RESISTRON

RES-415 GB

Operating Instructions

Important features

- Microprocessor technology
- LC display (green), 4 lines, 20 characters
  Alternatively:
  VF display (blue), 4 lines, 20 characters
- Automatic zero calibration (AUTOCAL)
- Automatic optimization (AUTOTUNE)
- Automatic configuration of the secondary voltage and current ranges (AUTORANGE, as of software revision 100)
- Automatic frequency adjustment
- Large current and voltage range
- Booster connection as standard
- Reduced menu structure
- Alarm for „Temperature not OK“
- Alarm function with fault diagnosis

12.1.09

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Contents

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:

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

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 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.

The use of RESISTRON temperature controllers results in:

- Repeatable quality 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

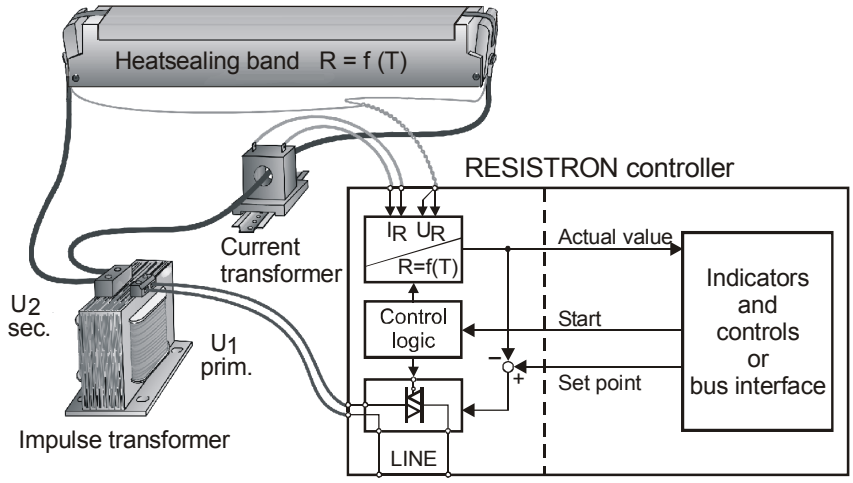
3 Principle of operation

The resistance of the heatsealing band, which is temperature-sensitive, is monitored 50x per second (60x at 60 Hz) 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 high secondary current can be controlled with only minimal power loss 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 with one another.

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-415 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 software revision 100) 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 to 63Hz.
- Increased protection against dangerous conditions, such as overheating of the heatsealing band.

The process data is represented on an LC display with 4 lines and 20 characters. Devices with a VF display are available as an option.
The real heatsealing band temperature is visualized on the display both as a digital number in °C and in the form of a dynamic bar.
The RESISTRON temperature controller RES-415 also features an integrated fault diagnosis function, which tests both the external system (heatsealing band, wiring etc.) and the internal electronics and outputs a selective error message in case of a fault.
To increase operational safety and interference immunity, all 24VDC logic signals are electrically isolated from the controller and the heating circuit.
The RESISTRON temperature controller RES-415 is designed for installation in a front panel cutout. The compact design and the plug-in connections make this controller easy to install.

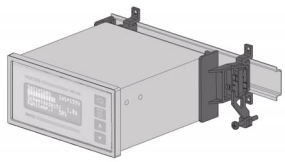
5 Accessories and modifications

A wide range of compatible accessories and peripheral devices are available for the RESISTRON temperature controller RES-415. 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).

	**Line filter LF-xx480** Essential in order to ensure CE conformity. Optimized for the RESISTRON temperature controller.
	**Impulse transformer ITR-x** 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).

	**Communication interface CI-USB-1** 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.
	**Monitoringcurrent transformer** For detecting frame short-circuits on the heatsealing band. Used as an alternative to the standard PEX-W2/-W3 current transformer.
	**Transparent front cover TFA-1** For increasing the degree of protection on the front of the controller to IP65. Also facilitates applications in the food technology sector (GMP).
	**Adapter for top hat rail mounting, HS-Adapter-01** For mounting the RESISTRON temperature controller RES-415 on a top hat rail (DIN TS35). Allows the controller to be installed in the electrical cabinet, for instance, where it is only accessible to authorized persons.
	**Lockable door TUER-S/K-1** Transparent door (with lock) for mounting on the bezel of the controller. The display is clearly legible at all times. The keyboard can only be operated, however, by authorized persons in possession of a key.
	**Measurement cable UML-1** Twisted measurement cable for the U_R voltage measurement. Trailing cable, halogen and silicone-free.

5.2 Modifications (MODs)

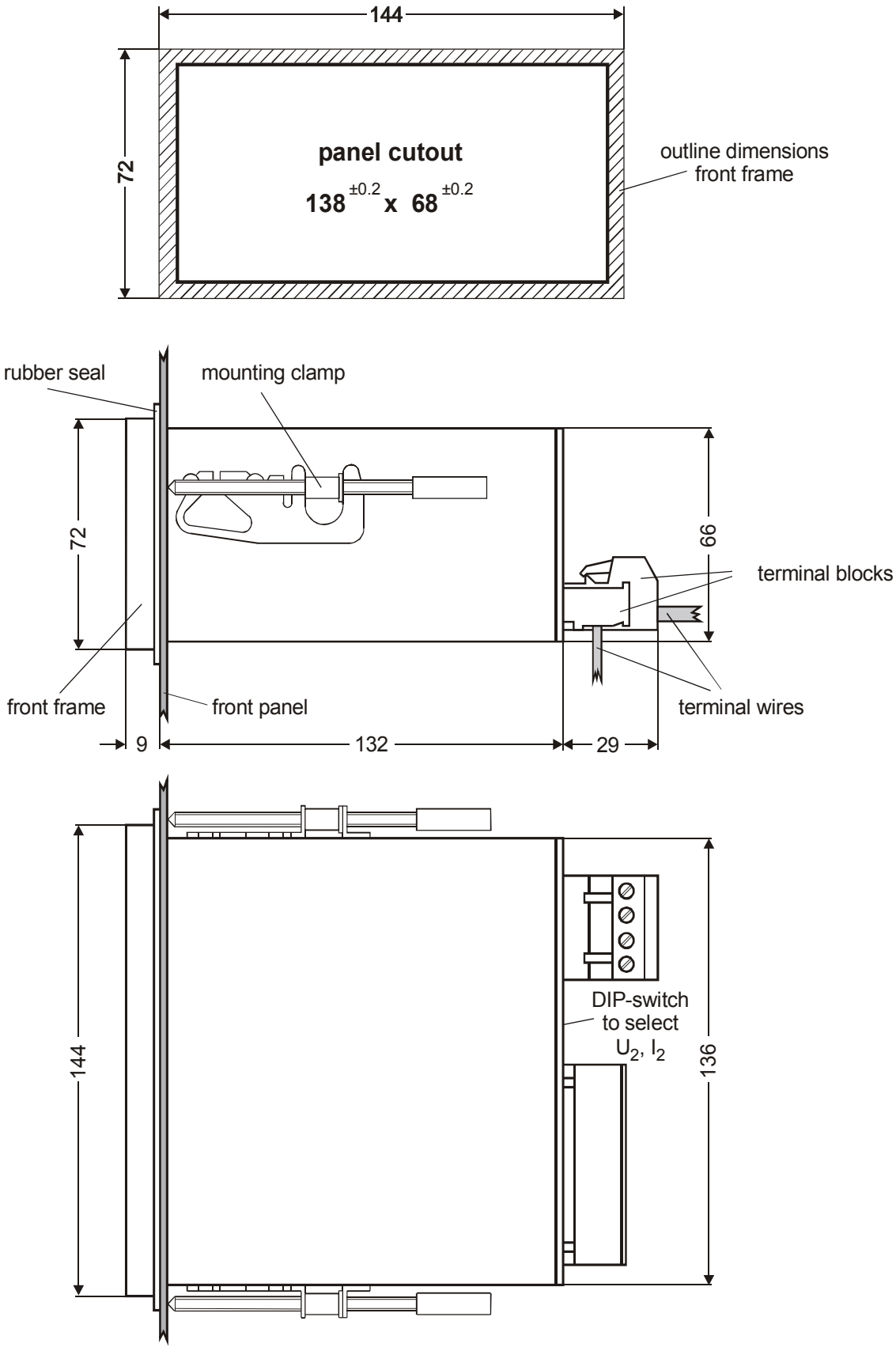
Modifications are not available for the RESISTRON temperature controller RES-415.

6 Technical data

Type of construction	Housing for front panel mounting Dimensions (W x H): 144 x 72 mm; depth: 161 mm (incl. terminals)
Line voltage	<u>All controller manufactured as of February 2006</u> <u>(as of software revision 100):</u> 115 VAC version: 110 VAC -15 %…120 VAC +10 % (equivalent to 94…132 VAC) 230 VAC version: 220 VAC -15 %…240 VAC +10 % (equivalent to 187…264 VAC) 400 VAC version: 380 VAC -15 %…415 VAC +10 % (equivalent to 323…456 VAC) <u>All controllers manufactured as of January 2004 up to January 2006</u> <u>(up to software revision 027):</u> 115 VAC version: 115 VAC -15 %…120 VAC +10 % (equivalent to 98…132 VAC) 230 VAC version: 230 VAC -15 %…240 VAC +10 % (equivalent to 196…264 VAC) 400 VAC version: 400 VAC -15 %…415 VAC +10 % (equivalent to 340…456 VAC) <u>All controllers manufactured up to December 2003:</u> 115 VAC, 230 VAC or 400 VAC, tolerance: +10 % / -15 % depending on device version (↳ Kap. 13 „How to order“ auf Seite 34)
Line frequency	47…63 Hz, automatic adjustment to frequencies in this range
Heatsealing band type and temperature range	<u>As of software revision 100:</u> The temperature range and temperature coefficient settings can be specified in the ROPEX visualization software (↳ section 10.10 "Diagnostic interface/visualization software (as of software revision 100)" on page 26): Temperature range: 200 °C, 300 °C, 400 °C or 500 °C Temperature coefficient: 400…4000 ppm (variable setting range) Factory setting: Temperature range: 0…300 °C Temperature coefficient: 1100 ppm (e.g. Alloy 20)
Set point selection	Via the "UP / "DOWN" keys on the front of the controller
Digital logic levels Terminals 3, 4	LOW (0 V): 0…2 VDC HIGH (24 VDC): 12…30 VDC (max. current input 6 mA) Electrically isolated, reverse polarity-protected
START with contact Terminals 2+7	Switching threshold: 3.5 VDC, U_{max} = 5 VDC, I_{max} = 5 mA
Alarm relay Terminals 5+6	Contact, potential-free, U_{max} = 50 V (DC/AC), I_{max} = 0.2 A
Maximum load (primary current of impulse transformer)	I_{max} = 5 A (duty cycle = 100 %) I_{max} = 25 A (duty cycle = 20 %)
Power dissipation	max. 25 W
Display	LC display (green), 4 lines, 20 characters, alternatively: VF display (blue), 4 lines, 20 characters
Ambient temperature	+5…+45 °C

Degree of protection	Front: IP42 (IP65 with transparent front cover, Art. No. 887000) Back: IP20
Installation	Installed in front panel cutout with (W x H) $138^{(+-0.2)}$ x $68^{(+-0.2)}$mm Fastened with clips
Weight	Approx. 1.0kg (incl. connector plug-in parts)
Housing material	Black plastic, type Noryl SE1 GFN2
Connecting cable Type / cross-sections	Rigid or flexible; 0.2…2.5mm² (AWG 24…12) Plug-in connectors **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.**

7 Dimensions/front panel cutout



8 Installation

↳ See also Kap. 1 „Safety and warning notes“ auf Seite 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

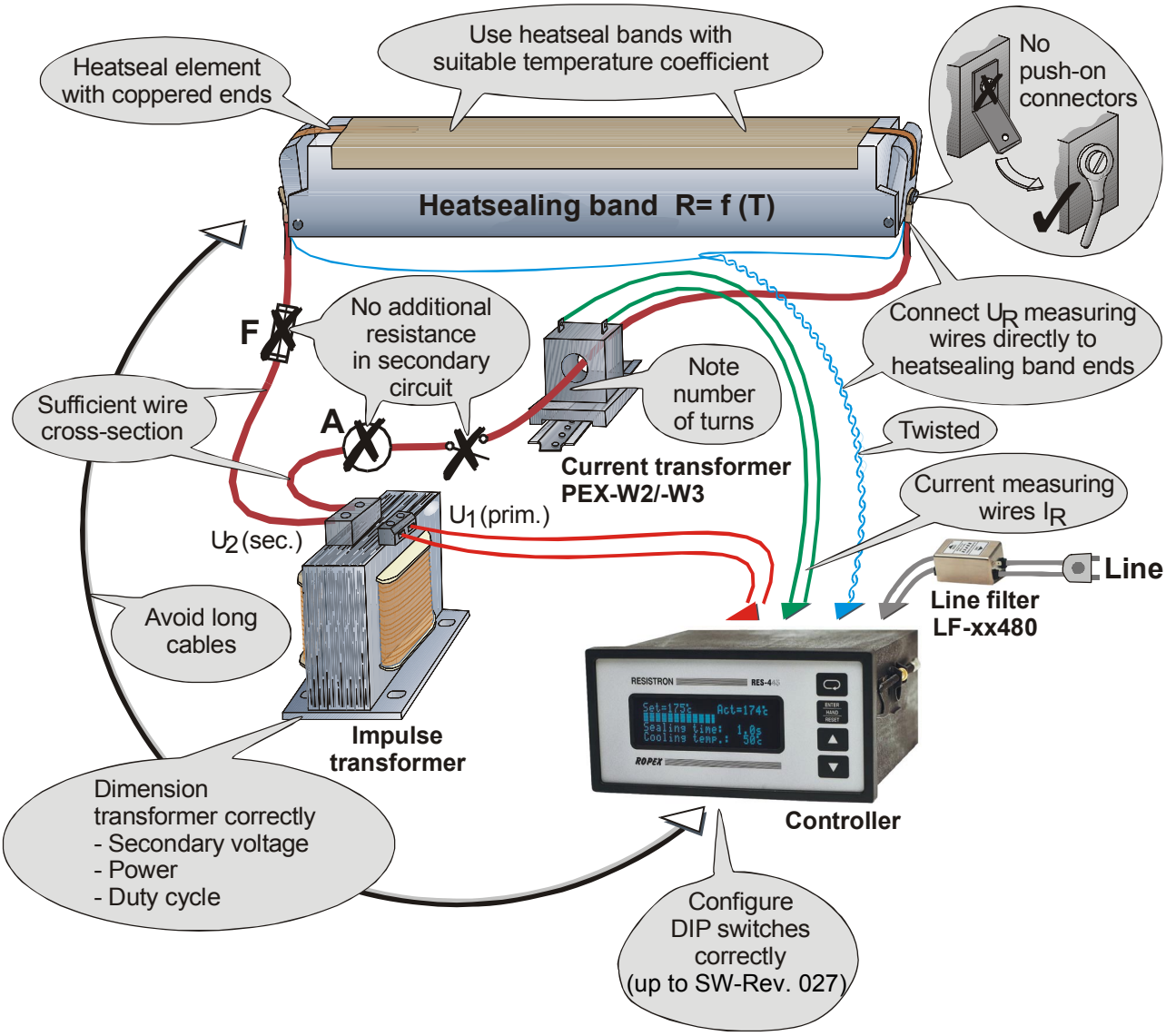
Proceed as follows to install the RESISTRON temperature controller RES-415:

1. Switch off the line voltage and verify that all circuits are deenergized.
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 temperature controller in the range from 47 Hz to 63 Hz.
3. Install the RESISTRON temperature controller in the front panel cutout. It is fastened by means of two clips which snap onto the side of the controller housing.
4. Wire the system in accordance with the instructions in Kap. 8.3 „Power supply“ auf Seite 13, Kap. 8.6 „Wiring diagram (standard)“ auf Seite 15 and the ROPEX Application Report. The information provided in Kap. 8.2 „Installation steps“ auf Seite 12 must be heeded additionally.

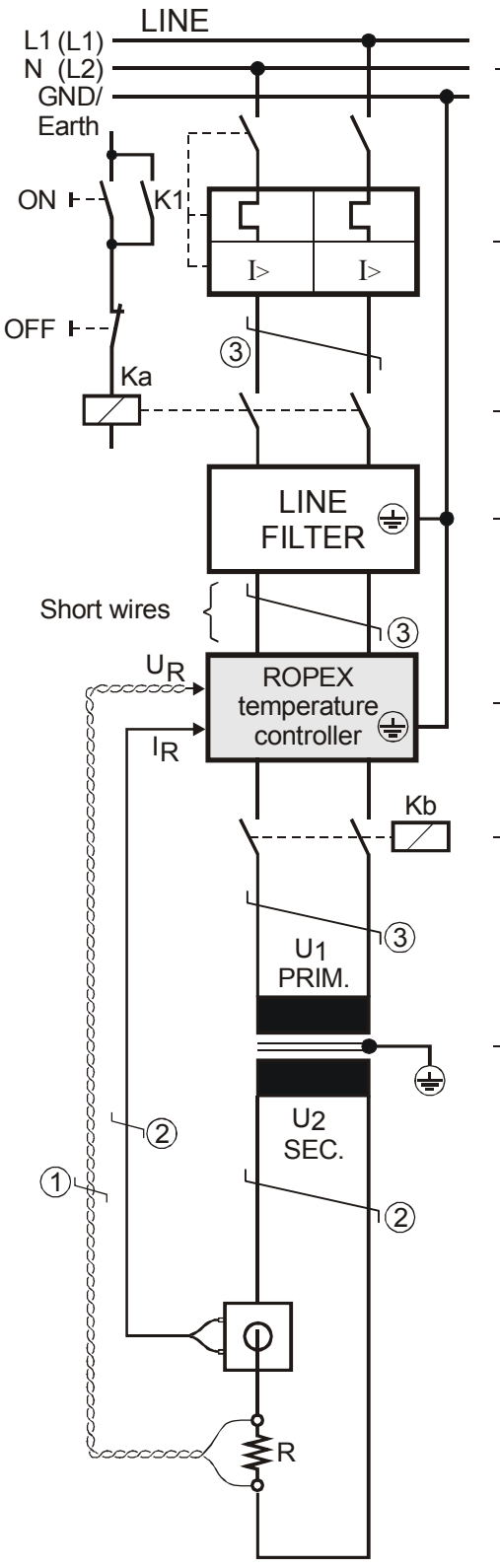
Check the tightness of all the system connections, including the terminals for the impulse transformer windings.

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

8.2 Installation steps



8.3 Power supply



Line
115 VAC, 230 VAC, 400 VAC
50/60 Hz

Circuit breaker
Double-pole, C characteristic
(↳ 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 belonging to the 4xx Series.

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

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

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. 1.5 mm², max. 2.5 mm²
Secondary circuit: min. 4.0 mm², max. 25 mm²

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

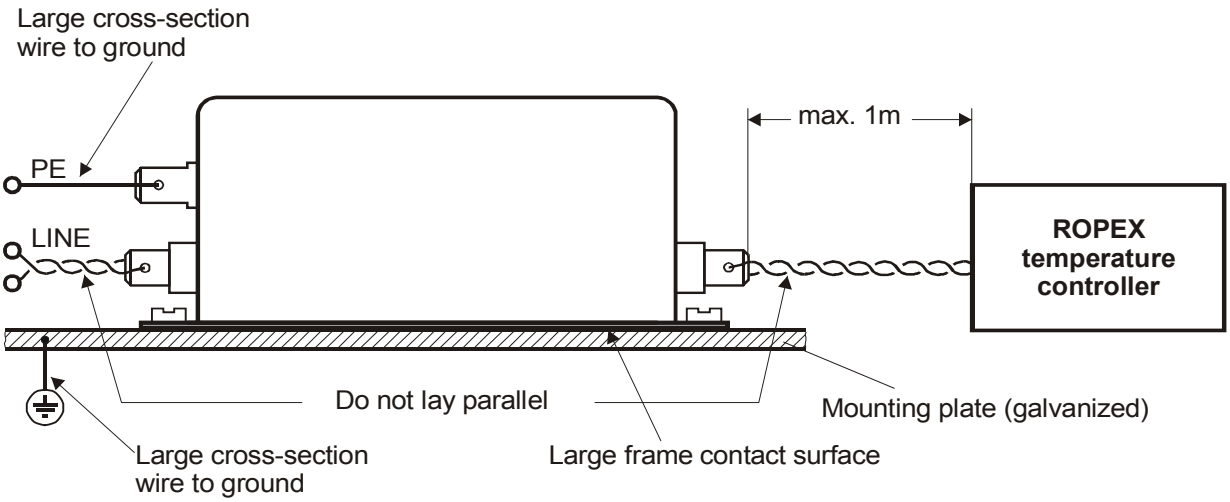
To comply with EMC directives – corresponding to EN 50081-1 and EN 50082-2 – RESISTRON control loops must be operated with line filters.
These filters damp the reaction of the phase-angle control on the line and protect the controller against line disturbances.

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

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.

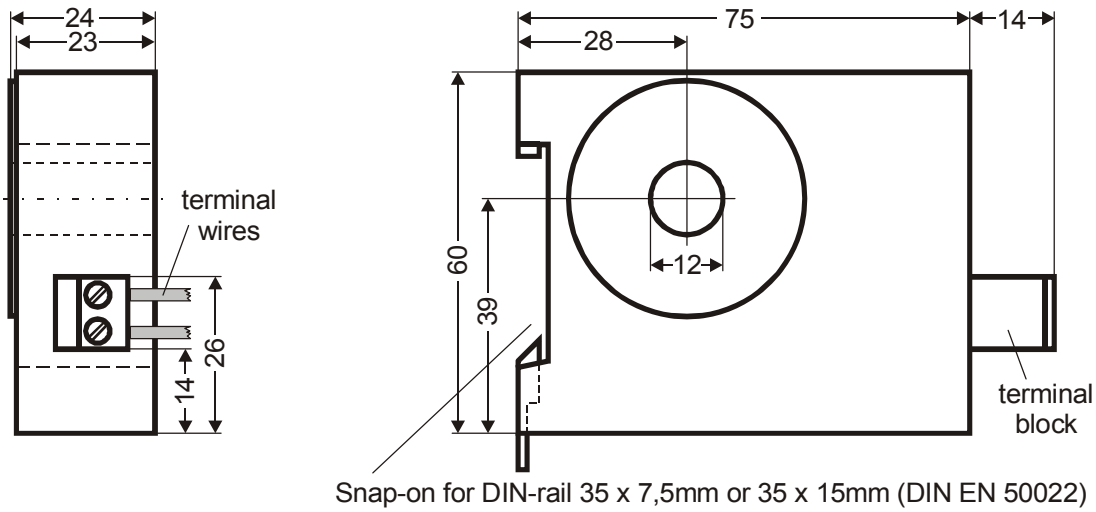
⚠ It is permissible to supply several RESISTRON control loops with a single line filter, providing the total current does not exceed the maximum current of the filter.

The wiring instructions contained in section 8.3 "Power supply" on page 13 must be observed.

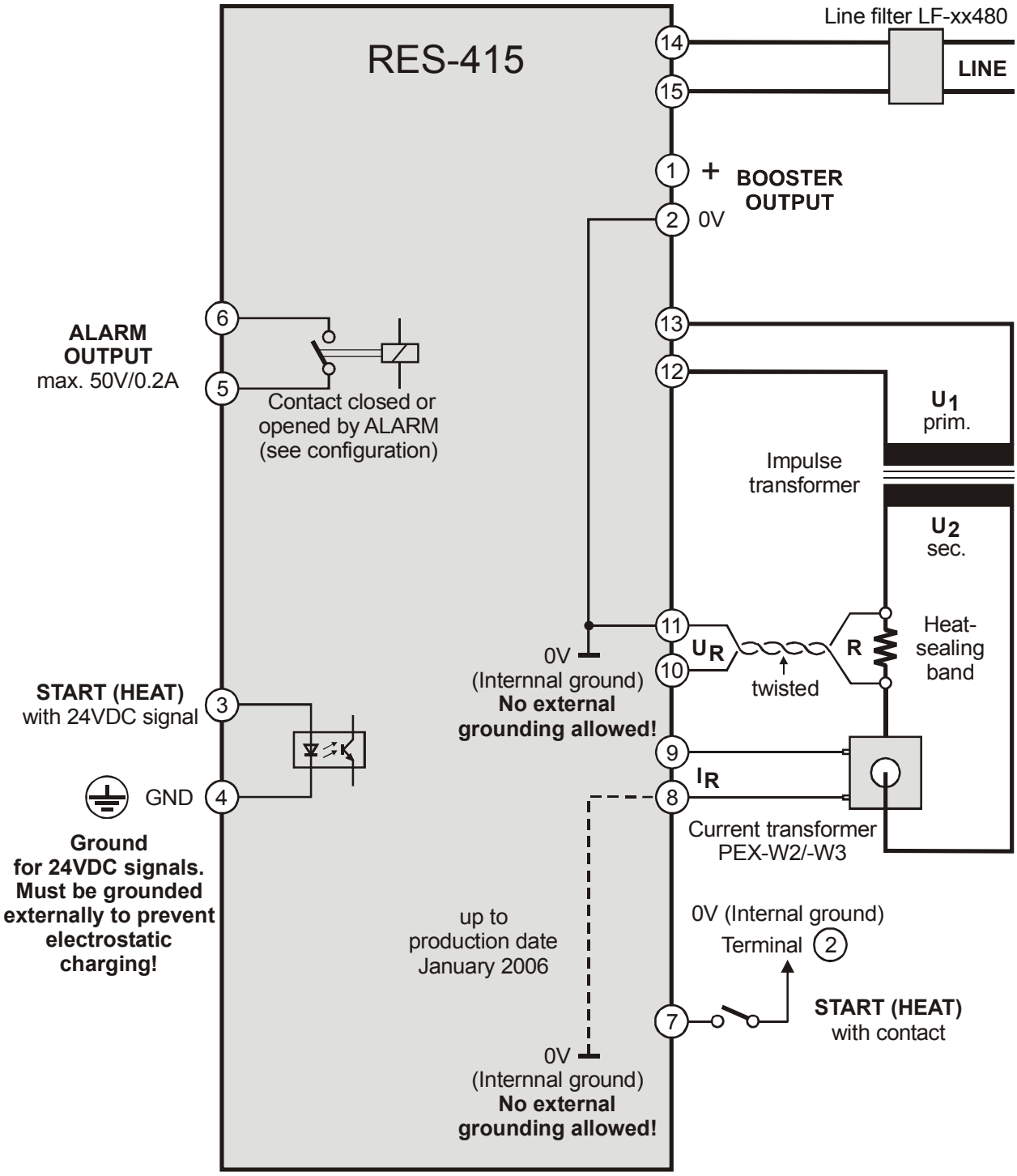


8.5 Current transformer PEX-W3

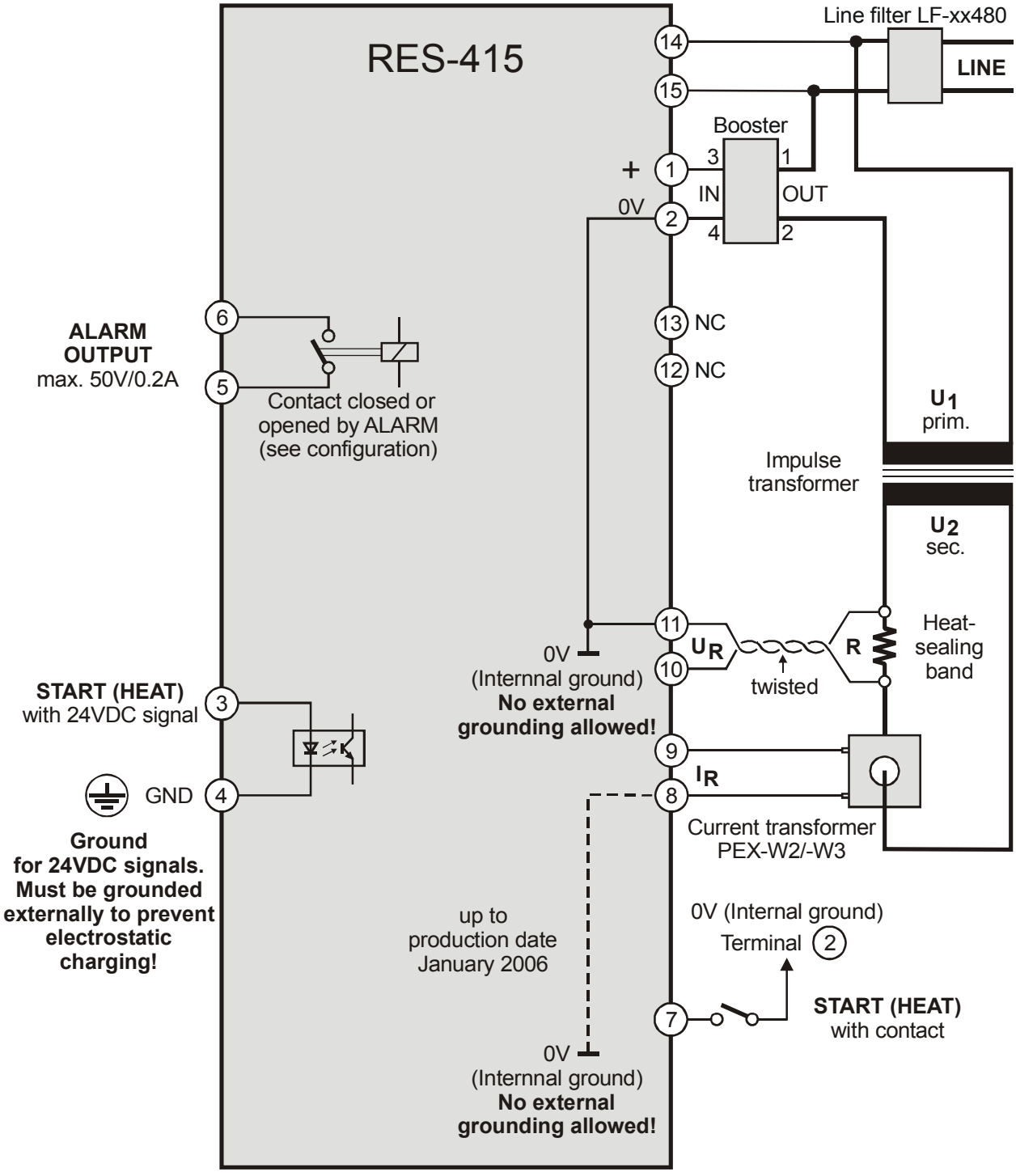
The PEX-W3 current transformer supplied with the RESISTRON temperature controller is an integral part of the control system. The current transformer may only be operated if it is connected to the temperature controller correctly (↳ section 8.3 "Power supply" on page 13).



8.6 Wiring diagram (standard)

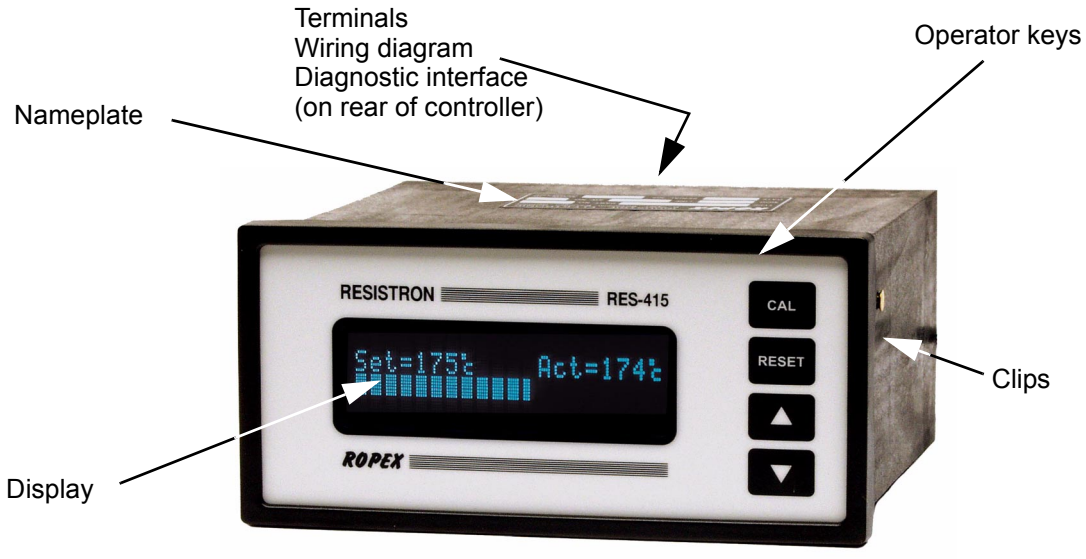


8.7 Wiring diagram with booster connection



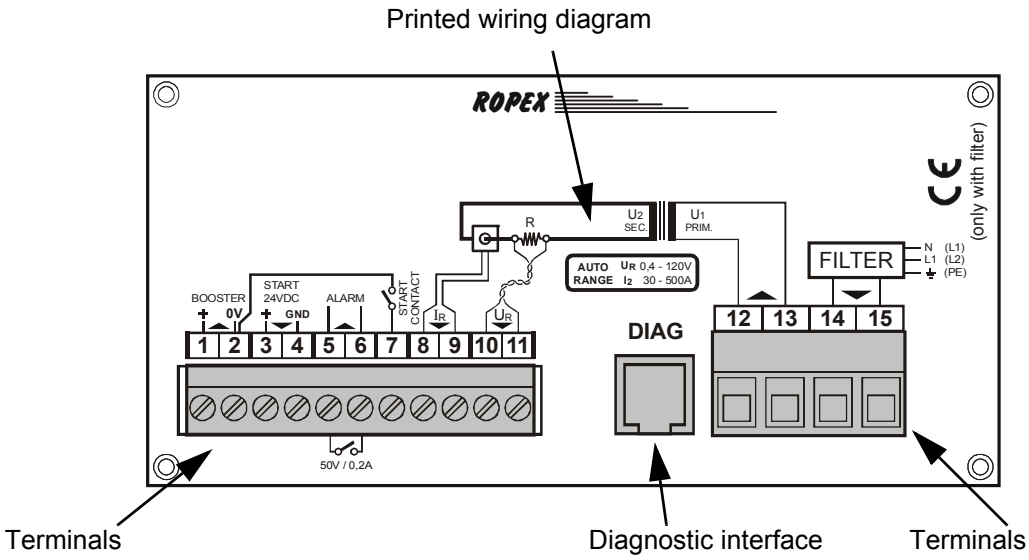
9 Startup and operation

9.1 Front view of the controller



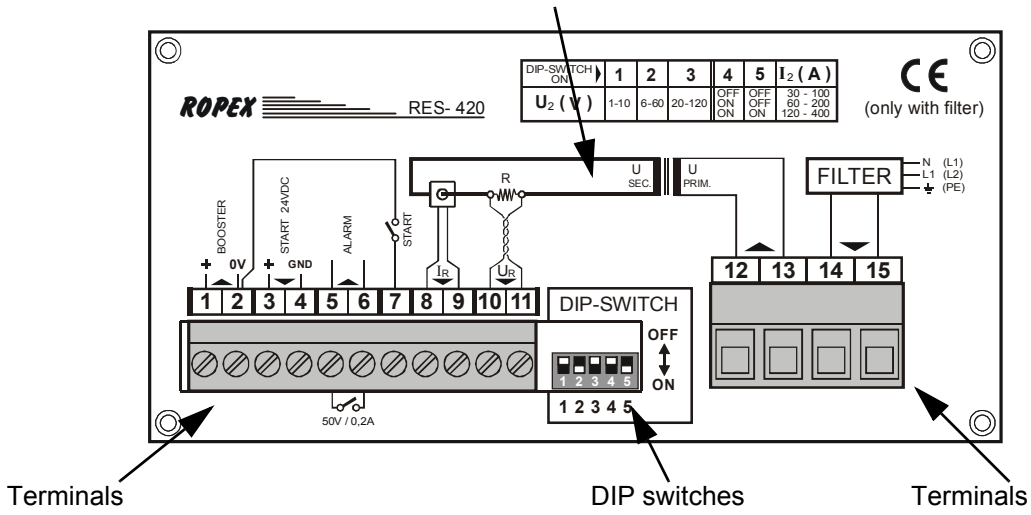
9.2 Rear view of the controller

As of software revision 100:



Up to software revision 027:

Printed wiring diagram



9.3 Controller configuration

The possible controller configurations are explained in the following sections. Proceed as described in Kap. 9.5.1 „Initial startup“ auf Seite 21 to start up the controller for the first time.

9.3.1 Configuration of the DIP switches for secondary voltage and current

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

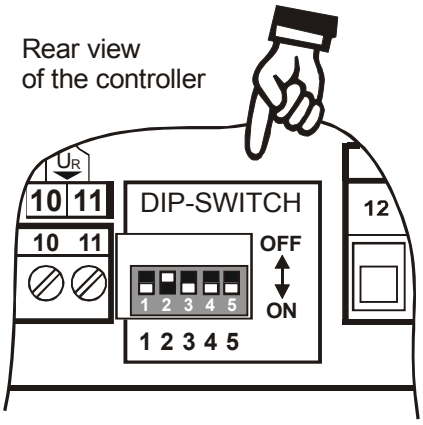
Automatic configuration (AUTORANGE)
(as of software revision 100)

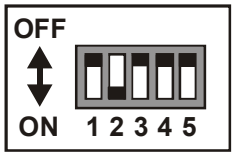
The secondary voltage and current ranges are automatically configured by the automatic calibration function (AUTOCAL). The voltage is configured in the range from 0.4VAC to 120VAC and the current in the range from 30A to 500A. If the voltage and/or the current is outside the permissible range, a detailed error message appears on the controller (s. section 10.14 "Fault areas and causes" on page 31).

Configuration with coding switches
(up to software revision 027)

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.





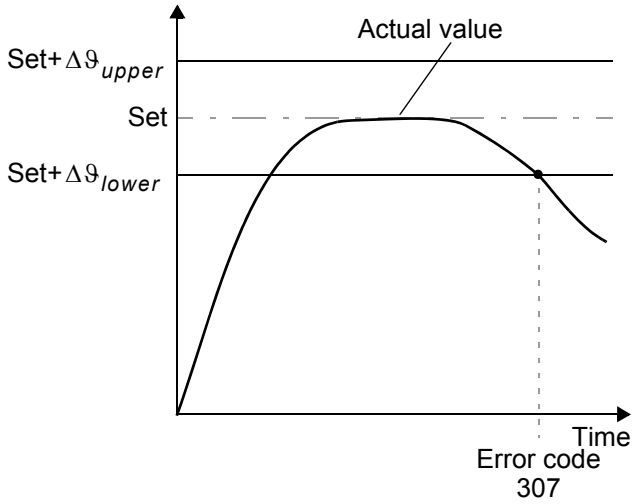
⇨ Factory settings

U_2 ⇩	DIP switch 1	2	3	I_2 ⇩	DIP switch 4	5
1...10V	ON	OFF	OFF	30...100A	OFF	OFF
6...60V	OFF	ON	OFF	60...200A	ON	OFF
20...120V	OFF	OFF	ON	120...400A	ON	ON

If the secondary current I_2 is less than 30A, the PEX-W2/W3 current transformer must have two turns (↳ ROPEX Application Report).

9.3.2 Temperature diagnosis

The RES-415 checks during the heatsealing phase whether the ACTUAL temperature is inside a specifiable tolerance band ("OK" window) on either side of the SET temperature. The lower and upper tolerance band limits are configured in the factory to$\Delta\vartheta_{lower} = -15?K$ and $\Delta\vartheta_{upper} = 10?K$. As of software revision 100, these limits can be changed independently of one another in the ROPEX visualization software (↳ section 10.10 "Diagnostic interface/visualization software (as of software revision 100)" on page 26).
If the ACTUAL temperature is inside the specified tolerance band when the "START" signal is activated, the temperature diagnosis is also activated. If the ACTUAL temperature leaves the tolerance band, the corresponding error code (307, 308) is indicated and the fault output is switched (↳ section 10.14 "Fault areas and causes" on page 31).

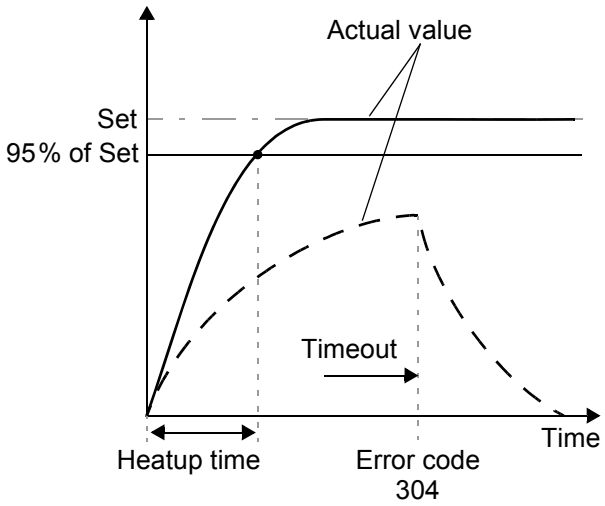


If the temperature diagnosis is not activated by the time the "START" signal is deactivated (i.e. if the ACTUAL temperature does not exceed the upper or lower tolerance band limit), the corresponding error code (309, 310) is indicated and the fault relay is switched.
As of software revision 100, an additional delay time (0..9.9s) can be set in the ROPEX visualization software. The first time the lower tolerance band limit is exceeded, the temperature diagnosis is not activated until the parameterized delay time has elapsed. The temperature diagnosis function can thus be explicitly deactivated, e.g. if the temperature drops temporarily owing to the closure of the sealing jaws.

9.3.3 Heatup timeout

This timeout is active as standard on the RES-415 (factory setting: 10.0s). As of software revision 100, the timeout can be configured in the ROPEX visualization software (↳ section 10.10 "Diagnostic interface/visualization software (as of software revision 100)" on page 26).

This timeout starts when the START signal is activated. The RES-415 then monitors the time required for the ACTUAL temperature to reach 95% of the SET temperature. If this time is longer than the parameterized time, the corresponding error code (304) is indicated and the fault relay is switched (↳ section 10.14 "Fault areas and causes" on page 31).



9.4 Heatsealing band

9.4.1 General

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, i.e. one whose resistance increases as the temperature rises.
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 (↳ chap. 9.4.2 „Burning in the heatsealing band“, page 20).
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.

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

9.4.2 Burning in the heatsealing band

If a new heatsealing band has been used, the zero point is first of all calibrated while the band is still cold by activating the "AUTOCAL" function on the controller. When the "AUTOCAL" function has finished, the controller outputs 20 °C. Adjust the set point to approximately 250 °C and activate the "START" signal to heat for approximately 1 second. After recooling, the controller usually indicates a value less than 20 °C. Repeat the "AUTOCAL" function. The heatsealing band has now been burned in and the change in the alloy properties stabilized.
The burn-in effect described here does not occur if the heatsealing band has already been thermally pretreated by the manufacturer.

9.4.3 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 must be performed for all new heatsealing bands.

9.5 Startup procedure

Please also refer to Kap. 1 „Safety and warning notes“ auf Seite 3 and Kap. 2 „Application“ auf Seite 4.

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

9.5.1 Initial startup

Prerequisites: The controller must be correctly installed and connected (↳ Kap. 8 „Installation“ auf Seite 11).
The possible settings are described in detail in chap. 9.3 „Controller configuration“, page 18 and chap. 10 „Controller functions“, page 22.
The essential controller configurations are described below:

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 63 Hz.
3. In case of controllers up to software revision 027, the setting of the DIP switches on the controller are indicated in the ROPEX Application report and depend on the heatsealing band (section 9.3 "Controller configuration" on page 18).
4. Make sure that a START signal is not present.
5. Switch on the line voltage.
6. A power-up message appears on the display for approximately 2 seconds when the controller is switched on to indicate that it has been started up correctly.

As of software revision 101:
If "+" characters appear instead of "*" characters in the corners of the top and bottom lines when the power-up message is displayed, the controller configuration has been changed in the ROPEX visualization software (↳ section 10.10 "Diagnostic interface/visualization software (as of software revision 100)" on page 26). In order to avoid malfunctions, please check the controller configuration before continuing the startup procedure.

7. One of the following states then appears:

DISPLAY	ACTION
No alarm indication	Go to 8
Error message with error codes 104…106, 111…113, 211	Go to 8
Error message with error codes 101…103, 107, 108, 201…203, 801, 9xx	Fault diagnosis (↳ 10.14)

8. Activate the AUTOCAL function while the heatsealing band is still cold. The progress of the calibration process is indicated by a counter on the display (approx. 10…15 s).
   When the zero point has been calibrated, 20 °C is indicated as the actual value.
   If the zero has not been calibrated successfully, an erro message indicates error codes 104…106, 211. In this case the controller configuration is incorrect (↳ Kap. 9.3 „Controller configuration“ auf Seite 18 and ROPEX Application Report). Repeat the zero point calibration after the controller has been configured correctly.
9. When the zero point has been calibrated successfully, specify a defined temperature (heatsealing temperature) by means of the "UP" and "DOWN" keys and activate the "START" signal (HEAT). The indication of the ACTUAL temperature on the display (digital value and dynamic bar) permits the heating and control process to be monitored.
   The controller is functioning correctly if the temperature indicated on the display has a continuous 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 wire has been laid incorrectly.
   If an error code is displayed, please proceed as described in section 10.14 "Fault areas and causes" on page 31.
10. Burn in the heatsealing band (↳ Kap. 9.4 „Heatsealing band“ auf Seite 20) and repeat the AUTOCAL function.

The controller is now ready

9.5.2 Restart after replacing the heatsealing band

To replace the heatsealing band, proceed as described in Kap. 9.4 „Heatsealing band“ auf Seite 20.

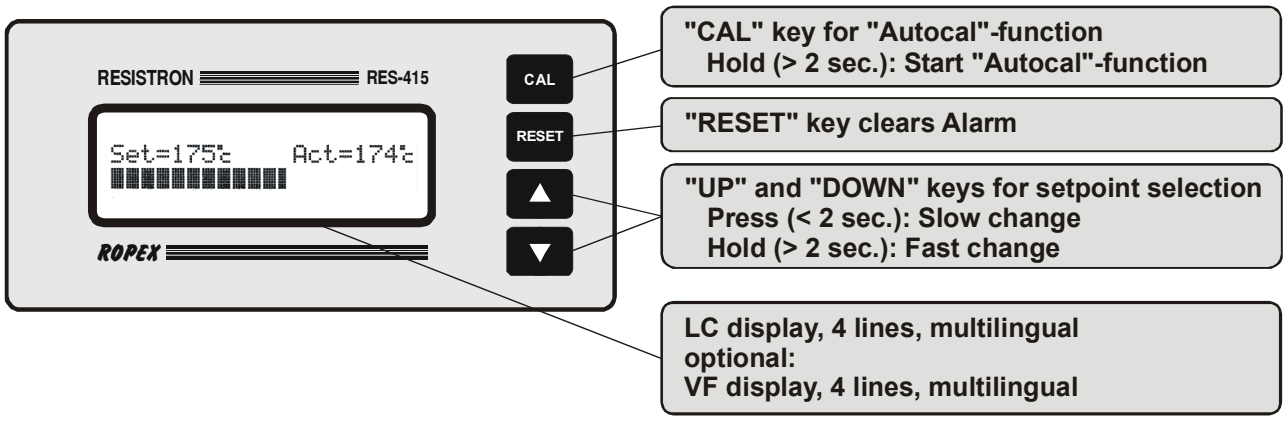
Always use a heatsealing band with the correct alloy, dimensions and copper-plating in order to avoid malfunctions and overheating.

Continue with section 9.5.1, steps 8 and 9.

10 Controller functions

See also Kap. 8.6 „Wiring diagram (standard)“ auf Seite 15.

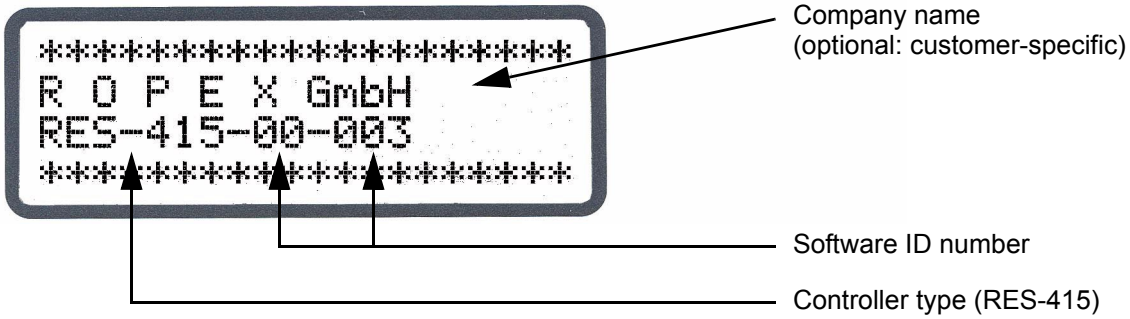
10.1 Indicators and controls



10.2 Display

10.2.1 Power-up message

A power-up message appears on the display for approximately 2 seconds when the controller is switched on.

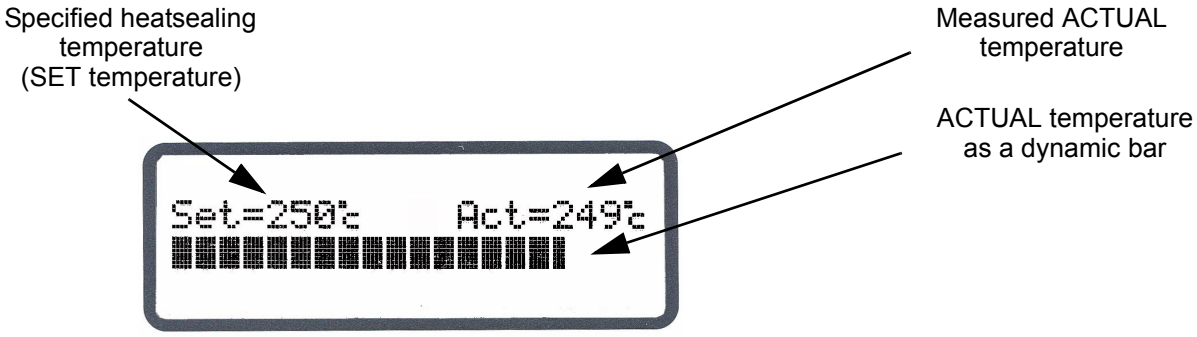


This message also includes details of the software version.

As of software revision 101:
If "+" characters appear instead of "*" characters in the corners of the top and bottom lines when the power-up message is displayed, the controller configuration has been changed in the ROPEX visualization software (↳ section 10.10 "Diagnostic interface/visualization software (as of software revision 100)" on page 26).

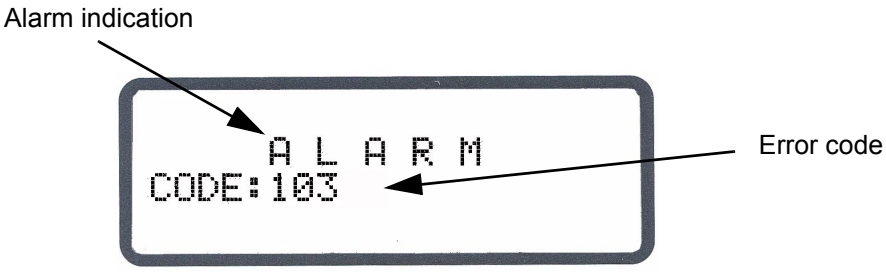
10.2.2 Display in home position

If no settings are entered on the controller and no error message are present, the display is in the home position, in other words it indicates the SET temperature as a digital value and the ACTUAL temperature as a digital value and a dynamic bar.



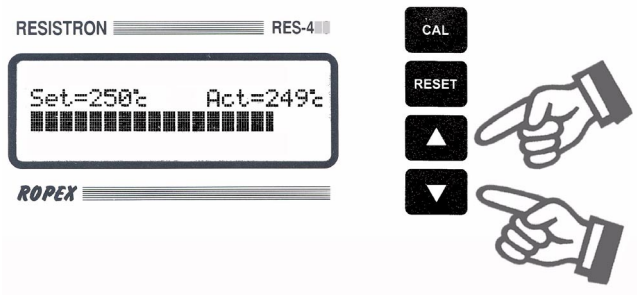
10.2.3 Error messages

The fault diagnosis function of the controller is always active. If a fault is detected, it is indicated on the display immediately in the form of an error message (↳ Kap. 10.12 „System monitoring/alarm output“ auf Seite 26).



10.3 Temperature setting (set point selection)

The heatsealing temperature can be set on the RES-415 controller by means of the "UP" and "DOWN" keys.
Changes are accepted immediately even when a heating process is active.

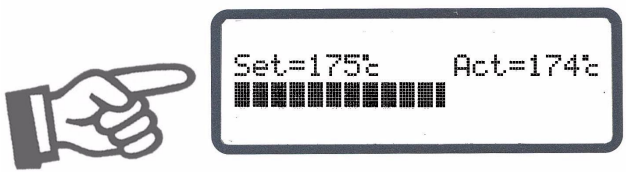


The maximum value of the setting range is limited to 300°C.

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.

10.4 Temperature indication

If the display is in the home position, the ACTUAL temperature is indicated there as a digital value and as a dynamic bar.



The heating and control process can thus be monitored at any time.

10.5 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. The "AUTOCAL" function matches the controller to the current and voltage signals that are present in the system.
This function can be activated by pressing the "CAL" key for more than 2 seconds.
The automatic calibration process takes around 10…15 seconds. The heatsealing band is not heated until the calibration process has finished.
A counter which counts down from 13 to 0 appears on the display while the "AUTOCAL" function is executing.
If the temperature of the heatsealing band varies on controllers as of software revision 100, the "AUTOCAL" function is executed a maximum of three times. If the function still cannot be terminated successfully, an error message appears (↳ section 10.14 "Fault areas and causes" on page 31).

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

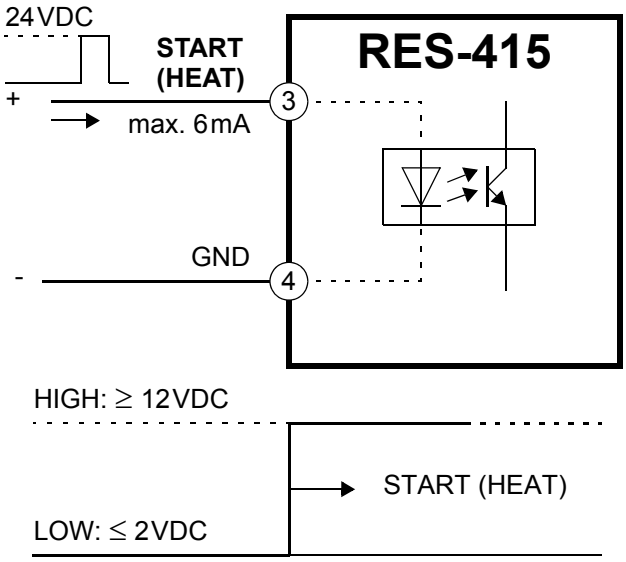
Reasons for disabled AUTOCAL function:

1. The "AUTOCAL" function cannot be activated if the heatsealing band cools down at a rate of more than 0.1K/second. If you try to activate the "AUTOCAL" function nevertheless by pressing the "CAL" key for more than 2 seconds, the display shows two flashing stars instead of the countdown.
2. If the "START" signal (24VDC or contact) is activated, the AUTOCAL function is not executed.
3. Directly after the controller is powered up, the AUTOCAL function cannot be activated if a fault with error code 101…103, 201…203, 801 or 9xx occurs (↳ section 10.14 "Fault areas and causes" on page 31). If the controller has already operated correctly - a minimum of once - after powering up, the AUTOCAL function cannot be activated with error codes 201…203, 304, 308, 801 or 9xx.

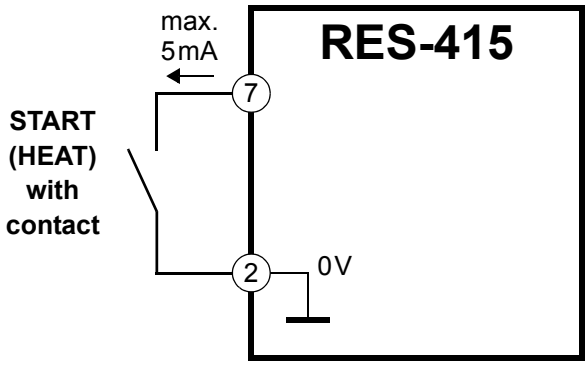
10.6 "START" signal (HEAT)

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

- By means of a 24VDC signal at terminals 3+4.



- By means of a control contact at terminals 2+7



The "START" signal is disabled as long as the AUTOCAL function is executing.

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 alarm relay is switched if the "START" signal is activated while an error message is indicating error codes 104…105, 111…113 or 211 (↳ section 10.14 "Fault areas and causes" on page 31). The heatsealing band is likewise not heated.

10.7 Measuring impulse duration (as of software revision 100)

The length of the measuring impulses generated by the controller can be set with this parameter. It may be necessary to set a measuring impulse that is longer than the default 1.7ms for certain applications (↳ ROPEX Application Report).

This parameter can only be set in the ROPEX visualization software (↳ section 10.10 "Diagnostic interface/visualization software (as of software revision 100)" on page 26).

10.8 Temperature unit Celsius / Fahrenheit (as of software revision 106)

As of software revision 106 the unit for the temperature indication and value selection can be switched between °C (Celsius) and °F (Fahrenheit).

1. **„Celsius“ (Factory setting)**
   Temperature indication and value selection in Celsius (°C).
2. **„Fahrenheit“**
   Temperature indication and value selection in Fahrenheit (°F)

Up to software revision 105 only Celsius (°C) can be specified on the controller as the temperature unit.

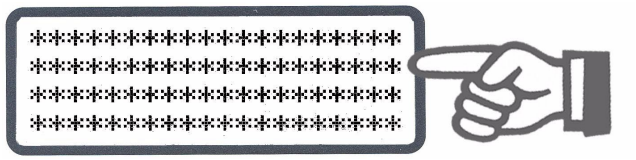
The degree unit can be changed on the controller without interrupting operation

If you specify temperature indication and value selection in Fahrenheit (°F), the controller still uses Celsius (°C) internally. Value steps are therefore possible with this function owing to the conversion from Celsius to Fahrenheit.

This parameter can only be set in the ROPEX visualization software (↳ section 10.10 "Diagnostic interface/visualization software (as of software revision 100)" on page 26).

10.9 Undervoltage detection

Trouble-free operation of the temperature controller is guaranteed within the line voltage tolerance range specified in section 6 "Technical data" on page 8.
If a line voltage which is less than the lower limit of the permissible range occurs, the controller is switched to a standby mode. No more heatsealing processes take place and no more measuring impulses are generated. The display changes to indicate this.

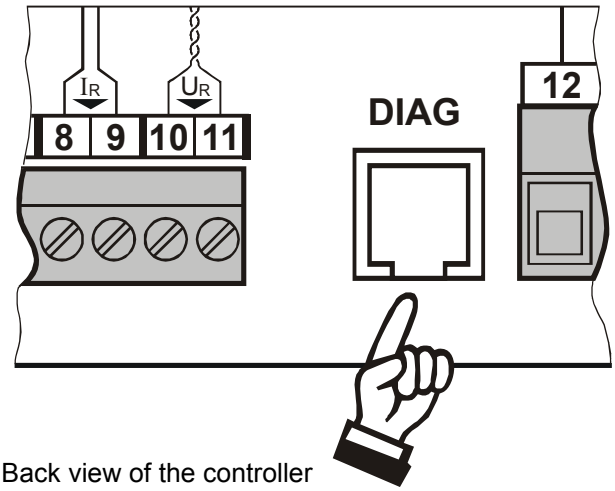


The main menu is displayed again, and operation is resumed, when the input voltage returns to the specified tolerance range.

Trouble-free operation of the controller is only guaranteed within the specified input voltage tolerance range. An external voltage monitor must be connected to prevent defective heatseals as a result of low line voltage.

10.10 Diagnostic interface/visualization software (as of software revision 100)

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.



Back view of the controller

Only a ROPEX comunication 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.

10.11 Booster connection

The RES-415 controller has a connection for an external switching amplifier (booster) as standard. This connection (at terminals 1+2) is necessary for high primary currents (continuous current > 5A, pulsed current > 25A). The switching amplifier should be connected as described in section 8.7 "Wiring diagram with booster connection" on page 16.

10.12 System monitoring/alarm output

To increase operating safety and to avoid faulty heatsealing, the controller incorporates special hardware and software features that facilitate selective fault detection and diagnosis. Both the external wiring and the internal system are monitored.

These features crucially support the system owner in localizing the cause of an abnormal operating state.
A system fault is reported or differentiated by means of the following elements.

A.) Error message on the display:

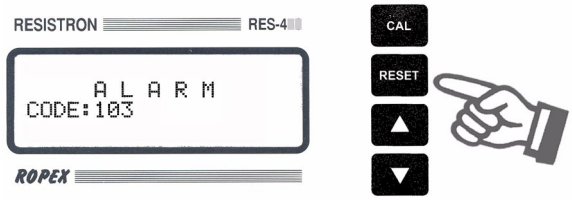
The cause of a fault can be localized quickly and easily with the help of the error code that appears on the display. Please refer to section 10.14 "Fault areas and causes" on page 31 for a list of the possible error codes.

B.) Alarm relay (relay contact, terminals 5+6):

This contact is:

- **OPEN** if error code 104…106, 111…113 or 211 is displayed. The contact closes, however, if a "START" signal is activated in this state.
- **CLOSED** if error code 101…103, 107, 108, 201…203, 304, 308, 801 or 9xx appears.

An error message can be reset by pressing the "RESET" key or by switching the controller off and then on again.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.

10.13 Error messages

The table below describes each fault and the required corrective action. The block diagram in section 10.14

"Fault areas and causes" on page 31 permits each fault to be cleared quickly and efficiently
The error codes described below can also be displayed in the ROPEX visualization software (↳ section 10.10 "Diagnostic interface/visualization software (as of software revision 100)" on page 26) to facilitate troubleshooting.

Part 1 of 3:

Error code		STATUS of alarm relay (factory set.)	Cause	Action if machine started for first time	Action if machine already operating, HS band not chang.
1	**101**	Closed	I_R signal missing	Fault area ①	Fault area ①
2	**102**		U_R signal missing	Fault area ③	Fault area ③
3	**103**		U_R and I_R signals missing	Fault area ②	Fault area ②⑨
4	**107** **108**		Temperature step, down Temperature step, up	Fault area ④⑤⑥ (loose contact)	Fault area ④⑤⑥ (loose contact)
4	**307** **308** **309** **310**		Temperature too low/high (↳ section 9.3.2)		
5	**201** **202** **203**		Frequency fluctuation, inadmissible line frequency	Check power supply	Check power supply
6	**304**		Heatup time too long (↳ section 9.3.3)	Run **RESET**	Run **RESET**
7	**901** **913** **914** **915** **916**		Int. faut, contr. defective Triac defective Int. faut, contr. defective Int. faut, contr. defective Int. faut, contr. defective	Replace controller Replace controller Replace controller Replace controller Replace controller	Replace controller Replace controller Replace controller Replace controller Replace controller
7	**917** **918**		Plug-in jumper for alarm relay wrong	Check plug-in jumper	Check plug-in jumper

Part 2 of 3:

NOTE: The specified error messages are initially output as warnings (alarm relay is open)
When the "START" signal is activated, the warning changes to a fault
(alarm relay is closed).

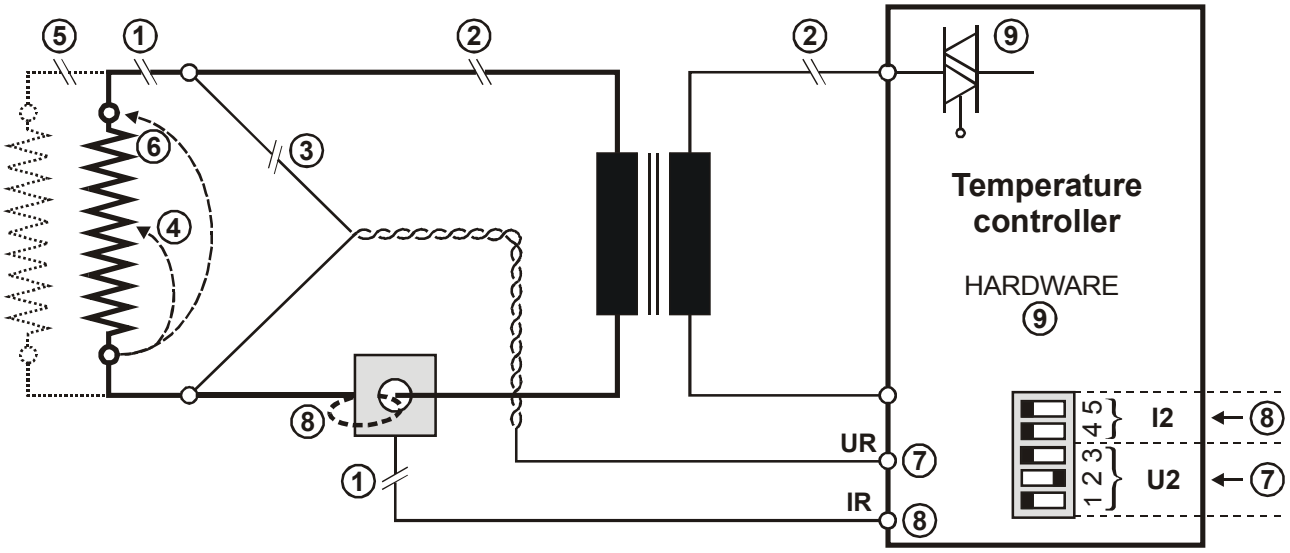
Error code		STATUS of alarm relay (factory set.)	Cause	Action if machine started for first time	Action if machine already operating, HS band not chang.
8	**104**	Warning: Open Fault: Closed (voltage value at actual value output then no longer changes)	I_R signals incorrect, incorrect specification of impulse-transformer	Run **AUTOCAL**, Check specification of transformer, Fault area ⑦⑧	Fault area ④⑤⑥ (loose contact)
	105		U_R signals incorrect, incorrect specification of impulse-transformer		
	106		U_R and/or I_R signals incorrect, incorrect specification of impulse-transformer		
	302 (AC)		Temperature too low, AUTOCAL wasn't performed, loose contact, ambient temp. fluctuates	Run **AUTOCAL** and/or fault area ④⑤⑥ (loose contact)	
	303 (AC)		temperature too high, AUTOCAL wasn't performed, loose contact, ambient temp. fluctuates		
9	**211**		Data error	Run **AUTOCAL**	---

Part 3 of 3:

NOTE: The specified error messages are initially output as warnings (alarm relay is open)
When the "START" signal is activated, the warning changes to a fault
(alarm relay is closed).

Error code		STATUS of alarm relay (factory set.)	Cause	Action if machine started for first time	Action if machine already operating, HS band not chang.
10	**111**	Warning: Open	I_R signal incorrect, calibration not possible	Fault area ⑧, check configuration	---
11	**112**		U_R signal incorrect, calibration not possible	Fault area ⑦, check configuration	---
12	**113**	Fault: Closed (voltage value at actual value output then no longer changes)	U_R and I_R signals incorrect, calibration not possible	Fault area ⑦⑧, check configuration	---
13	**114**		Temperature fluctuates, calibration not possible		
	115		Ext. calibration temperature too high,		
	116		Ext. calibration temperature fluctuates		

10.14 Fault areas and causes



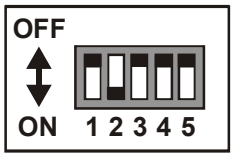
The table below explains the possible fault causes.

Fault area	Explanation	Possible causes
①	Load circuit interrupted after U_R pickoff point	- Wire break, heatsealing band break - Contacting to heatsealing band defective
	PEX-W2/W3 current transformer signal interrupted	- I_R measuring wire 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 wire 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 - Contacting to heatsealing band defective
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 software revision 027: DIP switches 1 - 3 configured incorrectly (U_2 range) - As of software revision 100: U_2 outside permissible range from 0.4…120VAC

Fault area	Explanation	Possible causes
⑧	I_R signal incorrect	- Up to software revision 027: DIP switches 4+5 configured incorrectly (I_2 range) - As of software revision 100: I_2 outside permissible range from 30…500 A
	Turns through PEX-W2/W3 current transformer incorrect	- Check number of turns (two or more turns required for currents < 30 A)
⑨	Internal controller fault	- Hardware fault (replace controller)

11 Factory settings

The RESISTRON temperature controller RES-415 is configured in the factory as follows:

DIP switches for secondary voltage U_2 and current I_2 (Up to software revision 027)		U_2 = 6…60 VAC I_2 = 30…100 A DIP switches: 2 ON 1, 3, 4, 5 OFF These switches are automatically set by the AUT-ORANGE function on all controllers as of software revision 100.
Measuring impulse length [X]		Measuring impulse length: 1.7 ms
Temperature diagnosis [X]		Temperature diagnosis: ON, -15K, +10K
Heatup timeout [X]		Heatup timeout: ON, 10.0 s
Temperature unit (as of software revision 106) [X]		Temperature unit: Celsius

[X] As of software revision 100
With ROPEX visualization software only.

12 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.

13 How to order

	**Contr. RES - 415- . / . . . VAC** **L / 115**: LC display, line voltage 115VAC, Art. No. 741511 **L / 230**: LC display, line voltage 230VAC, Art. No. 741512 **L / 400**: LC display, line voltage 400VAC, Art. No. 741513 **V / 115**: VF display, line voltage 115VAC, Art. No. 741521 **V / 230**: VF display, line voltage 230VAC, Art. No. 741522 **V / 400**: VF display, line voltage 400VAC, Art. No. 741523 Scope of supply: Controller includes connector plug-in parts (current transformer must be ordered separately) **Modification MOD . . (optional, if required)** e.g. **01**: MOD 01, Art. No. 800001 (amplifier for low voltage) Please indicate the article numbers of the controller and the required modifications (optional) in all orders, e.g. RES-415-L/400VAC + MOD 01 (controller with LC display for 400VAC line voltage and amplifier for low voltage) Art. Nos. 741513 + 800001 must be ordered
	**Current transformer PEX-W3** Art. No. 885105
	**Line filter LF- . . 480** **06**: Continuous current 6A, 480VAC, Art. No. 885500 **35**: Continuous current 35A, 480VAC, Art. No. 885506
	**Impulse transformer** See ROPEX Application Report for design and ordering information
	**Communication interface CI-USB-1** Art. No. 885650

For more accessories: ↳"Accessories" leaflet

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