PMA Prozeß- und Maschinen-Automation GmbH

Universal controller for burners
KS40-1 burner

KS40-1 burner
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KS40-1 burner
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KS40-1 burner

expert line
expert line

Operating manual

English

9499-040-66011

Valid from:8416

A publication of PMA Prozeß- und Maschinen Automation
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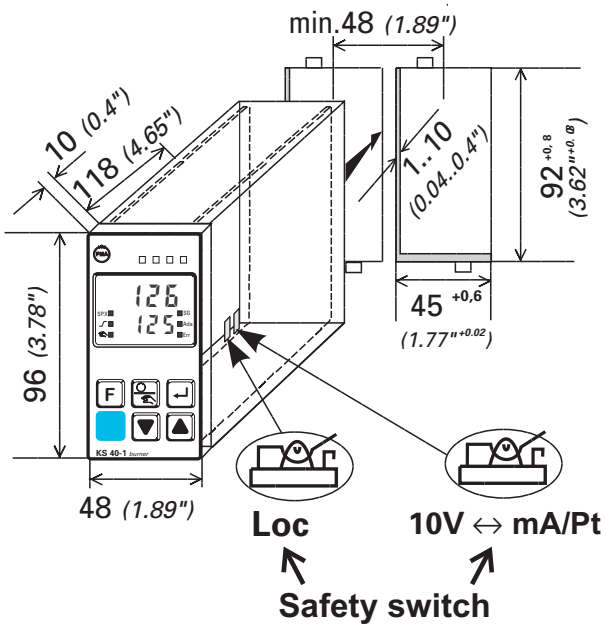
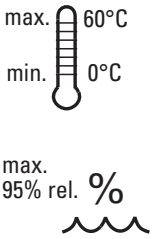
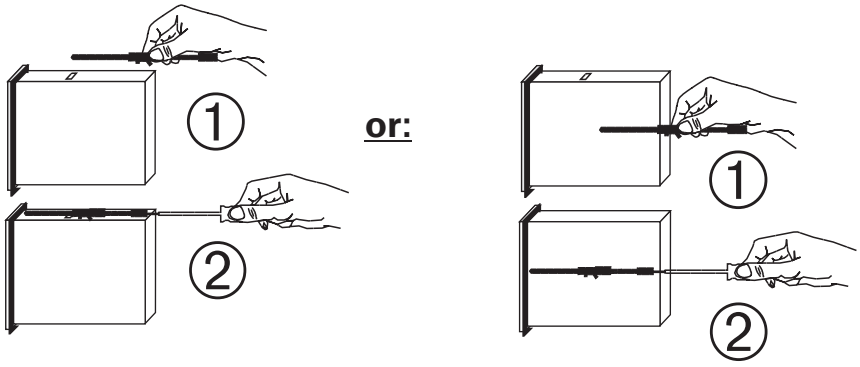
Germany

Contents

1 Mounting







Safety switch:
For access to the safety switches, the controller must be withdrawn from the housing.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.

10V ↔ mA/Pt	mA/Pt ❶	Thermocouple / Pt100 or transducer at `InP.1`
	10V	Pressure transmitter (0..10V) at `InP.1`
Loc	open	Access to the levels is as adjusted by means of BlueControl (engineering tool) ❷
	closed ❶	all levels accessible wihout restriction

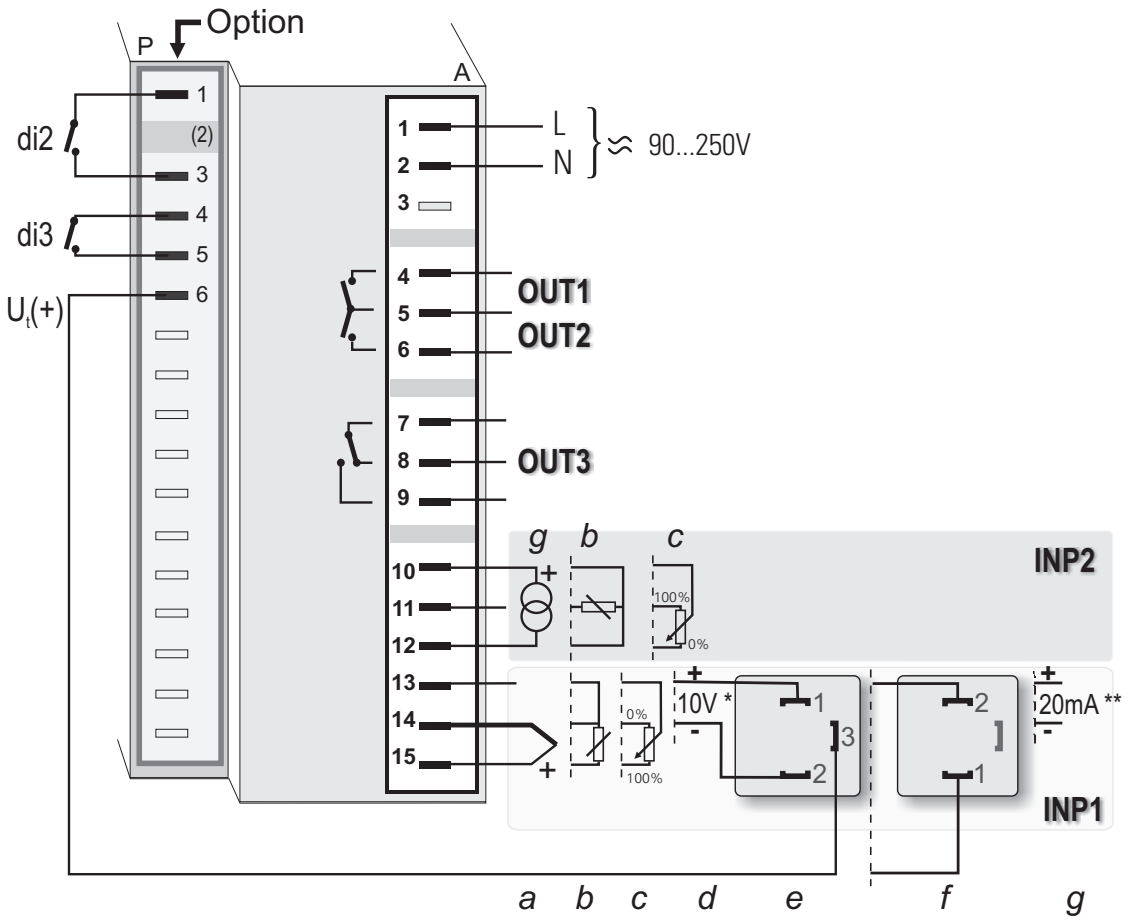
❶ Factory setting

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

Safety switch 10V ↔ mA/Pt always in position left or right. Leaving the safety switch open may lead to faulty functions!

Caution! The unit contains ESD-sensitive components.

2 Electrical connections



* Safety switch INP1 (mA ↔ 10V) in position 10V
** Safety switch INP1 (mA ↔ 10V) in position mA/Pt

Connection of input INP1

Input for variable x1 (process value)

a thermocouple
b resistance thermometer (Pt100/ Pt1000/ KTY/ ...)
c Transducer 50-30-50 Ω
d voltage (0/2...10V)
e pressure transmitter (3-wire connection)
f pressure transmitter (2-wire connection)
g current (0/4...20mA)

Connection of input INP2

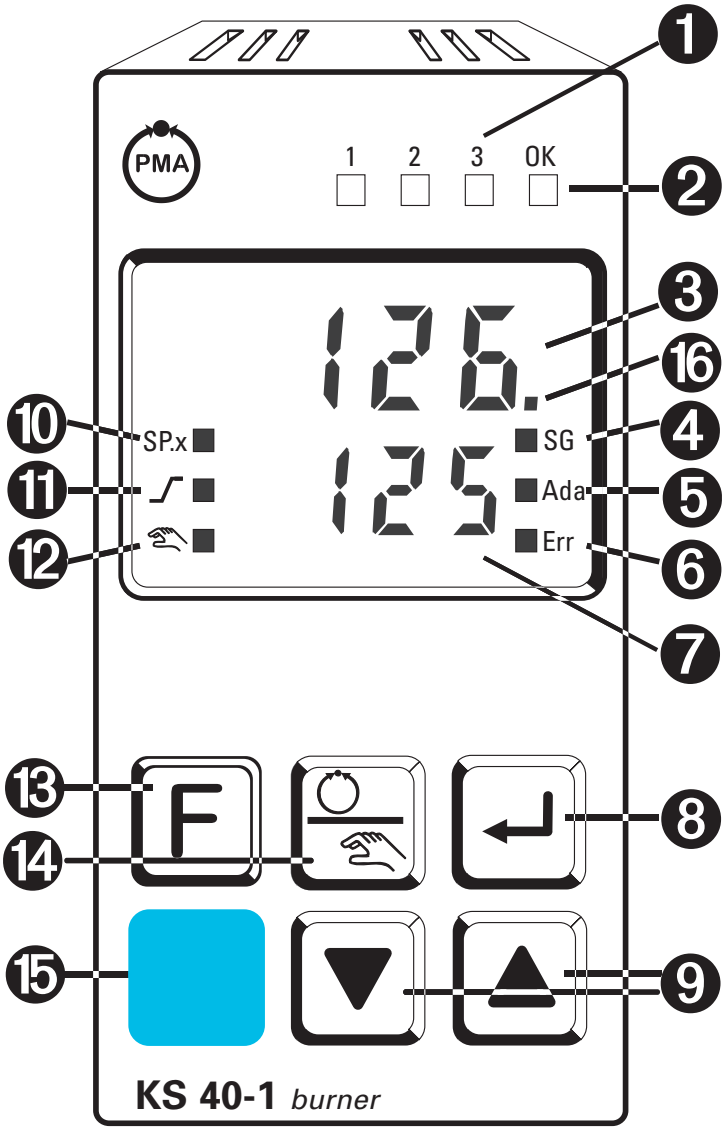
See input INP1.

Connection of inputs di2/di3

Digital input di2 for external switching between SP and SP.2 (SP/SP2).
Digital input di3 for external switching between 3-point-stepping controller and on/off controller (DPS/SG).

3 Operation

3.1 *Front view*

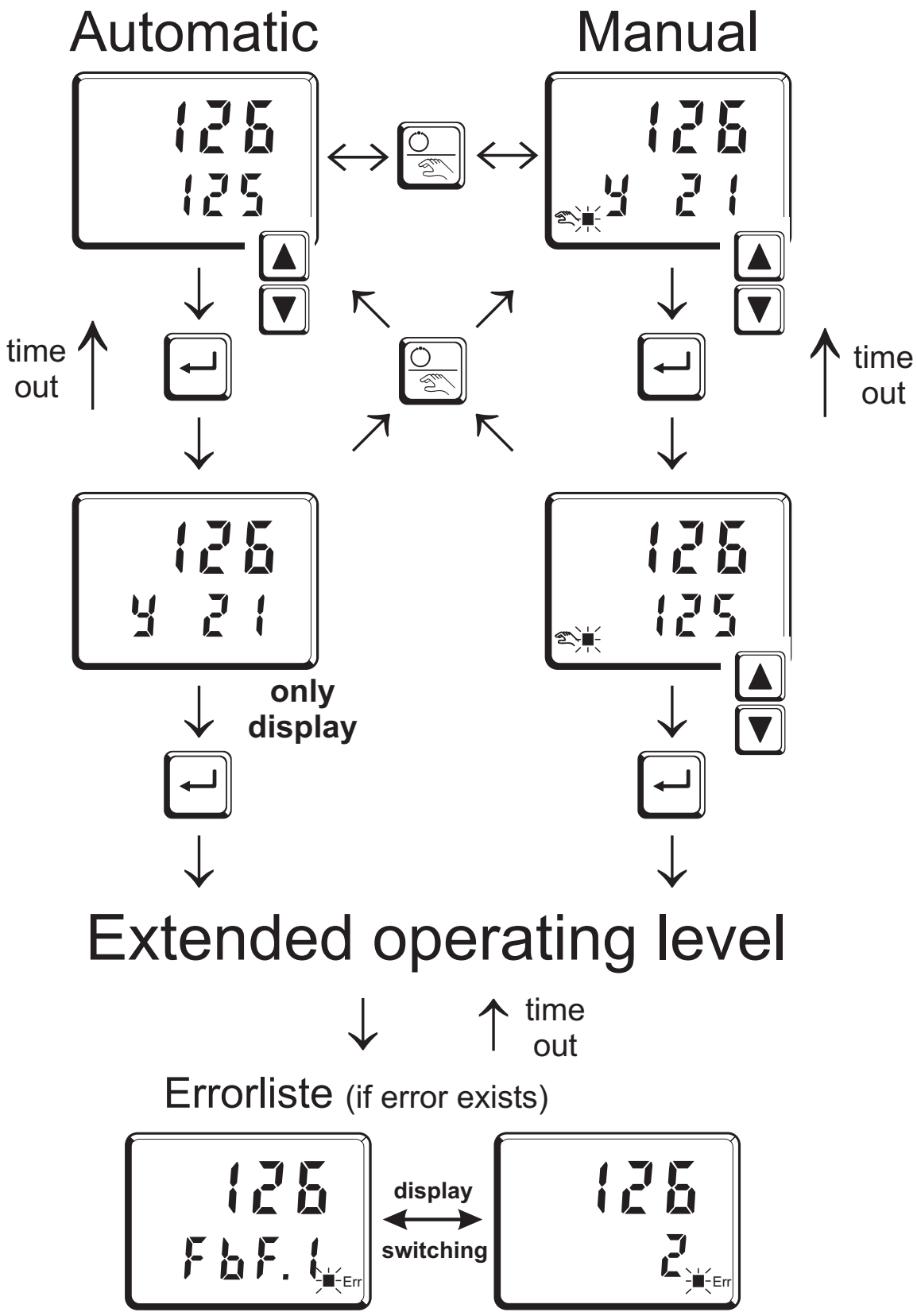


❶ Status of switching outputs
Out.1 ... 3
❷ Lit with limit value 1 not exceeded
❸ Process value display
❹ Controller works as on/off controller
❺ Self-tuning active
❻ Entry in error list
❼ Set-point, controller output
❽ Enter key:
calls up extended operating level / error list
❾ Up/down keys:
changing the set-point or the controller output value
❿ Set-point SP.2 or SP.E is effective
⓫ Set-point gradient effective
⓬ Manual mode
⓭ Function key
⓮ Manual-automatic-mode switching (⓬)
⓯ PC connection for BlueControl (engineering tool)
⓰ Signalization
PArA level (burns)
ConF level (blinks)

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.

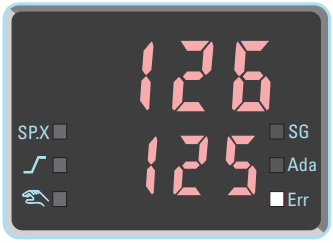
3.2 *Operating level*

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.



Maintenance manager / Error list

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 ↵ twice.



Err LED status	Signification	Proceed as follows
blinks	Alarm due to existing error	- Determine the error type in the error list via the error number - Remove the error
lit	Error removed, Alarm not acknowledged	- Acknowledge the alarm in the error list pressing key ▲ or ▼ - The alarm entry was deleted.
off	No error,all alarm entries deleted	

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
FbE.1 /2	Sensor break INP1 / 2	- Sensor defective - Faulty cabling	- Replace INP1 / 2 sensor - Check INP1 / 2 connection
ShE.1 /2	Short circuit INP1 / 2	- Sensor defective - Faulty cabling	- Replace INP1/ 2 sensor - Check INP1 / 2 connection
POL.1	INP1 polarity error	- Faulty cabling	- Reverse INP1 polarity
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
AdAH	Self-tuning heating alarm (ADAH)	- See Self-tuning heating error status	- see Self-tuning heating error status
L im.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

Error status (error status 3 - 9 only with error AdA.H / AdA.C):

Error status		Signification
0	No error/message	not visible, except with acknowledgement
1	Stored error	Change to error status 0 after acknowledgement in error list
2	Existing error	Change to error status 1 after error removal
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 (AdA.H) max. output limiting Y.H1 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.H1 or reduce (AdA.C) min. output limiting Y.Lo
8	Set-point reserve too small	Increase set-point (invers), reduce set-point (direct) or increase set-point range (→ PArA / SEtP / SP.LO and SP.H1)
9	Impulse tuning failed	The control loop is perhaps not closed: check sensor, connections and process

3.3 *Self-tuning*

After starting by the operator, the controller makes a self-tuning attempt. The controller uses the process characteristics for quick line-out to the set-point without overshoot.

t1 and td are taken into account only, if they were not set to OFF previously.

Self-tuning start

The operator can start self-tuning at any time. For this, keys ↵ and ▲ must be pressed simultaneously. The AdA LED starts blinking.
The controller outputs 0% or Y.Lo, waits until the process is at rest and starts self-tuning (AdA LED lit permanently).

The self-tuning attempt is started when the following prerequisite is met:

- The difference between process value ↔ set-point must be ≥ 10% of the set-point range (SP.H1 - SP.LO) (with inverse action: process value smaller than set-point, with direct action: process value higher than set-point).

After successful self-tuning, the AdA-LED is off and the controller continues operating with the new control parameters.

Self-tuning cancellation by the operator:

Self-tuning can always be cancelled by the operator. For this, press ↵ and ▲ key simultaneously. The controller continues operating with the old parameters in automatic mode in the first case and in manual mode in the second case.

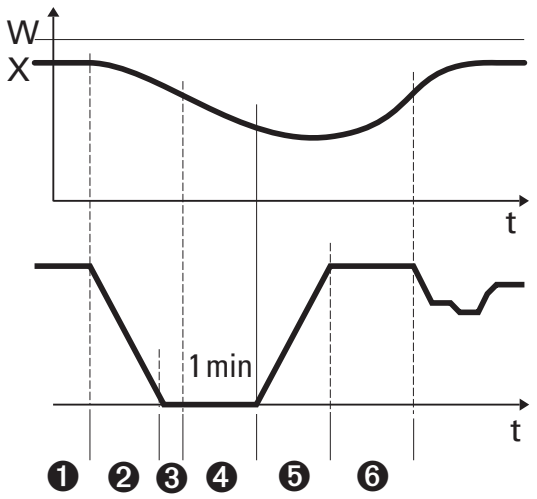
Self-tuning cancellation by the controller:
If the Err LED starts blinking while self-tuning is running, successful self-tuning is prevented due to the control conditions. In this case, self-tuning was cancelled by the controller. The controller switches off its outputs (controller output 0%).

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* ↵ *:*
   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 9: "Error status self-tuning heating (RdR.H) and cooling (RdR.C)"

Examples for self-tuning attempt 3-point-stepping controller

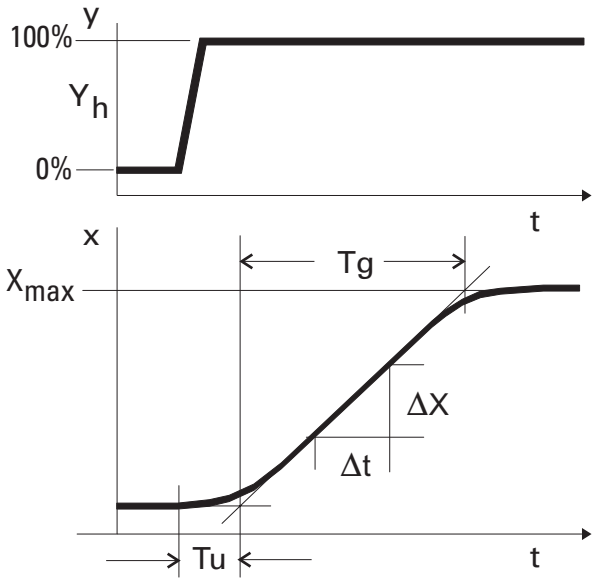
After the start (❶) the controller closes the actuator (❷ Out.3). When the difference between process value and set-point is big enough (❸), the changing of the process value is monitored for 1 min. (❹). Afterwards the actuator is opened (❺ Out.1). If the reversal point is reached (❻) or there are made enough measurements, the parameters are detected and are adopted.



3.4 *Manual tuning*

The optimization aid should 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

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

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
t.1	higher	increased damping	slower line-out	slower reduction of duty cycle
	lower	reduced damping	faster line-out	faster reduction of duty cycle

Formulas

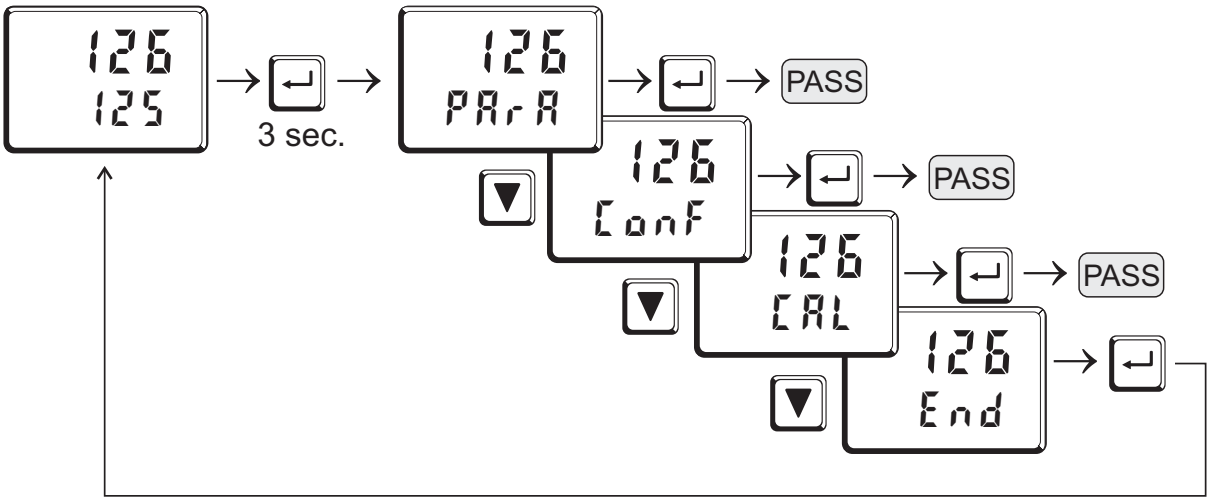
K = Vmax * Tu

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]	t.1 [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

3.5 *Operating structure*

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



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

ConF - level: At **ConF** - level, the right decimal point of upper display line *blinks*

PASS All levels are accessible only by entering the Password (**PASS**). If the safety switch **Loc** is open all levels are disabled

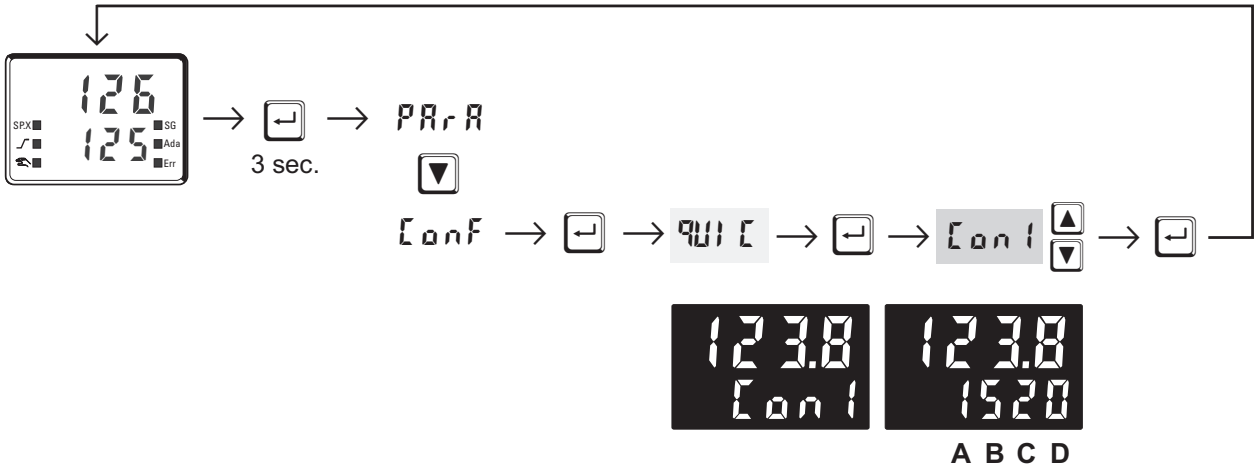
To get access to the configuration and the parameters the saftey switch Loc must be closed (factory setting).

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 with* QUICK

At configuration level, the controller function is determined by changing configuration word Con1. Con1 and the code adjusted for Con1 are displayed alternately on the lower display line.



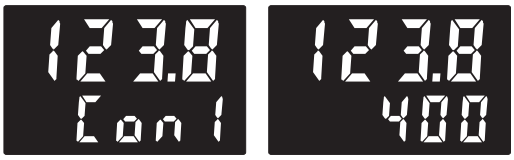
Code signification:

A	0	Reaction at sensor break as process value higher than set-point.
	1	Reaction at sensor break as process value smaller than set-point
	2	Only P30/W connection, always process value smaller than set-point *
B	0	Potentiometric transducer 50-30-50 Ω / pressure sensor 0..10V, display range 0,0...100,0 (%)
	1	Potentiometric transducer 50-30-50 Ω / pressure sensor 0..10V, display range 0,00...1,00 (bar)
	2	Potentiometric transducer 50-30-50 Ω / pressure sensor 0..10V, display range 0,0...16,0 (bar)
	3	Potentiometric transducer 50-30-50 Ω / pressure sensor 0..10V, display range 0,0...40,0 (bar)
	4	Resistance thermometer Pt 100 Ω , range 0...200°C
	5	Resistance thermometer Pt 100 Ω , range 0...400°C
	6	Thermocouple type L, range 0...900°C
	7	Thermocouple type K, range 0...1350°C
C	0	Signaller with switching
	1	3-point signaller
	2	3-point stepping controller (DPS) switchable to signaller (SG)
	3	3-point stepping controller (DPS) switchable to 3-point signaller (SG)
D	0	Not changeable
* Only possible with A = 2 and B = 0 … 3		

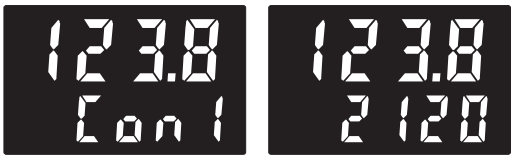
After exit from the configuration level (see page 43, the controller is re-initialized (all display elements are lit) and changes over to normal operation (operating level).

Leading zeros are not displayed (ex.: display 400 with code 0400)

Configuration example 1 (code 0400):
KS40-1 as a signaller with
switch-over contact for 2-stage burner:
Measuring range 0...200°C,
Resistance thermometer Pt 100,
Reaction at sensor break
as process value higher than set-point.



Configuration example 2 (code 2120):
KS40-1 as 3-point stepping controller:
Connection to pressure transmitter P30/W,
Measuring range 0,00...1,00 bar,
Reaction at sensor break as process value
smaller than set-point.



Function: Signaller with switch-over contact

CAUTION: The two relays 1 and 2 are coupled, i.e. the contacts have switch-over function. Ensure that the two relays are not energized or de-energized simultaneously. Exception: de-energized condition.

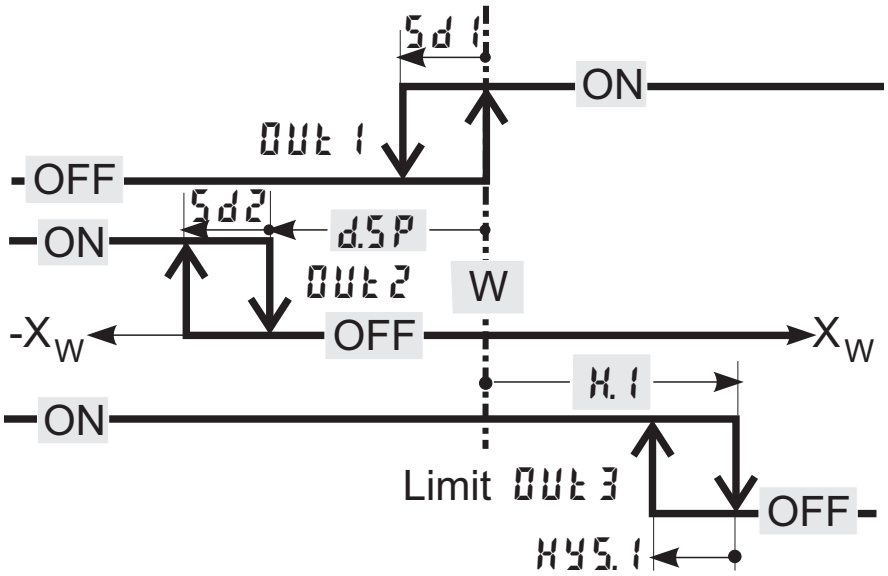
Settings:

Switching differences: Sd 1: in physical values
Limit value OUt3: The relay is de-energized when exceeding the limit.
Upper limit value H.1 : in units of phys. quantity.
Switching difference HYS.1 : in units of phys.quantity

Signalling LEDs:
LED1: lit when Out 1 is energized
LED2: lit when Out2 is energized
LED3: lit when Out3 is energized
OK-LED: lit, unless the limit value is reached

Parameter: see chapter 5 “Parameter level”

Function: 3-point signaller

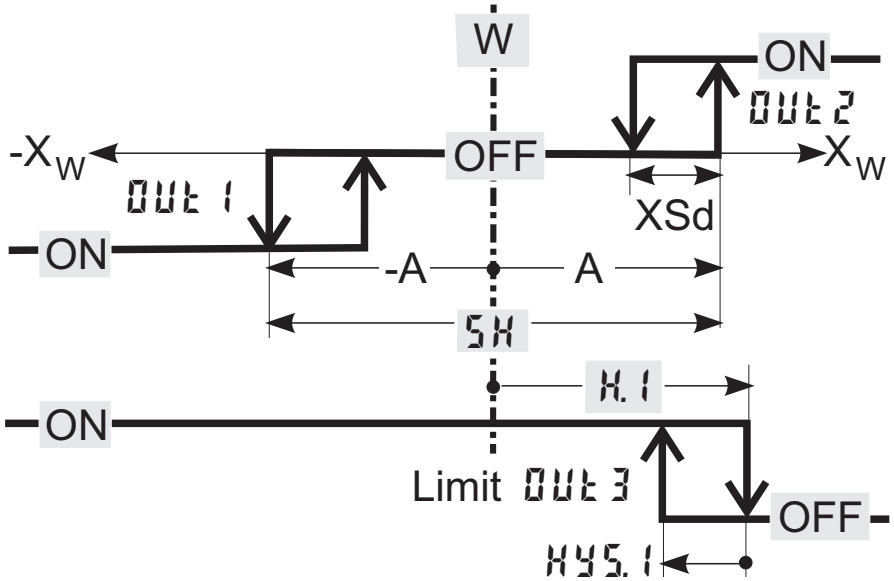


Settings:

OUt 1:	Switch-on point is coupled with the set-point. Switching difference Sd 1: in units of phys. quantity.
OUt2:	Switch-off point is always below the set-point! Adjustment range d.SP : in units of phys. quantity Switching difference Sd2: in units of phys. quantity.
Limit value OUt 3:	With the limit value exceeded, the relay is de-energized. High limit value H.1: in units of phys. quantity. Switching difference HYS.1: in units of phys.quantity.
Signal LEDs:	LED1: lit, when OUt 1 is energized LED2: lit, when OUt 2 is energized OK LED: lit, when limit value not reached

Parameters: see chapter 5 “Parameter level”

Function: 3-point stepping controller



Settings:

Controller:
SH: in units of phys. quantity
Response threshold A: 0,5 • SH
Switching difference XSd : 0,06 • SH + 0,08
Actuator travel time tt: 3...9999 s
Min.duty cycle: fixed, TEmin = 100 ms

Control parameters:
Pb 1 = 0,01...9999 : in unit of phys. quantity °C or °F
(number of digits behind the decimal point is determined by CON 1)
t 1 = 1...9999 s (OFF = no I-action)
td = 1...9999 s (OFF = no D-action)

Limit value OUt3:
With exceeded limit value, the relay is de-energized.
High limit value H.1 : in units of phys. quantity
Switching difference HYS.1 : in units of phys. quantity

Signalling LEDs:
LED1: lit when OUt 1 is energized
LED2: lit when OUt2 =S energized
OK LED: lit, unless limit value is reached

De-energized condition: all relays de-energized, contacts open

Parameters: see chapter 5 “Parameter level”

4.2 *Configuration without QUIC (QUIC=OFF)*

When key ↵ is kept pressed during controller supply voltage switch-on, the configuration is switched off with QUIC.
Now, all configuration settings are available to the user.

For changing back to configuration with QUIC, the two keys ▼ ▲ must be kept pressed during controller supply voltage switch-on.

⚠ **Hereby, the controller is reset to the factory-set default values !**

4.3 *Configuration survey:*

Con1

Name	Value range	Description	Default	Own setting
Con1	0000...2330	**QUIC - Configuration**	0000	

Wire hook switches (on electronic card)

Name	Value range	Description	Default	Own setting
Loc	open or closed	**Wire hook switch for locking the ConF - and PArA - level (if enabled with BlueControl)**	closed	
InP.1	mA/Pt or 10V	**Wire hook switch for chosing InP.1 signal type**	mA/Pt	

Cntr

Name	Value range	Description	Default	Own setting
SP.Fn		**Basic configuration of setpoint processing**	0	
	0	set-point controller can be switched over to external set-point (-> LOCI / SP.E)		
	1	programmer		
	8	standard controller with external offset (SP.E)		
C.Fnc		**Control behavior (algorithm)**	0	
	0	2-point signaller		
	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		
	7	3-point signaller		
	8	3-point stepping controller switchable to signaller		
	9	3-point stepping controller switchable to 3-point signaller		
mAn		**Manual operating permitted**	1	
	0	no		
	1	yes (see also LOCI / mAn)		
C.Act		**Method of controller operation**	0	
	0	Inverse, e.g. heating		
	1	Direct, e.g. cooling		

Name	Value range	Description	Default	Own setting
FAIL		**Behavior at sensor break**	1	
	0	Controller outputs switched of		
	1	y = Y2		
	2	y = mean output. The maximum permissible output can be adjusted with parameter YnH. To prevent determination of inadmissible values, mean value formation is only if the control deviation is lower than parameter L.Yn.		
rnGL	-1999...9999	**X0 (low limit range of control)** ❶	0	
rnGH	-1999...9999	**X100 (high limit range of control)** ❶	100	

❶ rnGL and rnGH indicate the control range to which e.g. self-tuning is related.

InP.1

Name	Value range	Description	Default	Own setting
S.tYP		**Sensor type selection**	50	
	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%		
	20	Pt100 (-200,0 ... 100,0 °C)		
	21	Pt100 (-200,0 ... 850,0 °C)		
	22	Pt1000 (-200,0...200,0 °C)		
	23	KTY 11-6 (special 0...4500 Ohm)		
	30	0...20mA / 4...20mA ❷		
	40	0...10V / 2...10V ❷		
	50	Potentiometer 0...160 Ohm ❷		
	51	Potentiometer 0...450 Ohm ❷		
	52	Potentiometer 0...1600 Ohm ❷		
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.		
Corr		**Measured value correction (scaling**	2	
	0	Without scaling		
	1	Offset correction (at CAL level)		
	2	2- point correction (at CAL level)		
	3	Scaling (at PArA level)		

❷ With current, voltage or potentiometer input signals, scaling is required (see section 5.1).

InP.2

Name	Value range	Description	Default	Own setting
1.Fnc		**Function selection of INP2**	0	
	0	No function		
	2	External set-point SP.E (switching -> LOGI / SP.E)		
SEnP		**Sensor type selection**	30	
	20	Pt100 (-200,0 ... 100,0 °C)		
	21	Pt100 (-200,0 ... 850,0 °C)		
	22	Pt1000 (-200,0...200,0 °C)		
	30	0...20mA / 4...20mA ❶		
	50	Potentiometer (0...160 Ohm) ❶		
	51	Potentiometer (0...450 Ohm) ❶		
	52	Potentiometer (0...1600 Ohm) ❶		
Corr		**Measured value correction / scaling**	0	
	0	Without scaling		
	1	Offset correction (at CAL level)		
	2	2-point correction (at CAL level)		
	3	Scaling (at PArA level)		

❶ With current or potentiometer input signals, scaling is required (see section 5.1).

Lim

Name	Value range	Description	Default	Own setting
Fnc.1		**Function of limit 1 / 2 / 3**	1 / 0 / 0	
Fnc.2	0	Switched off		
Fnc.3	1	Measured value monitoring		
	2	Measured value monitoring + alarm status storage. A stored limit value can be reset via error list, -key or a digital input (-> LOGI / Errr)		
Src.1		**Source of limit 1 / 2 / 3**	1 / 0 / 0	
Src.2	0	Process value = absolut alarm		
Src.3	1	Control deviation Xw (process value - set-point) relativ alarm		
	2	Control deviation Xw (relativ alarm) with suppression after start-up and set-point change		
	6	Effective set-point Weff		
	7	Correcting variable (controller output)		
LPAL		**Monitoring of control loop interruption**	0	
	0	Switched off		
	1	LOOP alarm active		

Out.1 / 2 / 3

Name	Value range	Description	Default	Own setting
O.Act		**Method of operation of output OUT1**	Out.1: 0 Out.2: 0 Out.3: 1	
	0	Direct / normally open		
	1	Inverse / normaly closed		
Y.1 Y.2		**Controller output Y1 / Y2**	Out.1: 1 / 0 Out.2: 0 / 1 Out.3: 0 / 0	
	0	Not active		
	1	Active		
Lim.1 Lim.2 Lim.3		**Limit 1 / 2 / 3 signal**	Out.1: 0 / 0 / 0 Out.2: 0 / 0 / 0 Out.3: 1 / 0 / 0	
	0	Not active		
	1	Active		
LP.AL		**Interruption alarm signal (LOOP)**	Out.1: 0 Out.2: 0 Out.3: 0	
	0	Not active		
	1	Active		
FA.1 FA.2		**INP1 / INP2 error signal**	Out.1: 0 / 0 Out.2: 0 / 0 Out.3: 1 / 0	
	0	Not active		
	1	Active		

LOCI

Name	Value range	Description	Default	Own setting
L.r		**Local / Remote switching (Remote: adjusting of all values by front keys is blocked)**	0	
	0	No function		
	1	Always active		
	3	DI2 switches *		
	4	DI3 switches *		
	5	F key switches *		
SP.2		**Switching to second set-point SP.2**	3	
	0	No function		
	3	DI2 switches *		
	4	DI3 switches *		
	5	F key switches *		
SP.E		**Switching to external set-point SP.E**	0	
	0	No function		
	1	Always active		
	3	DI2 switches *		
	4	DI3 switches *		
	5	F key switches *		
Y2		**Y/Y2 switching**	0	
	0	No function		
	3	DI2 switches *		
	4	DI3 switches *		
	5	F key switches *		
	6	key switches *		

Name	Value range	Description	Default	Own setting
nAn		**Automatic/manual switching**	6	
	0	No function		
	1	Always active		
	3	DI2 switches *		
	4	DI3 switches *		
	5	F key switches *		
	6	key switches *		
C.oFF		**Switch of the controller**	0	
	0	No function		
	3	DI2 switches *		
	4	DI3 switches *		
	5	F key switches *		
	6	key switches *		
n.Loc		**Blocage of the key**	0	
	0	No function		
	3	DI2 switches *		
	4	DI3 switches *		
	5	F key switches *		
Err.r		**Reset of all error list entries**	0	
	0	No function		
	3	DI2 switches *		
	4	DI3 switches *		
	5	F key switches *		
	6	key switches *		
SG		**Switching of the controller behavior between 3-point-stepping controller and signaller**	4	
	0	No function		
	3	DI2 switches *		
	4	DI3 switches *		
	5	F key switches *		
P.run		**Programmer Run/Stop**	5	
	0	No function		
	3	DI2 switches *		
	4	DI3 switches *		
	5	F key switches *		
d.Fn		**Function of digital inputs (valid for all inputs)**	0	
	0	Direct		
	1	Inverse		
	2	Toggle key function		

* Multiple switching is possible and should be excluded on demand.

otHr

Name	Value range	Description	Default	Own setting
Unit		**Unit**	1	
	0	Without unit		
	1	°C		
	2	°F		
dP		**Decimal point (max. number of digits behind the decimal point)**	0	
	0	No digit behind decimal point		
	1	1 digit behind decimal point		
	2	2 digits behind decimal point		
	3	3 digits behind decimal point		
C.dEL	0...200	**Modem delay [ms]**	0	

5 Parameter setting level

CntR

Visible with QUIC	Name	Value range	Description	Default	Own setting
✘	Pb1	1...9999	Proportional band 1 (heating) in phys. dimensions (e.g. °C)	10	
	Pb2	1...9999	Proportional band 2 (cooling) in phys. dimensions (e.g. °C)	10	
✘	t.i1	1...9999	Integral action time 1 (heating) [s]	10	
	t.i2	1...9999	Integral action time 2 (cooling) [s]	10	
✘	td1	1...9999	Derivative action time 1 (heating) [s]	10	
	td2	1...9999	Derivative action time 2 (cooling) [s]	10	
	t1	0,4...9999	Minimal cycle duration 1 (heating) [s]. The minimum impulse is 1/4 x t1	10	
	t2	0,4...9999	Minimal cycle duration 2 (heating) [s]. The minimum impulse is 1/4 x t2	10	
✘	SH	0...9999	Dead zone or switching differential for on-off control [phys. dimensions)	1	
✘	Sd1	0,0...9999	Switching differntial relais 1 for signaller with partial/full load switch-over	0,1	
✘	Sd2	0,0...9999	Switching differntial relais 2 for 3-point signaller	0,1	
✘	d.SP	-1999...9999	Trigger point speration for series contact Δ / Y / Off [phys. dimensions]	0	
✘	tP	0,1...9999	Minimum impulse [s]	OFF	
✘	tt	3...9999	Actuator response time for servo-motor [s]	60	
	Y.Lo	-120...120	Lower output limit [%]	0	
	Y.Hi	-120...120	Upper output limit [%]	100	
	Y2	-120...120	2. correcting variable	0	
	Y.0	-120...120	Working point for the correcting variable [%]	0	
	Yn.H	-120...120	Limitation of the mean value Ym [%]	5	
	L.Yn	0...9999	Max. deviation xw at the start of mean value calculation [phys. dimensions]	8	

SEtP

Visible with QUIC	Name	Value range	Description	Default	Own setting
	SP.Lo	-1999...9999	Set-point limit low for Weff	0	
	SP.Hi	-1999...9999	Set-point limit high for Weff	100	
✘	SP.2	-1999...9999	Set-point 2.	20	
	r.SP	0...9999	Set-point gradient [/min]	OFF	

PrOG

Visible with QUICK	Name	Value range	Description	Default	Own setting
	SP.01	-1999...9999	Segment end set-point 1	100	
	Pt.01	0...9999	Segment time 1 [min]	10	
	SP.02	-1999...9999	Segment end set-point 2	100	
	Pt.02	0...9999	Segment time 2 [min]	10	
	SP.03	-1999...9999	Segment end set-point 3	200	
	Pt.03	0...9999	Segment time 3 [min]	10	
	SP.04	-1999...9999	Segment end set-point 4	200	
	Pt.04	0...9999	Segment time 4 [min]	10	

InP.1

Visible with QUICK	Name	Value range	Description	Default	Own setting
	InL.1	-1999...9999	Input value for the lower scaling point	38,5	
	OuL.1	-1999...9999	Displayed value for the lower scaling point	0	
	InH.1	-1999...9999	Input value for the upper scaling point	61,5	
	OuH.1	-1999...9999	Displayed value for the lower scaling point	100	
	t.F 1	-1999...9999	Filter time constant [s]	0,5	

InP.2

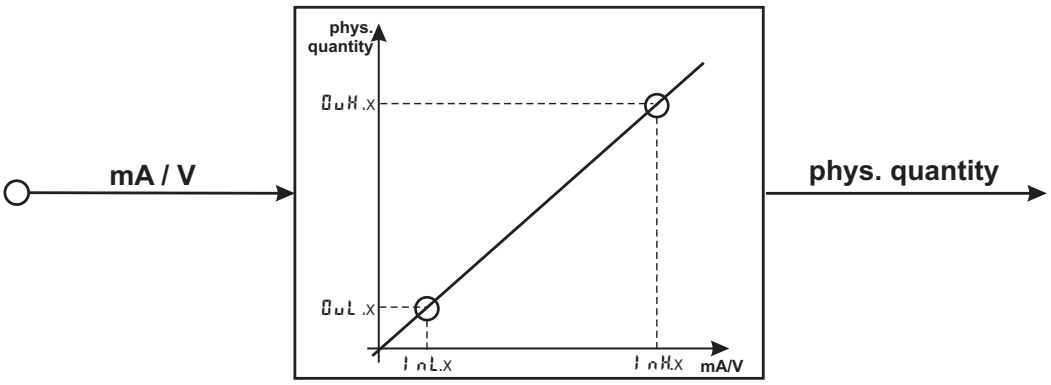
Visible with QUICK	Name	Value range	Description	Default	Own setting
	InL.2	-1999...9999	Input value for the lower scaling point	0	
	OuL.2	-1999...9999	Displayed value for the lower scaling point	0	
	InH.2	-1999...9999	Input value for the upper scaling point	100	
	OuH.2	-1999...9999	Displayed value for the upper scaling point	100	

Lim

Visible with QUICK	Name	Value range	Description	Default	Own setting
	L.1	-1999...9999	Lower limit 1	OFF	
✘	H.1	-1999...9999	Upper limit 1	20	
✘	HYS.1	0...9999	Hysteresis limit 1	0,1	
	L.2/3	-1999...9999	Lower limit 2 / 3	OFF	
	H.2/3	-1999...9999	Upper limit 2 / 3	OFF	
	HYS.2/3	0...9999	Hysteresis limit 2 / 3	0,1	

5.1 *Input scaling (only visible with* $\mathrm{QUI\,C} = \mathrm{OFF}$ *)*

When using current or voltage signals as input variables for $\mathrm{In.1}$ or $\mathrm{In.2}$, 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).



5.1.1 Input $\mathrm{In.1}$

Parameters $\mathrm{In.1}$, $\mathrm{OuL.1}$, $\mathrm{InH.1}$ and $\mathrm{OuH.1}$ are only visible if Conf / $\mathrm{In.1}$ / $\mathrm{Corr} = 3$ is chosen.

SEnS	Input signal	InL.1	OuL.1	InH.1	OuH.1
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

In addition to these settings, $\mathrm{InL.1}$ and $\mathrm{InH.1}$ can be adjusted in the range (0...20mA / 0...10V) determined by selection of SEnS .

For using the predetermined scaling with thermocouple and resistance thermometer (Pt100), the settings for $\mathrm{InL.1}$ and $\mathrm{OuL.1}$ and for $\mathrm{InH.1}$ and $\mathrm{OuH.1}$ must have the same value.

Input scaling changes at calibration level (→ page 27) are displayed by input scaling at parameter setting level. After calibration reset (OFF), the scaling parameters are reset to default.

5.1.2 Input $\mathrm{In.2}$

As input $\mathrm{In.1}$, but only $\mathrm{SEnS} = 30$ adjustable!

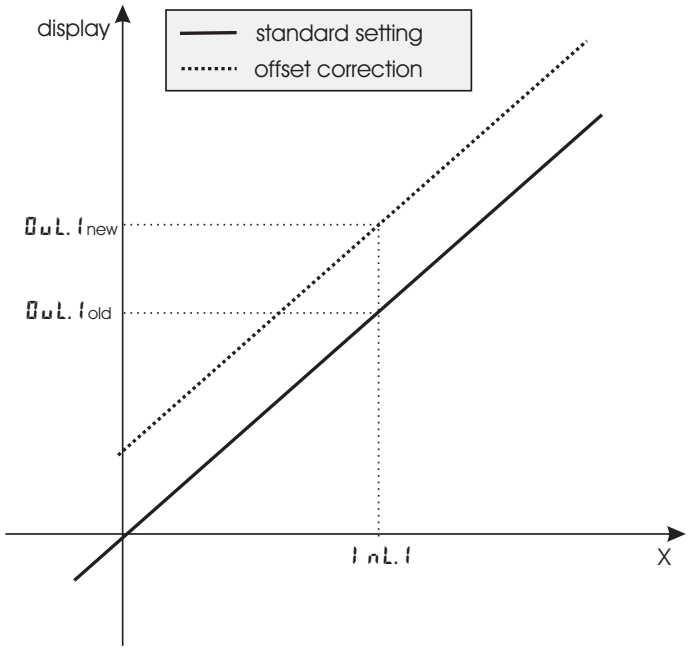
6 Calibration level

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

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

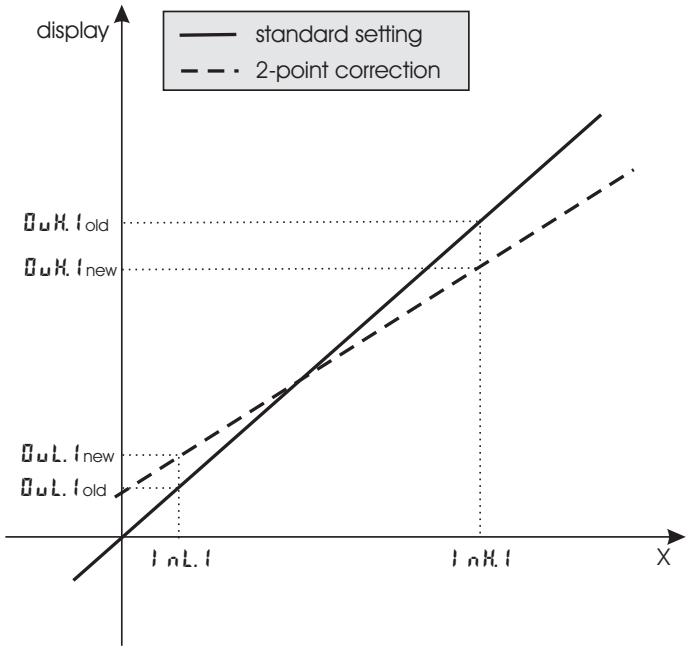
Offset correction
(ConF / InP.1 / Corr = 1):

- possible on-line at the process

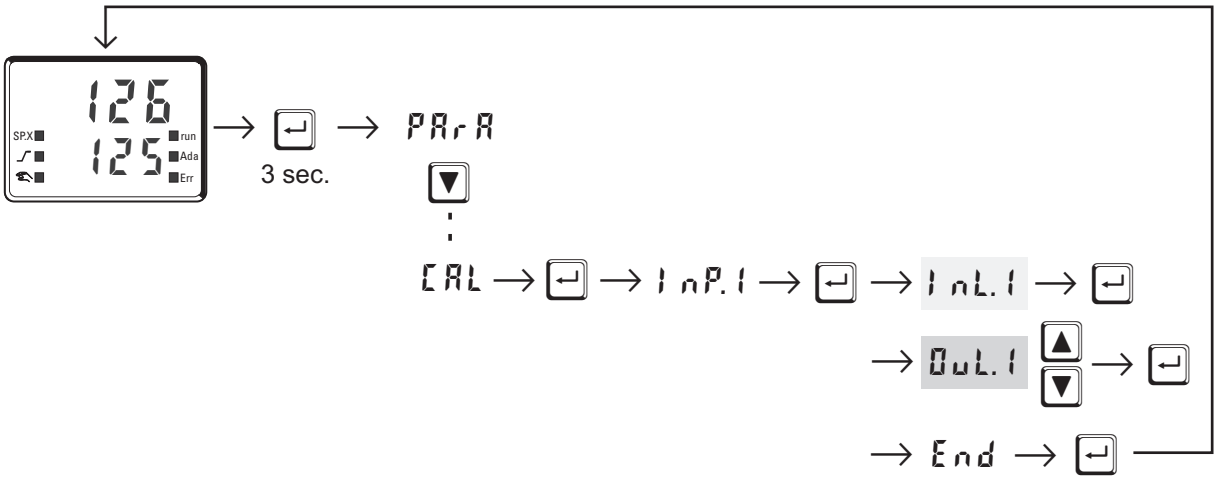


2-point correction
(ConF / InP.1 / Corr = 2):

- is possible off-line with process value simulator



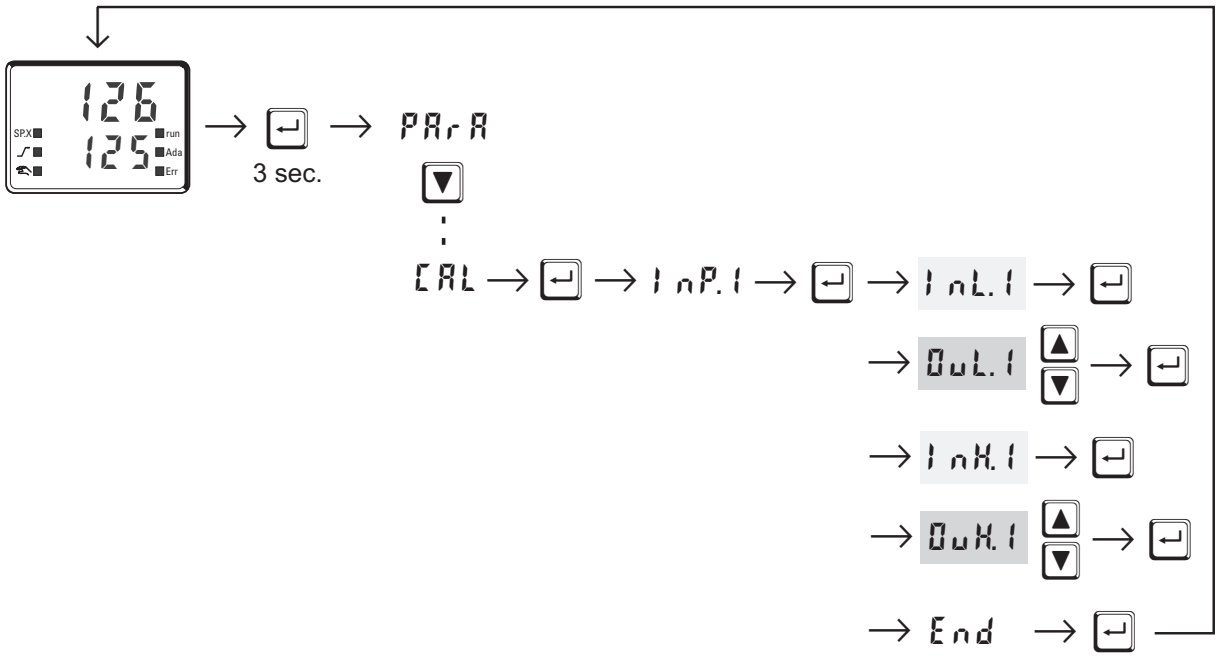
Offset correction **(ConF / InP.1 / Corr = 1):**



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 ↵.

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 ▲▼ .
Subsequently, he confirms the display value by pressing key ↵.

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



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 ↵.

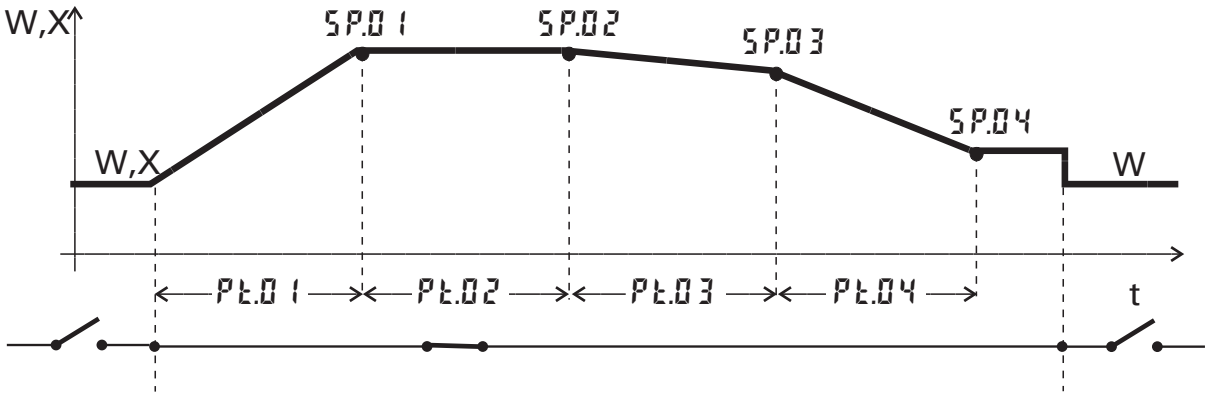
OuL.1: The display value of the lower scaling point is displayed.
Before calibration, OuL.1 equals InL.1.
The operator can correct the lower display value by pressing the ▲▼ keys. Subsequently, he confirms the display value by pressing key ↵.

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 ↵.

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 ▲▼
Subsequently, he confirms the display value by pressing key ↵.

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 ▼ .

7 Programmer



Programmer set-up:
For using the controller as a programmer, select parameter SPFn = 1 in the ConF menu. The programmer is started via one of digital inputs di2..3 or the F key. Which input shall be used for starting the programmer is determined by selecting parameter Prun = 3 / 4 / 5 in the ConF menu accordingly.
For assigning the program end as a digital signal to one of the relay outputs, parameter PEnd = 1 must be selected for the relevant output OUt.1...OUt.3 in the ConF menu.

Programmer parameter setting:
A programmer with 4 segments is available to the user. Determine a segment duration Pt.01 .. Pt.04 (in minutes) and a segment target set-point SP.01 .. SP.04 for each segment in the PArA menu.

Starting/stopping the programmer:
Starting the programmer is done by a digital signal at input di2..3 or by pressing the F key selected by parameter Prun .
The programmer calculates a gradient from segment end setpoint and segment time. This gradient is always valid. Normaly, the programmer starts the first segment at process value. Because of this the effective run-time of the first segment may differ from the at PArA level setted segment time (process value ≠ set-point).
After program end, the controller continues controlling with the target set-point set last.
If the program is stopped during execution (signal at digital input di2..3 or the F key is taken away), the programmer returns to program start and waits for a new start signal.

Program parameter changing while the program is running is possible.

Changing the segment time:
Changing the segment time leads to re-calculation of the required gradient. When the segment time has already elapsed, starting with the new segment is done directly, where the set-point changes with a step.

Changing the segment end setpoint:
Changing the set-point leads to re-calculation of the required gradient, in order to reach the new set-point during the segment rest time, whereby the required gradient polarity sign can change.

8 Technical data
9

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

→ Table 2 (page 58)

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

Cold-junction compensation

Maximal additional error:	0,5 K

Sensor break monitoring

Sensor current:	≤ 1 μA
Configurable output action	

Resistance thermometer

→ Table 2 (page 58)

Connection:	2 or 3-wire
Lead resistance:	max. 30 Ohm
Input circuit monitor:	break and short circuit

Potentiometric transducer 50-30-50

Current and voltage signals

→ Table 3 (page 58)

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
Accuracy:	< 0,5 %

Current measuring range

Technical data as for INP1

Potentiometer

→ Table 2 (page 58)

Connection:	3-wire
Lead resistance:	max. 30 Ohm
Input circuit monitor:	break

CONTROL INPUT DI2/DI3

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

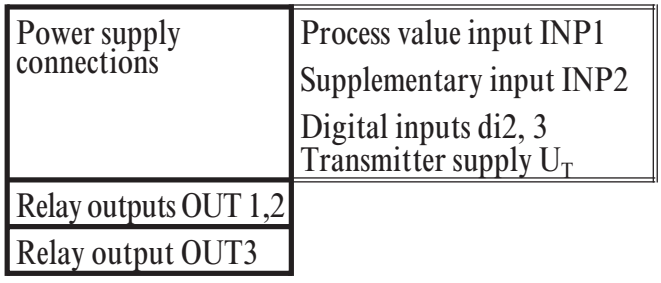
Switched voltage:	5 V
Current:	160 μA

TRANSMITTER SUPPLY U_T (OPTION)

Power:	22 mA / ≥ 18 V

GALVANIC ISOLATION

—— Safety isolation
═══ Function isolation



OUTPUTS

RELAY OUTPUTS OUT1, OUT2

Contact type:	2 NO contacts with common connection
Max. contact rating:	500 VA, 250 V, 2A at 48...62 Hz, resistive load
Min. contact rating:	6V, 1 mA DC
Operating life (electr.):	800.000 duty cycles with max. rating

RELAY OUTPUT OUT3

Contact type:	potential-free changeover contact
Max.contact rating:	500 VA, 250 V, 2A at 48...62 Hz, resistive load
Min. contact rating:	5V, 10 mA AC/DC
Operating life (electr.):	600.000 duty cycles with max. contact rating

Note:
If the relays OUT1...OUT3 operate external contactors, these must be fitted with RC snubber circuits to manufacturer specifications to prevent excessive switch-off voltage peaks.

POWER SUPPLY

AC SUPPLY

Voltage:	90...260 V AC
Frequency:	48...62 Hz
Power consumption	approx. 7,0 VA

BEHAVIOUR WITH POWER FAILURE

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

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 V0, 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

cUL certification

(Type 4x, indoor use)
File: E 208286

For compliance with cUL certificate,the following information must be taken into account:

- Use only 60 / 75 or 75°C copper (Cu) wire.
- Tighten the terminal- screws with a torque of 0,5 - 0,6 Nm

Electrical connections

Flat-pin connectors 1 x 6,3 mm or 2 x 2,8 mm to DIN 46 244

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

Type		Range		Accuracy	Resolution (∅)
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 100°C

Table 2 Resistance transducer measuring ranges

Type	Sensor current	Range		Accuracy	Resolution (∅)
Pt100	0,2 mA	-200...100°C	-140...212°F	≤ 1K	0,1K
Pt100		-200...850°C	-140...1562°F	≤ 1K	0,1K
Pt1000		-200...200°C	-140...392°F	≤ 2K	0,1K
KTY 11-6 *		-50...150°C	-58...302°F	≤ 2K	0,05K
Spezial		0...4500		≤ 0,1 %	0,01 %
Spezial		0...450			
Poti		0...160			
Poti		0...450			
Poti		0...1600			

* Or special

Table 3 Current and voltage measuring ranges

Range	Input resistance	Accuracy	Resolution (∅)
0-10 Volt	≈ 110 kΩ	≤ 0,1 %	≤ 0,6 mV
0-20 mA	49 Ω (voltage requirement ≤ 2,5 V)	≤ 0,1 %	≤ 1,5 µA

10 Safety hints

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

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.

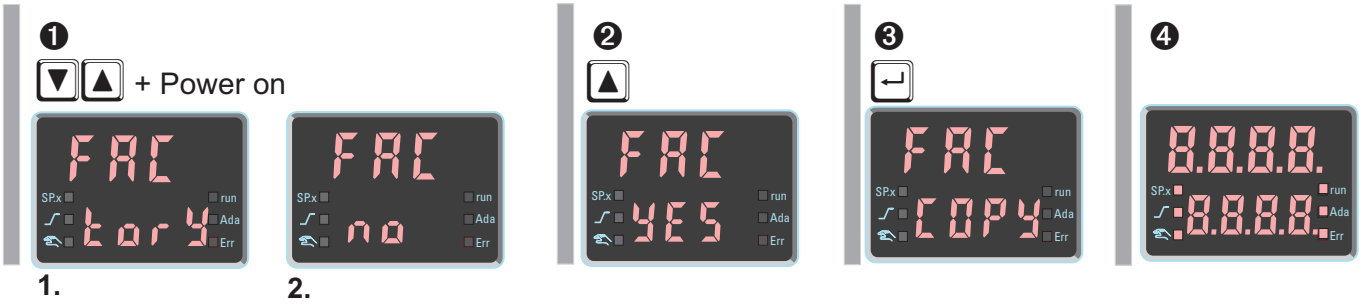
After completing this work, re-shut the unit and re-fit all covers and components. Check if specifications on the type label must be changed and correct them, if necessary.

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

10.1 *Resetting to factory setting*

In case of faultyconfiguration, KS4x-1 can be reset to the default condition.

For this, the operator must keep the keys increment and decrement pressed during power-on.
Then, press key increment to select YES.
Confirm factory resetting with Enter and the copy procedure is started (display COPY).
Afterwards the device restarts.



In all other cases, no reset will occur (timeout abortion).

If one of the operating levels was blocked and the safety lock is open, reset to factory setting is not possible.

If a pass number was defined (via BlueControl®) and the safety lock is open, but no operating level was blocked, enter the correct pass number when prompted in ❸. A wrong pass number aborts the reset action.

The copy procedure (COPY) can take some seconds.
Now, the transmitter is in normal operation.

Index

9499- 040- 66011

A6

A5 auf A6 gefaltet, 2-fach geheftet, SW-Druck Normalpapier weiß 80g/m^2