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 (x1, x2), two output values (x1, x2), and two reference points.

### Controller and positioner functions

Apart from operating as a transmitter, the KS 816 is configurable as a signal- ler, 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:

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

**INPUTS**

Thermocouples

<table>
<thead>
<tr>
<th>Type</th>
<th>Meas. range</th>
<th>Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>0...900 °C</td>
<td>±2 K</td>
</tr>
<tr>
<td>J</td>
<td>0...900 °C</td>
<td>±2 K</td>
</tr>
<tr>
<td>K</td>
<td>0...1350 °C</td>
<td>±2 K</td>
</tr>
<tr>
<td>N</td>
<td>0...1300 °C</td>
<td>±2 K</td>
</tr>
<tr>
<td>S</td>
<td>0...1760 °C</td>
<td>±3 K</td>
</tr>
<tr>
<td>R</td>
<td>0...1760 °C</td>
<td>±3 K</td>
</tr>
<tr>
<td>T</td>
<td>-200...400 °C</td>
<td>±2 K</td>
</tr>
<tr>
<td>W</td>
<td>0...2300 °C</td>
<td>±2 K</td>
</tr>
<tr>
<td>E</td>
<td>0...1000 °C</td>
<td>±2 K</td>
</tr>
</tbody>
</table>

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...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)

**ELECTROMAGNETIC RADIATION**
(complies with EN 50 081-2)

**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
**GENERAL**

**Housing**
Dimensions: 124 x 170 x 85 mm (W x 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

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**Ordering Data**

<table>
<thead>
<tr>
<th>Description</th>
<th>Order-No.</th>
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<tr>
<td>Multiple temperature controller</td>
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<tr>
<td>KS 816-RS (RS 422/485)</td>
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<tr>
<td>KS 816-DP (Profibus DP)</td>
<td>3</td>
</tr>
<tr>
<td>KS 816-CAN (CANopen)</td>
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**Ordering data for accessories**

<table>
<thead>
<tr>
<th>Description</th>
<th>Order-No.</th>
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<tbody>
<tr>
<td>Engineering Tool German/ English</td>
<td>9407 999 09121</td>
</tr>
<tr>
<td>PC adapter for connecting the Engineering Tool</td>
<td>9407 998 00001</td>
</tr>
<tr>
<td>Screw terminals FRONT-MSTB 2,5/18-ST-5,08 (18 terminals (5x required))</td>
<td>9407 799 00001</td>
</tr>
<tr>
<td>Screw terminals FRONT-MSTB 2,5/8-ST-5,08 (8 terminals (1x required))</td>
<td>9407 799 00001</td>
</tr>
<tr>
<td>CANbus termination resistor with plug</td>
<td>9407 800 90021</td>
</tr>
<tr>
<td>CANbus termination resistor/Gnd</td>
<td>9407 800 90051</td>
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<tr>
<td>CANbus cable length 5 m</td>
<td>9407 800 90041</td>
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<tr>
<td>IP 65 terminal housing for one or two KS 816 modules</td>
<td>on request</td>
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<tr>
<td>Operating instructions German</td>
<td>9409 040 55818</td>
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<tr>
<td>Operating instructions English</td>
<td>9409 040 55811</td>
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<tr>
<td>Manual (functional description) German</td>
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<td>Manual (functional description) English</td>
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<tr>
<td>Interface instructions ASCII (ISO 1745)</td>
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<tr>
<td>CANopen</td>
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<tr>
<td>Profibus DP</td>
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</tbody>
</table>

**Your local representative**

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