JUMO dTRON 316

JUMO dTRON 308

JUMO dTRON 308

JUMO dTRON 304

JUMO dTRON 304
JUMO dTRON 308
JUMO dTRON 316

Compact Controller
with program function

B 70.3041.0

Operating Manual

06.05/00442056

Please read this Operating Manual before commissioning the instrument. Keep the manual in a place which is accessible to all users at all times.

Please assist us to improve this operating manual. Your comments will be appreciated.

Phone +49 661 6003-0
Fax +49 661 6003-607

All necessary settings are described in this operating manual. If any difficulties should still arise during start-up, please do not 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.

When returning modules, assemblies or components, the regulations of EN 100 015 “Protection of electrostatic sensitive devices” must be observed. Only use the appropriate **ESD** packaging for transport.

Please note that we can not accept any liability for damage caused by ESD.

ESD = electrostatic discharge

Contents

Contents

1.1 Description

The controller series consists of four freely programmable instruments in different DIN formats for controlling temperature, pressure and other process variables. The high-contrast, multicolor LCD display for process value, setpoint and operator prompting contains two four-digit 7-segment displays, two single-character 16-segment displays, display of the active setpoints, six status indicators, and displays for the unit, ramp function and manual operation.

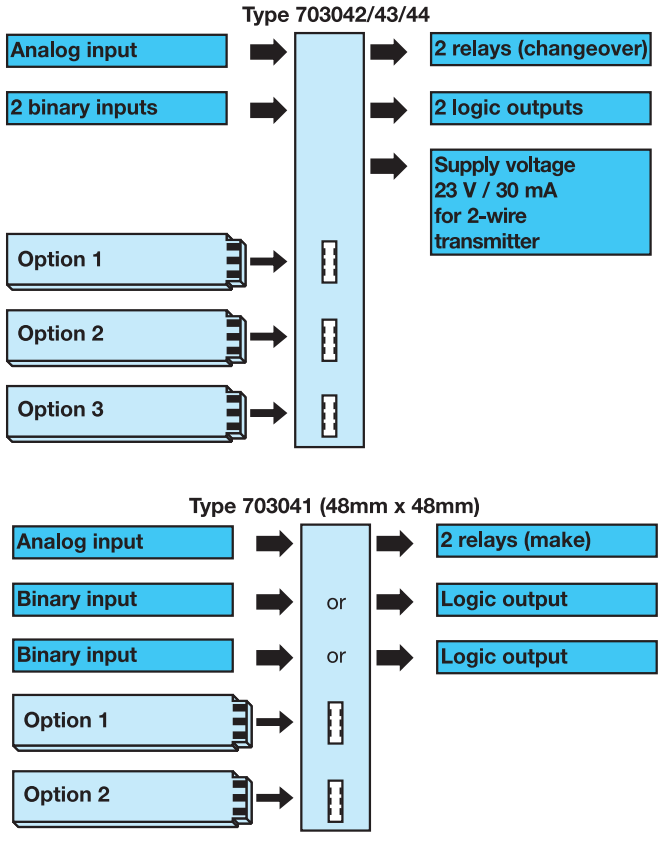
Just four keys on the front panel are needed for operation, parameterization and configuration. The instruments can be used as 2-state, 3-state, modulating or continuous controllers. The controller software includes a program or ramp function, parameter set changeover, autotuning (self-optimization), a math and logic module, as well as 4 limit comparators.

Linearizations for the usual transducers are stored, and a customer-specific linearization table can be programmed.

A setup program is available for user-friendly configuration from a PC.

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

The electrical connection is made at the back of the instrument, via 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 instructions, chapters or sections.

***** **Action instruction**

This symbol indicates that an action to be performed is described.

The individual steps are marked by this asterisk, e.g.

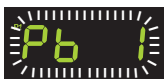
* Press EXIT

Representation

Menu items

Texts from the setup program are shown in italics, for example: *edit program.*

Blinking display



2.1 Type designation

	Basic type
703041	Type 703041, format 48mm x 48mm incl. 1 analog input, 2 relay outputs and 2 binary inputs or 2 logic outputs
703042	Type 703042, format 48mm x 96mm (portrait format) incl. 1 analog and 2 binary inputs, 2 relays and 2 logic outputs
703043	Type 703043, format 96mm x 48mm (landscape format) incl. 1 analog and 2 binary inputs, 2 relays and 2 logic outputs
703044	Type 703044, format 96mm x 96mm incl. 1 analog and 2 binary inputs, 2 relays and 2 logic outputs

			Basic type extensions
1			**Basic type 1**
			Version
	8		standard, with factory settings
	9		programming to customer specification
			logic outputs (2 are available as standard)
		1	0 / 12V
		2	0 / 18V

				Type 703042/43/44		Type 703041 (no option 3)		
1.	**2.**	**3.**	**Option slot**	**Max. number**		**Max. number**	**Option 1**	**Option 2**
0	0	0	not used				X	X
1	1	1	analog input 2 (universal)	1		1	X	X
2	2	2	relay (changeover)	2		1	X	-
3	3	3	2 relays (make contact)	2		1	X	-
4	4	4	analog output	2		2	X	X
5	5	5	2 binary inputs	2		1	X	X
6	6	6	solid-state relay 1A	2		2	X	X
7	7	7	RS422/485 interface	1		1	X	X
8	8	8	Profibus-DP interface	1		1	X	X

X = available in this option slot, - = not available in this option slot

		Supply
2	3	110 — 240V AC -15/+10%, 48 — 63Hz
2	5	20 — 53V AC/DC, 48 — 63Hz

			Extra codes
0	0	0	none
2	1	4	math and logic module
2	1	7	ratio controller (requirement: 2 analog inputs)
2	1	8	difference controller (requirement: 2 analog inputs)
2	1	9	humidity controller (requirement: 2 analog inputs)

			Approvals
0	0	0	none
0	6	1	Underwriters Laboratories Inc. (UL)

/ 1 – – / ,

703041 / 1 8 1 – 1 4 0 – 2 3 / 0 0 0 , 0 6 1

2 Identifying the instrument version

2.2 Scope of delivery

- 1 controller
- 1 seal
- mounting brackets
- brief operating instructions
- 1 CD including DEMO-software & operating manuals as pdf-file
  (Actual DEMO-software can be downloaded at www.JUMO.net.
  To enable DEMO-software to full rights, contact your local JUMO subsidiary.)

2.3 Accessories

PC interface

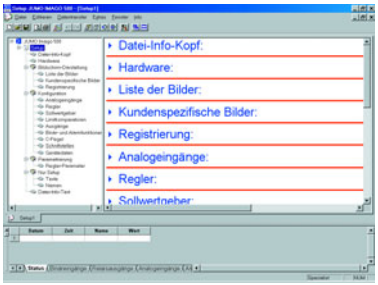
PC interface with TTL/RS232 converter and adapter (socket connector) for setup program
Sales No. 70/00350260

Setup programs

Versions:

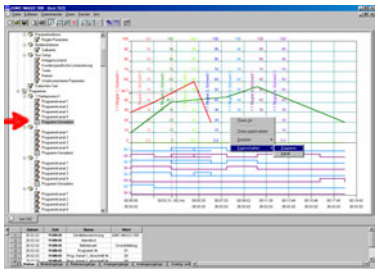
Setup program with program editor[1]
Sales No. 70/00445417

Setup program with program editor and startup[1]
Sales No. 70/00445443



Program editor

Program editor (software)[1]
Sales No. 70/00445444



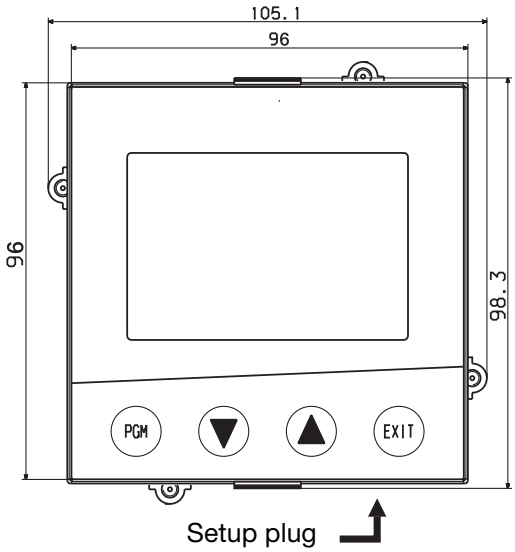
1. Requirements: Windows® 98/NT4.0/ME/2000/XP, PC Pentium II, 128 Mbyte RAM, 30 Mbyte free on hard disk, CD-ROM, one free serial interface

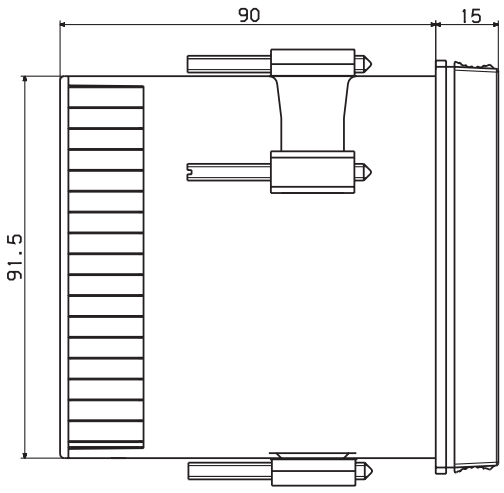
3.1 Mounting site and climatic conditions

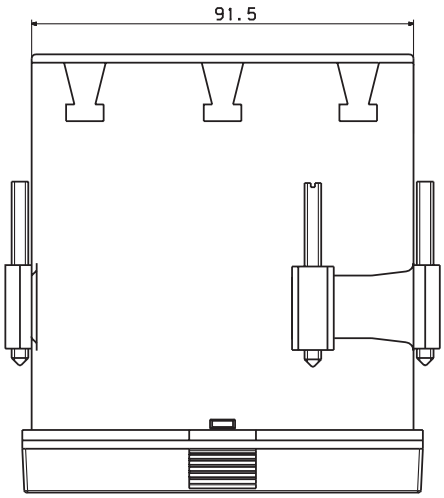
The conditions on the mounting site must meet the requirements specified in the technical data. The ambient temperature on the mounting site can be from 0 to 55 °C, with a relative humidity of not more than 90 %.

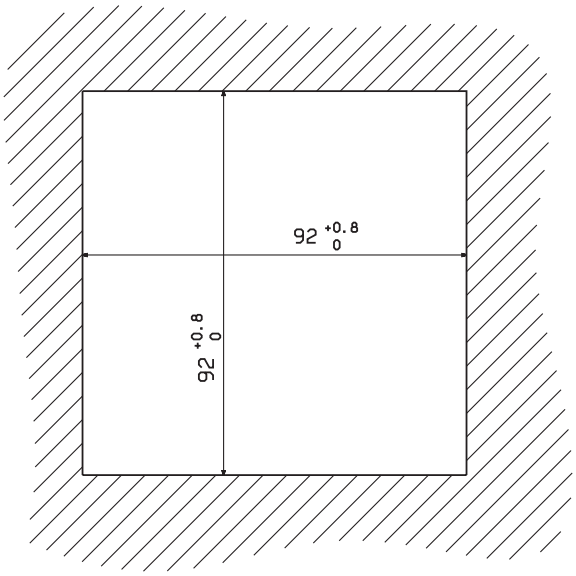
3.2 Dimensions

3.2.1 Type 703044



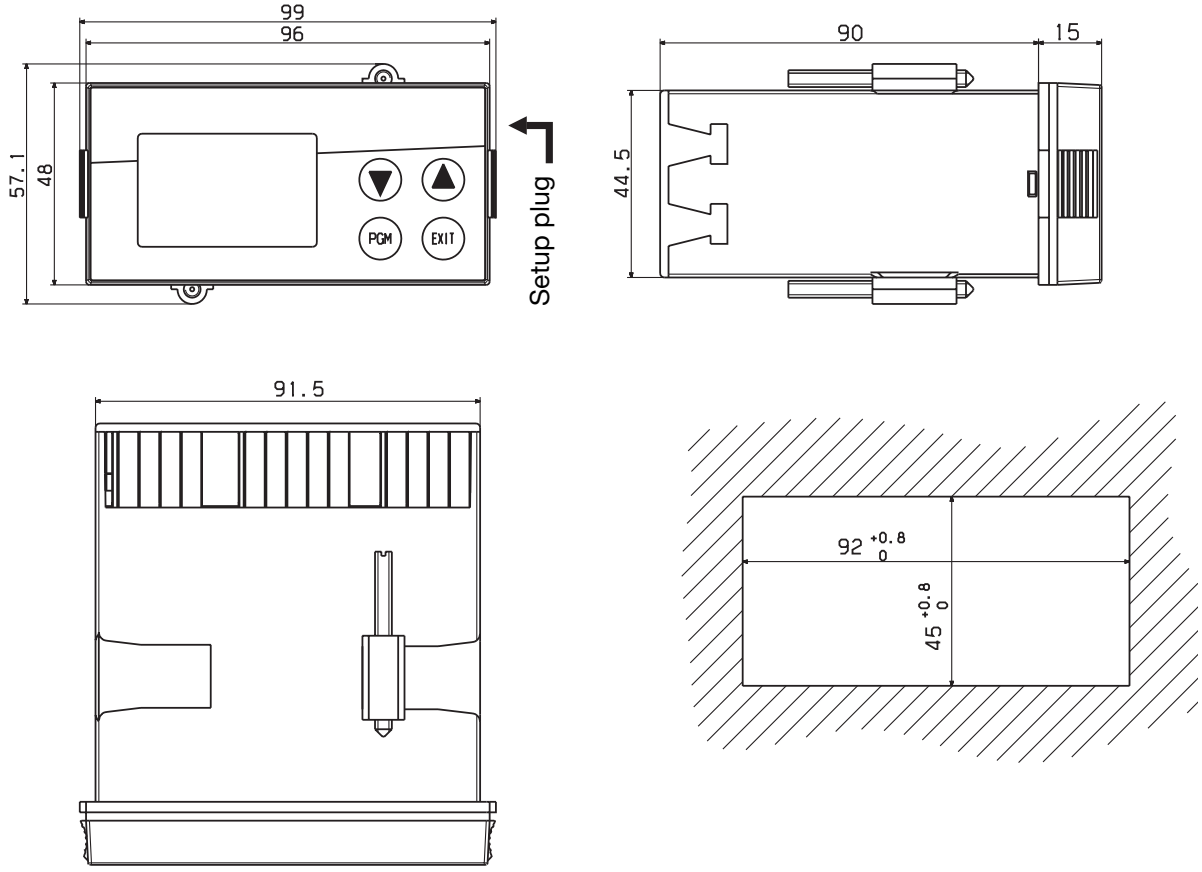




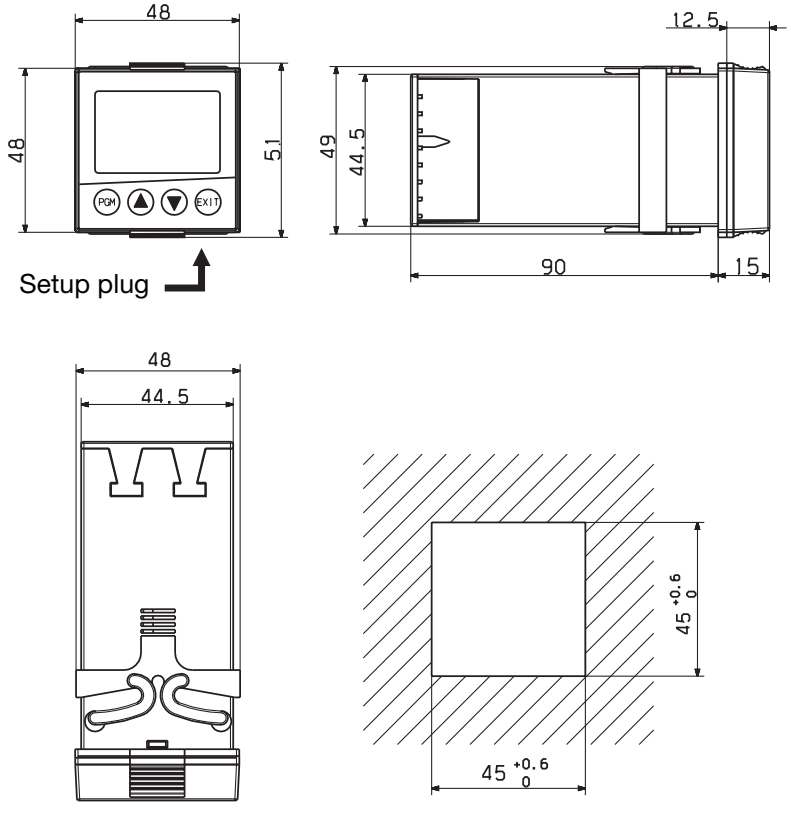


3 Mounting

3.2.2 Type 703042/43



3.2.3 Type 703041



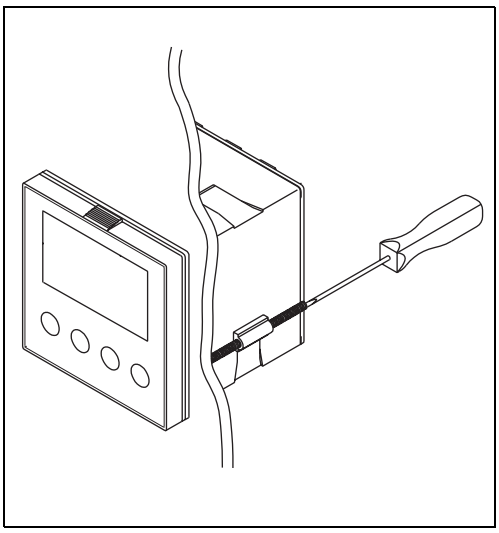
3.3 Side-by-side mounting

Minimum spacing of panel cut-outs		
Type	horizontal	vertical
without setup plug:		
703041 (48mm x 48mm)	11mm	30mm
703042 (portrait format: 48mm x 96mm))	11mm	30mm
703043 (landscape format: 96mm x 48mm)	30mm	11mm
703044 (96mm x 96mm)	11mm	30mm
with setup plug (see arrow):		
703041 (48mm x 48mm)	11mm	65mm
703042 (portrait format: 48mm x 96mm))	11mm	65mm
703043 (landscape format: 96mm x 48mm)	65mm	11mm
703044 (96mm x 96mm)	11mm	65mm

3.4 Fitting in position

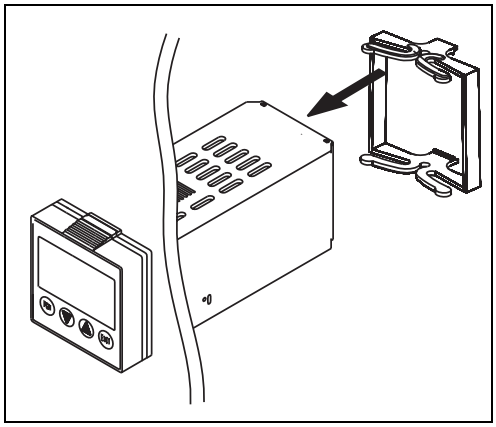
Type 703042/43/44

* Fit the seal that is supplied onto the instrument body.
* Insert the controller 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.



Type 703041

* Fit the seal that is supplied onto the instrument body.
* Insert the controller from the front into the panel cut-out.
* From the back of the panel, push the mounting frame onto the instrument body and press it against the back of the panel, compressing the springs, until the latches snap into the notches provided and it is firmly fixed in position.



Care of the front panel

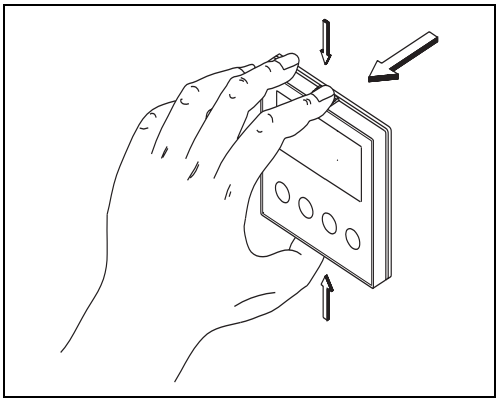
The front panel can be cleaned with normal commercial washing, rinsing and cleaning agents. It has a limited resistance to organic solvents (e.g. methylated spirits, white spirit, P1, xylol etc.). Do not use high-pressure cleaning equipment.

3 Mounting

3.5 Removing the controller module

The controller module can be removed from its housing for servicing.

* Press together the knurled areas (top and bottom, or left and right for landscape format) and pull out the controller module.



When inserting the controller module, make sure that the latches (below the knurled areas) snap into place.

4.1 Installation notes

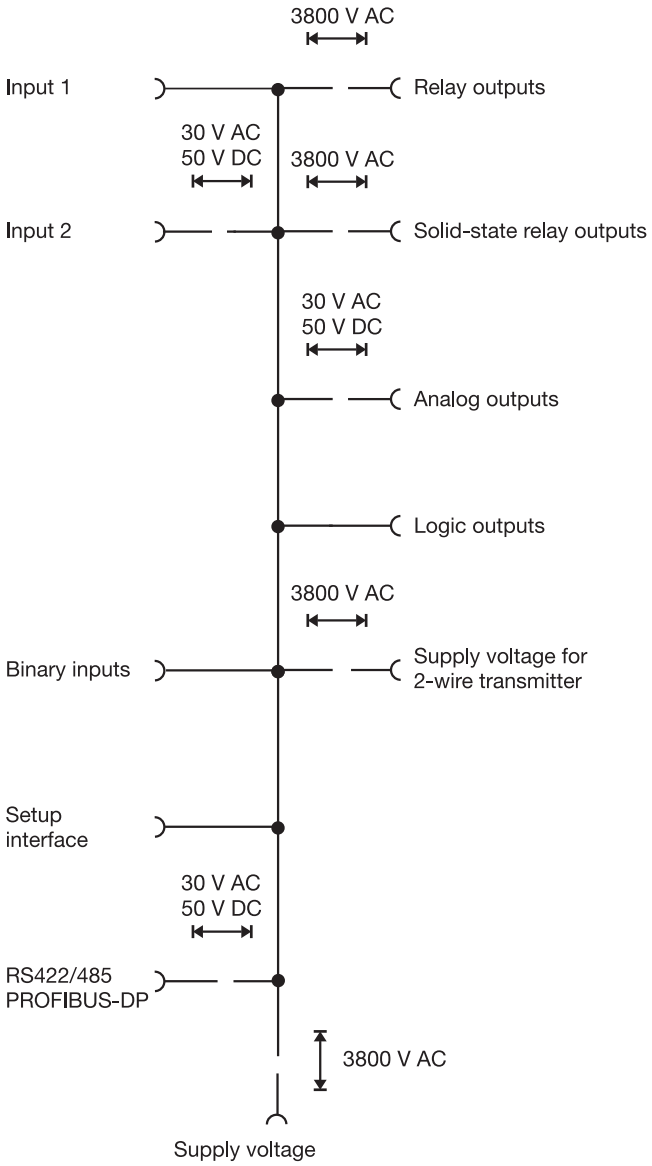
- The choice of cable, the installation and the electrical connection must conform to the requirements of VDE 0100 “Regulations on the Installation of Power Circuits with Nominal Voltages below 1000 V” or the appropriate local regulations.
- The electrical connection must only be carried out by qualified personnel.
- If contact with live parts is possible while working on the unit, it must be disconnected from the supply on both poles.
- A fuse interrupts the supply circuit in the event of a short-circuit. The load circuit must be fused for the maximum relay current, in order to prevent the output relay contacts becoming welded in the event of a short circuit.
- Electromagnetic compatibility conforms to the standards and regulations cited in the technical data.

⇨ Chapter 12.1 “Technical data”

- Run input, output and supply cables separately and not parallel to one another.
- Sensor and interface cables should be shielded cables with twisted conductors. Do not run them close to current-carrying components or cables. Ground the shielding on one side.
- 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 limiters/monitors) and only capable of adjustment by specialist personnel. Please observe the relevant safety regulations for such matters. Since adaptation (self-optimization) can not 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

4.2 Electrical isolation

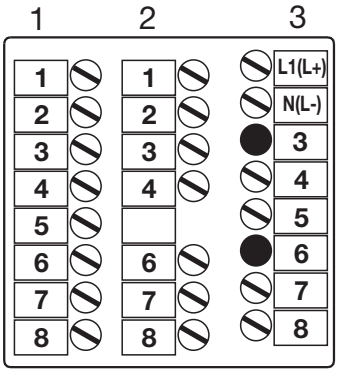


4.3 Connection diagrams

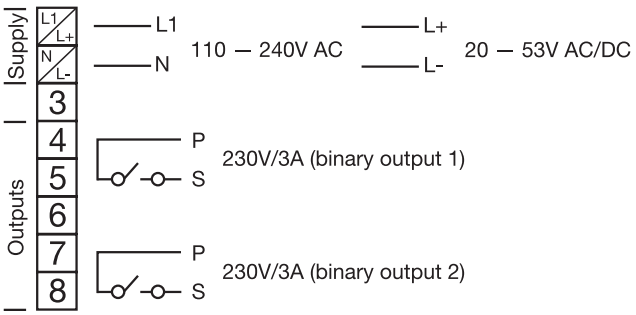
4.3.1 Type 703041

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

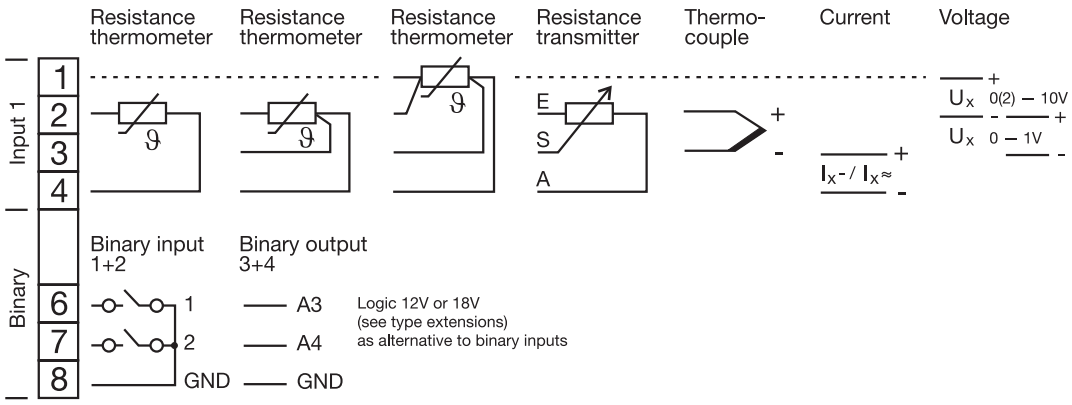
The instrument version can be identified by the typecode.



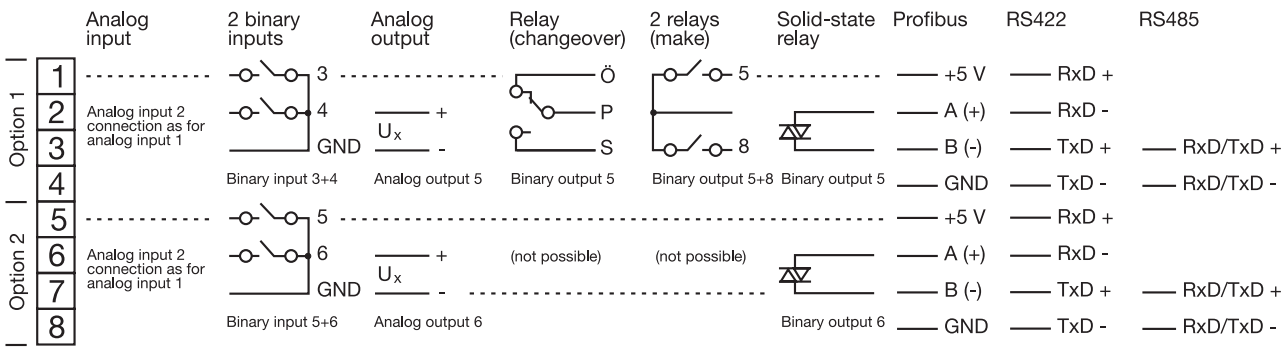
Terminal strip 3



Terminal strip 2



Terminal strip 1

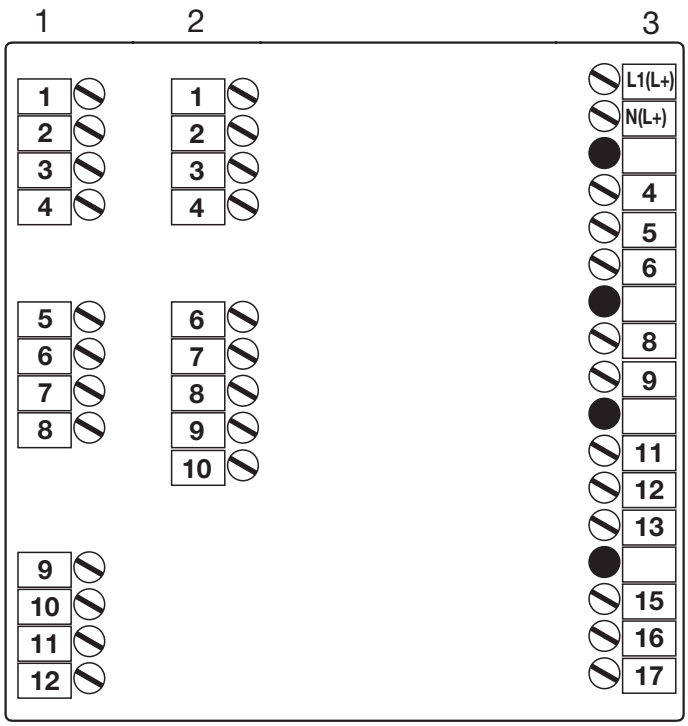


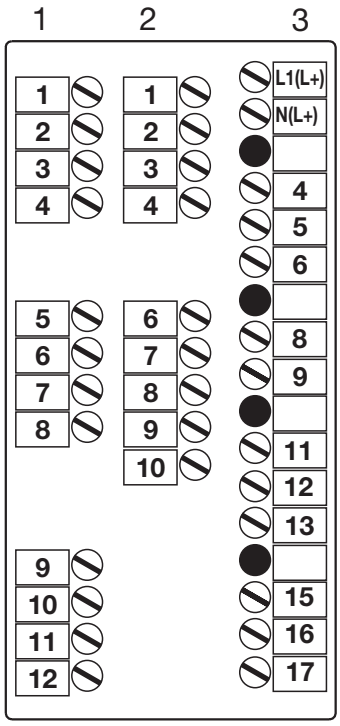
4 Electrical connection

4.3.2 Type 703042/43/44

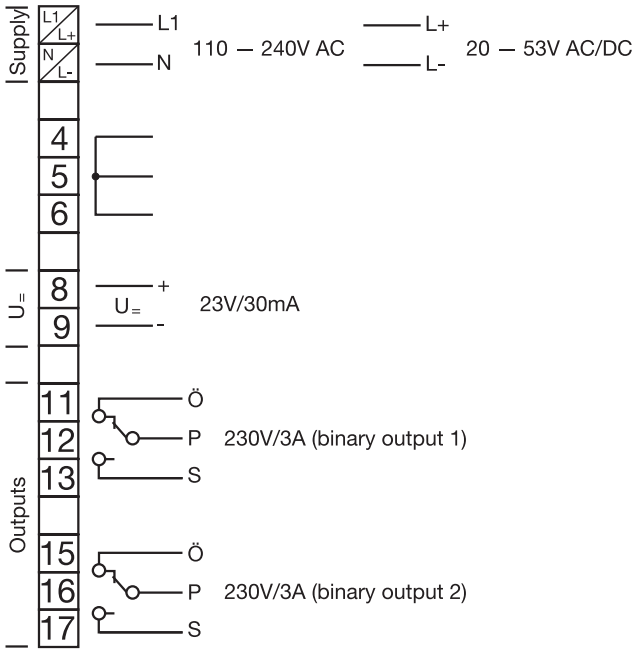
The electrical connection must only be carried out by specialist personnel.

The instrument version can be identified by the type code.

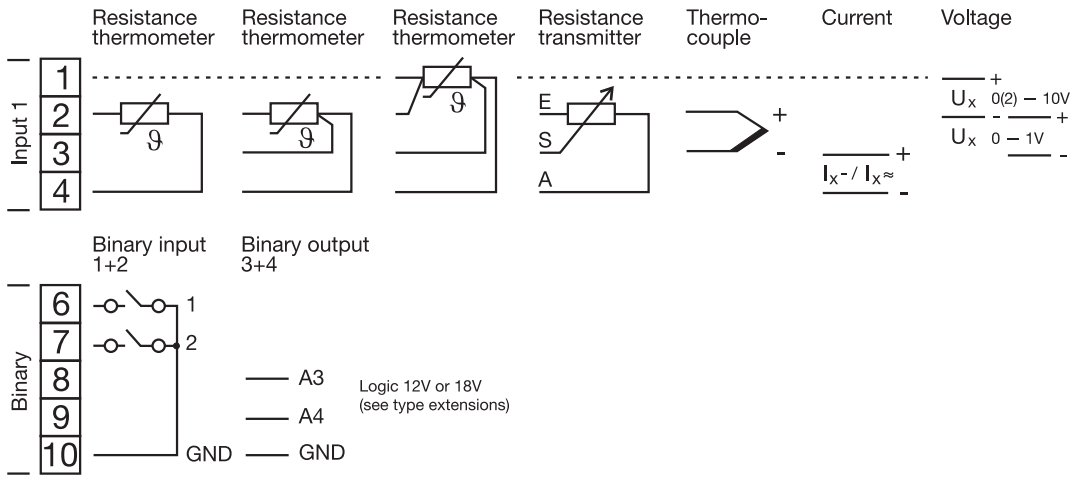




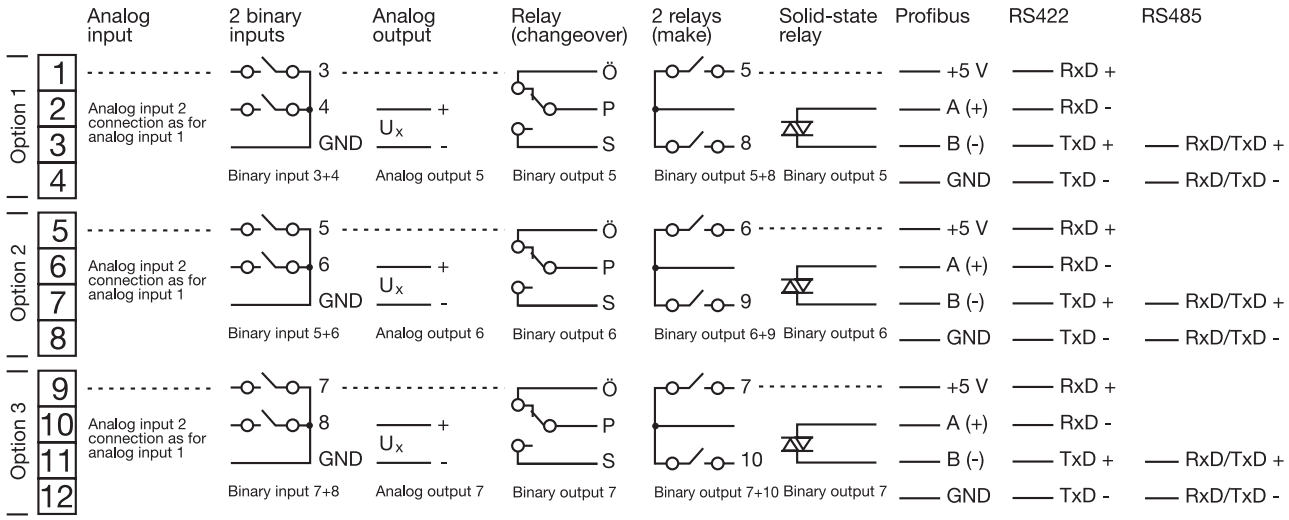
Terminal strip 3



Terminal strip 2

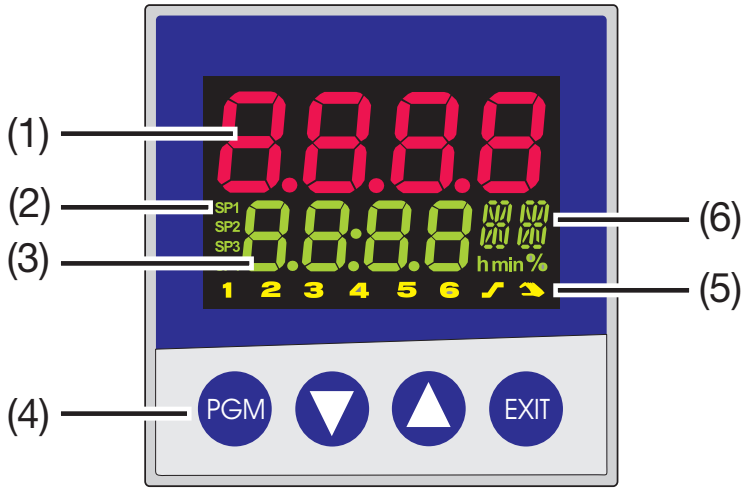


Terminal strip 1



4 Electrical connection

5.1 Displays and keys



(1)	**7-segment display** (factory setting: process value) four-digit, red, decimal place is configurable (automatic adjustment on display overflow)
(2)	**Active setpoint** (factory setting: SP1) SP1, SP2, SP3, SP4 (SP=setpoint); green;
(3)	**7-segment display** (factory setting: setpoint) four-digit, green; decimal place is configurable; also used for operator prompting (display of parameter and level symbols)
(4)	**Keys**
(5)	**Indication** yellow, for - switch status of binary outputs 1 — 6 (display lights up = on) - ramp/program function is active - manual operation is active
(6)	**16-segment display + dim. units** two-digit, green; for the unit °C/°F and symbols for h, min, % In addition, the current segment number (program), the parameter set or any two-place letter/number combination can be displayed through the setup program.

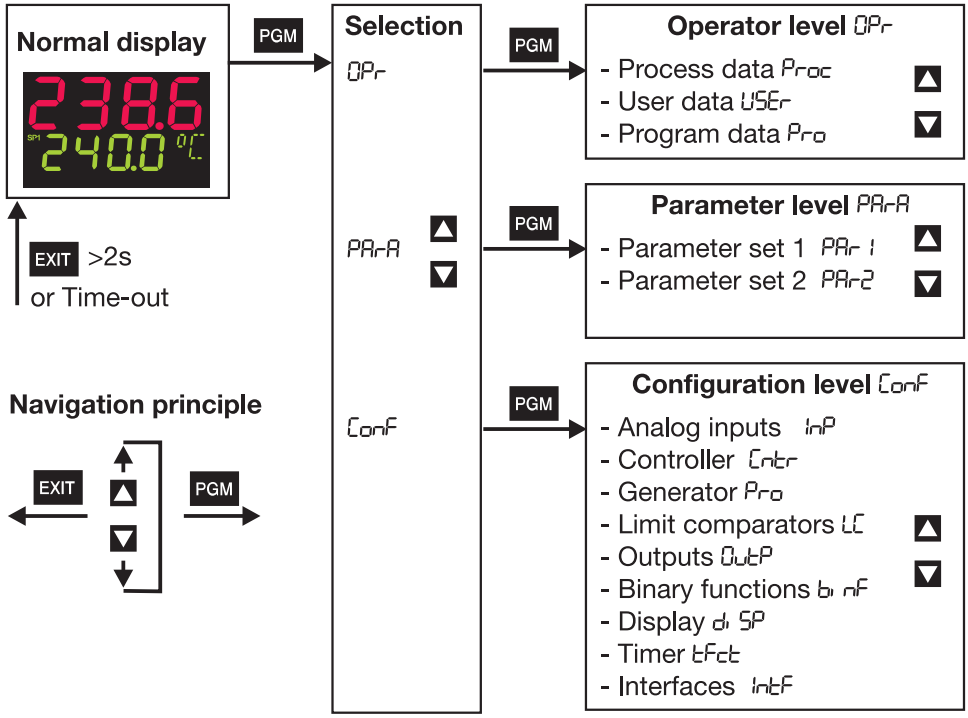
The displays are configurable.

⇨ Chapter 8.7 “Display “diSP””

5 Operation

5.2 Level concept

The parameters for making the settings on the instrument are arranged at different levels.



Time-out
If no key is pressed for 30 sec, the instrument returns to normal display.

⇨ Chapter 6 “Operator level”

⇨ Chapter 7 “Parameter level”

⇨ Chapter 8 “Configuration”

⇨ *Setup/Display - Operation/Time-out*

5.3 Level inhibit

The access to the individual levels can be prevented.

Code	Operator level	Parameter level	Configuration level
0	enabled	enabled	enabled
1	enabled	enabled	inhibited
2	enabled	inhibited	inhibited
3	inhibited	inhibited	inhibited

* Go to code entry with PGM and ▼ (simultaneously for >5 sec).
* Alter code with PGM (display blinks!)
* Enter code with ▲ and ▼. Ex-factory: all levels enabled.
* Return to normal display with EXIT or automatically after approx. 30 sec

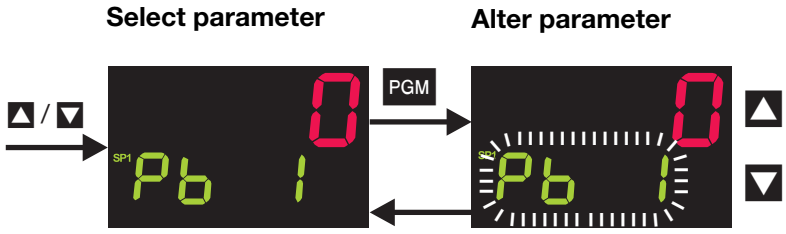
The parameter and configuration levels can also be inhibited via the binary function.

⇨ Chapter 8.6 “Binary functions “binF””

5.4 Entries and operator prompting

Entering values

When entries are made within the levels, the parameter symbol is shown in the lower display.



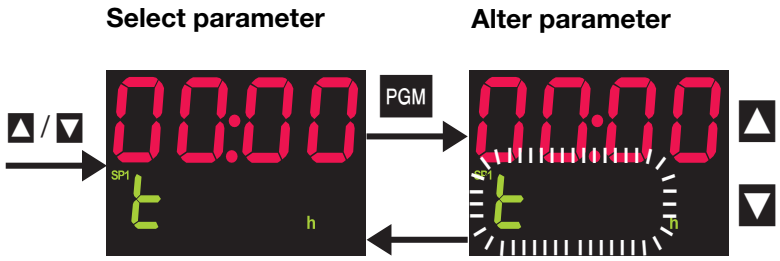
* Select parameter with ▲ or ▼
* Change to entry mode with PGM (lower display blinks!)
* Alter value with ▲ and ▼
  The value alters dynamically with the duration of the key stroke.
* Accept the setting with PGM or automatically after 2 sec

or

* Cancel entry with EXIT.
  The value is not accepted.

Entering times

When entering times (e.g. timer time), the time unit is shown in addition.



The highest time unit of the display is shown for the unit.

If, for instance, “h” is shown for the hour, then the time format for the value is hh:mm.

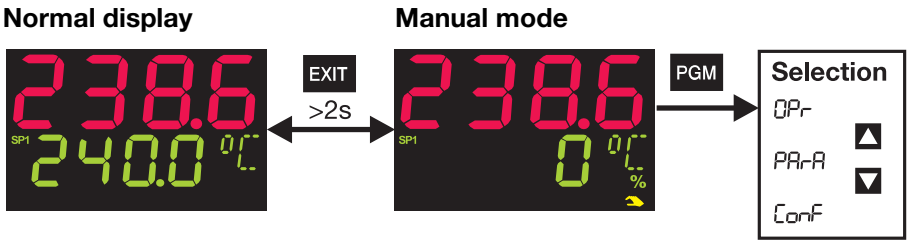
* Select parameter with ▲ or ▼
* Change over to the entry mode using PGM (lower display blinks!)
* Alter value with ▲ and ▼
  The value alters dynamically with the duration of the key stroke.
* Accept the setting with PGM or automatically after 2 sec

or

* Cancel entry with EXIT.
  The value is not accepted.

5 Operation

5.5 Operation of the fixed-setpoint controller



Altering the setpoint

In normal display:

* Alter the present setpoint with ▲ and ▼ (the value is accepted automatically)

Manual mode

In manual mode, the controller output can be altered by hand.

* Change to manual mode with EXIT (press for more than 2 seconds)

The output appears in the lower display. The hand symbol and the unit “%” light up in addition.

* Alter the output with ▲ and ▼

In the case of a modulating controller, the actuator is opened or closed using the keys.

The various levels can be accessed from the manual mode.

* Return to the normal display with EXIT (press for more than 2 seconds)

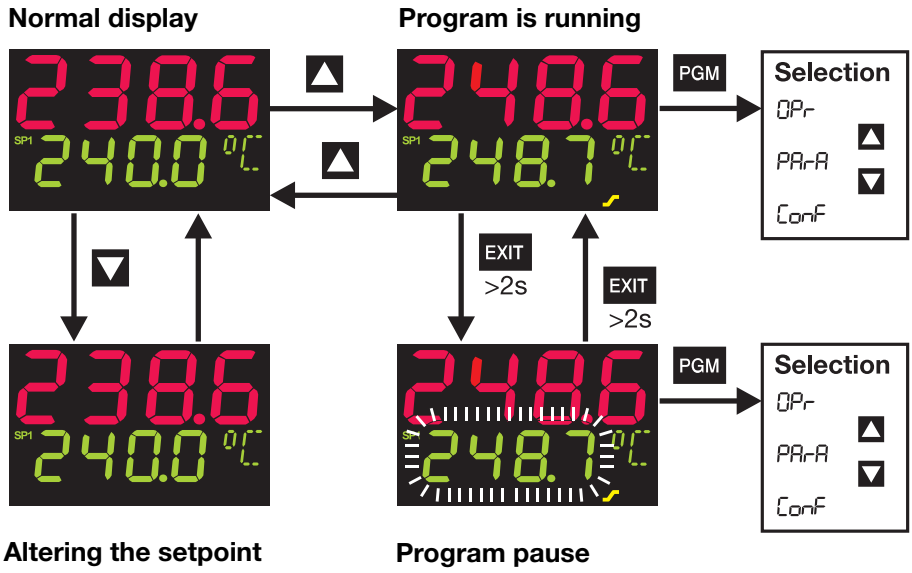
The output entry on a changeover is configurable. The manual mode can be inhibited.

⇨ Chapter 8.2 “Controller “Cntr””

Additional operating options for the fixed-setpoint controller can be implemented via the binary functions.

⇨ Chapter 8.6 “Binary functions “binF””

5.6 Operation of the program controller



Normal display

No program run in normal display, the controller controls to the selected setpoint.

Altering the setpoint

From normal display:

* Change to setpoint input with ▼
* Alter the present setpoint with ▲ and ▼
  (the value is accepted automatically)

Starting the program

From normal display:

* Start program with ▲
  (the ramp symbol lights up!)

A delay time can be configured through the setup program. When the delay time has elapsed, "Strt" is shown in the lower display, and then the program is processed.

Canceling the program

When the program is running:

* Cancel program with ▲

Pausing the program

When the program is running:

* Pause program with EXIT (press for more than 2 seconds)
  (the lower display blinks!)
* Continue with EXIT (press for more than 2 seconds)

The program is canceled in the event of a power failure.

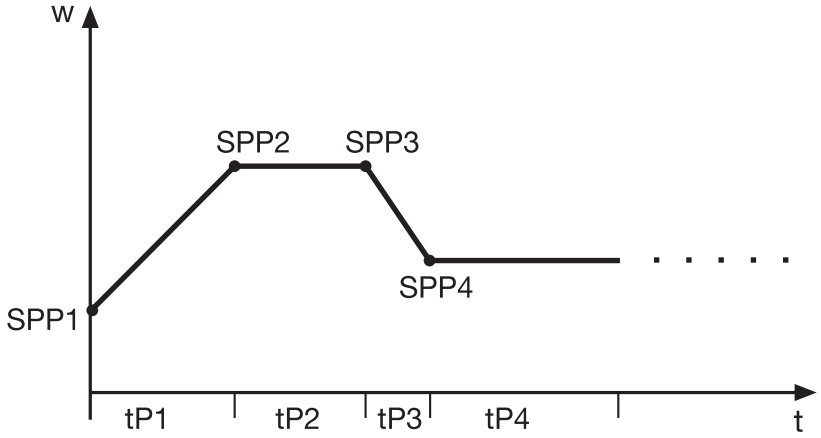
Additional program control functions via binary functions.

⇨ Chapter 8.6 "Binary functions "binF""

5.6.1 Entering programs

Function

A setpoint profile can be implemented with a maximum of 8 program segments.



Entry on the instrument

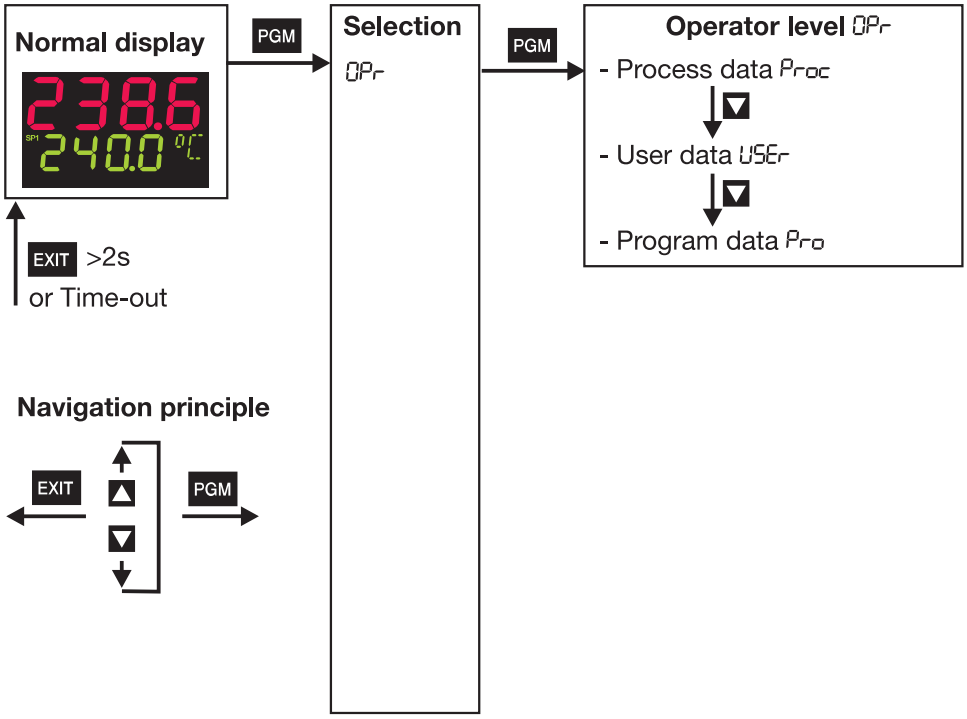
The instrument must be configured as a program controller/generator.

⇨ Chapter 8.3 “Generator “Pro”” (Function)

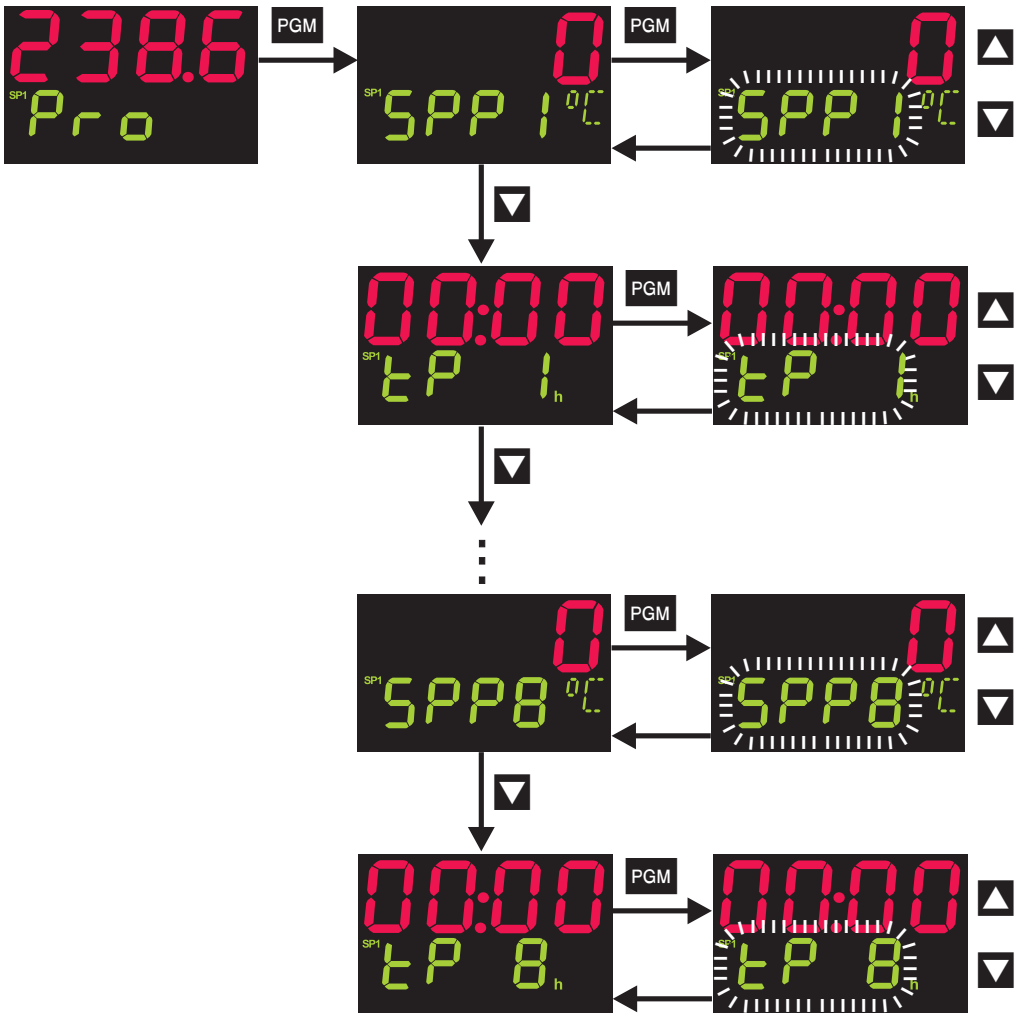
Configurable time base: mm:ss, hh:mm und dd:hh (s=seconds, m=minutes, h=hours, d=days).

⇨ Chapter 8.3 “Generator “Pro”” (unit)

The segment setpoints (SPP1 — SPP8) and segment times (tP1 — tP8) are set at the operator level (program data).



The program segments (up to eight) are defined by the segment setpoint and the segment time.



Entry through setup program

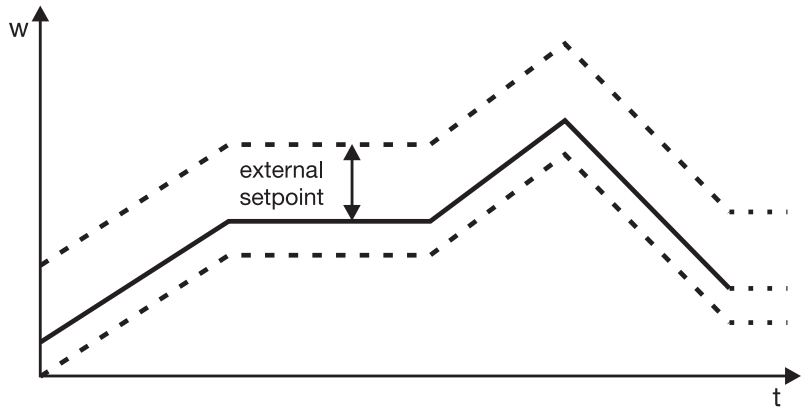
The setup program (accessory) features a user-friendly program editor, with a graphical presentation of the program profile.

Additional functions via the setup program

- Start at the process value
- Response to over/underrange
- Repeat program
- Setpoint input (ramp/step)
- Process is controlled to the most recent setpoint
- Delay time
- Program editor/management with graphical preview
- Up to four control contacts can be programmed segment by segment
- Parameter sets can be assigned segment by segment

5.6.2 Shifting the program profile

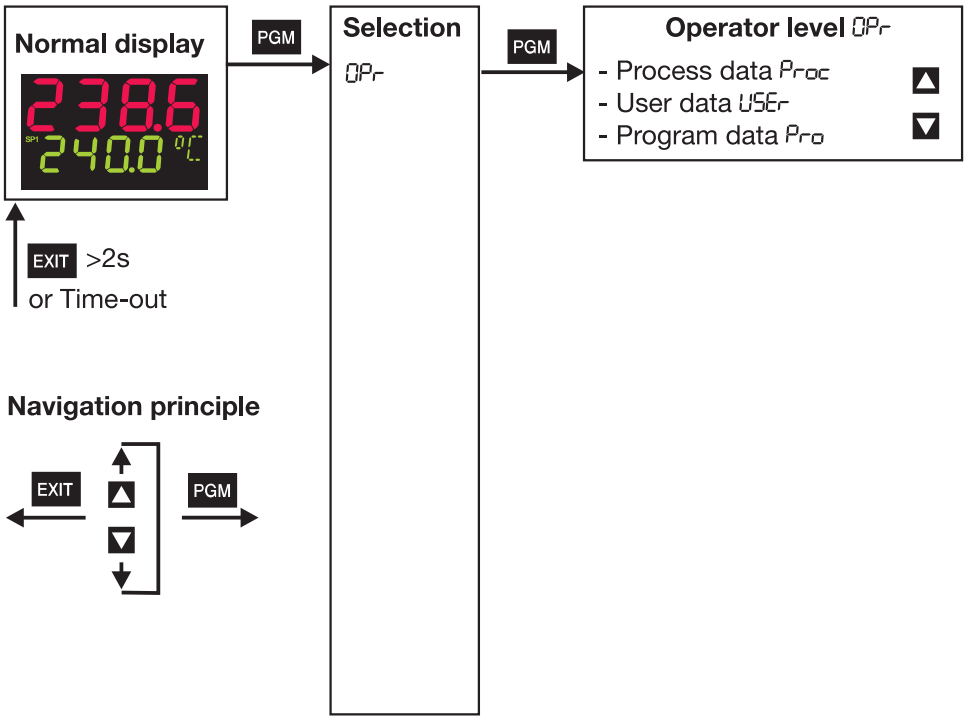
The function “External setpoint with correction” can be used to shift the program profile upwards or downwards (configurable through the setup program only).



The external setpoint is defined via an analog signal.

⇨ Chapter 8.2 “Controller “Cntr””

Access

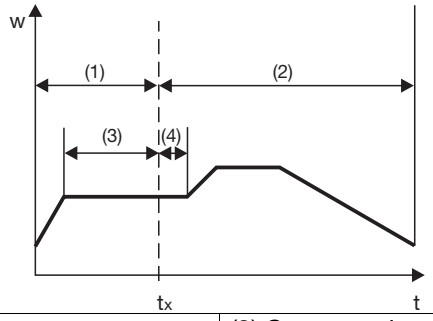


Process data "Proc"

The four setpoints are displayed and edited here, and additional process variables are shown in accordance with the configuration.

Symbol	Meaning
SP 1	Setpoint 1 (editable)
SP 2	Setpoint 2 (editable)
SP 3	Setpoint 3 (editable)
SP 4	Setpoint 4 (editable)
SPr	Ramp setpoint (only if configured)
InP 1	Measurement of analog input 1
InP2	Measurement of analog input 2 (only if available)
F 1	Calculated result of math formula 1 (only if available)
F2	Calculated result of math formula 2 (only if available)
y	Controller output
trun	Program run time (only with program controller/generator)
trES	Residual program time (only with program controller/generator)
t 1	Timer: time 1 (only if configured)
t2	Timer: time 2 (only if configured)

Definition of the program times



(1) Program time	(3) Segment time
(2) Residual program time	(4) Residual segment time

User data “USEr”

Any number of parameters (up to eight) can be displayed and edited here using the setup program.

⇨ Setup/Configuration level/Display - Operation/User data

The user himself can assign the symbol that is to be displayed for each parameter. Otherwise the standard symbol is used. Any letters and numbers are permitted that can be displayed in a 7-segment display.

Program data “Pro”

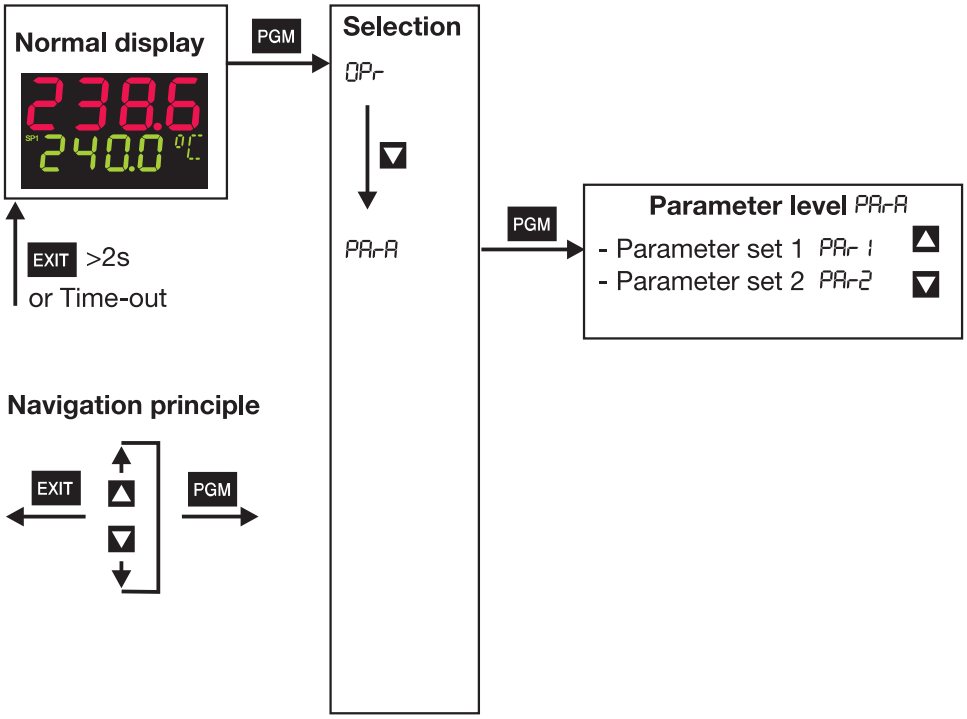
A program with up to eight segments is defined here, via the segment setpoints SPP 1 ... SPP8 and segment times tP 1 ... tP 8.

This can only be accessed when the instrument is configured as a program controller/ generator.

General

Two parameter sets (PAr1 and PAr2) can be stored.

Access



The level can be inhibited.

Applications

- Parameter set switching via binary function

⇨ Chapter 8.6 “Binary functions “binF””

- Allocating parameter sets to program segments (only through the setup program)

⇨ *Program editor/Program*

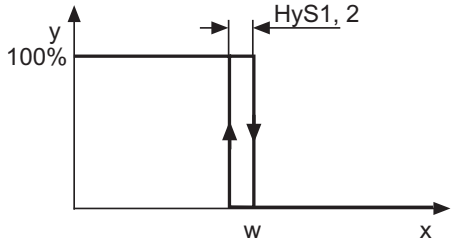
Example

Setting a 2-state controller with PI action:

Pb1=12 °C (proportional band)
rt=160 sec (reset time; I component)
dt=0 sec (derivative time, D component)

7 Parameter level

PArA → PAr 1 (PAr2)

Parameter	Display	Value range	Factory setting	Meaning
Proportional band	Pb 1	0…9999	0	Size of the proportional band The gain of the controller decreases with increasing proportional band. With Pb 1,2 = 0 the controller structure is ineffective (limit comparator response). Continuous controllers: Pb1,2 must be >0.
	Pb 2	0…9999	0	
Derivative time	dt	0…9999 s	80 s	Influences the differential component of the controller output signal The effect of the D component increases with increasing derivative time.
Reset time	rt	0…9999 s	350 s	Influences the integral component of the controller output signal The effect of the I component decreases with increasing reset time.
Actuator time	tt	5…3000 s	60 s	Actuator time range used by the control valve for modulating controllers.
Cycle time	Cy 1	0.0…999.9s	20 s	With a switched output, the cycle time should be chosen so that a) the pulsed energy flow to the process does not cause any impermissible PV fluctuations and b) the switching elements are not overloaded.
	Cy2	0.0…999.9 s	20 s	
Contact spacing	db	0.0…999.9	0	The spacing between the two control contacts for 3-state or modulating controllers.
Switching differential	HyS 1	0.0…999.9	1	Hysteresis for switching controllers with Pb1,2 = 0. 
	HyS2	0.0…999.9	1	
Working point	Y0	-100…+100%	0%	Output for P and PD controllers (when x = w then y = Y0).
Output limiting	y 1	0…100%	100%	The maximum limit for the output.
	y2	-100…+100 %	-100%	The minimum limit for the output.

The parameters Pb2, Cy2, HyS2 and y2 refer to the second controller output for a 3-state or modulating controller.

The decimal place of some parameters depends on the decimal place setting in the displays.

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

⇨ Chapter 8.2 “Controller “Cntr””

General

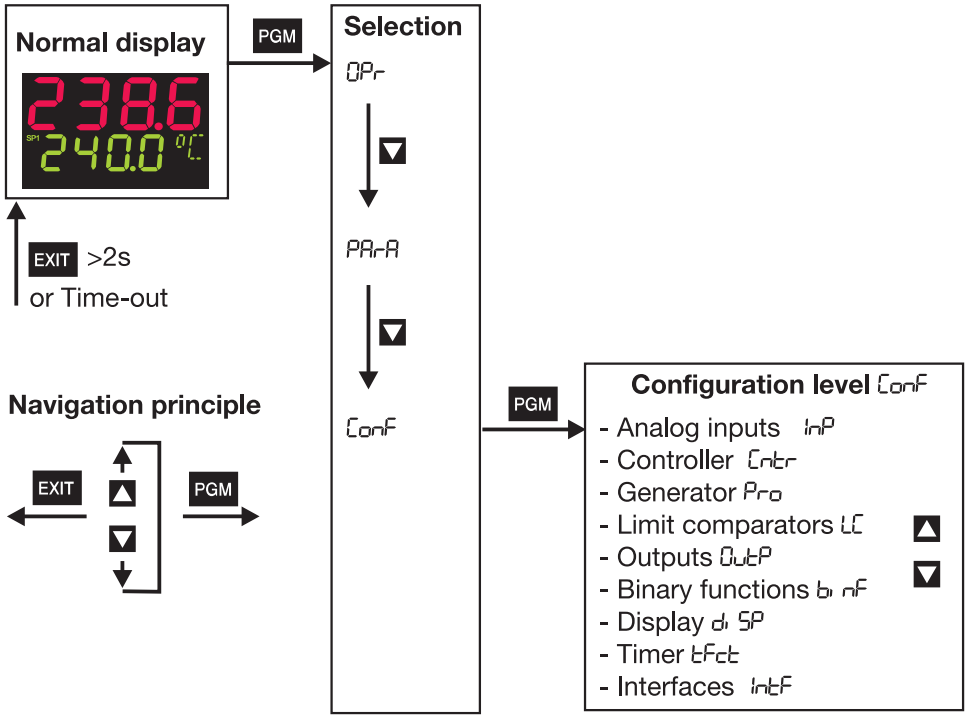
The following applies to the representation of parameters and functions at the configuration level:

The parameter is not displayed or can not be selected if

- the equipment level does not permit the function assigned to the parameter.
  Example: Analog output 2 can not be configured if
  analog output 2 is not implemented in the instrument.

Some parameters can only be programmed through the setup program. These are marked in the symbol column with “(setup)”.
The symbol (appears in the display) that corresponds to the menu item is shown in the chapter headings (e.g. 8.1 Analog inputs “InP”).

Access



Levels can be inhibited.

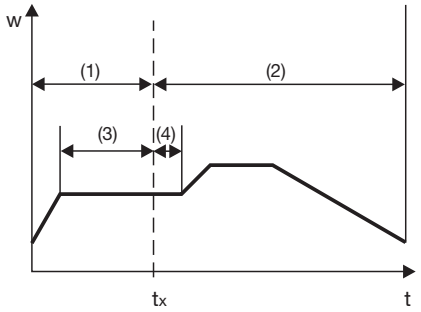
⇨ Chapter 5.3 “Level inhibit”

Analog selector

With some parameters, you can choose from a series of analog values. To provide you with an overview, this selection is listed below.

0 no function
1 analog input 1
2 analog input 2
3 process value
4 present setpoint
5 ramp end value
6 program setpoint
7 math 1
8 math 2
9 setpoint 1
10 setpoint 2
11 setpoint 3
12 setpoint 4
13 controller output level
14 controller output 1
15 controller output 2
21 program run time in sec
22 residual program time in sec
23 segment run time in sec
24 residual segment time in sec
25 timer run time for timer 1 in sec
26 timer run time for timer 2 in sec
27 residual run time for timer 1 in sec
28 residual run time for timer 2 in sec
29 present segment end value
30 analog marker (Profibus)
31 any analog value from storage address (only via setup program)
32 internal Pt100 in Ohm
33 sampling cycle time in msec

Definition of the program times



(1) Program time	(3) Segment time
(2) Residual program time	(4) Residual segment time

8.1 Analog inputs “InP”

Configuration
Analog inputs
Controller
Generator
Limit comparators
Outputs
Binary functions
Display
Timer
Interfaces

Depending on the instrument version, up to two analog inputs are available.

Analog input 1 InP 1 →
Analog input 2 InP2 →

Symbol	Value/selection	Description
Sensor type SEnS	0	no function
	1	**Resistance thermometer in 3-wire circuit**
	2	Resistance thermometer in 2-wire circuit
	3	Resistance thermometer in 4-wire circuit
	4	Thermocouple
	5	Resistance transmitter
	6	Heater current 0 — 50 mA AC (analog input 2 only)
	7	0 — 20 mA
	8	4 — 20 mA
	9	0 — 10 V
	10	2 — 10 V
	11	0 — 1 V
		factory-set on analog input 2: no function
Linearization Lin	0	Linear
	1	**Pt100**
	2	Pt500
	3	Pt1000
	4	KTY11-6
	5	W5Re_W26Re C
	6	W3Re_W25Re D
	7	NiCr-Con E
	8	Cu-Con T
	9	Fe-Con J
	10	Cu-Con U
	11	Fe-Con L
	12	NiCr-Ni K
	13	Pt10Rh-Pt S
	14	Pt13Rh-Pt R
	15	Pt30Rh-Pt6Rh B
	16	NiCrSi-NiSi N
	17	W3Re_W26Re
	18	customized linearization
		For customized linearization, a maximum of 10 knee-points can be implemented, or a 5th order polynomial function programmed (only through the setup program).
		For the linearization “KTY11-6”, the resistance is 2 kΩ at 25 °C (only through the setup program).

Factory settings are shown **bold**.

8 Configuration

Analog input 1 InP 1 →
Analog input 2 InP2 →

	Symbol	Value/selection	Description
Measurement offset	OFFS	-1999…**0**… +9999	The measurement 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 calculation. This value is not the same as the actually measured value. If incorrectly applied, this can result in impermissible values of the control variable. Special case: 2-wire circuit If the input is connected to a resistance thermometer in 2-wire circuit, then the lead resistance is set in ohms here.
Display start	SCL	-1999…**0**…+9999	On transducers with standard signal and on potentiometers, a display value is assigned to the physical signal. Example: 0 — 20mA ≙ 0 — 1500°C. The range of the physical signal can be 20 % wider or narrower without generating an out-of-range signal.
Display end	SCH	-1999…**100**…+9999	
Filter time constant	dF	0…**0.6**…100 s	To adjust the digital input filter (0sec = filter off). 63 % of the alterations are acquired 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)
Fine tuning start value	FtS	-1999… **0**…+9999	see description on the following pages. Unlike 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 can not be adopted by another instrument.
Fine tuning end value	FtE	-1999…**1**…+9999	
Heater current monitoring (output)	HEAt	**0** 1…10	**No function** Output 1—10 The AC heater current can be measured by using a current transformer on analog input #2. An alarm can be configured by using the LK-1 function and sent to a relay while the monitoring is active.
KTY correction value at 25°C	(setup)	0…**2000**…4000 Ω	Resistance at 25°C/77°F for linearization “KTY 11-6”

Factory settings are shown **bold**.

Analog inputs (general) In 12 →

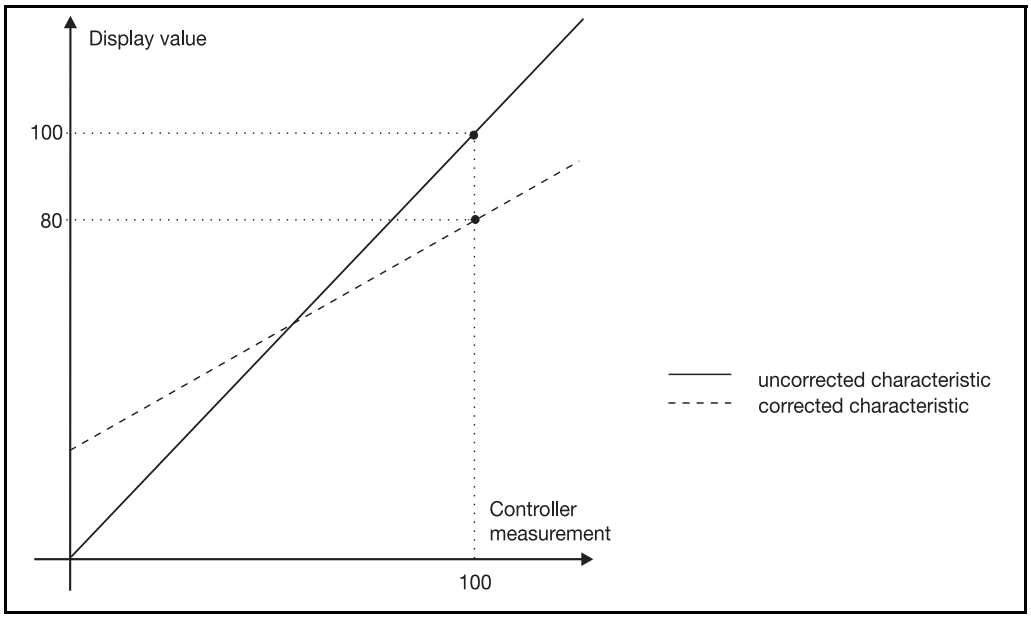
	Symbol	Value/selection	Description
Temperature unit	Unit	**0** 1	deg. Celsius deg. Fahrenheit Unit for temperature values
Sampling cycle time	CYCL	0 1 2 **3**	50 msec 90 msec 150 msec **250 msec**
Supply frequency	(setup)	**50 Hz** 60 Hz	Adaptation of the conversion time of the input circuitry to the supply frequency

Factory settings are shown **bold**.

Customized fine tuning

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 calculations of the controller and can be visualized in 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.

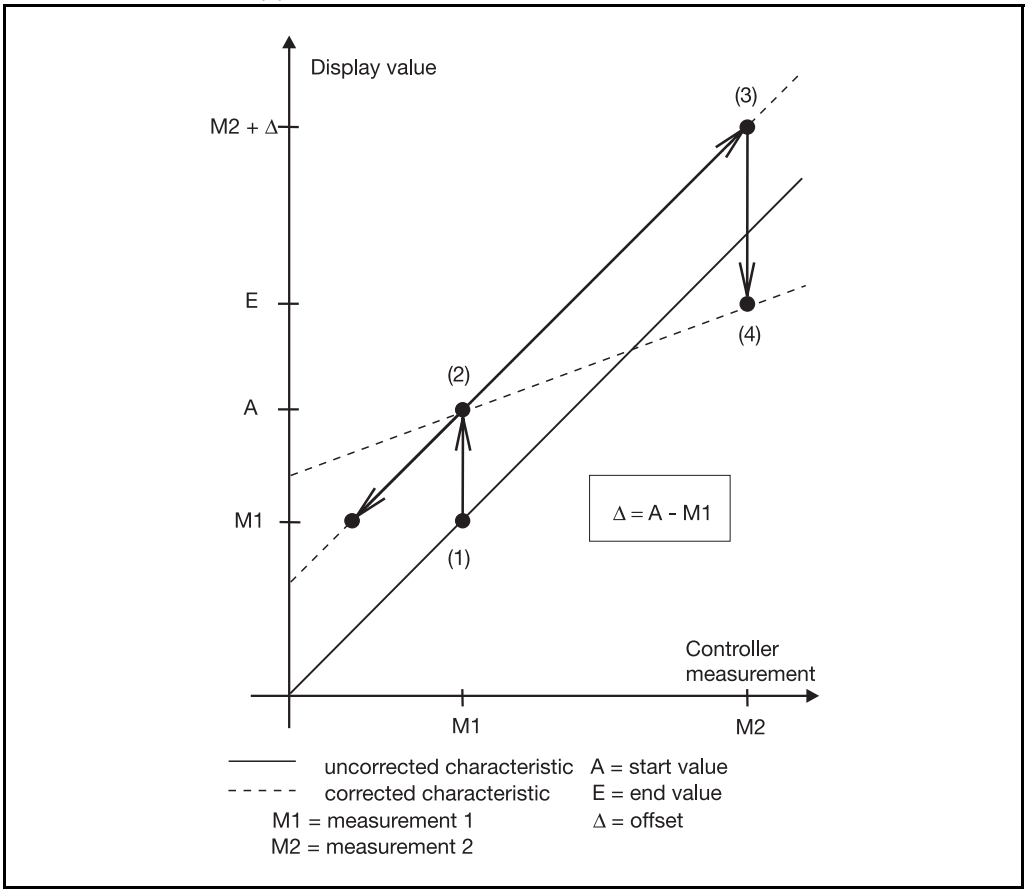


Procedure

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 FtS, end value FtE) 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 fine tuning is carried out without a reference instrument, the offset Δ must be taken into account when moving to measurement point (3).

To undo fine tuning, the start and end values (FtS, FtE) have to be programmed to the same value. This automatically sets the start value to 0 and the end value to 1.

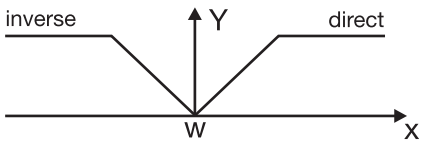
Any subsequent fine tuning will otherwise be based on the corrected characteristic.

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.

8.2 Controller “Cntr”

Configuration
Analog inputs
Controller
Generator
Limit comparators
Outputs
Binary functions
Display
Timer
Interfaces

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

	Symbol	Value/selection	Description
	Configuration		
Controller type	CtYP	0 **1** 2 3 4	no function **2-state controller** 3-state controller Modulating controller Continuous controller
Control action	CAct	0 **1**	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	InHA	**0** 1	**enabled** inhibited If the manual mode is inhibited, changing over to “manual” is not possible from the keys or via the binary input.
Manual output	HAnd	-100…**101**	Defines the controller output level after changing over to manual mode. 101 = last output
Range output	rOut	-100…**0**…101	Output on over/underrange. 101 = last output
Setpoint low	SPL	**-1999**…+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 high	SPH	-1999…**+9999**	

Factory settings are shown **bold**.

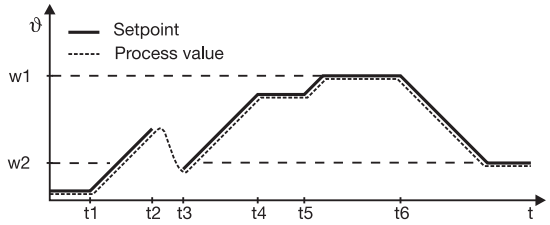
	Symbol	Value/selection	Description
	Inputs		
Controller process value	CPr	(analog selector) **Analog inp. 1**	Defines the source for the process value of the control channel. ⇨ See “Analog selector” on Page 32.
External setpoint	ESP	(analog selector) **switched off**	Activates the external setpoint input and defines the source for the external setpoint. ⇨ See “Analog selector” on Page 32. 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. Can only be adjusted through the setup program.
Output feedback	FEEd	(analog selector) **switched off**	Defines the source for output feedback for a modulating controller. ⇨ See “Analog selector” on Page 32.
	Autotuning		
Method of tuning	tYPt	**0** 1	Oscillation method Step response method ⇨ Chapter 9.1 “Autotuning (self-optimization)”
Inhibit tuning	InHt	**0** 1	**enabled** inhibited The start of autotuning can be inhibited from the keys or through the binary function.
Output of tuning 1 **Output of tuning 2**	Ot1 Ot2	**0** 1 2	**Relay** Solid-state + logic Continuous The type of the physical output for the signal of the controller outputs 1 and 2 has to be defined.
Controller standby output	SOut	-100…**0**…+100 %	Initial output with step response
Step size	St1	10…**30**…100 %	Step size with step response

Factory settings are shown **bold**.

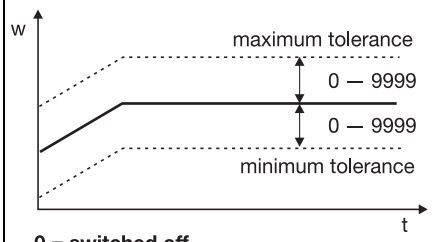
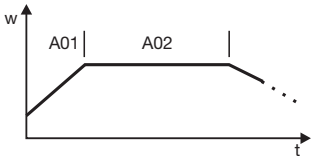
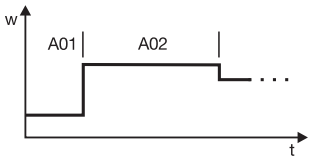
8.3 Generator “Pro”

Configuration
Analog inputs
Controller
Generator
Limit comparators
Outputs
Binary functions
Display
Timer
Interfaces

The basic function of the instrument is defined here. The instrument can be operated as a fixed-setpoint controller with or without a ramp function, or warm-up ramp for hot-channel equipment, program controller or program generator.

	Symbol	Value/selection	Description
	General		
Function	Fnct	**0** 1 2 3 4	Fixed-setpoint controller Ramp function Program controller Program generator Hot-channel controller 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 aktiv) t2…t3 Power failure / manual operation / probe break t4…t5 Ramp stop t6 Setpoint changeover to w2 The ramp function can be paused or canceled via the binary functions. ⇨ Chapter 8.6 “Binary functions “binF”” The ramp function is interrupted on a probe break, or for manual mode. The outputs react as for overrange/ underrange (configurable). Program generator: The setpoint profile is output via a continuous output.
Unit of slope	Unit	**0** 1 2	**Ramp function** / **Program** °C/min / mm:ss °C/hour / hh:mm °C/day / dd:hh s=seconds; m=minutes; h=hours;d=days Unit of ramp slope in °C per time unit, or format of segment times for program controller/generator.

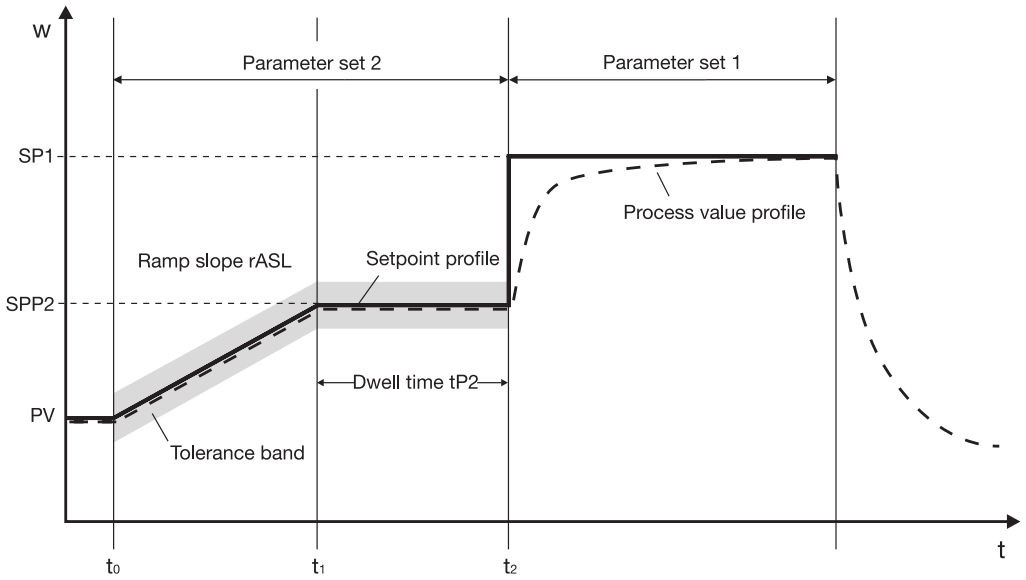
Factory settings are shown **bold**.

	Symbol	Value/selection	Description
Ramp slope	rASL	**0**…9999	Value of slope for ramp function
Tolerance band	toLP	**0**…999	0=off For a program controller/generator and ramp function, the process value can be monitored by applying a tolerance band around the setpoint profile. If the upper or lower limit is infringed, a tolerance limit signal is generated, which is internally processed or produced via an output.  **0 = switched off** Processing the tolerance limit signal, see: ⇨ Chapter 8.5 “Outputs “OutP”” ⇨ Chapter 8.6 “Binary functions “binF””
	Program		
Program start	(setup)	**Program start** start at the process value	Defines whether the program starts with the first program setpoint or whether the present process value is accepted as the first program setpoint.
Range response	(setup)	**Continue** pause program	Defines the response to over/underrange
Response to power-on	(setup)	**No start** automatic start	Defines whether the program starts on connecting the supply voltage.
Program repeat	(setup)	**none** cyclic	The “Cyclic” setting has the effect of continuously repeating the program.
Setpoint input	(setup)	**Ramp** Step	Setpoint ramp  Setpoint step 
Control to the most recent setpoint	(setup)	**inactive** active	If active, the process is controlled to the most recent program setpoint after the program has ended.
Delay time	(setup)	**0**…9999 min	Delays the program start by an adjustable time. “StrT” is shown in the lower display.
	Basic status		
Control contacts	(setup)	SK1 SK2 SK3 SK4	The four control contacts can be activated in the basic status (when the program is not running).

Factory settings are shown **bold**.

Hot-channel controller

The warm-up ramp for hot-channel equipment is used, for example, for the gentle operation of ceramic heater elements. Damage can be avoided by allowing moisture to evaporate slowly from the hygroscopic heater elements during the warm-up phase (t_0— t_2).



The present setpoint is accepted as the start value for the ramp at time t_0. Within the time period t_0 — t_1, the programmed ramp slope rASL is used to approach the hold setpoint SPP2. Within this period, the ramp setpoint is increased linearly. This is followed by the programmable dwell time tP2 (t_1— t_2), after which the process is controlled to the present setpoint (factory setting: setpoint 1 (SP1)).

The hot-channel function, with the settings for the ramp function and the program, is implemented through the setup program.

Relevant settings:

Setup/Generator/General

- Ramp slope rASL with time unit
- Tolerance band (optional)

Setup/Generator/Program

- Configure program start to “Start at process value”
- Define response after power-on; the warm-up ramp either starts automatically when switching on the supply voltage, or by pressing the ▲ key.

Setup/Parameter level/Controller parameters

- Output limiting for parameter sets 1 and 2 (optional)

Setup/Program editor/Program

- Set parameter set 2 for segment 1 (segment setpoint and time are not taken into account)
- Configure segment 2 with segment setpoint (= hold setpoint SPP2), segment time (= dwell time tP2) and parameter set 2

Setup/Display - Operation/ User data

- Relevant parameters can optionally be placed in the user data (operator level)

8 Configuration

8.4 Limit comparators “LC”

Configuration
Analog inputs
Controller
Generator
Limit comparators
Outputs
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Interfaces

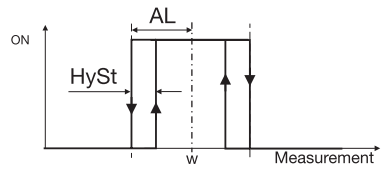
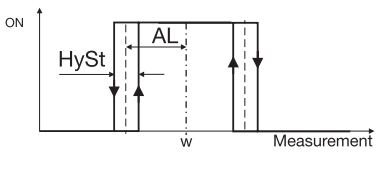
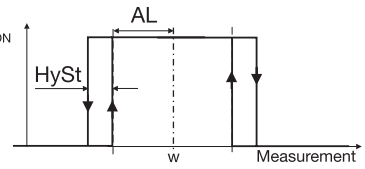
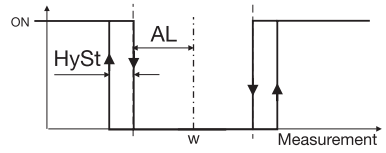
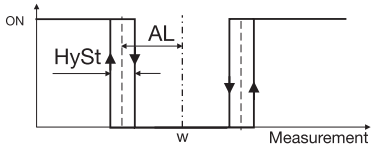
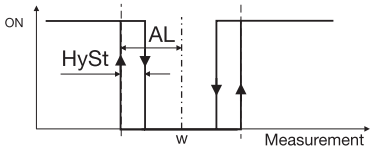
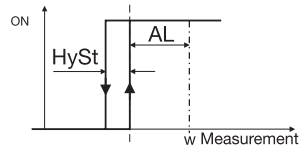
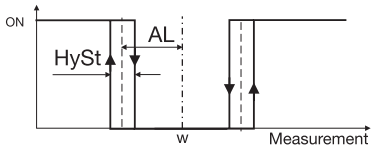
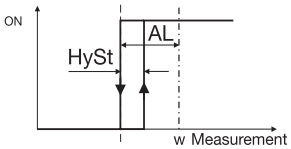
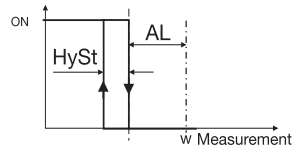
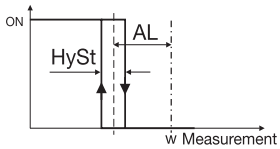
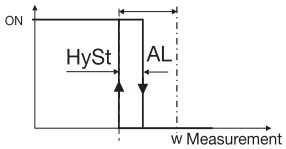
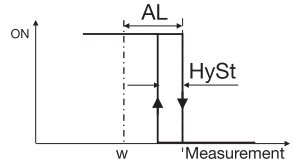
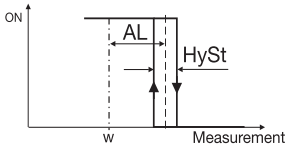
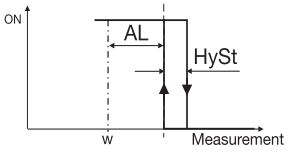
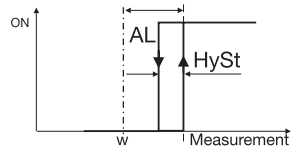
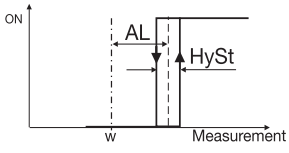
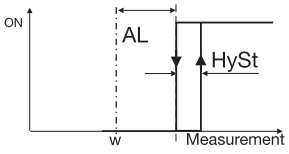
Limit comparators (threshold monitors, limit contacts) can be used to monitor an input variable (process value for the limit comparator) against a fixed limit or another variable (the setpoint for the limit comparator). When a limit is exceeded, a signal can be output or an internal controller function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

4 limit comparators are available.

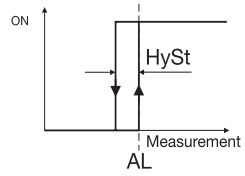
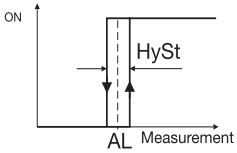
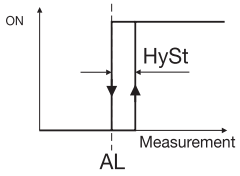
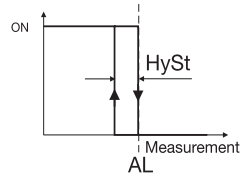
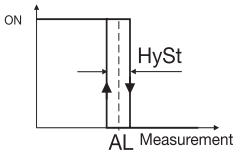
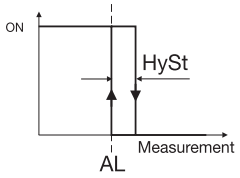
Limit comparator functions (lk)

Limit comparators can have different switching functions.

The hysteresis functions “asymmetrical, left” and “asymmetrical, right” can only be set through the setup program. The “symmetrical” hysteresis function is used as standard.

	Hysteresis function		
	asymmetrical, left	**symmetrical**	**asymmetrical, right**
lk1			
lk2			
lk3			
lk4			
lk5			
lk6			

In the case of the limit comparator functions lk7 and lk8, the measurement that is set is monitored with respect to a fixed value AL.

	Hysteresis function		
	asymmetrical, left	**symmetrical**	**asymmetrical, right**
lk7			
lk8			

Limit comparator 1 LC 1 →
Limit comparator 2 LC2 →
Limit comparator 3 LC3 →
Limit comparator 4 LC4 →

	Symbol	Value/selection	Description
Function	Fnct	**0** 1 2 3 4 5 6 7 8	no function lk1 lk2 lk3 lk4 lk5 lk6 lk7 lk8
Limit value	AL	-1999…**0**…+9999	Limit value to be monitored Limit range for lk1 and lk2: 0 — 9999
Switching differential	HYSt	0…**1**…9999	Switching differential

Factory settings are shown **bold**.

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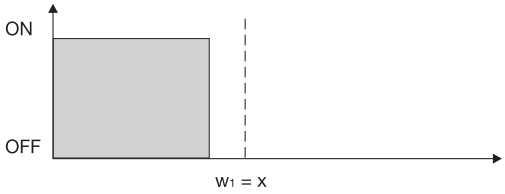
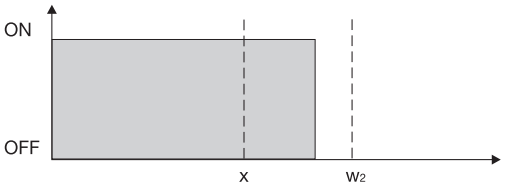
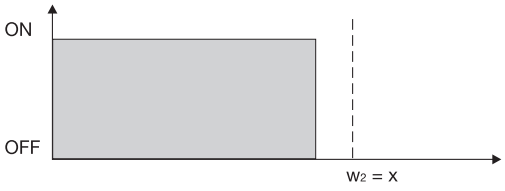
Limit comparator 1 LC 1 →
Limit comparator 2 LC2 →
Limit comparator 3 LC3 →
Limit comparator 4 LC4 →

	Symbol	Value/selection	Description
Action/ range response	AcrA	**0** 1 2 3	absolute/off relative/off absolute/on relative/on Action: Defines the switching action of the limit comparators on a setpoint change or power-on. absolute: At the time of alteration, the limit comparator acts according to 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 out of** 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 approach phase.
Switch-on delay	tOn	**0**…9999	Delays the switch-on edge by a definable time period
Switch-off delay	tOFF	**0**…9999s	Delays the switch-off edge by a definable time period

Factory settings are shown **bold**.

Limit comparator 1 LC 1 ➔
Limit comparator 2 LC2 ➔
Limit comparator 3 LC3 ➔
Limit comparator 4 LC4 ➔

	Symbol	Value/selection	Description
Acknowledgement	AcnL	**0** 1 2	no acknowledgement acknowledgement; only with inactive limit comparator acknowledgement; always possible For settings with acknowledgement, the limit comparator is latching, which means it remains ON, even when the switch-on condition is no longer present. The limit comparator must be reset via the ▼ + EXIT keys or binary signal.
Pulse time	tPuL	**0**… 9999s	The limit comparator is automatically reset after an adjustable time period.
Limit comparator PV	LCPr	(analog selector) **switched off**	see circuit diagrams ⇨ See “Analog selector” on Page 32.
Limit comparator SP	LCSP	(analog selector) **switched off**	see circuit diagrams (only with Ik1 — Ik6) ⇨ See “Analog selector” on Page 32.
Hysteresis function	(setup)	**symmetrical** asymmetrical, left asymmetrical, right	see circuit diagrams ⇨ Chapter 12.2 “Alarm messages”

Factory settings are shown **bold**.

8 Configuration

8.5 Outputs “OutP”

Configuration
Analog inputs
Controller
Generator
Limit comparators
Outputs
Binary functions
Display
Timer
Interfaces

Configuration of the instrument outputs are subdivided into analog outputs (OutA; max. 2) and binary outputs (OutL; max. 9). Binary outputs are relay, solid-state relay and logic outputs. Display and numbering of the outputs depends on the assignment of the option slots.

Numbering of the outputs

Standard for all instrument versions:
(Binary) output 1 = relay
(Binary) output 2 = relay
(Binary) output 3 = logic output
(Binary) output 4 = logic output

Extended numbering for the option slots:

Slot	Plug-in board with 1 analog output	Plug-in board with 1 binary output	Plug-in board with 2 binary outputs
Option 1	Output 5	Output 5	Output 5+8
Option 2	Output 6	Output 6	Output 6+9
Option 3	Output 7	Output 7	Output 7+10

The switching states of the binary outputs 1 — 6 are shown in the display.

Binary outputs OutL

	Symbol	Value/selection	Description
Binary output 1	Out 1	0	no function
		1	Controller output 1
		2	Controller output 2
...	...	5	Binary input 1
		6	Binary input 2
Binary output 10	Out0	7	Binary input 3
		8	Binary input 4
		9	Binary input 5
		10	Binary input 6
		11	Binary input 7
		12	Binary input 8
		13	Limit comparator 1
		14	Limit comparator 2
		15	Limit comparator 3
		16	Limit comparator 4
		17	Control contact 1
		18	Control contact 2
		19	Control contact 3
		20	Control contact 4
		21	Logic formula 1
		22	Logic formula 2
		23	Timer 1 active
		24	Timer 2 active
		25	Program active
		26	Program end signal
		27	Tolerance limit signal
		28	Manual mode on/off
		29	Binary marker
		30	Any binary value from storage address (only through setup)
		31	always active
			Function of the binary output

Factory settings are shown **bold**.

8 Configuration

Analog outputs OutA → ***Output 5*** Out5 →
Output 6 Out6 →
Output 7 Out7 →

	Symbol	Value/selection	Description
Function	Fnct	(analog selector) **switched off**	Function of the output ⇨ See “Analog selector” on Page 32.
Type of signal	S, Gn	0 1 **2** 3	0 — 10V 2 — 10V 0 — 20mA 4 — 20mA Physical output signal
Range output	rOut	**0**…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 the output level defined under “Controller”. The setting for rOut is not taken into account. ⇨ Chapter 8.2 “Controller “Cntr””
Zero point	OPnt	-1999…**0**…+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 an analog output (0 — 20mA). i.e.: 150 to 500°C ≙ 0 — 20mA Zero point: 150 / End value: 500 Setting for controller outputs for cooling. The following settings have to be defined for 3-state controllers: Zero point: 0 / End value: -100
End value	End	-1999…**100**…+9999	
Offset	(setup)	-1999…**0**…+9999	The offset is used to correct the output signal by a certain amount upwards or downwards. Examples: Original value / Offset / Output value 294.7 / +0.3 / 295.0 295.3 / - 0.3 / 295.0

Factory settings are shown **bold**.

8.6 Binary functions “binF”

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Analog inputs
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Binary functions
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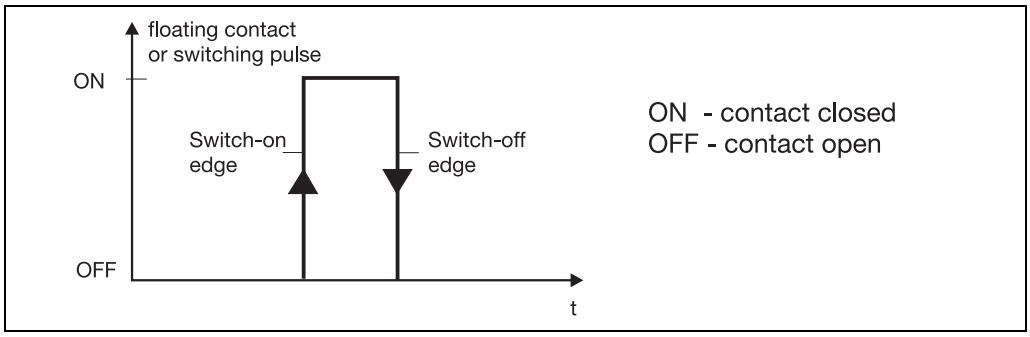
Interfaces

Functions are assigned here to the binary signals of the binary inputs and limit comparators.

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

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

Switching action



The functions are arranged in two groups:

Edge-triggered functions

The binary function reacts to switch-on edges.

The following functions are edge-triggered:

- Start/stop of autotuning
- Acknowledge limit comparators
- Program start/cancel
- Start timer
- Segment change

State-triggered functions

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

- All remaining functions

	Symbol	Value/selection	Description
Binary input 1	bin1	0	no function
		1	Start autotuning
...		2	Cancel autotuning
		3	Change to manual mode
Binary input 8	bin8	4	Controller off (controller outputs are switched off)
		5	Inhibit manual mode
Limit comparator 1	LC1	6	Hold ramp
		7	Cancel ramp
...		8	Setpoint changeover
		9	Parameter set switching
Limit comparator 4	LC4	10	Key inhibit
		11	Level inhibit
Timer 1	tF1	12	Display “off” with key inhibit
		13	Acknowledge limit comparators
Timer 2	tF2	14	Inhibit program start
		15	Start program
Logic 1	Lo1	16	Pause program
		17	Cancel program
Logic 2	Lo2	18	Segment change
		19	Start timer 1
Control contact 1	CC1	20	Start timer 2
		21	Cancel timer 1
...		22	Cancel timer 2
Control contact 4	CC4		Level inhibit: The parameter and configuration levels are inhibited.
Tolerance limit signal	toLS		Program end signal: The signal is active after approx. 1 second (pulse)
Program end signal	PrES		Text display: If the binary function is active, a configurable text is shown in the lower display. The text can be uniquely defined (only through the setup program).
			Type 703041: The settings for the binary inputs 1+2 have priority over those for the logic outputs.

Factory settings are shown **bold**.

Setpoint and parameter set switching

A binary function can be used to switch between setpoint 1 and setpoint 2 or parameter set 1 and parameter set 2.

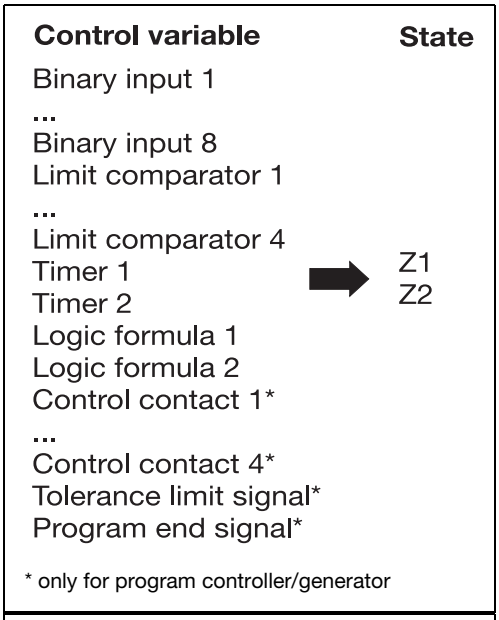
Setpoint switching	Parameter set switching	Binary signal
Setpoint 1 active	Parameter set 1 active	0/contact open
Setpoint 2 active	Parameter set 2 active	1/contact closed

In order to switch between the four possible setpoints, two binary functions must be configured to “setpoint switching”. The states of the two binary functions are designated Z1 and Z2 and switch the setpoints over as shown in the table below:

Setpoint	Z2	Z1
Setpoint 1	0	0
Setpoint 2	0	1
Setpoint 3	1	0
Setpoint 4	1	1

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

The states Z1 and Z2 are assigned to the binary functions in descending order (see list on the right), i. e. the first binary function selected in the list is Z1.

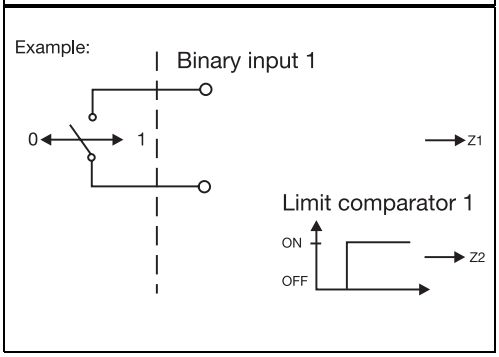


Example:

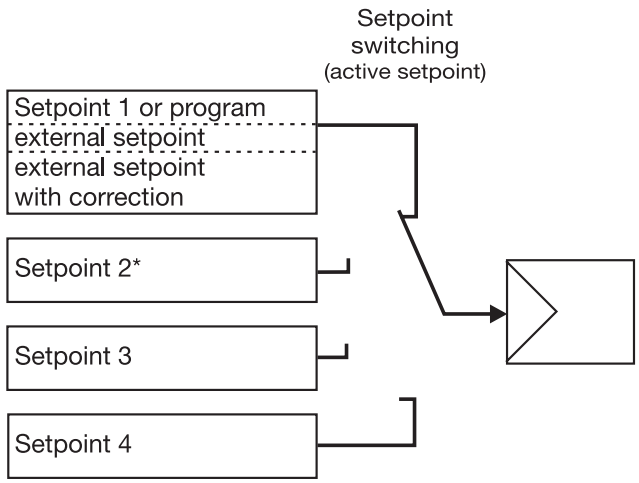
The setpoint is to be selected via a binary input and the state of one limit comparator.

This results in the following assignment:
Z1 - binary input 1
Z2 - limit comparator 1

The binary function for the binary input 1 and limit comparator 1 have to be configured to “setpoint switching”



Depending on the further configuration, the following diagram applies:



* An exception to this is the configuration for a program controller with external setpoint input, with or without correction. Setpoint 2 is the program setpoint in this case.

Additional functions via the setup program

Several binary functions can be combined through the setup program. In addition, the binary function “Text display” can be implemented. This is used to show a letter combination in the lower display.

8 Configuration

8.7 Display “diSP”

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Analog inputs
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Binary functions
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Interfaces

	Symbol	Value/selection	Description
	General		
Upper display	diSU	(analog selector) **controller process value**	Displayed value for the upper display ⇨ See “Analog selector” on Page 32.
Lower display	diSL	(analog selector) **controller setpoint**	Displayed value for the lower display ⇨ See “Analog selector” on Page 32.
Decimal point	dECP	**0** 1 2	no decimal place one decimal place two decimal places 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.
Brightness	bri6	**0**…5	(bright) 0 — 5 (dark)
16-segment display	(setup)	switched off **Unit** current segment current parameter set text	Displayed value for the two-digit 16-segment display
Time-out	(setup)	0…**30**…255 s	Time period, after which the instrument automatically returns to normal display if no key is pressed.
Level inhibit	(setup)	**none** configuration level parameter/ configuration level operator/ parameter/ configuration level	The access to the individual levels can be inhibited.
	User level (setup program)		
	Up to eight parameters from different levels can be shown under User data (operator level) on the instrument and edited. The symbols for these parameters (shown in the lower display) must be assigned by the user himself.		

Factory settings are shown **bold**.

8.8 Timer “tFct”

Configuration
Analog inputs
Controller
Generator
Limit comparators
Outputs
Binary functions
Display
Timer
Interfaces

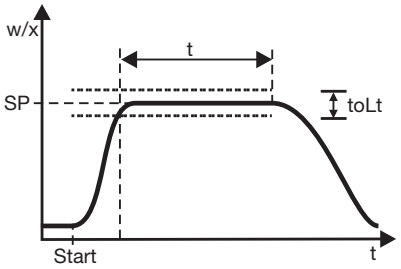
Time-dependent control actions can be carried out with the help of the timer. The timer signal (timer 1+ 2) shows whether the timer is active. It can be output via the binary outputs or processed internally.

The timers are started or canceled via the binary functions.

⇨ Chapter 8.6 “Binary functions “binF””

The current times for the timers can be viewed at the operator level (process data).

Timer 1 tF1 →
Timer 2 tF2 →

	Symbol	Value/selection	Description
Function	Fnct	**0** 1 2 3	no function with the timer running: binary signal=1 (signal is active) with the timer running: binary signal=0 (signal is not active) Tolerance band Function: “Tolerance band”  Timer is running when the process value has reached a tolerance band around the setpoint.
Timer time	t	0...99:59 (hh:mm)	Time input
Tolerance limit	toLt	**0**...999	0=off

Factory settings are shown **bold**.

8 Configuration

8.9 Interfaces “IntF”

The interface parameters for the RS422/485 or Profibus-DP interface have to be configured in order to communicate with PCs, bus systems and peripheral devices.

PROFIBUS-DP PrOF →

	Symbol	Value/selection	Description
Protocol	Prot	0 **1** 2	Motorola **Intel** Intel integer
Device address	Adr	0…**128**…255	Address in data network
Analog marker	AnAP	-1999…**0**…+9999	Analog value
Binary marker	bi nP	**0**…255	Binary value

Factory settings are shown **bold**.

MODbus r422 →

	Symbol	Value/selection	Description
Protocol	Prot	**0** 1	**MODbus** MODbus integer
Baud rate	bdrt	**0** 1 2	**9600 bps** 19200 bps 38400 bps
Data format	dFt	**0** 1 2 3	**8 data bits, 1 stop bit, no parity** 8 data bits, 1 stop bit, odd parity 8 data bits, 1 stop bit, even parity 8 data bits, 2 stop bits, no parity
Device address	Adr	0…**1**…255	Address in data network
Min. response time	(setup)	**0**…500ms	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**.

Interface description B70.3041.2

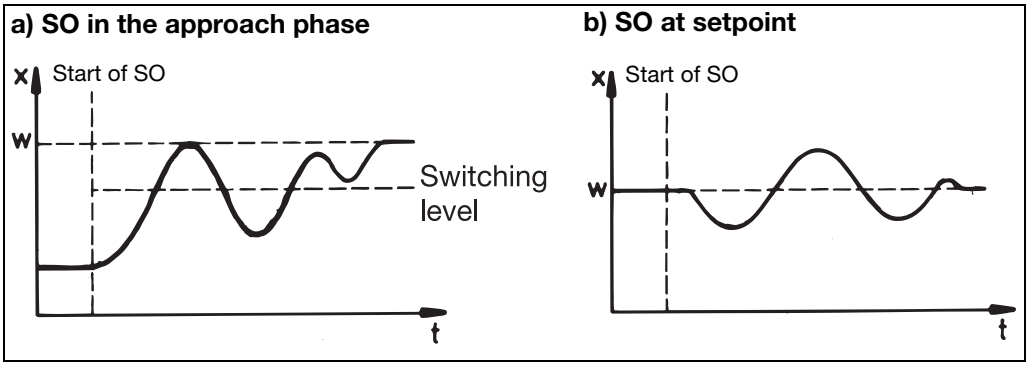
9.1 Autotuning (self-optimization)

Oscillation method

Autotuning (self-optimization, SO) establishes the optimum controller parameters for a PID or PI controller.

Depending on the controller type, the following controller parameters can be defined: Reset time (rt), derivative time (dt), proportional band (Pb), 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 standby 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.

Autotuning establishes the optimum control parameters for a PID or PI controller, according to the selected control structure.

Depending on the controller type, the following control parameters can be determined: Reset time (rt), derivative time (dt), proportional band (Pb), cycle time (Cy), filter time constant (dF)

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

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

Principal applications of the step response method

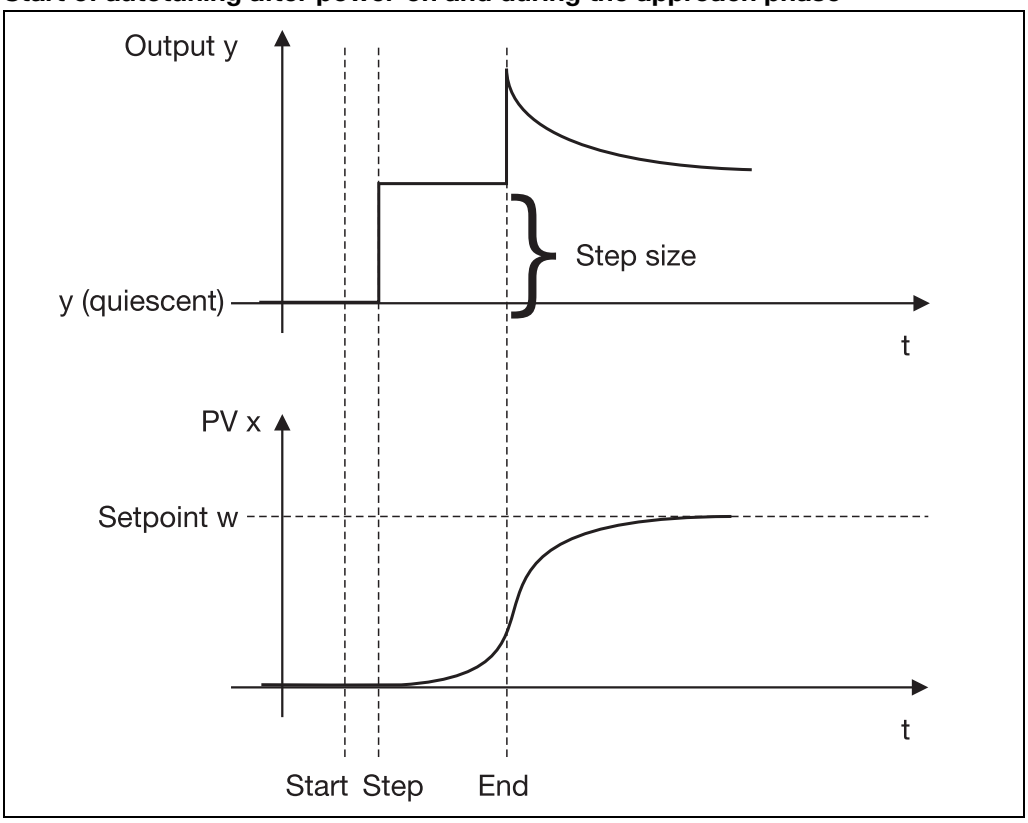
- Autotuning instantly after “power on”, during the approach phase
  Considerable time savings, setting: controller standby output = 0 %.
- The process does not readily permit oscillations (e.g. highly insulated furnaces with small losses, long oscillation period)
- Process value must not exceed setpoint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

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

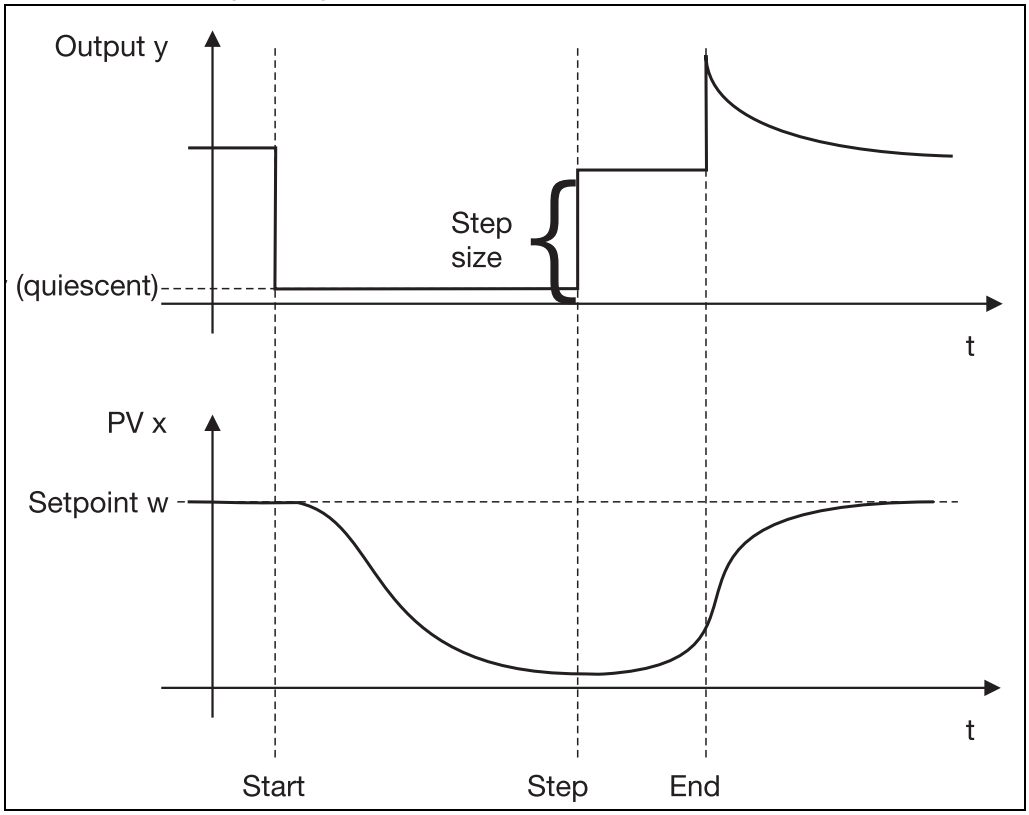
With the “relay” output type, care has to be taken that the process value is not influenced by the cycle time, since otherwise autotuning can not be completed successfully.

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

Start of autotuning after power-on and during the approach phase

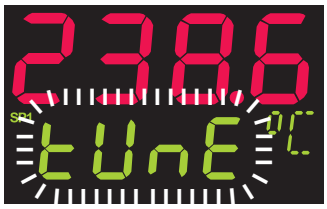


Start of autotuning during operation



Starting auto-tuning

* Start with ▲ and ▼ (simultaneously >2 sec
  “tUnE” is shown, blinking, in the lower display



Autotuning is ended when the display automatically changes over to normal display.
The duration of autotuning depends on the control process.

The controller output types have to be defined for autotuning.

⇨ Chapter 8.2 “Controller “Cntr””

For a program controller, autotuning can only be started in the normal display.

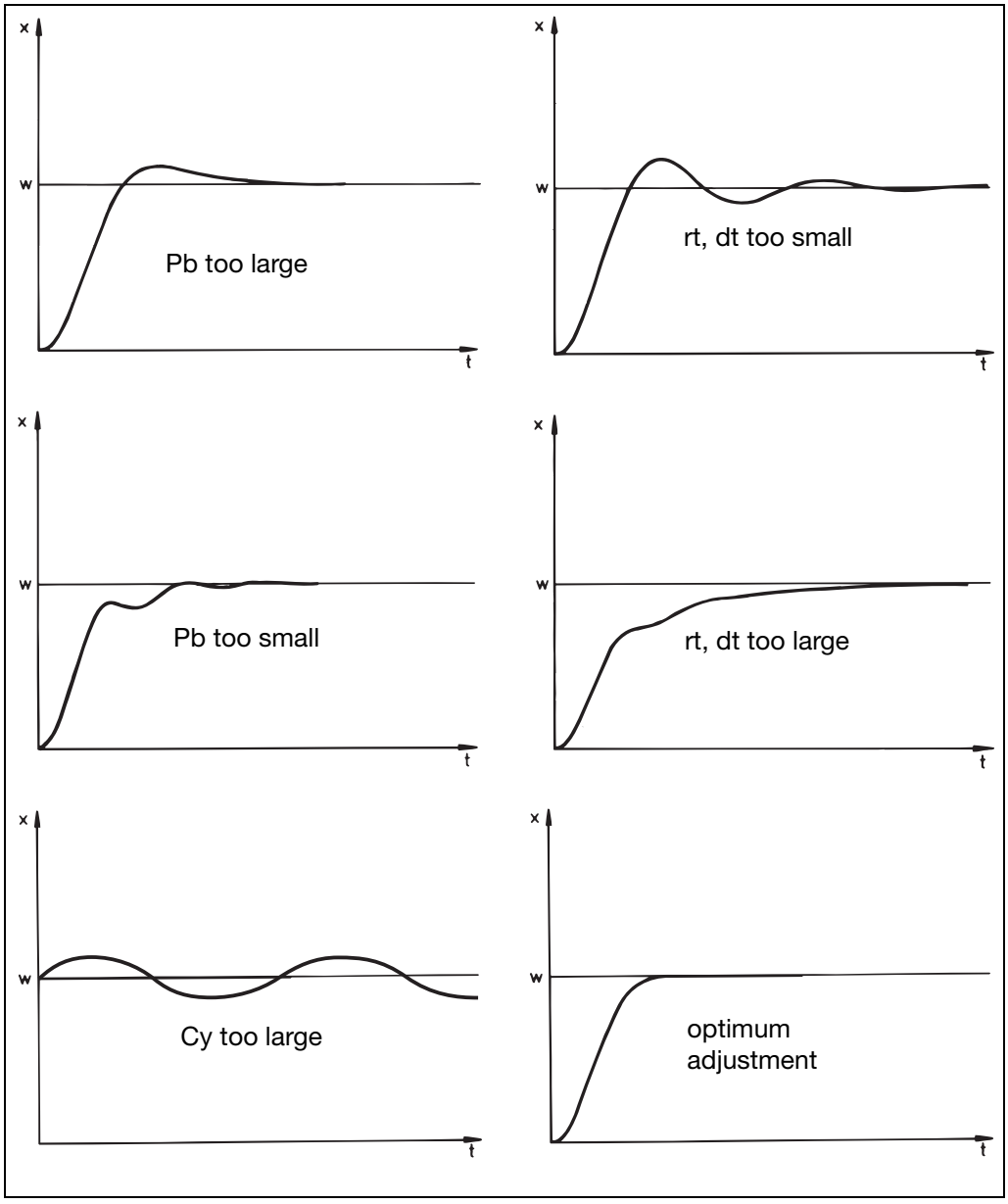
Canceling auto-tuning

* Cancel with ▲ and ▼ (simultaneously)

9.2 Check of the tuning

The optimum adaptation of the controller to the process can be checked by recording the approach 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 for a PID controller is shown as an example. However, the procedure for adjusting the controller parameters can also be applied to other control loops.



10.1 Math and logic module

The setup program can be used to implement two mathematical calculations or logical combinations of various signals and process variables from the controller in a formula.

With math formulae, the calculated result is presented through the two signals “Math 1” and “Math 2” in the analog section. With logic formulae, the result of the logical combination is presented through the signals “Math 1” and “Math 2” of the configuration for binary functions.

Chapter 8.6 “Binary functions “binF””

Entering formulae

- The string of signs in the formula consists of ASCII characters, and can have a maximum length of 60 characters.
- The formula can only be entered in the setup program.
- Formulae can be freely entered according to normal mathematical rules.
- Spaces can be inserted at will into the formula character string. But spaces are not permitted within function labels, variable names and constants.

10.2 Difference, humidity and ratio controllers

If the extra code is activated, these three types of controller can be selected through the setup program.

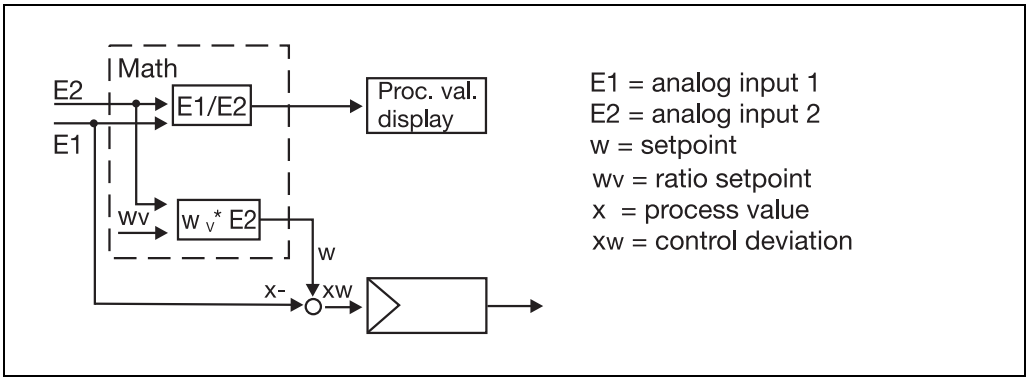
⇨ *Setup/Only setup/Math/Logic*

The process variables for the two analog inputs have a fixed definition.

Ratio control

The control is always based on analog input 1 (E1).
The math module forms the ratio of the measurements from E1 and E2, and produces the setpoint for the controller. The ratio of the measurements can be called up through the functions “Math 1” or Math 2” and displayed.
The required ratio E1/E2 is programmed as the setpoint (ratio setpoint) in the setpoint definition.

Ratio: E1/E2



10 Extra codes

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.

RELF (E1, E2)

E1 - Dry bulb temperature, via analog input 1
E2 - Wet bulb temperature, via analog input 2

Difference control

The difference between the two input signals is taken as the process value.

Difference: E1-E2

E1 - Analog input 1
E2 - Analog input 2

The following steps are necessary for retrofitting modules:

Safety notes

Retrofitting must only be carried out by qualified professional persons.

For safety reasons, care must be taken that, after making the changes, the back panel and the fixing screws are correctly replaced and fitted.

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

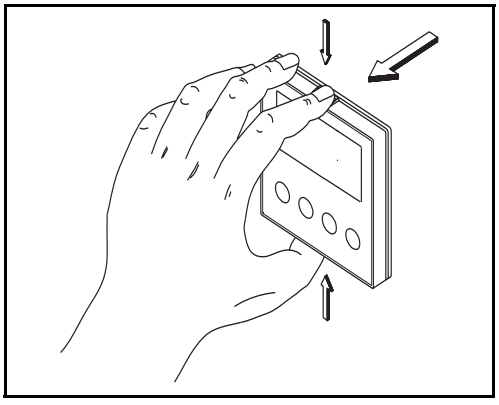
Identifying the module

* Identify the module by the Sales. No. glued onto the packaging

Modules	Code	Sales No.
Analog input 2	1	70/00442785
1 relay (changeover contact) 2 relays (make contact) 1 analog output 2 binary inputs 1 solid-state relay 230V/1A	2 3 4 5 6	70/00442786 70/00442787 70/00442788 70/00442789 70/00442790
RS422/485 interface	7	70/00442782
PROFIBUS-DP	8	70/00442791

Removing the controller module

* Press together the knurled surfaces on the front panel (top and bottom, or left and right for landscape format) and pull out the controller module.

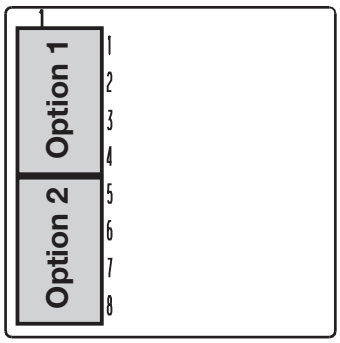


11 Retrofitting of modules

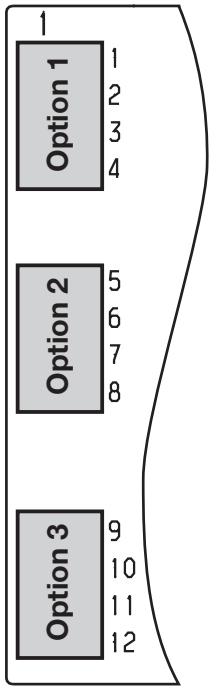
Retrofitting of modules

* Select the slot for the option
  (Observe the restrictions for Type 703041! (see connection diagram))

Type 703041

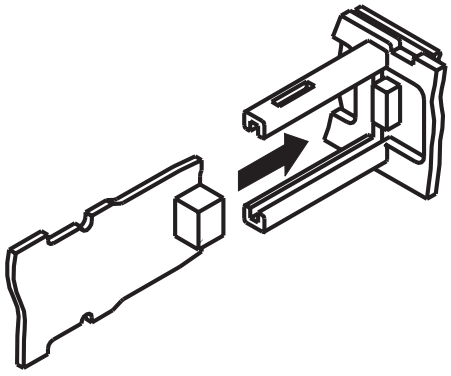


Type 703042/43/44



☞ On Type 703041, relays can only be retrofitted in option slot 1!

* Push the module into the slot until the plug connector snaps into place



* Push the module into the housing until the lugs snap into their slots

12.1 Technical data

Thermocouple input

Designation		Measuring range	Measuring accuracy	Ambient temperature error
Fe-Con L		-200 to + 900°C	≤0.25%	100 ppm /°C
Fe-Con J	EN 60 584	-200 to +1200°C	≤0.25%	100 ppm /°C
Cu-Con U		-200 to + 600°C	≤0.25%	100 ppm /°C
Cu-Con T	EN 60 584	-200 to + 400°C	≤0.25%	100 ppm /°C
NiCr-Ni K	EN 60 584	-200 to +1372°C	≤0.25%	100 ppm /°C
NiCr-Con E	EN 60 584	-200 to +1000°C	≤0.25%	100 ppm /°C
NiCrSi-NiSi N	EN 60 584	-100 to +1300°C	≤0.25%	100 ppm /°C
Pt10Rh-Pt S	EN 60 584	0 to 1768°C	≤0.25%	100 ppm /°C
Pt13Rh-Pt R	EN 60 584	0 to 1768°C	≤0.25%	100 ppm /°C
Pt30Rh-Pt6Rh B	EN 60 584	0 to 1820°C	≤0.25%[1]	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		

1. in the range 300 to 1820°C

Input for resistance thermometer

Designation		Connection	Measuring range	Measuring accuracy		Ambient temperature error
				3-/4-wire	2-wire	
Pt100	EN 60 751	2-wire / 3-wire / 4-wire	-200 to +850°C	≤0.05%	≤0.4%	50 ppm / °C
Pt500	EN 60 751	2-wire / 3-wire / 4-wire	-200 to +850°C	≤0.2%	≤0.4%	100 ppm /°C
Pt1000	EN 60 751	2-wire / 3-wire / 4-wire	-200 to +850°C	≤0.1%	≤0.2%	50 ppm /°C
KTY11-6		2-wire	-50 to +150°C	≤1.0%	≤2.0%	50 ppm /°C
Sensor lead resistance		max. 30Ω per lead for 3-wire or 4-wire circuit				
Measuring current		approx. 250µA				
Lead compensation		Not required for 3-wire or 4-wire circuit. With a 2-wire circuit, the lead resistance can be compensated in software by a correction of the process value.				

Input for standard signals

Designation	Measuring range	Measuring accuracy	Ambient temperature error
Voltage	0(2) — 10V 0 — 1V input resistance R_{IN} > 100kΩ	≤0.05% ≤0.05%	100 ppm / °C 100 ppm / °C
Current	0(4) — 20mA, voltage drop ≤ 1.5V	≤0.05%	100 ppm / °C
Heating current	0 — 50mA AC	≤1%	100 ppm / °C
Resistance transmitter	min. 100Ω, max. 4kΩ	≤0.5%	100 ppm / °C

Binary inputs

Floating contacts	

Standard version

12 Appendix

Measuring 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 — 10V 0 — 10V	• •	• -	• -
Current 4 — 20mA 0 — 20mA	• •	• -	• -

• = recognized - = not recognized

Outputs

Relay (changeover) for type 703042/43/44 contact rating contact life	 3A at 230V AC resistive load 350,000 operations at rated load / 750,000 operations at 1A
Relay (changeover) (option) contact rating contact life	 8A at 230V AC resistive load 100,000 operations at rated load / 350,000 operations at 3A
Relay (make) for type 703041 contact rating contact life	 3A at 230V AC resistive load 150,000 operations at rated load / 350,000 at 1A
Relay (changeover) (option) contact rating contact life	 3A at 230VAC resistive load 350,000 operations at rated load / 900,000 operations at 1A
Logic output	0/12V / 30mA max. (sum of all output currents) or 0/18V / 25mA max. (sum of all output currents)
Solid-state relay (option) contact rating protection circuitry	 1A at 230V varistor
Voltage (option) output signals load resistance	 0 — 10V / 2 — 10V $R_{load} \geq 500\Omega$
Current (option) output signals load resistance	 0 — 20mA / 4 — 20mA $R_{load} \leq 500\Omega$
Supply voltage for 2-wire transmitter voltage	 electrically isolated, not stabilized 30V DC with no load 23V at 30mA load

Controller

Controller type	2-state controller,
	3-state controller, modulating controller, continuous controller
Controller structures	P/PD/PI/PID
A/D converter	dynamic resolution up to 16-bit
Sampling cycle time	250msec
	50msec, 90msec, 150msec, 250msec

Electrical data

Supply voltage (switchmode PSU)	110 — 240V AC -15/+10%, 48 — 63Hz
	20 — 53V AC/DC, 48 — 63Hz
Electrical safety	to EN 61 010, Part 1 Overvoltage category II, pollution degree 2 for type 703041 with power supply AC/DC connect to SELV and PELV only
Power consumption	max. 7VA
Data backup	EEPROM
Electrical connection	at the back, via screw terminals, conductor cross-section up to 1.5mm^2 with core ferrules (length: 10mm)
Electromagnetic compatibility interference emission interference immunity	EN 61 326 Class B to industrial requirements

Standard version

Housing

Housing type	plastic housing for panel mounting to DIN 43 700
Depth behind panel	90 mm
Ambient/storage temperature range	0 to 55°C / -40 to +70°C
Climatic conditions	rel. humidity ≤90% annual mean, no condensation
Operating position	horizontal
Enclosure protection	to EN 60 529, front IP65 / back IP20
Weight (fully fitted)	JUMO dTRON316: approx. 220g JUMO dTRON308: approx. 380g JUMO dTRON304: approx. 490g

Interface

MODbus

Interface type	RS422/485
Protocol	Modbus, Modbus-integer
Baud rate	9600, 19200, 38400
Device address	0 — 255
Max. number of nodes	32

Profibus

Device address	0 — 255

12 Appendix

12.2 Alarm messages

Display	Cause	Fault removal test/repair/replace
- 1999 (blinking!)	Underrange for the value being displayed.	Is the medium being measured within the range (too hot? too cold?) Check probe for short-circuit and probe break Check the probe connection and the terminals. Check the cable.
9999 (blinking!)	Overrange for the value being displayed.	
all displays on; lower 7-segment display is blinking	Watchdog or power-on trigger initialization (reset).	Replace the controller if the initialization continues for more than 5sec.
Pr-OF	PROFIBUS error	Can be suppressed by setting the PROFIBUS address to “0”.
OPt	Hardware configuration error	Check which option boards are installed in the slots.

Overrange / underrange covers the following events:
- Probe break or short-circuit
- Measurement is outside the controllable range for the probe that is connected
- Display overflow

S

T

U

W

Z

Overview of the configuration level

inP Page 33	inP 1	SEnS		Sensor type
	inP2	Lin		Linearization
		OFFS		Measurement offset
		SCL		Display start
		SCH		Display end
		dF		Filter time constant
		FtS		Fine tuning start value
		FtE		Fine tuning end value
		HEAt		Heater current monitoring
	inP 12	Unit		Temperature unit
		CYcL		Sampling cycle time
Cntr Page 37		CtYP		Controller type
		CAct		Control action
		inHA		Inhibit manual mode
		HAnd		Manual output
		rOut		Range output
		SPL		Setpoint low
		SPH		Setpoint high
		CPr		Controller process value
		ESP		External setpoint
		FEEd		Output feedback
		tYPt		Method of tuning
		inHt		Inhibit tuning
		Ott 1		Output of tuning 1
		Ott2		Output of tuning 2
		SOut		Controller standby output
		StS 1		Step size
Pro Page 39		Fnct		Function
		Unit		Unit of slope
		rASL		Ramp slope
		toLP		Tolerance band
LC Page 42	LC 1	Fnct		Function
	LC2	AL		Limit value
	LC3	HYSt		Switching differential
	LC4	AcrA		Action/range response
		tOn		Switch-on delay
		tOFF		Switch-off delay
		AcnL		Acknowledgement
		tPuL		Pulse time
		LCPr		Limit comparator PV
		LCSP		Limit comparator SP
OutP Page 46	OutA	Out5		Analog output 5
			Fnct	Function
			Sign	Type of signal
			rOut	Range output
			OPnt	Zero point
			End	End value
		...		...
		Out7		Analog output 7
	OutL	Out 1		Binary output 1
		...		...
		OutO		Binary output 10
binF Page 49		bin 1		Binary input 1
		...		...
		bin8		Binary input 6
		LC 1		Limit comparator 1
		...		...
		LC4		Limit comparator 4
		tF 1		Timer 1
		tF2		Timer 2
		to 1		Logic 1
		to2		Logic 2
		CC 1		Control contact 1
		...		...
		CC4		Control contact 4
		toLS		Tolerance limit signal
		PrES		Program end signal
diSP Page 52		diSU		Upper display
		diSL		Lower display
		dECP		Decimal point
		bri G		Brightness
tFct Page 53	tF 1	Fnct		Function
	tF2	t		Timer time
		tolt		Tolerance limit
intF Page 54	ProF	Prot		Protocol
		Adr		Device address
	r422	Prot		Protocol
		bdrt		Baud rate
		dFt		Data format
		Adr		Device address

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