Industrial and process controller Pro-4

Operating manual

English

MA-PRO4-EN-1306

Valid from: 06/13

û BlueControl

More efficiency in engineering,
more overview in operating:
The projecting environment for the West Pro Series controllers.

Software and updates are available on www.West-CS.com

Description of symbols:

g General information

a General warning

l Attention: ESD sensitive devices

Contents

1 Mounting

a 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For access to the safety switch, the controller must be withdrawn from the housing.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 as adjusted by means of BlueControl (engineering tool) 2

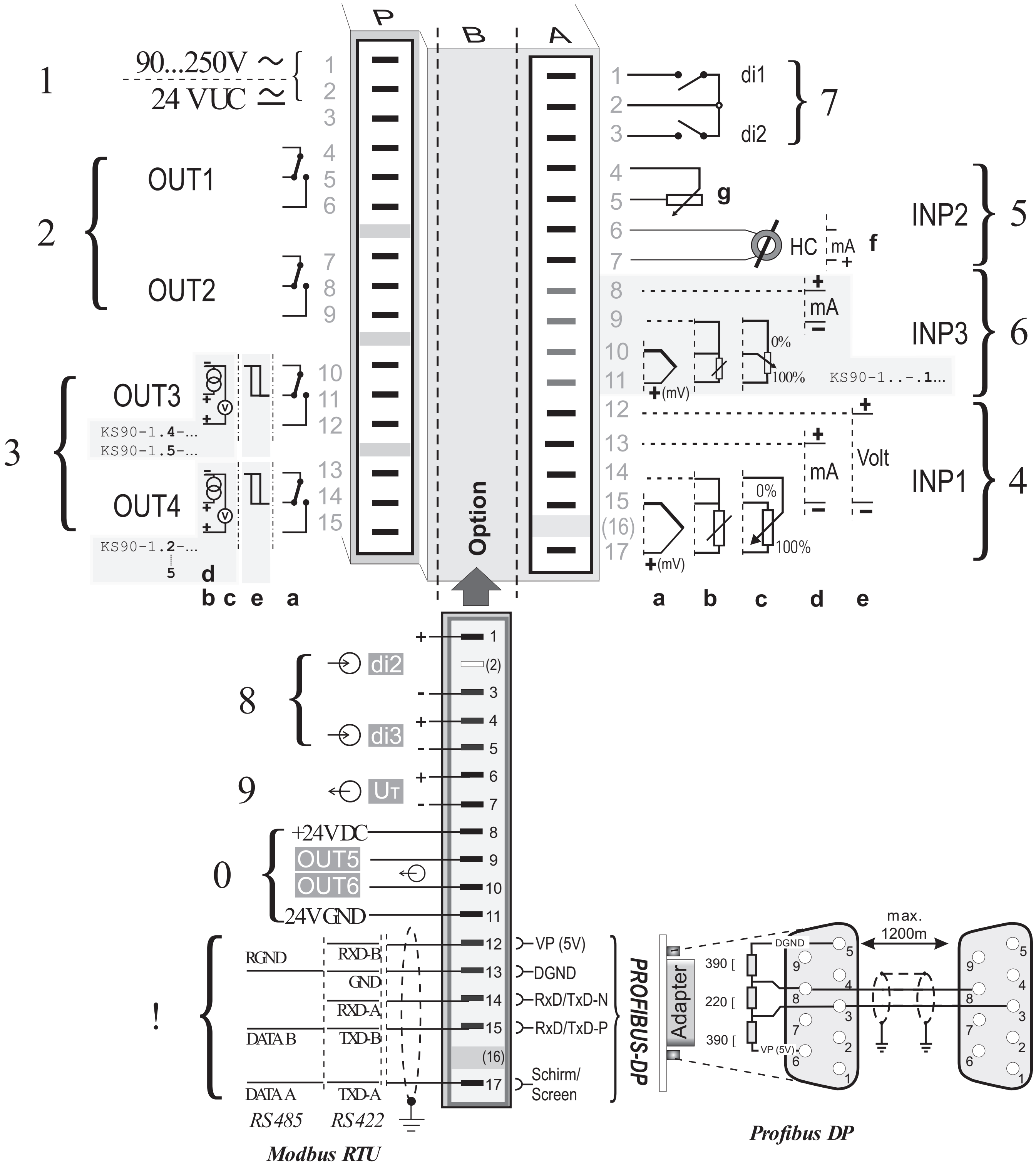
1 Factory setting

2 Default setting: display of all levels suppressed, password PASS = OFF

1 **Caution!** The unit contains ESD-sensitive components.

2 Electrical connections

2.1 *Connecting diagram*



g 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 1

See chapter "Technical data"

Connection of outputs OUT1/2 2

2 OUT1/2 heating/cooling

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

Connection of outputs OUT3/4 3

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 4

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 5

5 INP2 current tansformer

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

g potentiometer input for position feedback

Connection of input INP2 5

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 6

As input INP1, but without voltage

Connection of inputs di1, di2 7

Digital input, configurable as switch or push-button

Connection of inputs di2/3 8 (option)

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

Connection of output U_T 9 (option)

Supply voltage connection for external energization

Connection of outputs OUT5/6 0 (option)

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

Connection of bus interface ! (option)

PROFIBUS DP or RS422/485 interface with Modbus RTU protocol

8 9   di2/3, 2-wire transmitter supply

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

3 OUT3 transmitter supply

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

*** Interface description Modbus RTU in separate manual: see page 73.**

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

KS9x-1 connecting example:

a **CAUTION: Using a temperature limiter is recommendable in systems where overtemperature 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	°C or °F display signalling
5	Signals ConF- and PArA level	6	Signals activated function key
7	Selft-tuning active	8	Entry into the error list
9	Bargraph or plain text display	0	Setpoint SP.2 is effective
!	Setpoint SP.E is effective	"	Setpoint gradient is effective
§	Manual-automatic switchover: **Off:** automatic On: manual mode (adjustment possible) *Blinks:* manual mode (adjustment not possible (r ConF/ Cntr/ MAn))		
$	Enter key: call up extented operating level / error list		
%	Up/ down keys: changing setpoint or correcting variable		
&	automatic/manual or other functions (r ConF / LOGI)		
/	freely configurable function key with pure controller operation		
(	PC connection for BlueControl (engineering tool)		

LED colours: LED 1, 2, 3, 4: yellow, Bargraph: red, other LEDs: red

g In the upper display line, the process value is <u>always</u> 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 *Behaviour 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. Signalling 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 pressing key ÈorÌ - The alarm entry was deleted (status 0).

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	- Codenumber and hardware are not identical	- Contact PMA service - Elektronic-/Optioncard must be exchanged
FbF. 1/2/3	Sensor break INP1/2/3	- Sensor defective - Faulty cabling	- Replace INP1/2/3 sensor - Check INP1/2/3 connection
Sht. 1/2/3	Short circuit INP1/2/3	- Sensor defective - Faulty cabling	- Replace INP1/2/3 sensor - Check INP1/2/3 connection
POL. 1/2/3	INP1/2/3 polarity error	- Faulty cabling	- Reverse INP1/2/3 polarity
HCA	Heating current alarm (HCA)	- Heating current circuit interrupted, I< HC.A or I> HC.A (dependent of configuration) - Heater band defective	- Check heating current circuit - If necessary, replace heater band

Name	Description	Cause	Possible remedial action
SSr	Heating current short circuit (SSR)	- Current flow in heating circuit with controller off - SSR defective	- Check heating current circuit - If necessary, replace solid-state relay
LooP	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
AdA.H	Self-tuning heating alarm (ADAH)	- See Self-tuning heating error status	- see Self-tuning heating error status
AdA.C	Self-tuning heating alarm cooling (ADAC)	- See Self-tuning cooling error status	- see Self-tuning cooling error status
dAC	DAC-Alarm	Actor error	see errorstatus DAC-function
LiM.1/2/3	stored limit alarm 1/2/3	- adjusted limit value 1/2/3 exceeded	- check process
Inf.1	time limit value message	- adjusted number of operating hours reached	- application-specific
Inf.2	duty cycle message (digital ouputs)	- adjusted number of duty cycles reached	- application-specific
E.5	Internal error in DP module	self-test errorinternal communication interrupted	Switch on the instrument againContact PMA service
dp.1	No access by bus master	bus errorconnector problemno bus connection	Check cableCheck connectorCheck connections
dp.2	Faulty configuration	Faulty DP configuration telegram	Check DP configuration telegram in master

g 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: ConF / LOGI / Err.r

g 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 can not be acknowledged and deleted.

Self-tuning heating (ADA.H) and cooling (ADA.C) error status:

Error status	Description	Behaviour
0	No error	
3	Faulty control action	Re-configure controller (inverse i direct)
4	No response of process variable	The control loop is perhaps not closed: check sensor, connections and process
5	Low reversal point	Increase (ADA.H) max. output limiting Y.Hi or decrease (ADA.C) min. output limiting Y.Lo
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 (ADA.H) max. output limiting Y.Hi or reduce (ADA.C) min. output limiting Y.Lo

DAC function (DAC) error status:

Error status	Description	Behaviour
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

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, whereby 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:

Pb1	- Proportional band 1 (heating) in engineering units [e.g. °C]
ti1	- Integral time 1 (heating) in [s]r only, unless set to OFF
td1	- Derivative time 1 (heating) in [s]r only, unless set to OFF
t1	- Minimum cycle time 1 (heating) in [s]r only, unless Adt0 was set to “no self-tuning” during configuration by means of BlueControl®.
Pb2	- Proportional band 2 (cooling) in engineering units [e.g. °C]
ti2	- Integral time 2 (cooling) in [s]r only, unless set to OFF
td2	- Derivative time 2 (cooling) in [s]r only, unless set to OFF
t2	- Minimum cycle time 2 (cooling) in [s] r 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

w Adjust the controller measuring range as control range limits. Set values rnG.L and rnG.H to the limits of subsequent control.
(ConfigurationrControllerrlower and upper control range limits)
ConFrCntrr rnG.L and rnG.H

w Determine which parameter set shall be optimized.
-The instantaneously effective parameter set is optimized.
r Activate the relevant parameter set (1 or 2).

w Determine which parameter set shall be optimized (see tables above).

w 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 behaviour 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 (see page).

Optimization after start-up: (see page 4)
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 tunE = 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 (ConF/ Cntr/ tunE)

Selection criteria for the optimization method:

	Step attempt after start-up	**Pulse attempt after start-up**	**Optimization at the set-point**
tunE = 0	sufficient set-point reserve is provided		sufficient set-point reserve is **not** provided
tunE = 1		sufficient set-point reserve is provided	sufficient set-point reserve is **not** provided
tunE = 2	always step attempt after start-up		

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

3.5.4 Step attempt after start-up

Condition: - tunE = 0 and sufficient set-point reserve provided
or - tunE = 2

The controller outputs 0% correcting variable or Y.Lo and waits, until the process is at rest (see start-conditions on page 8).
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 successfull 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: - tunE = 1 and sufficient set-point reserve provided.

The controller outputs 0% correcting variable or Y.Lo and waits, until the process is at rest (see start conditions page 8)
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 or 1
- 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 (PArA/ SETP/ r.SP≠ OFF), 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% 1, to generate a slight process value undershoot. The changing process is analyzed and the parameters thus calculated are recorded in the controller. The optimized parameters are used for line-out to theset-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.

1 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 motor actuator position internally by varying an integrator with the adjusted actuator travel time. For this reason, precise entry of the actuator travel time (tt), 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:

Simulation actual position

Internal calculation
tt

Internal calculation always occurs, when the actuator was varied by travel time tt ***in one go*** , 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:

- w 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 (rnG.H - rnG.L).
- w For self-tuning start after start-up, a 10% difference from (SP.LO ... SP.Hi) is required.

g Self-tuning start can be blocked via BlueControl® (engineering tool) (P.Loc).

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

Strt = 1 Manual start by press keys Ù and È 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

3.5.9 Self-tuning cancellation

By the operator:

Self-tuning can always be cancelled by the operator. For this, press Ù and È 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 *Ù and È* 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 Ò (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 Ù :*
   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:

r page 15: "Error status self-tuning heating (ADA.H) and cooling (ADA.C)"

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 (1). When the change of process value X was constant during one minute (2), the power is switched on (3). At the reversal point, the self-tuning attempt 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 (1). Heating power Y is switched on (2). 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 a
The process is controlled to the set-point. With the control deviation constant during a defined time (1) (i.e. constant separation of process value and set-point), the controller outputs a reduced correcting variable pulse (max. 20%) (2). After determination of the control parameters using the process characteristic (3), control is started using the new parameters (4).

Three-point controller a
The parameter for heating and cooling are determined in two attempts. The heating power is switched on (1). Heating parameters Pb1, ti1, td1 and t1 are determined at the reversal point. Control to the set-point occurs(2). With constant control deviation, the controller provides a cooling correcting variable pulse (3). After determining its cooling parameters Pb2, ti2, td2 and t2 (4) from the process characteristics , control operation is started using the new parameters (5).

a During phase 3, 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 Δt and Δx (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)
Tg	=	recovery time (s)
X_{max}	=	maximum process value

V_{max} = ―――― = ―― = max. rate of increase of process value

The control parameters can be determined from the values calculated for delay time T_u , maximum rate of increase v_{max}, control range X_h and characteristic K according to the **formulas** given below. Increase Xp, if line-out to the set-point oscillates.

Parameter adjustment effects

Parameter		Control	Line-out of disturbances	Start-up behaviour
Pb1	higher	increased damping	slower line-out	slower reduction of duty cycle
	lower	reduced damping	faster line-out	faster reduction of duty cycle
td1	higher	reduced damping	faster response to disturbances	faster reduction of duty cycle
	lower	increased damping	slower response to disturbances	slower reduction of duty cycle

Formulas

K = Vmax * Tu

With 2-point and 3-point controllers, the cycle time must be adjusted to
t1 / t2 ≤ 0,25 * Tu

controller behavior	Pb1 [phy. units]	td1 [s]	ti1 [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

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, KS 9x-1 can be switched over between two parameter sets.
Parameter sets PArA and PAr.2 are provided for heating and cooling.

Dependent of configuration (ConF/LOG/Pid.2), switch-over to the second parameter set (ConF/LOG/Pid.2) is via one of digital inputs di1, di2, di3, key è or interface (OPTION).

g 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 OuT.1... OuT.6 can be used each for alarm signalling. If more than one signal is linked to one output the signals are OR linked. Each of the 3 limit values Lim.1 … Lim.3 has 2 trigger points H.x (Max) and L.x (Min), which can be switched off individually (parameter = “OFF”). Switching difference HYS.x and delay dEl.x of each limit value is adjustable.

Ü Operaing principle absolut alarm
L.1 = OFF

H.1 = OFF

* *Operating principle relative alarm*
L.1 = OFF

H.1 = OFF

1: normally closed (ConF/ Out.x / O.Act=1) (see examples in the drawing)
2: normally open (ConF/ Out.x / O.Act= 0)(inverted output relay action)

g The variable to be monitored can be selected seperately for each alarm via configuration
The following variables can be monitored:

- w process value
- w control deviation xw (process value - set-point)
- w 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 ti1, the alarm is activated. (ti1 = integral time 1; parameter r Cntr)
  If ti1 is switched off (ti1 = OFF), this is interpreted as Î, i.e. the alarm is not activated, before the process value was within the limits once.
- w Measured value INP1
- w Measured value INP2
- w Measured value INP3
- w effective set-point Weff
- w correcting variable y (controller output)
- w Deviation from SP internal
- w x1 - x2
- w 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.

g If measured value monitoring + alarm status storage is chosen (ConF / Lim / Fnc.x = 2/4), the alarm relay remains switched on until the alarm is resetted in the error list (Lim 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.

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

g ConF - level: At ConF - level, the right decimal point of bottom display line *blinks*.

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.

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

g Factory setting:Safety switch **Loc** closed: all levels accessible without restriction, password PASS = OFF.

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*

ConF Configuration level

Adjustment:

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

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

4.2 *Configuration parameters*

Cntr

Name	Value range	Description	Default
SP.Fn		**Basic configuration of setpoint processing**	0
	0	set-point controller can be switched over to external set-point (-> LOGI/ SP.E)	
	8	standard controller with external offset (SP.E)	
C.tYP		**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 (-> LOGI/ I.ChG)	
	7	O_2 function with constant sensor temperature	
	8	O_2 function with measured sensor temperature	
C.Fnc		**Control behaviour (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	
C.dif		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)	
mAn		**Manual operation permitted**	0
	0	no	
	1	yes (r LOGI / mAn)	

Name	Value range	Description	Default
C.Act		**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.	
FAIL		**Behaviour 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 Ym.H. To prevent determination of inadmissible values, mean value formation is only if the control deviation is lower than parameter L.Ym.	
rnG.L	-1999...9999	**X0** (start of control range) 1	-100
rnG.H	-1999...9999	**X100** (end of control range) 1	1200
CYCL		**Characteristic for 2-point- and 3-point-controllers**	0
	0	standard	
	1	water cooling linear (siehe Seite 46)	
	2	water cooling non-linear	
	3	with constant cycle	
tunE		**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	
Strt		**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	
Adt0		**Optimization of T1, T2** (only visible with BlueControl!)	0
	0	Automatic optimization	
	1	No optimization	

1 rnG.L and rnG.H are indicating the range of control on which e.g. the self-tuning is refering

InP.1

Name	Value range	Description	Defaul t
Corr		**Measured value correction / scaling**	0
	0	Without scaling	
	1	Offset correction (at CAL level) (controller offset adjustment is at CALlevel)	
	2	2-point correction (at CAL level) (calibration is at the controller CALlevel)	
	3	Scaling (at PArA level)	
	4	Autom. calibration (only with positionfeedback Yp)	
In.f	-1999...99 99	**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). a Before activating a substitute value, the effect in the control loop should be considered!	OFF
fAI1		**Forcing INP1** (only visible with BlueControl!)	0
	0	No forcing	
	1	Forcing via serial interface	

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

InP.2

Name	Value range	Description	Defaul t
I.Fnc		**Function selection of INP2**	1
	0	no function (subsequent input data are skipped)	
	1	heating current input	
	2	external set-point (SP.E)	
	3	Yp input	
	4	Second process value X2	
	5	External positioning value Y.E (switch-over r LOGI / Y.E)	
	6	no controller input (e.g. transmitter input instead)	
	7	Process value x1	
S.tYP		**Sensor type selection**	30
	30	0...20mA / 4...20mA 1	
	31	0...50mA AC 1	
	50	Potentiometer (0...160 Ohm) 1	
	51	Potentiometer (0...450 Ohm) 1	
	52	Potentiometer (0...1600 Ohm) 1	
	53	Potentiometer (0...4500 Ohm) 1	
Corr		**Measured value correction / scaling**	0
	0	Without scaling	
	1	Offset correction (at CAL level) (offset entry is at controller CALlevel)	
	2	2-point correction (at CALlevel) (calibration is at controller CALlevel)	
	3	Scaling (at PArA level)	

Name	Value range	Description	Default
In.F	-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). a Before activating a substitute value, the effect in the control loop should be considered!	OFF
fAI2		**Forcing INP2** (only visible with BlueControl!)	0
	0	No forcing	
	1	Forcing via serial interface	

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

InP.3

Name	Value range	Description	Default
I.Fnc		**Function selection of INP3**	1
	0	no function (subsequent input data are skipped)	
	1	heating current input	
	2	External set-point SP.E (switch-over -> LOGI/ SP.E)	
	3	Yp input	
	4	Second process value X2	
	5	External positioning value Y.E (switch-over r LOGI / Y.E)	
	6	no controller input (e.g. transmitter input instead)	
	7	Process value x1	
S.Lin		**Linearization (only at S.tYP = 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.	
S.tYP		**Sensor type selection**	30
	0	thermocouple type L (-100...900°C) , Fe-CuNi DIN	
	1	thermocouple type J (-100...1200°C) , Fe-CuNi	

Name	Value range	Description	Default
	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 ß160 [ )	
	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 1	
	41	special -2,5...115 mV 1	
	42	special -25...115 0mV 1	
	50	potentiometer 0...160 Ohm 1	
	51	potentiometer 0...450 Ohm 1	
	52	potentiometer 0...1600 Ohm 1	
	53	potentiometer 0...4500 Ohm 1	
Corr		**Measured value correction / scaling**	0
	0	Without scaling	
	1	Offset correction (at CAL level) (offset entry is at controller CALlevel)	
	2	2-point correction (at CAL level) (calibration is at controller CALlevel)	
	3	Scaling (at PArA level)	
	4	Automatic calibration (DAC)	
In.F	-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). a Before activating a substitute value, the effect in the control loop should be considered!	OFF
fAI3		**Forcing INP3** (only visible with BlueControl!)	0
	0	No forcing	
	1	Forcing via serial interface	

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

Lim

Name	Value range	Description	Default
dAc.A		**DAC alarm function** (see page 70)	0
	0	DAC alarm switched off / inactive	
	1	DAC alarm active	
Hour	OFF...999 999	**Operating hours** (only visible with BlueControl®!)	OFF
Swit	OFF...999 999	**Output switching cycles** (only visible with BlueControl®!)	OFF

Out.1 and Out.2

Name	Value range	Description	Default
O.Act		**Method of operation of output OUT1**	0
	0	direct / normally open	
	1	inverse / normally closed	
Y.1 Y.2		**Controller output Y1/Y2**	1
	0	not active	
	1	active	
Lim.1 Lim.2 Lim.3		**Limit 1/2/3 signal**	0
	0	not active	
	1	active	
dAc.A		**Valve monitoring (DAC)**	0
	0	not active	
	1	active	
LP.AL		**Interruption alarm signal (LOOP)**	0
	0	not active	
	1	active	
HC.AL		**Heat current alarm signal**	0
	0	not active	
	1	active	
HC.SC		**Solid state relay (SSR) short circuit signal**	0
	0	not active	
	1	active	
FAi.1 FAi.2 FAi.3		**INP1/ INP2 / INP3 error signal**	0
	0	not active	
	1	active	
dP.Er		PROFIBUS error	0
	0	not active	
	1	active: Profibus trouble, no communication with this instrument.	
fOut		**Forcing OUT1** (only visible with BlueControl!)	0
	0	No forcing	
	1	Forcing via serial interface	

Configuration parameters Out.2 = Out.1 except for:

Default Y.1 = 0 Y.2 = 1

Out.3 and Out4

Name	Value range	Description	Default
O.tYP		**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)	
O.Act		**Method of operation of output OUT3 (only visible when O.TYP=0)**	1
	0	direct / normally open	
	1	inverse / normally closed	
Out.0	-1999...9999	**Scaling of the analog output for 0% (0/4mA or 0/2V, only visible when O.TYP=1..5)**	0
Out.1	-1999...9999	**Scaling of the analog output for 100% (20mA or 10V, only visible when O.TYP=1..5)**	100
O.Src		**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	
O.FAI		Failbehaviour, behaviour of the analog output, if the signal source (O.Src) is disturbed.	0
	0	upscale	
	1	downscale	
Y.1 Y.2		**Controller output Y1/Y2 (only visible when O.TYP=0)**	0
	0	not active	
	1	active	

Name	Value range	Description	Default
Lim.1 Lim.2 Lim.3		**Limit 1/2/3 signal (only visible when O.TYP=0)**	1
	0	not active	
	1	active	
dAc.A		**Valve monitoring (DAC) (only visible when O.TYP=0)**	0
	0	not active	
	1	active	
LP.AL		**Interruption alarm signal (LOOP) (only visible when O.TYP=0)** (Loop-Alarm)	0
	0	not active	
	1	active	
HC.AL		**Heating current alarm signal (only visible when O.TYP=0)**	0
	0	not active	
	1	active	
HC.SC		**Solid state relay (SSR) short circuit signal (only visible when O.TYP=0)**	0
	0	not active	
	1	active	
FAi.1 FAi.2 FAi.3		**INP1/ INP2 / INP3 error (only visible when O.TYP=0)**	1
	0	not active	
	1	active	
dP.Er		PROFIBUS error	0
	0	not active	
	1	active: Profibus trouble, no communication with this instrument.	
fOut		**Forcing OUT3** (only visible with BlueControl!)	0
	0	No forcing	
	1	Forcing via serial interface	

Out.5/ Out.6

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

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

LOGI

Name	Value range	Description	Default
C.oFF		**Switching off the controller**	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	è - key switches	
	6	Ò - key switches	
m.Loc		**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	è - key switches	
Err.r		**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	è - key switches	
	6	Ò - key switches	
Pid.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	è - key switches	
I.Chg		**Switching of the actual process value between Inp1 and X2**	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	è - key switches	
di.Fn		**Function of digital inputs (valid for all inputs)**	0
	0	direct	
	1	inverse	
	2	toggle key function	
fDI1		**Forcing di1/2/3** (only visible with BlueControl!)	0
fDI2	0	No forcing	
fDI3	1	Forcing via serial interface	

othr

+ **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 72).

4.3 *Set-point processing*

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

4.3.1 Set-point gradient / ramp

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

With parameter r.SP set to OFFas in the factory setting, the gradient is switched off and setpoint changes are made directly.

4.4 *Switching behaviuor*

With these controllers, configuration parameter CYCL (ConF/ Cntr/ CYCL) 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 (CyCl= 0)

The adjusted cycle times t1 and t2 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 t1 or ¼ x t2. The characteristic curve is also called “bath tub curve”

Parameters to be adjusted:	t1 :	min. cycle time 1 (heating) [s]
(PArA/ Cntr)	t2 :	min. cycle time 2 (cooling) [s]

4.4.2 Switching attitude linear (CyCl= 1)

For heating (Y1), the standard method (see chapter 4.4.1) is used. For cooling (Y2), a special algorithm for cooling with water is used. Generally, cooling is enabled only at an adjustable process temperature (E.H2O), because low temperatures prevent evaporation with related cooling, whereby damage to the plant is avoided. The cooling pulse length is adjustable using parameter t.on and is fixed for all output values.
The “off” time is varied dependent of output value. Parameter t.off 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 t.on / (t.on + t.off) w 100%.

Parameters to be adjusted:	E.H2O:	minimum temperature for water cooling
(PArA / Cntr)	t.on:	pulse duration water cooling
	t.off:	minimum pause water cooling

4.4.3 Switching attitude non-linear (CyCl= 2)

With this method, the cooling power is normally much higher than the heating power, i.e. the effect on the behaviour 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 F.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)

F.H2O:	adaptation of (non-linear) characteristic Water cooling
t.on:	Pulse duration water cooling
t.off:	min. pause water cooling
E.H2O:	min. temperature for water cooling

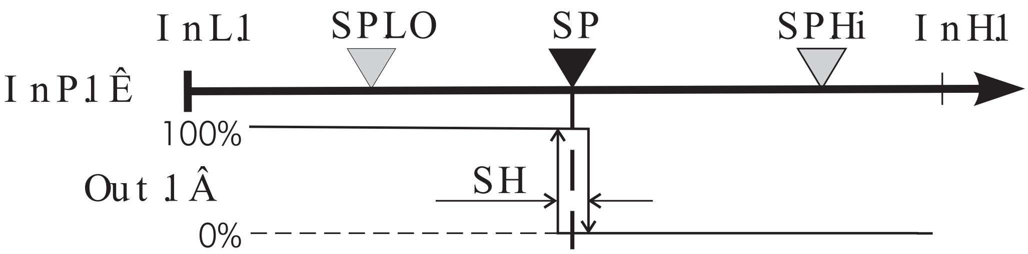
4.4.4 Heating and cooling with constant period (CyCl= 3)

1 and t2 are met in the overall output range . To prevent unreasonably short pulses, parameter tp is used for adjusting the shortest pulse duration. With small correcting values which require a pulse shorter than the value adjusted in tp, this pulse is suppressed. However, the controller stores the pulse and totalizes further pulses, until a pulse of duration tp can be output.

Parameters to be adjusted:	t1 :	Min. cycle time 1 (heating) [s]
(PArA/ Cntr)	t2 :	min. cycle time 2 (cooling) [s]
	tp:	min. pulse length [s]

4.5 *Configuration examples*

4.5.1 On-Off controller / Signaller (inverse)



ConF / Cntr:	SP.Fn	= 0	set-point controller
	C.Fnc	= 0	signaller with one output
	C.Act	= 0	inverse action (e.g. heating applications)
ConF / Out.1:	O.Act	= 0	action Out.1 direct
	Y.1	=1	control output Y1 active
PArA / Cntr:	Hys.l	= 0...9999	switching difference below SP
PArA / Cntr:	Hys.H	= 0...9999	switching difference above SP
PArA / SEtP:	SP.LO	= -1999...9999	set-point limit low for Weff
	SP.Hi	= -1999...9999	set-point limit high for Weff

g For direct signaller action, the controller action must be changed (ConF / Cntr / C.Act = 1)

4.5.2 2-point controller (inverse)

ConF / Cntr:	SP.Fn	=	0	set-point controller
	C.Fnc	=	1	2-point controller (PID)
	C.Act	=	0	inverse action (e.g. heating applications)
ConF / Out.1:	O.Act	=	0	action Out.1 direct
	Y.1	=	1	control output Y1 active
PArA / Cntr:	Pb1	=	1...9999	proportional band 1 (heating) in units of phys. quantity (e.g. °C)
	ti1	=	0,1...9999	integral time 1 (heating) in sec.
	td1	=	0,1...9999	derivative time 1 (heating) in sec.
	t1	=	0,4...9999	min. cycle time 1 (heating)
PArA / SEtP:	SP.LO	=	-1999...9999	set-point limit low for Weff
	SP.Hi	=	-1999...9999	set-point limit high for Weff

g For direct action, the controller action must be changed
(ConF / Cntr / C.Act = 1).

4.5.3 3-point controller (relay & relay)

ConF / Cntr:	SP.Fn	=	0	set-point controller
	C.Fnc	=	3	3-point controller (2xPID)
	C.Act	=	0	action inverse (e.g. heating applications)
ConF / Out.1:	O.Act	=	0	action Out.1 direct
	Y.1	=	1	control output Y1 active
	Y.2	=	0	control output Y2 not active
ConF / Out.2:	O.Act	=	0	action Out.2 direct
	Y.1	=	0	control output Y1 not active
	Y.2	=	1	control output Y2 active
PArA / Cntr:	Pb1	=	1...9999	proportional band 1 (heating) in units of phys. quantity (e.g. °C)
	Pb2	=	1...9999	proportional band 2 (cooling) in units of phys. quantity (e.g. °C)
	ti1	=	0,1...9999	integral time 1 (heating) in sec.
	ti2	=	0,1...9999	derivative time 2 (cooling) in sec.
	td1	=	0,1...9999	integral time 1 (heating) in sec.
	td2	=	0,1...9999	derivative time 2 (cooling) in sec.
	t1	=	0,4...9999	min. cycle time 1 (heating)
	t2	=	0,4...9999	min. cycle time 2 (cooling)
	SH	=	0...9999	neutr. zone in units of phys.quantity
PArA / SEtP:	SP.LO	=	-1999...9999	set-point limit low for Weff
	SP.Hi	=	-1999...9999	set-point limit high for Weff

4.5.4 3-point stepping controller (relay & relay)

ConF / Cntr:	SP.Fn	=	0	set-point controller
	C.Fnc	=	4	3-point stepping controller
	C.Act	=	0	inverse action (e.g. heating applications)
ConF / Out.1:	O.Act	=	0	action Out.1 direct
	Y.1	=	1	control output Y1 active
	Y.2	=	0	control output Y2 not active
ConF / Out.2:	O.Act	=	0	action Out.2 direct
	Y.1	=	0	control output Y1 not active
	Y.2	=	1	control output Y2 active
PArA / Cntr:	Pb1	=	1...9999	proportional band 1 (heating) in units of phys. quantity (e.g. °C)
	ti1	=	0,1...9999	integral time 1 (heating) in sec.
	td1	=	0,1...9999	derivative time 1 (heating) in sec.
	t1	=	0,4...9999	min. cycle time 1 (heating)
	SH	=	0...9999	neutral zone in units of phy. quantity
	tP	=	0,1...9999	min. pulse length in sec.
	tt	=	3...9999	actuator travel time in sec.
PArA / SEtP:	SP.LO	=	-1999...9999	set-point limit low for Weff
	SP.Hi	=	-1999...9999	set-point limit high for Weff

g For direct action of the 3-point stepping controller, the controller output action must be changed (ConF / Cntr / C.Act = 1).

4.5.5 Continuous controller (inverse)

ConF / Cntr:	SP.Fn	=	0	set-point controller
	C.Fnc	=	1	continuous controller (PID)
	C.Act	=	0	inverse action (e.g. heating applications)
ConF / Out.3:	O.tYP	=	1 / 2	Out.3 type (0/4 … 20mA)
	Out.0	=	-1999...9999	scaling analog output 0/4mA
	Out.1	=	-1999...9999	scaling analog output 20mA
PArA / Cntr:	Pb1	=	1...9999	proportional band 1 (heating) in units of phys. quantity (e.g. °C)
	ti1	=	0,1...9999	integral time 1 (heating) in sec.
	td1	=	0,1...9999	derivative time 1 (heating) in sec.
	t1	=	0,4...9999	min. cycle time 1 (heating)
PArA / SEtP:	SP.LO	=	-1999...9999	set-point limit low for Weff
	SP.Hi	=	-1999...9999	set-point limit high for Weff

g For direct action of the continuous controller, the controller action must be changed (ConF / Cntr / C.Act = 1).

g To prevent control outputs Out.1 and Out.2 of the continuous controller from switching simultaneously, the control function of outputs Out.1 and Out.2 must be switched off (ConF / Out.1 and Out.2 / Y.1 and Y.2 = 0).

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

ConF / Cntr:	SP.Fn	=	0	set-point controller
	C.Fnc	=	2	Δ -Y-Off controller
	C.Act	=	0	inverse action (e.g. heating applications)
ConF / Out.1:	O.Act	=	0	action Out.1 direct
	Y.1	=	1	control output Y1 active
	Y.2	=	0	control output Y2 not active
ConF / Out.2:	O.Act	=	0	action Out.2 direct
	Y.1	=	0	control output Y1 not active
	Y.2	=	1	control output Y2 active
PArA / Cntr:	Pb1	=	1...9999	proportional band 1 (heating) in units of phys. quantity (e.g. °C)
	ti1	=	0,1...9999	integral time 1 (heating) in sec.
	td1	=	0,1...9999	derivative time 1 (heating) in sec.
	t1	=	0,4...9999	min. cycle time 1 (heating)
	SH	=	0...9999	switching difference
	d.SP	=	-1999...9999	trigg. point separation suppl. cont. Δ / Y / Off in units of phys. quantity
PArA / SEtP:	SP.LO	=	-1999...9999	set-point limit low for Weff
	SP.Hi	=	-1999...9999	set-point limit high for Weff

4.5.7 Continuous controller with position controller

(Cntr/ C.Fnc = 6)

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

ConF / Cntr	SP.Fn	=	0	setpoint controller
	C.Fnc	=	6	continuous controller with position controller
	C.Act	=	0	inverse output action (e.g. heating applications)
ConF / InP.2:	I.Fnc	=	3	position feedback Yp
	S.typ	=	50	sensor e.g. potentiometer 0..160 Ω
ConF / Out.1:	O.Act	=	0	direct output action Out.1
	Y.1	=	1	control output Y1 active
	Y.2	=	0	control output Y2 not active
ConF / Out.2:	O.Act	=	0	direct output action Out.2
	Y.1	=	0	control output Y1 not active
	Y.2	=	1	control output Y2 active
PArA / Cntr:	Pb1	=	0,1...9999	proportional band 1 (heating) in units of the physical quantity (e.g. °C)
	ti1	=	1...9999	integral time 1 (heating) in sec.
	td1	=	1...9999	derivative time 1 (heating) in sec.
	t1	=	0,4...9999	min. cycle tim 1 (heating)
	SH	=	0...9999	switching difference

4.5.8 Measured value output

ConF / Out.3 / 4:	O.tYP	=	1	Out.3/ 4 0...20mA continuous
		=	2	Out.3/ 4 4...20mA continuous
		=	3	Out.3/ 4 0...10V continuous
		=	4	Out.3/ 4 2...10V continuous
	Out.0	=	-1999...9999	scaling Out.3/ 4 for 0/4mA or 0/2V
	Out.1	=	-1999...9999	scaling Out.3/ 4 for 20mA or 10V
	O.Src	=	3	signal source for Out.3/ 4 is the process value

5 Parameter setting level

5.1 *Parameter survey*

PArA Parameter setting level

	Cntr Control and self-tuning	**PAr.2** 2. set of parameters	**SEtP** Set-point and process value	**InP.1** Input 1	**InP.2** Input 2	**InP.3** Input 3	**Lim** Limit value functions	End
È	Pb1	Pb12	SP.Lo	InL.1	Inl.2	InL.3	L.1	
Ì	Pb2	Pb22	SP.Hi	OuL.1	OuL.2	OuL.3	H.1	
	ti1	ti12	SP.2	InH.1	InH.2	InH.3	HYS.1	
	ti2	ti22	r.SP	OuH.1	OuH.2	OuH.3	dEl.1	
	td1	td12		tF.1	tF.2	tF.3	L.2	
	td2	td22		E.tc		E.tc	H.2	
	t1						HYS.2	
	t2						dEl.2	
	SH						L.3	
	Hys.l						H.3	
	Hys.H						HYS.3	
	d.SP						dEl.3	
	tP						HC.A	
	tt							
	Y.Lo							
	Y.Hi							
	Y2							
	Y0							
	Ym.H							
	L.Ym							
	E.H2O							
	t.on							
	t.off							
	FH2							
	oFFS							
	tEmp							

Adjustment:

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

g **Return to the beginning of a group is by pressing the Ù key for 3 sec.**
If for 30 sec. no keypress is excecuted the controler returns to the process value and setpoint display (Time Out = 30 sec.)

5.2 *Parameters*

Cntr

Name	Value range	Description	Default
Pb1	1...9999 1	Proportional band 1 (heating) in phys. dimensions (e.g. °C)	100
Pb2	1...9999 1	Proportional band 2 (cooling) in phys. dimensions (e.g. °C)	100
ti1	0,1...9999	Integral action time 1 (heating) [s]	180
ti2	0,1...9999	Integral action time 2 (cooling) [s]	180
td1	0,1...9999	Derivative action time 1 (heating) [s]	180
td2	0,1...9999	Derivative action time 2 (cooling) [s]	180
t1	0,4...9999	Minimal cycle time 1 (heating) [s]. The minimum impulse is 1/4 x t1	10
t2	0,4...9999	Minimal cycle time 2 (heating) [s]. The minimum impulse is 1/4 x t2	10
SH	0...9999	Neutral zone or switching differential for on-off control [phys. dimensions)	2
Hys.l	0...9999	Switching difference Low signaller [engineering unit]	1
Hys.H	0...9999	Switching difference High signaller [engineering unit]	1
d.SP	-1999...9999	Trigger point seperation for additional contact Δ / Y / Off [phys. dimensions]	100
tP	0,1...9999	Minimum impulse [s]	OFF
tt	3...9999	Motor travel time [s]	60
Y.Lo	-120...120	Lower output limit [%]	0
Y.Hi	-120...120	Upper output limit [%]	100
Y2	-100...100	2. correcting variable	0
Y.0	-100...100	Working point for the correcting variable [%]	0
Ym.H	-100...100	Limitation of the mean value Ym [%]	5
L.Ym	0...9999	Max. deviation xw at the start of mean value calculation [phys. dimensions]	8
E.H2O	-1999...9999	Min. temperature for water cooling. Below the set temperature no water cooling happens	0
t.on	0,1...9999	Impulse lenght for water cooling. Fixed for all values of controller output.The pause time is varied.	1
t.oFF	1...9999	Min. pause time for water cooling. The max. effective controller output results from t.on/(t.on+t.off)·100%	10
F.H2O	0,1...9999	Modification of the (non-linear) water cooling characteristic (see page 47)	1
oFFS	-120...120	Zero offset	0

Name	Value range	Description	Default
tEmp	0...9999	Sensor temperature (in engineering units e.g. °C) With oxygen measurement (O) (see page 67)	750

1Valid for ConF/ othr/ dP = 0. With dP = 1 / 2 / 3 also 0,1 / 0,01 / 0,001 is possible.

PAr.2

Name	Value range	Description	Default
Pb12	1...9999 1	Proportional band 1 (heating) in phys. dimensions (e.g. °C), 2. parameter set	100
Pb22	1...9999 1	Proportional band 2 (cooling) in phys. dimensions (e.g. °C), 2. parameter set	100
Ti22	0,1...9999	Integral action time 2 (cooling) [s], 2. parameter set	10
Ti12	0,1...9999	Integral action time 1 (heating) [s], 2. parameter set	10
Td12	0,1...9999	Derivative action time 1 (heating) [s], 2. parameter set	10
Td22	0,1...9999	Derivative action time 2 (cooling) [s], 2. parameter set	10

SEtP

Name	Value range	Description	Default
SP.LO	-1999...9999	Set-point limit low for Weff	0
SP.Hi	-1999...9999	Set-point limit high for Weff	900
SP.2	-1999...9999	Set-point 2.	0
r.SP	0...9999	Set-point gradient [/min]	OFF
SP	-1999...9999	Set-point (only visible with BlueControl!)	0

g SP.LO and SP.Hi should be within the limits of rnGH and rnGL see configuration r Controller page

InP.1

Name	Value range	Description	Default
InL.1	-1999...9999	Input value for the lower scaling point	0

Name	Value range	Description	Default
OuL.1	-1999...9999	Displayed value for the lower scaling point	0
InH.1	-1999...9999	Input value for the upper scaling point	20
OuH.1	-1999...9999	Displayed value for the lower scaling point	20
t.F1	0,0...9999	Filter time constant [s]	0,5
Etc.1	0...100 (°C) 32...212 (°F)	External cold-junction reference temperature (external TC)	OFF

InP.2

Name	Value range	Description	Default
InL.2	-1999...9999	Input value for the lower scaling point	0
OuL.2	-1999...9999	Displayed value for the lower scaling point	0

g **Resetting the controller configuration to factory setting (Default) or resetting to the customer-specific default data set**
r chapter 11.1 (Page 82)

5.3 *Input scaling*

When using current, voltage or resistance signals as input variables for InP.1, InP.2 or/and InP.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	InL.x	OuL.x	InH.x	OuH.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 Inp.1 and InP.3

g Parameters InL.x , OuL.x, InH.x and OuH.x are only visible if ConF / InP.x / Corr = 3 is chosen.
In addition to these settings, InL.x and InH.x can be adjusted in the range (0...20mA / 0...10V / Ω) determined by selection of S.tYP .

a For using the predetermined scaling with thermocouple and resistance thermometer (Pt100), the settings for InL.x and OuL.x and for InH.x and OuH.x must have the same value.

g Input scaling changes at calibration level (r page 62) are displayed by input scaling at parameter setting level. After calibration reset (OFF), the scaling parameters are reset to default.

5.3.2 Input InP.2

S.tYP	Input signal	InL.2	OuL.2	InH.2	OuH.2
30	**0 … 20 mA**	0	any	20	any

In addition to these settings, InL.2 and InH.2 can be adjusted in the range (0...20/ 50mA/Ω) determined by selection of S.tYP.

6 Calibration level

Measured value correction (CAL) is only visible if ConF / InP.1 / Corr = 1 or 2 is chosen.

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

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

w possible on-line at the process

2-point correction
(ConF/ InP.1 / Corr = 2):

w is possible off-line with process value simulator

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

InL.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 Ù.

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

2-point correction **(ConF/ InP.1 / Corr = 2):**

InL.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 Ù.

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

InH.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 Ù.

OuH.1**:** The display value of the upper scaling point is displayed.
Before calibration OuH.1 equals InH.1.
The operator can correct the upper display value by pressing keys ÈÌ
Subsequently, he confirms the display value by pressing key Ù.

g The parameters (OuL.1, OuH.1) changed at CAL level can be reset by adjusting the parameters below the lowest adjustment value (OFF) by means of decrement key Ì .

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 monitored for functional troubles. The DAC® function can be started by chosing the parameter C.Fnc = 5 or 6 at the configuration level (ConF):

- ConF / Cntr / C.Fnc = 5 — 3-point-stepping controller with position feedback Yp as potentiometer
- ConF / Cntr / C.Fnc = 6 — Continuous controller with integrated positioner and position feedback Yp as potentiometer

If an error occures, 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 occures, parameter dAC.A = 1 and inverse action O.Act = 1 must be selected for the relevant output OUT.1 … OUT.4 in the ConF menu (OUt.3 and 4 only possible if O.tYP = 0 [relay/logic]):

- ConF / OUt.x / dAc.A = 1 — Motor actuator monitoring (DAC) aktive

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 outputs will be setted.

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

See also chapter 3.4 *"Mainenance manager / Error list"*, page 12 ff.

Functioning of the DAC function

No input filter should be defined for the Yp input (PArA / InP.x / t.Fx = 0). Therewith 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 messurements is enough for the DAC monitoring. The calibration will be stopped if the alteration between two messurements is too small.
The position of 0% is searched. Therefor 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 tt.
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 occure 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.

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

g If the conroller 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.

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

7.2 O_2 measurement

This function is available only on the instrument version with INP3.

As the O_2-measurement result range can extend over many decades, automatic display switch-over between " % " and "ppm" was realized.

The instantaneous unit is displayed in the lower line.
With set-point changing via keys I or D, the unit of the set-point and of the other parameters is displayed.

Lambda probes (λ probes) are used as sensors.
The electromotive force (in Volts) generated by λ probes is dependent of instantaneous oxygen content and temperature. Therefore, KS 9x-1 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 KS 9x-1.

Heated lambda probes
Controlled heating which ensures constant temperature is integrated in the heated λ probe. This temperature must be entered in KS 9x-1 parameter Probe temperature.

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

Cntr r tEmP	tem p.	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 r Process value processing r 7: O_2 functions with constant probe temperature

Cntr r C.tYP	7	O2-const

Oxygen measurement with **non-heated** lambda probe
Controller r Process value processing r O_2 functions with measured probe temperature

Cntr r C.tYP	8	O2+temp

Input 1 r Function INP1 r 7: process value X1

InP.1 r 1.Fnc	7	X1-Input

In **input** 1, the sensor type is set for one of the high-impedance voltage inputs:
Input 1 r Sensor type r 42: special (-25...1150 mV) or
41: special (-2,5...115 mV)

InP.1 r S.tyP	41	115 mV
InP.1 r S.tyP	42	1150 mV

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

InP.1 r S.Lin	0	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).

g With O_2 measurement, evaluation in ppm or % must be specified for all parameters related to the process value.
This is done centrally during configuration.

Other r Parameter unit for O_2r 0: parameter for O_2 function in ppm
1: parameter for O_2 function in %

othrr O2	0	unit : ppm
othrr O2	1	unit : %

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

othrr Unit	1	°C
othrr Unit	2	°F

7.3 *Linearization*

Linearization for inputs INP1 or INP3

Access to table “ Lin” is always with selection of sensor type S.TYP = 18: special thermocouple in INP1 or INP3, or with selection of linearization S.Lin 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 In.x value to OFF, all other ones are switched off.

Condition for these configuration parameters is an ascending order.

In.1 < In.2 < ...< In.16 and Ou.1 < Ou.2 ...< Ou.16.

7.4 *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).

7.5 *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 current transformer.

a With t1 < 400 ms or tp < 200 ms (effective time!), heating current monitoring is ineffective.

7.6 *KS9x-1 as Modbus master*

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

Additions othr *(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 with **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 KS9x-1 can be used as Modbus master (ConF / othr / **MASt** = 1). The Modbus master sends ist data to all slaves (Broadcast message, controller adress 0). It transmits its data (modbus adress **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 adress **AdrO**. If more than one data should be transmitted by the master controller (**Numb** > 1) , the modbus adress **AdrU** indicates the start adress of the data that should be transmitted and **AdrO** indicates the first target adress where the received data should be stored. The following data will be stored at the logically following modbus target adresses.
With this it is possible e.g. to specify the process value of the master controller as set-point for the slave controllers.

7.7 *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 of PMA. The following 3 versions with graded functionality are available:

The mini version is - free of charge - at your disposal as download at PMA homepage ***www.pma-online.de*** or on the PMA-CD (please ask for).

At the end of the installation the licence number has to be stated or DEMO mode must be chosen.

At DEMO mode the licence number can be stated subsequently under ***Help r Licence r Change***.

9 Versions

Accessories delivered with the unit

Operating manual (if selected by the ordering code)

- 2 fixing clamps
- operating note in 12 languages

Accessory equipment with ordering information

Description			Order no.
Heating current transformer 50A AC			9404-407-50001
PC-adaptor for the front-panel interface			9407-998-00001
Standard rail adaptor			9407-998-00061
Operating manual	German		9499-040-62918
Operating manual	English		9499-040-62911
Operating manual	French		9499-040-62932
Operating manual	Russian		9499-040-62965
Interface description Modbus RTU	German		9499-040-63718
Interface description Modbus RTU	English		9499-040-63711
BlueControl (engineering tool)	Mini	Download	www.pma-online.de
BlueControl (engineering tool)	Basic		9407-999-11001
BlueControl (engineering tool)	Expert		9407-999-11011

10 Technical data

INPUTS

PROCESS VALUE INPUT INP1

Resolution:	> 14 bits
Decimal point:	0 to 3 digits behind the decimal point
Dig. input filter:	adjustable 0,000...9999 s
Scanning cycle:	100 ms
Measured value correction:	2-point or offset correction

Thermocouples

r Table 1 (page 78)

Internal and external temperature compensation

Input resistance:	≥ 1 MΩ
Effect of source resistance:	1 µV/Ω

Internal temperature compensation

Maximal additional error:	± 0.5 K

Sensor break monitoring

Sensor current:	≤ 1 µA
Configurable output action	

Thermocouple to specification

Measuring range -25...75mV in conjunction with the linearization can be used for connecting thermocouples which are not included in Table 1.

Resistance thermometer

r Table 2 (page 78)

Connection:	3-wire
Lead resistance:	max. 30 Ohm
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 (characteristic is stored in the controller).

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

Current and voltage signals

r Table 3 (page 78)

Span start, end of span:	anywhere within measuring range
Scaling:	selectable -1999...9999
Linearization:	16 segments, adaptable with BlueControl
Decimal point:	adjustable
Input circuit monitor:	12.5% below span start (2mA, 1V)

SUPPLEMENTARY INPUT INP2

Resolution:	> 14 bits
Scanning cycle:	100 ms

Heating current measurement

via current transformer (→ Accessory equipment)

Measuring range:	0...50mA AC
Scaling:	adjustable -1999...0.000...9999 A

Current measuring range

Technical data as for INP1

Potentiometer

r Table 2 (page 78)

Connection:	2-wire
Lead resistance:	max. 30 Ohm
Input circuit monitor:	Break

SUPPLEMENTARY INPUT INP3 (OPTION)

Resolution:	> 14 bits
Scanning cycle:	100 ms

Technical data as for INP1 except 10V range.

CONTROL INPUTS DI1, DI2

Configurable as switch or push-button!
Connection of a potential-free contact suitable for switching "dry" circuits.

Switched voltage:	5 V
Current:	100 µA

CONTROL INPUTS DI2, DI3 (OPTION)

The functions of control input di2 on the analog card and of di2 on the options card are logically **OR**ed.
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)

Power: 22 mA / ≥ 18 V

As analog outputs OUT3 or OUT4 and transmitter supply U_T 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 (thick line)
Function isolation (double line)

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

OUTPUTS

RELAY OUTPUTS OUT1...OUT4

Contact type:	potential-free changeover contact
Max.contact rating:	500 VA, 250 V, 2A at 48...62 Hz, resistive load
Min. contact rating:	6V, 1mA DC
Number of electical switching cycles:	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, 4 AS UNIVERSAL OUTPUT

Galvanically isolated from the inputs.

Freely scalable resolution: 11 bits

Current output

0/4...20 mA configurable.

Signal range:	0...approx.22mA
Max. load:	≤ 500 Ω
Load effect:	no effect
Resolution:	≤ 22 µA (0.1%)
Accuracy	≤ 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 I_{max}
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. 8.0 VA

UNIVERSAL SUPPLY 24 V UC

AC voltage:	20.4...26.4 V AC
Frequency:	48...62 Hz
DC voltage:	18...31 V DC
Power consumption:	approx.. 8.0 VA

BEHAVIOUR 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

GOST-R Certificate (on request):
For each shipment to the russian federation and GUS-states, an authenticated certificate is to be delivered with the GOST-R certificated

controllers (KS4x-1, KS5x-1, KS9x-1, one certificate per shipment - 9499-047-14465).

Electrical connections

w flat-pin terminals 1 x 6.3mm or 2 x 2.8mm to DIN 46 244 or
w 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.

Table 1 Thermocouples measuring ranges

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

Table 2 Resistance transducer measuring ranges

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

* Or special

Table 3 Current and voltage measuring ranges

Measuring range	Input impedance	Accuracy	Resolution (Ô)
0-10 Volt	~ 110 kΩ	ß 0.1 %	0.6 mV
-2,5-115 mV	? 1MΩ	ß 0.1 %	6 µV

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

11 Safety hints

This unit was

- built and tested in compliance with VDE 0411-1 / EN 61010-1 and
- delivered in safe condition.
- complies European guideline 89/336/EWG (EMC) and is provided with CE marking.
- tested before delivery and passed the 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.

a **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.

a **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.

l **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. For this purpose, the PMA service should be contacted.

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

11.1 *Resetting to factory setting,*

or to a customer-specific data set
In case of faultyconfiguration, the device can be reset to a default condition. Unless changed, this basic setting is the manufacturer-specific controller default setting.

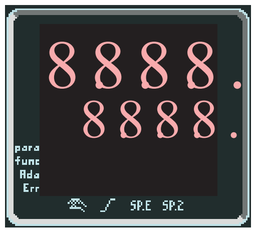
However, this setting may have been changed by means of the BlueControl® software. This is recommendable e.g. when completing commissioning in order to cancel accidental alteration easily.
Resetting can be activated as follows:

- Press keys È and Ì simultaneously FACtory is displayed after power on, after approx. 2 seconds, the display changes to FACno.
- Keys È and Ì 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:

1

2

3



4

	Safety switches	Levels	Password	Instrument reaction after confirming ”YES” by pressing U
1	closed	any	any	always factory reset
2	open	free	none	Factory reset without prompt for the password
3	open	free	defined	Factory reset after entry of the correct pass number
4	open	min. 1 disabled	any	Factory reset is omitted

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

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

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Subject to alterations without notice
Änderungen vorbehalten

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