RESISTRON

RES-5027

Operating Instructions

Important features

- Automatic zeroing (AUTOCAL)

- Automatic optimisation (AUTOTUNE)

- Automatic configuration of the secondary voltage and current range (AUTORANGE)

- Automatic phase correction (AUTOCOMP)

- Automatic frequency adaptation

- Booster output

- Temperature OK output

- Analogue input for setpoint specification with potentiometer or 0…10 VDC

- Analogue output 0…10 VDC for ACTUAL temperature

- 24 VDC control signals for START, AUTOCAL, RESET and CH-1, e.g. constant setting degree

- Alarm function with error diagnosis

- Heating element alloy and temperature range can be selected

- Wide voltage range for the use of 110…480 V

- Micro-USB interface for ROPEXvisual®

- cULus approval

Contents

1 Revision list

Version	Change
1	• Creation of documentation
2	• New: section 8.8 "TCR Calculator" on page 26 • New: section 8.14 "Restart delay after Reset" on page 34 • New: section 8.15 "Maximum measurement pause" on page 34
3	• Addition: list „The AUTOCAL function is blocked:" section 8.4 "Autom. zeroing (AUTOCAL)" on page 23 • Distinction: 24 V supply inrush current and control mode section 10 "Technical data" on page 44

2 General information

This RESISTRON$^®$ temperature controller is manufactured according to EN 61010-1. In the course of its manu-facture it passed through quality assurance, whereby it was subjected to extensive inspections and tests. As a result of this, the product left our factory in perfect condition.

Please carefully read through the operating manual before using the RESISTRON$^®$ temperature controller. Keep the operating manual for later reference and make sure that information and functions important for the user are available.

The recommendations and warning notes contained in these operating instructions must be complied with, in order to guarantee safe operation.

The device can be operated within the limits indicated in the "Technical Data" without impairing its operational safety. Installation and maintenance may only be performed by technically trained, skilled persons who are familiar with the associated risks and warranty provisions.

2.1 Copyright

All contents, in particular texts, photographs and graphics, are protected by copyright. All rights, including to rep-lication, publication, editing and translation, are reserved.

2.2 Intended use

RESISTRON$^®$ temperature controllers may only be used for heating and temperature control of heatsealing bands which are expressly approved for them, and providing the regulations, notes and warnings contained in these instructions are observed.

In case of non-observance or use contrary to the intended purpose, there is a risk that safety will be impaired or that the heatsealing band, electrical wiring, transformer etc. will overheat. This is the personal responsibility of the user.

2.3 Heatsealing band

The use of suitable heatsealing bands is a basic prerequisite for reliable and safe operation of the system.
The resistance of the heatsealing band which is used must have a positive minimum temperature coefficient in order to guarantee trouble-free operation of the RESISTRON$^®$ temperature controller.

The temperature coefficient must be specified as follows:

$$TCR = 10 \times 10^{-4} \text{K}^{-1} \text{ or } \text{K}^{-1} \text{ or } \text{ppm/K}$$

e.g.   Alloy A20:   TCR = 1100 ppm/K
         LEX3500:   TCR = 3500 ppm/K
         Vacodil: TCR = 1100 ppm/K

The RESISTRON® temperature controller must be set and coded according to the temperature coefficient of the heatsealing band.

The temperature coefficient must be taken from the ROPEX application report and must be set accordingly.

⚠️ **The use of incorrect alloys with a too low temperature coefficient and incorrect coding of the RESISTRON® temperature controller leads to uncontrolled heating of the heatsealing band, which will ultimately burn out!**

The original heatsealing bands must be clearly identified by means of suitable markings as well as the connector geometry, length, or other means to ensure that replacement bands are identical.

2.4   Impulse transformer

A suitable impulse transformer is necessary in order to guarantee trouble-free operation of the control loop. This transformer must be designed according to EN 61558 or UL 5058 (isolating transformer with reinforced insulation) and have a one section bobbin. When the impulse transformer is installed, suitable touch protection must be provided in accordance with the national installation regulations for electrical equipment. In addition to this, water, cleaning solutions and conductive fluids must be prevented from seeping into the transformer.

Incorrect installation of the impulse transformer impairs electrical safety.

2.5   Current transformer PEX-W4/-W5

The current transformer supplied with the RESISTRON® temperature controller is an integral part of the control system.

Only the original ROPEX PEX-W4 or PEX-W5 current transformer may be used. Other transformers may cause the equipment to malfunction.

The current transformer may only be operated if it is correctly connected to the RESISTRON® temperature controller (see section "Startup and operation"). The relevant safety instructions contained in section "Power supply", must be observed. External monitoring modules can be used in order to additionally increase operating safety. They are not included in the scope of supply of the standard control system and are described in a separate document.

2.6   Line filter

ROPEX provides line filters in different power classes. The ROPEX application report lists the suitable line filter which can be ordered accordingly.

The use of an original ROPEX line filter is mandatory in order to comply with the directives mentioned in section 2.10 "DECLARATION OF CONFORMITY" on page 6. This device must be installed and connected according to the instructions contained in section "Power supply" as well as the separate documentation enclosed with the line filter.

2.7 Maintenance

The controller requires no special maintenance. Regular inspection and / or tightening of the terminals – including the terminals for the winding connections on the impulse transformer – is recommended. Dust deposits on the controller can be removed with dry compressed air.

⚠ **Dust deposits and dirt from liquids result in a loss of function. Accordingly, installation in a switch cabinet or terminal cabined with IP 54 is recommended.**

2.8 Transportation

Store and transport the device in its original carton.
After transport, perform a visual inspection for possible damage.

2.9 Disposal

This device is subject to Directive 2012/19/EU concerning the reduction of the increasing amount of waste electrical and electronic equipment and the disposal of such waste in an environmentally sound way.

To guarantee proper disposal and / or the recover of reusable material, please take the device to a designated municipal collection point and observe local regulations.

Careless, uncontrolled disposal can cause damage to the environment and human health. By ensuring that your product is disposed of or recycled in a responsible way, you can help protect the environment and human health.

⚠ **This device must not be disposed of as residual waste!**

2.10 DECLARATION OF CONFORMITY

We hereby declare that the following device has been developed and manufactured in conformance with the directives cited below:

Designation: RESISTRON/CIRUS temperature controller with accessories

Type: With line filter and current transformer

Operating principle: Impulse sealing of films and plastics

Compliant with following standards and directives:

EN 61010-1   Safety requirements for electrical equipment, control, and laboratory use

2014/35/EU   Low voltage directive

2014/30/EU   Electromagnetic compatibility directive

2011/65/EU   RoHS directive

Note:

This declaration of conformity certifies that the device/electronic itself complies with the above-mentioned directives. The CE mark on the device/electronic does not relieve the machinery manufacturer of his duty to verify the conformity of the completely installed, wired and operationally ready system in the machine with the EMC directive.

Comments:

RESISTRON/CIRUS temperature controllers are not independently operable devices. They are used by the machinery manufacturer to form a sealing system by adding EMC-relevant components such as filters, transformers, heatsealing bands and wiring. The final configuration may vary significantly in terms of performance and physical dimensions. All information provided by us in connection with the line filter is merely intended as a guide and is based on a typical measuring setup. It serves to demonstrate that compliance with the EMC directive can be achieved by using a line filter that is suitable for the overall system. The line filter and current transformer must, however, be determined on the basis of the respective application. We also wish to point out that the transformer which is used must be designed in accordance with VDE 0551/EN 61558 or UL 5058 for safety reasons.

July 12, 2020

J. Kühner (CEO)

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3 Use

This RESISTRON® temperature controller is part of the "Series 5000", whose main characteristic is microprocessor technology. All RESISTRON® temperature controllers provide temperature regulation of heating elements as are used in a variety of foil sealing processes.
The most common heating elements include:

- ribbon cables (straight and contoured)

- clincher bands

- beaded bands

- cutting wires

- heat-sealing blades

- soldering bows

The main application area is sealing or cutting of thermoplastics using the thermal impulse process.
The most common application areas are:

- vertical and horizontal form-fill-seal machines (VFFS and HFFS)

- bagging, filling and sealing machines

- film-wrapping machines

- bag-production machines

- group packaging machines

- foil sealing devices

- spout and hose sealing

- and much more

4 Functional principle

The resistance of the heating element, which changes with temperature, is measured by means of current and voltage measurement, displayed and compared with the specified setpoint value. Measurements are made 50 times per second in a 50 Hz network, 60 times per second in a 60 Hz network.
The primary voltage of the impulse transformer is adjusted following the leading edge principle if the measured values deviate from the setpoint value. The related current change in the heating element results in a rise in temperature and change of resistance. The change in resistance is measured and evaluated by the RES-5027. The temperature controller adjusts the control variables according to the change and the set setpoint.
Even the smallest thermal loads on the heating element are recorded and can be quickly and precisely corrected. Measurement of pure electric variables, together with the high measurement rate, result in a highly dynamic thermoelectric control circuit. The principle of primary-side transformer control proves to be especially advantageous as it permits a very large secondary current range with low power loss. This permits an optimal adjustment to the load and thus the desired dynamics with extremely compact device measurements.

5 Controller features

The analogue interfaces for temperature setpoint and temperature actual value 0…10 VDC, which are electrically isolated from the heating circuit, permit temperature setting directly from the machine control or also through an external potentiometer (PD-x).

The real heating element temperature can also be visualised on a machine controller display or an external display instrument (ATR-x).

The RESISTRON® temperature controller RES-5027 has an integrated error diagnosis that checks both the external system (heating element, wiring, etc.) and the internal electronics and puts out a differentiated error message in case of malfunction.

To increase operational security and immunity to interference, all 24 VDC logic signals and 0-10 VDC analogue signals are electrically isolated from the heating circuit.

Adjustment for different heating element alloys (alloy A20, etc.) and setting of the temperature range to be used (0…300°C, 0…500°C, etc.) can be performed through coding switches on the temperature controller itself.

An external voltage supply of 24 VDC is required for the controller. The compact design of the RESISTRON® temperature controller RES-5027 as well as the plug-in connecting terminals make mounting and installation easier.

An overview of the most important features and functions:

- Easy calibration of the heating element through AUTOCAL, the automatic zero-point setting

- High control dynamics through AUTOTUNE, automatic adjustment to the controlled system

- High flexibility: A secondary voltage range of 0.4 V to 120 V and a current range of 30 A to 500 A are covered through the AUTORANGE function

- Automatic adjustment to the network frequency in the range of 47 Hz to 63 Hz

- Wide voltage range for flexible use from 110 VAC to 480 VAC

- Easy and convenient system diagnosis and process visualisation through the free, downloadable software ROPEXvisual®

- Error diagnosis

- Booster output available for connecting a switching amplifier

6   Mounting and Installation

↳ See also section 2 "General information" on page 3.

⚠ **Mounting, installation and commissioning may only be performed by qualified and trained persons who are familiar with the related hazards and warranty stipulations.**

⚠ **The supply voltage to the machine side must lie within the permitted voltage and frequency range of the RESISTRON® temperature controller. Otherwise, there is the danger of a defect.**

6.1   Installation sequence

Proceed as follows during mounting and installation of the RESISTRON® temperature controller RES-5027:

1. Switch off network voltage; verify that no voltage is present.

2. Mounting of the RESISTRON® temperature controller in the switching cabinet on a TS35 top hat rail (in accordance with DIN EN 50022). If several devices are mounted, the minimum distance specified in section 10 "Technical data" on page 44 must be maintained.

3. Wiring of the system in accordance with the regulations in section 6.3 "Power supply" on page 11, section 6.6 "Supply voltage" on page 14 and the ROPEX Application Report. The specifications in section 6.2 "Installation notes" on page 10 must also be observed.
   Cables that are connected to control or measurement connections may only run within the building.

4. During installation, an overcurrent protection device with max. 10 A must be provided, e.g.:
   - circuit breaker in accordance with EN 60898 (characteristic B, C, D, K or Z)
   - circuit breaker in accordance with UL489 (*) (characteristic B, C, D, K or Z)

- protective fuse gG in accordance with IEC 60269
- protective fuse "Class CC" or "Class J" in accordance with UL 248 (*)

The overcurrent protective devices marked with (*) must be used in installations falling under the UL regulations.

If this overcurrent protective device is not sufficient for the sealing application, two separate overcurrent protective devices must be provided for the controller and the sealing application (↳ ROPEX application report). The overcurrent protective device must be located in the immediate vicinity of the device.
In the ROPEX application report, the smallest possible specification for this overcurrent protective device is specified based on the calculated currents. If the protective device is dimensioned differently, the current carrying capacity of the components used (e.g. cable, impulse transformer, etc.) must be adjusted accordingly.

5. A disconnect device, which must be marked as belonging to the system and attached in an easily reachable position, must be provided In the installation.
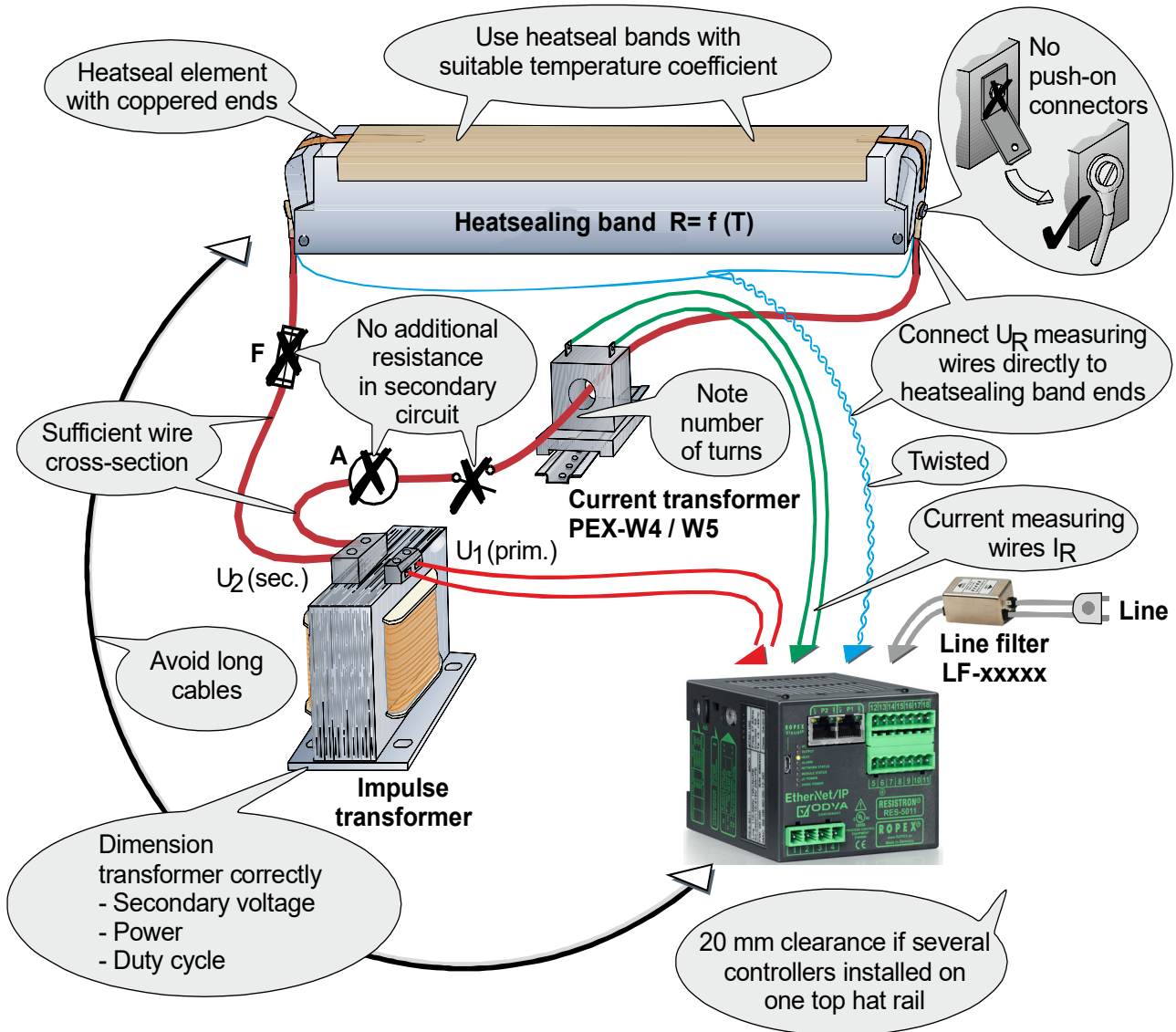If a circuit breaker is used, it can take over the function of the disconnect device.

⚠️ **Check all connection terminals of the system – including the terminals for the coil wires on the impulse transformer – that they are seated firmly.**
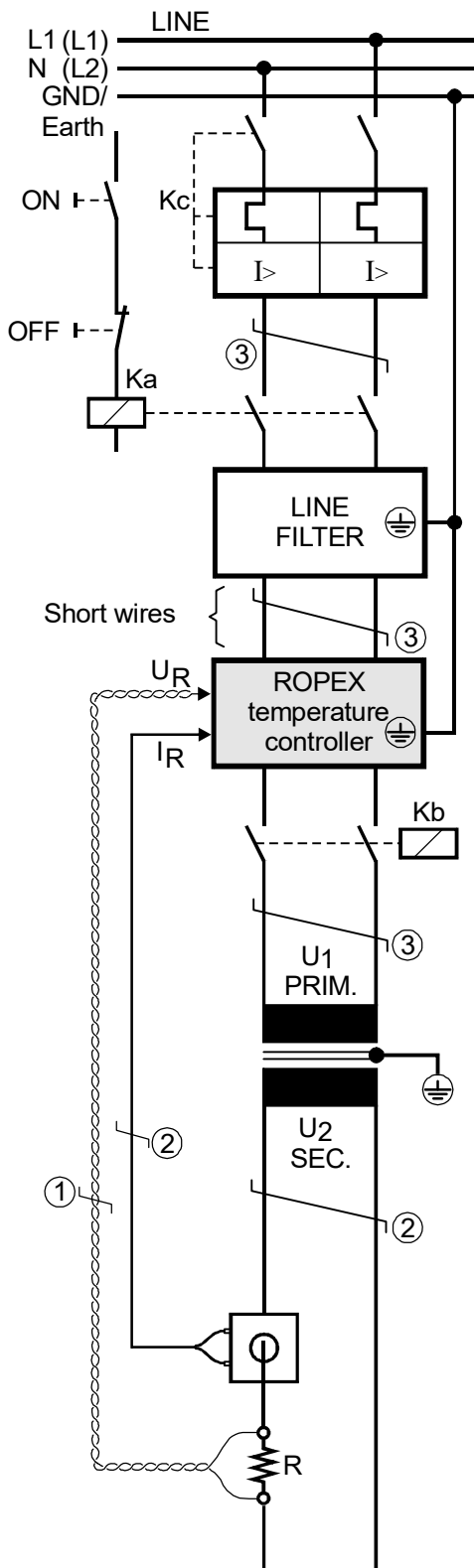
6. Check the wiring in accordance with the applicable national and international installation and setup stipulations.

6.2 Installation notes

Sample depiction

Use heatseal bands with suitable temperature coefficient

Heatseal element with coppered ends

No push-on connectors

Heatsealing band R= f (T)

F

No additional resistance in secondary circuit

Note number of turns

Current transformer PEX-W4 / W5

Connect U_R measuring wires directly to heatsealing band ends

Sufficient wire cross-section

A

U_2 (sec.)

U_1 (prim.)

Twisted

Current measuring wires I_R

Line

Line filter LF-xxxxx

Avoid long cables

Impulse transformer

Dimension transformer correctly
- Secondary voltage
- Power
- Duty cycle

20 mm clearance if several controllers installed on one top hat rail

6.3   Power supply

Line

Over-current protection

Double-pole circuit-breaker or fuses,
($\hookrightarrow$ ROPEX Application Report)

⚠️ Short-circuit protection only. RESISTRON® temperature controller not protected.

Relay Ka

For "HEAT ON - OFF" function (all-pole) or "EMERGENCY STOP".

Line filter

The filter type and size must be determined according to the load, the transformer and the machine wiring ($\hookrightarrow$ ROPEX Application Report).

⚠️ Do not run the filter supply wires (line side) parallel to the filter output wires (load side).

RESISTRON® temperature controller

Relay Kb

Load break (all-pole), e.g. in combination with the alarm output of the temp. controller (ROPEX recommendation).

⚠️ When using a series resistor RV-....-1 the relay Kb shall be installed.

Impulse Transformer

Designed according to EN 61558 (isolating transformer with reinforced insulation). Connect core to ground.

⚠️ Use transformers with a one section bobbin. The power, duty cycle and voltage values must be determined individually according to the application ($\hookrightarrow$ ROPEX Application Report and "Accessories" leaflet for impulse transformers).

Wiring

The wire cross-sections depend on the application ($\hookrightarrow$ ROPEX Application Report).

① Wires must always be twisted (min. 20 turns/meter).
② These wires must be twisted (min. 20 turns/meter) if several control loops are laid together ("crosstalk").
③ Twisting (min. 20 turns/meter) is recommended to improve EMC.

6.4 Line filter

To comply with EMC directives – corresponding to EN 50081-1 and EN 50082-2 – RESISTRON control loops must be operated with line filters.

These filters damp the reaction of the phase-angle control on the line and protect the controller against line disturbances.

⚠ **The use of a suitable line filter is part of the standards conformity and a prerequisite of the CE mark.**

ROPEX line filters are specially optimized for use in RESISTRON control loops. Providing that they are installed and wired correctly, they guarantee compliance with the EMC limit values.

You can find the exact specification of the line filter in the ROPEX Application Report calculated for your particular heatsealing application.

For more technical information: ↳ "Line filter" documentation.

It is permissible to supply several RESISTRON control loops with a single line filter, providing the total current does not exceed the maximum current of the filter.

The wiring instructions contained in section 6.3 "Power supply" on page 11 must be observed.

Example drawing for LF-06480:
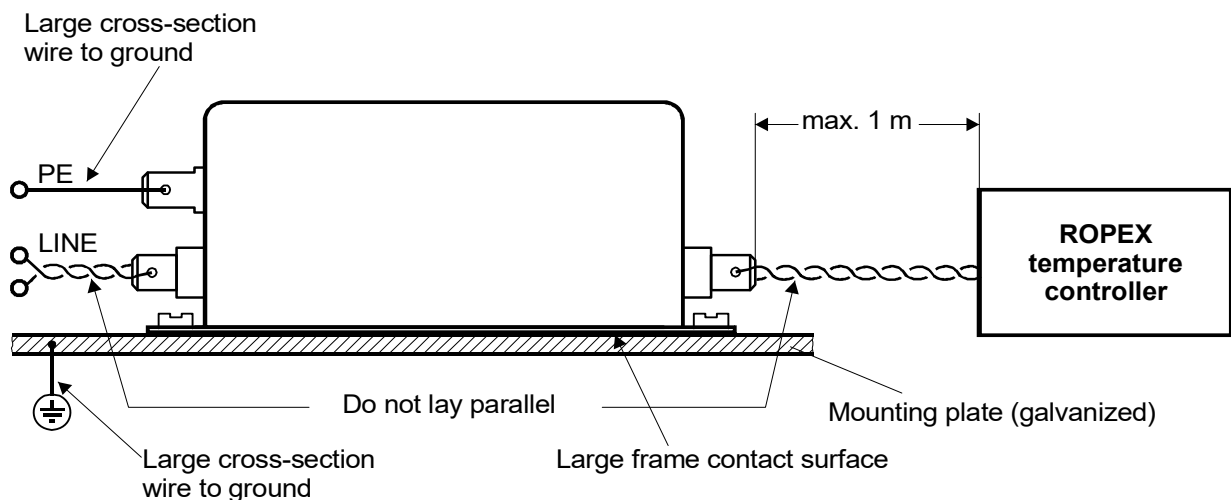
6.5 Current transformer PEX-W4/-W5

The PEX-W4/-W5 current transformer supplied with the RESISTRON® temperature controller is an integral part of the control system. The current transformer may only be operated if it is connected to the temperature controller correctly (↳ section 6.3 "Power supply" on page 11).

6.5.1 PEX-W4

Snap-on for DIN-rail 35 x 7,5 mm or 35 x 15 mm (EN 60715)
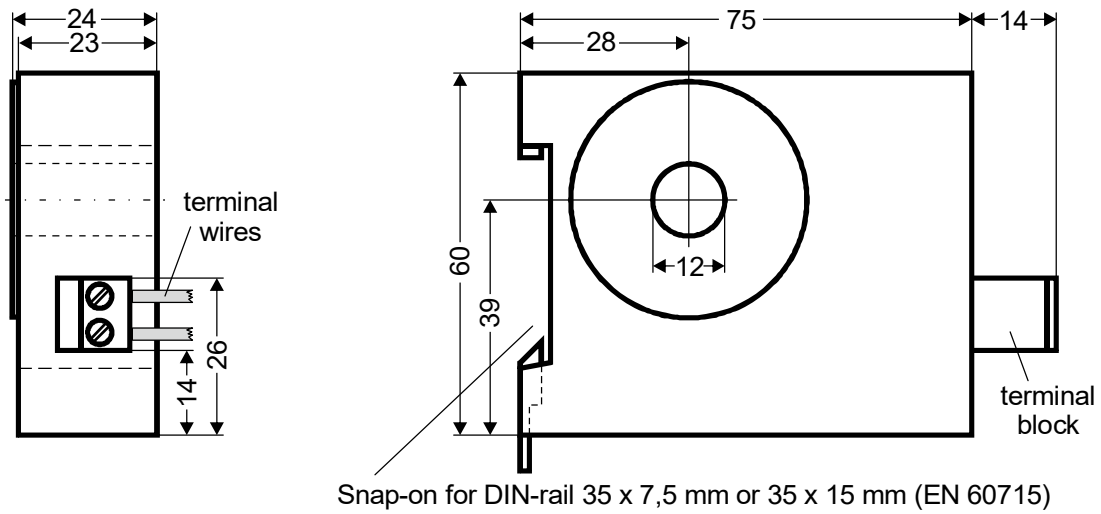
6.5.2 PEX-W5
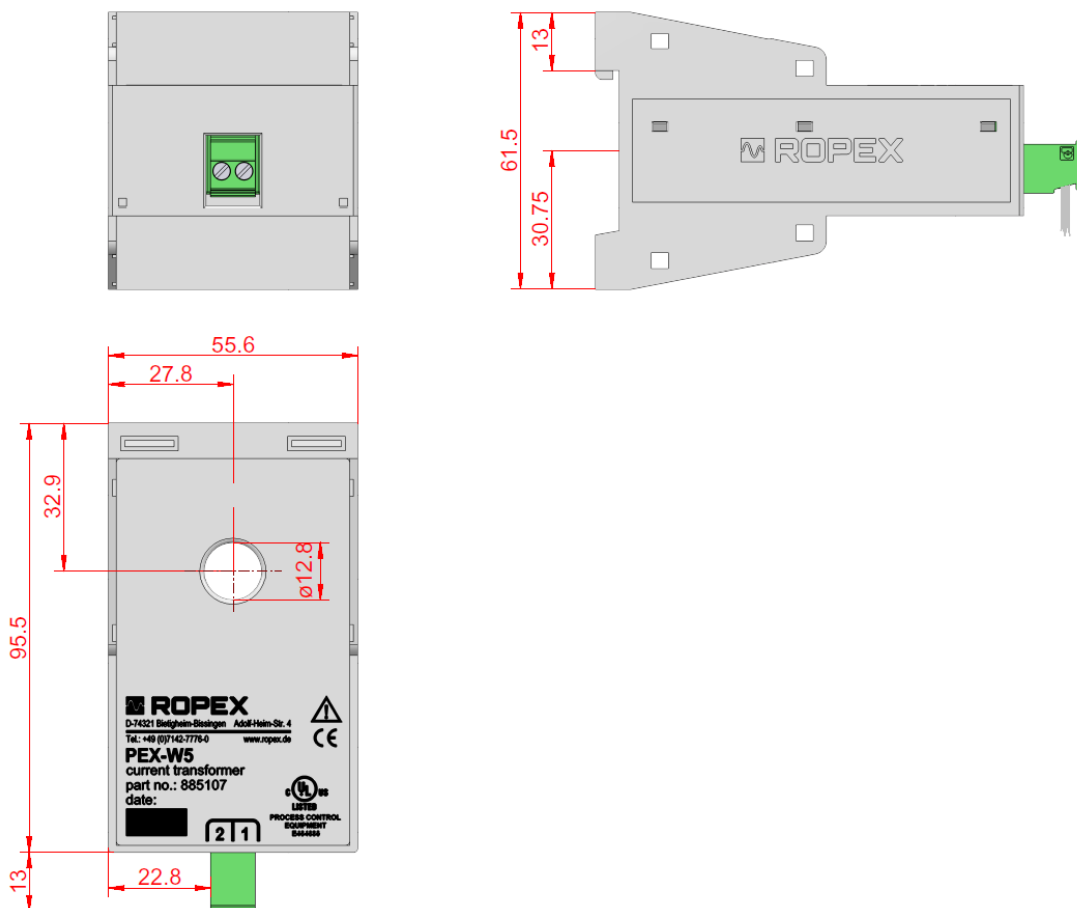
Mounting on DIN-rail 35 x 7.5 mm or 35 x 15 mm (EN 60715).
If the high-current wire cannot be routed through the opening provided, an HCB-1 high-current rail must be used.
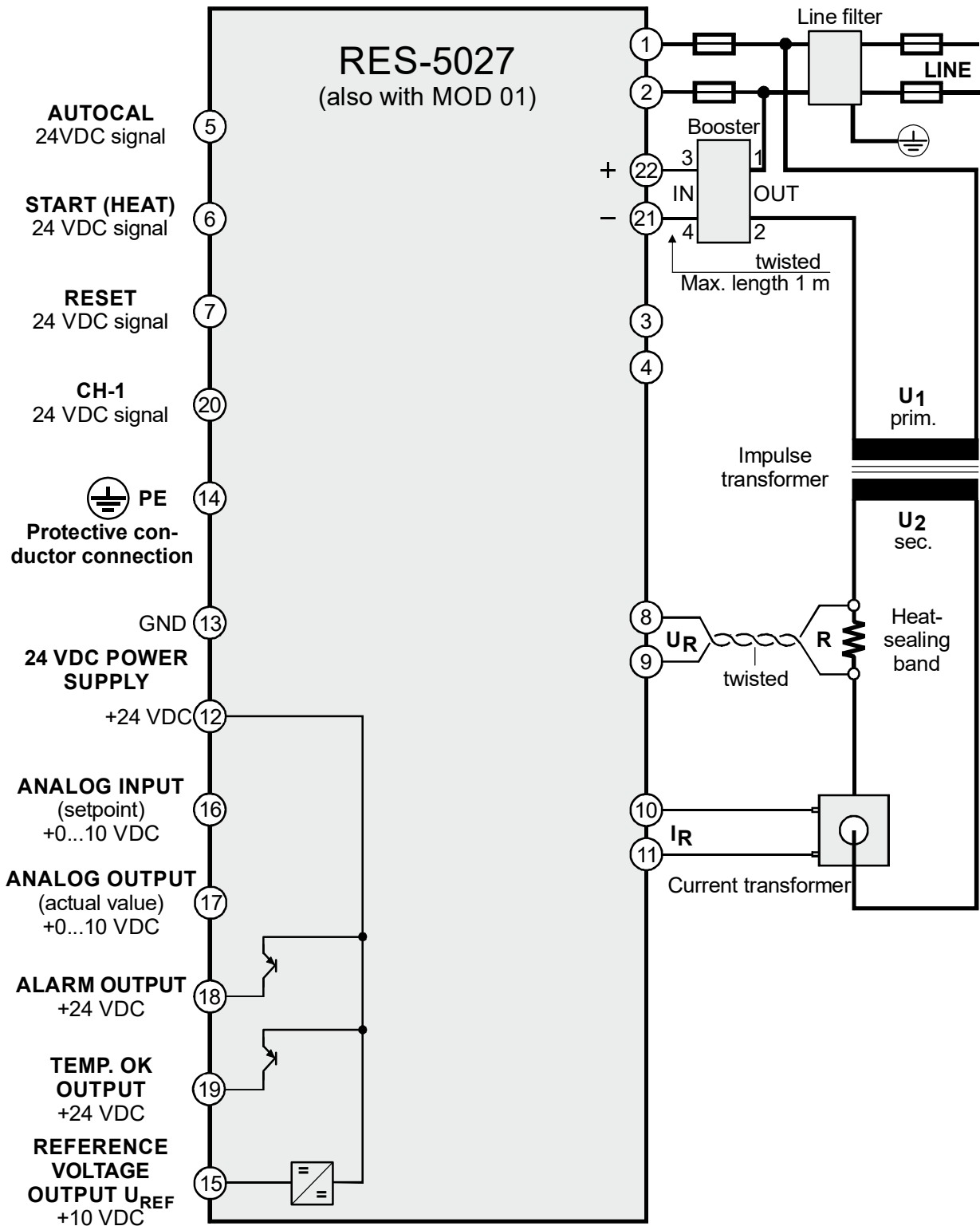
6.6 Supply voltage

To provide power to the RES-5027, voltage of 24 VDC must be applied to the terminals 12+13. The maximum current draw is 1.0 A. The supply voltage input is protected against faulty polarisation.

6.7 Connection diagram (standard)
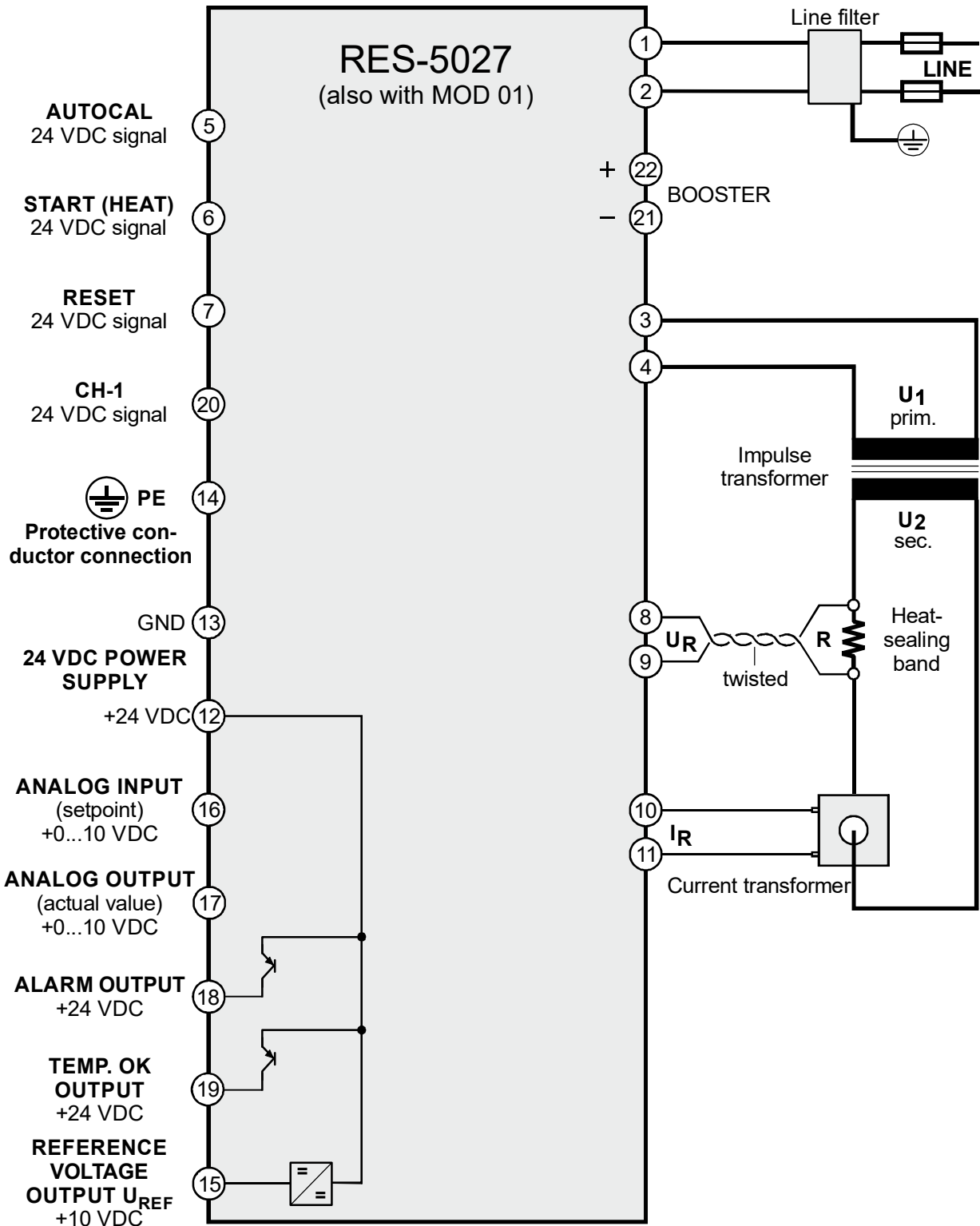
6.8   Connection diagram with booster connection

7 Commissioning and operation

7.1 Device view

Display LEDs

Coding and slide switch

USB interface

Rating plate

Connection terminals

Terminal plan
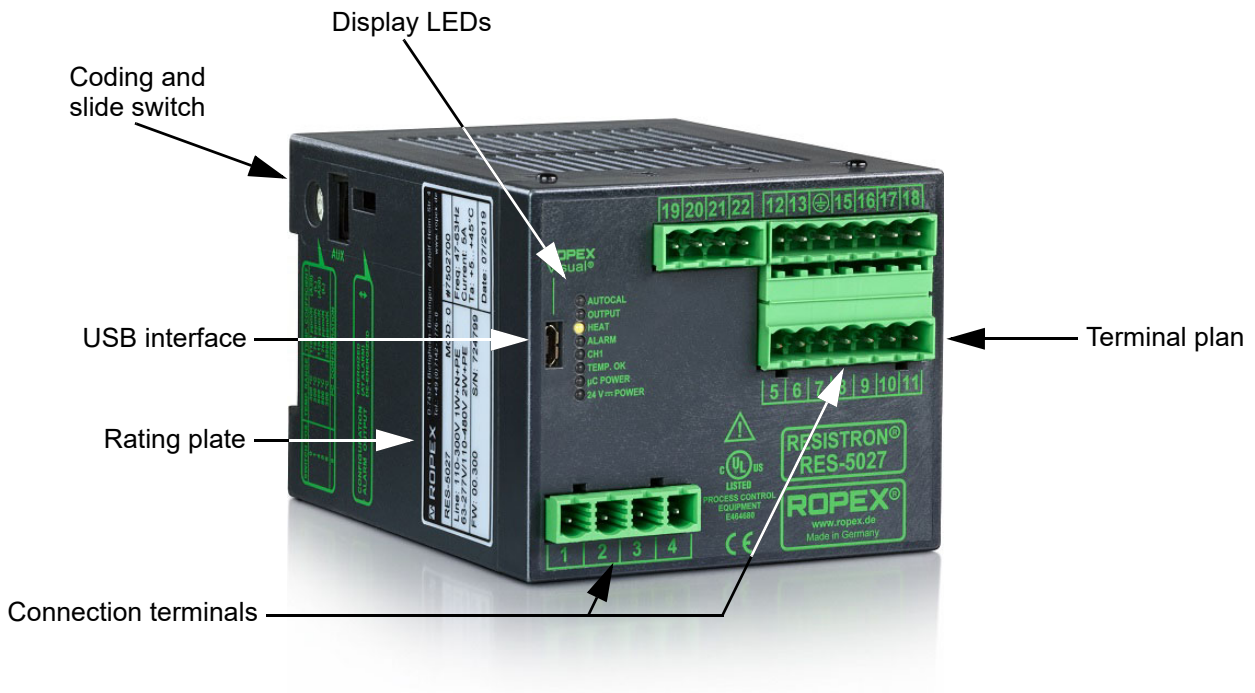
7.2 Device configuration

⚠ **The controller must be switched off to configure the coding switch of the slide switch.**

7.2.1 Configuration for secondary voltage and current

The ranges for secondary voltage and current are configured automatically when automatic calibration (AUTOCAL) is carried out. Configuration takes place in the voltage range of 0.4 VAC to 120 VAC and in the current range from 30 A to 500 A. If voltage and/or current is outside the allowed range, a detailed error message is output by the controller (✍ see section 8.22 "Error messages" on page 37).

For secondary currents I_2 less than 30 A, the secondary high-current line must be guided 2 times (or several times) through the transformer PEX-W4 or PEX-W5 (✍ ROPEX application report).

2x

7.2.2 Configuration of the rotary coding switch for temperature range and alloy

Switch position	Temp. range	Temp. coefficient	Band alloy
0	300°C	1100ppm/K	e.g. A20
1	300°C	780ppm/K	e.g. L
4	500°C	1100ppm/K	e.g. A20
5	500°C	780ppm/K	e.g. L
8	300°C	3500ppm/K	
9	PC-CONFIGURATION		

0 = Factory settings

This configuration is available as standard.

When the switch position "9" is selected, additional temperature ranges and alloys can be set through the ROPEX visualisation software (↳ see section 8.17 "USB interface for visualisation software ROPEXvisual®" on page 35).

7.2.3 Configuration of the alarm output

Alarm output opened by alarm/ PC-CONFIGURATION

Alarm output closed by alarm. (factory setting)

When the "Alarm output opens with Alarm/PC CONFIGURATION" is selected, additional configurations for the behaviour of the alarm output can be set through the ROPEX visualisation software (↳ section 8.17 "USB interface for visualisation software ROPEXvisual®" on page 35).

7.3 Changing and burning in the heating element

7.3.1 Burning in the heating element

The heating element is an important component in the control circuit, as it is both a heating element and sensor. The geometry of the heating element cannot be discussed here due to its diversity. Accordingly, only some important physical and electrical characteristics are pointed out here:

The measurement principle used here requires from the heating element alloy a suitable temperature coefficient TCR, ie an increase in resistance with temperature. A TCR that is too small results in vibrating or overheating of the heating element.

If the TCR is large, the controller must be calibrated for it. The RESISTRON® temperature controller is suitable for temperature coefficients in the range 400…4000 ppm/K.

The first time it is heated to approx. 200…250 °C, the usual alloy undergoes a one-time change in resistance (burn-in effect). The cold resistance of the heating element is reduced by about 2…3%. But this small change in

resistance generates a zero point error of 20…30 °C. The zero point must therefore be corrected after a few heating cycles, that is, the AUTOCAL function must be carried out again.

The burn-in effect described here does not need to be considered if the manufacturer pretreated the heating element for this purpose.

⚠️ **A damaged or worn-out heating element may no longer be used due to an irreversible TCR change.**

A very important design measure is copper-coating or silver-coating of the heating element ends. The thermal characteristics change in this range through coating of the heating element ends. As a result, the ends remain cold, which permits exact temperature control and increases the useful life of the heating element.

7.3.2 Changing the heating element

⚠️ **To change the heating element, the supply voltage must be disconnected from the RESISTRON® temperature controller on all pins.**

⚠️ **The heating element must be changed in accordance with the manufacturer's instructions.**

After every heating element change, the AUTOCAL function must be performed with a cold heating element (and cold surroundings: i.e. silicone, PTFE cover, sealing bar, among others) to compensate for production-related tolerances of the heating element resistance. With a new heating element, the above-described procedure for burning in must be performed.

7.4 Commissioning rules

Observe here section 2 "General information" on page 3 and section 3 "Use" on page 7.

⚠️ **Mounting, installation and commissioning may only be performed by qualified and trained persons who are familiar with the related hazards and warranty stipulations.**

7.4.1 Initial startup

Requirement: Device is correctly mounted and connected (⤷ section 6 "Mounting and Installation" on page 8). Proceed as follows when starting up the controller for the first time:

1. Switch off network voltage; verify that no voltage is present.
2. Set the coding switch on the device in accordance with the ROPEX application report and the heating element used (section 7.2 "Device configuration" on page 16).
3. Check that there is no START signal present.
4. Apply auxiliary voltage (24 VDC).
5. Switching on the network voltage.
6. After the voltage is switched on, the yellow "AUTOCAL" LED lights up for about 0.3 sec. and displays the correct switch-on process of the controller. As long as no network voltage is present, this LED flashes slowly (1 Hz).

⚠️ **At switch-on, if in addition to the yellow "AUTOCAL" LED the red "ALARM" LED lights up for 0.3 sec, the configuration with the visualisation software has been changed for this controller** (⤷ **section 8.17 "USB interface for visualisation software ROPEXvisual®" on page 35). The controller's configuration must be checked to avoid malfunctions before continuing with commissioning.**

7. The following statuses can then result:

"ALARM" LED	"OUTPUT" LED	MEASURE
OFF	Short pulses every 1.2 sec.	Continue with item 8
FLASHES quickly (4 Hz)	OFF	Continue with item 8
Permanently ON	OFF	Error diagnosis (↳ Chap. 8.22)

8. With a cold heating element, activate the AUTOCAL function (terminal 5+13). The yellow "AUTOCAL" LED lights up for the duration of the calibration process (approx. 10…15 seconds). During this process, a voltage of approx. 0 V is output at the actual value output (terminal 17+13). A connected ATR-x shows 0…3 °C.
After zeroing is completed, the "AUTOCAL" LED goes out, and a voltage of 0.66 V (in 300 °C range) or 0.4 V (in 500 °C range) is set at the actual value output. A connected ATR x must be on the "Z" marking.
If zeroing was not performed correctly, the red "ALARM" LED flashes slowly (1 Hz). Then configuration of the controller is not correct (↳ section 7.2 "Device configuration" on page 16, ROPEX application report). After device configuration is correct, perform zeroing again.

9. After successful zeroing, specify a defined temperature at the setpoint value input (terminal 16) and apply the START signal (HEAT). "HEAT" LED then lights up. The heat-up and control procedure can be observed at the actual value output:
It is functioning correctly when the temperature (i.e. signal change at the analogue output) is steady, that is, does not jump, oscillate or even go briefly in the wrong direction. Such behaviour indicates an incorrect placement of the U_R measurement line.
When an error message is issued, proceed according to section 8.22 "Error messages" on page 37.

10. Burning in the heating element (↳ section 7.3.1 "Burning in the heating element" on page 17) and repeat AUTOCAL function.

7.4.2   Placing back into operation after changing the heating element

When changing the heating element, proceed according to section 7.3.1 "Burning in the heating element" on page 17.

⚠️ **Pay attention to correct alloys, dimensions and copper coating of the new heating element to avoid malfunctions and overheating.**

Continue with chap. 7.4.1 item 3 to item 10.

# 8 Device functions

See also section 6.6 "Supply voltage" on page 14.

8.1 Display and operating elements

AUTOCAL (Yellow LED)	**Lit while AUTOCAL process is executing.**
OUTPUT (Green LED)	**Indicates pulses in measurement mode. In control mode, luminous intensity is proportional to heating current.**
HEAT (Yellow LED)	**Lit during heating phase.**
ALARM (Red LED)	**Lit or blinking to indicate fault.**

CH-1 (Yellow LED)	**Lit if the input signal CH-1 is active.**
TEMP. OK (Green LED)	**Lit if the actual temperature is within the monitoring band.**
µC POWER (Green LED)	**Lit if internal µC power supply is OK.**
24 V⎓POWER (Green LED)	**Lit if external 24 V power supply is present.**
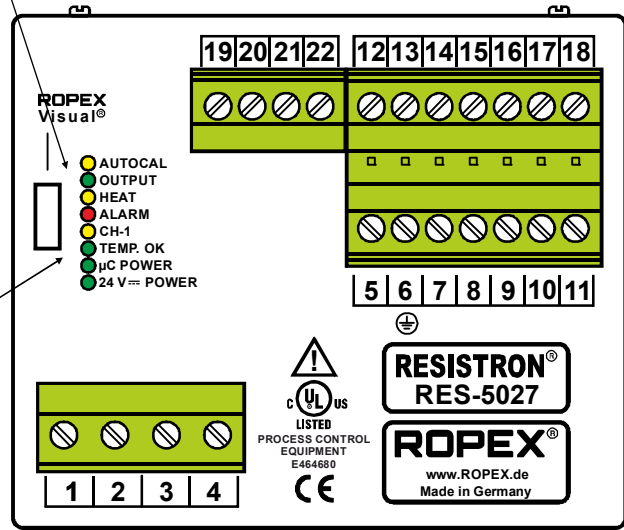
The LEDs display additional operating statuses of the controller besides the functions in the above illustration. These are shown in detail in the following table:

LED	Flashes slowly (1 Hz)	Flashes quickly (4 Hz)	On permanently
AUTOCAL (yellow)	RESET active, START and AUTOCAL function are blocked.	AUTOCAL requested, but function is blocked.	AUTOCAL is carried out
HEAT (yellow)	—	HEAT requested, But function is blocked	START is carried out
OUTPUT (green)	In control operation, the light intensity is proportional to the heating current.		
ALARM (red)	Configuration error, AUTOCAL not possible	Controller incorrectly calibrated, carry out AUTOCAL	Error, ⮎ chap. 8.22

LED	Flashes slowly (1 Hz)	Flashes quickly (4 Hz)	On permanently
CH-1 (yellow)	—	CH-1 function requested, but function is blocked	CH-1 function is carried out
TEMP. OK (green)	—	—	Temperature lies in the temperature monitoring band or: Actual value has achieved 95% of the setpoint value
µC POWER (green)	—	—	Voltage supply to the micro-controller is present
24 V ⎓ POWER	—	—	24 V ⎓ voltage supply is present

8.2   Temperature setting (setpoint specification)

The welding temperature can be set in the RES-5027 in two ways:

• Through application of a voltage 0…10 VDC at the terminal analogue input 16 + 13:
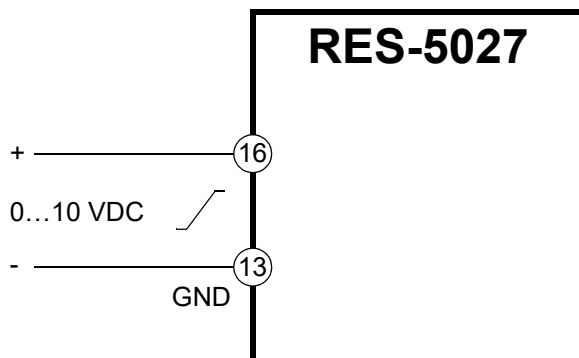
The correlation between the applied voltage and the ACTUAL temperature is linear.
Setting range:
  0 VDC →   0 °C
10VDC   → 300 °C or 500 °C, Depending on the device configuration
A corresponding diagram is depicted in section 8.3 "Temperature display (actual value output)" on page 22.

- Through connection of a 2 kOhm potentiometer at the terminals 13…16:
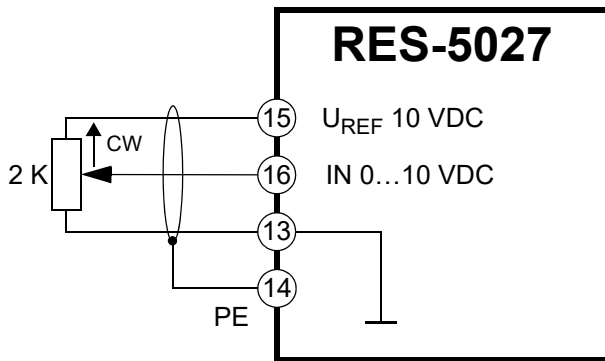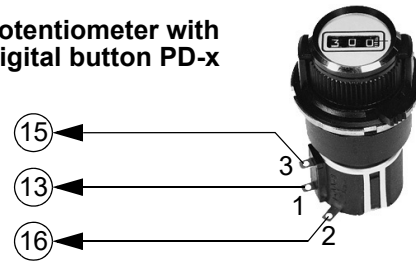
To be able to specify the setpoint with a potentiometer, the controller provides a reference voltage of +10 VDC (±5%) at terminal 15.

The correlation between potentiometer setting and the SETPOINT temperature is linear.

The connection line between controller and potentiometer must be screened.

When the ROPEX precision potentiometer PD-x (PD-03 for 300 °C or PD-05 for 500 °C) is used, the set SET-POINT temperature can be set exactly with the help of the numbers in the viewing window of the fine drive button. The set number equals the SETPOINT temperature in °C.

The setpoint specification for the welding temperature must be greater than 40 °C. If it is less, no heating process takes place when the START signal is activated.

⚠ **Setpoint value zero applies if the potentiometer is not connected or 0 VDC is applied at the setpoint value input. Pay attention to the direction of rotation when connecting the potentiometer!**

8.3 Temperature display (actual value output)

The RES-5027 sends to the terminals 17+13 an analogue signal 0…10 VDC, which is proportional to the real ACTUAL temperature.
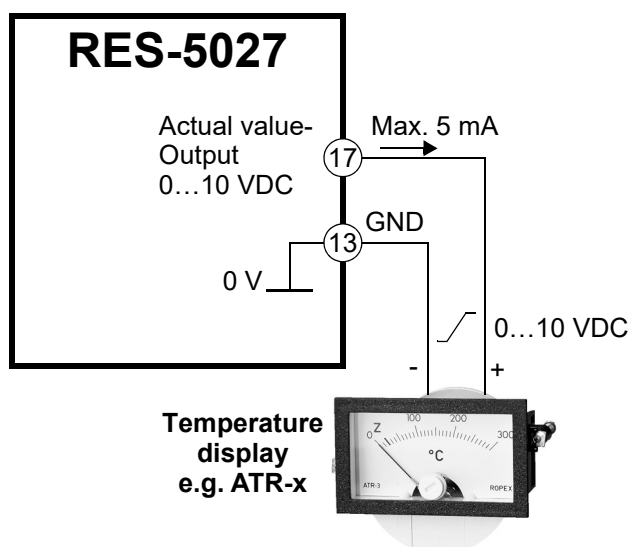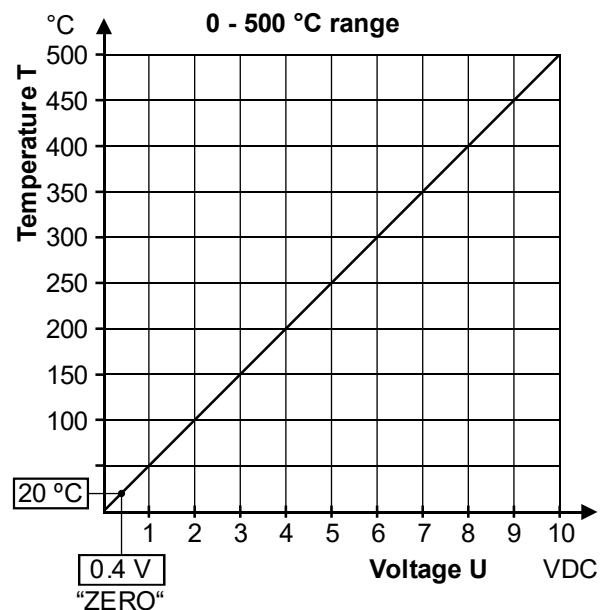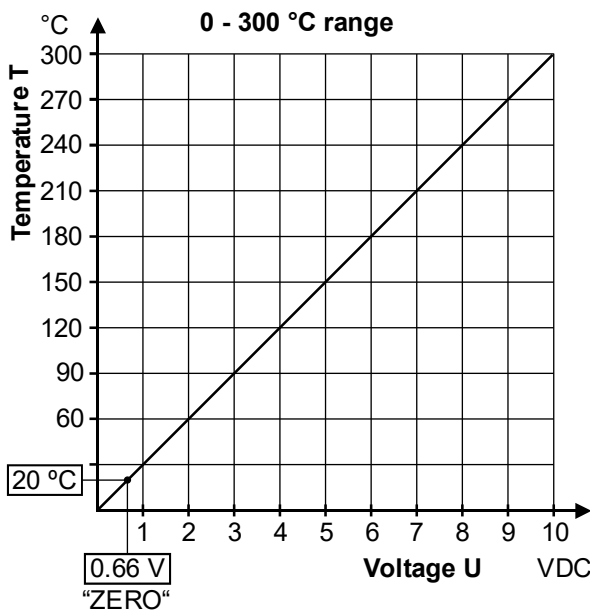

Voltage values:
  0 VDC → 0 °C
10 VDC → 300 °C (ATR-3) or 500 °C (ATR-5), depending on the device configuration

The correlation between the change in the output voltage and the ACTUAL temperature is linear.

A display instrument can be attached to this output for visualisation of the heating element temperature.
The ROPEX temperature display ATR-x in its overall characteristics (size, scaling, dynamic behaviour) is optimally suited for this use and can be used for this, if needed (⤷ section 13 "How to order" on page 47).
With this display, not only can TARGET-ACTUAL comparisons be made, but other criteria can be evaluated, such as heat-up speed, reaching the setpoint in the specified time, cooling of the heating element, etc.
Beyond that, malfunctions in the control circuit (loose connections, contacting and wiring problems) and possibly network faults can be observed very well at the display instrument and interpreted accordingly. This applies also for mutual influencing of several neighbouring control circuits.
In case of alarm, this analogue output is used to output differentiated error messages (⤷ section 8.22 "Error messages" on page 37).

8.4 Autom. zeroing (AUTOCAL)

Due to automatic zeroing (AUTOCAL), manual zero point setting at the controller is not necessary. With the AUTOCAL function, the controller adapts to the current and voltage symbols present in the system. In the factory setting, zeroing is carried out at the basic temperature of 20 °C.
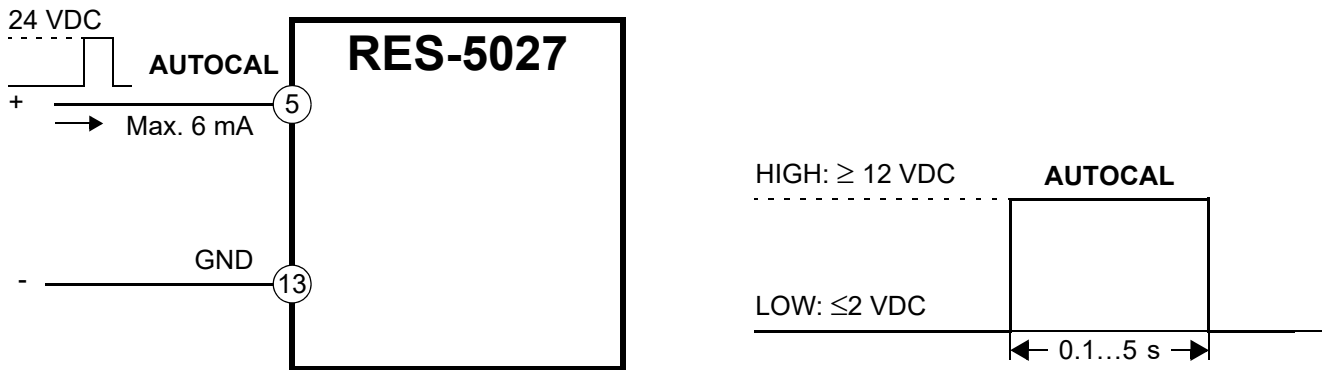
⚠ **Perform the AUTOCAL function only when heating element and support rail have cooled off (basic temperature).**

Variable basic temperature:
The basic temperature for the AUTOCAL function can be set in the range of 0…+40 °C with the visualisation software (⤷ section 8.17 "USB interface for visualisation software ROPEXvisual®" on page 35). This setting is maintained even after the controller is switched off and on.
Moreover, the "External calibration temperature" can be selected through the visualisation software. With this setting, the basic temperature is specified through the analogue input (terminal 16+13) in the range +3…+40 °C (⤷ section 8.2 "Temperature setting (setpoint specification)" on page 21). The specification value at the analogue input must be present when the AUTOCAL function is activated. If too high of a temperature (greater than 40 °C) or a fluctuating specification value is specified, a corresponding error message is output (error no.115 and 116; ⤷ section 8.22 "Error messages" on page 37).

The AUTOCAL is activated through a 24 VDC pulse at terminals 5+13.

The automatic calibration process lasts about 10…15 seconds. The heating element is not additionally heated during this process.

The related yellow LED on the front panel lights up when the AUTOCAL function is executed. The actual value output (terminal 17+13) goes to 0…3 °C (i.e. approx. 0 VDC).

If the heating element temperature fluctuates, the AUTOCAL function is performed a maximum of 3x. After that, if the function cannot be successfully ended, an error message is output (error no. 114; ↳ section 8.22 "Error messages" on page 37).

⚠️ **Perform the AUTOCAL function only when heating element and support rail have cooled off (basic temperature).**

The AUTOCAL function is blocked:

- during the first 10 seconds if the controller does not report an alarm after being switched on or reset and the cooling speed is less than 0.1 K/s.

- if the cooling speed of the heating element is greater than 0.1 K/s.
  Note:
  If the AC bit is activated and the cooling speed has fallen below 0.1 K/s, the controller carries out the AUTOCAL function.

- if the signal AUTOCAL is activated (24 V).
  The "HEAT" LED lights up or blinks.

- if the signal RESET bit is activated (24 V).

- if error numbers 101 to 103, 201 to 203 or 9xx occur directly after switching on the controller. (↳ section 8.22 "Error messages" on page 37).

- if the controller has operated correctly at least once after being switched on and error numbers 201 to 203 or 9xx occur (↳ section 8.22 "Error messages" on page 37).

- if the line voltage is missing when switching on.
 The "AUTOCAL" LED blinks slowly (1 Hz).

Note:
If the AUTICAL function is blocked and if there is an AUTOCAL request at the same time, the "AUTOCAL" LED blinks quickly (4 Hz).

8.5   START signal (HEAT)

With activation of the START signal, the device-internal target-actual comparison is enabled and the heating element is heated up to the set SETPOINT temperature. This takes place until the signal is switched off.

The "HEAT" LED on the front panel of the RES-5027 lights up permanently during this time.
The START signal is activated through a 24 VDC signal to the terminals 6+13.

24 VDC

**START
(HEAT)**

RES-5027

+

→ max. 6 mA

6

GND

13

HIGH: ≥ 12 VDC

LOW: ≤2 VDC
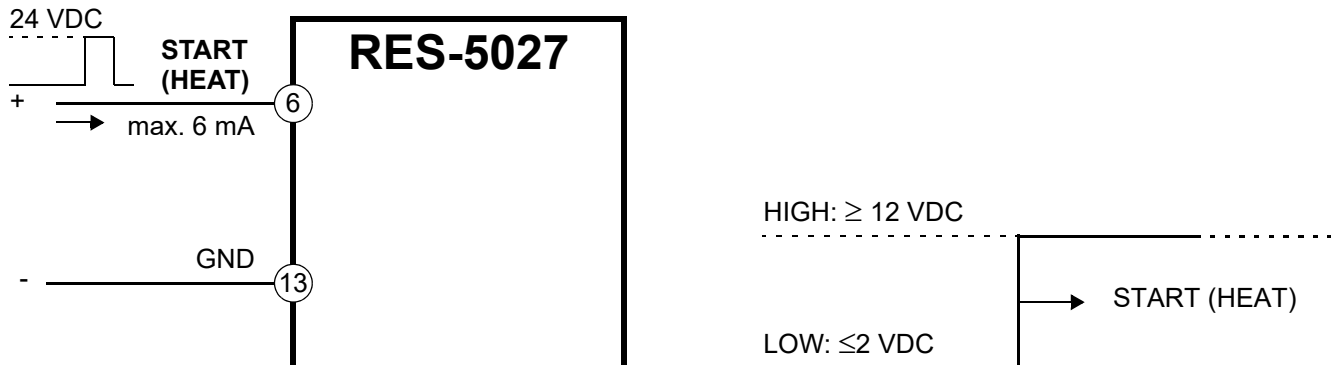
START (HEAT)

During execution of the AUTOCAL function or when the RESET signal is active, activation of the START signal is not accepted.
The setpoint specification for the welding temperature must be greater than 40 °C. If this is smaller, the heat-up process is not started (LED "HEAT" flashing).
During a warning message with error no. 104…106, 111…114, 211, 302 or 303, the alarm output is switched on when the START signal is activated (↳ section 8.22 "Error messages" on page 37). A heat-up procedure also does not take place.

8.6   RESET signal

The RESISTRON® temperature controller RES-5027 can be reset through the external RESET signal (terminal 7+13). Here:

- An ongoing welding cycle is interrupted

- No additional measurement impulses are generated

- Any error message displayed is reset
  (Note: The error message is not reset until the RESET signal is switched off)

24 VDC

RESET

RES-5027

+

→ max. 6 mA

7

GND

13

HIGH: ≥ 12 VDC

RESET

LOW: ≤2 VDC

← >0.1 s →
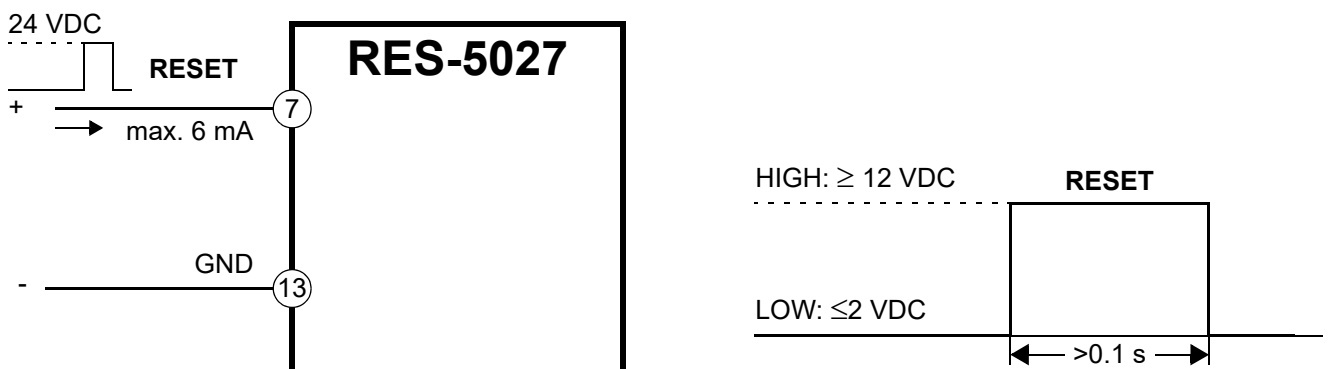
During activation of the RESET signal, the actual value output goes to 0…3 °C (i.e. approx. 0 VDC). This can be evaluated as feedback by the higher-level controller (e.g. PLC).
Performance of the AUTOCAL function is not interrupted through activation of the RESET signal.
After the RESET signal is switched off, the controller carries out an internal initialisation for about 500 ms. The next welding procedure can only be started after that.

A fuse Kb possibly used for switching off the control circuit (⤷ section 6.3 "Power supply" on page 11) must be securely switched on no later than 200 ms after resetting of the RESET signal (the switching and delay times of the fuse must be observed). Switching on later results in an alarm message from the controller.

The restart delay can be adjusted with the parameter „Restart delay after Reset" (⤷ section 8.14 "Restart delay after Reset" on page 34).

8.7   CH-1 signal

With activation of the CH-1 signal, a constant power setting degree is output in the range of 5…100 %. This takes place until the signal is switched off. The "CH-1" LED on the front panel of the RES-5027 lights up permanently during this time.

The height of the setting degree is determined through specification of the setpoint value. Here, 10 VDC correspond to a setting degree of 100 %.

The CH-1 signal is activated through a 24 VDC signal to the terminals 20+13.
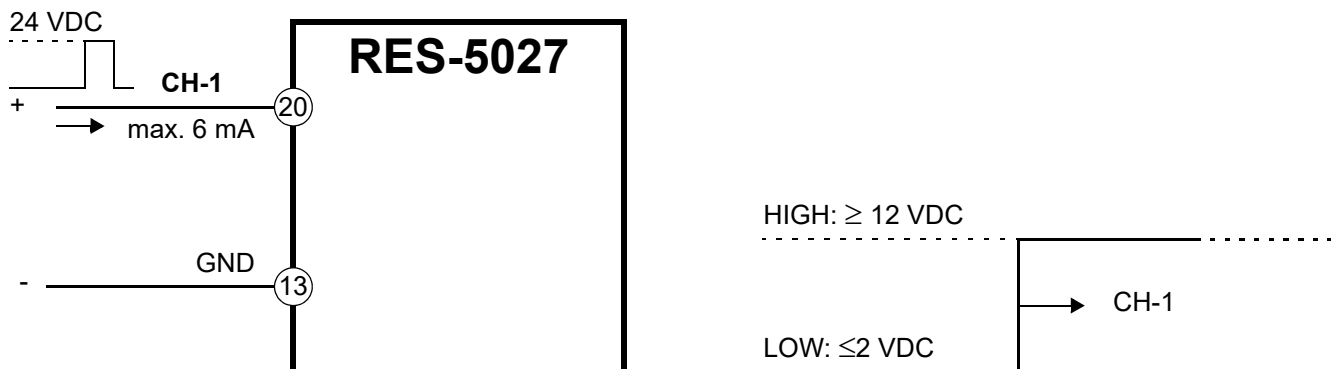
Activation of the CH-1 signal is not accepted during performance of the AUTOCAL function or with an active RESET signal.

The setpoint specification for the power setting degree must be greater than 5 %. If this is smaller, the heat-up process is not started (LED "CH-1" flashes).

During a warning message with error no. 104…106, 111…114, 211, 302 or 303, the alarm output is switched on when the CH-1 signal is activated (⤷ section 8.22 "Error messages" on page 37). A heat-up procedure also does not take place.

8.8   TCR Calculator

⚠️   **This functionality is first available as from firmware version 302.**

The TCR Calculator can be used to determine the temperature coefficient (TCR) of the heatsealing band used. The real temperature coefficient of the heatsealing band often differs from the standard value. The material composition and processing influence the properties of the heatsealing band. This leads to the fact that the temperature display of the controller differs from the real temperature of the heatsealing band. The usage of the TCR Cal-

culator allows an easy correction of the TCR value and thus a better matching of the temperature display of the controller and the real temperature of the heatsealing band.

⚠️ **The TCR Calculator can be used only with the Visualization software (⬚ section 8.17 "USB interface for visualisation software ROPEXvisual®" on page 35).**

To calculate the TCR value, the temperature at the heatsealing band is measured in control mode (START signal active) using an external temperature sensor (e.g. a thermocouple). The measured temperature is transferred to the temperature controller using the ROPEXvisual® visualization software. The calculated temperature coefficient can be read off there. The temperature coefficient is only calculated in control mode (START signal active). Reading back the calculated TCR value must be done during active control operation, i.e. during an active heating impulse, as the internal measured value of the current heatsealing band temperature is used for the calculation. Errors in the calculation of the temperature coefficient are reported with the value 0 (calculated temperature coefficient too low or no active control operation) or 65535 (calculated temperature coefficient too high).

To use the TCR calculator, proceed as follows:

1. The ROPEXvisual® visualization software must be unlocked with the password 'ropex3' under 'Settings' - 'Authorize'.

2. In the 'Controller' surface, the TCR calculator is opened with the 'TCR Calculator' icon button:
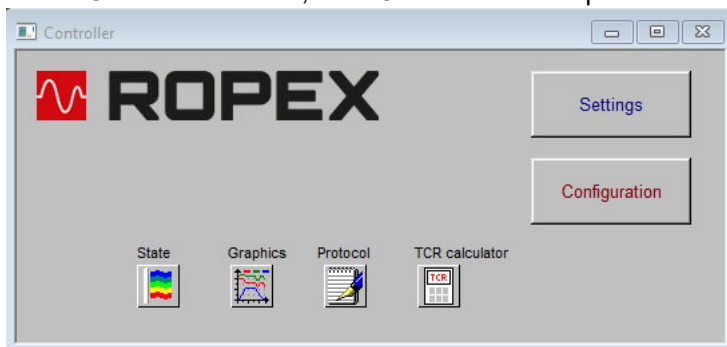
3. In this surface the externally measured temperature can be entered. During an active heating process, the calculated temperature coefficient is output:
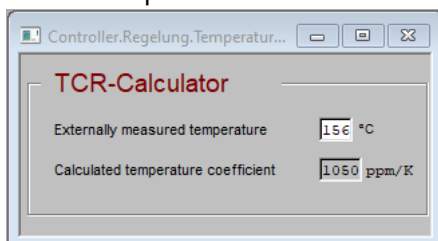
4. The variable temperature coefficient is set in the 'Configuration' surface. For this purpose, the rotary coding switch for temperature range and alloy on the RESISTRON® temperature controller RES-5027 must be set to position 9 PC-CONFIGURATION (⬚ section 7.2.2 "Configuration of the rotary coding switch for temperature range and alloy" on page 17). After the temperature coefficient has been configured as 'variable', another input field for the temperature coefficient appears. The previously calculated temperature coefficient is entered here:
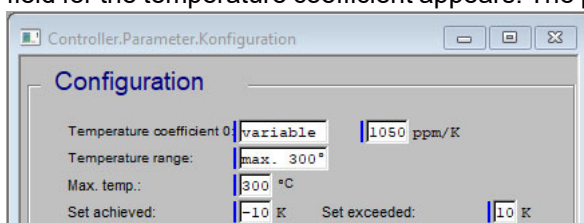
5. The elements marked in blue are stored retentively in the RESISTRON® temperature controller RES-5027. The settings are thus retained even after a device restart.

8.9 Measurement impulse duration

The length of the measurement impulses generated by the controller can be set with this parameter. For certain applications, it can be necessary to lengthen the measurement impulse beyond the standard of 1.7 ms ($\%$ ROPEX application report).

⚠️ **This parameter can only be set with the ROPEX visualisation software ($\%$ section 8.17 "USB interface for visualisation software ROPEXvisual®" on page 35).**

8.10 Automatic phase correction (AUTOCOMP)

In special welding applications, it may be necessary to compensate the phase displacement between the U_R and I_R measurement signals ($\%$ ROPEX application report). Use of the AUTOCOMP function can be necessary here. The AUTOCOMP function must be enabled for use with the ROPEX visualisation software ($\%$ section 8.17 "USB interface for visualisation software ROPEXvisual®" on page 35) (standard setting: AUTOCOMP off).
The following settings are possible:

1. **"OFF"** (factory setting)
   AUTOCOMP function switched off.

2. **"ON"**
   The AUTOCOMP function is carried out when the AUTOCAL function ($\%$ section 8.4 "Autom. zeroing (AUTOCAL)" on page 23) has been called up quickly twice in sequence. The pause between the end of the first and start of the second execution of AUTOCAL must be less than 2.0 seconds. The second execution of AUTOCAL lasts only about 2.0 seconds and contains the AUTOCOMP function.
   If the pause between the two executions is longer than 2.0 seconds, the normal AUTOCAL function is carried out the second time.
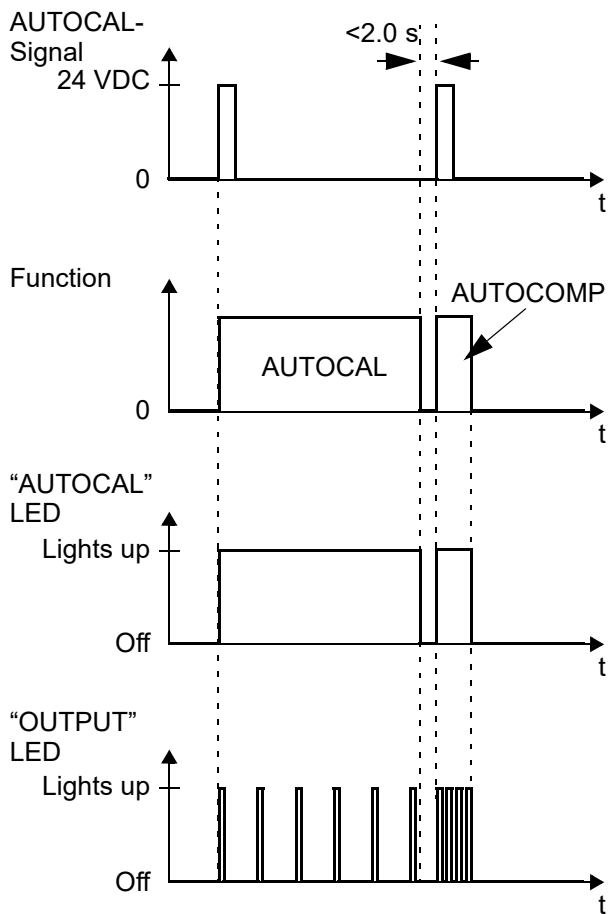
During execution of the AUTOCOMP function, the "OUTPUT" LED flashes several times and the actual value output (terminal 17+13) goes to 0…3 °C (i.e. approx. 0 VDC).

3. **"AUTO"**
   With this setting, the AUTOCOMP function is automatically started after a successful execution of the AUTOCAL function.
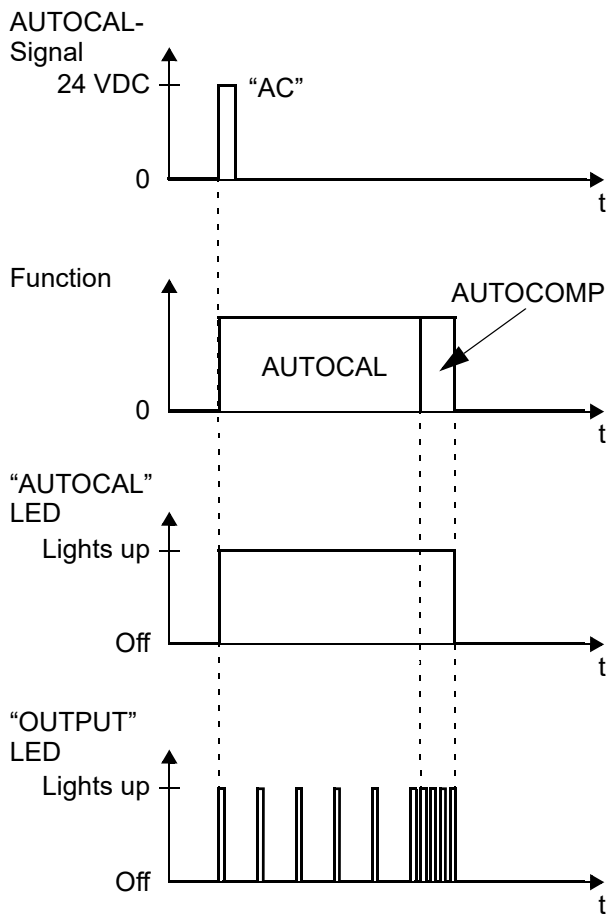
AUTOCAL-
Signal
24 VDC — "AC"

0

t

Function

AUTOCOMP

AUTOCAL

0

t

"AUTOCAL"
LED

Lights up

Off

t

"OUTPUT"
LED

Lights up

Off

t

During execution of the AUTOCOMP function, the "OUTPUT" LED flashes several times and the actual value output (terminal 17+13) goes to 0…3 °C (i.e. approx. 0 VDC).

8.11 Temperature diagnosis

An additional temperature diagnosis can be activated with the ROPEX visualisation software (⮱ section 8.17 "USB interface for visualisation software ROPEXvisual®" on page 35). Here, the RES-5027 checks whether the ACTUAL temperature lies within a settable "good window" tolerance band around the SETPOINT temperature. The lower ($\Delta\vartheta_{low}$) and upper ($\Delta\vartheta_{high}$) tolerance band limit are set at the factory to -10 K and +10 K, respectively. These values can be set separately from each other with the ROPEX visualisation software.
After activation of the START signal, if the ACTUAL temperature lies within the specified tolerance band, the temperature diagnosis is switched on. If the ACTUAL temperature leaves the tolerance band, the related error no. 307, 308 is output and the alarm output switches on (⮱ section 8.22 "Error messages" on page 37).
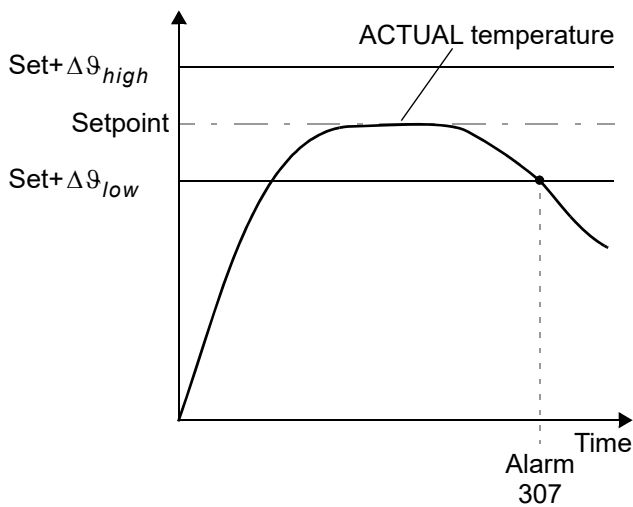
If the temperature diagnosis has not switched on before the START signal is deactivated (i.e. The ACTUAL temperature has not exceeded the lower tolerance band limit or dropped below the upper tolerance band limit), the related error no. 309, 310 is output and the alarm relay switches on.

A delay time (0...9.9 s.) can also be set with the ROPEX visualisation software. After the lower tolerance band limit is exceeded, the temperature diagnosis takes place only after the parameterised delay time has expired. As a result, the temperature diagnosis can be intentionally suppressed, such as during a temperature drop caused by closing the welding jaws.

The values for the lower and upper tolerance band limit that can be set in the ROPEX visualisation software are identical to the values for the "Temperature OK" signal (⮑ section 8.12 ""Temperature reached" or "Temperature OK" signal" on page 31).

8.12 "Temperature reached" or "Temperature OK" signal

In addition to the temperature diagnosis, the RES-5027 provides a digital switch output for the "Temperature reached" or "Temperature OK" signal at its connection terminal 19. This signal switches through a semiconductor output according to +24 VDC when the currently measured temperature is in the defined monitoring band (⮑ section 8.11 "Temperature diagnosis" on page 30) or the measured temperature has reached 95 % of the setpoint value.
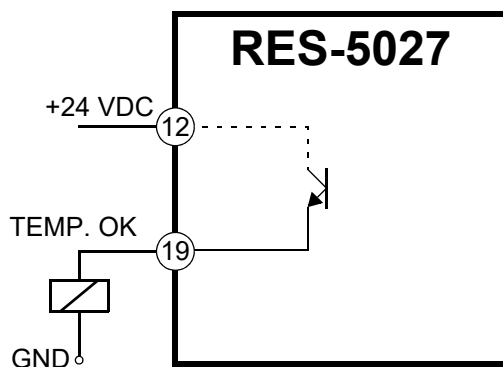
⚠️ **While the constant power setting mode is active (⮑ section 8.7 "CH-1 signal" on page 26) this output remains inactive.**

The switching behaviour can be set through the ROPEX visualisation software. The following operating modes can be selected:

1. OFF

2. Active when temp. reached

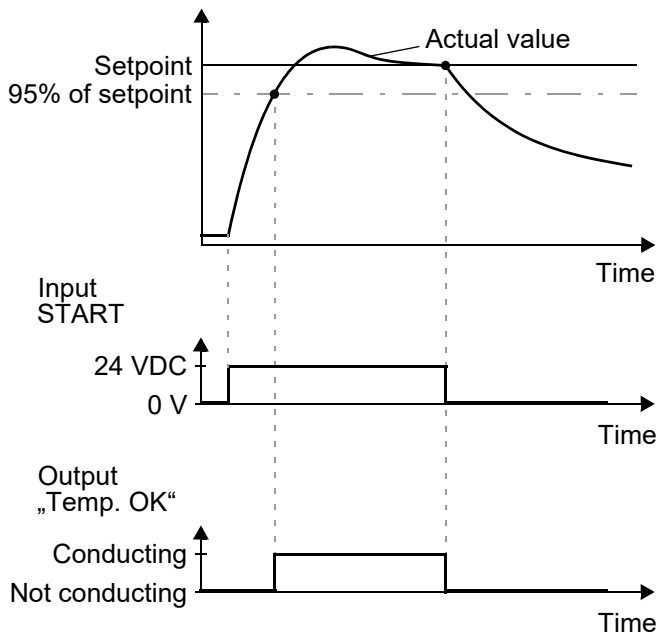3. Active when ACTUAL=SETPOINT

4. Active when ACTUAL=SETPOINT

8.12.1 Operating mode "OFF"

The output signal always remains switched off.

### 8.12.2 "Temp. Reached" operating mode

If the ACTUAL temperature of the heating element reaches more than 95 % of the SETPOINT welding temperature, the output signal is switched on. This can be used for process monitoring, for example, or for control of the closing process of the welding tools.
The output signal is switched off with the deactivation of the START signal or when an alarm occurs.

8.12.3 "ACTUAL=SETPOINT" operating mode

After activation of the START signal, if the actual temperature lies within the specified tolerance band, the output signal is switched on (see following graphic):
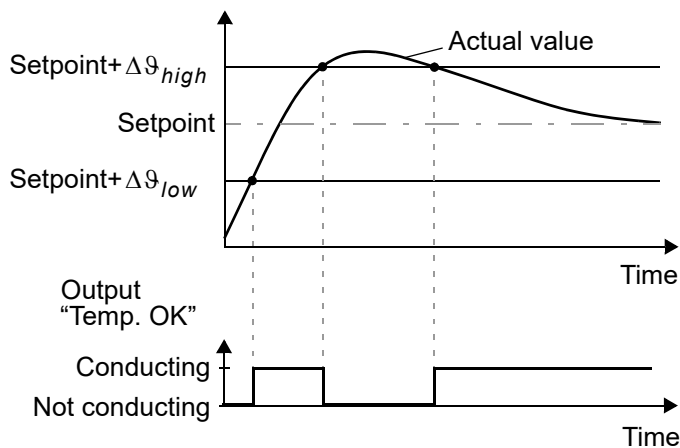
As soon as the ACTUAL temperature is again within the specified tolerance band, the output signal is switched back on again.

8.12.4 "ACTUAL=SETPOINT wL" operating mode

After activation of the START signal, if the actual temperature lies within the specified tolerance band, the output signal is switched on (see following graphic):
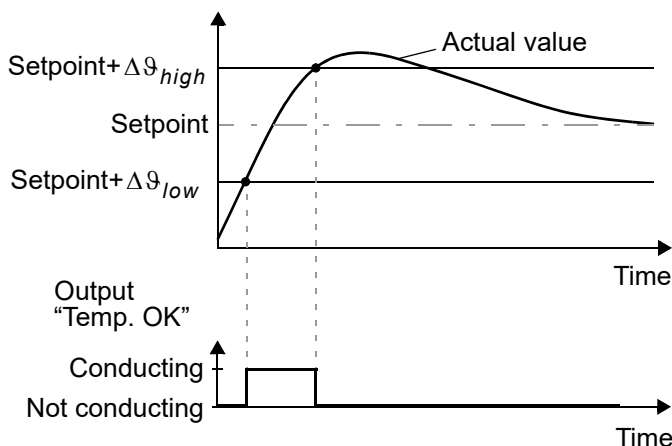
If the actual temperature leaves the tolerance band, the output signal is switched off.
The output signal remains switched off when the actual temperature later lies within the tolerance band.
At the end of the welding procedure, it can be checked whether the output signal is still switched on and so whether the actual temperature was within the defined tolerance band during the entire welding procedure.
The output signal is not switched off until the next activation of the START signal or when an alarm occurs.

8.13 Heat-up time monitoring

An additional heat-up time monitoring can be activated with the ROPEX visualisation software (⤷ section 8.17 "USB interface for visualisation software ROPEXvisual®" on page 35).
This monitoring is activated when the START signal is switched on. The RES-5027 then monitors the time until the ACTUAL temperature has reached 95 % of the setpoint temperature. If this takes longer than the parameter-ised time, error no. 304 is output and the alarm output switches on (⤷ section 8.22 "Error messages" on page 37).
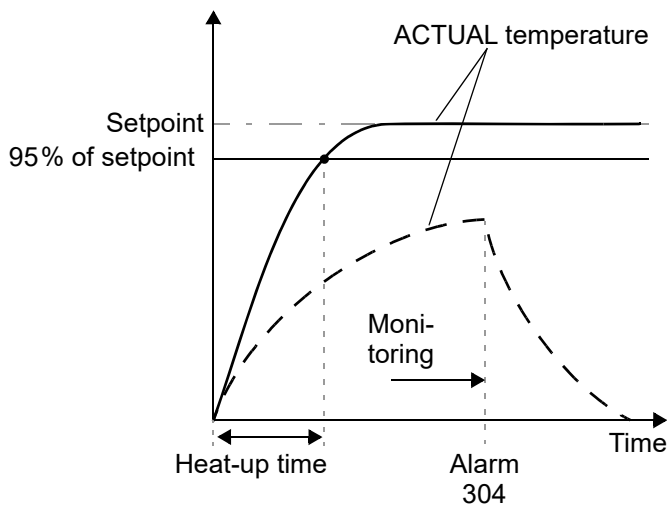
8.14 Restart delay after Reset

⚠ **This parameter is first available as from firmware version 302.**

After acknowledging an alarm with the RESET signal, the RESISTRON® temperature controller RES-5027 waits until any contactor Kb connected has closed the heating circuit again. Only after this waiting time has elapsed measuring pulses are generated in order to determine the current ACTUAL temperature and to carry out error diagnostics.

⚠ **This parameter can be used only with the Visualization software (⤷ section 8.17 "USB interface for visualisation software ROPEXvisual®" on page 35).**

This restart delay is 0.2 s by default and can be adjusted with the parameter „Restart delay after Reset". This allows slower switching contactors to be used.

8.15 Maximum measurement pause

⚠ **This parameter is first available as from firmware version 302.**

If the RESISTRON® temperature controller RES-5027 determines in control mode (START signal active), that the current ACTUAL temperature is greater than the setpoint, the power supply to the heatsealing band is reduced. If the power reduction is not sufficient, the low-power measuring pulses, which determine the current ACTUAL temperature, are paused. This measurement pause can last up to 10 periods in the default setting. During this measurement pause, the controller cannot react to a change in the ACTUAL temperature.
In certain applications it may be useful to shorten this maximum measurement pause, e.g. if the higher ACTUAL temperature values are caused by measurement errors. For these cases the maximum measuring pause can be shortened with the parameter „Maximum measurement pause".

⚠ **This parameter can be used only with the Visualization software (⤷ section 8.17 "USB interface for visualisation software ROPEXvisual®" on page 35).**

⚠ **A measuring pause that is set too small can lead to an increased temperature if the system is incorrectly dimensioned (secondary voltage of the impulse transformer is too large) or if the sealing temperatures are low.**

8.16 Booster connection

The controller RES-5027 has a connection for an external switching amplifier (booster) as standard. This connection (at the terminals 21+22) is required at high primary currents (constant current > 5 A, impulse current > 25 A). The switching amplifier must be connected in accordance with section 6.8 "Connection diagram with booster connection" on page 15.

⚠ **The connection line to the external switching amplifier must not exceed a length of 1 m and must be twisted to avoid EMC interference.**

8.17 USB interface for visualisation software ROPEXvisual®

A USB interface (type micro-USB) is available for system diagnosis and process visualisation. A data connection can be built up with the ROPEX visualisation software ROPEXvisual® over this USB interface.
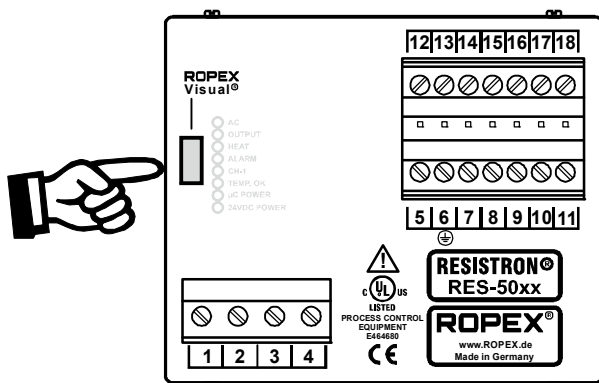
There is a separate documentation available for the ROPEX visualisation software. The software and the documentation are available in the download area (search term: "Visual").

8.18 AUX interface

Internal interface for diagnosis and maintenance. The interface is currently not available.
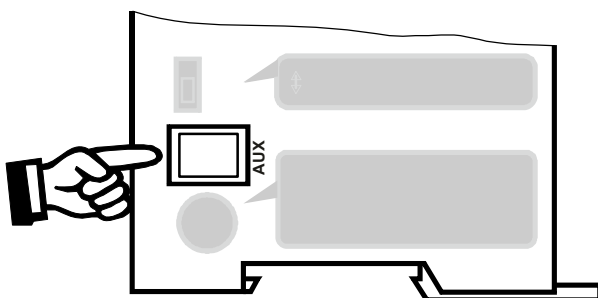
8.19   Data storage for error messages and AUTOCAL

To make error diagnosis easier in ongoing operation, the controller RES-5027 has data storage for error messages and executed AUTOCAL processes.

The last 400 messages are stored. These can be read and displayed with the ROPEX visualisation software.

The RES-5027 also has an integrated clock (↳ section 8.20 "Integrated clock (date and time)" on page 36). The messages are then stored with the date and time specified (time stamp).

⚠️ **The stored messages can be exported as a csv-file. If needed, ROPEX can evaluate the exported file and create an error diagnosis.**

8.20   Integrated clock (date and time)

The RES-5027 has an integrated clock. The messages in data storage are stored with the date and time specified (time stamp). This permits a more precise attribution of error messages.

The integrated clock can only be set and read out using ROPEX visualisation software.

A maintenance-free condenser is used for operation of the clock. There is <u>no</u> installed battery that has to be changed.

The controller must be switched on for at least 3 hours to charge the clock condenser completely. When the condenser is switched off, a fully charged condenser can operate the clock for approx. 2…4 weeks. If the controller is switched off longer, the date and time must be set again. This must be done with the ROPEX visualisation software (↳ section 8.17 "USB interface for visualisation software ROPEXvisual®" on page 35).

The condenser is discharged when shipped from the factory. During initial start-up of the controller, the clock must be set when the error messages in the data storage are to be stored with date and time.

Operation of the controller is possible without the clock being set. Then only invalid values for the date and time are stored in the data storage. The behaviour of the temperature controller is not influenced by this.

8.21   System monitoring/alarm output

To increase operational safety and avoid incorrect welding, this controller has hardware and software measures for error diagnosis and output of differentiated error messages. Both the outer wiring and the internal system are monitored thereby.

This characteristic helps the operator considerably in localising a defective operating status.

A system malfunction is reported or differentiated through the following elements:

A.)   Red LED "ALARM" at the controller with three statuses:

1. **Flashes quickly (4 Hz):**
   Means that the AUTOCAL function should be performed (error no. 104…106, 211, 302, 303).

2. **Flashes slowly (1 Hz):**
   Means that the system configuration is incorrect and therefore the executed zeroing (AUTOCAL function) was not successful (↳ section 7.2 "Device configuration" on page 16). This corresponds to the error numbers 111…114.

3. **Lights up continuously:**
   Displays that malfunctions are present that prevent a start-up (error no. 101…103, 107, 108, 201…203, 307, 308, 9xx).
   In cases 1 and 2, when the START signal is also activated.
   These are usually external wiring errors.

B.) Alarm output signal at the controller (terminal 18):

This is logic output in the factory setting:

- **LOW (OPEN)** in the operating statuses A.1) and A.2), but becomes HIGH (closed) when a START signal is issued in this status.

- **HIGH (CLOSED)** in case A.3)

⚠ **If the alarm output is configured differently than in the factory setting(**⬐ **section 7.2.3 "Configuration of the alarm output" on page 17), these statuses are inverted.**

C.) Output of the error number via actual value output 0…10 VDC (terminal 17+13):

As a temperature display is not required in case of malfunction, the actual value output is used to output the error in case of alarm.

Offered for this purpose, within the 0…10 VDC range, are 13 voltage levels, each of which has one error number assigned. (⬐ section 8.22 "Error messages" on page 37).

For statuses that require AUTOCAL – or when the device configuration is not correct – (error no. 104…106, 111…114, 211, 302, 303), the actual value output switches back and forth between the voltage value that corresponds to the error and the end value (10 VDC, i.e 300 °C or 500 °C) with 1 Hz. If the START signal is output during these statuses, the voltage value no longer changes.

Through the analogue input of a PLC – and a corresponding evaluation – a selective error detection and error display can be implemented simply and at low cost (⬐ section 8.22 "Error messages" on page 37).

An error message can be reset by applying the RESET signal or switching the controller off and on.

Resetting the error message using the RESET signal becomes effective only when the RESET signal is switched off.

Invalid error messages can occur when the controller is switched off due to the undefined operating status. This must be considered in evaluating the higher-level controller (e.g. PLC) to avoid false alarms.

8.22 Error messages

The following table shows the assignment of the output analogue voltage values at the actual value output to the errors that occur. In addition, the cause of the errors and the necessary measures to remedy them are described. The simplified circuit diagram in section 8.23 "Error ranges and causes" on page 41 permits fast and efficient error remedy.

The controller outputs at the actual value output 13 voltage levels for error diagnosis. Internally in the controller, the error messages are differentiated in even more detail. The described error numbers can be displayed with the ROPEX visualisation software (⬐ section 8.17 "USB interface for visualisation software ROPEXvisual®" on page 35). The error search can thus be performed even more effectively.

⚠ **Evaluation of the actual value output for detection of an error message - e.g. in the higher-order controller - must be done with an adapted tolerance window to avoid incorrect evaluations. The tolerances of the actual value output must be observed (**⬐ **section 10 "Technical data" on page 44).**

Part 1 of 3: Error messages (malfunctions)				

NOTE: The specified error messages are output as malfunctions (actual value output emits constant error voltage; alarm LED is continuously lit; alarm relay is active).

Error no.	Actual value output Voltage [V]	Cause	Measure if initial start-up	Measure of machine in operation, heating element not changed
101	0.66	Current signal missing	Error range ①	Error range ①
102	1.33	Voltage signal missing	Error range ③	Error range ③
103	2.00	Voltage and current signals missing	Error range ②	Error ranges ②⑨
107	2.66	Temperature jump downward	Error ranges ④⑤⑥ ("Loose connection")	Error ranges ④⑤⑥ ("Loose connection")
108		Temperature jump upward		
307 308 309 310		Temperature too low/high (⬉ chap. 8.11)	-	-
201	3.33	Network frequency missing/ fluctuates	Check network	Check network
202		Network frequency too large/ fluctuates		
203		Network frequency too small/ fluctuates		
304	4.00	Heat-up time too long (⬉ chap. 8.13)	Perform **RESET**	Perform **RESET**
901	4.66	Network voltage/synchronising signal missing	Replace device	Replace device
913		Triac defective	Replace device	Replace device
914 915 916		Int. error, device defective	Replace device	Replace device
917 918		Slide switch for alarm output incorrect	Check slide switch	Check slide switch

		Part 2 of 3: Error messages (warnings)		
		NOTE: The specified error messages are first output as warnings (actual value output switches between two values; alarm LED flashes; alarm output is not active). After activation of the START signal, it is output as a malfunction (actual value output no longer changes, see bold-italic values; alarm LED is permanently lit; alarm output is active).		
Error no.	**Actual value output Voltage [V]**	**Cause**	**Measure if initial start-up**	**Measure of machine in operation, heating element not changed**
104	☞ *5.33* ⤶ ⤷ 10 ⤴	Current signal incorrect Impulse transformer incorrectly sized	Perform **AUTOCAL,** Check transformer specification, Error ranges ⑦⑧	Error ranges ④⑤⑥ ("Loose connection")
105		Voltage signal incorrect Impulse transformer incorrectly sized		
106		Voltage and current signal incorrect Impulse transformer incorrectly sized		
302		Temperature too low Calibration not performed Loose connection Ambient temperature fluctuates	Perform **AUTOCAL** and/or Error ranges ④⑤⑥ ("Loose connection")	
303		Temperature too high Calibration not performed Loose connection Ambient temperature fluctuates		
211	☞ *6.00* ⤶ ⤷ 10 ⤴	Data error	Perform **AUTOCAL**	Perform **AUTOCAL**

Part 3 of 3: Error messages (warnings)

NOTE: The specified error messages are first output as warnings (actual value output switches between two values; alarm LED flashes; alarm output is not active). After activation of the START signal, it is output as a malfunction (actual value output no longer changes, see bold-italic values; alarm LED is permanently lit; alarm output is active).

Error no.	Actual value output Voltage [V]	Cause	Measure if initial start-up	Measure of machine in operation, heating element not changed
111	*6.66* ↻ 10	Current signal incorrect, Calibration not possible	Error range ⑧, Check configuration	Error ranges ④⑤⑥ ("Loose connection")
112	*7.33* ↻ 10	Voltage signal incorrect, Calibration not possible	Error range ⑦, Check configuration	Error ranges ④⑤⑥ ("Loose connection")
113	*8.00* ↻ 10	Voltage/current signal incorrect, Calibration not possible	Error ranges ⑦⑧, Check configuration	Error ranges ④⑤⑥ ("Loose connection")
114		Temperature fluctuates, Calibration not possible	Perform **AUTOCAL** and/or Error ranges ④⑤⑥ ("Loose connection")	Perform **AUTOCAL** and/or Error ranges ④⑤⑥ ("Loose connection")
115	*8.66* ↻ 10	Ext. calibration temperature too large, Calibration not possible	Perform **AUTOCAL** with ext. calibration temperature ≤40 °C	Perform **AUTOCAL** with ext. calibration temperature ≤40 °C
116		Ext. calibration temperature fluctuates, Calibration not possible	Perform **AUTOCAL** with stable ext. calibration temperature	Perform **AUTOCAL** with stable ext. calibration temperature

8.23 Error ranges and causes
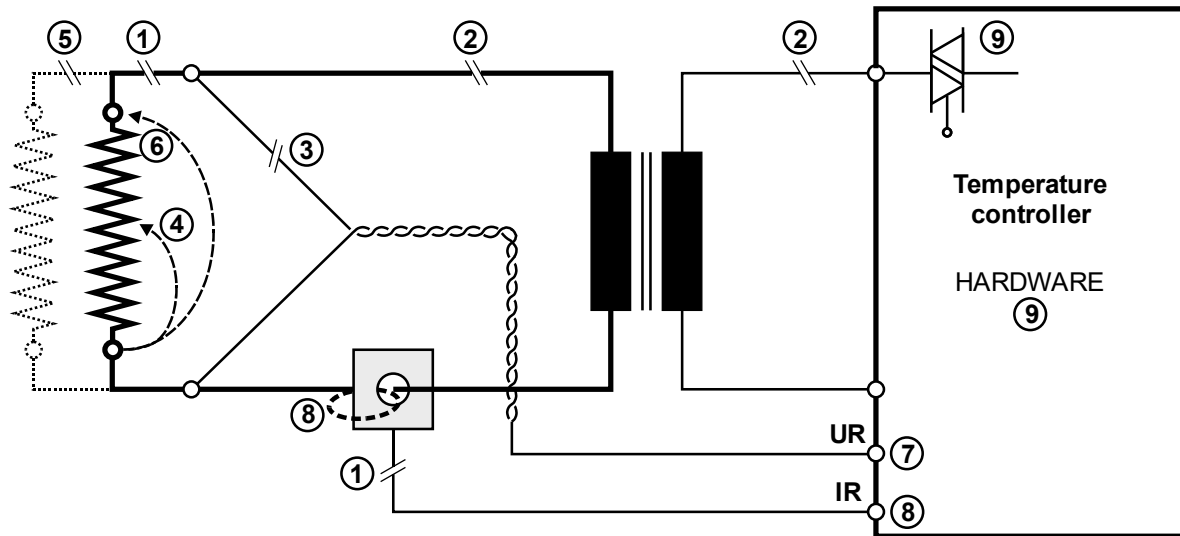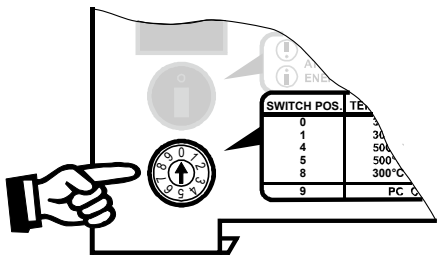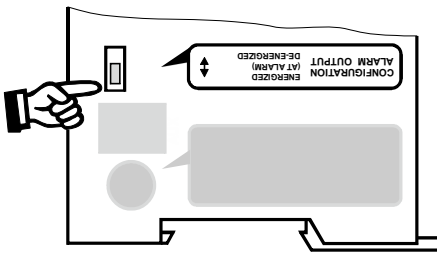
Explanations of the possible error causes can be taken from the following table.

Malfunc-tion range	Explanations	Possible causes
①	Interruption of the load circuit after the U_R pickup point	- Wire break, heating element break - Contacting at the heating element defective
	Interruption of the signal from the transformer	- I_R measurement line from the transformer interrupted
②	Interruption of the primary circuit	- Line break, Triac defective in the controller - Primary coil of the impulse transformer interrupted
	Interruption of the secondary circuit in front of the U_R pickup point	- Wire break - Primary coil of the impulse transformer interrupted
③	U_R signal missing	- Measurement line interrupted
④	Partial short circuit (Delta R)	- Heating element is partially bridged through a conducting part (hold-down device, safety rail, etc.)
⑤	Interruption of the parallel circuit	- Wire break, heating element break - Contacting at the heating element defective
⑥	Complete short circuit	- Heating element incorrectly installed, insulation at the head of the rail missing or incorrectly installed - Conducting part bridges heating element completely
⑦	U_R signal incorrect	- U_2 outside of the permitted range of 0.4…120 VAC
⑧	I_R signal incorrect	- I_2 outside of the permitted range of 30…500 A
	Coils through transformer incorrect	- Check number of coils (For current < 30 A, two or more coils are required)

Malfunc-tion range	Explanations	Possible causes
⑨	Internal device error	- Hardware error (replace controller) - Slide switch for alarm relay defective or not in correct position - Network voltage missing

9 Factory settings

The RESISTRON® temperature controller RES-5027 is configured as follows from the factory:
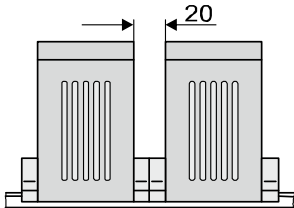
<u>Rotary encoder switch</u> for Heating element alloy and Temperature range (June 2003 and later)		Heating element alloy: Alloy A20 Temperature range: 300 °C Maximum temperature: 300 °C Rotary encoder switch: Position "0"
<u>Slide switch</u> for Alarm output		Alarm output active in case of alarm
Automatic Phase correction (AUTOCOMP) [X]		AUTOCOMP: OFF
Measurement impulse duration [X]		Measurement impulse duration: 1.7 ms
"Temperature OK" signal [X]		Tolerance band: -10 K…+10 K
Temperature diagnosis [X]		Temperature diagnosis: OFF

Heat-up time monitoring [X]		Heat-up time monitoring: OFF

[X] Only with ROPEX visualisation software

10 Technical data

Design	Housing for electrical cabinet mounting On TS35 top hat rail (35 mm) in accordance with DIN EN 50022 latchable Basic surface: 90 x 75 mm; depth: 135 mm (incl. connection terminals)
Network voltage	110 VAC -15%…300 VAC +10% Connected between neutral and an outside conductor or 110 VAC -15%…480 VAC +10% Connected between two outside conductors ⚠ **The voltage between outside conductor and earth must not exceed 300 VAC.**
Power supply network	Symmetrical TN- or TT-network Overvoltage category III ⚠ **Operation in voltage-free network (eg IT network) only after checking with ROPEX.**
Network frequency	47…63 Hz, automatic frequency adjustment in this range
Current consumption (Primary current of the impulse transformer)	I_{max} = 5 A (ED = 100%) I_{max} = 25 A (ED = 20%, duration of play 1 min)
24 VDC supply Terminals 12+13	24 VDC, I_{max} = 200 mA (control mode), 1 A (switch-on current), protected against faulty polarisation Tolerance: ±10% SELV or PELV supplied from maximum 300 VAC, Cat II
Measurement range	Secondary voltage U_R: 0.4…120 VAC Secondary current I_R: 30…500 A (transformer PEX-W4/-W5) ✎ ROPEX application report
Heating element type and temperature range	Besides setting through the rotary encoder switch (see below), the setting for the temperature range and temperature coefficient can be performed through the ROPEX visualisation software (✎ section 8.17 "USB interface for visualisation software ROPEXvisual®" on page 35): Temperature range: 200 °C, 300 °C, 400 °C or 500 °C Temperature coefficient: 400…4000 ppm/K (variable setting range) Five areas can be set on the device through rotary encoder switches: Temperature coefficient 1100 ppm/K, 0…300 °C (e.g. alloy A20) Temperature coefficient 780 ppm/K, 0…300 °C (e.g. alloy L) Temperature coefficient 1100 ppm/K, 0…500 °C (e.g. alloy A20) Temperature coefficient 780 ppm/K, 0…500 °C (e.g. alloy L) Temperature coefficient 3500 ppm/K, 0…300 °C (e.g. LEX3500) Standard value 300 °C, alloy A20
Analogue input (Setpoint) Terminal 16+13	0…10 VDC, I_{max} = 5 mA, electrically separated from the heating circuit corresponding to 0…300 °C or 0…500 °C or through an external precision potentiometer PD-3 or PD-5 (R = 2 kOhm) 0…2 kOhm corresponding to 0…300 °C or 0…500 °C

Analogue output (Actual value) Terminal 17+13	0…10 VDC, I_{max} = 5 mA, electrically separated from the heating circuit corresponding to 0…300 °C or 0…500 °C Precision: ±1% plus 50 mV
Reference voltage output	+10 VDC / ±5%, I_{max} = 5 mA
Digital logic level Terminals 5, 6, 7,	LOW (0 V): 0…2 VDC HIGH (24 VDC): 8…30 VDC (Current consumption max. 6 mA) galvanically separated from the heating circuit, protected against faulty polarisation
Switch output for "Temperature reached" signal or "Temperature OK" signal	U_{max} = 30 VDC I_{max} = 50 mA U_{ON} < 2 V (saturation voltage) galvanically separated from the heating circuit, short-circuit-proof.
Alarm output Terminal 18	U_{max} = 30 VDC I_{max} = 200 mA U_{ON} < 2 V (saturation voltage) galvanically separated from the heating circuit, short-circuit-proof. Can be inverted through slide switch.
Power loss	Max. 20 W
Ambient conditions	Maximum altitude 2000 m Ambient temperature: +5…+45 °C Maximum relative humidity: 80% at temperatures up to +31 °C, decreasing linearly to 50% relative humidity at +45 °C
Degree of protection	IP 20
UL file	E464680
Mounting	When mounting the device, a surrounding safety distance of 20 mm (e.g. To other devices and wiring) must be maintained. When mounting on a horizontal top hat rail, the movable latch, which is necessary for fastening, must face downward. When mounting on a vertical top hat rail, end holders must be installed on both sides to fasten the controller mechanically.
Weight	Approx. 0,5 kg (incl. plug-in connector parts)
Housing material	Plastic, polycarbonate, UL-94-V0

Connecting cable Type / cross-sections	Rigid or flexible; 0.2…2.5 mm² (AWG 24…12) through pluggable terminals Pluggable terminals: Tightening torque: 0.5…0.6 Nm (Screwdriver: SZS 0.6x3.5 mm) ⚠ **If ferrules are used, they must be crimped in accordance with DIN 46228 and IEC/EN 60947-1. Otherwise, correct electrical contact in the terminals is not guaranteed.**

11   Dimensions
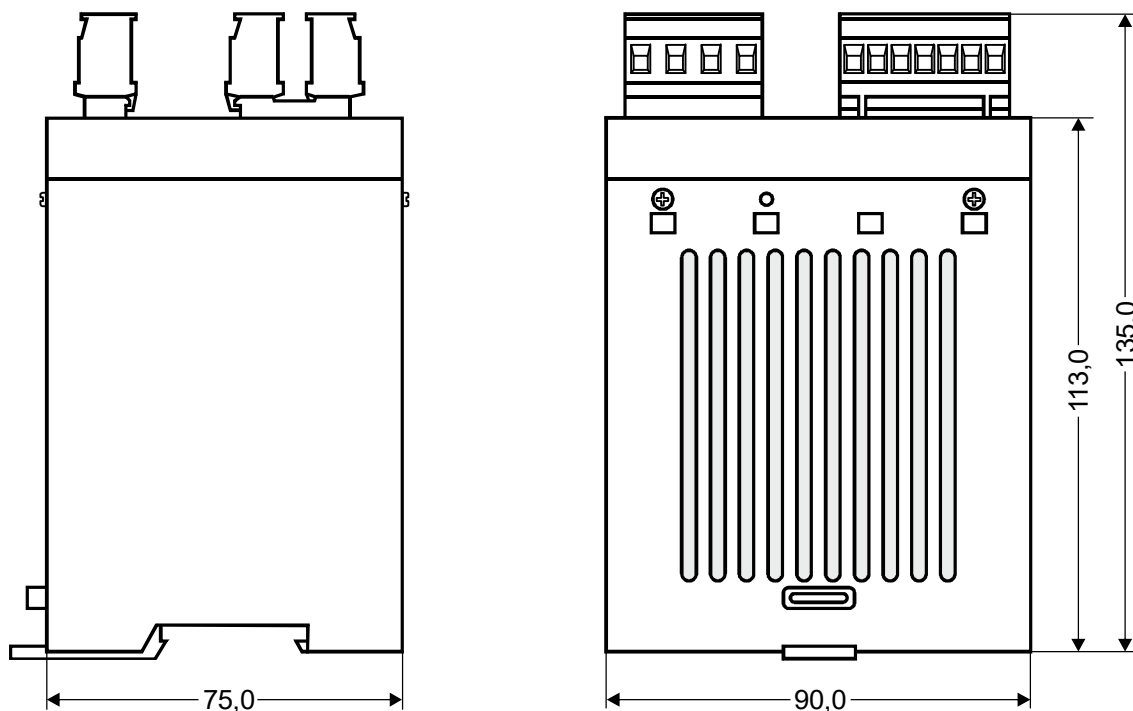
12   Modifications (MODs)

The RESISTRON® temperature controller RES-5027 is suitable for very many welding applications due to its universal design.

A device modification (MOD) is available for the RESISTRON® temperature controller RES-5027 to implement special applications.

The modifications must be ordered separately.

MOD 01

Supplemental booster for small secondary voltages (U_R = 0.25…16 VAC). This modification is necessary for very short or low-resistance heating elements, for example.

13   How to order

Illustrations are examples.

	Controller RES - 5027
	                    Art. no. 7502700
	Scope of delivery: Controller with plug-in connector parts (without transformer)
	
	Modification MOD . . (optional, if necessary)
	                    e.g.
	01: MOD 01, art. no. 800001 (suppl. booster for small voltage)
	
	The article numbers of the controller and of the desired modification (optional) must be specified when ordering.
	    e.g. RES-5027 + MOD 01 (controller with suppl. booster for small voltage)
	            order of art. no. 7502700 + 800001

	Current transformer PEX-W5 Art. no. 885107
	Monitoring current transformer MSW-2 Art. no. 885212
	Line filter LF- . . . . . . **06480**: Continuous current 6 A, 480 VAC, art. no. 885500 (with UL certification) **10520**: Continuous curr. 10 A, 520 VAC, art. no. 885504 (with UL and CSA certification) **35480**: Continuous curr. 35 A, 480 VAC, art. no. 885506 **50520**: Continuous curr. 50 A, 520 VAC, art. no. 885509 (with UL and CSA certification)
	Impulse transformer For design and order specifications, see ROPEX application report Design in accordance with EN 61558 Available with UL certifications and thermal switch, if necessary. In addition, we can individually design and offer you an upstream transformer.
	Potentiometer PD- . **3**: For 300 °C range, art. no. 881103 **5**: For 500 °C range, art. no. 881105 Scope of delivery: Potentiometer with digital button

	Temperature display ATR- . **3**: 300 °C range, art. no. 882130 **5**: 500 °C range, art. no. 882150
	Booster B- . . . **075415**: Impulse loaded 75 A, 415 VAC, art. no. 885302 **100400**: Impulse loaded 100 A, 400 VAC, art. no. 885304
	Lines For design and order specifications, see ROPEX application report

Additional accessories ⬦ "Accessories" brochure

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