

RES-415

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

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1 General information

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

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

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

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

1.1 Copyright

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

1.2 Intended use

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

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

1.3 Heatsealing band

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

The resistance of the heatsealing band which is used must have a positive minimum temperature coefficient in order to guarantee trouble-free operation of the RESISTRON® temperature controller.


The temperature coefficient must be specified as follows:

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

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

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

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

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

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

1.4 Impulse transformer

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

Incorrect installation of the impulse transformer impairs electrical safety.

1.5 Current transformer PEX-W4/-W5

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

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

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

1.6 Line filter

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

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

1.7 Maintenance

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



Dust deposits and dirt from liquids result in a loss of function. Accordingly, installation in a switch cabinet or terminal cabinet with IP54 is recommended.

1.8 Transportation

Store and transport the device in its original carton.


After transport, perform a visual inspection for possible damage.

1.9 Disposal



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

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

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



This device must not be disposed of as residual waste!

DECLARATION OF CONFORMITY

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

Designation: RESISTRON temperature controller with accessories
Type: RES-415 with line filter and current transformer
Operating principle: Impulse sealing of films and plastics

Compliant with following standards and directives:

EN 61010-1 Safety requirements for electrical equipment, control, and laboratory use
2014/35/EU low voltage directive
2014/30/EU electromagnetic compatibility directive
2011/65/EU RoHS directive

Note:

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

Comments:

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

July 12, 2020



J. Kühner (CEO)

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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 60Hz) by measuring the current and voltage. The temperature calculated with the help of these measurements is displayed and compared with the set point.

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

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

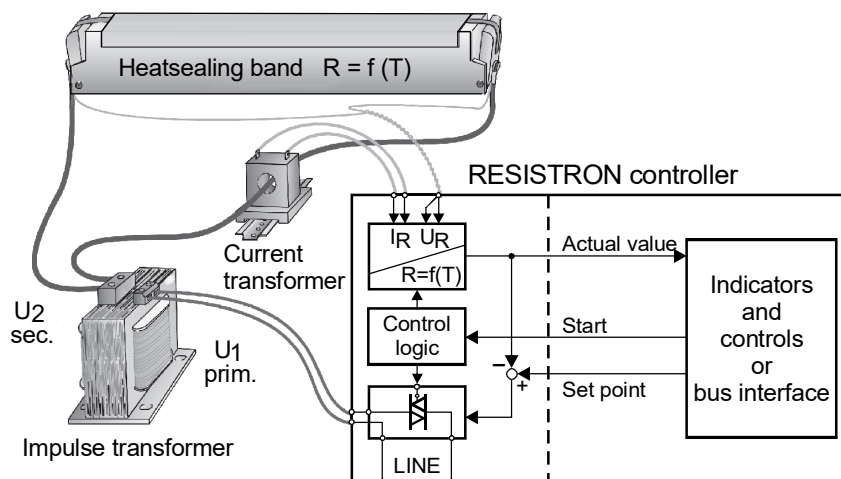
The thermoelectric control loop which is formed has a highly dynamic response because purely electrical variables are measured at a high sampling rate. A high secondary current can be controlled with only minimal power loss because power is controlled on the primary side of the transformer. This allows 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.


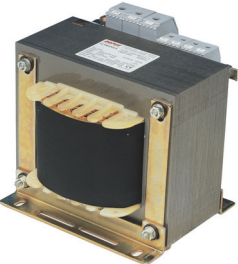



The RESISTRON[®] temperature controller RES-415 is designed for installation in a front panel cutout. The compact design and the plug-in connections make this controller easy to install.

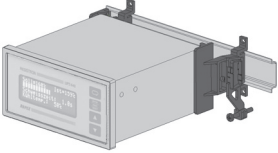


5 Accessories and modifications

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).

	<p>Line filter LF-xx480 Essential in order to ensure CE conformity. Optimized for the RESISTRON[®] temperature controller.</p>
	<p>Impulse transformer ITR-x Designed according to 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>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.</p>
	<p>Monitoring current transformer For detecting frame short-circuits on the heatsealing band. Used as an alternative to the standard PEX-W2/-W3 current transformer.</p>
	<p>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).</p>


	<p>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.</p>
	<p>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.</p>
	<p>Measurement cable UML-1 Twisted measurement cable for the U_R voltage measurement. Trailing cable, halogen and silicone-free.</p>

5.2 Modifications (MODs)

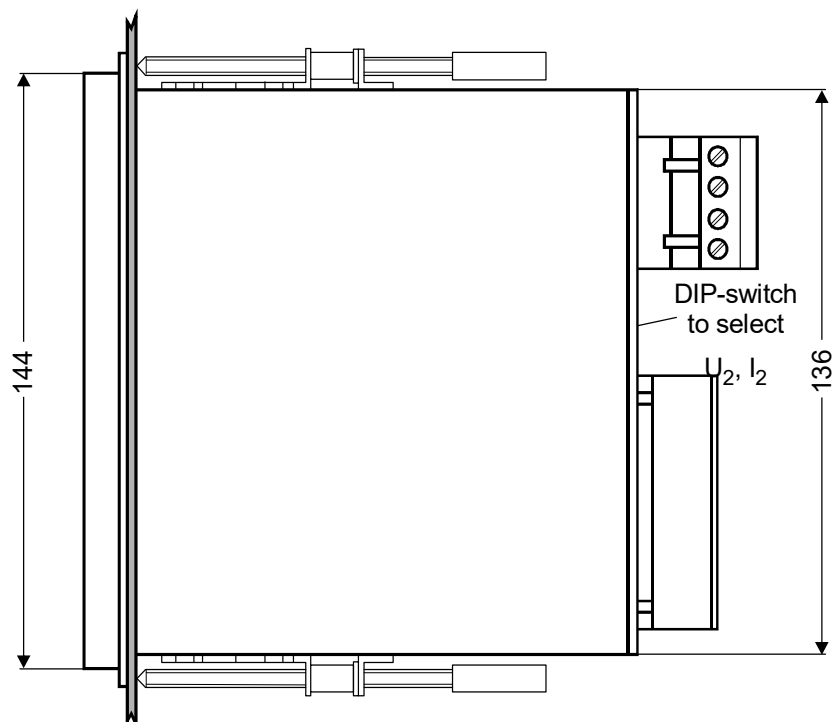
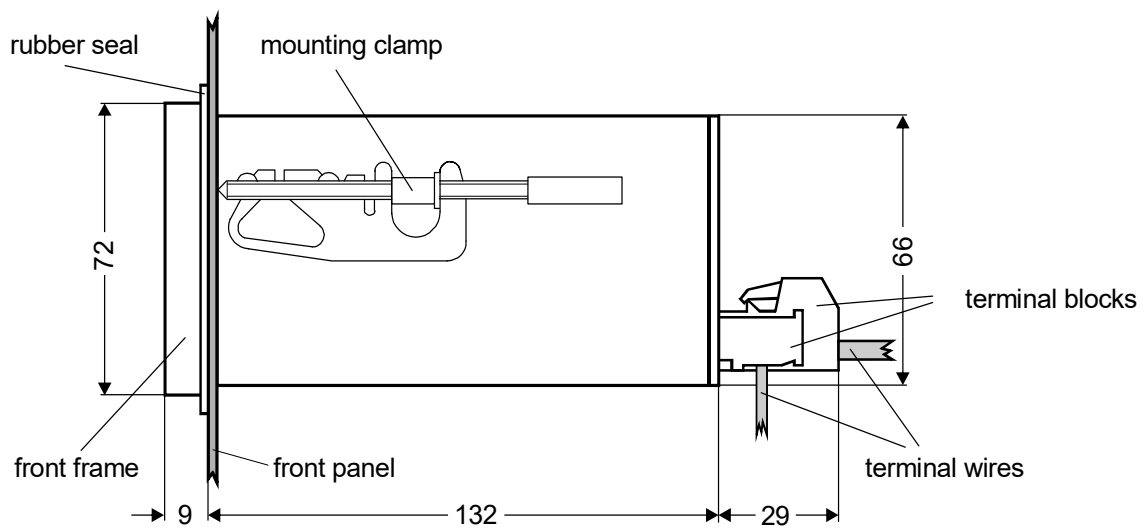
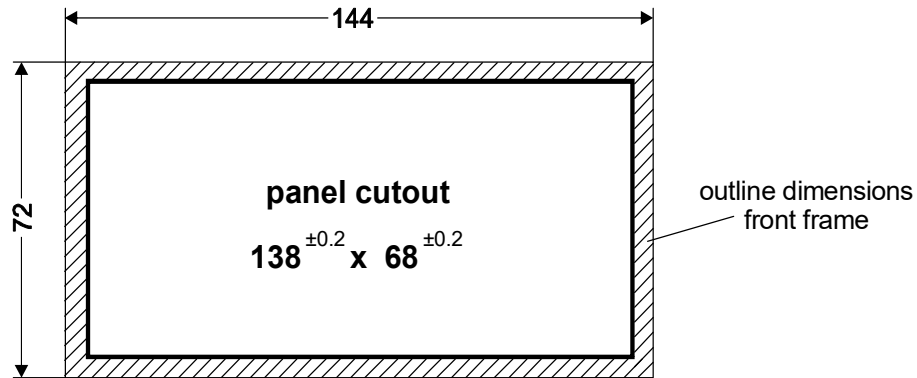
Modifications are not available for the RESISTRON[®] temperature controller RES-415.

6 Technical data

Type of construction	Housing for front panel mounting Dimensions (W x H): 144 x 72mm; depth: 161mm (incl. terminals)
Line voltage	<p><u>All controller manufactured as of February 2006 (as of software revision 100):</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 January 2006 (up to software revision 027):</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 device version (☞ section 13 "How to order" on page 41)</p>
Line frequency	47...63Hz, automatic adjustment to frequencies in this range
Heatsealing band type and temperature range	<p><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 33): Temperature range: 200°C, 300°C, 400°C or 500°C Temperature coefficient: 400...4000ppm (variable setting range)</p> <p>Factory setting: Temperature range: 0...300°C Temperature coefficient: 1100ppm (e.g. Alloy A20)</p>
Set point selection	Via the "UP / "DOWN" keys on the front of the controller
Digital logic levels Terminals 3, 4	LOW (0V): 0...2VDC HIGH (24VDC): 12...30VDC (max. current input 6mA) Electrically isolated, reverse polarity-protected
START with contact Terminals 2+7	Switching threshold: 3.5VDC, $U_{max} = 5VDC$, $I_{max} = 5mA$
Alarm relay Terminals 5+6	Contact, potential-free, $U_{max} = 30V$ (DC/AC), $I_{max} = 0.2A$
Maximum load (primary current of impulse transformer)	$I_{max} = 5A$ (duty cycle = 100%) $I_{max} = 25A$ (duty cycle = 20%)
Power dissipation	max. 25W
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...2.5mm ² (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 section 1 "General information" on page 3.

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

8.1 Installation procedure

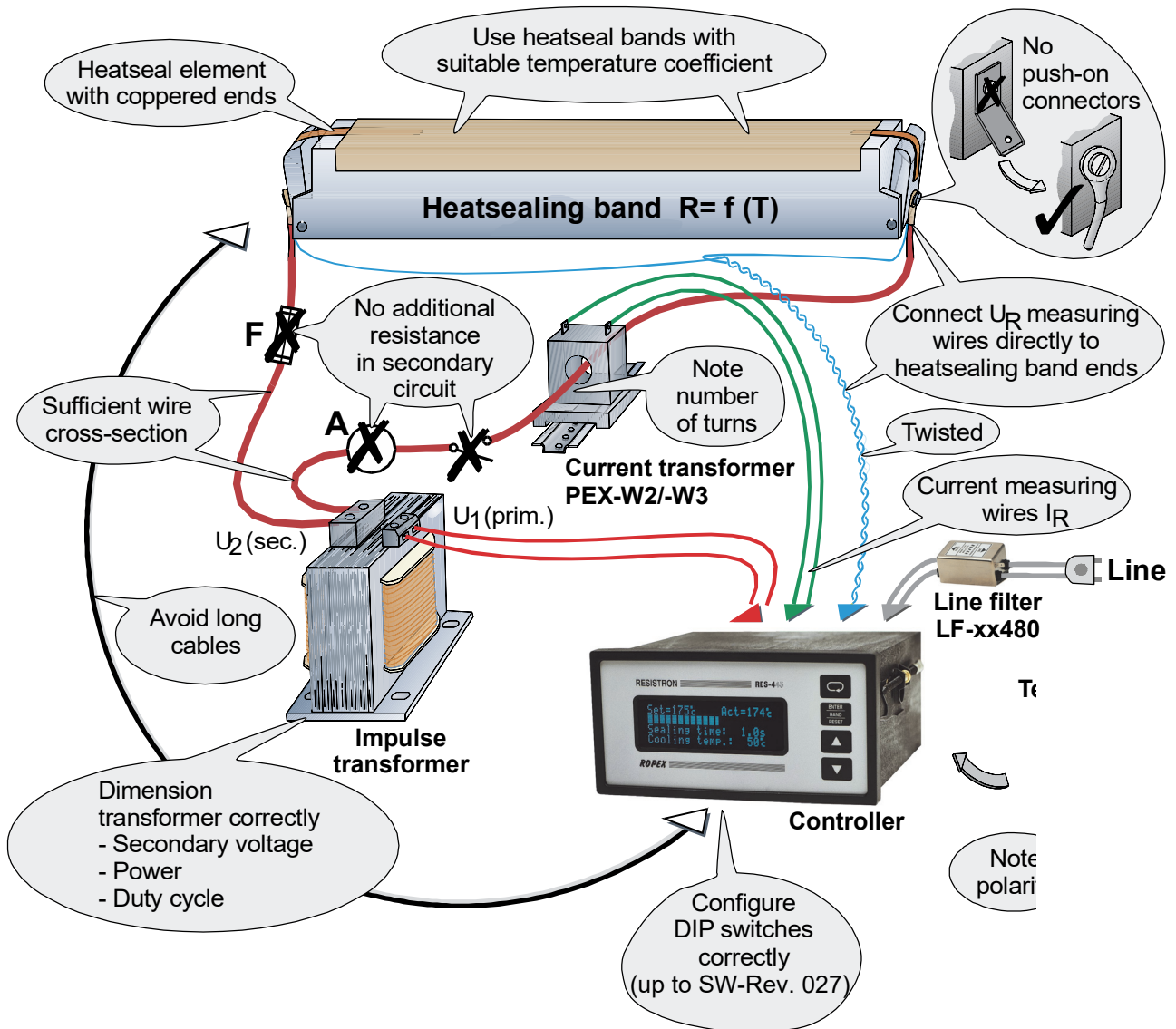
Proceed as follows to install the RESISTRON[®] temperature controller RES-415:

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 47Hz to 63Hz.
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 section 8.3 "Power supply" on page 16, section 8.6 "Wiring diagram (standard)" on page 19 and the ROPEX Application Report. The information provided in section 8.2 "Installation steps" on page 15 must be heeded additionally.

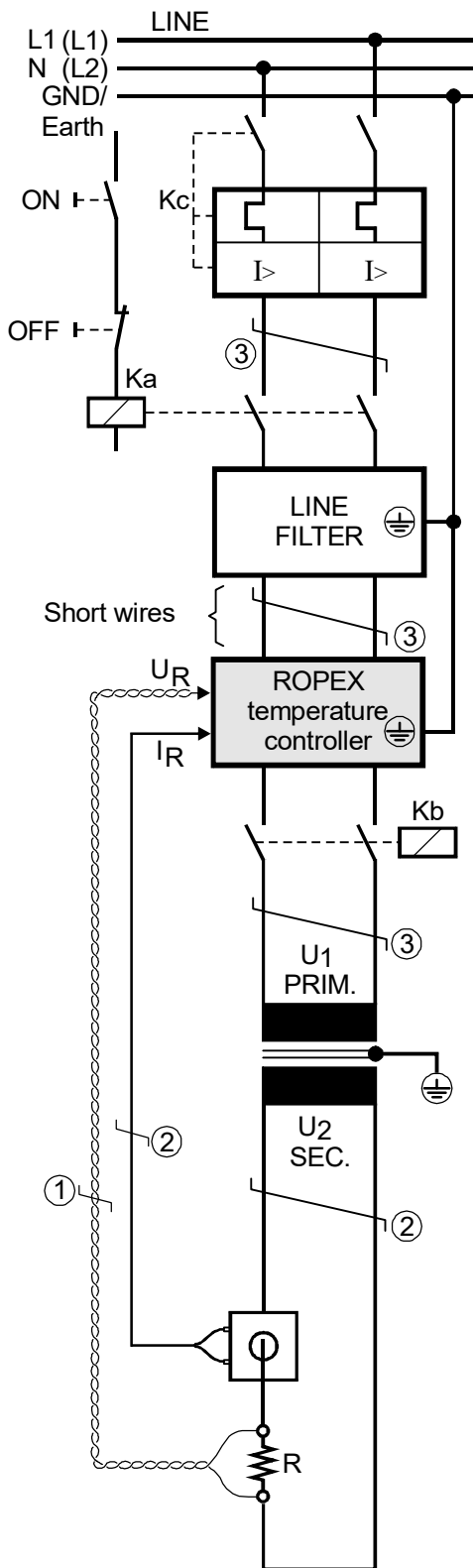
 **Check the tightness of all the system connections, including the terminals for the impulse transformer windings.**

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

8.2 Installation steps



8.3 Power supply



Line

Over-current protection

Double-pole circuit-breaker or fuses,
(☞ ROPEX Application Report)

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

Relay Ka

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

Line filter

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

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

RESISTRON® temperature controller

Relay Kb

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

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

Impulse Transformer

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

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

Wiring

The wire cross-sections depend on the application (☞ ROPEX Application Report).

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

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.

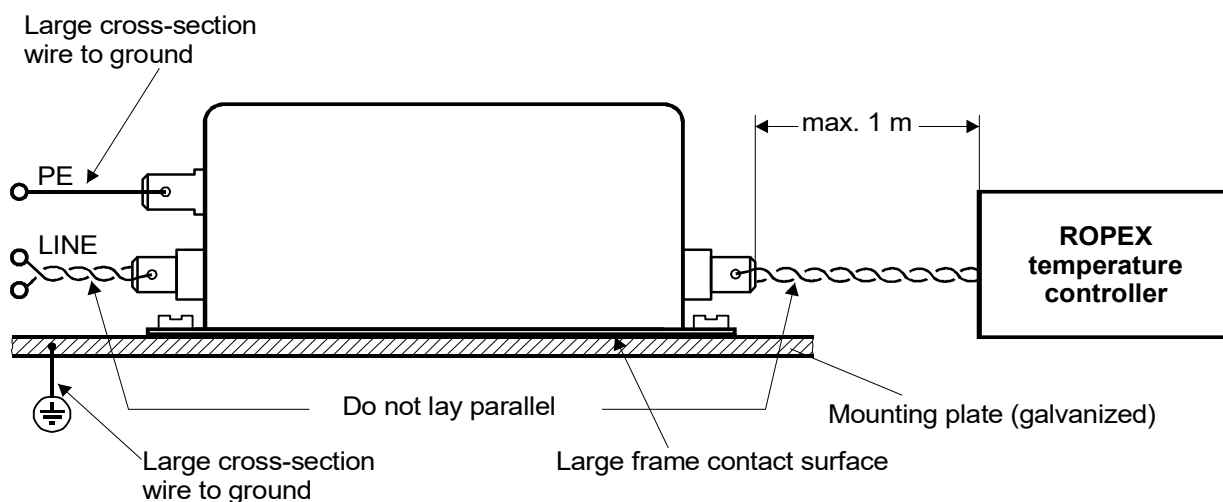
You can find the exact specification of the line filter in the ROPEX Application Report calculated for your particular heatsealing application.

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 16 must be observed.

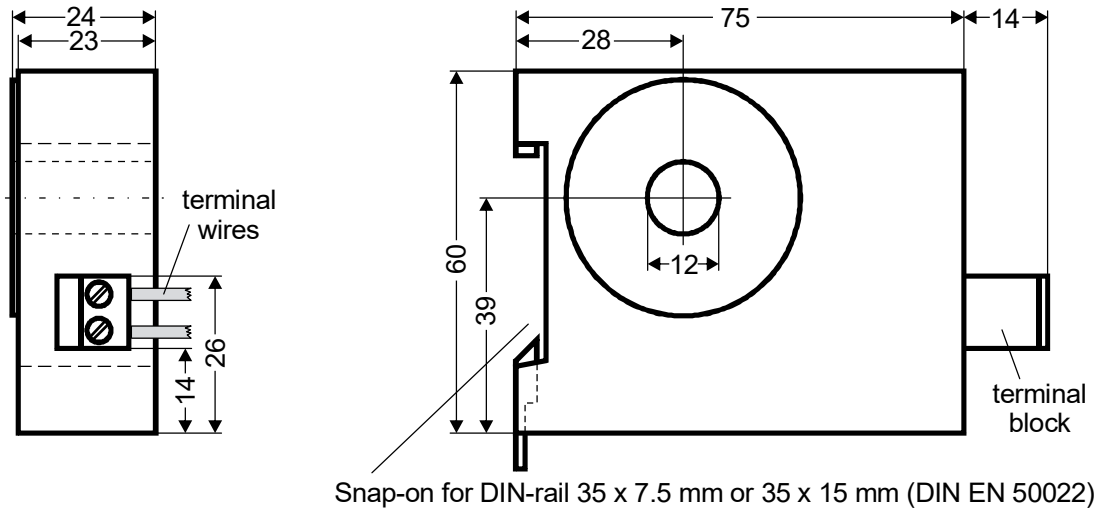
Example drawing for LF-06480:



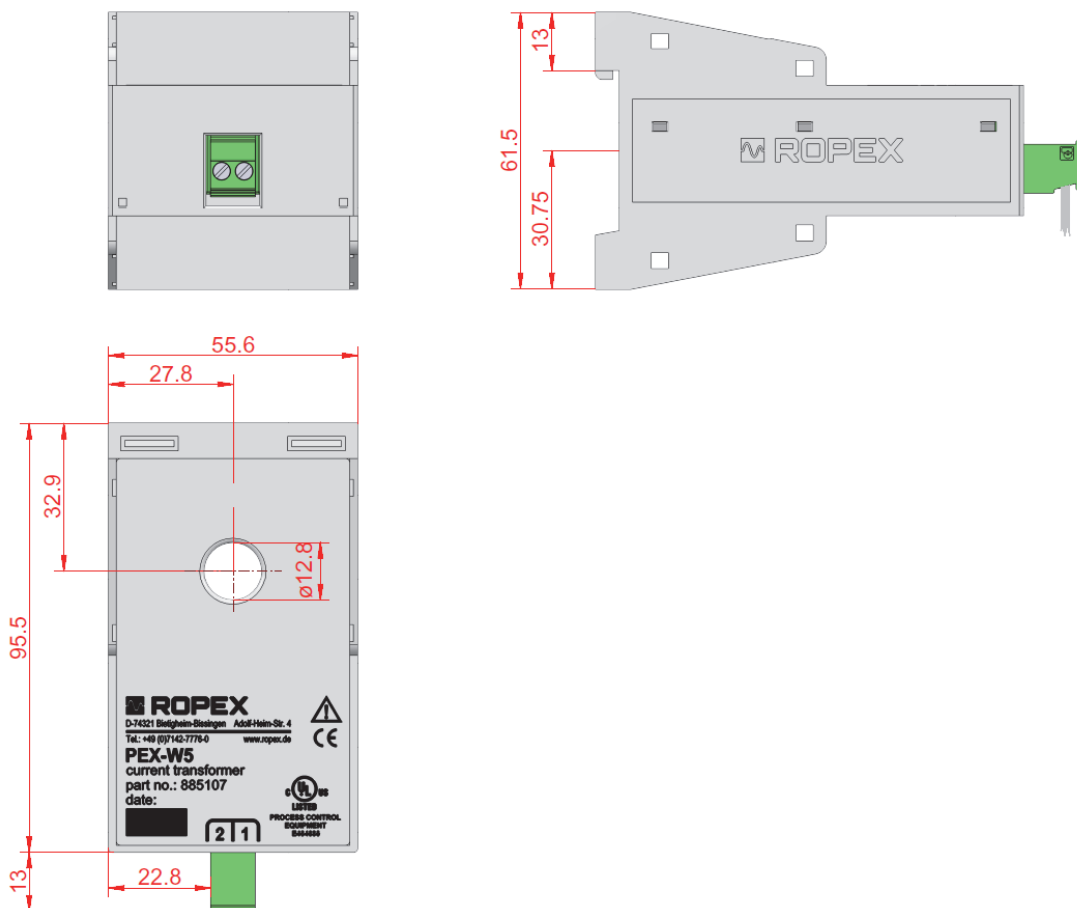
8.5 Current transformer PEX-W4/-W5

The PEX-W4/-W5 current transformer supplied with the RESISTRON[®] temperature controller is an integral part of the control system. The current transformer may only be operated if it is connected to the temperature controller correctly (↪ section 8.3 "Power supply" on page 16).

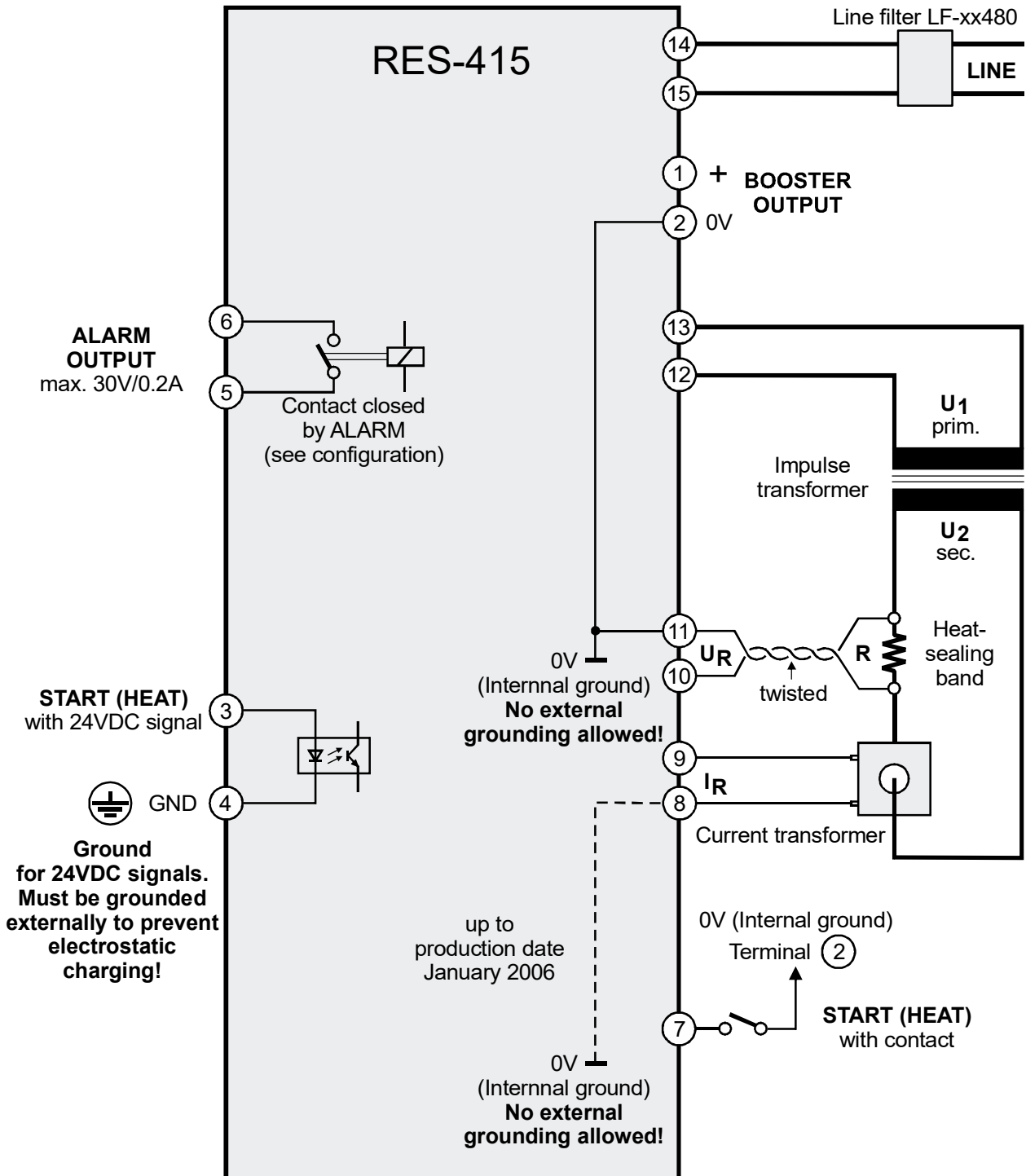
8.5.1 PEX-W4



8.5.2 PEX-W5

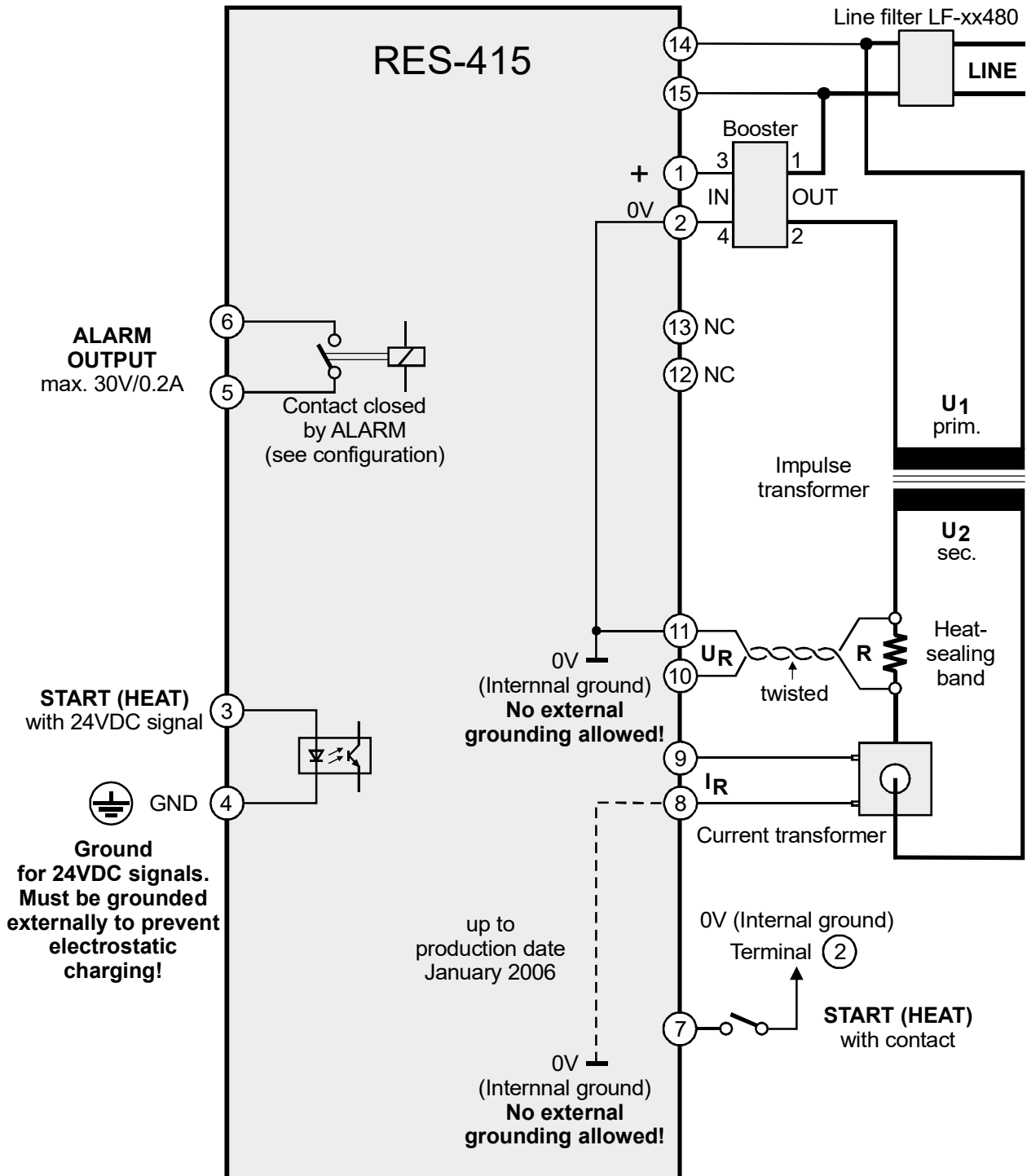


8.6 Wiring diagram (standard)



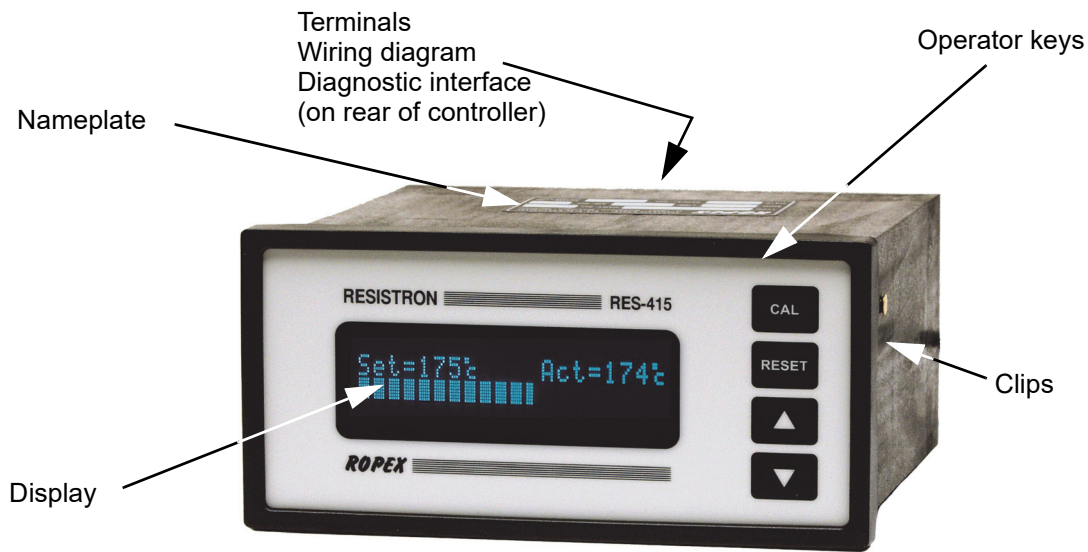
8.7 Wiring diagram with booster

connection



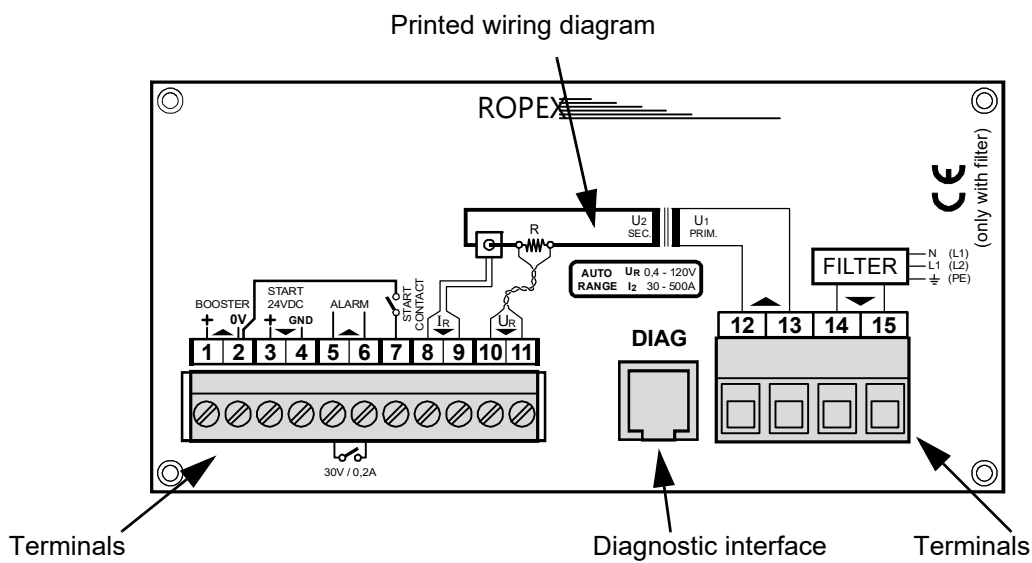
9 Startup and operation

9.1 Front view of the controller



9.2 Rear view of the controller

As of software revision 100:



Rear view of the controller

OFF

↑ ↓

ON

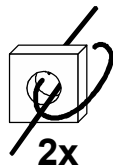
1 2 3 4 5

⇒

Factory settings

U_2 ↓	DIP switch			I_2 ↓	DIP switch	
	1	2	3		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 secondary high-current wire must be laid twice (or several times) through the PEX-W2 or PEX-W3 current transformer (↪ ROPEX Application Report).

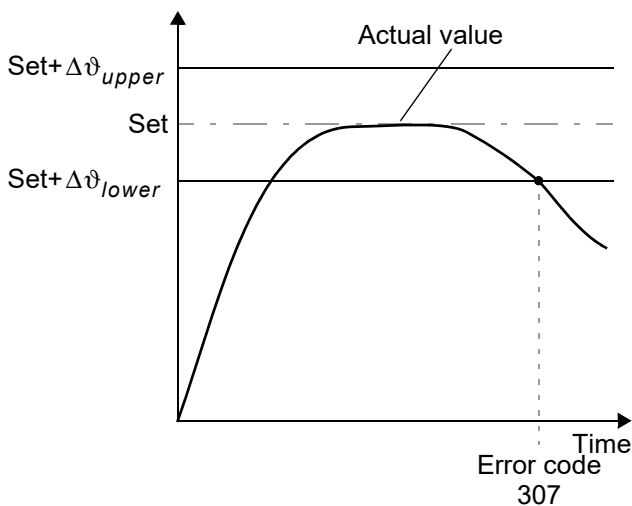


9.3.2

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 $\Delta\vartheta_{lower} = -15\text{ K}$ and $\Delta\vartheta_{upper} = 10\text{ K}$. 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 33).

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 38).



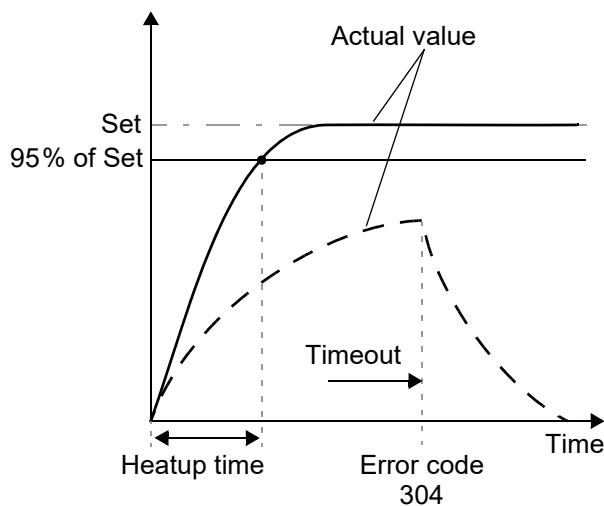
If the temperature diagnosis is not activated by the time the "START" signal is deactivated (i.e. if the ACTUAL temperature does not exceed the upper or lower tolerance band limit), the corresponding error code (309, 310) is indicated and the fault relay is switched.

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 33).

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 38).



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 25).

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 section 1 "General information" on page 3 and section 2 "Application" on page 7.


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

9.5.1 Initial startup

Prerequisites: The controller must be correctly installed and connected (↪ section 8 "Installation" on page 14). The possible settings are described in detail in chap. 9.3 „Controller configuration“, page 22 and chap. 10 „Controller functions“, page 27.

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 63Hz.
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 22).
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 33). 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...15s).
 When the zero point has been calibrated, 20°C is indicated as the actual value.
 If the zero has not been calibrated successfully, an error message indicates error codes 104...106, 211. In this case the controller configuration is incorrect (↪ section 9.3 "Controller configuration" on page 22 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 38.

10. Burn in the heatsealing band (↪ section 9.4 "Heatsealing band" on page 24) 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 section 9.4 "Heatsealing band" on page 24.

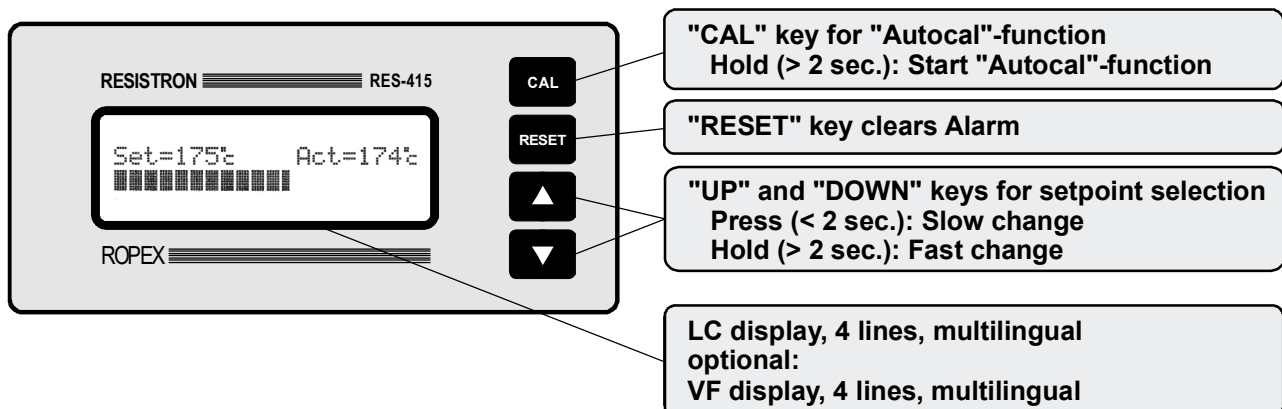
 **Always use a heatsealing band with the correct alloy, dimensions and copper-plating in order to avoid malfunctions and overheating.**

Continue with section 9.5.1, steps 8 and 9.

10 Controller functions

See also section 8.6 "Wiring diagram (standard)" on page 19.

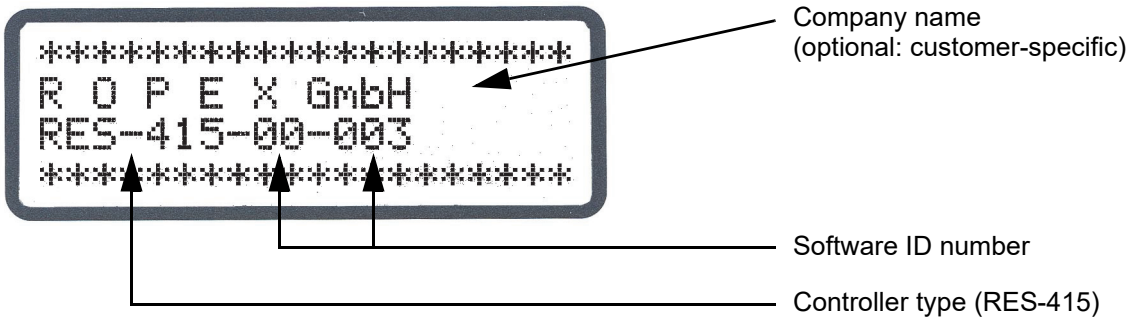
10.1 Indicators and controls



10.2 Display

10.2.1 Power-up message

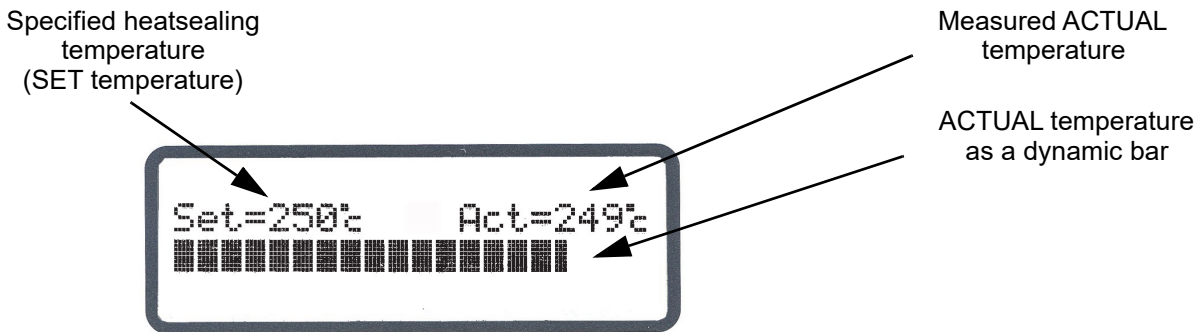
A power-up message appears on the display for approximately 2 seconds when the controller is switched on. This message also includes details of the software version.



⚠ 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 33).

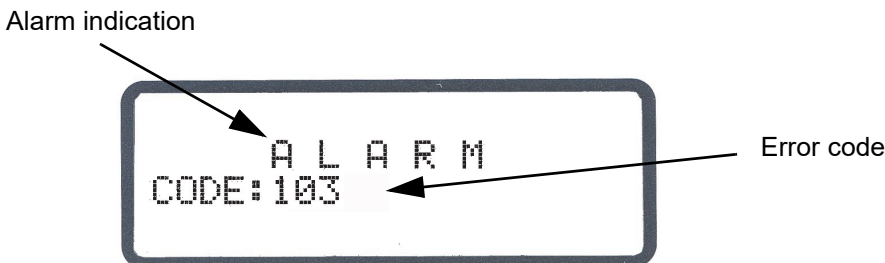
10.2.2 Display in home position

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

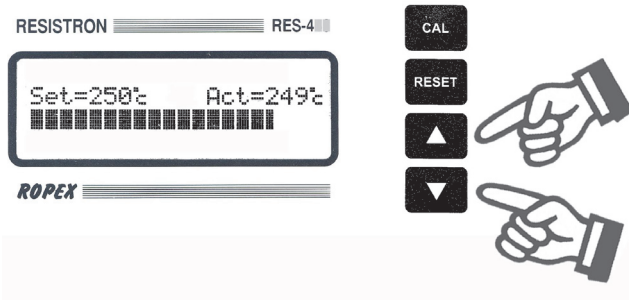
The fault diagnosis function of the controller is always active. If a fault is detected, it is indicated on the display immediately in the form of an error message (↪ section 10.12 "System monitoring/alarm output" on page 33).



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.

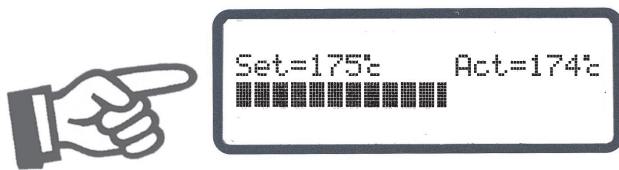


The maximum value of the setting range is limited to 300 °C.

The set point that is selected for the heatsealing temperature must be greater than 40 °C. If not, the heat-sealing 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 38).



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.

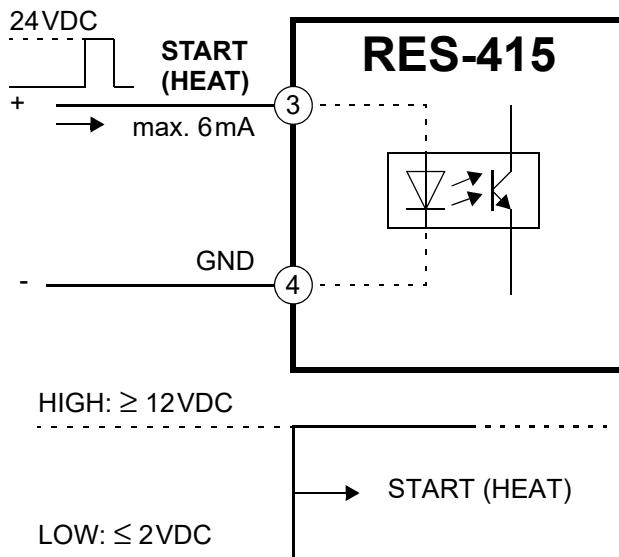
2. If the "START" signal (24VDC or contact) is activated, the AUTOCAL function is not executed.
3. Directly after the controller is powered up, the AUTOCAL function cannot be activated if a fault with error code 101...103, 201...203, 801 or 9xx occurs (↪ section 10.14 "Fault areas and causes" on page 38). 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)

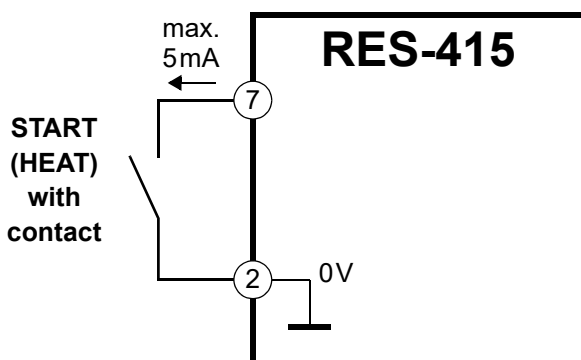
When the "START" signal is activated, the controller-internal set/actual comparison is enabled immediately and the heatsealing band is heated up to the SET temperature. It remains at this temperature until the signal is deactivated again.

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 38). 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 1.7 ms 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 33).**


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**

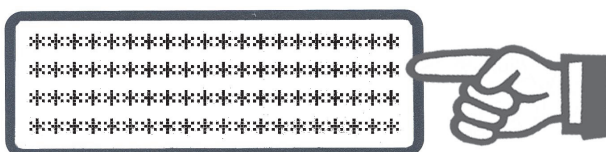
 **If you specify temperature indication and value selection in Fahrenheit (°F), the controller still uses Celsius (°C) internally. Value steps are therefore possible with this function owing to the conversion from Celsius to Fahrenheit.**

 **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 33).**

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 11.

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.



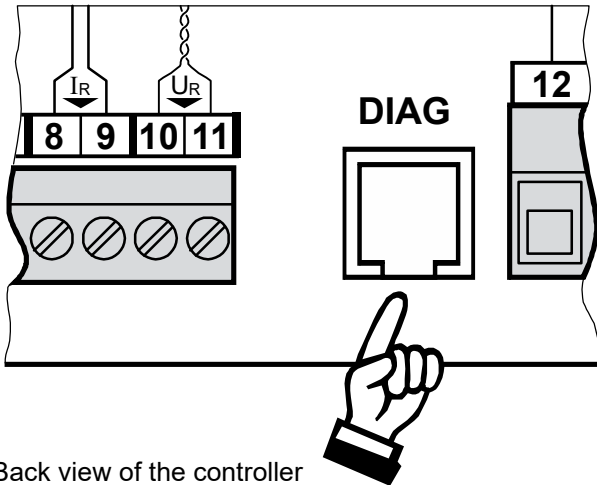
The main menu is displayed again, and operation is resumed, when the input voltage returns to the specified tolerance range.



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 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.

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 19.

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 38 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

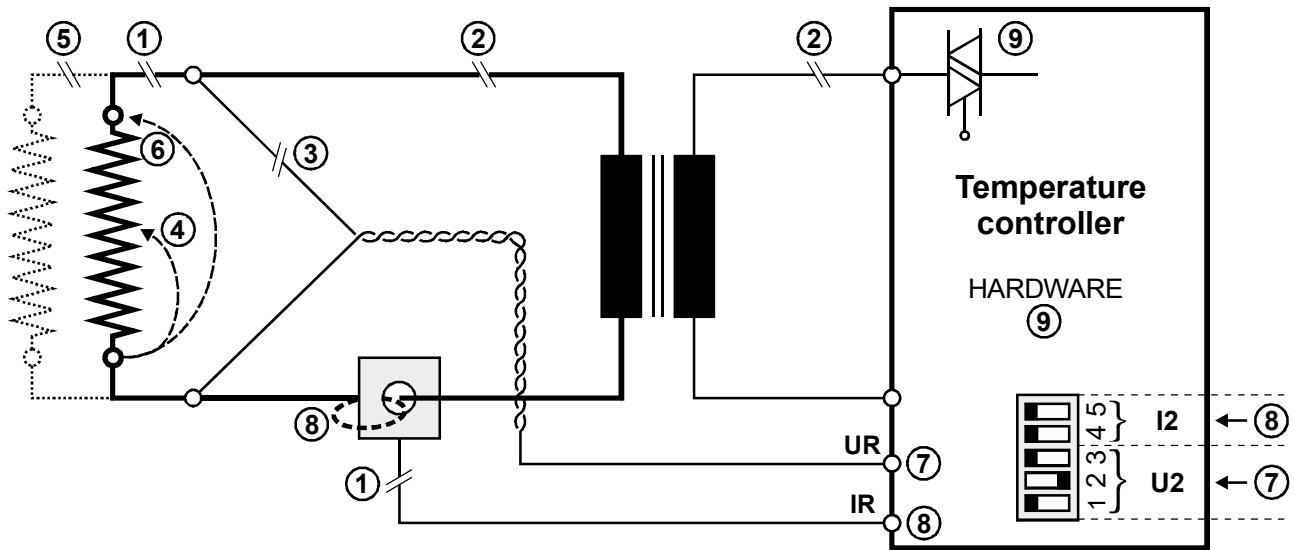
The table below describes each fault and the required corrective action. The block diagram in section 10.14 "Fault areas and causes" on page 38 permits each fault to be cleared quickly and efficiently

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 33) 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	Closed	I _R signal missing	Fault area ①	Fault area ①	
2		U _R signal missing	Fault area ③	Fault area ③	
3		U _R and I _R signals missing	Fault area ②	Fault area ②⑨	
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. fault, contr. defective Triac defective Int. fault, contr. defective Int. fault, contr. defective Int. fault, contr. defective	Replace controller Replace controller Replace controller Replace controller Replace controller	Replace controller Replace controller Replace controller Replace controller Replace controller

Part 2 of 3:					
<p>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).</p>					
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.	
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			
211		Data error	Run AUTOCAL		
9				---	

Part 3 of 3:					
<p>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).</p>					
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	Warning: Open	I _R signal incorrect, calibration not possible	Fault area ⑧, check configuration	---	
11		U _R signal incorrect, calibration not possible	Fault area ⑦, check configuration	---	
12		U _R and I _R signals incorrect, calibration not possible	Fault area ⑦⑧, check configuration	---	
13	Fault: Closed (voltage value at actual value output then no longer changes)	Temperature fluctuates, calibration not possible			
		Ext. calibration temperature too high,			
		Ext. calibration temperature fluctuates			
111					
112					
113					
114					
115					
116					

10.14 Fault areas and causes


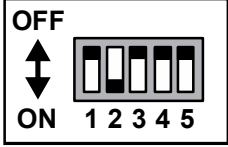




The table below explains the possible fault causes.

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	<ul style="list-style-type: none">- 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...500A
	Turns through PEX-W2/W3 current transformer incorrect	<ul style="list-style-type: none">- Check number of turns (two or more turns required for currents < 30A)
⑨	Internal controller fault	<ul style="list-style-type: none">- Hardware fault (replace controller)

11 Factory settings

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






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

[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

	<p>Contr. RES - 415- . / . . . VAC</p> <ul style="list-style-type: none"> 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 <p>Scope of supply: Controller includes connector plug-in parts (current transformer must be ordered separately)</p> <p>Modification MOD . . (optional, if required)</p> <ul style="list-style-type: none"> e.g. 01: MOD 01, Art. No. 800001 (amplifier for low voltage) <p>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</p>
	<p>Current transformer PEX-W3 Art. No. 885105</p>
	<p>Line filter LF- . . 480</p> <ul style="list-style-type: none"> 06: Continuous current 6A, 480VAC, Art. No. 885500 35: Continuous current 35A, 480VAC, Art. No. 885506
	<p>Impulse transformer</p> <p>See ROPEX Application Report for design and ordering information</p>
	<p>Communication interface CI-USB-1 Art. No. 885650</p>

For more accessories: ↪ "Accessories" leaflet

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