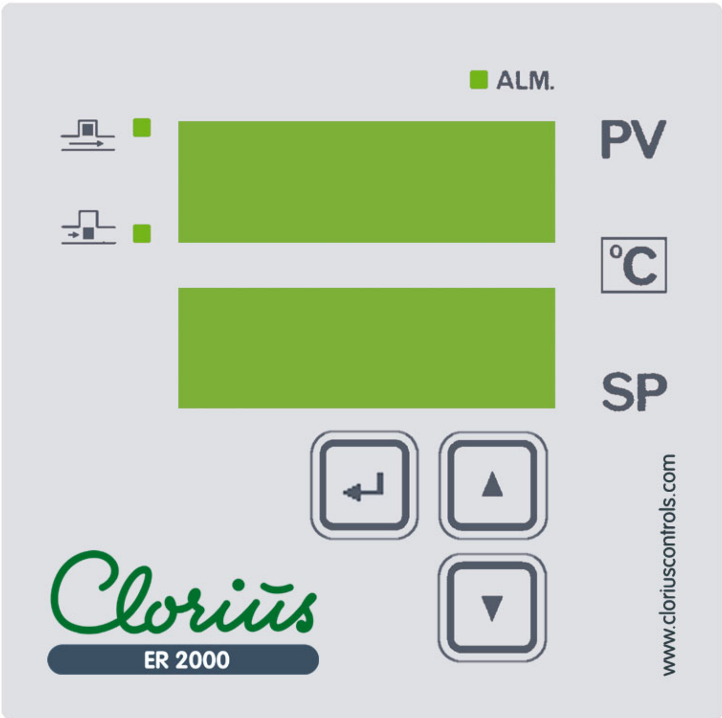
99.46.03-C
GB

ER 2000
Instruction

Microprocessor - based controller ER 2000
Universal three - position step controller
Industrial controller with special PID - step controller algorithm



- ❑ Easy operation
- ❑ User - defined operating level
- ❑ Digital displays for process variable and set point
- ❑ Control structure PI and PID
- ❑ Three - position control
- ❑ Robust self - optimization
- ❑ Compact design 96mm x 96mm x 135mm
- ❑ Selectable heating or cooling controller
- ❑ Measurement inputs for Pt 100
- ❑ Manual -/ automatic changeover
- ❑ Degree of protection Front IP 65
- ❑ Semi - conductor memory for data protection
- ❑ Plug - type terminals

Contents

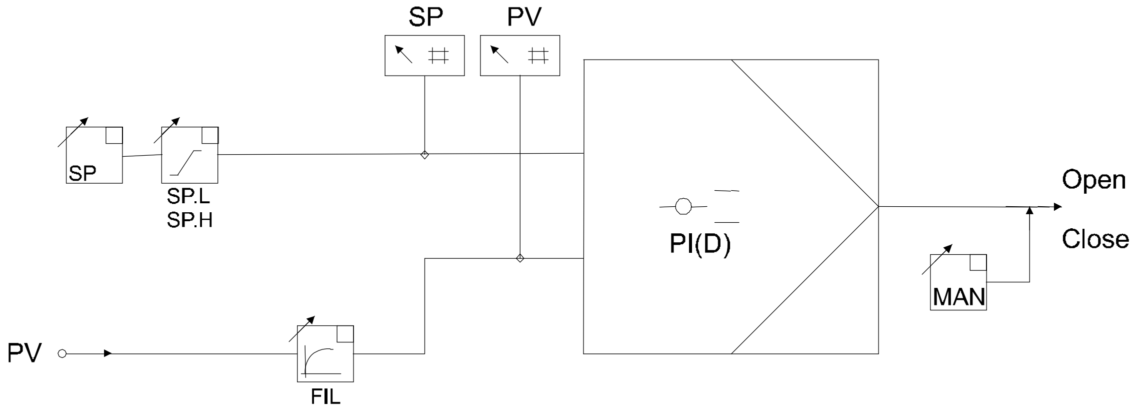
⚠ **Warning:**

During electrical equipment operation, the risk that several parts of this unit will be connected to high voltage is inevitable. Improper use can result in serious injuries or material damage. The warning notes included in the following sections of these operating instructions must therefore be observed accordingly. Personnel working with this unit must be properly qualified and familiar with the contents of these operating instructions.
Perfect, reliable operation of this unit presupposes suitable transport including proper storage, installation and operation.

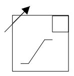
1. Function overview

Basic device

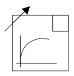
Analogue input Pt100	The analogue input for the process variable PV.
Relay OPEN	Controller output OPEN, opens the controlling element.
Relay CLOSE	Controller output CLOSE, closes the controlling element.
Relay ALARM 1	Selectable alarm. This alarm relay operates on the basis of the normally closed contact principle.



Block diagram



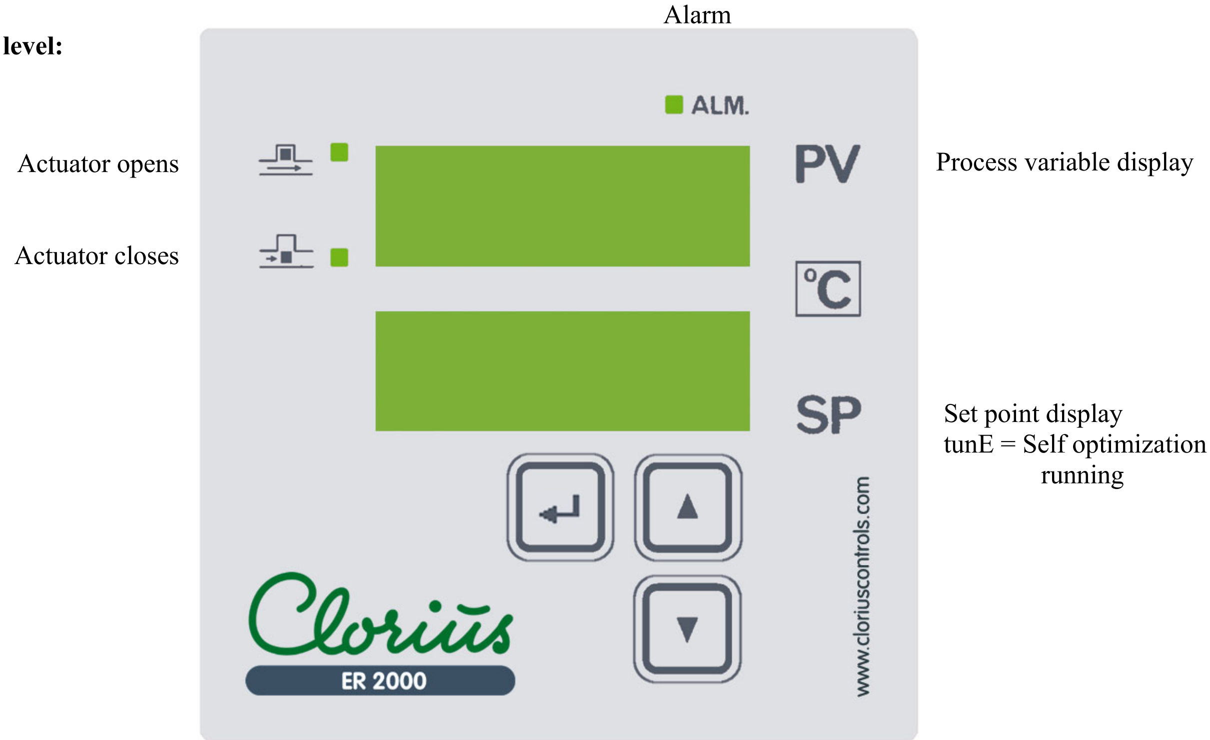
Set point limitation minimum value SP.L - set point low, maximum value SP.H - set point high. Only set points within the set point limits can be set by way of the keyboard.



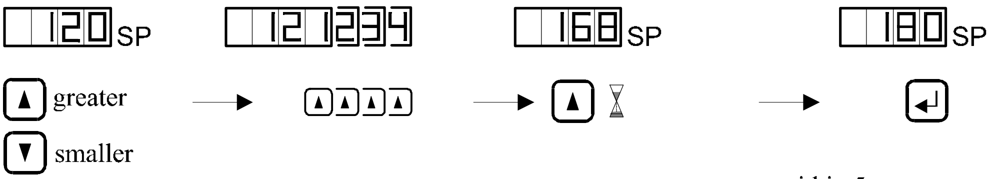
Filtering FIL of the process variable input PV. Interference signals and small process variable fluctuations can be smoothed by an adjustable software filter.

2. Operating and setting

Operating level:



2.1 Setting set point in automatic mode



in individual steps

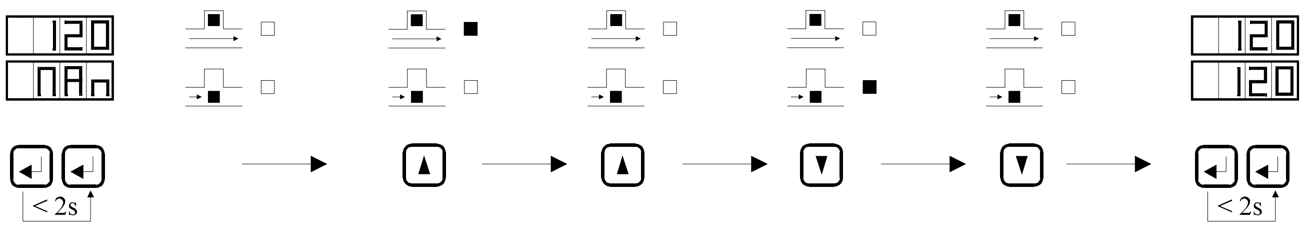
Continuous adjustment at increasing speed

within 5s accept new setpoint, otherwise back to the old, still effective setpoint

= press continuously

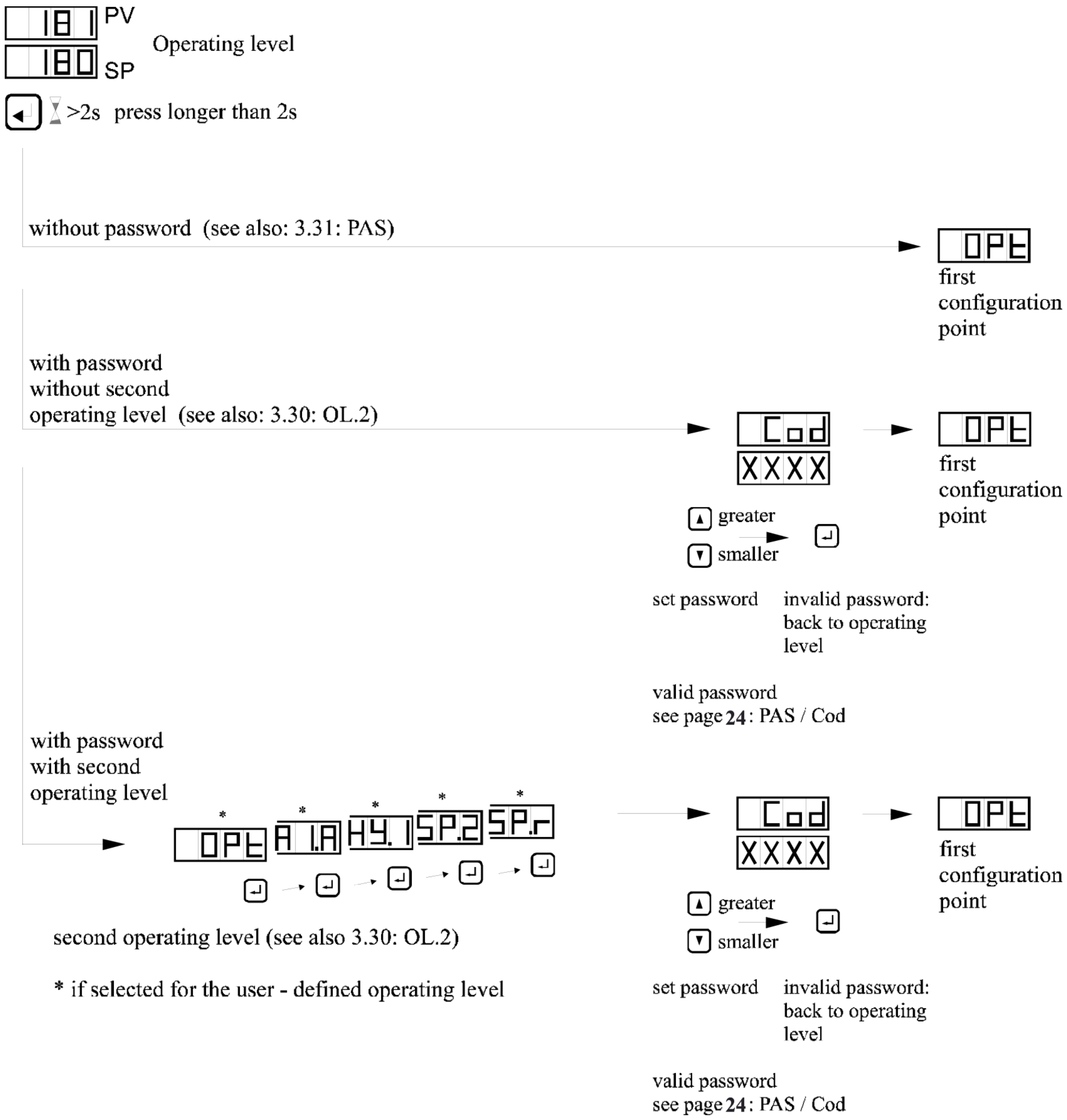
Setting range: SP.L to SP.H

2.2 Opening / closing actuator in manual mode



Change over to manual mode (lockable)	actuator stops	actuator opens	actuator stops	actuator closes	actuator stops	Change over to automatic mode

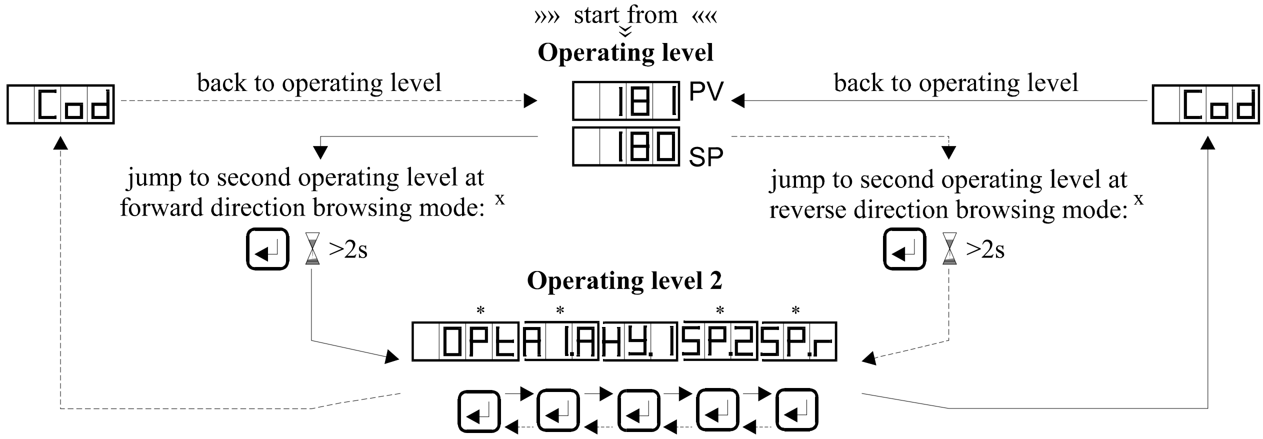
2.3 Branch to parameterization -/ configuration level



>2s Back to operating level possible at any time

2.4 Branch to second operating level (user - defined operating level)

Parameters and configuration points that have been selected for the second operating level (see also 3.18: OL.2) can be called up and set without entering the password, in case access to the parameterization -/ configuration level is protected by a password (see also 3.19: PAS). How to branch from the operating level to the second operating level see the following diagram. Which configuration point of the second operating level will be called up first is dependent on the selected browsing mode [x].



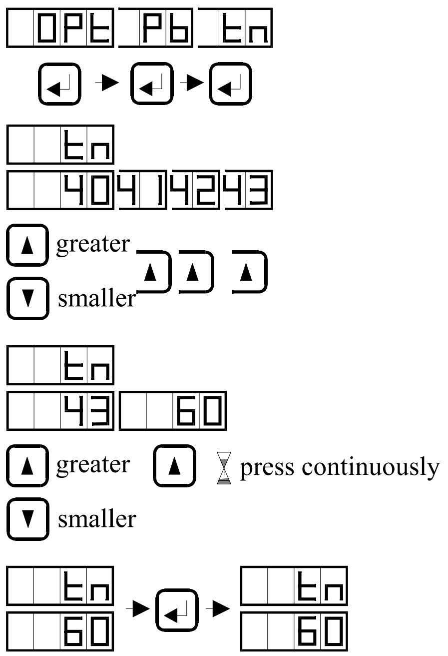
* if this function has been selected for the user-defined operating level and the access to the parameterization -/ configuration level has been interlocked by means of the password.

x How to set the browsing direction see below at 2.6.

The following can be set as an option on the second operating level:

- self-optimization OPt
- alarm A1.,HY.1
- serial communication S.C
- second set point SP.2
- set point ramp SP.r

2.5 Set parameters / configuration points

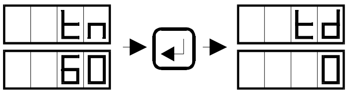


1 Select parameter / configuration point
(at this example the forward browsing mode is set).

2a Set new value in individual steps and / or ...

2b Set new value continuously,
at increasing speed (and / or 2a).

3 Within 5s accept new value (otherwise after 5s the controller would reset the input to the old value at start of the input procedure - tn = 40).



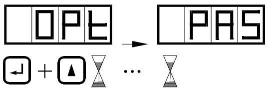
4 After the new value has been set, press to call up the next parameter / configuration point


>2s

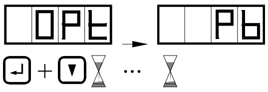
Back to operating level possible at any time

2.6 Changing the browsing mode for parameters / configuration points

When you have changed to the Operating level 2 or to the parameterization -/ configuration level it is possible to change the browsing direction. The forward browsing direction mode is set at every power - cycle.



To switch to the reverse browsing direction mode hold down the - key and the - key till the previous configuration point will be displayed. With this setting you will scroll in reverse mode through all configuration points on the parameterization -/ configuration level and the operating level 2. Changing the browsing direction mode is possible every time when scrolling across the parameterization -/ configuration level or the operating level 2.

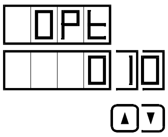


To switch to the forward browsing direction mode hold down the - key and the - key till the next configuration point will be displayed. With this setting you will scroll in forward mode through all configuration points on the parameterization -/ configuration level and the operating level 2. Changing the browsing direction mode is possible every time when scrolling across the parameterization -/ configuration level or the operating level 2.

3. Parameterization -/ configuration level

How to switch to this level see 2.3. To switch to next / previous point (depending on the browsing direction mode) press the - key. How to change the browsing mode see 2.6. The following list shows all the parameters and configuration points like they would appear when you browse in the forward mode through the parameterization -/ configuration points list (the appearance of some points is dependent on your device version and your configuration.
In the parameterization -/ configuration level no switch - over to manual mode is possible.

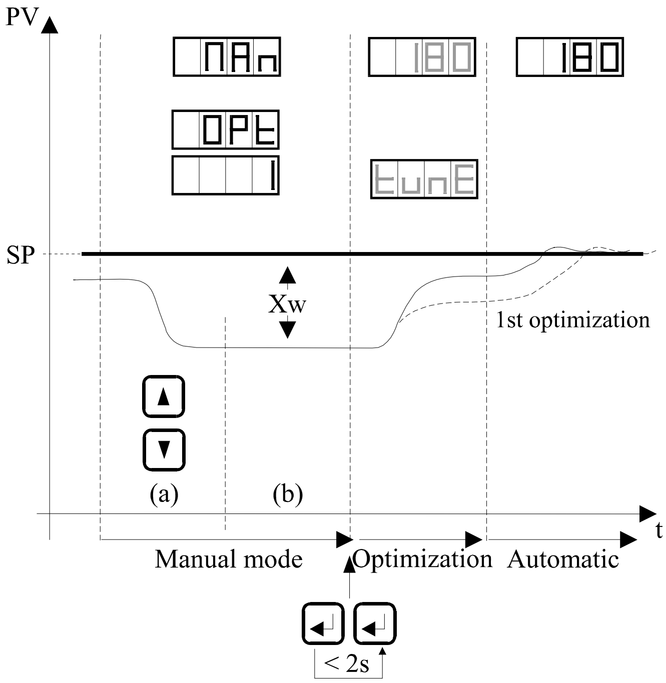
All parameterization -/ configuration points will be explained on the following pages ...



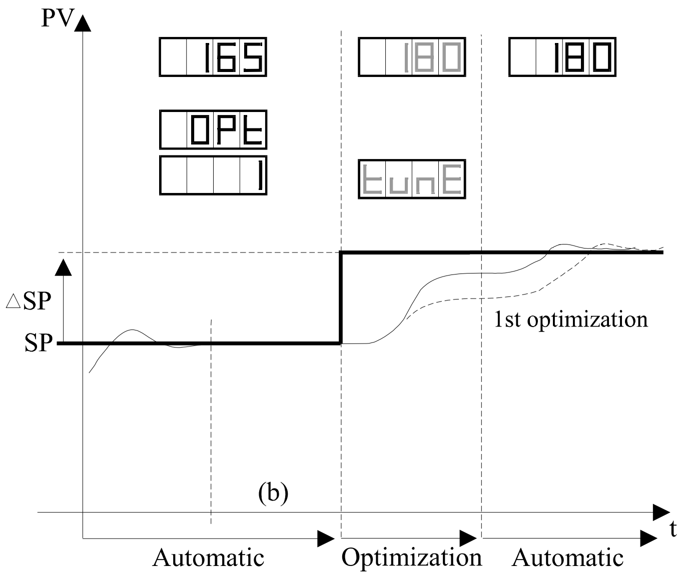
3.1 Optimization for automatic determination of favourable control parameters. OPt

Selections: 0 No self - optimization
1 Self - optimization activated

Self - optimization is triggered by:
- a change in the set point SP
- a changeover from manual to automatic mode



Optimization from manual mode



Optimization in automatic mode

Procedure during optimization:

From the manual mode:

- Set set point SP
- Switch over to manual mode
- By opening / closing the actuator, set the process variable PV to a value larger / smaller than the set point SP (a)
- Wait until PV has stabilized (b)
- Skip to the parameterization / configuration level
- Set OPt = "1"
- If known, enter process gain P.G (standard setting: P.G = 100%)
- Return to the operating level
- Switch over to automatic mode

In the automatic mode:

- Wait until PV has stabilized (b)
- Skip to the parameterization -/ configuration level
- Set OPt = "1"
- If known, enter process gain P.G (standard setting P.G = 100%)
- Return to the operating level
- Set the set point

The self - optimization starts with the manual / automatic switchover (for optimization from manual mode) or with the set point change ΔSP (for optimization in the automatic mode). The **tunE** display is shown cyclically in the set point display SP during the optimization process. The determined parameters (Pb, tn, td, P.G) are taken over automatically at the end of self - optimization.

The optimization routine is not started if the system deviation Xw (manual mode) or the set point change ΔSP (automatic mode) is less than 3.125% of the measuring range PV at the start of the optimization process. The change of the process variable PV or of the set point SP during the optimization should run in the same range and in the same direction in which the system is controlled after optimization, i.e. the optimization process should correspond as accurately as possible to the later

control process. If process sequences with strongly different time behaviour occur in the course of a control sequence (e.g. fast heating up, slow cooling down), then the more important part of the process must be optimized.
If the process sequences are equivalent, then the slower process must be optimized.

In systems with linear transmission behaviour (constant process gain $P.G = \frac{\Delta PV}{\Delta Y}$ over the entire control range), an optimization process already always delivers the optimum controller parameters.

If the transmission behaviour of the system is non - linear (the process gain $P.G = \frac{\Delta PV}{\Delta Y}$ changes, e.g. with the set point SP to be controlled), then the variable process gain P.G has a decisive influence on the controller parameters. Here the process variable PV should approximately reach the target set point during the optimization process.
If this is not the case, a further optimization process must be performed. The process gain P.G in the working point was determined automatically in the preceding optimization process.
If the process gain P.G in the working point is known, it can be entered manually before starting optimization
(see also 3.13: P.G)
The actuator may be neither closed nor 100 % open before the start of or during the optimization process.
The optimization is interrupted automatically, if it is not finished within 42 minutes.
After each performed optimization, the configuration point OPt is set automatically to 0.
An optimization process can be interrupted at any time by pressing the manual - or briefly the ↵ -key.

NO ENTRIES OR SWITCHING OVER MAY BE PERFORMED DURING THE OPTIMIZATION PROCESS!

Additional explanations for self-optimization of three - position step controllers

The optimization of a temperature control with a low initial temperature and a higher final temperature serves as an example.

- **The temperature difference of the initial temperature and the aim temperature must be more than 12.5 °C.**
  (At Pt100- measuring range 2.2: 0 to 400 °C, more than 12.5 °C
  at Pt100-measuring range 2.4: 0 to 300 °C; more than 9.5 °C)
  But it is more favourable, if there is a larger difference between initial temperature and final temperature.
  If heat - up action is optimized the initial temperature should correspond to the temperature of the cold plant, the aim temperature to the set point of the temperature control.

- **The temperature should be stable before starting the optimization.**
  For that purpose set the controller's set point to the initial temperature and wait until the temperature has balanced at this value.
  Actual value and set point do not have to be equal absolutely.
  If the controller is not able to keep the initial temperature stable in automatic mode, e.g. in case of temperature oscillation the initial temperature has to be adjusted in manual mode.
  Position the motorized valve via the CLOSE - key and the OPEN - key to reach the initial temperature approximately.

- **At beginning of optimization the motorized valve must be neither closed completely nor completely open.**

- **The optimization is started at changing the set point or at change - over from manual mode to automatic mode.**
  Assumption: configuration point OPt = "1"

- **At beginning of optimization the controller automatically opens the motorized valve for a certain amount.**
  How far the motor valve is opened depends on the difference of actual value and aim set point and of the adjusted process gain P.G (initial value P.G = 100%)
  The motorized valve remains in this position up to the end of optimization.
  Always check the position displacement on site at the motorized valve.

- **During optimization the motorized valve must not be opened completely.**
  The stroke of the control valve must be smaller than 95%.
  Check the position of the motorized valve on site.

- **The opening of the motorized valve causes a rise of temperature(heating systems).**
  Depending on the amount of temperature rise and its temporal progress the controller determines the parameters proportionalband Pb, integral action time tn, derivative action time td and the real progress gain P.G.

- **The controller automatically finishes the optimization as soon as the temperature is balanced on the higher value.**
  The parameters are calculated at the end of optimization.

- **The controller ceases the optimization if the temperature is not yet balanced on the higher value after 42 minutes.**
  Ceasing the optimization, no parameters are determined.
  This break is possible in plants with a very slow time behaviour.
  This break is possible in plants without balance
  (e.g. continuous rise of temperature at constant valve position, temperature drift)

- **In these cases optimization can be finished manually by switching over configuration point OPt from "1" to "0" within 42 minutes.**
  The parameters are calculated when configuration point OPt is switched over from "1" to "0"
  A manually finished optimization delivers favourable parameters
  - in plants with slow time behaviour, if the temperature approached the stable final value but did not yet reach it entirely. The approachement to a stable end-value is recognized by the strong reduction of speed in change of temperature as against to the first half of the optimization - time.
  - in plants with continuous temperature drift (no stable initial - and final temperature) if the rate of temperature rise during optimization is essentially higher than during the normal temperature drift. Optimization is ceased manually when temperature rise slides over to normal temperature drift

- **Therefor optimization can also be started if the temperature is not balanced before optimization but has a continuous drift rate.**
  In this case optimization has to be finished manually (see above).

- **The change of temperature during optimization must be more than 25% of the difference between actual value and set point (difference at start of optimization).**
  With smaller temperature changes no parameters are determined at the end of optimization.

- **If the change of temperature is too small, the setting of the parameter P.G (process gain) has to be decreased manually and afterwards a further optimization has to be done.**
  This causes a larger change of temperature during the following optimization.

- **If the change of temperature during optimization is too large and optimization is interrupted manually (overtemperature) the setting of the parameter P.G (progress gain) has to be increased manually.**
  This causes a smaller change of temperature during the following optimization.

- **If the temperature does not approximately reach the aim set point at the end of optimization (possible in plants with unlinear transfer behaviour) a further optimization is convenient.**
  The controller runs through a learning process and determines the real process gain P.G. During the next optimization actual value and set point come closer together.

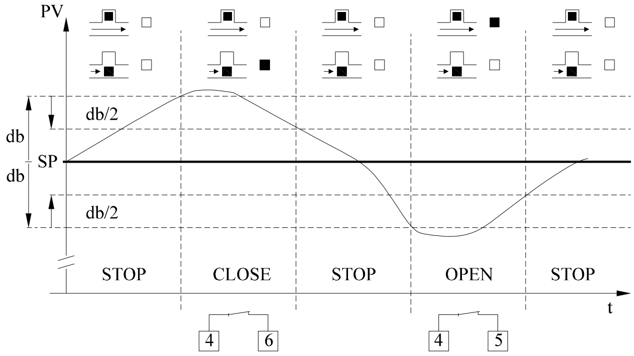
3.2 Proportional band Pb

Setting range: 1.0 % to 999.9%
Proportional action of the PI(D) three - position step controller

3.2.1 Three - position controller

by settings: **Pb = 0.0**
tn > 0

Control action adjustable via dead band db.
(see also 3.5: db)



3.2.1 Three - position controller

3.3 Integral action time tn

Setting range: 1s to 2600s
Integral action of the PI(D) three - position step controller

3.4 Derivative action time td

Setting range: 1 to 255s

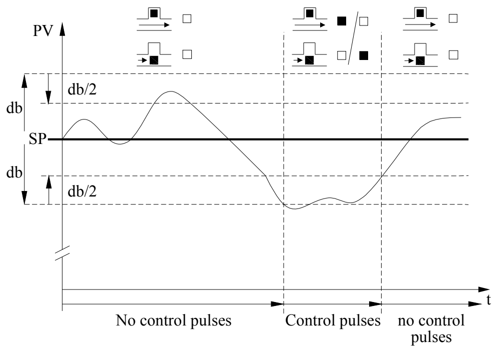
Derivative action of the PID three - position step controller
By setting td = 0: PI three - position step controller

3.5 Dead band db

Setting range: 0 to the tenth part of the measuring range [phys. units] (whole measuring range at dP = 3)

Hysteresis: db/2
No control pulses at control deviation smaller db.

(see also 3.2.1 three - position controller)



3.5 Dead band

3.6 Actuating time t.P (Valve actuation time)

Setting range: 5s to 300s
Time to pass through the correcting range 0 to 100 % (stroke) at constant OPEN or CLOSE - pulse

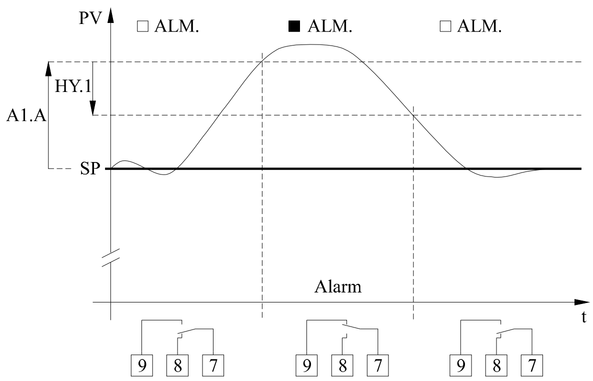
3.7 Basic Alarm - type description descripes the alarm types a,b and c

The controller features three basic types of alarms called type A, type B or type C. For type C are two versions available. Type C is typical.

3.7a Alarm - type A

Alarm at a limit value based on the set point SP (set point dependent). Alarm at over - temperature if alarm setting (at A1.A) is positive. Alarm at under - temperature if alarm setting (at A1.A) is negative. Alarm will be signalled if PV is bigger (at positive setting) than SP + A1.A or if PV is smaller (at negative setting) than SP - A1.A . The algebraic sign on the Alarm value A1.A only indicates the line of action (over- or under - temperature).

The hysteresis defines a span between alarm state and the switch back to normal mode. At positive setting of A1.A the return to normal state is at SP + A1.A - HY.1 . At negative setting of A1.A the return to normal state is at SP - A1.A + HY.1 .

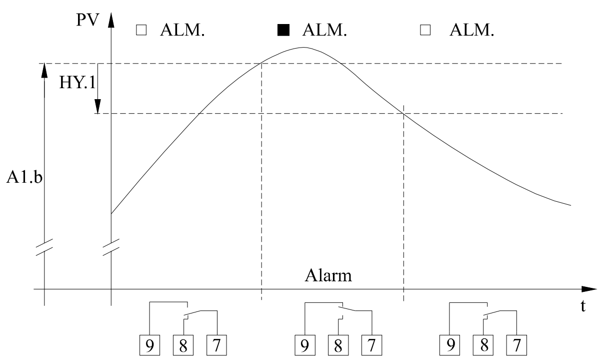


Alarm type A

3.7b Alarm - type B

Alarm at a fixed limit value.

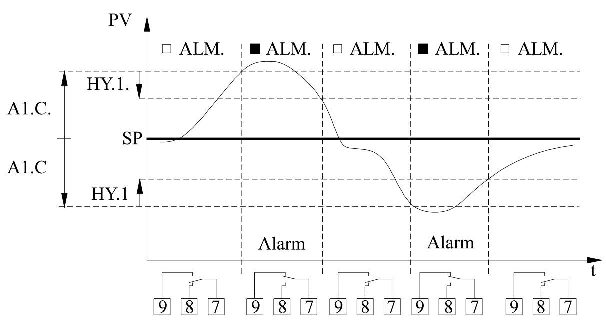
Alarm will be signalled if the value set at A1.b is reached or exceeded.
The hysteresis defines a span between alarm state and the switch back to normal mode. Return to normal mode is at A1.b - HY.1 .



Alarm type B

3.7c Alarm - type C (typical)

Alarm at leaving a band around the set point SP. The lower band is defined by A1.C , the higher band by A1.C. .
The number entered at A1.C is always negative because the process variable PV has to be A1.C smaller than the set point SP to switch to alarm state. The number entered at A1.C. is always positive because the process variable PV has to be A1.C. bigger than the set point SP to switch to alarm state.
The hysteresis defines a span between alarm state and the switch back to normal mode. For the lower band (A1.C) the hysteresis is entered at HY.1 and for the higher band (A1.C.) the hysteresis is entered at HY.1. .



Alarm type C

e.g.: HY.1. = controller display
(only alarm displays)

AL.1
0...4

3.7.1 Alarm - type selection for alarm relay AL.1

The alarm - relay is working with the normally closed contact principle.

Selection AL.1 = 0:
No alarm, also not in case of sensor failure (see also 3.15: SE.b)

A1.A

Selection AL.1 = 1
Alarm type A (see also 3.7a). Alarm at a limit value based on the set point SP (set point dependent). Alarm at over - temperature if A1.A is positive (SP + A1.A). Alarm at under - temperature if A1.A is negative (SP - A1.A). Also alarm in case of sensor failure.
Setting range: 0 to ± extend of measuring range [phys. units] at dP=0 (x0.1 at dP = 1; x0.01 at dP = 2 ; x0.001 at dP = 3).

HY.1

Alarm hysteresis HY.1 for A1.A at AL.1 = 1
The hysteresis defines a span (or dead - zone) between alarm state and the switch back to normal mode. If A1.A is positive the return to normal state is at SP + A1.A - HY.1. If A1.A is negative, the return to normal state is at SP - A1.A + HY.1 .
Setting range: 0 to tenth part of measuring range [phys. units] at dP=0 (measuring range: x0.01 at dP = 1; x0.001 at dP = 2 and 3).

A1.b

Selection AL.1 = 2
Alarm type B (see also 3.7b). Alarm at a fixed limit value. Alarm at A1.b is reached or exceeded (over - temperature). Also alarm in case of sensor failure.
Setting range: measuring range [phys. units] at dP=0 (measuring range: x0.01 at dP = 1; x0.001 at dP = 2 and 3).

HY.1

Alarm hysteresis HY.1 for A1.b at AL.1 = 2
The hysteresis defines a span (or dead - zone) between alarm state and the switch back to normal mode. Return to normal mode is at A1.b - HY.1 .
Setting range: 0 to tenth part of measuring range [phys. units] at dP=0 (measuring range: x0.01 at dP = 1; x0.001 at dP = 2 and 3)

Selection AL.1 = 3
Alarm type C (see also 3.7c). Alarm at leaving a band around the set point SP. Also alarm in case of sensor failure.

A1.C

Lower band half around set point (negative setting).
Setting range: 0 to - extend of measuring range [phys. units] at dP=0 (measuring range: x0.01 at dP = 1; x0.001 at dP = 2 and 3).

HY.1

Alarm hysteresis HY.1 for A1.C at AL.1 = 3 - Hysteresis for lower band half
The hysteresis defines a span (or dead - zone) between alarm state and the switch back to normal mode. Return to normal mode is at A1.C - HY.1 .
Setting range: 0 to tenth part of measuring range [phys. units] at dP=0 (measuring range: x0.01 at dP = 1; x0.001 at dP = 2 and 3)

A1.C

Upper band half around set point (positive setting).
Setting range: 0 to + extend of measuring range [phys. units] at dP=0 (measuring range: x0.01 at dP = 1; x0.001 at dP = 2 and 3).

HY.1

Alarm hysteresis HY.1. for A1.C. at AL.1 = 3 - Hysteresis for upper band half
The hysteresis defines a span (or dead - zone) between alarm state and the switch back to normal mode. Return to normal mode is at A1.C. - HY.1. .
Setting range: 0 to tenth part of measuring range [phys. units] at dP=0 (measuring range: x0.01 at dP = 1; x0.001 at dP = 2 and 3)

Selection AL.1 = 4
Alarm type B (see also 3.7b). Alarm at a fixed limit value for under - temperature. Alarm at process variable is lower than A1.b . Also alarm in case of sensor failure.
Setting range: measuring range [phys. units] at dP=0 (measuring range: x0.01 at dP = 1; x0.001 at dP = 2 and 3).

Alarm hysteresis HY.1 for A1.b at AL.1 = 4
The hysteresis defines a span (or dead - zone) between alarm state and the switch back to normal mode. Return to normal mode is at A1.b + HY.1 .
Setting range: 0 to tenth part of measuring range [phys. units] at dP=0 (measuring range: x0.01 at dP = 1; x0.001 at dP = 2 and 3)

3.8 Decimal point for LED displays dP

Selections:
0 Display without decimal point: ####
1 Display with decimal point (1 decimal): ###.#
2 Display with 2 decimals: ##.##
3 Display with 3 decimals: #.###

At any time the decimal point has been altered, the process variable display PV has to be re-scaled. (see also 3.9: dI.L, dI.H)
With a change in the dP setting several other inputs on the configuration -/ parameterization level will be concerned. Because of the high degree of accuracy of some inputs approximation errors may be possible.

3.9 Scaling the process variable display PV dI.L, dI.H

Display.Low Enter: Zero point of the transmitter
Indication at the LED - Display PV at start of measuring range
Setting range: -999 ... 9999 [phys. units] at dP = 0 (dI.L must be less than dI.H)
range depended on the dP setting : from -999 ... 9999 at dP= 0 to -0.999 ... 9.999 at dP = 3, see also 3.8: dP
standard value: **0**° C

Display.High Enter: End point of the transmitter
Indication at the LED - Display PV at end of measuring range
Setting range: -999 ... 9999 [phys. units] at dP = 0 (dI.H must be greater than dI.L)
range depended on the dP setting : from -999 ... 9999 at dP= 0 to -0.999 ... 9.999 at dP = 3, see also 3.8: dP
standard value: **300**° C

⚠
- At a change of dI.L or dI..H all values entered as physical units will be re-scaled in percents.
- With the Pt100 sensor dI.L and dI.H have to correspond to the Pt 100 - measuring range of the supplied device
  ER 2000 - 2.4 - ... : dI.L = 0, dI.H = 300

3.10 Set point limitation SP.L, SP.H

Set point.Low lowest set point that can be set
Setting range: dI.L to SP.H [phys. units] (see also 3.9: dI.L)
Effective for the set point entered via the keyboard.

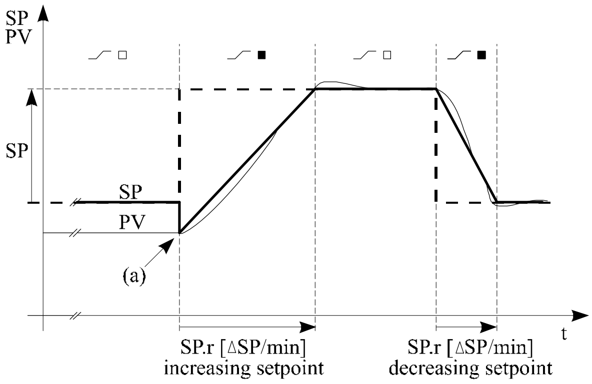
Set point.High highest set point that can be set
Setting range: SP.L to dI.H [phys. units] (see also 3.9: dI.H)
Effective for the set point entered via the keyboard.

⚠
- At a change of dI.L or dI..H, SP.L or SP.H will be re-scaled in percents.
- At SP.L = SP.H the set point has a fixed value - no change of set point possible.
- At SP.L > SP.H the set point alternates between SP.L and SP.H - only those two values are selectable via the keyboard.
  To set up the alternation between two set points: enter SP.L and SP.H (SP.L must be bigger than SP.H). Switch to operating level (you can see the last set point entered). Select one of the two possible set points with your keyboard an press the ↵ - key.

SP.r

3.11 Set point ramp SP.r

Setting SP.r = 0: no set point ramp - change of set point abruptly.
Change rate of set point SP(gradient)
Setting range: 1 to extent of measuring range in PV / as minutes or hours (see also 3.12: rA.d) ; PV [phys. unit] e.g.: K / min or hour (at dP = 0)
Range dependent on setting of dP: range x 0.1 at dP = 1, range x0.01 at dP = 2, range x0.001 at dP = 3



3.14 Set point ramp SP.r

The start point of the set point ramp is always the current value of the process variable PV (a). The current set point is displayed.

The set point ramp is triggered
- after switching on the device or after a power failure
- after sensor failure
- after every set point change
- after switching over to the second set point SP.2
- after a control function STOP, CLOSE, OPEN (via digital input)
- after switching over from manual mode to automatic mode

rA.d
0...6

3.12 Ramp direction rA.d

Effective direction and time mode setting of the set point ramp SP.r (at SP.r > 0)

Selections:
0 Ramp with SP.r as physical unit* per minute, at falling and rising set point changes.
1 Ramp with SP.r as physical unit* per minute, only at rising set point changes.
2 Ramp with SP.r as physical unit* per minute, only at falling set point changes.
3 Ramp is deactivated (simillar to the SP.r = 0 setting).
4 Ramp with SP.r as physical unit* per hour, at falling and rising set point changes.
5 Ramp with SP.r as physical unit* per hour, only at rising set point changes.
6 Ramp with SP.r as physical unit* per hour, only at falling set point changes.

(see also 3.11: SP.r) * physical unit set at 3.9: dI.L, dI.H

3.13 Process gain P.G

Setting range: 1 to 255 %

Gain of the controlled system $P.G = \frac{\text{Change of the process variable PV}}{\text{Change of the actuating variable Y}} = \frac{\Delta PV}{\Delta Y}$ in %

D PV [% of the measuring range of PV]
D Y [% of the actuating range (stroke) 0 - 100 %]

e.g.: P.G = 50%: $\frac{\Delta PV}{\Delta Y}$ = 0,5 — A change of the valve position ΔY of 10% results in a change in the process variable PV of 5%.

P.G = 100%: $\frac{\Delta PV}{\Delta Y}$ = 1,0 — A change of the valve position ΔY of 10% results in a change in the process variable PV of 10%.

P.G = 125%: $\frac{\Delta PV}{\Delta Y}$ = 1,25 — A change of the valve position ΔY of 10% results in a change in the process variable PV of 12.5%.

The process gain P.G is required for the self - optimization of the control parameters. If it is unknown, P.G is determined automatically during self - optimization. (see also 3.1: OPt)
On non - linear transfer behaviour of the system, the process gain changes with the working point (e.g. on controlling different set points).

3.14 Measured value filter for analog inputs **FIL**

Software 1st order low - pass filter with adjustable time constant Tf for suppressing interference signals and for smoothing fast measured value fluctuations.

Formula :
Tf = -0,04/ln(input/256)

Setting range: 0 to 255
At FIL = 0 : No softwarefilter active

The following assignment applies:

Input:	255	254	252	250	240	230 *	220	200	0
Tf [s]:	10,22	5,10	2,54	1,69	0,62	0,37	0,26	0,16	off

* Standard setting

3.15 Response to PV sensor failure **SE.b**

Reaction of the actuator in automatic mode on: Sensor short circuit, sensor break.

Selections: 0 Actuator closes
1 Actuator opens
2 Actuator stays in its current position

In a transmitter / sensor fault, the error message **Err** (error) appears in the LED display PV. Alarm message if alarm A, B or C is configured, independent of the set alarm limit. After the fault is no longer present, the controller returns automatically to the automatic mode.

PV

3.16 Interlocking the manual / automatic switchover **Man**

Selections: 0 Switching over by keyboard possible at any time
1 Interlocking in the momentary conditions, no switchover to other mode possible:
MAn. to "1" in automatic mode: constant automatic mode
MAn. to "1" in manual mode: constant manual mode

3.17 Direction of action of the controller **dIr**

Selections: 0 Heating controller: with rising controlled variable PV, the actuator closes
1 Cooling controller: with rising controlled variable PV, the actuator opens

OL.2

3.18 Second operating level (operating level 2) **OL.2**

Selecting the functions for the user - defined operating level.

Setting range: 0 to 255:

0 No second operating level
1 Self - optimization can be activated at the 2nd operating level (see also 3.1: OPt)
2 Limit and hysteresis of the selected alarm can be entered at the 2nd operating level (see also 3.7: Alarms)

The distinctive numbers of the required functions are added, and the result is entered.
The distinctive numbers 4, 32, 64, 128 are reserved and have no function yet. No functions will be shown for those distinctive numbers. In the event that only one, or some, reserved numbers without the definition of any functional distinctive number is defined, only Cod will be displayed on the operating level 2.

The password must have been activated, to activate the second operating level. (see also 3.19: PAS)

PAS
01

3.19 Access to the parameterization / configuration level (password) **PAS**

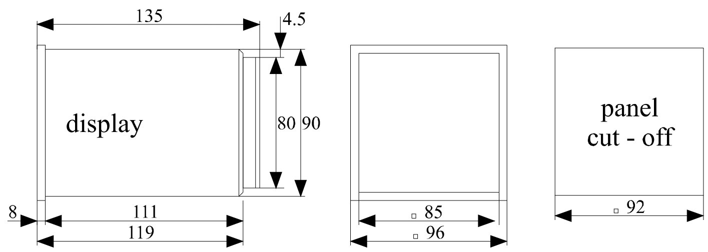
Interlocking the parameterization / configuration level via the password **Cod** prevents unauthorized access.

Selections: 0 No interlocking of the parameterization / configuration level. OL.2 ineffective.
1 Access to the parameterization / configuration level only after keyboard entry of the password. OL.2 effective.
(see also 3.18 OL.2; valid password: see page 29: PAS / Cod)

4. Mounting

The device is suitable for front panel installation and for integration in any position into consoles.
Insert the controller from the front into the prepared panel cut - off and secure with the supplied clamping tool.

⚠ The ambient temperature at the point of installation must not exceed the permissible temperature for rated operation.
Adequate ventilation must be assured, even with a high device packing density.
The device must not be installed within explosion - hazardous areas.

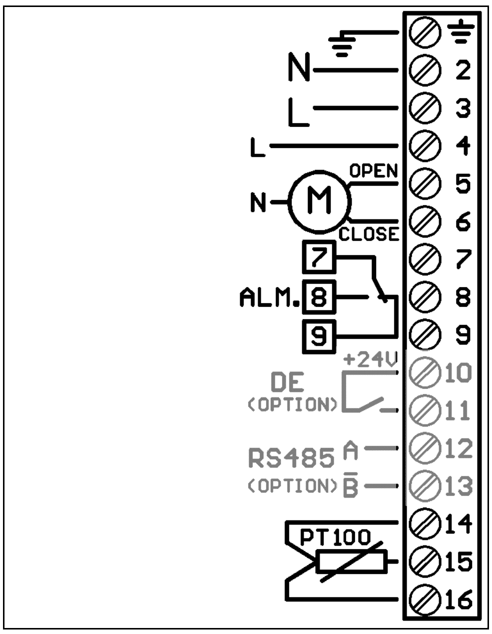


Device dimensions ER 2000

5. Electrical connection

The plug - type terminals are located at the back of the device. The wiring diagram is located at the back of the device.

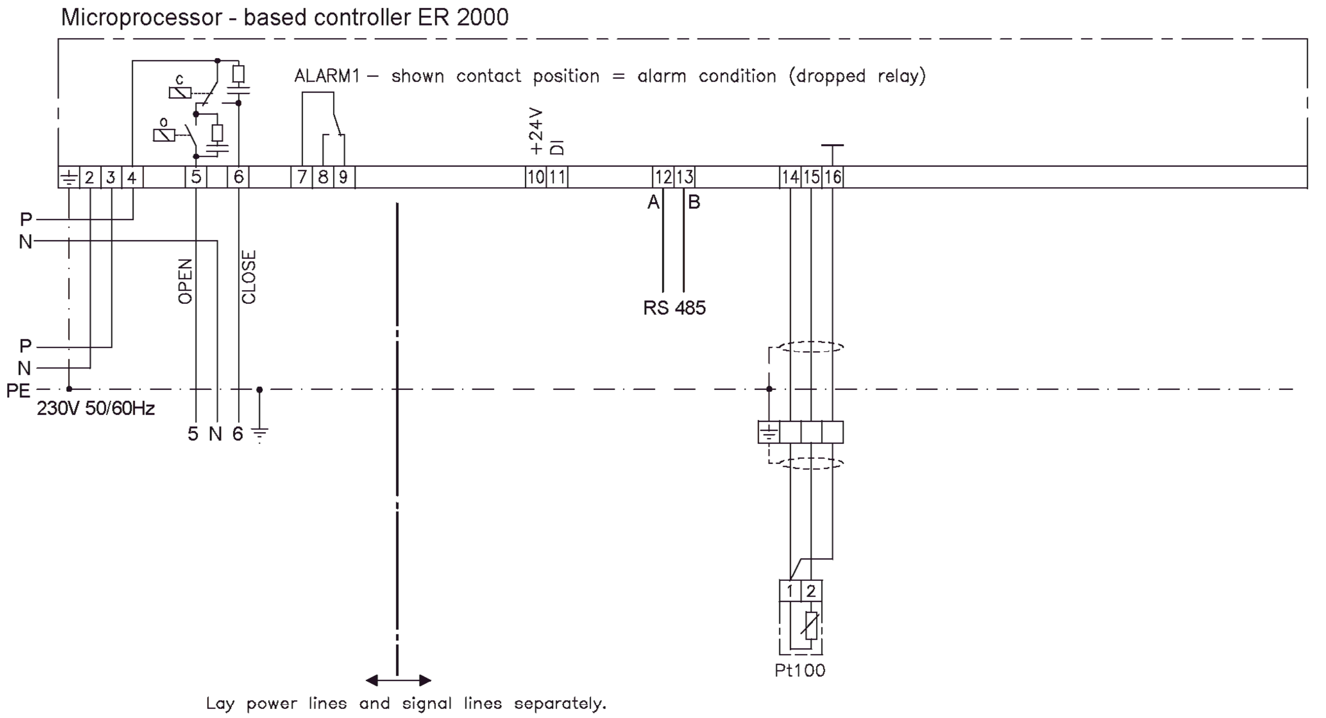
⚠ The given national rules must be observed for installation.
The electrical connection must be completed in conformity with the connection diagrams of the device.
Screened cable must be used for the measurement. This lead must be conducted separately from the power current cables in the switch cabinet.
It is essential to check before the device is switched on that the operating voltage specified on the rating plate conforms
with the mains voltage.
The connecting terminals must only be disconnected from the device while the connected lines are in a de - energized state.



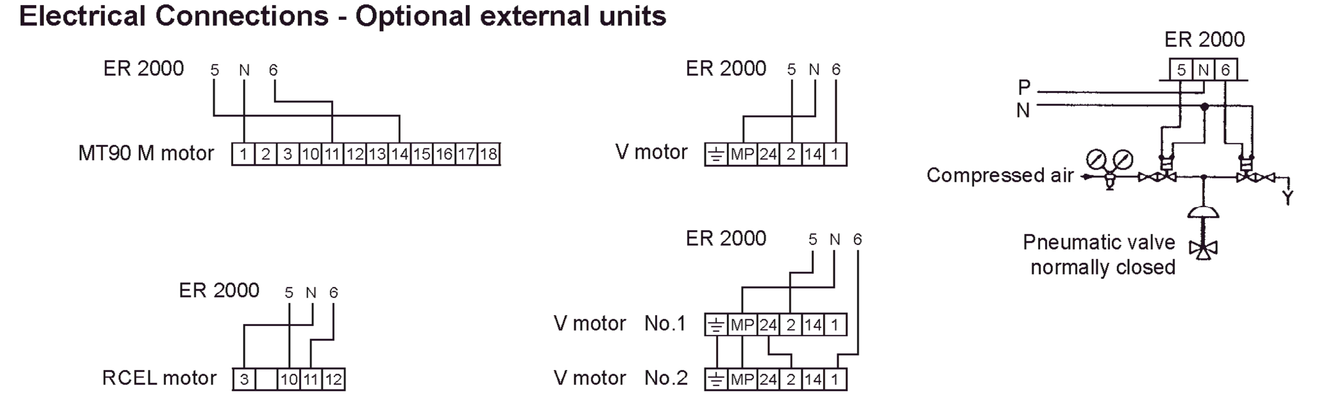
Configuration of ER 2000

5.1 Wiring diagram

Wiring diagram



Electrical Connections - Optional external units



Cooling: Remember to set controller into cooling mode.

6. Commissioning

Procedure:	Corrective measures in case of malfunctions
☐ Unit properly installed ?	see also 4.: Mounting
☐ Electrical connection according to valid regulations and connection diagrams ?	see also 5.: Electrical connection
☐ Switch on mains voltage. When the unit is switched on, all display elements in the front plate will light up for approx. 2 sec. (lamp test). The unit is then ready for operation.	Compare operating voltage, indicated on the type plate, to mains voltage.
☐ Switch over to manual mode.	see also 2.2: Manual mode
• Does the actual value display PV correspond to process variable at measuring point ?	Check sensor, measuring line and electrical connection. see also 5.: Electrical connection
• Actual value display PV fluctuating / jumping ?	Adjust measuring filter FIL. see also: 3.14: FIL Unit in the immediate vicinity of powerful electrical or magnetic interference fields ?
• Open actuator - Heating controller: Actual value PV increasing ? - Cooling controller: Actual value PV degreasing ? • Close actuator - Heating controller: Actual value PV decreasing ? - Cooling controller: Actual value PV increasing ?	see also 2.2: Manual operation No response: Check actuator and electrical connection controller - actuator reverse response: Interchange actuator drive OPEN and CLOSE see also 5.1: Wiring diagram
• Enter actuating time of connected actuator.	see also 3.6: t.P
• Set control parameters using self - optimization.	see also 3.1: OPt
☐ Automatic mode	
Manual -/ automatic changeover	see also 2.2: Manual mode
Set set point SP	see also 2.1: Setting the set point SP in the automatic mode
☐ Controller actuating pulses too short, switching rate too high	Adjust dead band db see also 3.5: db

7. Technical data

Line voltage	230 V AC 115 V AC* 24 V AC* * - optional } -15 % / +10 %, 50 / 60 Hz
Power consumption	approx. 7 VA
Weight	approx. 1 kg
Permissible ambient temperature	
- Operation	0 to 50ºC
- Transport and storage	-25º to + 65ºC
Degree of protection	Front IP 65 according to DIN 40050
Design	For control panel installation 96 x 96 x 135 mm (W x H x D)
Installation position	arbitrary
Analogue inputs	Pt100, 2.4 = 0°C to 300°C Connection in three - wire system
Measuring accuracy	0.1% of the measuring range
Displays	Two 4 - digit 7 segment displays, LED ,red, character height = 13 mm
Alarm	Alarm type A, B, C; working contact normally closed circuit principle
Relay	Switching capacity: 250 V AC / 3 A Spark quenching element
Data protection	Semi - conductor memory

8. Overview of parameterization -/ configuration level, data list

Parameter / configuration point	Display	Settings		Remarks	
Optimization	OPt	0		No self - optimization	
		1		Activate if required	
Proportional band	Pb	☐		1,0 to 999,9 %	
Three - position controller	Pb =	0	☐	tn > 0; db comply with dead zone	
Integral action time	tn	☐		1 to 2600 s	
Two - position controller	tn =	0	☐	db comply with dead zone	
Derivative action time	td	☐		1 to 255s; PI - control at td = 0	
Dead band (dead zone)	db	☐		0 to measuring range [phys. unit] at dP = 3 (x0.1 at dP = 0-2)	
Valve actuating time	t.P	☐		5 to 300 s	
Alarm 1	AL.1	0	☐	No alarm, also not in case of sensor failure	
		1	☐	Alarm A, dependent on set point	1-4: Alarm in case of sensor failure
		2	☐	Alarm B, fixed limit value	
		3	☐	Alarm C, band transgression by set point	
		4	☐	Alarm B, fixed limit value, Alarm at under - temperature	
Alarm 1 Type A	A1.A	☐		0 to ± extent of measuring range [°C]	at AL.1 = 1
Alarm 1 Type B	A1.b	☐		Measuring range: dI.L to dI.H [°C]	at AL.1 = 2/4 over-/ undertemp.
Alarm 1 Type C lower	A1.C	☐		0 to - extent of measuring range [°C]	at AL.1 = 3
Reset hysteresis, lower limit	HY.1	☐		0 to extent of measuring range	at dP=0 (x0.01 at dP = 1; x0.001 at dP = 2 and 3) at Al.1 = 1,2,3,4
Alarm 1 Typ C upper	A1.C.	☐		0 to + extent of measuring range [°C]	at AL.1 = 3
Reset hysteresis, upper limit	HY.1.	☐		0 to extent of measuring range	at dP=0 (x0.01 at dP = 1; x0.001 at dP = 2 and 3) at Al.1 = 1,2,3,4
Decimal point	dP	0	☐	Display without decimal point	e.g. 1234
		1	☐	Display with 1 decimal	e.g. 123.4
		2	☐	Display with 2 decimals	e.g. 12.34
		3	☐	Display with 3 decimals	e.g. 1.234
Scaling, low	dI.L	☐		Displayed value at start of measuring range, -999 to dI.H-1 [°C]	
Scaling, high	dI.H	☐		Displayed value at end of measuring range dI.L+1 to 9999 [°C]	
Set point limit, lower	SP.L	☐		usually dI.L to SP.H [°C]	SP.L = SP.H: fixed SP
Set point limit, upper	SP.H	☐		usually SP.L to dI.H [°C]	SP.L > SP.H: 2 SPs
Set point ramp	SP.r	☐		0 to measuring range [phys. unit (°C) per min, hour]	
Ramp direction, time unit	rA.d	0	☐	phys. unit / min increasing and decreasing set point ramp	
		1	☐	phys. unit / min only increasing set point ramp	
		2	☐	phys. unit / min only decreasing set point ramp	
		3	☐	Ramp deactivated (is similar to SP.r = 0)	
		4	☐	phys. unit / hour increasing and decreasing set point ramp	
		5	☐	phys. unit / hour only increasing set point ramp	
		6	☐	phys. unit / hour only decreasing set point ramp	
Process gain	P.G	☐		1 to 255 %, for self - optimization	
Measured value filter	FIL	☐		0 to 255 comply with 0 ms to 10 s	
Sensor break PV	SE.b	0	☐	Actuator closes	in automatic mode
		1	☐	Actuator opens	

Parameter / configuration point	Display	Settings		Remarks
		2	☐	Actuator stops in its current position
Manual -/ automatic changeover	MAn	0	☐	Changeover via keyboard
		1	☐	Interlocking in current status automatic
			☐	Interlocking in current status manual
Direction of action of controller	dIr	0	☐	Heating controller
		1	☐	Cooling controller
Password	PAS	0	☐	No interlocking, OL.2 deactivated
		1	☐	Access only after entry of the password. OL.2 active: functions on OL.2 not interlocked
		1500		Code

Notices :

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