example of an industrial process gives the possibility to examine the mode of operation of transducers for:

- liquid level
- balance power
- pressure
- flow rate
- temperature



Observe measurement value processing (e.g. sensors, transformation, display).
Visualisation is based on international standards.
All processes can be changed online at any time and process technology is documented.





Options:

- choose transducers by task
- calibrate transducer to input signals operating range
- control and parameterise in- and output signals in the control loop

SystemTechnik

POWER ELECTRONICS / Drive Engineering
Electric Machines

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CASPOC

CASPOC Education

Simulation software for drive engineering and power electronics

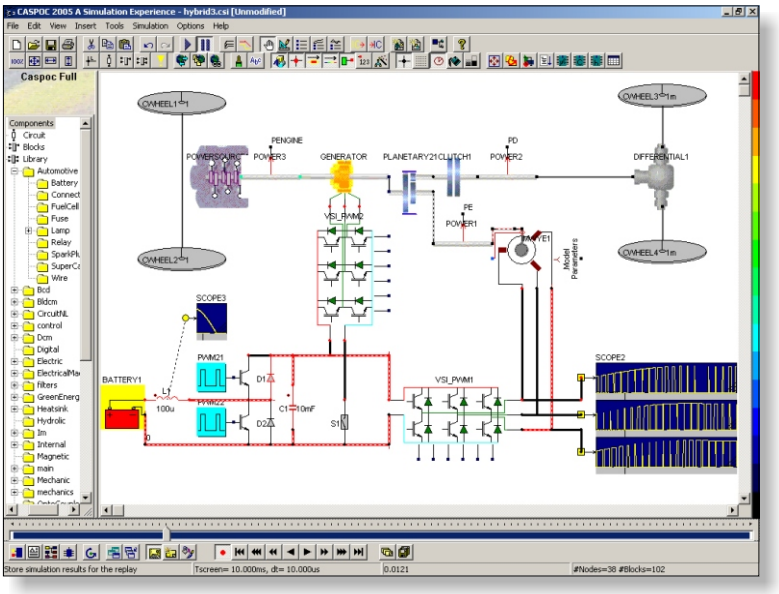
(Typ 005012 EVXX)

CASPOC EDUCATION – Power Electronics is a simulation software specially developed for power electronics. The fast, simple program development and parameterization allow all circuits to be developed and simulated directly without any great introduction. The express version is restricted in the quantity of blocks and nodes in the development level.

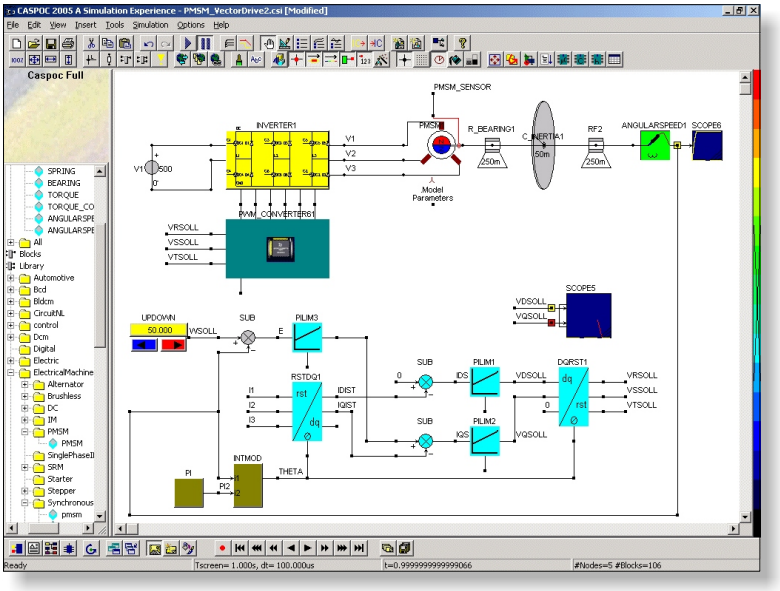
Performance:
- Fast simulation, no convergence problems
- View results during simulation
- Simple parameterization
- C-script to create user defined blocks
- Menu in English / German, switchable

Teach Ware:
- Short guide on CD (English and German)
- User guide on CD (English)

Available as:
- Licence for 1 computer incl. dongle
- Classroom licence for max. 16 computers within one network domain



Reference:
- Only for schools and non-commercial educational institutes!



System Requirements:
- PC with Windows® Software
- Hard disk: 10 MB free
- RAM: 4 MB
- CD ROM drive
- SVGA graphic card (800 x 600)

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