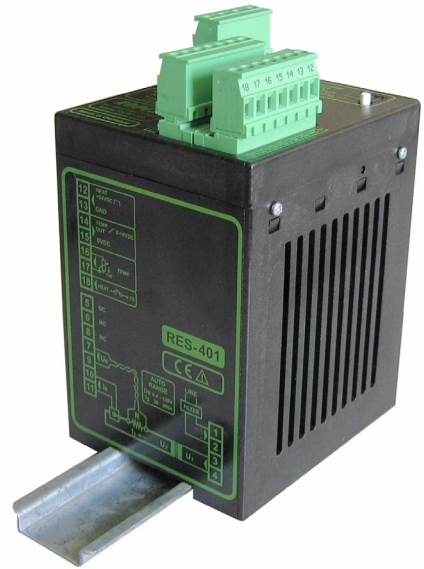


## RES-401

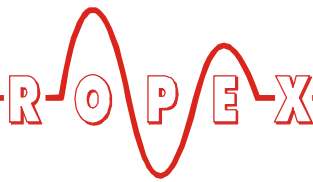
®

### Operating Instructions



#### Important features

- Microprocessor technology
- Automatic zero calibration (AUTOCAL)
- Automatic optimization (AUTOTUNE)
- Automatic configuration of the secondary voltage and current ranges (AUTORANGE, as of October 2005)
- Automatic frequency adjustment
- Large current and voltage range
- Set point selection with potentiometer
- Temperature range: 300°C
- 0...10VDC analog output for ACTUAL temperature
- Activated with contact or 24VDC signal
- Alarm function



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# 1 Safety and warning notes

This RESISTRON temperature controller is manufactured according to DIN EN 61010-1. In the course of its manufacture it passed through quality assurance, whereby it was subjected to extensive inspections and tests.


It left the factory in perfect condition.

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 Use

RESISTRON temperature controllers may only be used for heating and temperature control of heatsealing bands which are expressly suitable for them, and providing the regulations, notes and warnings contained in these instructions are complied with.

 **In case of non-compliance 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. Ensuring such compliance is the personal responsibility of the user.**

## 1.2 Heatsealing band

A basic prerequisite for reliable and safe operation of the system is the use of suitable heatsealing bands.


 **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:

$$TCR \geq 10 \times 10^{-4} \text{ K}^{-1}$$

e.g. Alloy-20: TCR = 1100 ppm/K  
NOREX: TCR = 3500 ppm/K

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

 **The use of incorrect alloys with a too low temperature coefficient and incorrect coding of the RESISTRON temperature controller lead to uncontrolled heating and ultimately to burn-out of the heatsealing band!**

The heatsealing bands that were originally supplied must be identified by detail specification, part number or some other means that will assure that replacement bands are identical.


## 1.3 Impulse transformer

A suitable impulse transformer is necessary to ensure that the control loop functions perfectly. This transformer must be designed according to VDE 0570/EN 61558 (isolating transformer with reinforced insulation) and have a one section bobbin. When the impulse transformer is installed, suitable shock protection must be provided in accordance with the national installation regulations for electrical equipment. In addition, water, cleaning solutions and conductive fluids must be prevented from seeping into the transformer.

 **Incorrect installation of the impulse transformer impairs electrical safety.**

## 1.4 Current transformer PEX-W2/-W3

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

 **Only the original ROPEX PEX-W2 or PEX-W3 current transformer may be used. Other transformers may cause the equipment to malfunction.**

The current transformer may only be operated if it is connected to the RESISTRON temperature controller correctly (see section 9, "Startup and operation"). The relevant safety instructions contained in section 8.3, "Power supply", must be obeyed. 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.

### 1.5 Line filter

The use of an original ROPEX line filter is mandatory in order to comply with the standards and provisions mentioned in section 1.7 "Standards / CE marking" on page 4. This device must be installed and connected according to the instructions contained in section 8.3, "Power supply" as well as the separate documentation enclosed with the line filter.

### 1.6 Warranty provisions

The statutory provisions for warranties apply for a period of 12 months following the delivery date.

All devices are tested and calibrated in the factory. Devices that have been damaged due to faulty connections, dropping, electrical overloading, natural wear, incorrect or negligent handling, chemical influences or mechanical overloading as well as devices that have been modified, relabeled or otherwise altered by the customer, for example in an attempt to repair them or install additional components, are excluded from the warranty.

Warranty claims must be examined in the factory and approved by ROPEX.

### 1.7 Standards / CE marking

The controller described here complies with the following standards, provisions and directives:

DIN EN 61010-1 (VDE 0411-1)	Safety provisions for electrical measuring, control and laboratory devices (low voltage directive). Overvoltage category III, pollution severity 2, safety class II.
DIN EN 60204-1	Electrical equipment of machines (machinery directive)
EN 50081-1	EMC interference emissions according to EN 55011, group 1, class B
EN 50082-2	EMC interference immunity: ESDs, RF radiation, bursts, surges.

Compliance with these standards and provisions is only guaranteed if original accessories and/or peripheral components approved by ROPEX are used. If not, then the equipment is operated on the user's own responsibility.

The CE marking on the controller confirms that the device itself complies with the above-mentioned standards.

It does not imply, however, that the overall system also fulfils these standards.

It is the responsibility of the machine manufacturer and of the user to verify the completely installed, wired and operationally ready system in the machine with regard to its conformity with the safety provisions and the EMC directive (see also section 8.3, "Power supply"). If peripheral components (e.g. the transformer or the line filter) from other manufacturers are used, no functional guarantee can be provided by ROPEX.

## 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 heat-sealing processes.

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

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

The use of RESISTRON temperature controllers results in:

- Repeatability of the heatseals under any conditions

- Increased machine capacity
- Extended life of the heatsealing bands and teflon coatings
- Simple operation and control of the sealing process

### 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.

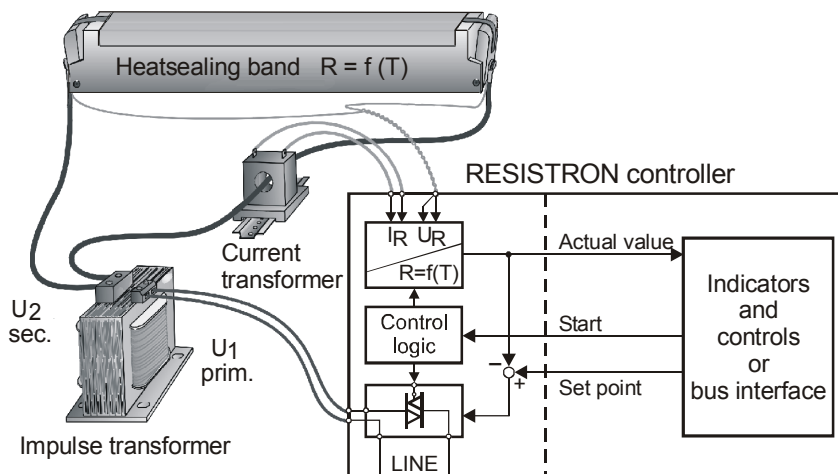
A highly high response thermo-electric control loop is formed which is highly accurate because purely electrical variables are measured at a high sampling rate. A high secondary current can be controlled because power is controlled on the primary side of the transformer. This allows optimum adaptation to the load and

to the required dynamic range despite the exceptionally compact dimensions of the controller.

#### PLEASE NOTE!

RESISTRON temperature controllers play a significant role in enhancing the performance of modern machines. However, the full benefit can only be obtained from the advanced technology offered by this control system if all the system components, in other words the heatsealing band, the impulse transformer, the wiring, the timing signals and the controller itself, are compatible and interrelated.

**We will be pleased to contribute our many years of experience towards optimizing your heatsealing system.**



## 4 Description of the controller

The microprocessor technology endows the RESISTRON temperature controller RES-401 with previously unattainable capabilities:

- 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 October 2005) covers a secondary voltage range from 0.4V to 120V and a current range from 30A to 500A.
- Automatic adjustment to the line frequency in the range from 47Hz...63Hz.

- Increased protection against dangerous conditions, such as overheating of the heatsealing band.

The ACTUAL temperature of the heatsealing band is supplied to an analog 0...10VDC output. The real heatsealing band temperature can thus be displayed on an external temperature indicator (e.g. ATR-3).

The RESISTRON temperature controller RES-401 features an integrated fault diagnosis function, which tests both the external system (heatsealing band, wiring etc.) and the internal electronics and indicates a fault by means of the LED.

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

The compact design of the RESISTRON temperature controller RES-401 and the plug-in connections make this controller easy to install.





## 5 Accessories and modifications

A wide range of compatible accessories and peripheral devices are available for the RESISTRON temperature controller RES-401. They allow it to be optimally adapted to your specific heatsealing application and to your plant's design and operating philosophy.

### 5.1 Accessories

The products described below are only a few of the wide range of accessories available for RESISTRON temperature controllers (↳ "Accessories" leaflet).

	<p><b>Analog temperature meter ATR-3</b> For front panel mounting or mounting on a top hat rail (DIN TS35 rail). Analog indication of the ACTUAL temperature of the heatsealing band in °C. The meter damping of the unit is optimized for the abrupt temperature changes that occur in impulse mode.</p>
	<p><b>Digital temperature meter DTR-3</b> For front panel mounting or mounting on a top hat rail (DIN TS35 rail). Digital indication of the ACTUAL temperature of the heatsealing band in °C, with HOLD function.</p>
	<p><b>Set point potentiometer PD-3</b> Front panel mounting version for setting the required SET heatsealing temperature of the RESISTRON temperature controller. The number which appears on the display corresponds to the SET heatsealing temperature in °C.</p>

	<p><b>Line filter</b>                  Essential in order to ensure CE conformity.                  Optimized for the RESISTRON temperature controller.</p>
	<p><b>Impulse transformer</b>                  Designed according to VDE 0570/EN 61558 with a one section bobbin.                  Optimized for impulse operation with RESISTRON temperature controllers.                  Specified according to the heatsealing application (↪ ROPEX Application Report).</p>
	<p><b>Communication interface CI-USB-1</b>                  Interface for connecting a RESISTRON temperature controller with diagnostic interface (DIAG) to the PC (USB port). Associated PC visualization software for displaying setting and configuration data, and for recording SET and ACTUAL temperatures in real time.</p>
	<p><b>Monitoring current transformer</b>                  For detecting frame short-circuits on the heatsealing band.                  Used as an alternative to the standard PEX-W2 current transformer.</p>

## 5.2 Modifications (MODs)

Modifications are not available for the RES-401.

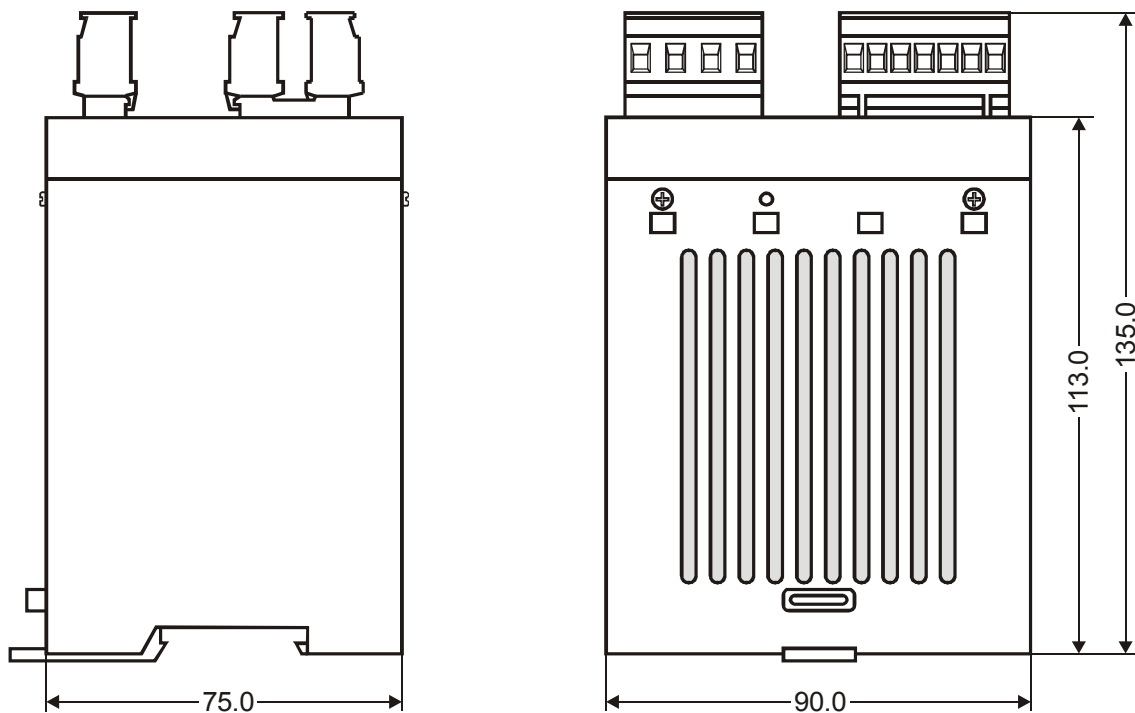
## 6 Technical data

<b>Type of construction</b>	Housing for installation in the electrical cabinet Snaps onto a standard top hat rail (DIN TS35 rail, 35 mm) acc. to DIN EN 50022 Dimensions: 90 x 75mm; height: 135mm (incl. terminals)
<b>Line voltage</b>	<p><u>All controllers manufactured as of October 2005:</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)</p> <p><u>All controllers manufactured as of January 2004 up to September 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)</p> <p><u>All controllers manufactured up to December 2003:</u> 115VAC, 230VAC or 400VAC, tolerance: +10% / -15%</p> <p>depending on version selected (↘ section 12 "How to order" on page 25)</p>
<b>Line frequency</b>	47...63Hz, automatic adjustment to frequencies in this range
<b>Heatsealing band type and temperature range</b>	Temperature coefficient 1100ppm, 0...300°C (e.g. Alloy-A20)
<b>Set point selection</b> Terminals 16+17	With an external PD-3 precision potentiometer (R = 2kΩ) 0...2kΩ, equivalent to 0...300°C
<b>Analog output</b> (actual value) Terminals 14+15	0...10VDC, I <sub>max</sub> = 5mA Equivalent to 0...300°C Accuracy: ±1% add. 50mV
<b>Digital logic levels</b> Terminals 8, 12, 13	LOW (0V): 0...2VDC HIGH (24VDC): 12...30VDC (max. current input 6mA) Reverse polarity-protected
<b>Maximum load</b> (primary current of impulse transformer)	I <sub>max</sub> = 5A (duty cycle = 100%) I <sub>max</sub> = 25A (duty cycle = 20%)
<b>Power dissipation</b>	max. 20W
<b>Ambient temperature</b>	+5...+45°C
<b>Degree of protection</b>	IP20




<p><b>Installation</b></p>	<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>	
<p><b>Weight</b></p>	<p>Approx. 0.7kg (incl. connector plug-in parts)</p>	
<p><b>Housing material</b></p>	<p>Plastic, polycarbonate, UL-90-V0</p>	
<p><b>Connecting cables</b> Type / cross-sections</p>	<p>Rigid or flexible; 0.2...2.5mm<sup>2</sup> (AWG 24...12) Plug-in</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>	

## 7 Dimensions



## 8 Installation

↪ See also section 1 "Safety and warning notes" 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.**


### 8.1 Installation procedure

Proceed as follows to install the RESISTRON temperature controller RES-401:

1. Switch off the line voltage and verify that the circuit is de-energized.
2. The supply voltage specified on the nameplate of the RESISTRON 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 RESISTRON temperature

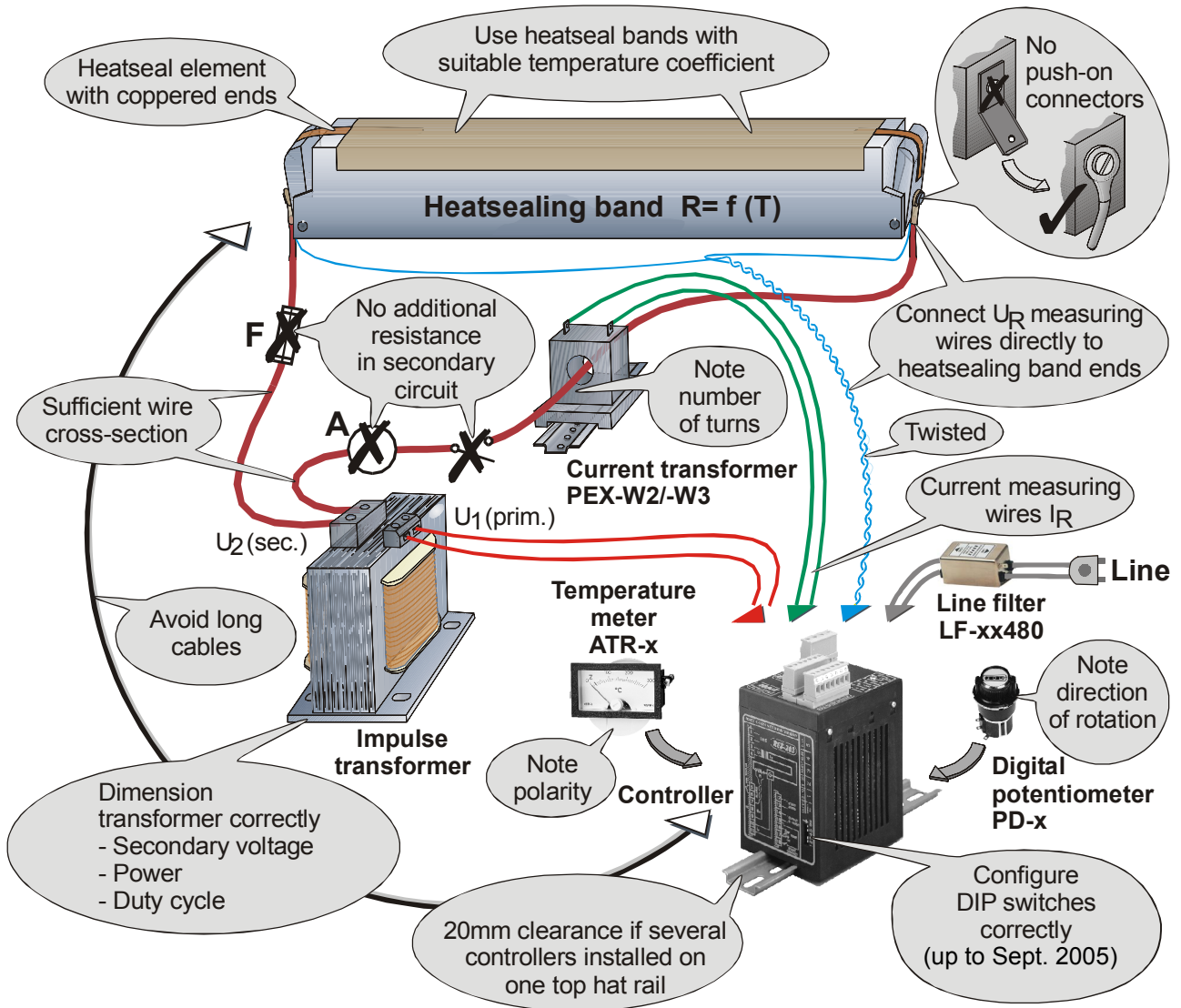
controller in the range from 47Hz...63Hz.

3. Install the RESISTRON 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 6 "Technical data" on page 8 must be allowed between them.
4. Wire the system in accordance with the instructions in section 8.3 "Power supply" on page 12, section 8.6 "Wiring diagram" on page 14 and the ROPEX Application Report. The information provided in section 8.2 "Installation steps" on page 11 must also be heeded additionally.

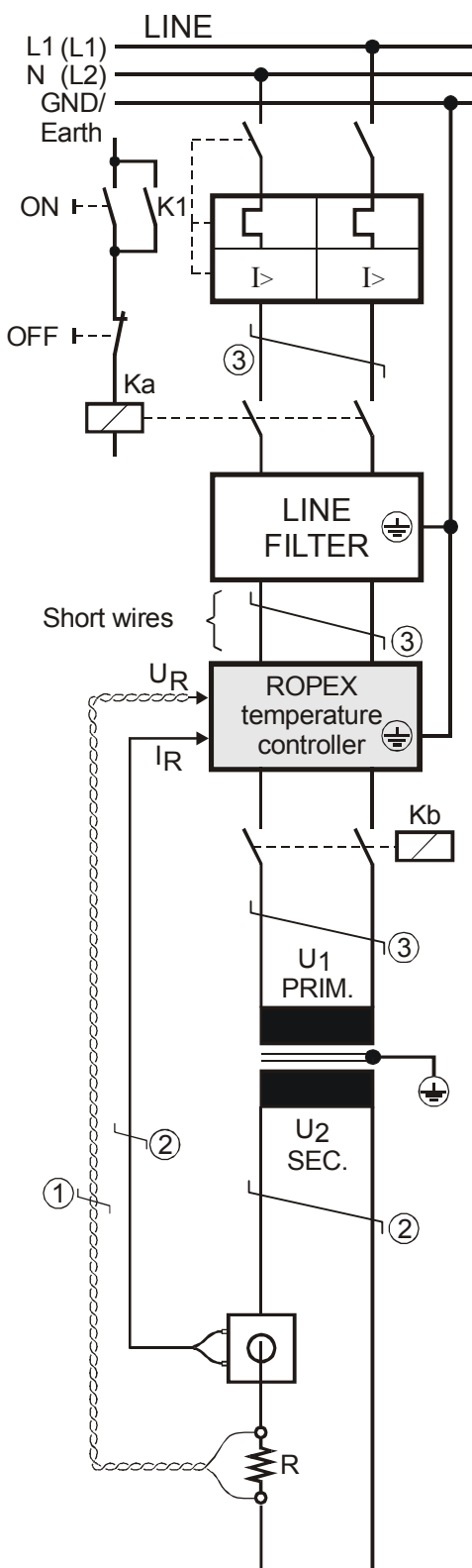
 **Check the tightness of all the system connections, including the terminals for the impulse transformer windings.**

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

## 8.2 Installation steps



## 8.3 Power supply



### Line

115VAC, 230VAC, 400VAC

### Circuit breaker

Double-pole, Z characteristic

Rated current: 16A, e.g. ABB-STOTZ, Type S282-Z16 (for all applications)

⚠ 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 belonging to the 4xx Series.

### Relay Kb

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

### Impulse Transformer

Designed according to VDE 0570/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).

Guide values:

Primary circuit: min. 1.5mm<sup>2</sup>, max. 2.5mm<sup>2</sup>

Secondary circuit: min. 4.0mm<sup>2</sup>, max. 25mm<sup>2</sup>

① These wires must always be twisted (>20/m)

② These wires must be twisted (>20/m) if several control loops are laid together ("crosstalk").

③ Twisting (>20/m) is recommended to improve EMC.

### 8.4 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.**

installed and wired correctly, they guarantee compliance with the EMC limit values.

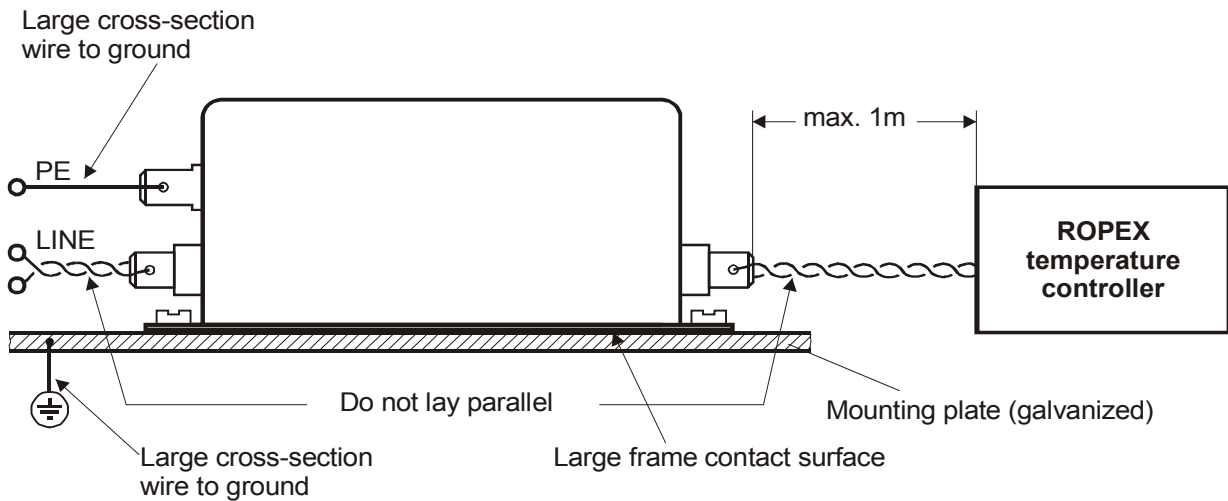
You can find the exact specification of the line filter in the ROPEX Application Report calculated for your particular heatsealing application.

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.**

ROPEX line filters are specially optimized for use in RESISTRON control loops. Providing that they are

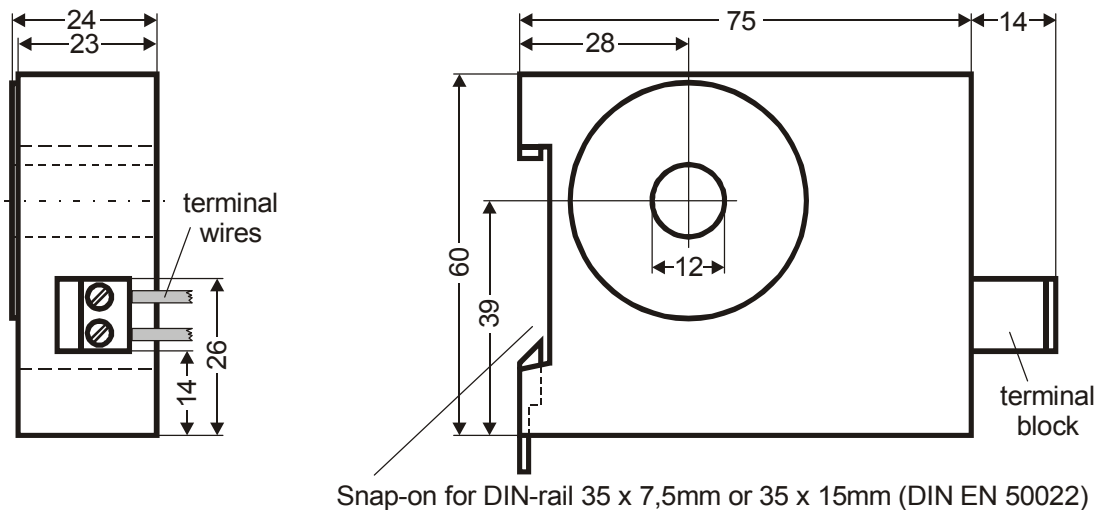
The wiring instructions contained in section 8.3 "Power supply" on page 12 must be observed.



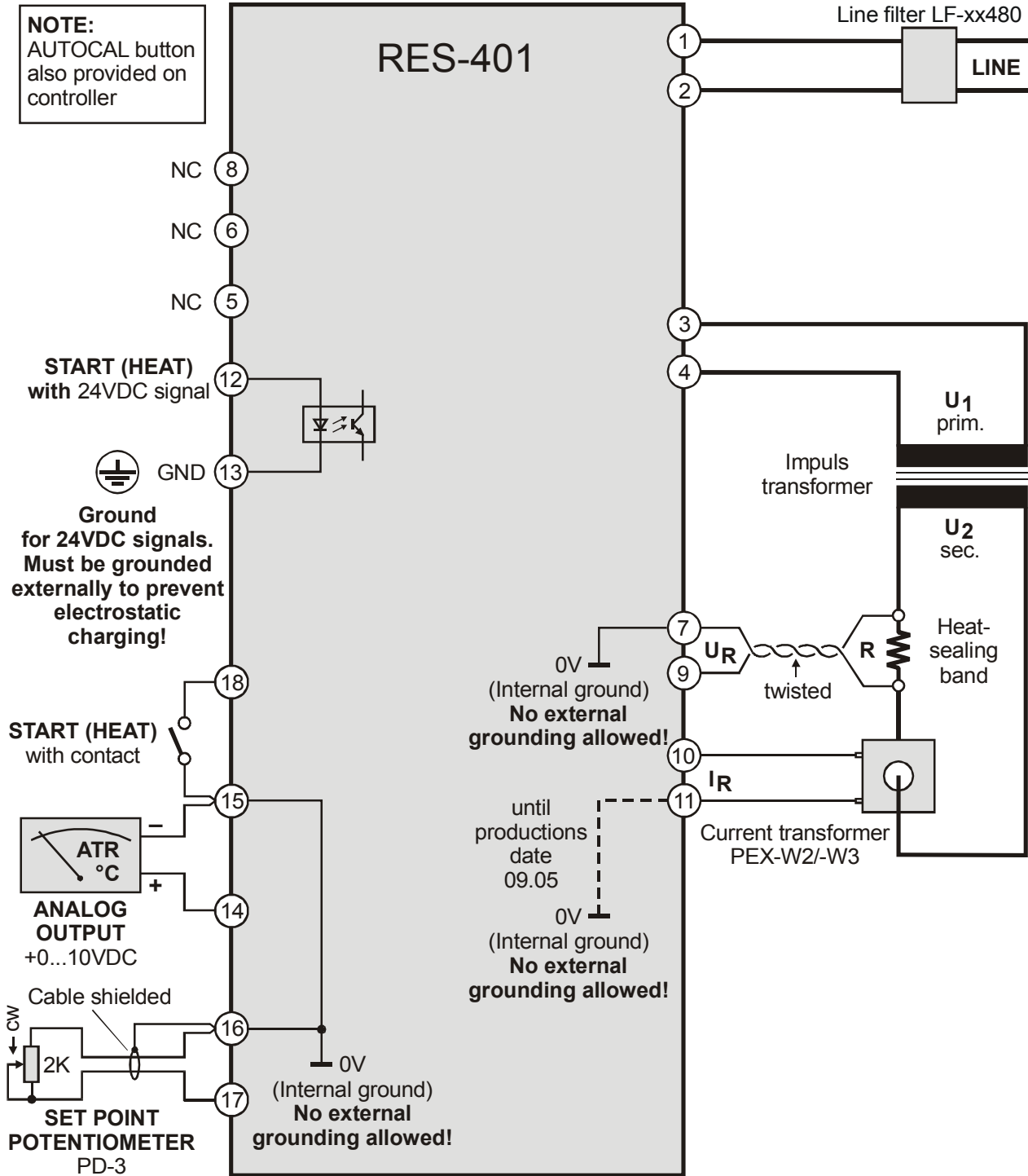
### 8.5 Current transformer PEX-W3

The PEX-W3 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 8.3 "Power supply" on page 12).

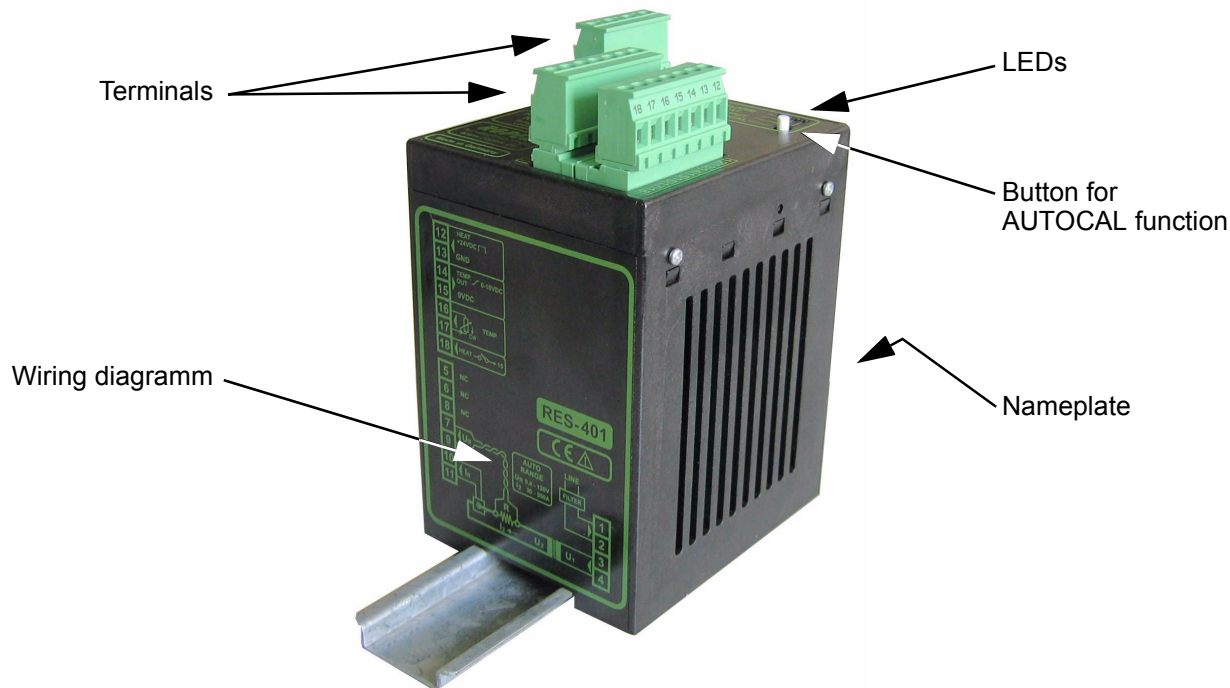


## 8.6 Wiring diagram



**8.7 Startup and operation**

**8.8 View of the controller**



**8.9 Controller configuration**

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

**8.9.1 Configuration of the DIP switches for secondary voltage and current**

**Automatic configuration (AUTORANGE) (as of October 2005)**

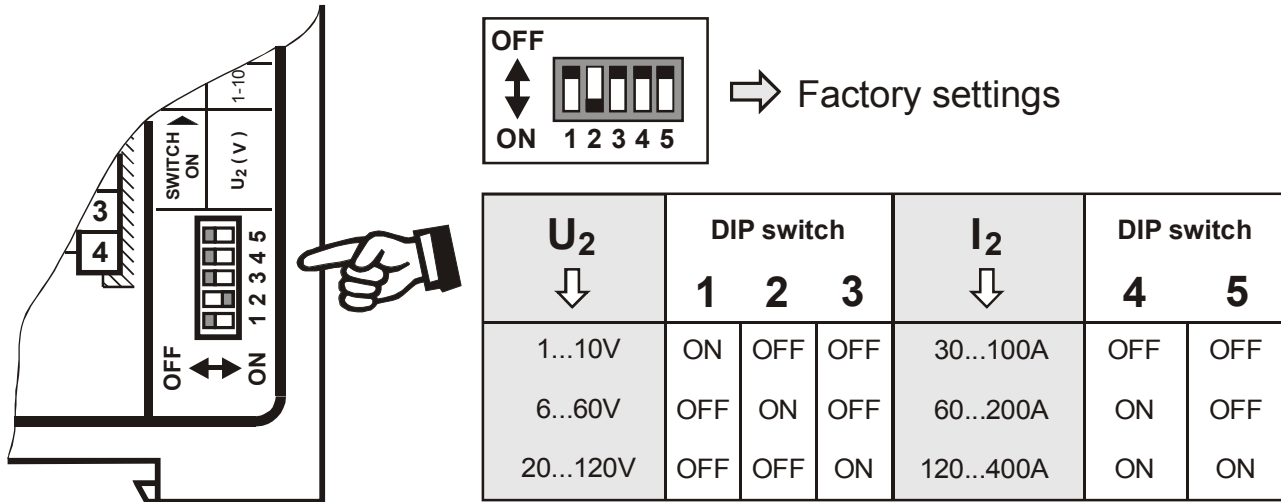
The secondary voltage and current ranges are automatically configured by the automatic calibration function (AUTOCAL). The voltage is configured in the range from 0.4VAC to 120VAC and the current in the

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 9.8 "Error messages" on page 24).

**Configuration with coding switches (up to September 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 PEX-W2 or PEX-W3 current transformer must have two turns (↪ ROPEX Application Report).



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

### 8.10.1 "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

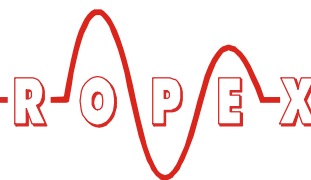
resistance of the heatsealing band is reduced by approximately 2...3%. However, this at first glance slight resistance change results in a zero point error of 20...30°C. The zero point must therefore be corrected after a few heating cycles, i.e. the AUTOCAL function must be repeated.

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.





### 8.10.2 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.

### 8.11 Startup procedure

Please also refer to section 1 "Safety and warning notes" on page 3 and section 2 "Application" on page 4.

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

#### 8.11.1 Initial startup

Prerequisites: The controller must be correctly installed and connected (↪ section 8 "Installation" on page 10). Proceed as follows to start up the controller for the first time:

1. Switch off the line voltage and verify that all circuits are de-energized.
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...63Hz.
3. In the case of controllers manufactured up to September 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 8.9 "Controller configuration" on page 15).
4. Make sure that no START signal is activated.
5. Switch on the line voltage.
6. 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 (up to September 2005: Twin-color LED lights up for 0.3s).

**! 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 9.6 "Diagnostic interface/ visualization software (as of October 2005)" on page 24). In order to avoid malfunctions, please check the controller configuration before continuing the startup procedure.**

7. One of the following states then appears:  
As of October 2005:

"ALARM" LED	"OUTPUT" LED	ACTION
OFF	Short pulses every 1.2s	Go to 8
BLINKS fast (4Hz)	OFF	Go to 8
Lit Continuously	OFF	Fault diagnosis (↪ sec. 9.8)

Up to September 2005:

LED	ACTION
Short pulses every 1.2s	Go to 8
BLINKS fast (4Hz) RED	Go to 8
Lit continuously RED	Fault, check controller configuration and installation (↪ sec. 9.7)

8. Activate the AUTOCAL function while the heatsealing band is still cold (with the manual button on the controller). The yellow "AUTOCAL" LED lights up (up to September 2005: Twin-color LED blinks red and green alternately) the duration of the calibration process (approx. 10...15s). A voltage of app. 0VDC appears at the same time at the actual value output (terminals 14+15). If an ATR-3 is connected, it indicates 0...3°C.  
 When the zero point has been calibrated, the "AUTOCAL" LED goes out (up to September 2005: The twin-color LED flashes green every 1.2s then) and a voltage of 0.66VDC 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 (1Hz) (up to September 2005: Twin-color LED blinks red slowly). In this case the controller configuration is incorrect (↪ section 8.9 "Controller configuration" on page 15 and ROPEX Application Report). Repeat the calibration after the controller has been configured correctly.

9. When the zero point has been calibrated successfully, set a defined temperature on the set point potentiometer and activate the "START" signal (HEAT). The "HEAT" LED then lights up (up to September 2005: the twin-color LED "HEAT" 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) has a harmonious motion, in other words it must not jump abruptly, fluctuate or deviate temporarily in the wrong direction. This kind of beha-


avior would indicate that the  $U_R$  measuring wires have been wired incorrectly.

10. Burn in the heatsealing band (↪ section 8.10 "Replacing and "burning in" the heatsealing band" on page 16) and repeat the AUTOCAL function.

**The controller is now ready**

### 8.11.2 Restart after replacing the heatsealing band

To replace the heatsealing band, proceed as described in section 8.10 "Replacing and "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.**

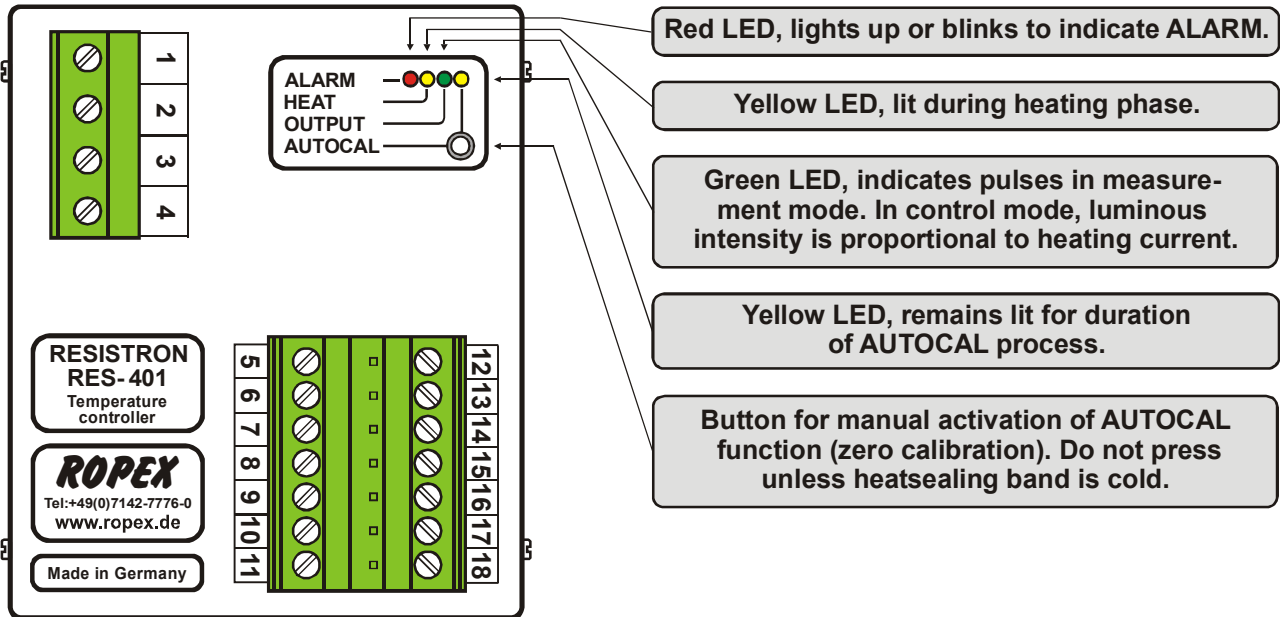
Continue with section 8.11.1 steps 4 to 10.

## 9 Controller functions

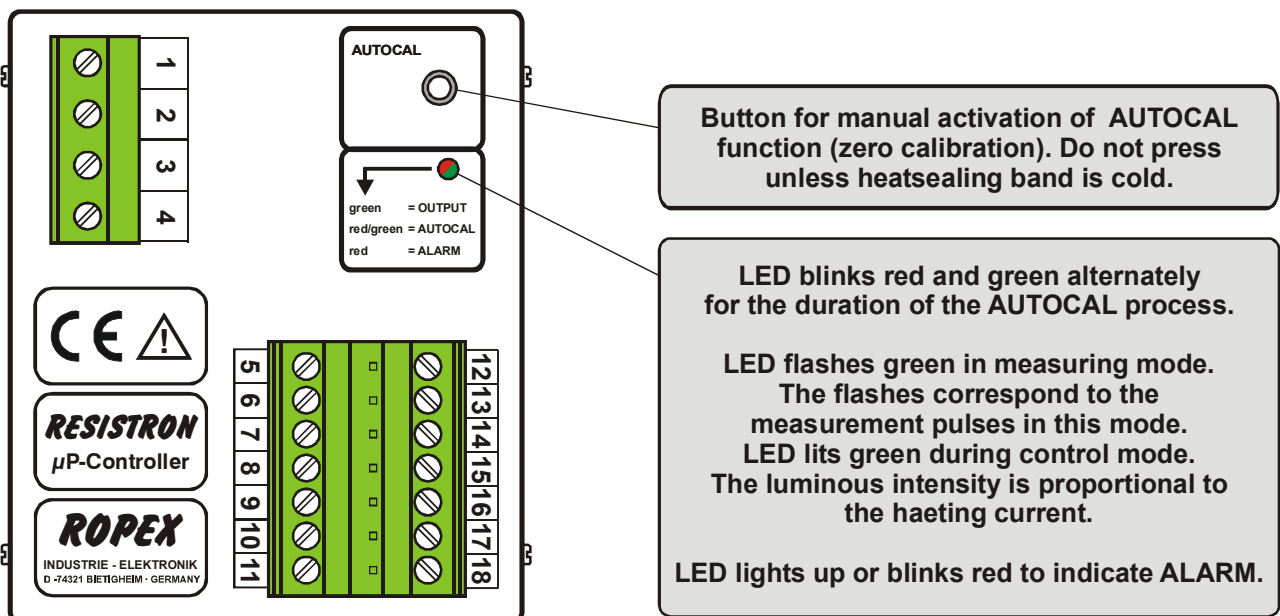
See also section 8.6 "Wiring diagram" on page 14.

### 9.1 Indicators and controls

Manufactured as of October 2005



Manufactured up to September 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:

As of October 2005:

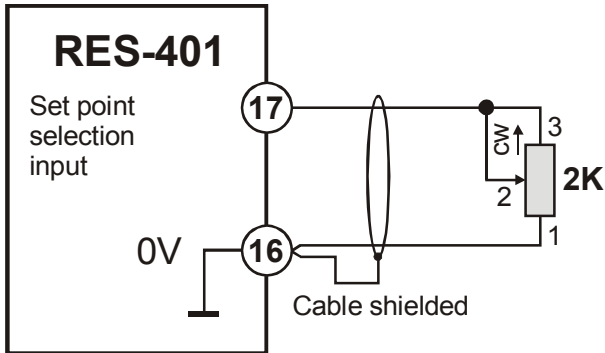
LED	Blinks slowly (1Hz)	Blinks fast (4Hz)	Lit continuously
<b>AUTOCAL</b> (yellow)	RESET active, START and AUTOCAL functions are locked	AUTOCAL requested, but function disabled	AUTOCAL executing
<b>HEAT</b> (yellow)	—	START requested, but function disabled	START executing
<b>OUTPUT</b> (green)	In control 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 9.8

Up to September 2005:

LED	Meaning	Function
<b>Blinks/lits green</b>	In control mode the luminous intensity is proportional to the heating current.	Measure/Control mode
<b>Blinks red/green alternately</b>	AUTOCAL executing	AUTOCAL
<b>Lit red for 1s</b>	AUTOCAL requested, but function disabled	
<b>Blinks red slowly (1Hz)</b>	Configuration error, AUTOCAL not possible	ALARM
<b>Blinks red fast (4Hz)</b>	Controller calibrated incorrectly, run AUTOCAL	
<b>Lit red continuously</b>	Fault, check controller configuration and installation	

## 9.2 Temperature setting (set point selection)

The heatsealing temperature is set by means of a 2kΩ potentiometer at terminals 16+17. The connecting wires between the controller and the potentiometer must be shielded (↪ section 8.6 "Wiring diagram" on page 14).



**PD-3**  
Potentiometer P03  
with  
digital dial KD



Setting range:  
 $0\Omega \rightarrow 0^\circ\text{C}$   
 $2\text{k}\Omega \rightarrow 300^\circ\text{C}$

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

**!** The terminals 16+17 are not potential-free and might have the potential of the secondary voltage of the impulse transformer. For the terminals of the external potentiometer touch voltage protection must be installed. External grounding is not allowed. If this warning is ignored, the controller will be damaged by frame currents.

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

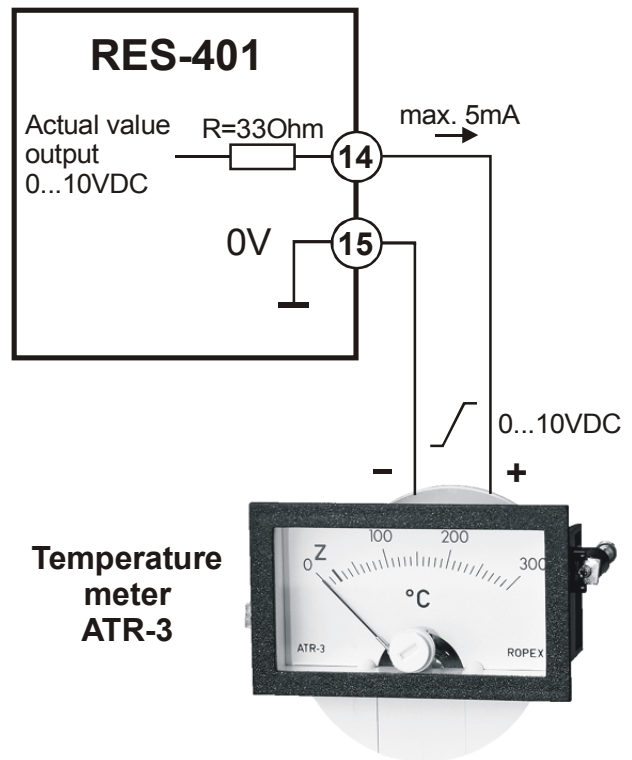
number which appears on the display corresponds to the SET temperature in °C.

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, the set point is assumed to be zero. When you connect the potentiometer, please note the direction of rotation!

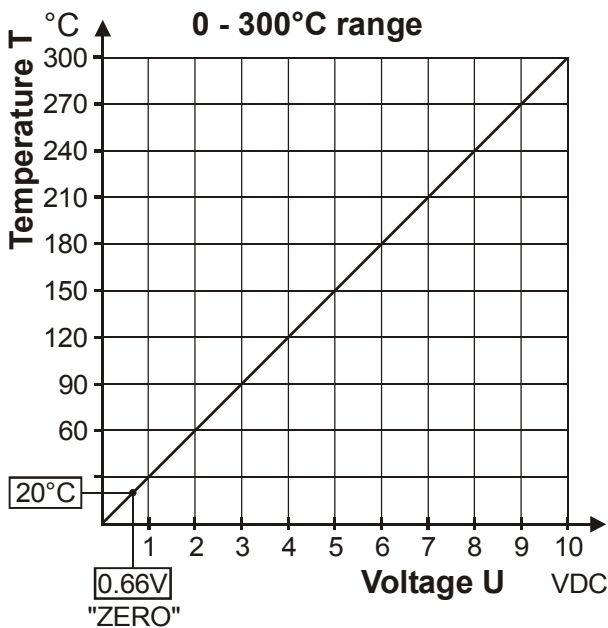
## 9.3 Temperature indication (actual value output)

The RES-401 supplies an analog 0...10VDC signal, which is proportional to the real ACTUAL temperature, at terminals 14+15.



Voltage values:  
 $0\text{VDC} \rightarrow 0^\circ\text{C}$   
 $10\text{VDC} \rightarrow 300^\circ\text{C}$

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 heat-sealing band.

The characteristics of the ROPEX ATR-3 temperature indicator (size, scaling, dynamic response) are ideally suited to this application and this instrument should therefore always be used (↪ section 5 "Accessories and modifications" on page 6).

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 indicator 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.

**⚠ This output is not potential-free and might have the potential of the secondary voltage of the impulse transformer. External grounding is not allowed. If this warning is ignored, the controller will be damaged by frame currents. For the terminals of the external temperature meter touch voltage protection must be installed.**

If an alarm is signaled, the voltage at the analog output at terminals 14+15 changes between 0VDC and 10VDC with 1Hz.

## 9.4 Automatic zero calibration (AUTOCAL)

Because of 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 resistance of the system and calibrates it to a value of 20°C.

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



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

The yellow LED on the front panel lights up when the AUTOCAL function is active (up to September 2005: Twin-color LED blinks red/green alternately). The actual value output (terminals 14+15) is 0...3°C (corresponds to app. 0VDC) during this process.

If the temperature of the heatsealing band varies on controllers manufactured as of October 2005, the "AUTOCAL" function is executed a maximum of three times. If the function still cannot be terminated successfully, an error message appears (↪ section 9.8 "Error messages" on page 24).

**⚠ 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 10 seconds after the controller is switched on. If you attempt to activate it sooner, it will not function.
2. The AUTOCAL function is not activated if the heatsealing band is cooling down at a rate of more than 0.1K/sec. If the control signal is activated, the function is activated 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 (as of October 2005: "HEAT" LED lit).

4. 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 (up to September 2005: If the twin-color LED lit continuously).

**!** If the AUTOCAL function is disabled and if you attempt to activate it then the "AUTOCAL" LED blinks (up to September 2005: The twin-color LED lits red for 1s (except case 4)).

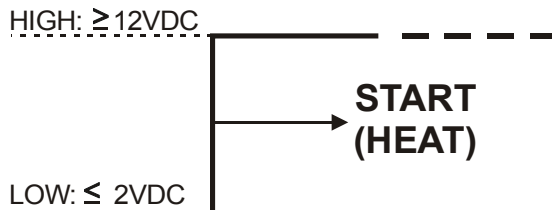
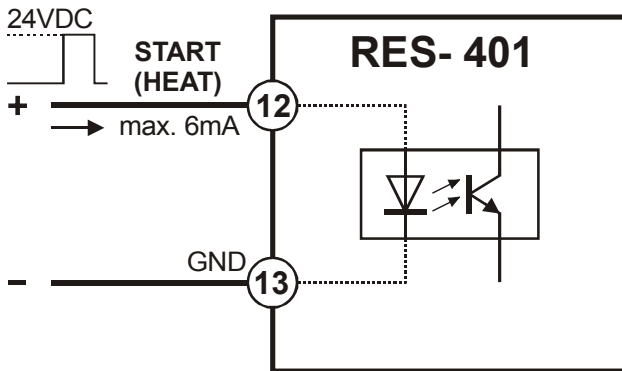
### 9.5 "START" signal (HEAT)

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

As of October 2005: The "HEAT" LED on the front panel of the RES-401 is lit continuously for the duration of the heating phase.

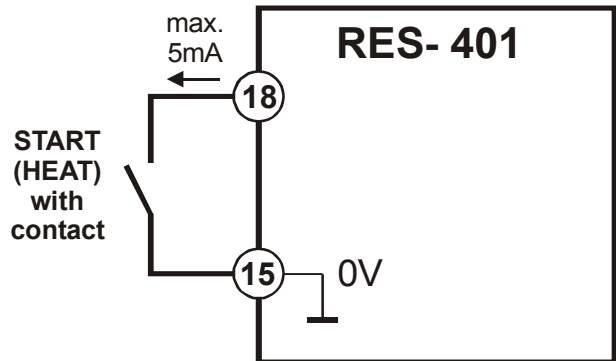
The "START" signal can be activated in two ways:

- By means of a 24VDC signal at terminals 12+13



or

- By means of a control contact at terminals 15+18



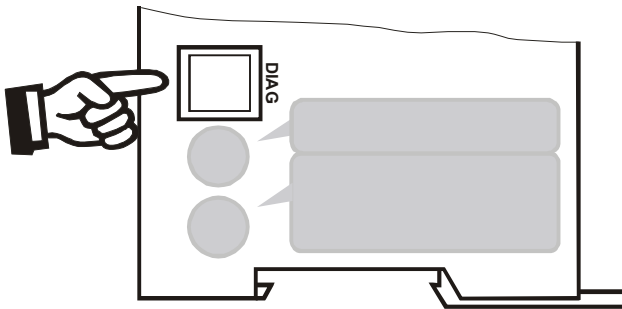
**!** The "START" signal is disabled as long as the AUTOCAL function is executing (As of October 2005: "AUTOCAL" LED lit, "HEAT" LED blinks).

**!** The terminals 15+18 are not potential-free and might have the potential of the secondary voltage of the impulse transformer. For the terminals of the control contact touch voltage protection must be installed. External grounding is not allowed. If this warning is ignored, the controller will be damaged by frame currents.

The set point that is selected for the heatsealing temperature must be greater than 40°C. If not, the heat-sealing band will not be heated up (as of October 2005: "HEAT" LED blinks).

### 9.6 Diagnostic interface/visualization software (as of October 2005)

An interface with a 6-pole Western socket 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.

### 9.7 System monitoring/alarm output

To increase operating safety and to avoid faulty heat-sealing, this controller incorporates special hardware and software features that facilitate selective fault detection and 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 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:**  
This indicates that a fault is preventing the controller from being started.  
As a rule, it refers to an external wiring fault.

**!** An alarm can only be reset by switching the controller off and then on again.

### 9.8 Error messages

The RESISTRON temperature controller RES-401 indicates faults only by means of the LED. No additional error indication is available.

## 10 Factory settings

The RESISTRON temperature controller RES-401 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 September 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 October 2005.</p>
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## 11 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.

## 12 How to order

	<p><b>Contr. RES - 401 / . . . VAC</b></p> <ul style="list-style-type: none"> <li>↳ <b>115:</b> Power supply 115VAC, Art. No. 740101</li> <li>↳ <b>230:</b> Power supply 230VAC, Art. No. 740102</li> <li>↳ <b>400:</b> Power supply 400VAC, Art. No. 740103</li> </ul> <p>Scope of supply: Controller includes connector plug-in parts (without current transformer)</p> <p>Please indicate the article numbers in all orders.</p>
	<p><b>Current transformer PEX-W3</b> Art. No. 885105</p>
	<p><b>Line filter LF- . . . 480</b></p> <ul style="list-style-type: none"> <li>↳ <b>06:</b> Continuous current 6A, 480VAC, Art. No. 885500</li> <li>↳ <b>35:</b> Continuous current 35A, 480VAC, Art. No. 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> Art. No. 885650</p>
	<p><b>Potentiometer PD- 3:</b> For 300°C range, Art. No. 881103 Scope of supply: Potentiometer with digital dial</p>
	<p><b>Temp. meter ATR- 3:</b> 300°C range, Art. No. 882130</p>

For more accessories: ↪ "Accessories" leaflet

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