Compact controller ER 2022S and ER 2022SA

Input: PT100 and analog/remote setpoint
Output: 3-point or analog

INSTALLATION & USER MANUAL

NO.: 99.227.01 A
DATE: MAY 2024
APPROVAL: APPROVED - JMI

Clorius CONTROLS

Table of contents

1. Introduction

1.1 Safety information

General

This manual contains information that must be observed in the interest of your own safety and to avoid material damage. This information is supported by symbols which are used in this manual as indicated. Please read this manual before starting up the device. Store this manual in a place that is always accessible If difficulties occur during startup, please do not intervene in any way that could jeopardize your warranty rights.

(tr

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

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

E

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

Warning symbols

WARNING!

This symbol in connection with the signal word indicates that **personal injury** may occur if the respective precautionary measures are not conducted.

CAUTION!

This symbol in connection with the signal word indicates that **material damage or data loss** will occurif the respective precautionary measures are not taken.

CAUTION!

This symbol indicates that **components could be destroyed** by electrostatic discharge (ESD = ElectrostDischarge) if the respective cautionary measures are not taken.
Only use the ESD packages intended for this purpose to return device inserts, assembly groups, or assembly components.

READ THE DOCUMENTATION!

This symbol, which is attached to the device, indicates that the associated **documentation for the device** must be **observed**. This is necessary to identify the nature of the potential hazard, and to take measures to prevent it.

Note symbols NOTE!

This symbol refers to **important information** about the product, its handling, or additional benefits.

REFERENCE!

This symbol refers to **additional information** in other sections, chapters, or other manuals.

FURTHER INFORMATION!

This symbol is used in tables and indicates that **further information** is provided after the table.

DISPOSAL!

At the end of its service life, the device and any batteries present do not belong in the trash! Please ensure that they are **disposed of** properly and in an **environmentally friendly** manner.

1. Introduction

1.2 Intended use

This device is designed for use in an industrial environment as specified in the technical data. Other uses beyond those defined are not viewed as intended uses.

The device is manufactured in compliance with applicable standards and directives as well as the applicable safety regulations. Nevertheless, improper use may lead to personal injury or material damage.

To avoid danger, only use the device:

- For the intended use
- When in good order and condition
- When taking the technical documentation provided into account

Risks resulting from the application may arise, e.g., as the result of missing safety provisions or wrongsettings, even when the device is used properly and as intended.

1.3 Qualification of personnel

This document contains the necessary information for the intended use of the device to which it relates.

It is intended for staff with technical qualifications who have been specially trained and have the appropriate knowledge in the field of automation technology.

The appropriate level of knowledge and the technically fault-free implementation of the safety information and warnings contained in the technical documentation provided are prerequisites for risk-free mounting, installation, and startup as well as for ensuring safety when operating the described modules. Only qualified personnel have the required specialist knowledge to correctly interpret and implement the safety information and warnings contained in this document in specific situations.

1.4 Description

The controller 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, two autotuning (self-optimization) procedures, a math and logic module, as well as 4 limit comparators.

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

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.

2. Typographical conventions

Warning signs to

V **Danger** This symbol is used when there may be **danger to personnel** in 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!

E **Caution** This symbol is used where special care is required when handling components liable to damage through electrostatic discharge.

Note signs

H **Note** This symbol is used when **your special attention** is drawn to a remark.

V **Reference** This symbol refers to further information in other operating instruction chapters and sections.

H **Action Instruction** This symbol indicates that an action to be performed is decided.

The individual steps are marked by asterisk e.g.,
h Press **X**

Representation

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

Blinking display

2. Typographical conventions

2.1 Type designation

ER2022S
Supply 110 — 240 V AC -15/+10%, 48 — 63Hz
INPUT PT100
INPUT ANALOG
OUTPUT 3-point
2x Relays- ALARM

ER2022SA
Supply 110 — 240 V AC -15/+10%, 48 — 63Hz
INPUT PT100
INPUT ANALOG
OUTPUT ANALOG
2x Relays- ALARM

2. Typographical conventions

2.2 Scope of delivery

8 1 controller
9 1 seal
10 mounting brackets
11 Wiring diagram with factory setting

2.3 Accessories

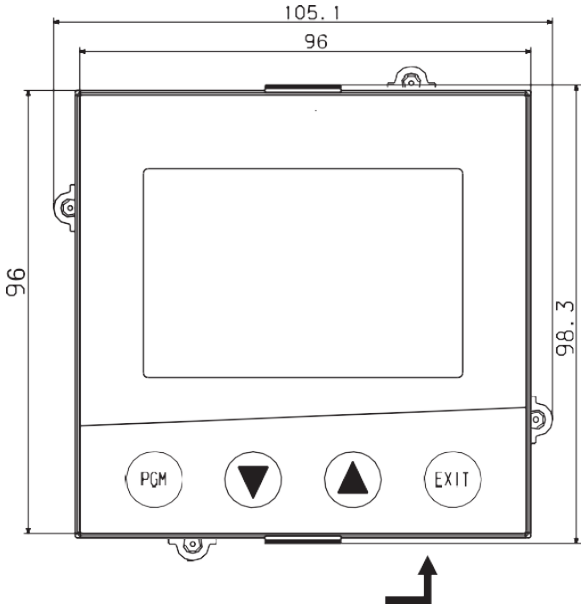
ORDER NO.	DESCRIPTION
1-0158221	ER2022S Module Analog input
1-0158222	ER2022S Module 2xRelays
1-0158223	ER2022S module Analog output
1-0158225	ER2022S module RS485

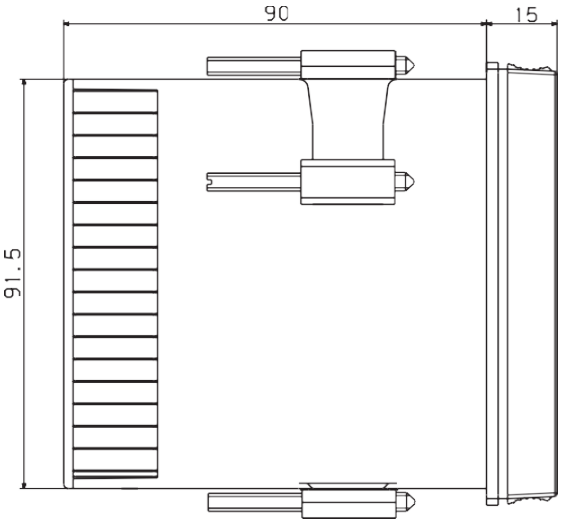
3. Mounting site and climatic conditions

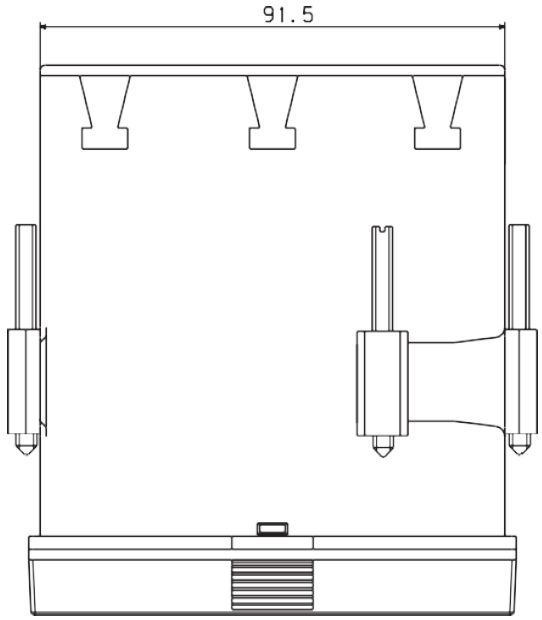
The conditions on the mounting site must meet the requirements specified in the technical data. The ambient temperature on the mounting site can be from 0 to 55 °C, with a relative humidity of not more than 90 %.

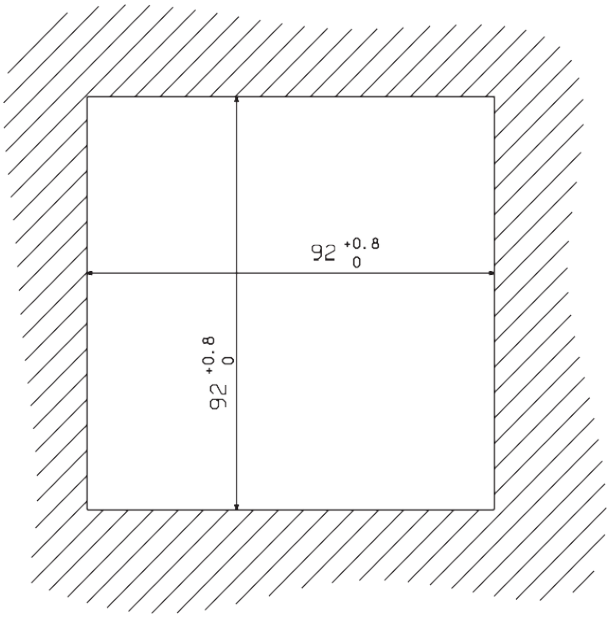
3.1 Dimensions

3.1.1 ER 2022s and ER 2022SA









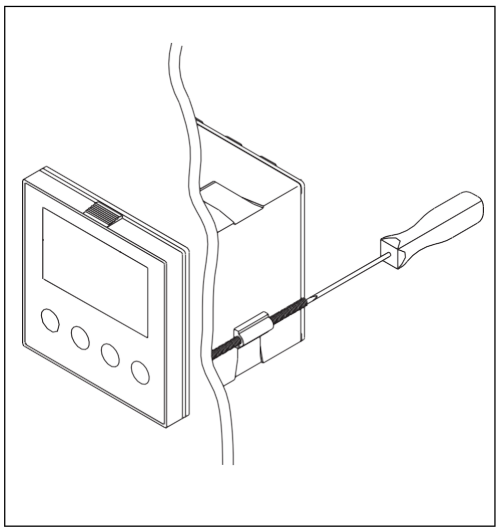
3. Mounting site and climatic conditions

3.2 Side by side mounting

Minimum spacing of panel cut-outs		
Type	**horizontal**	**vertical**
ER2022A/SA (96mm x 96mm)	11mm	65mm

3.2 Fitting in position

Type ER2022S/SA



- **h** Fit the seal that is supplied onto the instrument body.
- **h** Insert the controller from the front into the panel cut-out.
- **h** 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.
- **h** Push the mounting brackets up to the back of the panel and tighten them with a screwdriver.

Care on the front panel

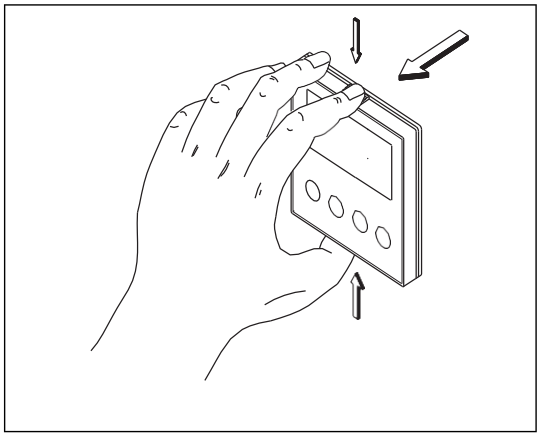
The front panel can be cleaned with normal commercial washing, rinsing and cleaning agents. It has a limited resistance to organic solvents (e.g., ethylated spirits, white spirit, P1, xylol etc.). Do not use high-pressure cleaning equipment.

3. Mounting site and climatic conditions

3.3 Removing the controller module

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

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



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

4. Electric connections

4.1 Installations 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.
- Qualified personnel must only conduct the electrical connection.
- If contact with live parts is possible while working on the unit, it must be disconnected from the supply on both poles.
- The load circuit must always be fused for the maximum relay current, 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.

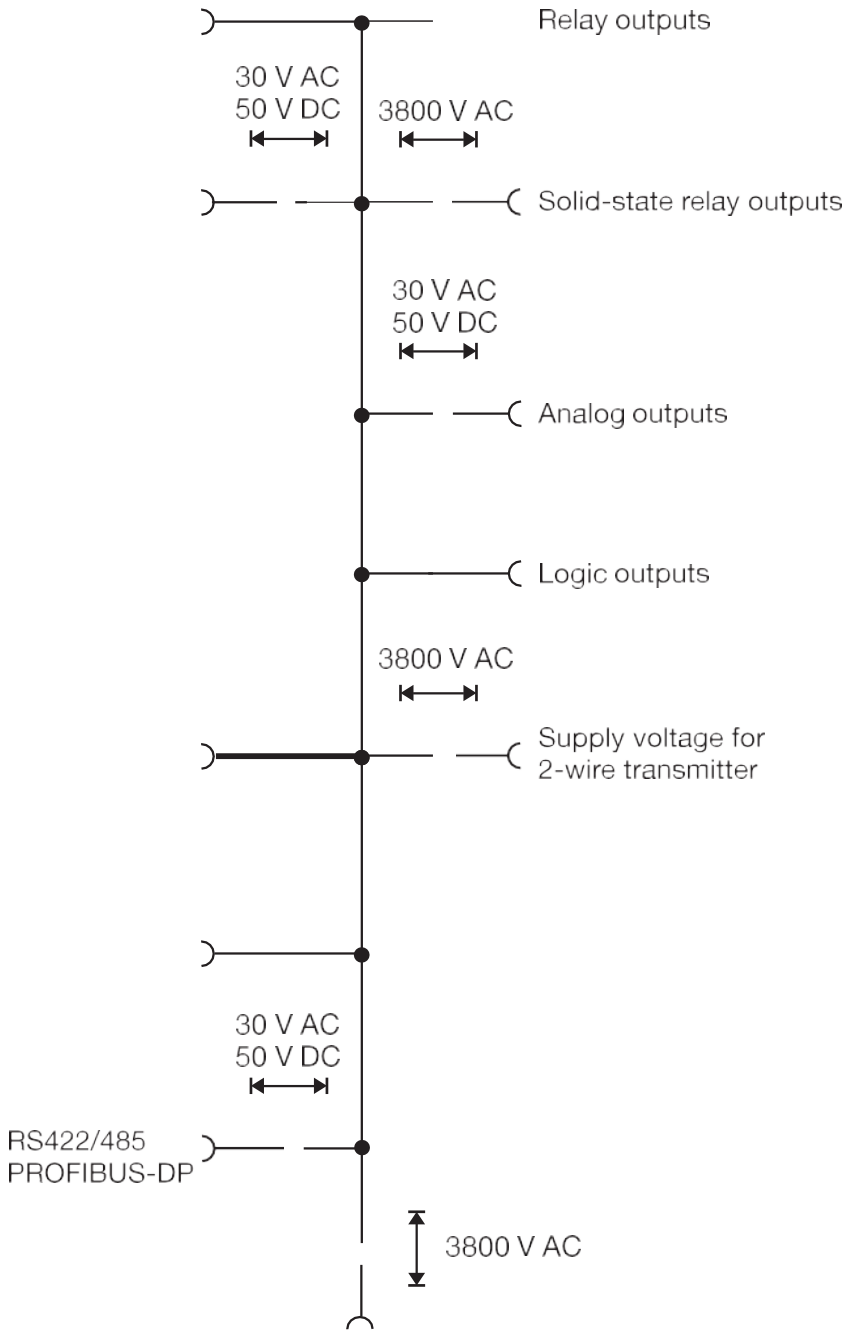
  Chapter 12. “Technical data”
- Run input, output, and supply cables separately and not parallel to one another.
- Sensor and interface cables must always be shielded cables with twisted conductors.
  Do not run them close to current-carrying components or cables. Ground the shielding on one side.
- Do 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 must always be provided so that they 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 manage all control loops, and if unstable parameterization theoretically is possible.
  The stability of the actual value that is produced should therefore be checked.

V carried out by specialist personnel

H *The instrument version can be determined by the type of code.*

4. Electric connections

4.2 Electric isolation



5. Operation

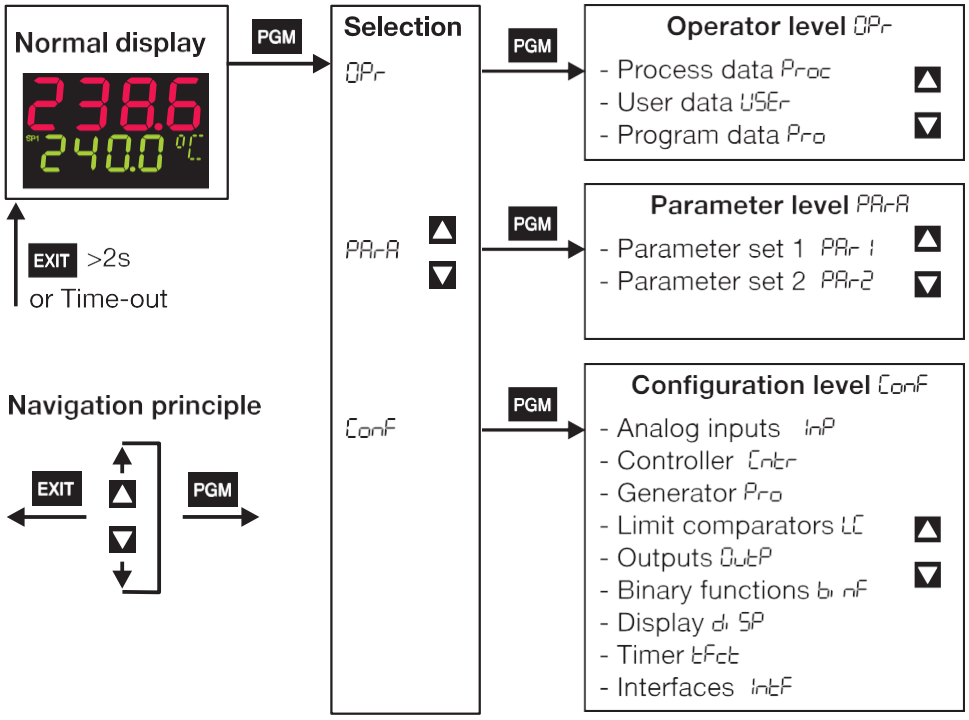
5.1 Displays and controls

(1)	**7-segment display** (factory setting: process value) four-digit, red, decimal place is configurable
(2)	(automatic adjustment on display overflow) **Active setpoint** (factory setting: SP1)
(3)	SP1, SP2, SP3, SP4 (SP=setpoint; green: **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) **(5)**	**Keys** **Indification** Yellow, for - Switch status of binary outputs 1-6 (display lights up = ON)
(6)	- manual operation is active **16-segment display for the unit °C/°F and text** two-digit, green, configurable, 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 various levels.



Time-out

If no key is pressed for 180sec, the instrument returns to normal display.

Chapter 6 “Operator level”

Chapter 7 “Parameter level”

Chapter 8 “Configuration”

v Setup/Display - Operation/Time-out

5. Operation

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 P and D (simultaneously for >5sec).
- Alter code with P (display blinks!)
- Enter code with I and D. Ex-factory: all levels enabled.
- Return to normal display with X or automatically after approx. 180sec

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

Chapter 8.6 Binary functions “binF”

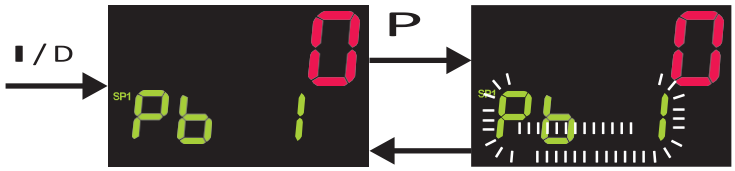
5. Operation

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 *Alter parameter*

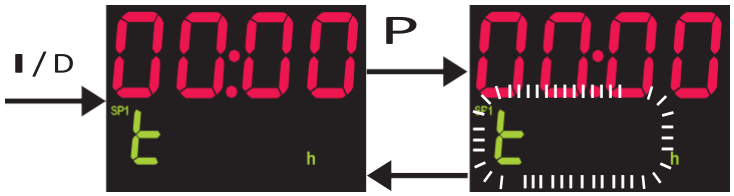


h Select parameter with I or D
h Change to entry mode with P (lower display blinks!)
h Alter value with I and D
The value alters dynamically with the duration of the key stroke.
h Accept the setting with P, or automatically
after 2sec or
h Cancel entry with X.

Entering times

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

Select parameter *Alter parameter*



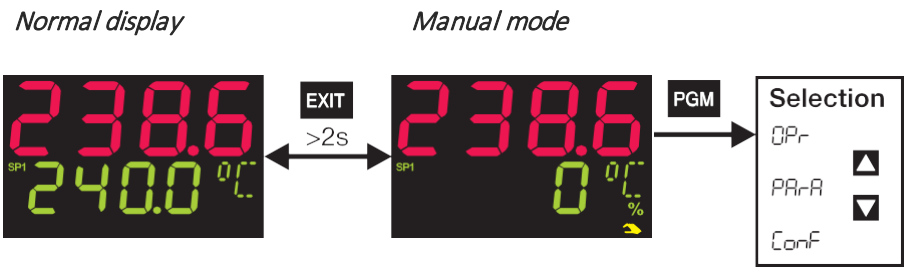
The highest time unit of the display is shown for the unit.

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

h Select parameter with I or D
h Change over to the entry mode using P (lower display blinks!)
h Alter value with I and D
The value alters dynamically with the duration of the key stroke.
h Accept the setting with P or automatically after 2sec
or
h Cancel entry with X.
The value is not accepted.

5. Operation

5.5 Fixed – set point controller (ex-factory)



Altering the Setpoint

In normal display:
h Alter the present setpoint with ❙ and D (the value is accepted automatically)

Manual mode

In manual mode, the controller output can be altered by hand.
h Change to manual mode with X (> 2 sec)

The output appears in the lower display. The hand symbol and the unit “%” light up in addition.
h Alter the output with ❙ and D

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.

h Finish manual mode with X (>2 sec)

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”

On overrange/under range and probe break, the controller automatically changes over to manual mode.

5. Operation

5.6 Program Controller

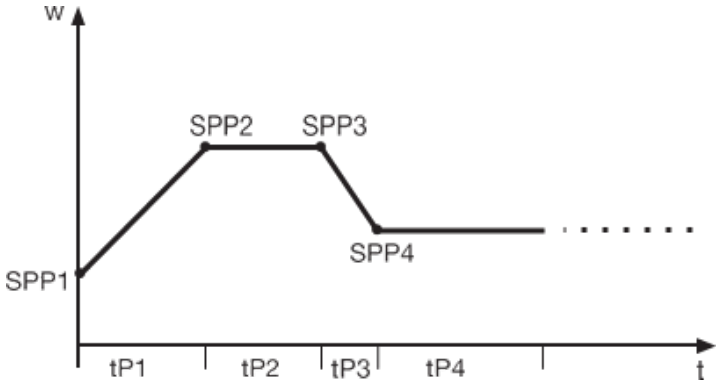
Condition as delivered

The instrument must be configured as a program controller/generator. Furthermore, a program must be entered beforehand, to operate the instrument as a program controller/generator.

5.6.1 Entering programs

Function

A set point can be implemented with maximum of 8 programs segments



Entry on the instrument

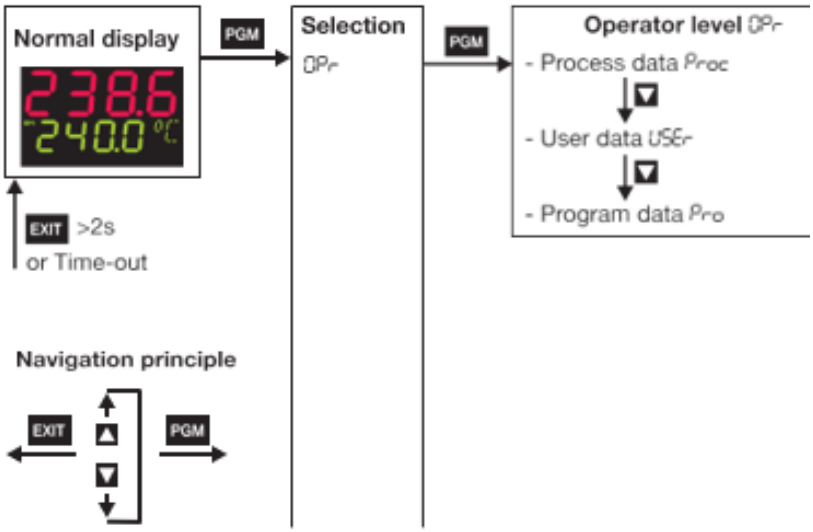
The instrument must be configured as a program controller/generator.

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

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

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

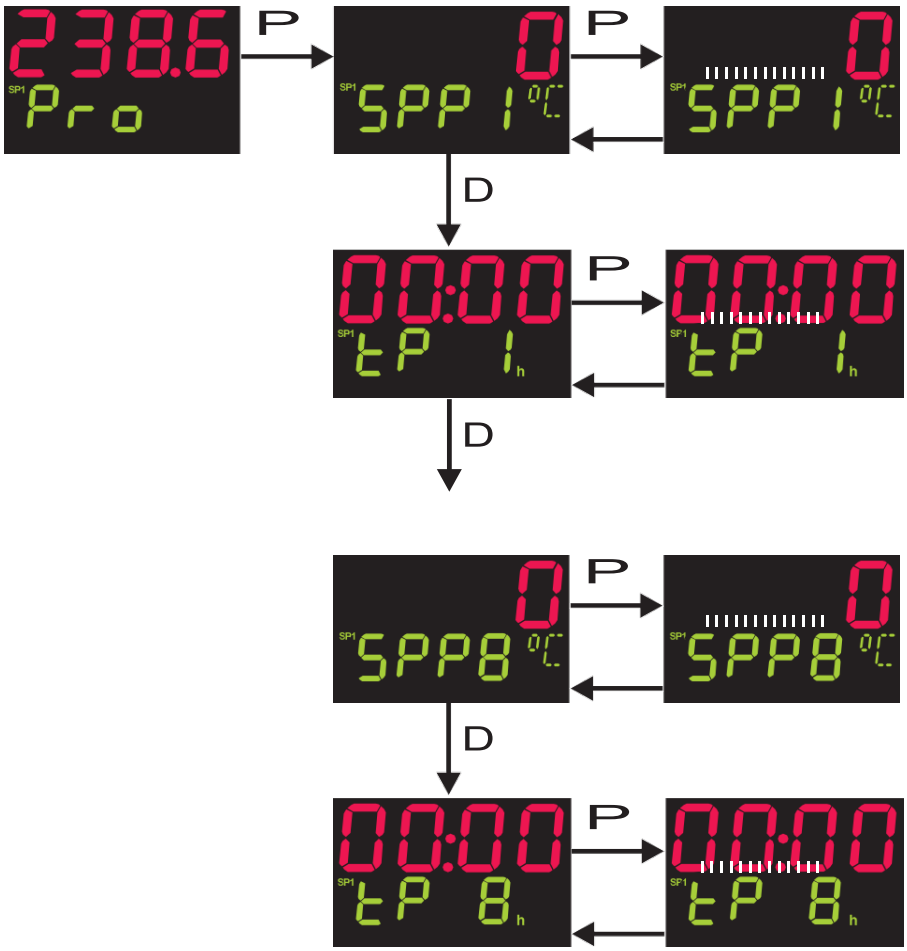
The segment setpoints (SPP1 — SPP8) and segment times (tP1 — tP8) are set at the operator level (program data).



5. Operation

5.6.1 Entering programs

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



Entry trough setup program

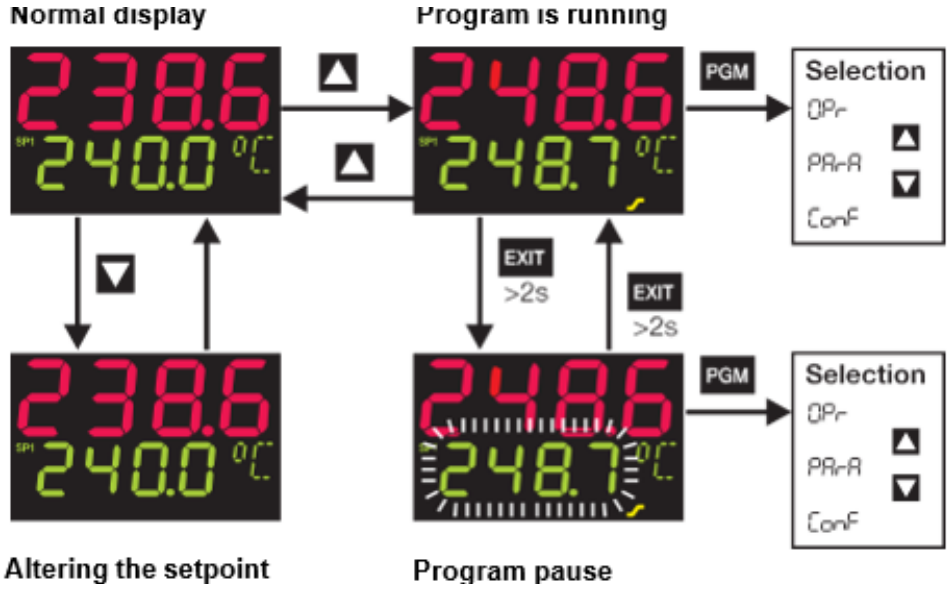
The setup program (accessory) features a user-friendly program editor, with a graphical presentation of the program profile.

Additional functions via the setup program

- Start the process value
- Response to over/under range
- Repeat program
- Set point input (ramp/step)
- Process is controlled to the most recent set point
- 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. Operation

5.6.2 Operation

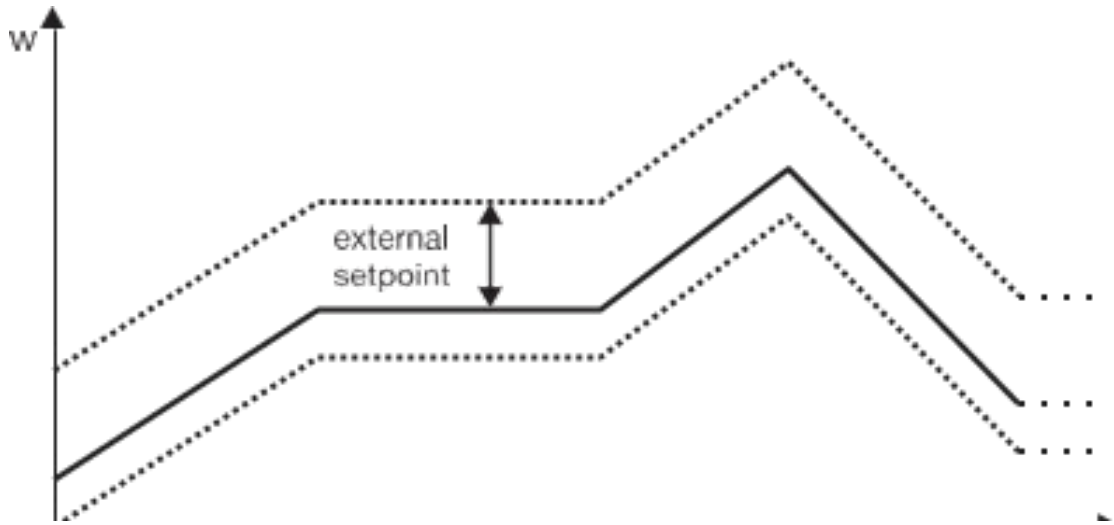


Normal display	No program run in normal display, the controller controls to the selected setpoint
Altering set point	From normal display: h Change to setpoint input with D h Alter the present setpoint with ▮ and D (the value is accepted automatically)
Starting the program	From normal display: h Start 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: h Cancel program with I
Pausing the program	When the program is running: h Pause program with X (>2 sec) (the lower display blinks!) h Continue with X (>2 sec) 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. Operation

5.6.3 Shifting the program profile

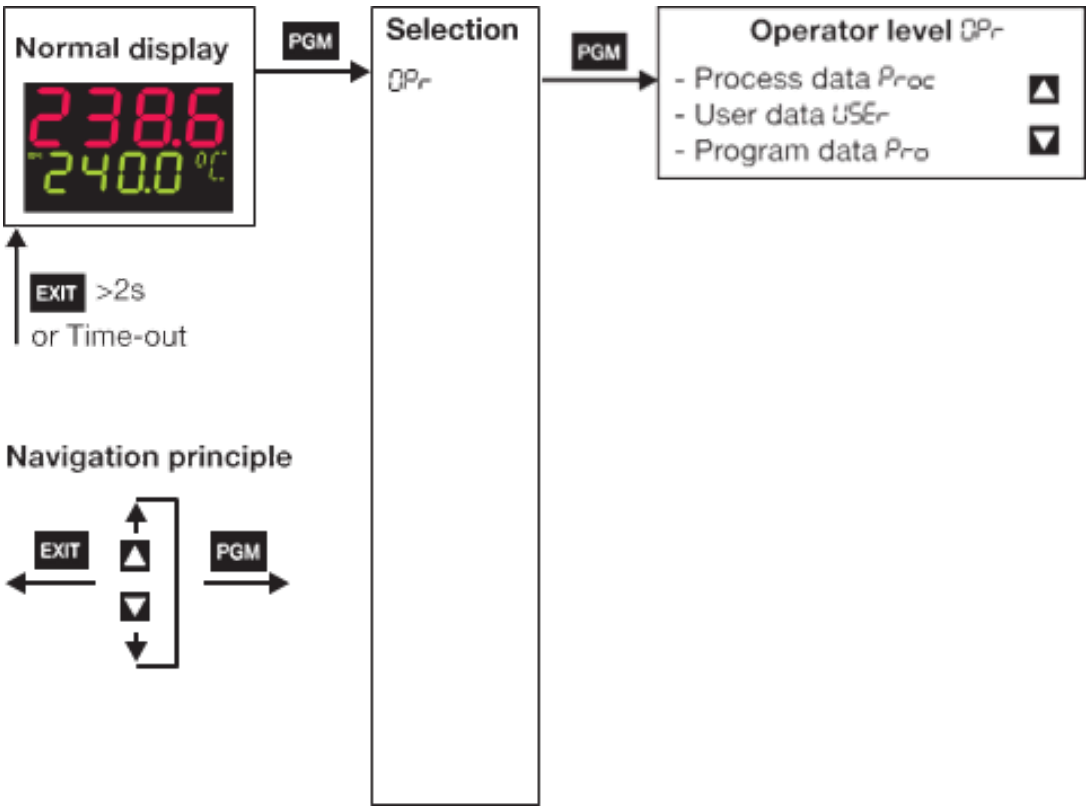
The function “External setpoint with correction” can be used to shift the program profile upwards or downwards (configurable through the setup program only).



The external setpoint is defined via an analog signal.

Chapter 8.2 Controller “Cntr”

Access

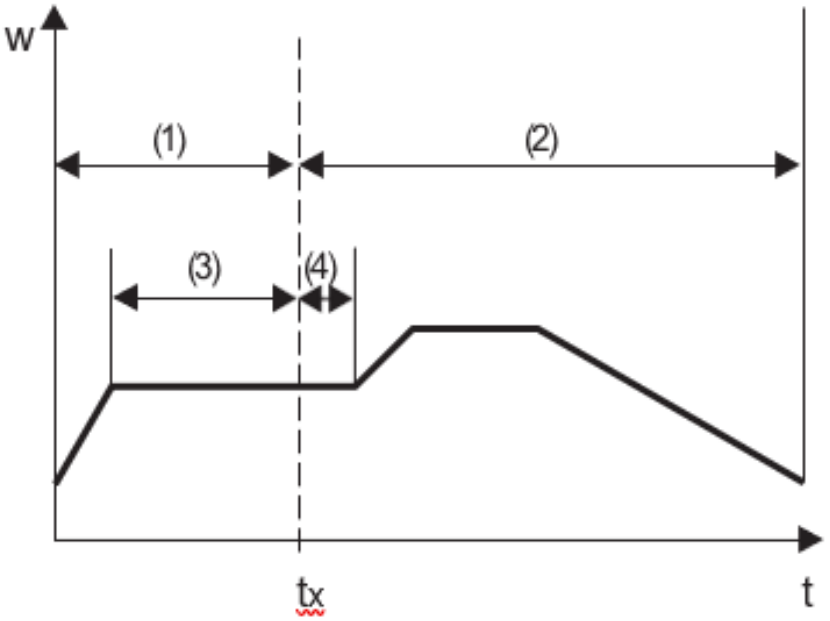


Process data

The four setpoints displayed and edited according to below information.
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)
InP1	Measurement of analog input 1
InP2	Measurement of analog input 2 (only if available)
F1	Calculated result of math formula 1 (and for difference, ratio and humidity controller)
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)
t1	Timer run time 1 (only if configured)
t2	Timer run time 2 (only if configured)

Access



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

User data "USER"

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

v Setup/Configuration Leve/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 letter and numbers are permitted that can be displayed in a 7-segment display

Program data "Pro"

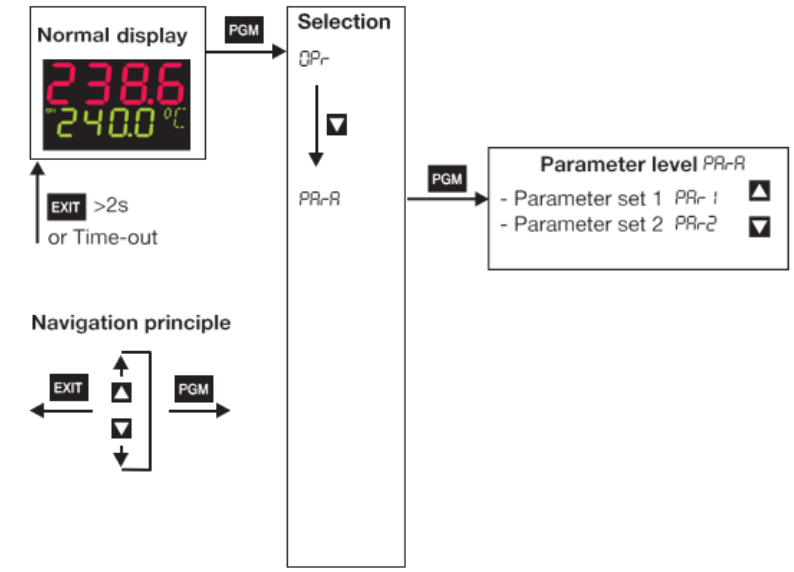
A program with up to eight segments is defined here, via the segments set points SSP1…. And SSP8 and segments tP 1….tP8

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)

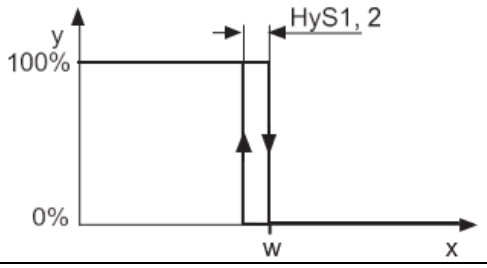
v Program editor/Program

Example

Setting a 2-state controller with

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

PArA ➔ PAr1 (PAr2)

	Display	Value range	Factory setting	Description
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	CY1	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 (dead band)	db	0.0…999.9	0	The spacing between the two control contacts for 3-state or modulating controllers.
Switching differential	HyS1	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	Y1	0…100%	100%	Maximum output limiting.
	Y2	-100…+100 %	-100%	Minimum output limiting. (only effective with PB>0!)

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.

General

H The parameter display on the instrument depends on the controller type selected.
Chapter 8.2 Controller “Cntr”

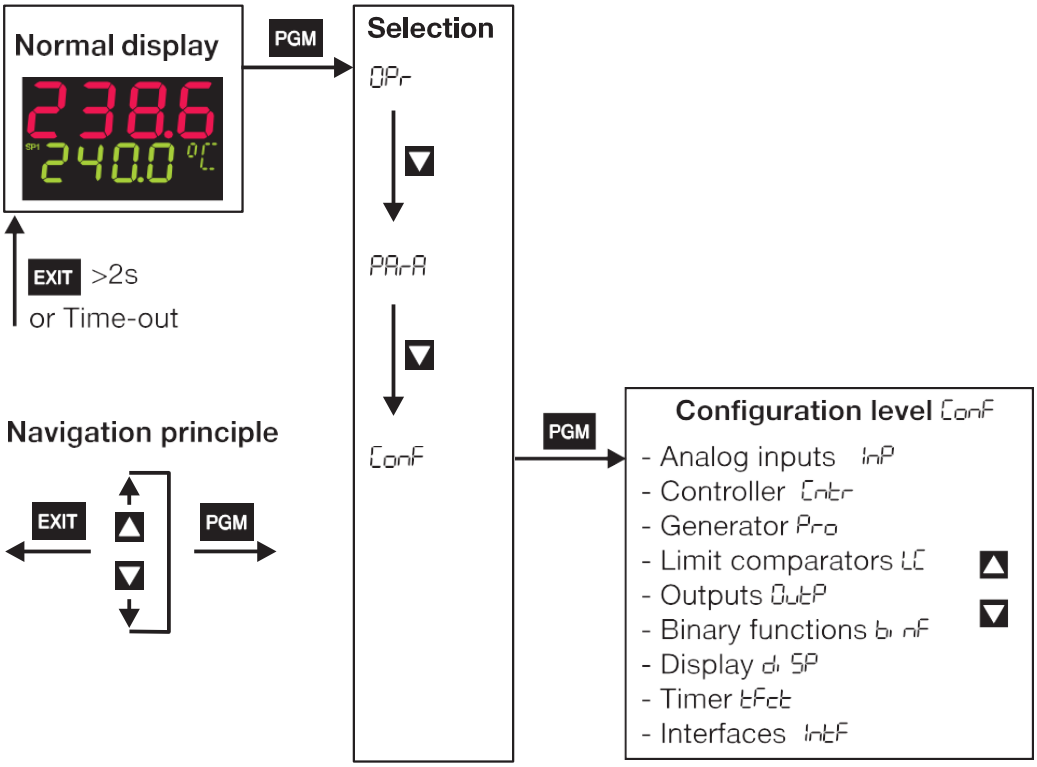
The following applies to the representation of parameters and functions at the configuration level:

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.

H 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



H Levels can be inhibited.

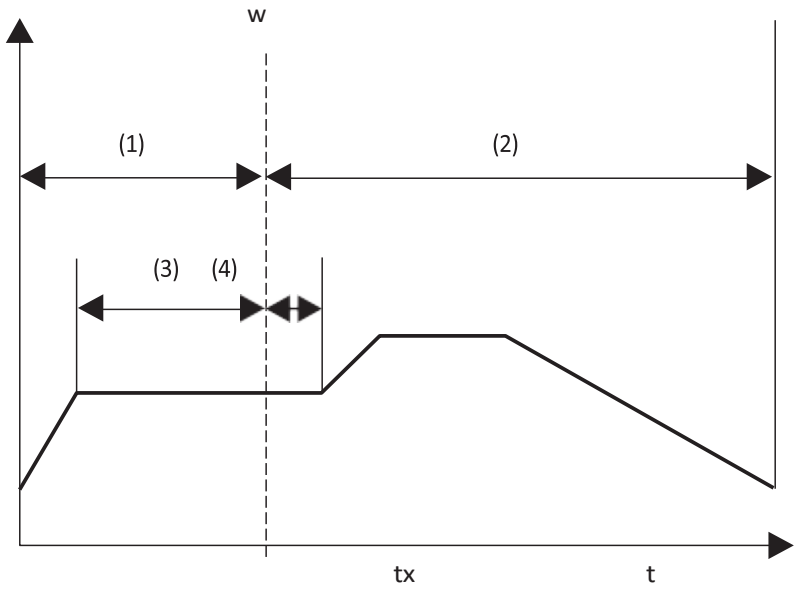
Chapter 5.3 Level inhibit

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 set point
5 ramp end value
6 program setpoint
7 math 1
8 math 2
9 set point 1
10 set point 2
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 reserved
32 reserved
33 reserved

Definition of the program times



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

8. Analog Inputs

8.1 Analog inputs ”Inp”

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Analog inputs
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InP: Analog input

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

Analog input 1 InP1 →
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 0-50mA AC (analog input 2 only)
		7	0-20mA
		8	4-20mA
		9	0-10V
		10	2-10V
		11	0-1V
			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	P110Rh-Pt S
		14	P1t13Rh-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 2kΩ at 25°C (only through the setup program).

NOTE: *Factory settings shown with **BOLD** text*

8. Configuration

8.1 Analog inputs ”Inp”

Analog input 1 InP1 →
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 / Displayed value / offset 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 cas: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…0…+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. If these values are altered by mistake, then this setting has to be canceled, using the procedure described under “Customized fine tuning”. These values can not be accepted by another instrument.
Dine tuning end value		-1999…0…+9999	
Heater current monitoring (output)	**HEAt**	0 1…10	**No function** Output 1—10 The heater current is measured via a current transformer with standard signal output and can be monitored by linking analog output 2 to a limit comparator. The input signal range is 0 — 50mA AC (see probe type: “Heater current”) and must be scaled correspondingly (display start/end). The heater current is measured when the heating contact is closed.
KTY correcting value at 25°C	**(setup)**	0…2000….4000Ω	Resistance at 25°C/77°F for linearization “KTY 11-6”

NOTE: *Factory settings shown with **BOLD** text*

8. Configuration

8.1 Analog inputs ”Inp”

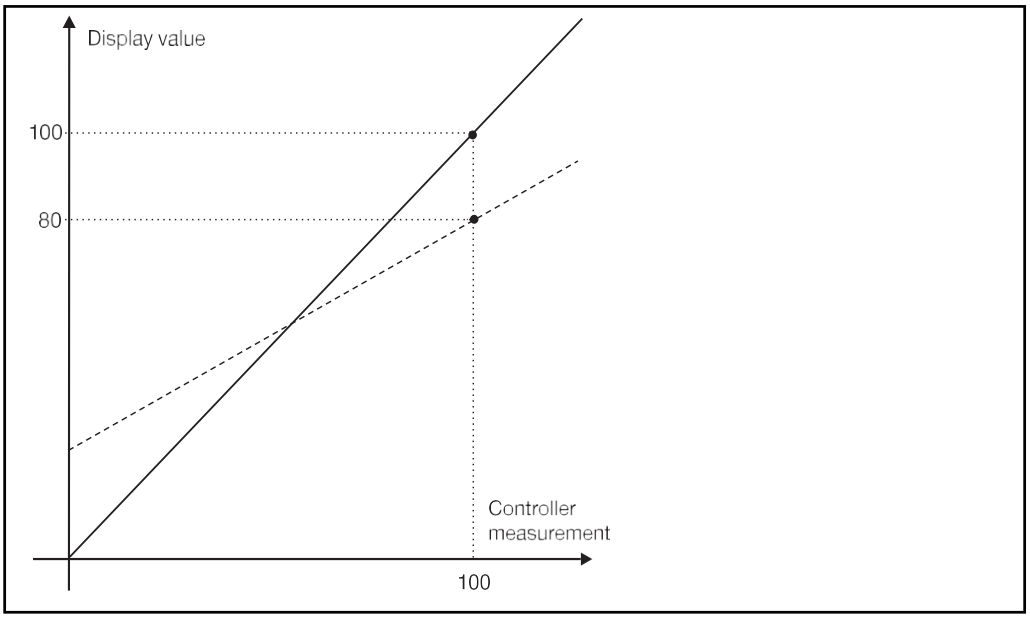
Analog inputs (general (In 12 →)

	Symbol	Value/selection	Description
Temperature unit	UNIT	**0** 1	**deg. Celsius** deg. Fahrenheit Unit for temperature valves
Sampling cycle unit	CycL	0 1 2 **3**	50msec 90msec 150msec **250msec**
Supply frequency	(set up)	50 Hz 60 Hz	Adaptation of the conversion time of the input circuitry to the supply frequency
NOTE: *Factory settings shown with **BOLD** text*			

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.



8. Configuration

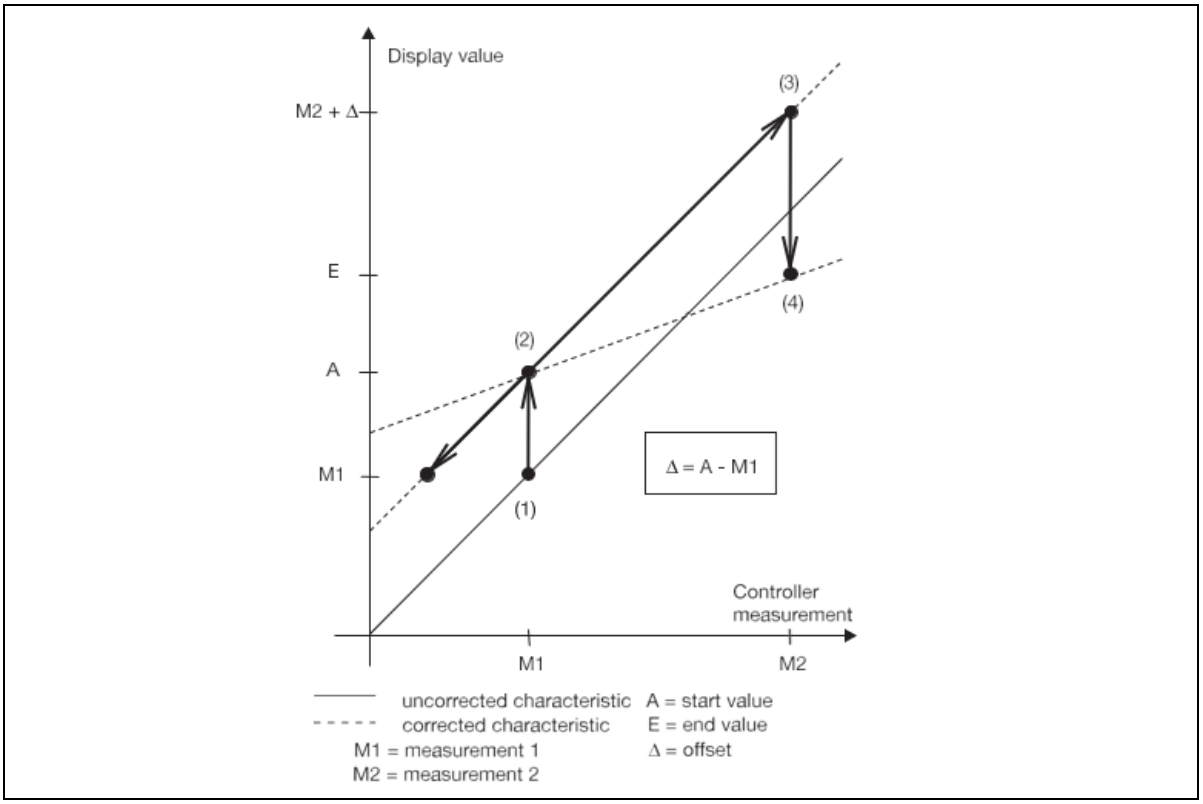
8.1 Analog inputs ”Inp”

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

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



H If fine tuning is conducted without a reference instrument, the offset □ must be taken in account when moving to measurement point (3).

To undo fine tuning the start and end values (EtS, FtE) must 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 to 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 I or D to enable correction.

8. Configuration

8.2 Controller ”Cntr”

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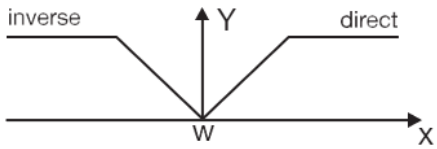
Cntr: Controller

The following are det here: controller type, input variables of the controller, the set point limits, conditions for manual mode and the presetting’s 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 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 For modulating controller: 101 = actuator is stationary. 0 = actuator closes; 100 = actuator opens
Range output	**rOut**	100…**0**…101	Output on over/underrange. 101 = last output For modulating controller: 101 = actuator is stationary. 0 = actuator closes; 100 = actuator opens
Set point 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.
Set point high	**SPH**	-1999…**+9999**	

NOTE: *Factory settings shown with **BOLD** text*

8. Configuration

8.2 Controller ”Cntr”

	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.
External setpoint	**ESP**	(analog selector) **switched off**	Activates the external setpoint input and defines the source for the external setpoint. 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. v See “Analog selector” on Page 38.
		Autotuning	
Method of tuning	**TyPt**	0 1	**Oscillation method** Step response method. v Chapter 9.1 “Autotuning (self-optimization)”
Inhibit tuning	**InHt**	0 1	**enabled** inhibited If autotuning is inhibited, it can not be started via the keys or the binary function.
Output of tuning 1 **Output of tuning 2**	**Ott1** **Ott2**	**0** **1** **2**	**Relay** Solid-state + logic Continuous The type of the physical output for the signal of the controller outputs 1 and 2 must be defined.
Controller standby output	**SOut**	-100…**0**…+100%	Initial output with step response
Step size	**StSI**	10…**30**…100%	Step with step response

NOTE: *Factory settings shown with **BOLD** text*

Analog selector

0 no function
1 analog input 1
2 analog input 2
3 Process value
4 present
5 ramp end value
6 program set point
7 math 1
8 math 2
9 set point 1
10 set point 2
11 set point 3
12 set point 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 tun time for timer in sec
28 residual tun time for timer in sec
29 present segment end value
30 analog marker (Profibus)
31 reserved
32 reserved
33 reserved

8. Configuration

8. 3 Generator ”Pro”

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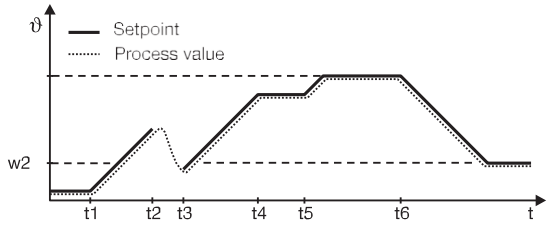
Pro: (Program) Generator

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.

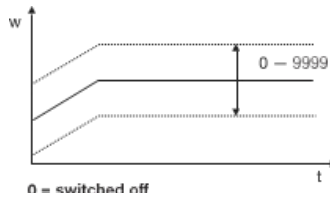
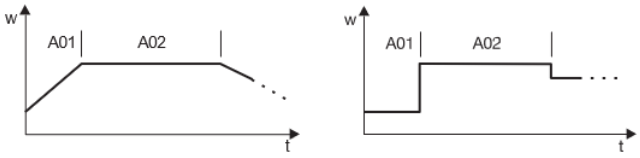
Function

Symbol	Value/selection	Description
		General
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 and can be altered from the ▮ and D keys, just as for a fixed-setpoint controller.  The ramp function can be paused or canceled via the binary functions. The ramp function is interrupted on a probe break, or for manual mode. The outputs react as for overrange/ underrange (configurable). Program generator: Is used, for instance, to output the setpoint profile via a continuous output without a control function. Settings for the program generator are not evaluated regarding the process value (e. g. start at process value, continue, tolerance band).

NOTE: *Factory settings shown with **BOLD** text*

8. Configuration

8. 3 Generator ”Pro”

	Symbol	Value/selection	Description
			General
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.
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.  Example: Signal is produced when process value is 20 °C larger or smaller than setpoint. toLP=40 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/under range
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.
Set point repeat	**(setup)**	**Ramp** Step	Setpoint ramp Setpoint step 
Control to the most recent set point	**(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).

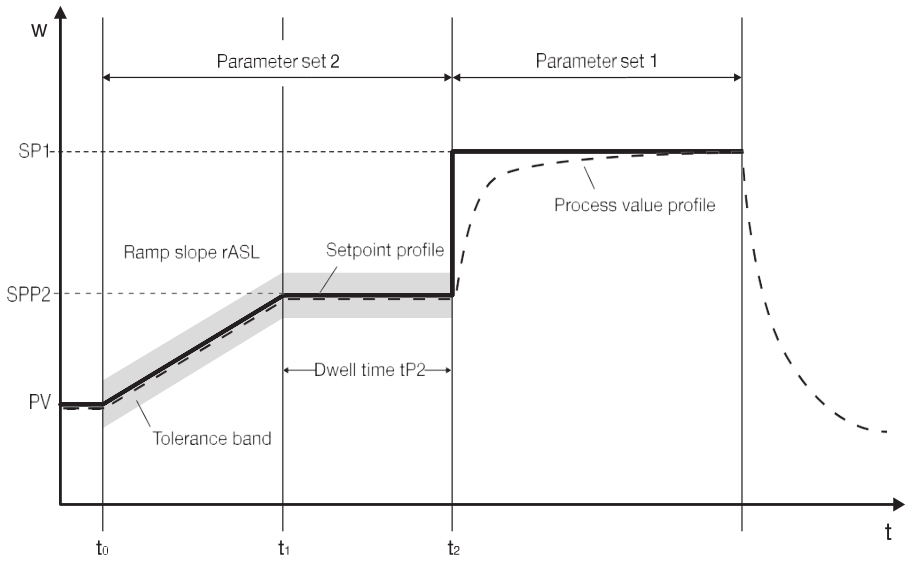
NOTE: *Factory settings shown with **BOLD** text*

8. Configuration

8. 3 Generator ”Pro”

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 set point 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 I 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"

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LC: Limit comparator

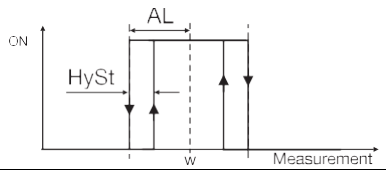
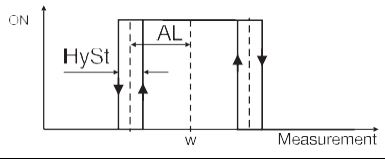
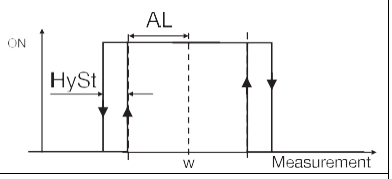
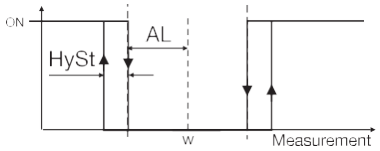
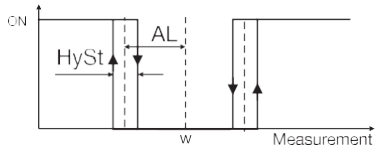
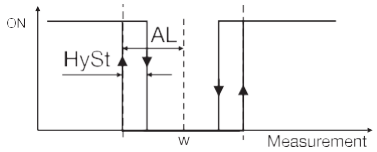
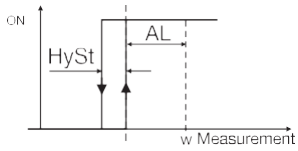
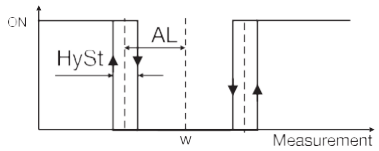
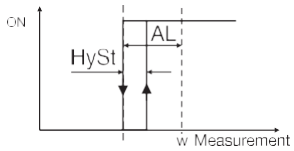
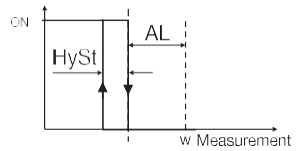
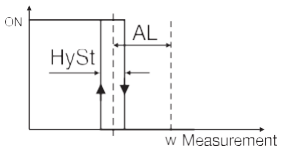
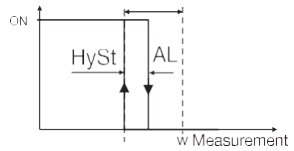
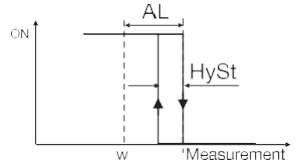
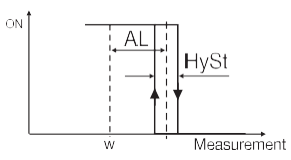
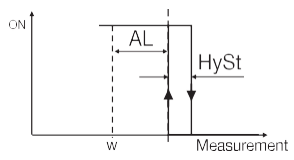
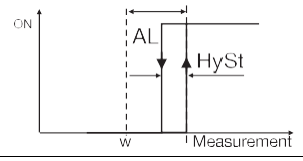
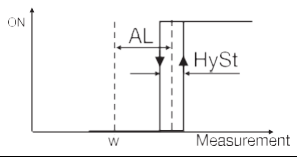
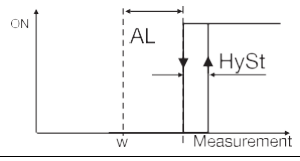
Limit comparators (threshold monitors, limit contacts) can be used to monitor an input variable (process value for the limit comparator) against a fixed limit or another variable (the setpoint for the limit comparator). When a limit is exceeded, a signal can be output or an internal controller function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

4 limit comparators are available

Limit comparators function (IK)

Limit comparators can have different switching functions.

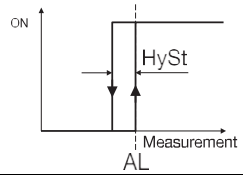
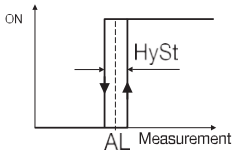
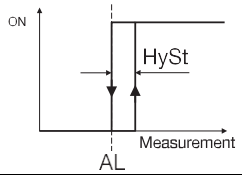
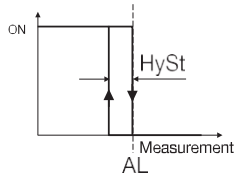
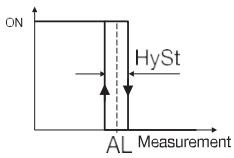
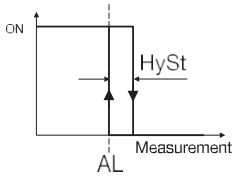
The hysteresis functions "asymmetrical, left" and "asymmetrical, right" can only be set through the setup program.
The "symmetrical" hysteresis function is used as standard.

	Hysteresis function		
	asymmetrical, left	**symmetrical**	**asymmetrical, right**
Ik1			
Ik2			
Ik3			
Ik4			
Ik5			
Ik6			

8. Configuration

8. 4 Limit comparators" LC"

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.

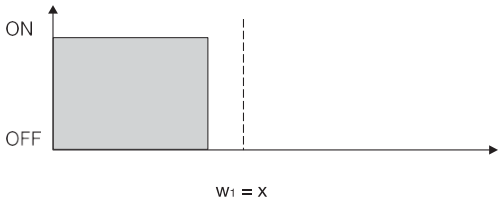
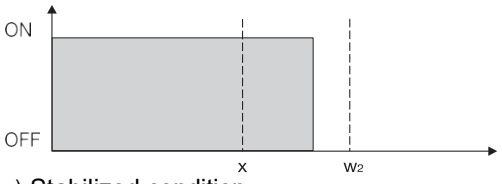
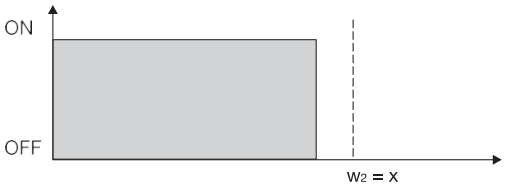
	Hysteresis function		
	asymmetrical, left	**symmetrical**	**asymmetrical, right**
lk7			
lk8			

Limit comparator 1 LC1 ➔
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

8. Configuration

Limit comparator 1 LC1 ➔
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	**t0n**	**0**…9999	Delays the switch-on edge by a definable time period
Switch-off delay	**t0FF**	**0**… 9999s	Delays the switch-off edge by a definable time period

NOTE: *Factory settings shown with **BOLD** text*

8. Configuration

Limit comparator 1 LC1 ➔
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 D + X 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) **process value**	see circuit diagrams
Limit comparator SP	**LCSP**	(analog selector) **present setpoint**	see circuit diagrams (only with lk1—lk6)
Hysteresis function	**(setup)**	**symmetrical** asymmetrical, left asymmetrical, right	see circuit diagrams Chapter 12.2 “Alarm messages”

NOTE: *Factory settings shown with **BOLD** text*

Analog selector

0 no function
1 analog input 1
2 analog input 2
3 process value
4 present set point
5 ramp end value
6 program set point
7 math 1
8 math 2
9 set point 1
10 set point 2
11 set point 3
12 set point 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 time in sec
25 timer run timer 1 in sec
26 timer run rimer 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 reserved
32 reserved
33 reserved

8. Configuration

8.5 Outputs "OutP"

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

OutP: Outputs

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.

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

Numbering of the outputs

Standard for all instrument versions:
(Binary) output 1 (Out1) = relay (Binary) output 2 (Out2) = relay (Binary) output 3 (Out3) = logic output (Binary) output 4 (Out4) = logic output

Extended numbering for the option slots:

Slot	Plug-in board with 1 analog output	Plug-in board with 1 binary output (relay or solid- state relay)	Plug-in board with 1 binary output (2 relays)
Option 1	Output 5 (Out5)	Output 5 (Out5)	Output 5+8 (out5/Out8)
Option 2	Output 6 (Out6)	Output 6 (Out6)	Output 6+9 (out6/Out9)
Option 3	Output 7 (Out7)	Output 7 (Out7)	Output 7+10 (out7/Out10)

Symbol	Value/selection	Description
Binary output 1 Out1	**0**	**no function**
....	**1**	**Controller output 1** (ex-factory with Out1)
	2	Controller output 2
	5	Binary input 1
	6	Binary input 2
	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
Binary Output 10 Out0	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
	29	Manual mode on/off
	29	Binary marker
	30	Any binary value from storage address (only through setup)
	31	Always active

NOTE: *Factory settings shown with **BOLD** text*

8. Configuration

8.5 Outputs “OutP

Analog outputs 0utA ➔ ***Output 5*** 0ut5 ➔
Output 6 0ut6 ➔
Output 7 0ut7 ➔

	Symbol	Value/selection	Description
Function	Sign	0 1 **2** 3	0 — 10V 2 — 10V **0— 20mA** 4— 20mA Physical output signal
Range output	r0ut	**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 in chapter “Controller Cntr” under rOut. Chapter 8.2 “Controller “Cntr””
Zero point	0Pnt	-1999… **0**…+9999	A physical output signal is assigned to the value range of an output variable. Ex-factory, the setting corresponds to an output level of 0 — 100% for controller outputs. 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 ☞ **Setting for controller outputs for cooling** With 3-state controllers, the following settings must be predefined: zero: 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

NOTE: *Factory settings shown with **BOLD** text*

Analog selector

0 no function
1 analog input 1
2 analog input 2
3 process value
4 present set point
5 ramp end value
6 program set point
7 math 1
8 math 2
9 set point 1
10 set point 2
11 set point 3
12 set point 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 time in sec
25 timer run timer 1 in sec
26 timer run rimer 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 reserved
32 reserved
33 reserved

8. Configuration

8.6 Binary functions “binF”

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

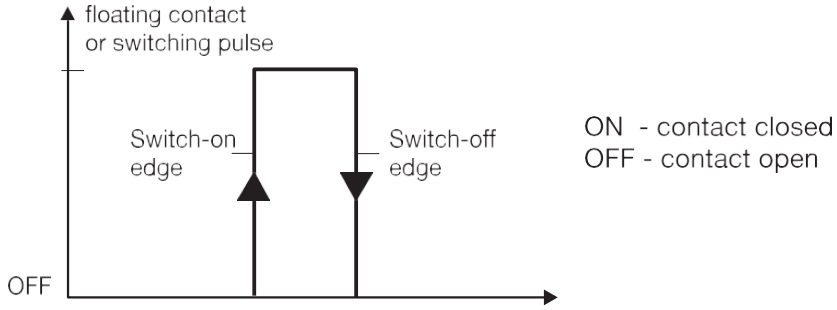
binF: Binary functions

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

8. Configuration

8.6 Binary functions “binF”

	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
Logistic 1	**Lo1**	16	Pause program
		17	Cancel program
Logistic 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
Tolerance limit signal	**toLS**		The parameter and configuration levels are inhibited. In addition, the start of autotuning is inhibited
Program end signal	**PrES**		Program end signal: The signal is active after approx. 1 second (pulse) Text display: If the binary functions are active, a configurable text is shown in the lower display. The text can be uniquely defined (only through the setup program)
NOTE: *Factory settings shown with **BOLD** text*			

Set point and parameter set switching

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

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

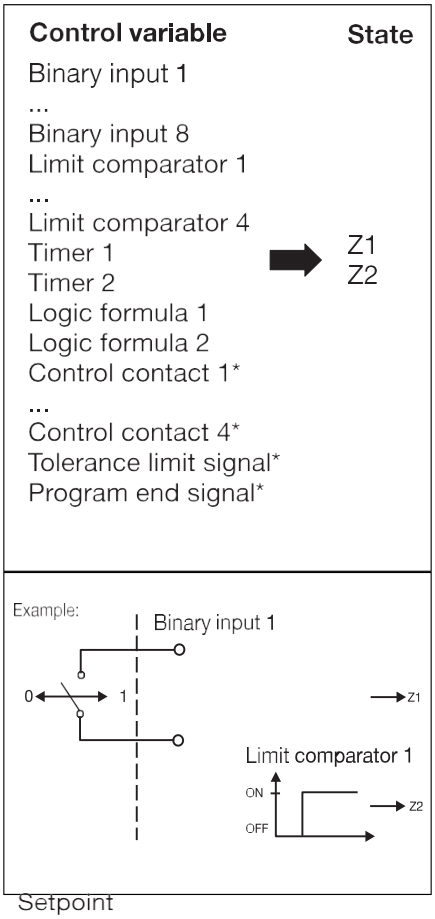
In order to switch between the four possible set points, two binary functions must be configured to set point switching. The stats of the two binary functions are designated Z1 ab z” and switch the set points over as shown in the table below.

Set points	Z2	Z1
Set point 1	0	0
Set point 2	0	1
Set point 3	1	0
Set point 4	1	1
0 = contact open/OFF - 1 = contact closed/ON		

8. Configuration

8.6 Binary functions “binF”

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

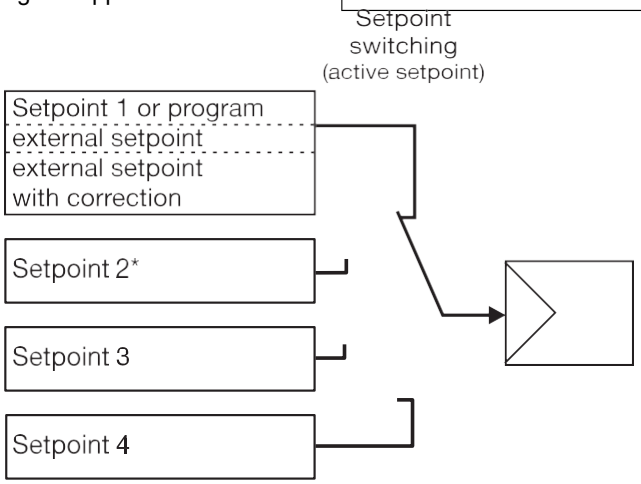


Example
The set point is to be selected via a binary
input and the state of one limit comparator.

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 “set point switching”

Depending on the further configuration, the following diagram applies:



*** An exception to this is the configuration for a program controller with external set point, with or without corrections. Set point 2 is the program set point in this case.**

Additional functions via the set-up 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”

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

diSP: Display

The values displayed can be matched to the existing requirements. Furthermore, time-out and level inhibit can be configured here

	Symbol	Value/selection	Description
Upper display	d iSU	(analog selector) **controller process value**	Displayed value for the upper display
Lower display	d iSL	(analog selector) **controller set point**	Displayed value for the lower display
Decimal point	dEcP	**0** 1 2	**no decimal place** one decimal place two decimal places If the value is be displayed can no longer be represented with the programmed decimal point, then the number of decimal places will automatically reduce. If subsequently the measured value decreases the number increases to the programmed value of the decimal point,
Brightness	br iG	**0**…5	(bright) 0—5 (dark)
16-segment display	(set up)	switched off **Unit** current segment current parameter set text	Displayed value for the two-digit 16-segment display
Timeout	(set up)	0…**180**…255s	Time period, after which the instrument automatically returns to normal display if no key is pressed.
Level inhibit	(set up)	**None** configuration level parameter/ configuration level operator/ parameter/ configuration level	The access to the individual levels can be inhibited. The setting is independent of the binary function “level inhibit.” Inhibiting the parameter level will, at the same time, also inhibit the start of autotuning.
User data (setup program)			
Up to eight parameters from various 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.			

NOTE: *Factory settings shown with **BOLD** text*

8. Configuration

8.7 Display “diSP”

Analog selector

0 no function	21 program run time in sec
1 analog input 1	22 residual program time in sec
2 analog input 2	23 segment run time in sec
3 process value	24 residual time in sec
4 present set point	25 timer run timer 1 in sec
5 ramp end value	26 timer run rimer 2 in sec
6 program set point	27 residual run time for timer 1 in sec
7 math 1	28 residual run time for timer 2 in sec
8 math 2	29 present segment end value
9 set point 1	30 analog marker (Profibus)
10 set point 2	31 reserved
11 set point 3	32 reserved
12 set point 4	33 reserved
13 controller output level	
14 controller output 1	
15 controller output 2	

8. Configuration

8.8 Timer “tFct”

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

tFct: Timer

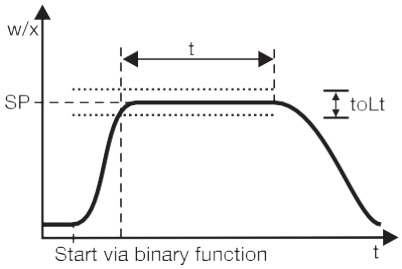
Timme-dependent control actions can be conducted with the help of the timer. The timer signal (timer 1+ 2) shows whether the timer is active. It can be output via the binary outputs or processed internally.

The timers are started or canceled via the binary functions.

v Chapter 8.6 “Binary functions “binF””

The current timer run times 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 4 5 6	**no function** with timer running: timer signal=1 (signal is active) / unit of time: hh:mm with timer running: timer signal=0 (signal is inactive) / unit of time: hh:mm tolerance band / unit of time: hh:mm with timer running: timer signal=1 (signal is active) / unit of time: mm:ss with timer running: timer signal=0 (signal is inactive) / unit of time: mm:ss tolerance band / unit of time: mm:ss Function: “Tolerance band”  Time is running when the process value has reached a tolerance band around the setpoint. Timer signal=1 (signal is active) while time is running.
Timer level	t	0...99:59	Time input (unit of time, see “Function”)
Tolerance limit	toLt	**0**…999	0=off
	User data (setup program)		
	Up to eight parameters from various 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.		

NOTE: *Factory settings shown with **BOLD** text*

8. Configuration

8.9 Interface “intE”

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

intE: Interface

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 Pr0F ➔

	Symbol	Value/selection	Description
Protocol	Prot	0 **1** 2	Motorola **Intel** Intel integer
Device address	Adr	0…**125** …255	Address in data network
Analog marker	AnAP	-1999…**0**…+9999	Analog value
Binary marker	binP	**0** …255	Binary value

NOTE: *Factory settings are shown in* ***BOLD***

PR 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 bit, 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.

NOTE: *Factory settings are shown in* ***BOLD***

H Interface description B70.3041.2

8. Configuration

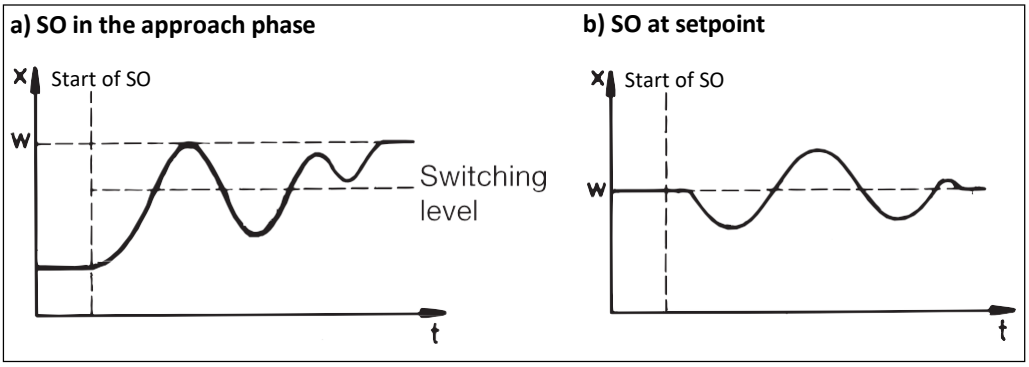
8.9 Interface “intE”

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%) must 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

8. Configuration

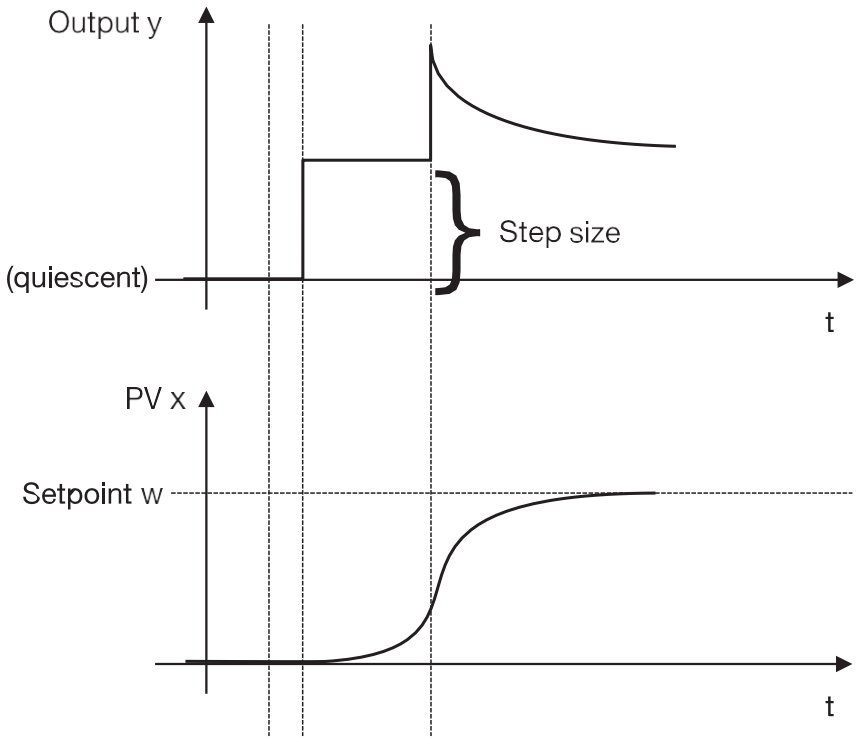
8.9 Interface “intE”

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 must 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!)

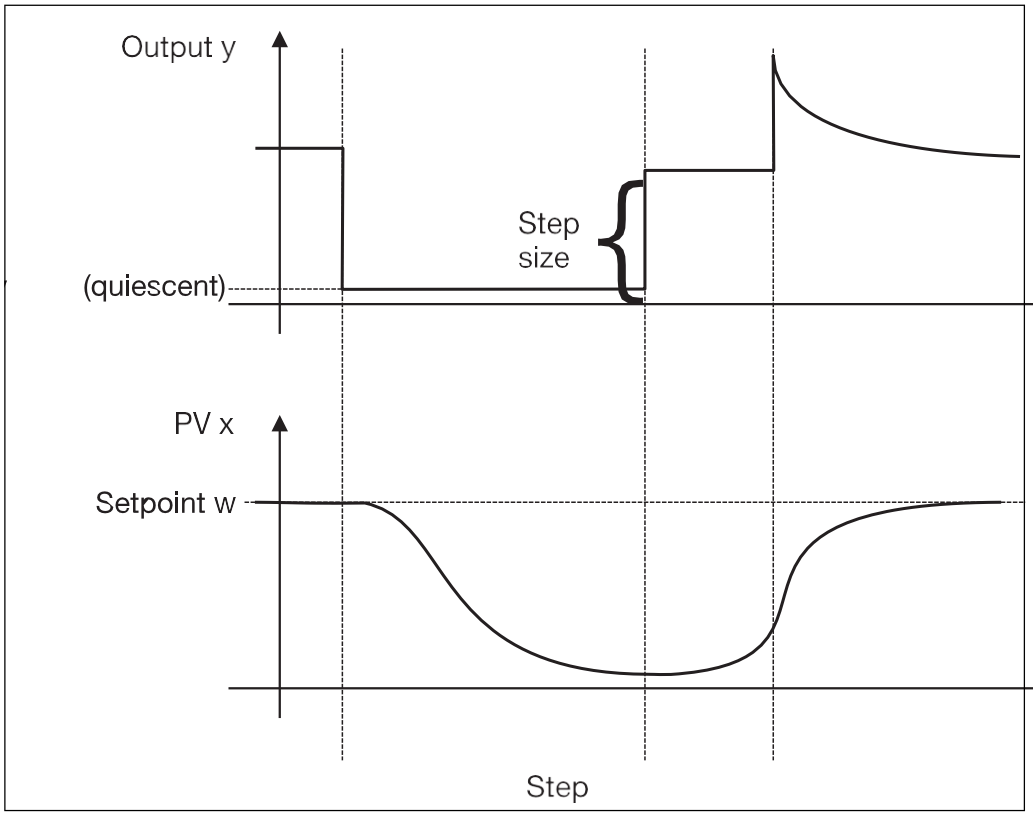
Start of autotuning after power-on and during the approach phase



8. Configuration

8.9 Interface “intE”

Start of autotuning during operation



Starting auto- tuning

h Start with ▮ and D (simultaneously >2sec
“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.

H The controller output types must be defined for autotuning.

v Chapter 8.2 “Controller “Cntr””

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

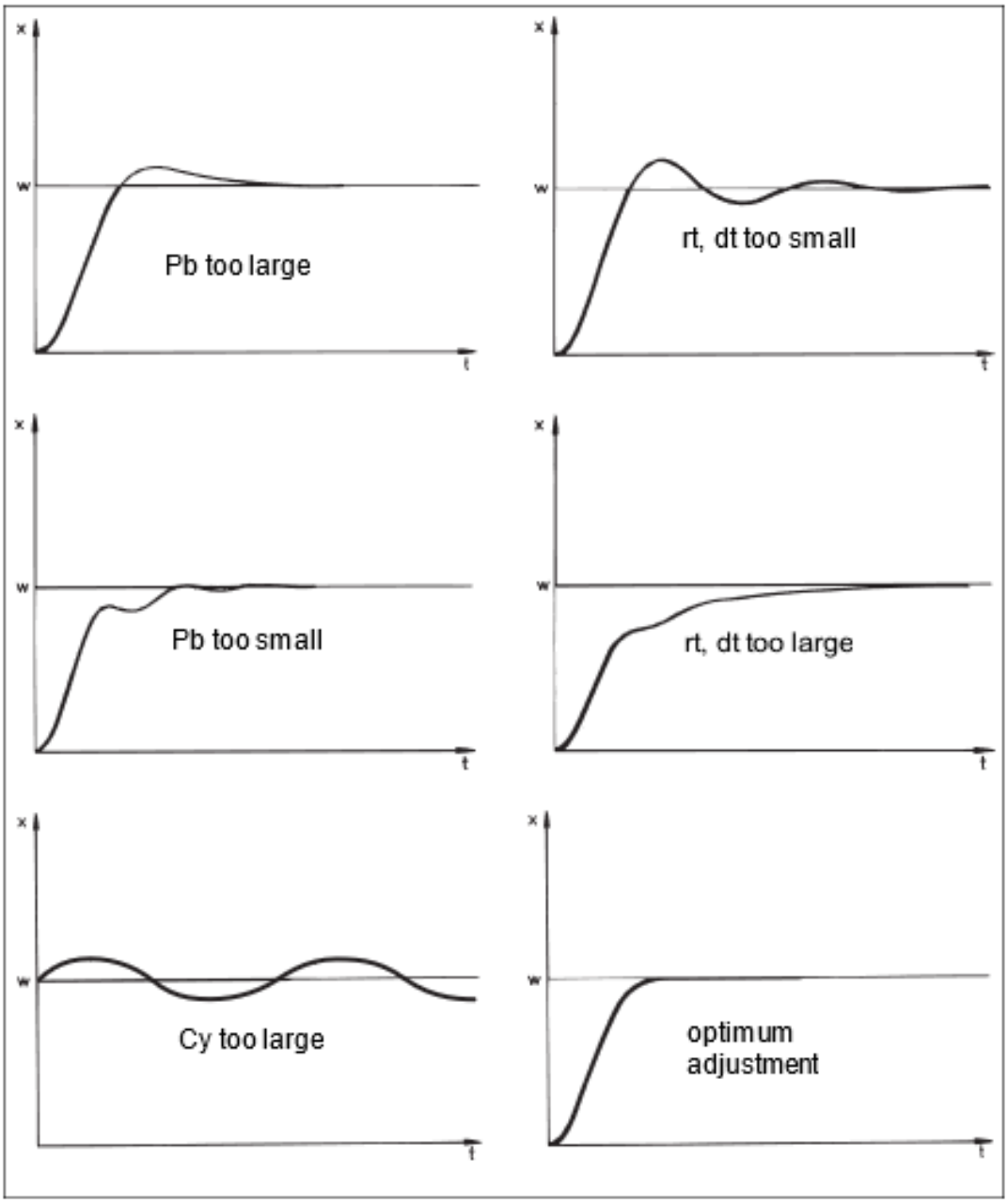
Canceling auto - tuning

h Cancel with ▮ and D (simultaneously)

9. Check 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 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. Extra codes

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 formula

- 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 or radio controller

Radio control

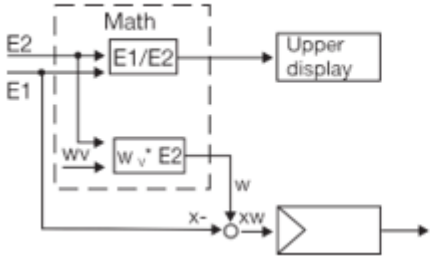
The controller is preset either as a difference/humidity or ratio controller (extra code) or must be configured via the setup program. Analog input 2 must be available.

v Setup/Only setup/Math/Logic/Math 1

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

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 function “Math 1” and displayed.
The required ratio E1/E2 is programmed as the setpoint (ratio setpoint) in the setpoint definition.

Ratio: E1/E2



E1 = analog input 1
E2 = analog input 2
w = setpoint
wv = ratio setpoint
x = process value
xw = control deviation, controller

10. Extra codes

10.2 Difference, humidity, or radio controller

For the controller to function as a ratio controller, further settings must be made:

- controller process value: analog input 1
- external setpoint: ramp end value

Chapter 8.2 “Controller “Cntr””

If the ratio needs to be displayed, then one display must be configured to “Math 1”.

Chapter 8.7 “Display “diSP””

Humidity control

A psychrometric humidity sensor is used to determine relative humidity, through the mathematical combination of wet bulb and dry bulb temperatures.

relative humidity: (E1, E2)

E1 – analog input 1
E2 – analog input 2

Fort he controller to function as a difference controller, settings have to be made:

- controller process value math 1

Chapter 8.2. Controller “Cntr”

If the value for relative humidity needs to be displayed, the one display must be configured to “Math 1”

Chapter 8.7. “Display “diSP”

Difference control

The difference between the measurements from analog input 1 and 2 is formed and made available via “Math 1”.

Difference: E1-E2

E1 – analog input 1
E2 – analog input 2

For the controller function as a difference controller, further settings have to made:
- controller process value : math 1

Chapter 8.2. Controller “Cntr”

If difference is to be displayed, then one display must be configured to “math 1”

Chapter 8.7. Display “diSP”

11. Retrofitting of modules

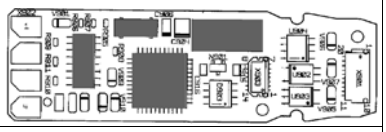
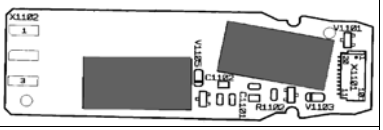
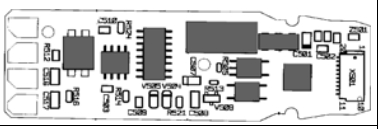
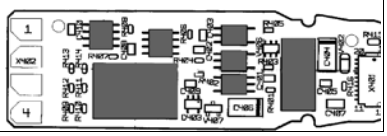
The following steps are necessary for retrofitting modules:

Safety notes

A Retrofitting must only be conducted by qualified professional persons.

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

Identifying the module

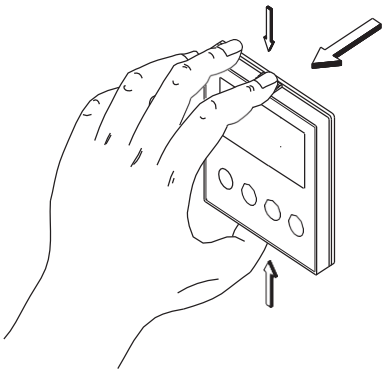
Module	Sales no.	View of boards
Analog input	1-0158221	
2 relays	1-0158222	
Analog output	1-0158223	
RS422/485 interface	1-0158225	

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

11. Retrofitting of modules

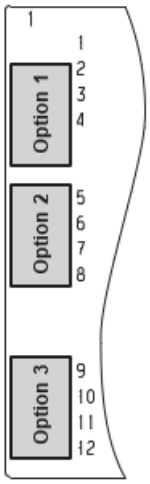
Removing the controller module

h 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.

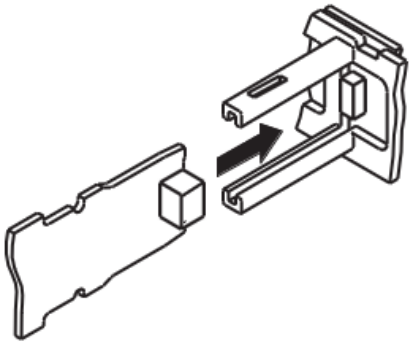


Retrofitting of modules

h Select the slot for the option



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



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

12. Technical data (appendix)

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} > 100k□	≤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. 100□, max. 4k□	≤0.5%	100 ppm / °C

Binary inputs

Floating contacts	

Standard version

12. Technical data (appendix)

Measuring circuit monitoring

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

Sensor	Overrange / under range	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) contact rating contact life	**3A at 230VAC resistive load 350,000 operations at rated load / 750,000 operations at 1A**
Logic output	0/12V / 30 mA max. (sum of all output currents) or 0/18V / 25 mA max. (sum of all output currents)
Solid-state relay (option) contact rating protection circuitry	1A at 230V varistor
Voltage (option) output signals load resistance accuracy	0 — 10V / 2 — 10V R_{load} ≥ 500Ω ≤0.5%
Current (option) output signals load resistance accuracy	0 — 20mA / 4 — 20mA R_{load} ≥500Ω ≤0.5%
Supply voltage for 2-wire transmitter voltage current	electrically isolated, not stabilize 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

12. Technical data (appendix)

Electrical data

Supply voltage (switchmode PSU)	110 — 240 V AC -15/+10%, 48 — 63Hz 20—30 V AC/DC, 48—63Hz
Electrical safety	to EN 61 010, Part 1 Overvoltage category II, pollution degree 2 for type 703041 with supply 20 — 30 AC/DC connect to SELV and PELV only
Power consumption	8VA max.
Data backup	EEPROM
Electrical connection	at the back, via screw terminals, conductor cross-section up to 2.5 mm^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)	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. Technical data

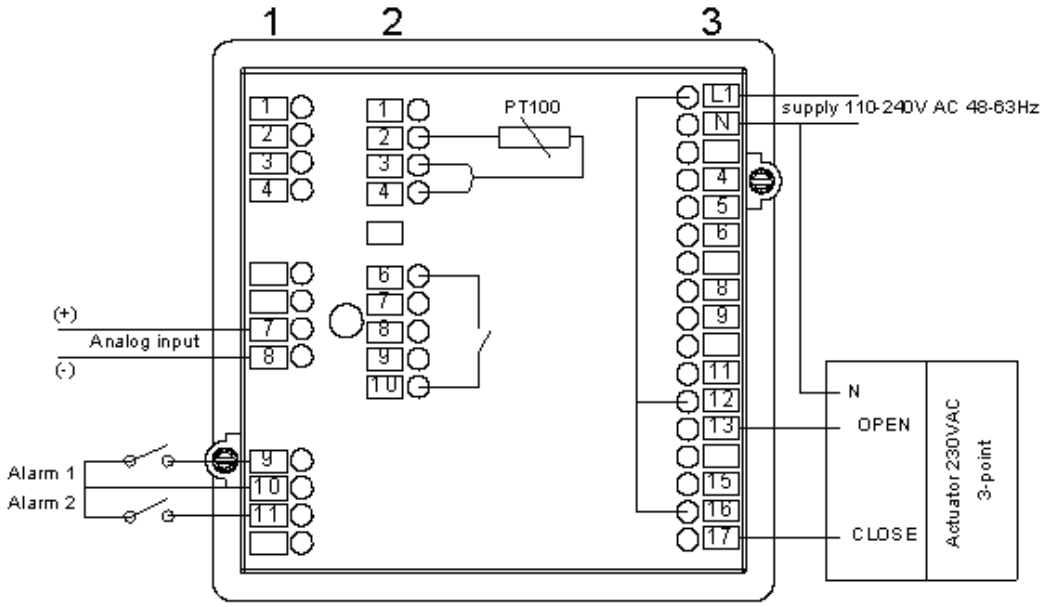
Alarm messages

Display	Cause	Fault removal test/repair/replace
-1999 (blinking!)	Under range 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.
PrOF	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 / under range covers the following events:
- Probe break or short-circuit
- Measurement is outside the controllable range for the probe that is connected
- Display overflow

13. Wiring ER2022S – 3-points

Controller ER2022S – 3-points



ER2022S

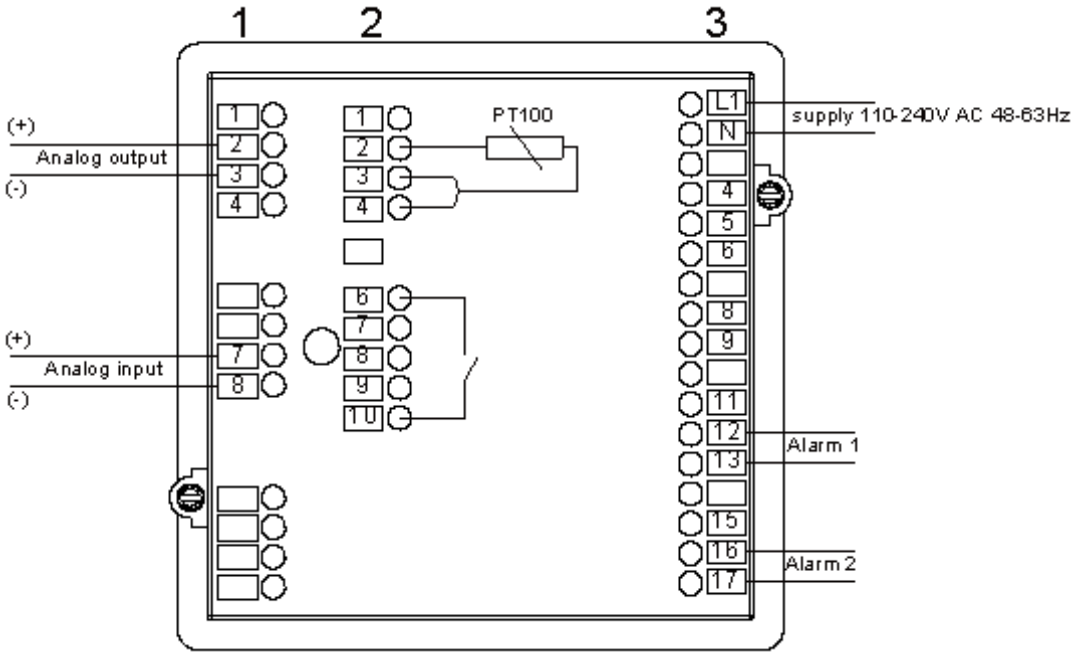
Terminal strip 1		
7	Input signal 4-20mA (+)	set point controller signal 4 mA - 65 °C/ 20 mA - 95°C
8	Input signal 4-20mA (-)	
9	ALARM 1	
10	ALARM common	
11	ALARM 2	
Terminal strip 2		
2	Input /PT100 -three-wire/ E	
3	Input /PT100 -two-wire/ S	
4	Input /PT100 -two-wire/ A	
6	Binary PT100 / Input 4-20mA	
10		
Terminal strip 3		
L1(+) and N(-)	Voltage supply 110-240VAC	
8 (+)	Supply voltage for 2-wire transmitter (off-load voltage approx. 25V)	17V/20mA
9 (-)		
13	OPEN	
17	CLOSE	

Shielded cables should been used.
It is recommended to use the cable end clamps when installing the wire.

ELECTRIC CONNECTION
at the back, via screw terminals, conductor cross-section up to 2.5 mm2
with core ferrules (length: 10mm)
Please refer to the instruction depending on the type of actuator

13. Wiring ER2022S – 3-points

Controller ER2022SA – analog



ER2022SA

Terminal strip 1		
2	Output signal 4-20mA (+)	
3	Output signal 4-20mA (-)	
7	Input signal 4-20mA (+)	set point controller signal
8	Input signal 4-20mA (-)	4 mA - 65 °C/ 20 mA - 95°C

Terminal strip 2		
2	Input /PT100 -three-wire/ E	
3	Input /PT100 -two-wire/ S	
4	Input /PT100 -two-wire/ A	
6	Binary PT100 / Input 4-20mA	
10		
Terminal strip 3		
L1(+) and N(-)	Voltage supply 110-240VAC	
8 (+)	Supply voltage for 2-wire transmitter (off-load voltage approx. 25V)	17V/20mA
9 (-)		
12,13	ALARM 1	
16,17	ALARM 2	

Shielded cables should been used.
It is recommended to use the cable end clamps when installing the wire.

ELECTRIC CONNECTION.
at the back, via screw terminals, conductor cross-section up to 2.5 mm2
with core ferrules (length: 10mm)
Please refer to the instruction depending on the type of actuator

13. Wiring ER2022S – 3-points

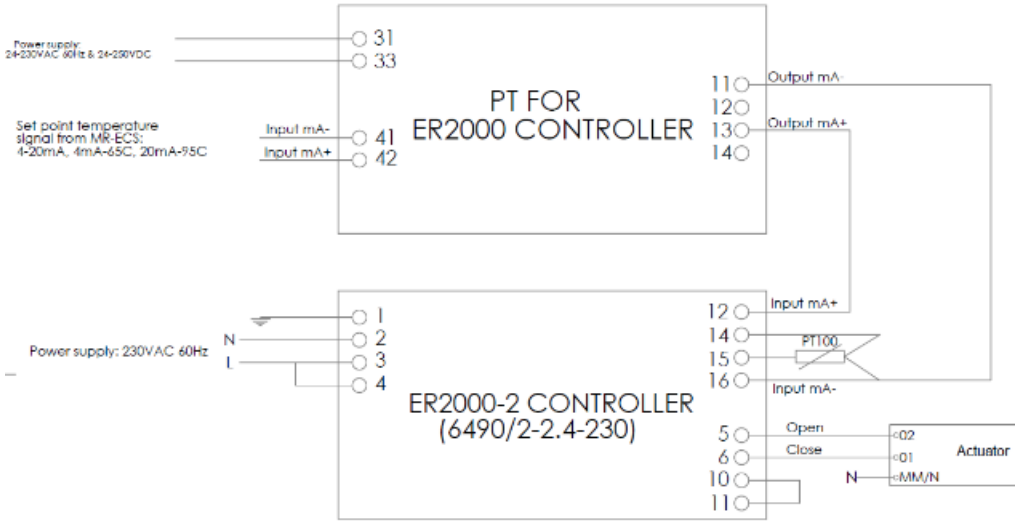
Replacing R2000 by ER2022S

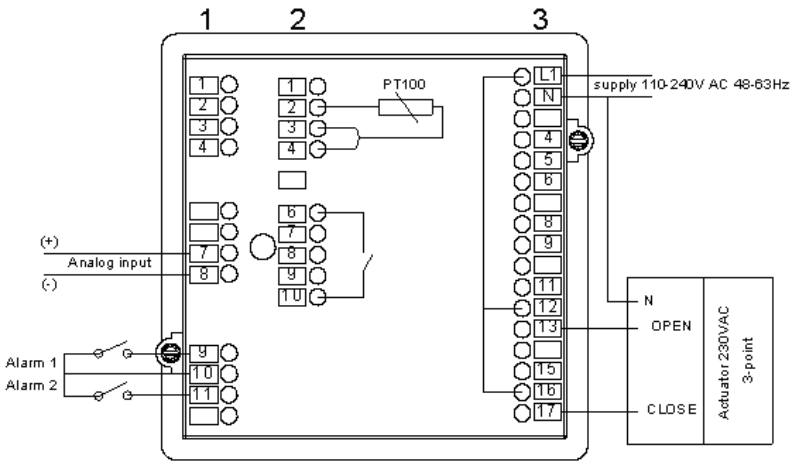
ER2000

PT transmiter		
31	Voltage supply 110-240VAC	
33		
41	Input signal 4-20mA (+)	set point controller signal
42	Input signal 4-20mA (-)	4 mA - 65 °C/ 20 mA - 95°C
13	Ouput signal mA (+)	
11	Ouput signal mA (-)	
ER2022		
2 [N]	Voltage supply 110-240VAC	
3 [L]		
4 [L]		
10	Binary PT100 / Input 4-20mA	
11		
14	Input /PT100 -three-wire/ E	
15	Input /PT100 -two-wire/ A	
16	Input /PT100 -two-wire/ S	
5	OPEN	to actuator
6	CLOSE	
12	Input signal mA (+)	from PT transmiter
16	Input signal mA (-)	

ER2022S

Terminal strip 1		
7	Input signal 4-20mA (+)	set point controller signal
8	Input signal 4-20mA (-)	4 mA - 65 °C/ 20 mA - 95°C
9	ALARM 1	
10	ALARM common	
11	ALARM 2	
Terminal strip 2		
2	Input /PT100 -three-wire/ E	
3	Input /PT100 -two-wire/ S	
4	Input /PT100 -two-wire/ A	
6	Binary PT100 / Input 4-20mA	
10		
Terminal strip 3		
L1(+) and N(-)	Voltage supply 110-240VAC	
8 (+)	Supply voltage for 2-wire transmitter (off-load voltage approx. 25V)	17V/20mA
9 (-)		
13	OPEN	
17	CLOSE	





13. Wiring ER2022SA – Analog

Replacing R2000 by ER2022SA analog

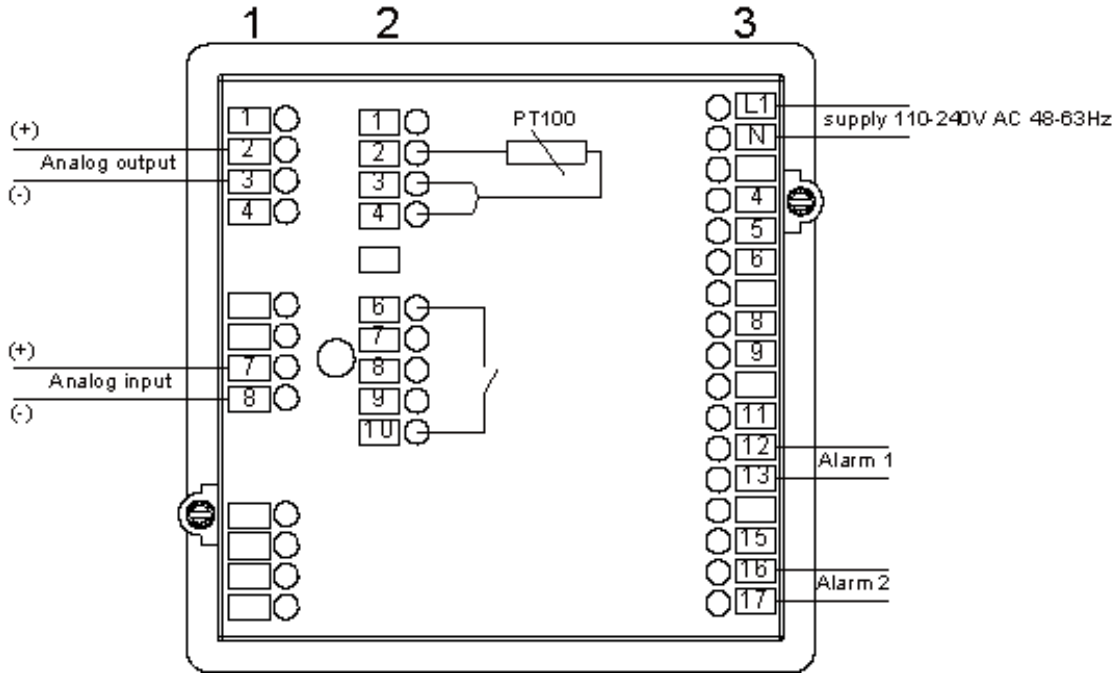
ER2000

PT transmiter		
31	Voltage supply 110-240VAC	
33		
41	Input signal 4-20mA (+)	set point controller signal
42	Input signal 4-20mA (-)	4 mA - 65 °C/ 20 mA - 95°C
13	Ouput signal mA (+)	
11	Ouput signal mA (-)	
ER2022		
2 [N]	Voltage supply 110-240VAC	
3 [L]		
4 [L]		
10	Binary PT100 / Input 4-20mA	
11		
14	Input /PT100 -three-wire/ E	
15	Input /PT100 -two-wire/ A	
16	Input /PT100 -two-wire/ S	
8	Output signal 4-20mA (+)	to actuator
9	Output signal 4-20mA (-)	
12	Input signal mA (+)	from PT transmiter
16	Input signal mA (-)	

ER2022SA

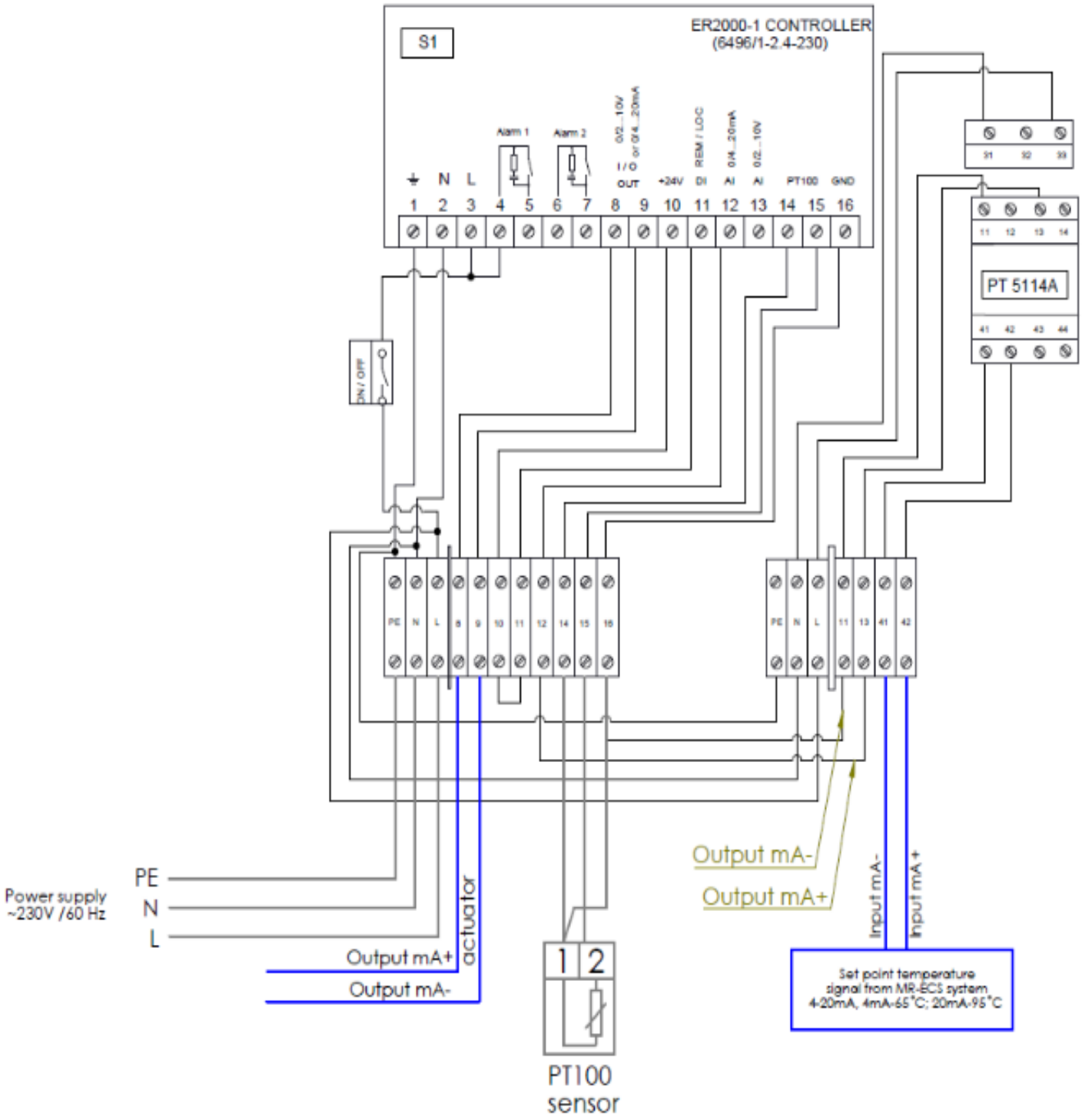
Terminal strip 1		
2	Output signal 4-20mA (+)	
3	Output signal 4-20mA (-)	
7	Input signal 4-20mA (+)	set point controller signal
8	Input signal 4-20mA (-)	4 mA - 65 °C/ 20 mA - 95°C

Terminal strip 2		
2	Input /PT100 -three-wire/ E	
3	Input /PT100 -two-wire/ S	
4	Input /PT100 -two-wire/ A	
6	Binary PT100 / Input 4-20mA	
10		
Terminal strip 3		
L1(+) and N(-)	Voltage supply 110-240VAC	
8 (+)	Supply voltage for 2-wire transmitter (off-load voltage approx. 25V)	17V/20mA
9 (-)		
12,13	ALARM 1	
16,17	ALARM 2	



13. Wiring ER2022SA – Analog

Replacing R2000 by ER2022SA analog



14. CONTACT

Clorius Controls**: mail@cloriuscontrols.com**

See also **https://www.cloriuscontrols.com/** for further information