



KS 30

Compact industrial controller

- Simplest operation
- Bright LED display
- Plug-in controller module
- Confident handling under extreme conditions
- Precise control behaviour
- Self-tuning
- Long life
- Low price and fast delivery

PROFILE

The new generation of KS 30 compact controllers features microcomputer operation for precise, cost-effective temperature control in all branches of industry: from flow-soldering lines to textile driers, from steam boilers to packing machines, from mould heating to furnaces.

Consistent application of modern technology (mask-programmed processor, ASIC, SMD) enabled the volume of the electronic components to be reduced to a minimum, which also means low internal temperatures. Modern production methods ensure highest quality and reliability, plus short delivery times.

Furthermore, KS 30 controllers comply with the standards EN 50 081-1 and EN 50 082-2 concerning electromagnetic compatibility, and have therefore qualified for CE marking. In addition, they are built according to the safety standards of IEC 348. Every unit is tested with 3 kV before shipment.

DESCRIPTION

Plug-in controller modules

KS 30 controllers are plug-in modules which ensures fast replacement without any tools. Electrical connections are made via rear flat-pin connectors.

Two hardware versions, freely configurable

The controllers are available with either 2 or 3 output relays. Input, control function and alarms are freely configurable.

Standard on all versions are self-tuning, a second set-point with ramp function, an additional input for monitoring heating current, a logic output for heating control, and a 115/230 V mains transformer.

Simple operation

Only three robust keys are used for all settings and adjustments. Tactile feedback from the keys and an automatic increase in rate of change when a key is pressed for a longer period ensure fast and safe settings.

Clear operating concept and lockable parameter adjustment

All operating functions are user-friendly and clearly structured as follows:

Operating Level for set-point adjustment.

Parameter Level for adjusting the required control parameters, limit values, etc.

Configuration Level for adjusting the controller functions.

An internal switch prevents unauthorized access to the Parameter and Configuration Levels.

Disabling of display and operation

It is possible to de-activate set-point display and adjustment in the Operating Level. Furthermore, the set-point adjustment range can be limited in the Parameter Level.

Input circuit monitoring

In case of faults in sensor or leads, the built-in monitor provides increased operational safety. Controller output can be configured for upscale or downscale action when the monitor is triggered. With 3-point controllers, the outputs are set to 0%.

Thermocouple input

The monitor detects an open-circuit sensor and also if the polarity is reversed.

Resistive input

The input is monitored for a break or a short circuit in the sensor and leads.

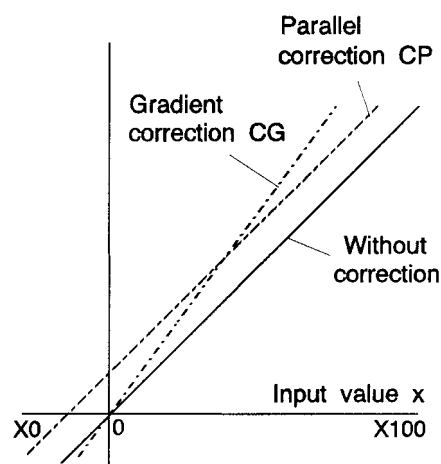
Input 4...20 mA

The monitor is triggered if the current is less than 2 mA.

Measurement value correction for thermocouples and Pt 100

Correction is done with the relevant measurement value or with open input. The correction type is selectable for thermocouple and Pt 100 input: Gradient correction CG or parallel correction CP (see Fig. 1).

Fig. 1 Measurement value correction



With parallel correction, all display values are shifted in parallel by the positive or negative correcting value. With gradient correction, the display value characteristic is rotated at 0°C or 32°F . The display values increase or decrease proportionally to the measured value.

Heating current display and alarm

The controllers have a special input for connecting an external current transformer. The heating current and its adjustable limit value are displayed as parameters. Heating current alarm signalling is provided by a red LED and via alarm relay 3.

Configuration „Monitoring for low current and actuator short circuit“

An alarm is signalled if the heating current falls below the limit value while relay 1 is energized or the logic output is active.

With relay 1 de-energized or logic output inactive, monitoring for heating current $> 0,4\text{ A}$ is provided.

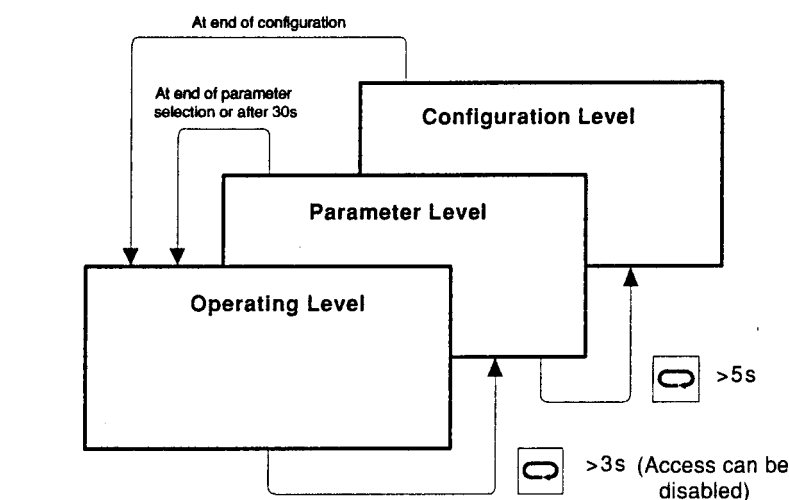
Configuration „Excess current monitoring“

An alarm is signalled if the heating current limit value is exceeded while relay 1 is energized or the logic output is active.

Controller and positioner functions

The KS 30 is configurable as a signaller, two-point controller (heating), or as a three-point controller (heating/cooling).

Fig. 2 Operating concept



When configured as a positioner, the unit works without an input signal. The output has an adjustable duty cycle of $0\ldots 100\%$. The controller structure can be modified by disabling the integral and/or derivative action.

Disabled outputs

The controller outputs can be disabled by adjusting the set-point to a value below the lower limit (all outputs de-energized).

Alarm functions

The alarm contact output is configurable as follows:

- Relative alarm** for monitoring the control deviation (relative to set-point).
- Absolute alarm** for limit monitoring (independent of set-point setting).
- Relative alarm with alarm suppression**
The alarm is not triggered during start-up or after a change of set-point.

Second set-point with ramp function and the program controller

The external control contact $W/W2$ is used to activate a second set-point (safety set-point, which is also effective after a mains failure). The second set-

point becomes effective after an adjustable time has elapsed. Three additional set-points with corresponding segment times are available for program control. After mains failure, start or re-start is from the actual process value x .

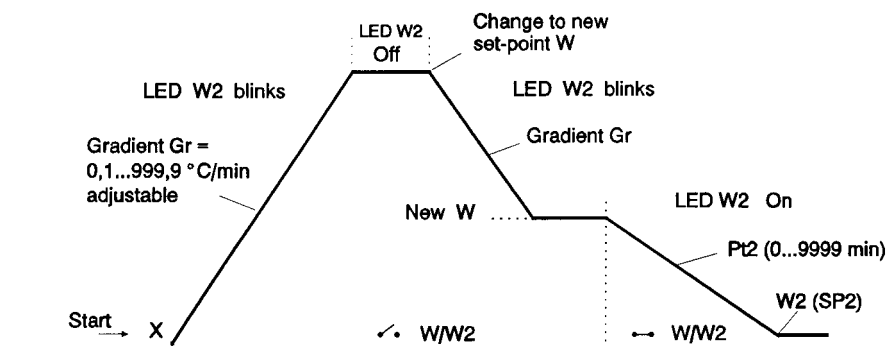
The set-point gradient function (Fig. 3) can be adjusted by means of parameter Gr with the corresponding controller version. In case of set-point adjustment, after re-start, or switch-over from $W2$ to W , the set-point starts changing from process value x at the adjusted speed (e.g. $5^\circ\text{C}/\text{min}$), and LED $W2$ blinks. With $Gr = ---$, the function is switched off.

Self-tuning function

This function is fitted as standard for the automatic determination of the best control parameters. Self-tuning is started at the push of a button and uses the delay time T_u and the max. rate of change V_{max} of the temperature control loop to calculate the optimum settings for fast line-out without overshoot.

When configured for three-point control, the „cooling“ parameters are determined separately.

Fig. 3 Set-point gradient function



TECHNICAL DATA

INPUTS

Thermocouples

Types L, J, K, N, S, and R to DIN IEC 584.

For ranges, see Ordering data.

Input resistance: $\geq 1\text{ M}\Omega$

Display: in $^{\circ}\text{C}$ or $^{\circ}\text{F}$ (temperature-linear)

Display error: $\leq 3\text{ K} \pm 1\text{ digit}$

TC break monitor:

Sensor current $\leq 1\text{ }\mu\text{A}$, output action configurable upscale or downscale.

Polarity monitoring:

Responds when input signal is 30 K below span start, output action configurable upscale or downscale.

Resistance thermometer

Pt 100 Ω to DIN IEC 751

Range: $-99,9\dots500,0\text{ }^{\circ}\text{C}$ or $-148\dots932\text{ }^{\circ}\text{F}$ (temperature-linear)

Display error: $\leq 1\text{ K} \pm 1\text{ digit}$

Sensor current: $\leq 1,5\text{ mA}$

Connection in three-wire technique without lead adjustment.

Lead resistance: $\leq 30\text{ }\Omega$

Input circuit monitoring for break in sensor or lead, or short circuit.

Output action configurable upscale or downscale.

Direct current

0/4...20 mA, linear

Input resistance: $15\text{ }\Omega$

Measurement limits:

selectable within $-999\dots9999$

Decimal point: adjustable

Display error: $\leq 0,1\%$

Input circuit monitor for 4...20 mA:

with $I \leq 2\text{ mA}$, output action configurable upscale or downscale.

Direct voltage

0...10 V, linear

Input resistance: $\geq 110\text{ k}\Omega$

Measurement limits:

selectable within $-999\dots9999$

Decimal point: adjustable

Display error: $\leq 0,1\%$

Measurement earth

Connection to plant ground or protective earth.

Current transformer input

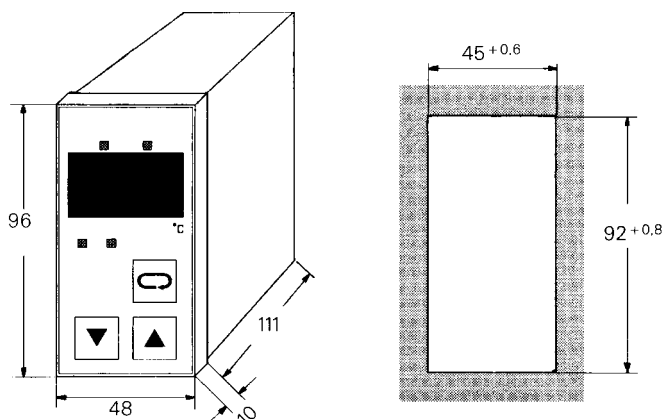
Fitted. For details of current transformer, see „Accessories“.

Control inputs

Switch-over to W2

Start/stop of programmer

Fig. 4 Overall dimensions and panel cut-out (mm)



Control signal

Contacts for „dry“ current loops, NPN transistors, or active logic signal:

Low $\leq 1\text{ V}$

High = 3...6 V

OUTPUTS

All outputs can be switched off by setting W to „---“.

Switching outputs

2 or 3 output relays plus a logic output, depending on version.

Contact rating: $\leq 250\text{ VAC}$, $\leq 1\text{ A}$, $\leq 500\text{ VA}$, resistive load

Logic output

The logic output is galvanically connected with the input.

Signal level: 0/13 V with a load

$\geq 1300\text{ }\Omega$

or 10 mA with a load $\leq 1300\text{ }\Omega$

POWER SUPPLY

Voltage: 230/115 VAC, $-15\dots+20\%$

Frequency: 48...62 Hz

Power consumption: approx. 6,5 VA

CONTROL CHARACTERISTICS

Configurable as:

- signaller (0,2% switching difference)
- two-point controller with DPID behaviour
- three-point controller with DPID/DPID behaviour

Control parameters

Self-tuning or adjustable (see Fig. 7 „Parameter adjustment“).

Switching differential of signaller: 0,2%

Positioner function

Configurable for „Heating“ or „Heating/Cooling“

ALARM FUNCTIONS

Configurable as relative or absolute alarm (optionally in combination with the heating current monitor) or as relative alarm with alarm suppression.

HEATING CURRENT MONITOR

Measurement and display range

0...30,0 A_{rms} with resistive load and external current transformer.

Display error: $\pm 5\%$ of display range

Heating current limit

Adjustable 0...30,0 A, acting on alarm outputs, if required.

Alarm indication via red LED.

Monitoring for undercurrent or short-circuited actuator (SSR)

Red LED lights up, if heating current is below limit value or with short-circuited actuator (residual current $> 0,4\text{ A}$).

Excess current monitoring

Red LED lights up, if heating current is above limit value.

SET-POINT

Adjustment range

Upper and lower limits of the set-point range $W_0\dots W_{100}$ are selectable.

DISPLAYS

Multi-function display

Two red 4-digit LED displays.

Digit height:

Process value $X = 10\text{ mm}$

Set-point $W = 7,6\text{ mm}$

Display range: $-999\dots9999$

Status LED

Yellow W2: for set-point W2 or programmer „On“

LEDs for relay status

Yellow left: heating „On“

Yellow right: cooling „On“

Green LED: „process value within limits“

Red LED: „limit of heating current exceeded“

Input circuit monitoring

„FbF“ = sensor break

„POL“ = reversed polarity

ENVIRONMENTAL CONDITIONS

Permissible temperatures

For specified accuracy: 0...55°C

Operation: 0...60°C

Storage/transport: -20...70°C

Climatic category

KUF to DIN 40 040

Relative humidity: $\leq 75\%$ yearly average, no condensation

INFLUENCING FACTORS

Power supply effect

None. In case of mains failure, the configuration data are stored in a non-volatile EEPROM.

Shock and vibration

Vibration test Fc

to DIN 68-2-6 (10...150 Hz)

Unit in operation: 1g or 0,075 mm

Unit not in operation: 2g or 0,15 mm

Shock test Ea

to DIN IEC 68-2-27 (15g, 11 ms)

ELECTROMAGNETIC COMPATIBILITY

Complies with EN 50 081-1 and EN 50 082-2 for unrestricted use in rural and industrial areas.

ELECTROMAGNETIC IMMUNITY
(complies with EN 50 082-2)

Electrostatic discharge

Test to IEC 801-2

Air discharge: 8 kV

Contact discharge: 4 kV

High-frequency interference

Test to IEC 801-3

Frequency: 80...1000 MHz, 10 V/m

HF interference on leads

Test to IEC 801-6

Frequency: 0,15...80 MHz, 10 V

Effect: ≤ 7 K

Low-frequency magnetic field

Test to IEC 1000-4-8

Frequency: 50 Hz

Field strength: 30 A/m

Fast pulse trains (burst)

Test to IEC 801-4

2 kV applied to leads for supply voltage and signal leads

High-energy single pulses (surge)

Test to IEC 801-5

Test voltage applied to following leads:

Supply leads: 1 kV symmetric, 2 kV asymmetric

Signal leads: 0,5 kV symmetric, 1 kV asymmetric

ELECTROMAGNETIC RADIATION
(complies with EN 50 081-1)

GENERAL

Housing

Plug-in module, inserted from front.

Material: Makrolon 9415 flame-retardant, self-extinguishing.

Flammability class: UL 94 VO

Front dimensions: 48 x 96 mm

Depth behind panel: 111 mm

Protection mode

(to EN 60 529)

Front: IP 54 (vertical mounting $\pm 15^\circ$)

Housing: IP 20

Terminals: IP 00

Electrical safety

Complies with EN 61 010-1

Over-voltage category II

Contamination degree 2

Working voltage range 300 V

Protection class I

CE-marking

According to European Directive

89/336/EEC for electromagnetic compatibility.

Electrical connections

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

Mounting method

Panel-mounting with two fixing clamps at top/bottom

Weight: approx. 0,45 kg

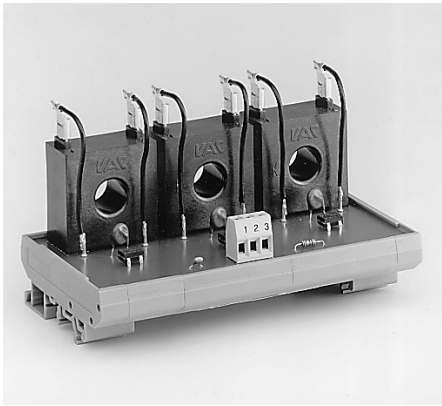
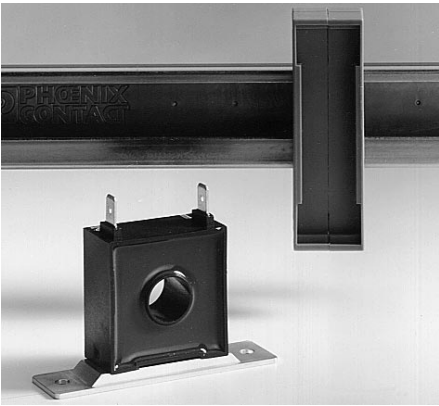
Accessories

Operating instructions

2 fixing clamps

ACCESSORY EQUIPMENT

Current transformers



Current transformers are available in single-phase and three-phase versions. All versions are suitable for mounting to standard rails. The mounting clip for the single-phase version (above) must be ordered separately (e.g. Phoenix).

Dimensions

Single-phase: 38x38x20 mm
Three-phase: 137x77x86 mm

Weight

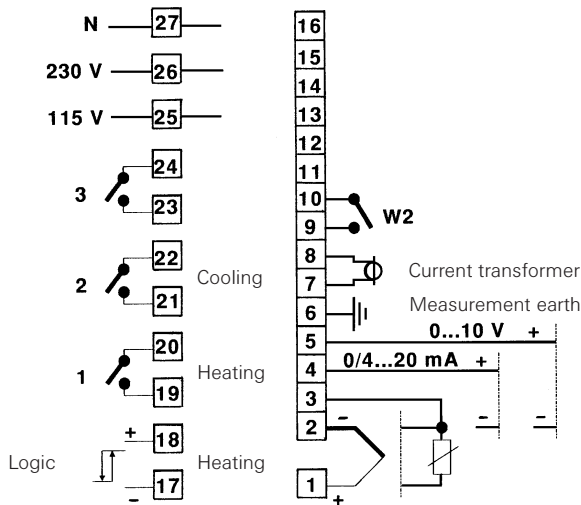
Single-phase: 70 g
Three-phase: 310 g

ORDERING DATA FOR ACCESSORY EQUIPMENT

Description	Order no.
Single-phase transformer 0...30 A, complete with mounting plate for wall mounting	9404 407 50001

Three-phase transformer 3x10 A or 3x30 A depending on connection	9404 407 50021
----------------------------------------------------------------------------	-----------------------

Fig. 5 Connecting diagram



ORDERING DATA FOR ACCESSORIES

Description	Order no.
Dummy panel black, 48 x 96 mm	9404 723 11231
Label for engineering unit	4012 140 66041
Standard rail adapter for mounting the controllers to a standard rail (DIN EN 50 022)	9404 407 50061

Fig. 6 Controller and alarm functions

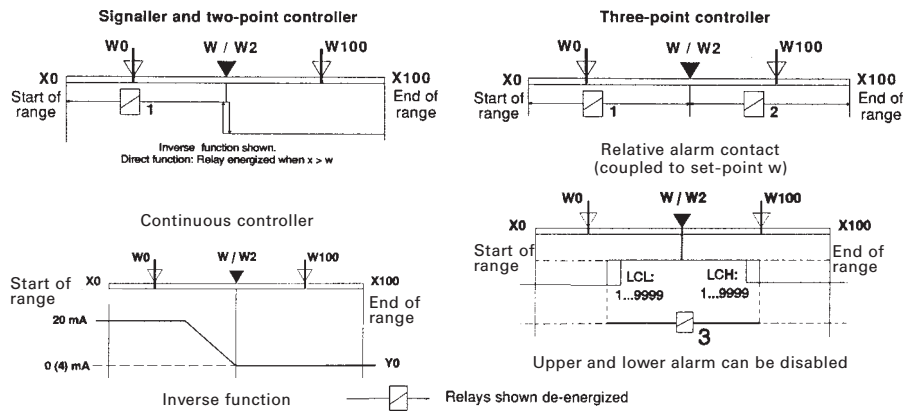


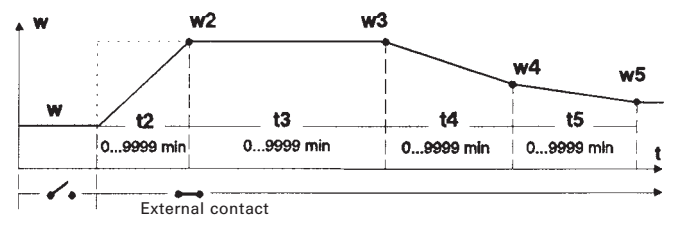
Fig. 7 Parameter adjustment

Parameter	Symbol	Adjustment range ¹⁾
2nd set-point w2 (ramp)	SP2	w0...w100
Segment time t2 (ramp)	Pt2	0...9999 minutes
3rd set-point w3	SP3	w0...w100
Segment time t3	Pt3	0...9999 minutes
4th set-point w4	SP4	w0...w100
Segment time t4	Pt4	0...9999 minutes
5th set-point w5	SP5	w0...w100
Segment time t5	Pt5	0...9999 minutes
Low limit contact	LCL	Relative: 1...9999 Absolute: x0...9999
High limit contact	LCH	Relative: 1...9999 Absolute: x0...9999
Switching difference x _{sd} for both limit contacts	Sd	1...9999
Heating current	HC	only display
Heating current alarm	HCA	0...30,0A
Blocking of operation	Loc	0...3 (see right)
Lower set-point limit w0	SPL	x0...x100
Upper set-point limit w0	SPH	x0...x100
Set-point gradient	Gr	0,1...999,9/min
Proport. band Xp1 (heating)	Pb1	0,1...999,9%
Proport. band Xp2 (cooling)	Pb2	0,1...999,9%
Integral action time Tn	ti	0...9999 seconds (0 = no I-action)
Derivative action time Tv	td	0...9999 seconds (0 = no D-action)
Duty cycle for heating	t1	0,4...999,9 sec
Duty cycle for cooling	t2	0,4...999,9 sec
Decimal point	dP²⁾	0 or 1 (0 = no dec. point)
Measuring span start x0	InL²⁾	-999...9999
Measuring span end x100	InH²⁾	-999...9999

¹⁾ Values in % referred to range x0...x100

²⁾ Only with input 0/4...20 mA or 0...10 V

Fig. 8 Set-point w2 with ramp and program controller



Blocking of operation

- Loc 0:** Display of x and w with adjustment and self-tuning
- Loc 1:** Display of x and w with adjustment
- Loc 2:** Only display of x and w
- Loc 3:** Only display of x

Note: After selecting Loc 1, 2 or 3, all subsequent parameters are not displayed.

ORDERING EXAMPLES

Example 1

Required is a two-point controller with inverse output, absolute alarm and Pt 100 input:

Pos.	Order no./Description	Qty.
1	9404 407 40391 C06310000	1

Example 2

Required is a three-point controller with input 0...20 mA, absolute alarm, programmer:

Pos.	Order no./Description	Qty.
1	9404 407 42391 C07510100	1

ORDERING INFORMATION

An order consists of the 12-digit Order no., completed with "30" or "39".

If "39" is used, the 3-digit C-code must also be specified.

The basic configuration "30" is supplied with C00310100 (2 relays) or C00510100 (3 relays), and must be re-configured by the user as required.

Output configuration

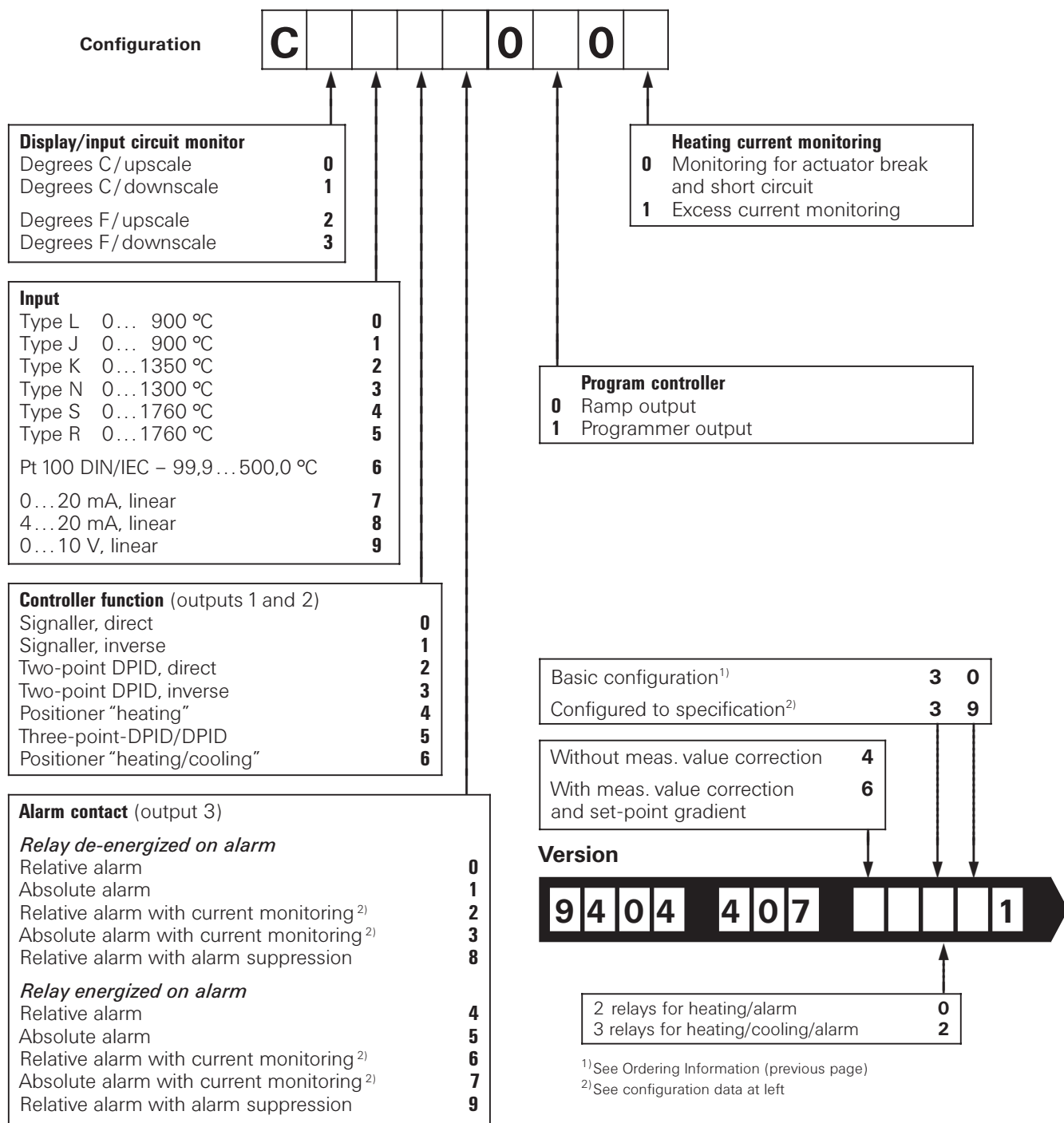
Version with:	Configuration as:	Output 1 Relay 1	Output 2 Relay 2	Output 3 Rel. 3 (Alarm)	Logic Output
2 relays 9404 407 40xx1 9404 407 60xx1	0/1 Signaller	Signalling	–	LC/HCA	Signalling
	2/3 Two-point DPID	Heating	–	LC/HCA	Heating
	4 Positioner	Heating	–	HCA	Heating
3 relays 9404 407 42xx1 9404 407 62xx1	0...4 see above	see above	not configured	see above	see above
	5 Three-point DPID / DPID	Heating	Cooling	LC/HCA	Heating
	6 Positioner "H / C"	Heating	Cooling	HCA	Heating

Note

Output 1 (heating) is available in parallel as a relay contact and a logic signal.

For optimum control of fast control loops ($T_u < 30$ s), an on/off ratio of < 10 s is necessary. For such applications, the wear-free logic output should be used together with a solid-state relay.

Relay 1 can be disabled by opening a wire-hook switch.



²⁾ Current transformer required, see Accessory Equipment