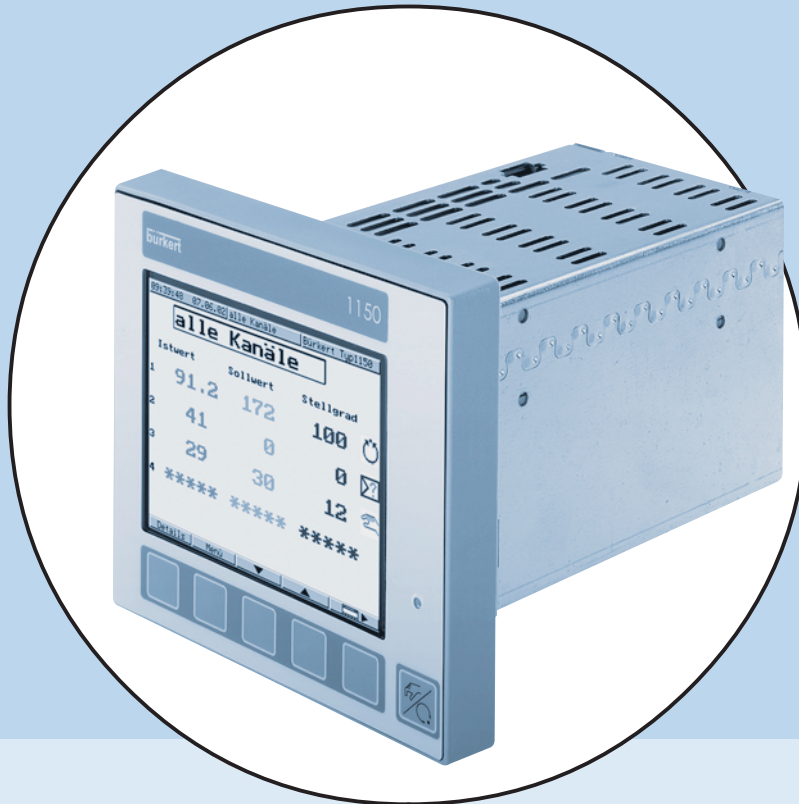


Operating Instructions

Bedienungsanleitung
Instructions de Service



Type 1150

Process and Program controller

We reserve the right to make technical changes without notice.
Technische Änderungen vorbehalten.
Sous réserve de modification techniques.

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Operating Instructions 0507/02_EU-EN_00804664

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GENERAL NOTES

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Typographical conventions

Symbols

→ Indicates procedure(s) that you must carry out.



ATTENTION!

Indicates information, where failure to observe, your safety or the proper function of the device will be compromised.



NOTE

Indicates important additional information, tips and recommendations.



CAUTION!

This device is sensitive to electrostatic discharge (ESD). Contact with an electrically charged personnel or object will damage this device. In the worst case, immediate damage or failure on commissioning will occur.

Representation

Menu items

Texts relating to screen representations are shown in italics (e.g. Exit program).

Factory Preset Parameters

Factory presets or setting at delivery (E.g.: 0 ... 9999, where 9999 is the factory setting at delivery).

Safety instructions



Please observe the notes in these operating instructions together with the conditions of use and permitted data that are specified in the data sheets for the Process and Program Controller and for the respective pneumatically operated valve, in order that the device will function perfectly and remain operable for a long time:

- *Keep to standard engineering rules in planning the use of and operating the device!*
- *Installation and maintenance work are only allowed by specialist personnel using suitable tools!*
- *Observe the current regulations on accident prevention and safety for electrical devices during operation and maintenance of the device!*
- *Switch off the supply voltage in all cases before intervening in the system!*
- *Take suitable precautions to prevent inadvertent operation or damage by unauthorized action!*
- *Make sure that after an interruption to the electrical or pneumatic supply, the process is configured to resume in a well-defined, controlled manner!*

Protection from damage by electrostatic charging



This device contains electronic components that are sensitive to electrostatic discharge (ESD). Contact with electrostatically charged persons or objects will damage these components. In the worst case, they will be immediately destroyed or will fail after commissioning.

Observe the requirements of EN 100 015 - 1 in order to minimize the possibility of, or avoid, damage from instantaneous electrostatic discharge. Also take care not to touch components that are under supply voltage.

Scope of delivery

Immediately after receipt of a shipment, make sure that the contents are undamaged and match the scope of delivery stated on the packing slip.

If there are discrepancies, please contact immediately our customer service:

Bürkert Fluid Control Systems
Service Department
Chr.-Bürkert-Str. 13-17

D-76453 Ingelfingen

Tel.: 07940 10-111, Fax: 07940 10-448, Email info@de.buerkert.com

or maybe local Bürkert Rep. See back page for contact information in other countries.

Warranty conditions

This document contains no warranty statements. Please refer to our general sales and business conditions. A prerequisite for validity of the warranty is use of the device als intended with observance of the specified conditions of use.



ATTENTION!

The warranty covers only faultless condition of the Process and Program controller. No liability will be accepted for consequential damage of any kind that may arise from failure or malfunctioning of the device.

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SYSTEM DESCRIPTION

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Function description

Type 1150 is a process and program controller with up to four controller or program channels. The instrument is built to the format 144 mm x 130 mm for a standard 92 mm x 92 mm panel cut-out and a mounting depth of 170 mm.

The display is a 5" color screen with 27 colors. The layout of the screen templates can be individually adapted and adjusted. Two freely configurable screen templates make it possible to customize the placing of texts, process values, background pictures and icons.

A maximum of 4 analog inputs and 6 logic inputs are available, as well as six expansion slots for switched or analog outputs.

A setup program is available for direct configuration via a PC. Linearizations for the usual transmitter outputs are stored within the instrument, four customer-specific linearization tables can be programmed.

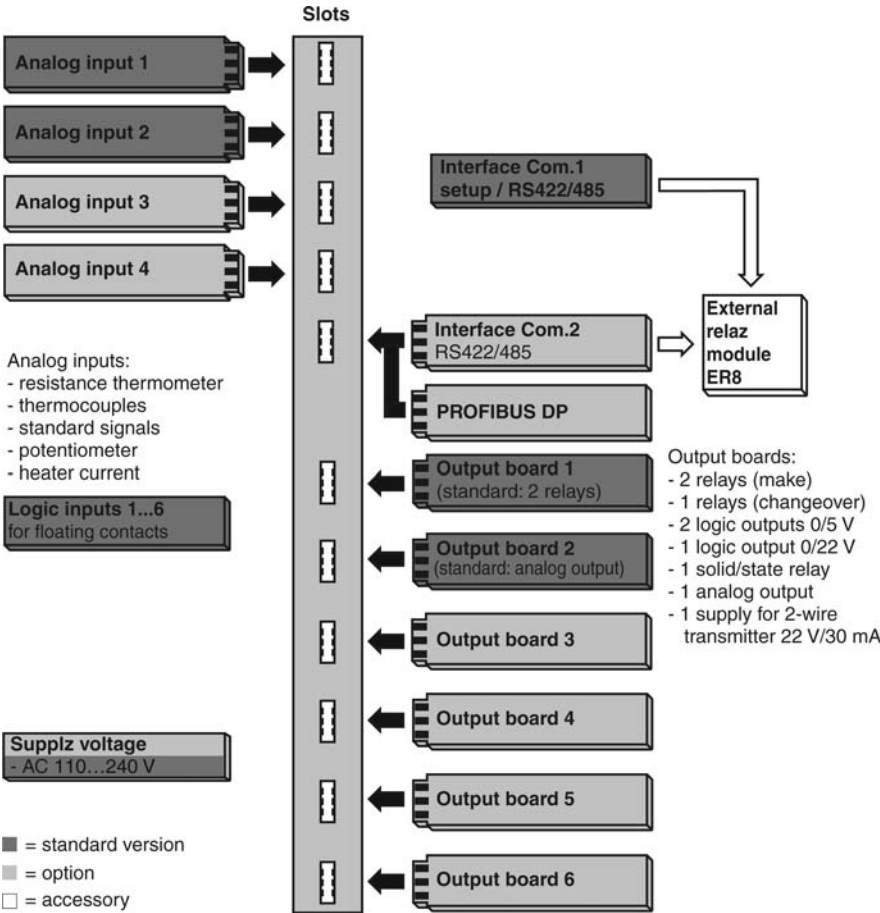
A math and logic module can be used to adapt the instrument to a very wide range of control tasks.

A serial interface RS422/485 or Profibus-DP can be used to integrate the instrument into a data network.

Modules can be retrofitted quite simply by the user.

The electrical connection is made at the back of the instrument, via plug-in screw terminals.

Block structure



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Visual Representation



Technical data

Thermocouple input

Designation		Measurement range	Meas. accuracy ¹	Ambient temperature error
Fe-CuNi "L"		-200 to +900°C	0.25%	100 ppm/K
Fe-CuNi "J"	DIN EN 60584	-200 to +1200°C	0.25%	100 ppm/K
Cu-CuNi "U"		-200 to +600°C	0.25%	100 ppm/K
Cu-CuNi "T"	DIN EN 60584	-200 to +400°C	0.25%	100 ppm/K
NiCr-Ni "K"	DIN EN 60584	-200 to +1372°C	0.25%	100 ppm/K
NiCr-CuNi "E"	DIN EN 60584	-200 to +1000°C	0.25%	100 ppm/K
NiCrSi-NiSi "N"	DIN EN 60584	-200 to +1300°C	0.25%	100 ppm/K
Pt10Rh-Pt "S"	DIN EN 60584	0 to 1768°C	0.25%	100 ppm/K
Pt13Rh-Pt "R"	DIN EN 60584	0 to 1768°C	0.25%	100 ppm/K
Pt30Rh-Pt6Rh "B"	DIN EN 60584	0 to 1820°C	0.25%	100 ppm/K
W5Re-W26Re "C"		0 to 2320 °C	0.25%	100 ppm/K
W3Re-W25Re "D"		0 to 2495 °C	0.25%	100 ppm/K
W3Re-W26Re		0 to 2400 °C	0.25%	100 ppm/K
Cold junction	Pt 100 internal, external or constant			

¹ With 250 msec sampling time.

Input for resistance thermometer (RTD)

Designation		Connection circuit	Measurement range	Meas. accuracy ¹	Ambient temperature error
Pt100	DIN EN 60751	2-wire/3-wire	-200 to +850°C	0.05%	50 ppm/K
Pt 50,500, 1000	DIN EN 60751	2-wire/3-wire	-200 to +850°C	0.1%	50 ppm/K
Cu50		2-wire/3-wire	-50 to +200°C	0.1%	50 ppm/K
Ni100	DIN 43 760	2-wire/3-wire	-60 to +250°C	0.05%	50 ppm/K
KTY11-6		2-wire	-50 to +150°C	1.0%	50 ppm/K
PtK9		2-wire	lithium-chloride transducer		
Sensor lead resistance	max. 30 ohms per lead for 2-wire or 3-wire circuit				
Meas. current	250 A				
Lead compensation	is not required for 3-wire circuit. With a 2-wire circuit, the lead resistance can be compensated in software by a correction of the process value.				

¹ With 250 msec sampling time.

Input for standard signals

Designation	Measurement range	Meas. accuracy ¹	Ambient temperature error
Voltage	0 to 10 V	0.05 %	100 ppm/K
	-10 to +10 V	0.05 %	100 ppm/K
	-1 to +1 V	0.05 %	100 ppm/K
	0 to +1 V	0.05 %	100 ppm/K
	0 to 100 mV	0.05 %	100 ppm/K
	-100 to +100 mV Input resistance R_E 100 k	0,05 %	100 ppm/K
Current	4 to 20 mA, voltage drop 1 V	0.1 %	100 ppm/K
	0 to 20 mA, voltage drop 1 V	0.1 %	100 ppm/K
Heater current	0 to 50 mA AC	1 %	100 ppm/K
Potentiometer	min. 100 max. 10 k		

¹ With 250 msec sampling time.

Logic inputs

Floating contacts	
-------------------	--

Measurement circuit monitoring

In the event of fault, the outputs move to a defined (configurable) status.

Sensor	Overrange / underrange	Probe or lead short-circuit	Probe or lead break
Thermocouple	●	-	●
Resistance thermometer	●	●	●
Voltage 2 to 10V 0 to 10V	●	●	●
	●	-	-
Current 4 to 20 mA 0 to 20 mA	●	●	●
	●	-	-

● recognized

- not recognized

Outputs

Relay contact rating contact life	changeover contact or 2 x make 3A at 250 V AC resistive load 150.000 operations at rated load	
Logic current limiting	0/5 V 20 mA	or 0/22 V 30 mA
Solid-state relay contact rating protection circuitry	1 A at 230 V varistor	
Voltage output signals load resistance	0 to 10 V / 2 to 10 V R_{Last} 500	
Current output signals load resistance	0 to 20 mA / 4 to 20 mA R_{Last} 450	
Supply voltage for 2-wire transmitter voltage current	22 V 30 mA	

Controller

Controller type	single-setpoint controller
	double-setpoint controller, modulating controller, proportional controller, proportional controller with integrated actuator driver
Controller structures	P/PD/PI/PID/I
A/D converter	dynamic resolution up to 16 Bit
Sampling time	250 msec
	50 msec, 150 msec, 250 msec (configurable)

Color screen

Resolution	320 x 240 pixels
Size (screen diagonal)	5" (12.7 cm)
No. of colors	27 colors

Electrical data

Supply voltage (switchmode PSU)	AC 48 to 63 Hz, 110 to 240 V -15/+10%
Electrical safety	to DIN EN 61 010, Part 1 overvoltage category III, pollution degree 2
Power consumption	max. 30 VA
Data backup	flash memory
Electrical connection	at rear, via plug-in screw terminals conductor cross-selection max. 2.5mm ² with core ferrules (length: 10mm)
Electromagnetic compatibility interference emission interference immunity	EN 61 326 Class B to industrial requirements

Interface COM1

Interface type	PC-Interface or RS 422/RS 485
Protocol	MOD-Bus
Baud rate	9600, 19200, 38400
Device address	1 to 255
Minimum response time	0 to 500 ms

Interface COM2

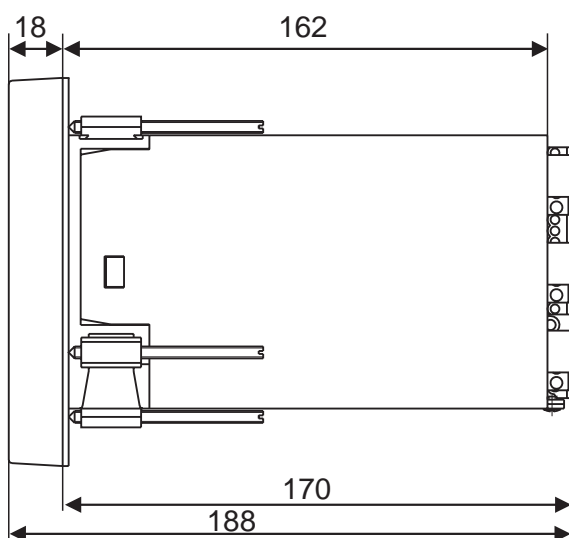
MOD bus	
Interface type	RS 422/RS 485
protocol	MOD-Bus
Baud rate	9600, 19200, 38400
Device address	1 to 255
Profibus DP	
Device address	1 to 128
Data transmission rate	12 MBaud

Housing

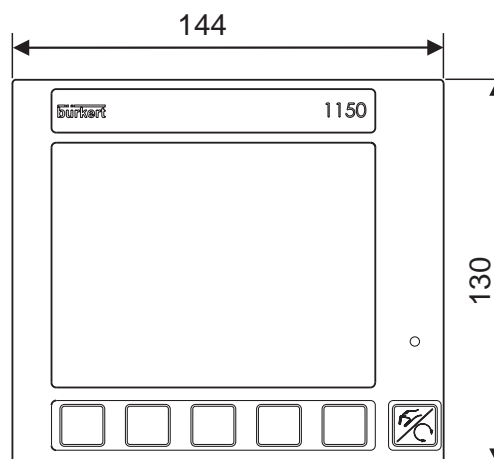
Housing type	housing and back panel: metal for panel mounting as per DIN 43700
Front bezel	plastic to UL 94 V0 144 mm x 130 mm
Mounting depth	170 mm
Panel cut-out	92 ^{+0,8} x 92 ^{+0,8} mm
Ambient/storage temperature range	-5 to 50 °C / -40 to +70 °C
Climatic conditions	rel. humidity 75 % annual mean, no condensation
Operating position	horizontal
Enclosure protection	to EN 60 529, front IP 65, rear IP 20
Weight (fully fitted)	approx. 1400 g
Membrane keypad	polyester film, resistant to normal washing and cleaning agents

Dimensions

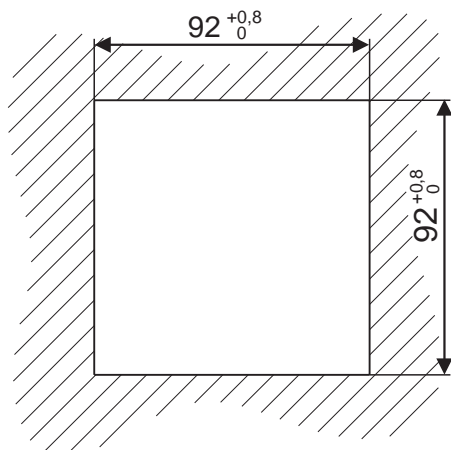
Side view



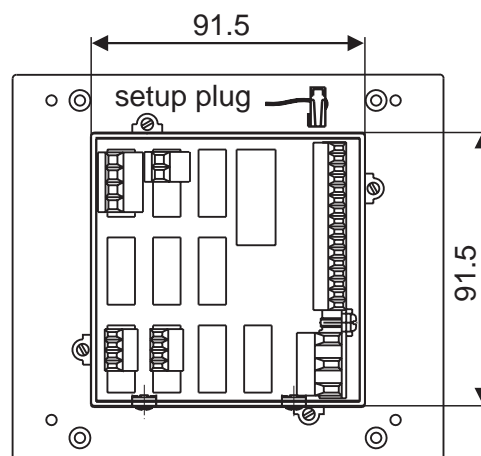
Front view



Panel cut-out
to DIN ISO 43 700



Rear view



Order table

Process and program controller Type 1150	ID-No.
Basic unit	
20 to 30 V AC/DC	787703
110 to 240 V 48 to 63 Hz	787704
Input modules	
1 analog input	787750
Output modules	
1 relay, changeover	787751
1 solid-state relay	787752
2 relay, n.o.	787753
1 analog output	787754
Interface	
Profibus DP	787755
Added optional functions *	
Controller channels 3+4	787756
Recording function	787757
Math and logic module	787758
Accessories	
PC-Interface for setup program	787759
Setup software with Program editor	787760
* Configuration of added optional functions is only possible by means of the Setup-Software PC editor.	

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INSTALLATION, COMMISSIONING AND MAINTENANCE

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General notes



ATTENTION!

- This device should only be installed or repaired by qualified personnel using the correct tools!
- Always disconnect the power to this device before servicing or changing signal connections!
- Failure or interference may result from contamination, short circuit, voltage interruption or faulty/missing wiring termination.
- Check for loose or improper electrical connections or under voltage if unit does not power up.

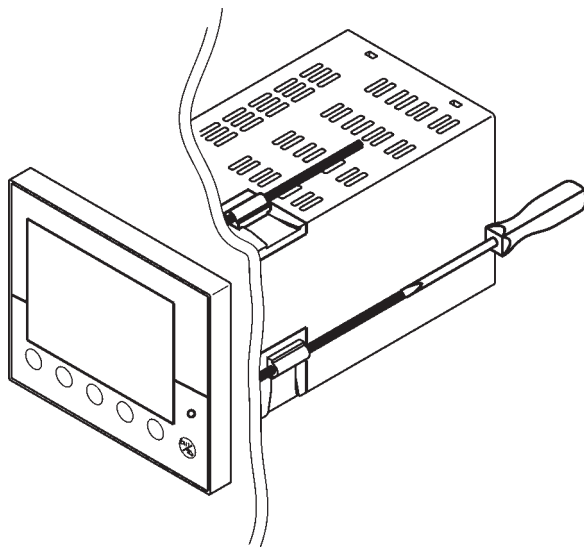
Location and climatic conditions

- The conditions at the location must meet the requirements specified in the technical data.
- The ambient temperature at the location should be - 5 to + 50 °C with a relative humidity below 75%

Close mounting

- Minimum spacing of panel cut-outs
 horizontal min. 54 mm
 vertical min. 54 mm

Assembly



- From the back, fit the seal that is supplied onto the instrument.
- Insert the instrument from the front into the panel cut-out.
- From behind the panel, slide the mounting brackets into the guides on the sides of the housing. The flat faces of the mounting brackets must lie against the housing.
- Push the mounting brackets up to the back of the panel, and tighten them evenly with a screwdriver.

Installation

**ATTENTION!**

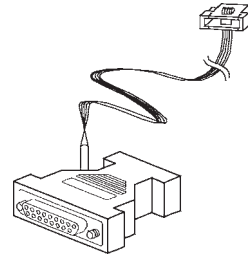
Please observe the relevant safety regulations and electrical installation codes for your area.

- The choice of cable - the installation and the electrical connection must conform to the requirements of VDE 0100 "Regulations on the Installation of Power Circuits with Nominal Voltages below 1000 V" or the appropriate local regulations.
- The electrical connection may only be carried out by properly qualified personnel.
- The instrument must be disconnected/isolated electrically in case of accidental contact with live parts.
- A current-limiting resistor interrupts the supply circuit in the event of a short-circuit. However, the load must be fused for the maximum relay current to prevent the contacts of the output relay from becoming welded in the event of a short-circuit.
- Electromagnetic compatibility conforms to the standards and regulations cited in the technical data (see Chapter Technical data).
- Run input, output and supply cables separately and not parallel to one another.
- All input and output signal cables must be shielded twisted pairs to prevent crosstalk, electrical noise and interferences.
- The shield of all transmission lines must be connected on the instrument side to potential earth.
- The PE terminal on the instrument must be connected to earth ground. This cable must have at least the same conductor cross-section as used for the supply cables. Grounding and earthing leads must be wired in a star configuration to a common earth point that is connected to the protective earth of the electrical supply. Do not loop earth or ground connections, i.e. do not run them from one instrument to another.
- Do not connect any additional loads to the supply terminals of the instrument.
- The instrument is not suitable for use in areas with an explosion hazard (Ex areas).
- In addition to faulty installation, incorrect programming/configuration of the controller (setpoint, data of the parameter and configuration levels, internal alterations) can also interfere with the correct operation of dependent processes, or even cause damage. Safety devices should always be provided that are independent of the controller (such as overpressure valves or temperature monitors/limiters) and only capable of adjustment by authorized personnel.
- Since adaptation (self-optimization) cannot be expected to handle all possible control loops, an unstable process parameterization is theoretically possible. The stability of the actual value derived from the self-tune should therefore be checked.
- The measurement inputs of the controller must not exceed a maximum potential of 30 V AC or 50 V DC against PE.

Accessories

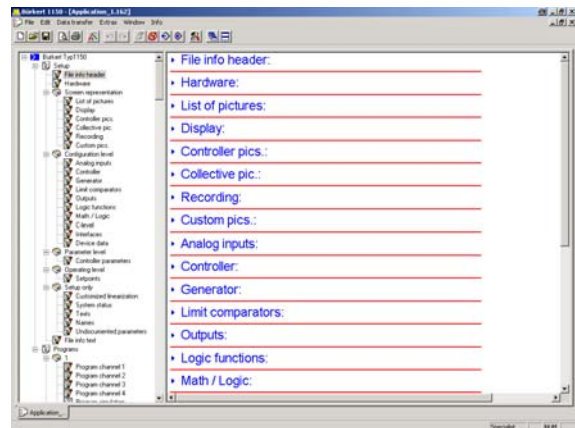
PC Interface

PC interface for setup program



Setup programs

Setup program with program editor



Maintenance

Cleaning

The front panel can be cleaned with normal commercial washing, rinsing and cleaning agents. It has a limited resistance to organic solvents (e.g. methylated spirits, white spirit, P1, xylol etc.). Do not use high-pressure cleaning equipment.

Disposal



ATTENTION!

Please refer to local bylaws/regulations for proper disposal of device.

ELECTRICAL CONNECTIONS

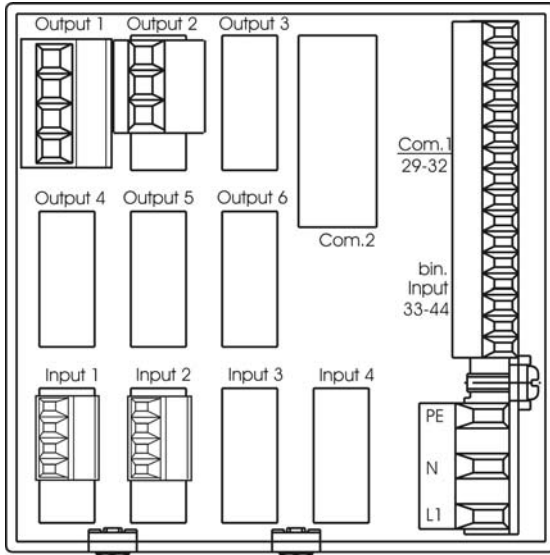
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Connection diagram



ATTENTION!

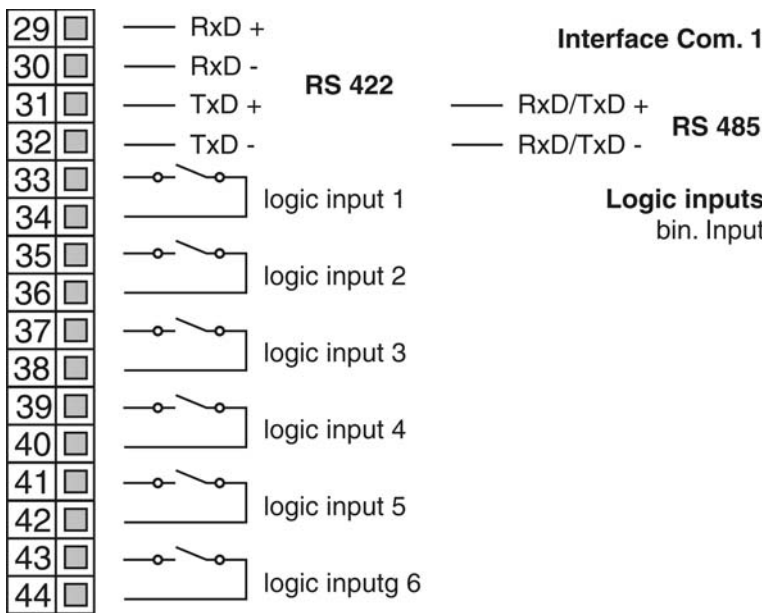
The electrical connection must only be carried out by properly qualified personnel.



NOTE

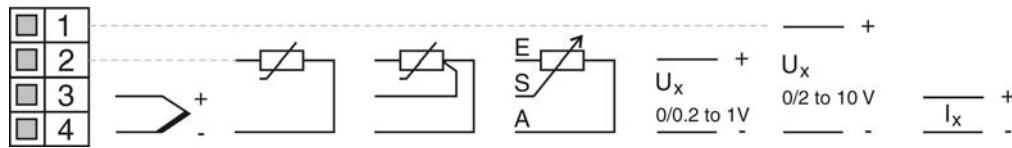
The instrument version can be identified by means of the type code (See nameplate on the housing).

Terminal strip numerical assignment

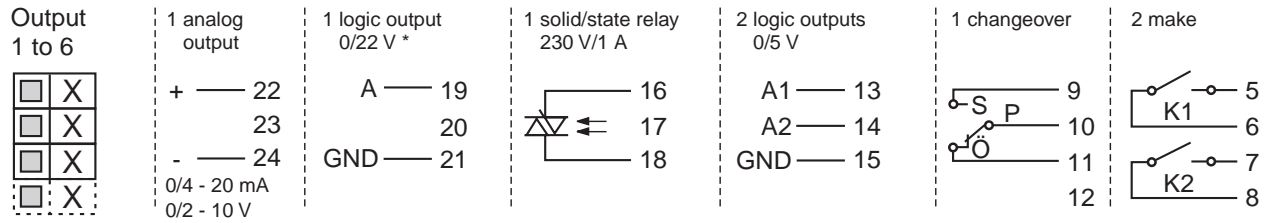


Analog inputs

Input 1 to 4

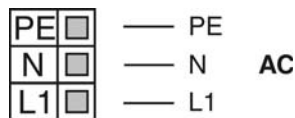


Outputs



* or supplz for 2-wire transmitter

Supply voltage

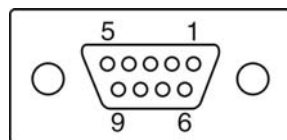


Interface COM.2



Profibus-DP

Pin	Assignment
3	RxD/TxD-P
4	RTS
5	DGND
6	VP
8	RxD/TxD-N



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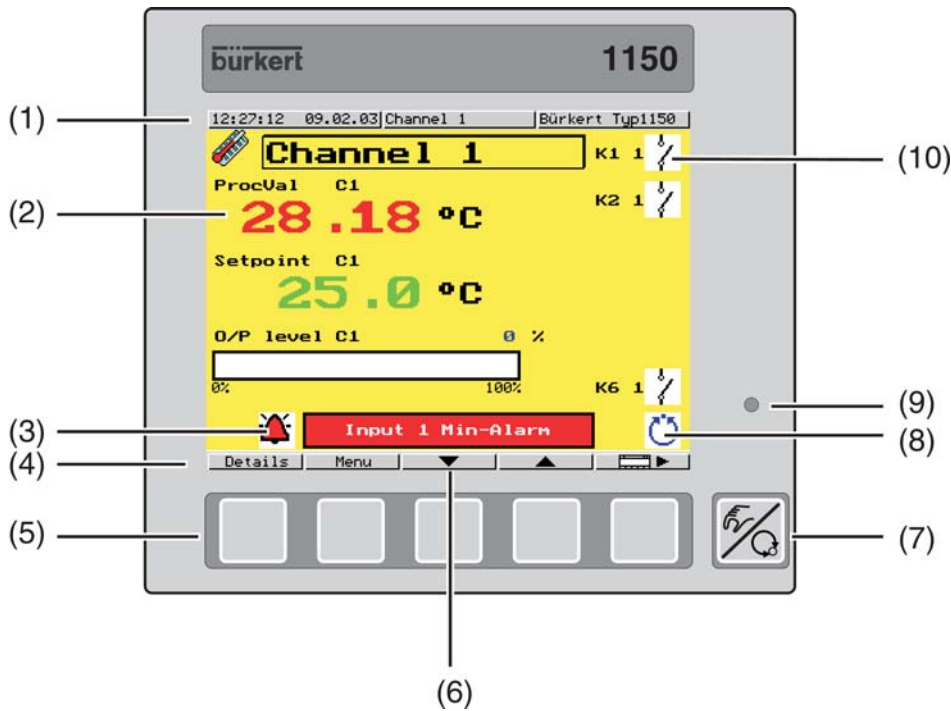
OPERATION AND CONTROLLER FUNCTIONS

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Operation

Displays and controls











Front view



Displays and controls

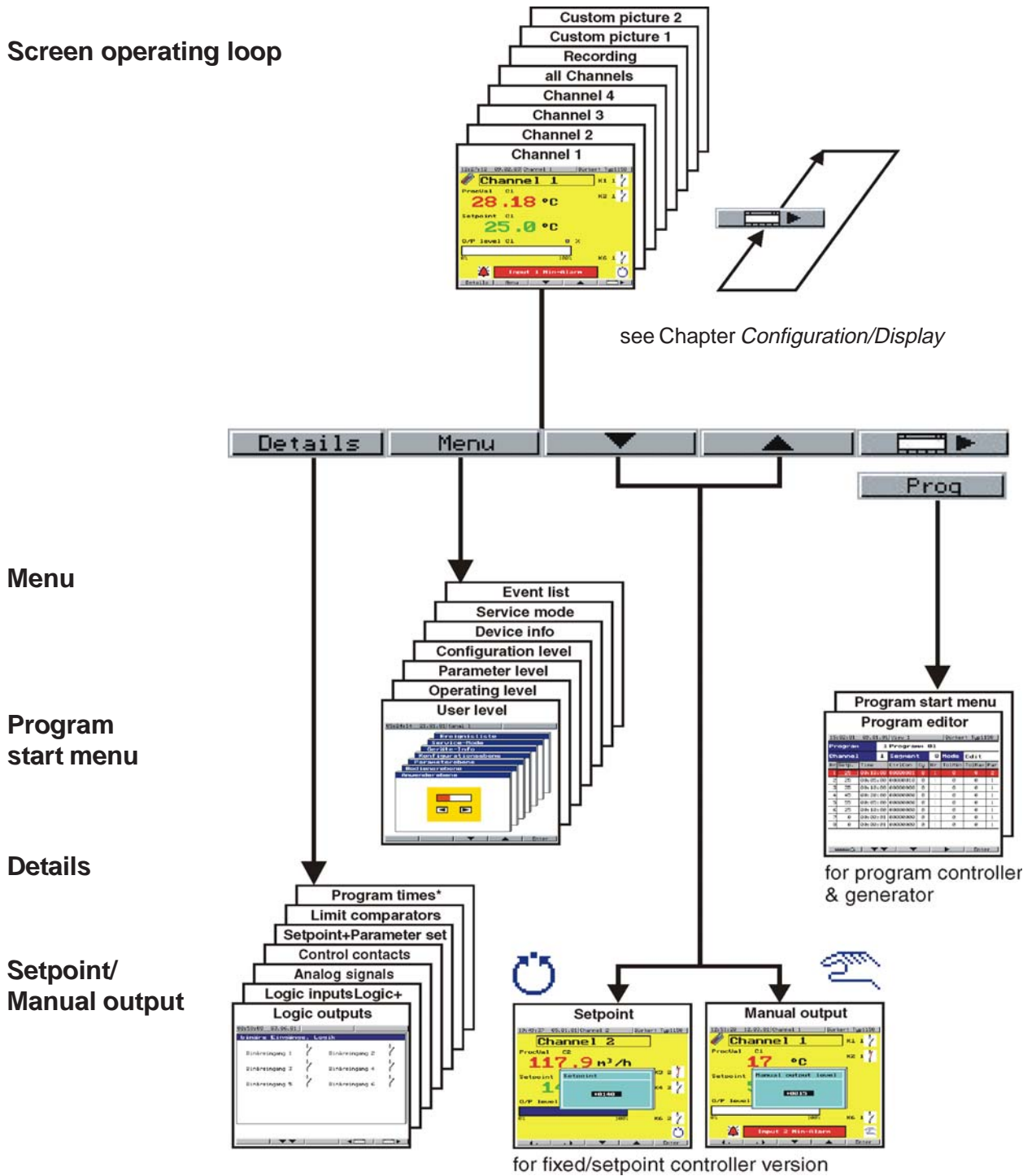
- (1) **Status line**
with time, date, name of screen template and instrument name
- (2) **Color screen (screen templates can be configured)**
Factory setting for fixed-setpoint controller: process value, setpoint, output (bar graph)
Factory setting for program controller: process value, setpoint, program number/name, segment number, remaining programm time
- (3) **Info/alarm symbol**
- (4) **Title**
Current meaning of the softkeys
- (5) **Keys**
(Softkeys) with various interpretations in the color screen
- (6) **Info/alarm symbol**
Display of infos (blue) or alarms (red)
- (7) **EXIT/manual key**
for manual mode, navigation, and for a program pause
- (8) **Operating mode/state**
- (9) **Power LED**
lights up green when voltage is applied
- (10) **Status indicators of the outputs (configurable)**

Symbols in display

Symbol	Meaning
	Info
	Alarm is present
	Automatic mode/Program is running
 (blue)	Manual mode/"Manual" operating mode
 (green)	Controller manual mode
	Self-optimization is active (symbol flashes)
	Ramp function is active
	Program pause
	Actuator open (modulating controller)
	Actuator closed (modulating controller)

Overview of operation

Screen operating loop



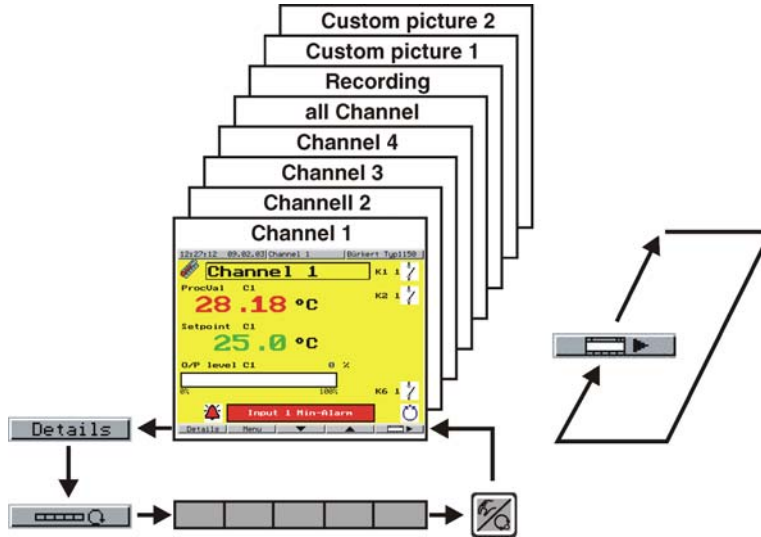
(> 2 s) = back to the screen operating loop

Time Out = If no key is pressed the display will automatically return to the screen operating loop after a definable time.



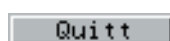


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Screen operating loop

The operating loop contains the screen templates for a maximum of four controller channels, the collective picture of all the active controller channels, the recording function as well as two freely definable screen templates. The screen templates can be individually switched into display. (see Chapter Configuration/Display)

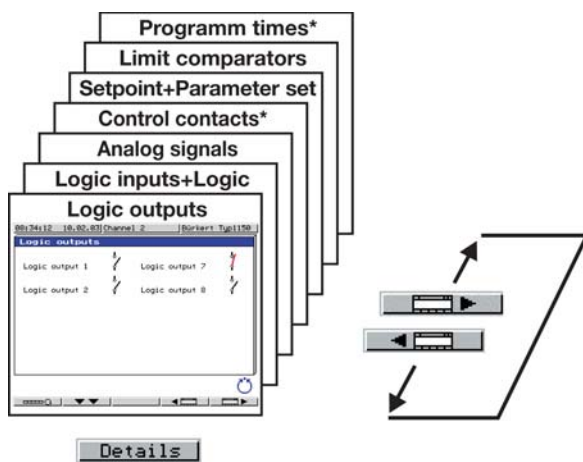


Meaning of the keys:

-  - additional functions of the softkeys
-  - start/cancel self-optimization for the channel that is displayed
-  - acknowledge alarm messages and limit comparators
-  - step on one segment (program controller)
-  - controller manual mode (program controller)

Details

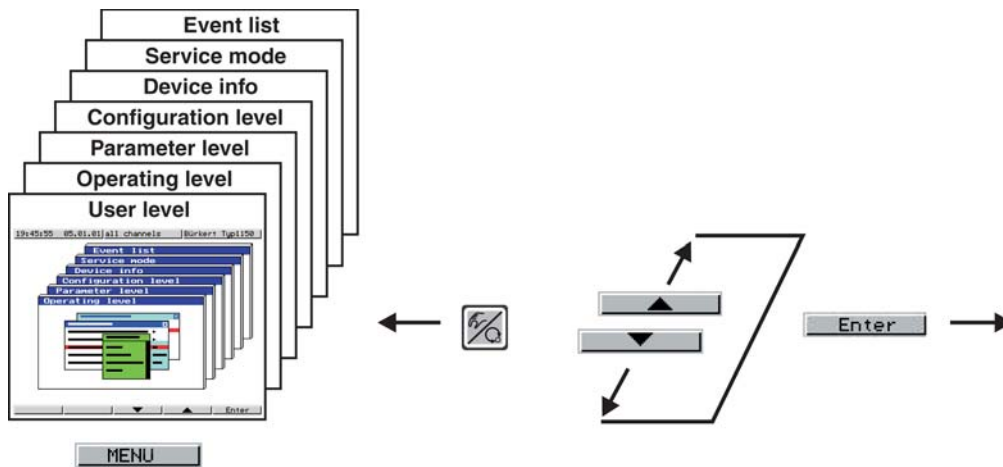
The states and values of the various process variables are presented in a clear and structured manner.



* Screens only available for process controllers

-  - scroll screen down

Menu



- **User level**

With the help of this screen template, the user can compile parameters that have to be frequently altered, through the setup program. This screen template is only displayed when appropriately configured.

- **Operating level**

Here the setpoints for all four controller channels are defined and self optimization is started (see Chapter “Self-optimization”).

- **Parameter level**

The controller parameters for the controller channels are defined here (see Chapter “Parameterization”).

- **Configuration level**

The instrument is adapted to the control task here (see Chapter “Configuration”).

- **Device info**

Information on hardware equipment, software version and instrument options are shown here.

- **Service mode**

This screen template can only be accessed by service personnel.




- **Event list**

Different events (e.g. alarm messages, limit comparator signals) are documented here.

Entering values and selecting settings

Entering values



Parameters can be altered in a number of screen templates:

- Select parameters 
- Increase parameter value with 
- Decrease parameter value with 





The longer the key is pressed the faster the value changes. Approx. 2 sec after releasing the key, the entry will be automatically accepted.

Parameters can be altered within their range of values or within the maximum displayable values (e. g. two decimal places: -99.99 to +99.99).

Shifting the decimal point






- Increase decimal place with 
- Decrease decimal place with 

Selecting

- Select parameter 
- Move up in selection list with 
- Move down in selection list with 
- Confirm entry with 

Entering codes and times

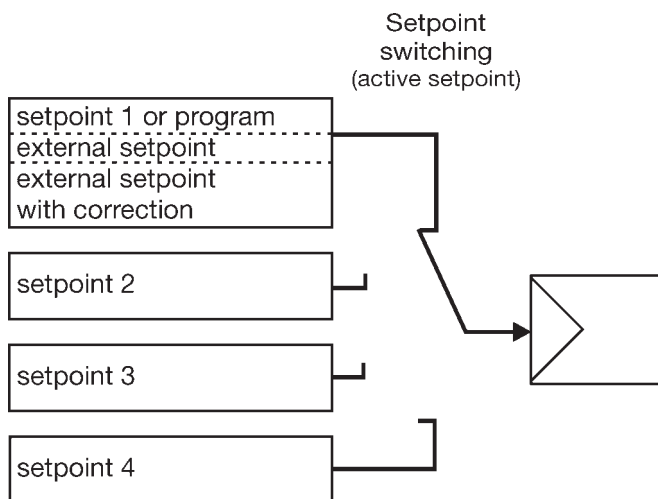
Times and codes are entered digit by digit.

- Increase or decrease value (digit) with  and 
- On to the next digit with  or 
- Confirm entry with 

Setpoint input

Configuration in controller

Each controller channel has four setpoints and the provisions to switch between them. Setpoints for the controller are defined as shown below:



(see Chapter "Controller and Logic functions")

Recording

Screen template

The recording function can be used to show the traces of up to four analog signals and the switching actions of up to three logic signals.

Momentary values of up to four analog signals

Graphical representation of the analog signals

Scaling of the analog signals (switchable)





Time axis (format hh:mm:ss)

Graphical representation of the logic signals










Time grid

Keys

-  - call up history
-  - switch display for the analog signal scalings

History

Data that have already been recorded can be viewed here. The recorded time span is shown on the time axis. The recorded time span depends on the sampling rate (adjustable) and varies between 12 hours and a maximum of 1 day.

- Shift the trace with , , , 
- Call up zoom function with  (key field is switched)
- Zoom in /zoom out of trace with  or 
- Return to the scroll functions with 
- Quit history with 

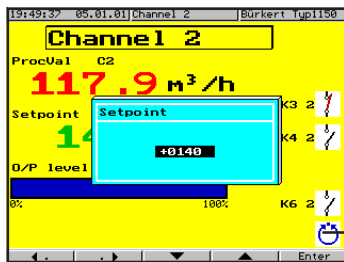
Operation “Controller“

If the instrument has been configured as a fixed-setpoint controller, the following actions can be performed in automatic/manual mode:

Altering the setpoint

The active setpoint of a controller channel can be altered in the corresponding screen template. The controller must be in automatic mode.

- Alter setpoint using and (the meaning of the softkeys changes, an input window appears)



automatic mode

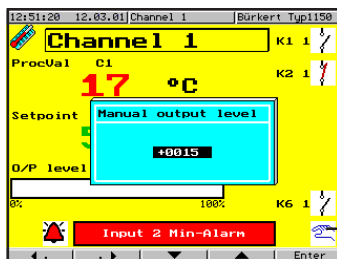
- Shift the decimal point using and
- New setpoint is automatically accepted after 2 sec or by using

Manual mode

Altering the output

The control loop of the controller channel that is displayed can be interrupted by switching to manual mode.

- Switch to manual mode with (hold key down for at least 2 sec!) (the symbol for manual mode appears in the operating mode display)
- Alter the output with and (the meaning of the softkeys changes, an input window appears)



manual mode

- Shift the decimal point using and
- The new output is automatically accepted after about 2 sec or by using

Altering the output for modulating controllers

In the case of modulating controllers, the keys are used to directly influence the right and left motion of a motorized actuator. The output is only indicated if the output feedback is connected.

 - open actuator

 - close actuator

The manual mode can be inhibited.

Operating „program controller/generator“

If the instrument is configured as a program controller/generator, programs have to be created first, by using the internal program editor or the setup program.

Program editor

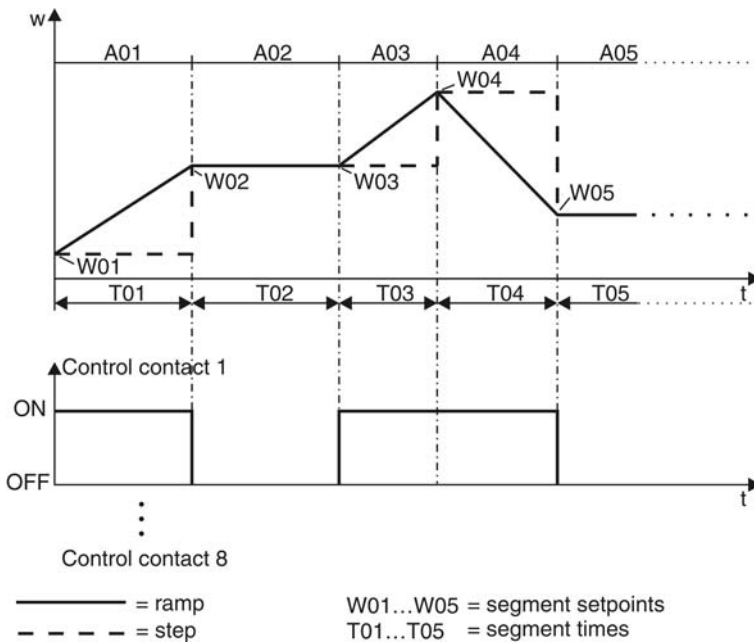
General

50 programs with up to 99 segments can be programmed; a total of 1000 segments can be implemented. Programs are created by programming setpoints and segment times, segment by segment.

Furthermore, the states of the control contacts 1 — 8 and the active parameter set can be defined for each segment.

The setpoint profiles can be output either as a ramp or a step (configurable).

Output as a ramp has been chosen for the following diagrams.

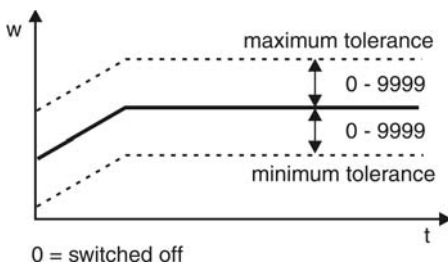


Tolerance band


To monitor the process value, a tolerance band can be applied around the setpoint profile for each segment.

If the upper or lower limit is infringed, a tolerance band signal is generated, which is internally processed or produced via an output.

(see Chapter “Outputs and Logic functions”)



Program editor

- Call up with  edit program
- Select program using the cursor keys
- Select program channel using the cursor keys

Number of program channel

Program number and name

Number of program segments

Entry mode
- edit
- temporary alteration

15:02:01		09.01.01		View 1		Bürkert Typ1150			
Program				1 Programm 01					
Channel		1		Segment		8		Mode	Edit
Nr	Setp.	Time	CtrlCon	Cy	Nr	TolMin	TolMax	Par	
1	25	00:10:00	00000001	0	1	0	0	2	
2	25	00:05:00	00000010	0	1	0	0	1	
3	35	00:10:00	00000000	0	1	0	0	1	
4	45	00:20:00	00000000	0	1	0	0	1	
5	55	00:05:00	00000000	0	1	0	0	1	
6	25	00:10:00	00000000	0	1	0	0	1	
7	0	00:00:01	00000000	0	1	0	0	1	
8	0	00:00:01	00000000	0	1	0	0	1	

Parameter set number

Lower and upper tolerance band

Number of repeat cycles (Cy) with start segment (No.)

Control contacts 8 — 1 (1=On)

Segment time

Segment setpoint

Segment number

 - call up additional softkey functions

Entering a new program


The segments are edited in sequence when creating a new program.

→ Append a new segment to the last segment of the profile trace with 


Copying segments

Existing segments can be copied and inserted in another position in the program. The segment that was copied is inserted above the cursor position.

→ Position the cursor on the segment to be copied


→ Copy segment with 

→ Position the cursor on the desired position

→ Insert segment with 

Inserting segments

A new segment can be inserted above the cursor position into an existing sequence of segments.

→ Insert segment with 

Removing segments

→ Delete marked segment with 

Entering repeat cycles

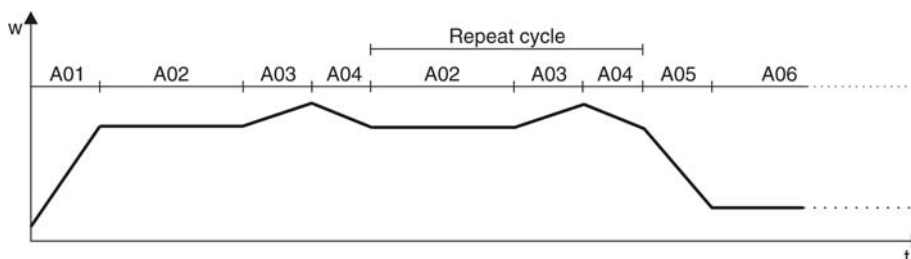
A group of segments that are arranged in sequence can be repeated up to 99 times or repeated endlessly (input: -1). The repeat cycles are programmed in the last segment of the group.

Example: S02 - S04 are to be repeated once.

→ Edit segment 4

→ Set number of repeat cycles to Cy=1

→ Set start segment of repeat to No.=2



Checking the program profile


The program segments entered in the table can be graphically displayed and checked. Repeat cycles are not taken into account for the display.

→ Show program profile with 

Starting the program

Immediate start of program

The program displayed on the screen in the basic status is started.

→ Start program with 

A program can also be selected, started and canceled via the logic functions. The logic function "Program selection" has priority over the settings in the menu "Program start".

(see Chapter "Logic functions")

Selecting and starting the program

The representation of the program selection can be configured as a list or an icon.
(see Chapter "Device data")

→ Call up program selection with  *start program*

→ Select program using the cursor keys

→ Start program with 2x  the program starts immediately at the start

Starting the program with time input

A program can be started at a specific point of time. There are two configurable options:

1. Start at a specified date and time
2. Start with a specified start delay in hours, minutes and seconds.

(see Chapter "Generator")



NOTE

|| The settings are reset to their standard values after the start of the program.

→ Call up program selection with  *start program*

→ Select program using the cursor keys

→ Change to menu "Program start" with 

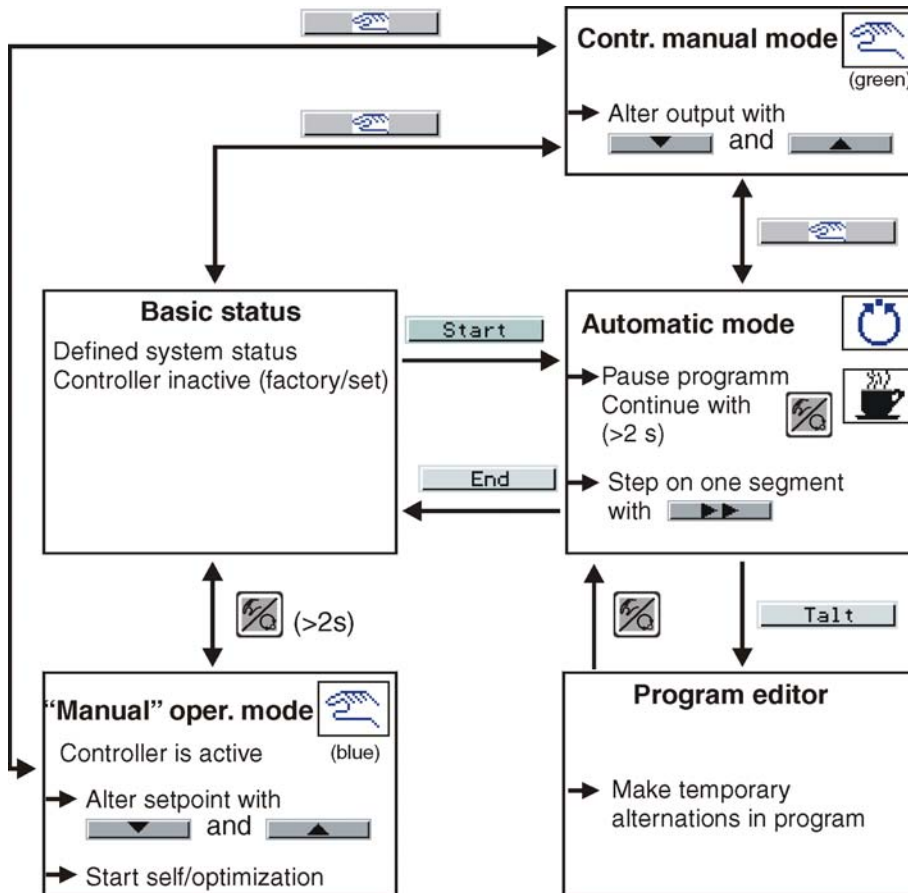
→ Enter start time/start date or start delay, start segment and remaining segment time

→ Start program with 

Overview of operation

The diagram below provides an overview of the different operating modes and operating options of a program controller.

Many operating options can also be implemented via the logic functions.



Buttons and can be accessed via "Details".

Basic status

In basic status the system state is defined, with the following factory settings for all program channels:

- controller, control contacts and limit comparators are inactive

- the controller setpoints are 0

- parameter set 1 is active for all controllers

The system state can be modified via the setup program.

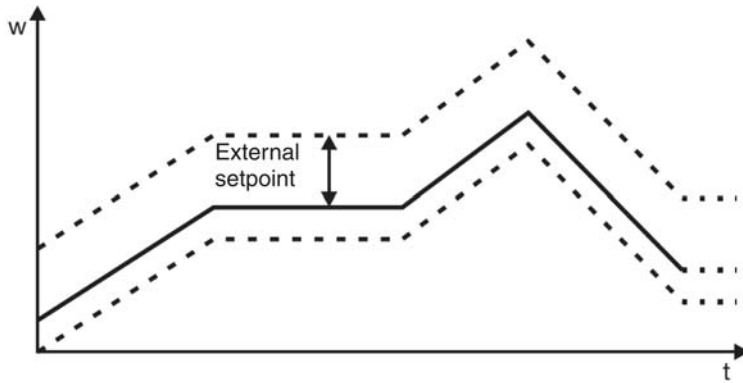
Temporary alterations

Temporary alterations are modifications to the current program in the program editor. They are not stored in the program memory, i.e. modifications will be lost after a restart.

In the case of alterations concerning the current segment, the setpoint sequence is automatically adapted.

Shifting the program profile

The function “External setpoint with correction” can be used to shift the program profile upwards or downwards.



The external setpoint is defined via an analog signal (see Chapter “Controller”).

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PARAMETERIZATION

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Parameter sets

General

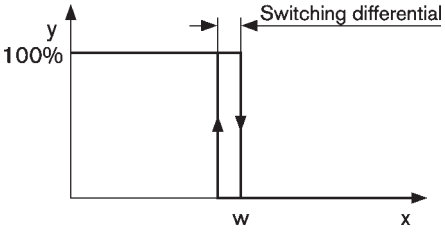
Two parameters sets can be stored for each controller channel.

Access code

Factory-set code: **0001**

The access code can be modified via the setup program.

Parameter level / Controller 1 (2...4) / Parameter set 1 (2)

Parameter	Value range	Factory setting	Meaning
Controller structure 1	P, I, PD, PI, PID	PID	Only PI and PID can be implemented on modulating controllers.
Proportional band	0 - 9999 Digit	0 Digit	Size of the proportional band Proportional band = 0 means that the controller structure is ineffective! (limit comparator response) In the case of proportional controllers, the proportional band must be > 0.
Derivative time	0 - 9999 sec	80 sec	Determines the derivative component of the controller output signal.
Reset time	0 - 9999 sec	350 sec	Determines the integral component of the controller output signal.
Cycle time	0 - 9999 sec	20 sec	When using a switched output, the cycle time should be chosen so that a) the pulsed energy flow to the process does not cause any intermissible fluctuations of the process value and b) the switching elements are not overloaded.
Contact spacing	0 - 999 Digit	0 Digit	The spacing between the two control contacts for 2-setpoints or modulating controllers, or proportional controllers with an integrated actuator driver.
Switching differential	0 - 999 Digit	1 Digit	Hysteresis for switching controllers with proportional band = 0 
Actuator time	5 ... 3000 sec	60 sec	The actually utilized operating time of the regulating valve for modulating controllers or proportional controllers with an integrated actuator driver.
Working point	- 100 ... + 100 %	0 %	Output level for P and PD controllers (when $x =$ then $y = Y_0$)
Output level limiting	0 ... 100 %	100 %	The maximum limit for the output level.
	- 100 ... + 100 %	- 100 %	The minimum limit for the output level.
Minimum relay ON time	0 ... 60 sec	0 sec	Limits the frequency of switching for switched outputs.

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Controller structure 2 / ...			
Controller structure 2	P, I, PD, PI, PID	PID	The parameters refer to the second controller output for 2-setpoint and modulating controllers.
Proportional band	0 - 9999 Digit	0 Digit	
Derivative time	0 - 9999 s	80 sec	
Reset time	0 - 9999 s	350 sec	
Cycle time	0 - 9999 s	20 sec	
Switching differential	0 - 999 Digit	1 Digit	
Minimum relay ON time	0 - 60 s	0 sec	



NOTE

|| The parameter display on the instrument depends on the controller type selected.
 (see Chapter "Controller")

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CONFIGURATION

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Parameters and functions at the configuration level

General

The following applies to the representation of parameters and functions at the configuration level:

The parameter is not displayed or cannot be selected if

- the instrument features do not permit the function assigned to the parameter.

Example:

Output 3 cannot be configured if no output 3 is available in the instrument.

- the parameter is irrelevant to the function that has been configured.

Example:

Analog input 1 is configured to "Pt100", which means that display start and end for standard signals cannot be selected.



NOTE

Some parameters are only available for a fixed-setpoint controller (with or without ramp function) or a program controller/generator. For fixedsetpoint controllers, these parameters and settings are marked by a superscript "F" (e.g. ramp^F), for program controllers /generators by a "P".

Access code

Factory-set code: 0002

Selectors

Selectors are menus which fold down when an individual parameter is selected.

Two standard selectors are defined for the configuration tables below, for reasons of clarity:

E.G. Analog selector

Switched off	Switched off
Analog Imp. 1	Measurement of analog input 1
...	...
Analog Imp. 4	Measurement of analog input 4
Math 1	Result of math formula 1
...	...
Math 8	Result of math formula 8
Process value C1	Process value for controller 1
Setpoint C1	Setpoint for controller 1
Ramp end C1	Ramp end value for controller 1
Control dev. C1	Control deviation for controller 1
Output C1	Output for controller 1
Process value C2	Process value for controller 2
Setpoint C2	Setpoint for controller 2
Ramp end C2	Ramp end value for controller 2
Control dev. C2	Control deviation for controller 2
Output C2	Output for controller 2
Process value C3	Process value for controller 3
Setpoint C3	Setpoint for controller 3
Ramp end C3	Ramp end value for controller 3
Control dev. C3	Control deviation for controller 3
Output C3	Output for controller 3

Process value C4	Process value for controller 4
Setpoint C4	Setpoint for controller 4
Ramp end C4	Ramp end value for controller 4
Control dev. C4	Control deviation for controller 4
Output C4	Output for controller 4
Y cascade C1	Standardized output with cascade control for controller 1
...	...
Y cascade C4	Standardized output with cascade control for controller 4
Setpoint 1 C1	Setpoint 1 for controller 1
...	...
Setpoint 4 C1	Setpoint 4 for controller 1
Setpoint 1 C2	Setpoint 1 for controller 2
...	...
Setpoint 4 C2	Setpoint 4 for controller 2
Setpoint 1 C3	Setpoint 1 for controller 3
...	...
Setpoint 4 C3	Setpoint 4 for controller 3
Setpoint 1 C4	Setpoint 1 for controller 4
...	...
Setpoint 4 C4	Setpoint 4 for controller 4
Setpoint 1 PCh1 ^P	Setpoint 1 for program channel 1
...	...
Setpoint 1 PCh4 ^P	Setpoint 1 for program channel 4
Setpoint 2 PCh1 ^P	Setpoint 2 for program channel 1
...	...
Setpoint2 PCh4 ^P	Setpoint 2 for program channel 4
Seg. end val. PCh1 ^P	Current final segment value for program channel1
...	...
Seg. end val. PCh4 ^P	Current final segment value for program channel 4
Output 1 C1	Controller output 1 for controller 1
Output 2 C1	Controller output 2 for controller 1
Output 1 C2	Controller output 1 for controller 2
Output 2 C2	Controller output 2 for controller 2
Output 1 C3	Controller output 1 for controller 3
Output 2 C3	Controller output 2 for controller 3
Output 1 C4	Controller output 1 for controller 4
Output 2 C4	Controller output 2 for controller 4
RemSegT PCh1 ^P	Remaining segment time for program channel 1 (in seconds)
...	...
RemSegT PCh4 ^P	Remaining segment time for program channel 4 (in seconds)
Seg. Time PCh1 ^P	Segment time for program channel 1 (in seconds)
...	...
Seg. Time PCh4 ^P	Segment time for program channel 4 (in seconds)
Program time ^P	Total program time (in seconds)
RemProgT ^P	Remaining run time of program (in seconds)
Analog value	any analog value (from adress)
Internal Pt100	Temperature measurement of internal Pt100
Sampling time	Sampling time of instrument

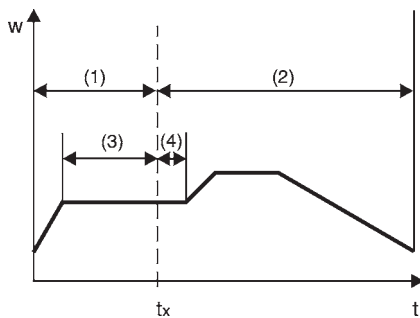
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E.G. Binary selectors

Switched off	Switched off
Output 1 C1	Controller output 1 for Controller 1
Output 2 C1	Controller output 2 for Controller 1
Output 1 C2	Controller output 1 for Controller 2
Output 2 C2	Controller output 2 for Controller 2
Output 1 C3	Controller output 1 for Controller 3
Output 2 C3	Controller output 2 for Controller 3
Output 1 C4	Controller output 1 for Controller 4
Output 2 C4	Controller output 2 for Controller 4
Limit comp. 1	Controller output 1
...	...
Limit comp. 16	Limit comparator 16
Contr. contact 1 ^P	Control contact 1
...	...
Contr. contact 8 ^P	Control contact 8
Logic input 1	Logic input 1
...	...
Logic input 6	Logic input 6
Logic 1	Result of logic linkage 1
...	...
Logic 8	Result of logic linkage 8
Binary logic value	any binary logic value (from address)
Program end ^P	Program end signal
Ramp end 1 ^F	Ramp end signal for controller 1
...	...
Ramp end 4 ^F	Ramp end signal for controller 4
Tolerance band ^P	Signal on going above/below tolerance band
Manual mode C ¹	Controller 1 in manual mode / program pause
...	...
Manual mode C ⁴	Controller 4 in manual mode / program pause
Transmitter	Signal always active
Logic OFF	Logic 0
Logic ON	Logic 1

Definition of program times

Different times are defined for the program controller/generator, which can be internally processed and displayed.



- (1) Program time
- (2) Remaining program time
- (3) Segment time
- (4) Remaining segment time

Analog inputs

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Analog inputs
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Depending on the instrument version, up to four analog inputs are available. The analog inputs are numbered in sequence (input 1 — 4) according to their slot assignment.

Analog input 1 (2 to 4) / ...

Value / selection	Description
Probe	
No function	No function
RTD 3-wire	Resistance thermometer in 3-wire circuit
RTD 2-wire	Resistance thermometer in 2-wire circuit
RTD 4-wire	Resistance thermometer in 4-wire circuit
T/C int.	Thermocouple (internal cold junction)
T/C ext.	Thermocouple (external cold junction)
T/C const.	Thermocouple (constant cold junction)
Pot	Potentiometer
Heater current	Heater current 0 to 50 mA AC
0 to 20 mA	0 to 20 mA
0 to 10 V	0 to 10 V
0 to 1 V	0 to 1 V
0 to 100 mV	0 to 100 mV
- 10 to + 10 V	- 10 V to + 10 V
- 1 to + 1 V	- 1 to + 1 V
- 100 to + 100 mV	- 100 to + 100 mV
4 to 20 mA	4 to 20 mA
2 to 10 V	2 to 10 V
0,2 to 1 V	0,2 to 1 V
20 to 100 mV	20 to 100 mV
- 6 to 10 V	- 6 to 10 V
- 0,6 to 1 V	- 0,6 to 1 V
- 60 to + 100 mV	- 60 to + 100 mV
	Factory-set on analog input 2 to 4: No function

Analog input 1 (2 to 4) / ...

Value / selection	Description									
Linearization										
Linear	For customized linearization (e.g. „customized 1“) a maximum of 20 knee-points can be implemented, or a 5th order polynomial function programmed (only with setup program). „C-level“ linearization is used for the C-level control with a zircon dioxide sensor. For the linearization „KTY11-6“, the resistance is 2 k Ω at 25 °C. The resistance value can be adapted via the parameter „KTY:“ at 25°C / 77°F.									
Pt100										
Pt100 JIS										
Ni100										
Pt500										
Pt1000										
Ni1000										
Pt50										
CU50										
Pt K9										
KTY11-6										
Fe-CuNi J										
NiCr-CuNi E										
NiCr-Ni K										
NiCrSi-NiSi N										
Cu-CuNi T										
Pt30Rh-Pt6Rh B										
Pt13Rh-Pt R										
Pt10Rh-Pt S										
Cu-CuNi U										
Fe-CuNi L										
W5Re_W26Re C										
W3Re_W25Re D										
W3Re_W26Re										
C-level										
Customized 1										
Customized 2										
Customized 3										
Customized 4										
Offset										
- 1999 to 0 to + 9999	The offset is used to correct a measured value by certain amount upwards or downwards. Example: <table border="0"> <thead> <tr> <th>Measured value</th> <th>Offset</th> <th>Displayed value</th> </tr> </thead> <tbody> <tr> <td>294,7</td> <td>+ 0,3</td> <td>295,0</td> </tr> <tr> <td>295,3</td> <td>- 0,3</td> <td>295,0</td> </tr> </tbody> </table>	Measured value	Offset	Displayed value	294,7	+ 0,3	295,0	295,3	- 0,3	295,0
Measured value	Offset	Displayed value								
294,7	+ 0,3	295,0								
295,3	- 0,3	295,0								



NOTE

The controller uses the corrected value (i.e. displayed value) for its computation. This value does not correspond to the actual measured value.
 If incorrectly applied, this can result in impermissible values of the control variable.

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Analog input 1 (2 to 4) / ...

Value / selection	Description
Range	
Start - 1999 to + 9999	The instrument will change over earlier to the response defined for overrange / underrange if the range is restricted. Example: Pt100 (Range: - 200 to + 850 °C). An alarm message is to be generated for temperatures outside the range 15 to 200 °C. 🔍 Range start: 15 🔍 Range end: 200
End - 1999 to + 9999	
Display	
Start - 1999 to 0 to + 9999	On transducers with standard signal and on potentiometers, a display value is assigned to the physical signal. Example: 0 to 20 mA = 0 to 1500 °C. The range of the physical signal can be 20 % wider or narrower without generating an out-of-range signal.
End - 1999 to 100 to + 9999	
Filter	
0 to 0.6 to 100 s	To adjust the digital input filter (0 s = filter off). 63 % of the alternations are accounted for after 2x filter time constant at a signal step change. When the filter time constant is large: - high damping of disturbance signals - slow reaction of the process value display to process value changes - low limit-frequency (2nd order low-pass filter)
TK constant value	
0 to 50 to 100	Temperature of the external cold-junction thermostat.
TK external	
Analog input 1 Analog input 2 Analog input 3 Analog input 4	Measurement of the cold-junction temperature with an temperature probe.
Heater current monitoring (output)	
No function. Output 1 ... Output 12	The heater current is evaluated using a current transformer with a standard signal output, which can be monitored by linking the analog input with a limit comparator. The measurement is always made when the heating contact is closed. The measurement is retained until the next measurement.
Correction value KTY	
0 to 400	1 k * Correction value

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Analog input 1 (2 to 4) / ...

Value / selection	Description
Recalibration	
Start - 1999 to <u>0</u> to + 9999	(See below for explanation)
End - 1999 to <u>1</u> to + 9999	



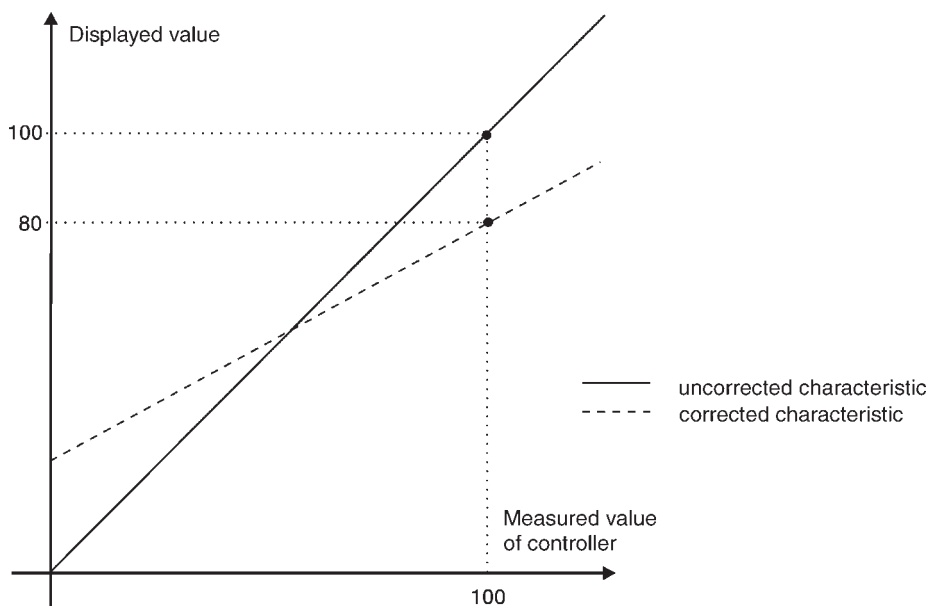
NOTE

As opposed to all the other settings, entry of the start and end value is linked to the latest measurement at the input concerned.
As a rule, these values cannot be adopted by another instrument.

Customized recalibration

A signal is processed electronically (conversion, linearization ...) to produce a measured value via the analog inputs of the controller. This measured value enters into the computations of the controller and can be visualized on the displays (measured value = displayed value).

This fixed relationship can be modified if required, i.e. the position and the slope of the measurement characteristic can be altered.



Procedure



Apply two measurement points ((1), (3)), one after another, to the controller; they should be as far apart as possible.

At these measurement points, enter the required display value (start value, end value) in the controller. A reference instrument is most convenient for determining the measured values M1 and M2.

Measurement conditions must remain stable during programming.

Programming

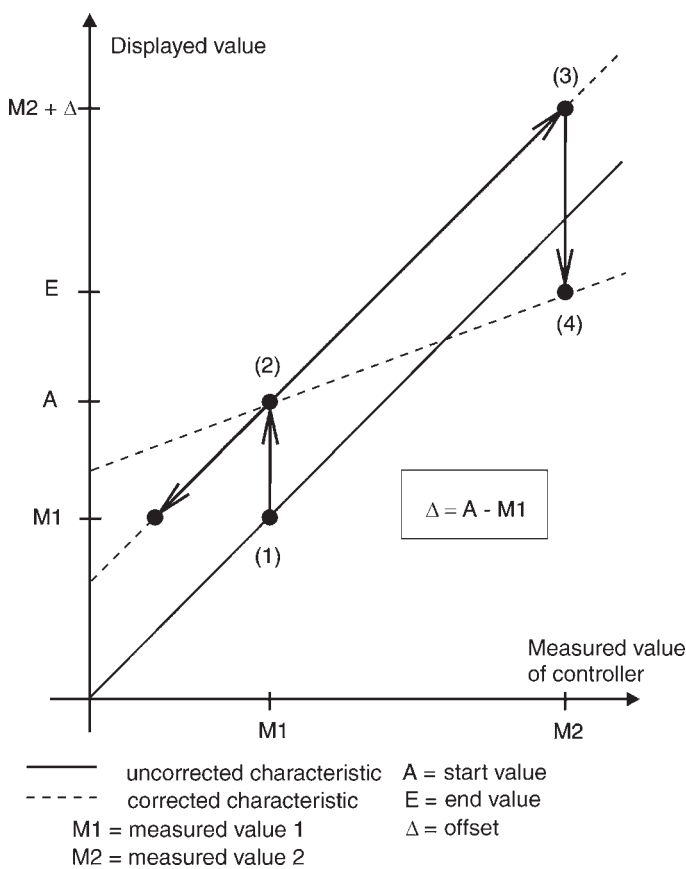
- (1) Move to measurement point
- (2) Enter start value ¹⁾
- (3) Move to measurement point
- (4) Enter end value E ¹⁾

¹⁾ If start value=0 or end value=1 is to be set, then the value must first be altered using  or  to enable correction.



NOTE

|| If recalibration is carried out without a reference instrument, the offset Δ must be taken into account when moving to measurement point (3).



To cancel recalibration, the start and end values have to be programmed to the same value. This automatically sets the start value to 0 and the end value to 1.

Any subsequent recalibration will otherwise be based on the corrected characteristic.

Controller

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Analog inputs
Controller
Generator
Limit comparators
Outputs
Logic functions
Math / Logic
C-level
Display
Interfaces
Device data
Recording

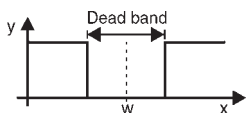
The following are set here: controller type, input variables of the controller, the setpoint limits, conditions for manual mode and the presettings for selfoptimization of the four controller channels.

Controller 1 (2 to 4) / Configuration

Value / selection	Description
Controller type	
2 point process controller	2 point process controller
3 point process controller	3 point process controller
3 point step	3 point step automatic controller
Position control	Continuous automatic controller with integrated position control
Continuous	Continuous automatic controller
Control action	
Direct Inverse	<p>Direct: The controller output Y is > 0 when the process value is smaller than the setpoint (e.g. cooling).</p> <p>Inverse: The controller output Y is > 0 when the process value is larger than the setpoint (e.g. heating).</p>
Inhibit manual mode	
Free Inhibited	If the manual mode is inhibited, changing over to "manual" is not possible from the keys or via the logic input.
Manual output	
- 100 to 101	Defines the output after changing over to manual mode. 101 = last output
Range output	
- 100 to 0 to 101	Output on out-of-range. 101 = last output

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Controller 1 (2 to 4) / Configuration

Value / selection	Description
Dead band	
0 to 100	<p>The output movement is suppressed within the dead band; e.g. with noisy signals.</p>  <p>The dead band is only effective for controller structures with an I-component.</p>
External setpoint	
without correction with correction	<p>External setpoint input without correction External setpoint input with correction</p> <p>External setpoint with correction: External setpoint + sepoint 1 = present setpoint The external setpoint is corrected up or down from the keypad (setpoint 1). The display shows the present setpoint.</p> <p>Activating the function: <i>Controller 1 / Inputs / External setpoint</i></p>
Setpoint	
Start value - 1999 to 0 to + 9999	Setpoint limiting prevents the input of values outside the defined range.
End value - 1999 to 400 to + 9999	
Output level	
Start value - 1999 to 0 to + 9999	Output standardization for cascade control: If the controller channel serves as a master controller, then the controller output signal (output 0 to 100 %) must be scaled to match the setpoint range of the slave controller.
End value - 1999 to 100 to + 9999	
Cascade controller	
No function Master controller 1 Slave controller 1 Master controller 2 Slave controller 2	Activates cascade control and defines the control channel as a master or slave controller for cascade 1 or 2.

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NOTE

The setpoint limits are not effective if the setpoint is set by the pc via the interface.
In case of correction of an external setpoint the limitation is valid for the sum of both (setpoint + correction).

Controller 1 (2 to 4) / Inputs

Value / selection	Description
Process value	
(Analog selector) Analog inp. 1	Defines the source for the process value of the control channel.
External setpoint	
(Analog selector) Switched off	Activates the external setpoint input and defines the source for the external setpoint.
Program setpoint	
(Analog selector) Setpt.1 PROF1	Assigns one of the four available profile traces to the controller channel. "No funct." means that the controller channel responds as for fixed-setpoint control.

Controller 1 (2 to 4) / Inputs

Value / selction	Description
Manual output	
(Analog selector) Switched off	The manual output is defined through an analog signal, instead of via the keys or the interfaces.
Output feedback	
(Analog selector) Switched off	Defines the source for output feedback. Output feedback must be configured in the case of a proportional controller with integral actuator driver.
Additive disturbance	
(Analog selector) Switched off	Defines the source for the additive disturbance.
Multiplicative disturbance	
(Analog selector) Switched off	Defines the source for the multiplicative disturbance.

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Controller 1 (2 to 4) / Self-optimization

Value / selection	Description
Method	
Oscillation Step response	One of two procedures can be selected for self-optimization. (see Chapter <i>Optimization</i>)
Self-optimization	
Enabled Inhibited	If the function is inhibited, self-optimization cannot be started from the keys or the logic input..
Output 1 for "Tune"	
Relay + logic Solid-state Analog	The type of the physical output for the signal of the controller output 1 has to be defined.
Output 2 for "Tune"	
Relay + logic Solid-state Analog	The type of the physical output for the signal of the controller output 2 has to be defined.
Steady output	
- 100 to 0 to + 100 %	Initial output level with step response
Step size	
10 to 20 to 100 %	Step size with step response

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Generator

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The basic function of the instrument is defined here. The instrument with all the available controller channels can be operated as a fixed setpoint controller, program controller or program generator.

Furthermore, ramp functions (fixed-setpoint controller) can be activated for the individual controller channels with different parameters defined for the program controller/generator.

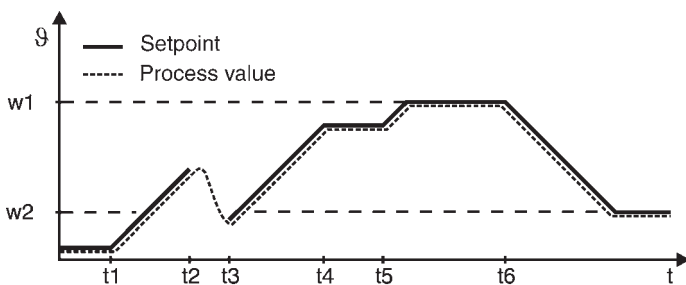
Function / ...

Value / selection	Description
Function	
Fixed-setpt.contr. Progr.contr. Progr.gen.	Basic instrument function

Ramp function

A rising or a falling ramp function can be implemented. The ramp-end value is determined by the setpoint input.

The ramp function can be stopped and canceled via the logic functions (see Chapter "Logic functions").



- t1 Power on (w1 active)
- t2...t3 Power down / manual mode / probe break
- t4...t5 Ramp stop
- t6 Setpoint switching to w2



NOTE

|| The ramp function is interrupted on a probe break, or for manual mode. The outputs react the same as for overrange/underrange (user configurable).

Ramp / Ramp controller 1 (2 to 4)

Value / selection	Description
Function^F	
Inactiv Activ	Defines whether the ramp function is to be activated for the corresponding controller channel.
Unit of slope^F	
K / minute K / hour K / day	Defines the unit of the slope in kelvin per unit of time.
Ramp slope^F	
0 to 9999	Amount of slope

Program / ...

Value / selection	Description
Program start^P	
Program start At process value	Program start at the first programmed setpoint. The present process value from program channel 1 is accepted as the first setpoint.
Response for range^P	
Continue Program stop	Response of the program run to out-of-range.



NOTE

- || ^F = Parameter only available for fixed-setpoint controller.
- || ^P = Parameter only available for program controller / generator.

Program / ...

Value / selection	Description
Response to power failure^P	
<p>Prog. canceled Continue Standstill Continue X % Continue PV</p>	<p>Response of the program run on a power failure.</p> <p>Program canceled: Program run canceled; instrument switches to basic status.</p> <p>Continue: The program continues from the point at which it was canceled at the time of the supply failure.</p> <p>Standstill: Outputs, limit comparators, control contacts and controller respond as was defined in the system status "Basic status". A message appears asking you to either cancel program or resume it.</p> <p>Continue at deviation < X %: The program continues from the point at which it was interrupted at the time of the power failure, if the deviation between the process value before and after the power failure does not exceed a programmable percentage value (process value deviation) on program channel 1. If this value is exceeded, the instrument goes into standstill.</p> <p>Continue at process value: This sign of the gradient (falling or rising edge) at the time of the power failure is stored in the event of a power failure. After the supply voltage has been restored, the program is checked from the beginning to find matching process values and setpoints on program channel 1. The program continues from the point at which the process value matches the setpoint and the sign of the gradient corresponds to the gradient that was stored.</p>
Process value deviation^P	
0 to 10 to 100 %	Maximum deviation on a restart after a power failure (continue at deviation < X %)
Setpoint input^P	
<p>Setpoint ramp Setpoint step</p>	<p>Setpoint ramp:</p> <p>Setpoint step:</p>

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Program / ...

Value / selection	Description
Start at time^P	
No Yes	Starts the program after an adjustable start delay, or at a time that can be defined (start with time delay). Setting the Clock: (see Chapter <i>Device data</i>)
Program end time^P	
- 1 to <u>0</u> to 9999 s	Duration of program end signal -1 = continous signal until acknowledgement (see Chapter <i>Outputs</i>)
Function control^P (.../Controller 1 to 4, .../1 to 16. Limit comparator	
Generator control Control contact 1 ... Control contact 8	Defines when controllers and limit comparators are active. Generator control: This function is only active in "Automatic mode"; Otherwise as per defined system status for the basic status in the setup program. Control contact: This function is only active if the control contact is in the "ON" condition.

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Limit comparators

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Limit comparators (limit monitors, limit contacts) can be used to monitor an input variable (limit comparator process value) against a fixed limit or another variable (limit comparator setpoint). When a limit is exceeded, a signal can be output or an internal controller function initiated.

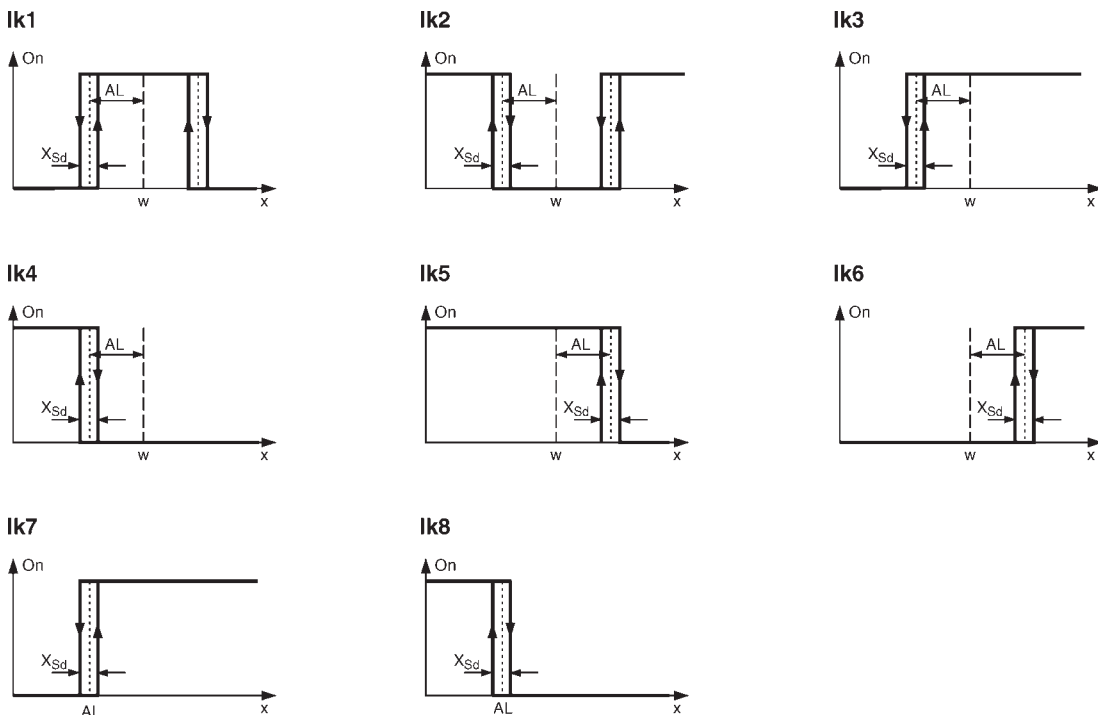
16 limit comparators are available.

Limit comparator functions

Limit comparator scan have different switching functions.

Ik1 ... Ik6 Monitoring referred to the limit comparator setpoint

Ik7/Ik8 Monitoring referred to a fixed value AL



- w limit comparator setpoint, AL = limit value
- AL limit value
- x limit comparator process value
- X_{Sd} switching differential

1. (2 to 16.) Limit comparator / ...

Value / selection	Description
LK function	
No function LK type 1 ... LK type 8	Limit comparator function.
-1999 to <u>0</u> to +9999	Limit value to be monitored.
Switching differential	
0 to <u>1</u> to 100	Switching differential Xsd.
Action	
Absolute Relative	See explanation on next page.
Range response	
Relay OFF Relay ON	Function on over / underrange.
Switch-on delay	
<u>0</u> to 9999s	Delays the switch-on edge by a definable time period.
Switch-off delay	
<u>0</u> to 9999s	Delays the switch-off edge by a definable time period.
Acknowledgement	
none when inactive when active	none: The limit comparator is automatically reset. when inactive: The limit comparator must be acknowledged; acknowledgement is only possible in the inactive condition. when active: The limit comparator must be acknowledged; acknowledgement is also possible in the active condition.
Pulse time	
<u>0</u> to 9999s	The limit comparator is automatically reset after an adjustable time period.
LK process value	
(Analog selector) Switched off	Limit comparator process value.
LK setpoint	
(Analog selector) Switched off	Limit comparator setpoint.

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NOTE

Range response: If a limit comparator is connected to an output, then the setting “Output signal on over / underrange“ of the outputs has priority (see Chapter *Outputs*).

Absolute

At the time of alteration, the limit comparator acts in accordance with its function.

Relative

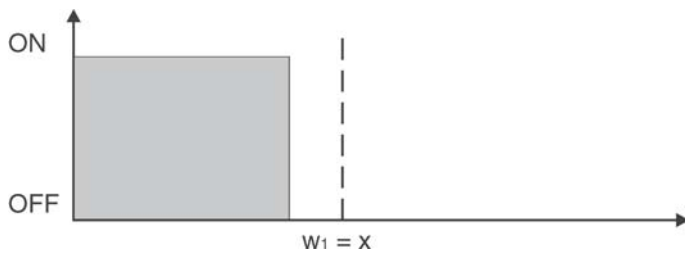
The limit comparator is in the OFF status. An alteration of the limit value or the (limit comparator) setpoint could cause the limit comparator to switch ON. Such a reaction will be suppressed, and this condition is maintained until the (limit comparator) process value has moved away from the switch-on region (gray area).

Example:

Monitoring the (controller) process value x with function lk4

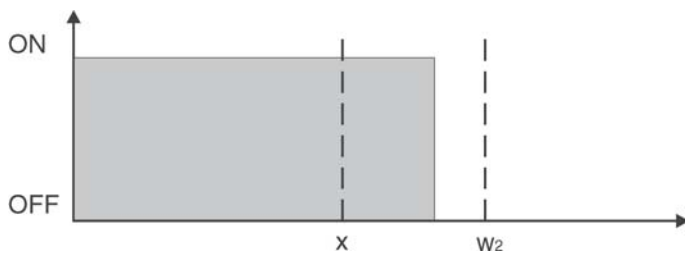
Setpoint alteration $w_1 \rightarrow w_2$

a) Initial condition



b) Condition at the time of the alternation

The limit comparator remains "OFF" although the process value is within the switch-on region!



c) Stabilized condition

The limit comparator again operates in accordance with its function.



This function also prevents a limit comparator from being triggered during the start-up phase.

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Outputs

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Configuration of the instrument outputs are subdivided into analog outputs (max. 6) and logic outputs (max. 12). Display and numbering of the outputs depends on the assignment of the output slots Output 1- 6.

Numbering of the outputs

Slot	Plug-in board with		
	1 analog output	1 logic output	2 logic output
Output 1	Analog output 1	Logic output 1	Logic output 1+7
Output 2	Analog output 2	Logic output 2	Logic output 2+8
Output 3	Analog output 3	Logic output 3	Logic output 3+9
Output 4	Analog output 4	Logic output 4	Logic output 4+10
Output 5	Analog output 5	Logic output 5	Logic output 5+11
Output 6	Analog output 6	Logic output 6	Logic output 6+12

Analog outputs / Analog output 1 (2 ... 6) / ...

Value / selection	Description
Function	
(Analog selector) Analog inp. 1	Factory-set for analog output 2 to 6: Switched off
Signal	
0 to 10 V 2 to 10 V 0 to 20 mA 4 to 20 mA	Physical output signal
Signal for range	
0 to 101 %	Signal on going above / below range



NOTE

Signal for range: If the output is a controller output, the controller switches over to manual mode and produces an output level that can be defined.

see Chapter "Controller"

Analog outputs / Analog output 1 (2 to 6) / ...

Value / selection	Description
Zero point	
- 1999 to <u>0</u> to + 9999	A physical output signal is assigned to the value range of a output variable. Example: Setpoint 1 (value range: 150 to 500°C) is to be output via the analog output (0 to 20 mA). i.e.: 150 to 500 °C = 0 to 20 mA Zero point: 150 / End value: 500
End value	
- 1999 to <u>100</u> to + 9999	A physical output signal is assigned to the value range of a output variable. Example: see above "Zero point"
Offset	
- 1999 to <u>0</u> to + 9999	Value of the parallel shift applied to the analog output values.



NOTE

Zero point resp. end value - Example: Setting with controller outputs for cooling.
The following settings have to be defined for double-setpoint controllers:
Zero point: 0 / End value: -100

Logic outputs / Logic output 1 (2 to 12) / ...

Value / selection	Description
Function	
(Binary selector) Outp. 1 contr. 1	Factory-set for logic output 2 to 12: Switched off
Output mode	
none Time delay Pulse	Time delay: The switch-on / switch-off edges can be delayed by a definable time period. Pulse: A definable pulse / pause ratio can be applied to the output.
ON time	
- 1999 to <u>0</u> to + 9999	Delay of switch-on edge or pulse time.
OFF time	
- 1999 to <u>0</u> to + 9999	Delay of switch-off edge or pulse time.

Logic functions

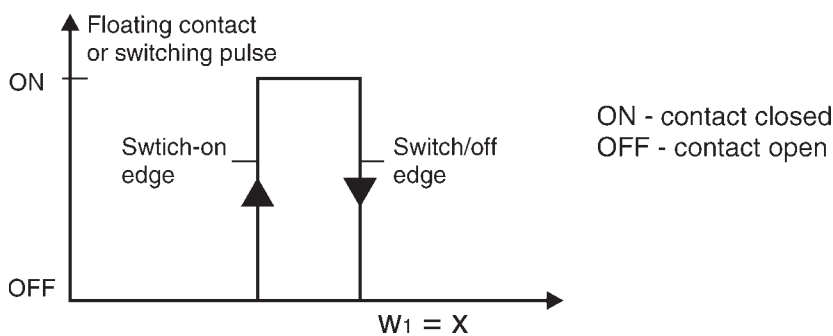
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Functions are assigned here to the logic signals of the logic inputs, limit comparators and logic functions (formula).

In addition, the functions for control contacts, tolerance band signal and program end signal are defined for program controllers/generators.

In the case of the fixed-setpoint controller, the ramp end signals can have functions assigned.

Switching Action



The functions are arranged in two groups:

Edge-triggered functions

The logic function reacts to switch-on edges.

The following functions are edge-triggered:

- Start/stop of self-optimization
- Acknowledgement of limit comparators
- Program start/stop/cancel
- Segment change

State-triggered functions

The logic function reacts to switch-on or switch-off states.

- All remaining functions

Combined logic functions

The functions are implemented through the combination of up to four control variables.

Any control variable can be selected. The states Z1 to Z4 are assigned to the control variables in descending order of the control variables (see list on the right).

Control variable	State
Logic input 1	
...	
Logic input 6	
Limit comparator 1	
...	
Limit comparator 16	Z1
Logic 1	Z2
...	Z3
Logic 8	Z4
Control contact 1	
...	
Control contact 8	
Tolerance band signal*	
Ramp end signal	

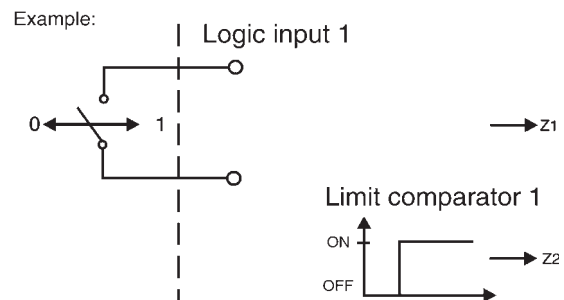
* only for programm contr. / generator

Example:

The process value is to be selected via a logic input and the state of one limit comparator.

This results in the following assignment:

- Z1 - logic input 1
- Z2 - limit comparator 1



Setpoint/process value switching

Setpoint	Process value	Z2	Z1
Setpoint 1 Setpoint of system status External setpoint	configured controller process value of controller channel	0	0
Setpoint 2	Analog input 2	0	1
Setpoint 3	Analog input 3	1	0
Setpoint 4	Analog input 4	1	1

0 = contact open / OFF
1 = contact closed / ON



NOTE

If switching between two setpoints or two process values is required, only one logic function has to be configured.

If more than two logic functions are configured to setpoint switching or process value switching, only the first two (see list "Control variable - State") are significant.

Program selection

Program	Z4	Z3	Z2	Z1
Program 1	0	0	0	0
Program 2	0	0	0	1
Program 3	0	0	1	0
Program 4	0	0	1	1
...
Program 16	1	1	1	1

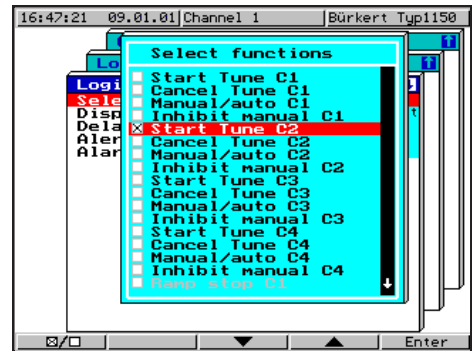
0 = kontakt open / OFF
 1 = kontakt closed / ON

Multifunctional logic functions

Logic functions can cover several functions simultaneously. The desired function can be marked

→ Select/delete function with 

→ Confirm with 



Selection of functions

Logic input 1 (2 to 6) / ...

Limit comparator (2 to 16) / ...

Logic 1 (2 to 8) / ...

Control contact 1 (2 to 8) / ...

Tolerance band signal / ...

Program end signal / ...

Ramp end signal 1 (2 to 4) / ...

Value / selection	Description
Start Tune C1	Start self-optimization for controller 1
Cancel Tune C1	Cancel self-optimization for controller 1
Manual/Auto C1	Changeover to manual mode for controller 1
Inhibit Manual C1	Inhibit manual mode for controller 1
Start Tune C2	Start self-optimization for controller 2
Cancel Tune C2	Cancel self-optimization for controller 2
Manual/Auto C2	Changeover to manual mode for controller 2
Inhibit Manual C2	Inhibit manual mode for controller 2
Start Tune C3	Start self-optimization for controller 3
Cancel Tune C3	Cancel self-optimization for controller 3
Manual/Auto C3	Changeover to manual mode for controller 3
Inhibit Manual C3	Inhibit manual mode for controller 3
Start Tune C4	Start self-optimization for controller 4
Cancel Tune C4	Cancel self-optimization for controller 4
Manual/Auto C4	Changeover to manual mode for controller 4
Inhibit Manual C4	Inhibit manual mode for controller 4
Ramp stop C1	Ramp stop for controller 1
Cancel ramp C1	Ramp OFF for controller 1
Setpoint switching C1	Setpoint switching for controller 1
Proc. val. switching C1	Process value switching for controller 1
Paramset switching C1	Parameter set switching for controller 1 (0 = parameter set 1)
Ramp stop C2	Ramp stop for controller 2
Cancel ramp C2	Ramp OFF for controller 2
Setpoint switching C2	Setpoint switching for controller 2
Proc. val. switching C2	Process value switching for controller 2
Paramset switching C2	Parameter set switching for controller 2 (0 = parameter set 1)
Ramp stop C3	Ramp stop for controller 3
Cancel ramp C3	Ramp OFF for controller 3
Setpoint switching C3	Setpoint switching for controller 3
Proc. val. switching C3	Process value switching for controller 3
Paramset switching C3	Parameter set switching for controller 3 (0 = parameter set 1)
Ramp stop C4	Ramp stop for controller 4
Cancel ramp C4	Ramp OFF for controller 4
Setpoint switching C4	Setpoint switching for controller 4
Proc. val. switching C4	Process value switching for controller 4
Paramset switching C4	Parameter set switching for controller 4 (0 = parameter set 1)
Key inhibit	Key inhibit
Level inhibit	Level inhibit
Text display	Text display
Display off	Screen OFF
Display changeover	Switch over screen templates
Acknowledgement LK	Acknowledgement of limit comparators
Prg.Auto/Man. switching	Changeover between automatic and manual
Inhibit prgramm start	Program cannot be started
Program start	Program start
Program stop	Program stop
Program cancel	Program cancel
Program selection	Program selection (see below)
Fast forward	Dynamic speed increase of programm sequence
Segment change	Segment change

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- Logic input 1 (2 to 6) / ...**
- Limit comparator 1 (2 to 16) / ...**
- Logic 1 (2 to 8) / ...**
- Control contact 1 (2 to 8) / ...**
- Tolerance band signal / ...**
- Program end signal / ...**
- Ramp end signal 1 (2 to 4) / ...**

Value / selection	Description
Inhibit program start Program start Program stop Program cancel Program selection Fast forward Segment change	Program cannot be started Program start Program stop Program cancel Programselection (see below) Dynamic speed increase of program sequence Segment change
Display text	
Standard text Text 1 ... Text 100 No text	System texts according to function Definable texts (only via setup program) No entry in event list
Delay	
0 to 9999 s	An info or an alarm is only activated with delay (see "Message types")
Message	
No Yes	Defines whether an info is produced when the logic function is activated.
Alarm	
No Yes	Defines whether an alarm message is produced when the logic function is activated. Alarms must be acknowledged.

Message types

- Should the info be displayed immediately:
just set info to "yes"
- Should the info be displayed after a delay:
set info to "yes" and enter delay time
- Should the alarm be displayed immediately:
just set alarm to "yes"
- Should the alarm be displayed after a delay:
set alarm to "yes" and enter delay time
- Should the info change to alarm after a delay time:
set info and alarm to "yes" and enter delay time.

Math and logic module

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Special controller types (differential, ratio, humidity, C-level controller) or mathematical formula and logic combinations are configured here.

C-level control and math/logic formula (math and logic module) are extras.

The results of the calculations can be called up, under the variables "Math X" (math formulae) and "Logic X" (logic formulae) (X=1 — 8).

Math / logic 1 (2 to 8) / ...

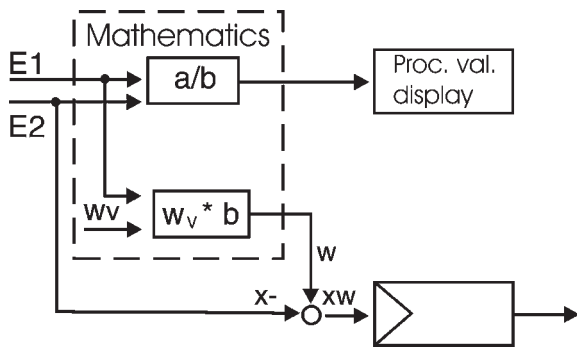
Value / selection	Description
Function	
No function	No function
Differ. (a-b)	Difference control (a-b)
Ratio (a/b)	Ratio control (a/b)
Humidity (a;b)	Humidity control (a;b)
C-level	C-level control
Math formula	Math formula (only via setup program)
Logic formula	Logic formula (only via setup program)
Variable a	
(Analog selector) Switched off	Variable a
Variable b	
(Analog selector) Switched off	Variable b
Range start	
- 1999 to + 9999	Definition of a value range for the result of the mathematical calculation. If the value range is exceeded, an out-of-range condition will be signaled.
Range end	
- 1999 to + 9999	Definition of a value range for the result of the mathematical calculation. If the value range is exceeded, an out-of-range condition will be signaled.
Linearization	
Linear	The mathematical calculation can be combined with a (customer-specific) linearization table. (see <i>Chapter Analog inputs/Probe</i>)

Ratio control

Control is always based on variable a.

The math module forms the ratio of the measurements of a and b (a/b) and produces the setpoint for the controller. The ratio is made available as a value, via the function "Math X", and can be displayed.

The required ratio a/b is programmed as the setpoint (ratio setpoint) in the setpoint definition.



- E1 = analog input 1 (variable b)
- E2 = analog input 2 (variable a)
- w = setpoint
- wv = ratio setpoint
- x = process value
- xw = control deviation for controller

Humidity control

The humidity controller receives the process value from a psychrometric humidity probe, through the mathematical combination of wet bulb and dry bulb temperatures.

- Variable a - dry temperature
- Variable b - wet temperature

Enabling the math and logic module

The math and logic module can be enabled through the code or the setup program.

→ Extras → Enable device options

C-level control

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C-level control is used for the control of carbon in the atmosphere of a gas coking furnace. The C-level is determined through the oxygen measurement with a zircon dioxide sensor and measurement of the sensor temperature.

C-level control is an extra.

C-level calculation

The calculations of the controller are based on the following:

$$E = 0.0992 T \{ -\lg (P_{CO}) + 1.995 + 0,15 C_p + \lg(C_p) \} \text{ mVK} + 816.1 \text{ mV}$$

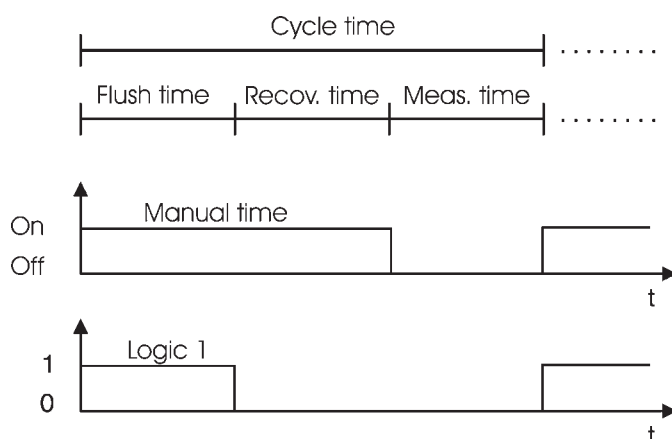
- E - e.m.f. of the zircon dioxide sensor
- T - sensor temperature in K
- P_{CO} - partial pressure CO in percentage of volume
- C_p - carbon level

Sequence control

Operation using a zircon dioxide sensor is subject to a fixed time schedule. The sensor has to be “flushed” at regular intervals (cycle time) to ensure faultfree measurement.

During flushing and the subsequent recovery time, the controller is in manual mode. The latest measurement is stored. The average value of the most recent outputs is produced.

During flushing, the output variable logic 1 is “1” The flushing procedure can be controlled by linking it to an output.



Value / selection	Description
Sensor voltage	
(Analog selector) Switched off	Source for the voltage signal of the zircon dioxide sensor.
Sensor temperature	
(Analog selector) Switched off	Source for the temperature signal of the zircon dioxide
CO measurement	
(Analog selector) Switched off	Source for the measurement signal of the CO content
CO content	
0 to 30 to 9999	If the CO content is not measured, a fixed value can be defined here
Correction value	
0 to 1 to 9999	The correction value is a C-level determined through reference measurement
Cycle time	
0 to 9999 min.	Cycle time for sensor flushing
Flushing time	
0 to 9999 min.	Flushing time for sensor flushing
Recovery time	
0 to 9999 min.	Recovery time for sensor flushing

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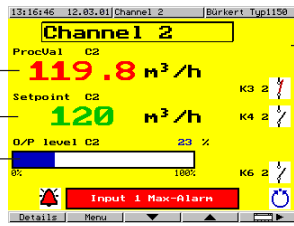
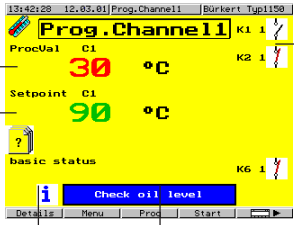
The time-dependent screen saving is defined here. In addition, time-out and the sequence of the different screen templates can be defined. The representations on the controller pictures 1 - 4 and on the collective picture can be adapted to suit individual requirements.

Value / selection	Description
Contrast	
0 to 22 to 31	Contrast of color screen
Continous operation from	
hh:mm:ss 06:30:00	Switch-on time for screen
Continous operation until	
hh:mm:ss 22:00:00	Switch-off time for screen
Screen saving	
0 to 9999 min.	If no key is pressed for a specified time, the screen switches off. The screen comes on automatically when a key is pressed. The function is not active with continous operation. 0 = no function
Time-Out	
0 to 60 to 9999 sec	The instrument automatically returns to the display of the screen operating loop if no key is pressed for a specified time. 0 = no time-out
Automatic channel changeover	
0 to 9999 sec	The screen templates of the operating loop are automatically switched over after a selectable time. 0 = switched off
Display after a reset	
Last picture	Last picture before power-off is shown
Controller pic. 1	Controller channel 1
Controller pic. 2	Controller channel 2
Controller pic. 3	Controller channel 3
Controller pic. 4	Controller channel 4
Collective pic.	All channels as a group picture
Recording	Recording (extra code)
Custom pic. 1	Freely configurable screen template 1
Custom pic. 2	Freely configurable screen template 2

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Value / selection	Description
Operation loop	
... / Controller pic. 1 ... / Controller pic. 2 ... / Controller pic. 3 ... / Controller pic. 4 ... / Collective pic. ... / Recording ... / Custom pic. 1 ... / Custom pic. 2 Yes No	The screen templates that are to appear in the screen operating loop can be selected.

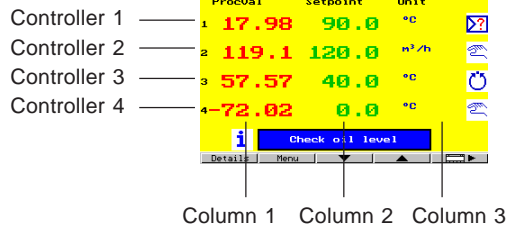
Controller pictures / Controller picture 1 (2 to 4) / ...

Value / selection	Description	
Analog value 1		
... / Display (Analog selector) Process value C1 ... / Decimal place xxx.x	Display for fixed-setpoint controller: 	
Analog value 2		
... / Display (Analog selector) Setpoint C1 ... / Decimal place xxx.x		
Analog value 3		
... / Display (Analog selector) Output C1 ... / Decimal place xxxx.		
Logic value 1 to 6		
(Binary selector) Output 1 C1		
Program value 1^P		
Segment RemSegT PCh1 to PCh4 SegTime PCh1 to PCh4 Program time RemProgT	Display for program controller: 	
Program value 2^P		
Segment RemSegT PCh1 to PCh4 SegTime PCh1 to PCh4 Program time RemProgT	Program value 1 Program value 2	

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Collective picture / Controller 1(2 to 4) / ...

Value / selection	Description
Value column 1	Display:
(Analog selector) Ramp end C1	
Decimal point column 1	
XXX.X	
Value column 2	
(Analog selector) Setpoint C1	
Decimal point column 2	
XXX.X	
Value column 3	
(Analog selector) Output C1	
Decimal point column 3	
XXXX	



Decimal point

If the value that is to be displayed can no longer be represented with the user-programmed decimal point, then the number of decimal places will be automatically reduced. If, subsequently, the measured value decreases, the number of decimal places increases to the preprogrammed value of the decimal point.

Interfaces

Configuration
Analog inputs
Controller
Generator
Limit comparators
Outputs
Logic functions
Math / logic
C-level
Display
Interfaces
Device data
Recording

The interface parameters for the standard RS422/485 interface (MODbus 1) and an optional RS422/485 (MODbus 2) or Profibus-DP interface have to be configured in order to communicate with PCs, bus systems and peripheral devices.

MODbus / ...

Value / selection	Description
Protocol	
MODBUS MODBUS int.	Modbus integer: All values are transferred in the integer format
Baud rate	
9600 19200 38400	
Data format	
8-1-none 8-1-odd 8-1-even 8-2-none	(data bits)-(stop bits)-(parity)
Device address	
0 to 1 to 255	
Minimal response time	
0 to 500 msec	Minimum time that elapses between the request of a device in the data network and the response of the controller.

PROFIBUS-DP / ...

Value / selection	Description
Device address	
0 to 1 to 255	
Data transmission rate	
12 MBaud	

Device data

Basic settings such as supply frequency or temperature unit are made here.

Configuration
Analog inputs
Controller
Generator
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C-level
Display
Interfaces
Device data
Recording

Value / selection	Description
Device designation	
(16-character text)	any text
Supply frequency	
50 Hz 60 Hz	Country-specific supply frequency of supply voltage.
Temperature unit	
°C °F	Unit for temperature values
Program selection	
Icon Text list	A program can be selected in the program start menu either graphically via icons, or via a text list.
Sampling time	
50 ms 150 ms 250 ms	Required basic sampling time The sampling time possible depends on the number of active controller channels and the utilization of the math and logic module. The actual sampling time is shown under "System sampling time".
System sampling time	
(Time display)	Actual sampling time of device.
Date and time	
Date dd.mm.yy Time hh:mm:ss	Real-time clock with calendar
Summer time	
Switched off Time definition Automatic	Determines how to change over to summer time.
Start date tt.mm.jj Start time hh:mm:ss End date tt.mm.jj End time hh:mm:ss	Details for the changeover through time definition.

Recording

Configuration
Analog inputs
Controller
Generator
Limit comparators
Outputs
Logic functions
Math / logic
C-level
Display
Interfaces
Device data
Recording

The recording function permits the visualization of up to four analog and three logic signals. The signal sources are defined here.

Analog value 1 (2 to 4) / ...

Value / selection	Description
Function	
(Analog selector) Switched off	Recording of analog signals
Scaling start - 1999 to <u>22</u> to + 9999	Defines the lower and upper limit on the y-axis. The screen templates "Recording" (operating loop) can be used to switch between the scaling of the analog values for the graphical display of the traces.
Scaling end - 1999 to <u>22</u> to + 9999	
Decimal place	
XXX.X	
Unit	
(4-character text) %	Any 4-character sequence can be specified

Value / selection	Description
Logic value 1, logic value 2, logic value 3	
(Binary selector) Switched off	Recording of logic signals
Storage rate	
1 to <u>6</u> to 60 sec	Defines the time span between the measurement points.

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OPTIMIZATION

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Self-optimization

Oscillation method

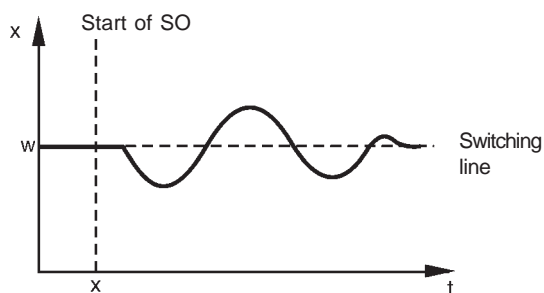
Self-optimization SO establishes the optimum controller parameters for PID or PI controllers.

Depending on the controller type, the following controller parameters can be defined:

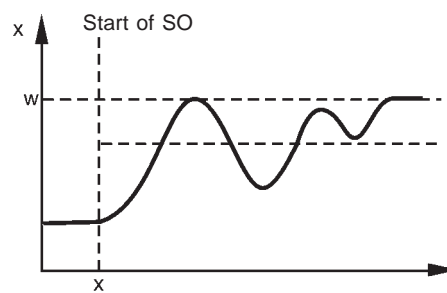
Reset time (T_n), derivative time (T_v), proportional band (X_p), cycle time (C_y), filter time constant (dF)

The controller selects one of two procedures (a or b), depending on the size of the control deviation:

a) SO in start-up phase



b) SO at setpoint



Step response method

This type of optimization involves determining the control parameters through an output step that is applied to the process. First a steady output is produced until the process value is “steady” (constant). Afterwards, an output step (step size - user defined), which can be defined by the user, is automatically applied to the process. The resulting response of the process value is used to calculate the control parameters.

Self-optimization establishes the optimum control parameters for PID or PI controllers, in accordance with the selected control structure.

Depending on the controller type, the following control parameters can be defined:

Reset time (T_n), derivative time (T_v), proportional band (X_p), cycle time (C_y), filter time constant (dF)

Optimization can be started from any system status and can be repeated as often as is required.

The controller outputs (analog, relay, solid-state), the steady output and the step size (min. 10%) have to be defined.

Principal applications of the step response method

- Optimization instantly after “power on”, during the start-up phase considerable time savings, setting: steady output = 0 %.
- The process does not readily permit oscillations (e.g. highly insulated furnaces with small losses, long oscillation period)
- Process value must not exceed setpoint. If the output (with stabilized setpoint) is known, an overshoot can be avoided through the following adjustment:
steady output + step size \leq output in stabilized condition



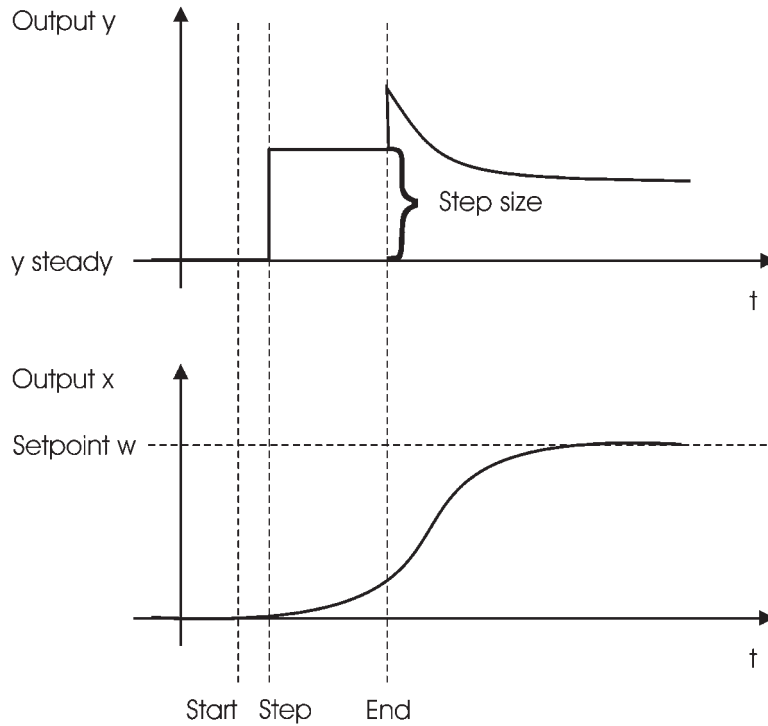
NOTE

With output type “solid-state”, the cycle time during optimization is reduced to 8 x the sampling time.

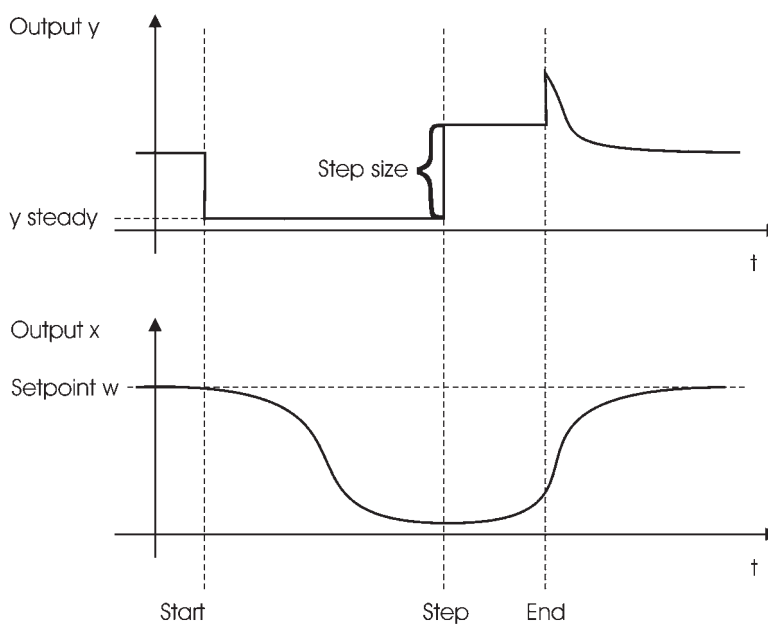
With the “relay” output type, care has to be taken that the process value is not influenced by the switching cycle time, otherwise optimization cannot be completed successfully.

Solution: Reduce the cycle time Cy , until the process value is no longer influenced. (Manual mode can be used for the adjustment!)

Start of self-optimization after power-on and during the start-up phase



Start of self-optimization during operation








Starting self-optimization

Start at the operating level

- Select the controller channel in / *Operation level* / *Self-optimization* / *Controller number 1 to 4*
- Start self-optimization for the selected controller channel with / *Status* / „Active“

Start from the operating loop


- Change the screen template for the required controller channel with  (press repeatedly, if necessary!)
- Press 
- Press 
- Start self-optimization for the required controller channel with 
- Pressing  resets the significance of the softkeys.



NOTE

The controller outputs types have to be defined for self-optimization. They also have to be enabled for the corresponding controller channel for self-optimization to start. (see Chapter „Controller“).

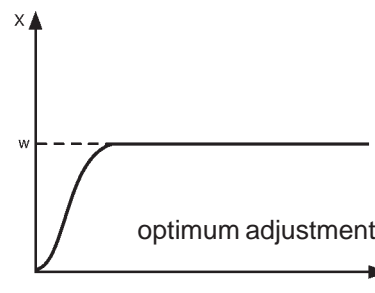
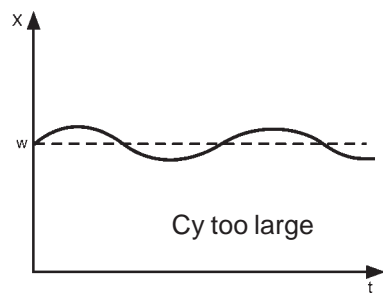
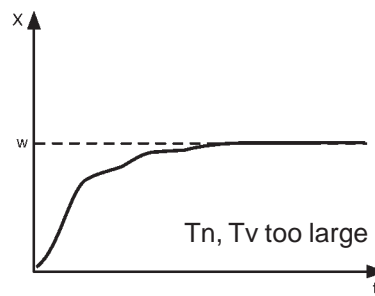
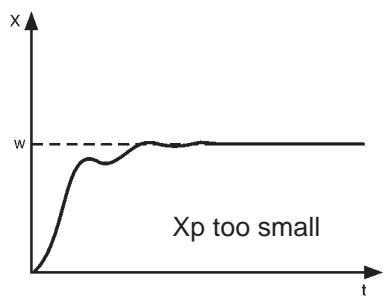
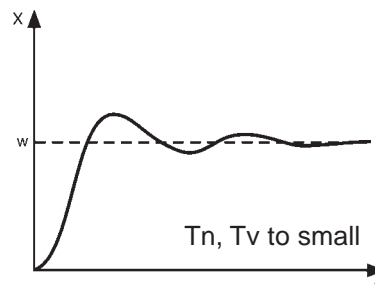
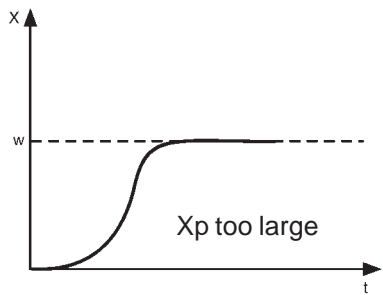
Canceling self-optimization

- Switch the “Status” parameter at the operating level to “inactive” or press  again.

Check of the optimization

The optimum adaptation of the controller to the process can be checked by recording the start-up phase with the control loop closed. The diagrams below indicate possible adjustment errors and how these can be corrected.

The control response of a third-order control loop of a PID controller is shown as an example. However, the procedure for adjusting the controller parameters can also be applied to other control loops.



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RETROFITTING OF MODULES

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Retrofitting of modules	94

The following steps are necessary for retrofitting modules:

Safety notes



ATTENTION!

Only qualified personnel are permitted to install retrofit modules.



ATTENTION! The modules can be damaged by electrostatic discharge. Avoid electrostatic charge during installation and removal. Carry out retrofitting on a workbench that is properly grounded and follow ESD precautionary measures.

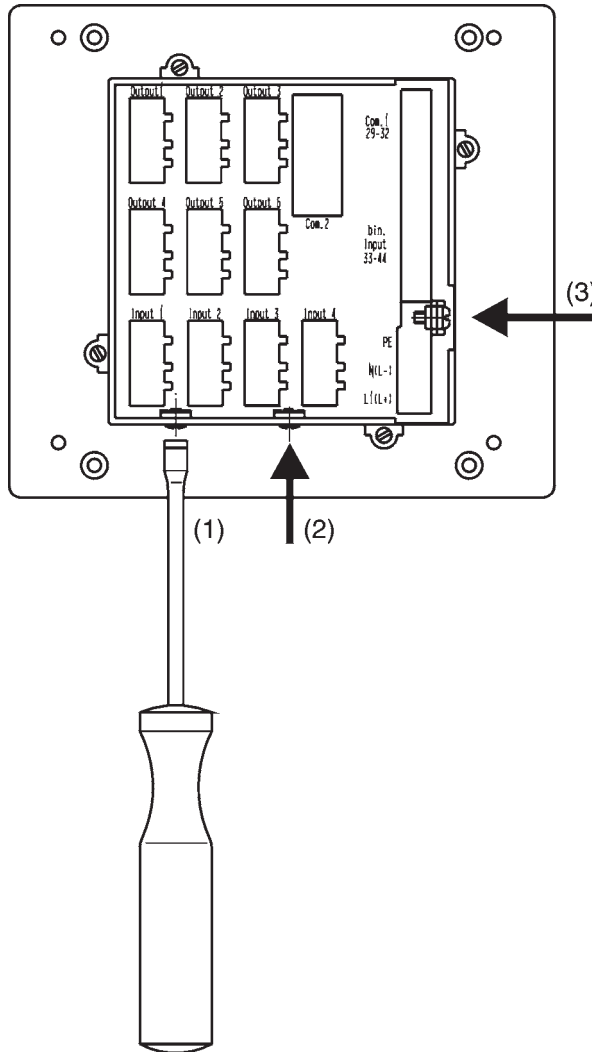
Identifying the module

→ Identify the module by the Sales. No. affixed to the packaging

Modules	Code	Sales No.	Board No.
Universal input		787 750	00403612
<u>Outputs:</u>			
1 relay (changeover contact)	1	787 751	00401153
Solid-rate relay 230 V/1A	2	787 752	00401185
2 relays (n.o.) make	3	787 753	00397011
1 analog output	5	787 754	00403601
PROFIBUS-DP	64	787 755	00401264

Removing the back panel from the housing

- Pull off the pluggable connector
- Loosen screws (do not remove (1) and (2)!)



- Fold back panel upwards and take it off

Slot assignment

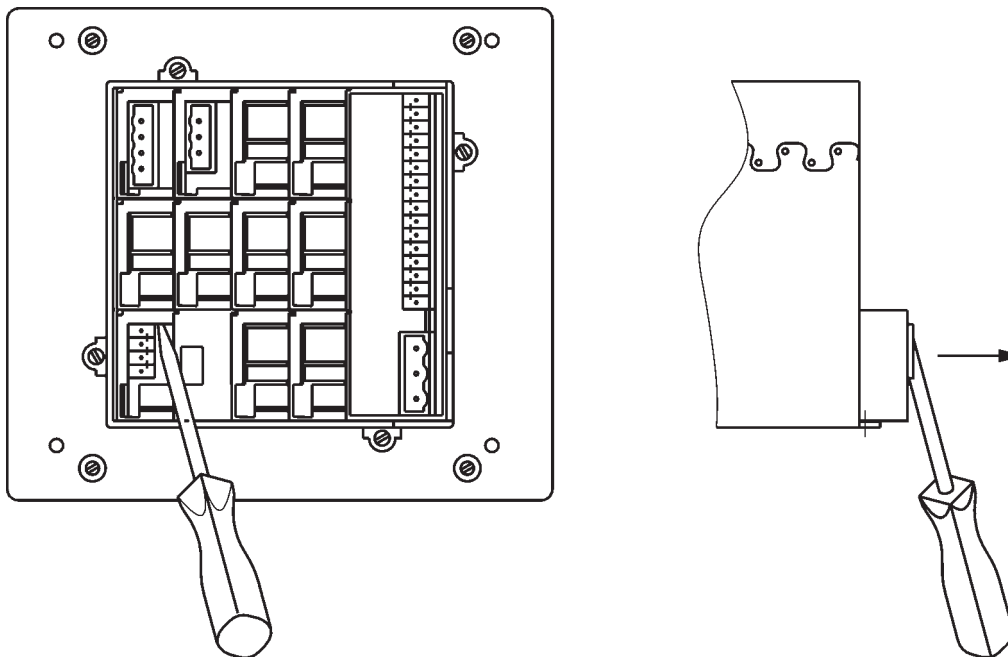
The slots for the individual modules are printed on the back panel of the housing:

Slot	Module	Function
Input 1 ... Input 4	Universal input	Analog input 1 ... Analog input 4
Output 1 ... Output 6	Outputs	Output 1+7 ¹ ... Output 6+12 ¹
Com 2	RS422/485 PROFIBUS-DP Ethernet	Interface 2

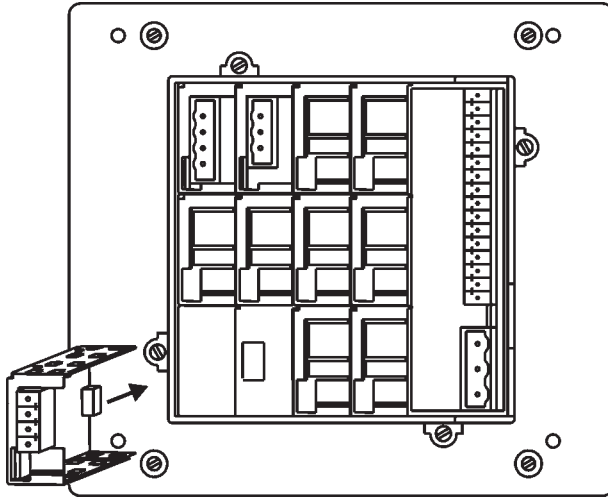
¹ Number of output, if two outputs are available on the board.

Retrofitting of modules

→ Remove dummy module or existing module by using a screwdriver or similar tool.



- Push module into the vacant slot until the pluggable connector snaps into place



- Hook the back panel into the slots provided on the top edge and close it.
- Tighten the screws

Contact addresses / Kontaktadressen

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Die Kontaktadressen finden Sie im Internet unter:

Les adresses se trouvent sur internet sous :

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