



KS 800 Multiple temperature controller

8-channel controller in housing for rail mounting
CAN/ CANopen, PROFIBUS-DP, DeviceNet, RS 485/422
Connection of Engineering Tool or local operation
Self-Tuning to the setpoint without oscillation
Automatic start-up circuit
Switch-over to output "hold" on sensor break
Monitoring for heating current and actuator
3 configurable alarm outputs or relays
8 analog outputs (option)
Direct connection of melt pressure sensors (option)

advanced line

GENERAL

The microprocessor-controlled KS 800 ensures precise, low-cost multi-loop control of temperature, and features an interface for bus or field-bus. Standard functions such as "set-point lowering" and "heating/cooling with four alarms" make the KS 800 ideally suited for temperature control of plastics processing machines, heated moulds, packaging machines, tempering units, and other similar thermal processes.

Furthermore, with high-power heating elements (e.g. in hot-runner moulds), the selectable functions "output hold" in case of sensor break, and "start-up circuit" ensure increased element life and prevent interruptions during Production. The self-tuning feature guarantees very short start-up times.

For implementing continuous and split-range controllers, the KS 800 can be fitted with 8 additional analog control outputs.

DESCRIPTION

The following description is based on the fact that every one of the 8 control loops contains a completely independent controller.

Input circuit monitoring

In case of a fault in sensor or leads, the built-in monitor provides increased operational safety. The controller output ac-

tion after monitor triggering can be configured for:

- downscale (min. output)
- upscale (max. output)
- outputs switched off
- switch-over to average output value

Thermocouple input

The monitor is triggered by wrong sensor polarity or TC break.

Resistive input

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

Measurement value correction for thermocouples, Pt 100, linear input

The correcting function is used to change or scale the measurement value.

It can be applied either for zero offset (b) or for gain adjustment (m), or both, according to the equation " $mx + b$ ". For this, the controller computes the values for m and b from two input values (x_{1in} , x_{2in}) and two set-points (x_{1out} , x_{2out}).

Easy calibration is possible online via an operating page of the engineering tool.

Heating current monitoring and alarm

The KS 800 has an input for an external current transformer, whereby rectification of the input signal is done on board. All the connected heating leads of the KS 800's controllers are passed through the current transformer.

If the monitoring function has been activated, the heating outputs of all the con-

trol loops are switched on briefly in succession, and the heating current is measured. If the measured current is lower than a defined limit value, this information can be signalled to one of the alarm outputs or transmitted via the field bus.

Similarly, the heating output can be monitored for a short-circuited actuator (SSR). In this case, the heating current is measured when the heating output is switched off. If the measured current exceeds 3% of the selected range, an alarm is triggered.

In addition to checking for exceeded heating current limits, the actuator (solid state relays) is checked for short circuit. With the outputs switched off, the heating current must not exceed 1.5% of the selected heating current measuring range. With detected errors, the relevant channel number is also output by KS 800.

Leakage current monitoring

Heating elements with a high leakage current (e.g. due to penetrated moisture) are detected by this circuit.

Monitoring is carried out with the heating output switched off. An external current relay monitors the difference between the phase currents and the current in the neutral lead. If the difference exceeds a pre-defined value of 10...100 mA, the system transmits a 24 V DC alarm signal to the controller module.

Through cyclical activation of the heating circuits and corresponding scanning, a single current relay can be used for all 8

of the heating elements, the duty cycle is reduced to ¼ during start-up.

The start-up set-point (e.g. 95°C) is maintained during the selected start-up holding time. Subsequently, the controller uses main set-point W.

“Hold” function for output signal

In order to continue with production in case of sensor break, the KS800 offers the possibility of maintaining the temperature at the last mean value of the output signal.

On sensor break, the KS 800 generates an according signal via the alarm outputs or via the field-bus, so that the sensor can be replaced.

As soon as the KS 800 detects a valid input value after replacement, controller operation is continued automatically. The “hold” value is determined continuously from the mean output value, provided that the process value is within an adjustable response threshold (e.g. $X_w = \pm 2K$).

After switching on the supply voltage again or after re-configuration, the “hold” output value is set to 0%. To prevent excessively high output values, i.e. overheating with TC break, the “hold” output value can be limited.

Self-tuning

This function is fitted as standard for 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.

With three-point controller configuration, the “cooling” parameters are determined separately. For applications with adjacent heating zones and strong thermal coupling, synchronous self-tuning can be started for the loops involved. Synchronous self-tuning can be activated or disabled individually for every control loop.

Self-tuning at the set-point

The new method determines the optimum control parameters also at the set-point either on request or automatically (if a trend towards oscillation was noticed). The method works without oscillation and with only a minimum control variable deviation.

Configurable digital inputs

If not required otherwise, 4 of the “cooling” outputs can be configured as Inputs. These inputs can be used for remote activation of the following functions:

- Input 1: switch-over to a 2nd set of parameters
- Input 2: disabling all outputs
- Input 3: input for leakage current monitoring
- Input 4: switch-over to a 2nd set-point (W/W2)

Digital outputs

In total, the multicontroller has nineteen optocoupler-isolated short circuit proof outputs. The switching states of the outputs is displayed at the unit.

Analog outputs, transmitter function

KS800 has 8 other optional analog outputs (20mA), the function of which is configurable.

They can be configured as:

- outputs for continuous or split-range controllers
- Transmitter function: analog output of input and controller signals is possible (process value, set-point, correcting variable)
- remote outputs which can be written via fieldbus

Connection and operation of the Engineering Tool

The Engineering Tool runs on a standard PC, which is connected to the KS 800 via an additional serial interface. The Tool is used for remote Configuration, parameter setting and operation of the KS 800.

The same (UART) interface can be used to connect a simple operating/display unit for local use.

Address selector switch

Three rotary switches are fitted for adjusting transmission speed and address of the KS 800. Alternatively, these adjustments can be done via the bus or by means of the Engineering Tool.

Watchdog timer

An on-board watchdog timer checks the module’s hardware every 1,6 Seconds.

TECHNICAL DATA

INPUTS

Thermocouples

Types L, J, K, N, S, R to DIN IEC584.

Type	Measuring range	Error
L	0... 900 °C	≤ 2 K
J	0... 900 °C	≤ 2 K
K	0...1350 °C	≤ 2 K
N	0...1300 °C	≤ 2 K
S	0...1760 °C	≤ 3 K
R	0...1760 °C	≤ 3 K
T	-200...400 °C	≤ 2 K
W	0...2300 °C	≤ 2 K
E	0...1000 °C	≤ 2 K

Output: in °C or °F

Input resistance: =1M Ω

TC break monitor: built-in, configurable output action

Monitoring current: =1 μ A

Polarity monitoring: responds when input signal is 30 K below span start

Temperature compensation: built in

Sensor or compensating leads must be taken up to the controller terminals.

Additional error: ≤ 1K/ 10K change of terminal temperature

Permissible voltages between inputs:

1V DC and 2V AC

Permissible voltage between inputs and ground: 5 V AC

Resistance thermometer

Pt 100 Ω to DIN IEC 751

Range: -100,0...850,0 °C

With linearization (temperature-linear)

Error: ≤ 2K

Connection in three-wire technique without lead adjustment.

With two-wire connection, a calibrating resistor equal to the lead resistance must be fitted.

Lead resistance: ≤ 30 Ω

Sensor current: ≤ 0,3 mA

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

Configurable output action.

Resistance linear

Range: 0...400 Ω, without linearization

Connection in 3-wire circuit without lead resistance adjustment

2-wire connection: with compensating resistor

Sensing current: ≤ 0,3 mA

Input circuit monitoring for sensor and lead break

Direct voltage

-100...100 mV, linear
Input resistance: $\leq 1\text{M } \Omega$
Error: $\leq 0,1\%$
Input span scalable via measurement correction.

Scanning frequency

With thermocouple or Pt 100 input, all 8 inputs are scanned within 625 ms.

Heating current input

Connection of normal current transformers
Input range: 0...42 mA AC
Ri approx.. 170 Ω
Resolution > 14bit
e.g. for PMA standard current transformer 0...30A/ 0...30 mA AC.

Digital inputs

The 4 digital inputs can also be configured as digital outputs. Galvanic isolation via opto-couplers.
Rated voltage: 24 V DC external
Current sink (IEC 1131 type 1)
Logic "0" = -3...5 V
Logic "1" = 15...30 V
Current requirement: approx. 5 mA
The digital inputs are galvanically isolated from the other temperature inputs.

Digital inputs for relay switching

2 optional inputs
Rated voltage: 24 V DC external
Current sink (IEC 1131 type 1)
galvanically isolated

INTERFACES

- KS 800-RS
Stand-alone temperature controller with RS 485 /RS 422 interface and ISO 1745 protocol.
- KS 800-CAN
Stand-alone temperature controller with integrated CANbus interface and CAL/CANopen protocol.
- KS 800-DP
Stand-alone temperature controller with integrated PROFIBUS-DP interface and PROFIBUS-DP protocol.
Data to be transmitted are freely configurable
- KS 800-DN
Stand-alone temperature controller with integrated CANbus interface and DeviceNet protocol.

Interface for PC and remote operation

An additional serial interface is provided for connecting the PC-based Engineering Tool, which is used for remote configura-

tion, parameter setting and operation of the KS 800.

OUTPUTS

Logic outputs

12 logic outputs are available for direct connection of solid-state relays. If required, 4 digital inputs can also be configured as digital outputs.

In addition, 3 outputs are available for alarm signalling. All outputs are short-circuit proof, and switch 24 V DC (grounded load). Nominal range of switched output voltage: 18...30 V DC to DIN 19 240.
Nominal output current: ≤ 70 mA
Voltage drop across output a full load: 0,6 V typical, 1 V max.

Continuous outputs

For continuous and split-range control, the KS 800 can be fitted with 8 additional analog outputs. The outputs are short-circuit proof and galvanically isolated from the inputs.

Current output

Signal: 0/4...20 mA, configurable
Resolution: 10 bits
Error: typically $\pm 0,2\% \pm 1$ digit
Load: max. 470 Ω
Settling time: within 625 ms

Constant voltage output (optional)

For melt pressure sensor energization:
Output voltage: 10 V $\pm 0,3\%$ typically
Max. load: 60 mA protected against short circuit (not permanently short circuit proof) The constant voltage source is galvanically isolated.

Relay outputs (optional)

2 potential-free changeover contacts
Contact rating: 24 V, 2 A
When used for strain gauge bridge (melt pressure) calibration, a relay load of 2 mA must not be exceeded.

POWER SUPPLY

Voltage: 24 V DC (+24 V, gnd)
Nominal range: 18...30 V DC
Power consumption: approx. 5 W
Protection class III (protective low voltage).

CONTROL CHARACTERISTICS

Control output: 0...100% duty cycle.
Modules configurable as:
-signaller with 1 or 2 outputs
-two-point DPID controller

-three-point DPID/DPID controller
-three-point controller with DPID/DPID behaviour and output algorithm for water evaporation cooling (extruders)
-split-range controller
-continuous controller
-positioner function with manual operation of three-point controller
-three-point stepping controller
-cascade controller

Control parameters

Self-tuning or adjustable.

ALARM FUNCTIONS

Output: logic signal or via interface. The following functions are configurable for every control loop and every limit value:
-relative or absolute alarm
-relative alarm with alarm suppression
-loop alarm
-sensor break alarm
-heating current alarm
-output monitor alarm

HEATING CURRENT MONITOR

Heating current is monitored with an external transformer (see Accessories).
Transformer rating: 0...30A /30 mA AC
For smaller heating currents, the load cable can be looped through the transformer several times for higher accuracy, e.g. 2 x 15A /30 mA AC. Range selectable 1,0...99,0 A, so that other current transformers can be used.
Error: $\pm 5\%$ of display range
Heating current limit: adjustable within selected range, acting on an alarm output. Monitoring for undercurrent or short-circuited actuator (SSR).

Trigger value for short-circuit monitor: 1,5% of selected range (e.g. 0,45 A with range 0...30 A).

SET-POINT

Upper and lower limits of the set-point range are selectable within the measuring range limits.

DISPLAYS

Status LEDs
-for "module OK"
-for "communication OK"
LEDs for switching status
One LED for each input/output.
LED lights if input or output is active (High).

PROGRAM MEMORY

EEPROM

ENVIRONMENTAL CONDITIONS

Permissible temperatures:

For specified accuracy: 0...55 °C
(0...50°C for versions with analog outputs)

Operation: 0...60 °C

Storage/transport: -20...60 °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 I.C. 68-2-27

(15g,11 ms)

ELECTROMAGNETIC COMPATIBILITY

Electromagnetic immunity

(complies with EN 50 082-2)

Leads of measurement inputs and analog outputs must be screened.

Electrostatic discharge

Test to I.C. 801-2

Air discharge:8 kV

Contact discharge:4 kV

High-frequency interference

Test of IEC 801-3 (ENV50140)

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

HF interference on leads

Test to IEC 801-6 (ENV 50 141)

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

Effect:±13 K (no effect with screened leads)

Fast pulse trains (burst)

Test to IEC 801-4

2 kV applied o leads for supply voltage and signal leads

ELECTROMAGNETIC RADIATION

(complies with EN 50 081-2)

GENERAL

Housing

Dimensions:

124 x 170 x 85 mm (Wx H xD)

Protection mode

(to IEC 529, DIN 40 050)

Housing: IP 20

Terminals: IP 00

CE-marking

Fulfils the European Directives for electromagnetic compatibility and low voltage.

Approval

UL-listed, CSA-approved

Electrical safety

Tested to I.C. 348 (VDE 0411)

Protection class III (protective low voltage)

Electrical connections

Choice of screw terminals (Phoenix type FRONT-MSTB 2,5/18-ST-5, 08) or screwless spring-clamp connection.

Both terminal types simply plug onto the connector strips of the KS 800.

Mounting method

Clip-on rail mounting

("top-hat "rails to DIN EN 50 022)

Weight:

approx.0,65 kg

Accessories

Operating instructions

ACCESSORY EQUIPMENT

BlueControl (Engineering Tool)

Functionality	Mini	Basic	Expert
parameter and configuration setting	yes	yes	*
controller and control loop simulation	yes	yes	*
download: writes an engineering to the controller	yes	yes	*
online mode/ visualisation	SIM only	yes	*
upload: reads an engineering from the controller	SIM only	yes	*
basic diagnosis function	SIM only	yes	*
file, save engineering data	no	yes	*
printer function	no	yes	*
online documentation, help system	no	yes	*
measurement correction (calibration procedure)	no	yes	*
data acquisition and trend function	SIM only	yes	*
personal assistant function	yes	yes	*

* expert version planned.

PC-based program for configuring, setting parameters, and operating (commissioning) the KS 50-1 controller. Moreover, all the settings are saved, and can be printed on demand.

Depending on version, a powerful data acquisition module is available, complete with trend graphics.

Simulation

The built-in simulation serves to test the controller settings, but can also be used for general training and observing the interaction between controller and control loop.

Software requirements:
Windows 95/98/NT/2000.

Hardware requirements:

A PC adapter (see „Accessories“) is required for connecting the controller.

Updates and demo software can be downloaded from:
www.pma-online.de

ORDERING DATA

9	4	0	7	4	8	0	0	0	0	1
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Multiple temperature controller

KS 800-RS (RS 422/485)	0
KS 800-DP (Profibus DP)	3
KS 800-CAN (CANopen)	6
KS 800-DN (DeviceNet)	7
With current outputs 0/4...20 mA ¹⁾	1
With voltage outputs 0...10 V (on request)	2
With constant voltage source and 2 relays ¹⁾	3

¹⁾two additional 8-pin connectors are required for analog outputs/constant voltage

ORDERING DATA FOR ACCESSORIES

Description	Order no.
BlueControl (Engineering-Tool)	9407 999 09101
Engineering Set Profibus	9407 999 09111
	9407 999 09211
PC-Adaptor	9407 998 00001
	for connecting the Engineering Tool
Screw terminals	
FRONT-MSTB 2,5/18-ST-5,08 18 terminals (4x required)	9407 799 00001
FRONT-MSTB 2,5/8-ST-5,08 8 terminals (1x required)	9407 799 00011
CANbus termination resistor	9407 800 90021
CANbus termination resistor with plug	9407 800 90051
CANbus cable for connecting CAN bus modules, standard length 5 m	9407 800 90041
DeviceNet adaptor	9407 799 00301
Current transformer	9404 407 50001
3-phase current transformer	9404 407 50022
75 A current transformer	9404 829 10222
Active current transformer 75 A	9404 829 10223
Solid-state relays	
SSR 25A,230V	9407 509 22221
SSR 50A,230V	9407 509 22421
SSR 50A,480V	9407 509 22431
Solid-state relay with heat sink	
SSR 10A,480V	9407 509 32031
SSR 20(25)A,480V	9407 509 32131
SSR 30A,480V	9407 509 32231
SSR 50A,480V	9407 509 32431
Manual (functional description)	
	German 9499 040 49218
	English 9499 040 49211
Operating instructions	
	German 9499 040 49118
	English 9499 040 49111
Interface instructions	
ASCII (ISO 1745)	
	German 9499 040 49418
	English 9499 040 49411
CANopen	
	German 9499 040 49518
	English 9499 040 49511
Profibus DP	
	German 9499 040 50518
	English 9499 040 50511
DeviceNet	
	German 9499 040 57718
	English 9499 040 57711

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