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 action 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 (x1in, x2in) and two set-points (x1out, x2out).

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 control 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
control loops. The leakage current moni-
tor is coupled internally to the heating
current monitor.

**Controller and positioner functions**
The KS 800 is configurable as a signaller,
as a two-point or three-point controller,
three-point controller with water evapo-
ration cooling, as a master controller or
as a three-point stepping controller. Al-
ternatively, two and three-point con-
rollers can be configured for continuous or
split-range control. All versions feature
auto/manual switch-over, also via the in-
terface.

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 \cdot Y_{master}).

**Melt pressure measurement for
extruders**
For direct connection of melt pressure
sensors, a KS800 version provides the
precise supply voltage required for up to
2 sensors (typ. 10 V ± 0.3 % ) and the 2
relays required for 80% calibration. The
relays can be switched via 2 digital in-
puts and via fieldbus.

The millivolt output of the pressure sen-
sor must be taken to one of the 8 KS800
inputs. With this KS800 version, external
transmitters (also transmitters in the
pressure sensor), supply voltage and re-
lays are saved

**Alarm functions, alarm outputs**
Triggered alarms can be used to operate the
relevant alarm outputs, or can be
scanned via the fieldbus. The monitored
signals are process value \( x \), set-point \( w \),
control deviation \( x_\text{r} \), and output signal \( y \).
Furthermore, 4 limit values (2 low alarms
and 2 high alarms) can be adjusted for
every control loop.

For each of these 4 limit values per
channel, the monitoring function can be
adjusted (absolute, relative, etc.)

The following alarm functions are freely
configurable for outputs 1, 2 and 3 and
for each of the control loops:
- **Relative alarm** for monitoring the con-
  trol deviation (relative to set-point)
- **Absolute alarm** for limit monitoring
  (independent of set-point)
- **Relative alarm with alarm suppression**
The alarm is not triggered during
start-up or after set-point changes.

- **Sensor fault alarm**
- **Heating current alarm**
- **Monitoring of digital outputs**
If more than one alarm function is allo-
cated to an alarm output, the functions
are combined internally.

**Loop Alarm**
Used for checking the functionality of the
complete control loop. Failure of the
process value on an output variable is
detected in order to react accordingly.

**Second set-point with ramp function**
The external control signal \( W/W2 \) is used
to activate a second set-point (e.g.
standby set-point, which can be used
when starting after mains recov-
ery). 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 \( Gr_\text{+} \) (positive gradi-
ent) and \( Gr_\text{-} \) (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 humid-
ity and to prevent destruction.

With activated start-up circuit, the con-
troller uses the adjusted start-up temper-
ature (e.g. 40%) until reaching the start-
up set-point (e.g. 95°C). For protection

---

**Fig. 1 Set-Point gradient function**

**Fig. 2 Start-up circuit**
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 800 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. \( X_{m} \pm 2K \)).

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


<table>
<thead>
<tr>
<th>Type</th>
<th>Measuring 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>
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<tr>
<td>N</td>
<td>0...1300 °C</td>
<td>≤ 2 K</td>
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<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>
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<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:=1M Ω

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: ≤ 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 stabilizing 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: ≤1 MΩ
Error: ≤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 > 14 bit
e.g. for PMA standard current transformer 0...30 A/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)
Rated voltage: 24 V DC external
Current requirement: approx. 5 mA
Logic "1" = 15...30 V
Logic "0" = –3...5 V
Current sink (IEC 1131 type 1)
via opto-couplers.

**Digital inputs for relay switching**
2 optional inputs
Rated voltage: 24 V DC external
Current sink (IEC 1131 type 1)
galvanically isolated.

**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 ±0,2 % ±1 digit
Load: max. 470 Ω
Settling time: within 625 ms

**Constant voltage output (optional)**
For melt pressure sensor energization:
Output voltage: 10 V ±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.

**HEATING CURRENT MONITOR**
Heating current is monitored with an external transformer (see Accessories).
Transformer rating: 0...30 A/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 15 A/30 mA AC. Range selectable 1,0...99,0 A, so that other current transformers can be used.
Error: ±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).

**DIRECT CURRENT MONITOR**
Heating current is monitored with a direct current transformer (see Accessories).
Transformer rating: 0...30 A/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 15 A/30 mA AC. Range selectable 1,0...99,0 A, so that other current transformers can be used.
Error: ±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).

**INTERFACE**
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.

**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

**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:
 SIGNALER 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
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 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 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

ACCESSORY EQUIPMENT
BlueControl (Engineering Tool)

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Mini</th>
<th>Basic</th>
<th>Expert</th>
</tr>
</thead>
<tbody>
<tr>
<td>parameter and configuration setting</td>
<td>yes</td>
<td>yes</td>
<td>*</td>
</tr>
<tr>
<td>controller and control loop simulation</td>
<td>yes</td>
<td>yes</td>
<td>*</td>
</tr>
<tr>
<td>download: writes an engineering to the controller</td>
<td>yes</td>
<td>yes</td>
<td>*</td>
</tr>
<tr>
<td>online mode/ visualisation</td>
<td>SIM only</td>
<td>yes</td>
<td>*</td>
</tr>
<tr>
<td>upload: reads an engineering from the controller</td>
<td>SIM only</td>
<td>yes</td>
<td>*</td>
</tr>
<tr>
<td>basic diagnosis function</td>
<td>SIM only</td>
<td>yes</td>
<td>*</td>
</tr>
<tr>
<td>file, save engineering data</td>
<td>no</td>
<td>yes</td>
<td>*</td>
</tr>
<tr>
<td>printer function</td>
<td>no</td>
<td>yes</td>
<td>*</td>
</tr>
<tr>
<td>online documentation, help system</td>
<td>no</td>
<td>yes</td>
<td>*</td>
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<tr>
<td>measurement correction (calibration procedure)</td>
<td>no</td>
<td>yes</td>
<td>*</td>
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<tr>
<td>data acquisition and trend function</td>
<td>SIM only</td>
<td>yes</td>
<td>*</td>
</tr>
<tr>
<td>personal assistant function</td>
<td>yes</td>
<td>yes</td>
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* expert version planned.
### ORDERING DATA

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<tr>
<td>Multiple temperature controller</td>
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<tr>
<td>KS 800-RS (RS 422/485)</td>
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<tr>
<td>KS 800-DP (Profibus DP)</td>
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<tr>
<td>KS 800-CAN (CANopen)</td>
<td>6</td>
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<tr>
<td>KS 800-DN (DeviceNet)</td>
<td>7</td>
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<td></td>
</tr>
</tbody>
</table>

With current outputs 0/4...20 mA

With voltage outputs 0...10 V (on request)

With constant voltage source and 2 relays

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

### ORDERING DATA FOR ACCESSORIES

<table>
<thead>
<tr>
<th>Description</th>
<th>Order no.</th>
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<tbody>
<tr>
<td>BlueControl (Engineering-Tool) German/English</td>
<td>9407 999 09101</td>
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<tr>
<td>Engineering Set Profibus German</td>
<td>9407 999 09111</td>
</tr>
<tr>
<td>Engineering Set Profibus English</td>
<td>9407 999 09211</td>
</tr>
<tr>
<td>PC-Adaptor for connecting the Engineering Tool</td>
<td>9407 998 00001</td>
</tr>
</tbody>
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**Screw terminals**

<table>
<thead>
<tr>
<th>Description</th>
<th>Order no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRONT-MSTB 2,5/18-ST-5,08 18 terminals (4x required)</td>
<td>9407 799 00001</td>
</tr>
<tr>
<td>FRONT-MSTB 2,5/8-ST-5,08 8 terminals (1x required)</td>
<td>9407 799 00011</td>
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**CANbus termination resistor**

<table>
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<th>Order no.</th>
<th></th>
</tr>
</thead>
<tbody>
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<td>9407 800 90021</td>
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<tr>
<td>9407 800 90051</td>
<td></td>
</tr>
<tr>
<td>9407 800 90041</td>
<td></td>
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</table>

**CANbus cable for connecting CAN bus modules, standard length 5 m**

<table>
<thead>
<tr>
<th>Order no.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>9407 800 90021</td>
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<tr>
<td>9407 800 90051</td>
<td></td>
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<tr>
<td>9407 800 90041</td>
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**DeviceNet adaptor**

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<td>9407 799 00301</td>
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<tr>
<td>9407 829 10222</td>
<td></td>
</tr>
<tr>
<td>9407 829 10233</td>
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**Current transformer**

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<tbody>
<tr>
<td>9404 407 50001</td>
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<tr>
<td>9404 407 50022</td>
<td></td>
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<tr>
<td>9404 407 50023</td>
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**Active current transformer 75 A**

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<td>9404 829 10223</td>
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**Solid-state relays**

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<td>9407 509 22241</td>
<td></td>
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<tr>
<td>9407 509 22431</td>
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**Solid-state relay with heat sink**

<table>
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</thead>
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<td>9407 509 32131</td>
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**Manual (functional description)**

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**Operating instructions**

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**Interface instructions**

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**PMA**

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