KS 816
Multiple transmitter & temperature controller

16-channel transmitter/controller in housing for rail mounting

CAN/CANopen, PROFIBUS-DP, RS 485/422

16 individually configurable universal inputs for ± 0...10 V, 0...20 mA, thermocouples, Pt 100

Comprehensive software functions: self-tuning, start-up circuit, set-point gradients, etc.

Controller outputs via (field) bus

Connection of Engineering Tool or local operating terminal

GENERAL

The microprocessor-controlled KS 816 ensures precise, low-cost multi-loop control of temperature, and features an interface for bus or field-bus.
In addition, it can be used as a freely configurable field-bus transmitter with universal inputs for standard signals, thermocouples, and Pt 100 signals.

Standard functions such as „set-point lowering" and „heating/cooling with four alarms" make the KS 816 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.

The KS 816 does not have control outputs in the usual sense. Its output signals are made available on the field bus as % duty cycle and binary signals (on/off). For the control of heating elements, PMA provides remote power output modules that are also operated via a field bus.

DESCRIPTION

The following description is based on the fact that every one of the 16 control loops contains a completely independent controller or transmitter.

Input circuit monitoring

In case of a fault in sensor or leads, the built-in monitor provides increased operational safety. The controller output action (on the bus) after monitor triggering can be configured for:
- upscale (max. output)
- downscale (min. 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 all inputs

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 (x1in, x2in), two output values (x1out, x2out), and two reference points.

Controller and positioner functions

Apart from operating as a transmitter, the KS 816 is configurable as a signaller, a two-point or three-point controller, a cascade controller or as a three-point stepping controller.
All versions feature auto/manual switch-over, also via the interface.
In manual operation, the output has an adjustable duty cycle of 0...100%.
With cascaded operation, the slave controllers can also be operated as positioners, whereby the positioning signal is defined from the output of the master controller ($Y_{slave} = m \times Y_{master}$).

Alarm functions

Triggered alarms can be scanned via the field-bus. The monitored signals are process value x, control deviation xw, and output signal y or set-point w. Furthermore, 4 limit values (2 low alarms and 2 high alarms) can be adjusted for every control loop.
Apart from channel-specific alarm status bytes, there are 3 common alarm bits that can be used to signal the following configurable alarm functions for each control loop:

a) ***Relative alarm*** for monitoring the control deviation (relative to set-point)
b) ***Absolute alarm*** for limit monitoring (independent of set-point)
c) ***Relative alarm*** with alarm suppression. (Alarm is not triggered during start-up or after set-point changes.)
d) ***Sensor fault alarm***

The 3 common alarms are also signalled by means of 3 LEDs.

Second set-point with ramp function
Via the field bus, an external control signal is used to activate a second set-point (e.g. standby set-point for use during re-start after mains recovery). Switch-over to the second set-point is immediate, or follows a gradient (GRW2).

Set-point gradient functions
This function (Fig. 1) can be adjusted by means of parameters Gr+ (positive gradient) and Gr- (negative gradient). After start-up, the function starts at process value x, and changes at the adjusted speed (e.g. 5 °C/min) until it reaches the adjusted set-point. If a new set-point is adjusted, the function ramps up or down to the new value.

Start-up circuit
For temperature control, e.g. with hot runners (Fig. 2). High-performance heating elements with magnesium oxide insulation must be heated slowly, to remove any humidity and to prevent destruction.
With activated start-up circuit, the controller uses the adjusted start-up temperature (e.g. 40 %) until reaching the start-up set-point (e.g. 95 °C).
For protection 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 KS 816 offers the possibility of maintaining the temperature at the last mean value of the output signal.
On sensor break, the KS 816 generates an according signal via the field-bus, so that the sensor can be replaced.
As soon as the KS 816 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. Xw = ± 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 via the field bus 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.
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.

Connection and operation of the Engineering Tool
The Engineering Tool runs on a standard PC, which is connected to the KS 816 via an additional serial interface.
The Tool is used for remote configuration, parameter setting and operation of the KS 816.

Via the same (UART) interface, a simple display unit or terminal can also be connected for local display or operation. Alternatively, the remote BT 800 terminal can be coupled to the KS 816 via the CANbus port.

Watchdog timer
An on-board watchdog timer checks the module's hardware every 1,6 seconds.

Fig. 1 Set-point gradient function

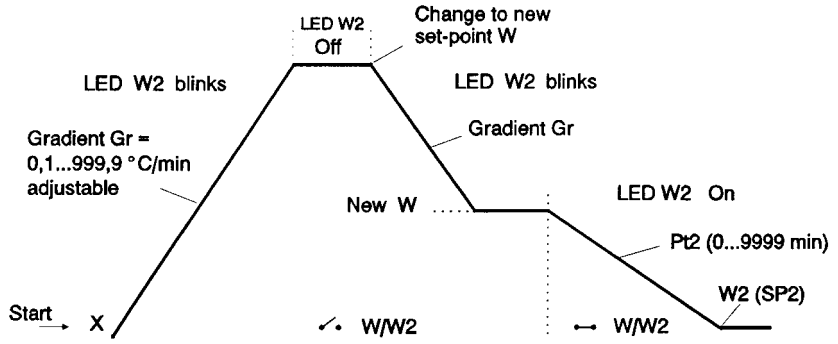
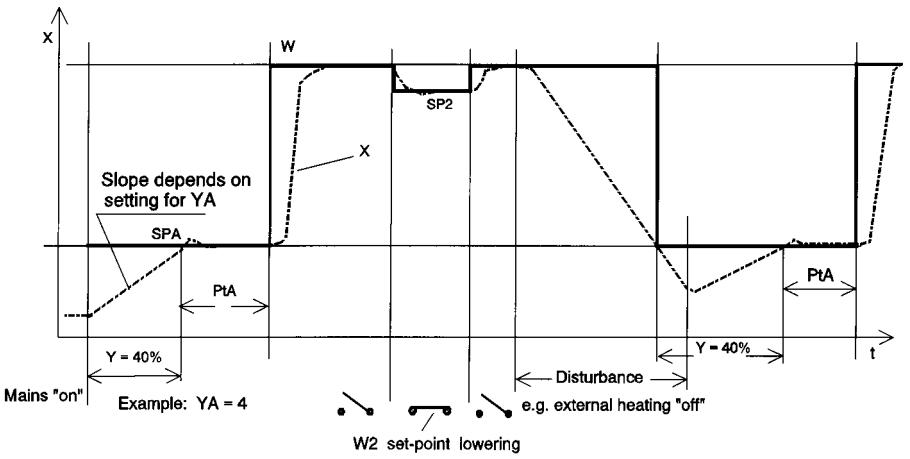


Fig. 2 Start-up circuit



TECHNICAL DATA

INPUTS

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

Type	Meas. 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: ≧1 MΩ
TC break monitor: built-in, configurable output action
Monitoring current: ≦ 1 µA
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: ≦ 1 K/10 K change of terminal temperature
Permissible voltages between inputs: 1 VDC and 2 VAC
Permissible voltage between inputs and ground: 5 VAC

Resistance thermometer
Pt 100 Ω to DIN IEC 751
Range: –100,0...850,0
With linearization (temperature-linear)
Error: ≦ 2 K
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.

Direct voltage
± 0...10 V, linear
Input resistance: ≧ 20 kΩ
Error: ≦ 0,2 %
Resolution: ≦ 0,8 mV
Input span scalable via measurement correction.

Direct current
0...20 mA or 4...20 mA, configurable
Input resistance: ≦ 50 Ω
Error: ≦ 0,2 %
Resolution: ≦ 0,8 µA
Input span scalable via measurement correction.

Input circuit monitor with 4...20 mA
Triggered, if input signal ≦ 2 mA.
Output action configurable.

Scanning frequency
Approx. 1 s for all 16 inputs.

INTERFACES

KS 816-RS
Stand-alone transmitter/temperature controller with RS 485 / RS 422 interface and ISO 1745 protocol.

KS 816-CAN
Stand-alone transmitter/temperature controller with CANbus interface and CAL/CANopen protocol.

KS 816-DP
Stand-alone transmitter/temperature controller with PROFIBUS-DP interface.

Interface for PC and remote operation
An additional serial interface is provided for connecting the PC-based Engineering Tool, that is used for remote configuration, parameter setting and operation of the KS 816.

POWER SUPPLY

Voltage: 24 VDC (+24 V; gnd)
Nominal range: 18...30 VDC
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 controller with DPID behaviour
- three-point controller with DPID/DPID behaviour
- positioner function with manual operation of three-point controller
- three-point stepping controller
- cascade controller

Control parameters
Self-tuning or adjustable.
Switching differential of signaller: 0,2 %

ALARM FUNCTIONS

The following functions are configurable for every control loop:
- relative or absolute alarm
- relative alarm with alarm suppression
- sensor break alarm

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"
- 3 LEDs for common alarm

PROGRAM MEMORY

EEPROM

ENVIRONMENTAL CONDITIONS

Permissible temperatures
For specified accuracy: 0...55 °C
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 IEC 68-2-27 (15g, 11 ms)

ELECTROMAGNETIC COMPATIBILITY

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 (ENV 50 140)
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 to 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 x D)

Protection mode

(to EN 60 529, DINVDE 0470)
Housing: IP 20
Terminals: IP 00

CE-marking

Fulfils the European Directives for electromagnetic compatibility and low voltage.

Electrical safety

Tested to IEC 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 and FRONT-MSTB 2,5/8-ST-5,08) or screwless spring-clamp connection. Both terminal types simply plug onto the connector strips of the KS 816.

Mounting method

Clip-on rail mounting („top-hat" rails to DIN EN 50 022)

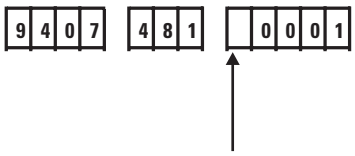
Weight:

approx. 0,65 kg

Accessories

Operating instructions

Ordering Data



Multiple temperature controller	
KS 816-RS (RS 422/485)	**0**
KS 816-DP (Profibus DP)	**3**
KS 816-CAN (CANopen)	**6**

Ordering data for accessories

Description		***Order-No.***
Engineering Tool	German/ English	**9407 999 09121**
PC adapter for connecting the Engineering Tool		**9407 998 00001**
Screw terminals		
FRONT-MSTB 2,5/18-ST-5,08	18 terminals (5x required)	**9407 799 00001**
FRONT-MSTB 2,5/8-ST-5,08	8 terminals (1x required)	**9407 799 00011**
CANbus termination resistor with plug		**9407 800 90021**
CANbus termination resistor/Gnd		**9407 800 90051**
CANbus cable length 5 m		**9407 800 90041**
IP 65 terminal housing for one or two KS 816 modules		**on request**
Operating instructions	German	**9499 040 55818**
	English	**9499 040 55811**
Manual (functional description)	German	**9499 040 55918**
	English	**9499 040 55911**
Interface instructions		
ASCII (ISO 1745)	German	**9499 040 56118**
	English	**9499 040 56111**
CANopen	German	**9499 040 56018**
	English	**9499 040 56011**
Profibus DP	German	**9499 040 56218**
	English	**9499 040 56211**

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