

## RES-402

### Operating Instructions



#### Important features

- Automatic zero calibration (AUTOCAL)
- Automatic optimization (AUTOTUNE)
- Automatic configuration of the secondary voltage and current ranges (AUTORANGE, as of January 2006)
- Automatic frequency adjustment
- Temperature range: 300°C
- Electrically isolated analog input for set point selection with potentiometer or 0...10VDC
- Electrically isolated 0...10VDC analog output for ACTUAL temperature
- 24VDC control signals for START, AUTOCAL and RESET with electrical isolation
- Alarm function

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# 1 General information

This RESISTRON® temperature controller is manufactured according to EN 61010-1. In the course of its manufacture 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.

## 1.1 Copyright

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

## 1.2 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.

## 1.3 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:

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

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.

## 1.4 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.

## 1.5 Current transformer PEX-W4/-W5

The current transformer supplied with the RESISTRON<sup>®</sup> 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<sup>®</sup> 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.

## 1.6 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 "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.

## 1.7 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 cabinet with IP54 is recommended.**

## 1.8 Transportation

Store and transport the device in its original carton.


After transport, perform a visual inspection for possible damage.

## 1.9 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!**

## DECLARATION OF CONFORMITY

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

Designation: RESISTRON temperature controller with accessories  
Type: RES-402 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

  
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J. Kühner (CEO)

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## 2 Application

This RESISTRON® temperature controller is an integral part of the "series 400", the outstanding feature of which is its microprocessor technology. All RESISTRON temperature controllers are used to control the temperature of heating elements (heatsealing bands, beaded bands, cutting wires, heatsealing blades, solder elements etc.), as required in a variety of heatsealing processes.

The controller is most commonly used for impulse-heatsealing PE and PP films in:

- Vertical and horizontal f/f/s machines
- Pouch, filling and sealing machines
- Film wrapping machines
- Pouch-making machines
- Group packaging machines
- L-sealers
- etc.

## 3 Principle of operation

The resistance of the heatsealing band, which is temperature-sensitive, is monitored 50x per second (60x at 60Hz) by measuring the current and voltage. The temperature calculated with the help of these measurements is displayed and compared with the set point.

The primary voltage of the impulse transformer is adjusted by phase-angle control if the measured values deviate from the set point. The resulting change in the current through the heatsealing band leads to a change in the band temperature and thus also its resistance. This change is measured and evaluated by the RESISTRON® temperature controller.

The control loop is closed: ACTUAL temperature = SET temperature. Even minute thermal loads on the heatsealing band are detected and can be corrected quickly and precisely.

The thermoelectric control loop which is formed has a highly dynamic response because purely electrical variables are measured at a high sampling rate. A very wide secondary current range can be controlled with only minimal power loss - a considerable advantage - because power is controlled on the primary side of the transformer. This allows optimum adaptation to the load and to the required dynamic range despite the exceptionally compact dimensions of the controller.

## 4 Traits of the controller

- Very simple operation thanks to AUTOCAL, the automatic zero calibration function.
- Good dynamic response of the control system thanks to AUTOTUNE, which adapts automatically to the controlled system.
- High precision thanks to further improved control accuracy and linearization of the heatsealing band characteristic.
- High flexibility: The AUTORANGE function (as of January 2006) covers a secondary voltage range from 0.4V to 80V and a current range from 30A to 500A.
- Automatic adjustment to the line frequency in the range from 47Hz to 63Hz.
- Increased protection against dangerous conditions, such as overheating of the heatsealing band.

The electrically isolated analog interfaces for the temperature set point and the actual temperature (0-10VDC) allow the temperature to be set either directly on the machine PLC or by means of an external potentiometer (PD-3).

Similarly, the real heatsealing band temperature can be visualized either on the display of the machine PLC or on an external temperature meter (ATR-3).

To increase operational safety and interference immunity, all 24VDC logic signals are electrically isolated from the controller and the heating circuit.

An external 24VDC auxiliary voltage is required to supply the isolating amplifiers and optocouplers. The compact design of the RESISTRON<sup>®</sup> temperature controller RES-402 and the plug-in connections make this controller easy to install.

## 5 Installation

↳ See also section 1 "General information" on page 3.



**Installation and startup may only be performed by technically trained, skilled persons who are familiar with the associated risks and warranty provisions.**

### 5.1 Installation procedure

Proceed as follows to install the RESISTRON<sup>®</sup> temperature controller RES-402:

1. Switch off the line voltage and verify that all circuits are deenergized.
2. The supply voltage specified on the nameplate of the RESISTRON<sup>®</sup> temperature controller must be identical to the line voltage that is present in the plant or machine. The line frequency is automatically detected by the temperature controller in the range from 47Hz to 63Hz.
3. Install the RESISTRON<sup>®</sup> temperature controller in the electrical cabinet on a standard top hat rail (DIN TS35 rail, according to DIN EN 50022). If several controllers are installed on one top hat rail, the minimum clearance specified in section 9 "Technical data" on page 29 must be allowed between them.
4. Wire the system in accordance with the instructions in section 5.3 "Power supply" on page 10, section 5.6 "Auxiliary voltage" on page 13 and the ROPEX Application Report. The information provided in section 5.2 "Installation steps" on page 9 must be heeded additionally.

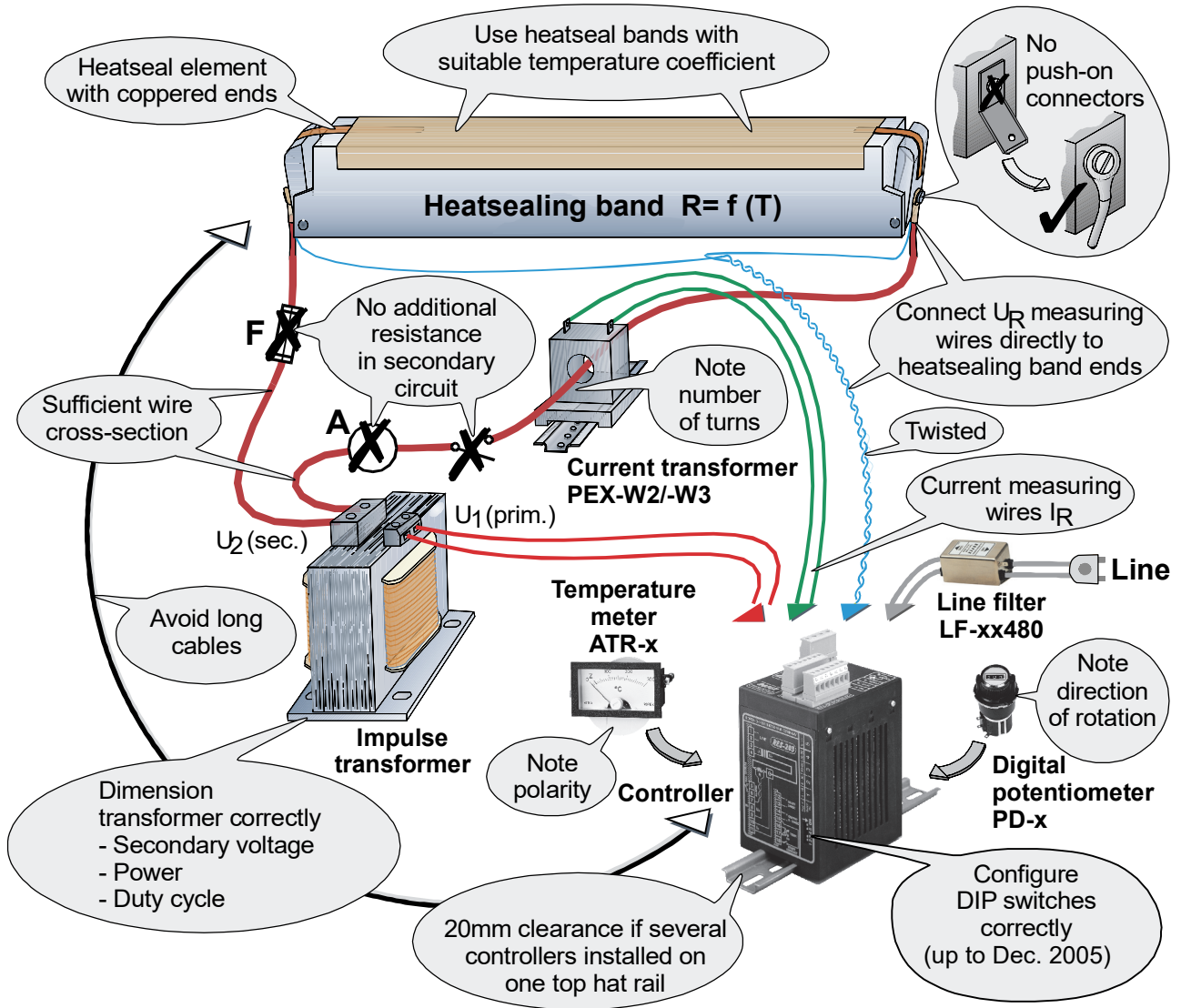


**Check the tightness of all the system connections, including the terminals for the impulse transformer windings.**

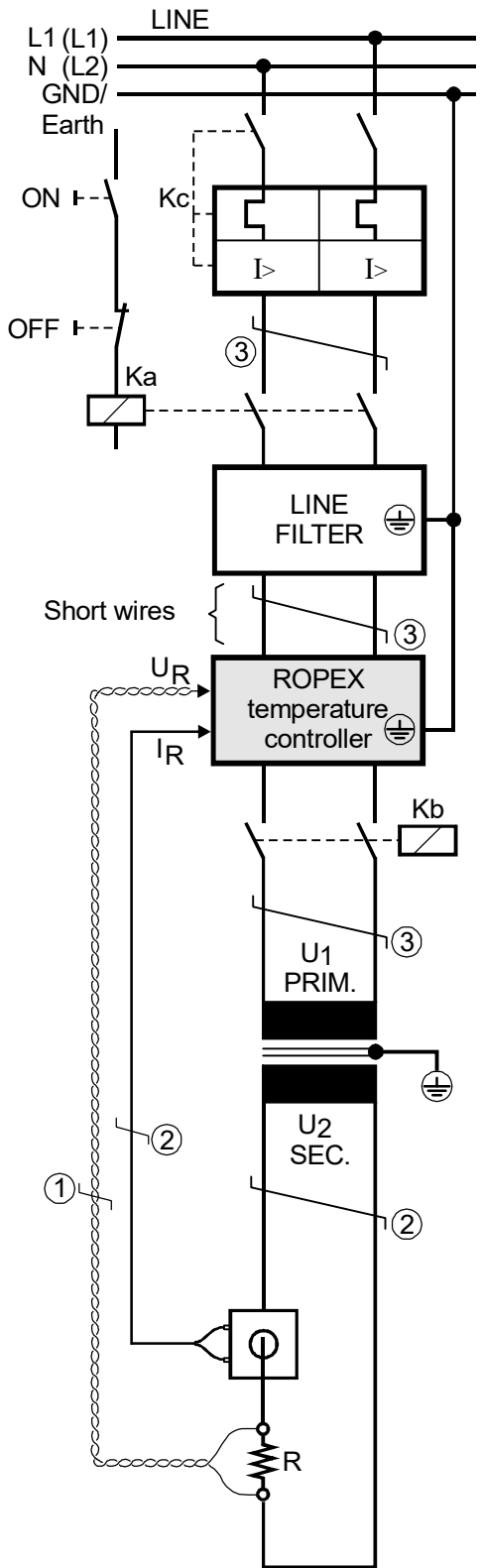
5. Make sure that the wiring conforms to the relevant national and international installation regulations.



## 5.2 Installation steps



**5.3 Power supply**



Line

**Over-current protection**

Double-pole circuit-breaker or fuses,  
(☞ 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 (☞ 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 (☞ ROPEX Application Report and "Accessories" leaflet for impulse transformers).

**Wiring**

The wire cross-sections depend on the application (☞ 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.

## 5.4 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.

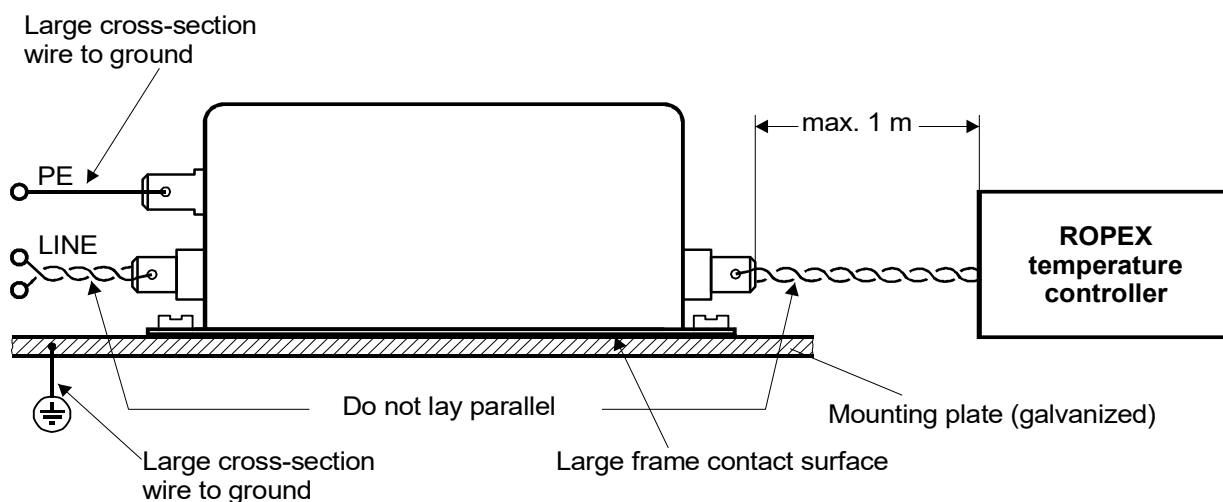
You can find the exact specification of the line filter in the ROPEX Application Report calculated for your particular heatsealing application.

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 5.3 "Power supply" on page 10 must be observed.

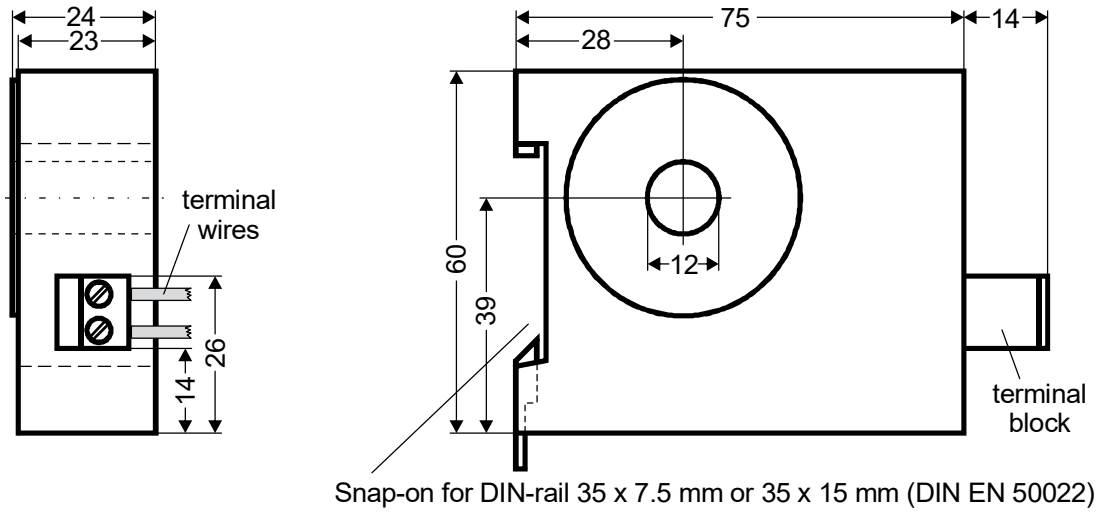
Example drawing for LF-06480:



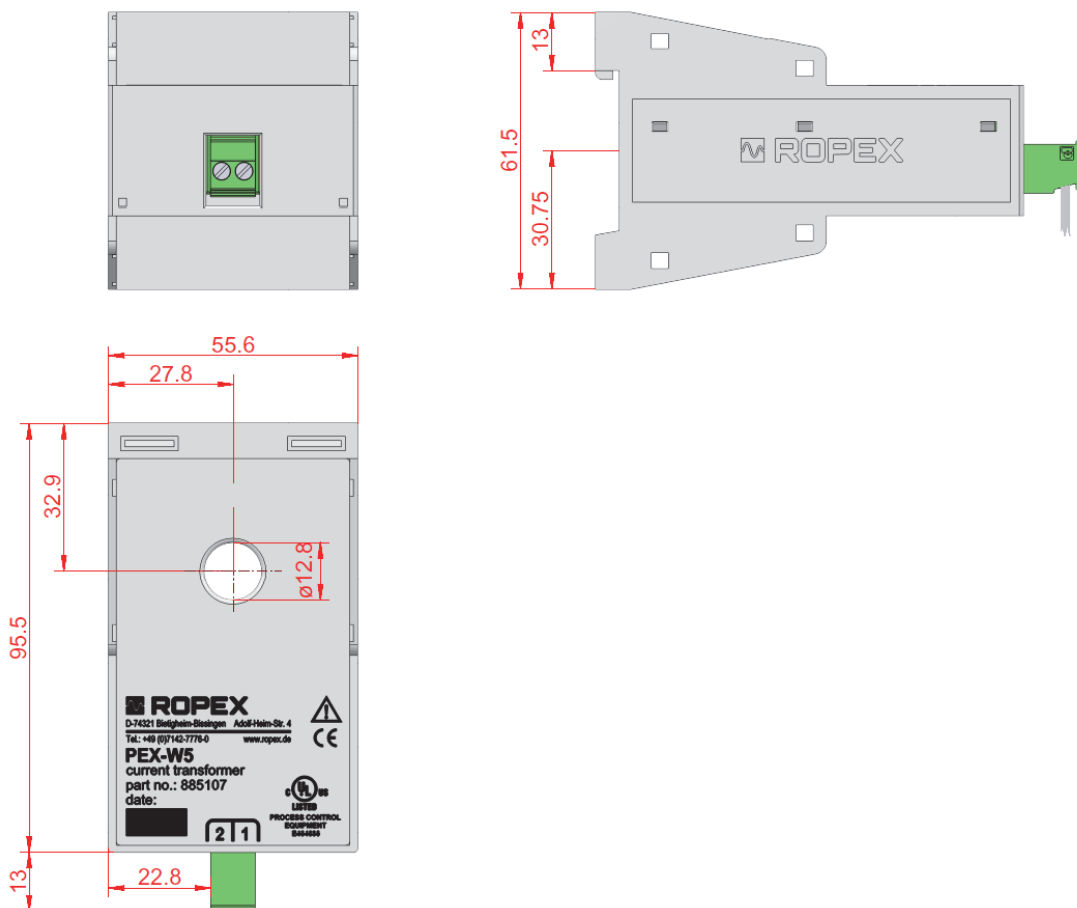
## 5.5 Current transformer PEX-W4/-W5

The PEX-W4/-W5 current transformer supplied with the RESISTRON<sup>®</sup> 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 5.3 "Power supply" on page 10).

**5.5.1 PEX-W4**



**5.5.2 PEX-W5**

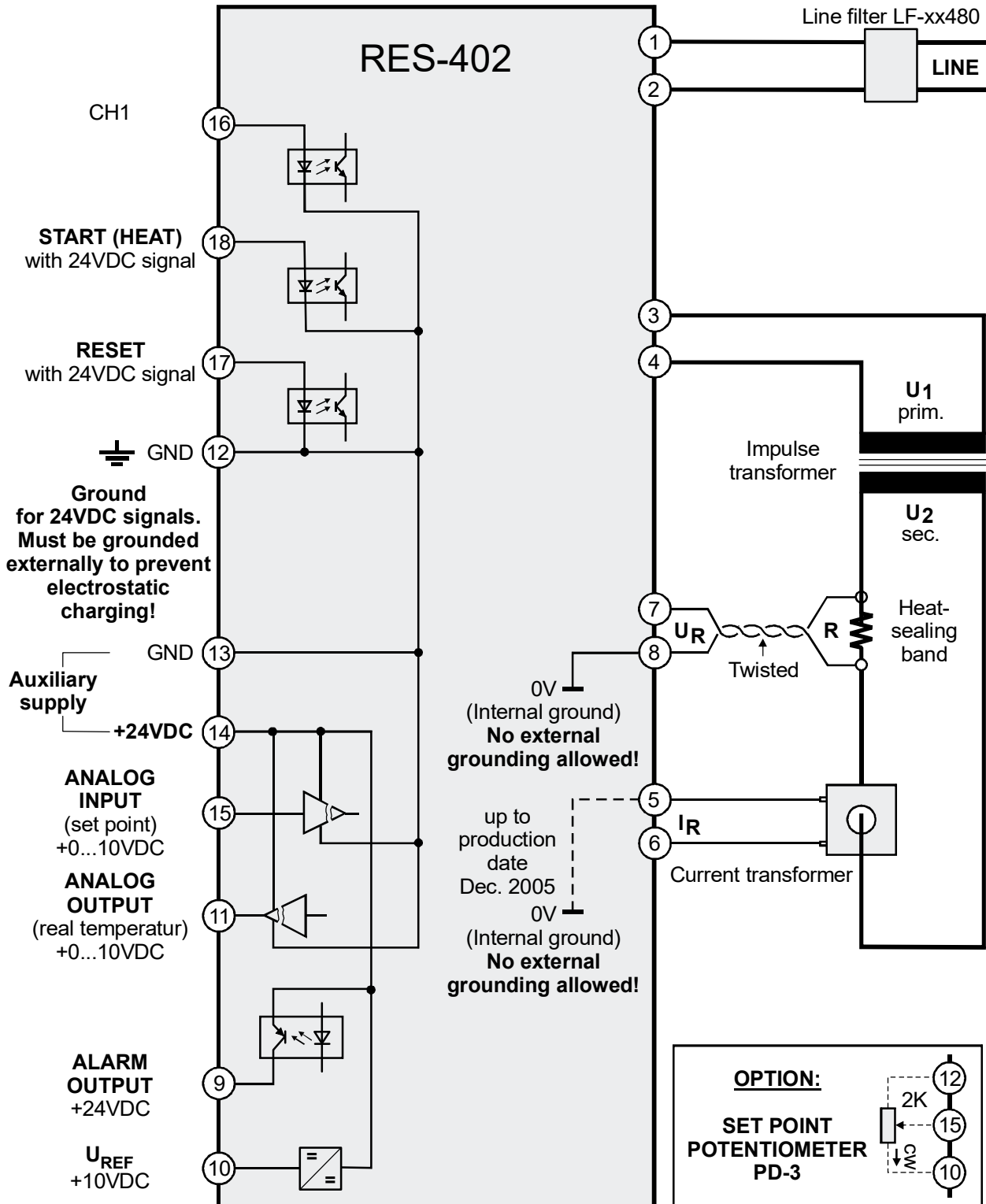


Mounting on DIN-rail 35 x 7.5 mm or 35 x 15 mm (DIN EN 50022).

## 5.6 Auxiliary voltage

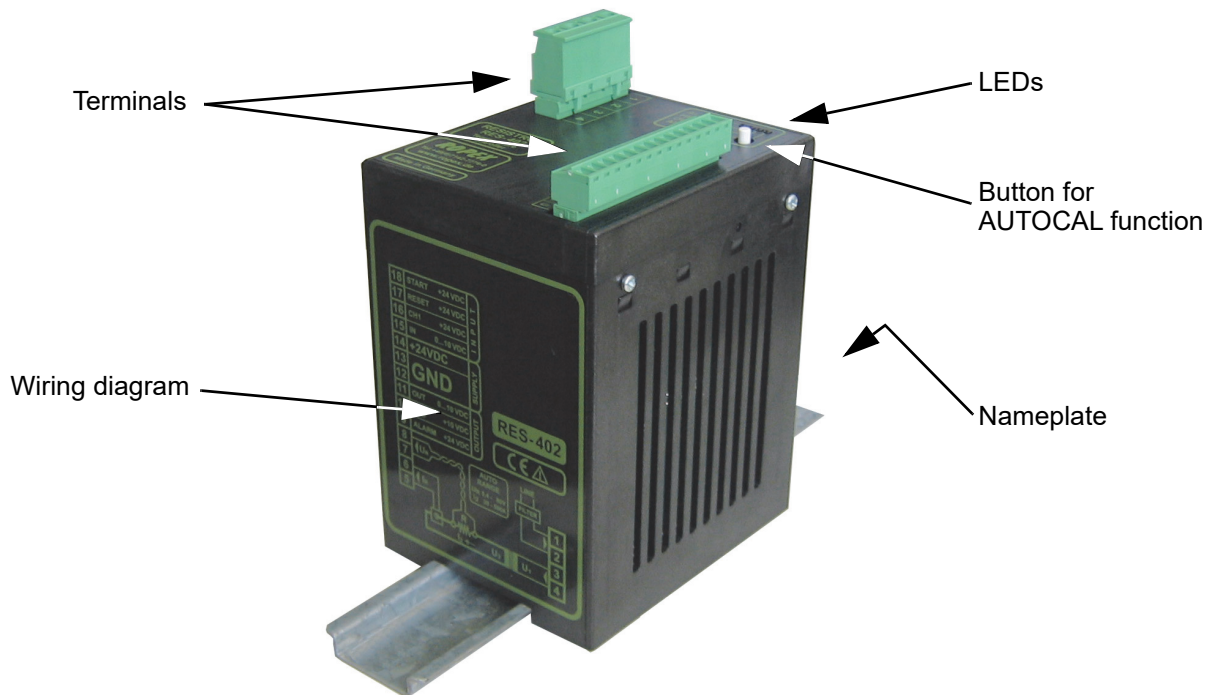
Since the inputs and outputs of the RES-402 are electrically isolated, a 24VDC auxiliary voltage must be applied to terminals 14+13. The auxiliary voltage has a maximum current input of 1,0A and it is also protected against reverse polarity.

**5.7 Wiring diagram**



**6 Startup and operation**

## 6.1 View of the controller



## 6.2 Controller configuration



The controller must be switched off in order to configure the coding switches.

### 6.2.1 Configuration of the DIP switches for secondary voltage and current

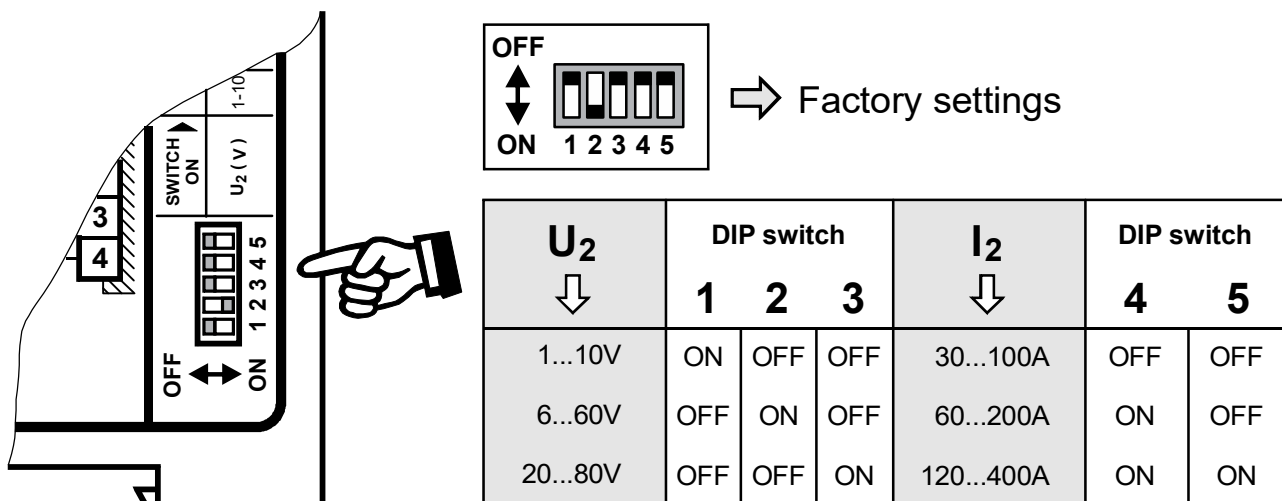
#### Automatic configuration (AUTORANGE) (as of January 2006)

The secondary voltage and current ranges are automatically configured by the automatic calibration function (AUTO CAL). The voltage is configured in the range from 0.4VAC to 80VAC and the current in the range from 30A to 500A. If the voltage and/or the current is outside the permissible range, a detailed error message appears on the controller (↪ see section 7.9 "Error messages" on page 27).

#### Configuration with coding switches (up to December 2005)

Set the DIP switches for matching the secondary voltage  $U_2$  and the secondary current  $I_2$  to the correct position for **your** application.

You can find the exact configuration of the DIP switches in the ROPEX Application Report calculated for your particular application.



If the secondary current  $I_2$  is less than 30A, the secondary high-current wire must be laid twice (or several times) through the PEX-W3 or PEX-W4 current transformer (↪ ROPEX Application Report).



## 6.3 Replacing and "burning in" the heatsealing band

### 6.3.1 "Burning in" the heatsealing band

The heatsealing band is a key component in the control loop, since it is both a heating element and a sensor. The geometry of the heatsealing band is too complex to be discussed at length here. We shall therefore only refer to a few of the most important physical and electrical properties:

The measuring principle applied for this system necessitates a heatsealing band alloy with a suitable temperature coefficient TCR. Too low a TCR leads to oscillation or uncontrolled heating.

When heatsealing bands with a higher TCR are used, the controller must be calibrated for this.

The first time the heatsealing band is heated to approximately 200...250°C, the standard alloy undergoes a once-only resistance change (burn-in effect). The cold resistance of the heatsealing band is reduced by approximately 2...3%. However, this at first glance slight resistance change results in a zero point error of 20...30°C. The zero point must therefore be corrected after a few heating cycles, i.e. the AUTOCAL function must be repeated.

The burn-in effect described here does not occur if the heatsealing band has already been thermally pretreated by the manufacturer.

**⚠ An overheated or burned-out heatsealing band must no longer be used because the TCR has been altered irreversibly.**

One very important design feature is the copper or silver-plating of the heatsealing band ends. Cold ends allow the temperature to be controlled accurately and increase the life of the teflon coating and the heatsealing band.

### 6.3.2 Replacing the heatsealing band

**⚠ All power supply leads must be disconnected from the RESISTRON® temperature controller in order to replace the heatsealing band.**



 **The heatsealing band must be replaced in accordance with the instructions provided by the manufacturer.**

Each time the heatsealing band is replaced, the zero point must be calibrated with the AUTOCAL function while the band is still cold, in order to compensate production-related resistance tolerances. The burn-in procedure described above should be performed for all new heatsealing bands.

## 6.4 Startup procedure

Please also refer to section 1 "General information" on page 3 and section 2 "Application" on page 7.


 **Installation and startup may only be performed by technically trained, skilled persons who are familiar with the associated risks and warranty provisions.**

### 6.4.1 Initial startup

Prerequisites: The controller must be correctly installed and connected (↪ section 5 "Installation" on page 8).

Proceed as follows to start up the controller for the first time:

1. Switch off the line voltage and verify that all circuits are deenergized.
2. The supply voltage specified on the nameplate of the controller must be identical to the line voltage that is present in the plant or machine. The line frequency is automatically detected by the temperature controller in the range from 47 to 63Hz.
3. In the case of controllers manufactured up to December 2005, the settings of the DIP switches on the controller are indicated in the ROPEX Application Report and depend on the heatsealing band that is used (section 6.2 "Controller configuration" on page 15).
4. Make sure that no START signal is present.
5. Apply the auxiliary voltage (24VDC).
6. Switch on the line voltage.
7. When the voltage is switched on, the yellow "AUTOCAL" LED lights up for approximately 0.3 seconds to indicate that the controller is being powered up correctly.

 **As of SW-Revision 106:**  
**If the red "ALARM" LED lights up for 0.3s in addition to the yellow "AUTOCAL" LED when the voltage is switched on, the configuration of this controller has been changed in the visualization software (↪ section 7.7 "Diagnostic interface/visualization software (as of January 2006)" on page 26). In order to avoid malfunctions, please check the controller configuration before continuing the startup procedure.**

8. One of the following states then appears:

"ALARM" LED	"OUTPUT" LED	ACTION
OFF	Short pulses every 1.2s	Go to 9
BLINKS fast (4Hz)	OFF	Go to 9
Lit continuously	OFF	Fault diagnosis (↪ section 7.9)

9. Activate the AUTOCAL function while the heatsealing band is still cold (by pressing the button on the cover of

the housing). The yellow "AUTOCAL" LED lights up for the duration of the calibration process (approx. 10...15s). A voltage of app. 0V appears at the same time at the actual value output (terminals 11+12). If an ATR-3 is connected, it indicates 0...3°C.

When the zero point has been calibrated, the "AUTOCAL" LED goes out and a voltage of 0.66V appears at the actual value output instead. If an ATR-3 is connected, it must be set to "Z".

If the zero point has not been calibrated successfully, the red "ALARM" LED blinks slowly (1 Hz). In this case the controller configuration is incorrect (↪ section 6.2 "Controller configuration" on page 15 and ROPEX Application Report). Repeat the calibration after the controller has been configured correctly.

10. When the zero point has been calibrated successfully, set a defined temperature at the set point input (terminal 15) and apply the "START" signal (HEAT). The "HEAT" LED then lights up. The heating and control process can be observed at the actual value output:

The controller is functioning correctly if the temperature (which corresponds to the signal change at the analog output) follows a harmonious curve, in other words it must not jump abruptly, fluctuate or deviate temporarily in the wrong direction. This kind of behavior would indicate that the  $U_R$  measuring wires have been laid incorrectly.

If an error message is displayed, please proceed as described in section 7.9 "Error messages" on page 27.

11. Burn in the heatsealing band (↪ section 6.3.1 ""Burning in" the heatsealing band" on page 16) and repeat the AUTOCAL function.

**The controller is now  
ready**

#### 6.4.2 Restart after replacing the heatsealing band

To replace the heatsealing band, proceed as described in section 6.3.1 ""Burning in" the heatsealing band" on page 16 .



**Always use a heatsealing band with the correct alloy, dimensions and copper-plating in order to avoid malfunctions and overheating.**

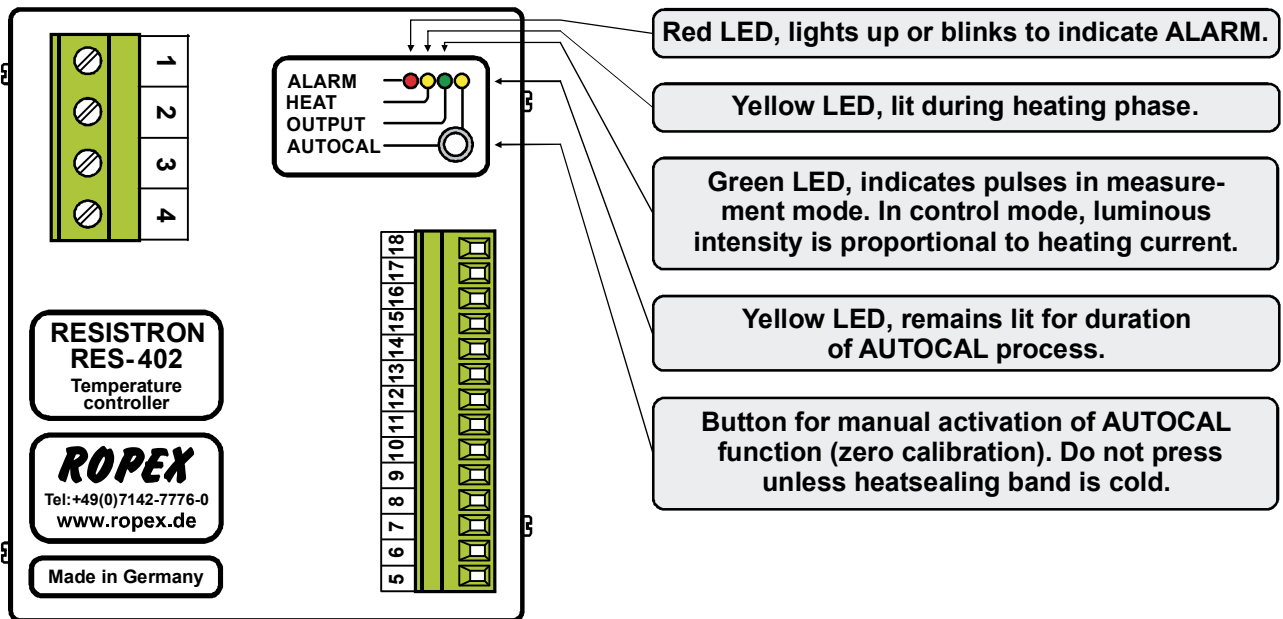
Continue with section 6.4.1, steps 4 to 11.

## 7 Controller functions

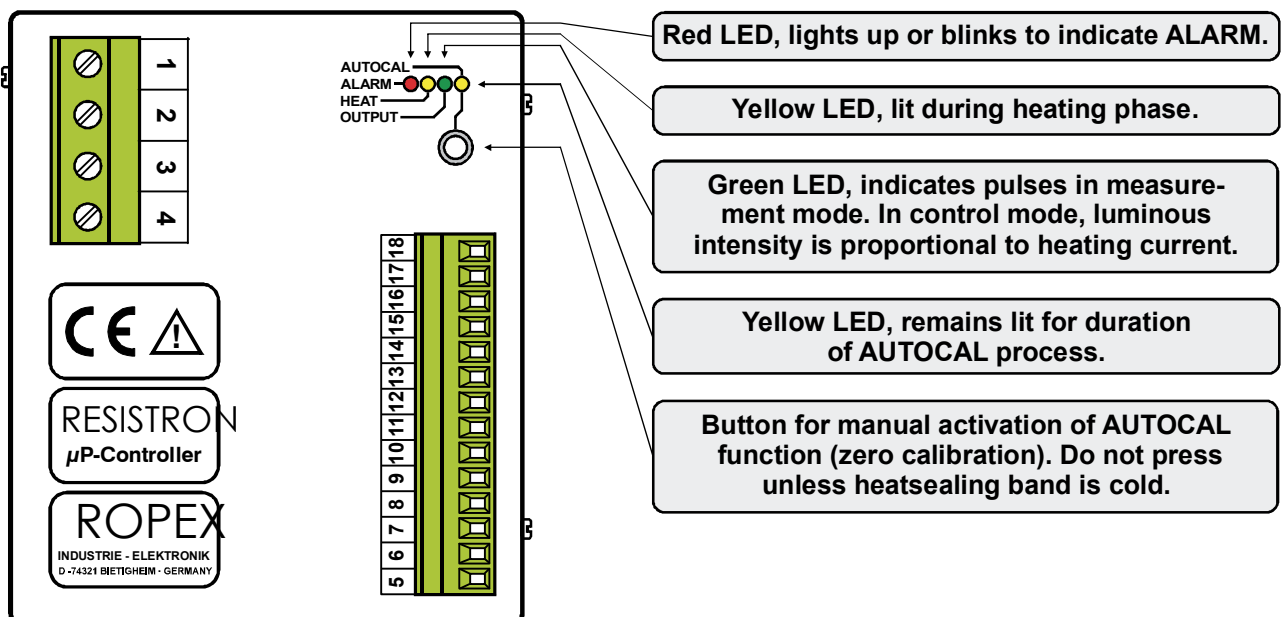
See also section 5.6 "Auxiliary voltage" on page 13.

### 7.1 Indicators and controls

**Manufactured as of January 2006**



**Manufactured up to December 2005**



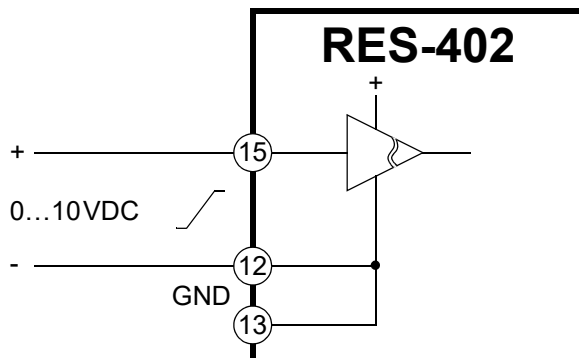
In addition to the functions shown in the diagram above, various controller operating states are indicated by the LEDs. These states are described in detail in the table below:

LED	Blinks slowly (1Hz)	Blinks fast (4Hz)	Lit continuously
<b>AUTOCAL</b> (yellow)	RESET active, START and AUTOCAL functions are locked	AUTOCAL requested, but function is locked	AUTOCAL executing
<b>HEAT</b> (yellow)	—	HEAT requested, but function is locked	START executing
<b>OUTPUT</b> (green)	In control mode the luminous intensity is proportional to the heating current.		
<b>ALARM</b> (red)	Configuration error, AUTOCAL not possible	Controller calibrated incor- rectly, run AUTOCAL	Fault, ↪ section 7.9

## 7.2 Temperature setting (set point selection)

The heatsealing temperature of the RES-402 can be set in two ways:

- By applying a 0...10VDC voltage to the analog input terminals 15 + 12:



The relationship between the applied voltage and the SET temperature is linear.

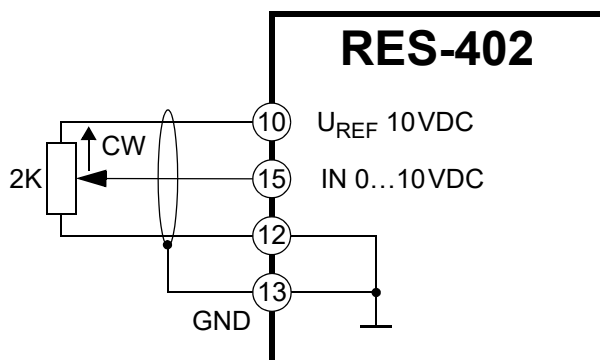
Setting range:

0VDC → 0°C

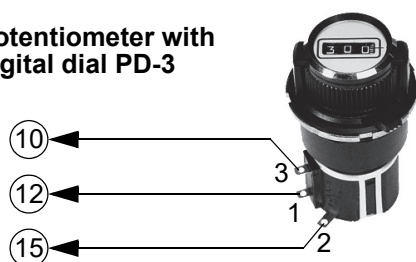
10VDC → 300°C

Please refer to section 7.3 "Temperature indication (actual value output)" on page 22 for a circuit diagram.

- By connecting a 2kohm potentiometer to terminals 10, 12, 15:



Potentiometer with digital dial PD-3



In order to be able to select the set point with a potentiometer, the controller makes a +10VDC ( $\pm 5\%$ ) reference voltage available at terminal 10.

The relationship between the potentiometer setting and the SET temperature is linear.

The connecting wires between the controller and the potentiometer must be shielded.

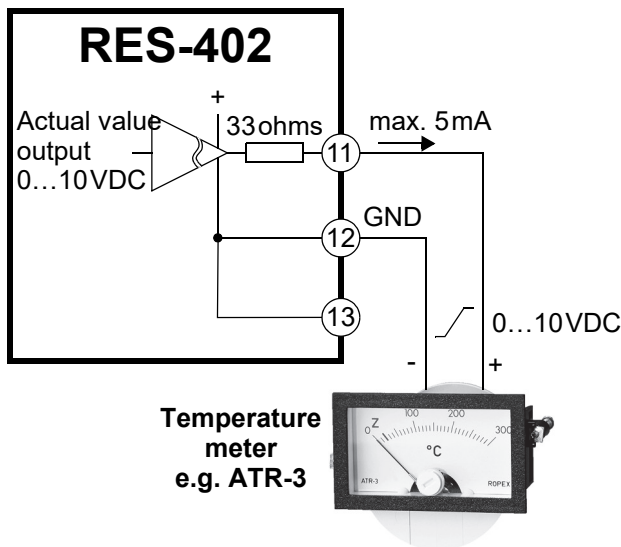
If a ROPEX PD-3 precision potentiometer is used, the SET temperature can be adjusted exactly with the help of the digital display in the window of the dial. The number which appears on the display corresponds to the SET temperature in °C.

The set point that is selected for the heatsealing temperature must be greater than 40°C. If not, the heatsealing band will not be heated up when the "START" signal is activated.

**⚠ If a potentiometer is not connected or if 0VDC is applied to the set point input, the set point is assumed to be zero. When you connect the potentiometer, please note the direction of rotation!**

### 7.3 Temperature indication (actual value output)

The RES-402 supplies an analog 0...10VDC signal, which is proportional to the real ACTUAL temperature, at terminals 11+12.

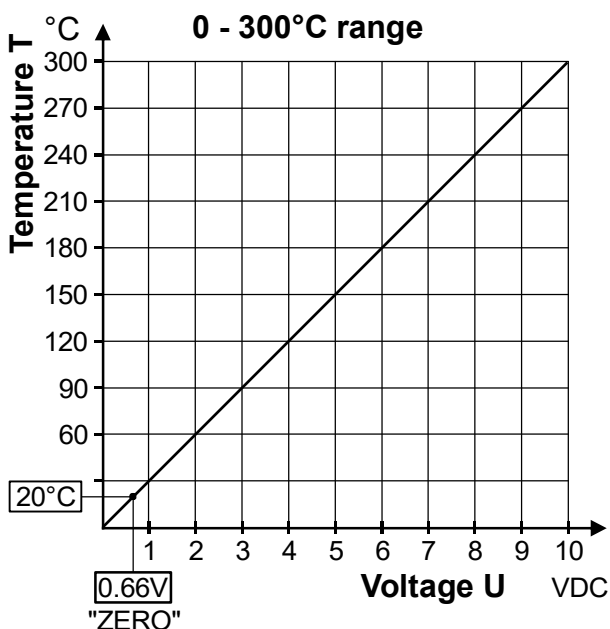


Voltage values:

0VDC → 0°C

10VDC → 300°C (ATR-3)

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



An indicating instrument can be connected to this output in order to visualize the temperature of the heatsealing band.

The characteristics of the ROPEX ATR-3 temperature meter (size, scaling, dynamic response) are ideally suited to this application and this instrument should therefore always be used (↪ section 12 "How to order" on page 31). It not only facilitates SET-ACTUAL comparisons, but also enables other criteria such as the heating rate, set point reached within the specified time, cooling of the heatsealing band etc. to be evaluated.

This meter moreover permits disturbances in the control loop (loose connections, contacting or wiring problems) as well as any line disturbances to be observed extremely effectively and interpreted accordingly. The same applies if mutual interference occurs between several neighboring control loops.

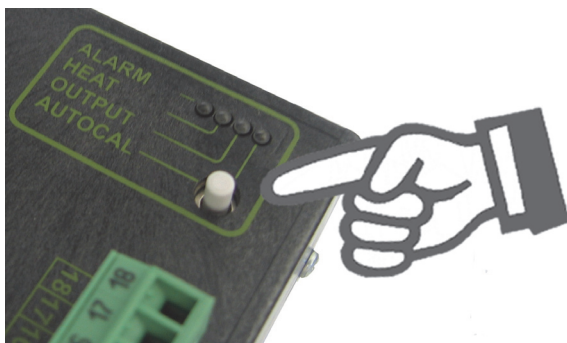
**⚠ If an alarm is signaled, the voltage at this analog output jumps back and forth at approx. 1Hz between 0VDC and 10VDC .**

### 7.4 Automatic zero calibration (AUTOCAL)

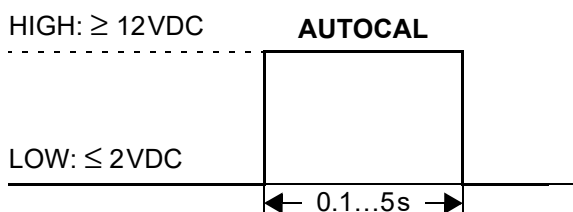
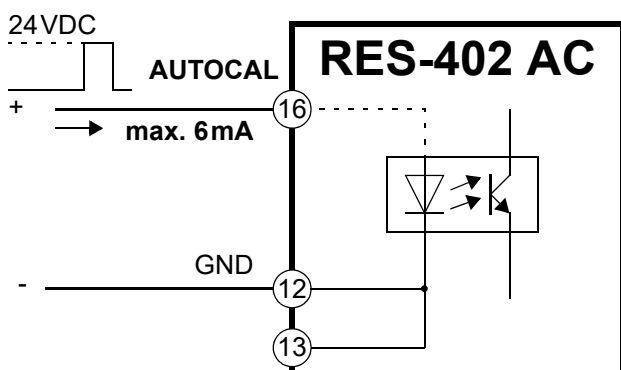
Owing to the automatic zero calibration (AUTOCAL) function, there is no need to adjust the zero point manually on the controller. This function matches the controller to the current and voltage signals that are present in the system and calibrates it to a value of 20°C.

**⚠ You should always wait for the heatsealing band and the bar to cool down (to ambient temperature) before activating the "AUTOCAL" function.**

The "AUTOCAL" function is activated by pressing the AUTOCAL button on the controller.



When using the controller RES-402/...VAC-AC the "AUTOCAL" function can be activated by means of a 24VDC pulse at terminals 16+12 (CH1) too.



The automatic calibration process takes around 10...15seconds. The heatsealing band is not heated during this process.

The yellow LED on the front panel lights up when the "AUTOCAL" function is active. The actual value output (terminals 11+12) is 0...3°C (corresponds to app. 0VDC).

If the temperature of the heatsealing band varies on controllers manufactured as of January 2006, the "AUTOCAL" function is executed a maximum of three times. If the function still cannot be terminated successfully, an error message appears (↪ section 7.9 "Error messages" on page 27).

**⚠ You should always wait for the heatsealing band and the bar to cool down (to ambient temperature) before activating the "AUTOCAL" function.**

#### Reasons for disabled "AUTOCAL" function:

1. The "AUTOCAL" function cannot be activated until 10seconds after the controller is switched on. If you attempt to activate it sooner, it will not work.
2. The "AUTOCAL" function cannot be not activated if the heatsealing band cools down at a rate of more than 0.1K/s. If the control signal is activated, the function is executed automatically providing the cooling rate has fallen below the above-mentioned value.
3. If the "START" signal (24VDC) is active, the "AUTOCAL" function is not executed ("HEAT" LED lit).
4. If the "RESET" signal (24VDC) is active, the "AUTOCAL" function is not executed.
5. If the controller has already operated correctly - at least once - after starting up, the "AUTOCAL" function cannot be activated if the "ALARM" LED is lit continuously.

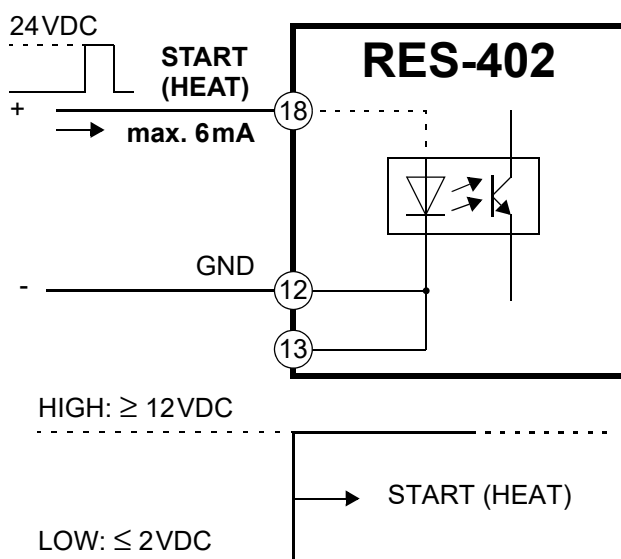
**⚠ If the "AUTOCAL" function is locked and you attempt to activate it, the yellow LED blinks.**

## 7.5 "START" signal (HEAT)

When the "START" signal is activated, the controller-internal set/actual comparison is enabled and the heatsealing band is heated up to the SET temperature. It remains at this temperature until the signal is deactivated again.

The "HEAT" LED on the front panel of the RES-402 is lit continuously for the duration of the heating phase.

The "START" signal is activated by means of a 24VDC signal at terminals 18+12.



The "START" signal is disabled as long as the "AUTOCAL" function is executing or the „RESET“ signal is active. The set point that is selected for the heatsealing temperature must be greater than 40°C. If not, the heatsealing band will not be heated up (the "HEAT" LED blinks).

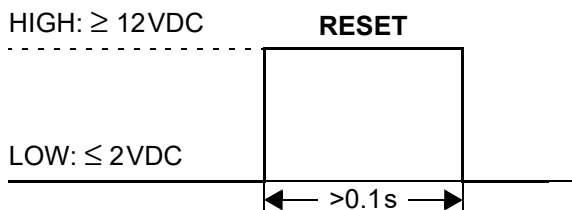
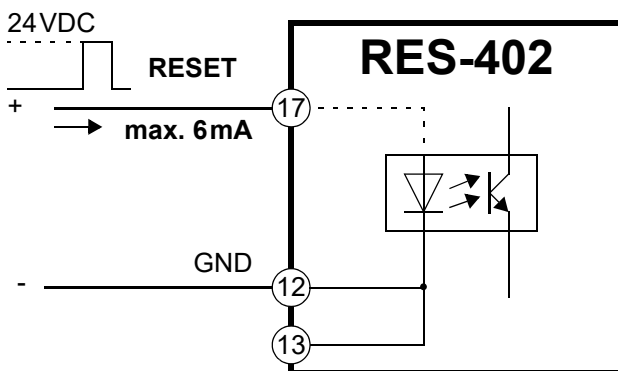


The heatsealing band is not heated up if the "START" signal is activated while an error message is indicated.

## 7.6 "RESET" signal

The RESISTRON<sup>®</sup> temperature controller RES-402 can be reset by means of an external "RESET" signal at terminals 17+12). As a result:

- A heatsealing cycle is aborted if one is in progress
- No more measuring impulses are generated
- An error message is reset if one is present  
(Note: The error message is not reset until the "RESET" signal is deactivated)



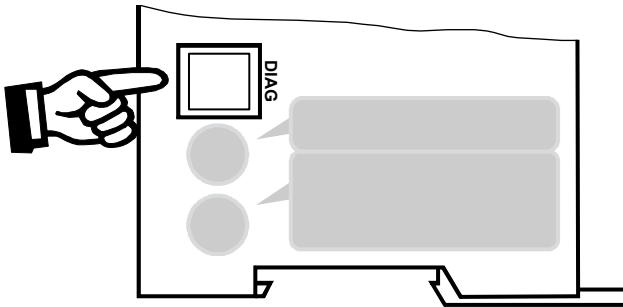
As of SW revision 103, the controller actual value output changes to 0...3°C (i.e. approximately 0VDC) while the "RESET" signal is being activated. This may be interpreted by the higher-level controller (e.g. a PLC) as feedback. The "AUTOCAL" function is not aborted if the "RESET" signal is activated while it is still executing.

**!** The controller performs an internal initialization run lasting approximately 500ms after the "RESET" signal is deactivated. The next heatsealing process cannot be started until it has finished.

**!** If a contactor Kb is used to deactivate the control loop (↪ section 5.3 "Power supply" on page 10), it must be reliably energized again 200ms at the latest after the "RESET" signal is deactivated (note the contactor switching and delay times). If it is energized too late, an error message will be output by the controller.

## 7.7 Diagnostic interface/visualization software (as of January 2006)

An interface with a 6-pole Modular socket (RJ-12) is provided for systemdiagnostics and process visualization. This interface allows a data connection to be set up to the ROPEX visualization software using the ROPEX communication interface CI-USB-1.



**!** Only a ROPEX communication interface is allowed to be connected to the diagnostic interface. Connecting another device (e.g. a telephone cable) could result in malfunctions or damage to the controller.

The ROPEX visualization software is described in a separate document.

## 7.8 System monitoring/alarm output

To increase operating safety and to avoid faulty heatsealing, this controller incorporates special hardware and software features that facilitate fault diagnosis. Both the external wiring and the internal system are monitored. A system fault is reported or differentiated by means of the following indications:

### A.) Red "ALARM" LED on the controller with three states:

- 1. Blinks fast (4Hz):**  
The "AUTOCAL" function should be executed.
- 2. Blinks slowly (1Hz):**  
The system configuration is incorrect and the zero calibration ("AUTOCAL" function) was unsuccessful .
- 3. Lit continuously:**  
A fault is preventing the controller from being started.  
Also in instances 1 and 2 if the "START" signal is activated simultaneously.  
As a rule, it refers to an external wiring fault.

### B.) Alarm output signal on the controller (terminals 14+9):

This logic output is:

- **LOW (OPEN)** in operating states A.1) and A.2), but high (closed) if a "START" signal is activated in one of these states.
- **HIGH (CLOSED)** in operating state A.3)

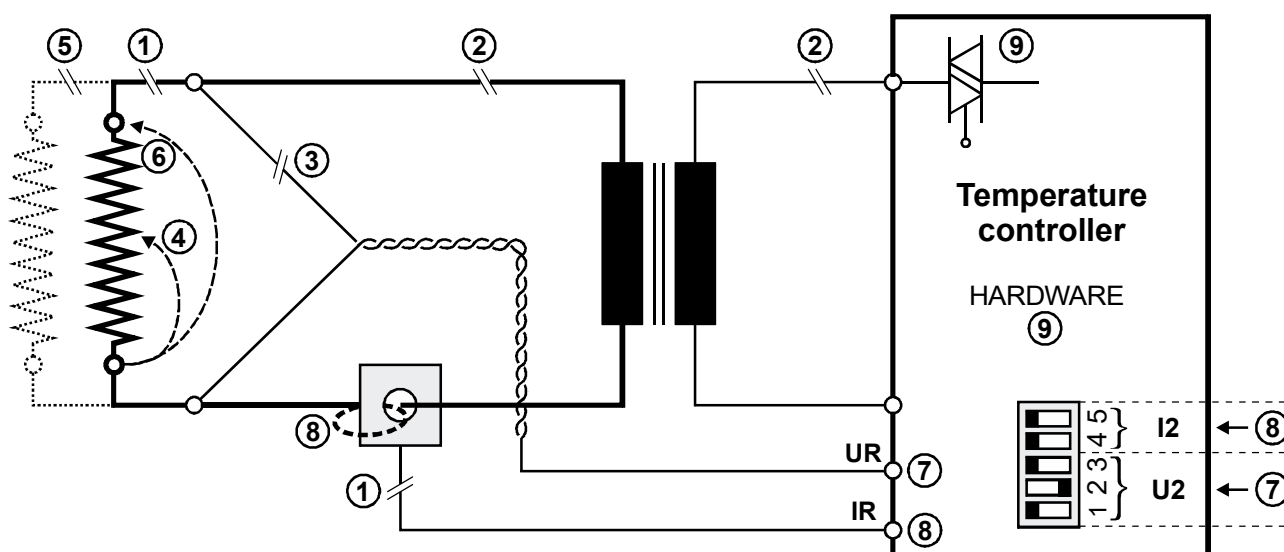
**!** An alarm can only be reset by applying a "RESET" signal or by switching the controller off and then on again.

- If an error message is reset using the "RESET" signal, the "RESET" signal must be deactivated first.
- Invalid error messages may appear when the controller is switched off owing to the undefined operating state. This must be taken into account when they are evaluated by the higher-level controller (e.g. a PLC) in order to avoid false alarms.

### 7.9 Error messages

The RES-402 indicates faults only by means of the "ALARM" LED. No additional error indications are available.

### 7.10 Fault areas and causes



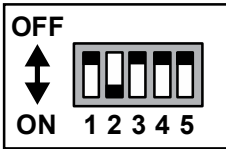
The table below explains the possible fault causes.

Fault area	Explanation	Possible causes
①	Load circuit interrupted after $U_R$ pickoff point	- Wire break, heatsealing band break - Contact to heatsealing band defective
	Current transformer signal interrupted	- $I_R$ measuring wires from current transformer interrupted
②	Primary circuit interrupted	- Wire break, triac in controller defective - Primary winding of impulse transformer interrupted
	Secondary circuit interrupted before $U_R$ pickoff point	- Wire break - Secondary winding of impulse transformer interrupted
③	$U_R$ signal missing	- Measuring wires interrupted
④	Partial short-circuit ( $\Delta R$ )	- Heatsealing band partially bypassed by conducting part (clamp, opposite heatsealing bar etc.)
⑤	Parallel circuit interrupted	- Wire break, heatsealing band break - Contact to heatsealing band defective

Fault area	Explanation	Possible causes
⑥	Total short-circuit	- Heatsealing band installed incorrectly, insulation at heatsealing bar ends missing or incorrectly installed - Conducting part bypasses heatsealing band completely
⑦	$U_R$ signal incorrect	- Up to Dec. 2005: DIP switches 1 - 3 configured incorrectly ( $U_2$ range) - As of Jan. 2006: $U_2$ outside permissible range from 0.4...80VAC
⑧	$I_R$ signal incorrect	- Up to Dec. 2005: DIP switches 4 + 5 configured incorrectly ( $I_2$ range) - As of Jan. 2006: $I_2$ outside permissible range from 30...500A
	Turns through current transformer incorrect	- Check number of turns (two or more turns required for currents < 30A)
⑨	Internal controller fault	- Hardware fault (replace controller)

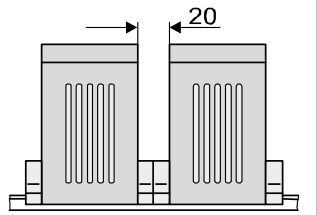
## 8 Factory settings

The RESISTRON<sup>®</sup> temperature controller RES-402 is configured in the factory as follows:

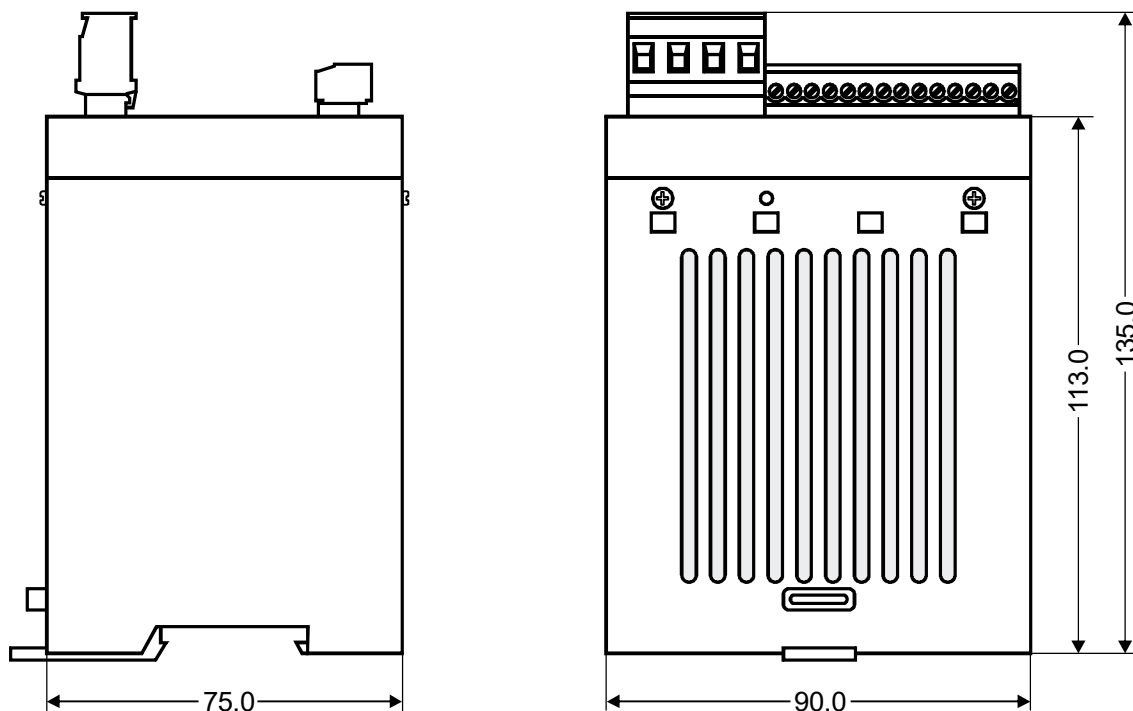
<p><u>DIP switches</u> for secondary voltage <math>U_2</math> and current <math>I_2</math> (up to December 2005)</p>		<p><math>U_2 = 6...60VAC</math> <math>I_2 = 30...100A</math></p> <p>DIP switches:        2 ON                               1, 3, 4, 5 OFF</p> <p>These switches are automatically set by the AUTORANGE function on all controllers manufactured as of January 2006.</p>
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## 9 Technical data

<b>Type of construction</b>	Housing for installation in the electrical cabinet Snaps onto a standard top hat rail (DIN TS35 rail, 35mm) acc. to DIN EN 50022 Dimensions: 90 x 75mm; height: 135 mm (incl. terminals)
<b>Line voltage</b>	<u>All controllers manufactured as of January 2006:</u> 115VAC version: 110VAC -15%...120VAC +10% (equivalent to 94...132VAC) 230VAC version: 220VAC -15%...240VAC +10% (equivalent to 187...264VAC) 400VAC version: 380VAC -15%...415VAC +10% (equivalent to 323...456VAC)  <u>All controllers manufactured up to December 2005:</u> 115VAC version: 115VAC -15%...120VAC +10% (equivalent to 98...132VAC) 230VAC version: 230VAC -15%...240VAC +10% (equivalent to 196...264VAC) 400VAC version: 400VAC -15%...415VAC +10% (equivalent to 340...456VAC) Depending on the controller version (↪ section 12 "How to order" on page 31)
<b>Line frequency</b>	47...63Hz, automatic adjustment to frequencies in this range
<b>Auxiliary voltage</b> Terminals 14+13	24VDC, +20%, -10%, reverse polarity-protected Current input: max. 1.0A
<b>Heatsealing band type and temperature range</b>	Default value 300°C, Alloy A20
<b>Analog input</b> (set point) Terminals 15+12	0...10VDC, $I_{max} = 5\text{mA}$ , electrically isolated Equivalent to 0...300°C or with an external PD-3 precision potentiometer ( $R = 2\text{kohms}$ ) 0...2kohms equivalent to 0...300°C
<b>Analog output</b> (actual value) Terminals 11+12	0...10VDC, $I_{max} = 5\text{mA}$ , electrically isolated Equivalent to 0...300°C Accuracy: $\pm 1\%$ add. 50mV
<b>Reference voltage</b>	+10VDC / $\pm 5\%$ , $I_{max} = 5\text{mA}$
<b>Digital logic levels</b> Terminals 16, 17, 18	LOW (0V): 0...2VDC, electrically isolated HIGH (24VDC): 12...30VDC (max. current input 6mA) Reverse polarity-protected
<b>Alarm output</b>	$U_{ON} < 3\text{V}$ (saturation voltage), $I_{max} = 200\text{mA}$ , electrically isolated, short-circuit proof
<b>Maximum load</b> (primary current of impulse transformer)	$I_{max} = 5\text{A}$ (duty cycle = 100%) $I_{max} = 25\text{A}$ (duty cycle = 20%)
<b>Power dissipation</b>	max. 20W
<b>Ambient temperature</b>	+5...+45°C
<b>Degree of protection</b>	IP20

<b>Installation</b>	<p>If several controllers are installed on one top hat rail (DIN TS35 rail), a clearance of at least 20mm should be allowed between them.</p> <p>The moving clip required for fastening must be facing down for mounting on a horizontal top hat rail.</p> <p>End holders to mechanical fix the controller must be fitted at both ends for mounting on a vertical top hat rail.</p>	
<b>Weight</b>	Approx. 0.7kg (incl. connector plug-in parts)	
<b>Housing material</b>	Plastic, polycarbonate, UL-94-V0	
<b>Connecting cables</b> Type / cross-sections	<p>Terminals 1...4: Rigid or flexible; 0.2...2.5mm<sup>2</sup> (AWG 24...12)</p> <p>Terminals 5...18: Rigid or flexible: 0.2...1.5mm<sup>2</sup> (AWG 24...16)</p> <p>Plug-in connectors</p> <p><b>⚠ If ferrules are used, they must be crimped in accordance with DIN 46228 and IEC/EN 60947-1. This is essential for proper electrical contact in the terminals.</b></p>	

## 10 Dimensions










## 11 Modifications (MODs)

Modifications are not available for the RES-402.

## 12 How to order

Pictures exemplary.

	<p><b>Contr. RES - 402 / . . . VAC</b></p> <ul style="list-style-type: none"> <li>└─ 115: Power supply 115VAC, P/N 740201</li> <li>└─ 230: Power supply 230VAC, P/N 740202</li> <li>└─ 400: Power supply 400VAC, P/N 740203</li> </ul> <p>Scope of supply: Controller includes connector plug-in parts (without current transformer)</p> <p><b>Contr. RES - 402 / . . . VAC - AC (With digital AUTOCAL-signal, terminal 16)</b></p> <ul style="list-style-type: none"> <li>└─ 115: Power supply 115VAC, P/N 740205</li> <li>└─ 230: Power supply 230VAC, P/N 740206</li> <li>└─ 400: Power supply 400VAC, P/N 740207</li> </ul> <p>Scope of supply: Controller includes connector plug-in parts (without current transformer)</p> <p>Please indicate the part numbers in all orders.</p>
	<p><b>Current transformer PEX-W4</b> P/N 885106</p>
	<p><b>Line filter LF- . . . 480</b></p> <ul style="list-style-type: none"> <li>└─ 06: Continuous current 6A, 480VAC, P/N 885500</li> <li>└─ 35: Continuous current 35A, 480VAC, P/N 885506</li> </ul>
	<p><b>Impulse transformer</b></p> <p>See ROPEX Application Report for design and ordering information</p>
	<p><b>Communication interface CI-USB-1</b> P/N 885650</p>
	<p><b>Potentiometer PD- 3</b></p> <ul style="list-style-type: none"> <li>└─ For 300°C range, P/N 881103</li> </ul> <p>Scope of supply: Potentiometer with digital dial</p>
	<p><b>Temp. meter ATR- 3</b></p> <ul style="list-style-type: none"> <li>└─ 300°C range, P/N 882130</li> </ul>

For more accessories: ↪ "Accessories" leaflet

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