RESISTRON

RES-408 (GB)

Operating Instructions

Important features

- Microprocessor technology

- Separate terminal for operation and display

- Automatic zero calibration (AUTOCAL)

- Automatic optimization (AUTOTUNE)

- Automatic configuration of the secondary voltage and current ranges (AUTORANGE, as of May 2006)

- Automatic phase angle compensation (AUTOCOMP, as of June 2006)

- Automatic frequency adjustment

- Wide current and voltage range

- 0…10VDC analog output for ACTUAL temperature

- 24VDC control signals for START and PREHEAT with electrical isolation

- Alarm function with fault diagnosis

- Heatsealing band alloy and temperature range selectable as standard (as of June 2006)

Contents

1 Safety and warning notes

This RESISTRON-Temperaturregler 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-Temperatur-regler.**

The temperature coefficient must be specified as follows:

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

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

The RESISTRON-Temperaturreglers 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-Temperaturreglers 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 bobin. 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-Temperaturregler 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 very wide secondary current range can be controlled with only minimal power loss - a considerable advantage - because power is controlled on the primary side of the

transformer. This allows optimum adaptation to the load and to the required dynamic range despite the exceptionally compact dimensions of the controller.

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.
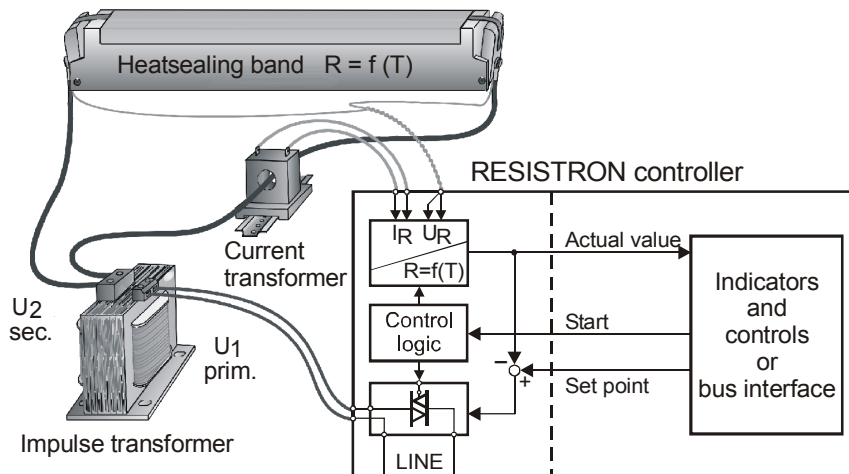
4 Description of the controller

The microprocessor technology endows the RES-408 RESISTRON temperature controller 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 June 2006) 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 temperature can be set on the separate T-408-1 (or T-400) operator terminal.

The real heatsealing band temperature is also visualized on the operator terminal.

The RES-408 RESISTRON temperature controller 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.

Coding switches on the temperature controller itself can be used to adapt to different heatsealing band alloys (Alloy 20, NOREX etc.) and set the required temperature range (0...300°C, 0...500°C etc.) on all controllers manufactured as of June 2006.
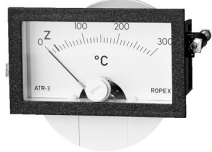
The compact design of the RES-408 RESISTRON temperature controller and the plug-in connections make this controller easy to install.

5 Accessories and modifications

A wide range of compatible accessories and peripheral devices are available for the RES-408 RESISTRON temperature controller. 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).

	Analog temperature meter ATR-x For front panel mounting or mounting on a top hat rail (DIN TS35 rail). Analog indication of the ACTUAL temperature of the heatsealing band in °C. The meter damping of the unit is optimized for the abrupt temperature changes that occur in impulse mode.
	Digital temperature meter DTR-x For front panel mounting or mounting on a top hat rail (DIN TS35 rail). Digital indication of the ACTUAL temperature of the heatsealing band in °C, with HOLD function.
	Line filter Essential in order to ensure CE conformity. Optimized for the RESISTRON temperature controller.

	Impulse transformer 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).
	CI-USB-1 communication interface Interface for connecting a RESISTRON temperature controller with a 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.
	Booster External switching amplifier, necessary for high primary currents (continuous current > 5A, pulsed current > 25A).
	Monitoringcurrent transformer For detecting frame short-circuits on the heatsealing band. Used as an alternative to the standard PEX-W2/W3 current transformer.

5.2 Modifications (MODs)

Owing to its universal design, the RES-408 RESIS-TRON temperature controller is suitable for a very wide range of heatsealing applications.

Various modifications (MODs) are offered for the RES-408 RESISTRON temperature controller for implementing special applications.

The modifications described here are just a few of the large number available. Separate documentation is supplied for all modifications.

MOD 01

Amplifier for low secondary voltages (U_R = 0.25…16VAC). This modification is necessary, for example, for very short or low-resistance heat-sealing bands.

MOD 26

Additional terminal for connecting an external switching amplifier (booster). This modification is necessary for high primary currents (continuous current > 5A, pulsed current > 25A).

MOD 37 (up to May 2006)

Additional rotary coding switch for the heatsealing band alloy and the temperature range. Various heatsealing band alloys (e.g. Alloy 20, NOREX) and temperature ranges (e.g. 300°C, 500°C) can be selected.

This modification is supplied as standard with all controllers manufactured as of June 2006 (↳ section 10.2.2 "Configuration of the rotary coding switch for the temperature range and alloy (as of June 2006)" on page 21).

Switch position	Temp. range	Temp. coefficient	Band alloy
0	300°C	1100ppm/K	e.g. Alloy-20
1	300°C	780ppm/K	e.g. Alloy L
4	500°C	1100ppm/K	e.g. Alloy-20
5	500°C	780ppm/K	e.g. Alloy L
8	300°C	3500ppm/K	e.g. NOREX

0 = Factory settings

6 Technical data

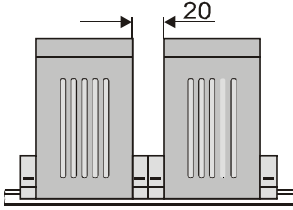|	
Type of construction	Controller: Housing for installation in the electrical cabinet Snaps onto a standard top hat rail (DIN TS35 rail, 35mm) acc. to DIN EN 50022 Dimensions: 90 x 75mm; height: 135mm (incl. terminals) Terminal: Housing for installation in the electrical cabinet Dimensions (W x H): 96 x 48mm; depth: 55mm (excl. connector)
Line voltage	Controllers manufactured as of June 2006: 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) Controllers manufactured between January 2004 and May 2006: 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) Controllers manufactured up to December 2003: 115VAC, 230VAC or 400VAC, tolerance: +10% / -15% depending on device version (↳ section 14 "How to order" on page 46)
Line frequency	47…63Hz, automatic adjustment to frequencies in this range

Heatsealing band type and temperature range	Controllers manufactured as of June 2006:
	The temperature range and temperature coefficient settings can also be specified in the ROPEX visualization software (↳ section 11.16 "Diagnostic interface / visualization software (as of June 2006)" on page 37) in addition to using the rotary coding switch (see below):
	   Temperature range: 200°C, 300°C, 400°C or 500°C
	   Temperature coefficient: 400…4000ppm (variable setting range)
	
	Five different ranges can be set on the controller with the rotary coding switch:
	   Temperature coefficient 1100ppm, 0…300°C (e.g. Alloy A20), default
	   Temperature coefficient 780ppm, 0…300°C (e.g. Alloy L)
	   Temperature coefficient 1100ppm, 0…500°C (e.g. Alloy A20)
	   Temperature coefficient 780ppm, 0…500°C (e.g. Alloy L)
	   Temperature coefficient 3500ppm, 0…300°C (e.g. NOREX)
	
	Controllers manufactured up to May 2006:
	Default value 300°C, Alloy 20
	The temperature range and alloy can be selected with MOD 37.

Analog output (actual value) Terminals 17+18	0…10VDC, I_{max} = 5mA Equivalent to 0…300°C or 0…500°C Accuracy: ±1% plus 50mV
Digital logic levels Terminals 5+7	LOW (0V): 0…2VDC, electrically isolated HIGH (24VDC): 12…30V DC (max. current input 6mA) Reverse polarity-protected

Alarm relay Terminals 12, 13, 14	U_{max} = 50 VDC, I_{max} = 0.2 A, changeover contact, potential-free Can be inverted by means of a plug-in jumper
Maximum load (primary current of impulse transformer)	I_{max} = 5 A (duty cycle = 100 %) I_{max} = 25 A (duty cycle = 20 %)
Power loss	max. 22 W
Ambient temperature	+5…+45 °C
Degree of protection	IP 20
Installation	If several controllers are installed on one top hat rail (DIN TS35 rail), a clearance of at least 20 mm should be allowed between them. The moving clip required for fastening must be facing down for mounting on a horizontal top hat rail. End holders to mechanically fix the controller must be fitted at both ends for mounting on a vertical top hat rail.
Weight	Controller: Approx. 0.7 kg (incl. connector plug-in parts) Terminal: Approx. 0.15 kg
Housing material	Controller: Plastic, polycarbonate, UL-90-V0 Terminal: Black plastic, type Noryl SE1 GFN2
Controller connecting cables Type / cross-sections	Rigid or flexible; 0.2…2.5 mm² (AWG 24…12) with plug-in connections ⚠ **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 Controller/terminal compatibility

All RES-408 RESISTRON temperature controllers manufactured as of June 2006 are supplied as an upgraded version.

Among other things, the data transfer between the controller and the terminal has been modified. These changes were necessitated by the new European RoHS/WEEE Directives. Lead has now been banned from some of the electronic components used in our products.

⚠ **As a result, all RES-408 controllers manufactured up to May 2006 can only be operated with a T-400 terminal. Controllers manufactured as of June 2006 can only be operated with a T-408-1. Malfunctions or damage may otherwise occur.**

This has no effect on temperature control or on the external PLC control signals.

⚠ **RES-408 controllers manufactured as of June 2006 are fully electrically compatible with the old version (as far as the PLC control signals are concerned).**

Please pay attention to the controller and terminal versions when ordering spare parts. The controller may have to be exchanged together with the terminal. Refer to the compatibility table below:

New version (as of June 2006):

Controller type	Art. No.	Compatible with
RES-408/115VAC	740841	**Terminal T-408-1**
RES-408/230VAC	740842	
RES-408/400VAC	740843	**Art. No. 885441**

Old version (up to May 2006):

Controller type	Art. No.	Compatible with
RES-408-0-3/115VAC	740801 or 740831	
RES-408-0-3/230VAC	740802 or 740832	**Terminal T-400**
RES-408-0-3/400VAC	740803 or 740833	
RES-408-0-5/xxxVAC	740805, 740806, 740807, 740835, 740836 or 740837	**Art. No. 885440**
RES-408-1-x/xxxVAC	740811, 740812, 740813, 740815, 740816 or 740817	

8 Dimensions

RES-408 controller

T-400 or T-408-1 terminal

panel cutout

$92^{+0.8}_{-0}$ x $45^{+0.6}_{-0}$

outline dimensions front frame

front panel

ø 5mm
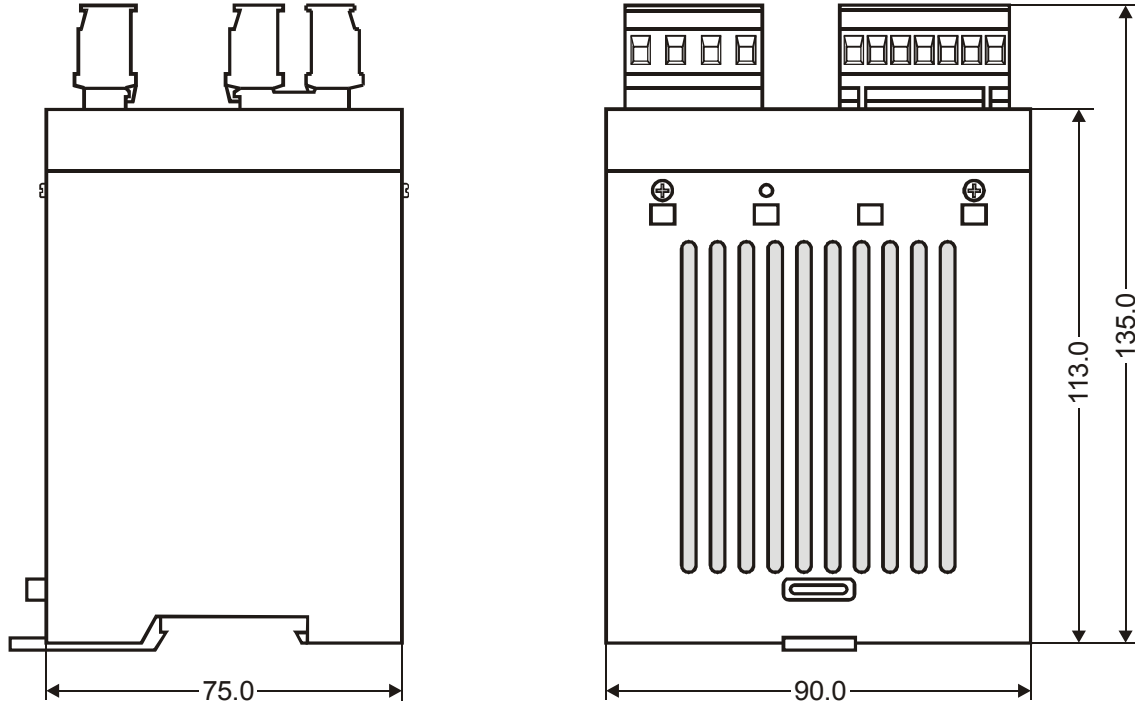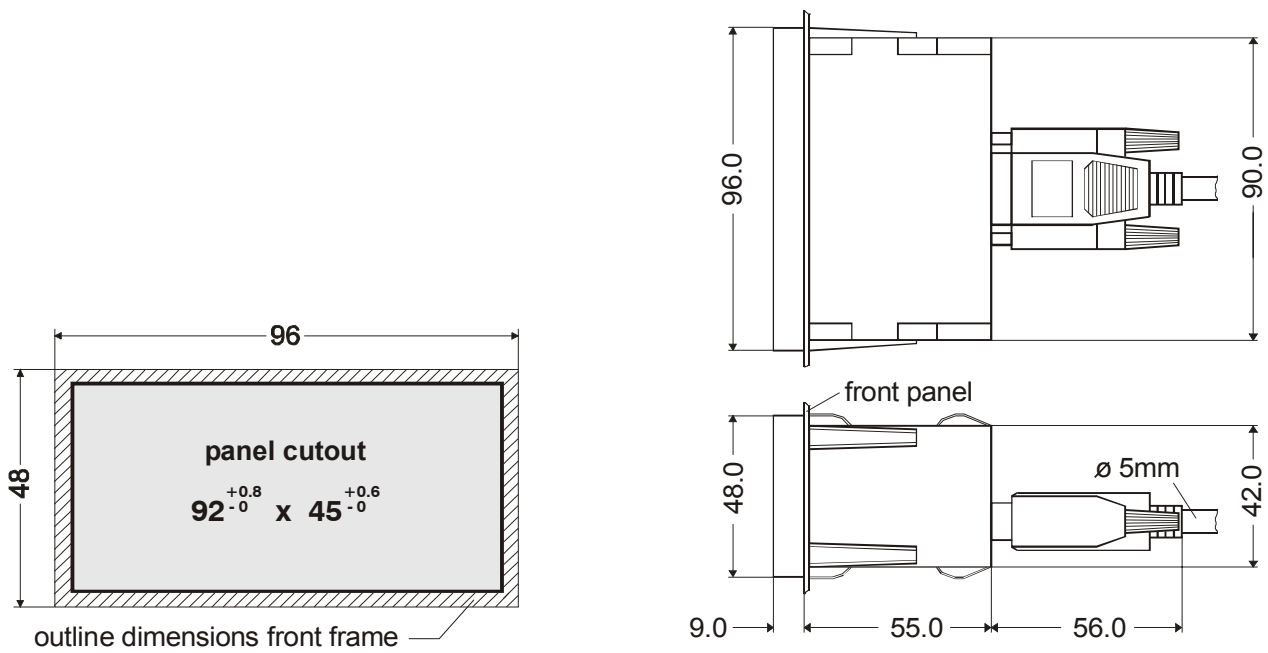
9 Installation

↳ See also section 1 "Safety and warning notes" on page 3.

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

9.1 Installation procedure

Proceed as follows to install the RES-408 RESISTRON temperature controller:

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 electrical cabinet on a standard top hat rail (DIN TS35 rail according to DIN EN 50022). If several controllers are installed on one top hat rail, the minimum clearance specified in section 6 "Technical data" on page 9 must be allowed between them.

4. Install the terminal in the front panel cutout. It is fastened by means of four clips which snap onto the side of the terminal housing.

5. Connect the controller and terminal together with the cable provided for this purpose.

⚠ **Controllers manufactured up to May 2006 are only allowed to be operated with a T-400 terminal. Controllers manufactured as of June 2006 can only be operated with a T-408-1. Malfunctions or damage may otherwise occur (↳ section 7 "Controller/terminal compatibility" on page 11).**

6. Wire the system in accordance with the instructions in section 9.3 "Power supply" on page 15 and the ROPEX Application Report. The information provided in section 9.2 "Installation steps" on page 14 must be heeded additionally.

⚠ **Check the tightness of all system connections, including the terminals for the impulse transformer winding wires.**

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

9.2 Installation steps

Heatseal element with coppered ends

Use heatseal bands with suitable temperature coefficient

No push-on connectors

Heatsealing band R= f (T)

F

No additional resistance in secondary circuit

Note number of turns

Connect U_R measuring wires directly to heatsealing band ends

Sufficient wire cross-section

A

Current transformer PEX-W2/-W3

Twisted

U_1 (prim.)

U_2 (sec.)

Current measuring wires I_R

Line

Avoid long cables

Temperature meter ATR-x

Line filter LF-xx480

Terminal

Impulse transformer

Note polarity

Controller

Dimension transformer correctly
- Secondary voltage
- Power
- Duty cycle

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

Configure DIP switches correctly (up to May 2006)

RES-408

9.3   Power supply

Line
115VAC, 230VAC, 400VAC

Circuit breaker
Double-pole, C characteristic
(⮫ ROPEX Application Report)

⚠️ Short-circuit protection only.
RESISTRON-Temperaturreglers 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-Temperaturregler 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. 1.5mm², max. 2.5mm²
Secondary circuit: min. 4.0mm², max. 25mm²

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.

9.4 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 9.3 "Power supply" on page 15 must be observed.
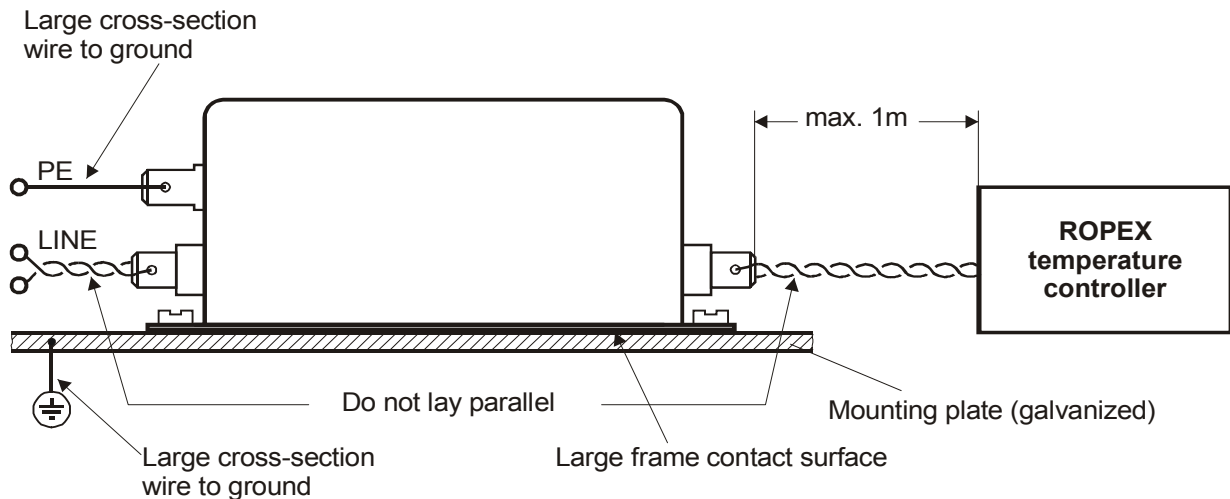
9.5 Current transformer PEX-W3

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 9.3 "Power supply" on page 15).

Snap-on for DIN-rail 35 x 7,5mm or 35 x 15mm (DIN EN 50022)

RES-408
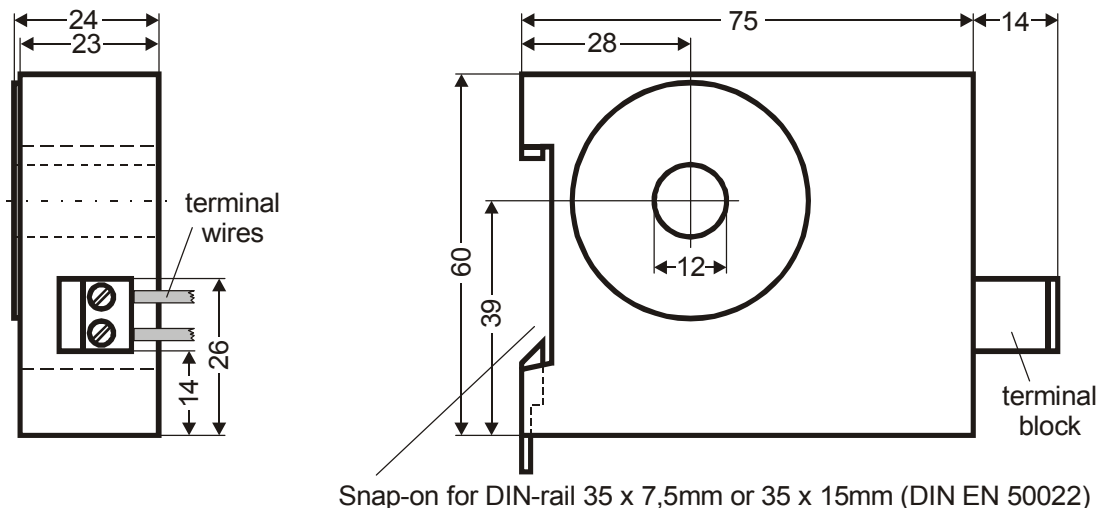
9.6 Wiring diagram (standard)
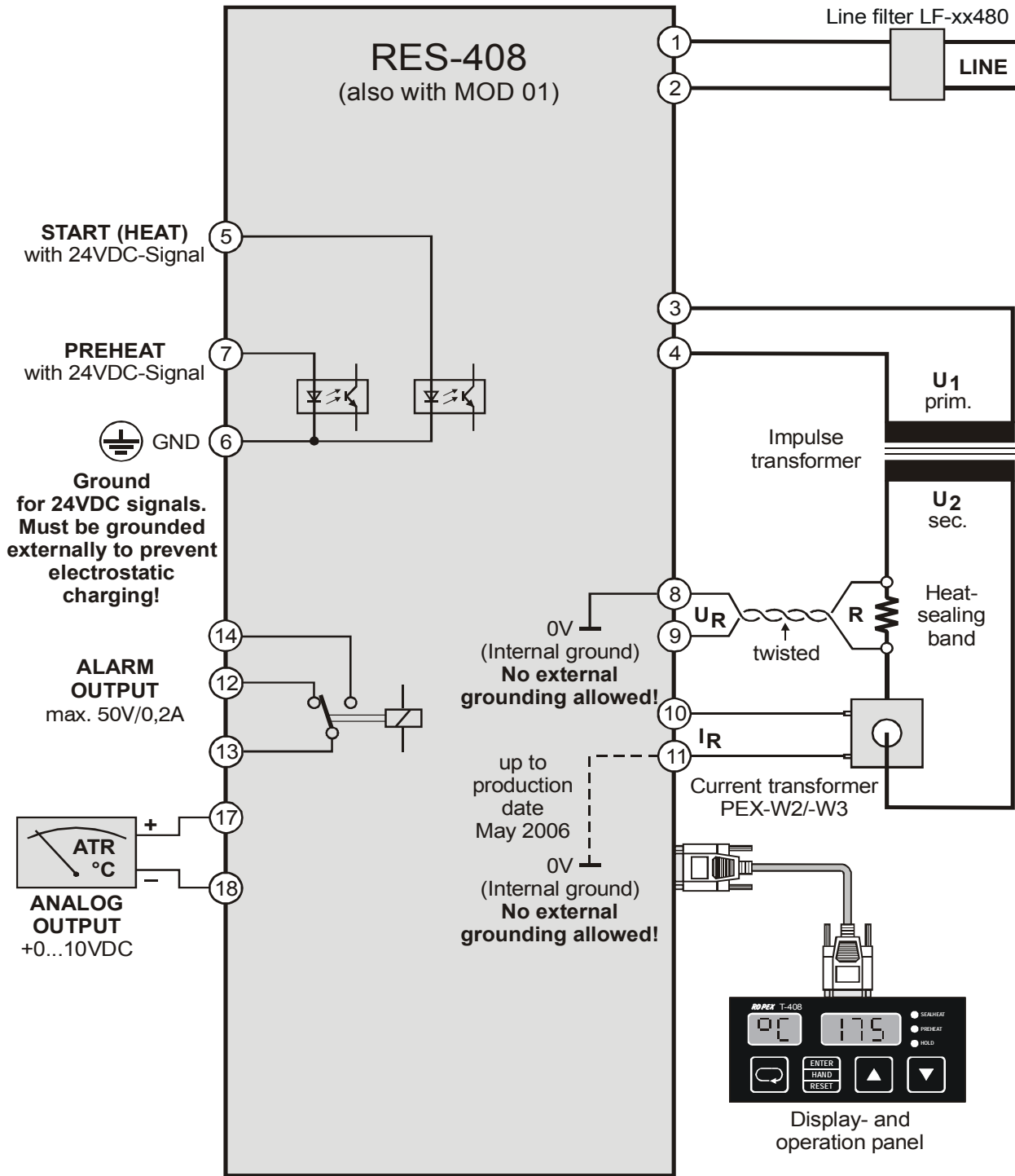
Up to production date March 2003 the standard output power circuit (terminals 3+4) has NO function when the booster-connection (MOD 26) is installed.
As of April 2003 the terminals 3+4 are active too when the booster-connection is installed.

9.7 Wiring diagram with booster connection (MOD 26)
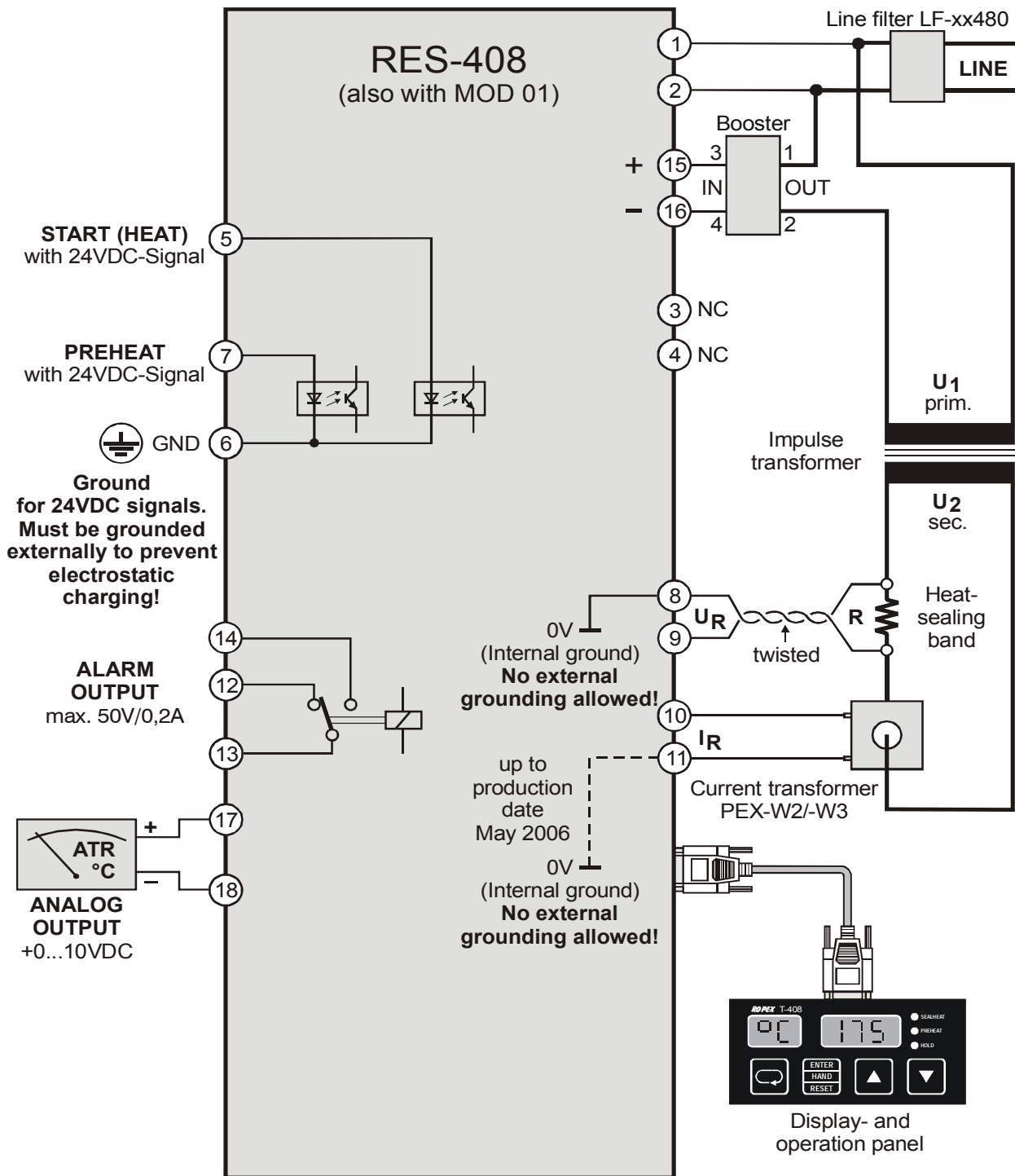
Up to production date March 2003 the standard output power circuit (terminals 3+4) has NO function when the booster-connection (MOD 26) is installed.
As of April 2003 the terminals 3+4 are active too when the booster-connection is installed.

10   Startup and operation

10.1   View of the controller

RES-408 controller

T-400 or T-408-1 terminal

10.2 Controller configuration

⚠️ **The controller must be switched off in order to configure the coding switches and plug-in jumpers.**

10.2.1 Configuration for secondary voltage and current

Automatic configuration (AUTORANGE)
(as of June 2006)

The secondary voltage and current ranges are automatically configured by the automatic calibration function (AUTOCAL). The voltage is configured in the range from 0.4 VAC to 120 VAC and the current in the range from 30 A to 500 A. If the voltage and/or current are out-side the permissible range, a detailed error message appears on the controller (🔖 see section 11.18 "Error messages" on page 38).
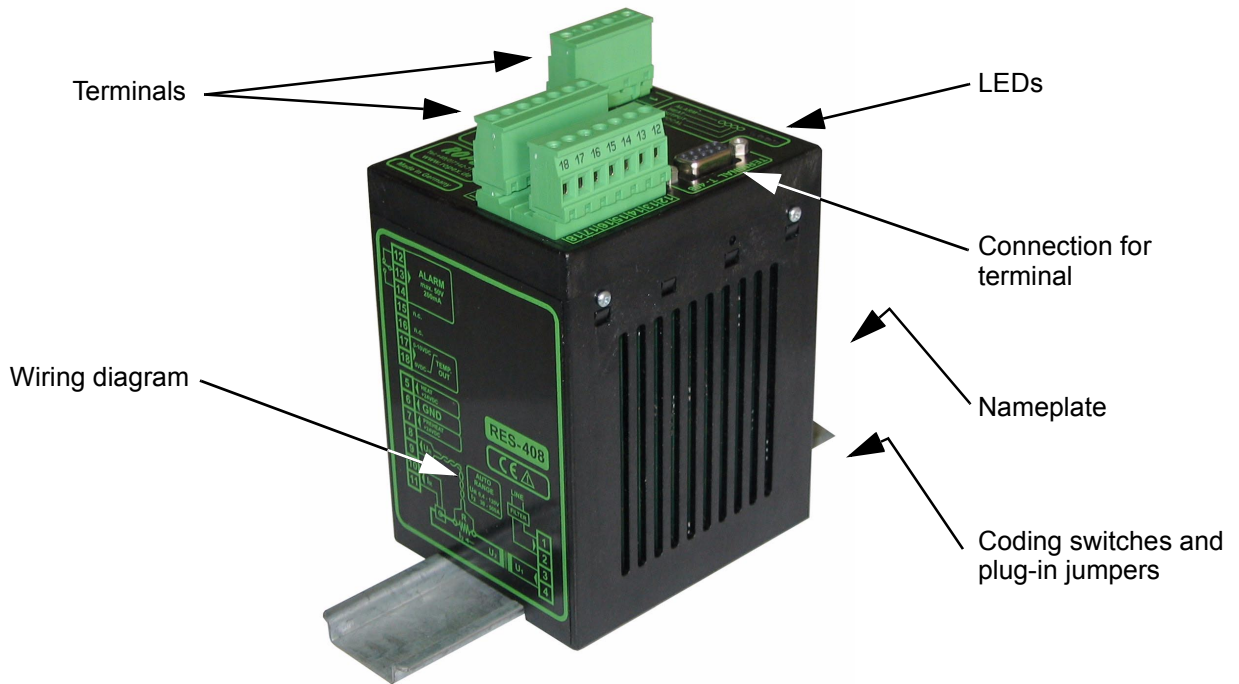
Configuration with coding switches
(up to May 2006)

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.**
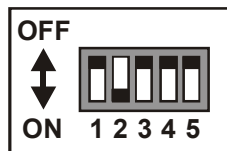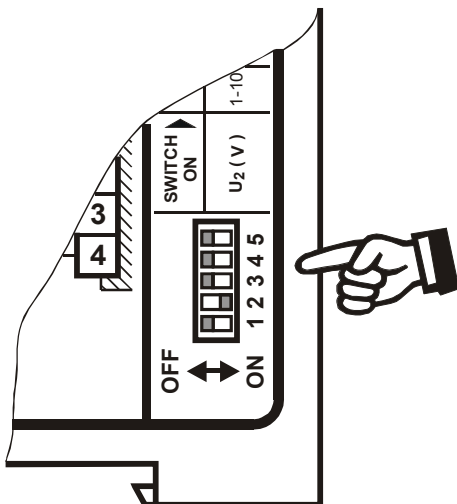
⇨ Factory settings

U_2 ⇩	DIP switch			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 I2 is less than 30 A, the PEX-W2 or PEX-W3 current transformer must have two turns (🔖 ROPEX Application Report).

2x

RES-408

10.2.2 Configuration of the rotary coding switch for the temperature range and alloy (as of June 2006)

Switch position	Temp. range	Temp. coefficient	Band alloy
0	300°C	1100ppm/K	e.g. Alloy-20
1	300°C	780ppm/K	e.g. Alloy L
4	500°C	1100ppm/K	e.g. Alloy-20
5	500°C	780ppm/K	e.g. Alloy L
8	300°C	3500ppm/K	e.g. NOREX
9	PC-CONFIGURATION		

0 = Factory settings

SWITCH POS.	TEMP. RANGE	ALLOY
0	300°C	1100ppm/K (A20)
1	300°C	780ppm/K (L)
4	500°C	1100ppm/K (A20)
5	500°C	780ppm/K (L)
8	300°C	3500ppm/K (NOREX)
9	PC CONFIGURATION	
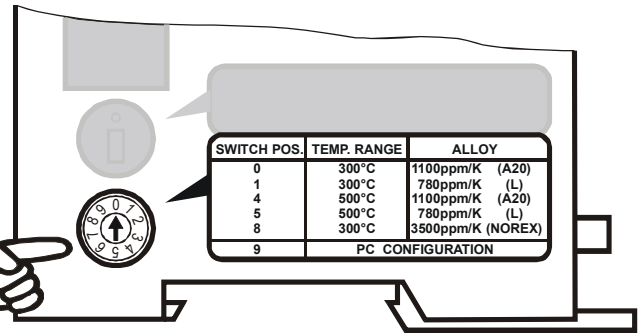
⚠ **This configuration is set as standard on all controllers manufactured as of June 2006. The settings are only possible on older controllers in conjunction with MOD 37 (⮎ section "MOD 37 (up to May 2006)" on page 8).**

If the switch is set to "9" (as of June 2006), other temperature ranges and alloys can be selected in the ROPEX visualization software (⮎ see section 11.16 "Diagnostic interface / visualization software (as of June 2006)" on page 37).

10.2.3 Configuration of the alarm relay

Alarm relay de-energized by alarm/PC-CONFIGURATION.

Alarm relay energized by alarm. (factory setting)

DE-ENERGIZED / PC AT ALARM
ENERGIZED
CONFIGURATION ALARM OUTPUT
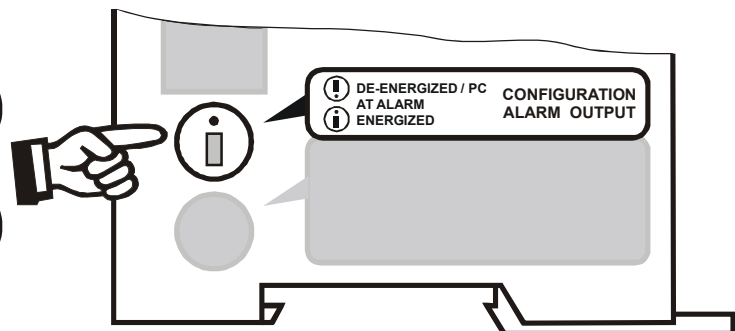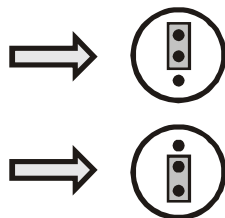
⚠ **If the plug-in jumper is not inserted on controllers manufactured up to May 2006, the alarm relay is permanently energized (alarm contact between terminals 13 and 14 closed). The other functions of the controller (e.g. heating the heatsealing band, AUTOCAL etc.) are not affected. If the plug-in jumper is not inserted on controllers manufactured as of June 2006 - or if it is incorrectly inserted - an error message appears when the controller is switched on (⮎ section 11.18 "Error messages" on page 38).**

If the "Alarm relay de-energized by alarm/PC CONFI-GURATION" position is selected (as of June 2006), the behavior of the alarm output can be configured more finely in the ROPEX visualization software (⮎ see section 11.16 "Diagnostic interface / visualization software (as of June 2006)" on page 37).

10.3 Heatsealing band

10.3.1 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 tempe-

rature coefficient TCR, i.e. one whose resistance increases as the temperature rises.

Too low a TCR leads to oscillation or uncontrolled heating.

If a heatsealing band with a higher TCR is used, the controller must be specially calibrated.

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 (⇖ section 10.3.2 "Burning in the heatsealing band" on page 22).

One very important design feature is the copper or silver-plating of the heatsealing band ends. Cold ends allow the temperature to be controlled precisely 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.**

10.3.2   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 a voltage equivalent to a temperature of 20°C at the actual value output. Adjust the set point to approximately 250°C and activate the "START" signal to heat for approximately 1 second. After recooling, the controller usually outputs an actual value of less than 20°C. Repeat the "AUTOCAL" function. The heatsealing band has now been burned in and the change in the alloying properties stabilized.

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

10.3.3   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.

10.4   Startup procedure

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

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

10.4.1   Initial startup

Prerequisites: The controller must be correctly installed and connected (⇖ section 9 "Installation" on page 13). Proceed as follows to start up the controller for the first time:

1. Switch off the line voltage and verify that all circuits are deenergized.

2. The supply voltage specified on the nameplate of the controller must be identical to the line voltage that is present in the plant or machine. The line frequency is automatically detected by the temperature controller in the range from 47 to 63 Hz.

3. In the case of controllers manufactured up to May 2006, the DIP switches on the controller must be set according to the ROPEX Application Report and depend on the heatsealing band that is used (section 10.2 "Controller configuration" on page 20).

4. Make sure that a START signal is not present.

5. Switch on the line voltage.

6. When the voltage is switched on, the yellow "AUTOCAL" LED lights up for approximately 0.3 seconds on all controllers manufactured as of June 2006 to indicate that the controller is being powered up correctly.

⚠️ **Controllers manufactured as of June 2006:**
If the red "ALARM" LED lights up for 0.3s in addition to the yellow "AUTOCAL" LED when the voltage is switched on, the configuration of this controller has been changed in the visualization software (⮡ section 11.16 "Diagnostic interface / visualization software (as of June 2006)" on page 37). In order to avoid malfunctions, please check the controller configuration before continuing the startup procedure.

7. One of the following states then appears:

Controllers manufactured as of June 2006:

"ALARM" LED	"OUTPUT" LED	ACTION
OFF	Short pulses every 1.2s	Go to 8
BLINKS fast (4 Hz)	OFF	Go to 8
Lit continuously	OFF	Fault diagnosis (⮡ section 11.18)

Controllers manufactured up to May 2006:

Alarm no.	"OUTPUT" LED	ACTION
---	Short pulses every 1.2s	Go to 8
Alarm no. 104…106, 211	OFF	Go to 8
Alarm no. 101…103, 107 108, 201…203 9xx	OFF	Fault diagnosis (⮡ section 11.18)

8. Activate the AUTOCAL function on the T-408-1 (or T-400) terminal while the heatsealing band is cold. "AC" blinks on the terminal display for the duration of the calibration process (approx. 10…15s) (the yellow "AUTOCAL" LED lights up as well on all controllers manufactured as of June 2006). A voltage of app. 0V appears at the same time at the actual value output (terminals 17+18). If an ATR-x is connected, it indicates 0…3°C.
When the zero point has been calibrated, the ter-

minal display returns to the home position and a voltage of 0.66V (300°C range) or 0.4V (500°C range) appears at the actual value output instead. If an ATR-x is connected, it must be set to "Z". The "AUTOCAL" LED goes out again on controllers manufactured as of June 2006.
If the zero point has not been calibrated successfully, an alarm is indicated on the terminal display. In addition, the red "ALARM" LED blinks slowly (1Hz) on all controllers manufactured as of June 2006. In this case the controller configuration is incorrect (⮡ section 10.2 "Controller configuration" on page 20 and ROPEX Application Report). Repeat the calibration after the controller has been configured correctly.

9. When the zero point has been calibrated successfully, select a defined SET temperature and activate the "START" signal (HEAT). The "SEAL-HEAT" LED on the terminal then lights up. The ACTUAL temperature appears on the display. The heating and control process can now be observed
The controller is functioning correctly if the temperature 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 11.18 "Error messages" on page 38.

10. Burn in the heatsealing band (⮡ section 10.3.2 "Burning in the heatsealing band" on page 22) and repeat the AUTOCAL function.

> ### The controller is now ready

10.4.2 Restart after replacing the heatsealing band

To replace the heatsealing band, proceed as described in section 10.3.2 "Burning in the heatsealing band" on page 22 .

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

Continue with section 10.4.1, steps 4 to 10.

11 Controller functions

11.1 Indicators and controls

11.1.1 Controllers manufactured as of June 2006

RES-408 controller

Red LED, lights up or blinks to indicate ALARM.

Yellow LED, lit during heating phase.

Green LED, indicates pulses in measurement mode. In control mode, luminous intensity is proportional to heating current.

Yellow LED, remains lit for duration of AUTOCAL process.
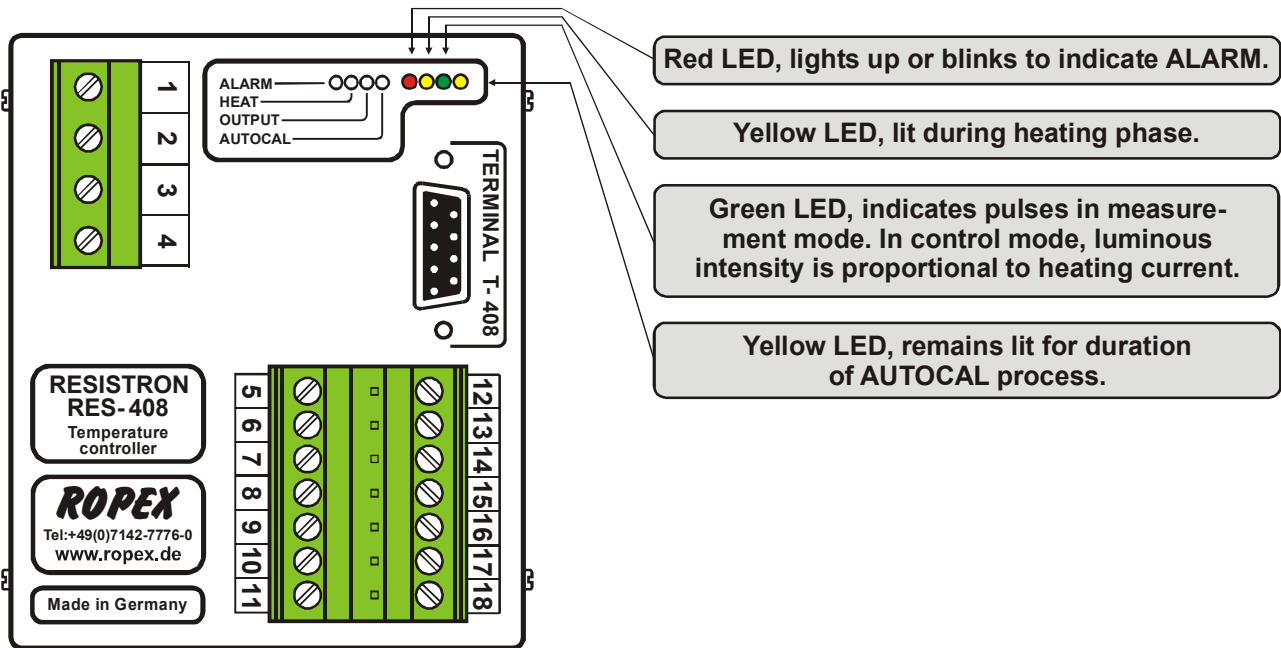
In addition to the functions shown in the diagram above, various operating states are indicated by the controller LEDs. These states are described in detail in the table below:

LED	Blinks slowly (1 Hz)	Blinks fast (4 Hz)	Lit continuously
AUTOCAL (yellow)	—	AUTOCAL requested, but function is locked	AUTOCAL executing
HEAT (yellow)	—	HEAT requested, but function is locked	START executing
OUTPUT (green)	In control mode, luminous intensity is proportional to heating current		
ALARM (red)	Configuration error, AUTOCAL not possible	Controller calibrated incorrectly, run AUTOCAL	Fault, ↳ section 11.18

T-408-1 terminal

LED display, 5 characters

① **Green LED:** Heatung up/temp. control to set temperature active
② **Yellow LED:** PREHEAT active
③ **Green LED:** Hold mode active

"UP" and "DOWN" keys for setting values
Press (< 2 sec.): Slow change
Hold (> 2 sec.): Fast change

"ENTER" key
ENTER function: Save values
HAND function: Manual mode
RESET function: Reset after alarm

"MENU" key for advancing to next menu step or switching menu
Press (< 2 sec.): Next menu step
Hold (> 2 sec.): Return to home position
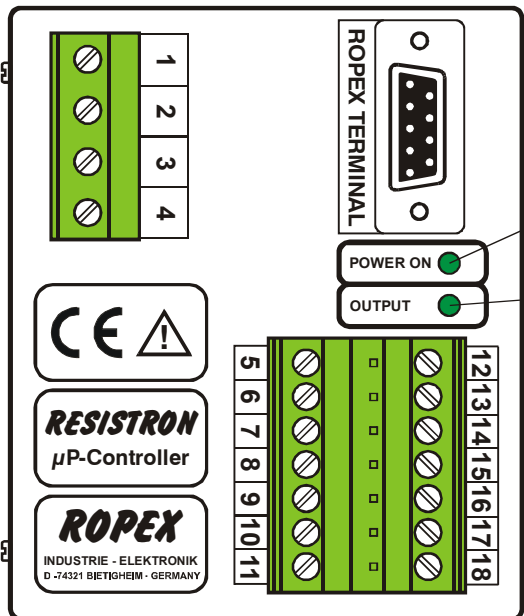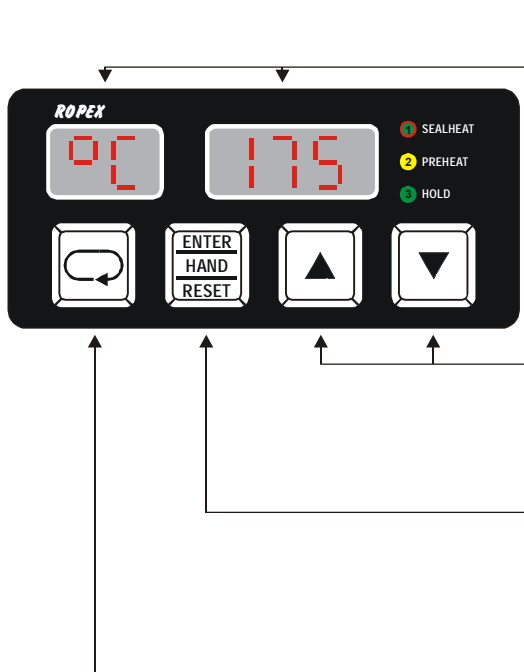
11.1.2 Controllers manufactured up to May 2006

RES-408 controller

Green LED, lit when power supply is ok.

Green LED, indicates pulses in measurement mode. In control mode, luminous intensity is proportional to heating current.

T-400 terminal

LED display, 5 characters

① Red/Green LED: Red, during heating up
                                  Green, set temp. achieved
② Yellow LED: PREHEAT active
③ Green LED: Hold mode active

"UP" and "DOWN" keys for setting values
 Press (< 2 sec.): Slow change
  Hold (> 2 sec.): Fast change

"ENTER" key
  ENTER function: Save values
  HAND function: Manual mode
  RESET function: Reset after alarm

"MENU" key for advancing to next menu step or switching menu
  Press (< 2 sec.): Next menu step
  Hold (> 2 sec.): Return to home position

11.2 Display

11.2.1 Power-up message

A power-up message appears on the display for appro-ximately 3 seconds when the controller is switched on. On controllers manufactured as of June 2006, this message shows the SW revision of the terminal for the first 1.5s (e.g.: 00.105) and the SW revision of the con-troller for the next 1.5s (e.g.: 00.105).
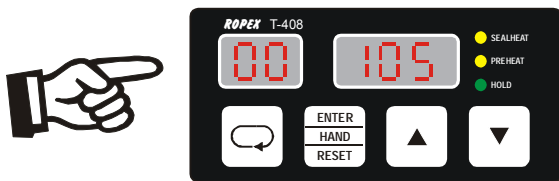
On controllers manufactured up to May 2006, the power-up message only shows "00 000".
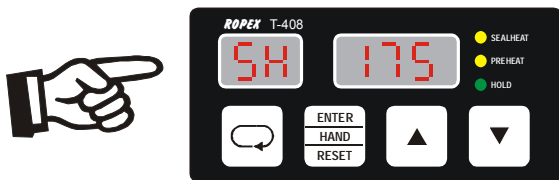
11.2.2 Display in home position

If no settings are entered on the controller and no alarm signal is indicated, the display is in the home position, in other words it shows the ACTUAL temperature.
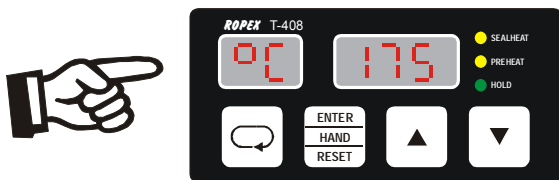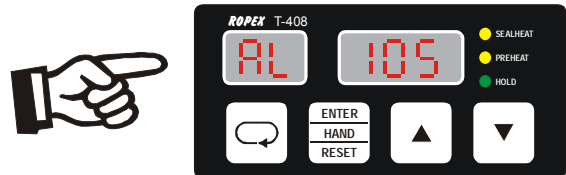

11.2.3 Settings menu

The required parameters are set in the Settings menu (↳ section 11.4 "Menu structure" on page 28)

11.2.4 Alarm signals

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 alarm signal (↳ section 11.17 "System monitoring / alarm output" on page 37).

11.3 Navigation in the menus

11.3.1 Navigation in menus without an alarm

A "MENU" key is provided for navigating through the various menu steps. By pressing this key briefly (<2s) at any time, you can jump to the next menu step. By pressing the key for longer (>2s), you can return to the home position from anywhere in the menu structure, providing a controller alarm is not active. In this case, the Alarm menu is opened.

In addition, you always return to the home position if you do not press any keys for a period of 30s. There is no automatic return after 30s from "AC" [**A**uto**C**al] or "AL" [**AL**arm].

11.3.2 Navigation in menus with an alarm

If an alarm is indicated, the terminal display shows the Alarm menu. Some faults can be acknowledged by pressing the "RESET" key (↳ section 11.17 "System monitoring / alarm output" on page 37). In this case, the display switches back to the home position.

If the fault can be rectified by executing the AUTOCAL function, you can select the "AC" [**A**uto**C**al] menu step directly by briefly pressing the "MENU" key (<2s). You can then activate the "AUTOCAL" function by pressing the "ENTER" key (↳ section 11.8 "Automatic zero cali-bration (AUTOCAL)" on page 32).

11.4   Menu structure
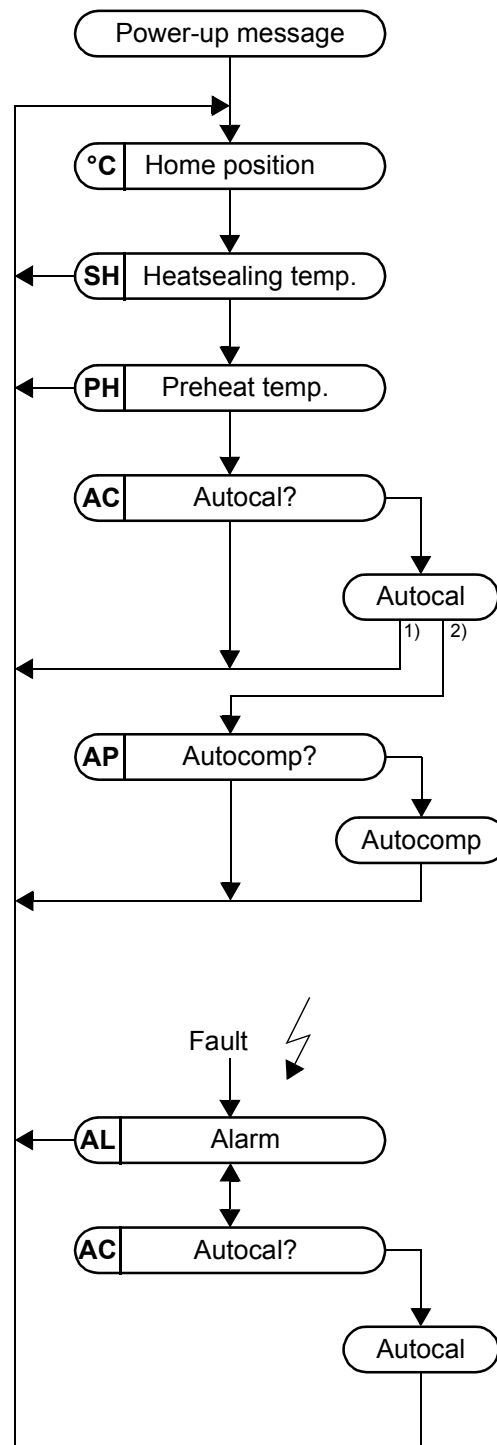
1) AUTOCOMP: OFF
2) AUTOCOMP: ON

RES-408

11.5   Menu steps

	Name	Description	Setting range
°C	Home position	The current actual value appears on the terminal display. The heatsealing band can be heated manually (to the specified heatsealing or preheat temperature) by pressing the "HAND" key.	
HA	[**HA**nd] Hand menu	The heatsealing band can be heated manually (to the specified heatsealing or preheat temperature) by pressing the "HAND" key. ⚠ **This menu step is only available on controllers manufactured up to December 2000.**	
SH	[**S**eal**H**eat] Heatsealing temperature	The required heatsealing temperature (set point) can be set with the "UP" and "DOWN" keys. <u>Controllers manufactured up to May 2006:</u> The maximum selectable set point is limited by the controller version (300°C or 500°C). <u>Controllers manufactured as of June 2006:</u> The maximum selectable set point is limited by the rotary coding switch (alloy/range) and/or the PC visualization software.	<u>Controllers manufactured up to May 2006:</u> 0…300°C or 0…500°C <u>Controllers manufactured as of June 2006:</u> 0, 40°C…maximum temperature
PH	[**P**re**H**eat] Preheat temperature	The required preheat temperature (PREHEAT) can be set with the "UP" and "DOWN" keys. <u>Controllers manufactured up to May 2006:</u> The preheat temperature must always be lower than the selected heatsealing temperature. <u>Controllers manufactured as of June 2006:</u> The maximum selectable preheat temperature is limited by the rotary coding switch (alloy/range) and/or the PC visualization software. The preheat function can be deactivated by entering 0°C.	<u>Controllers manufactured up to May 2006:</u> 0°C…set point <u>Controllers manufactured as of June 2006:</u> 0, 40°C…maximum temperature

	Name	Description	Setting range
AC	[**A**uto**C**al] Automatic calibration AUTOCAL	The AUTOCAL function matches the controller to the current and voltage signals that are present in the system. The required calibration temperature can be set with the "UP" and "DOWN" keys on controllers manufactured as of June 2006. Pressing the "ENTER" key stores the set value and starts the "AUTOCAL" function. On controllers manufactured up to May 2006, the calibration temperature is set to a fixed value of 20°C by pressing the "ENTER" key. "AC" blinks on the display while the AUTOCAL function is executing. When the controller has been calibrated successfully, the display switches back directly to the home position providing the "AUTO-COMP" function is deactivated. If "AUTOCOMP" is active, the display jumps to the AP step. If the controller cannot be calibrated, the AUTOCAL function is aborted and an error message is displayed instead.	Controllers manufactured up to May 2006: Setting not possible Controllers manufactured as of June 2006: 0…40°C
AP	[**A**utocom**P**] Automatic phase compensation AUTOCOMP	Pressing the "ENTER" key starts the "AUTO-COMP" function. If the "ENTER" key is not pressed within 2s, the display returns to the home position. This step is automatically displayed if the "AUTOCAL" function is successfully executed and "AUTOCOMP" is active.	
HO	[**HO**ld] Hold mode	If Hold mode ("On") is activated, the last measured value at the end of the heating phase is stored and displayed on the terminal. The "HOLD" LED lights up on the terminal when hold mode is active. This procedure is repeated in every cycle and the displayed value is updated. Controllers manufactured as of June 2006: If you select the "On2" function, the display switches back from hold mode to the actual value in real time after 2 seconds. The hold function is activated again for 2 seconds at the end of the next cycle.	Controllers manufactured up to May 2006: On OFF Controllers manufactured as of June 2006: On On2 OFF

RES-408

|	Name	Description	Setting range
AL	[**AL**arm] Alarm menu	If an alarm is indicated, the controller shows the Alarm menu. Some faults can be acknowledged by pressing the "RESET" key. In this case, the controller switches back to the home position. If the fault can be rectified by executing the AUTOCAL function, you can select the "AC" [**A**uto**C**al] menu step directly by briefly pressing the "MENU" key (<2s). You can then activate the "AUTOCAL" function by pressing the "ENTER" key. ⚠️ **This step is included in the menu structure of all controllers manufactured up to May 2006. If no alarm signal is indicated, the display shows "000". On controllers manufactured as of June 2006, this step only appears if an alarm is indicated.**	

11.6 Temperature setting (set point selection)

The heatsealing temperature can be set on the RES-408 controller with the setting in the "SH" [**S**eal-**H**eat] menu step.

The set point selected for the heatsealing temperature must be greater than 40°C. If not, the heatsealing band is not heated when the "START" signal is activated or the "HAND" key is pressed. The 1…39°C setting range is not available on controllers manufactured as of June 2006.
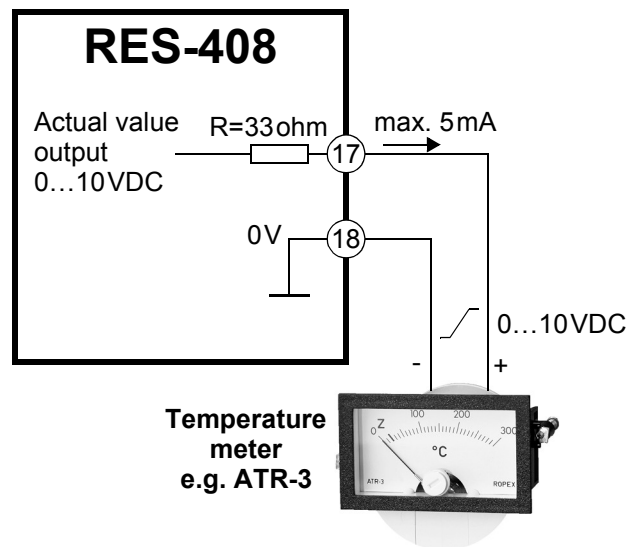
11.7 Temperature indication / actual value output

If the display is in the home position ("°C"), the ACTUAL temperature is indicated.
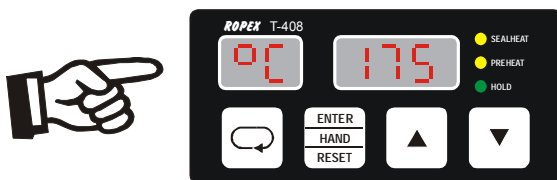
The heating and control process can thus be observed at any time.

In addition, the RES-408 controller outputs an analog 0…10VDC signal, which is proportional to the real ACTUAL temperature, at terminals 17+18.
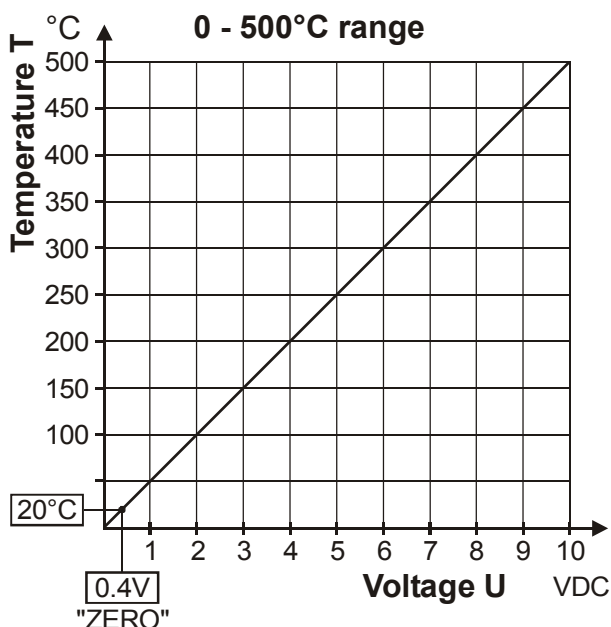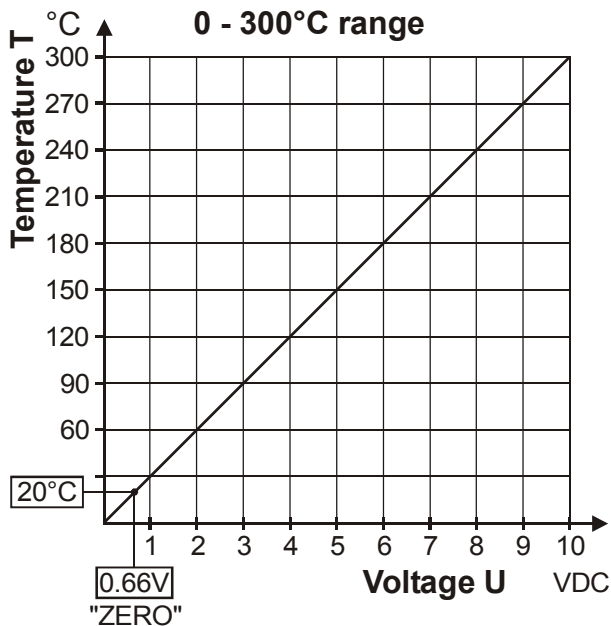
Voltage values:

0 VDC → 0 °C

10 VDC → 300 °C or 500 °C

(depending on the controller configuration)

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

0 - 300°C range

0 - 500°C range

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

The characteristics of the ROPEX ATR-x temperature meter (size, scaling, dynamic response) are optimized for this application (✎ section 5 "Accessories and modifications" on page 6).

The meter not only facilitates SET-ACTUAL comparisons, but also enables other criteria such as the heating rate, set point reached within the specified time, cooling of the heatsealing band etc. to be evaluated.

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

If an alarm is signaled, this analog output is used – in addition to the terminal display – to show a selective error message on controllers manufactured as of June 2006 (✎ section 11.18 "Error messages" on page 38). On controllers manufactured up to May 2006, no alarm signals appear at the analog output. In the event of an alarm, the last ACTUAL temperature continues to be indicated at the analog output.

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

11.8 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 in the "AC" [**A**uto**C**al] step by pressing the "ENTER" key.

On controllers manufactured as of June 2006, the currently valid initial temperature (ambient temperature) of the heatsealing bar(s) required for calibration can be preset in the 0…40 °C range using the "UP" and "DOWN" keys.

The zero point is calibrated in the factory to 20 °C.

The automatic calibration process takes around 10…15 seconds. The heatsealing band is not heated. "AC" blinks on the display while the "AUTOCAL" function is executing. The actual value output (terminals 17+18) is set to 0…3 °C (corresponds to approximately 0 VDC) until the function has ended.

If the temperature of the heatsealing band varies on controllers manufactured as of June 2006, the "AUTOCAL" function is executed a maximum of three

times. If the function still cannot be terminated successfully, an error message appears (✎ section 11.18 "Error messages" 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 locked AUTOCAL function:

1. The "AUTOCAL" function cannot be activated if the heatsealing band cools down at a rate of more than 0.1 K/s. This is additionally indicated in the "AC" [**A**uto**C**al] step by the message "no1" (up to May 2006: "no").

2. If the "START" signal is activated, the "AUTOCAL" function is not executed. This is additionally indicated in the "AC" [**A**uto**C**al] step by the message "no2" (up to May 2006: "no").

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 is indicated (✎ section 11.18 "Error messages" 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, 801, or 9xx.

11.9 Heating to the heatsealing temperature (HEAT)

When the "START" signal is activated, the controller-internal set/actual comparison is performed immediately and the heatsealing band is heated to the SET temperature (the "PREHEAT" signal must be deactivated). It remains at this temperature until the signal is deactivated again. This process can also be started independently of the "START" signal by pressing the "HAND" key while the display is in the home position (on controllers manufactured up to December 2000, the same effect can be achieved by pressing the "HAND" key in the "HA" [**HA**nd] step).

The "START" signal is activated by applying a 24 VDC signal at terminals 5+6.
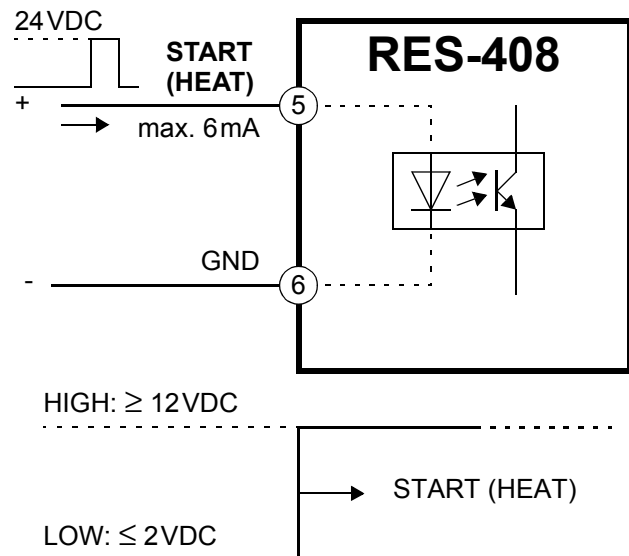
⚠ **The "START" signal is disabled as long as the "AUTOCAL" function is executing in the "AC" step.**

On controllers manufactured as of June 2006, the set point selected for the heatsealing temperature ("SH" [**S**eal**H**eat]) step) must be greater than 40 °C. If not, the heatsealing band is not heated up.
The "SEALHEAT" LED on the T-400 or T-408-1 terminal lights up during the heating and control process until the heatsealing temperature is reached.
The alarm relay is switched if the "START" signal is activated while an alarm signal is indicating error codes 104…105, 111…113 or 211 (✎ section 11.18 "Error messages" on page 38). The heatsealing band is not heated.

⚠ **If a "PREHEAT" signal is used, it must be deactivated during the heating and control process. If not, the heatsealing band is heated to the set preheat temperature instead of the heatsealing temperature (✎ section 11.10 ""PREHEAT" signal" on page 34).**
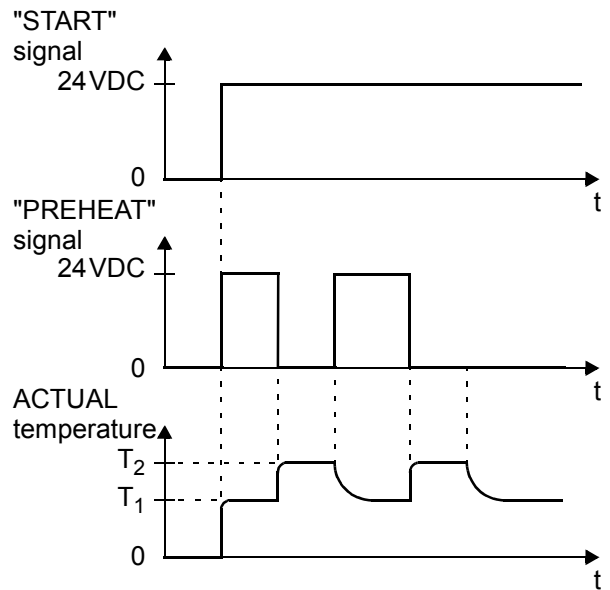
11.10 "PREHEAT" signal

The heatsealing band can be heated to a specified pre-heat temperature with the "PREHEAT" function, in order to shorten the heating time to the selected SET temperature in time-critical applications.

The preheat temperature is set with the "PH" [**P**re**H**eat] step in the Settings menu. The value selected for the preheat temperature must be greater than 40°C. If not, the heatsealing band is not heated when the "START" signal is activated or the "HAND" key is pressed. The 1…39°C setting range is not available on controllers manufactured as of June 2006.

The "PREHEAT" signal is activated by applying a 24 VDC signal at terminals 7+6.
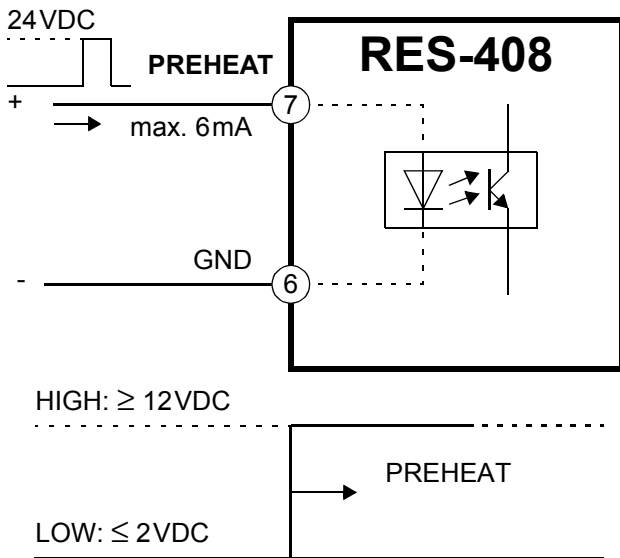
⚠️ **The heatsealing band is heated to the preheat temperature if the "START" and "PREHEAT" signals are active. In this case, the "PREHEAT" LED on the T-400 or T-408-1 terminal lights up.**

T_1 = Preheat temperature (PREHEAT)
T_2 = Heatsealing temperature

The heatsealing band is heated to the set preheat temperature if the "HAND" key is pressed and the "PRE-HEAT" signal is activated when the terminal display is in the home position. The "PREHEAT" LED then lights up. On controllers manufactured up to December 2000, the same effect can be achieved by pressing the "HAND" key in the "HA" [**HA**nd] step.

11.11 Hold mode

The behavior of the ACTUAL temperature display in the home position can be changed with the "HO" [**HO**ld] step. The following settings are possible:

1. **"OFF"** [1]

   If the home position is visible on the display, the real ACTUAL temperature is always indicated.

2. **"On"**

   If the display is in the home position, the ACTUAL temperature that was valid at the end of the last heatsealing phase is always indicated as a digital value. When the controller is powered up, the real ACTUAL temperature is shown until the end of the first heating phase.

---

1. Factory setting

3. **"On2"**
   This setting is available on controllers manufactured as of June 2006.
   It causes the current ACTUAL temperature to be displayed for an additional 2 seconds at the end of a heatsealing phase. This temperature is then indicated again in real time until the end of the next heatsealing phase.

⚠ **Hold mode only affects the value on the display. The ACTUAL temperature is always indicated in real time, regardless of the setting, at the actual value output.**

The various hold modes are shown below:

START signal

ACTUAL temperature

ACTUAL indication

Hold OFF

Hold On

Hold On2

End of Heatsealing phase
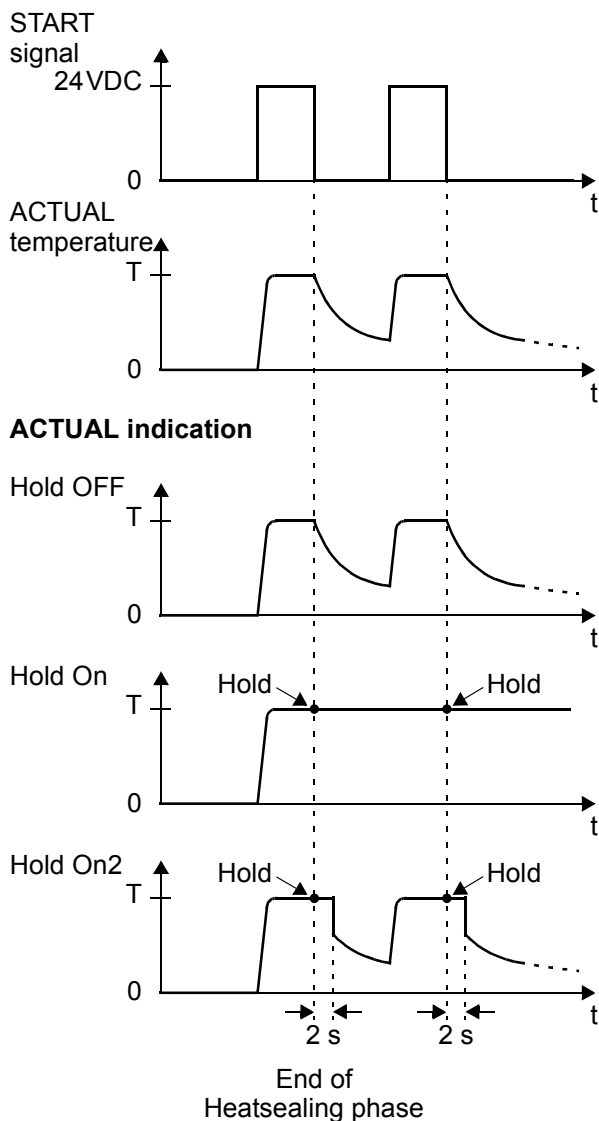
The "HOLD" LED on the terminal lights up if a temperature value is indicated in hold mode.

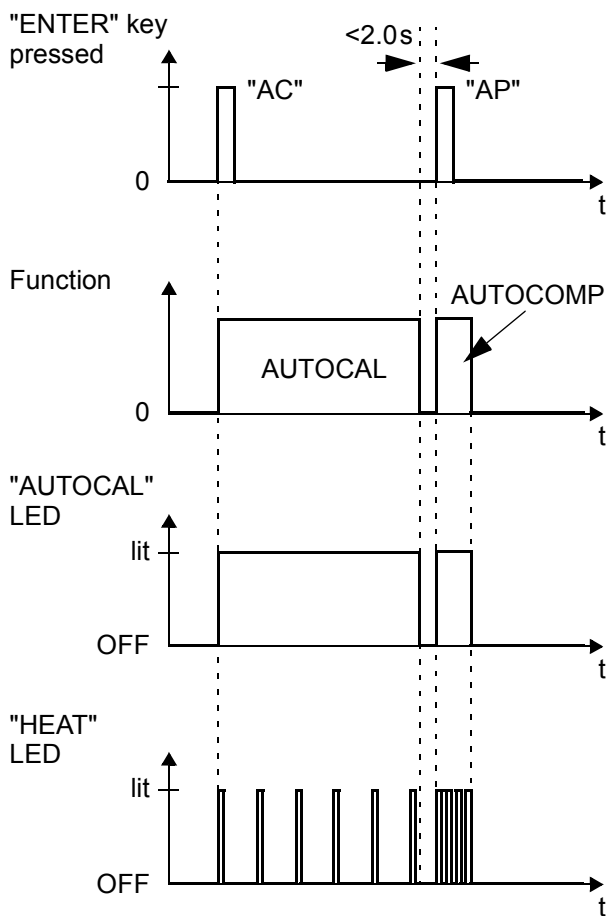## 11.12 Measuring impulse duration (as of June 2006)

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 11.16 "Diagnostic interface / visualization software (as of June 2006)" on page 37).**

11.13 Automatic phase compensation (AUTOCOMP) (as of June 2006)

It may be necessary to compensate the phase angle displacement between the U_R and I_R measuring signals in certain heatsealing applications (⬑ ROPEX Application Report). The "AUTOCOMP" function is provided for this purpose. It is activated by pressing the "ENTER" key after the "AUTOCAL" function has been successfully executed (⬑ section 11.18 "Error messages" on page 38). The interval after the end of the "AUTOCAL" function must be less than 2.0 s ("AP" appears on the terminal display during this time and the three decimal points light up). The "AUTOCOMP" function only takes around 2.0 s ("AP" appears on the terminal display and the three decimal points light up consecutively).
If the interval following a successful "AUTOCAL" function is longer than 2.0 s, the display returns to the home position without executing the „AUTOCOMP" function.

"ENTER" key pressed

"AC"   <2.0s   "AP"

0   t

Function

AUTOCOMP

AUTOCAL

0   t

"AUTOCAL" LED

lit

OFF   t

"HEAT" LED

lit

OFF   t

The "HEAT" LED blinks repeatedly when the "AUTO-COMP" function is executed and the actual value output (terminals 17+18) is set to 0…3°C (i.e.approx. 0VDC).

⚠ **The "AUTOCOMP" function must be activated in the ROPEX visualization software (↻ section 11.16 "Diagnostic interface / visualization software (as of June 2006)" on page 37) (default setting: AUTOCOMP off).**

11.14 Temperature diagnosis (as of June 2006)

An additional temperature diagnosis can be activated in the ROPEX visualization software (↻ section 11.16 "Diagnostic interface / visualization software (as of June 2006)" on page 37). The RES-408 checks whether the ACTUAL temperature is within a settable tolerance band ("OK" window) on either side of the SET temperature. The lower ($\Delta\vartheta_{lower}$) and upper ($\Delta\vartheta_{upper}$) tolerance band limits are configured in the factory to -10K and +10K. These values can be set independently of one another in the ROPEX visualization software.

If the ACTUAL temperature is inside the specified tolerance band when the "START" signal is activated, the temperature diagnosis is activated as well. If the ACTUAL temperature leaves the tolerance band, the corresponding error code (307 or 308) is indicated and the alarm relay is switched (↻ section 11.18 "Error messages" on page 38).

ACTUAL temp.

Set+$\Delta\vartheta_{upper}$

Set

Set+$\Delta\vartheta_{lower}$
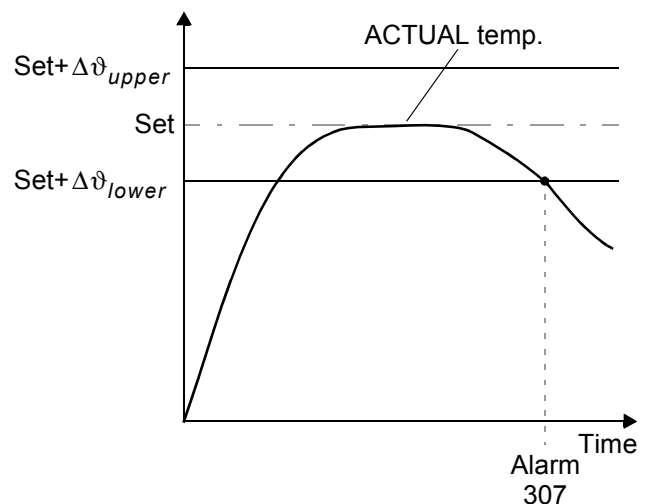
Time
Alarm
307

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 alarm relay is switched. 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 selectively deactivated, e.g. if the temperature drops temporarily owing to the closure of the sealing jaws.

11.15 Heatup timeout (as of June 2006)

An additional heatup timeout can be activated in the ROPEX visualization software (⤷ section 11.16 "Diagnostic interface / visualization software (as of June 2006)" on page 37).
This timeout starts when the START signal is activated. The RES-408 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 alarm relay is switched (⤷ section 11.18 "Error messages" on page 38).
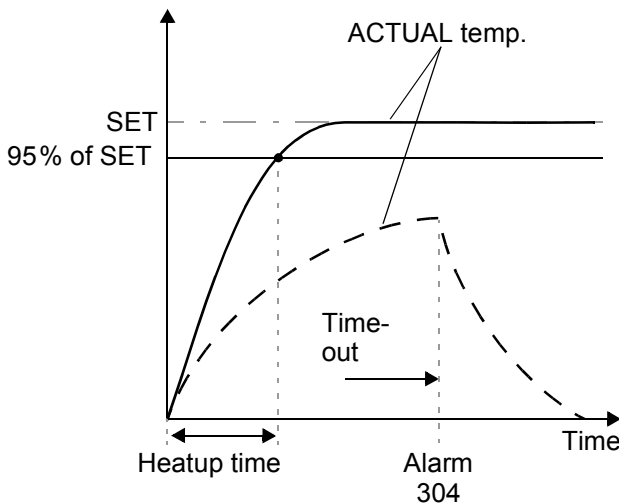
11.16 Diagnostic interface / visualization software (as of June 2006)

An interface with a 6-pole Western socket is provided for system diagnostics and process visualization. This interface allows a data connection to be set up to the ROPEX visualization software using the ROPEX CI-USB-1 communication interface.
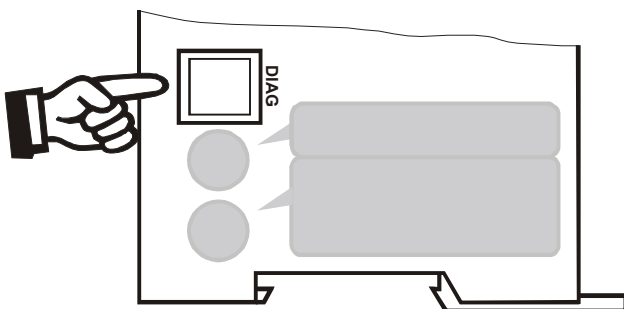
⚠ **Only a ROPEX communication interface is allowed to be connected to the diagnostic interface. Connecting another device (e.g. a telephone cable) could result in malfunctions or damage to the controller.**

The ROPEX visualization software is described in a separate document.

11.17 System monitoring / alarm output

To increase operating safety and avoid faulty heat-sealing, this controller incorporates special hardware and software features that facilitate fault diagnosis and selective error messages. 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 indications:

A.) Error message on the terminal display:
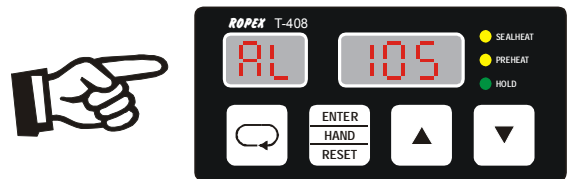
The cause of a fault can be localized quickly and easily with the help of the error code that appears on the display. Please refer to section 11.18 "Error messages" on page 38 for a list of possible error codes.

B.) Controllers manufactured as of June 2006: Red "ALARM" LED on the controller with three states:

1. **Blinking fast (4 Hz)**
   The "AUTOCAL" function should be executed (error codes 104…106, 211, 302, 303).

2. **Blinking slowly (1 Hz)**
   The system configuration is incorrect and the zero calibration (AUTOCAL function) was therefore unsuccessful (⤷ section 10.2 "Controller configuration" on page 20). This corresponds to error codes 111…114.

3. **Lit continuously:**
A fault is preventing the controller from being started up (error codes 101…103, 107, 108, 201…203, 307…310, 801, 9xx).
Also in instances 1 and 2 if the "START" signal is activated simultaneously.
As a rule, this refers to an external wiring fault.

C.) Alarm relay (relay contact terminals 12, 13, 14):

The alarm relay is set in the factory as follows:

- **DE-ENERGIZED** in operating states B.1 and B.2, but energized if a "START" signal is activated in one of these states.

- **ENERGIZED** in operating state B.3.

If the alarm relay is configured differently from the factory setting (⮡ section 10.2.3 "Configuration of the alarm relay" on page 21), these states are inverted.

D.) Controllers manufactured as of June 2006: Error code appears at the 0 to 10VDC actual value output (terminals 17+18):

Since the temperature no longer needs to be indicated if a fault occurs, the actual value output is used to display error codes in the event of an alarm.
13 voltage levels are offered for this purpose in the 0…10VDC range, each of which is assigned an error code (⮡ section 11.18 "Error messages" on page 38).
If a state that requires "AUTOCAL" occurs – or if the controller configuration is incorrect – (error codes 104…106, 111…114, 211, 302, 303), the actual value output jumps back and forth at 1Hz between the voltage value that corresponds to this error and the end of the scale (10VDC, i.e 300°C or 500°C). If the "START" signal is activated in one of these states, the voltage value does not change any more.
Selective fault detection and indication can thus be implemented simply and inexpensively using the analog input of a PLC with a corresponding error message (⮡ section 11.18 "Error messages" on page 38).

⚠ **An alarm can only be reset by pressing the "RESET" key or by switching the controller off and then on again. The alarm is not reset until the key is released.**
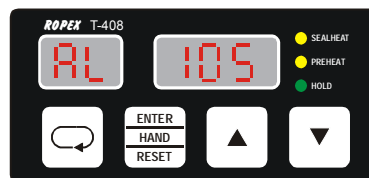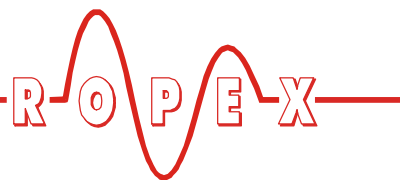

⚠ **Invalid alarm signals may appear when the controller is switched off owing to the undefined operating state. This must be taken into account when they are evaluated by the higher-level controller (e.g. a PLC) in order to avoid false alarms.**

11.18 Error messages

The table below shows how the analog voltage values that appear at the actual value output are assigned to the faults that have occurred. It also describes each fault and the required corrective action. The error messages are listed in two separate tables for controllers "up to May 2006" and "as of June 2006". The block diagram in section 11.19 "Fault areas and causes" on page 43 permits each fault to be cleared quickly and efficiently.
13 voltage levels for fault diagnostics appear at the actual value output of all controllers manufactured as of June 2006. The error messages are differentiated even more finely in the controller. The error codes described below can be displayed in the ROPEX visualization software (⮡ section 11.16 "Diagnostic interface / visualization software (as of June 2006)" on page 37) to facilitate troubleshooting.

⚠ **If the actual value output is evaluated in order to identify an error message - in the higher-level controller, for instance - the tolerance window must be adjusted to prevent it from being incorrectly interpreted. Please note the tolerances of the actual value output (⮡ section 6 "Technical data" on page 9).**

Part 1 of 3: Error messages as of June 2006

Error code	Act. value output; Voltage [V]	Temp. 300°C [°C]	Temp. 500°C [°C]	ALARM LED	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)	0.66	20	33			I_R signal missing	Fault area ①	Fault area ①
2 (102)	1.33	40	66			U_R signal missing	Fault area ③	Fault area ③
3 (103)	2.00	60	100			U_R and I_R signals missing	Fault area ②	Fault area ② ⑨
(107) (108)						Temperature step, down / Temperature step, up	Fault area ④ ⑤ ⑥ (loose contact)	Fault area ④ ⑤ ⑥ (loose contact)
4 (307) (308) (309) (310)	2.66	80	133	Lit continuously	Energized	Temperature too low/high (↳ section 11.14)		
5 (201) (202) (203)	3.33	100	166			Frequency fluctuation, inadmissible line frequency	Check power supply	Check power supply
6 (304)	4.00	120	200			Heatup time too long (↳ section 11.15)	Run **RESET**	Run **RESET**
7 (901) (913) (914) (915) (916)	4.66	140	233			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
(917) (918)						Plug-in jumper for alarm output wrong	Check plug-in jumper	Check plug-in jumper

Part 2 of 3: Error messages as of June 2006

NOTE: The specified error messages are initially output as warnings (actual value output jumps back and forth between two values; alarm LED blinks; alarm relay is de-energized). When the "START" signal is activated, the warning changes to a fault (actual value output no longer jumps back and forth, see **bold italic values**; alarm LED lit continuously; alarm relay is energized.

Error code	Act. value output; Volt. [V]	Temp. 300°C [°C]	Temp. 500°C [°C]	ALARM LED	STATUS of alarm relay (factory set.)	Cause	Action if machine started for first time	Action if machine already operating, HS band not chang.
(104)	**5.33** ↘ / 10 ↗	**160** ↘ / 300 ↗	**266** ↘ / 500 ↗	Warning: Blinks fast (4Hz)	Warning: De-Energized	I_R signals incorrect, incorrect specification of impulse-transformer		
(105)	**6.00** ↘ / 10 ↗	**180** ↘ / 300 ↗	**300** ↘ / 500 ↗			U_R signals incorrect, incorrect specification of impulse-transformer	Run **AUTOCAL**, Check specification of transformer, Fault area ⑦⑧	Fault area ④⑤⑥ (loose contact)
8 (106)	**6.66** ↘ / 10 ↗	**200** ↘ / 300 ↗	**333** ↘ / 500 ↗	Fault: Lit continuously	Fault: Energized (voltage value at actual value output then no longer changes)	U_R and/or I_R signals incorrect, incorrect specification of impulse-transformer		
(302)	**7.33** ↘ / 10 ↗	**220** ↘ / 300 ↗	**366** ↘ / 500 ↗			Temperature too low, AUTOCAL wasn't performed, loose contact, ambient temp. fluctuates	Run **AUTOCAL** and/or fault area ④⑤⑥ (loose contact)	
(303)	**8.00** ↘ / 10 ↗	**240** ↘ / 300 ↗	**400** ↘ / 500 ↗			temperature too high, AUTOCAL wasn't performed, loose contact, ambient temp. fluctuates		
9 (211)						Data error	Run **AUTOCAL**	---

RES-408

## Part 3 of 3: Error messages as of June 2006

NOTE: The specified error messages are initially output as warnings (actual value output jumps back and forth between two values; alarm LED blinks; alarm relay is de-energized). When the "START" signal is activated, the warning changes to a fault (actual value output no longer jumps back and forth, see **bold italic values**; alarm LED lit continuously; alarm relay is energized).

Error code		Act. value output; Volt. [V]	Temp. 300°C [°C]	Temp. 500°C [°C]	ALARM LED	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)	↗ **6.66** ↘ 10	↗ **200** ↘ 300	↗ **333** ↘ 500	Warning: Blinks slowly (1 Hz)	Warning: De-Energized	I_R signal incorrect, calibration not possible	Fehlerbereich ⑧, Konfiguration prüfen	---
11	(112)	↗ **7.33** ↘ 10	↗ **220** ↘ 300	↗ **366** ↘ 500			U_R signal incorrect, calibration not possible	Fehlerbereich ⑦, Konfiguration prüfen	---
12	(113)	↗ **8.00** ↘ 10	↗ **240** ↘ 300	↗ **400** ↘ 500	Fault: Lit continuously	Fault: Energized (voltage value at actual value output then no longer)	U_R and I_R signals incorrect, calibration not possible	Fehlerbereich ⑦⑧, Konfiguration prüfen	---
13	(114)	↗ **8.66** ↘ 10	↗ **260** ↘ 300	↗ **433** ↘ 500			Temperature fluctuates, calibration not possible		

Error codes up to May 2006

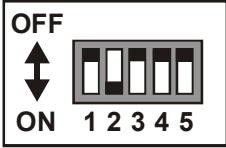| Error code	STATUS of alarm relay (factory setting)	Cause	Action if machine started for first time	Action if machine already operating, HS band not chang.
101	Energized	I_R signal missing	Fault area ①	Fault area ①
102		U_R signal missing	Fault area ③	Fault area ③
103		U_R and I_R signals missing	Fault area ②	Fault areas ② ⑨
107 108		Temperature step	Fault areas ④ ⑤ ⑥ (loose contact)	Fault areas ④ ⑤ ⑥ (loose contact)
201 202 203		Frequency fluctuation, inadmissible line frequency	Check power supply	Check power supply
801		Internal fault	Run **RESET**	Run **RESET**
9xx		Internal fault, controller defective	Replace controller	Replace controller
104 105 106 AC	De-energized, will be energized with "START" signal (voltage value at actual value output then no longer changes)	U_R and/or I_R signal incorrect	Run **AUTOCAL**	Fault areas ④ ⑤ ⑥
211		Data error	Run **AUTOCAL**	---
111		I_R signal incorrect, calibration not possible	Fault area ⑧, check configuration	---
112		U_R signal incorrect, calibration not possible	Fault area ⑦, check configuration	---
113		U_R and I_R signals incorrect, calibration not possible	Fault areas ⑦ ⑧, check configuration	---

RES-408

11.19   Fault areas and causes
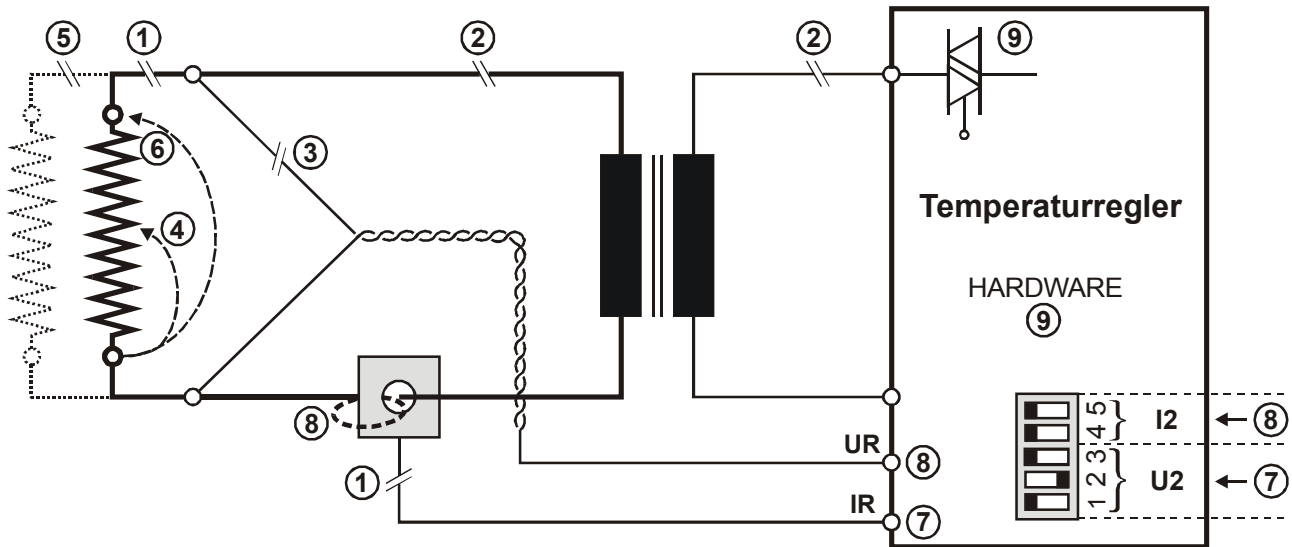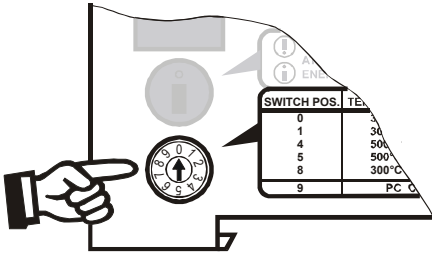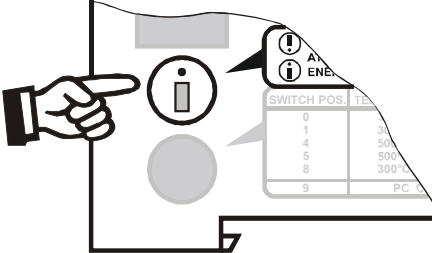
The table below explains the possible fault causes.

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 wires from current transformer interrupted
②	Primary circuit interrupted	- Wire break, triac in controller defective - Primary winding of impulse transformer interrupted
	Secondary circuit interrupted before U_R pickoff point	- Wire break - Secondary winding of impulse transformer interrupted
③	U_R signal missing	- Measuring 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 May 2006: DIP switches 1 - 3 configured incorrectly (U_2 range) - As of June 2006: U_2 outside permissible range from 0.4…120VAC

Fault area	Explanation	Possible causes
⑧	I_R signal incorrect	- Up to May 2006: DIP switches 4 + 5 configured incorrectly (I_2 range) - As of June 2006: 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) - Plug-in jumper for alarm output not connected or incorrectly connected

12   Factory settings

The RES-408 RESISTRON temperature controller is configured in the factory as follows:

DIP switches for secondary voltage U_2 and current I_2 (up to May 2006)	OFF ⬆⬇ ON 1 2 3 4 5	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 AUTORANGE function on all controllers manufactured as of June 2006.
<u>Rotary coding switch</u> for heatsealing band alloy and temperature range (as of June 2006)		Heatsealing band alloy: Alloy A20 Temperature range: 300°C Maximum temperature: 300°C Rotary coding switch: "0" position
<u>Plug-in jumper</u> for alarm relay		Relay closed by alarm
Automatic phase compensation (AUTOCOMP) [X]		AUTOCOMP: OFF

Measuring impulse duration [X]		Measuring impulse duration: 1.7 ms
Temperature diagnosis [X]		Temperature diagnosis: OFF
Heatup timeout [X]		Heatup timeout: OFF

[X] As of June 2006:
Only in ROPEX visualization software

13 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.

14 How to order

Controller RES - 408 / . . . V AC

> **115**: Line voltage 115 VAC, Art. No. 740841
> **230**: Line voltage 230 VAC, Art. No. 740842
> **400**: Line voltage 400 VAC, Art. No. 740843

Scope of supply: Controller includes connector plug-in parts
(without terminal and current transformer)

Terminal T-408-1

Art. No. 885441

Scope of supply: Terminal with fixing clips

Sub-D connecting cable

> **2m**: Art. No. 884202
> **5m**: Art. No. 884205
> **10m**: Art. No. 884210

Modification MOD . . (optional, if required)

> e.g.
> **01**: MOD 01, Art. No. 800001 (amplifier for low voltage)
> **26**: MOD 26, Art. No. 800026 (booster connection)

Please indicate the article numbers of the controller and the required
modifications in all orders,

> e.g.   RES-408/400 VAC + MOD 26
> (controller for 400 VAC power supply with booster connection)
> Art. Nos. 740843 + 800026 must be ordered

Current transformer PEX-W3

Art. No. 885105

Line filter LF- . . 480

> **06**: Continuous current   6 A, 480 VAC, Art. No. 885500
> **35**: Continuous current 35 A, 480 VAC, Art. No. 885506

Impulse transformer

See ROPEX Application Report
for design and ordering information

Communication interface CI-USB-1

Art. No. 885650

	Temperature meter ATR- .
	      3: 300 °C range, Art. No. 882130
	      5: 500 °C range, Art. No. 882150

	Booster B- . . . 400
	      075: Max. pulse load 75A, 400 VAC, Art. No. 885301
	      100: Max. pulse load 100A, 400 VAC, Art. No. 885304

For more accessories: ☟"Accessories" leaflet

15   Index

A

Accessories   *6*
Actual value output   *31*
Alarm output   *37*
Alarm relay   *10, 21*
Alloy   *21, 23*
Ambient temperature   *10*
Analog input   *9*
Analog output   *9*
Analog temperature meter   *6*
Application   *4*
Application Report   *13, 16, 20*
AUTOCAL   *6, 23, 32*
AUTOCOMP   *35*
Automatic phase compensation   *35*
Automatic zero calibration   *6, 23, 32*
AUTOTUNE   *6*

B

Booster   *7, 8, 47*
Burning in heatsealing band   *22, 23*

C

Circuit breaker   *15*
CI-USB-1   *7, 37, 46*
Communication interface   *7, 37, 46*
Controller configuration   *20*
Controls   *24*
Current transformer   *7, 16, 46*

D

Degree of protection   *10*
Diagnostic interface   *37*
Digital temperature meter   *6*
Dimensions   *12*
DIP switches   *20*
Display   *27*

E

Error messages   *38*
External switching amplifier   *7*

F

Factory settings   *44*
Fault areas   *43*
Fault diagnosis   *6*

H

HEAT   *23, 33*
Heatsealing band type   *9*
Heatsealing temperature   *33*
Heatup timeout   *37*
How to order   *46*

I

Impulse heatsealing method   *4*
Impulse transformer   *7, 15, 46*
Installation   *10, 13*
Installation procedure   *13*
Installation regulations   *13*

L

Line filter   *6, 15, 16, 46*
Line frequency   *6, 9*
Line voltage   *9, 46*

M

Maintenance   *45*
Manual mode   *31, 34*
Measuring impulse duration   *35*
Modifications   *8, 18, 46*
MODs   *8, 18, 46*
Monitoring current transformer   *7*

O

Overheating of heatsealing band   *6*

P

PEX-W2/-W3   *3*
PEX-W3   *16, 46*
Phase compensation   *35*
Power loss   *10*
Power supply   *15*
"PREHEAT" signal   *34*
Preheating   *34*
Principle of operation   *5*

R

Replacing heatsealing band   *22, 23*

S

Secondary current I_2 *20*
Secondary voltage U_2 *20*
Set point selection   *31*
"START" signal   *23, 33*
Startup   *19*
System diagnostics   *37*
System monitoring   *37*

T

TCR   *3, 22*
Technical data   *9*
Temperature coefficient   *3, 21*
Temperature control   *4*
Temperature diagnosis   *36, 37*
Temperature indication   *6, 31*