



# KS 40-1 lab

## Universal laboratory controller



Including data acquisition software

Controller output via maintenance-free solid-state relays

BluePort front interface and BlueControl software

Maintenance manager and error list

Auto/manual key

Heating current monitor and input circuit alarm

Timer and programmer

Extended limit signalling function with memory

expert line

- ⊕ 100 ms cycle time, i.e. also suitable for fast control loops
- ⊕ Customer-specific linearization
- ⊕ Measurement value correction as offset or 2-point
- ⊕ Emergency operation on sensor break by acceptance of the mean output value
- ⊕ Logical interlock of the digital outputs, e.g. for common alarm
- ⊕ Program controller with 4 segments and „End“ signal

### APPLICATIONS

- Heating plates
- Heating bands
- Cartridge heaters
- Tempering baths
- Heating ovens

### DESCRIPTION

The universal controller KS 40-1lab is intended for precise and cost-effective control tasks in laboratories and manufacturing. Hereby, it is possible to choose between simple on/off control and PID control. The supplementary analog input can be used for an external setpoint.

### Self-tuning function

During start-up, the self-tuning function determines the optimum parameters for the control loop quickly and safely, thus ensuring fast lineout without overshoot.

### Display and operation

Ten indicator LEDs in the front panel provide a reliable indication of I/O states, operating mode, and fault conditions. An Auto/manual key switches the controller into the manual mode directly, without having to follow confusing operating sequences.

If necessary, the key can be disabled or it can be configured to start the internal timer. This provides a degree of operational safety that previously could only be expected from equipment with a considerably higher price tag.

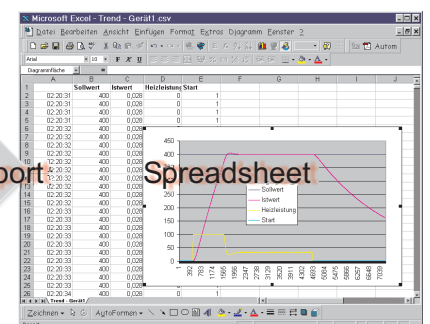
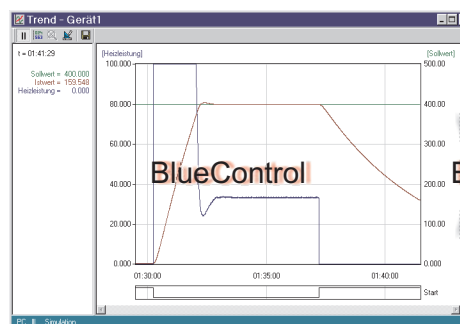
### Front interface and Engineering Tools

Controller tuning within seconds is now also possible with controllers of the KS 40 range.

By means of the standard BlueControl software (including controller and loop simulation) and especially the very convenient connection via the BluePort front interface, it is possible to find the best control solution quickly, without lengthy study of the operating instructions. Of course practically all the settings are also possible via the front panel keys (see page 4, BlueControl). Furthermore, the software contains a data acquisition feature, complete with a data export function.

### Password protection

If required, the various operating levels can be protected against unauthorized access by means of a password, or an entire level can be disabled.



## TECHNICAL DATA

### INPUTS

### SURVEY OF INPUTS

| Input | Used for                                                                                                                                                                                                              |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| INP1  | x (process value)                                                                                                                                                                                                     |
| INP2  | external setpoint                                                                                                                                                                                                     |
| di1   | Disabling operation, switch-over to second setpoint SP.2, external setpoint SP.E, fixed output signal Y2, manual operation, controller off, disabling of Auto/manual key, reset of stored alarms, timer start (= Y.2) |

### 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                       |
| Measurement value correction: | 2-point or offset correction |

### Thermocouples (Table 1)

|                           |        |
|---------------------------|--------|
| Input impedance:          | ≥ 1 MΩ |
| Source resistance effect: | 1 μV/Ω |

### Cold junction compensation

|                        |         |
|------------------------|---------|
| Max. additional error: | ± 0,5 K |
|------------------------|---------|

### Sensor break monitor

|                                           |        |
|-------------------------------------------|--------|
| Sensor current:                           | ≤ 1 μA |
| Operating sense configurable (see page 3) |        |

### Resistance thermometer

|                        |                         |
|------------------------|-------------------------|
| Connection:            | 3-wire                  |
| Lead resistance:       | max. 30 Ohm             |
| Input circuit monitor: | break and short circuit |

### Special measuring range

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

|                           |              |
|---------------------------|--------------|
| Physical measuring range: | 0...4500 Ohm |
| Linearization segments:   | 16           |

### Current and voltage signals

|                          |                                         |
|--------------------------|-----------------------------------------|
| Span start, end of span: | anywhere within the measurement range   |
| Scaling:                 | selectable -1999...9999                 |
| Linearization:           | 16 segments, adaptable with BlueControl |
| Decimal point:           | adjustable                              |
| Input circuit monitor:   | 12,5% below span start (2mA, 1V)        |

**Table 1: Thermocouple measurement range**

| Thermocouple type* |         | Measuring range |               | Accuracy | Resolution (Ø) |
|--------------------|---------|-----------------|---------------|----------|----------------|
| K                  | NiCr-Ni | -100...1350°C   | -148...2462°F | ≤ 2 K    | 0.2 K          |

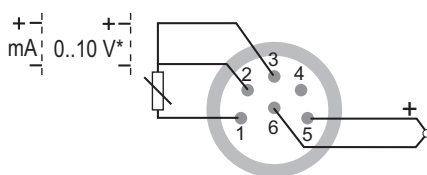
\* The controller KS40-1 is configurable for all thermocouple types. If a different type is used, the corresponding equalizing lead must be fitted in the tabletop housing.

**Table 2: Resistance thermometers**

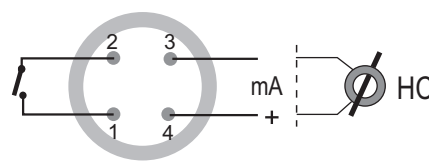
| Type      | Sensor current | Measuring range |               | Accuracy | Resolution (Ø) |
|-----------|----------------|-----------------|---------------|----------|----------------|
| Pt100     | 0,2 mA         | -200...850°C    | -328...1562°F | ≤ 1 K    | 0,1 K          |
| Pt1000    |                | -200...850°C    | -328...1562°F | ≤ 2 K    | 0,1 K          |
| KTY 11-6* |                | -50...150 °C    | -58...302 °F  | ≤ 2 K    | 0.05 K         |

\* or special measuring range

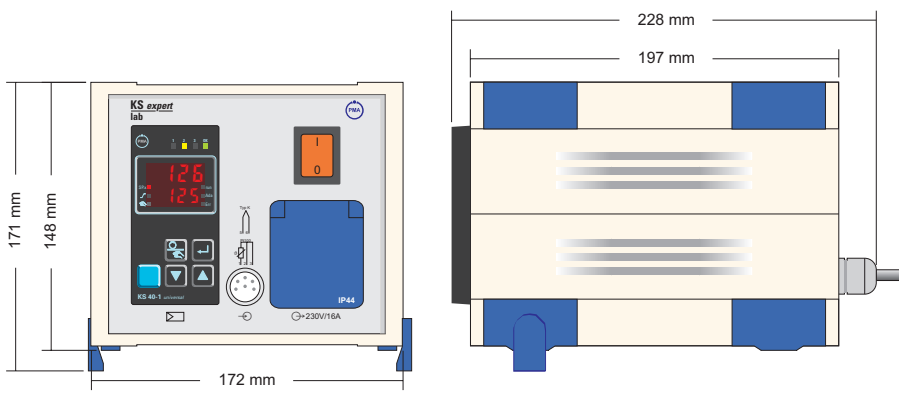
### Pin-out of the process value sensor



### Pin-out of the supplementary inputs di1, INP2



### Measures:



### SUPPLEMENTARY INPUT INP2

|                 |              |
|-----------------|--------------|
| Resolution:     | > 14 bits    |
| Scanning cycle: | 100 ms       |
| Error:          | within 0,1 % |

### Current measurement

|                          |                                          |
|--------------------------|------------------------------------------|
| Input resistance:        | approx. 120 Ω                            |
| Span start, end of span: | anywhere between 0 and 20 mA             |
| Scaling:                 | selectable -1999...9999                  |
| Input circuit monitor:   | 12,5% below span start (4...20 mA, 2 mA) |

### Heating current measurement

|                         |                        |
|-------------------------|------------------------|
| via current transformer |                        |
| Measuring range:        | 0...50 mA AC           |
| Scaling:                | selectable             |
|                         | -1999...0,000...9999 A |

### CONTROL INPUT DI1

|                                                                               |       |
|-------------------------------------------------------------------------------|-------|
| Configurable as direct / inverse switch or push-button!                       |       |
| Connection of a potential-free contact suitable for switching „dry“ circuits. |       |
| Switched voltage:                                                             | 2,5 V |
| Switched current:                                                             | 50 μA |

### CONTROL OUTPUT

|                                        |  |
|----------------------------------------|--|
| Solid-state relay 3600 VA, 250 V, 16 A |  |
| Operating life: unlimited.             |  |

## FUNCTIONS

### Control behaviour

- Signaller with adjustable switching differential (On/Off controller)
- PID controller (2-point)

Control parameters self-tuning or manually adjustable via front panel keys or BlueControl software.

### Setpoint functions

- Adjustable setpoint gradient 0,01...9999 °C/min
- Setpoint controller
- Setpoint / cascade controller
- Program controller with 4 segments (setpoint / segment time)
- Timer

### Timer

Time  $t_{SP}$  adjustable from 0,1 to 9999 minutes

#### Timer start:

- Power On
- Control input
-  key (= Y.2 switch-over)
- Direct presetting of the timer

### Behaviour with sensor break or short circuit

- Controller outputs switched off
- Switch-over to a pre-defined safe output value
- Switch-over to the mean output value (PID controller)

### LIMIT SIGNALLING FUNCTIONS

Max., Min. or Max./Min. monitoring with adjustable hysteresis

### Signals that can be monitored

- Process value
- Control deviation
- Control deviation with suppression during start-up or setpoint changes
- Effective setpoint
- Output value Y

### Signalling functions

- Input circuit monitor

- Input circuit monitor with storage (reset via front key or digital input)

## ALARMS

### Open control loop

Automatic detection if process value does not react to a change of output value.

### Sensor break or short circuit

Depending on selected sensor type, the input signal is monitored for break and short circuit. In case of an open control loop, thermocouple short circuit, sensor break, etc., the control signal to the heater is switched off.

## MAINTENANCE MANAGER

Display of error signals, warnings, and stored limit values in the error list. Signals are stored, and can be reset manually.

Possible signals in the error list:

|                                                                                                                               |
|-------------------------------------------------------------------------------------------------------------------------------|
| Sensor break, short circuit, reversed polarity                                                                                |
| Control loop alarm                                                                                                            |
| Fault during self-tuning                                                                                                      |
| Stored limit values                                                                                                           |
| e.g. recalibration warning<br>(if an adjustable operating time is exceeded, a warning is given)                               |
| e.g. maintenance interval for an actuator<br>(if an adjustable number of actuator operations is exceeded, a warning is given) |
| Internal faults (RAM, EEPROM, ...)                                                                                            |

## OPERATION AND DISPLAY

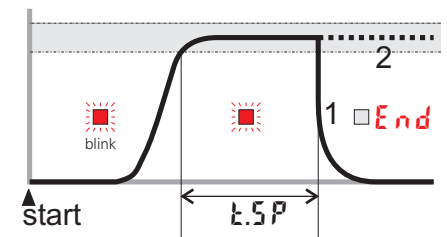
### Display

|                    |                        |
|--------------------|------------------------|
| Process value      | 7-segment LED, 10,5 mm |
| Lower display line | 7-segment LED, 7,8 mm  |

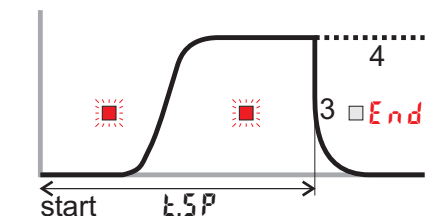
### Mains switch

Interrupts the controller's supply voltage

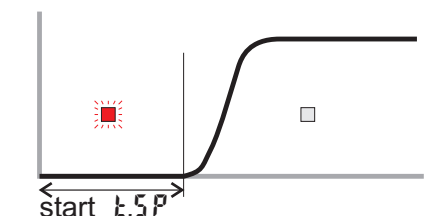
### Timer modes 1 and 2



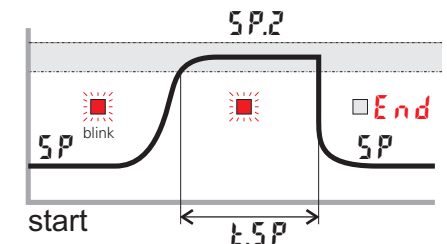
### Timer modes 3 and 4



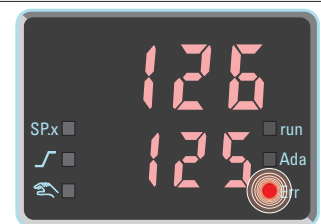
### Timer mode 5



### Timer mode 6



Maintenance manager: Blinking error LED indicates an active alarm in the error list

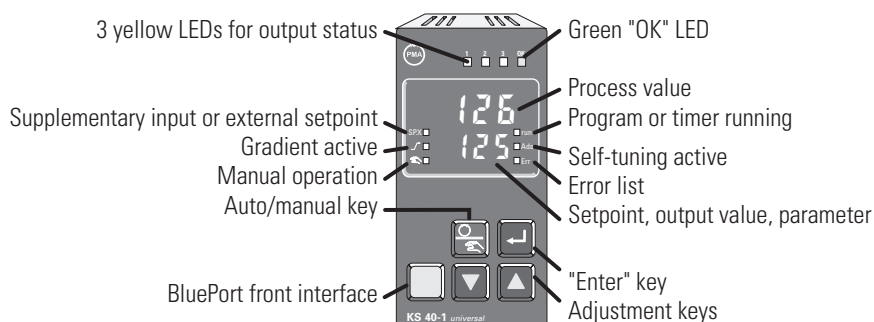


### Galvanic isolation

- Safety isolation
- Functional isolation

|                        |                                                             |
|------------------------|-------------------------------------------------------------|
| Mains supply terminals | Process value input INP1                                    |
|                        | Supplementary input INP2                                    |
|                        | Digital input di1                                           |
|                        | Universal output OUT3<br>(control of the solid-state relay) |

### Display and operating elements



## POWER SUPPLY

### AC supply

Voltage: 90...260 V AC  
Frequency: 48...62 Hz  
Power consumption: approx. 7 VA

## BEHAVIOUR WITH POWER FAILURE

Configuration, parameters, adjusted setpoints, and control mode:  
Non-volatile storage in EEPROM

## BLUEPORT FRONT INTERFACE

The RS 232 interface of the PC is connected via a PC adapter (see "Accessories supplied"). The BlueControl software can be used to configure, set parameters, and operate the KS 40-1 *lab*.

Galvanically isolated  
(isolation provided by the PC adapter)  
Protocol: Modbus RTU  
Transmission speed: 9600 bits/sec  
Address: fixed at 0

## ENVIRONMENTAL CONDITIONS

### Protection mode: IP 50

### Permissible temperatures

For specified accuracy: 0...60°C  
Warm-up time: < 15 minutes  
Temperature effect: < 100 ppm/K  
Operating limits: -20...65°C  
Storage: -40...70°C

### Humidity

75 % yearly average, no condensation

### Electromagnetic compatibility

Complies with EN 61 326-1

- Meets the interference immunity regulations for continuous, unattended operation.
- Meets the interference radiation regulations of Class B for residential areas.
- Increased measurement errors must be expected in case of surge-type interference.

## GENERAL

### Tabletop housing

Material: ABS housing with folding feet

### Safety tests

Complies with EN 61010-1 (VDE 0411-1):  
Overvoltage category II  
Contamination class 2  
Working voltage range 300 V  
Protection class II

### Electrical connections

Mains supply: 1,5 m cable with mains plug  
Controller output: built-in power socket  
Sensor: DIN connector  
Supplementary inputs: DIN connectors

### Accessories supplied

- Operating instructions
- BlueControl Expert software
- PC adapter for connection to a PC

## ORDERING DATA

| Description                                                                              | Order no.      |
|------------------------------------------------------------------------------------------|----------------|
| Laboratory controller KS 40-1 <i>lab</i> including BlueControl data acquisition software | 9407-998-00071 |
| Mineral-insulated thermocouple Type K, 3 mm dia., 200 mm length, 3 m connecting lead     | 9404-103-13211 |
| Mineral-insulated thermocouple Type K, 1 mm dia., 200 mm length, 3 m connecting lead     | 9404-103-10211 |
| Mineral-insulated Pt 100/B sensor, 3 mm dia., 200 mm length, 3 m connecting lead         | 9404-105-13211 |

### BlueControl functions

Adjustment of parameters and configuration data  
Controller and control loop simulation  
Download: Transfer of an engineering to the controller  
Online mode / visualization  
Generation of an application-specific linearization  
Configuration of the extended Operating Level  
Upload: Read-out of the engineering from the controller  
Basic diagnostic function  
Saving of files and the engineering  
Printer function  
Online documentation / Help  
Implementation of a measurement value correction  
Program editor  
Data acquisition and trend recording with data export  
Network and multi-user license  
Assistant function  
Extended Simulation  
Extended Diagnosis and Service

- One connector each for sensor and supplementary inputs

### BlueControl (Engineering Tool)

PC-based program for configuration, parameter setting, and operation (commissioning) of the KS 40-1 controller. Moreover, a powerful data acquisition module with trend graphics is available.

Required software platform  
Windows 95/98/NT/2000. The built-in simulation serves to test the controller settings, but can also be used for general training and observation of the interaction between controller and control loop.

### Required hardware platform

A special PC adapter (see Accessories) is required for connecting the controller to a PC.

Updates and demo software can be downloaded from: [www.pma-online.de](http://www.pma-online.de)



### PMA

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