**DESCRIPTION**

The universal temperature controller KS 40-1 burner are intended for universal, precise, and cost-effective control tasks of modulating, two- and three-stage burners. It can be switched between the simple on/off control of 2-stage burners and motorized control for modulating burners during operation. Thus different fuels are optimally applicable.

The process value signal is connected via a universal input. Thus thermocouples and Pt100 can be used for temperature control. 2-wire, 3-wire or 50/30/50 Ω pressure transmitters can be used for boiler pressure control. The additional input INP2 can be used eg. for external setpoint or weather-compensation.

**Plug-in module**

KS 40-1 controllers are built as plug-in modules. This enables them to be replaced very quickly without tools, and without disturbing the wiring.

**Self-tuning**

During start-up, the self-tuning function determines the optimum settings for fast line-out without overshoot.

**Display and operation**

Clear informations are given by ten indicator LED’s in the front panel that display operating mode, I/O states, and errors. The auto/manual key switches the controller into the manual mode directly, without lengthy operating sequences. If required, the direct switch over can be disabled or the key can be configured e.g. switch off the controller. This results in a level of operational safety that is usually found only in controllers of a higher price category.

**Lower interface and Engineering Tools**

Via the BlueControl software incl. its simulation functions, and especially the convenient BluePort® front panel interface, the required set-up for a specific control task can be determined without a detailed study of the operating instructions.

Off cause almost all adjustments can be done comfortably over the instrument front. (see page 5, BlueControl)

**Password protection**

If required, access to the various operating levels can be protected with a password. Similarly, access to a complete level can be blocked.
**TECHNICAL DATA**

**INPUTS**

**SURVEY OF THE INPUTS**

<table>
<thead>
<tr>
<th>Input</th>
<th>Used for</th>
</tr>
</thead>
<tbody>
<tr>
<td>INP1</td>
<td>( x ) (process value)</td>
</tr>
<tr>
<td>INP2</td>
<td>SP.E (external set-point or external correction)</td>
</tr>
<tr>
<td>di2</td>
<td>Control mode selection</td>
</tr>
<tr>
<td></td>
<td>Operation disabled, switch-over to second set-point SP.2, external set-point SP.E, fixed output signal Y2, manual operation, controller off, disabled auto/manual function, reset stored alarms</td>
</tr>
</tbody>
</table>

**PROCESS VALUE INPUT INP1**

- Resolution: 14 bits
- Decimal point: 0 to 3 decimals
- Limiting frequency: 2 Hz
- Digital input filter: adjustable 0,000...9999 s
- Scanning cycle: 100 ms
- Measured value correction: 2-point or offset correction

**Thermocouples (a)**

- Input impedance: \( \geq 1 \text{ M}\Omega \)
- Effect of source resistance: 1 \( \mu \text{V/}\Omega \)

**Cold junction compensation**

- Max. additional error: \( \pm 0.5 \text{ K} \)

**Sensor break monitoring**

- Sensor current: \( \leq 1 \mu\text{A} \)
- Operating sense configurable (see page 3)

**Resistance thermometer (b)**

- Connection: 3-wire
- Lead resistance: max. 30 \( \Omega \)
- Input circuit monitor: Break and short circuit

**Resistance measuring range**

The BlueControl software can be used to match the input to the sensor KTY 11-6 (characteristic is stored in the controller).

- Physical measuring range: 0...4500 \( \Omega \)
- Linearization segments: 16

**Potentiometer (c)**

- Connection of eg 50-30-50 \( \Omega \)

**Current and voltage signals (d, g)**

- Span start, end of span: anywhere within measuring range
- Scaling: selectable -1999...9999
- Linearization: 16 segments, adaptable with BlueControl
- Decimal point: adjustable
- Input circuit monitor: 12.5% below span start (2mA, 1V)

**Direct connection of transmitters (Option)**

**3-wire transmitters (c)**

- Supply voltage \( \geq 18 \text{ V/22 mA} \)
- Measuring range 0...10V

**2-wire transmitters (f)**

- Supply voltage \( \geq 18 \text{ V/22 mA} \)
- Measuring range 4...20mA

**Thermocouples**

<table>
<thead>
<tr>
<th>Thermocouple</th>
<th>Range</th>
<th>Accuracy</th>
<th>Resolution (( \Omega ))</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>100...900°C</td>
<td>2K</td>
<td>0.1 K</td>
</tr>
<tr>
<td>J</td>
<td>100...1200°C</td>
<td>2K</td>
<td>0.1 K</td>
</tr>
<tr>
<td>K</td>
<td>100...1350°C</td>
<td>2K</td>
<td>0.2 K</td>
</tr>
<tr>
<td>N</td>
<td>100...1300°C</td>
<td>2K</td>
<td>0.2 K</td>
</tr>
<tr>
<td>S</td>
<td>12...3200°F</td>
<td>2K</td>
<td>0.2 K</td>
</tr>
<tr>
<td>R</td>
<td>12...3200°F</td>
<td>2K</td>
<td>0.2 K</td>
</tr>
</tbody>
</table>

**Resistance transducers (INP1)**

<table>
<thead>
<tr>
<th>Type</th>
<th>Sensor current</th>
<th>Range</th>
<th>Accuracy</th>
<th>Resolution (( \Omega ))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pt100</td>
<td>0.2 mA</td>
<td>-200...850°C</td>
<td>2K</td>
<td>0.1 K</td>
</tr>
<tr>
<td>Pt1000</td>
<td>-200...850°C</td>
<td>-200...850°F</td>
<td>2K</td>
<td>0.1 K</td>
</tr>
<tr>
<td>Resistance</td>
<td>4500 \Omega</td>
<td></td>
<td>0.1 %</td>
<td>0.1 %</td>
</tr>
<tr>
<td>Potentiometer</td>
<td>160/450/1600 \Omega</td>
<td></td>
<td>0.1 %</td>
<td>0.1 %</td>
</tr>
</tbody>
</table>

* The characteristic of a KTY 11-6 is preadjusted (-60...150°C)

**Current and voltage (INP1)**

<table>
<thead>
<tr>
<th>Type</th>
<th>Input resistance</th>
<th>Accuracy</th>
<th>Resolution (( \mu\text{A} ))</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10 Volt</td>
<td>110 ( \Omega )</td>
<td>( \leq 0.1 % )</td>
<td>0.6 ( \mu\text{A} )</td>
</tr>
<tr>
<td>0-20 mA</td>
<td>49 ( \mu\text{A} ) (voltage requirement ( \leq 2.5 \text{ V} ) )</td>
<td>( \leq 0.1 % )</td>
<td>1.5 ( \mu\text{A} )</td>
</tr>
</tbody>
</table>

**Electrical connections:**

- **Option:**
  - di2
  - di3
  - \( U(+), U(-) \)

**Table 1 Thermocouple ranges (INP1)**

**Table 2 Resistance transducers (INP1)**

**Table 3 Current and voltage (INP1)**

**Dimensions (mm):**

**KS 40-1 burner**
SUPPLEMENTARY INPUT INP2

Resolution: > 14 bit
Scanning cycle: 100 ms
Accuracy: ≤ 0,5%

Current measurement
Input resistance: approx. 15 Ω
Span: configurable within 0 to 20mA
Scaling: adjustable -1999...9999
Input circuit monitor: 12,5% below span start (4..20mA → 2mA)

Potentiometer
Connection: 3-wire
Ranges: 160/450/1600 Ω
Scaling: beliebig -1999...9999
Input circuit monitor: Break and short circuit

Resistance thermometer
Connection: 3-Leiter
Ranges: Pt100, Pt1000
Input circuit monitor: Break and short circuit

CONTROL INPUTS (OPTION)
Connection of a potential-free contact suitable for switching „dry“ circuits.
Switched voltage: 5 V
Switched current: 160 µA

TRANSMITTER SUPPLY UT (OPTION)
Output: 22 mA / ≥ 18 V

OUTPUTS

SURVEY OF THE OUTPUTS

Output | Used for | Optional
---|---|---
OUT1 | Control output Y1 | Control outputs Y1, Y2, limit contacts, alarms*
OUT2 | Control output Y2 | 
OUT3 | Limit contact 1 | 

* All logic signals can be OR-linked!

RELAY OUTPUTS OUT1, OUT2
Contacts: 2 NO contacts with common connection
Max. contact rating: 500 VA, 250 VAC, 2A at 48..62 Hz, resistive load
Min. contact rating: 6 V, 1 mA DC
Operating life (electric): 800.000 duty cycles with max. rating

RELAY OUTPUT OUT3
Contacts: Potential-free changeover contact
Max. contact rating: 500 VA, 250 VAC, 2A at 48..62 Hz, resistive load
Min. contact rating: 5 V, 10 mA AC/DC
Operating life (electric): 600.000 duty cycles with max. rating

Note:
If the relays OUT1...OUT3 operate external contactors, these must be fitted with RC snubber circuits to manufacturer specifications to prevent excessive switch-off voltage peaks.

FUNCTIONS

Control behaviour
- Signaler with adjustable switching differential (ON/OFF controller)
- 3-point signaler (3-stage)
- PID controller (2-point)
- Delta / Star / Off or 2-point controller with switch over from partial to full load
- 2 x PID (heating/cooling)
- 3-point stepping controller (modulating)
- 3-point stepping controller switch-over to signaler (2-stage)
- 3-point stepping controller switch-over to 3-point signaler (3-stage)

Self-tuning control parameters or adjustable manually via front keys or BlueControl software.

Set-point functions
- Adjustable set-point gradient 0,01...9999 °C/min
- Set-point control
- Set-point/cascade control
- Set-point with external correction (weather control)

Behaviour with sensor break or short circuit:
- Control outputs switched off
- Switch-over to a safe output value
- Switch-over to a mean output value (PID-controller only)

LIMIT SIGNALLING FUNCTIONS
Max., Min. or Max./Min. monitoring with adjustable hysteresis.

Signals which can be monitored:
- Process value
- Control deviation
- Control deviation with suppression during start-up or set-point changes
- Effective set-point
- Output signal Y

Functions
- Input signal monitoring
- Input signal monitoring with latch (reset via front key or digital input)

Several limit signals or alarms can be OR-linked before being output.
Applications: Release of a brake with motor actuators, general alarms, etc.

ALARMS

Sensor break or short circuit
Depending on selected input type, the input signal is monitored for break and short circuit.

MAINTENANCE MANAGER
Display of error signals, warnings, and latched limit messages in the error list. Signals are latched, and can be reset manually.

Possible signals in the error list:
- Sensor break, short circuit, reversed polarity
- Heating current alarm
- Control loop alarm
- Fault during self-tuning
- Latched limit messages
  - e.g. re-calibration warning
  - If the adjusted operating hours are exceeded a message is displayed
  - e.g. maintenance interval of actuator
  - If the adjusted switching cycles are exceeded a message is displayed
- Internal fault (RAM, EEPROM, ...)

Flashing Error LED indicates active alarm in the error list:
## OPERATION AND DISPLAY

**Display**
- Process value: 10.5 mm LED
- Lower display: 7.8 mm LED

**Function key**
Available for the following functions:
- Control mode selection modulating/stage
- Operation blocked
- Switch-over to second setpoint SP.2
- Switch-over to external setpoint SP.E
- Switch-over to setpoint correction SP.E
- Switch-over to fixed output signal Y2
- Manual operation
- Controller off
- Disabled auto/manual function
- Reset of latched alarms

## ENVIRONMENTAL CONDITIONS

### Protection modes
- Front panel: IP 65
- Housing: IP 20
- Terminals: IP 00

### Permissible temperatures
- For specified accuracy: 0...60°C
- Warm-up time: < 15 minutes
- Temperature effect: < 100 ppm/K
- For operation: -20...65°C
- For storage: -40...70°C

### Humidity
- 75% yearly average, no condensation

### Shock and vibration

#### Vibration test Fc (DIN 68-2-6)
- Frequency: 10...150 Hz
- Unit in operation: 1g or 0.075 mm
- Unit not in operation: 2g or 0.15 mm

#### Shock test Ea (DIN IEC 68-2-27)
- Shock: 15g
- Duration: 11ms

### Electromagnetic compatibility
Complies with EN 61 326-1 (for continuous, unattended operation)

## POWER SUPPLY

Depending on version:

### AC SUPPLY
- Voltage: 90...260 VAC
- Frequency: 48...62 Hz
- Power consumption: approx. 7 VA

### UNIVERSAL SUPPLY 24 V UC
- AC voltage: 20,4...26,4 VAC
- Frequency: 48...62 Hz
- DC voltage: 18...31 V DC
- Power consumption: approx. 7 VA (W)

## BEHAVIOUR WITH POWER FAILURE
Configuration, parameters, and adjusted set-points, control mode:
- Non-volatile storage in EEPROM

## BluePort® FRONT INTERFACE
Connection of PC via PC adapter (see „Accessories“). The BlueControl software is used to configure, set parameters, and operate the KS 40-1.

## GENERAL

### Housing
- Material: Makrolon 9415, flame-retardant
- Flammability class: UL 94 VO, self-extinguishing
- Plug-in module, inserted from the front

### Safety tests
Complies with EN 61010-1 (VDE 0411-1):
- Over voltage category II
- Contamination class 2
- Working voltage range 300 VAC
- Protection class II

### Certifications
Type test to DIN 3440
With certified sensors it can be used in:
- Heat generating plants with outflow temperatures up to 120°C to DIN 4751
- Hot-water plants with outflow temperatures above 110°C to DIN 4752
- Thermal transfer plants with organic transfer media to DIN 4754
- Oil-heated plants to DIN 4755

### UL certification (applied for)

## Electrical connections

### Depending on version:
- Flat-pin connectors 1 x 6,3 mm or 2 x 2,8 mm to DIN 46 244
- Screw terminals for conductor cross-section from 0,5 to 2,5 mm²

### Mounting
Panel mounting with two fixing clamps at top/bottom or left/right
Close mounting possible

### Mounting position:
- not critical

### Weight:
- 0,27 kg (9.52 oz)

### Accessories supplied with unit
Operating instructions
- 2 fixing clamps

### Display and operation:
- 3 yellow LEDs for the output states
- Green "OK"-LED
- Process value
- Signaler active (on/off control)
- Selftuning is active
- Error list
- Setpoint, actuating value, parameter
- Enter-key
- Operation keys
**ACCESSORY EQUIPMENT**

**BlueControl (Engineering Tool)**

PC-based program for configuring, setting parameters, and operating (commissioning) the KS 40-1 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.

**Software requirements:**


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.

**Configurations that can only be implemented via the BlueControl software (not via the front-panel keys):**

- Customer-specific linearizations
- Enable „forcing“ for inputs/outputs. Forcing allows to write the analog and digital inputs and outputs via Modbus interface.
- Adjustment of limits for operating hours and switching cycles
- Switch-over to 60 Hz mains frequency
- Disable operator actions and operating levels, plus password definition
- Prevent automatic optimization of cycle times T1, T2

**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

---

**BlueControl, versions and functionality:**

<table>
<thead>
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<th>Functionality</th>
<th>Mini</th>
<th>Basic</th>
<th>Expert</th>
</tr>
</thead>
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<tr>
<td>parameter and configuration setting</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
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<tr>
<td>controller and control loop simulation</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
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<tr>
<td>download: writes an engineering to the controller</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
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<tr>
<td>online mode/visualization</td>
<td>SIM only</td>
<td>yes</td>
<td>yes</td>
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<tr>
<td>creation of user defined linearizations</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>configuration of extended operating level</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
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<td>diagnosis function</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>file, save engineering data</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
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<tr>
<td>printer function</td>
<td>no</td>
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<td>yes</td>
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<td>online documentation, help system</td>
<td>no</td>
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<td>network and multiuser licence</td>
<td>no</td>
<td>no</td>
<td>yes</td>
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<tr>
<td>personal assistant function</td>
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<td>yes</td>
<td>yes</td>
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<tr>
<td>extended simulation</td>
<td>yes</td>
<td>yes</td>
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**ORDERING INFORMATION**

<table>
<thead>
<tr>
<th>Beschreibung</th>
<th>Bestell-Nr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC adapter, for connecting BlueControl software to the BluePort®</td>
<td>9407-998-00001</td>
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<tr>
<td>Standard rail adapter</td>
<td>9407-998-00061</td>
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<tr>
<td>Operating manual German</td>
<td>9499-040-66018</td>
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<tr>
<td>Operating manual English</td>
<td>9499-040-66011</td>
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<tr>
<td>Operating manual French</td>
<td>9499-040-66042</td>
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<tr>
<td>BlueControl Mini German/English/french</td>
<td>9407-999-11001</td>
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<tr>
<td>BlueControl Basic German/English/french</td>
<td>9407-999-11010</td>
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<tr>
<td>BlueControl Expert German/English/french</td>
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**ACCESSORIES**

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Functionality Mini Basic Expert

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</tbody>
</table>
Application example for weather-control:

- **X**: process value
- **SP.E**: external setpoint
- **Y**: correcting variable
- **Yp**: position feedback

**KS 40-1 burner**

**boiler-temperature**

Application example for synchronisation control with additional master controller:

- **X**: process value
- **SP.E**: external setpoint
- **Y**: correcting variable
- **Yp**: position feedback

**KS 40-1 burner**

**master controller**

\[ Y = 0 - 20 \text{ mA} \]

**PI behaviour**

\[ P_b = 100\% \]

\[ t_i = 10 \text{ s} \]

\[ t = 60 \text{ s} \]

Application example for synchronisation control for two burners:

- **X**: process value
- **SP.E**: external setpoint
- **Y**: correcting variable
- **Yp**: position feedback

**KS 40-1 burner**

**burner 1**

**burner 2**