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 deactivate 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 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 signaler, two-point controller (heating), or as a three-point controller (heating/cooling).

When configured as a positioner, the unit works without an input signal. The output has an adjustable duty cycle of 0...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:

a) Relative alarm for monitoring the control deviation (relative to set-point).

b) Absolute alarm for limit monitoring (independent of set-point setting).

c) 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 °C/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 Tu and the max. rate of change Vmax 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.
**TECHNICAL DATA**

**INPUTS**

*Thermocouples*
For ranges, see Ordering data.
Input resistance: ≥ 1 MΩ
Display: in °C or °F (temperature-linear)
Display error: ≤ 3 K ± 1 digit

*TC break monitor:*
Sensor current ≤ 1 µA, output action configurable upscape or downscale.

*Polarity monitoring:*
Responds when input signal is 30 K below span start, output action configurable upscape or downscale.

*Resistance thermometer*
Pt 100 Ω to DIN IEC 751
Range: −99,9...500,0 °C or −148...932 °F (temperature-linear)
Display error: ≤ 1 K ± 1 digit
Sensor current: ≤ 1,5 mA

Connection in three-wire technique without lead adjustment.
Lead resistance: ≤ 30 Ω
Input circuit monitoring for break in sensor or lead, or short circuit.
Output action configurable upscape or downscale.

*Direct current*
0/4...20 mA, linear
Input resistance: 15 Ω
Measurement limits: selectable within -999...9999
Decimal point: adjustable
Display error: ≤ 0,1%

*Input circuit monitor for 4...20 mA:*
with I ≤ 2 mA, output action configurable upscape or downscale.

*Direct voltage*
0...10 V, linear
Input resistance: ≥ 110 kΩ
Measurement limits: selectable within -999...9999
Decimal point: adjustable
Display error: ≤ 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

*Control signal*
Contacts for „dry“ current loops, NPN transistors, or active logic signal:
Low ≤ 1V
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: ≤ 250 VAC, ≤ 1 A,
≤ 500 VA, resistive load

*Logic output*
The logic output is galvanically connected with the input.
Signal level: 0/13 V with a load ≥ 1300 Ω
or 10 mA with a load ≤ 1300 Ω

*POWER SUPPLY*

Voltage: 230/115 VAC, -15...+20%
Frequency: 48...62 Hz
Power consumption: approx. 6,5 VA

*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 Aresh with resistive load and external current transformer.
Display error: ± 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 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 W0...W100 are selectable.

*DISPLAYS*

Multi-function display
Two red 4-digit LED displays.
Digit height: 10 mm
Set-point W = 7,6 mm
Display range: -999...9999

*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: ≤ 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.

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 IMMUNITY
(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 ± 15°)
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

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
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: 38 x 38 x 20 mm  
Three-phase: 137 x 77 x 86 mm

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

**ORDERING DATA FOR ACCESSORY EQUIPMENT**

<table>
<thead>
<tr>
<th>Description</th>
<th>Order no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-phase transformer 0...30 A, complete with mounting plate for wall mounting</td>
<td>9404 407 50001</td>
</tr>
<tr>
<td>Three-phase transformer 3 x 10 A or 3 x 30 A depending on connection</td>
<td>9404 407 50021</td>
</tr>
</tbody>
</table>

**ORDERING DATA FOR ACCESSORIES**

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

Fig. 5 Connecting diagram

Contact w2 closed: Ramp or programmer “On”
Fig. 6 Controller and alarm functions

Continuous controller

Inverse function

Start of range

End of range

Relays shown de-energized

Start of range

Upper and lower alarm can be disabled

Fig. 7 Parameter adjustment

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Adjustment range</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd set-point w2 (ramp)</td>
<td>SP2</td>
<td>w0...w100</td>
</tr>
<tr>
<td>Segment time t2 (ramp)</td>
<td>Pt2</td>
<td>0...9999 minutes</td>
</tr>
<tr>
<td>3rd set-point w3</td>
<td>SP3</td>
<td>w0...w100</td>
</tr>
<tr>
<td>Segment time t3</td>
<td>Pt3</td>
<td>0...9999 minutes</td>
</tr>
<tr>
<td>4th set-point w4</td>
<td>SP4</td>
<td>w0...w100</td>
</tr>
<tr>
<td>Segment time t4</td>
<td>Pt4</td>
<td>0...9999 minutes</td>
</tr>
<tr>
<td>5th set-point w5</td>
<td>SP5</td>
<td>w0...w100</td>
</tr>
<tr>
<td>Segment time t5</td>
<td>Pt5</td>
<td>0...9999 minutes</td>
</tr>
<tr>
<td>Low limit contact</td>
<td>LCL</td>
<td>Relative: 1...9999, Absolute: x0...9999</td>
</tr>
<tr>
<td>High limit contact</td>
<td>LCH</td>
<td>Relative: 1...9999, Absolute: x0...9999</td>
</tr>
<tr>
<td>Switching difference x_{sd} for both limit contacts</td>
<td>Sd</td>
<td>1...9999</td>
</tr>
<tr>
<td>Heating current</td>
<td>HC</td>
<td>only display</td>
</tr>
<tr>
<td>Heating current alarm</td>
<td>HCA</td>
<td>0...30.0A</td>
</tr>
<tr>
<td>Blocking of operation</td>
<td>Loc</td>
<td>0...3 (see right)</td>
</tr>
<tr>
<td>Lower set-point limit w0</td>
<td>SPL</td>
<td>x0...x100</td>
</tr>
<tr>
<td>Upper set-point limit w0</td>
<td>SPH</td>
<td>x0...x100</td>
</tr>
<tr>
<td>Set-point gradient</td>
<td>Gr</td>
<td>0.1...999.9/min</td>
</tr>
<tr>
<td>Proport. band Xp1 (heating)</td>
<td>Pb1</td>
<td>0.1...999.9%</td>
</tr>
<tr>
<td>Proport. band Xp2 (cooling)</td>
<td>Pb2</td>
<td>0.1...999.9%</td>
</tr>
<tr>
<td>Integral action time Tn</td>
<td>ti</td>
<td>0...9999 seconds (0 = no I-action)</td>
</tr>
<tr>
<td>Derivative action time Tv</td>
<td>td</td>
<td>0...9999 seconds (0 = no D-action)</td>
</tr>
<tr>
<td>Duty cycle for heating</td>
<td>t1</td>
<td>0.4...999.9 sec</td>
</tr>
<tr>
<td>Duty cycle for cooling</td>
<td>t2</td>
<td>0.4...999.9 sec</td>
</tr>
<tr>
<td>Decimal point</td>
<td>dP</td>
<td>0 or 1 (0 = no dec. point)</td>
</tr>
<tr>
<td>Measuring span start x0</td>
<td>InL</td>
<td>-999...9999</td>
</tr>
<tr>
<td>Measuring span end x100</td>
<td>InH</td>
<td>-999...9999</td>
</tr>
</tbody>
</table>

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 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.

**ORDERING EXAMPLES**

**Example 1**
Required is a two-point controller with inverse output, absolute alarm and Pt100 input:

<table>
<thead>
<tr>
<th>Pos.</th>
<th>Order no./Description</th>
<th>Qty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9404 407 40391</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>C06310000</td>
<td></td>
</tr>
</tbody>
</table>

**Example 2**
Required is a three-point controller with input 0...20 mA, absolute alarm, programmer:

<table>
<thead>
<tr>
<th>Pos.</th>
<th>Order no./Description</th>
<th>Qty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9404 407 42391</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>C07510100</td>
<td></td>
</tr>
</tbody>
</table>

**Output configuration**

<table>
<thead>
<tr>
<th>Configuration as:</th>
<th>Output 1 Relay 1</th>
<th>Output 2 Relay 2</th>
<th>Output 3 Rel. 3 (Alarm)</th>
<th>Logic Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 relays: 9404 407 40x1</td>
<td>Signaller</td>
<td>-</td>
<td>-</td>
<td>LC/HCA</td>
</tr>
<tr>
<td>9404 407 60x1</td>
<td>2 / 3 Two-point DPID</td>
<td>Heating</td>
<td>-</td>
<td>LC/HCA</td>
</tr>
<tr>
<td>4</td>
<td>Positioner</td>
<td>Heating</td>
<td>-</td>
<td>HCA</td>
</tr>
<tr>
<td>3 relays: 9404 407 42x1</td>
<td>0...4 see above</td>
<td>see above</td>
<td>not configured</td>
<td>see above</td>
</tr>
<tr>
<td>9404 407 62x1</td>
<td>5 Three-point DPID/DPID</td>
<td>Heating</td>
<td>Cooling</td>
<td>LC/HCA</td>
</tr>
<tr>
<td>6 Positioner “H / C”</td>
<td>Heating</td>
<td>Cooling</td>
<td>HCA</td>
<td>Heating</td>
</tr>
</tbody>
</table>

**Note**
Output 1 (heating) is available in parallel as a relay contact and a logic signal.
For optimum control of fast control loops (Tu < 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.
Configuration C00

Display/input circuit monitor
- Degrees C / upscale: 0
- Degrees C / downscale: 1
- Degrees F / upscale: 2
- Degrees F / downscale: 3

Input
- Type L 0...900 °C
- Type J 0...900 °C
- Type K 0...1350 °C
- Type N 0...1300 °C
- Type S 0...1760 °C
- Type R 0...1760 °C
- Pt 100 DIN/IEC – 99,9…500,0 °C
- 0…20 mA, linear
- 4…20 mA, linear
- 0…10 V, linear

Controller function (outputs 1 and 2)
- Signaller, direct: 0
- Signaller, inverse: 1
- Two-point DPID, direct: 2
- Two-point DPID, inverse: 3
- Positioner “heating”: 4
- Three-point-DPID/DPID: 5
- Positioner “heating/cooling”: 6

Alarm contact (output 3)
- Relay de-energized on alarm
  - Relative alarm: 0
  - Absolute alarm: 1
  - Relative alarm with current monitoring: 2
  - Absolute alarm with current monitoring: 3
  - Relative alarm with alarm suppression: 8
- Relay energized on alarm
  - Relative alarm: 4
  - Absolute alarm: 5
  - Relative alarm with current monitoring: 6
  - Absolute alarm with current monitoring: 7
  - Relative alarm with alarm suppression: 9

Heating current monitoring
- Monitoring for actuator break and short circuit: 0
- Excess current monitoring: 1

Program controller
- 0 Ramp output
- 1 Programmer output

Basic configuration
- Configured to specification: 3 0

Without meas. value correction: 4
With meas. value correction and set-point gradient: 6

Version
9404071

2) Current transformer required, see Accessory Equipment

Your local representative:

PMA
Prozeß- und Maschinen-
Automation GmbH
P.O. Box 310229
D-34058 Kassel
Tel.: +49 - 561 - 505 13 07
Fax: +49 - 561 - 505 17 10
e-mail: mailbox@pma-online.de
Internet: http://www.pma-online.de

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