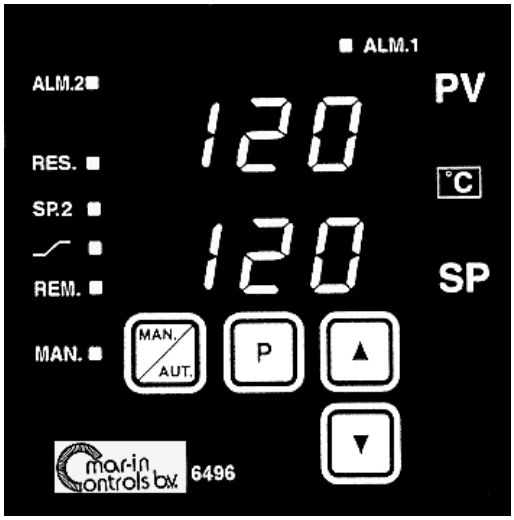
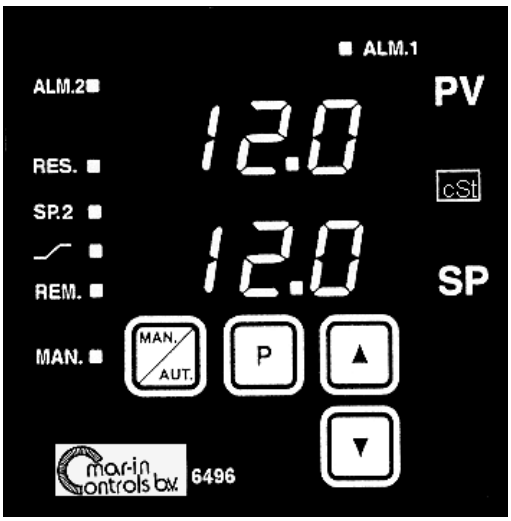
Microprocessor - based controller 6496





Industrial controller with continuous output

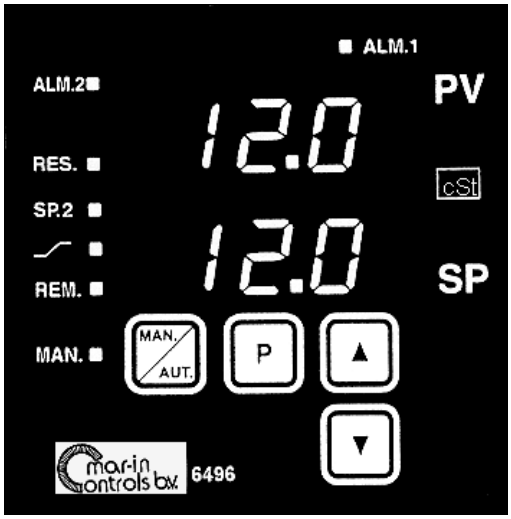
1. Function Overview

- Easy operation
- User - defined operating level
- Control via digital inputs
- Control structure P, PD, PI and PID
- Two alarms
- Plug - type terminals
- Degree of protection Front IP 65
- Manipulated variable ramp
- Semi - conductor memory for data protection
- Measurement inputs for Pt 100, current and voltage signals
- Digital displays for process variable and setpoint
- Compact design 96mm x 96mm x 135mm
- Indication of the manipulated variable
- Output signal 0/4 to 20 mA or 0/2 to 10 V
- Remote set-point
- Set-point ramp
- Two adjustable set-points
- Serial interface
- Robust self - optimization
- Manual -/ automatic changeover

2. Operating and Setting

Alarm 1
Alarm.1

Alarm.2



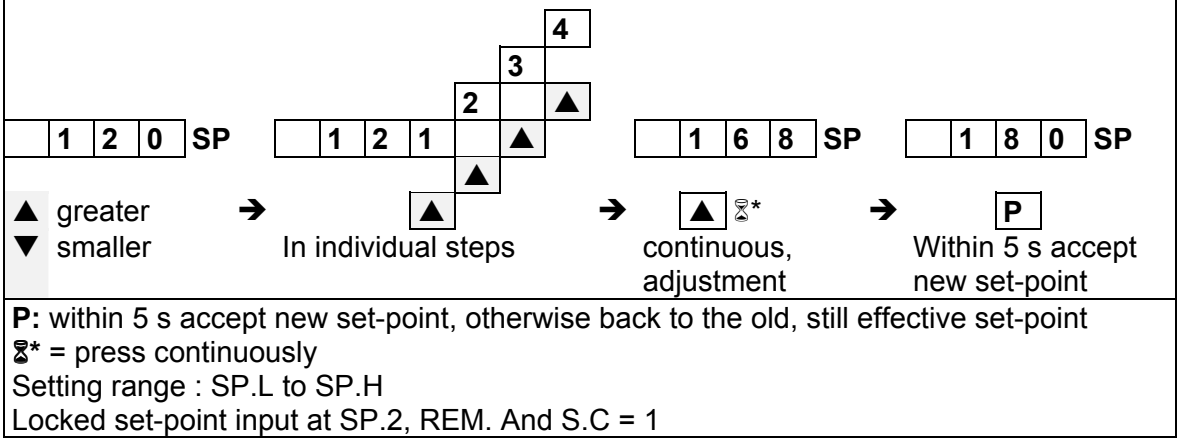
RES: Reserve No function presently
SP2: Second set-point effective:

Set-point ramp active
REM: remote set-point effective
serial communication
MAN: Manual mode

Process variable display

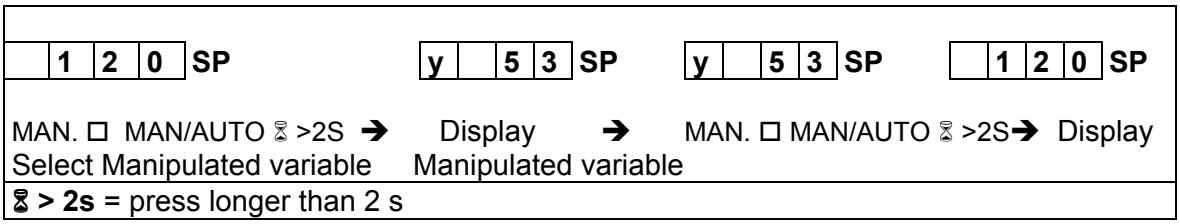
Set point display or commutable to manipulated variable Y

2.1- Setting set-point in automatic mode



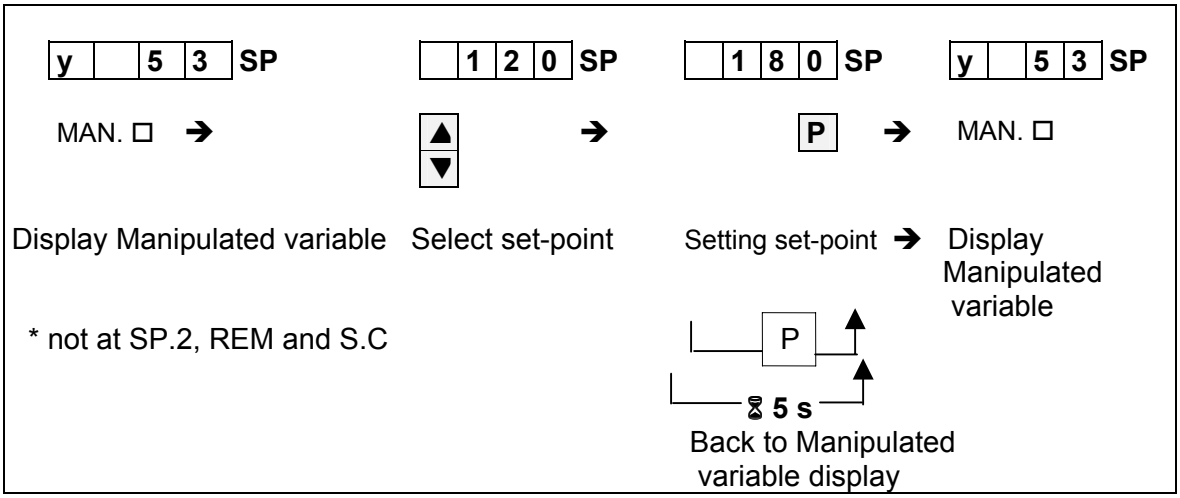
P: within 5 s accept new set-point, otherwise back to the old, still effective set-point
⌛* = press continuously
Setting range : SP.L to SP.H
Locked set-point input at SP.2, REM. And S.C = 1

2.2- Displaying the manipulated variable Y in automatic mode

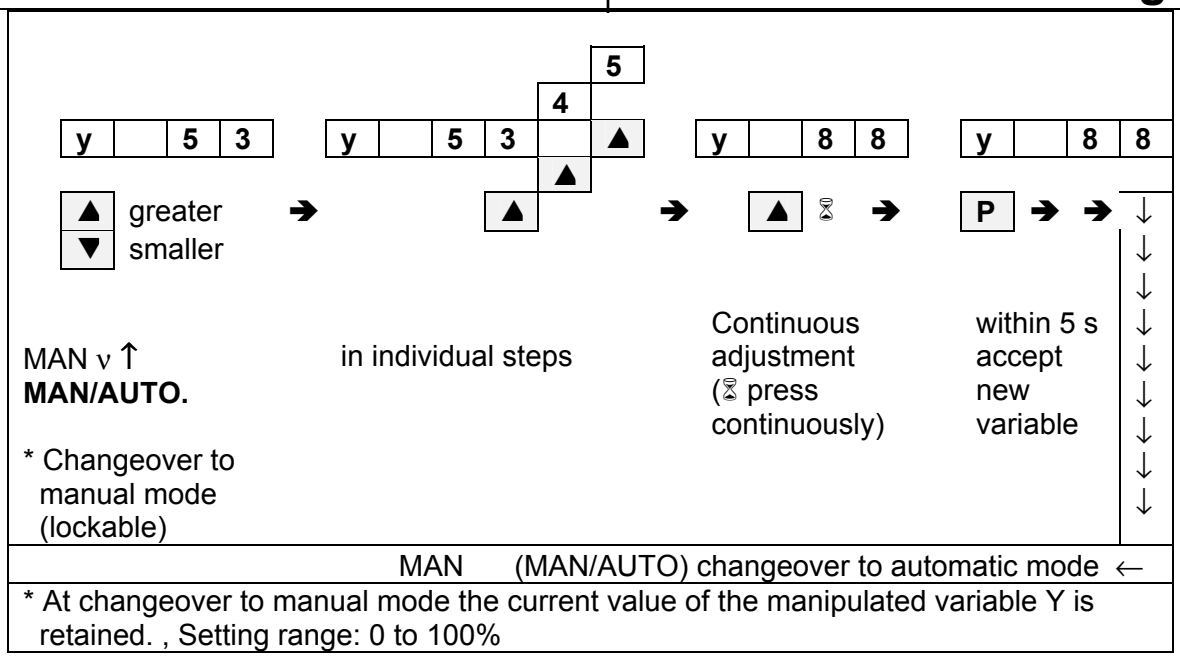


⌛ > 2s = press longer than 2 s

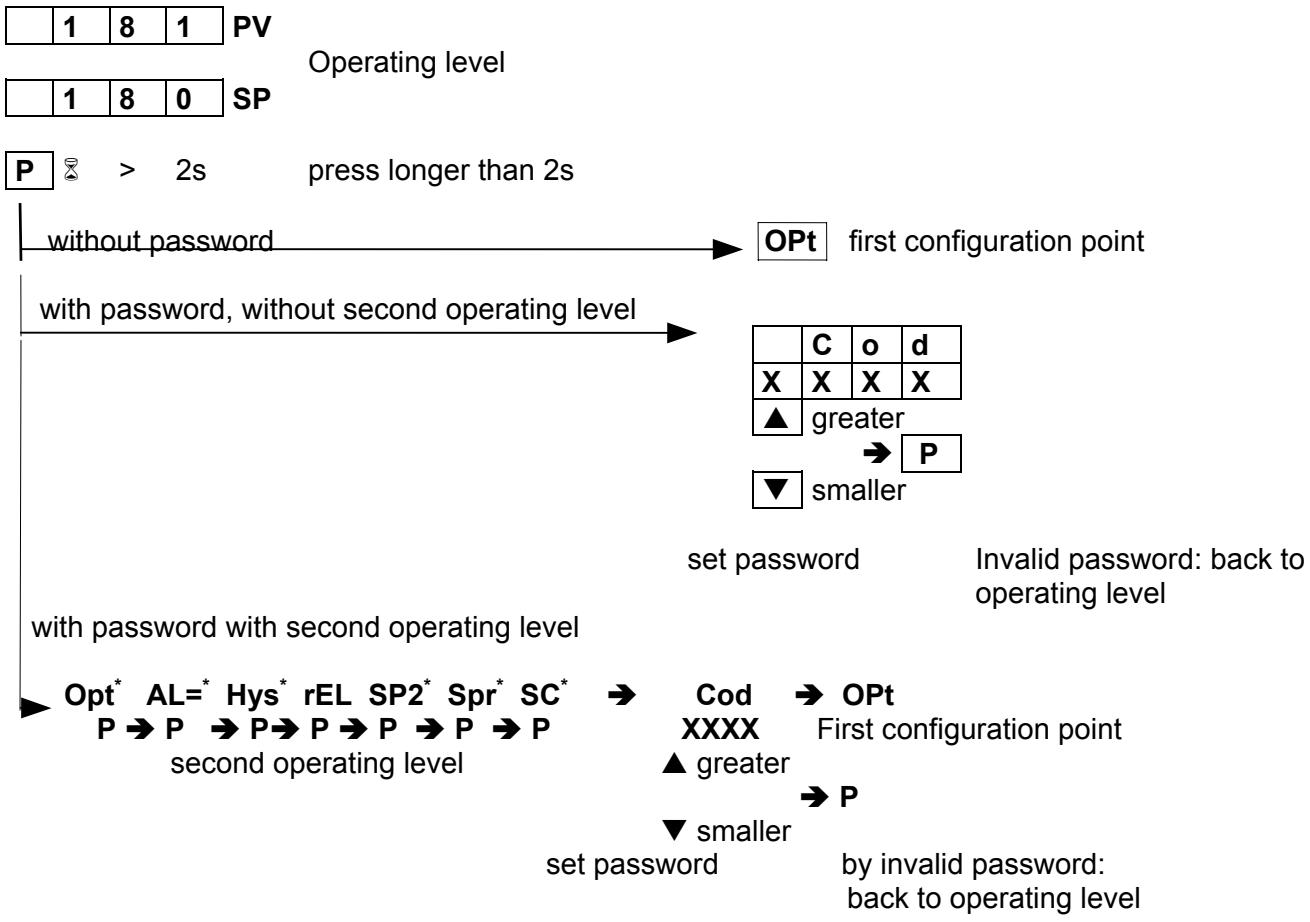
2.3- Temporary changeover from manipulated variable Y to set-point SP in automatic mode*



2.4- Opening / closing final control element in manual mode



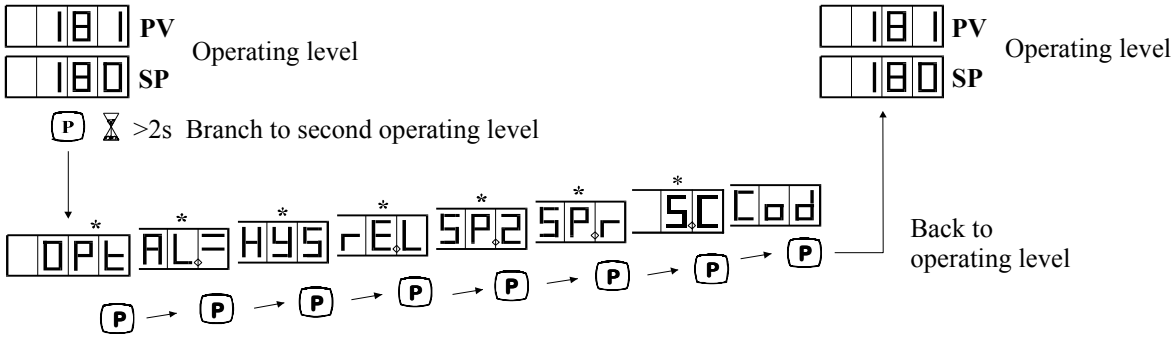
2.5 - Branch to parameterisation-/ configuration level



* if selected for the user-defined operating level

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

Parameters and configuration points that have been selected for the second operating level (see also par." Second Operating Level": OL.2) can be called up and set without entering the password, in case access to the parameterisation -/ configuration level is protected by a password (see also par." Access to Parameterisation" PAS).

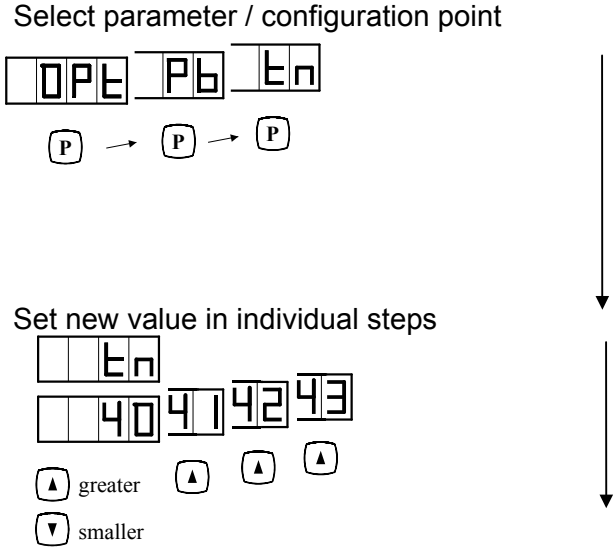


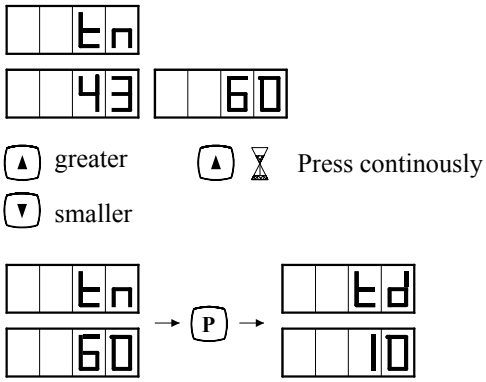
*if this function has been selected for the user-defined operating level and the access to the parameterisation -/ configuration level has been interlocked by means of the password.

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

- self-optimisation OPt
- alarm AL.,HYS
- remote -/ local changeover r.EL
- second set-point SP.2
- set-point ramp SP.r
- serial communication S.C

2.7 - Set parameters / configuration points





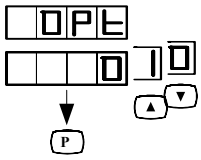
Set new value continuously, at increasing speed

Within 5s accept new value and call up next variable

Back to operating level possible at any time
Manual -/ automatic changeover possible at any time

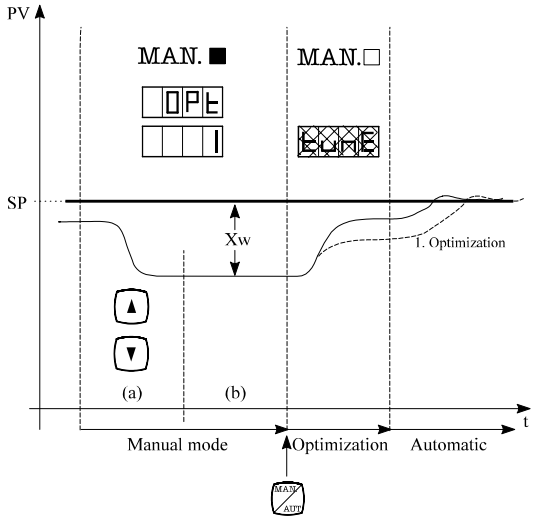
3. - Parameterisation -/ configuration level

3.1- Optimisation for automatic determination of favourable control parameters

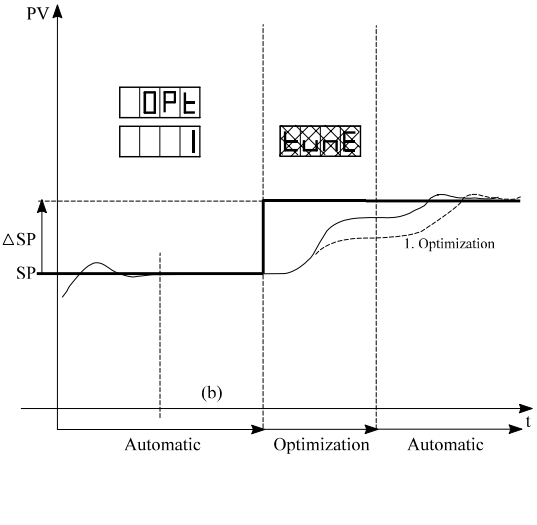


Selections: 0 No self -optimisation
1 Self - optimisation activated

Self - optimisation is triggered by:
- a change in the set-point SP (not for remote set-point r.EL)
- a change in the set-point SP. 2 on the parameterisation configuration level, if SP. 2 is the effective set-point (see also par. 3.11“Second set-point” SP.2)
- a changeover from manual to automatic mode



Optimisation from manual mode



Optimisation in automatic mode

Procedure during optimisation:

From the manual mode:	In the automatic mode:
- Set the set-point SP - Switch over to manual mode - Set the process variable PV greater/smaller than the set-point SP by opening / closing the controlling element (a) - Wait until PV is stable (b) - Branch to parameterisation -/ configuration level - Set OPt = "1" - If known, enter process gain P. G. (standard setting: P.G = level 100%) - Back to operating level - Switch over to automatic mode	- Wait until PV is stable (b) - Branch to parameterisation -/ configuration level - Set OPt = "1" - If known, enter process gain P. G. (standard setting: P. G = 100%) - Back to operating level - Set the set-point

Self - optimisation starts upon manual -/automatic changeover (for optimisation from the manual mode) or upon set-point change ΔSP (for optimisation in the automatic mode).
During the optimisation procedure, the **tunE** display is shown cyclically in the set-point display SP. The determined parameters (Pb, tn, Td, P.G) are accepted automatically at the end of the self - optimisation procedure.
Only PI and PID-controllers can be optimised
P-controllers are optimised as PI-controllers, PD-controllers as PID-controllers
The optimisation routine will not be started, if the control deviation Xw (manual mode) or the set-point change ΔSP (automatic mode) is less than 3.125% of the measuring range PV at the beginning of the optimisation procedure. The change in the process variable PV or the set-point must, during optimisation, run in the same range and in the same direction in which the process is controlled following optimisation, which means that the optimisation procedure must correspond to the later control procedure as far as possible. If, during a control process, sequences -of the process show extreme differences in time behaviour (e.g. rapid heating, slow cooling), the more important part of the process should be optimised.
If the process sequences are equivalent, the slower procedure has to be optimised.

For systems with linear transfer behaviour (constant process gain P.G = Δ PV/ ΔY over the entire control range), one optimisation procedure will always provide the optimum control parameters.
If the transfer behaviour of the system is non-linear (e.g. process gain P.G = ΔPV/ ΔY changes with the set-point SP to be controlled), the variable process gain P.G will have a significant effect on the control parameters. In this case, the process variable PV should come close to achieving the target set-point during the optimisation procedure.
Otherwise, an additional optimisation procedure must be carried out. The process gain P.G in the working point was determined automatically in the preceding optimisation procedure.
If the process gain P.G in the working point is known, it can be entered manually prior to optimisation. (see also par. ”Process Gain”: P.G). The configuration point OPt is reset to 0 automatically following each optimisation procedure.
An optimisation procedure can be interrupted anytime by

- pressing the hand - key
- pressing the P - key briefly, if set-point SP is displayed
- pressing twice the P - key briefly, if manipulated variable **Y** is displayed

NO ENTRIES OR CHANGEOVER OPERATIONS MUST BE MADE DURING THE OPTIMISATION PROCEDURE!

3.2- Proportional band Pb

		P	b	➔	P

Setting range: 1.0% to 999.9%
Proportional action of the P(ID)-controller

3.3- Integral action time tn

		t	n	➔	P

Setting range: 1s to 2600s
Integral action of the PI(D) - controller
tn=0: P - controller at td = 0
PD - controller at td > 0

3.4- Derivative action time td

		t	d	➔	P

Setting range: 1s to 255s
Derivative action of the P(I)D - controller
td=0: P - controller at tn=0
PI - controller at tn > 0

3.5- Working point for set-point = 0% (at P(D) - controller)

		y.	0	➔	P

Manipulated variable Y at PV = SP
Setting range: 0 to 255% of correcting range Y
Y.0 = Y.E: fixed working point
Y.0 = Y.E: sliding working point, dependent on the set-point
Calculation of Y.0 at sliding working point:

$$Y.0 = \frac{Y2 - Y1}{SP2 - SP1}(SP0 - SP1) + Y1$$

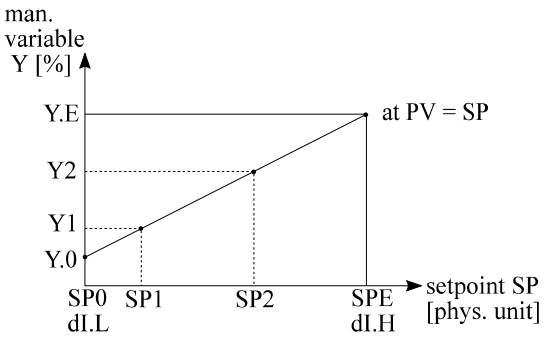
Working point for setpoint = 100% (at P(D) - controller)

		y.	E	➔	P

Manipulated variable Y at PV = SP
Setting range: 0 to 255% of correcting range Y
Y.0 = Y.E: fixed working point
Y.0 = Y.E: sliding working point, dependent on the set-point.

Calculation of Y.E at sliding working point:

$$Y.E = \frac{Y2 - Y1}{SP2 - SP1}(SPE - SP1) + Y1$$



Choice of control mode:

- P-controller: tn=0, td=0
- PD-controller: tn=0, td>0
- PI-controller: tn>0, td=0
- PID-controller: tn>0, td>0

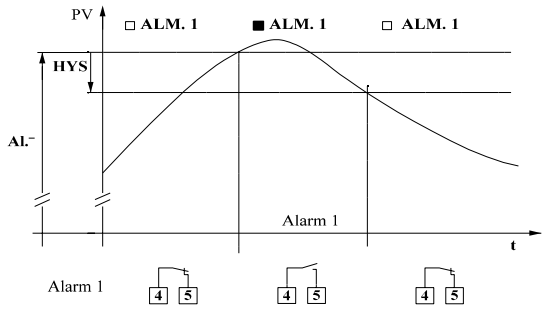
3.6- Setting Alarm (AL^-) and Alarm hysteresis (Hys)

- Selection AL=0: No alarm, also not in case of sensor failure
- Selection AL=4: Alarm relay 1and alarm relay 2 active
- Alarm relay 1 at a fixed limit value
- Alarm relay 2 at a fixed limit value
- **Alarm, also in case of sensor failure**

Normally the setting of alarm is done in the factory according to the process data given by the customer. In case the customer wishes to change the setting of minimum and maximum alarm values, the following steps should be carried out:

a)
- Press the **P** key for more than 2 seconds
- The letters **AL^-** (selection first alarm) will appear in the LED-display **PV**.
- Set the required (first) alarm value with the help of ▲ (increasing) and ▼ (decreasing) keys.
- Accept the new alarm value by pressing the **P** key. This must be done within 5 seconds, otherwise the old alarm value will still be effective.

b)
- Press the **P** key again and the letters **Hys** (Alarm hysteresis) will be displayed in the LED-display **PV**.
- Select a value within the setting range (0 to extent of measuring range) with the help of ▲ and ▼ keys. A value of 0,5 is the most practical one.
- Accept the new value within 5 seconds by pressing the **P** key, otherwise the old value will still be effective..



c)
- Press the **P** key again and the letters **AL^-** (selection 2nd alarm) will appear in the LED-display **PV**.
- Set the required (second) alarm value with the help of ▲ and ▼ keys.
- Accept the new alarm value by pressing the **P** key. This must be done within 5 seconds, otherwise the old alarm value will still be effective.

d)
- Press the **P** key again and the letters **Hys** (second Alarm hysteresis) will appear.
- Give a value within the setting range (0 to extend of measuring range) with the help of ▲ and ▼ keys. A value of 0,5 is the most practical one.
- Accept the new value within 5 seconds by pressing the **P** key, otherwise the old value will still be effective.

3.7- Decimal point for LED - displays

		d	P	➔	P

Selections: 0 Indication without decimal point
1 Indication with decimal point

At any time the decimal point has been altered, the process variable display PV has to be re-scaled. (see next paragraph)

3.8- Scaling the process variable display PV

Display. Low

	d	I	L	➔	P

Enter: Zero point of the transmitter
Indication at start of measuring range
Setting range: -999 (-99.9 at dP = 1) ≤ dI.L ≤ dI.H-1
[phys. units] (dI.L must be less than dI.H)
standard value: O°C or **32**°F

Display. High

	d	I	L	➔	P

Enter: End point of the transmitter
Indication at end of measuring range
Setting range: dI.L+1 ≤ dI.H ≤ 9999 (999.9 at dP = 1) [phys. units]
(dI.H must be greater than dI-L)
standard value: **300**° C or **572**° F

∆ At In.P = 0, dI.L and dI.H have to correspond to the Pt 100 - measuring range of the supplied device. (see type plate)
6496 - 2.4 -...: dI.L = 000(.0), dI.H = 300(.0)
6496 - 2.2 - ... dI.L = 000(.0), dI.H = 400(.0)

At In.P≠0, dI.L and dI.H have to correspond to the measuring range of the connected transmitter.

3.9- Set-point limitation

Set-point limitation applies to the set-point SP which can be set via the keyboard
It is ineffective for - the second set-point SP.2
- all remote set-points

At SP.L = SP.H the set-point has a fixed value

Set-point. Low lowest set-point that can be set

	S	P	L	➔	P

Setting range: dI.L to SP.H [phys. units] (see also: previous paragraph)
At SP.L = SP.H the set-point has a fixed value.

Set-point. High highest set-point that can be set

	S	P	H	➔	P

Setting range: SP.L to dI.H [phys. units] (see also: previous paragraph)
.

3.10- Remote -/ local changeover (option)

Changeover from remote analogue to local set-point and vice versa

	r	E	L	➔	P

Selections: 0 Only local set-point and SP.2 effective
1 Changeover via digital input REM/LOC,
set-point via analogue input (see also par. “Measure value filter for PV”)
2 jolt - free (smooth) remote -/local changeover by tracking the local set-point to the remote set-point before remote -/local changeover.
SP loc. = SP rem. otherwise as1
A remote analogue set-point has higher priority than a remote set-point transferred via serial interface. In case of a signal error the internal set-point is effective.

3.11- Second set-point SP.2 (option)

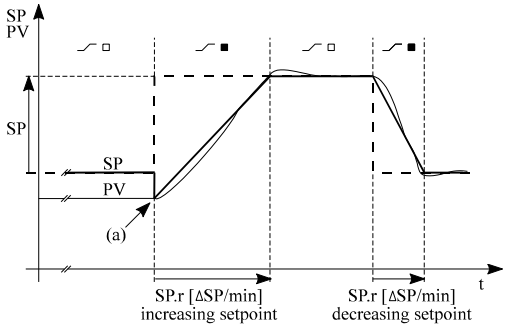
	S	P	2	➔	P

Setting range: dI.L to dI.H [phys. units] (see also par. Scaling the process variable)
Changeover to SP.2 via digital input SP.2

3.12- Set-point ramp SP.r

	S	P	r	➔	P

Change rate of set-point SP (gradient)
Setting range: 1 (0.1 at dP = 1) to extent of measuring range in SP / min; SP [phys. unit]
e.g.: ΔSP = 5K / min
Setting SP. r = 0: no set-point ramp, change of set-point abruptly.
Effective for local and remote set-points.
An analogue, remote set-point has to alter at least 0.2 % of measuring range PV to trigger the set-point ramp.



The set-point ramp is triggered (at SP.r > 0):
- after switching on the device or after a power failure
- after sensor failure
- after every set-point change (remote, local or SP.2)
- after switching over to the second set-point SP.2
- after remote -/ local changeover and vice versa
- after a control function STOP, CLOSE, OPEN (via digital input)
- after switching over from manual mode to automatic mode

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.

3.13- Ramp direction

	r	A	d	➔	P

Effective direction of set-point ramp SP.r (at SP.r > 0)

Selections:
0 Set-point ramp effective for increasing and decreasing set-points
1 Set-point ramp effective only for increasing set-points
2 Set-point ramp effective only for decreasing set-points
(see also paragraph “Set-point ramp SP.r”)

3.14 - Process Gain P.G

		P	G	➔	P

Setting range: 1 to 255%
Gain of controlled process (system)

$$P.G = \frac{\text{Change in process variable PV}}{\text{Change in actuating variable Y}} = \frac{\Delta PV \text{ in\%}}{\Delta Y}$$

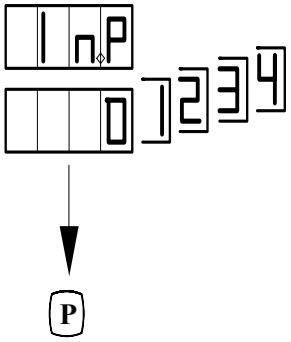
Δ PV [% of measuring range of PVI
ΔY [% of actuating range (stroke) 0 - I 00 %]

e.g.: P. G = 5 0%: $\frac{\Delta PV}{\Delta Y} = 0.5$ A change of 10% in the valve position ΔY will result in a change of 5% in the process variable PV.

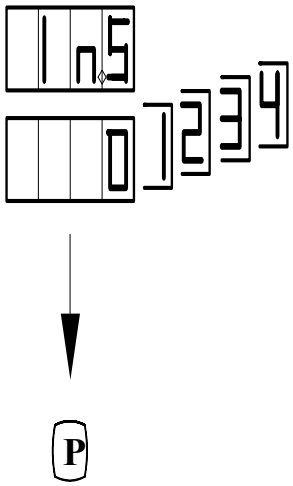
P. G = 100%: $\frac{\Delta PV}{\Delta Y} = 1.0$ A change of 10% in the valve position ΔY will result in a change of 10% in the process variable PV.

P. G = 125%: $\frac{\Delta PV}{\Delta Y} = 1.25$ A change of 10% in the valve position ΔY will result in a change of 12.5% in the process variable PV.

The process gain P.G is required for self - optimisation of the control parameters. If unknown, P.G is determined automatically during self-optimisation (see also paragraph Optimisation)
In case of non - linear transfer behaviour of the system, the process gain changes with the working point (e.g. when controlling different set-points).



3.15- Input for process variable PV (input PV)
Selections:
0 PV is detected with a Pt 100 sensor and connected to the terminals 14,15,16
1 PV is supplied as current signal 0-20 mA and connected to the terminals 12, 16*.
2 PV is supplied as current signal 4-2OmA and connected to the terminals 12, 16*.
3 PV is supplied as voltage signal 0- I OV and connected to the terminals 13, 16
4 PV is supplied as voltage signal 2- 1 OV and connected to the terminals 13, 16
* Not if a transmitter is connected in two-wire technology
(see also par. "Electrical connection")



3.16- Input for remote setpoint SP (input SP)
Selections:
0 SP is detected with a Pt 100 sensor and connected to the terminals 14, 15, 16
1 SP is supplied as current signal 0-20 mA and connected to the terminals 12, 16.
2 SP is supplied as current signal 4-2OmA and connected to the terminals 12, 16.
3 SP is supplied as voltage signal 0- 10V and connected to the terminals 13, 16 .
4 SP is supplied as voltage signal 2- 10V and connected to the terminals 13, 16
By detected signal failure: changeover to internal setpoint.
(see also par. Electrical connection)

3.17 - Measured value filter for process variable PV (Filter)

	F	I	L	➔	P

Software low-pass filter 1st order with adjustable time constant Tf to suppress interference signals and to smooth small process variable fluctuations.
Setting range-. 100 to 255

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

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

* standard setting

3.18 - Response to sensor failure PV (sensor break)

S E b

		0	1	➔	P

Response of actuator in case of. sensor short-circuit, sensor break, too low or too high signal value at 4-20 mA and 2-10 V signals.

Selections:

0 Final control element closes
1 Final control element opens

The error message **Err** is indicated in the LED - display PV in the case of a transmitter / sensor fault. Alarm-message, when alarm A, B or C is configured, independent of adjusted limit value.
Once the fault has been rectified, the controller reverts automatically to normal mode.
Monitoring is not possible in the case of electrical input signal without live zero point, 0-20 mA or 0-10V.

3.19- Controller output signal

o u t	

		0	1	➔	P

Selections:

0 Output signal 0 to 20 mA or 0 to 10V
1 Output signal 4 to 20 mA (standard) or 2 to 10 V

3.20 - Manipulated variable ramp Y.r

		y	r	➔	P

Maximum change rate of manipulated variable Y

Setting range: 1 to 255

Setting Y.r = 0: no manipulated variable ramp, change of manipulated variable without delay

Y.r = actuating time for a displacement of DY = 100 %

Formula : $Y.r = \frac{163{,}84}{\text{input 1 to 255}}$ [s]

Following assignments apply:

Input :	164	33	16	6	3	2	1
Y.r [s]	1	5	10	30	60	80	160

The end value of the manipulated variable ramp is displayed.

3.21- Interlocking manual -/ automatic changeover (manual)

	n	A	m	➔	P

		0	1	➔	P

Selections: 0 Changeover via keyboard possible at any time
1 Interlocking in current status

Changeover MAn. to -1 - in automatic mode: always automatic mode
Changeover MAn. to -1- in manual mode: always manual mode

3.22 - Direction of action of controller

	d	i	r	➔	P

		0	1	➔	P

Selections :

<u>0 Heating controller</u>:
final control element closes at increasing process variable PV

<u>1 Cooling controller</u>:
final control element openss at increasing process variable PV

3.23 - Transfer rate for serial interface (baud) (effective at 6496/ 3)

		b	d	➔	P

0	1	2	3	➔	P

Serial interface RS 485, data transfer in accordance with MODBUS - Protocol in RTU -mode

Selections: 0- 19200 baud 3- 2400 baud
1- 9600 baud 4- 1200 baud
2- 4800 baud

3.24 - Address for serial interface (effective at 6496 / 3)

	A	d	r	➔	P

Setting range: 1 to 247
Address of the controller

3.25 - Serial communication (effective at 6496 / *3)*

		S	C	➔	P

		0	1	➔	P

Selections:

0 The controller can be operated and set via the master computer and via the controller keyboard (parallel operating).
1 The controller is operated and set via the master computer.

The controller keyboard, with the exception of the setting of S. C, is locked.

3.26 - Second operating level

	O	L	2	➔	P

Select functions for the user - defined operating level.
Setting range: 0 to 31:
0 No second operating level
1 Self-optimisation can be activated on the operating level 2 (see also: par."OPtimisation")
2 Limit value and hysteresis of the selected alarm can be set on operating level 2 (see also par. "Alarm relays")
4 Remote -/ local changeover possible on operating level 2 (see also par. "Remote -/ local changeover" rE.L)
8 The second set-point SP.2 can be set on operating level 2 (see also par. "second set-point" SP.2)
16 The second set-point ramp SP.r can be set, switched on and off on the operating level 2 (see also par. "set-point ramp": SP.r)
32 The serial communication S.C.can be set by defined on operating level 2.

The identifier numbers of the required functions are to be added and the result is set.
The password has to be activated. (see also next paragraph)
The access to the user - defined operating level is not interlocked via the password.

3.27- Access to the parameterisation -/configuration level (password)
Interlocking the parameterisation -/ configuration level by means of the **password Cod** prevents unauthorized access.

	P	A	S		

		0	1	➔	P

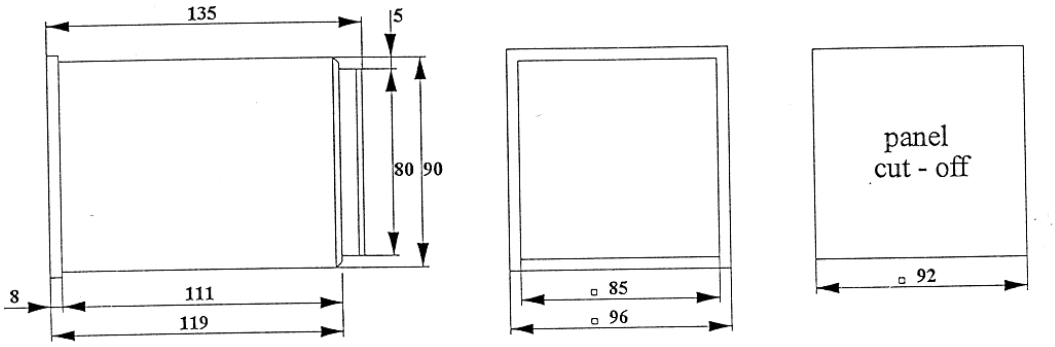
Selections :

0 No interlocking of parameterisation -/ configuration level.OL.2 is deactivated.
1 Access to parameterisation -/ configuration level only after entry of the password via keyboard.OL.2 is active.(see also: par. "second operating level OL.2 -, valid password:)

4. Installation

The controller is suitable for installation in a front panel and control desk at arbitrary installation position. Insert device from front in the prepared control panel cut-out and secure with the aid of the clamping tool. The centering on the housing ease the installation of the device.

△ The ambient temperature at the installation location must not exceed the permissible temperature specified for nominal use. Sufficient ventilation must always be provided, including instances of high component density.
The unit must not be mounted in explosion - hazardous areas.

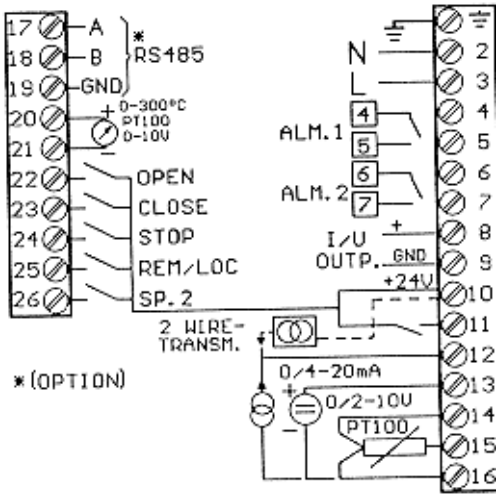


5. Electrical connection

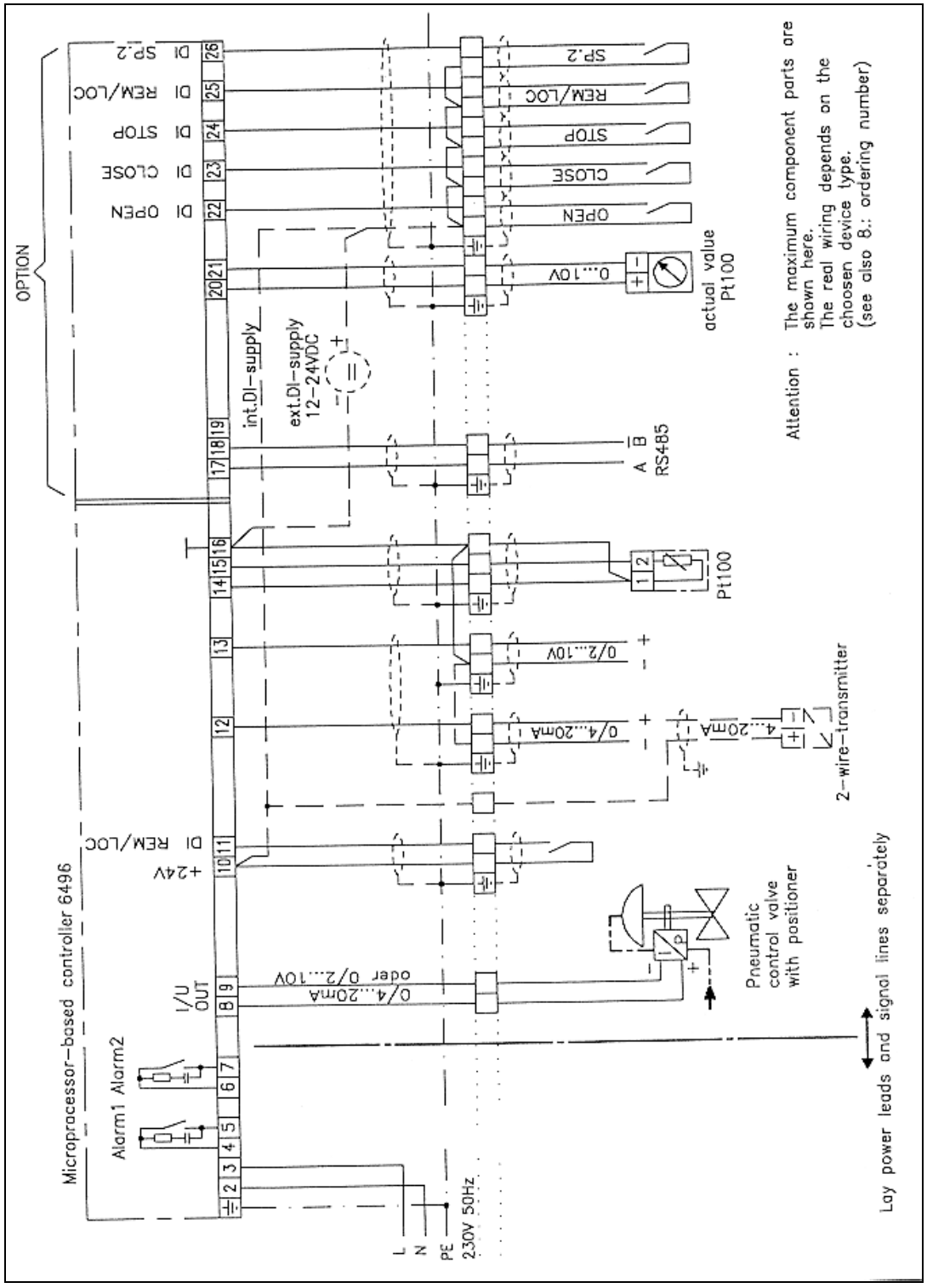
The plug - type terminals and the wiring diagram are located at the rear of the unit.

△During installation, the regulations that are applicable to each country (DIN VDE 0100 in Germany) must be observed. Electrical connection must be carried out in accordance with the connecting diagrams / wiring diagrams of the unit. Shielded cables must be used for the measuring lines and control lines. These lines must be separated from the high power lines, also in the control cabinet. Prior to switching on the unit, make sure that the operating voltage indicated on the type plate corresponds to the mains voltage.
The connection terminals with the connected lines may be disconnected from the unit in power - off state only.

.



5.1 - Wiring Diagram



6. Commissioning

Procedure:	Corrective measures in case of malfunctions
Unit properly installed?	See also par. “Installation”
Electrical connections according to valid regulations and connection diagram?	See also par.5 : Electrical Connection
Switch on mains voltage. When the unit is switched on, all display elements in the front panel will light up for approx. 2 seconds (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 par. “Manual mode”
- Does the actual display PV corresponds to process variable at measuring point?	Check sensor, measuring line and electrical connection. See also par. Electrical Connection
- Actual value display PV fluctuating/jumping?	- Adjust measuring filter (refer to par. “FIL”) - Unit in the immediate vicinity of powerful electrical or magnetic interference fields? Contact MAR-IN Controls B.V.
▪ Open final control element - Heating controller: Actual value PV increasing? - Cooling controller: Actual value PV decreasing?	See also par. “Manual operation” No response: Check final control element, positioner and electrical connection controller-final control element
▪ Close final control element - Heating controller: Actual value PV decreasing? - Cooling controller: Actual value PV increasing?	Reverse response: switch over Heating / Cooling (see par. ”Direction of action”)
▪ final control element does not close properly	Adapt zero points of controller output signal and positioner (see also par. “Controller output signal”
Automatic mode	
Manual-/automatic changeover	See also par. “Manual mode”
Set set-point SP	See also par. “Setting the set-point SP” in the automatic mode