R1000 / R1040 / R1080

1 – Zone Temperature Controller: Heat-only
Heating-off-cooling
Three-point stepping

Installation depth: 60mm
DIN-Format: 96mm x 96mm / 48mm x 96mm / 96mm x 48mm

Description and operating manual

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1 Contents

2 General Information

Used symbols:

	Messages shown by the controller display
<§>	Symbolizes the value of the factory adjustment of the respective parameter.
>PID<	This parameter is available in PID controller mode only.
>DPS<	This parameter is available in Three-Point Stepping mode only.

3 Installation Instructions

Make sure that the device is used for the intended purpose only.
This controller is designed for installation in control panels.
Protect the device against impermissible humidity and contamination.

Ambient temperature must not exceed 50 °C (122 °F).
Electrical connections must be made according to valid regulations and by properly qualified personnel.

If using thermocouple sensors, compensation lines have to be connected directly to the controller terminals. Sensors may be connected only in compliance with the programmed range.

Sensor cables and signal lines (e.g. logic or linear voltage outputs) must be laid separately from control lines and mains voltage supply cables (power cables).

It is not permitted to connect the grounds of the sensor-inputs and logic-outputs with each other!

Separate installation of controller and inductive loads is recommended.
Interference from contactor coils must be suppressed by connecting adapted RC-combinations parallel to the coils.
Control circuits (e.g. for contactors) should not be connected to the mains power supply terminals of the controller.

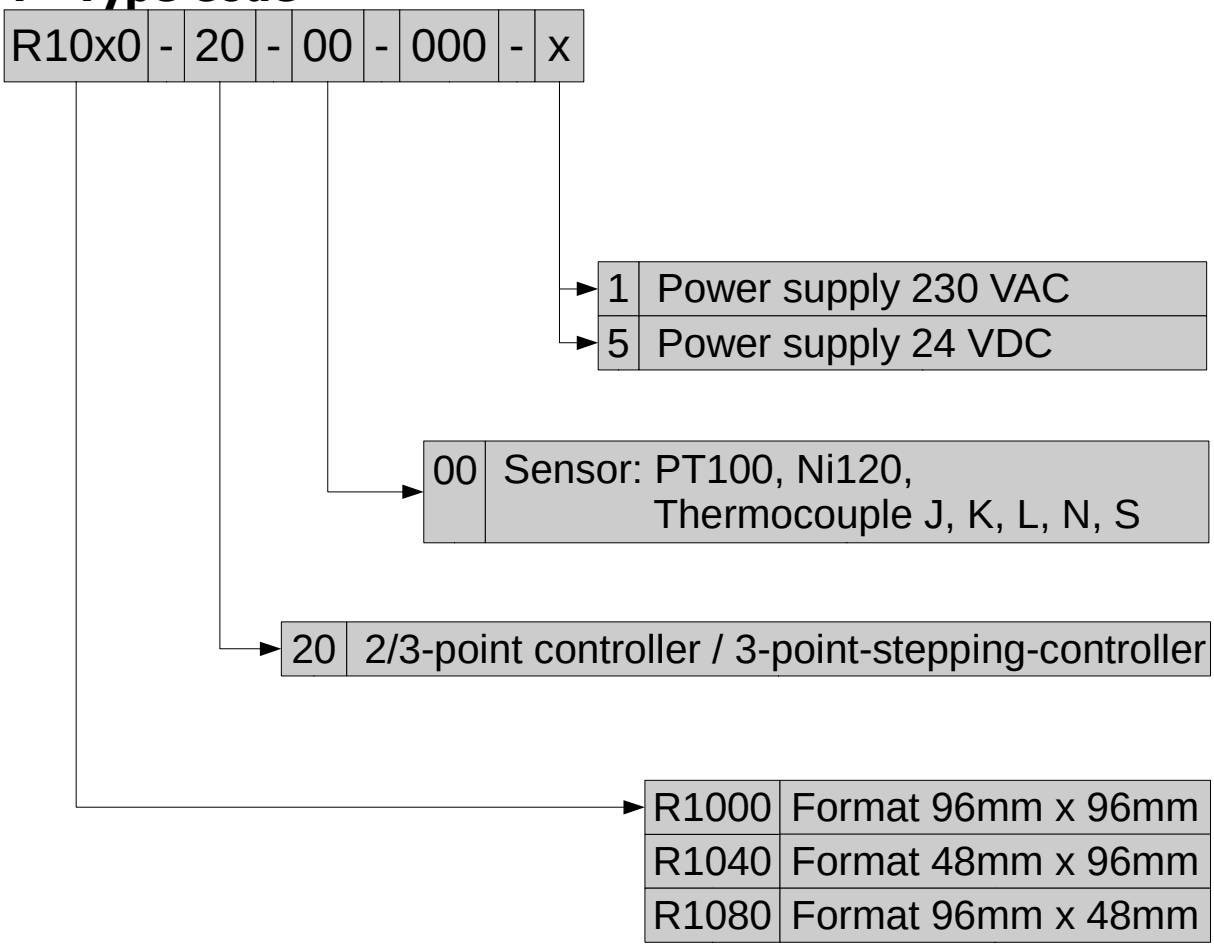
The configuration parameters are generally to be selected first.

Disclaimer of Liability
We have checked the contents of this document for conformity with the hardware and software described. Nevertheless, we are unable to preclude the possibility of deviations so that we are unable to assume warranty for full compliance. However, the information given in the publication is reviewed regularly. Necessary amendments are incorporated in the following editions.
We would be pleased to receive any improvement suggestions which you may have.
The information contained herein is subject to change without notice.

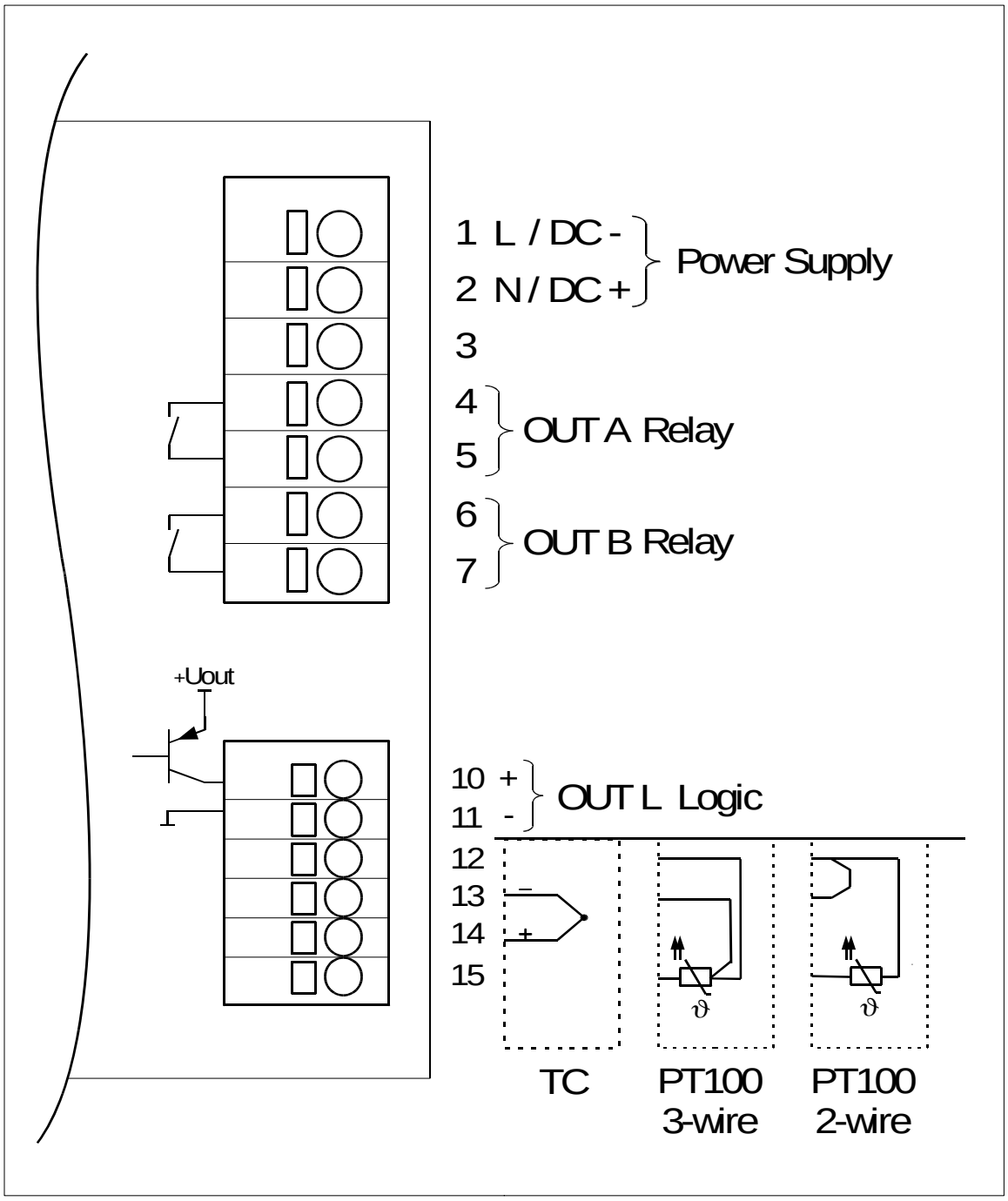
Electronic scrap and components are subject to special treatment and must be disposed of by authorized companies.



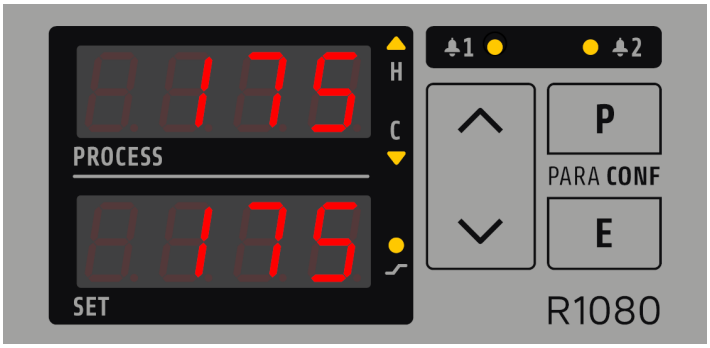

4 Type Code


R10x0 - 20 - 00 - 000 - x
1 Power supply 230 VAC
5 Power supply 24 VDC
00 Sensor: PT100, Ni120, Thermocouple J, K, L, N, S
20 2/3-point controller / 3-point-stepping-controller
R1000 Format 96mm x 96mm
R1040 Format 48mm x 96mm
R1080 Format 96mm x 48mm

5 Connection Diagram



6 Display and Keyboard



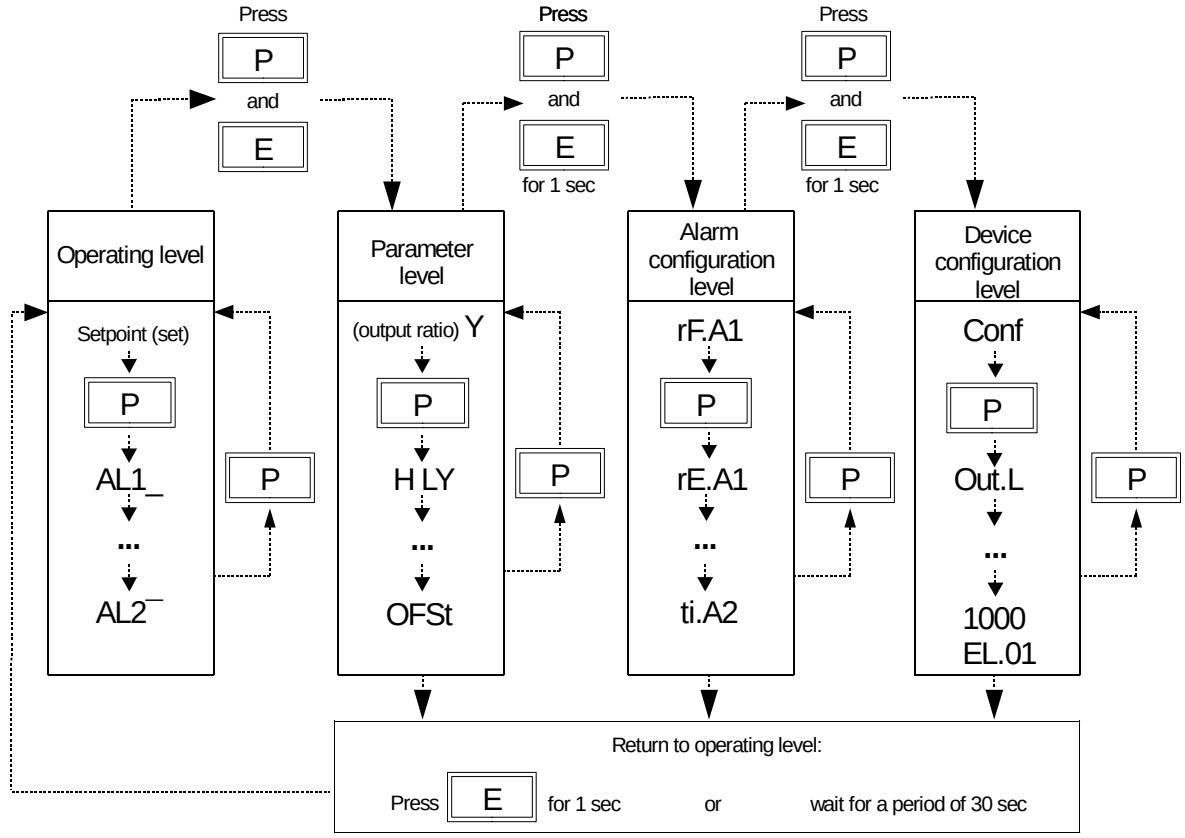
LED H:	Heating active			**LED A1:**	Alarm 1
LED C:	Cooling active	**LED**	Setpoint ramp active	**LED A2:**	Alarm 2

Key functions:

P	Parameter key (parameter preselection)
▲ ▼	Adjustment of chosen parameter (e.g. setpoint) to higher or lower values. Short operation: single-step adjustment Longer operation: quick-scanning When the parameter adjustments have been altered but not entered, the display will flash bright/dark.
E	Confirmation and storage of the preselected values. The display will show a light chain as a control of this function.

6.1 Operating Levels

The operation of the controller is divided into 4 levels.
After power up the device will be in the operating level.



Operating level:
Process- and Setpoint value will be displayed simultaneously.
In the operating level the setpoint and other parameters can be adjusted by pressing the **"UP"-/ "DOWN"**-keys.
Every adjustment has to be confirmed by pressing the **"E"**-key.
All parameters in the operating level can, in succession, be displayed by pressing the "**P**"-key.

The three other levels can be reached by simultaneously pressing the **"P"**- and "**E"**-keys.
By pressing for a longer time (approx. 1 s) it can be switched to the next level.
The parameters are selected and set according to the descriptions of the operating level.

After either pressing the "E"-key for approx. 1 second, or waiting for a period of approx. 30 seconds, the unit will automatically return to the operating level.

Control parameter level:
In the control parameter level the parameter values are adjusted to suit each individual process.

Alarm configuration level:
In the alarm configuration level the parameters are adjusted for the alarm monitoring.

Device configuration level:
In the configuration level the basic configurations of the controller are set.
These adjustments have to be carried out first of all when starting the controller for the first time.

7 Parameter descriptions

7.1 Device configuration level

ConF Controller **conf**iguration	When changing the controller configuration, the settings of the outputs will be changed, too. They can be altered manually afterwards.	
	2P h	**2-p**oint controller "**h**eating-off" **<§>** Output settings: **Out.L**= **H**; **Out.A**= **AL 1**; **Out.b**= **AL2**
	2P c	**2-p**oint controller "**c**ooling-off" Output settings: **Out.L**= **C**; **Out.A**= **AL 1**; **Out.b**= **AL2**
	2Pnc	**2-p**oint controller "cooling non-linear ". Cooling action with **n**on-linear **c**ooling response curve (e.g. for vapour cooling) Output settings: **Out.L**= **C**; **Out.A**= **AL 1**; **Out.b**= **AL2**
	3P	**3-p**oint-controller "heating-off-cooling" Output settings: **Out.L**= **H**; **Out.A**= **C**; **Out.b**= **AL 1**
	3Pnc	**3-p**oint-controller "heating-off-cooling". Cooling action with **n**on-linear **c**ooling response curve (e.g. for vapour cooling) Output settings: **Out.L**= **H**; **Out.A**= **C**; **Out.b**= **AL 1**
	3PSt	Three-point-stepping controller Heating corresponds to "OPEN", Cooling corresponds to "CLOSE" Output settings: **Out.L**= **AL 1**; **Out.A**= **H**; **Out.b**= **C**
Out.L Assignment of the signal for the output "Logic"	**OFF**	Output is turned off
	H	Output represents the "heating"-signal**<§>**
	C	Output represents the "cooling"-signal
	AL 1	Output represents the alarm 1-signal
	AL2	Output represents the alarm 2-signal
Out.A Assignment of the signal for the output "Relay A"	**OFF**	Output is turned off
	H	Output represents the "heating"-signal**<§>**
	C	Output represents the "cooling"-signal
	AL 1	Output represents the alarm 1-signal
	AL2	Output represents the alarm 2-signal
Out.b Assignment of the signal for the output "Relay B"	**OFF**	Output is turned off
	H	Output represents the "heating"-signal**<§>**
	C	Output represents the "cooling"-signal
	AL 1	Output represents the alarm 1-signal
	AL2	Output represents the alarm 2-signal

SEn **Sen**sor selection	P4°C	Pt100 0...400 °C **<§>**
	P4°F	Pt100 32...752 °F
	P8°C	Pt100 0...800 °C
	P8°F	Pt100 32...1472 °F
	n2°C	Ni120 0...250 °C
	n2°F	Ni120 32....482 °F
	L4°C	Thermocouple (TC) Fe-CuNi(L) 0...400 °C
	L4°F	Thermocouple (TC) Fe-CuNi(L) 32..752 °F
	L8°C	Thermocouple (TC) Fe-CuNi(L) 0...800 °C
	L8°F	Thermocouple (TC) Fe-CuNi(L) 32..1472 °F
	J8°C	Thermocouple (TC) Fe-CuNi(J) 0...800 °C
	J8°F	Thermocouple (TC) Fe-CuNi(J) 32..1472 °F
	K1°C	Thermocouple (TC) NiCr-Ni(K) 0..1200 °C
	K1°F	Thermocouple (TC) NiCr-Ni(K) 32..2192 °F
	S1°C	Thermocouple (TC) PtRh-Pt(S) 0..1600 °C
	S1°F	Thermocouple (TC) PtRh-Pt(S) 32..2912 °F
	N1°C	Thermocouple (TC) NiCrSi-NiSi(N) 0...1200 °C
	N1°F	Thermocouple (TC) NiCrSi-NiSi(N) 32...2192 °F
SP.Lo Lower setpoint limitation	Lowest adjustable setpoint value **<§ = 0 °C>** programming range: bottom range ... SP.Hi	
SP.Hi Higher setpoint limitation	Highest adjustable setpoint value **<§= 400 °C>** programming range: SP.Lo ... top range	

Ramp function:
A programmed ramp is always activated when the setpoint is changed or when the mains supply is switched on. The ramp starts at the actual process value and ends at the preselected setpoint.

SPr Rising ramp	OFF**<§>**; 0,1 ... 100,0 °C/min or °F/min
SPr_ Falling ramp	OFF**<§>**; 0,1 ... 100,0 °C/min or °F/min

Softstart Function in General:

If the softstart function is selected, it has to be made sure that the bistable voltage (logic) output is activated. Otherwise the relays will be damaged.

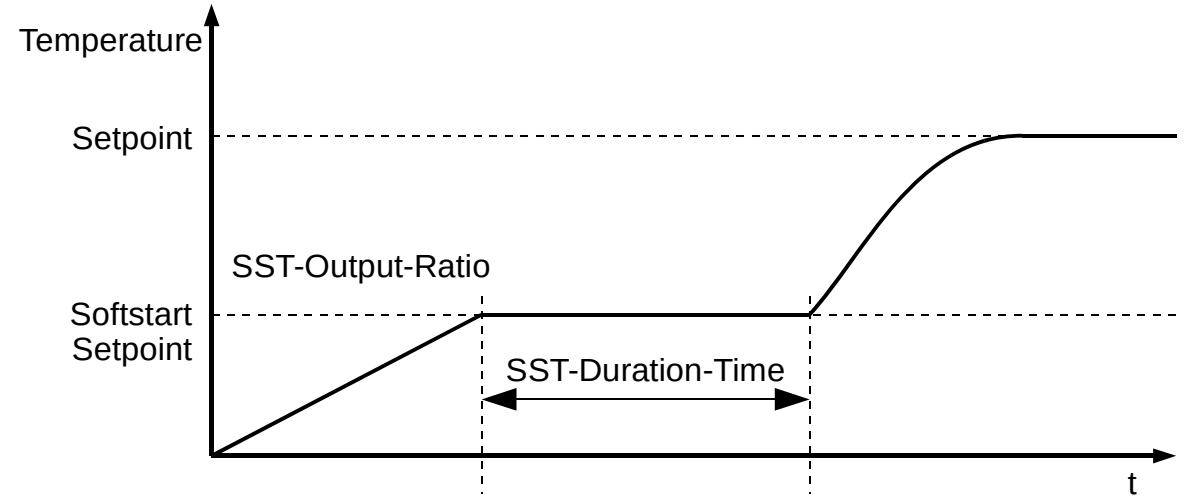
During the softstart the controllers heating output response is limited to a preselected ratio, in order to achieve a slow drying of high performance heat cartridges.
This results in a slower, more regular heating period.
Simultaneously the output clock frequency is quadrupled.

Once the process value reaches the softstart setpoint, it remains stable at this value for the preselected duration time.
At the end of this period the process value rises to the valid setpoint.

If the softstart is active, the controller's autotune function cannot operate (Er.0P).
If a setpoint ramp has been programmed, the softstart has priority, and the ramp will become active after the softstart has been completed.

The parameters for the softstart function are only available if the parameter P (xp) is programmed to a value $\geq$ 0,1% (parameter level).

The softstart only works if the actual process value is lower than the softstart setpoint at the time the controller is turned on.



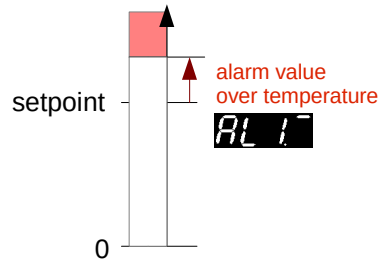
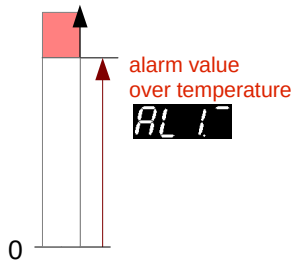
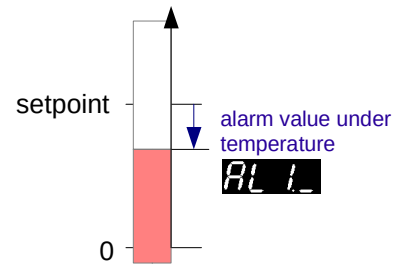
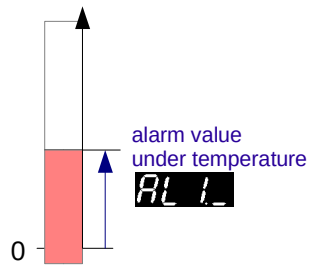
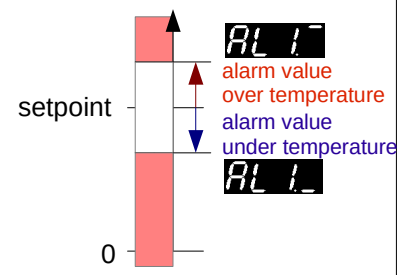
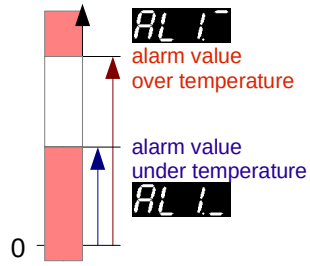
SoSt **So**ft**st**art	OFF Softstart function is not active. **<§>** The other softstart parameters are not displayed.
	on Softstart function is active.
So. Y Softstart output ratio **Y**	Range: 10...100% **<§ = 30>**
SoSP **So**ftstart **s**et**p**oint	Range: SP.Lo ... SP.Hi **<§ = 100>**
Soti **So**ftstart duration **ti**me	Range: OFF, 0.1 … 10.0 min. **<§ = 2.0>**

HAnd Manual mode	OFF	Controller mode **<§>**
	Auto **Auto**matic Mode	In the case of a sensor break the last valid output ratio is maintained. An "H" is then displayed as the first digit in the setpoint display, followed by the valid output ratio. Like the setpoint, the output ratio can be changed manually. Under the following circumstances, the output ratio will be 0%: - if the output ratio at the time of the sensor break was 100%. - if a setpoint ramp is active. - if the control deviation was more than 0,25% of the total range at the time of sensor break. - if the Proportional-band (P) = off. - if the softstart was active at the time of the sensor break. A few seconds after the sensor break has been rectified, the controller returns to automatic operation and calculates the required output ratio. An additional signal can be issued in the event of sensor break, if the alarm contacts are programmed accordingly.
	MAn **Man**ual Mode	The controller now operates only as an actuator. The control function (PID) is inactive. PROCESS: Actual process value is shown. Display of setpoint: First an "H", then the actual adjustable output ratio. Negative value: cooling, positive value: heating Like the setpoint, the output ratio can be changed manually.

CoSb **Co**nfiguration **S**ensor **b**reak Behaviour of the relays in case of sensor break **>DPS<**	OFF	Outputs: OPEN = off CLOSE = off**<§>**
	OPEn	Outputs: OPEN = **on** CLOSE = off
	CLoS	Outputs: OPEN = off CLOSE = **off**
Fi.ti **Fi**lter **ti**me	Range: OFF; 0.1 … 10.0 s **<§ = OFF>** If the process is not stable, filter time can be set to reduce oscillations of the process display. It has no influence on the controlling process.	
LOC Adjustment **loc**k	OFF	no adjustment lock **<§>**
	P C	**p**arameter and **c**onfiguration levels locked
	nSP1	all parameters apart from SP1 locked (**n**ot **SP1**)
	ALL	**all** parameters locked
LUM1 **Lumi**nance	Adjustment of the luminance of the 7-segment-display. Adjustment range : 0...6**<§>**	
1000 or 1040	ELO1	Device code and version

7.2 Alarm configuration level

General alarm information (example alarm 1):

Description	**Based to setpoint**	**Absolut**
Alarm configuration	FA1 = BASE	FA1 = Abs
Range of alarm value	0...100 / -100...0	Whole measuring range
Switch point	Setpoint + alarm value	Alarm value
Singlesided alarm "top": (over temperature alarm) The temperature has to be higher to activate the alarm. The under temperature alarm is not active: AL1_ = OFF		
Singlesided alarm "bottom": (under temperature alarm) The temperature has to be lower to activate the alarm. The over temperature alarm is not active: AL1 = OFF		
Both-sided alarm: (limit-alarm) The temperature has to be outside the selected range. Both alarms (AL1 and AL1_) have to be set.		

The parameter for the alarm values (AL1_, AL1, AL2_, AL2) are located in the operating level.

Please note:
In case of sensor error the alarms react in the same way as range override.
The alarm contacts therefore do not offer protection against all types of plant breakdown.
We recommend the use of a second, independent monitoring unit.

rFA1 Alarm 1 configuration **(re**ference. **a**larm **1)**	Abs	**abs**olute **<§ >**
	bASE	**base**d on setpoint
rEA1 **re**lay action for **a**larm **1**	OFF	relay is turned **off** when alarm 1 is active
	on	relay is turned **on** when alarm 1 is active **<§ >**
LdA1 Display of front **LE**D at **a**larm **1**	OFF	LED is turned **off** when alarm 1 is active
	on	LED is turned **on** when alarm 1 is active **<§ >**
StA1 **St**art up suppression **a**larm **1**	OFF	Start up suppression deactivated **<§ >**
	Strt	Start up suppression activated The temperature has to enter the “OK range“ once. Thereafter the alarm triggers when the temperature reaches the alarm limits.
ti.A1 delay **ti**me **a**larm **1**	OFF, 1 ... 1000 s **<§ = OFF>**	

rFA2 Alarm 2 configuration **re**ference. **a**larm **2**	Abs	**abs**olute **<§ >**
	bASE	**base**d on setpoint
rEA2 **re**lay action for **a**larm **2**	OFF	relay is turned **off** when alarm 2 is active
	on	relay is turned **on** when alarm 2 is active **<§ >**
LdA2 Display of front **LE**D at **a**larm **2**	OFF	LED is turned **off** when alarm 2 is active
	on	LED is turned **on** when alarm 2 is active **<§ >**
StA2 **St**art up suppression **a**larm **2**	OFF	Start up suppression deactivated **<§ >**
	Strt	Start up suppression activated The temperature has to enter the “OK range“ once. Thereafter the alarm triggers when the temperature reaches the alarm limits.
ti.A2 delay **ti**me **a**larm **2**	OFF, 1 ... 1000 s **<§ = OFF>**	

7.3 Parameter level

y valid output ratio **>PID<**	0 … 100% The output ratio shows the momentary calculated ratio. It cannot be altered. The display is in per cent of the installed performance capability for heating or cooling. Output ratio for cooling is shown as a negative value.
H LY Output ratio limit ”heating“ **>PID<**	0 … 100%**<§ >** The limitation of the output ratio is only necessary if the heating energy supply is grossly overdimensioned compared to the power required. Under normal conditions a limitation is not necessary (setting = 100%). The limitation becomes effective when the controller's calculated output ratio is greater than the maximum permissible (limited) ratio. **Warning!** The output ratio limitation does not work during autotune.
C LY Output ratio limit “cooling“ **>PID<**	0 … 100%**<§ >** same as output ratio limit ”heating“

Adjustment of the control parameters:

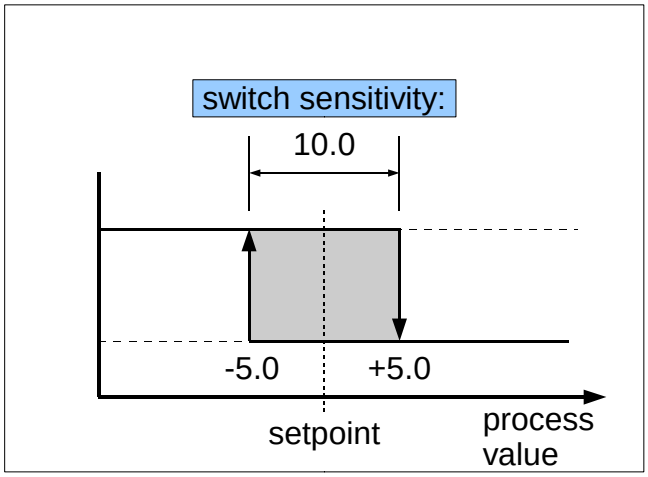
As standard the controller operates in PD/I control mode, i. e. controlling without deviation and with practically no overshoot during start-up.

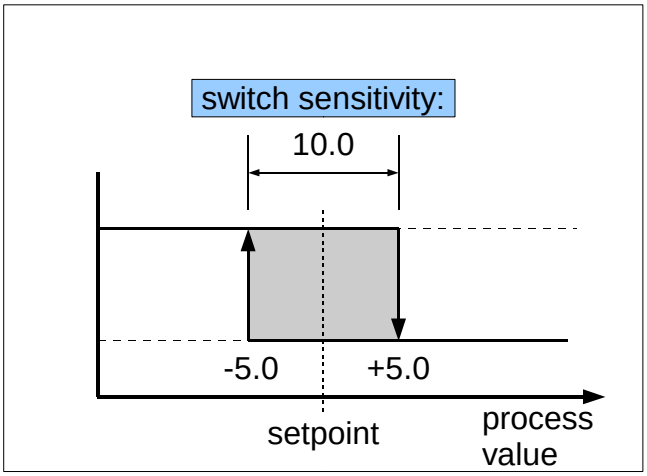
The control action can be altered in its structure by adjusting the following values to the parameters:

a. no control action, on-off	setting	P= **OFF**
b. P-action	setting	D and I = **OFF**
c. PD-action	setting	I = **OFF**
d. PI-	setting	D = **OFF**
e. PD/I	modified PID-mode (set: P, D, I)	

According to the configuration, certain parameters are not visible.

H P prop. band (P) “**h**eating” **>PID<**	**OFF**; 0.1 … 100.0 % **<§=3,0>** If **H P** = **OFF** (control action: on-off, without feedback) Next visible parameter: **H Sd**
H d rate (D) “**h**eating” **>PID<**	**OFF** 1 … 200 s **<§ = 30>**
H I reset(I) “**h**eating” **>PID<**	**OFF** 1 … 1000 s **<§ = 150>**
H CY **cy**cle time “**h**eating” **>PID<**	0.5 … 240.0 s **<§=15.0>** The switching frequency of the actuator can be determined by adjusting the cycle time. In this time interval the controller switches on and off once. Voltage outputs for SSRs cycle time: 0,5...10 s Optimal value for fast control loops: 0,8 s Relay outputs: cycle time: > 15 s The cycle time should be adjusted to a time as long as possible to minimize the wear of the relay contacts.

P xp, prop.-band **(P)** **>DPS<**	**OFF**; 0.1 ... 200.0 % **<§ = 10.0>**
tS Motor actuating time (d) **>DPS<**	5 ... 800 s **<§ = 40>**
tn reset time (I) **>DPS<**	0.5 ... 80.0 min **<§ = 3.0>**
H Sd / **Sd** switch sensitivity "heating"	This parameter is only available if: **H P**= **OFF** **OFF**; 0.1**<§>** ... 80.0 

Sh Switch point difference ”heating“ and ”cooling“	**OFF**; 0.1**<§ >** … 20.0 If the controller is in heating mode, the actual process value has to rise by the adjusted value above the setpoint before the cooling mode will become active. By this the switching frequency between the heating and cooling outputs can be reduced. Simultaneous activation of heating and cooling outputs is not possible.
C P prop. band (**P**) ”**c**ooling“	**OFF**; 0.1 … 100.0 % **<§=3,0>** If **C P**= **OFF** (control action: on-off, without feedback) next parameter: **C Sd**
C d rate (**D**) ”cooling“	**OFF**; 1 … 200 s **<§ = 30>**
C I reset(**I**) ”**c**ooling“	**OFF**; 1 … 1000 s **<§ = 150>**
C CY **cy**cle time ”**c**ooling“	**OFF** 0.5 … 240.0 s **<§ = 15.0>** The switching frequency of the actuator can be determined by adjusting the cycle time. In this time interval the controller switches on and off once. Voltage outputs for SSRs cycle time: 0.5...10 s Optimal value for fast control loops: 0.8 s Relay outputs: cycle time: > 15 s The cycle time should be adjusted to a time as long as possible to minimize the wear of the relay contacts.
C Sd switch sensitivity ”**c**ooling“	This parameter is only available if: **C P**= **OFF** **OFF**; 0.1**<§>** … 80.0 °C 

Autotune:
The tuning algorithm determines the characteristic values within the controlled process and calculates the valid feedback parameters (P, D, I) and the cycle time (= 0.3 x D) of a PD/I-controller for a wide section of the range.

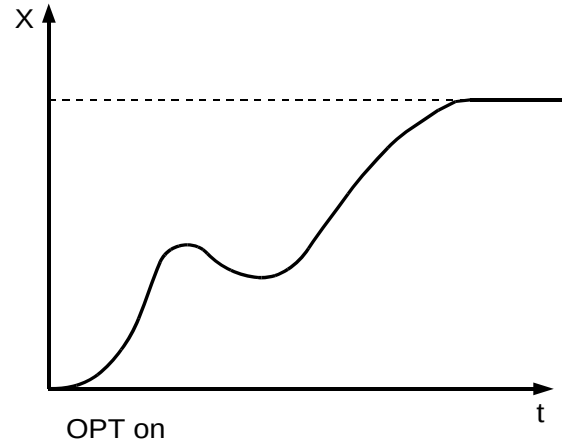
The autotune mode is activated during start-up shortly before the setpoint is reached.
If activated after the setpoint has already been reached, the temperature will first drop by approx. 5 % of the measuring range in order to detect the exact amplification of the process.

The tuning algorithm can be activated at any time by selecting **OPt = on** and pressing the **"E"**-key. After having calculated the correct feedback parameters, the controller will lead the process value to the setpoint.

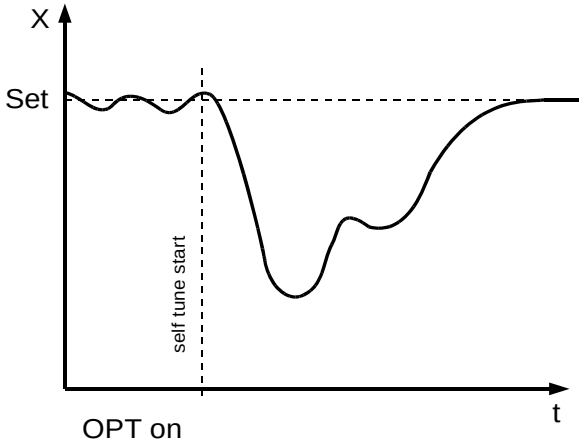
Selecting **OPt = OFF** will stop the autotune function.

Zone display: During self tuning **OPt** is shown in the display, alternating with the setpoint value.

Conditions for starting the Autotune algorithm:
- The setpoint must add up to at least 5 % of the measuring range.
- The sensor must not have a failure.
- The softstart function must not be active.



OPT on
self tune during start-up



OPT on
self tune, after the setpoint has already been reached

OPt autotune	**OFF** autotune / self tuning out of action**<§>**
	on autotune / self tuning active (one time)
	Auto Autotune starts every time the controller is turned on, if the difference between setpoint and actual process value is more than 7 % of the measuring range.
OFSt process value offset	- 999... **OFF<§>** … 1000 °C/°F This parameter serves to correct the input signal, e.g. for: - the correction of a gradient between the measuring point and the sensor tip - the line resistance balancing of 2-line RTD (Pt100) sensors - correction of the control deviation when using P- or PD-action If for example the offset value is set to +5°C, the real temperature measured by the sensor (when process is balanced) is 5 °C less than the setpoint and the displayed actual process value. Make sure that the corrected temperature process value does not leave the selected measuring range.

7.4 Operating Level

The function and configuration of the alarms is described in the chapter "alarm configuration level". Within the operating level only the alarm values can be set.

	Alarm reference	**Adjustment range:**
AL 1_ Alarm 1: alarm value under temperature	rFA1= AbS absolute	OFF **<§>**; SP.Lo … SP.Hi Alarm active if the actual process value is lower than the alarm value
	rFA1=bASE based to setpoint	OFF **<§>** -1 … -100 °K; Alarm active if the actual process value is lower than (Setpoint + alarm value)
AL 1¯ Alarm 1: alarm value over temperature	rFA1= AbS absolute	OFF **<§>**; SP.Lo … SP.Hi Alarm active if the actual process value is higher than the alarm value
	rFA1=bASE based to setpoint	OFF **<§>;**1 ... 100 °K Alarm active if the actual process value is higher than (Setpoint + alarm value)
AL2_ Alarm 2: alarm value under temperature	rFA2= AbS absolute	OFF **<§>**; SP.Lo … SP.Hi Alarm active if the actual process value is lower than the alarm value
	rFA2=bASE based to setpoint	OFF **<§>-**1 … -100 °K Alarm active if the actual process value is lower than (Setpoint + alarm value)
AL2¯ Alarm 2: alarm value over temperature	rFA2= AbS absolute	OFF **<§>**; SP.Lo … SP.Hi Alarm active if the actual process value is higher than the alarm value
	rFA2=bASE based to setpoint	OFF **<§>**;1 ... 100 °K Alarm active if the actual process value is higher than (Setpoint + alarm value)

8 Error Messages

Error Message	**Cause**	**Possible remedy**
SP.Lo	Lower setpoint limit has been reached	Reduce limit, if need be
SP.Hi	Upper setpoint limit has been reached	Increase limit, if need be
LOC	Parameter has been locked	Unlock, if need be Device configuration level: LOC
Er.Hi	Top range end has been exceeded, sensor defect	Check sensor and cable
Er.Lo	Bottom range end has been exceeded, sensor defect	Check sensor and cable Check process value offset
Er.OP	Self tuning error	Quit error message by pressing the key "E". Check the self tuning conditions and restart.
Er.SY	System error	Quit error message by pressing the key "E". Check all parameters. If the error message continues, please send the controller back to the manufacturer.

9 Technical Data

Input PT100 (RTD)	2- or 3-wire connection possible Built-in protection against sensor break and short circuit Sensor current: < 0,5 mA Calibration accuracy: … ≤ 0,2 % Linear error: … ≤ 0,2 % Influence of the ambient temperature: … ≤ 0,01 % / K
Input Thermocouple	Built-in internal compensation point and protection against sensor break and incorrect polarity. Re-calibration not required for a line resistance of up to 50 Ohm. Calibration accuracy: … ≤ 0,25 % Linear error: … ≤ 0,2 % Influence of the ambient temperature: … ≤ 0,01 % / K
Output logic	Bist. voltage signal, 0/18 V DC, max. 10 mA, short-circuit proof
Outputs relay	Relay, max. 250 VAC, max. 2 A (resistive load) For control loops requiring a high switching frequency of the control output it is recommended to use the logic output controlling a SSR.
7-Segment-Display:	4 digits, Process: 10 mm red, Set: 10 mm red
Data protection	EAROM
CE-mark	Tested according to 2004/108/EG; EN 61326-1 Electrical safety: EN 61010-1
Power supply	Depends on the version of the device: - 230 V AC, +/-10 %, 48...62 Hz; approx. 3VA - 24 V DC, +/-25 %, approx. 3W
Connections	Spring-cage connector, Protection mode IP 20 (DIN 40050), Insulation class I Conductor cross section terminals 1-7: 0,2 - 2,5mm² Conductor cross section terminals 10-15: 0,2 - 1,5mm²
Permissible operating conditions	Operating temperature: 0 … 50°C / 32 … 122°F Storage temperature: -30 … 70°C / -22 … 158°F Climate class: KWF DIN 40040; equivalent to annual average max. 75 % rel. humidity, no condensation
Casing	Material: Noryl, self-extinguishing, non-drip, UL 94-V1 Protection mode: IP 20 (DIN 40050), IP 50 front side Case: DIN 43700, installation depth approx. 60 mm Format R1000: 96 x 96 mm Panel cutout: 92 +0,5 mm x 92 +0,5 mm Format R1040: 48 x 96 mm Panel cutout: 45 +0,6 mm x 92 +0,8 mm
Weight	Approx. 350 g depending on the version of the device

Subject to technical improvements.

10 Notes