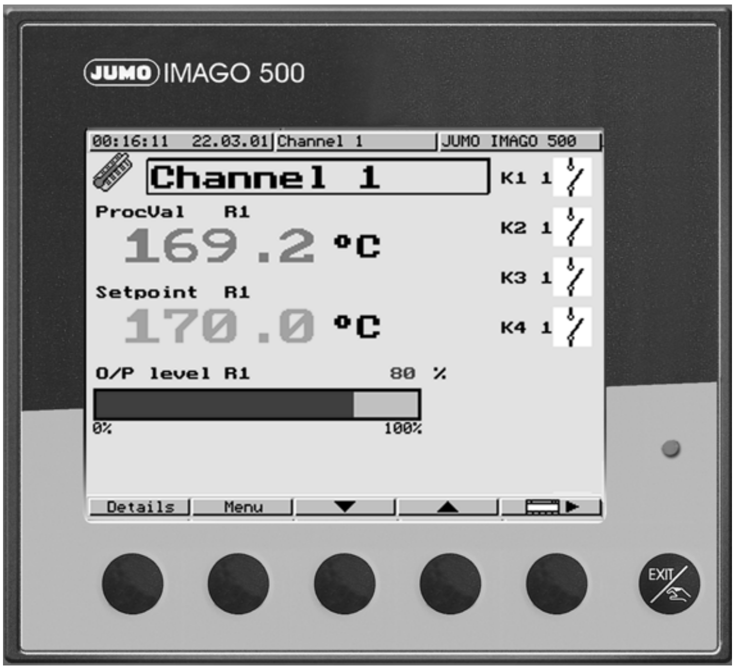
JUMO IMAGO 500

Multi-channel Process and
Program Controller



Operating Manual

70359000T90Z001K000

V2.01/EN/00403546

Please read these Operating Manual before starting up the instrument. Keep these operating manual in a place which is accessible to all users at all times.

These operating manual are valid from software version 162.03.05.

Please assist us to improve these operating manual, where necessary.

Your suggestions will be welcome.

All necessary settings are described in these operating manual. If any difficulties should still arise during start-up, you are asked not to carry out any unauthorized manipulations on the unit. You could endanger your rights under the instrument warranty!

Please contact the nearest subsidiary or the head office in such a case.

The regulations of EN 61340-5-1 and EN 61340-5-2 “Protection of electronic devices from electrostatic phenomena” must be observed when returning modules, assemblies or components. Use only the appropriate **ESD** packaging for transport.

Please note that we cannot accept any liability for damage caused by **ESD** (electrostatic discharge).

Contents

Contents

1.1 Description

Type 703590 is a process and program controller with up to eight controller channels or four program channels. The instrument is built to the format 144 mm × 130 mm for a standard 92 mm × 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 eight analog inputs and 6 logic inputs are available, as well as six expansion slots for switched or analog outputs. Four of these slots can be used alternatively for analog inputs or outputs.

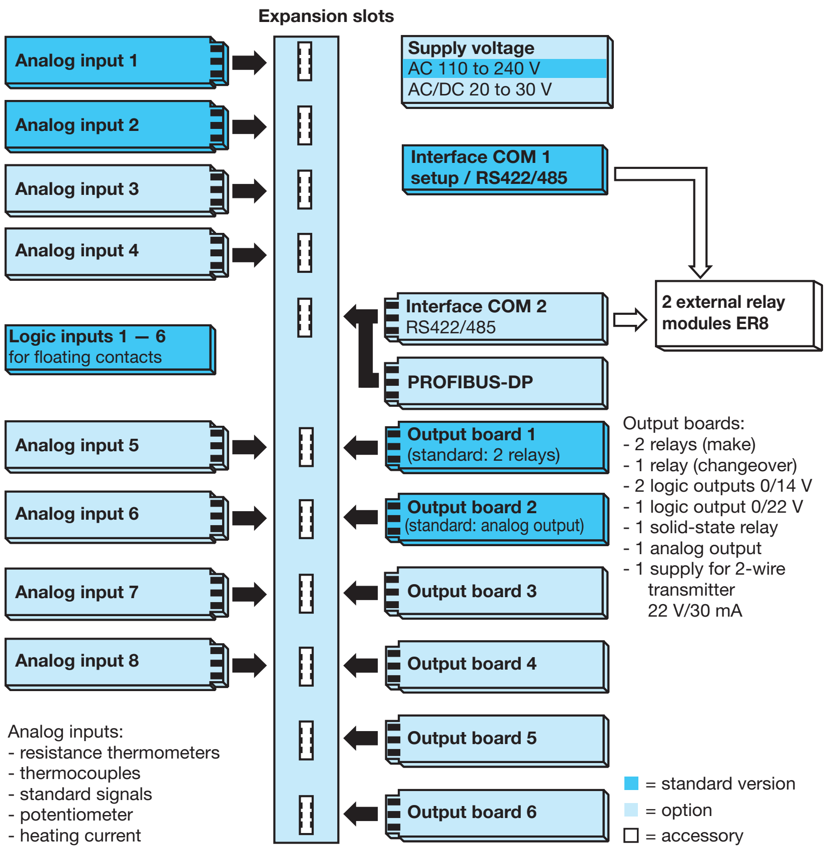
A setup program is available for comfortable configuration from a PC. Linearizations for the usual transmitter outputs are stored within the instrument, four customer-specific linearization tables can be programmed.

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, via plug-in screw terminals.



1 Introduction

1.2 Typographical conventions

Warning signs	**Danger**	This symbol is used when there may be **danger to personnel** if the instructions are ignored or not followed correctly!
	Caution	This symbol is used when there may be **damage to equipment or data** if the instructions are ignored or not followed correctly!
	Caution	This symbol is used where special care is required when handling components liable to damage through electrostatic discharge.
Note signs	**Note**	This symbol is used when **your special attention** is drawn to a remark.
	Reference	This symbol refers to further information in other operating manuals, chapters or sections.
	H **Action**	This symbol indicates that an action to be performed is described. The individual steps are marked by this asterisk, e.g. ∗ Press Enter
Representation	**Menu items**	Texts relating to screen representations are shown in italics, e.g. *Edit program*

2.1 Type designation

	Basic type
703590	Type 703590: Process snd program controller

			Basic type extensions
			No. of controller and program channels
2			2 controller channels with max. 2 program channels
4			4 controller channels with max. 4 program channels
8			8 controller channels with max. 4 program channels
			Version
	8		standard, with factory settings
	9		customized programming, as specified
			Language for instrument texts
		1	German
		2	English
		3	French
		9	customer-specific language (Italian, Hungarian, Czech, Russian, Dutch, Swedish)

1	2	3	4	Analog inputs
0	0	0	0	not used
8	8	8	8	universal input (configurable)
3	3	3	3	input for zirconium dioxide sensor 0 to 2 V

1	2	3	4	5	6	Outputs and analog inputs
0	0	0	0	0	0	none
1	1	1	1	1	1	1 relay (changeover)
2	2	2	2	2	2	1 solid-state relay 1 A 230 V
3	3	3	3	3	3	2 relay (n.o.) make
4	4	4	4	4	4	1 logic output 0/22 V[a]
5	5	5	5	5	5	1 analog output
6	6	6	6	6	6	1 supply for 2-wire transmitter 22 V/30 mA[a]
7	7	7	7	7	7	2 logic outputs 0/14 V
8	8	8	8	-	-	1 universal input

		Supply voltage
2	3	AC 110 to 240 V +10/-15 % 48 to 63 Hz
2	5	AC/DC 20 to 30 V 48 to 63 Hz

		Interface COM2
0	0	not used
5	4	RS422/485 with Modbus/Jbus protocol
6	4	PROFIBUS-DP
8	0	Ethernet (under development)

			Extra codes
0	0	0	no extra code
2	1	2	C-level control
2	1	3	recording function
2	1	4	math and logic module 1 to 8
2	1	5	math and logic module 9 to 16 (requirement: extra code 214)

703590/ ☐☐☐ – ☐☐☐☐ – ☐☐☐☐☐☐ – ☐☐ – ☐☐ / ☐☐☐ , ...[b]

▒ Standard version

[a] The board for the 0/22 V logic output and the supply for a 2-wire transmitter are identical, and are detected by the instrument and the setup program as "Logic output 0/22 V".

[b] List extra codes in sequence, separated by commas.

2.2 Accessories

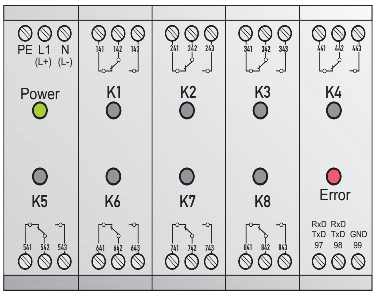
External relay module

One of the RS422/485 interfaces is required to operate one or two external relay modules (external relay or logic outputs).

Versions:

Voltage supply AC 110 to 240 V
Relay version: Part no. 00405292
Logic version: Part no. 00439131

Voltage supply AC/DC 20 to 53 V
Relay version: Part no. 00405297
Logic version: Part no. 00471459



PC interface

PC interface for setup program
(TTL/RS232 converter)
Part no. 00301315

PC interface for setup program
(USB/TTL converter)
Part no. 00456352

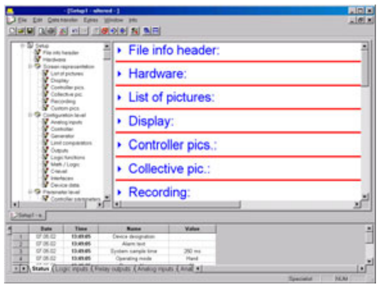
Setup program

Versions:

Setup program with program editor[1]
Part no. 00399795

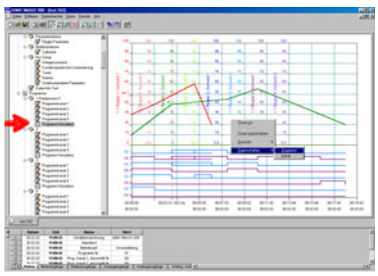
Setup program with program editor and startup[1]
Part no. 00403094

Setup program with program editor, startup and Teleservice[1]
Part no. 00400012



Program editor

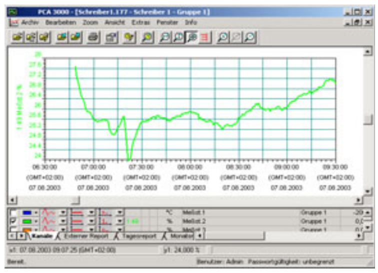
Program editor (software)[1]
Part no. 00400460



1. Requirements: Windows® 2000, XP, Vista, 7 (32-bit and 64-bit);
PC with 512 MByte RAM, 60 MByte free on HD, CD-ROM, 1 free serial or USB interface

PC evaluation software

PCC+PCA (software)
under Windows® XP, Vista, 7 (32-bit and 64-bit)



2.3 Nameplate

Position

The nameplate is glued onto the instrument.

Contents

It carries important infomation, for instance:

Description	Designation on nameplate	Example
Instrument type	Typ	703590/281-8800-350000-23-00/000
Part no.	TN	00394875
Serial No.	F-Nr	0070033801207270006
Supply voltage		AC 110 ... 240 V +10/-15 %, 48 ... 63 Hz

Type

Compare the type that has been delivered with that specified in your order documentation. You can use Chapter 2.1 “Type designation” to identify the type.

TN

The part no. is an unambiguous designation in the catalog. It is used for communication between the sales department and the customer.

F-Nr

The factory serial number also reveals the date of production (year/week) and the hardware version number.

Production date
Example. F-Nr = 00700338012**0727**0006
The positions 12 – 15 (from the left) indicate that the instrument was manufactured in week 27 of 2007.

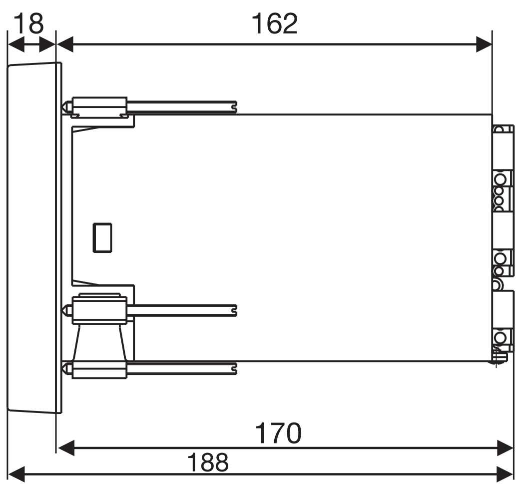
Hardware
Example: F-Nr = 0070033801**2**07270006
If the 11th position (from the left) has a 2 or higher, then the instrument has been fitted with the new analog input cards.

3.1 Location and climatic conditions

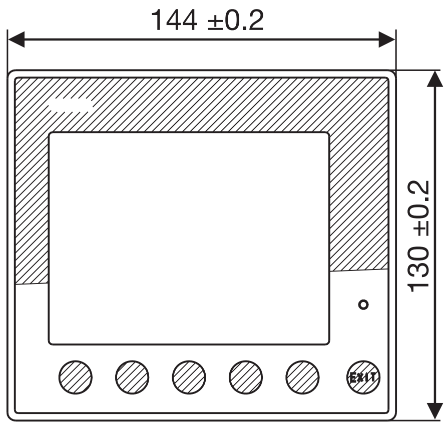
The conditions at the location must meet the requirements specified in the Technical Data. The ambient temperature at the location can be -5 to +50 °C, with a relative humidity of not more than 75 %.

3.2 Dimensions

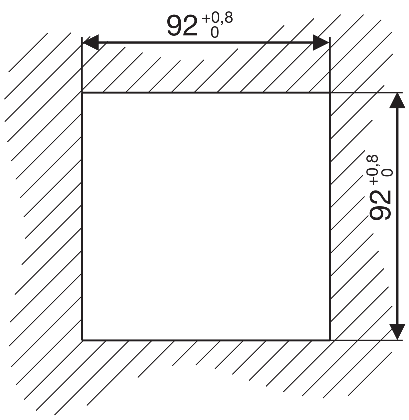
Side view



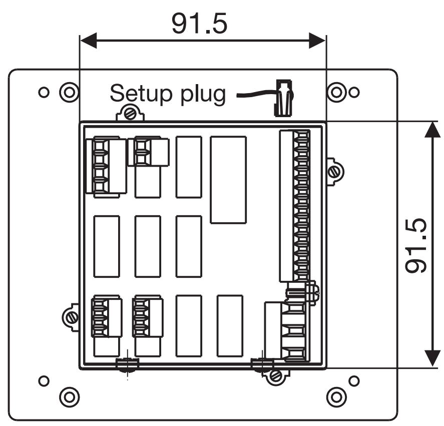
Front view



Panel cut-out
to ISO 43 700

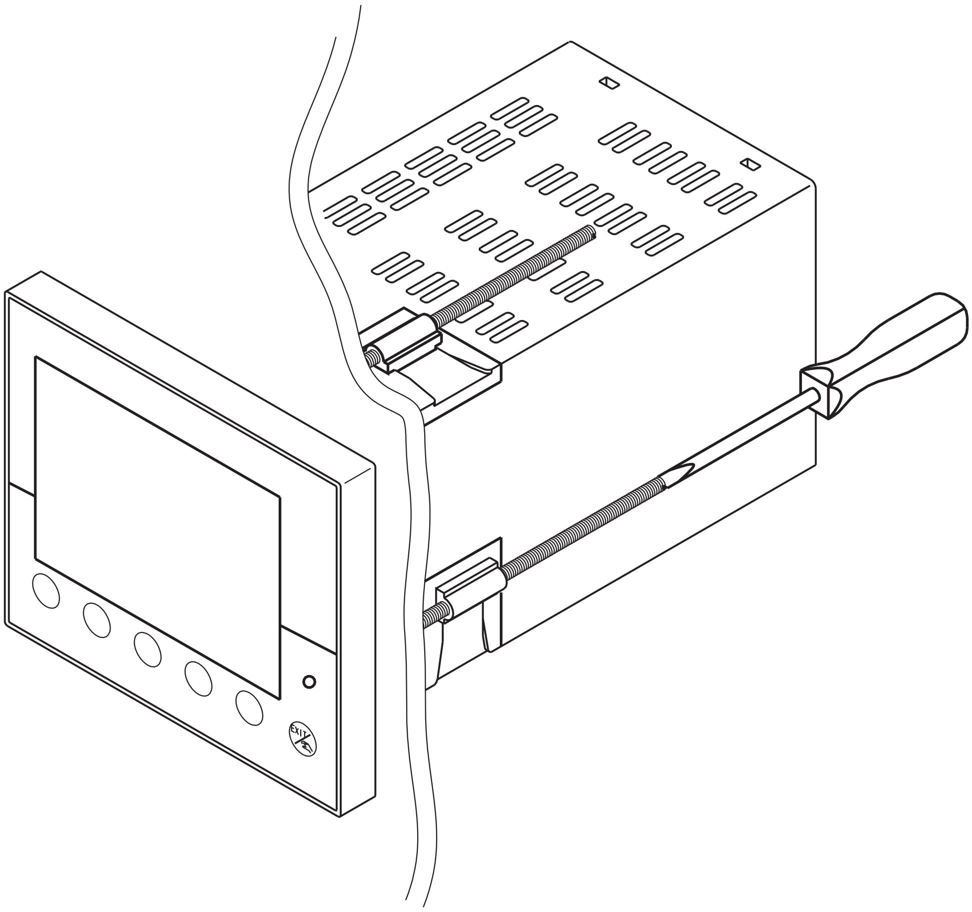


Rear view



Close mounting	
Minimum spacing of panel cut-outs	
horizontal	54 mm
vertical	41 mm

3.3 Fitting



✱ 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.

3.4 Cleaning the front panel

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.

4.1 Installation notes

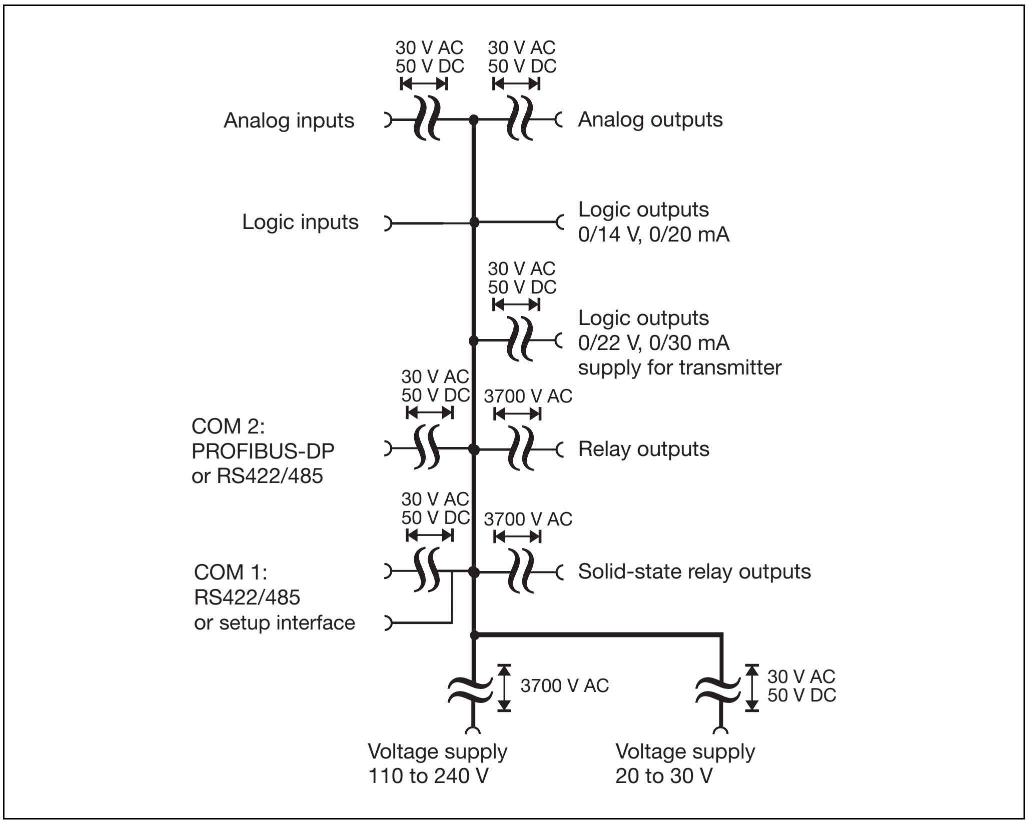
- The choice of cable, the installation and the electrical connection must conform to the requirements of VDE 0100 "Regulations on the Installation of Power Circuits with Nominal Voltages below 1000 V" or the appropriate local regulations.
- At maximum load, the cables must be heat resistant up to at least 80 °C.
- The electrical connection may only be carried out by qualified personnel.
- The instrument must be disconnected on both poles from the electrical supply if contact with live parts is possible.
- The load must be fused for the maximum relay current, in order to prevent the contacts of the output relay becoming welded in the event of a short-circuit.
- The user must not replace internal safety devices. The instrument must be returned to the supplier for repair in the event of a fault.
- Electromagnetic compatibility conforms to the standards and regulations cited in the technical data.

  ⇨Chapter 10.1 "Technical data"
- Run input, output and supply cables separately and not parallel to one another.
- All input and output cables without connection to the mains supply must be arranged as twisted and screened cables.
  Ground the screen on the instrument side to the potential earth.
- The PE terminal on the instrument must be earthed. 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 settings on 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 specialist personnel. Please observe the relevant safety regulations for such matters. Since adaptation (self-optimization) cannot be expected to handle all possible control loops, an unstable parameterization is theoretically possible. The stability of the actual value that is produced should therefore be checked.

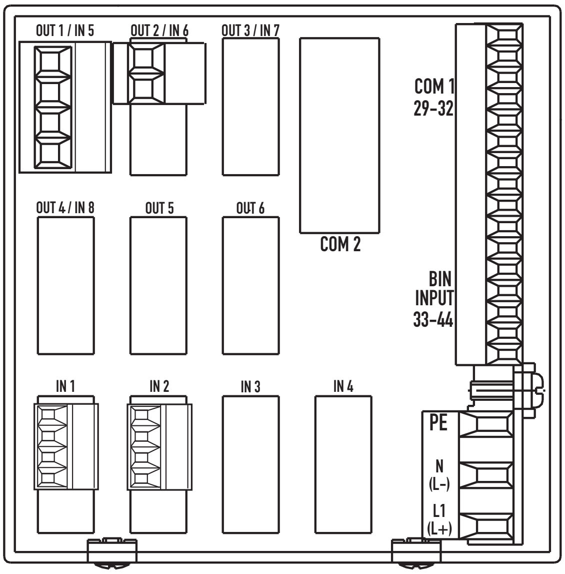
4 Electrical connection

- Since the instrument is short-circuit proof only to a limited extent, an external fusing and a switch-off facility must be provided. Depending on the supply voltage, the following values apply to the external fusing:
  AC/DC 20 to 53 V, 48 to 63 Hz fuse 4 A slow
  (only for operation in SELV or PELV current circuits)
  AC 110 to 240 V +10/-15 %, 48 to 63 Hz fuse 0.8 A slow
- The measurement inputs of the controller must not exceed a maximum potential of AC 30 V or DC 50 V against PE.

4.2 Electrical isolation



4.3 Connection diagram



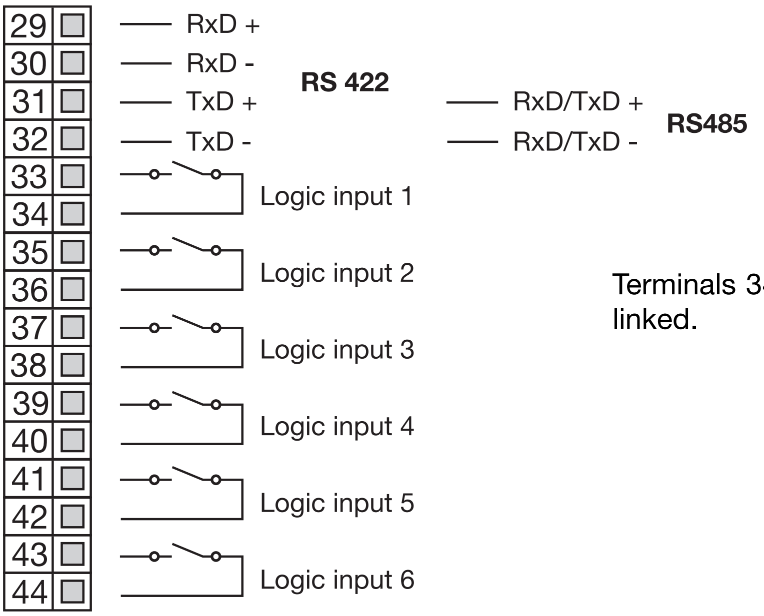
The electrical connection must only be carried out by qualified personnel.

The instrument version can be identified by means of the type code.

See nameplate on the housing.

Supply voltage as on nameplate!

The diagram shows the stock version.

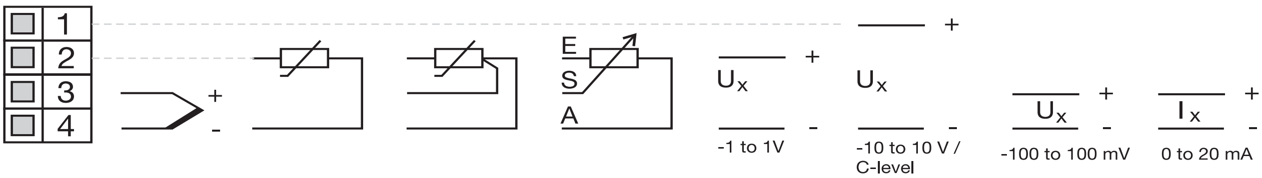


Interface COM 1
The shielding for the bus cable must be connected to PE on the instrument side (e.g. in switchgear cabinet).

Logic inputs
BIN INPUT

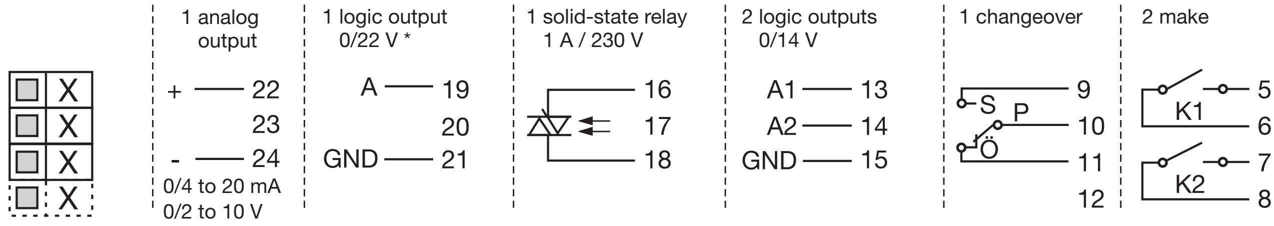
Terminals 34, 36, 38, 40, 42, 44 are internally linked.

Analog inputs (slots: IN1 to 8)



With current input, care must be taken that the max. input current of 50 mA is not exceeded.

Outputs (slots: OUT1 to 6)



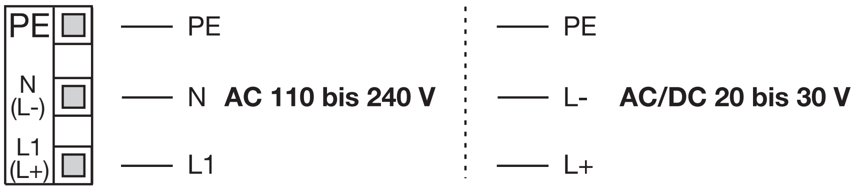
* or supply for two-wire transmitter

Slot	Plug-in pcb with 1 output	Plug-in pcb with 2 outputs
OUT1	Output 1	Output 1+7
OUT2	Output 2	Output 2+8
OUT3	Output 3	Output 3+9
OUT4	Output 4	Output 4+10
OUT5	Output 5	Output 5+11
OUT6	Output 6	Output 6+12

Output board "2 make contacts"

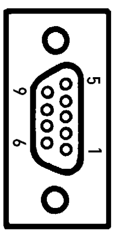
It is not permissible to combine supply circuits and circuits with safety extra-low voltage on one board.

Voltage supply



Interface COM 2

PROFIBUS-DP

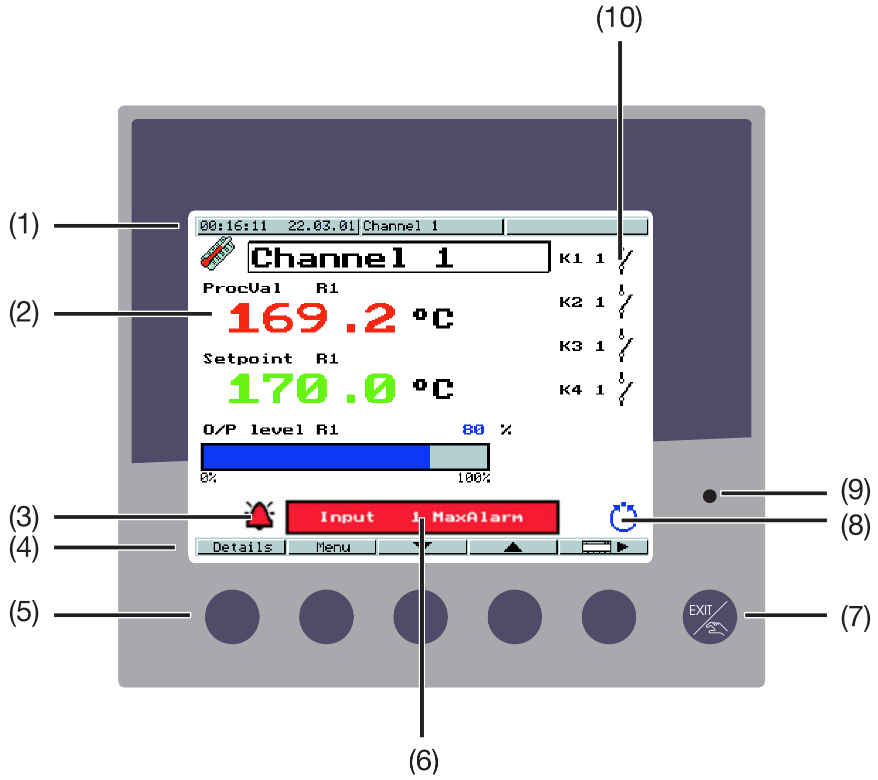


Pin	Assignment
3	RxD/TxD-P (B)
4	RTS
5	DGND
6	VP
8	RxD/TxD-N (A)

5.1 Operation: General

5.1.1 Displays and controls

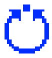
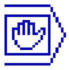
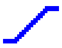
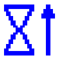
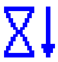
Front view



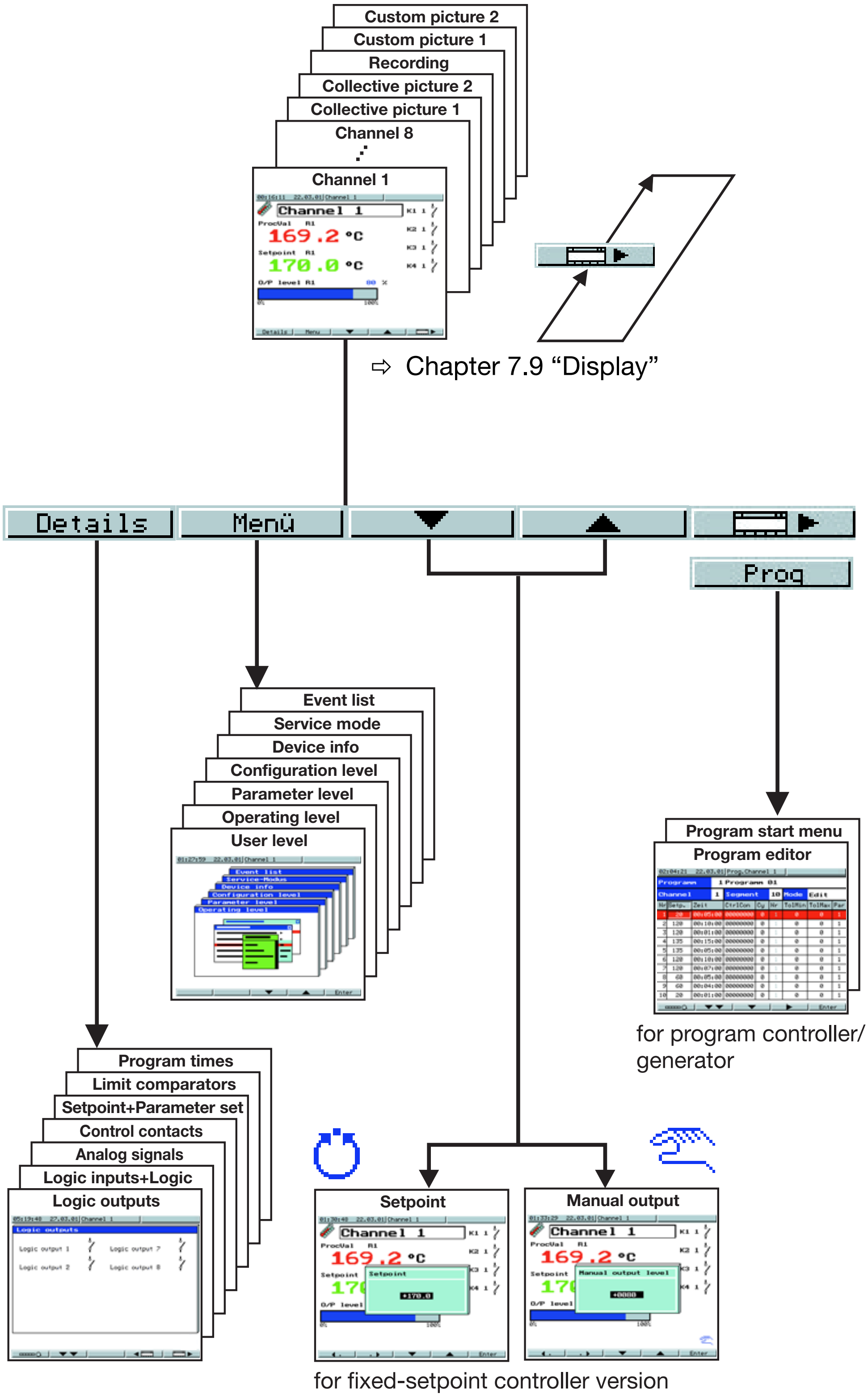
Displays and controls

No.	Meaning
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 level (bar graph). Factory setting for program controller: process value, setpoint, program number/name, segment number, remaining program time
3	**Info/alarm symbol**
4	**Current meaning of the softkeys**
5	**Keys** (Softkeys) with various interpretations in the color screen.
6	**Info/alarm display** 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	Bedeutung
	Info
	Alarm is present Alarm messages must be acknowledged (see explanation for “screen operating loop”)
	Automatic mode/Program is running
	Manual (“Hand”) operating mode Enables setpoint and control contact definition in the case of a program controller.
	Controller manual mode Enables output definition in the case of a fixed-setpoint or program controller.
	Self-optimization is active (symbol flashes)
	Ramp function is active
	Program pause
	Open actuator (modulating controller)
	Close actuator (modulating controller)

5.1.2 Overview of operation



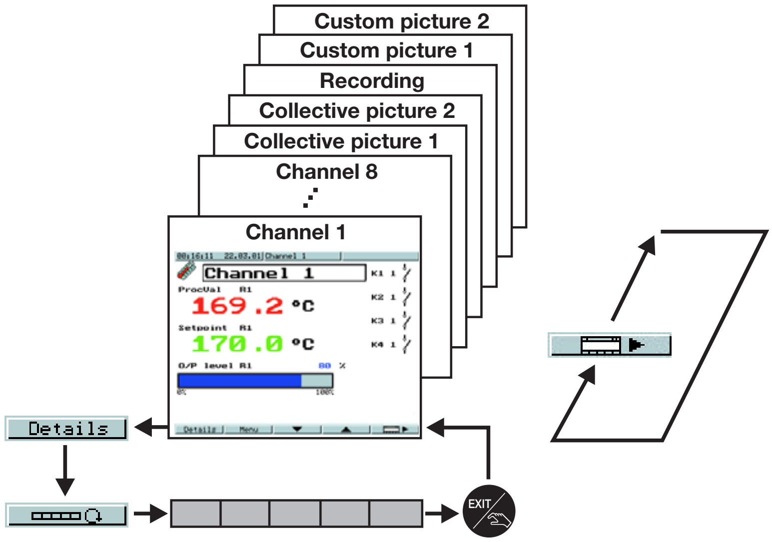
(>2 s) = back to the screen operating loop

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

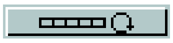
Screen operating loop

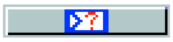
The operating loop contains the screen templates for a maximum of four controller channels, the collective picture of all the active controller channels, the recording function as well as two freely definable screen templates.
The screen templates can be individually switched into display.

⇨ Chapter 7.9 “Display”



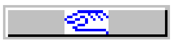
Meaning of the keys:

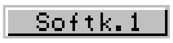
 - additional functions of the softkeys

 - start/cancel self-optimization for the channel that is displayed

 - acknowledge alarm messages and limit comparators

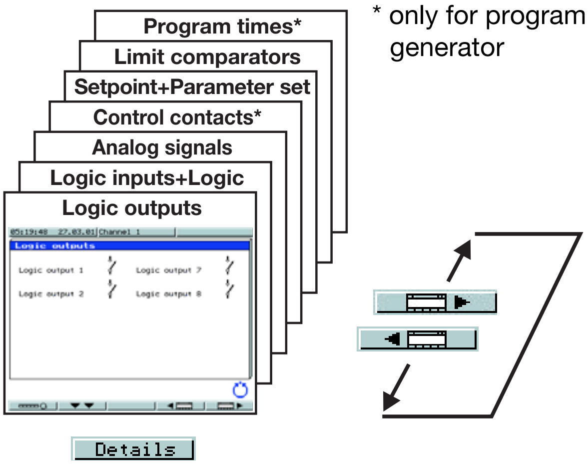
 - step on one segment (program controller)

 - controller manual mode (program controller)

 - key can be freely assigned (only through setup program)

Details

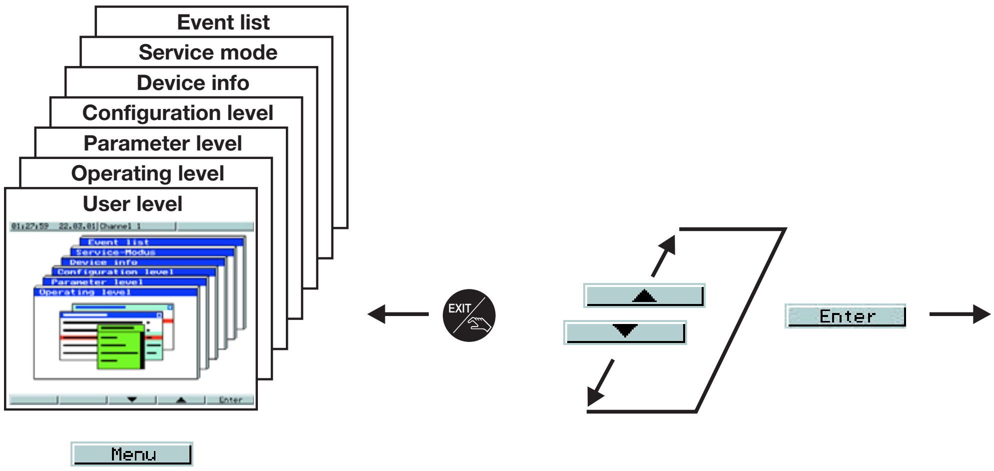
The states and values of a large variety of process variables are shown clearly and in a structured form.



* only for program controller/ generator

 - 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 Manual 703590.6

Operating level
Here the setpoints for all eight controller channels are defined and self-optimization is started. In the case of a program controller, system states can additionally be set in the manual (“Hand”) operating mode.

⇨ Chapter 8.1 “Self-optimization”

Parameter level
The controller parameters for the controller channels are defined here.

⇨ Chapter 6 “Parameterization”

Configuration level
The instrument is adapted to the control task here.

⇨ Chapter 7 “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
The last 16 events with date, time and designation are displayed here.

- Supply ON/OFF
- Overrange/underrange and probe break
- Math error
- Freely definable alarms

5.1.3 Entering values and selecting settings

Entering values

Parameters can be altered in a number of screen templates.

* Select parameter Enter
* 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 Enter
* Move up in selection list with ▲
* Move down in selection list with ▼
* Confirm entry with Enter

Entering codes and times

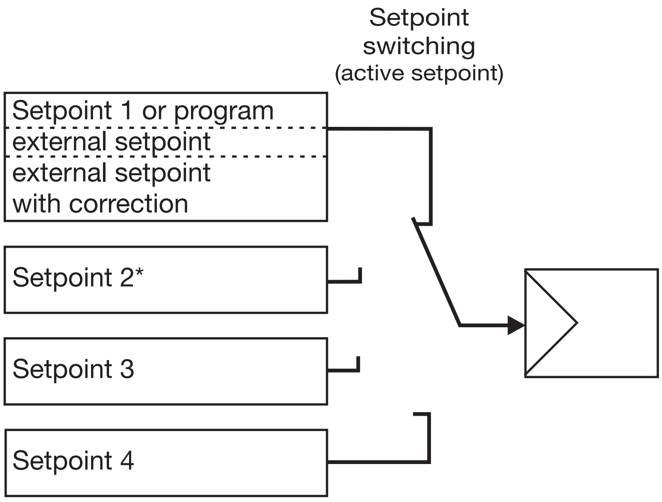
Times and codes are entered digit by digit.

* Increase or decrease value (digit) with ▲ and ▼
* On to the next digit with ◀ or ▶
* Confirm entry with Enter

5.1.4 Setpoint input

Configuration in controller

Each controller channel has four setpoints which can be switched by logic signals. Setpoints for the controller are defined as shown below.



* Exception: configuration of a program controller with external setpoint input. In this case, setpoint 2 corresponds to the program setpoint.

⇨ Chapter 7.2 “Controller”

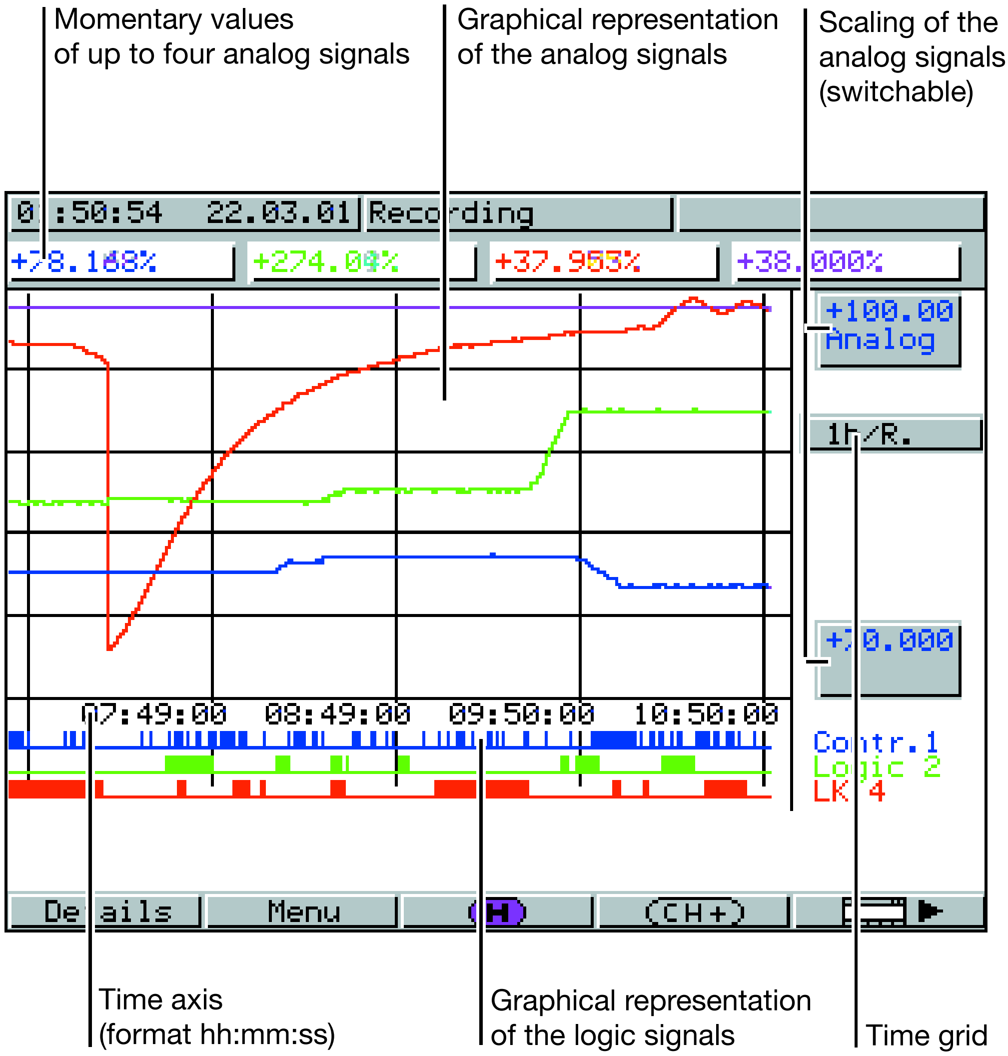
⇨ Chapter 7.6 “Logic functions”

5 Operation

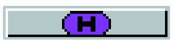
5.1.5 Recording

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.



Keys

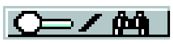
 - call up history

 - 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). The ring memory contains 43200 measurement points.

✱ 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

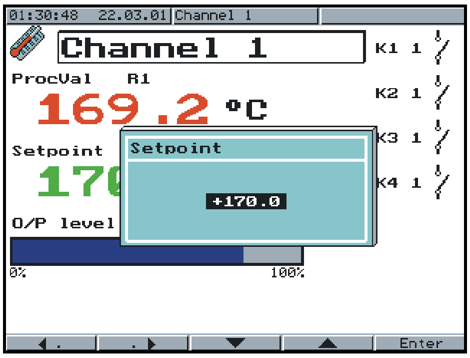
5.2 Operation: Controller

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

5.2.1 Altering the setpoint

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

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



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

5.2.2 Manual mode

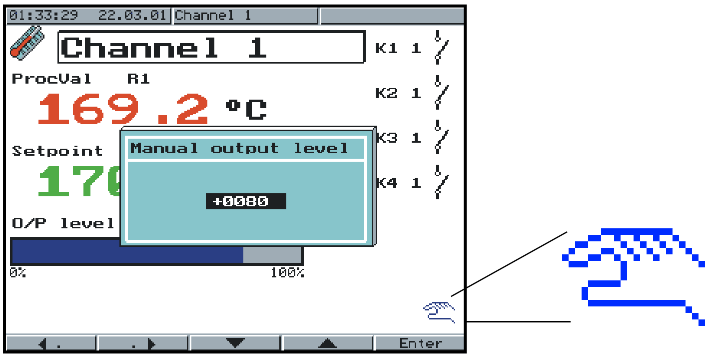
Altering the output

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

✱ Switch to manual mode with EXIT (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)



✱ Shift the decimal point using ◄ . and . ►

✱ The new output is automatically accepted after about 2 sec or by using Enter

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.

5.3 Operation: 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.

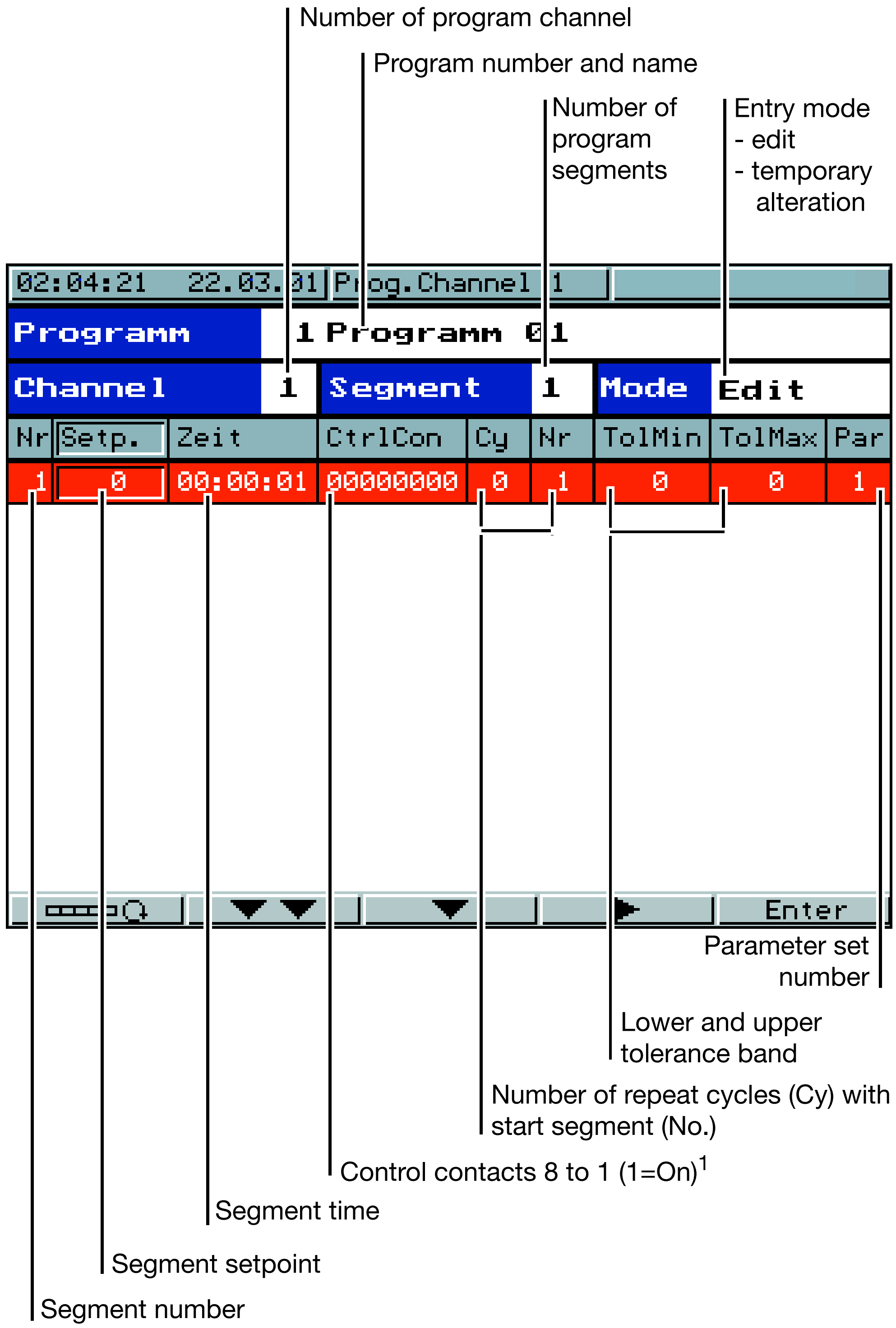
Setpoint limiting for the program channels is performed via the setpoint limitation for the controller channels. There is a fixed 1 to 1 assignment, which is independent of the program setpoint channel that has actually been selected. Example: Setpoint limiting for program channel 2 is always performed via the setpoint limitation of controller channel 2.

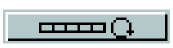
⇨ Chapter 7.3 “Generator”

5.3.1 Program editor

Input template

- ✱ Call up with Prog → ***Edit program***
- ✱ Select program using the cursor keys
- ✱ Select program channel using the cursor keys



 - call up additional softkey functions

1. Control contacts 9 to 16 can only be displayed in the setup program

General

50 programs with up to 99 segments each 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 to 16 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).

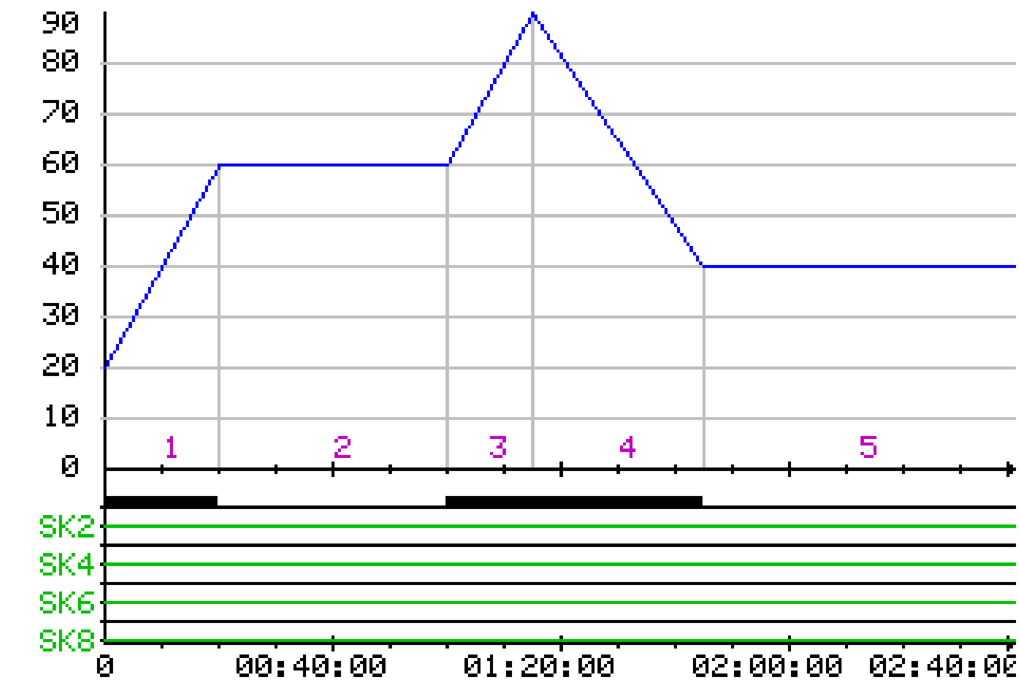
⇨ Chapter 7.3 “Generator” (setpoint input)

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

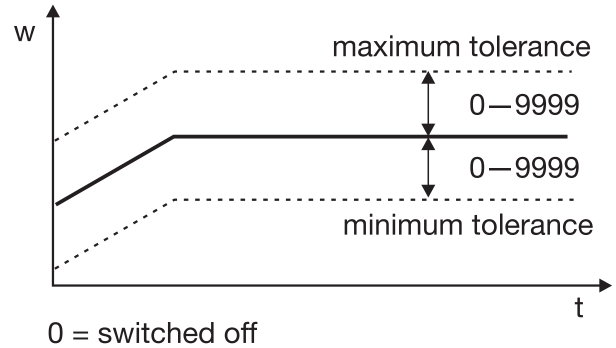
Programm 1 Programm 01

Channel 1 Segment 1 Mode Edit

Nr	Setp.	Zeit	CtrlCon	Cy	Nr	TolMin	TolMax	Par
1	20	00:20:00	00000001	0	1	0	0	1
2	60	00:40:00	00000000	0	1	0	0	1
3	60	00:15:00	00000001	0	1	0	0	1
4	90	00:30:00	00000001	0	1	0	0	1
5	40	00:55:00	00000000	0	1	0	0	1



Tolerance band



0 = switched off

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.

Example:
If the process value goes above the set tolerance band, the logic function “Program stop” can be used to hold the program until the process value is within the tolerance band.

⇨ Chapter 7.5 “Outputs”

⇨ Chapter 7.6 “Logic functions” (tolerance band signal as program stop)

⇨ Chapter 7.3 “Generator”

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 `Copy`

✱ Position the cursor on the desired position

✱ Insert segment with `Insert`

Inserting segments

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

✱ Insert segment with `Insert`

Removing segments

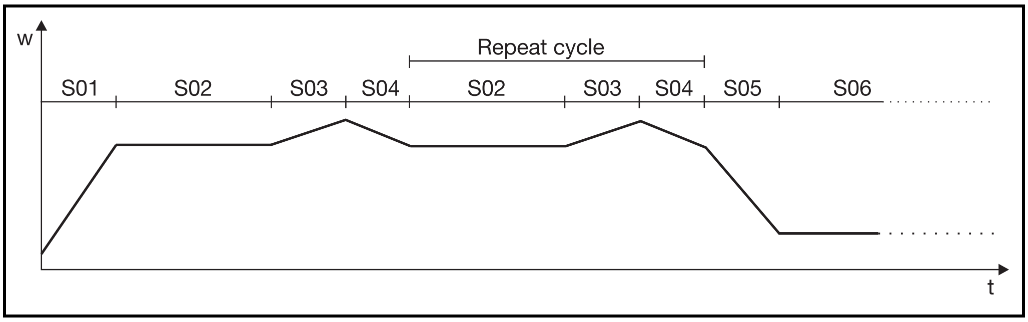
✱ Delete marked segment with `Delete`

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 to 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 [ ]

5.3.2 Starting the program

Immediate start of program

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

* Start program with [Start]

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”.

⇨ Chapter 7.6 “Logic functions”

Selecting and starting the program

The representation of the program selection can be configured as a list or an icon.

⇨ Chapter 7.11 “Device data”

* Call up program selection with [Prog] → ***Start program***
* Select program using the cursor keys
* Confirm the selection by using [Enter]
* Start program in the basic status, with [Start]
  (the program starts immediately from the beginning)

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.

⇨ Chapter 7.3 “Generator” (program)

☞ The settings for the time and start delay are reset to their default values after the start of the program.

✱ Call up program selection with Prog → ***Start program***

✱ Select program using the cursor keys:

✱ Use to switch to other softkey functions

✱ Change to menu “Program start” with Start

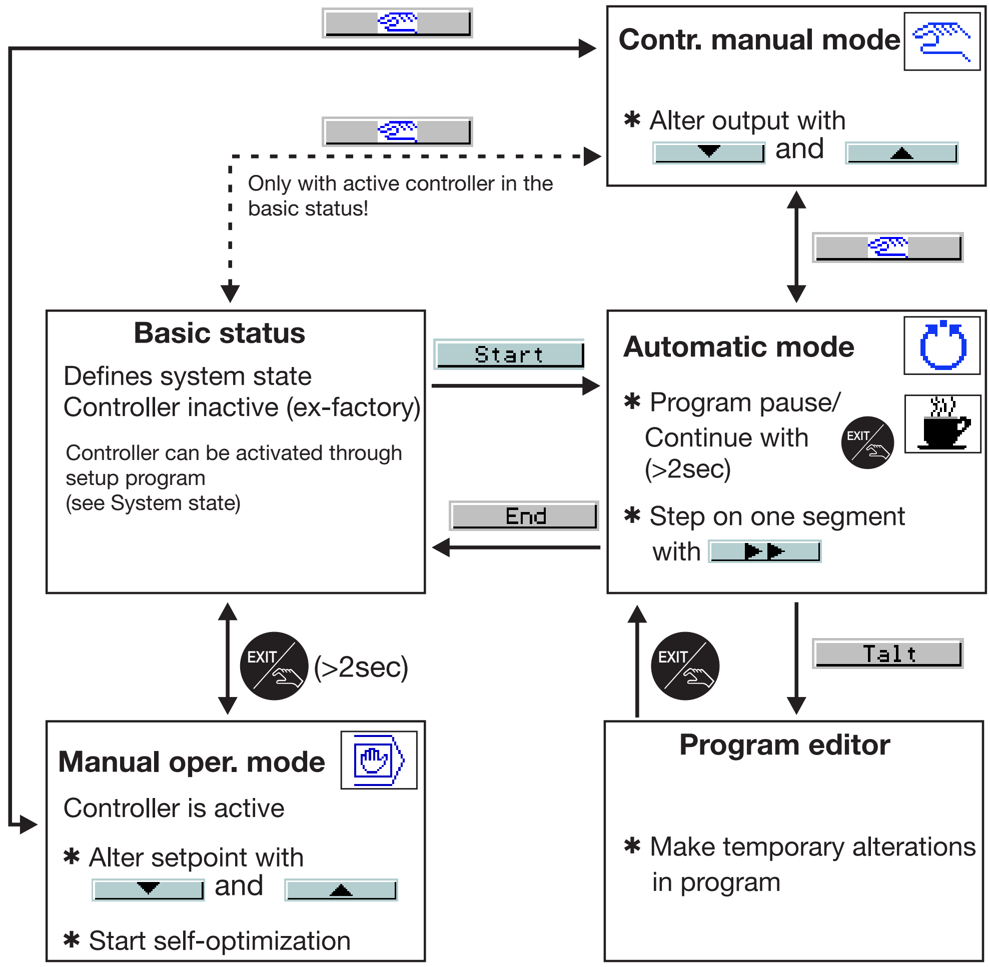
✱ Enter start time/start date or start delay, start segment and remaining segment time

✱ Start program with Start

5.3.3 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

The system state can be modified via the setup program.

System state “Hand”

Setpoints, parameter sets and control contacts can be altered at the operating level, in the manual operating modes “Hand” and “Controller manual mode”.

Temporary alterations

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

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

Curve a:
Setpoint progression for alterations in the current segment.

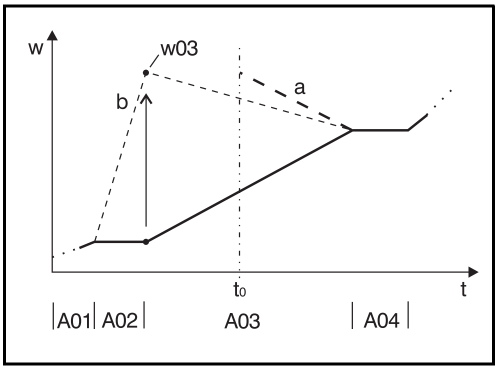
Curve b:
Setpoint progression for subsequent segments or repeat cycles.

Example:		
Segment	Segment setpoint	Segment time
A01	7	1 hour
A02	10	1 hour
A03	50	4 hours
A04	50	1 hour

Alteration of the setpoint during the current segment

If the setpoint is altered at time t_0, then the setpoint curve continues its progression with the setpoint that has been entered. During the residual segment time (=the time remaining to the end of the segment) the setpoint moves to the setpoint for the next segment (Curve a).

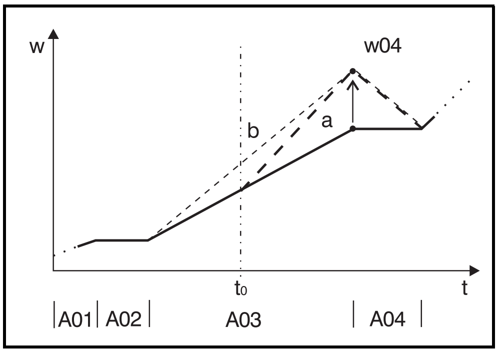
Example: alteration of A03
Segment setpoint w03: 10 → 60



Alteration of the setpoint for the next segment

If the setpoint is altered at time t_0, then the setpoint moves to the entered setpoint for the residual segment time. The slope of the ramp is altered (Curve a).

Example: alteration of A04
Segment setpoint w04: 50 → 60

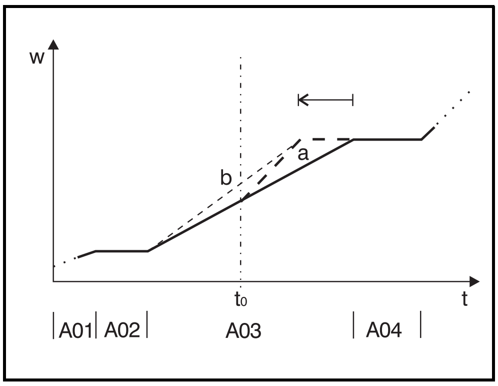


Alteration of the segment time for the current segment

If the segment time is altered, then the the setpoint moves to the following setpoint during the residual segment time (Curve a).

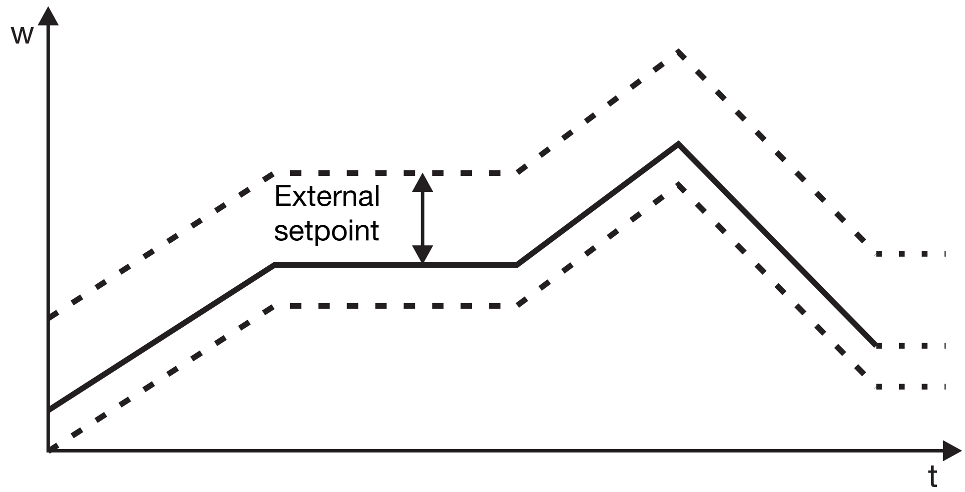
If the new segment time is shorter than the segment time that has already elapsed, then the setpoint curve continues from the start of the next segement.

Example: alteration of A03
Segment time: 4h → 3h



5.3.4 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.

⇨ Chapter 7.2 “Controller”

General

Two parameters sets can be stored for each controller channel.

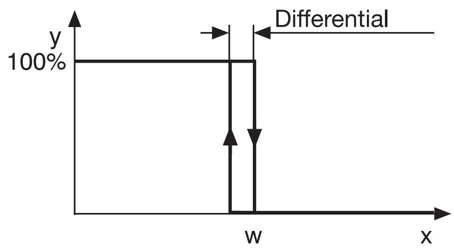
The parameter sets can be switched via the logic function, for example.

Access code

Factory-set code: 0001

The access code can be modified via the setup program.

Parameter level → Controller 1 (2 to 8) → 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 to 9999 digits	0 digits	Size of the proportional band Proportional band = 0 means that the controller structure is ineffective! (limit comparator response) In the case of continuous controllers, the proportional band must be >0.
Derivative time	0 to 9999 sec	80 sec	Determines the differential component of the controller output signal
Reset time	0 to 9999 sec	350 sec	Determines the integral component of the controller output signal
Cycle time	0 to 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 impermissible fluctuations of the process value and b) the switching elements are not overloaded.
Contact spacing	0 to 999 digits	0 digits	The spacing between the two control contacts for 2-setpoint or modulating controllers, or continuous controllers with an integrated actuator driver.
Switching differential	0 to 999 digits	1 digit	Hysteresis for switching controllers with proportional band = 0. 
Actuator time	5 to 3000 sec	60 sec	The actual utilized operating time of the regulator valve with modulating controllers or continuous controllers with an integrated actuator driver.
Working point	-100 to +100 %	0 %	Output level for P and PD controllers (when x = w then y = Y0).
Output level limiting	0 to 100 %	100 %	The maximum limit for the output level.
	-100 to +100 %	-100 %	The minimum limit for the output level.
Minimum relay ON time	0 to 60 sec	0 sec	Limits the frequency of switching for switched outputs.

	Controller structure 2 ➔		
Controller structure 2	P, I, PD, PI, PID	PID	The parameters refer to the second controller output for a 3-state controller.
Proportional band	0 to 9999 digits	0 digits	
Derivative time	0 to 9999 sec	80 sec	
Reset time	0 to 9999 sec	350 sec	
Cycle time	0 to 9999 sec	20 sec	
Switching differential	0 to 999 digits	1 digit	
Minimum relay ON time	0 to 60 sec	0 sec	

☞ The parameter display on the instrument depends on the controller type selected.

⇨ Chapter7.2 “Controller”

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.

☞ Some parameters are only available for a fixed-setpoint controller (with or without ramp function) or a program controller/generator. For fixed-setpoint 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 selection menus which fold down when selecting individual parameters.

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

Analog selector

Switched off Analog inp.1 to Analog inp.8 Math 1 to Math 16	Switched off Measurement of analog input 1 to Measurement of analog input 8 Result of math formula 1 to Result of math formula 16
Process value C1 Setpoint C1 Ramp end C1 Control dev. C1 Output C1 to Process value C8 Setpoint C8 Ramp end C8 Control dev. C8 Output C8	Process value for controller 1 Setpoint for controller 1 Ramp end value for controller 1 Control deviation for controller 1 Output for controller 1 (see note ☞ on page 39 to Process value for controller 8 Setpoint for controller 8 Ramp end value for controller 8 Control deviation for controller 8 Output for controller 8 (see note ☞ on page 39)

Analog selector

Y cascade C1	Standardized output with cascade control for controller 1
to	to
Y cascade C8	Standardized output with cascade control for controller 8
Setpoint 1 C1	Setpoint 1 for controller 1
to	to
Setpoint 4 C1	Setpoint 4 for controller 1
Setpoint 1 C2	Setpoint 1 for controller 2
to	to
Setpoint 4 C2	Setpoint 4 for controller 2
Setpoint 1 C3	Setpoint 1 for controller 3
to	to
Setpoint 4 C3	Setpoint 4 for controller 3
Setpoint 1 C4	Setpoint 1 for controller 4
to	to
Setpoint 4 C4	Setpoint 4 for controller 4
Setpoint 1 C5	Setpoint 1 for controller 5
to	to
Setpoint 4 C5	Setpoint 4 for controller 5
Setpoint 1 C6	Setpoint 1 for controller 6
to	to
Setpoint 4 C6	Setpoint 4 for controller 6
Setpoint 1 C7	Setpoint 1 for controller 7
to	to
Setpoint 4 C7	Setpoint 4 for controller 7
Setpoint 1 C8	Setpoint 1 for controller 8
to	to
Setpoint 4 C8	Setpoint 4 for controller 8
Marker 1 to Marker 4	Values which can be described and read out via the interfaces, and can also be processed internally.
Timer time 1	elapsed time for timer 1 (in seconds)
Timer rem. 1	remaining running time for timer 1 (in seconds)
to	to
Timer time 4	elapsed time for timer 4 (in seconds)
Timer rem. 4	remaining running time for timer 4 (in seconds)
Setpt.1 PCh1[P]	Setpoint 1 for program channel 1
to	to
Setpt.1 PCh4[P]	Setpoint 1 for program channel 4
Setpt.2 PCh1[P]	Setpoint 2 for program channel 1
to	to
Setpt.2 PCh4[P]	Setpoint 2 for program channel 4
Seg. end val.PCh1[P]	Current final segment value for program channel 1
to	to
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
to	to
Output 1 C8	Controller output 1 for controller 8
Output 2 C8	Controller output 2 for controller 8

Analog selector

RemSegT PCh1[P]	Remaining segment time for program channel 1 (in seconds)
to	to
RemSegT PCh4[P]	Remaining segment time for program channel 4 (in seconds)
Seg. Time PCh1[P]	Segment time for program channel 1 (in seconds)
to	to
Seg. Time PCh4[P]	Segment time for program channel 4 (in seconds)
Progam time[P]	Total program time (in seconds)
RemProgT[P]	Remaining run time of program (in seconds)
Analog value	any analog value (from address)
internal Pt100	Temperature measurement of internal Pt100
Sampling time	Sampling time of instrument

Times are shown in the format hh:mm:ss.

The analog signals “Output C1to C8” should only be used for the display on the screen.
For the physical controller output, the signals “Output 1 (2) C1to C8” should be used.

During self-optimization, the signals “Output C1 to C8” are switched off.

Binary selector

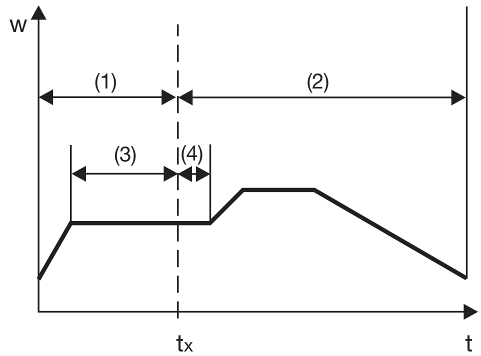
Switched off	Switched off
Output 1 C1	Controller output 1 for controller 1
Output 2 C1	Controller output 2 for controller 1
to	to
Output 1 C8	Controller output 1 for controller 8
Output 2 C8	Controller output 2 for controller 8
Limit comp. 1	Limit comparator 1
to	to
Limit comp.16	Limit comparator 16
Contr. contact. 1[P]	Control contact 1
to	to
Contr. contact 16[P]	Control contact 16
Logic inp. 1	Logic input 1
to	to
Logic inp. 6	Logic input 6
Logic 1	Result of logic linkage 1
to	to
Logic 16	Result of logic linkage 16
Timer 1	Timer 1
to	to
Timer 4	Timer 4
Marker 1 to Marker 4	Values which can be described and read out via the interfaces, and can also be processed internally.

Binary selector

Binary logic value Program end[P] Ramp end 1[F] to Ramp end 8[F] Tolerance band[P] Manual mode C1 to Manual mode C8 Transmitter Logic OFF Logic ON	any binary logic value (from address) Program end signal Ramp end signal for controller 1 to Ramp end signal for controller 8 Signal on going above/below tolerance band Controller 1 in manual mode / program pause to Controller 8 in manual mode / program pause Signal always active Logic 0 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	(3) Segment time
(2) Remaining program time	(4) Remaining segment time

7.1 Analog inputs

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

Depending on the instrument version, up to eight analog inputs are available. The analog inputs are numbered in sequence (IN 1 to 8) according to their slot assignment.

Analog input 1 (2 to 8)➔

	Value/selection	Description
Probe	no funct.	No function
	RTD 3-wire	Resistance thermometer in 3-wire circuit
	RTD 2-wire	Resistance thermometer in 2-wire circuit
	T/C int.	Thermocouple (internal temperature compensation)
	T/C ext.	Thermocouple (external temperature compensation)
	T/C const.	Thermocouple (constant temperature compensation)
	Res. trans.	Resistance transmitter
	Heater current	Heater current AC 0 to 50 mA
	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 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 8: no funct.

Factory settings are shown **bold**.

Analog input 1 (2 to 8)➔

	Value/selection	Description
Linearization	Linear **Pt100** Pt100 JIS Ni100 Pt500 Pt1000 Ni1000 Pt50 CU50 Pt K9 KTY11-6 Fe-Con J NiCr-Con E NiCr-Ni K NiCrSi-NiSi N Cu-Con T Pt30Rh-Pt6Rh B Pt13Rh-Pt R Pt10Rh-Pt S Cu-Con U Fe-Con L W5Re_W26Re C W3Re_W25Re D W3Re_W26Re C-level Customized 1 Customized 2 Customized 3 Customized 4	For customized linearization (e.g. “customized 1”) a maximum of 20 knee-points can be implemented, or a 5th order polynominal function programmed (only with setup program). For the linearization “KTY11-6”, the resistance is 2 kΩ at 25 °C. The resistance value can be adapted via the parameter “KTY: Ω at 25 °C/77 °F”. **Do not use C-level linearization!** The correct setting is described in Chapter 7.8.1 “C-level control example”
Offset	-1999 to **0** to +9999	The offset is used to correct a measured value by a certain amount upwards or downwards. Examples: Measured value / Offset / Displayed value 294.7 / +0.3 / 295.0 295.3 / - 0.3 / 295.0 The controller uses the corrected value (=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.

Factory settings are shown **bold**.

Analog input 1 (2 to 8)➔

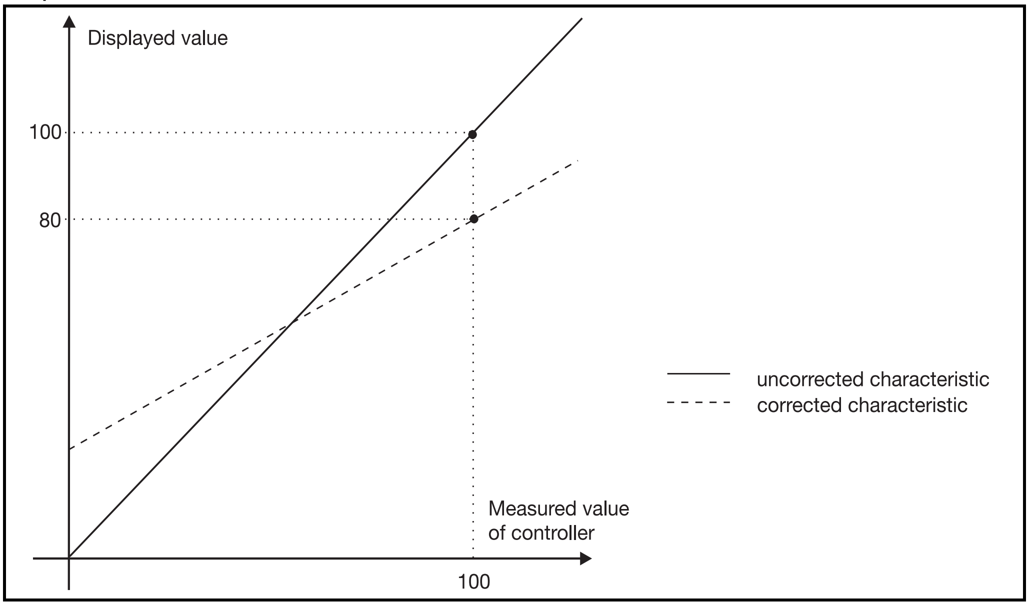
	Value/selection	Description
Range start	**-1999** to +9999	The instrument will change over earlier to the response defined for overrange/underrange if the range is restricted. Example: Range: Pt100 -200 to +850 °C. An alarm message is to be generated for temperatures outside the range 15 to 200 °C. → Range start: 15 Range end: 200
Range 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 20mA = 0 to 1500 °C. The range of the physical signal can be 20 % wider or narrower without generating an out-of-range signal.
Display end	-1999 to **100** to +9999	
Filter	0 to **0.6** to 100 sec	To adjust the digital input filter (0sec = filter off). 63% of the alterations 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)
Fixed temperature compensation	0 to **50** to 100	Temperature of the external cold-junction thermostat.
External temperature compensation	**Analog inp.1** Analog inp. 2 Analog inp. 3 Analog inp. 4	Measurement of the cold-junction temperature with an external temperature probe.
Heater current monitoring (output)	**no funct.** Output 1 to 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.
KTY: Ω at 25°C/ 77 °F.	0 to **2000** to 4000	Resistance at 25 °C/77 °F with linearization “KTY 11-6”
	Recalibration ➔	
Start value	-1999 to **0** to +9999	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.
End value	-1999 to **1** to +9999	

Factory settings are shown **bold**.

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.

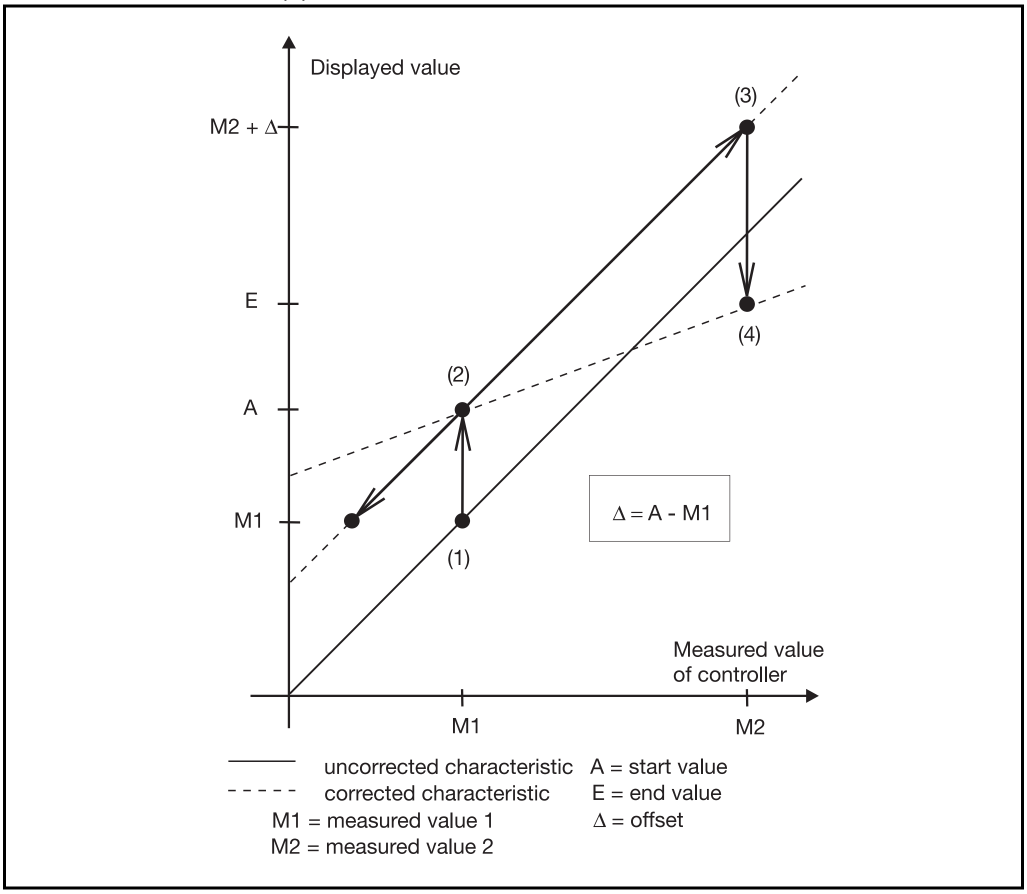


Procedure

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

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



☞ 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.

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.

7.2 Controller

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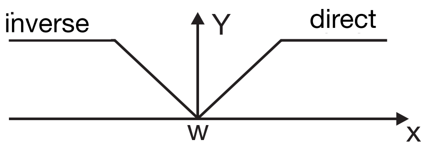
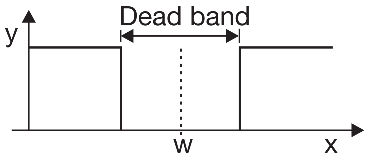
The following are set here: controller type, input variables of the controller, the setpoint limits, conditions for manual mode and the presettings for self-optimization of the eight controller channels.

Controller 1 (2 to 8)➔ Configuration

	Value/selection	Description
Controller type	**2-state contr.** 3-state contr. Modulating ActuatingC. Cont.	2-state controller 3-state controller Modulating controller Continuous controller with integral actuator driver Continuous controller
Control action	Direct **Inverse**	Direct Inverse  inverse: The controller output Y is >0 when the process value is smaller than the setpoint (e. g. heating). direct: The controller output Y is >0 when the process value is larger than the setpoint (e. g. cooling).
Inhibit manual mode	**Enabled** 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

Factory settings are shown **bold**.

Controller 1 (2 to 8)➔ Configuration

	Value/selection	Description
Dead band	**0** to 100	The output movement is suppressed within the dead band; e. g. with noisy signals.  The dead band is only effective for controller structures with an **I**-component.
External setpoint	**no correction** with correction	External setpoint input without correction External setpoint input with correction External setpoint with correction External setpoint + setpoint 1 = present setpoint The external setpoint is corrected up or down from the keypad (setpoint 1). The display shows the present setpoint. Activating the function: ⇨ *Controller 1 ➔ Inputs ➔ External setpoint*
Setpoint start	**-1999** to +9999	Setpoint limiting prevents the input of values outside the defined range. The setpoint limits are not effective with setpoint input via the interface. The correction value is limited for external setpoint with correction.
Setpoint end	-1999 to **+9999**	
Output start	-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.
Output end	-1999 to **100** to +9999	

Factory settings are shown **bold**.

Controller 1 (2 to 8)➔ 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. Cascade controller: The standardized output of the master controller (Y cascade CX) has to be defined here for the slave controller.
Program setpoint	(Analog selector) **Setpt.1 PCh1**	Assigns one of the four available profile traces to the controller channel. “Switched off” means that the controller channel responds as for fixed-setpoint control (on channels 2 to 8).
Manual output	(Analog selector) **Switched off**	The manual output is defined through an analog signal, instead of via the keys or the interface.

Factory settings are shown **bold**.

Controller 1 (2 to 8)➔ Inputs

	Value/selection	Description
Output feedback	(Analog selector) **Switched off**	Defines the source for output feedback. Output feedback must be configured in the case of a continuous controller with integral actuator driver!
Additive disturbance	(Analog selector) **Switched off**	Defines the source for the additive disturbance. The analog value is added to the present output.
Multiplicative disturbance	(Analog selector) **Switched off**	Defines the source for the multiplicative disturbance. The analog value is multiplied by the proportional band.

Factory settings are shown **bold**.

Controller 1 (2 to 8)➔ Self-optimization

	Value/selection	Description
Method	**Oscillation** Step response	One of two procedures can be selected for self-optimization. ⇨ Chapter 8 “Optimization”
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** Solid-state + logic Analog	The type of the physical output for the signal of the controller outputs 1 and 2 has to be defined.
Output 2 for “Tune”	**Relay** Solid-state + logic Analog	
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

Factory settings are shown **bold**.

7.3 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 fixed-setpoint controller, program controller or program generator.

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

If the instrument has the basic function of a program controller/generator, channels 2 to 8 can still be operated as a fixed-setpoint controller.
Controller ➔ Inputs ➔ Program setpoint (switched off)

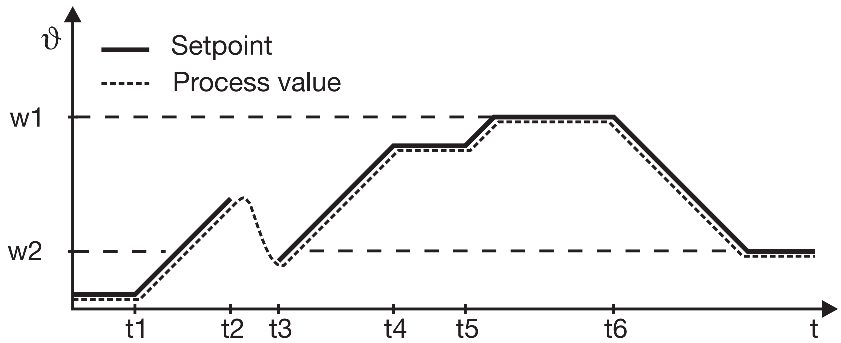
Function ➔

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

Factory settings are shown **bold**.

Ramp function

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



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

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

The ramp function can be stopped and canceled via the logic functions.

⇨ Chapter 7.6 “Logic functions”

Ramp ➔ Ramp controller 1 (2 to 8)

	Value/selection	Description
Function[F]	**Inactive** Active	Defines whether the ramp function is to be activated for the corresponding controller channel.
Unit of slope[F]	**°C/minute** °C/hour °C/day	Defines the unit of the slope in degree Celsius per unit of time.
Ramp slope[F]	**0** to 9999	Amount of slope

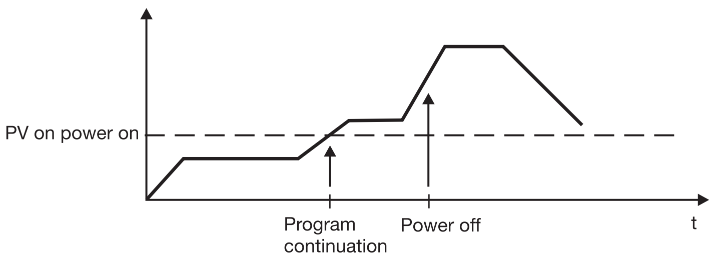
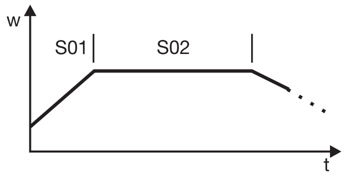
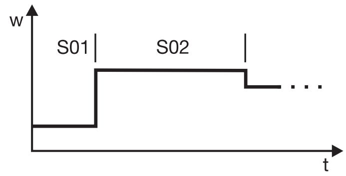
Factory settings are shown **bold**.
F = parameter only available for fixed-setpoint controller

Program ➔

	Value/selection	Description
Program start[P]	**from the beginning** from the process value from the time	from the beginning: Program start at the first programmed setpoint from the process value: The present process value from program channel 1 is accepted as the first setpoint. All the other channels run synchronously from this moment on. from the time: The present time in a 24-hr program is taken as the starting time.
Response for range[P]	**Continue** Progr.stop	Response of the program sequence to out-of-range

Factory settings are shown **bold**.
P = parameter only available for program controller/generator

Program ➔

	Value/selection	Description
Response to power failure^P	**Prog.canceled** Continue Standstill Continue X% Continue PV	Response of the program run on a power failure Program canceled: Program run canceled; instrument switches to basic status. Continue: The program continues from the point at which it was canceled at the time of the supply failure. 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. 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. (The instrument goes into the basic status, the program setpoint at the moment of interruption is taken as the setpoint.) 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. 
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	**Setpoint ramp** Setpoint step	Setpoint ramp:  Setpoint step: 

Factory settings are shown **bold**.
P = parameter only available for program controller/generator

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). Setting the clock: ⇨ Chapter 7.11 “Device data”
Program end time[P]	-1 to **0** to 9999 sec	Duration of program end signal If a program is ended, the program end signal is switched on for a definable time period and can, for example, be output via a logic output. -1 = continuous signal until acknowledgement via button ⇨ Chapter 7.5 “Outputs”
Function control[P] ➔ Controller 1 to 4 ➔ Limit comparator 1 to 16	**Generator control** Control contact 1 to Control contact 16	Defines when controllers and limit comparators are active. Generator control: Controllers and limit comparators are active when a program is running (automatic mode); otherwise according to defined system state for the basic status in the setup program Control contact: Controllers and limit comparators are only active when the control contact is ON.
Process value inputs[P] ➔ Proc.val. for program channel 1 to 4	(Analog selector) **Process value C1**	Value to which the tolerance band and range monitoring refers to in a program.

Factory settings are shown **bold**.
P = parameter only available for program controller/generator

7.4 Limit comparators

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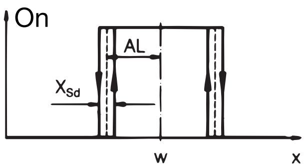
Limit comparators (limit monitors, limit contacts) can be used to monitor an input variable (limit comparator process value) against a fixed limit or another variable (limit comparator setpoint). When a limit is exceeded, a signal can be output or an internal controller function initiated.

16 limit comparators are available.

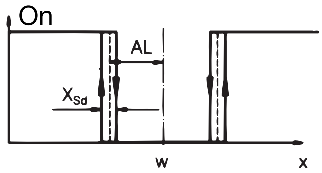
Limit comparator functions

Limit comparators can have different switching functions.

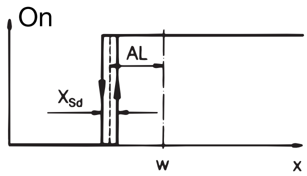
lk1



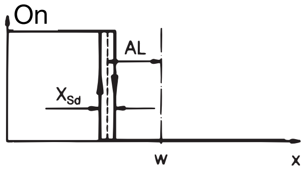
lk2



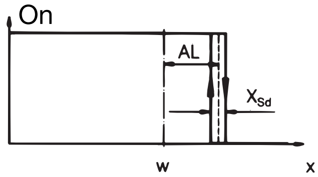
lk3



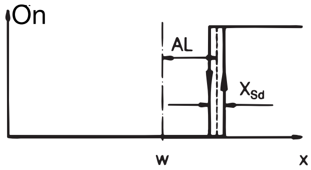
lk4



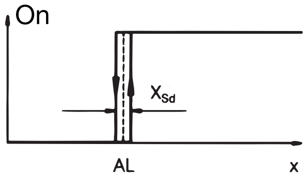
lk5



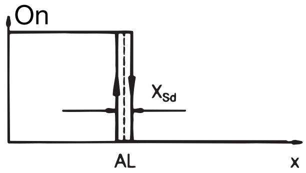
lk6



lk7



lk8



lk1 to lk6:
Monitoring referred to the limit comparator setpoint.
lk7/lk8:
Monitoring referred to a fixed value AL

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

Limit range AL with lk1 and lk2: 0 to 9999

Limit comparator 1 (2to16) ➔

	Value/selection	Value/selection
LK function	**no funct.** LK type 1 to LK type 8	Limit comparator function
Limit value	-1999 to **0 to** +9999	Limit value to be monitored
Switching differential	0 to **1** to 9999	Switching differential
Action	Absolute Relative	see explanation below
Range response	Relay OFF Relay ON	Function on over/underrange ☞ If a limit comparator is connected to an output, then the setting “Output signal on over/underrange” of the output has priority. ⇨ Chapter 7.5 “Outputs”
Switch-on delay	**0** to 9999 sec	Delays the switch-on edge by a definable time period
Switch-off delay	**0** to 9999 sec	Delays the switch-off edge by a definable time period
Acknowledgement	**none** when active always	none: The limit comparator is automatically reset when active: The limit comparator must be acknowledged; acknowledgment is only possible in the inactive condition always: The limit comparator must be acknowledged; acknowledgment is also possible in the active condition
Pulse time	**0** to 9999 sec	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 (only for lk1 to lk6)

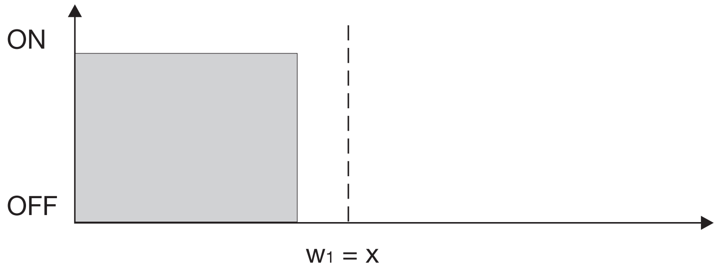
Factory settings are shown **bold**.

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

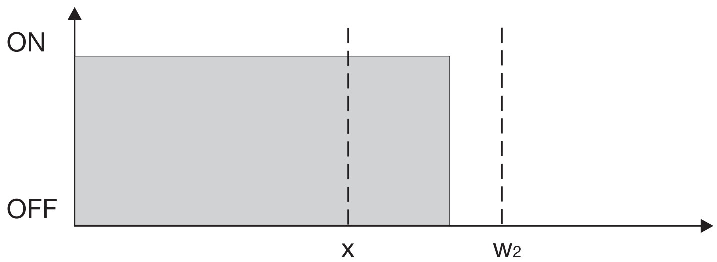
Relative The limit comparator is in the OFF status.
An alteration of the limit value or the (limit comparator) setpoint could cause the limit comparator to switch ON. Such a reaction will be suppressed, and this condition is maintained until the (limit comparator) process value has **moved away** from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

Example:
Monitoring the (controller) process value x with function lk4
Setpoint alteration $w_1 \rightarrow w_2$

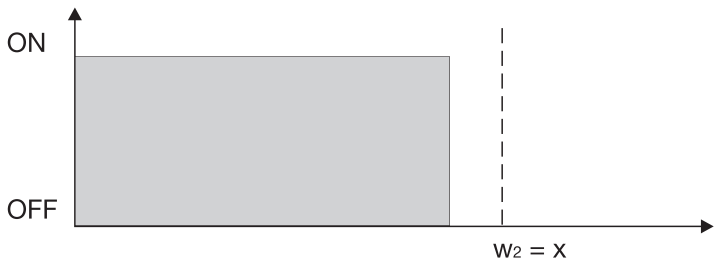
a) Initial condition



b) Condition at the time of the alteration.
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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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 OUT 1 to 6.

☞ Up to 2 optional ER8 modules (additional relay or logic outputs) can be configured through the setup program.
Caution: The ER8 modules cannot be addressed through the COM1 interface of the controller during ongoing communication between the controller and the PC via the setup interface.
The COM1 interface of the controller is out of operation while communication is in progress via the setup.

Numbering of Outputs

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

Analog outputs ➔ Analog output 1 (2 to 6)➔

	Value/selection	Description
Function	(Analog selector) **Analog inp. 1**	Factory-set for analog output 2 to 6: Switched off ⇨ See note on the analog selectors on page 39
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 101 = last output signal ☞ If the output is a controller output, the controller switches over to manual mode and produces an output level that can be defined. ⇨ Chapter 7.2 “Controller”

Factory settings are shown **bold**.

Analog outputs ➔ Analog output 1 (2 to 6)➔

	Value/selection	Description
Zero point	-1999 to **0** to +9999	A physical output signal is assigned to the value range of an 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 Setting with controller outputs for cooling. The following settings have to be defined for 3-state controllers: Zero point: 0 / End value: -100
End value	-1999 to **100** to +9999	
Offset	-1999 to **0** to +9999	Value of the parallel shift applied to the analog output values.

Factory settings are shown **bold**.

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 **0** to +9999	Delay of switch-on edge or pulse time.
OFF time	-1999 to **0** to +9999	Delay of switch-off edge or pause time.

Factory settings are shown **bold**.

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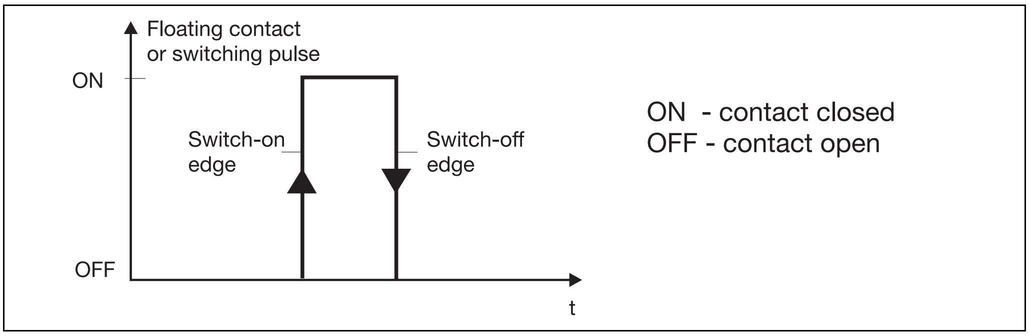
Functions are assigned here to the logic signals of the logic inputs, limit comparators and logic functions (formula).

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/cancel
- Start timer
- Synchronize clock
- Remote alert
- 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).

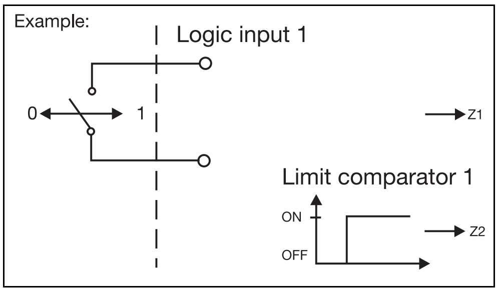
Control variable	State
Logic input 1 ... Logic input 6 Limit comparator 1 ... Limit comparator 16 Logic 1 ... Logic 16 Control contact 1* ... Control contact 16* Tolerance band signal* Program end signal* Ramp end signal	Z1 Z2 Z3 Z4

* only for pro-

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

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

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

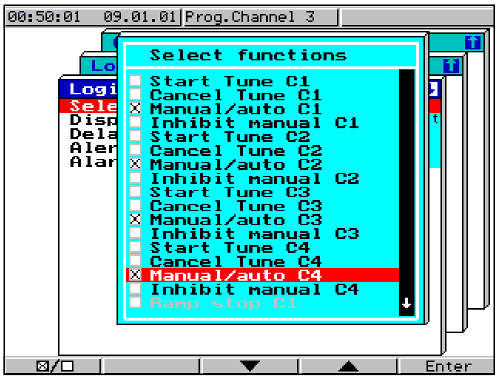
Program selection

Program	Z6	Z5	Z4	Z3	Z2	Z1
Program 1	0	0	0	0	0	0
Program 2	0	0	0	0	0	1
Program 3	0	0	0	0	1	0
Program 4	0	0	0	0	1	1
to	to	to	to	to	to	to
Program 64	1	1	1	1	1	1

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

Multifunctional logic functions

Logic functions can cover several functions simultaneously. The desired function can be marked by a cross in the selection list.



✱ Select/delete function with ⊠/☐

✱ Confirm with Enter

Logic input 1 (2 to 6) ➔
Limit comparator 1 (2 to 16) ➔
Logic 1 (2 to 16) ➔
Control contact 1 (2 to 16) ➔
Tolerance band signal➔
Program end signal➔
Ramp end signal 1 (2 to 8)➔
Timer 1 (2 to 4)

Selection of functions

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
to	to
Start Tune C8	Start self-optimization for controller 8
Cancel Tune C8	Cancel self-optimization for controller 8
Manual/Auto C8	Changeover to manual mode for controller 8
Inhibit Manual C8	Inhibit manual mode for controller 8
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)
to	to
Ramp stop C8	Ramp stop for controller 8
Cancel ramp C8	Ramp OFF for controller 8
Setpoint switching C8	Setpoint switching for controller 8
Proc. val. switching C8	Process value switching for controller 8
Paramset switching C8	Parameter set switching for controller 8 (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. switch^P	Changeover between automatic and manual
Inhibit program start	Program cannot be started
Program start^P	Program start
Program stop^P	Program stop
Program cancel^P	Program cancel
Program selection^P	Program selection (see below)
Fast forward^P	Dynamic speed increase of program sequence
Segment change^P	Segment change

Factory settings are shown **bold**.
P = parameter only available for program controller/generator

Logic input 1 (2 to 6) ➔
Limit comparator 1 (2 to 16) ➔
Logic 1 (2 to 16) ➔
Control contact 1 (2 to 16) ➔
Tolerance band signal➔
Program end signal➔
Ramp end signal 1 (2 to 8)➔
Timer 1 (2 to 4)

	Value/selection	Description
	Synchronize clock Remote alert Switch off controller 1 to Switch off controller 4 Start timer 1 to Start timer 4 Stop timer 1 to Stop timer 4 Start/stop recording function	Examples: 12:55:29 -> 12:55:00; 12:55:30 -> 12:56:00 Send e-mail (setup program) Controller 1 is inactive to Controller 4 is inactive Timer 1 is started to Timer 4 is started Timer 1 is canceled to Timer 4 is canceled If this signal is active, no values will be recorded.
Display text	**Standard text** Text 1 to Text 100 No text	System texts according to function Definable texts (only via setup program) No entry in event list
Delay	**0** to 9999 sec	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. The message disappears automatically when the logic signal changes.
Alarm	**No** Yes	Defines whether an alarm message is produced when the logic function is activated. Alarms must be acknowledged. An entry is generated in the event list.

Factory settings are shown **bold**.
P = parameter only available for program controller/generator

Message types

- To display the info immediately: just set info to “yes”
- To display the info after a delay: set info to “yes” and enter delay time
- To display the alarm immediately: just set alarm to “yes”
- To display the alarm after a delay: set alarm to “yes” and enter delay time
- To change the info to alarm after a delay time: set info and alarm to “yes” and enter delay time.

Level inhibit

- No access via “Menu” key
- The setpoint can be modified in manual operation. No access to control contacts.
- Programs can be started and altered

7.7 Math and logic module

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

C-level control and math/logic formulae (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 to 16).

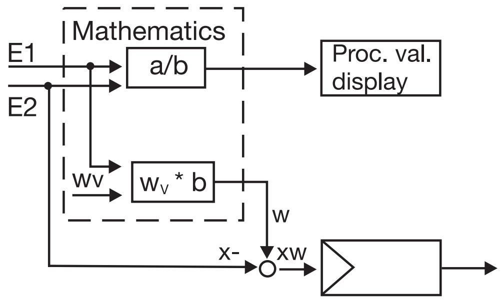
Math / logic 1 (2 to 16)➔

	Value/selection	Description
Function	**no funct.** Differ. (a-b) Ratio (a/b) Humidity (a;b) C-level Math formula Logic formula	No function Difference control (a-b) Ratio control (a/b) Humidity control (a;b) C-level control Math formula (only via setup program) 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 infringed, an out-of-range condition will be signaled.
Range end	-1999 to **+9999**	
Linearization	⇨ *Analog inputs* ➔ *Probe* **Linear**	The mathematical calculation can be combined with a (customer-specific) linearization table.

Factory settings are shown **bold**.

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*

⇨ Operating Manual 703590.6 (on-line documentation)

7.8 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 zirconium dioxide sensor and measurement of the sensor temperature.

C-level control is an extra.

Additionally, the math function has to be activated!

C-level calculation

The calculations of the controller are based on the following:

$$E = 0.0992 \cdot T \cdot (-\lg(P_{co}) + 1.995 + 0.15 \cdot C_p + \lg(C_p)) \cdot mV/K + 816.1\ mV$$

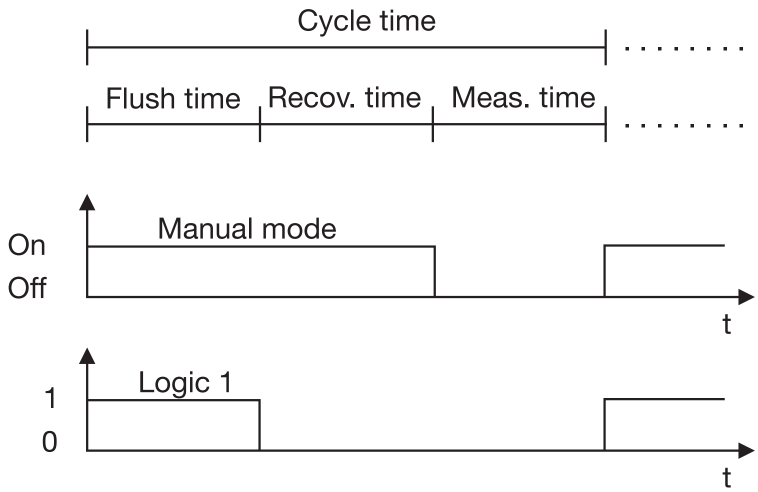
E - e.m.f. of the zirconium dioxide sensor
T - sensor temperature in °C
P_{co} - partial pressure CO in percentage of volume
C_p - carbon level

Sequence control

Operation using a zirconium dioxide sensor is subject to a fixed time schedule. The sensor has to be “flushed” at regular intervals (cycle time) to ensure fault-free 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 zirconium dioxide sensor
Sensor temperature	(Analog selector) **Switched off**	Source for the temperature signal of the zirconium dioxide sensor
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 uses a reference measurement to correct the C-level calculated by the instrument.
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

Factory settings are shown **bold**.

7.8.1 C-level control example

Analog input

For C-level control, extra code C-level has to be activated and a special input card for zirconium dioxide sensor voltage has to be installed.

Linearization

* Select 0 to 10 V at the appropriate analog input
* Set to linear (not C-level)

Set display range

* - Set display start to 0
* - Set display end to 2000 mV

⇨ "Display start" page 43 and "Display end" page 43

Correct assignment

The number of the controller channel must be the same as the math/logic number and C-level number. Otherwise, the current C-level value cannot be calculated or the controller will not switch to manual mode during the flushing procedure.

Example: if controller 3 is used for C-level control, C-level 3 and math/logic 3 have to be used for calculating the current C-level value. In this case logic 3 is the signal for sensor flushing procedure.

7.9 Display

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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 to 8 and on the collective picture can be adapted to suit individual requirements.

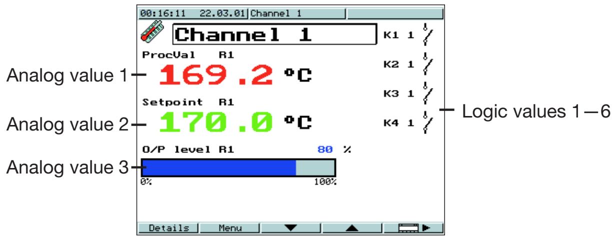
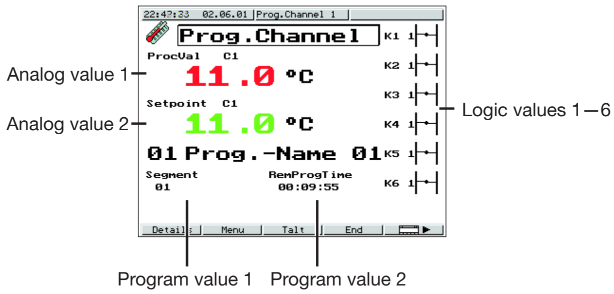
	Value/selection	Description
Contrast	0 to **25** to 31	Contrast of color screen
Continuous operation from	hh:mm:ss **00:00:00**	Switch-on time for screen
Continuous operation until	hh:mm:ss **00:00:00**	Switch-off time for screen
Screen saving	**0** to 9999 min.	If no key is pressed for a specified time, the screen switches off. The screen comes on automatically when a key is pressed. The function is not active during continuous operation. 0 = display is always switched on
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** Controller pic. 1 to Controller pic. 8 Collective pic. 1 Collective pic. 2 Recording Custom pic. 1 Custom pic. 2	Last picture before power-off is shown Controller channel 1 to Controller channel 8 Controller 1 to 4 as a group picture Controller 5 to 8 as a group picture Recording (extra code) freely configurable screen template 1 freely configurable screen template 2

Factory settings are shown **bold**.

	Value/selection	Description
Operating loop ➔ Controller pic. 1 to ➔ Controller pic. 8 ➔ Collective pic. 1 ➔ Collective pic 2 ➔ Recording ➔ Custom pic. 1 ➔ Custom pic. 2	Yes No	The screen templates that are to appear in the screen operating loop can be selected. Visible as a factory setting: - Controller pic. 1 - Recording

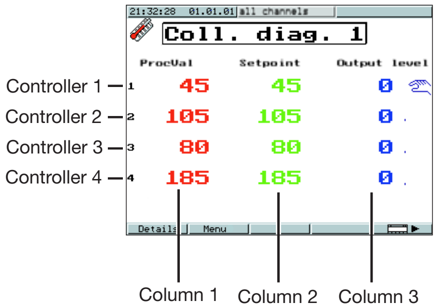
Factory settings are shown **bold**.

Controller pictures ➔ Controller picture 1 (2 to 8) ➔

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

Factory settings are shown **bold**.
P = parameter only available for program controller/generator

Collective picture → Controller 1 (2 to 8)→

	Value/selection	Description
Value column 1	(Analog selector) **Ramp end C1**	Display:  Collective pic. 2: Controller 5 to 8
Decimal point column 1	**XXXX.**	
Value column 2	(Analog selector) **Setpoint C1**	
Decimal point column 2	**XXXX.**	
Value column 3	(Analog selector) **Output C1**	
Decimal point column 3	**XXXX**	

Factory settings are shown **bold**.

Decimal point

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

7.10 Interfaces

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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	If two interfaces are operated at the same time, then the baud rate 38400 for one individual interface is not permissible.
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	Address in data network
Minimum 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.

Factory settings are shown **bold**.

PROFIBUS DP →

	Value/selection	Description
Device address	0 to **1** to 255	Address in data network

Factory settings are shown **bold**.

☞ Interface description 703590.2

7.11 Device data

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

	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 msec 150 msec **250 msec**	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 Time	 dd.mm.yy hh:mm:ss	Real-time clock with calendar d=day; m=month; y=year h=hours; m=minutes; s=seconds
Summer time Changeover Start date Start time End date End time	 Switched off Time definition **Automatic** dd.mm.yy hh:mm:ss dd.mm.yy hh:mm:ss	 Determines how to change over to summer time. Details for the changeover through time definition

Factory settings are shown **bold**.

7.12 Recording

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

The ring memory contains a total of 43200 measurement points. The maximum recording time depends on the storage rate that was set and the number of measurement signals. Using the setup program, the maximum recording time can be calculated and indicated.

A special software (accessory) is available for reading out the historical data.

Analog value 1 (2 to 4) ➔

	Value/selection	Description
Function	(Analog selector) **Switched off**	Recording of analog signals
Scaling start	-1999 to **0** to +9999	Defines the lower and upper limit on the y-axis. The screen template “Recording” (operating loop) can be used to switch between the scalings of the analog values for the graphical display of the traces.
Scaling end	-1999 to **100** to +9999	
Decimal place	**XXX.X**	
Unit	(4-character text) **%**	Any 4-character sequence can be specified.

Factory settings are shown **bold**.

	Value/selection	Description
Logic value 1 **Logic value 2** **Logic value 3**	(Binary selector) **Switched off**	Recording of logic signals
Storage rate	1 to **6** to 60 sec	Defines the time span between the measurement points. The ring memory will be overwritten after 43200 measurement points.

Factory settings are shown **bold**.

7.13 Timers

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Timers are used for time-dependent control. The timer signal (timer 1 to 4) indicates whether the timer is active. The signal can be output via the logic outputs or processed internally.

It is possible to program up to four timers.

The timers are started and canceled through the logic functions.

Timer 1 (2 to 4) ➔

	Value/selection	Description
Function	**no function**	
	Signal active	with the timer running: logic signal=1; canceled after power-down
	Signal inactive	with the timer running: logic signal=0; canceled after power-down
	active, continue	with the timer running: logic signal=1; continues after power -down
	inactive, continue	with the timer running: logic signal=0; continues after power down
Timer value	hh:mm:ss **00:00:00**	Time setting

Factory settings are shown **bold**.

Example

You need to switch from setpoint 1 over to setpoint 2 for a defined time period. Start the timer via logic input 1.

✱ Set the two setpoints at the operating level

✱ Set the timer and the timer value
Timer ➔ *Timer 1* ➔ *Function* ➔ *Signal active*

✱ Configure the logic input
Logic functions ➔ *Logic input 1* ➔ *Select functions* ➔
Start timer 1

✱ Configure the setpoint changeover
Logic functions ➔ *Timer 1* ➔ *Select functions* ➔
Setpoint changeover C1

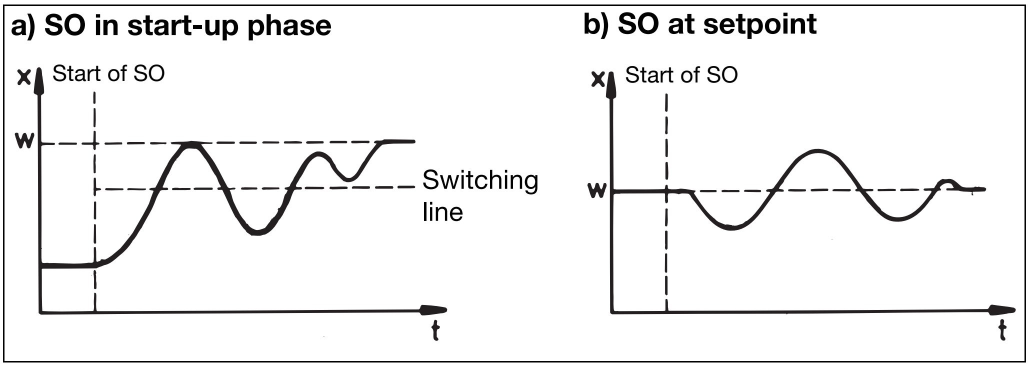
8.1 Self-optimization

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 (Tn), derivative time (Tv), proportional band (Xp), cycle time (Cy), filter time constant (dF)

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



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), 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 (Tn), derivative time (Tv), proportional band (Xp), cycle time (Cy), 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:

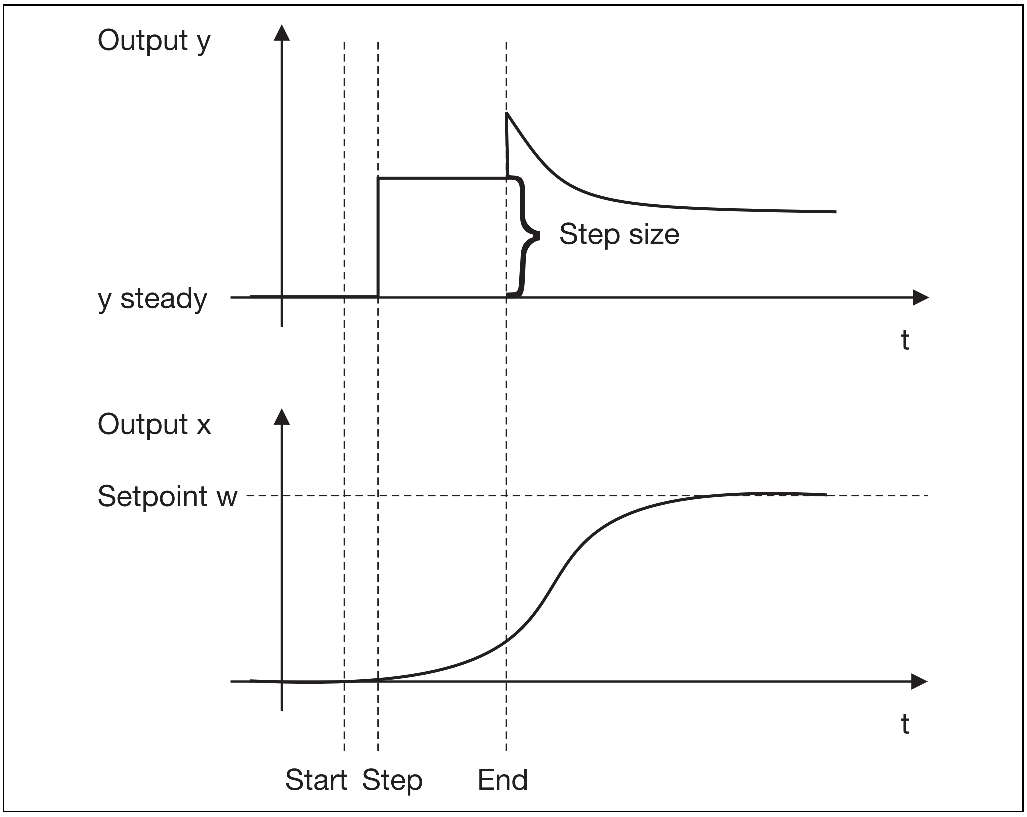
- Optimization instantly after “power on”, during the start-up phase
  Considerable time savings, setting: steady output = 0 %.
- The process does not readily permit oscillations (e.g. highly insulated furnaces with small losses, long oscillation period)
- Process value must not exceed setpoint
  If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

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

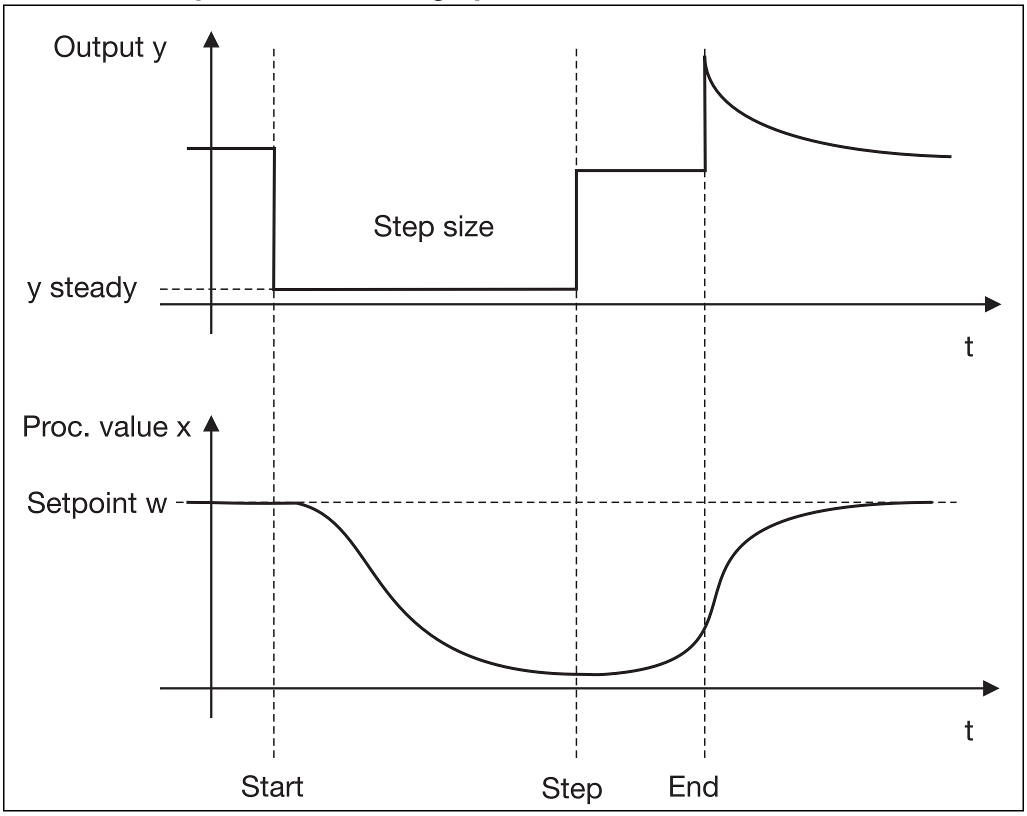
With the “relay” output type, care has to be taken that the process value is not influenced by the switching cycle time, since otherwise optimization cannot be completed successfully.

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
  ➔ *Operating level* ➔ *Self-optimization* ➔ *Controller number 1 to 8*
* 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 Details
* Press
* Start self-optimization for the required controller channel with
* Pressing EXIT resets the significance of the softkeys

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.

⇨ Chapter 7.2 "Controller"

In the case of a program controller, self-optimization can only be started in the manual controller mode, during a program pause or in the basic status (with active controller!).

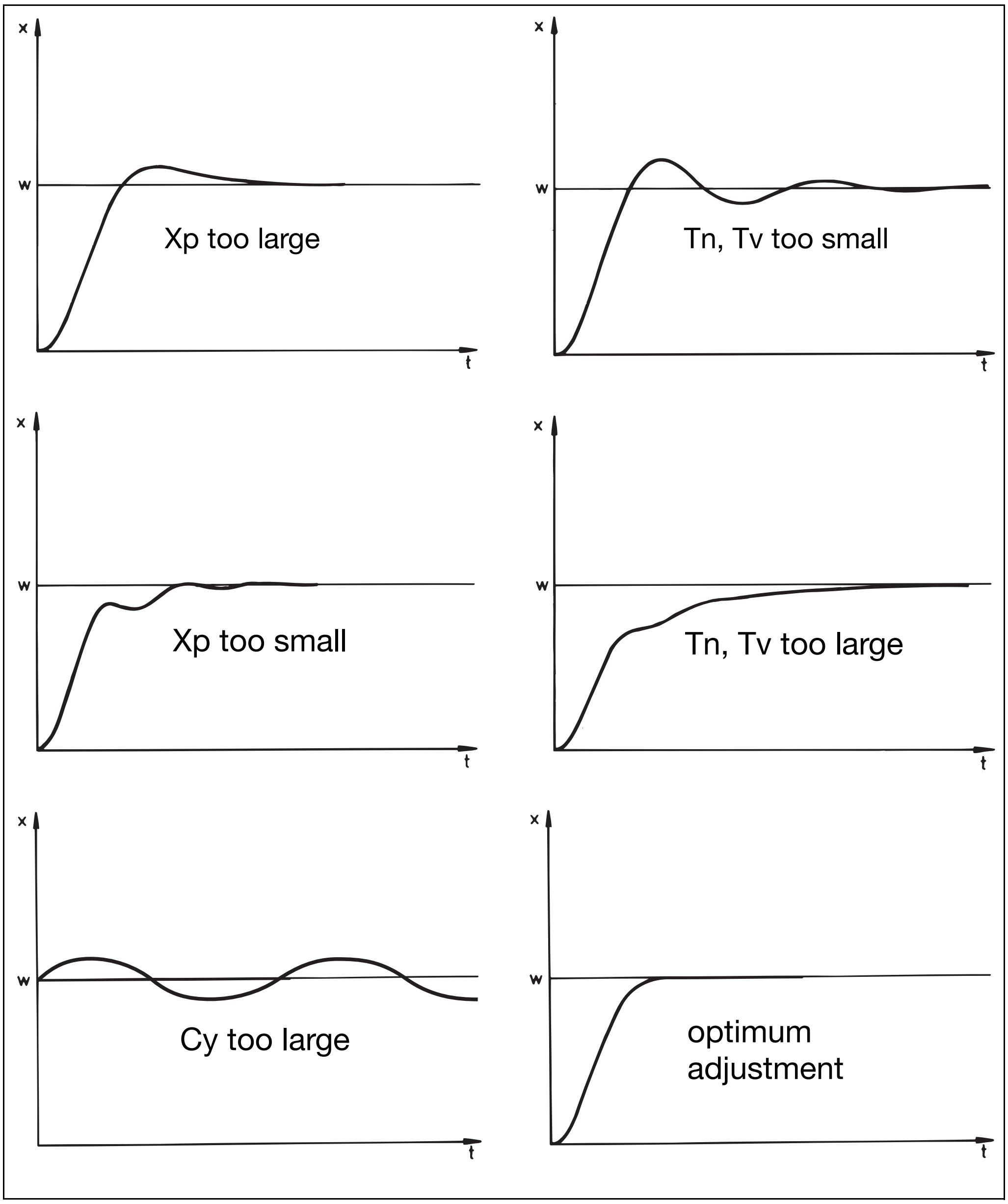
Canceling self-optimization

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

8.2 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 maladjustments 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.



The following steps are necessary for retrofitting modules:

Safety notes

Only qualified personnel are permitted to retrofit modules.

For safety reasons, care must be taken that the back panel and the fixing screws are correctly reassembled and mounted after the alterations.

The modules can be damaged by electrostatic discharge. Avoid electrostatic charge during fitting and removal. Carry out retrofitting on a workbench that is earthed.

Identifying the module

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

Modules	Code	Part no.	Board No.
Universal input[a] Input[a] for zirconium dioxide sensor 0 to 2 V		00489149	00483500 00483395
<u>Outputs:</u> 1 relay (changeover contact) Solid-state relay 230 V/1 A 2 relays (n.o.) make 1 logic output 0/22 V[b] 1 analog output 1 supply for two-wire transmitter[b] 2 logic outputs 0/14 V	 1 2 3 4 5 6 7	 00399782 00399783 00399784 00399785 00399786 00399785 00399788	 00401153 00401185 00397011 00401267 00403601 00401267 00621622
RS422/485 interface	54	00399789	00401269
PROFIBUS-DP	64	00399790	00401264

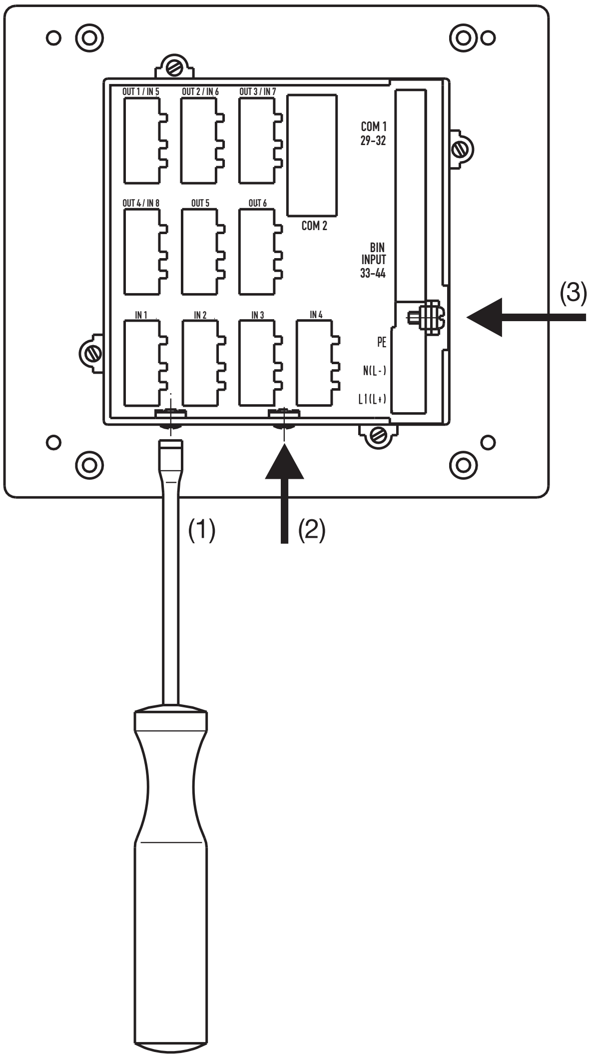
[a] The instrument is fitted from device software version 162.04.01 on with a new type of analog input card. If analog input cards are retrofitted, it must be noted that they cannot be operated together with the older type of card (i.e. do not mix card types).
Please note also that an update of the setup program may be required in order to carry out the configuration through the setup program.
The device software version (version number) can be read out from the instrument in the “Device info” menu.
The nameplate can also be used to determine whether the new analog input modules have been fitted to the instrument (see Chapter 2.3 “Nameplate”).

[b] The boards for the 0/22 V logic output and the supply for a two-wire transmitter are identical, and are detected by the instrument and the setup program as “Logic output 0/22 V”.

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

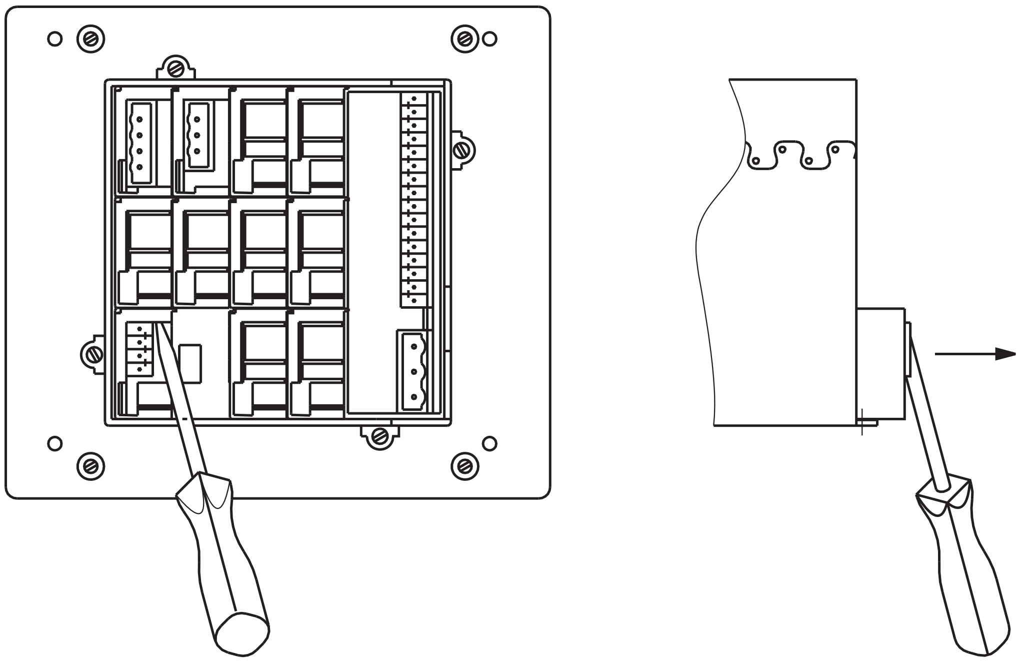
The slots for the individual modules are printed on the back panel of the housing:

Slot	Module	Function
IN 1 to IN 8	Universal input	Analog input 1 to Analog input 4
OUT 1 to OUT 6	Outputs	Output 1+7[a] to Output 6+12[a]
COM 2	RS422/485 PROFIBUS DP	Interface 2

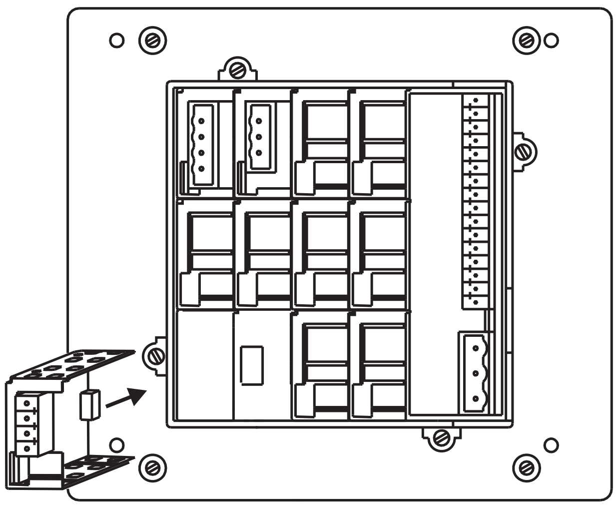
[a] Number of output, if two outputs are available on the board

Retrofitting of modules

* Remove dummy module or existing module by using a screwdriver, for example



* 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
  Mount screws correctly with shake-proof washers, since they ensure the protective earth (PE) function (tightening torque: 100 — 120 Ncm).

10.1 Technical data

Thermocouple input

Designation		Measurement range	Meas. accuracy[a]	Ambient temperature error
Fe-Con L		-200 to +900 °C	≤ 0.25 %	100 ppm / °C
Fe-Con J	EN 60584	-200 to +1200 °C	≤ 0.25 %	100 ppm / °C
Fe-Con U		-200 to +600 °C	≤ 0.25 %	100 ppm / °C
Cu-Con T	EN 60584	-200 to +400 °C	≤ 0.25 %	100 ppm / °C
NiCr-Ni K	EN 60584	-200 to +1372 °C	≤ 0.25 %	100 ppm / °C
NiCr-Con E	EN 60584	-200 to +915 °C	≤ 0.25 %	100 ppm / °C
NiCrSi-NiSi N	EN 60584	-100 to +1300 °C	≤ 0.25 %	100 ppm / °C
Pt10Rh-Pt S	EN 60584	0 to 1768 °C	≤ 0.25 %	100 ppm / °C
Pt13Rh-Pt R	EN 60584	0 to 1768 °C	≤ 0.25 %	100 ppm / °C
Pt30Rh-Pt6Rh B	EN 60584	0 to 1820 °C	≤ 0.25 %[b]	100 ppm / °C
W5Re-W26Re C		0 to 2320 °C	≤ 0.25 %	100 ppm / °C
W3Re-W25Re D		0 to 2495 °C	≤ 0.25 %	100 ppm / °C
W3Re-W26Re		0 to 2400 °C	≤ 0.25 %	100 ppm / °C
Cold junction		Pt100 internal, external, or constant		

[a] With 250 msec sampling time
[b] Within range 300 to 1820 °C

Input for resistance thermometer

Designation		Connection circuit	Measurement range	Meas. accuracy[a]	Ambient temperature error
Pt100	EN 60751	Two-wire/three-wire	-200 to +850 °C	≤ 0.05 %	50 ppm / °C
Pt50, 500, 1000	EN 60751	Three-wire	-200 to +850 °C	≤ 0.1 %	50 ppm / °C
Cu50		Three-wire	-50 to +200 °C	≤ 0.1 %	50 ppm / °C
Ni100	DIN 43760	Two-wire/three-wire	-60 to +250 °C	≤ 0.05 %	50 ppm / °C
KTY11-6		Three-wire	-50 to +150 °C	≤ 1.0 %	50 ppm / °C
PtK9		Three-wire	lithium-chloride transducer		
Sensor lead resistance		max. 30 Ω per lead for 2-wire or 3-wire circuit			
Meas. current		250 µA			
Lead compensation		Is not required for a three-wire circuit. With a two-wire circuit, the lead resistance can be compensated in software by a correction of the process value.			

[a] With 250 msec sampling time

Input for standard signals

Designation	Measurement range	Meas. accuracy[a]	Ambient temperature error
Voltage	0 to 10 V -10 to +10 V -1 to +1 V 0 to +1 V 0 to 100 mV -100 to +100 mV Input resistance R_{IN} >100 kΩ	≤ 0.2 % ≤ 0.2 % ≤ 0.1 % ≤ 0.1 % ≤ 0.1 % ≤ 0.1 %	100 ppm / °C 100 ppm / °C 100 ppm / °C 100 ppm / °C 100 ppm / °C 100 ppm / °C
C-level	0 to 2 V Input resistance R_{IN} >7.5 MΩ	≤ 0.1 %	100 ppm / °C
Current	4 to 20 mA, voltage drop ≤ 1 V 0 to 20 mA, voltage drop ≤ 1 V (max. current load = 50 mA)	≤ 0.1 % ≤ 0.1 %	100 ppm / °C 100 ppm / °C
Heater current	AC 0 to 50 mA	≤ 1 %	100 ppm / °C
Potentiometer	min. 100 Ω, max. 4 kΩ		

[a] With 250 msec sampling time

Standard version

Logic inputs

Floating contacts	

Measurement circuit monitoring

In the event of a 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 20mA 0 to 20mA	● ●	● -	● -

• = recognized - = not recognized

Outputs

Relay contact rating contact life	changeover contact, or 2 x make 3 A at AC 250 V resistive load 150,000 operations at rated load (with 2 x make, the supply circuits ≥ AC 48 V cannot be combined on one board with SELV circuitry!)		
Logic current limiting	0/14 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 or 2 to 10 V R_{load} ≥ 500 Ω		
Current output signals load resistance	0 to 20 mA or 4 to 20 mA R_{load} ≤ 450 Ω		
Supply voltage for 2-wire transmitter voltage current	22 V 30 mA		

Controller

Controller type	two-state controller, three-state controller, modulating controller, continuous controller, continuous 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 × 240 pixels
Size (screen diagonal)	5" (12.7 cm)
Type	TFT screen with LED backlighting
No. of colors	27 colors

Electrical data

Supply voltage (switchmode PSU)	AC 110 to 240 V +10/-15 % 48 to 63 Hz AC/DC 20 to 30 V 48 to 63 Hz (only for operation in SELV or PELV current circuits)
Electrical safety	to EN 61010, Part 1 overvoltage category III, pollution degree 2
Power consumption	max. 30 VA
Data backup	flash memory
Data buffering	battery (restart data/start conditions of program controller/clock time)
Electrical connection	at rear, via plug-in screw terminals conductor cross-section max. 2.5 mm^2 with core ferrules (length: 10 mm)
Electromagnetic compatibility interference emission interference immunity	EN 61326 Class A - only for industrial use to industrial requirements

Housing

Housing type	housing and back panel: metal for mounting in control panels/switchgear cabinets (indoor use) to IEC 61554
Front bezel	plastic to UL 94 V0, 144 mm × 130 mm
Mounting depth	170 mm
Panel cut-out	$92^{+0.8} \times 92^{+0.8}$ mm
Ambient/storage temperature range	-5 to 50 °C/-40 to +70 °C
Climatic conditions	rel. humidity ≤ 75 % annual mean, no condensation
Site altitude	up to 2000 m above sea level
Operating position	horizontal
Enclosure protection	to EN 60529 front IP65/rear IP20
Weight (fully fitted)	approx. 1400 g
Membrane keypad	polyester film, resistant to normal washing and cleaning agents

Interface (COM 1)

Interface type	PC interface or RS422/485
Protocol	Modbus
Baud rate	9600, 19200, 38400
Device address	1 to 255
Minimum response time	0 to 500 msec

Interface (COM 2)

Modbus

Interface type	RS422/485
Protocol	Modbus
Baud rate	9600. 19200, 38400
Device address	1 to 254
Minimum response time	0 to 500 msec

Profibus

Device address	1 to 128

Approvals/marks of conformity

Mark of conformity	Testing laboratory	Certificates / certification numbers	Test basis	valid for
c UL us	Underwriters Laboratories	E201387	UL 61010-1 UL 50 - Type 1 CAN/CSA-C22.2 No. 61010-1	703590/...

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