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PROTHERM 20

OPERATING MANUAL

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DESCRIPTION OF SYMBOLS:

General information

General warning

Attention: ESD sensitive devices

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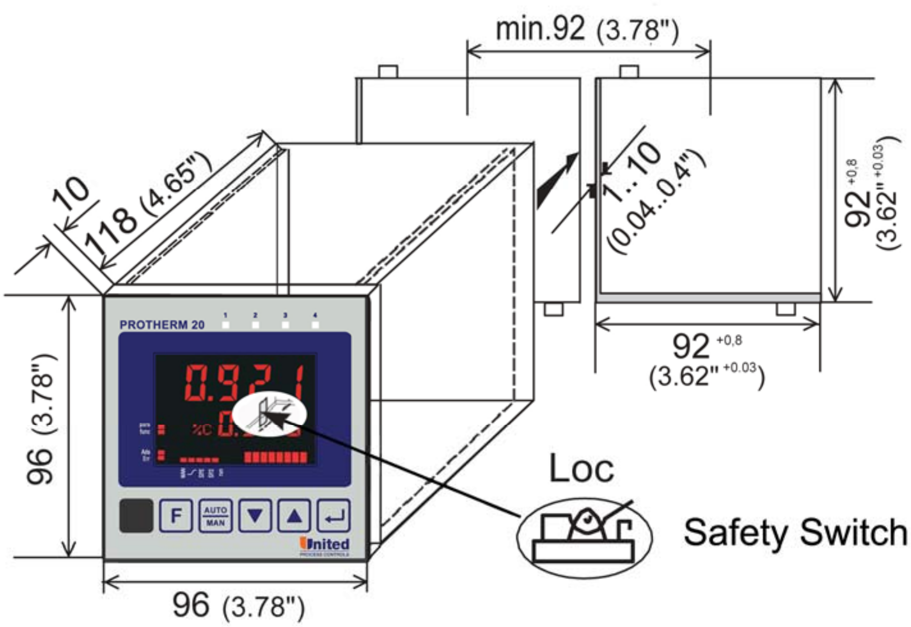
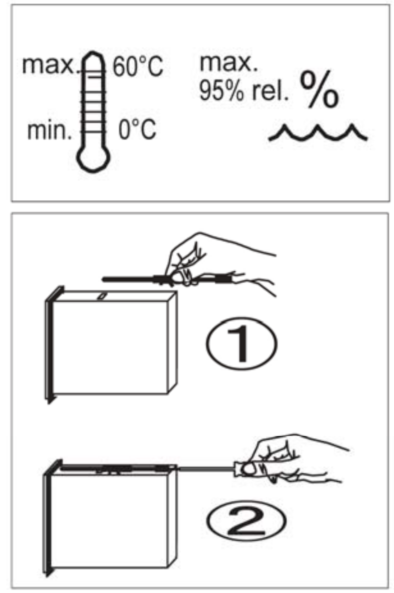
1 Mounting





Fix the instrument **only at top** and **bottom** to avoid damaging it.

Safety switch:
For access to the safety switch, the controller must be withdrawn from the housing. Squeeze the top and bottom of the front bezel between thumb and forefinger and pull the controller firmly from the housing.

Loc open	Access to the levels is adjusted by means of BlueControl® (engineering tool) ❷ closed ❶ all levels accessible without restriction

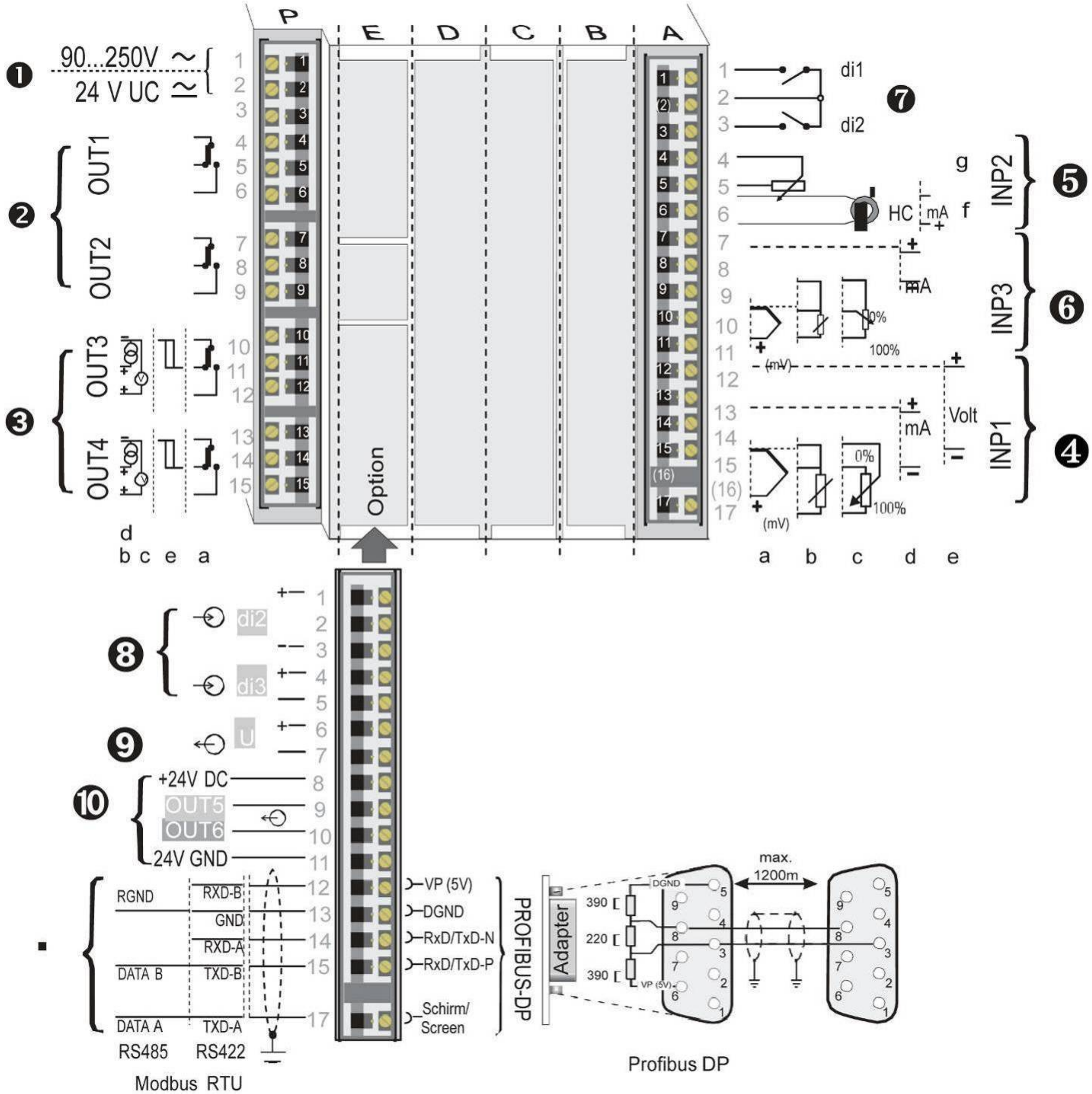
❶ Factory setting

❷ Default setting: display of all levels suppressed, password ΠΑΣΣ = ΟΦΦ

Caution! The unit contains ESD-sensitive components

2 Electrical Connections

2.1 Connecting diagram



Dependent of order, the controller is fitted with :

- flat-pin terminals 1 x 6,3mm or 2 x 2,8mm to DIN 46 244 or
- screw terminals for 0,5 to 2,5mm²

On instruments with screw terminals, the insulation must be stripped by min. 12 mm. Choose end crimps accordingly!

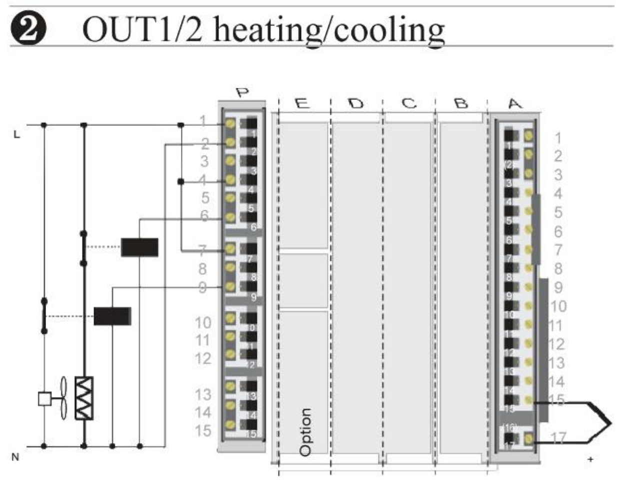
2.2 Terminal Connection

Power supply connection...❶

See chapter "Technical data"

Connection of outputs OUT1/2...❷

Relay outputs (250V/2A), potential-free changeover contact



Connection of outputs OUT3/4...❸

a. relay (250V/2A), potential-free changeover contact universal output
b. current (0/4...20mA)
c. voltage (0/2...10V)
d. transmitter supply
e. logic (0..20mA / 0..12V)

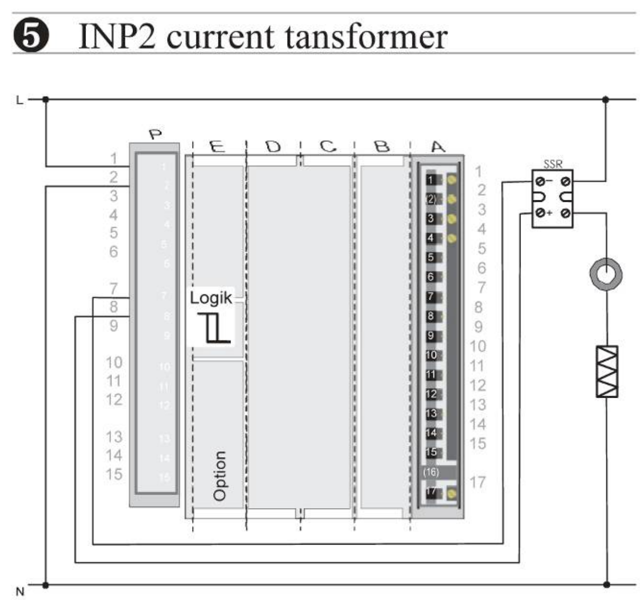
Connection of input INP1...❹

Input mostly used for variable x1 (process value)

a. thermocouple
b. resistance thermometer (Pt100/ Pt1000/ KTY/ ...)
c. current (0/4...20mA)
d. voltage (0/2...10V)

Connection of input INP2...❺

e. heating current input (0..50mA AC) or input for ext. set-point (0/4...20mA)
f. potentiometer input for position feedback



Connection of input INP2...❺

a. Heating current input (0...50mA AC) or input for ext. Set-point (0/4...20mA)
b. Potentiometer input for position feedback

Connection of input INP3... ❻

As input INP1, but without voltage

Connection of inputs di1, di2... ❼

Digital input, configurable as switch or push-button

Connection of inputs di2/3... ❽ *(option)*

Digital inputs (24VDC external), galvanically isolated, configurable as switch or push-button

Connection of output UT... ❾ *(option)*

Supply voltage connection for external energization

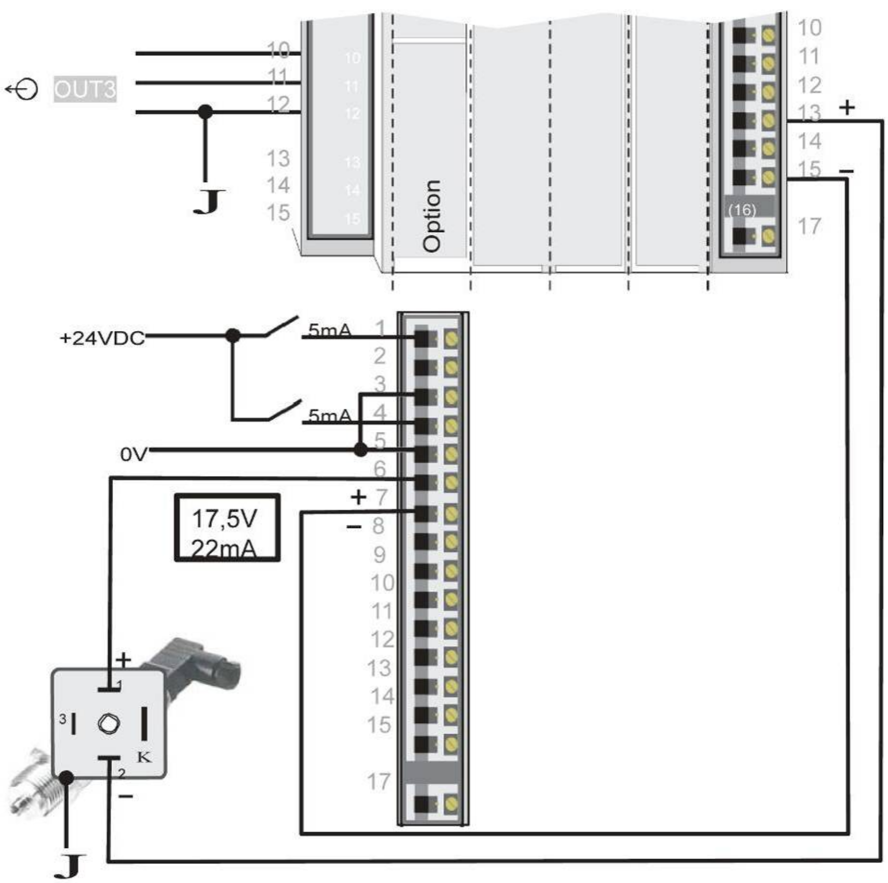
Connection of outputs OUT5/6... ❿ *(option)*

Digital outputs (opto-coupler), galvanic isolated, common positive control volta- ge, output rating: 18...32VDC

Connection of bus interface... *(option)*

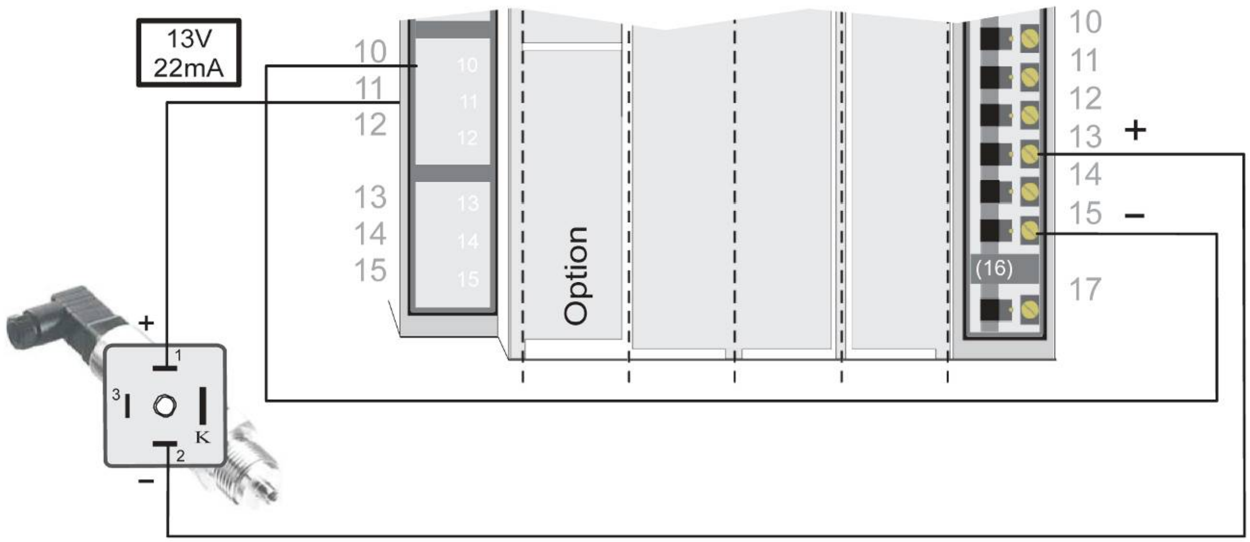
PROFIBUS DP or RS422/485 interface with Modbus RTU protocol

❽ ❾ *di2/3, 2-wire transmitter supply*

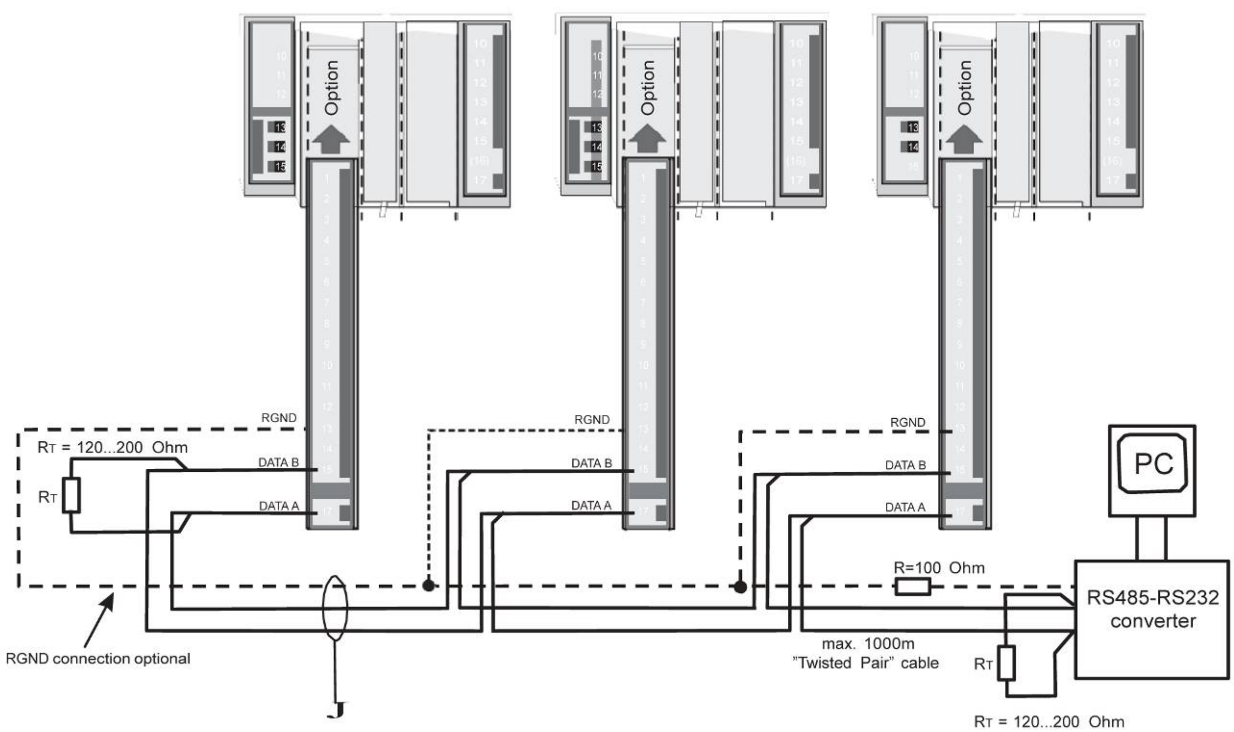


Analog outputs OUT3 or OUT4 and transmitter supply UT are connected to different voltage potentials. Therefore, take care not to make an external galvanic connection between OUT3/4 and UT with analog outputs!

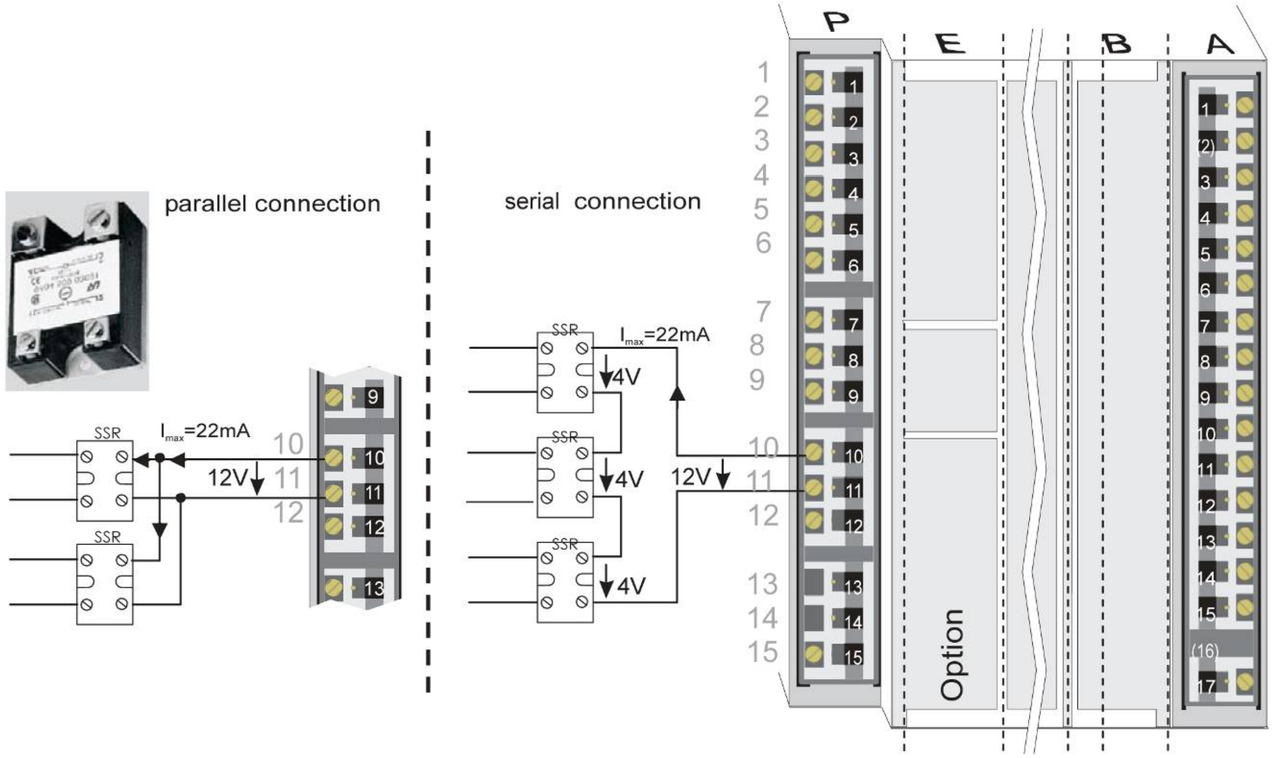
❸ *OUT3 transmitter supply*



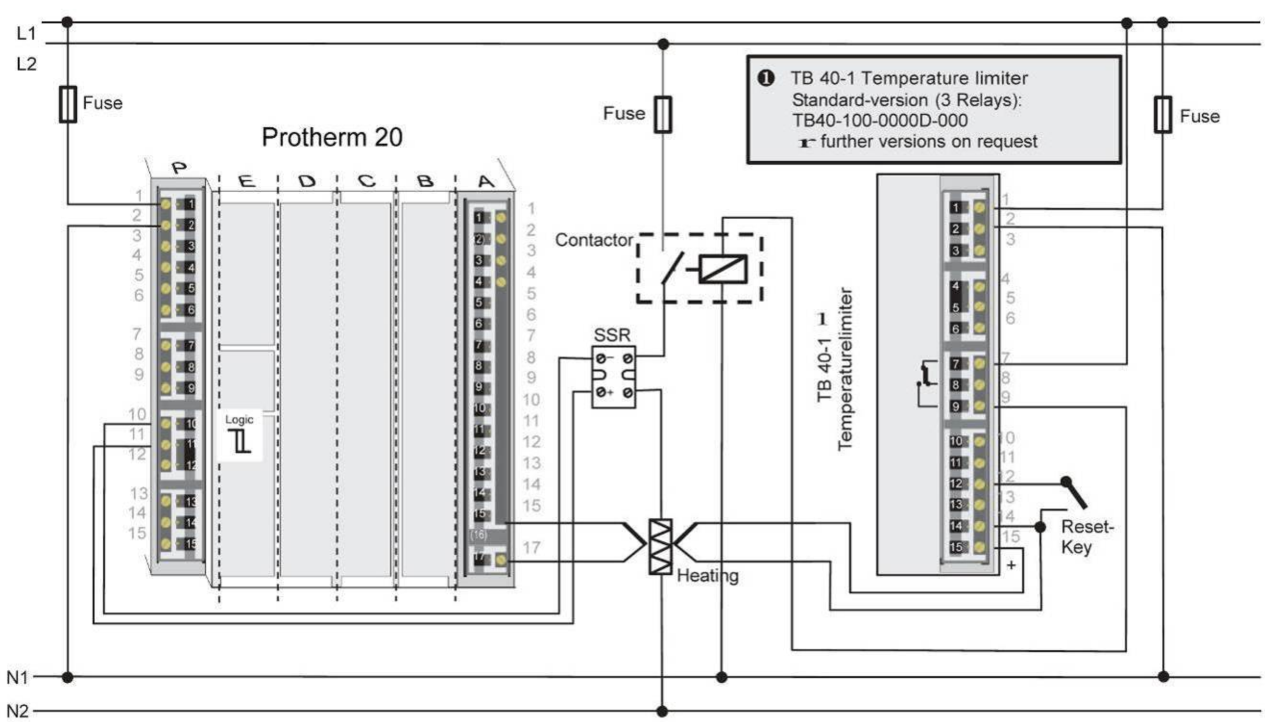
❾ *RS485 interface (with RS232-RS485 interface converter)* *



❸ *OUT3 as logic output with solid-state relay (series and parallel connection)*

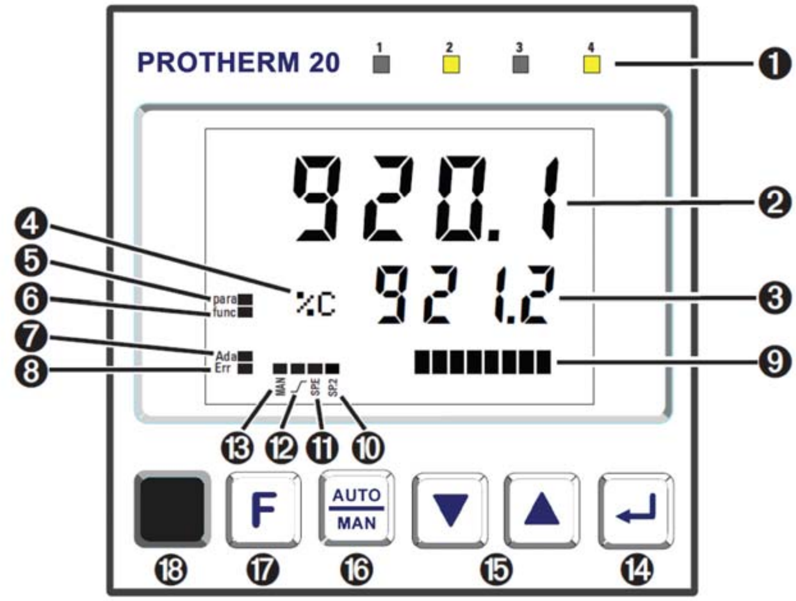


Protherm 20 carbon-1 connecting example:



CAUTION: Using a temperature limiter is recommendable in systems where over temperature implies a fire hazard or other risks.

3 OPERATION
3.1 Front View



1	Statuses of switching outputs OuT.1... 6	2	Process value display
3	Setpoint or correcting variable display	4	Display signaling in %C, %O2, ppm, °C or °F
5	Signals ΧονΦ– and ΠΑρΑ level	6	Signals activated function key
7	Self-tuning active	8	Entry into the error list
9	Bargraph or plain text display	10	Setpoint SP.2 is effective
11	Setpoint SP.E is effective	12	Setpoint gradient is effective
13	Manual-automatic switchover: Off: automatic On: manual mode (adjustment possible) Blinks: manual mode (adjustment not possible (► ΧονΦ/ Χντρ/ νΑν))		
14	Enter key: call up extended operating level / error list		
15	Up/ down keys: changing setpoint or correcting variable		
16	Automatic/manual or other functions (►ΧονΦ / ΛΟΓΙ)		
17	Freely configurable function key with pure controller operation		
18	PC connection for BlueControl (engineering tool)		

LED colors: LED 1, 2, 3, 4 – yellow; Bargraph – red; other LEDs – red

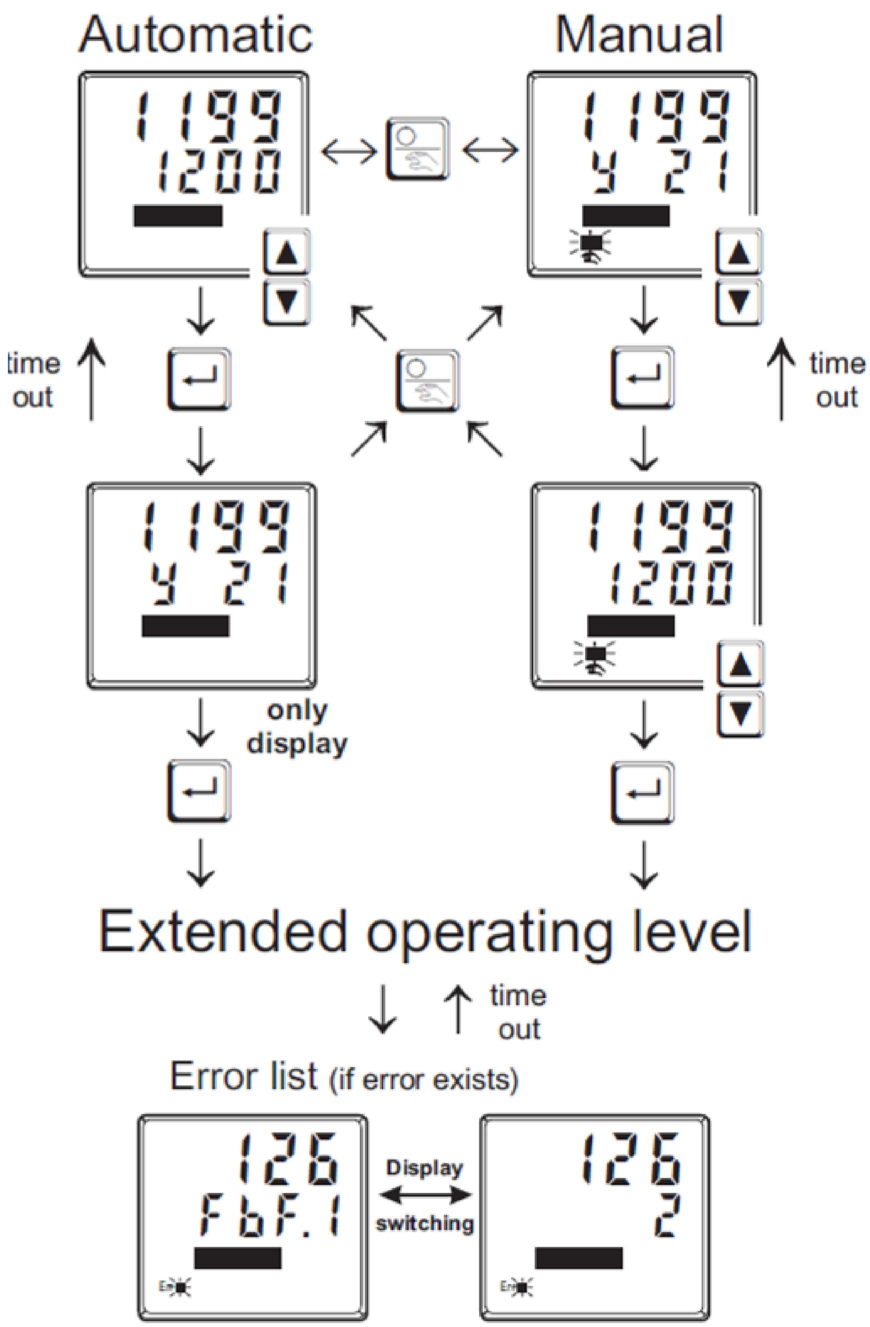
In the upper display line, the process value is always displayed. At parameter, configuration, calibration as well as extended operating level, the bottom display line changes cyclically between parameter name and parameter value.

3.2 Behavior after power-on

After supply voltage switch-on, the unit starts with the **operating level**. The unit is in the condition which was active before power-off.
If the controller was in manual mode at supply voltage switch-off, the controller will re-start with the last output value in manual mode at power-on.

3.3 Operating level

The content of the extended operating level is determined by means of BlueControl (engineering tool). Parameters which are used frequently or the display of which is important can be copied to the extended operating level.



3.4 Error list / Maintenance Manager

With one or several errors, the extended operating level always starts with the error list. Signaling an actual entry in the error list (alarm, error) is done by the Err LED in the display. To reach the error list press Ù twice.

Err LED status	Signification	Proceed as follows
blinks (status 2)	Alarm due to existing error	- Determine the error type in the error list - After error correction, the unit changes to status 1
lit (status 1)	Error removed, alarm not acknowledged	- Acknowledge the alarm in the error list by pressing key ▲ or ▼ - The alarm entry is deleted (status).
off (status)	No error, all alarm entries deleted	- Not visible except when acknowledging

ERROR LIST			
Name	**Description**	**Cause**	**Possible remedial action**
E.1	Internal error, cannot be removed	- e.g. defective EEPROM	- Contact PMA service - Return unit to our factory
E.2	Internal error, can be reset	- e.g. EMC trouble	- Keep measurement and power supply cables in separate runs - Ensure that interference suppression of contactors is provided
E.3	Configuration error, can be reset	- wrong configuration - missing configuration	- Check interaction of configuration / parameters
E.4	Hardware error	- Code number and hardware are not identical	- Contact UPC Support - Elektronic / Optioncard must be exchanged
ΦβΦ 1/2/3	Sensor break INP1/2/3	- Sensor defective - Faulty cabling	- Replace INP1/2/3 sensor - Check INP1/2/3 connection
Σητ. 1/2/3	Short circuit INP1/2/3	- Sensor defective - Faulty cabling	- Replace INP1/2/3 sensor - Check INP1/2/3 connection
ΠΟΛ 1/2/3	INP1/2/3 polarity error	- Faulty cabling	- Reverse INP1/2/3 polarity
ΗΧΑ	Heating current alarm (HCA)	- Heating current circuit interrupted, I< HX.A or I> HX.A (dependent of configuration) - Heater band defective	- Check heating current circuit - If necessary, replace heater band

ERROR LIST			
Name	**Description**	**Cause**	**Possible remedial action**
ΣΣρ	Heating current short circuit (SSR)	- Current flow in heating circuit with controller off	- Check heating current circuit - - If necessary, replace solid-state relay
ΛοοΠ	Control loop alarm (LOOP)	- Input signal defective or not connected correctly - Output not connected correctly	- Check heating or cooling circuit - Check sensor and replace it, if necessary - Check controller and switching device
ΑδΑ.Η	Self-tuning heating alarm (ADAH)	- See Self-tuning heating error status	- See Self-tuning heating error status
ΑδΑ.Χ	Self-tuning heating alarm cooling (ADAC)	- See Self-tuning cooling error status	- See Self-tuning cooling error status
δΑΧ	DAC-Alarm	- Actor error	- See error status DAC-function
Λιν.1/ 2/3	stored limit alarm 1/2/3	- Adjusted limit value 1/2/3 exceeded	- Check process
Ινφ.1	time limit value message	- Adjusted number of operating hours reached	- Application-specific
Ινφ.2	duty cycle message (digital outputs)	- Adjusted number of duty cycles reached	- Application-specific
Ε.5	Internal error in DP module	- Self-test error internal communication interrupted	- Switch on the instrument again Contact UPC Support
δπ.1	No access by bus master	- Bus error connector problem no bus connection	- Check cable - Check connector - Check connections
δπ.2	Faulty configuration	- Faulty DP configuration telegram	- Check DP configuration telegram in master
δπ.3	Inadmissible parameter setting telegram sent	- Faulty DP parameter setting telegram	- Check DP parameter setting telegram in master
δπ.4	No data communication	- Bus error Address error Master stopped	- Check cable connection - Check address - Check master setting

Saved alarms (Err-LED is lit) can be acknowledged and deleted with the digital input di1/2/3, the è-key or the Ò-key.

Configuration, see page 38: ΧονΦ / ΛΟΓΙ / Ερρ.ρ

If an alarm is still valid that means the cause of the alarm is not removed so far (Err-LED blinks), then other saved alarms cannot be acknowledged and deleted.

SELF-TUNING HEATING (ΑδΑ.Η) AND COOLING (ΑδΑ.Χ) ERROR STATUS:		
Error Status	**Description**	**Possible remedial action**
0	No error	
3	Faulty control action	Re-configure controller (inverse ⇔ direct)
4	No response of process variable	The control loop is perhaps not closed: check sensor, connections and process
5	Low reversal point	Increase (ΑΔΑ.Η) max. output limiting Ψ.Ηι or decrease (ΑΔΑ.Χ) min. output limiting Ψ.Λο
6	Danger of exceeded set-point (parameter determined)	If necessary, increase (inverse) or reduce (direct) set-point
7	Output step change too small (dy > 5%)	Increase (ΑΔΑ.Η) max. output limiting Ψ.Ηι or reduce (ΑΔΑ.Χ) min. output limiting Ψ.Λο
8	Set-point reserve too small	Acknowledgment of this error message leads to switch-over to automatic mode. If self-tuning shall be continued, increase set-point (inverse), reduce set-point (direct) or decrease set-point range (→ ΠΑρΑ / ΣΕτπ / ΣΠ.ΛΟ and ΣΠ.Ηι)

DAC FUNCTION (δΑΧ) ERROR STATUS:		
Error Status	**Description**	**Possible remedial action**
0	No error	
3	Output is blocked	Check the drive for blockage
4	Wrong method of operation	Wrong phasing, defect motor capacitor
5	Fail at Yp measurement	Check the connection to the Yp input
6	Calibration error	Manual calibration necessary

3.5 Self-tuning

For determination of optimum process parameters, self-tuning is possible.

After starting by the operator, the controller makes an adaptation attempt, where- by the process characteristics are used to calculate the parameters for fast line-out to the set-point without overshoot.

The following parameters are optimized when self-tuning: Parameter set 1:

Πβ1 - Proportional band 1 (heating) in engineering units [e.g. °C] τι1
- Integral time 1 (heating) in [s]→only, unless set to ΟΦΦ

τδ1 - Derivative time 1 (heating) in [s]→only, unless set to ΟΦΦ

τ1 - Minimum cycle time 1 (heating) in [s]→ only, unless Adt0 was set to “no self-tuning” during configuration by means of BlueControl®.

Πβ2 - Proportional band 2 (cooling) in engineering units [e.g. °C] τι2
- Integral time 2 (cooling) in [s] → only, unless set to OFF

τδ2 - Derivative time 2 (cooling) in [s] → only, unless set to OFF τ2
– Minimum cycle time 2 (cooling) in [s] → only, unless Adt0 was set to “no self-tuning” during configuration by means of BlueControl®.

Parameter set 2: analogous to parameter set 1 (see page 25)

3.5.1 Preparation for self-tuning

- Adjust the controller measuring range as control range limits. Set values ρνΓ.Λ and ρνΓ.Η to the limits of subsequent control. (Configuration→Controller→lower and upper control range limits) ΧονΦ→Χντρ→ρνΓ.Λ and ρνΓ.Η
- Determine which parameter set shall be optimized.
    - The instantaneously effective parameter set is optimized.
    - Activate the relevant parameter set (1 or 2).
- Determine which parameter set shall be optimized (see tables above).
- Select the self-tuning method see chapter 3.5.3
    - Step attempt after start-up
    - Pulse attempt after start-up
    - Optimization at the set-point

3.5.2 Optimization after start-up or at the set-point

The two methods are optimization after start-up and at the set-point.
As control parameters are always optimal only for a limited process range, various methods can be selected dependent of requirements. If the process behavior is very different after start-up and directly at the set-point, parameter sets 1 and 2 can be optimized using different methods. Switch-over between parameter sets dependent of process status is possible.

Optimization after start-up: (see page 18)

Optimization after start-up requires a certain separation between process value and set-point. This separation enables the controller to determine the control parameters by evaluation of the process when lining out to the set-point.
This method optimizes the control loop from the start conditions to the set-point, whereby a wide control range is covered.
We recommend selecting optimization method **"Step attempt after start-up"** with τυνΕ = 0 first. Unless this attempt is completed successfully, we recommend a **"Pulse attempt after start-up".**

Optimization at the set-point: (see page 18)

For optimizing at the set-point, the controller outputs a disturbance variable to the process. This is done by changing the output variable shortly. The process value changed by this pulse is evaluated. The detected process parameters are converted into control parameters and saved in the controller.
This procedure optimizes the control loop directly at the set-point. The advantage is in the small control deviation during optimization.

3.5.3 Selecting the method (Χονφ /Χντρ /τυνε)

Selection criteria for the optimization method:

	Step attempt after start-up	Pulse attempt after start-up	Optimization at the set-point
τυνΕ =0	sufficient set-point reserve is provided		sufficient set-point reserve is
τυνΕ =1		sufficient set-point reserve is provided	sufficient set-point reserve is
τυνΕ =2	always step attempt after start-up		

Sufficient set-point reserve:
inverse controller:(with process value < set-point- (10% of ρνΓΗ–ρνΓΛ)
direct controller: (with process value > set-point + (10% of ρνΓΗ–ρνΓΛ)

3.5.4 Step attempt after start-up

Condition: - τυνΕ = 0 and sufficient set-point reserve provided
or - τυνΕ =2
The controller outputs 0% correcting variable or Ψ.Λο and waits, until the process is at rest Subsequently, a correcting variable step change to 100% is output.
The controller attempts to calculate the optimum control parameters from the process response. If this is done successfully, the optimized parameters are taken over and used for line-out to the set-point.
With a 3-*point controller*, this is followed by "*cooling*".
After completing the 1st step as described, a correcting variable of -100% (100% cooling energy) is output from the set-point. After successful determination of the "cooling parameters", line-out to the set-point is using the optimized parameters.

3.5.5 Pulse attempt after start-up

Condition: - τυνΕ = 1 and sufficient set-point reserve provided.
The controller outputs 0% correcting variable or Ψ.Λο and waits, until the process is at rest (see start conditions)

Subsequently, a short pulse of 100% is output (Y=100%) and reset.
The controller attempts to determine the optimum control parameters from the process response. If this is completed successfully, these optimized parameters are taken over and used for line-out to the set-point.

With a 3-*point controller*, this is followed by "*cooling*".

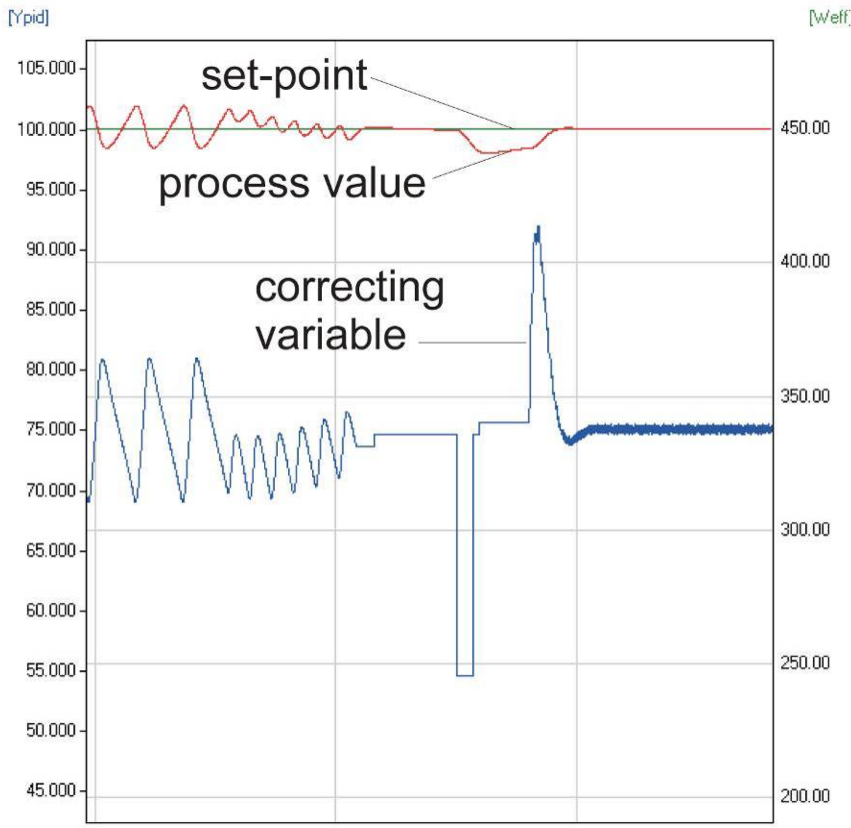
After completing the 1st step as described and line-out to the set-point, correcting variable "heating" remains unchanged and a cooling pulse (100% cooling energy) is output **additionally**. After successful determination of the "cooling parameters", the optimized parameters are used for line-out to the set-point.

3.5.6 Optimization at the set-point

Conditions:
- A sufficient set-point reserve is not provided at self-tuning start (see page 17).
- tunE is 0 or1
- With Strt = 1 configured and detection of a process value oscillation by more than ± 0,5% of (rnG.H - rnG.L) by the controller, the control parameters are preset for process stabilization and the controller realizes an optimization at the set-point (see figure "Optimization at the set-point").
- when the step attempt after power-on has failed
- with active gradient function (ΠΑρΑ/ ΣΕΤΠ/ ρ.ΣΠ≠ ΟΦΦ), the set-point gradient is started from the process value and there isn't a sufficient set-point reserve.

Optimization-at-the-set-point procedure:
The controller uses its instantaneous parameters for control to the set-point. In lined out condition, the controller makes a pulse attempt. This pulse reduces the correcting variable by max. 20% ❶, to generate a slight process value undershoot. The changing process is analyzed and the parameters thus calculated are re- corded in the controller. The optimized parameters are used for line-out to the set-point.

Optimization at the set point

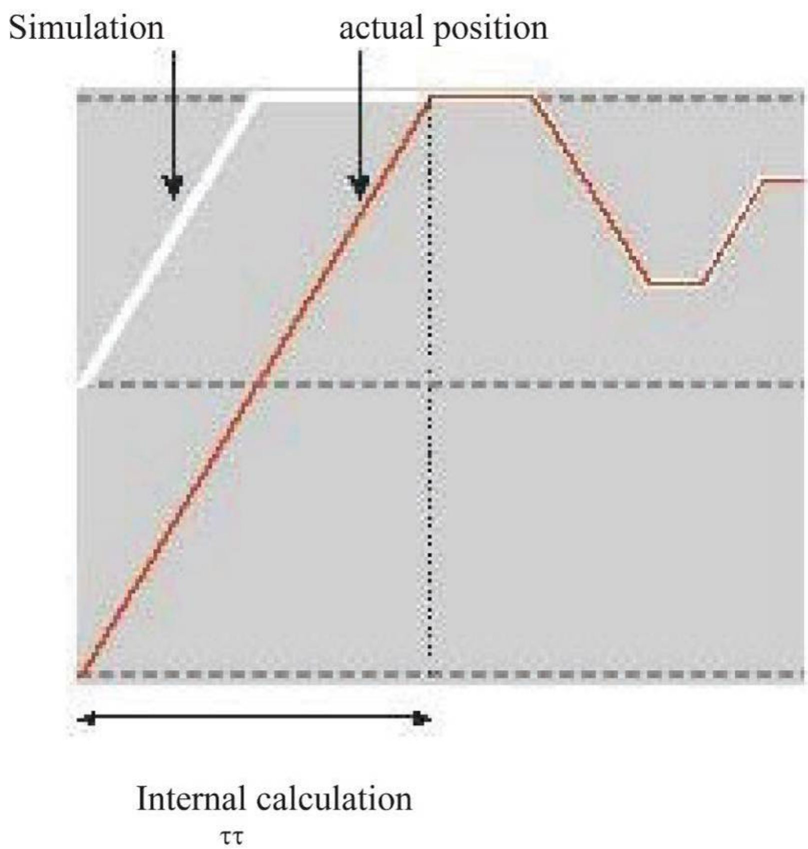


With a 3-*point controller*, optimization for the “heating“ or “cooling” parameters occurs dependent of the instantaneous condition.
These two optimizations must be started separately.

❶ If the correcting variable is too low for reduction in lined out condition it is increased by max. 20%.

3.5.7 Optimization at the set-point for 3-point stepping controller

With 3-point stepping controllers, the pulse attempt can be made with or without position feedback. Unless feedback is provided, the controller calculates the mo- tor actuator position internally by varying an integrator with the adjusted actuator travel time. For this reason, precise entry of the actuator travel time ($\tau\tau$), as time between stops is highly important. Due to position simulation, the controller knows whether an increased or reduced pulse must be output. After supply voltage switch-on, position simulation is at 50%. When the motor actuator was varied by the adjusted travel time in one go, internal calculation occurs, i.e. the position corresponds to the simulation:



Internal calculation always occurs, when the actuator was varied by travel time <u>ττ</u> ***<u>in one go</u>*** , independent of manual or automatic mode. When interrupting the variation, internal calculation is cancelled. Unless internal calculation occurred already after self-tuning start, it will occur automatically by closing the actuator once.

Unless the positioning limits were reached within 10 hours, a significant deviation between simulation and actual position may have occurred. In this case, the controller would realize minor internal calculation, i.e. the actuator would be closed by 20 %, and re-opened by 20 % subsequently. As a result, the controller knows that there is a 20% reserve for the attempt.

3.5.8 Self-tuning start

Start condition:

- For process evaluation, a stable condition is required. Therefore, the controller waits until the process has reached a stable condition after self-tuning start.
  The rest condition is considered being reached, when the process value oscillation is smaller than ± 0,5% of (ρνΓ.Η - ρνΓ.Λ).
- For self-tuning start after start-up, a 10% difference from (ΣΠ.ΛΟ ... ΣΠ.Ηι) is required.

ⓘ Self-tuning start can be blocked via BlueControl® (engineering tool) (Π.Λοχ).

Στρτ = 0 Only manual start by pressing keys and simultaneously or via interface is possible.

Στρτ = 1 Manual start by press keys and simultaneously via interface and automatic start after power-on and detection of process oscillations.

ADA LED STATUS	SIGNIFICATION
blinks	Waiting, until process calms down
lit	Self-tuning is running
off	Self-tuning not active or ended

3.5.9 Self-tuning cancellation

By the operator:
Self-tuning can always be cancelled by the operator. For this, press and key simultaneously. With controller switch-over to manual mode after self-tuning start, self-tuning is cancelled. When self-tuning is cancelled, the controller will continue operating using the old parameter values.

By the controller:
If the Err LED starts blinking whilst self-tuning is running, successful self-tuning is prevented due to the control conditions. In this case, self-tuning was cancelled by the controller. The controller continues operating with the old parameters in automatic mode. In manual mode it continues with the old controller output value.

3.5.10 Acknowledgement procedures in case of unsuccessful self-tuning

1. Press keys and simultaneously:
   The controller continues controlling using the old parameters in automatic mode. The Err LED continues blinking, until the self-tuning error was acknowledged in the error list.

2. *Press key (if configured):*
   The controller goes to manual mode. The Err LED continues blinking, until the self-tuning error was acknowleged in the error list.

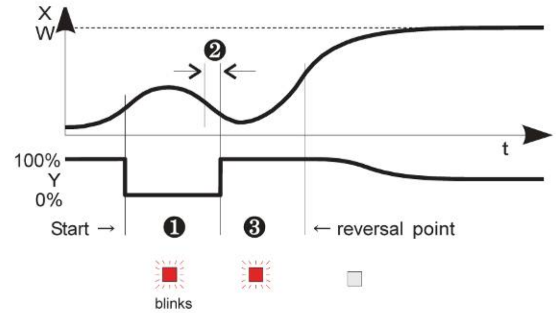
3. *Press key :*
   Display of error list at extended operating level. After acknowledgement of the error message, the controller continues control in automatic mode using the old parameters.

Cancellation causes:
→ page 15: "Error status self-tuning heating (AδA.H) and cooling (AδA.X)"

3.5.11 Examples for self-tuning attempts
(controller inverse, heating or heating/cooling)

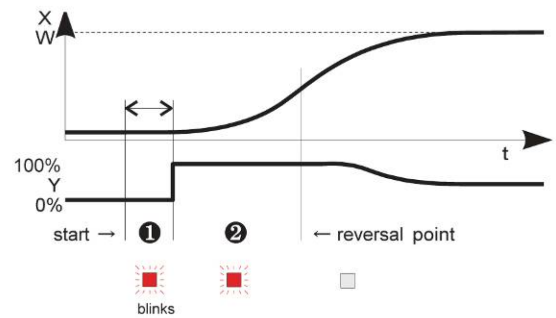
Start: heating power switched on

Heating power Y is switched off (❶). When the change of process value X was constant during one minute (❷), the power is switched on (❸). At the reversal point, the self-tuning at- tempt is finished and the new parameter are used for controlling to set-point W.



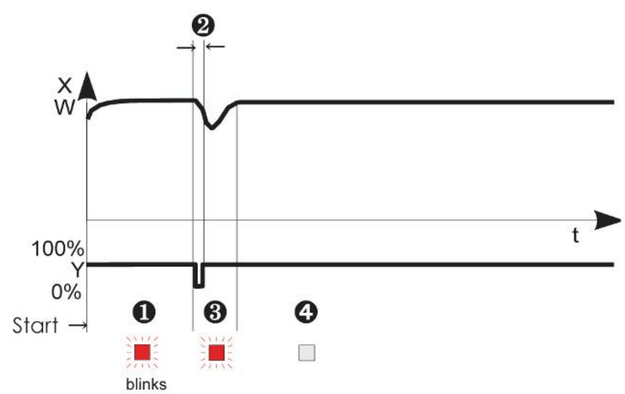
Start: heating power switched off

The controller waits 1,5 minutes (❶). Heating power Y is switched on (❷). At the reversal point, the self-tuning attempt is finished and control to the set-point is using the new parameters.



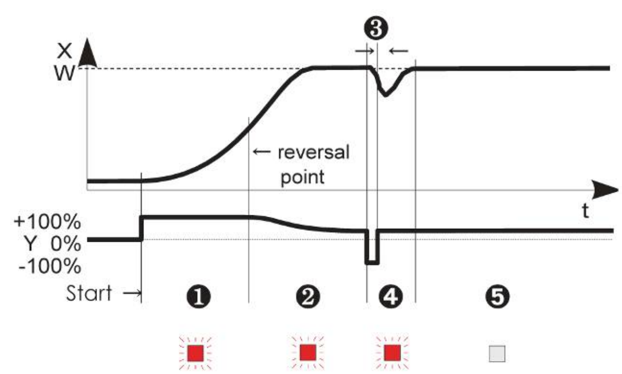
Self-tuning at the set-point ⚠

The process is controlled to the set-point. With the control deviation constant during a defined time (❶) (i.e. constant separation of process value and set-point), the controller outputs a reduced correcting variable pulse (max. 20%) (❷). After determination of the control parameters using the process characteristic (❸), control is started using the new parameters (❹).



Three-point controller ⚠

The parameter for heating and cooling are determined in two attempts. The heating power is switched on (❶). Heating parameters Πβ1, τι1, τδ1 and □□ are determined at the reversal point. Control to the set-point occurs(❷). With constant control deviation, the controller provides a cooling correcting variable pulse (❸). After determining its cooling parameters Πβ2, τι2, τδ2 and τ2 (❹) from the process characteristics , control operation is started using the new parameters (❺).

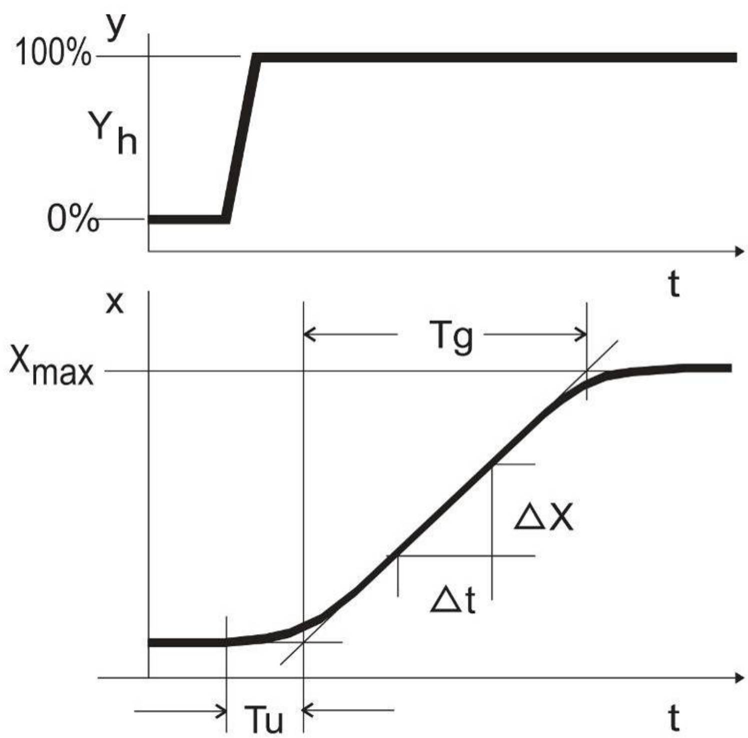


⚠ During phase ❸, heating and cooling are done simultaneously!

3.6 Manual self-tuning

The optimization aid can be used with units on which the control parameters shall be set without self-tuning.

For this, the response of process variable x after a step change of correcting variable y can be used. Frequently, plotting the complete response curve (0 to 100%) is not possible, because the process must be kept within defined limits. Values T_g and x_{max} (step change from 0 to 100 %) or $\triangle t$ and $\triangle x$ (partial step response) can be used to determine the maximum rate of increase v_{max}.



y	=	correcting variable
Y_h	=	control range
Tu	=	delay time (s)
T_g	=	recovery time (s)
X_{max}	=	maximum process value

$$V_{max} = \frac{Xmax}{Tg} = \frac{\triangle x}{\triangle t} = \text{ max. rate of increase of process value}$$

The control parameters can be determined from the values calculated for delay time Tu, maximum rate of increase vmax, control range Xh and characteristic K according to the formulas given below. Increase Xp, if line-out to the set-point oscillates.

Parameter	Control	Line-out of disturbances	Start-up behavior
Πβ1 higher lower	increased damping	slower line-out	slower reduction of duty cycle
	reduced damping	faster line-out	faster reduction of duty cycle
τδ1 higher lower	reduced damping	faster response to disturbances	faster reduction of duty cycle
	increased damping	slower response to disturbances	slower reduction of duty cycle
τι1 higher lower	increased damping	slower line-out	slower reduction of duty cycle
	reduced damping	faster line-out	faster reduction of duty cycle

FORMULAS			
controller behavior	**Πβ□ [phy. units]**	**τδ1 [s]**	**τι1 [s]**
PID	1,7 * K	2* Tu	2* Tu
PD	0,5 * K	Tu	OFF
PI	2,6 * K	OFF	6* Tu
P	K	OFF	OFF
3-point-stepping	1,7 * K	Tu	2 * Tu

K = Vmax* Tu
With 2-point and 3-point controllers, the cycle time must be adjusted to τ1 / τ2 ≤ 0,25 * Tu

3.7 Second PID parameter set

The process characteristic is frequently affected by various factors such as process value, correcting variable and material differences. To comply with these requirements, Protherm 20 can be switched over between two parameter sets.

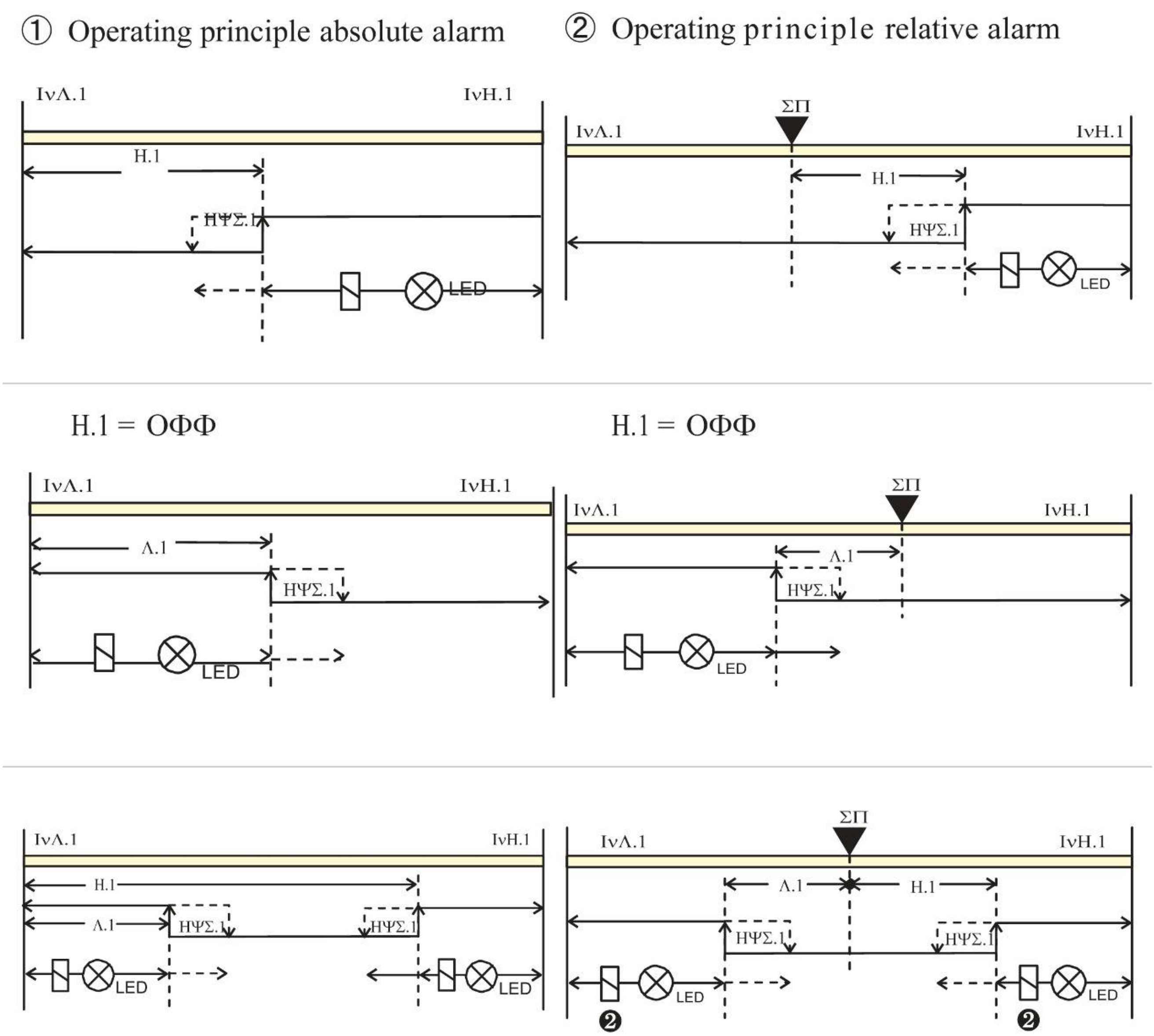
Parameter sets ΠΑρΑ and ΠΑρ.2 are provided for heating and cooling.

Dependent of configuration (ΧονΦ/ΛΟΓ/Πιδ.2), switch-over to the second parameter set (ΧονΦ/ΛΟΓ/Πιδ.2) is via one of digital inputs di1, di2, di3, key F or interface (OPTION).

Self-tuning is always done using the active parameter set, i.e. the second parameter set must be active for optimizing.

3.8 Alarm handling

Max. three alarms can be configured and assigned to the individual outputs. Generally, outputs ΟυΤ.1... ΟυΤ.6 can be used each for alarm signaling. If more than one signal is linked to one output the signals are OR linked. Each of the 3 limit values Λιν.1 … Λιν.3 has 2 trigger points Η.x (Max) and Λ.x (Min), which can be switched off individually (parameter = “ΟΦΦ”). Switching difference ΗΨΣ.x and delay δΕλ.x of each limit value is adjustable.



❶: normally closed (ΧονΦ/ Ουτ.x/ Ο.Αχτ =1) (see examples in the drawing)

❷: normally open (ΧονΦ/ Ουτ.x/ Ο.Αχτ = 0) (inverted output relay action)

The variable to be monitored can be selected separately for each alarm via configuration

The following variables can be monitored:

- process value
- control deviation xw (process value - set-point)
- control deviation xw + suppression after start-up or set-point change
  After switching on or set-point changing, the alarm output is suppressed, until the process value is within the limits for the first time. At the latest after expiration of time 10 τι1, the alarm is activated. (τι1 = integral time 1; parameter →Χντρ). If τι1 is switched off (τι1 = ΟΦΦ), this is interpreted as Î, i.e. the alarm is not activated, before the process value was within the limits once.
- Measured value INP1/2/3
- effective set-point Weff
- correcting variable y (controller output)
- Deviation from SP internal
- x1- x2
- control deviation xw + suppression after start-up or setpoint change without time limit.
  After switch-on or setpoint change, alarm output is suppressed, until the process value was within the limits once.

If measured value monitoring + alarm status storage is chosen (ΧονΦ / Λιν / Φνχ.x = 2/4), the alarm relay remains switched on until the alarm is resetted in the error list (Λιν 1..3 = 1).

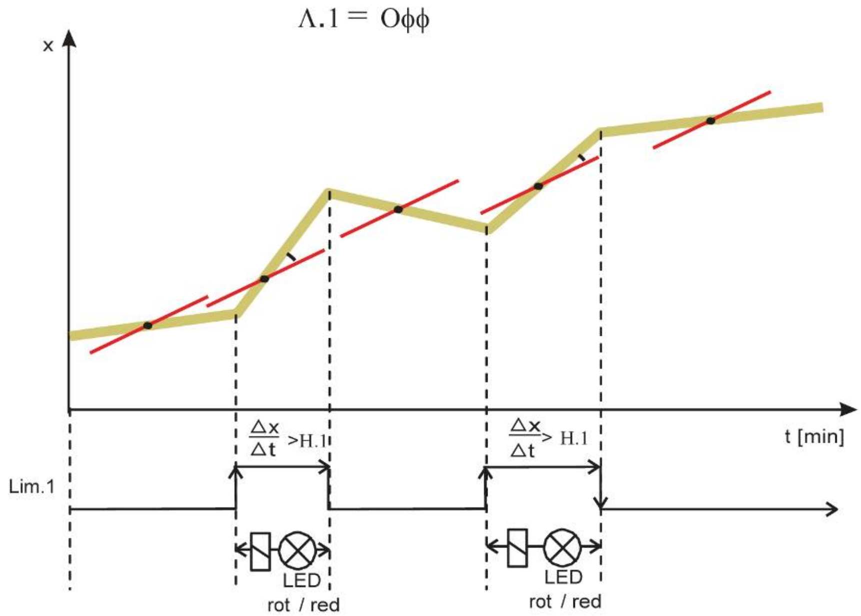
3.8.1 Alarm delay

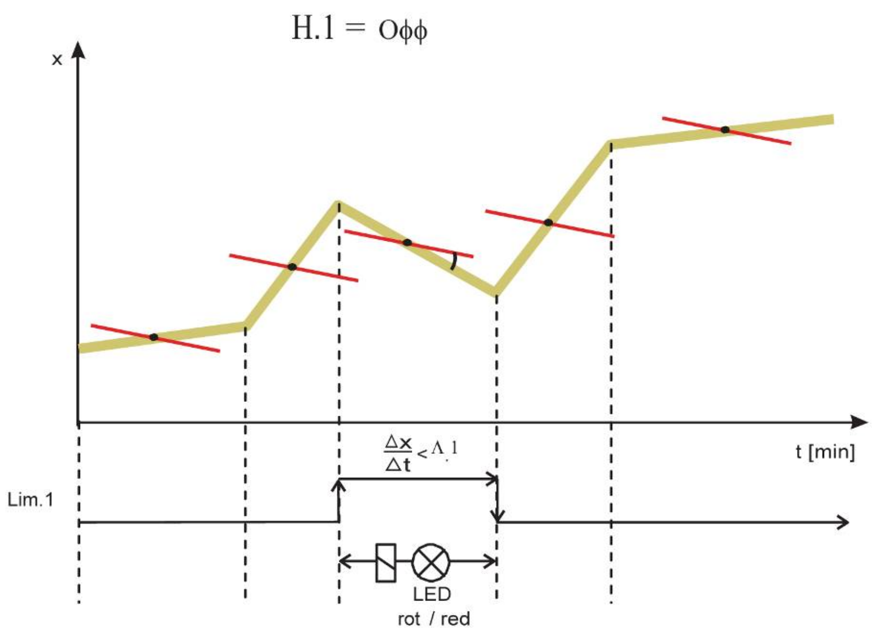
Alarms can be delayed. The alarm output is set only, if the out-of-limits situation persists after elapse of the delay. Out-of-limits shorter than the adjusted delay are ignored.

3.8.2 Rate-of-change monitoring

3.8.3 Another function of the alarm processing is signal rate-of-change (per minute) monitoring.

Output action with rate-of-change monitoring (ex: Lim.1)

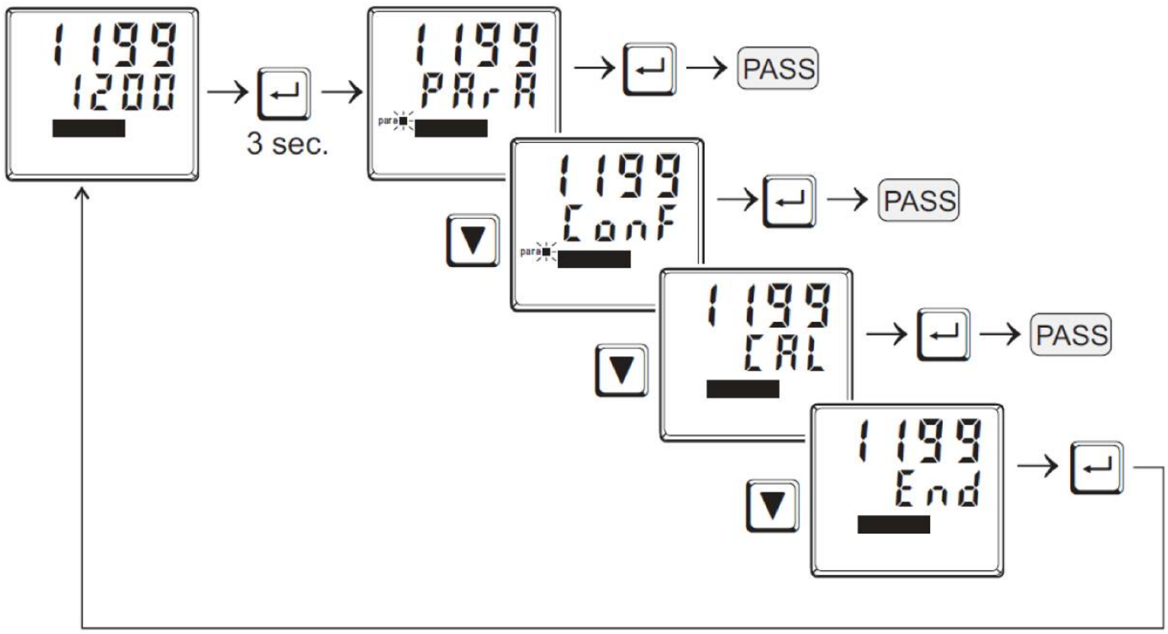




If input signal monitoring with latch or rate-of-change monitoring with latch was selected (ΧονΦ / Λιν / Φνχ.x = 2/4) the alarm relay remains set, until the alarm on the error list was reset (Λιν 1..3 = 1).

3.9 Operating structure

After supply voltage switch-on, the controller starts with the operating levels. The controller status is as before power off.



ΠΑρΑ - level: At ΠΑρΑ - level, the right decimal point of the bottom display line is lit continuously.

ΧονΦ - level: At ΧονΦ - level, the right decimal point of bottom display line blinks.

PASS

When safety switch **Loc** is open, only the levels enabled by means of BlueControl (engineering tool) are visible and accessible by entry of the password also adjusted by means of BlueControl (engineering tool). Individual parameters accessible without password must be copied to the extended operating level.

All password-protected levels are disabled only, if the Loc safety switch is closed.

<u>Factory setting:</u> Safety switch **Loc** closed: all levels accessible without restriction, password ΠΑΣΣ = ΟΦΦ.

Safety switch Loc	**Password entered with BluePort®**	**Function disabled or enabled with BluePort®**	**Access via the instrument front panel:**
closed	OFF / password	disabled / enabled	enabled
open	OFF / password	disabled	disabled
open	OFF	enabled	enabled
open	Password	enabled	enabled after password entry

4 Configuration level

4.1 Configuration survey

ΧονΦ Configuration level													
	Χντρ Control and self-tuning	ΙνΠ.1 Input 1	ΙνΠ.2 Input 2	ΙνΠ.3 Input 3	Λιν Limit value functions	ΟΥτ.1 Output 1	ΟΥτ.2 Output 2	ΟΥτ.3 Output 3	ΟΥτ.4 Output 4	Ουτ.5 Output 5	Ουτ.6 Output 6	ΛΟΓΙ Digital inputs	ΟτηρDisplay, operation,
	ΣΠ.Φν	Ι.Φνχ	Ι.Φνχ	Ι.Φνχ	Φνχ.1	Ο.Αχτ	See output 1	Ο.τΨΠ	See output 1	See output 1	See output 1	Λ_ρ	βΑυδ
È Ì	Χ.τΨΠ	ΣτΨΠ	ΣτΨΠ	Σ.Λιν	Σρχ.1	Ψ.1		Ο.Αχτ				ΣΠ.2	Αδδρ
	Χ.Φνχ	Σ.Λιν	Χορρ	Σ.Τψπ	Φνχ.2	Ψ.2		ΟυΤ.0				ΣΠ.Ε	ΠρτΨ
	Χ.διφ	Χορρ	Ιν.Φ	Χορρ	Σρχ.2	Λιν.1		Ουτ.1				Ψ.2	δΕΛΨ
	νΑν	Ιν.Φ		Ιν.Φ	Φνχ.3	Λιν.2		Ο.Σρχ				Ψ.Ε	δπ.Αδ
	Χ.Αχτ				Σρχ.3	Λιν.3		Ο.ΦΑΙ				μΑν	βχ.υπ
	ΦΑΙΛ				ΗΧ.ΑΛ	δΑχ.Α		Ψ.1				Χ.οΦΦ	Ο2
	ρνΓ.Λ				ΛΠ.ΑΛ	ΛΠ.ΑΛ		Ψ.2				μ.Λοχ	Υνιτ
	ρνΓ.Η				δΑχ.Α	ΗΧ.ΑΛ		Λιμ.1				Ερρ.ρ	δΠ
	ΧΨΧΛ					ΗΧ.ΣΧ		Λιμ.2				Πιδ.2	ΛΕδ
	τυνΕ					Π.Ενδ		Λιμ.3				Ι.Χηγ	δΙΣΠ
	Στρτ					ΦΑι.1		δΑχ.Α				δι.Φν	Χ.δΕλ
						ΦΑι.2		ΛΠ.ΑΛ				β.Στα	
						ΦΑι.3		ΗΧ.ΑΛ					
						δΠ.Ερ		ΗΧ.ΣΧ					
								ΦΑι.1					
								ΦΑι.2					
								ΦΑι.3					
								δΠ.Ερ					
								β.οφφ					

Adjustment:

- The configuration can be adjusted by means of keys ▲ ▼ .
- Transition to the next configuration is by pressing key ↵ .
- After the last configuration of a group, δονΕ is displayed and followed by automatic change to the next group.

Return to the beginning of a group is by pressing the ↵ key for 3 sec.

4.2 Configuration parameters

Name	Value Range	Description	Default
ΣΠ.Φν		**Basic configuration of setpoint processing**	0
	0	set-point controller can be switched over to external set-point (-> ΛΟΓΙ/ ΣΠ.Ε)	
	8	standard controller with external offset (ΣΠ.Ε)	
Χ.τΨΠ		**Calculation of the process value**	0
	0	standard controller (process value = x1)	

	1	ratio controller (x1/x2)	
	2	difference (x1 - x2)	
	3	Maximum value of x1and x2. It is controlled with the bigger value. At sensor failure it is controlled with the remaining actual value.	
	4	Minimum value of x1and x2. It is controlled with the smaller value. At sensor failure it is controlled with the remaining actual value.	
	5	Mean value (x1, x2). With sensor error, controlling is continued with the remaining process value.	
	6	Switchover between x1 and x2 (-> ΛΟΓΙ/ Ι.ΧηΓ)	
	7	O function with constant sensor temperature	
	8	O function with measured sensor temperature	
	9	Carbon function with constant CO value	
	10	Carbon function with measured CO value	
	11	Dewpoint function	
Χ.Φνχ		**Control behavior (algorithm)**	1
	0	on/off controller or signaller with one output	
	1	PID controller (2-point and continuous)	
	2	Δ / Y / Off, or 2-point controller with partial/full load switch-over	
	3	2 x PID (3-point and continuous)	
	4	3-point stepping controller	
	5	3-point stepping controller with position feedback Yp	
	6	continuous controller with integrated positioner	
Χ.διφ		**Output action of the PID controller derivative action**	0
	0	Derivative action acts only on the measured value.	
	1	Derivative action only acts on the control deviation (set-point is also differentiated)	
νΑν		**Manual operation permitted**	0
	0	No	
	1	Yes (→ ΛΟΓΙ / νΑν)	

Name	Value Range	Description	Default
Χ.Αχτ		**Method of controller operation**	0
	0	inverse, e.g. heating The correcting variable increases with decreasing process value and decreases with increasing process value.	
	1	direct, e.g. cooling The correcting variable increases with increasing process value and decreases with decreasing process value.	
ΦΑΙΛ		**Behavior at sensor break**	1
	0	controller outputs switched off	
	1	y= Y2	
	2	y = mean output. The maximum permissible output can be adjusted with parameter Yn.H. To prevent	

		determination of inadmissible values, mean value formation is only if the control deviation is lower than parameter L.Ym.	
ρνΓ.Λ	1999…9999	**X0 (start of control range) ❶**	-100
ρνΓ.Η	1999…9999	**X100 (end of control range) ❶**	1200
ΧΨΧΛ		**Characteristic for 2-point- and 3-point-controllers**	0
	0	Standard	
	1	water cooling linear (see page 48)	
	2	water cooling non-linear	
	3	with constant cycle	
τυνΕ		**Auto-tuning at start-up**	0
	0	At start-up with step attempt, at set-point with impulse attempt	
	1	At start-up and at set-point with impulse attempt. Setting for fast controlled systems (e.g. hot runner control)	
	2	Always step attempt at start-up	
Στρτ		**Start of auto-tuning**	0
	0	Manual start of auto-tuning	
	1	Manual or automatic start of auto-tuning at power on or when oscillating is detected	
Αδτ0		**Optimization of T1, T2** (only visible with BlueControl!)	0
	0	Automatic optimization	
	1	No optimization	

❶ ρνΓ.Λ and ρνΓ.Η are indicating the range of control to which e.g. the self-tuning refers

IνΠ.1

Name	Value Range	Description	Default
Ι.φνχ		**INP1 function selection**	7
	0	No function (following INP data are skipped)	
	1	Heating current input	
	2	External set-point ΣΠ.Ε (switch-over -> ΛΟΓΙ/ ΣΠ.Ε)	
	3	Position feedback Yp	
	4	Second process value x2 (ratio, min, max, mean)	
	5	External positioning value Y.E (switch-over → ΛΟΓΙ / Ψ.Ε)	
	6	No controller input (e.g. limit signaling instead)	
	7	Process value x1	
	8	Process value x3	
Σ.τΨΠ		**Sensor type selection**	1
	0	thermocouple type L (-100...900°C) , Fe-CuNi DIN	
	1	thermocouple type J (-100...1200°C) , Fe-CuNi	
	2	thermocouple type K (-100...1350°C), NiCr-Ni	
	3	thermocouple type N (-100...1300°C), Nicrosil-Nisil	
	4	thermocouple type S (0...1760°C), PtRh-Pt10%	
	5	thermocouple type R (0...1760°C), PtRh-Pt13%	
	6	thermocouple type T (-200...400°C), Cu-CuNi	

	7	thermocouple type C (0...2315°C), W5%Re-W26%Re	
	8	thermocouple type D (0...2315°C), W3%Re-W25%Re	
	9	thermocouple type E (-100...1000°C), NiCr-CuNi	
	10	thermocouple type B (0/100...1820°C), PtRh-Pt6%	
	18	special thermocouple	
	20	Pt100 (-200.0 ... 100,0 °C) (-200,0 ... 150,0°C with reduced lead resistance: measuring resistance + lead resistance ≤160 Ω)	
	21	Pt100 (-200.0 ... 850,0 °C)	
	22	Pt1000 (-200.0 ... 850.0 °C)	
	23	special 0...4500 Ohm (preset to KTY11-6)	
	24	special 0...450 Ohm	
	30	0...20mA / 4...20mA ❶	
	40	0...10V / 2...10V ❶	
	41	special -2,5...115 mV ❶	
	42	special -25...1150 mV ❶	
	50	potentiometer 0...160 Ohm ❶	
	51	potentiometer 0...450 Ohm ❶	
	52	potentiometer 0...1600 Ohm ❶	
	53	potentiometer 0...4500 Ohm ❶	
Σ.Λιν		**Linearization** (only at Σ.τΨΠ = 23 (KTY 11-6), 24 (0...450 Q), 30 (0..20mA), 40 (0..10V), 41 (0...100mV) and 42 (special -25...1150 mV))	0
	0	none	
	1	Linearization to specification. Creation of linearization table with BlueControl (engineering tool) possible. The characteristic for KTY 11-6 temperature sensors is preset.	
Χορρ		**Measured value correction / scaling**	0
	0	Without scaling	
	1	Offset correction (at ΧΑΛ level) (controller offset adjustment is at ΧΑΛ level)	
	2	2 point correction (at ΧΑΛ level) (calibration is at the controller ΧΑΛ level)	
	3	Scaling (at ΠΑρΑ level)	
	4	Autom. calibration (only with position feedback Yp)	
Ιν.φ	1999…9999	**Alternative value for error at INP1** **If a value is adjusted, this value is used for display and calculation in case of error (e.g. FAIL).** ⚠ **Before activating a substitute value, the effect in the control loop should be considered!**	ΟΦΦ
fAI1		**Forcing INP1** (only visible with BlueControl!)	0

	0	No forcing	
	1	Forcing via serial interface	

❶ with current and voltage input signals, scaling is required (see chapter 5.3)

ΙνΠ.2

Name	Value Range	Description	Default
Ι.Φνχ		**Function selection of INP2**	1
	0	no function (subsequent input data are skipped)	
	1	Heating current input	
	2	External set-point ΣΠ.Ε	
	3	Yp input	
	4	Second process value x2	
	5	External positioning value Y.E (switch-over → ΛΟΓΙ / Ψ.Ε)	
	6	No controller input (e.g. transmitter input instead)	
	7	Process value x1	
	8	Process value x3	
Σ.τΨΠ		**Sensor type selection**	30
	30	0...20mA / 4...20mA ❶	
	31	0...50mA AC ❶	
	50	potentiometer 0...160 Ohm ❶	
	51	potentiometer 0...450 Ohm ❶	
	52	potentiometer 0...1600 Ohm ❶	
	53	potentiometer 0...4500 Ohm ❶	
Χορρ		**Measured value correction / scaling**	0
	0	Without scaling	
	1	Offset correction (at CAL level) (offset entry is at controller CAL level)	
	2	2 point correction (at CAL level) (calibration is at the controller CAL level)	
	3	Scaling (at PArA level)	
Ιν.φ	1999…9999	**Alternative value for error at INP2** **If a value is adjusted, this value is used for display and calculation in case of error (e.g. FAIL).** ⚠ **Before activating a substitute value, the effect in the control loop should be considered!**	ΟΦΦ
fAI2		**Forcing INP2** (only visible with BlueControl!)	0
	0	No forcing	
	1	Forcing via serial interface	

❶ with current and voltage input signals, scaling is required (see chapter 5.3)

InP.3

Name	Value Range	Description	Default
I.Φνχ		**Function selection of INP3**	1
	0	No function (subsequent input data are skipped)	
	1	Heating current input	
	2	External set-point ΣΠ.Ε (switch-over -> ΛΟΓΙ/ ΣΠ.Ε)	
	3	Yp Input	
	4	Second process value x2	
	5	External positioning value Y.E (switch-over → ΛΟΓΙ / Ψ.Ε)	
	6	No controller input (e.g. transmitter input instead)	
	7	Process value x1	
	8	Process value x3	
Σ.Λιν		**Linearization** (only at Σ.τΨΠ = 30 (0..20mA) and 40 (0..10V), adjustable)	0
	0	none	
	1	Linearization to specification. Creation of linearization table with BlueControl (engineering tool) possible. The characteristic for KTY 11-6 temperature sensors is preset.	
Σ.τΨΠ		**Sensor type selection**	1
	0	thermocouple type L (-100...900°C) , Fe-CuNi DIN	
	1	thermocouple type J (-100...1200°C) , Fe-CuNi	
	2	thermocouple type K (-100...1350°C), NiCr-Ni	
	3	thermocouple type N (-100...1300°C), Nicrosil-Nisil	
	4	thermocouple type S (0...1760°C), PtRh-Pt10%	
	5	thermocouple type R (0...1760°C), PtRh-Pt13%	
	6	thermocouple type T (-200...400°C), Cu-CuNi	
	7	thermocouple type C (0...2315°C), W5%Re-W26%Re	
	8	thermocouple type D (0...2315°C), W3%Re-W25%Re	
	9	thermocouple type E (-100...1000°C), NiCr-CuNi	
	10	thermocouple type B (0/100...1820°C), PtRh-Pt6%	
	18	special thermocouple	
	20	Pt100 (-200.0 ... 100,0 °C) (-200,0 ... 150,0°C with reduced lead resistance: measuring resistance + lead resistance ≤160 Ω)	
	21	Pt100 (-200.0 ... 850,0 °C)	
	22	Pt1000 (-200.0 ... 850.0 °C)	
	23	special 0...4500 Ohm (preset to KTY11-6)	
	24	special 0...450 Ohm	
	30	0...20mA / 4...20mA ❶	
	41	special -2,5...115 mV ❶	
	42	special -25...1150 mV ❶	

	50	potentiometer 0...160 Ohm ❶	
	51	potentiometer 0...450 Ohm ❶	
	52	potentiometer 0...1600 Ohm ❶	
	53	potentiometer 0...4500 Ohm ❶	
Χορρ		**Measured value correction / scaling**	0
	0	Without scaling	
	1	Offset correction (at ΧΑΛ level) (offset entry is at controller ΧΑΛ level)	
	2	2 point correction (at ΧΑΛ level) (calibration is at controller ΧΑΛ level)	
	3	Scaling (at ΠΑρΑ level)	
	4	Automatic calibration (DAC)	
Ιv.φ	1999…9999	**Alternative value for error at INP3** **If a value is adjusted, this value is used for display and calculation in case of error (e.g. FAIL).** ⚠ **Before activating a substitute value, the effect in the control loop should be considered!**	ΟΦΦ
fAI1		**Forcing INP3** (only visible with BlueControl!)	0
	0	No forcing	
	1	Forcing via serial interface	

❶ with current and voltage input signals, scaling is required (see chapter 5.3)

Lim

Name	Value Range	Description	Default
Φvχ.1 Φvχ.2 Φvχ.3		**Function of Limit 1/2/3**	1
	0	Switched off	
	1	Measured value monitoring	
	2	Measured value monitoring + alarm latch. A latched limit value can be reset via error list or via a digital input, or by pressing key [AUTO/MAN] or [F] (-> ΛΟΓΙ/ Ερρ.ρ)	
	3	Signal change (change/minute)	
	4	Signal change and storage (change/minute)	
Σρχ.1 Σρχ.2 Σρχ.3		**Source of Limit 1/2/3**	1
	0	Process value	
	1	control deviation xw (process value - set-point)	
	2	Control deviation Xw (=relative alarm) with suppression after start-up and setpoint change After switch-on or setpoint change, alarm output is suppressed, until the process value was within the limits once. At the latest after elapse of time 10 τι1 the alarm is activated. (τι1 = integral time 1; parameter → Χvτρ)	

		τι1 switched off (τι1 = 0) is considered as ∞ , i.e. the alarm is not activated, until the process value was within the limits once.	
	3	measured value INP1	
	4	measured value INP2	
	5	measured value INP3	
	6	effective setpoint Weff	
	7	correcting variable y (controller output)	
	8	control variable deviation xw (actual value - internal setpoint) = deviation alarm to internal setpoint	
	9	difference x1 - x2 (utilizable e.g. in combination with process value function “mean value” for recognizing aged thermocouples	
	11	Control deviation (=relative alarm) with suppression after start-up and setpoint change without time limit After switch-on or setpoint change, alarm output is suppressed, until the process was within the limits once.	
HX.AΛ		**Alarm heat current function (INP2)**	0
	0	Switched off	
	1	Overload short circuit monitoring	
	2	Break and short circuit monitoring	
ΛΠ.AΛ		**Monitoring of control loop interruption for heating (see page 73)**	0
	0	switched off / inactive	
	1	LOOP alarm active. A loop alarm is output, unless the process value reacts accordingly after elapse of 2 x ti1 with Y=100%. With ti1=0 , the LOOP alarm is inactive.	
δAχ.A		**DAC alarm function (see page 65)**	
	0	DAC alarm switched off / inactive	
	1	DAC alarm active	
Hour	Off…999999	**Operating hours (only visible with BlueControl®!)**	Off
Swit	Off…999999	**Output switching cycles (only visible with BlueControl®!)**	Off

Oυτ.1 and Oυτ.2

Name	Value Range	Description	Default
O.Aχτ		**Method of operation of output OUT1**	0
	0	direct / normally open	
	1	inverse / normally closed	
Ψ.1 Ψ.2		**Controller output Y1/Y2**	1
	0	Not active	
	1	Active	
Λιν.1 Λιν.2 Λιν.3		**Limit 1/2/3 signal**	0
	0	Not active	
	1	Active	
δAχ.A		**Valve monitoring (DAC)**	0

	0	Not active	
	1	Active	
ΛΠ.ΑΛ		**Interruption alarm signal (LOOP)**	0
	0	Not active	
	1	Active	
ΗΧ.ΑΛ		**Heat current alarm signal**	0
	0	Not active	
	1	Active	
ΗΧ.ΣΧ		**Solid state relay (SSR) short circuit signal**	0
	0	Not active	
	1	Active	
ΦΑι.1		**INP1/ INP2 / INP3 error signal**	0
ΦΑι.2	0	Not active	
ΦΑι.3	1	Active	
δΠ.Ερ		**PROFIBUS error**	0
	0	Not active	
	1	active: Profibus trouble, no communication with this instrument.	
β.οφφ		**Burn-off function**	0
	0	Not active	
	1	Burn-off function is switched on	
φΟυτ		**Forcing OUT1 (only visible with BlueControl!)**	0
	0	No forcing	
	1	Forcing via serial interface	

Configuration parameters Out.2 = Out.1 except for:
Default Ψ.1 =0 Ψ.2 =1

Ουτ.3 and Ουτ.4

Name	Value Range	Description	Default
Ο.τΨΠ		**Signal type selection OUT3**	0
	0	relay / logic (only visible with current/logic voltage)	
	1	0...20 mA continuous (only visible with current / logic / voltage)	
	2	4...20 mA continuous (only visible with current / logic / voltage)	
	3	0...10 V continuous (only visible with current / logic / voltage)	
	4	2...10 V continuous (only visible with current / logic / voltage)	
	5	transmitter supply (only visible without OPTION)	
Ο.Αχτ		**Method of operation of output OUT3 (only visible when O.TYP=0)**	1
	0	Direct / normally open	
	1	Inverse / normally closed	
Ουτ.0	-1999…9999	**Scaling of the analog output for 0% (0/4mA or 0/2V, only visible when O.TYP=1..5)**	0

Ουτ.0	-1999…9999	**Scaling of the analog output for 100% (20mA or 10V, only visible when O.TYP=1..5)**	100
Ο.Σρχ		**Signal source of the analog output OUT3 (only visible when O.TYP=1..5)**	1
	0	Not used	
	1	Controller output y1 (continuous)	
	2	Controller output y2 (continuous)	
	3	Process value	
	4	Effective set-point Weff	
	5	Control deviation xw (process value - set-point)	
	6	Measured value position feedback Yp	
	7	Measured value INP1	
	8	Measured value INP2	
	9	Measured value INP3	
Ο.ΦΑΙ		**Fail behavior, behavior of the analog output, if the signal source (Ο.Σρχ) is disturbed.**	0
	0	Upscale	
	1	Downscale	
Ψ.1		**Controller output Y1/Y2 (only visible when O.TYP=0)**	0
Ψ.1	0	Not active	
	1	Active	
Λιν.1		**Limit 1/2/3 signal (only visible when O.TYP=0)**	0
Λιν.2	0	Not active	
Λιν.3	1	Active	
δΑχ.Α		**Valve monitoring (DAC) (only visible when O.TYP=0)**	0
	0	Not active	
	1	Active	
ΛΠ.ΑΛ		**Interruption alarm signal (LOOP) (only visible whenO.TYP=0) (Loop-Alarm)**	0
	0	Not active	
	1	Active	
ΗΧ.ΑΛ		**Heating current alarm signal (only visible when O.TYP=0)**	0
	0	Not active	
	1	Active	
ΗΧ.ΣΧ		**Solid state relay (SSR) short circuit signal (only visible when O.TYP=0)**	0
	0	Not active	
	1	Active	
ΦΑι.1		**INP1/ INP2 / INP3 error (only visible when O.TYP=0)**	1
ΦΑι.2	0	Not active	
ΦΑι.3	1	Active	
δΠ.Ερ		**Profibus Error**	0
	0	Not active	
	1	Active: Profibus trouble, no communication with this instrument.	
β.οφφ		**Burn-off function**	0
	0	Not active	

	1	Burn-off function is switched on	
φΟυτ		**Forcing OUT3 (only visible with BlueControl!)**	0
	0	No forcing	
	1	Forcing via serial interface	

Ουτ.5/ Ουτ.6
Configuration parameters Out.2 = Out.1 except for: Default Ψ.1 =0 Ψ.2 =0

Method of operation and usage of output Ουτ.1 to Ουτ.6:
Is more than one signal chosen active as source, those signals are OR-linked.

ΛΟΓΙ

Name	Value range	Description	Default
Λ_ρ		**Local / Remote switching (Remote: adjusting of all values by front keys is blocked)**	0
	0	no function (switch-over via interface is possible)	
	1	always active	
	2	DI1 switches	
	3	DI2 switches (basic instrument or OPTION)	
	4	DI3 switches (only visible with OPTION)	
	5	è - key switches	
ΣΠ.2		**Switching to second setpoint ΣΠ.2**	0
	0	no function (switch-over via interface is possible)	
	2	DI1 switches	
	3	DI2 switches (only visible with OPTION)	
	4	DI3 switches (only visible with OPTION)	
	5	F - key switches	
ΣΠ.Ε		**Switching to external setpoint ΣΠ.Ε**	0
	0	no function (switch-over via interface is possible)	
	1	always active	
	2	DI1 switches	
	3	DI2 switches (only visible with OPTION)	
	4	DI3 switches (only visible with OPTION)	
	5	F - key switches	
Ψ2		**Y/Y2 switching**	0
	0	no function (switch-over via interface is possible)	
	2	DI1 switches	
	3	DI2 switches (only visible with OPTION)	
	4	DI3 switches (only visible with OPTION)	
	5	F - key switches	
	6	AUTO MAN - key switches	
Ψ.Ε		**Switching to fixed control output Y.E**	0
	0	no function (switch-over via interface is possible)	
	1	always activated (manual station)	

	2	DI1 switches	
	3	DI2 switches (only visible with OPTION)	
	4	DI3 switches (only visible with OPTION)	
	5	F - key switches	
	6	AUTO MAN- key switches	
νΑν		**Automatic/manual switching**	0
	0	no function (switch-over via interface is possible)	
	1	always activated (manual station)	
	2	DI1 switches	
	3	DI2 switches (only visible with OPTION)	
	4	DI3 switches (only visible with OPTION)	
	5	F - key switches	
	6	AUTO MAN- key switches	
Χ.οΦΦ		**Switching off the controller**	**0**
	0	no function (switch-over via interface is possible)	
	1	DI1 switches	
	2	DI2 switches (only visible with OPTION)	
	3	DI3 switches (only visible with OPTION)	
	4	F - key switches	
	5	AUTO MAN- key switches	
ν.Λοχ		**Blockage of hand function**	**0**
	0	no function (switch-over via interface is possible)	
	2	DI1 switches	
	3	DI2 switches (only visible with OPTION)	
	4	DI3 switches (only visible with OPTION)	
	5	F - key switches	
Ερρ.ρ		**Reset of all error list entries**	**0**
	0	no function (switch-over via interface is possible)	
	2	DI1 switches	
	3	DI2 switches (only visible with OPTION)	
	4	DI3 switches (only visible with OPTION)	
	5	F - key switches	
		AUTO MAN- key switches	
Πιδ.2		**Switching of parameter set (Pb, ti, td)**	**0**
	0	no function (switch-over via interface is possible)	
	2	DI1 switches	
	3	DI2 switches (only visible with OPTION)	
	4	DI3 switches (only visible with OPTION)	
	5	F - key switches	
Ι.ΧηΓ		**Switching of the actual process value between Inp1**	**0**
	0	no function (switch-over via interface is possible)	
	2	DI1 switches	
	3	DI2 switches (only visible with OPTION)	
	4	DI3 switches (only visible with OPTION)	

	5	F - key switches	
δι.Φν		**Function of digital inputs (valid for all inputs)**	**0**
	0	Direct	
	1	Inverse	
	2	Toggle key function	
β.στα		**Burn-off function start**	**0**
	0	no function (switch-over via interface is possible)	
	2	DI1 switches	
	3	DI2 switches (basic unit or OPTION)	
	4	DI3 switches (only visible with OPTION)	
	5	F - key switches	
fDI1		**Forcing di1/2/3 (only visible with BlueControl!)**	**0**
fDI2	0	No forcing	
fDI3	2	Forcing via serial interface	

οτηρ

Name	Value range	Description	Default
βΑυδ		**Baudrate of the interface (only visible with OPTION)**	2
	0	2400 Baud	
	1	4800 Baud	
	2	9600 Baud	
	3	19200 Baud	
Αδδρ	1...247	**Address on the interace (only visible with OPTION**	1
ΠρτΨ		**Data parity on the interface (only visible with OPTION)**	1
	0	no parity (2 stop bits)	
	1	Even parity	
	2	Odd parity	
	3	No parity (1 stop bit)	
δΕΛΨ	0…200	**Delay of response signal [ms] (only visible with OPTION)**	0
δΠ.ΑΔ	0…126	**Profibus address**	126
βχ.υπ		**Behaviour as backup controller**	0
	0	No backup functionality	
	1	With backup functionality	
O2		**Entering parameter for O in ppm or %**	**0**
	0	Parameter for O -function in ppm	
	1	Parameter for O -function in %	
Υνιτ		**Unit**	**1**
	0	Without unit	
	1	°C	
	2	°F	
δΠ		**Decimal point (max. number of digits behind the decimal point)**	**0**

	0	no digit behind the decimal point	
	1	1 digit behind the decimal point	
	2	2 digits behind the decimal point	
	3	3 digits behind the decimal point	
ΛΕΔ		**Function allocation of status LEDs 1/2/3/4**	**0**
	10	OUT1, OUT2, OUT3, OUT4	
	11	Heating, alarm 1, alarm 2, alarm 3	
	12	Heating, cooling, alarm 1, alarm 2	
	13	Cooling, heating, alarm 1, alarm 2	
	14	Bus error	
δΙΣΠ	0…10	**Display luminosity**	**0**
Χ.δΕλ	0…20	**Modem delay [ms]** **Additional delay time, before the received message is evaluated in the Modbus. This time is required, unless messages are transferred continuously during modem transmission.**	**0**
FrEq		**Switching 50 Hz/60 Hz (only visible with BlueControl!)**	**0**
	0	50 Hz	
	1	60 Hz	
ΜΑst		**Modbus master/slave (visible only with BlueControl!)**	**0**
	0	No	
	1	Yes	
CycL	0…240	**Master cycle (sec.) (visible only with BlueControl!)**	**120**
AdrO	-32768...32767	**Forcing di1/2/3 (only visible with BlueControl!)**	**1100**
AdrU	-32768...32767	**Forcing di1/2/3 (only visible with BlueControl!)**	**1100**
Numb	0…100	**Number of data (visible only with BlueControl!)**	**1**
ICof		**Block controller off (only visible with BlueControl!)**	**0**
	0	Released	
	1	Blocked	
IAda		**Block auto tuning (only visible with BlueControl!)**	**0**
	0	Released	
	1	Blocked	
IExo		**Block extended operating level (only visible with BlueControl!)**	**0**
	0	Released	
	1	Blocked	
ILat		**Suppression error storage (visible only with BlueControl®!)**	**0**
	0	No: error message remain in the error list until acknowledgement.	
	1	Yes alarms are deleted from the error list as soon as corrected	
Pass	OFF…9999	**Password (only visible with BlueControl!)**	**OFF**
IPar		**Block parameter level (only visible with BlueControl!)**	**0**
	0	Released	

	1	Blocked	
ICnf		**Block configuration level (only visible with BlueControl!)**	**0**
	0	Released	
	1	Blocked	
ICal		**Block calibration level (only visible with BlueControl!)**	**0**
	0	Released	
	1	Blocked	
CDis3		**Display 3 controller operating level (only visible with BlueControl!)**	**2**
	0	No value / only text	
	1	Display of value	
	2	Output value as bargraph	
	3	Control deviation as bargraph	
	4	Process value as bargraph	
TDis3	2…60	**Display 3 display alternation time [s] (only visible with BlueControl!)**	**10**
T.dis3	8 Zeichen	**Text display 3 (only visible with BlueControl!)**	**0**
T.InF1	8 Zeichen	**Text Inf.1 (only visible with BlueControl!)**	**0**
T.InF2	8 Zeichen	**Text Inf.2 (only visible with BlueControl!)**	

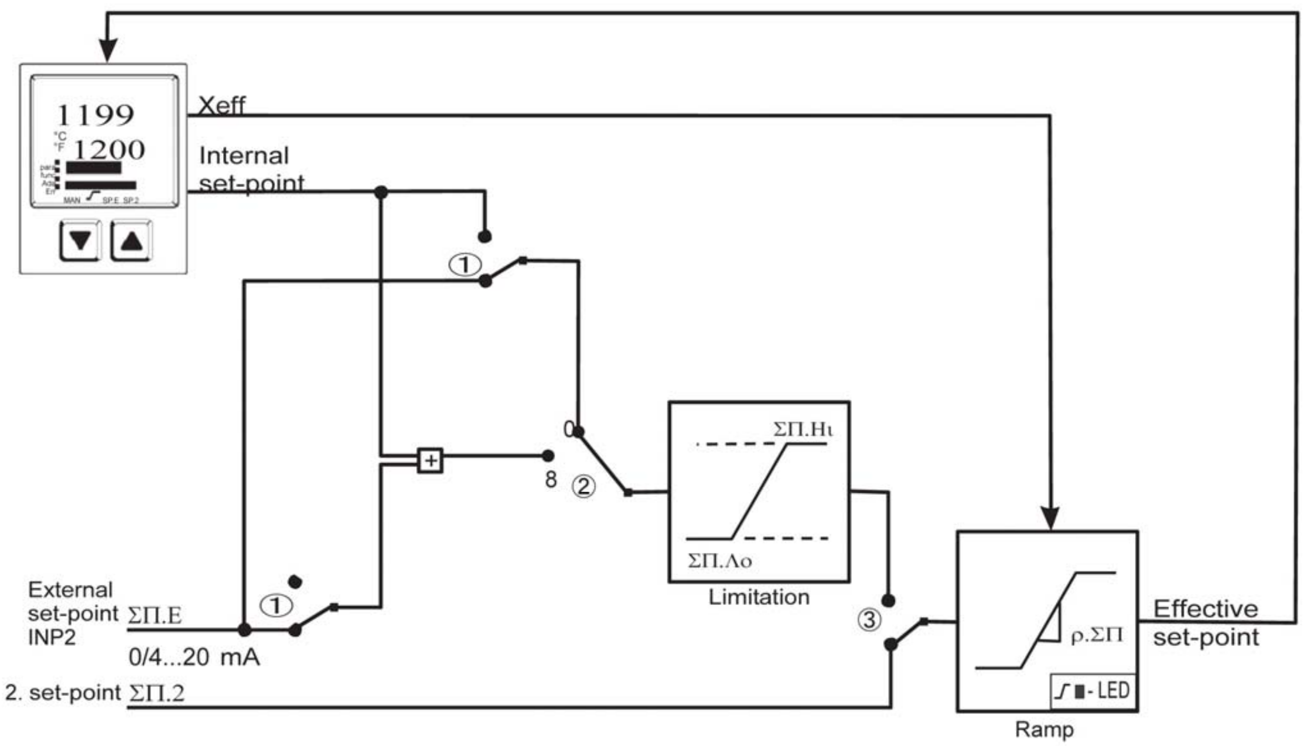
Λιν (only visible with BlueControl®)

Name	Value range	Description	Default
Λιν		**Linearization for inputs INP1 or INP3 Access to this table is always with selection special thermocouple for IvΠ.1 or IvΠ.3 or with setting Σ.Λιν = 1: special linearization for linearization. Default: KTY 11-6 (0...4,5 kOhm)**	
Y.ΛιvT		**Unit of linearization table**	0
	0	No unit	
	1	In Celsius [°C]	
	2	In Fahrenheit [°F]	
Iv.1	-999.0..99999	**Input value 1** **The signal is in [µV] or in [Ω] dependent of input type**	**1036**
Oυ.1	0,001...9999	**Output value 1** **Signal assigned to** Iv.1	**-49,94**
Iv.2	-999.0..99999	**Input value 2** **The signal is in [µV] or in [Ω] dependent of input type**	**1150**
Oυ.2	0,001...9999	**Output value 2** **Signal assigned to** Iv.2	-38,94
Iv.16	-999.0..99999	**Input value 16** **The signal is in [µV] or in [Ω] dependent of input type**	**4470**
Oυ.16	0,001...9999	**Output value 1 6** **Signal assigned to** Iv.16	**150,0**

☞ BlueControl - the engineering tool for the BluePort® controller series
3 engineering tools with different functionality facilitating the device configuration and parameter setting are available (see chapter 9: Accessory equipment with ordering information).
In addition to configuration and parameter setting, blue control® is used for data acquisition and offers long-term storage and print functions. Blue control® is connected to the device via the front-panel interface "BluePort®" by means of PC (Windows 95 / 98 / NT) and a PC adaptor.
Description BlueControl®: see chapter 8: BlueControl® (page 73).

4.3 Set-point processing

The set-point processing structure is shown in the following picture:



Index:

① : int/ext-setpoint switching

② : configuration ΣΠ.Φν

③ : SP / SP.2 switching

The ramp starts at process value with the following switchings:
- int / ext-setpoint switching
- ΣΠ / ΣΠ.2 switching
- Manual-/ Automatic switching
- at power on

4.3.1 Set-point gradient / ramp

To prevent setpoint step changes, a maximum rate of change is adjustable for parameter → setpoint → ρ.ΣΠ. This gradient acts both in positive and negative direction.

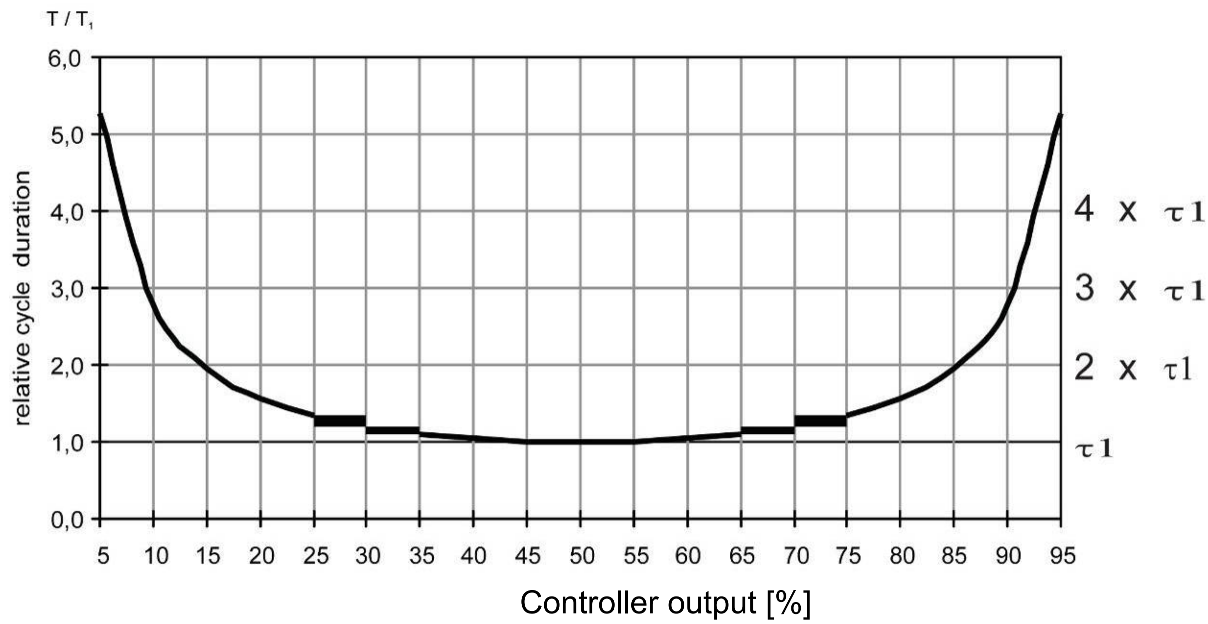
With parameter ρ.ΣΠ set to ΟΦΦ as in the factory setting, the gradient is switched off and setpoint changes are made directly.

4.4 Switching behavior

With these controllers, configuration parameter ΧΨΧΛ (ΧονΦ/ Χντρ/ ΧΨΧΛ) can be used for matching the cycle time of 2-point and 3-point controllers. This can be done using the following 4 methods.

4.4.1 Standard (ΧΨΧΛ=0□□)

The adjusted cycle times τ1and τ2 are valid for 50% or -50% correcting variable.
With very small or very high values, the effective cycle time is extended to prevent unreasonably short on and off pulses. The shortest pulses result from ¼ x τ1 or ¼ x τ2. The characteristic curve is also called “bath tub curve”



Parameters to be adjusted: τ1 : min. cycle time 1 (heating) [s] (ΠΑρΑ/ Χντρ)
τ2 : min. cycle time 2 (cooling) [s]

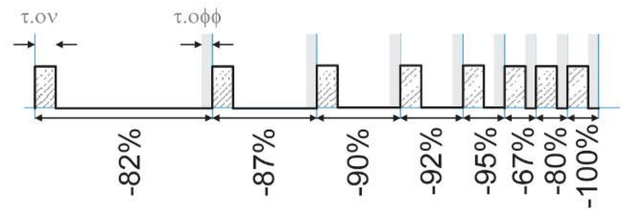
4.4.2 Switching attitude linear (ΧΨΧΛ=1)

For heating (Ψ1), the standard method (see chapter 4.4.1) is used. For cooling (Ψ2), a special algorithm for cooling with water is used. Generally, cooling is enabled only at an adjustable process temperature (Ε.Η2Ο), because low temperatures prevent evaporation with related cooling, whereby damage to the plant is avoided. The cooling pulse length is adjustable using parameter τ.ον and is fixed for all output values.

The “off” time is varied dependent of output value. Parameter τ.οφφ is used for determining the min “off” time. For output of a shorter off pulse, this pulse is suppressed, i.e. the max. effective cooling output value is calculated according to formula τ.ον /(τ.ον + τ.οφφ) w 100%.

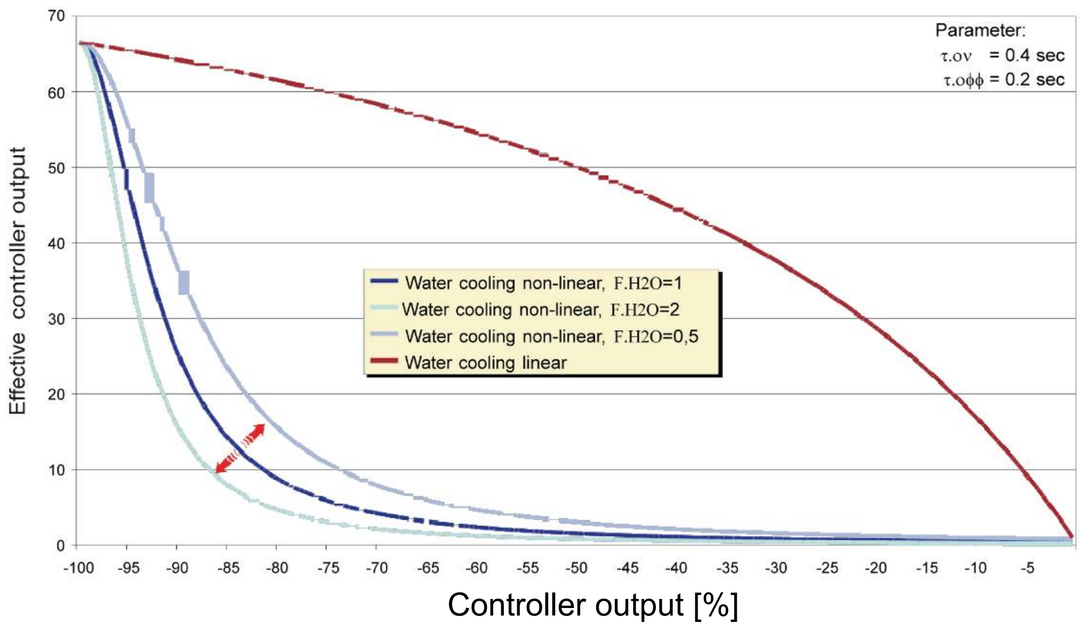
Parameters to be adjusted:	E.H2O:	minimum temperature for water cooling
(ΠΑρΑ / Χντρ)	τ.ον:	pulse duration water cooling
	τ.οφφ:	minimum pause water cooling

4.4.3 Switching attitude non-linear (ΧΨΧΛ=2)



With this method, the cooling power is normally much higher than the heating power, i.e. the effect on the behavior during transition from heating to cooling may be negative.

The cooling curve ensures that the control intervention with 0 to -70% correcting variable is very weak. Moreover, the correcting variable increases very quickly to max. possible cooling. Parameter Φ.H2O can be used for changing the characteristic curve. The standard method (see section 4.4.1) is also used for heating. Cooling is also enabled dependent of process temperature.

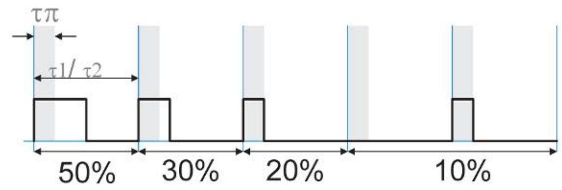


Parameters to be adjusted:
(PArA / Cntr)

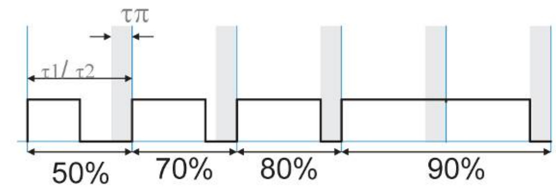
Φ.H2O:	adaptation of (non-linear) characteristic Water cooling
τ.ον:	Pulse duration water cooling
τ.οφφ:	min. pause water cooling
E.H2O:	min. temperature for water cooling

4.4.4 Heating and cooling with constant period (ΧΨΧΛ=3)

1 and τ2 are met in the overall output range. To prevent unreasonably short pulses, parameter τπ is used for adjusting the shortest pulse duration.



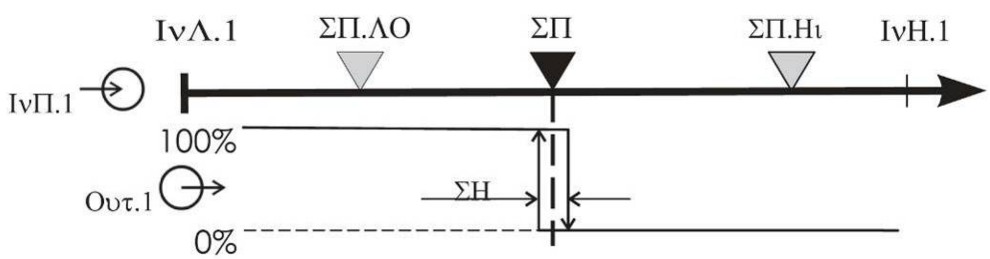
With small correcting values which require a pulse shorter than the value adjusted in τπ, this pulse is suppressed. However, the controller stores the pulse and totalizes further pulses, until a pulse of duration τπ can be output.



Parameters to be adjusted:	τ1 :	Min. cycle time 1 (heating) [s]
(ΠΑρΑ/ Χντρ)	τ2 :	min. cycle time 2 (cooling) [s]
	τπ:	min. pulse length [s]

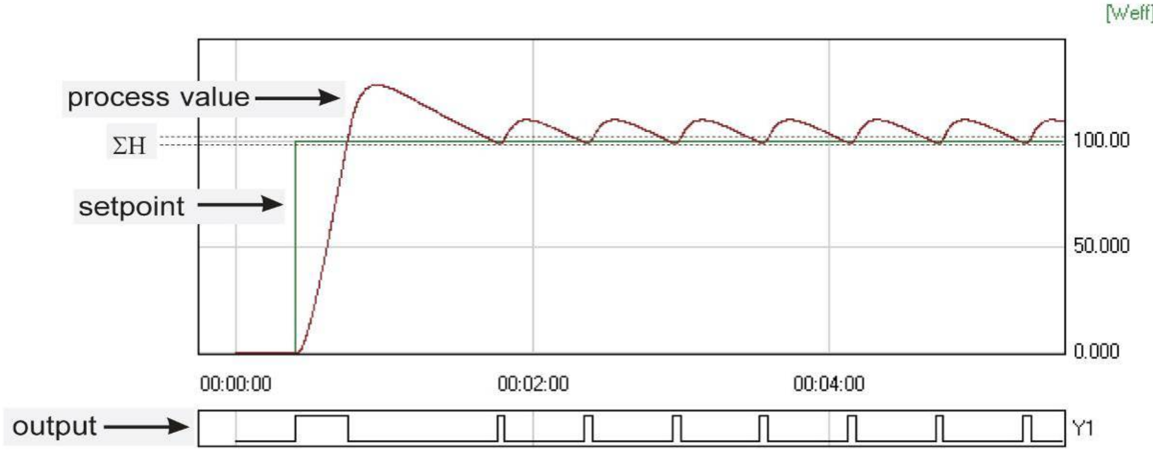
4.5 Configuration examples

4.5.1 On-Off controller / Signaler (inverse)

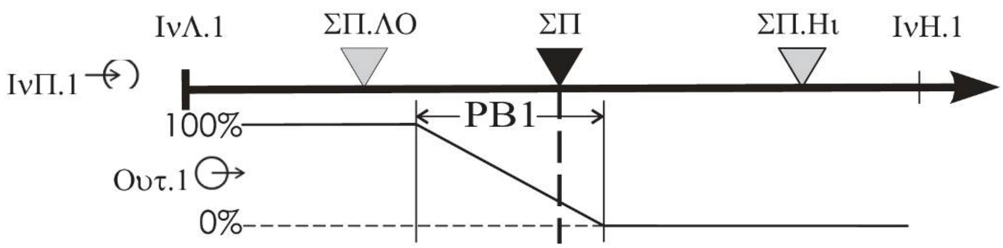


ΧονΦ / Χντρ:	ΣΠ.Φν = 0	set-point controller
	Χ.Φνχ = 0	signaler with one output
	Χ.Αχτ = 0	inverse action (e.g. heating applications)
ΧονΦ / Ουτ.1:	Ο.Αχτ = 0	action Out.1 direct
	Ψ.1=1	control output Y1 active
ΠΑρΑ / Χντρ:	Ηψσ.λ = 0...9999	switching difference below SP
ΠΑρΑ / Χντρ:	Ηψσ.Η = 0...9999	switching difference above SP
ΠΑρΑ / ΣΕτΠ:	ΣΠ.ΛΟ = -1999...9999	set-point limit low for Weff
	ΣΠ.Ηι = -1999...9999	set-point limit high for Weff

ⓘ For direct signaler action, the controller action must be changed (ΧονΦ / Χντρ / Χ.Αχτ = 1)

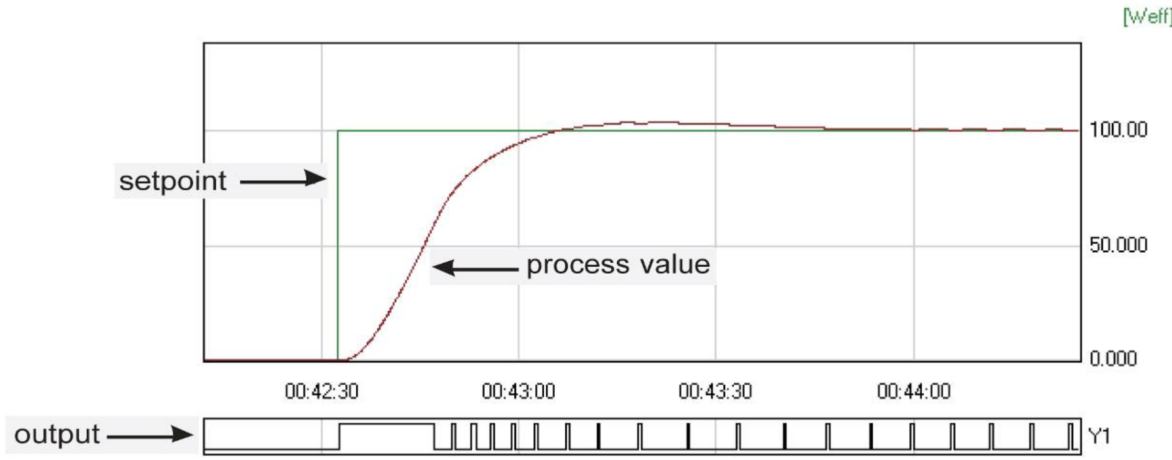


4.5.2 2-point controller (inverse)

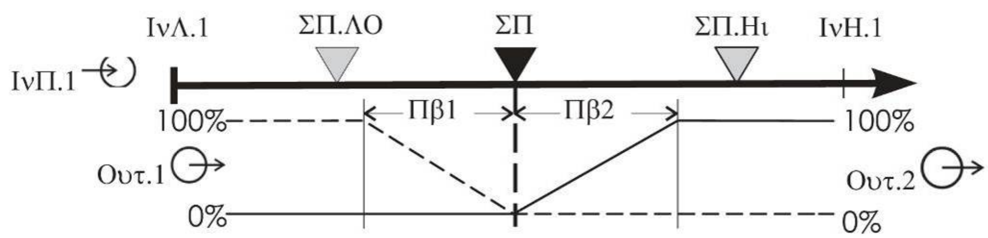


ΧονΦ / Χντρ:	ΣΠ.Φν = 0	set-point controller
	Χ.Φνχ = 1	2-point controller (PID)
	Χ.Αχτ = 0	inverse action (e.g. heating applications)
ΧονΦ /Ουτ.1:	Ο.Αχτ = 0	action Out.1 direct
	Ψ.1 = 1	control output Y1 active
ΠΑρΑ /Χντρ:	Πβ1= 1...9999	proportional band 1 (heating) in units of phys. quantity (e.g. °C)
	τι1 = 0,1...9999	integral time 1 (heating) in sec.
	τδ1 = 0,1...9999	derivative time 1 (heating) in sec.
	τ1 = 0,4...9999	min. cycle time 1 (heating)
ΠΑρΑ /ΣΕτΠ:	ΣΠ.ΛΟ = -1999...9999	set-point limit low for Weff
	ΣΠ.Ηι =-1999...9999	set-point limit high for Weff

ⓘ For direct signaler action, the controller action must be changed (ΧονΦ / Χντρ / Χ.Αχτ = 1)



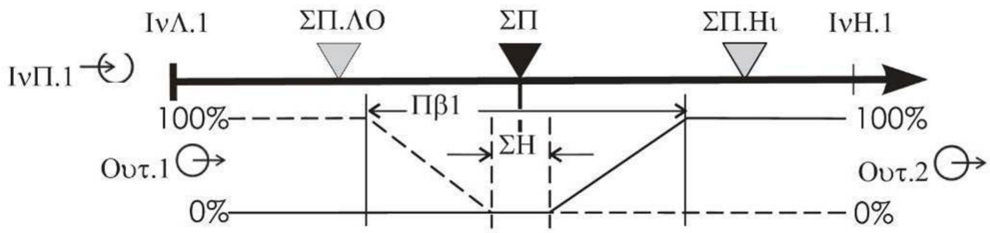
4.5.3 3-point controller (relay & relay)



ΧονΦ / Χντρ:	ΣΠ.Φν =0	set-point controller
	Χ.Φνχ = 3	3-point controller (2xPID)
	Χ.Αχτ = 0	action inverse (e.g. heating applications)
ΧονΦ / Ουτ.1:	Ο.Αχτ = 0	action Out.1 direct
	Ψ.1 = 1	control output Y1 active
	Ψ.2 = 0	control output Y2 not active
ΧονΦ / Ουτ.2:	Ο.Αχτ = 0	action Out.2 direct
	Ψ.1 = 0	control output Y1 not active
	Ψ.2 = 1	control output Y2 active
ΠΑρΑ / Χντρ:	Πβ1 = 1...9999	proportional band 1 (heating) in units of phys. quantity (e.g. °C)
	Πβ2 = 1...9999	proportional band 2 (cooling) in units of phys. quantity (e.g. °C)
ΠΑρΑ / ΣΕτΠ:	τι1 = 0,1...9999	integral time 1 (heating) in sec.
	τι2 = 0,1...9999	derivative time 2 (cooling) in sec.
	τδ1 = 0,1...9999	integral time 1 (heating) in sec.
	τδ2 = 0,1...9999	derivative time 2 (cooling) in sec.
	τ1 = 0,4...9999	min. cycle time 1 (heating)
	τ2 = 0,4...9999	min. cycle time 2 (cooling)
	ΣΗ = 0...9999	neutr. zone in units of phys.quantity
	ΣΠ.ΛΟ = -1999...9999	set-point limit low for Weff

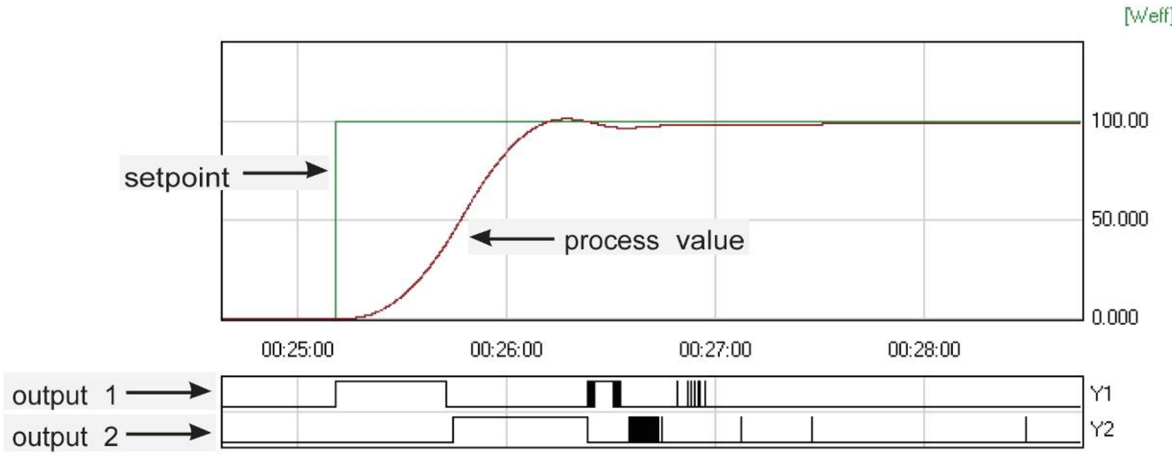
	ΣΠ.Ηι = -1999...9999	set-point limit high for Weff

4.5.4 3-point stepping controller (relay & relay)

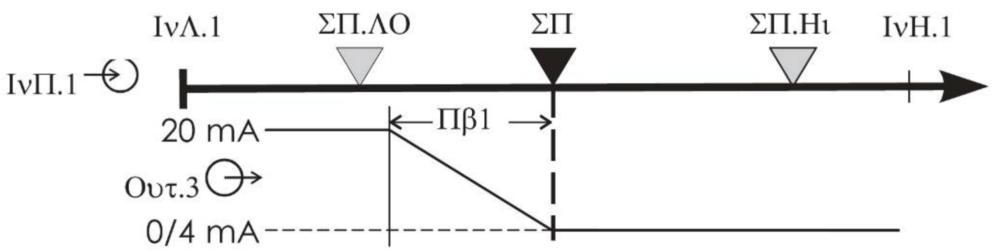


ΧονΦ /Χντρ:	ΣΠ.Φν = 0	set-point controller
	Χ.Φνχ = 4	3-point stepping controller
	Χ.Αχτ = 0	inverse action (e.g. heating applications)
ΧονΦ /Ουτ.1:	Ο.Αχτ = 0	action Out.1 direct
	Ψ.1 = 1	control output Y1 active
	Ψ.2 = 0	control output Y2 not active
ΧονΦ /Ουτ.2:	Ο.Αχτ = 0	action Out.2 direct
	Ψ.1 = 0	control output Y1 not active
	Ψ.2 = 1	control output Y2 active
ΠΑρΑ / Χντρ:	Πβ1 = 1...9999	proportional band 1 (heating) in units of phys. quantity (e.g. °C)
ΠΑρΑ /ΣΕτΠ:	τι1 = 0,1...9999	integral time 1 (heating) in sec.
	τδ1 = 0,1...9999	derivative time 1 (heating) in sec.
	τ1 = 0,4...9999	min. cycle time 1 (heating)
	ΣΗ = 0...9999	neutral zone in units of phy. quantity
	τΠ = 0,1...9999	min. pulse length in sec.
	ττ = 3...9999	actuator travel time in sec.
	ΣΠ.ΛΟ = -1999...999	9 set-point limit low for Weff
	ΣΠ.Ηι = -1999...999	9 set-point limit high for Weff

For direct action of the 3-point stepping controller, the controller output action must be changed (ΧονΦ / Χντρ / Χ.Αχτ = 1)



4.5.5 Continuous controller (inverse)

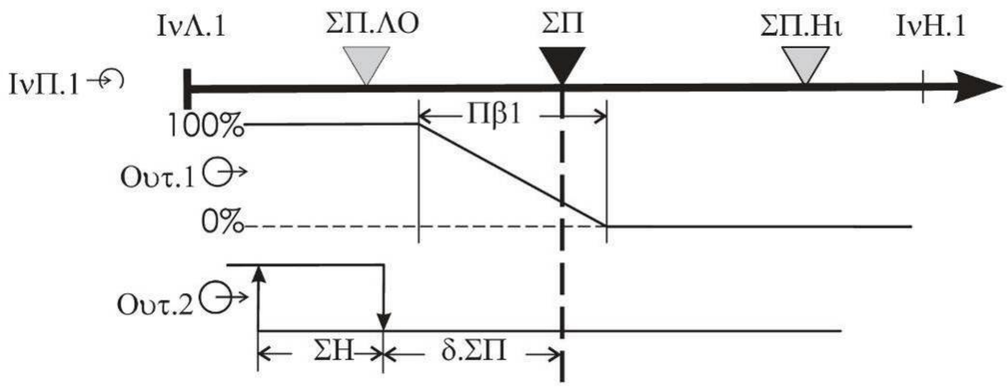


ΧονΦ /Χντρ:	ΣΠ.Φν = 0	set-point controller
	Χ.Φνχ = 1	continuous controller (PID)
	Χ.Αχτ = 0	inverse action (e.g. heating applications)
ΧονΦ / Ουτ.3:	Ο.τΨΠ = 1/2	Out.3 type (0/4 … 20mA)
	Ουτ.0 = -1999...9999	scaling analog output 0/4mA
	Ουτ.1 = -1999...9999	scaling analog output 20mA
ΠΑρΑ / Χντρ:	Πβ1 = 1...9999	proportional band 1 (heating) in units of phys. quantity (e.g. °C)
	τι1 = 0,1...9999	integral time 1 (heating) in sec.
	τδ1 = 0,1...9999	derivative time 1 (heating) in sec.
	τ1 = 0,4...9999	min. cycle time 1 (heating)
ΠΑρΑ / ΣΕτΠ:	ΣΠ.ΛΟ = -1999...9999	set-point limit low for Weff
	ΣΠ.Ηι = -1999...9999	set-point limit high for Weff

ⓘ For direct action of the continuous controller, the controller action must be changed (ΧονΦ / Χντρ / Χ.Αχτ = 1)

To prevent control outputs Ουτ.1 and Ουτ.2 of the continuous controller from switching simultaneously, the control function of outputs Ουτ.1 and Ουτ.2 must be switched off (ΧονΦ / Ουτ.1 and Ουτ.2 / Ψ.1 and Ψ.2 = 0).

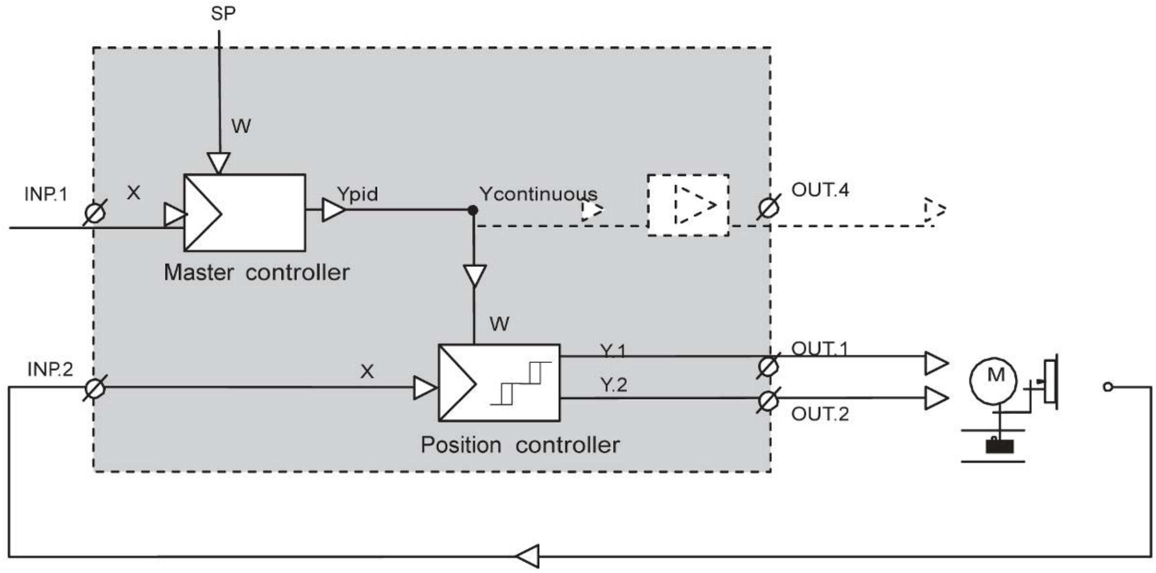
4.5.6 Δ z Y - Off controller / 2-point controller with pre-contact



ΧονΦ / Χντρ:	ΣΠ.Φν = 0	set-point controller
	Χ.Φνχ = 2	△-Y-Off controller
	Χ.Αχτ = 0	inverse action (e.g. heating applications)
ΧονΦ / Ουτ.1:	Ο.Αχτ = 0	action Out.1 direct
	Ψ.1 = 1	control output Y1 active
	Ψ.2 = 0	control output Y2 not active
ΧονΦ / Ουτ.2:	Ο.Αχτ = 0	action Out.2 direct
	Ψ.1 = 0	control output Y1 not active
	Ψ.2 = 1	control output Y2 active
ΠΑρΑ / Χντρ:	Πβ1 = 1...9999	proportional band 1 (heating) in units of phys. quantity (e.g. °C)
	τι1 = 0,1...9999	integral time 1 (heating) in sec.
	τδ1 = 0,1...9999	derivative time 1 (heating) in sec.
	τ1= 0,4...9999	min. cycle time 1 (heating)
	ΣΗ = 0...9999	switching difference
	δ.ΣΠ = -1999...9999	trigg. point separation suppl. cont. △ / Y / Off in units of phys. Quantity
ΠΑρΑ / ΣΕτΠ:	ΣΠ.ΛΟ = -1999...9999	set-point limit low for Weff
	ΣΠ.Ηι = -1999...9999	set-point limit high for Weff

4.5.7 Continuous controller with position controller

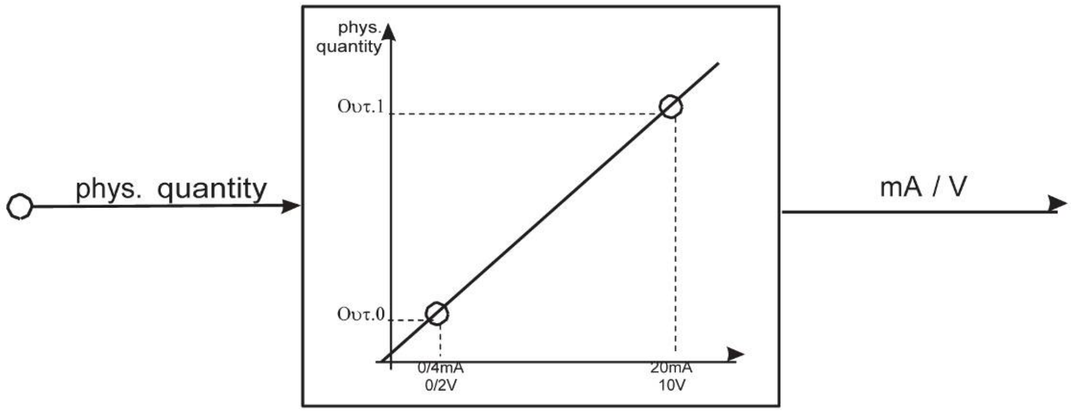
(Χντρ/ Χ.Φνχ =6)

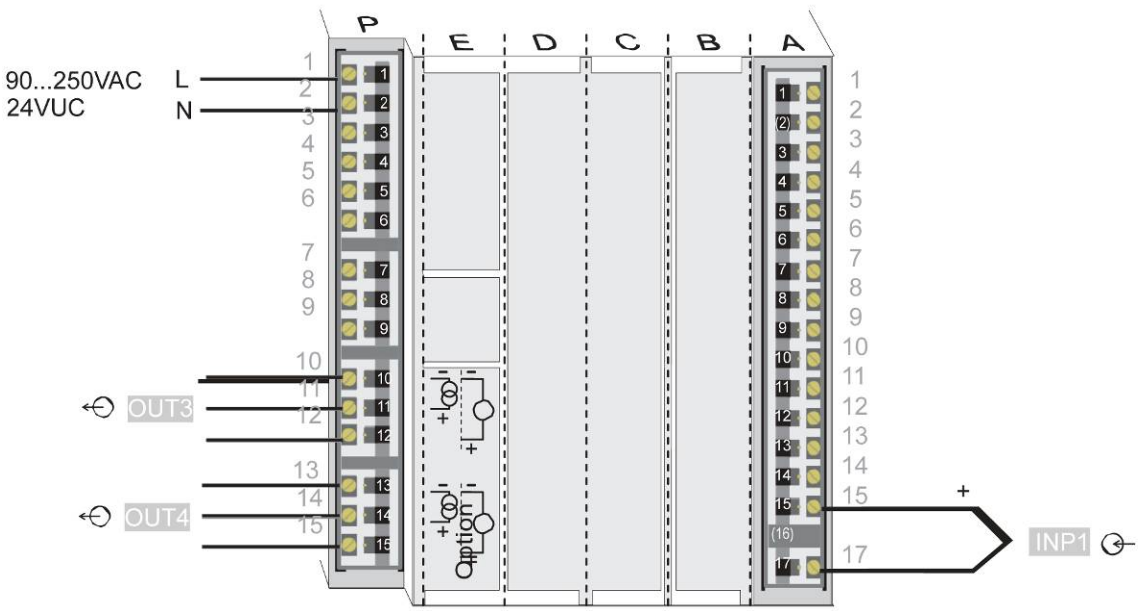


Basically, this controller function is a cascade. A slave controller with three-point stepping behavior working with position feedback Yp as process value (INP2 or INP3) is added to a continuous controller.

ΧονΦ / Χντρ	ΣΠ.Φν = 0	setpoint controller
	Χ.Φνχ = 6	continuous controller with position controller
	Χ.Αχτ = 0	inverse output action (e.g. heating applications)
ΧονΦ / ΙνΠ.2:	Ι.Φνχ = 3	position feedback Yp
	Σ.τψπ = 50	sensor e.g. potentiometer 0..160 Ω
ΧονΦ / Ουτ.1:	Ο.Αχτ = 0	direct output action Ουτ.1
	Ψ.1 = 1	control output Y1 active
	Ψ.2 = 0	control output Y2 not active
ΧονΦ / Ουτ.2:	Ο.Αχτ = 0	direct output action Out.2
	Ψ.1 = 0	control output Y1 not active
	Ψ.2 = 1	control output Y2 active
ΠΑρΑ / Χντρ:	Πβ1 = 0,1...9999	proportional band 1 (heating) in units of the physical quantity
	τι1= 1...9999	integral time 1 (heating) in sec.
	τδ1 = 1...9999	derivative time 1 (heating) in sec.
	τ1 = 0,4...9999	min. cycle tim 1 (heating)
	ΣΗ = 0...9999	switching difference

4.5.8 Measured value output





ΧονΦ / Ουτ.3 / 4:	Ο.τΨΠ = 1	Ουτ.3/ 4 0...20mA continuous
	= 2	Ουτ.3/ 4 4...20mA continuous
	= 3	Ουτ.3/ 4 0...10V continuous
	= 4	Ουτ.3/ 4 2...10V continuous
	Ουτ.0 = -1999...9999	scaling Ουτ.3/ 4 for 0/4mA or 0/2V
	Ουτ.1 = -1999...9999	scaling Ουτ.3/ 4 for 20mA or 10V
	Ο.Σρχ = 3	signal source for Ουτ.3/ 4 is the process value

5 Parameter setting level

5.1 Parameter survey

PArA Parameter setting level

Χντρ Control and	ΠΑρ.2 2. set of parameters	ΣΕτΠ Set-point and process value	ΙνΠ.1 Input 1	ΙνΠ.2 Input 2	ΙνΠ.3 Input 3	Λιν Limit value functions	Ενδ
Πβ1	Πβ12	ΣΠ.Λο	ΙνΛ.1	Ινλ.2	ΙνΛ.3	Λ.1	
Πβ2	Πβ22	ΣΠ.Ηι	ΟυΛ.1	ΟυΛ.2	ΟυΛ.3	Η.1	
τι1	τι12	ΣΠ.2	ΙνΗ.1	ΙνΗ.2	ΙνΗ.3	ΗΨΣ.1	
τι2	τι22	ρ.ΣΠ	ΟυΗ.1	ΟυΗ.2	ΟυΗ.3	δΕλ.1	
τδ1	τδ12		τΦ.1	τΦ.2	τΦ.3	Λ.2	
τδ2	τδ22		Ε.τχ		Ε.τχ	Η.2	
τ1						ΗΨΣ.2	
τ2						δΕλ.2	
ΣΗ						Λ.3	
Ηψσ.λ						Η.3	
Ηψσ.Η						ΗΨΣ.3	
δ.ΣΠ						δΕλ.3	
τΠ						ΗΧ.Α	
ττ							
Ψ.Λο							
Ψ.Ηι							
Ψ2							
Ψ0							
Ψμ.Η							
Λ.Ψμ							
Ε.Η2Ο							
τ.ον							
τ.οφφ							
ΦΗ2							
οΦΦΣ							
τΕνπ							

Adjustment:

- The parameters can be adjusted by means of keys
- Transition to the next parameter is by pressing key
- After the last parameter of a group, δονΕ is displayed, followed by automatic change to the next group.

Return to the beginning of a group is by pressing the key for 3 sec. If for 30 sec. no keypress is executed, the controller returns to the process value and setpoint display (Time Out = 30 sec.)

5.2 Parameters

Χντρ

Name	Value range	Description	Default
Πβ1	1...9999 ❶	Proportional band 1 (heating) in phys. dimensions (e.g. °C)	100
Πβ2	1...9999 ❶	Proportional band 2 (cooling) in phys. dimensions (e.g. °C)	100
τι1	0,1...9999	Integral action time 1 (heating) [s]	180
τι2	0,1...9999	Integral action time 2 (cooling) [s]	180
τδ1	0,1...9999	Derivative action time 1 (heating) [s]	180
τδ2	0,1...9999	Derivative action time 2 (cooling) [s]	180
τ1	0,4...9999	Minimal cycle time 1 (heating) [s]. The minimum impulse is 1/4 x t1	10
τ2	0,4...9999	Minimal cycle time 2 (heating) [s]. The minimum impulse is 1/4 x t2	10
ΣΗ	0...9999	Neutral zone or switching differential for on-off control [phys. dimensions)	2
Ηψσ.λ	0...9999	Switching difference Low signaler [engineering unit]	1
Ηψσ.Η	0...9999	Switching difference High signaler [engineering unit]	1
δ.ΣΠ	-1999...9999	Trigger point separation for additional contact △ /Y/ Off [phys. dimensions]	100
τΠ	0,1...9999	Minimum impulse [s]	ΟΦΦ
ττ	3...9999	Motor travel time [s]	60
Ψ.Λο	-120...120	Lower output limit [%]	0
Ψ.Ηι	-120...120	Upper output limit [%]	100
Ψ2	-100...100	2. correcting variable	0
Ψ00	-100...100	Working point for the correcting variable [%]	0
Ψμ.Η	-100...100	Limitation of the mean value Ym [%]	5
Λ.Ψν	0...9999	Max. deviation xw at the start of mean value calculation [phys. dimensions]	8
Ε.Η2Ο	-1999...9999	Min. temperature for water cooling. Below the set temperature no water cooling happens	0
τ.ον	0,1...9999	Impulse lenght for water cooling. Fixed for all values of controller output.The pause time is varied.	1
τ.οΦΦ	1...9999	Min. pause time for water cooling. The max. effective controller output results from τ.ον/(τ.ον+τ.οφφ)·100%	10
Φ.Η2Ο	0,1...9999	Modification of the (non-linear) water cooling characteristic (see page 48)	1
οΦΦΣ	-120...120	Zero offset	0
τΕνπ	0...9999	Sensor temperature (in engineering units e.g. °C) With oxygen measurement (O) (see page 68)	750
Χο.χο	0..100	CO compensation value [%] 2	20
Η2.χο	0..100	H2 compensation value [%]	40
Ο2ρεφ	0,00..100,0	O2 reference value [%]	21
Ιντ.β	0,0..9999	Time in hours between burn-off operations [h]	4
Τμπ.Β	0..9999	Burn-off start temperature (e.g. °C)	800

τ.Δυρ	0..9999	Burn-off duration [min]	3
τ.Ρεχ	0..9999	Recovery time [min]	3

❶ Valid for ΧονΦ/ οτηρ/ δΠ = 0. With δΠ = 1 / 2 / 3 also 0,1 / 0,01 / 0,001 is possible.

ΠΑρ.2

Name	Value range	Description	Default
Πβ12	1...9999 ❶	Proportional band 1 (heating) in phys. dimensions (e.g. °C), 2. parameter set	100
Πβ22	1...9999 ❶	Proportional band 2 (cooling) in phys. dimensions (e.g. °C), 2. parameter set	100
Τι22	0,1...9999	Integral action time 2 (cooling) [s], 2. parameter set	10
Τι12	0,1...9999	Integral action time 1 (heating) [s], 2. parameter set	10
Τδ12	0,1...9999	Derivative action time 1 (heating) [s], 2. parameter set	10
Τδ22	0,1...9999	Derivative action time 2 (cooling) [s], 2. parameter set	10

ΣΕτΠ

Name	Value range	Description	Default
ΣΠ.ΛΟ	-1999...9999	Set-point limit low for Weff	0
ΣΠ.Ηι	-1999...9999	Set-point limit high for Weff	900
ΣΠ.2	-1999...9999	Set-point 2.	0
ρ.ΣΠ	0...9999	Set-point gradient [/min]	ΟΦΦ
ΣΠ	-1999...9999	Set-point (only visible with BlueControl!)	0

ΣΠ.ΛΟ and ΣΠ.Ηι should be within the limits of ρνΓΗ and ρνΓΛ see configuration → Controller page

ΙνΠ.1

Name	Value range	Description	Default
ΙνΛ.1	-1999...9999	Input value for the lower scaling point	0
ΟυΛ.1	-1999...9999	Displayed value for the lower scaling point	0
ΙνΗ.1	-1999...9999	Input value for the upper scaling point	20
ΟυΗ.1	-1999...9999	Displayed value for the lower scaling point	20
τ.Φ1	0,0...9999	Filter time constant [s]	0,5
Ετχ.1	0...100 °C 32...212 °F	External cold-junction reference temperature (external TC)	ΟΦΦ

ΙνΠ.2

Name	Value range	Description	Default
ΙνΛ.2	-1999...9999	Input value for the lower scaling point	0
ΟυΛ.2	-1999...9999	Displayed value for the lower scaling point	0
ΙνΗ.2	-1999...9999	Input value for the upper scaling point	50
ΟυΗ.2	-1999...9999	Displayed value for the upper scaling point	50
τ.Φ2	0,0...9999	Filter time constant [s]	0,5

ΙνΠ.3

Name	Value range	Description	Default
ΙνΛ.3	-1999...9999	Input value for the lower scaling point	0
ΟυΛ.3	-1999...9999	Displayed value for the lower scaling point	0
ΙνΗ.3	-1999...9999	Input value for the upper scaling point	20
ΟυΗ.3	-1999...9999	Displayed value for the upper scaling point	20
τ.Φ3	-1999...9999	Filter time constant [s]	0
Ετχ.3	0...100 °C 32...212 °F	External cold-junction reference temperature (external TC)	ΟΦΦ

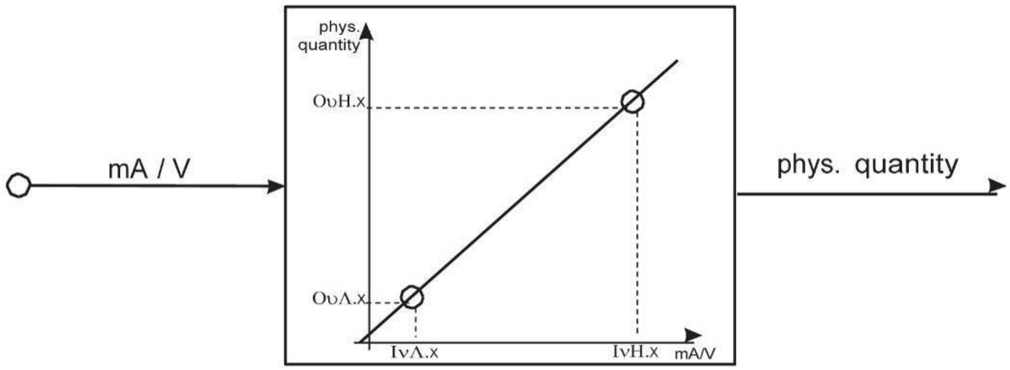
Λιν

Name	Value range	Description	Default
Λ.1	-1999...9999	Lower limit 1	10
Η.1	-1999...9999	Upper limit 1	10
ΗΨΣ.1	0...9999	Hysteresis limit 1	1
δΕλ.1	0...9999	Alarm delay from limit value 1	0
Λ.2	-1999...9999	Lower limit 2	ΟΦΦ
Η.2	-1999...9999	Upper limit 2	ΟΦΦ
ΗΨΣ.2	0...9999	Hysteresis limit 2	1
δΕλ.2	0...9999	Alarm delay from limit value 2	0
Λ.3	-1999...9999	Lower limit 3	OFF
Η.3	-1999...9999	Upper limit 3	-32000
ΗΨΣ.3	0...9999	Hysteresis limit 3	1
δΕλ.3	0...9999	Alarm delay from limit value 3	0
ΗΧ.Α	-1999...9999	Heat current limit [A]	50

ⓘ Resetting the controller configuration to factory setting (Default) or resetting to the customer-specific default data set → chapter 11.1 (Page 79)

5.3 Input scaling

When using current, voltage or resistance signals as input variables for ΙνΠ.1, ΙνΠ.2 or/and ΙνΠ.3 scaling of input and display values at parameter setting level is required. Specification of the input value for lower and higher scaling point is in the relevant electrical unit (mA / V / Ω).



S.tYP	Input Signal	IνΛ.x	OυΛ.x	IνH.x	OυH.x
30 (0...20mA)	0…20 mA	0	Any	20	Any
	4…20 mA	4	Any	20	Any
40 (0...10V)	0…10 V	0	Any	10	Any
	2…10 V	2	Any	10	Any

5.3.1 Input Iνπ.1 and Iνπ.3.

Parameters IνΛ.x, OυΛ.x, IνH.x and OυH.x are only visible if ΧονΦ / ΙνΠ.x/ Χορρ = 3 is chosen.
In addition to these settings, IνΛ.x and IνH.x can be adjusted in the range (0...20mA / 0...10V / Ω) determined by selection of Σ.τΨΠ.

For using the predetermined scaling with thermocouple and resistance thermometer (Pt100), the settings for IνΛ.x and OυΛ.x and for IνH.x and OυH.x must have the same value.

Input scaling changes at calibration level (→ page 61) are displayed by input scaling at parameter setting level. After calibration reset (ΟΦΦ), the scaling parameters are reset to default.

5.3.2 Input Iνπ.2

Σ.τΨΠ	Input Signal	IνΛ.2	OυΛ.2	IνH.2	OυH.2
30	0…20 mA	0	Any	20	Any
31	0…50 mA	0	Any	50	Any

In addition to these settings, IνΛ.2 and IνH.2 can be adjusted in the range (0...20/ 50mA/Ω) determined by selection of Σ.τΨΠ.

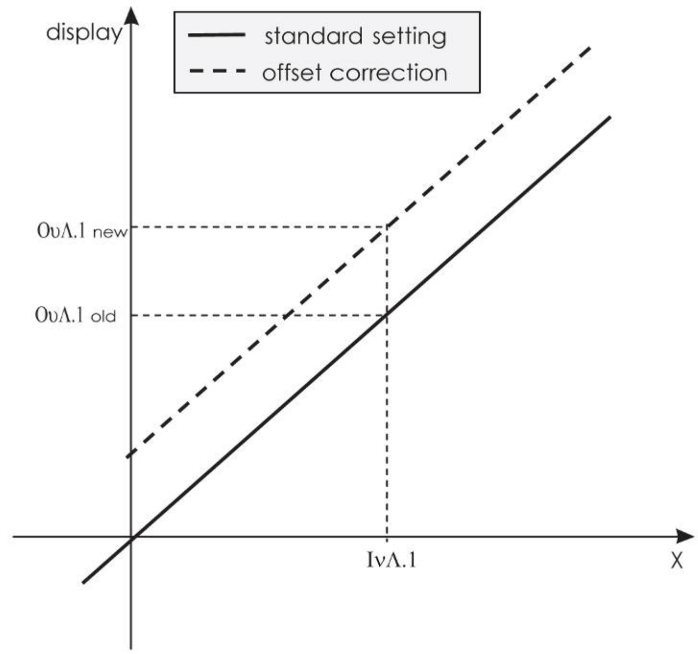
6 Calibration level

Measured value correction (ΧΑΛ) is only visible if ΧονΦ / ΙνΠ.1 / Χορρ = 1 or 2 is chosen.

The measured value can be matched in the calibration menu (ΧΑΛ). Two methods are available:

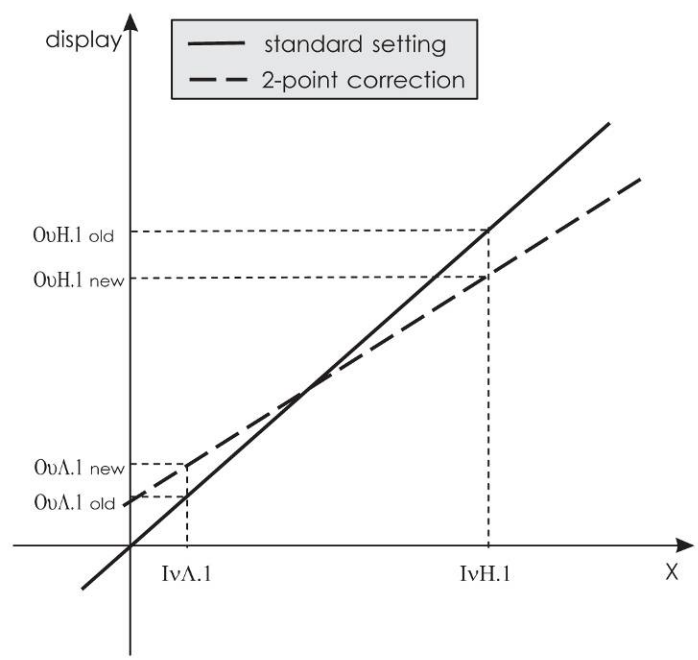
Offset correction
(ΧονΦ/ ΙνΠ.1 / Χορρ =1):

- possible on-line at the process

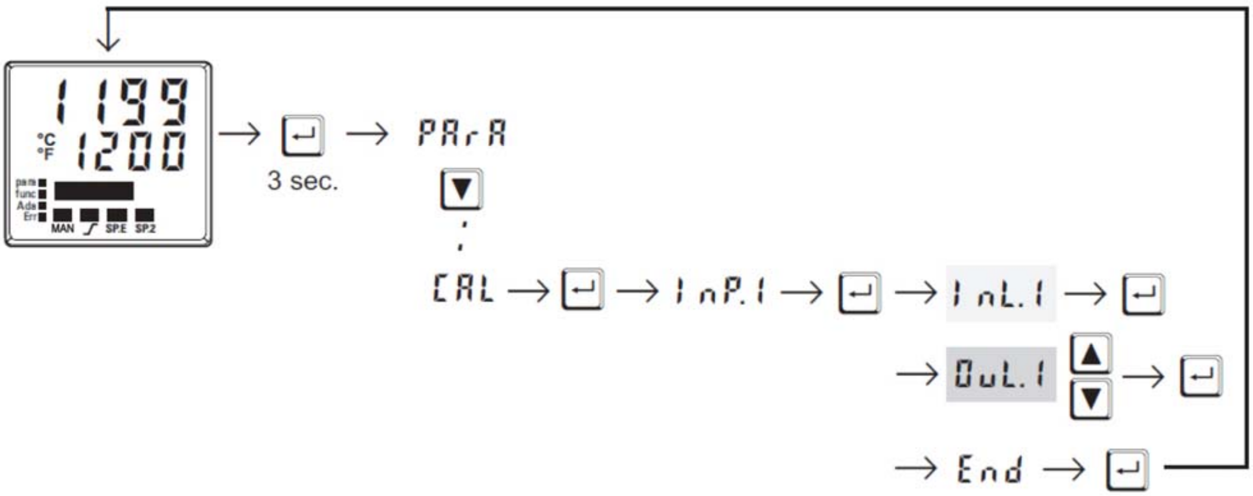


2-point correction
(ΧονΦ/ ΙνΠ.1 / Χορρ = 2):

- is possible off-line with process value simulator



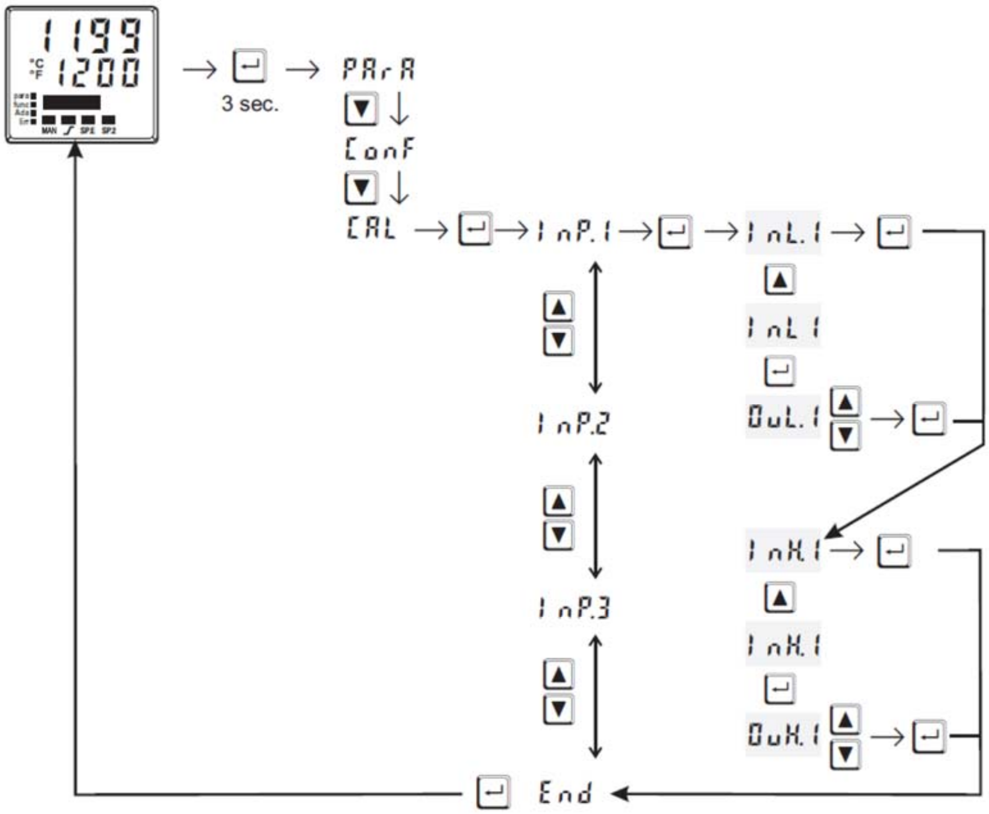
Offset correction (ConF/ InP.1 / Corr =1):



IνΛ.1: The input value of the scaling point is displayed.
The operator must wait, until the process is at rest.
Subsequently, the operator acknowledges the input value by pressing key .

OυΛ.1: The display value of the scaling point is displayed.
Before calibration, OυΛ.1 is equal to IνΛ.1.
The operator can correct the display value by pressing keys .
Subsequently, he confirms the display value by pressing key .

2-point correction (ΧονΦ/ ΙνΠ.1 / Χορρ = 2):



IνΛ.1: The input value of the lower scaling point is displayed.
The operator must adjust the lower input value by means of a process value simulator and confirm the input value by pressing key .

ΟυΛ.1: The display value of the lower scaling point is displayed.
Before calibration, ΟυΛ.1 equals IνΛ.1.
The operator can correct the lower display value by pressing the keys.
Subsequently, he confirms the display value by pressing key .

IνH.1: The input value of the upper scaling point is displayed.
The operator must adjust the upper input value by means of the process value simulator and confirm the input value by pressing key .

ΟυH.1: The display value of the upper scaling point is displayed.
Before calibration ΟυH.1 equals IνH.1.
The operator can correct the upper display value by pressing keys
Subsequently, he confirms the display value by pressing key .

The parameters (ΟυΛ.1, ΟυH.1) changed at ΧΑΛ level can be reset by adjusting the parameters below the lowest adjustment value (ΟΦΦ) by means of decrement key .

7 Special functions

7.1 DAC®– motor actuator monitoring

(Digital Actor Control DAC®)

With all controllers with position feedback Yp, the motor actuator can be monito- red for functional troubles. The DAC® function can be started by choosing the parameter Χ.Φνχ = 5 or 6at the configuration level (ΧονΦ):

- ΧονΦ / Χντρ / Χ.Φνχ = 5 — 3-point-stepping controller with position feedback Yp as potentiometer
- ΧονΦ / Χντρ / Χ.Φνχ = 6 — Continuous controller with integrated positioner and position feedback Yp as potentiometer

If an error occurs, the controller switches to manual operation (ò - LED blinks) and no impulses are given out any longer. If one of the relays shall switch when a DAC® error occurs, parameter δΑΧ.Α = 1 and inverse action Ο.Αχτ = 1 must be selected for the relevant output ΟΥΤ.1 … ΟΥΤ.4 in the ΧονΦ menu (ΟΥτ.3 and 4 only possible if Ο.τΨΠ = 0 [relay/logic]):

- ΧονΦ / ΟΥτ.ξ / δΑχ.Α = 1 — Motor actuator monitoring (DAC) active

The system detects the following stepping controller errors:

- defective motor
- defective capacitor (wrong rotating direction)
- wrong phase followers (wrong rotating direction)
- defective force transmission at spindle or drive
- excessive backlash due to wear
- jamming of the control valve e.g. due to foreign body

In these cases the controller will change to manual operation and the outputs will be switched off. Is the controller switched to automatic operation again or any modification is done the controller activates the DAC function again and the out- puts will be set.

Resetting of a DAC error:
After solving the technical problem the DAC error can be acknowledged in the error list. Thereafter the controller works again in normal operation mode.

See also chapter 3.4 *"Maintenance manager / Error list"*.

Functioning of the DAC function
No input filter should be defined for the Yp input (ΠΑρΑ / ΙνΠ.ξ / τ.Φξ = 0). There with no wrong detection of blocking or wrong method of operation can be recognized.
The automatic calibration can be used with drives outfitted with spring assembly.

Execution of the calibration:
It is controlled if the mean alteration between two measurements is enough for the DAC monitoring. The calibration will be stopped if the alteration between two measurements is too small.

The position of 0% is searched. Therefore the drive will be closed until there is no changing of the input signal for 0,5 sec. Assuming that the drive is outfitted with spring assembly, the drive is opened for 2,8 sec. The drive should then still be within the spring assembly. This position is allocated and stored as 0%.

With the same procedure the position for 100% is allocated and stored. Simultaneously the motor running time is determined and saved as parameter $\tau\tau$. Afterwards the controller sets the drive in the position before calibration. Was the controller in automatic mode before calibration, it will be set to automatic mode again otherwise it remains in manual mode.

The following errors can be occur during calibration:

- the change of the Yp input is to small, no monitoring is possible
- the motion is in wrong direction
- the Yp input is broken

In these cases the automatic calibration will be stopped and the controller remains in manual mode.

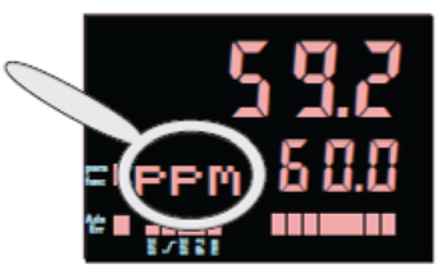
If the automatic calibration leads to no reasonable results the calibration of the Yp input can be done manual.

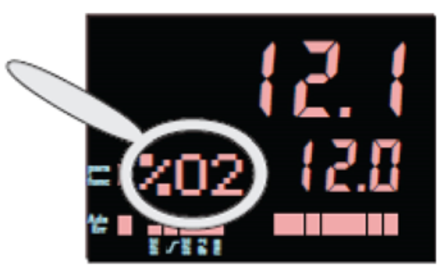
If the controller reaches the positions of 0% or 100% the outputs will be switched off. Also in manual mode it is not possible to exceed these limits.

Because no controller with continuous output and Yp input is defined there won't be the DAC function for this controlling type.

7.2 O2 measurement

As the result of O2 measurement can extend over many decades, an automatic switch-over function between " %O2" and "ppm" was implemented.





The physical quantity is displayed left beside
Lambda sensors (λ sensors) are used for measurement.

The electromotive force (in Volts) generated by Λ probes is dependent of instantaneous oxygen content and temperature. Therefore, Protherm 20 can only evaluate exact measurement results, if it knows the sensor temperature.

Distinction of heated and non-heated lambda probes is made. Both can be evaluated by Protherm 20.

Heated lambda probes

Controlled heating which ensures constant temperature is integrated in the heated λ probe. This temperature must be entered in KS 92-1 parameter Probe temperature.

Parameter → Controller → Probe temperature → .....°C (/°F - dependent of configuration)

Χντρ →τΕνΠ	temp.	0...9999

Non-heated lambda probes

With the probe always operated at a fixed, known temperature, a procedure as used for a heated probe can be used.

A non-heated λ probe is used, unless the temperature is constant. In this case, the probe temperature in addition to the probe mV value must be measured. For this purpose, any temperature measurement with one of the analog inputs INP2 or INP3 can be used. During function selection, the input must be set to X2 (second process value).

7.2.1 Connection

Connect the input for the lambda probe to INP1. Use terminals A15 and A17.
If necessary, temperature measurement must be connected to INP2 or INP3.

7.2.2 Configuration

Oxygen measurement
Oxygen measurement with heated lambda probe
Controller → Process value processing → 7: O2 functions with constant probe temperature

Χντρ → Χ.τΨΠ	7	O2-const

Oxygen measurement with non-heated lambda probe
Controller → Process value processing → O2 functions with measured probe temperature

Χντρ → Χ.τΨΠ	8	O2+temp

Input 1 → Function INP1 → 7: process value X1

ΙνΠ.1 → 1.Φνχ	7	X1-Input

In input 1, the sensor type is set for one of the high-impedance voltage inputs:
Input 1 → Sensor type → 42: special (-25...1150 mV) or
41: special (-2.5...115 mV)

ΙνΠ.1 → Σ.τψΠ	41	115 mV
ΙνΠ.1 → Σ.τψΠ	42	1150 mV

Input 1 → meas. value correction → 0: no correction

ΙνΠ.1 → Σ.Λιν	O	No

Temperature measurement (required with non-heated lambda probe)
Any temperature measurement with one of analog inputs INP2 or INP3 can be used. Select input X2 during function selection (second set-point).

With O2 measurement, evaluation in ppm or % must be specified for all parameters related to the process value. This is done centrally during configuration.

Other → Parameter unit for O2→ 0: parameter for O2 function in ppm
1: parameter for O2 function in %

οτηρ→ Ο2	0	unit : ppm
οτηρ→ Ο2	1	unit : %

Whether the temperature of the non-heated A probe is specified in °C or °F can be selected during configuration.
Other →Unit →1: in Celsius
2: in Fahrenheit

οτηρ→ Υνιτ	1	°C
οτηρ→ Υνιτ	2	°F

7.2.3 O2 sensor calibration

For calibrating the zero (purging air; 20,946 % O2) and the slope (reference gas), proceed as described below:

- Apply purging air to the sensor.
- Keep the Enter key ↵ pressed during more than 3s. Text ΠΑρΑ is displayed.
- Press key ▼ 2 twice, until ΧΑΛ is displayed and press ↵ to confirm it.
- Press ↵ to confirm display ΙνΠ.1.
- ΙνΛ.1 and ΟΦΦ are displayed alternately (zero). If calibration of the zero is not necessary, press ↵ to go directly to the calibration of slope.
- Zero calibration
- After pressing the ▲ key, ΙνΛ.1 and a number corresponding to the instantaneously applied EMK /mV, e.g. 3.000, are displayed alternately.
- After confirmation using the ↵ key, ΟυΛ.1 and 20.946 are displayed alternately. Now, adjust the O2-value to be displayed using ▲▼ and press ↵ to confirm it.
- Zero calibration is complete and ΙνΗ.1 and ΟΦΦ are displayed alternately.
- Unless the slope must be adjusted, press ↵ to skip this procedure.
- Calibrating the slope: apply reference gas to the sensor and continue the procedure as described above.
- Finally, δονΕ followed by Ενδ are displayed. After pressing the ↵ key to confirm Ενδ, quit the calibrating level. Calibration is finished.

Note:
Configuration, parameter setting and calibrating level can be disabled by opening a wire hook switch inside Protherm 20.

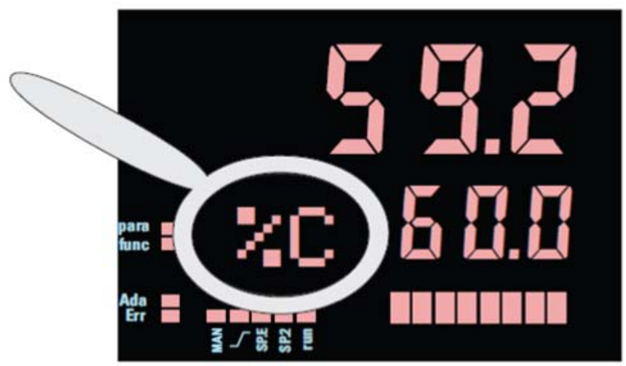
7.3 C-level control

This function is used for control of carbon content and dewpoint. Lambda sensors (λ sensors) are used for measuring.
Additionally, a sensor cleaning function is provided (burning off).
The A sensor generates a mV signal (EMK) based on the ratio between the oxygen concentration of the reference air outside the furnace to the one inside the furnace.

The controller calculates the current percentage of the C level inside the furnace using the temperature, the mV sensor signal and the CO content.

Gas correction
The CO content of gas can be determined using a gas analyzer. For continuous correction of the calculated C level, this signal can be connected to Protherm 20 Carbon via 0/4...20 mA. If the configuration with constant CO compensation is selected, the CO content can be specified also as a parameter (Co.co).

Display
If C-level control is configured the %C unit is displayed left beside the setpoint.



When using the [F] key as a start function for the burn-off procedure, the normal function of the Func LED (active function key signaling) is deactivated to avoid confusion.

7.3.1 Connection

The inputs for C-level measurement must be used as described below:

INP1
Select X1 as a function for this input. This is the input to which the lambda sensor must be connected. Select sensor type 42 (-25..1300mV). Terminals A15 and A17 are used.

INP2
Select X3 as a function for this input. Connect the CO compensation to this input.
Select sensor type 30 (0/4..20mA).Terminals A6 and A7 must be used.

INP3
Select X2 as a function for this input and connect the temperature measurement to it.

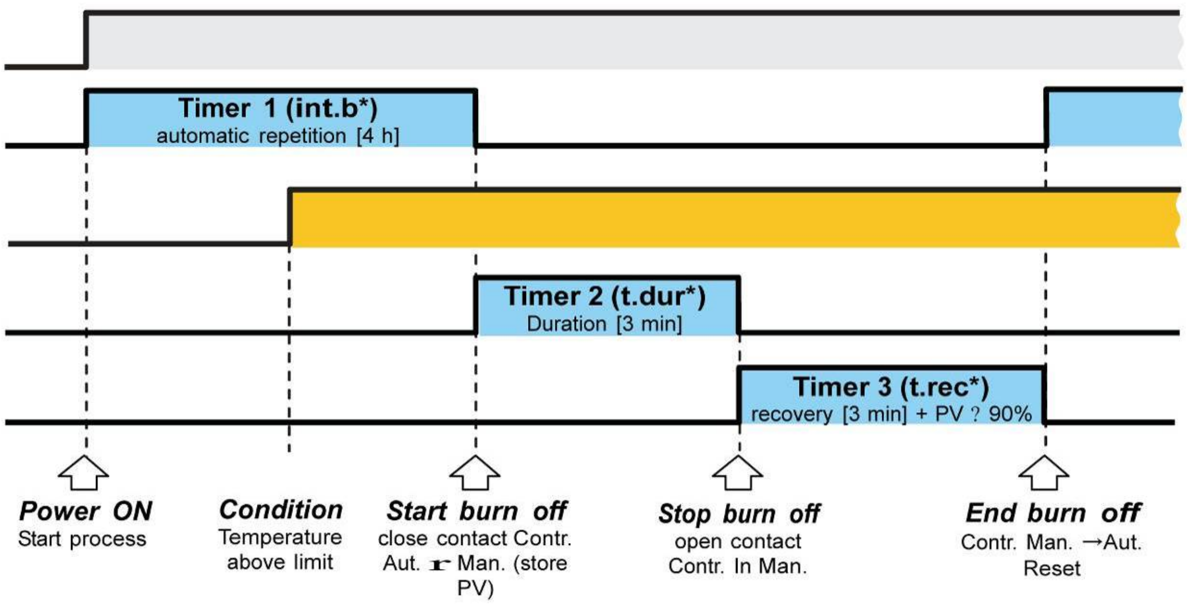
7.3.2 Burn-off procedure

The sensors are used in furnaces and require regular cleaning. Soot and other dirt particles are burned off using air. Protherm 20 can be configured for cyclical and/or manual activation of the procedure.

During cleaning and recovery, the C level is frozen to ensure continuous operation of the furnace.

The controller goes to automatic operation only when the recovery time has elapsed and the process value has returned to at least 90% of its former value.

Burn-off flow chart



Explanation of parameters:

Int.b Interval of the burn-off procedure [h]. After elapse of this time, the burn off procedure restarts.

Τνπ.β Minimum temperature. For starting the burn-off procedure, the temperature must have reached at least this value.

t.dur Duration of burn-off procedure [min]. During this time, the sensor is purged with clean air.

t.rec Sensor recovery time [min]. When the sensor is exposed to measurement air, settlement of the measured value takes some time.

7.3.3 Configuration and parameter setting

The configuration and parameter settings required for the particular function are specified in the tables below:

Carbon function with constant CO value

Χονφ	Χντρ	Χ.τΨΠ	9	CO constant
	ΙνΠ.1	Ι.Φνχ	7	X1
		Σ.τψΠ	42	1300 mV
	ΙνΠ.3	Ι.Φνχ	4	X2

		Σ.τψΠ	1	type J
ΠΑρΑ Χντρ Χο.χο			typ. 20	

Carbon function with measured CO value

Χονφ	Χντρ	Χ.τΨΠ	10	CO
	ΙνΠ.1	Ι.Φνχ	7	X1
		Σ.τψΠ	42	1300 mV
	ΙνΠ.2	Ι.Φνχ	8	X3
		Σ.τψΠ	30	0/4..20 mA
	ΙνΠ.3	Ι.Φνχ	4	X2
		Σ.τψΠ	1	Typ J

Dewpoint function

Χονφ	Χντρ	Χ.τΨΠ	11	Dewpoint
	ΙνΠ.1	Ι.Φνχ	7	X1
		Σ.τψΠ	42	1300 mV
	ΙνΠ.3	Ι.Φνχ	4	X2
		Σ.τψΠ	1	type J
ΠΑρΑ Χντρ Χο.χο			typ. 40	

7.3.4 A sensor calibration

For calibrating the zero (purging air; 20,946 % O2) and slope (reference gas), proceed as follows:

Apply purging air to the sensor.
Keep the Enter key ↵ pressed during more than 3s. Text ΠΑρΑ is displayed.
Press key ▼ twice, until ΧΑΛ is displayed and press ↵ to confirm.
Press ↵ to cConfirm display ΙνΠ.1 .
Now ΙνΛ.1 and ΟΦΦ are displayed alternately (zero). Unless the zero must be calibrated, press ↵ to go to the slope calibration directly.
Zero calibration
After pressing the ▲ key ΙνΛ.1 and a number corresponding to the currently applied EMK /mV, e.g. 3.000 are displayed alternately.
After confirming by pressing the ↵ key ΟυΛ.1 and 20.946 are displayed alternately. Adjust the A value to be displayed using ▲ ▼ and press ↵ to confirm.
Now the zero is calibrated and ΙνΗ.1 and ΟΦΦ are displayed alternately.
Unless the slope must be calibrated, press ↵ to skip this procedure.
Slope calibration: Apply reference gas to the sensor and continue the procedure as described above.
Finally, δονΕ followed by Ενδ are displayed. After pressing ↵ to confirm Ενδ the calibration level is quit and calibration is completed.

Note:

Configuration, parameter setting and calibration level can be disabled by opening a wire hook switch inside Protherm 20.

7.4 Linearization

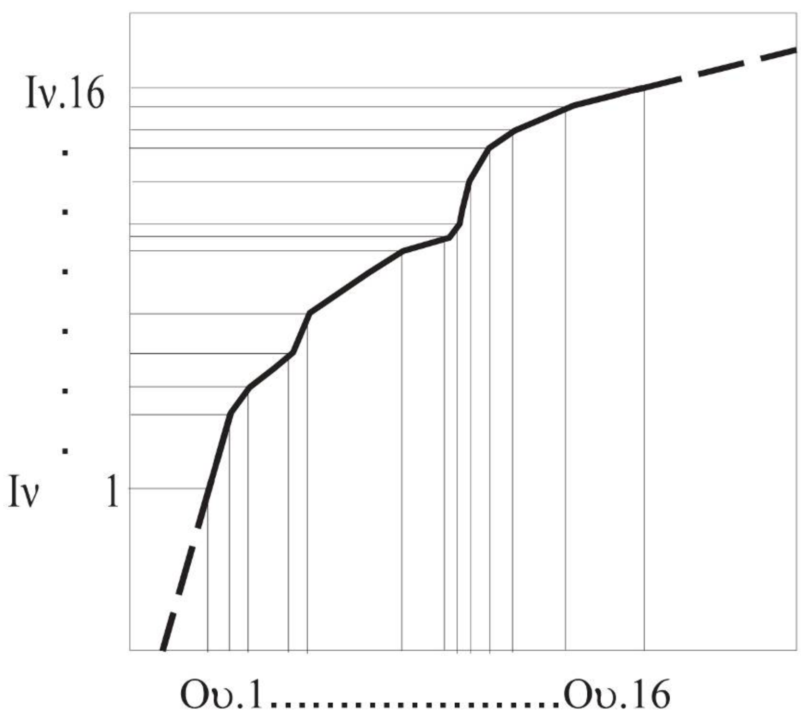
Linearization for inputs INP1 or INP3
Access to table “ Λιν” is always with selection of sensor type S.TYP = 18: special thermocouple in INP1 or INP3, or with selection of linearization Σ.Λιν 1: special linearization.
Dependent of input type, the input signals are specified in µV or in Ohm dependent of input type.

With up to 16 segment points, non-linear signals can be simulated or linearized. Every segment point comprises an input (In.1 … In.16) and an output (Ou.1… Ou.16). These segment points are interconnected automatically by means of straight lines.

The straight line between the first two segments is extended downwards and the straight line between the two largest segments is extended upwards. I.e. a defined output value is also provided for each input value.

When switching an Iν.x value to ΟΦΦ, all other ones are switched off. Condition for these configuration parameters is an ascending order.

Iν.1 < Iν.2 < ...< Iν.16 and Oυ.1 < Oυ.2 ...< Oυ.16.



7.5 Loop alarm

The loop alarm monitors the control loop for interruption (not with three-point stepping controller and not with signallers). With parameter LP.AL switched to 1(= loop alarm active), an interruption of the control loop is detected, unless the process value reacts accordingly with Y=100% after elapse of 2xTi.

The loop alarm shows that the control loop is interrupted. You should check heating or cooling circuit, sensor, controller and motor actuator.
During self-tuning, the control loop is not monitored (loop alarm is not active).

7.6 Heating current input / heating current alarm

The heating current alarm monitors the heating current.
In addition to short circuit monitoring, checking either for overload (current > heating current limit value) or for interruption (current < heating current limit value) is done.

Each of the analog inputs can be used as measurement input.
If electrical heating is concerned, INP2 which is always provided can be configured for measuring range 0...50mA AC and connected directly using a heating cur- rent transformer.

⚠ With τ1< 400 ms or τπ< 200 ms (effective time!), heating current monitoring is ineffective.

7.7 Protherm 20 as Modbus master

⚠ This function is only selectable with BlueControl (engineering tool)!

Additions οτηρ (*only visible with BlueControl!*)

Name	Value range	Description	Default
MASt		**Controller is used as Modbus master**	0
	0	Slave	
	1	Master	
Cycl	0...200	Cycle time [ms] for the Modbus master to transmit its data to the bus.	60
AdrO	1...65535	Target address to which the **AdrU** specified data is given out on the bus.	1
AdrU	1...65535	Modbus address of the data that Modbus master gives to the bus.	1

The Protherm 20 carbon can be used as Modbus master (ΧονΦ/ οτηρ/ **MASt** =1). The Modbus master sends its data to all slaves (Broadcast message, controller adress 0). It transmits its data (modbus address **AdrU**) cyclic with the cycle time **Cycl** to the bus.

The slave controller receives the data transmitted by the masters and allocates it to the modbus target address AdrO. If more than one data should be transmitted by the master controller (Numb > 1) , the modbus address **AdrU** indicates the start address of the data that should be transmitted and **AdrO** indicates the first target address where the received data should be stored. The following data will be stored at the logically following modbus target addresses.

With this it is possible e.g. to specify the process value of the master controller as set-point for the slave controllers.

7.8 Back-up controller (PROFIBUS)

Back-up operation: calculation of the control outputs is in the master. The controller is used for process value measurement, correcting variable output and for display.
With master or communication failure, control is taken over independently and bumplessly by the controller.

8 BlueControl

BlueControl is the projecting environment for the BluePort® controller series PT20 The following 3 versions with graded functionality are available:

Functionality	Mini	Basic	Expert
Parameter and configuration setting	Yes	Yes	Yes
Controller and loop simulation	Yes	Yes	Yes
Download: transfer of an engineering to the controller	Yes	Yes	Yes
Online mode / visualization	SIM only	Yes	Yes
Defining an application specific linearization	Yes	Yes	Yes
Configuration in the extended operating level	Yes	Yes	Yes
Upload: reading an engineering from the controller	SIM only	Yes	Yes
Basic diagnostic functions	No	No	Yes
Saving data file and engineering	No	Yes	Yes
Printer function	No	Yes	Yes
Online documentation, help	Yes	Yes	Yes
Implementation of measurement value correction	Yes	Yes	Yes
Data acquisition and trend display	SIM only	Yes	Yes
Wizard function	Yes	Yes	Yes
Extended simulation	No	No	Yes
Customer-specific default data-set	No	No	Yes
Programeditor (KS 90-1programmer only)	No	No	Yes
Support for the "railline"-system	no	No	Yes

9 Technical data

INPUTS

PROCESS VALUE INPUT INP1

Resolution: > 14 bit
Decimal point: 0 to 3 decimals
Digital input filter: adjustable 0.0...100.0 s
Scanning cycle: 100 ms
Measured value correction: 2-point or offset correction

Thermocouples
(Table 1, Page 77)
Internal and external temperature compensation
Input impedance: ≥ 1 MQ
Effect of source resistance: 1 μV/Q

Internal Temperature Compensation
Max. additional error ±0.5 K

Sensor break monitoring
Sensor current: ≤1 1A
Operating sense configurable

Thermocouple to Specification
Measuring range -25...75mV in conjunction with linearization can be used for connecting thermocouples that are not included in table 1.

Resistance thermometer
(Table 2, Page 77)
Connection: 3-wire
Lead resistance: max. 30 _
Input circuit monitor: Break and short circuit

Special Measuring Range
BlueControl (engineering tool) can be used to match the input to sensor KTY 11-6 (character- istic is stored in the controller).

Physical measuring range: 0...4500 Ohm
Linearization segments 16

Current and voltage signals
(Table 3, Page 77)
Span start, end of span: anywhere within measuring range
Scaling: selectable -1999...9999
Linearization: 15 segments, adaptable with BlueControl
Decimal point: adjustable
Input circuit monitor: 12.5% below span start (2mA, 1V)

SUPPLEMENTARY INPUT INP2

Resolution: > 14 bit
Scanning cycle: 100 ms

Heating current measurement
via current transformer (→ Accessory equipment)
Measuring range: 0...50 mA AC
Scaling: adjustable -1999..0.000..9999 A

Current measurement range
Technical data as for INP1

Potentiometer
(Table 2, Page 77)
Connection: 2-wire
Lead resistance: max. 30 Ohm
Input circuit monitor: Break

SUPPLEMENTARY INPUT INP3

Resolution: > 14 bit
Scanning cycle: 100 ms
Technical data as for INP1 except the 10V range.

CONTROL INPUTS DI1, DI2

Configurable as direct or inverse switch or push-button! Connection of a potential-free contact suitable for switching „dry“ circuits.
Switched voltage: 5 V
Switched current: 1 00 _A

CONTROL INPUTS DI2, DI3 (OPTION)

The functions of control input di2 on the analog card and of di2 on the options card are logically O Red.
Configurable as direct or inverse switches or keys.
Optocoupler input for active triggering.
Nominal voltage: 24 V DC, external
Current sink (IEC 1131 Type 1)
Logic „0": -3...5 V
Logic „1": 15...30 V
Current requirement: approx. 5 mA

TRANSMITTER SUPPLY U_T (OPTION)

Output: 22 mA / ≥ 18 V
As analog outputs OUT3 or OUT4 and transmitter supply UT are connected to different voltage potentials, an external galvanic connection between OUT3/4 and U_T is not permissible with analog outputs.

GALVANIC ISOLATION

Safety isolation
Function isolation

Mains supply	Process value input INP1 Supplementary input INP2 Optional input INP3 Digital input di1, di2
Relay OUT1	RS422/485 interface
Relay OUT2	Digital inputs di2, 3
Relay OUT3	Universal output OUT3
Relay OUT4	Universal output OUT4
	Transmitter supply U_T

OUTPUTS

RELAY OUTPUTS OUT1...OUT4

Contacts:	Potential-free changeover contact
Max. contact rating:	500 VA, 250 VAC, 2A at 48...62 Hz, resistive load
Min. contact rating:	6 V, 1 mA DC
Duty cycle electric:	for I = 1A/2A: ≥ 800,000 / 500,000 (at ~ 250V / (resistive load))

Note:
If the relays operate external contactors, these must be fitted with RC snubber circuits to manufacturer specifications to prevent excessive switch-off voltage peaks.

OUT3, OUT4 AS UNIVERSAL OUTPUT
Galvanically isolated from the inputs.
Freely scalable Resolution: 11 bit

Current output
0/4...20 mA, configurable.

Signal range:	0...approx. 22 mA
Load:	500 Ω
Load effect:	no effect
Resolution:	≤ 22 µA (0,1%)
Error:	≤ 40 µA (0,2%)

Voltage output
0/2...10V, configurable

Signal range	0...11 V
Min. Load:	≥2 kΩ
Load effect:	no effect
Resolution:	≤ 11 mV (0.1%)
Accuracy	≤ 20 mV (0.2%)

OUT3, 4 used as transmitter supply

Output power:	22 mA / ≥ 13 V

OUT3, 4 used as logic output

Load ≤ 500 Ω	0 / ≤ 20 mA
Load > 500 Ω	0 / > 13 V

OUTPUTS OUT5/6 (OPTION)

Galvanically isolated opto-coupler outputs. Grounded load: common positive voltage.
Output rating: 18...32 VDC; ≤ 70 mA
Internal voltage drop: ≤ 1 V with Imax
Protective circuit: built-in against short circuit, overload, reversed polarity (free-wheel diode for relay loads).

POWER SUPPLY

Dependent of order:

AC SUPPLY

Voltage:	90...260 V AC
Frequency:	48...62 Hz
Power consumption:	approx. 10 VA

UNIVERSAL SUPPLY 24 V UC

AC voltage:	20.4...26.4 V AC
Frequency:	48...62 Hz
DC voltage:	18...31 V DC class 2
Power consumption:	approx.. 10 VA

BEHAVIOR WITH POWER FAILURE
Configuration, parameters and adjusted set-points, control mode:
Non-volatile storage in EEPROM

BLUEPORT FRONT INTERFACE

Connection of PC via PC adapter (see "Accessory equipment"). The BlueControl software is used to configure, set parameters and operate the device.

BUS INTERFACE (OPTION)

Galvanically isolated

Physical:	RS 422/485
Protocol:	Modbus RTU
Transmission speed:	2400, 4800, 9600, 19.200 bits/sec
Address range:	1...247
Number of controllers per bus:	32

Repeaters must be used to connect a higher number of controllers.

ENVIRONMENTAL CONDITIONS

Protection modes

Front panel:	IP 65 (NEMA 4X)
Housing:	IP 20
Terminals:	IP 00

Permissible temperatures

For specified accuracy:	0...60°C
Warm-up time:	≥ 15 minutes
For operation:	-20...65°C
For storage:	-40...70°C

Humidity
75% yearly average, no condensation

Shock and vibration

Vibration test Fc (DIN 68-2-6)

Frequency:	10...150 Hz
Unit in operation:	1g or 0.075 mm
Unit not in operation:	2g or 0.15 mm

Shock test Ea (DIN IEC 68-2-27)

Shock:	15g
Duration:	11ms

Electromagnetic compatibility
Complies with EN 61 326-1
(for continuous, non-attended operation)

GENERAL

Housing

Material:	Makrolon 9415 flame-retardant
Flammability class:	UL 94 VO, self-extinguishing

Plug-in module, inserted from the front

Safety test
Complies with EN 61010-1 (VDE 0411-1): Overvoltage category II
Contamination class 2
Working voltage range 300 V Protection class II

Certifications

Type tested to EN 14597 (replaces DIN 3440)
With certified sensors applicable for:

- Heat generating plants with outflow temperatures up to 120°C to DIN 4751
- Hot-water plants with outflow temperatures above 110°C to DIN 4752
- Thermal transfer plants with organic transfer media to DIN 4754
- Oil-heated plants to DIN 4755

cULus-certification
(Type 1, indoor use)
File: E 208286

Electrical connections

- flat-pin terminals 1 x 6.3mm or 2 x 2.8mm to DIN 46 244 or
- screw terminals for 0.5 to 2.5mm²
  On instruments with screw terminals, the insulation must be stripped by min.12 mm. Choose end crimps accordingly.

Mounting
Panel mounting with two fixing clamps at top/ bottom or right/left, high-density mounting possible

Mounting position:	uncritical
Weight:	0.27kg

Accessories delivered with the unit
Operating manual
Fixing clamps

Table 1 - Thermocouples measuring ranges

Thermoelement type		Measuring range		Accuracy	Resolution (Ø)
L	Fe-CuNi (DIN)	-100...900°C	-148...1652°F	≤ 2K	0.1 K
J	Fe-CuNi	-100...1200°C	-148...2192°F	≤ 2K	0.1 K
K	NiCr-Ni	-100...1350°C	-148...2462°F	≤ 2K	0.2 K
N	Nicrosil/Nisil	-100...1300°C	-148...2372°F	≤ 2K	0.2 K
S	PtRh-Pt 10%	0...1760°C	32...3200°F	≤ 2K	0.2 K
R	PtRh-Pt 13%	0...1760°C	32...3200°F	≤ 2K	0.2 K
T	Cu-CuNi	-200...400°C	-328...752°F	≤ 2K	0.05 K
C	W5%Re-W26%Re	0...2315°C	32...4199°F	≤ 2K	0.4 K
D	W3%Re-W25%Re	0...2315°C	32...4199°F	≤ 2K	0.4 K
E	NiCr-CuNi	-100...1000°C	-148...1832°F	≤ 2K	0.1 K
B *	PtRh-Pt6%	0(100)...1820°C	32(212)...3308°F	≤ 2K	0.3 K

* Specifications valid for 400°C

Table 2 - Resistance transducer measuring ranges

Type	Signal Current	Measuring range		Accuracy	Resolution (Ø)
Pt100	0,2mA	-200...100°C (150**)	-140...212°F	≤ 1K	0.1K
Pt100		-200...850°C	-140...1,562°F	≤ 1K	0.1K
Pt1000		-200...850°C	-140...1562°F	≤ 2K	0.1K
KTY 11-6 *		-50...150°C	-58...302°F	≤ 2K	0.05K
Spezial		0...4,500		≤ 0.1 %	0.01 %
Spezial		0...450			
Poti		0...160			
Poti		0...450			
Poti		0...1,600			
Poti		0...4,500			

* Or special
** Measuring range 150°C with reduced lead resistance. Max. 160 [for meas. and lead resistances (150°C = 157,33 [).

Table 3 - Current and voltage measuring ranges

Measuring range	Input impedance	Accuracy	Resolution (Ø)
0-10 Volt	~ 110 kΩ	≤ 0.1 %	0.6 mV
-2,5-115 mV	≥ 1MΩ	≤ 0.1 %	6 µV
-25-1,150 mV	≥ 1MΩ	≤ 0.1 %	60 µV

10 Safety hints

This unit
was built and tested in compliance with VDE 0411-1 / EN 61010-1 and delivered in safe condition;
complies with European guideline 89/336/EWG (EMC) and is provided with CE marking;
and was tested before delivery and passed all tests required by test schedule.

To maintain this condition and to ensure safe operation, the user must follow the hints and warnings given in this operating manual.
The unit is intended exclusively for use as a measurement and control instrument in technical installations.

⚠ **Warning**

If the unit is damaged to an extent that safe operation seems impossible, the unit must not be taken into operation.

ELECTRICAL CONNECTIONS

The electrical wiring must conform to local standards (e.g. VDE 0100).
The input measurement and control leads must be kept separate from signal and power supply leads.
In the installation of the controller a switch or a circuit-breaker must be used and signified.
The switch or circuit-breaker must be installed near by the controller and the user must have easy access to the controller.

COMMISSIONING

Before instrument switch-on, check that the following information is taken into account:
Ensure that the supply voltage corresponds to the specifications on the type label.
All covers required for contact protection must be fitted.
If the controller is connected with other units in the same signal loop, check that the equipment in the output circuit is not affected before switch-on. If necessary, suitable protective measures must be taken.
The unit may be operated only in installed condition.
Before and during operation, the temperature restrictions specified for controller operation must be met.

SHUT-DOWN

For taking the unit out of operation, disconnect it from all voltage sources and protect it against accidental operation.
If the controller is connected with other equipment in the same signal loop, check that other equipment in the output circuit is not affected before switch-off. If necessary, suitable protective measures must be taken.

MAINTENANCE, REPAIR AND MODIFICATION

The units do not need particular maintenance.

⚠ **Warning**

When opening the units, or when removing covers or components, live parts and terminals may be exposed.
Before starting this work, the unit must be disconnected completely.

After completing this work, re-shut the unit and re-fit all covers and components. Check if specifications on the type label must be changed and correct them, if necessary.

Caution

When opening the units, components which are sensitive to electrostatic discharge (ESD) can be exposed. The following work may be done only at workstations with suitable ESD protection. Modification, maintenance and repair work may be done only by trained and authorized personnel.

The cleaning of the front of the controller should be done with a dry or a wetted (spirit, water) handkerchief.

10.1 Resetting to factory setting

or to a customer-specific data set

In case of faulty configuration, the device can be reset to a default condition. Unless changed, this basic setting is the manufacturer-specific controller default setting.

However, this setting may have been changed by means of the BlueControl® software. This is recommendable e.g. when completing commissioning in order to cancel accidental alteration easily.

Resetting can be activated as follows:

Press keys and simultaneously FACtorY is displayed after power on, after approximately 2 seconds, the display changes to FACno.

Keys and can be used for switch-over between NO and YES in the second line.

When pressing the Enter key with “no”, the unit starts without copying the default data.

When pressing the Enter key with “yes”, there are four possibilities:

	Safety switches	Levels	Password	Instrument reaction after confirming "YES" by pressing Ù
❶	closed	any	any	always factory reset
❷	open	free	none	Factory reset without prompt for the password
❸	open	free	defined	Factory reset after entry of the correct pass number
❹	open	min. 1 disabled	any	Factory reset is omitted

Timeout
Unless a key is pressed during 10 seconds, a timeout occurs and the instruments starts without copying the default data.

The process COPY can take several seconds.
Subsequently, the instrument changes to normal operation.