



RAYCHEM

TCONTROL-CONT-03

COMPACT MICROPROCESSOR CONTROLLER
OPERATING AND INSTALLATION MANUAL



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1. Introduction

1.1 Preface

Please read this manual before commissioning the device. Keep the manual in a place accessible to all users at all times. Your comments are appreciated and may assist us in improving this manual.

All necessary settings are described in this operating manual. Manipulations not described in the manual or expressly forbidden will jeopardize your warranty rights. Please contact the nearest subsidiary or the head office, should you encounter problems.

The manual is valid from **device software version 223.01.04**

⇒ Chapter 4.7 "Display of the software version"

Warning signs



DANGER!

This symbol indicates that **Injury or death caused by electrical shock** can/may occur, if the respective protective measures are not carried out.



CAUTION!

This symbol in combination with the signal word indicates that **Damage to assets or data loss** will occur, if the respective protective measures are not carried out.

Note symbols



TIP!

This symbol refers to an **Important information** about the product or its handling or additional use.



REFERENCE!

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

1.2 Type designation

Type key	Type description
702071/9-1131-23-00 (nVent Part No.: 1244-0006829)	TCONTROL-CONT-03 nominal dimension 48 mm x 48 mm <ul style="list-style-type: none">• 1 analog input• 3 relays
702071/9-1131-23-00 (nVent Part No.: 1244-0006829)	TCONTROL-CONT-03/MA nominal dimension 48 mm x 48 mm <ul style="list-style-type: none">• 1 analog input• 2 relays• 1 analog output (user configurable 0/4...20 mA or 0/2...10 V)
702071/9-1131-23-53 (nVent Part No.: 1244-0006982)	TCONTROL-CONT-03/COM nominal dimension 48 mm x 48 mm <ul style="list-style-type: none">• 1 analog input• 3 relays• Interface RS485
702071/9-1134-23-53 (nVent Part No.: 1244-0006981)	TCONTROL-CONT-03/COMA nominal dimension 48 mm x 48 mm <ul style="list-style-type: none">• 1 analog input• 2 relays• 1 analog output (user configurable 0/4...20 mA or 0/2...10 V)• Interface RS485

1.3 Scope of delivery

- Controller (including seal and fastening elements)
- Operating and Installation manual INSTALL-148 in DIN A4 format

1.4 Accessories

Computer aided setup and configuration utility (TCONTROL-CONT-03/CONFIG)

Content:

- Mini CD with software, license + manuals
- PC interface with USB/TTL converter, cable and connector

Hardware requirements (PC):

- 512 MB RAM
- 250 MB free space on hard disk
- CD ROM drive
- Free USB interface
- Operating system:
Microsoft¹ Windows 2000 / XP / Vista / 7
(32-bit and 64-bit version)

1.5 Type-dependent factory settings

The following tables show the type-dependent factory settings. The standard factory settings are shown in the respective sections of this manual.

The settings for type TCONTROL-CONT-03 are also valid for type TCONTROL-CONT-03/COM.

The settings for type TCONTROL-CONT-03/MA are also valid for type TCONTROL-CONT-03/COMA.

Set points (available within User level - USER)

Parameter	Factory setting for type	
	TCONTROL- CONT-03	TCONTROL- CONT-03/MA
Set point 1 (SP1)	5.0	5.0
Set point 2 (SP2)	0.0	0.0

Parameter level (PARA)

Parameter	Factory setting for type	
	TCONTROL- CONT-03	TCONTROL- CONT-03/MA
Proportional band (Pb1)	0.0	10.0
Derivative time (dt)	0 s	80 s
Reset time (rt)	0 s	350 s

Configuration level (ConF)

Parameter	Factory setting for type	
	TCONTROL- CONT-03	TCONTROL- CONT-03/MA
Analog input (InP):		
Scale low level (SCL)	-50	-50
Scale high level (SCH)	250	250
Controller (Cntr):		
Controller type (CtYP)	1 (= 2-state ON/OFF)	4 (= continuous 4...20 mA)
Output value at Out of Range	100	100
Manual mode	inhibited	inhibited
Self-optimization	inhibited	inhibited

¹ Microsoft and Windows are registered trademarks of Microsoft Corporation.

Configuration level (ConF) cont...

Parameter	Factory setting for type	
	TCONTROL- CONT-03	TCONTROL- CONT-03/MA
Limit comparator 1 (LC1):		
Function (FnCt)	lk8	lk8
Alarm value (AL)	2.0	2.0
Response by Out of Range (ACrA)	1 (= ON)	1 (= ON)
Limit comparator 2 (LC2):		
Function (FnCt)	lk7	lk7
Alarm value (AL)	120.0	120.0
Response by Out of Range (ACrA)	1 (= ON)	1 (= ON)
Binary outputs (OutL):		
Binary output 1 (Out1)	1 (= Controller output 1)	5 (= Limit comparator 1)
Binary output 2 (Out2)	5 (= Limit comparator 1)	6 (= Limit comparator 2)
Binary output 3 (Out3)	0 (= no function)	0 (= no function)
Binary output 4 (Out4)	6 (= Limit comparator 2)	
Analog output (OutA):		
Type of signal (SiGn)		3 (= 4...20 mA)
Display/Operation/Service counter (diSP):		
Decimal place (dECP)	1 (= one digit after decimal point)	1 (= one digit after decimal point)
Service interval (oCAL)	30000	0 (= switched off)
Level inhibit	Parameter and Configuration level	Parameter and Configuration level

User level (USER) configuration

Factory setting for type				
	TCONTROL-CONT-03		TCONTROL-CONT-03/MA	
#	Parameter	Name	Parameter	Name
1	Set point 1	SP1	Set point 1	SP1
2	Limit comparator 1: Limit value (Alarm value)	AL1	Limit comparator 1: Limit value (Alarm value)	AL1
3	Limit comparator 2: Limit value (Alarm value)	AL2	Limit comparator 2: Limit value (Alarm value)	AL2
4	Mains ON delay (Power ON delay)	Strt	Mains ON delay (Power ON delay)	Strt
5	Analog input: Probe type (Sensor type)	InP	Analog input: Probe type (Sensor type)	InP
6	Display: Decimal point	dEC	Display: Decimal point	dEC
7	Parameter set 1: Proportional band 1	Pb1	Parameter set 1: Proportional band 1	Pb1
8	Parameter set 1: Cycle time 1	CY1	(Switched off)	

Undocumented parameters

Parameter		Factory setting for type	
TCONTROL- CONT-03		TCONTROL- CONT-03/MA	
Bit parameter:			
Parameter 11 (enables to use for parameter "Cy" values from 1 to 9999)	ON	ON	

3. Electrical connection

3.1 Installation notes

- The choice of cable, the installation and the electrical connection of the device 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.
- The instrument shall be operated by mains protected with a branch circuitry overcurrent protection device not more than 20 Amps. For servicing/repairing a Disconnecting Device shall be provided to disconnect all conductors.
- 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 occurring at that point.
- The electromagnetic compatibility conforms to the standards and regulations cited in the technical data.
- Run input, output and supply cables separately and not in parallel with one another.
- Sensor and interface cables should be shielded cables with twisted conductors. Do not run cables 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 device.



DANGER!

Hazardous electrical voltage.
Injury or death caused by electric shock. The electrical connection must only be carried out by qualified personnel.



TIP!

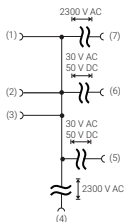
Identify the device version by way of the type key.

Installation information on conductor cross sections

Cable size	Cross section
Solid core	$\leq 1.3 \text{ mm}^2$
Stranded wire, with core-end ferrule	$\leq 1.0 \text{ mm}^2$

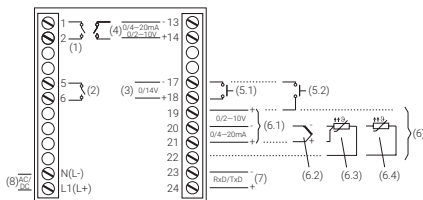
Plug-in terminal strips (screw terminals).

3.2 Electrical isolation



- (1) Analog input
- (2) Binary inputs/Output K3 (Logics)
- (3) Setup interface
- (4) Voltage supply
- (5) RS485 interface
- (6) Analog output
- (7) Outputs K1, K2 and K4 (relay)

3.3 Connection diagram



- | | |
|--|--|
| (1) Output 1 (K1): Relay 230 V AC/3 A | (2) Output 2 (K2): Relay 230 V AC/3 A |
| (3) Output 3 (K3): Logic 0/14 V (alternative to binary input 1, configurable) | (4) Output 4 (K4) (option): Analog output or Relay 230 V AC/3 A |
| (5.1) Binary input 1 (for potential-free contact); (alternative to output 3, configurable) | (5.2) Binary input 2 (for potential-free contact); (alternative to input 0/2–10V, configurable with setup program) |
| (6) Analog input | |
| (6.1) Standard signals (input 0/2–10V alternative to binary input 2) | (6.2) Thermocouple |
| (6.3) RTD temperature probe (3 wire) | (6.4) RTD temperature probe (2 wire) |
| (7) RS485 interface (Option) | (8) Voltage supply 110–240 V AC (Option: 20–30 V AC/DC) |

4. Operation

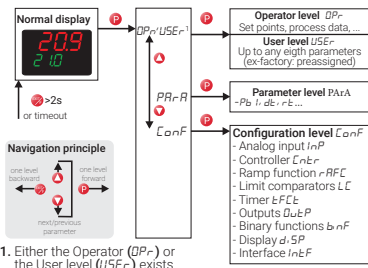
4.1 Display and operating elements



- (1) **Red 7-segment display** (factory-setting: Process value);
4-digit, configurable decimal place (automatic adjustment on display overflow)
- (2) **Green 7-segment display** (factory-setting: Set point value);
4-digit, configurable decimal place, serves also for operator guide (display of parameter and level symbols)
- (3) **Signals, yellow LED**
Switching states of the binary outputs 1 ... 4 (display lit = ON)
- (4) **Keys**
 - Programming key
 - leave level/function key
⇒ Chapter 7.8 "Display/Operation/Service counter"
 - Value reduction/previous parameter
 - Value increase/next parameter
- (5) **Signals, green LED**
 - Manual mode active
 - Ramp function active
 - Timer active

4.2 Level concept

The parameters for the device setting are structured in different levels.



- ⇒ Chapter 5 “Operator level”
- ⇒ Chapter 6 “Parameter level”
- ⇒ Chapter 7 “Configuration level”



TIP!

If no key is pressed for 180 s the device changes back to normal display (factory-setting). The setting can be changed in the Setup program (Display/Operation/Service counter -> Operation -> Time-out).

4.3 User level configuration

A maximum of eight frequently used parameters can be made available in the User level. Use the Setup program to configure these parameters.

Once these parameters are selected a customer friendly name can be assigned. Names can consist out of maximum four characters (represented on 7-segment display). If no name is assigned the factory defaults will be used.

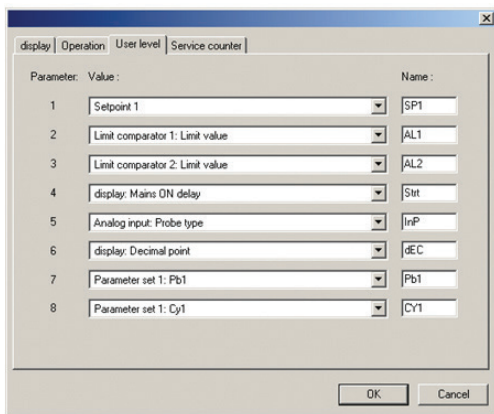


Figure shows the menu of the Setup program
(in case of TCONTROL-CONT-03/MA and .../COMA parameter 8 is switched off)

4.4 Defining various user levels

Access to the individual levels can be inhibited.

Code	Operator, User level	Parameter level	Configuration level
0	free	free	free
1	free	free	inhibited
2	free	inhibited	inhibited
3	inhibited	inhibited	inhibited

1. For code entry use **P** and **▼** (simultaneously for > 5 s)
2. Change code by pressing **P** (display blinks!)
3. Enter code using **▲** and **▼** (Ex-factory: all levels enabled)
4. Return to the normal display using **EXIT** or automatic return after 180 s

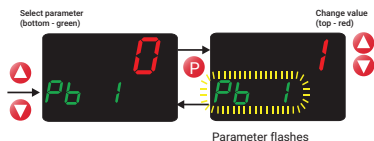
The parameter and configuration level can also be inhibited via the binary function.

⇒ Chapter 7.7 "Binary functions"

4.5 Entries and operator prompting

Entering values

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



1. Select parameter by pressing **▲** or **▼**
2. Change to the entry mode using **P** (lower display blinks)
3. Change a value using **▲** and **▼**
The value alters dynamically for as long as the key is kept pressed.
4. Take over the entry with **P** or automatic return after 2 s or cancel the entry with **EXIT** the value will not be applied.



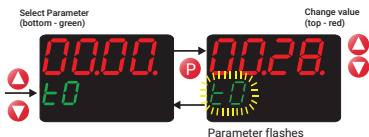
TIP!

If the function key **EXIT** is pressed for > 2 s, the device changes back to normal display.

Time entry

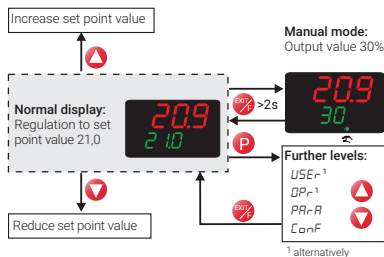
A decimal place is mapped in the centre and on the right to display times. The time unit can be configured.

⇒ Chapter 7.5 “Timer”



1. Select parameter by pressing ▲ or ▼
2. Change to the entry mode using P (lower display blinks)
3. Change a value using ▲ and ▼
The value alters dynamically for as long as the key is kept pressed.
4. Take over the entry with P or automatic return after 2 s or cancel the entry with EXIT the value will not be applied.

4.6 Controller



Normal display

In normal display, the controller regulates to the entered set point value.




Changing the set point value

From the normal display:

1. Change the set point value using ▲ and ▼ (the value will be automatically applied)
The longer the key is kept pressed, the faster the set point value changes.

Changing to the manual mode

In the manual mode, the controller output value can be changed manually.

1. Change to the manual mode using function key  (> 2 s)
(ex-factory setting)
→ The output value is displayed in percent in the lower display.
The "Manual mode active" LED is also lit.
2. Change the output value using  and 

With a modulating controller, the actuator is opened or closed using the keys.

The various levels can be accessed in the manual mode.

The Setup program can be used to configure the default output value on a changeover. The manual mode can also be inhibited.

⇒ Chapter 7.2 "Controller"

The controller automatically changes to manual mode in the event of overrange/underrange and probe break.

Manual mode exit

1. Exit the manual mode using function key  (> 2 s)

Operation via binary functions

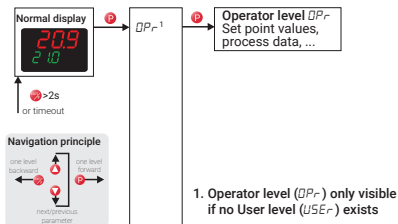
Further operating possibilities for the fixed value controller can be realised via binary functions.

⇒ Chapter 7.7 "Binary functions"

4.7 Display of the software version

Simultaneously press the  and  keys to display the software version.

Four-digit display; example: "01.01" in case of software version xxx.01.01



Levels can be inhibited.

⇒ Chapter 4.4 "Defining various user levels"

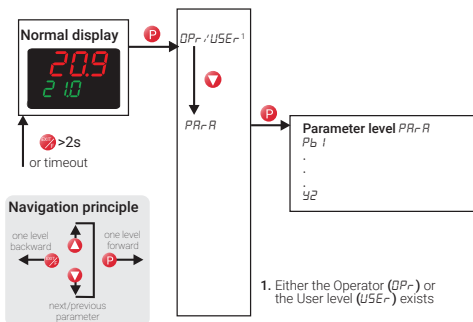
5. Operator level

Parameters

Depending on the configuration, the following values are displayed:

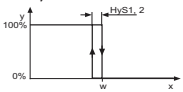
Symbol	Meaning
$SP\ 1$	Set point value 1 (can be edited)
$SP\ 2$	Set point value 2 (can be edited), only when switching over to set point value 2 v ⇒ Chapter 7.7 “Binary functions”
SP_r	Ramp set point value (only if configured) ⇒ Chapter 7.3 “Ramp function”
$INP\ 1$	Measured value of analog input 1
y	Output value
$t\ 1$	Timer time (only if configured and timer is not running) ⇒ Chapter 7.5 “Timer”
tL	Timer running time (only if timer runs) ⇒ Chapter 7.5 “Timer”
t_r	Residual timer running time (only if timer runs) ⇒ Chapter 7.5 “Timer”
DC	Service counter display (only if service counter runs or as long as a reached limit value was not reset) ⇒ Chapter 7.8 “Display/Operation/Service counter”

6. Parameter level



Levels can be inhibited.

⇒ Chapter 4.4 “Defining various user levels”

Parameters	Symbol	Value range	Description
Proportional band	$Pb1$	0...9999	Proportional band At $Pb1,2 = 0$, the controller structure is ineffective. For the continuous controller $Pb1,2$ must be > 0 .
	$Pb2$ 1)	0...9999	
Derivative time	$d\tau$	0...9999s	Influences the differential component of the controller output signal The larger the derivative time the higher the effectiveness of the D component.
Reset time	$r\tau$	0...9999s	Influences the integral component of the controller output signal The larger the reset time the lower the effectiveness of the I component.
1) For 3-state controllers only (controller output 2)			
Cycle time of output	τ_{CY1}	0...20...9999s	For a switching output, the cycle time should be selected such that on one hand no inadmissible process values fluctuations are generated and on the other hand no overload of the actuators occurs by the cyclic supply of energy.
	τ_{CY2} 1)	0...20...9999s	
Dead band	db	0.0...999.9	Spacing between the two control contacts of the 3-state controller and the modulating controller
Hysteresis	$hys1$	0.0...1.0...999.9	Hysteresis for switching controller with $Pb1,2 = 0$. 
	$hys2$ 1)	0.0...1.0...999.9	
Valve run time	τ_v	5...60...3000s	Used run time range of the control valve (actuator) of the modulating controller
Operating value	$y0$	-100...0...+100%	Output value for P and PD controllers (for $x = w$ is $y = y0$)
Output value limits	$y1$	0...100%	Maximum output value limit
	$y2$	-100...+100%	Minimum output value limit (Only effective when $Pb>0$!)
1) For 3-state controllers only (controller output 2)			

Standard factory settings are shown **bold**.

Non-standard factory settings:

⇒ Chapter 1.5 "Type-dependent factory settings"

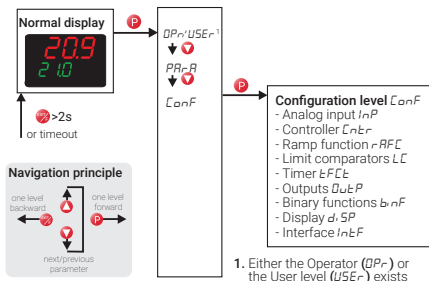
Parameter display independent of the controller type:

⇒ Chapter 7.2 "Controller"

Decimal places for some parameters depend on the device setting:

⇒ Chapter 7.8 "Display/Operation/Service counter"

7. Configuration level



Levels can be inhibited.

⇒ Chapter 4.4 "Defining various user levels"



TIP!

Parameters are not displayed unless the equipment level permits the function assigned to the parameter. This means, for example, that interface parameters can only be configured, if the device is equipped with an interface.



TIP!

Some parameters can only be programmed through the Setup program. In the following tables, these are marked in the "Parameters" column with "(Setup)".



TIP!

Standard factory settings are displayed **bold** in the following tables in the "Value/Selection" and "Description" columns. Non-standard factory settings are shown in Chapter 1.5 "Type-dependent factory settings".



TIP!

For activation of binary input 2 the setup program is required (Hardware assistant).

Analog selector

Some parameters in the Configuration level allow users to select from a series of analog values. The list below shows all available options.

Value	Description
0	Deactivated
1	Analog input
2	Process value
3	Current set point value
4	Ramp limit value
5	Ramp set point value
6	(Reserved)
7	(Reserved)
8	Set point value 1
9	Set point value 2
10	Controller output value (-100%...+100%)
11	Controller output 1 (0...+100%; e. g. "Heating")
12	Controller output 2 (0...-100%; e. g. "Cooling")
13	Timer run time (time unit of the timer)
14	Residual timer run time (time unit of the timer)
15	(Reserved)
16	(Reserved)
17	(Reserved)

7.1 Analog input

One analog input is available.

$C_{onF} \rightarrow I_{nP} \rightarrow$

Parameters	Value / Selection	Description
Sensor type <i>SEn5</i>	0	Pt100, 3 wire
	1	Pt1000, 3 wire
	2	Pt100, 2 wire
	3	Pt1000, 2 wire
	4	KTY 2 wire
	5-9	(reserved)
	10	Cu-CuNi T
	11	Fe-CuNi J
	12	Cu-CuNi U
	13	Fe-CuNi L
	14	NiCr-Ni K
	15	Pt10Rh-Pt S
	16	Pt13Rh-Pt R
	17	Pt30Rh-Pt6Rh B
	18	NiCrSi-NiSi N
	19	NiCr-CuNi E
	20	W5Re_W26Re C
	21	W3Re_W25Re D
	22	W3Re_W26Re
	23	0... 20 mA
	24	4...20mA
	25	0...10 V
	26	2...10 V

Parameters	Value / Selection	Description		
Measured value offset <i>OFFS</i>	-1999 ... 0 ... +9999	The measured value correction (offset) is used to correct a measured value by a certain amount upward or downward.		
		Examples:		
		Measured value	Offset	Displayed value
		294.7	+0.3	295.0
		295.3	-0.3	295.0
Scale low level <i>SCl</i>	-1999 ... +9999	On transducers with standard signal, a display value is assigned to the physical signal (scaling).		
Scale high level <i>SCH</i>	-1999 ... +9999	Example: 0 ... 20 mA = 0 ... 1500°C. The range of the physical signal can be 20% wider or narrower without generating an overrange/underrange signal.		
Digital filter <i>dF</i>	0.0 ... 0.6 ... 100.0	To adapt the digital input filter (time in seconds; 0s = filter off). 63 % of the alterations are acquired after 2x filter time constant (2nd order filter) at a step change. When the filter time constant is large: - High damping of interference signals - Slow reaction of the process value display to process value changes - Low limit frequency (low-pass filter)		



CAUTION!

Measured value offset: The controller uses the corrected value for calculation (= displayed value). This value does not comply with the value measured at the measuring point.

Incorrect use can cause inadmissible control values.

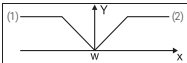
Only carry out a measured value offset within the admissible range.

Parameters	Value / Selection	Description
Temperature unit <i>Un, t</i>	1 2	deg. Celsius deg. Fahrenheit Unit for temperature values
Correction value KTY at 25 °C (Setup)	0... 2000 ... 4000	Resistance in ohms at 25 °C/77 °F for "KTY 2-wire" probe type Setting in the Setup program (-> Analog input -> Analog input 1)

7.2 Controller

Controller type and controller input values, set point limit values, functions for manual mode and the presets of self-optimization are set here.

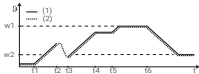
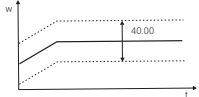
CONF -> ENTER ->

Parameters	Value / Selection	Description
Controller type <i>CTYP</i>	1 2 3 4	2-state controller 3-state controller Modulating controller Continuous controller
Control direction <i>CRCT</i>	0 1	Direct Inverse  (1) = Inverse: Output value Y of the controller is > 0, if process value x is smaller than set point value w (e.g. heating). (2) = Direct: Output value Y of the controller is > 0, if process value x is higher than set point value w (e.g. cooling).
Output value, manual mode <i>HRND</i>	-100 ... +101	Defines the output value after switching to manual mode. 101 = last output value For modulating controllers: 0 = Actuator closes 100 = Actuator opens 101 = Actuator stops Setting in the Setup program (-> Controller -> Output value, manual mode)
Output value at Out of Range <i>ROUT</i>	-100 ... +101	Output value in the event of overrange or underrange. 101 = last output value For modulating controllers: 0 = Actuator closes 100 = Actuator opens 101 = Actuator stops Setting in the Setup program (-> Controller -> Output value at Out of Range)

Parameters	Value / Selection	Description
Set point limit low <i>SPL</i>	-1999 ... +9999	The set point limitation prevents the entry of values outside the default range. The set point limit values are not effective when entering set point default values via the interface. The correction value is limited for external set point values with offset.
Set point limit high <i>SPH</i>	-1999 ... +9999	
Process value for controller <i>CP_r</i>	(analog selector) Analog input	Determines the source of the controller process value. ⇒ Page 16, Analog selector
Manual mode (Setup)	free inhibited	If the manual mode is inhibited, it is not possible to change to the manual mode using the keys or the binary input. Setting in the Setup program (-> Controller -> Manual mode)
Self-optimization (Setup)	free inhibited	If self-optimization is inhibited, it cannot be started using keys or the binary function. ⇒ Chapter 8.3 "Self-optimization" Setting in the Setup program (-> Controller -> Self-optimization) Self-optimization is also inhibited, if the Parameter level is inhibited. ⇒ Chapter 7.7 "Binary functions" ⇒ Chapter 7.8 "Display/Operation/Service counter"

7.3 Ramp function

The device can be operated as a fixed value controller with and without ramp function. When the ramp function is active, a new temperature set point value is controlled along a ramp and no longer as a step. It is possible to realize an ascending or descending ramp function. The ramp limit value is defined by the set point default value.

Parameters	Value / Selection	Description
Function <i>Funct</i>	0 1 2 3	<p>deactivated</p> <p>Ramp Kelvin/Minute</p> <p>Ramp Kelvin/Hour</p> <p>Ramp Kelvin/Day</p> <p>The ramp limit value can be changed using the ▲ or ▼ keys.</p>  <p>(1) = Set point value (2) = Process value t1: Power ON/Ramp start (w1 active) t2-t3: Mains failure/Manual mode/Probe break t4-t5: Ramp stop t6: Set point value changeover to w2 The ramp function can be stopped, cancelled and restarted using binary functions. ⇒ Chapter 7.7 "Binary functions"</p>
Ramp rate <i>rRSL</i>	0.0... 999.9	<p>Value of ramp rate (for functions 1 to 3 only)</p>
Tolerance band <i>tolP</i>	0...9999	<p>Range of the tolerance band (in Kelvin) around the set point value 0 = Tolerance band inactive (for functions 1 to 3 only)</p> <p>For the ramp function, it is possible to enter a tolerance band around the set point value curve to monitor the process value. A tolerance band signal to be used internally or transmitted via an output is triggered when the upper or lower limit is exceeded. In the following example, the tolerance band (tolP) is 40 K. Thus a tolerance band signal is triggered when the process value exceeds the upper or lower set point value by 20 K.</p>  <p>Further information about the use of the tolerance band signal: ⇒ Chapter 7.6 "Outputs" ⇒ Chapter 7.7 "Binary functions"</p>



TIP!

The ramp function is cancelled in the event of a probe break or in manual mode. The outputs react in the same manner as for an overrange/underrange (configurable).

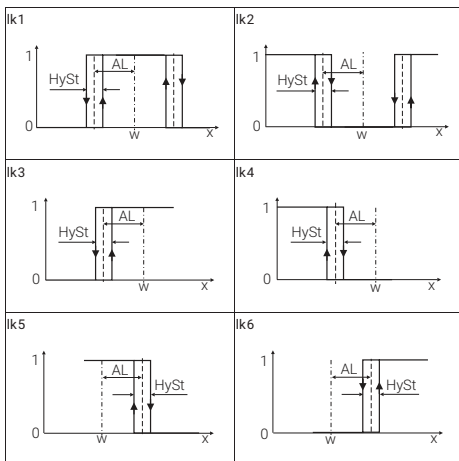
7.4 Limit comparators

Limit comparators can be used to monitor the process value against defined alarm limits. The way the limit comparators operate can be configured by the user (lk1 to lk8). Once an alarm limit (alarm set point) is exceeded, an alarm signal can be output or an internal function can be initiated.

There are 2 limit comparators available (LC1, LC2). The switching differential HySt can be user defined and will always be symmetrical in relation to the alarm set point (AL).

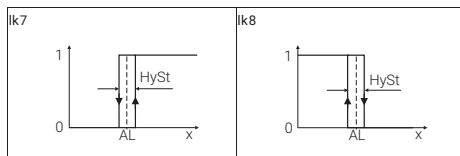
Alarm value AL relative to the set point value w

The limit comparator functions lk1 to lk6 monitor the process value x for an alarm value AL which is relative to the set point value w . This means that if the set point is changed the absolute alarm values will shift as well.



Fixed alarm value AL

The limit comparator functions lk7 and lk8 monitor the process value x for a fixed alarm value AL to be set.



ConF -> LC -> LC 1, LC2 ->

Parameters	Value / Selection	Description
Function <i>FncL</i>	0 1 2 3 4 5 6 7 8	no function lk1 lk2 lk3 lk4 lk5 lk6 lk7 lk8
Function <i>AL</i>	-1999 ... +9999	Alarm value (limit value) to be monitored (see limit comparator functions lk1...lk8: alarm value AL) Alarm value range for lk1 and lk2: 0 ... 9999
Hysteresis <i>HYSt</i>	0... 1 ... 9999	Hysteresis in respect to the alarm value (see limit comparator functions lk1...lk8: hysteresis HySt)
Response by Out of Range <i>RCrR</i>	0 1	Switching state in the event of overrange or underrange ("Out of Range") off on
Limit comparator process value <i>LCPr</i>	(analog selector) Process value	Input variable for limit comparator (see limit comparator functions lk1... lk8: process value x)
Limit comparator set point value <i>LCSP</i>	(analog selector) Current set point value	Set point value for limit comparator (see limit comparator functions lk1 ... lk6: set point value w)

7.5 Timer

Timer signal

A timer signal (tF1) is provided which can be transmitted via binary outputs or used for internal links, e. g. to switch off the **controller** (output value 0%) or **to toggle the set point values**.

⇒ Chapter 7.6 "Outputs" and Chapter 7.7 "Binary functions"

The timer signal is active either when the timer runs or during the timer follow-up time (see below). The signal can be inverted via the "SiGn" parameter.

Timer time

The timer runs for the set time t1.

Timer time, current timer running time and residual timer time can be displayed in the operator or User level (the timer time can also be changed here).

Starting the timer

The start behavior can be set and triggered via power ON, function key or binary signal. Subsequently, the timer time t1 is counted to zero either immediately or after the process value has reached a programmable tolerance limit. The timer can be stopped (waiting time) or cancelled.

How can I see that the timer is running?

The green timer LED above the clock symbol flashes while the timer time counts down, and, if a timer value is displayed on the green display, its middle decimal place (xx.xx) flashes.

Timer follow-up time

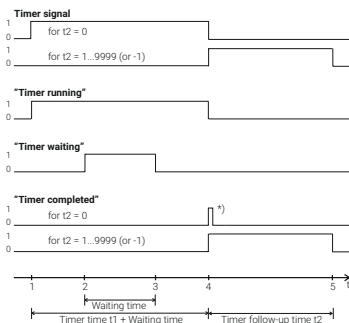
When the timer follow-up time t2 is activated, it starts after the timer has elapsed. The timer follow-up time can be used, e. g. to control a horn.

Timer in connection with the ramp function

In general, set point values can also be moved to with the ramp function. For timer functions started via the tolerance limit, only the set point value (ramp limit value) is monitored.

Timer signals

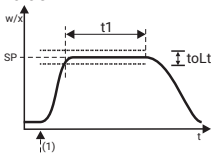
The additional signals "Timer running", "Timer waiting" and "Timer completed" can be used for binary outputs.



- | | |
|-----------------------|----------------------------------|
| 1 Timer started | 4 Timer elapsed |
| 2 Timer stopped | 5 Timer follow-up time elapsed |
| 3 Timer run continued | *) Short pulse ("Wiper contact") |

ConF -> tFct ->

Parameters	Value / Selection	Description
Function <i>FnCt</i>	0	no function
	1	Timer
	2	Timer for time-delayed control
Start condition Strt	0	Manual start by using the function key or the binary signal (no restart or continuation after power supply interruption)
	1	Manual start with automatic start or restart after power ON
	2	Manual start and continuation after power supply interruption (residual running time is saved every minute)
Time unit Unit	0	mm.ss
	1	hh.mm
	2	hhh.h
Timer signal <i>S16n</i>	0	inverted
	1	not inverted
Set time t1 <i>t1</i> (Timer time)	00.00. 99.99	The started timer runs for this time in the specified time unit.

Parameters	Value / Selection	Description
Set time t2 <i>t2</i> (Timer follow-up time)	-1... 0... +9999	This time (in seconds) can be used to transmit a time limited or acknowledgeable signal after the timer time has elapsed. 0 = switched off 1...9999 = active for the set time -1 = active until acknowledged Acknowledgement: For t2 = -1 the timer follow-up time is infinite. Cancel the signal using a function key or the binary signal.
Tolerance band <i>tol</i>	0...9999	The set timer time only elapses when the process value has reached the tolerance band. 0 = Start without tolerance band The tolerance band (in Kelvin) is symmetrical in relation to the SP set point value.  <p>(1) = Start via function key, binary input or when power ON</p>

7.6 Outputs

The configuration of the device outputs is subdivided in binary outputs (OutL) and analog outputs (OutA). Binary outputs are relays and logic outputs. The switching states of the binary outputs 1 to 4 are shown in the display (K1 to K4).

Binary outputs

Output 1 (Out1) = Relay

Output 2 (Out2) = Relay

Output 3 (Out3) = Logic output Output 4 (Out4) = Relay (option)

Conf -> OutP-> OutL ->

Parameters	Value / Selection	Description
Binary outputs	0	No function
Out 1	1	Controller output 1
Out 2		(e.g. "Heating", with inverse control direction)
Out 3	2	Controller output 2 (e.g. "Cooling", see above)
Out 4	3	Binary input
	4	(reserved)
	5	Limit comparator 1
	6	Limit comparator 2
	7	Timer signal
	8	Timer runs
	9	Timer completed
	10	Timer waiting
	11	(reserved)
	12	(reserved)
	13	Tolerance band signal, ramp
	14	Ramp end signal
	15	Service alarm
	16	(reserved)
	17	Actuate the F key
	18	Manual mode

Analog output

The device can optionally be equipped with an analog output.

Conf -> OutP-> OutA ->

Parameters	Value / Selection	Description
Function Funct	(Analog selector) Controller output 1	Function of the output
Type of signal Signal	0 1 2 3	0... 10 V 2... 10 V 0... 20 mA 4... 20 mA Physical output signal
Value at Out of Range rOut	0 ... 101	Signal (in percent) at overrange or underrange 101=last output signal

Parameters	Value / Selection	Description
Zero point <i>OPnt</i>	-1999 ... 0... +9999	A value range of the output variable is assigned to a physical output signal. The ex-factory setting corresponds to an output value of 0 ... 100 % for controller outputs. No changes of the ex-factory setting are required for continuous controllers. For a 3-state controller, enter the following settings for cooling: Zero point = 0 / End value = -100 Example (function as a transducer): The analog output (0...20 mA) is to be used to put out the process value (value range: 150...500 °C), this means: 150...500°C = 0...20 mA Zero point: 150 / End value: 500
End value <i>End</i>	-1999 ... 100... +9999	

7.7 Binary functions

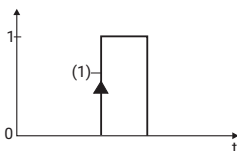
In terms of this manual a function initiated by a binary signal is called "binary function". Several binary functions can be realized by using the signals of binary input, limit comparators, timer and ramp function.

Switching behavior

The following binary functions react to switch-on edges:

- Start, abort self-optimization
- Start, abort, start/abort timer

All remaining binary functions react to switch-on or switch-off states.



Power free contact or switching pulse

0 = Contact open (1) = Switch-on edge
1 = Contact closed

Further functions via Setup program

In the Setup program binary functions can be combined with each other (selection under "Additional functions").

It is also possible to select "Text display" as an additional function. A maximum of 4 characters can be entered as text ("Text display" button) and displayed with a 7-segment display.

The text appears in the lower display when the binary function is active.

$\overline{ConF} \rightarrow b.nF$

Parameters	Value / Selection	Description
Binary inputs	0	no function
$b.n1$	1	Start self-optimization
$b.n2$	2	Abort self-optimization
1	3	Change to manual mode
Limit comparators	4	Controller off (controller outputs are switched off)
$\overline{LC1}$	5	Switch on controller
$\overline{LC2}$	6	Inhibit manual mode
Timer signal	7	Stop ramp
$\overline{tF1}$	8	Abort ramp
	9	Restart ramp
	10	Set point value toggling: 0/Contact open = Set point value 1 active, 1/Contact closed = Set point value 2 active)
Ramp end signal	11	(reserved)
$rEnd$	12	(reserved)
Tolerance band signal, ramp	13	(reserved)
$tOL5$	14	(reserved)
	15	(reserved)
	16	(reserved)
	17	Key inhibit
		Level inhibit:
		The parameter and the configuration level are inhibited.
	18	Start of self-optimization is inhibited.
	19	Display off with key inhibit
	20	(reserved)
	21	(reserved)
	22	Timer acknowledgement
	23	Starting the timer
	24	Timer abort
		Timer stop
		Timer start/abort

¹ For activation of binary input 2 the setup program is required (Hardware assistant).



7.8 Display/Operation/Service counter

Both displays can be adapted to the respective requirements by the configuration of the displayed value, the decimal place and the automatic change (timer).

The time-out of the operation, the function key assignment and the level inhibit can also be configured.

ConF -> d.SP ->

Parameters	Value / Selection	Description
Upper display <i>d. SU</i>	(Analog selector) Process value	Display value for the upper display
Lower display <i>d. SL</i>	(analog selector) Current set point value	Display value for the lower display
Display change to timer value <i>d. SE</i>	0 1 2	Time appears in the lower display (only effective after the timer is started) no function Display of residual timer time Display of timer run time
Time-out <i>t.out</i>	0... 180... 255	Time period in seconds, after which the device automatically returns to normal display if no key is pressed.
Restart time <i>t.RES</i> (Power ON delay)	0...9999	Start delay time in seconds after Power ON All functions of the device are only active after this time has elapsed.
Decimal place <i>d.ECP</i>	0 1 2	no digit after the decimal point one digit after the decimal point two digits after the decimal point If the value to be displayed cannot be shown including the programmed decimal point, the number of digits after the decimal point are automatically reduced. If subsequently the measured value contains less digits, the reading appears with the decimal point as programmed.

Parameters	Value / Selection	Description
Function key  short <i>EXIT F</i> (Push time < 2 seconds)	0 1 2 3 4 5	Function if the key is briefly pressed in the normal display (max. two seconds) no function Starting the timer Timer abort Stop timer/continue timer run Timer start/abort Display timer value (manual)
Function key  long <i>EXIT F</i> (Push time >2 seconds)	0 1 2 3 4 5	Function if the key is pressed for more than two seconds in the normal display Change to manual mode Starting the timer Timer abort Stop timer/continue timer run Timer start/abort Display timer value (manual)
Level inhibit (Setup)	None ConF PArA and ConF OPr, PArA and ConF	Access to the individual levels can be inhibited. Setting in the Setup program (-> Display/Operation/Service counter -> Operation): - None - Configuration level (ConF) - Parameter (PArA) and configuration level - Operator (OPr), parameter and configuration level The setting is independent of binary function "Level inhibit". When inhibiting the Parameter level, the self-optimization start is simultaneously inhibited.

Parameters	Value / Selection	Description
Service interval (Setup) oCRL	Number: 0... 9999000 Time (h): 0...999 Time (d): 0...999	<p>Limit value for service counter (when select. "Number" in increm. of 1000) 0 = Service counter switched off</p> <p>The service counter can be used to monitor a binary signal in respect to number (switch-on edge) or time (ON state).</p> <p>The service counter is started when entering a value > 0. When the limit value is exceeded, a signal is generated which can be put out to a binary output.</p> <p>The signal can only be acknowledged by resetting the limit value to zero (service counter switched off).</p> <p>The counter value is saved every hour in the EEPROM; the counter value saved last is used to continue counting after a power failure.</p> <p>Special features on the device when selecting "Number" (operation and display only in the User level):</p> <ul style="list-style-type: none"> - Value range: 0...9999 (1 corresponds to 1000) - Counter reading is displayed in Thousand (1 corresponds to 1000); when the counter value is below 1000, the display shows 0. - Simultaneously press the P + ↶ keys: The complete counter value is displayed on both displays for approx. 3 s. Example: Counter value 1234567; upper display = 1234, lower display = 567 <p>Setting in the Setup program (-> Display/Operation /Service counter -> Service counter)</p>
Service type (Setup)	Monitoring number	<p>Selection of the interval type</p> <p>Setting in the Setup program (-> Display/Operation/Service counter -> Service counter):</p> <ul style="list-style-type: none"> - Monitoring number (quantity) - Monitoring time (h) - Monitoring time (d)

Signal to be monitored (Setup)	Controller output 1	<p>Selection of the binary signal to be monitored Setting in the Setup program (-> Display/Operation/Service counter -> Service counter):</p> <ul style="list-style-type: none"> - deactivated - Controller output 1 - Controller output 2 - Binary input 1 - Binary input 2 - Limit comparator 1 - Limit comparator 2 - Timer signal - Timer runs - Timer completed - Timer waiting - Tolerance band signal - Ramp end - Service alarm - Key actuation - Manual mode
User level (Setup)		<p>A maximum of eight parameters from the various levels can be defined to be available in the User level of the device. The parameter name (max. 4 characters which can be displayed with 7-segment display) can be user-defined. Without a user-default entry, the name programmed in the device will appear.</p> <p>Setting in the Setup program (-> Display/Operation/Service counter -> User level)</p>

7.9 Interface

The device can be integrated into a data network (Modbus) via an optional RS485 interface.

CONF -> INTF ->

Parameters	Value / Selection	Description
Baud rate <i>bdr_t</i>	0 1 2	9600 bps 19200 bps 38400 bps
Data format <i>dFt</i>	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 <i>Adr</i>	0...1... 255	Address in data network
Min. response time (Setup)	0 ... 500 ms	Time period in milli-seconds that elapses between the request of a device in the data network and the response of the controller. Setting in the Setup program (-> Interface)



TIP!

When the communication takes place via the setup interface, the RS485 interface is inactive.



TIP!

For further information a separate interface description Modbus is available (as a PDF file).

8. Supplement

8.1 Technical Data

Thermocouple input

Designation		Measuring range ¹	Measuring accuracy ²	Ambient temperature coefficient
	EN			
Fe-CuNi "L"		-200... +900 °C	≤ 0.25%	100 ppm/ K
Fe-CuNi "J"	60584	-200...+1200 °C	≤ 0.25%	100 ppm/ K
Cu-CuNi "U"		-200... +600 °C	≤ 0.25%	100 ppm/ K
Cu-CuNi "T"	60584	-200... +400 °C	≤ 0.25%	100 ppm/ K
NiCr-Ni "K"	60584	-200...+1372 °C	≤ 0.25%	100 ppm/ K
NiCr-CuNi "E"	60584	-200... +900 °C	≤ 0.25%	100 ppm/ K
NiCrSi-NiSi "N"	60584	-100...+1300 °C	≤ 0.25%	100 ppm/ K
Pt10Rh-Pt "S"	60584	0... +1768 °C	≤ 0.25%	100 ppm/ K
Pt13Rh-Pt "R"	60584	0... +1768 °C	≤ 0.25%	100 ppm/ K
Pt30Rh-Pt6Rh "B"	60584	0... +1820 °C	≤ 0.25% ³	100 ppm/ K
W5Re-W26Re "C"		0... +2320 °C	≤ 0.25%	100 ppm/ K
W3Re-W25Re "D"		0... +2495 °C	≤ 0.25%	100 ppm/ K
W3Re-W26Re		0... +2400 °C	≤ 0.25%	100 ppm/ K

Cold junction: Pt100 internal

¹ The specifications refer to an ambient temperature of 20 °C.

² Incl. measuring accuracy at the cold junction. The accuracy values refer to the maximum measuring range. Small measuring ranges lead to reduced linearisation accuracy.

³ In the range of 300 ... 1820 °C

RTD temperature probe input

Designation, Connection type	Measuring range	Measuring accuracy ¹	Ambient temperature coefficient
Pt100 EN 60751 2 wire connection 3 wire connection	-200... +850 °C	≤ 0.4% ≤ 0.1%	50 ppm/K
Pt1000 EN 60751 2 wire connection 3 wire connection	-200...+850 °C	≤ 0.2% ≤ 0.1%	50 ppm/ K
KTY11-6 2 wire connection	-50...+150 °C	≤ 0.25%	50 ppm/ K

Sensor lead resistance: max. 30 Ω per lead with three wire circuit

Measuring current: approx. 250 µA

Lead compensation: Not required for three wire circuit. For a 2-wire circuit, the lead resistance can be compensated by correcting the actual value.

¹ The accuracy values refer to the maximum measuring range.
Small measuring ranges lead to reduced linearisation accuracy.

Standard signals input

Measuring range	Measuring accuracy ¹	Ambient temperature coefficient
Voltage 0(2)–10 V Input resistance R_E > 100 kΩ	≤ 0.1%	100 ppm/K
Current 0(4)– 20 mA Voltage drop ≤ 2.2 V	≤ 0.1%	100 ppm/ K

¹ The accuracy values refer to the maximum measuring range. Small measuring ranges lead to reduced linearisation accuracy.

Binary inputs

Potential-free contact	open = inactive closed = active
------------------------	------------------------------------

Measuring circuit monitoring

In the event of a fault, the outputs change to defined statuses (configurable).

Sensor	Overrange/ underrange	Input sensor/ lead short- circuit	Input sensor/ lead break
Thermocouple	•	–	•
Resistance thermometer	•	•	•
Voltage 2–10 V 0–10 V	• (•)	• –	• –
Current 4–20 mA 0–20 mA	• (•)	• –	• –

• = detected – = not detected

(•) = only overranges are detected

Outputs

Relay (N/O) Contact rating Contact life	max. 3 A at 230 V AC resistive load 150,000 operations at rated load 350,000 operations at 1 A 310,000 operations at 1 A and $\cos \varphi > 0.7$
Logic output	0/14 V / 20 mA max.
Voltage (option) Output signals Load resistance Accuracy	0–10 V / 2–10 V $R_{Load} \geq 500 \Omega$ $\leq 0.5\%$
Current (option) Output signals Load resistance Accuracy	0–20 mA / 4–20 mA $R_{Load} \geq 500 \Omega$ $\leq 0.5\%$

Controller

Controller type	2-state, 3-state, modulating controller, continuous controller
Controller structures	P/PI/PD/PID
A/D converter	16 bit resolution
Sampling cycle time	250 ms

Timer

Accuracy	$\pm 0.8 \% \pm 25 \text{ ppm/K}$
----------	-----------------------------------

Electrical data

Supply voltage (switch mode PSU)	AC 110–240 V -15/+10%, 48–63 Hz AC/DC 20–30 V, 48 – 63 Hz	
Electrical safety	acc. to EN 61010, part 1 Overvoltage category III, pollution degree 2	
Amperage	max. 15 VA	
Data backup	EEPROM	
Electrical connection	at the back via screw terminals, Conductor cross section up to max. 1.3 mm ² Installation information on conductor cross sections	
	Solid core	$\leq 1.3 \text{ mm}^2$
	Stranded, with core-end ferrule	$\leq 1.0 \text{ mm}^2$
Electromagnetic compatibility	EN 61326-1	
Interference emission	Class B	
Interference immunity	Industrial requirements	

Case

Case type	Plastic case for panel mounting acc. to IEC 61554
Installation depth	90.5 mm
Ambient/storage temperature range	-5...+55 °C / -40...+70 °C
Ambient conditions	rel. humidity < 90% annual average, no condensation

Operating position	any
Protection type	acc.to EN 60529, at the front IP 65, at the rear IP 20
Weight (fully equipped)	approx. 123 g

Interface

Interface type	RS485
Protocol	Modbus
Baud rate	9600, 19200, 38400
Device address	0–255
Max. number of stations	32

8.2 Alarm and fault messages

Thermocouple input

Display	Cause	Fault remedy Test/repair/replace
<i>RLrLt</i> (factory-specific text, can be changed)	Binary function for which a text display was configured is active	Carry out the measure intended for this case
- 1999 (flashing!)	Underrange for the value being displayed.	Is the medium being measured within the range (too hot? too cold?) Check probe for break and probe short-circuit. Check the probe connection and the terminals. Check cable. Check that the connected probe complies with the configured probe type
9999 (flashing!)	Overrange for the value being displayed.	
All displays ON; lower 7-segment display flashes	Watchdog or power ON trigger initialisation (reset).	Replace controller, if initialisation takes longer than 5 s.

Overrange/underrange covers the following events:

- Probe break/short-circuit
- Measured value outside the probe measuring range
- Display overflow

8.3 Self-optimization

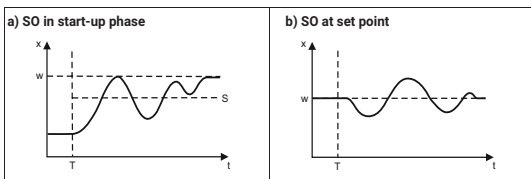
Principle

Self-optimization (SO) is carried out according to the oscillation method and establishes the optimum controller parameters for PID or PI controllers.

Depending on the configured controller type, the following controller parameters are defined:

Proportional band (Pb), derivative time (dt), reset time (rt), cycle times (Cy), filter time constant (dF)

Depending on the range of the control deviation, the controller selects between to methods **a** or **b**:





S = Switching level

T = Start of self-optimization (SO)

Prerequisites

The following prerequisites must be fulfilled to be able to start self-optimization:

- No active level inhibit via binary functions (binF)
- No active inhibit of Parameter level via Setup program (Display/Operation/Service counter -> Operation -> Level inhibit)
- Ensure that the  +  keys are not pressed asynchronously. Simultaneous actuation must be synchronous.

Furthermore, the following five points should be taken into consideration, checked and, if necessary, adjusted, prior to starting self-optimization:

- Is the suitable controller type configured?
- Check and/or adjust the control action of the controller
- Is it possible to sufficiently influence the process value in manual mode?
- Prior to starting optimization on PID structure, ensure that the reset time (rt) is not set to 0.

- For continuous controller only: Ensure that the function of the output (OutP -> OutA) is configured to controller output 1 and scaled to 0...100%.

This means:



Function (FnCt) = Controller output 1 (11)

Zero point (OPnt) = 0

End value (End) = 100

- For modulating controllers only: Determine the actuator time (tt) and set in the Parameter level

Start of self-optimization

1. Simultaneously press the  +  keys (> 2 s)

↪ In the lower display,

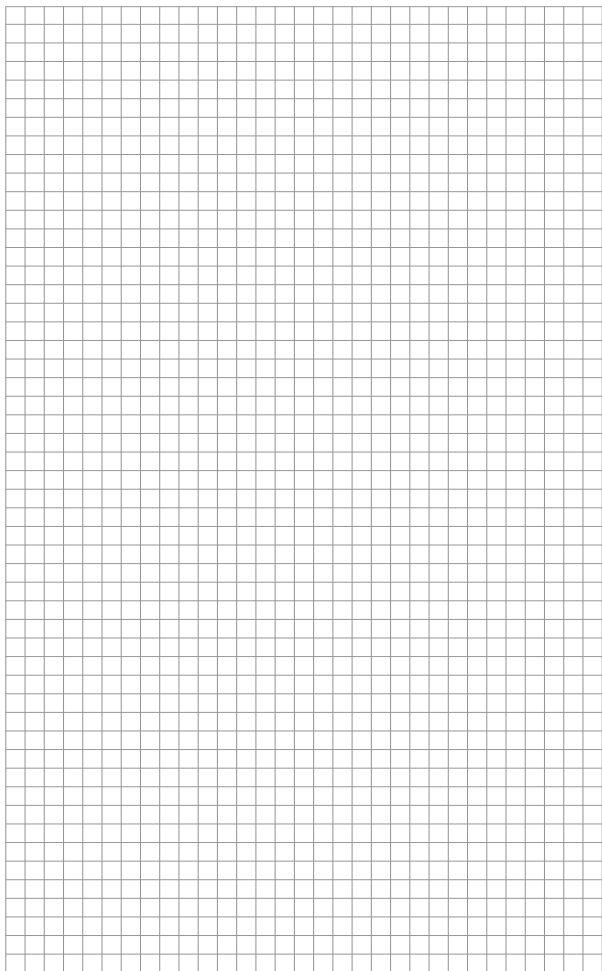
"tUnE" appears flashing.

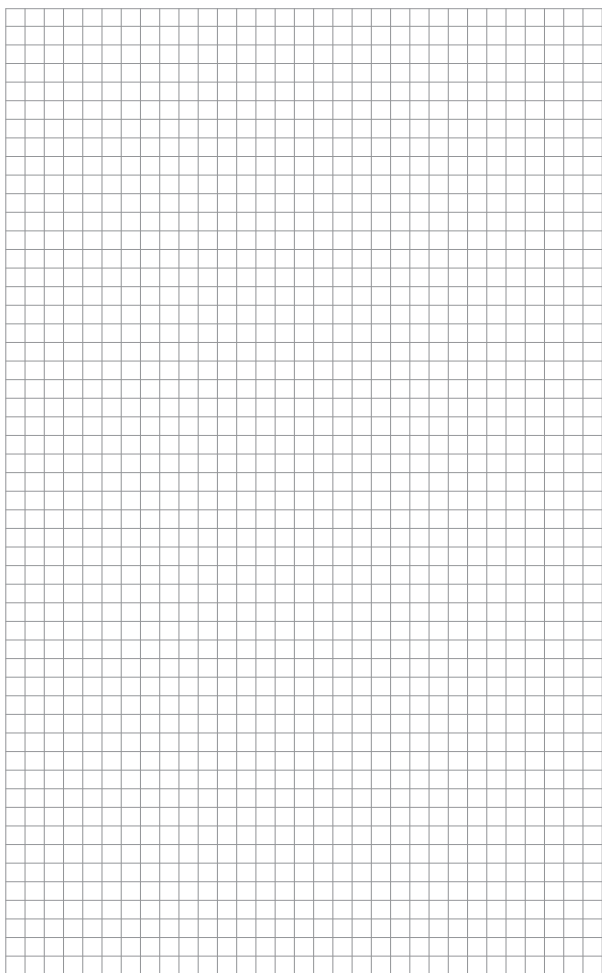


Self-optimization is completed when the display automatically changes to the standard display. The duration of self-optimization depends on the process.

Canceling self-optimization

1. Cancel using  +  (simultaneously)





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