RESISTRON

RES-403 ^{GB}

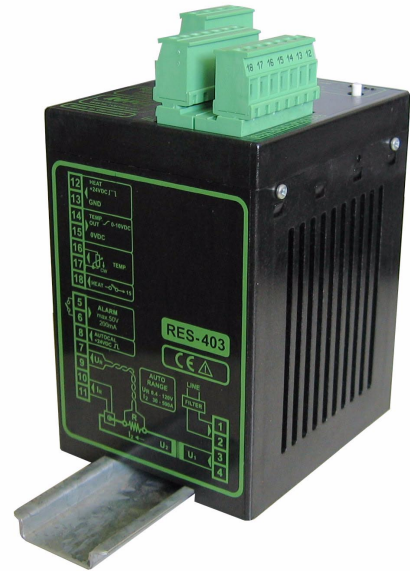## Operating Instructions

Important features

- Microprocessor technology

- Automatic zero calibration (AUTOCAL)

- Automatic optimization (AUTOTUNE)

- Automatic configuration of the secondary voltage and current ranges (AUTORANGE, as of October 2005)

- Automatic phase angle compensation (AUTOCOMP, as of October 2005)

- Automatic frequency adjustment

- Large current and voltage range

- Set point selection with potentiometer

- 0…10 VDC analog output for ACTUAL temperature

- Activated with contact or 24 VDC signal

- Alarm function with fault diagnosis

- Heatsealing band alloy and temperature range selectable

Contents

1 Safety and warning notes

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

It left the factory in perfect condition.

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

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

1.1 Use

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

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

1.2 Heatsealing band

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

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

The temperature coefficient must be specified as follows:

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

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

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

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

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

1.3 Impulse transformer

A suitable impulse transformer is necessary to ensure that the control loop functions perfectly. This transformer must be designed according to VDE 0570/ EN 61558 (isolating transformer with reinforced insulation) and have a one section 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 temperature controller correctly (see section 9, "Startup and operation"). The relevant safety instructions contained in section 8.3, "Power supply", must be obeyed. External monitoring modules can be used in order to additionally increase

operating safety. They are not included in the scope of supply of the standard control system and are described in a separate document.

1.5 Line filter

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

1.6 Warranty provisions

The statutory provisions for warranties apply for a period of 12 months following the delivery date.
All devices are tested and calibrated in the factory. Devices that have been damaged due to faulty connections, dropping, electrical overloading, natural wear, incorrect or negligent handling, chemical influences or mechanical overloading as well as devices that have been modified, relabeled or otherwise altered by the customer, for example in an attempt to repair them or install additional components, are excluded from the warranty.
Warranty claims must be examined in the factory and approved by ROPEX.

1.7 Standards / CE marking

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

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

Compliance with these standards and provisions is only guaranteed if original accessories and/or peripheral components approved by ROPEX are used. If not, then the equipment is operated on the user's own responsibility.
The CE marking on the controller confirms that the device itself complies with the above-mentioned standards.
It does not imply, however, that the overall system also fulfils these standards.
It is the responsibility of the machine manufacturer and of the user to verify the completely installed, wired and operationally ready system in the machine with regard to its conformity with the safety provisions and the EMC directive (see also section 8.3, "Power supply"). If peripheral components (e.g. the transformer or the line filter) from other manufacturers are used, no functional guarantee can be provided by ROPEX.

2 Application

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

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

• Vertical and horizontal f/f/s machines

• Pouch, filling and sealing machines

• Film wrapping machines

• Pouch-making machines

• Group packaging machines

• etc.

The use of RESISTRON temperature controllers results in:

- 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.

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

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

PLEASE NOTE!

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

> **We will be pleased to contribute our many years of experience towards optimizing *your* heatsealing system.**
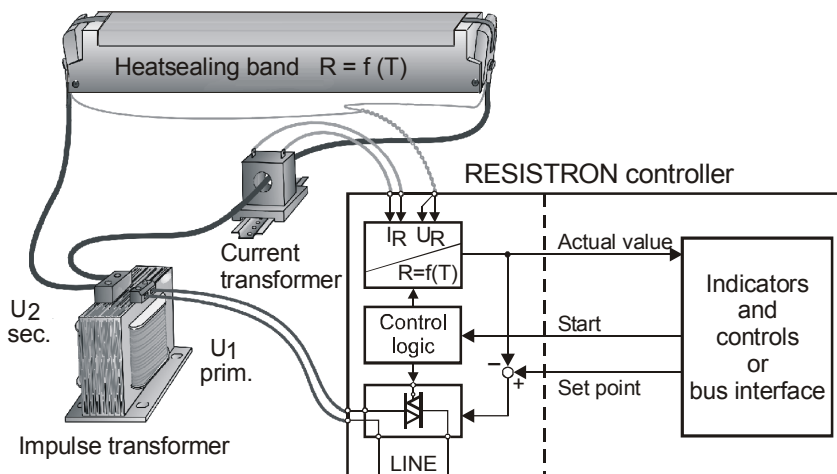
4 Description of the controller

The microprocessor technology endows the RESIS-TRON temperature controller RES-403 with previously unattainable capabilities:

- Very simple operation thanks to AUTOCAL, the automatic zero calibration function.

- Good dynamic response of the control system thanks to AUTOTUNE, which adapts automatically to the controlled system.

- High precision thanks to further improved control accuracy and linearization of the heatsealing band characteristic.

- High flexibility: The AUTORANGE function (as of October 2005) covers a secondary voltage range from 0.4 V to 120 V and a current range from 30 A to 500 A.

- Automatic adjustment to the line frequency in the range from 47 Hz…63 Hz.

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

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

The RESISTRON temperature controller RES-403 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 24 VDC 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 to the required temperature range (0…300 °C, 0…500 °C etc.).

The compact design of the RESISTRON temperature controller RES-403 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-403. 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.
	Set point potentiometer PD-x Front panel mounting version for setting the required SET heatsealing temperature of the RESISTRON temperature controller. The number which appears on the display corresponds to the SET heatsealing temperature in °C.

	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).
	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.
	Booster External switching amplifier, necessary for high primary currents (continuous current > 5A, pulsed current > 25A).
	Monitoring current transformer For detecting frame short-circuits on the heatsealing band. Used as an alternative to the standard PEX-W2 current transformer.

5.2 Modifications (MODs)

Owing to its universal design, the RESISTRON temperature controller RES-403 is suitable for a very wide range of heatsealing applications.

Various modifications (MODs) are available for the RESISTRON temperature controller RES-403 for implementing special applications.

The modifications described here are just a few of the large number available. Separate documents are 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 heatsealing 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 40

Additional terminal for "Temperature reached" signal. This output signal is activated when the ACTUAL temperature of the heatsealing band exceeds 95% of the SET heatsealing temperature. It can be used to monitor the process, for example, or to control the closure of the heatsealing bars.

⚠️ **MOD 40 cannot be used in combination with MOD 26 (booster connection) manufactured prior to September 2005.**

MOD 46 (as of October 2005)

Additional terminal for "Temperature OK" signal. If this modification is installed, the RES-403 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 (⤷ section 9.10 "Diagnostic interface/visualization software (as of October 2005)" on page 30).

If the actual temperature is inside the specified tolerance band when the "START" signal is activated, the output signal is activated as well (see graph below):
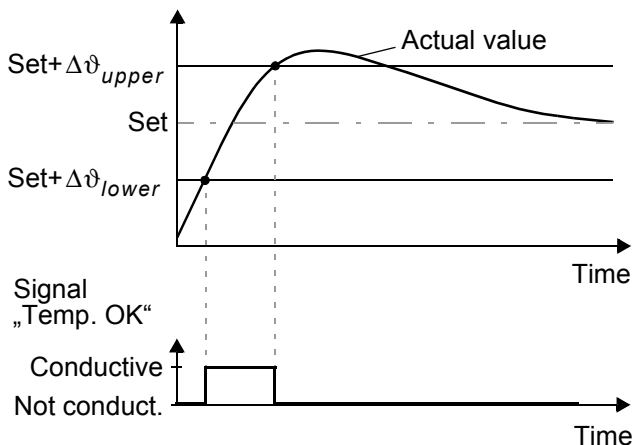
If the actual temperature leaves the tolerance band, the output signal is deactivated again. The output signal then remains deactivated, even if the actual temperature subsequently returns to the tolerance band.
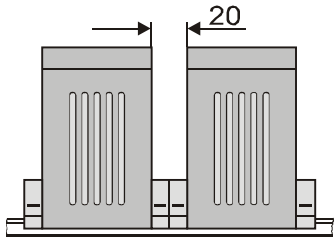
It is thus possible to check - as part of the monitoring concept, for instance - whether the output signal is still active at the end of the heatsealing process, in other words whether the actual temperature has remained within the defined tolerance band throughout the entire process.

The output signal is not deactivated again until the next "START" signal is activated or until an alarm is signaled.

⚠️ **MOD 46 ("Temperature OK" signal) cannot be used in combination with MOD 40 ("Temperature reached" signal).**

6   Technical data

|	
Type of construction	Housing for installation in the electrical cabinet Snaps onto a standard top hat rail (DIN TS35 rail, 35 mm) acc. to DIN EN 50022 Dimensions: 90 x 75mm; height: 135mm (incl. terminals)
Line voltage	<u>All controllers manufactured as of October 2005:</u> 115VAC version: 110VAC -15%…120VAC +10% (equivalent to 94…132VAC) 230VAC version: 220VAC -15%…240VAC +10% (equivalent to 187…264VAC) 400VAC version: 380VAC -15%…415VAC +10% (equivalent to 323…456VAC) <u>All controllers manufactured as of January 2004 up to September 2005:</u> 115VAC version: 115VAC -15%…120VAC +10% (equivalent to 98…132VAC) 230VAC version: 230VAC -15%…240VAC +10% (equivalent to 196…264VAC) 400VAC version: 400VAC -15%…415VAC +10% (equivalent to 340…456VAC) <u>All controllers manufactured up to December 2003:</u> 115VAC, 230VAC or 400VAC, tolerance: +10% / -15% depending on version selected (↳ section 12 "How to order" on page 39)
Line frequency	47…63Hz, automatic adjustment to frequencies in this range

Heatsealing band type and temperature range	<u>All controllers manufactured as of October 2005:</u>
	The temperature range and temperature coefficient settings can also be specified by means of the ROPEX visualization software (↳ section 9.10 "Diagnostic interface/visualization software (as of October 2005)" on page 30) in addition to 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 a 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)
	
	The settings for a temperature coefficient of 780ppm are only available on controllers manufactured as of October 2003.

Set point selection Terminals 16+17	With an external PD-3 or PD-5 precision potentiometer (R = 2kΩ) 0…2kΩ, equivalent to 0…300°C or 0…500°C
Analog output (actual value) Terminals 14+15	0…10VDC, I_{max} = 5mA Equivalent to 0…300°C or 0…500°C Accuracy: ±1% add. 50mV
Digital logic levels Terminals 8, 12, 13	LOW (0V): 0…2VDC HIGH (24VDC): 12…30VDC (max. current input 6mA) Reverse polarity-protected
Digital logic levels „Temp. OK" signal (MOD 40)	U_{max} = 30VDC I_{max} = 50mA U_{ON} < 2V (saturation voltage)

Alarm relay	U_{max} = 50 VDC, I_{max} = 0.2 A, potential-free
Maximum load (primary current of impulse transformer)	I_{max} = 5 A (duty cycle = 100 %) I_{max} = 25 A (duty cycle = 20 %)
Power dissipation	max. 20 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 mechanical fix the controller must be fitted at both ends for mounting on a vertical top hat rail.
Weight	Approx. 0.7 kg (incl. connector plug-in parts)
Housing material	Plastic, polycarbonate, UL-90-V0
Connecting cables Type / cross-sections	Rigid or flexible; 0.2…2.5 mm² (AWG 24…12) Plug-in ⚠ **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
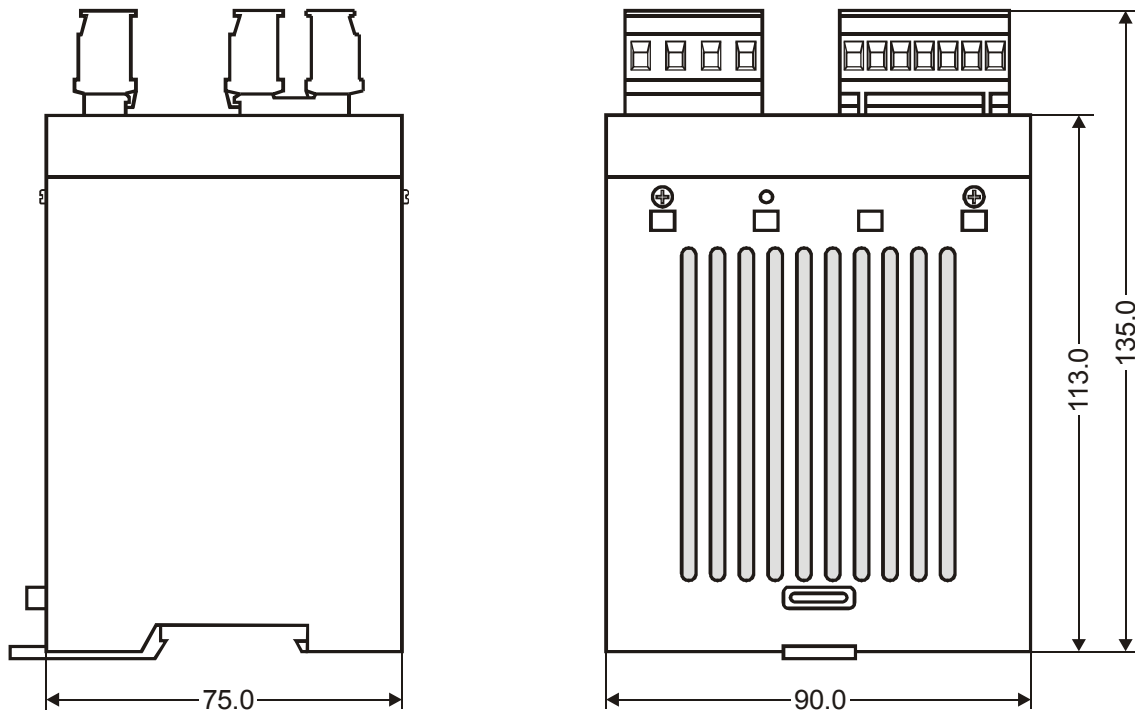
8 Installation

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

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

8.1 Installation procedure

Proceed as follows to install the RESISTRON temperature controller RES-403:

1. Switch off the line voltage and verify that the circuit is de-energized.

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

controller in the range from 47 Hz…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. Wire the system in accordance with the instructions in section 8.3 "Power supply" on page 13, section 8.6 "Wiring diagram (Standard)" on page 15 and the ROPEX Application Report. The information provided in section 8.2 "Installation steps" on page 12 must also be heeded additionally.

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

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

8.2 Installation steps

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

Sufficient wire cross-section

A

Connect U_R measuring wires directly to heatsealing band ends

Note number of turns

Current transformer PEX-W2/-W3

Twisted

Current measuring wires I_R

U_1 (prim.)

U_2 (sec.)

Avoid long cables

Temperature meter ATR-x

Line filter LF-xx480

Line

Note direction of rotation

Impulse transformer

Note polarity

Controller

Digital potentiometer PD-x

**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 Sept. 2005)

RES-403

8.3   Power supply

Line
115 VAC, 230 VAC, 400 VAC

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

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

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

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

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

RESISTRON temperature controller belonging to the 4xx Series.

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

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

Impulse Transformer
Designed according to VDE 0570/EN 61558 (isolating transformer with reinforced insulation). Connect core to ground.

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

Wiring
The wire cross-sections depend on the application (↳ ROPEX Application Report).
Guide values:

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

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

8.4 Line filter

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

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

ROPEX line filters are specially optimized for use in RESISTRON control loops. Providing that they are installed and wired correctly, they guarantee compliance with the EMC limit values.
You can find the exact specification of the line filter in the ROPEX Application Report calculated for your particular heatsealing application.
For more technical information: ↳ "Line filter" documentation.

⚠️ **It is permissible to supply several RESISTRON control loops with a single line filter, providing the total current does not exceed the maximum current of the filter.**
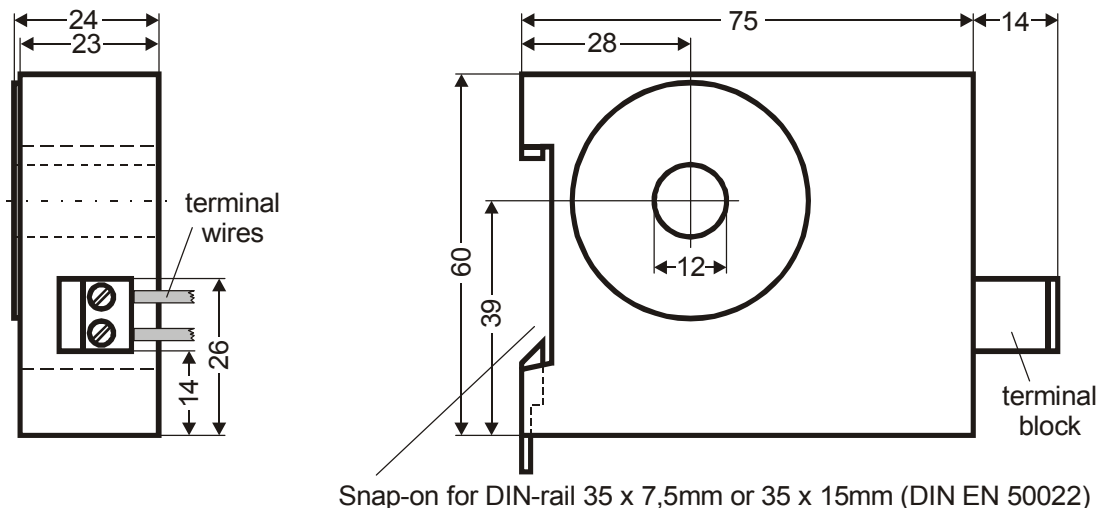
The wiring instructions contained in section 8.3 "Power supply" on page 13 must be observed.
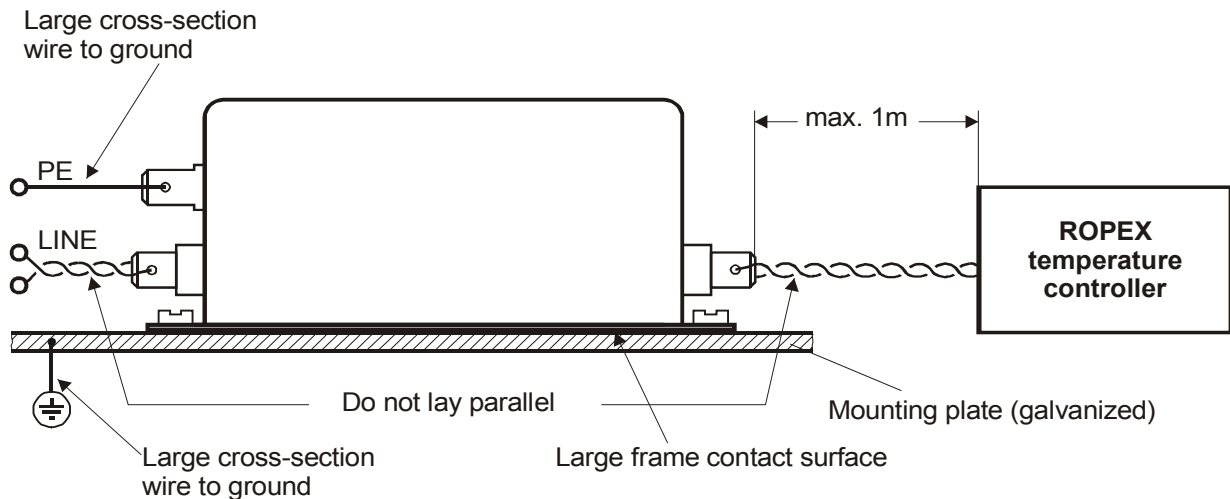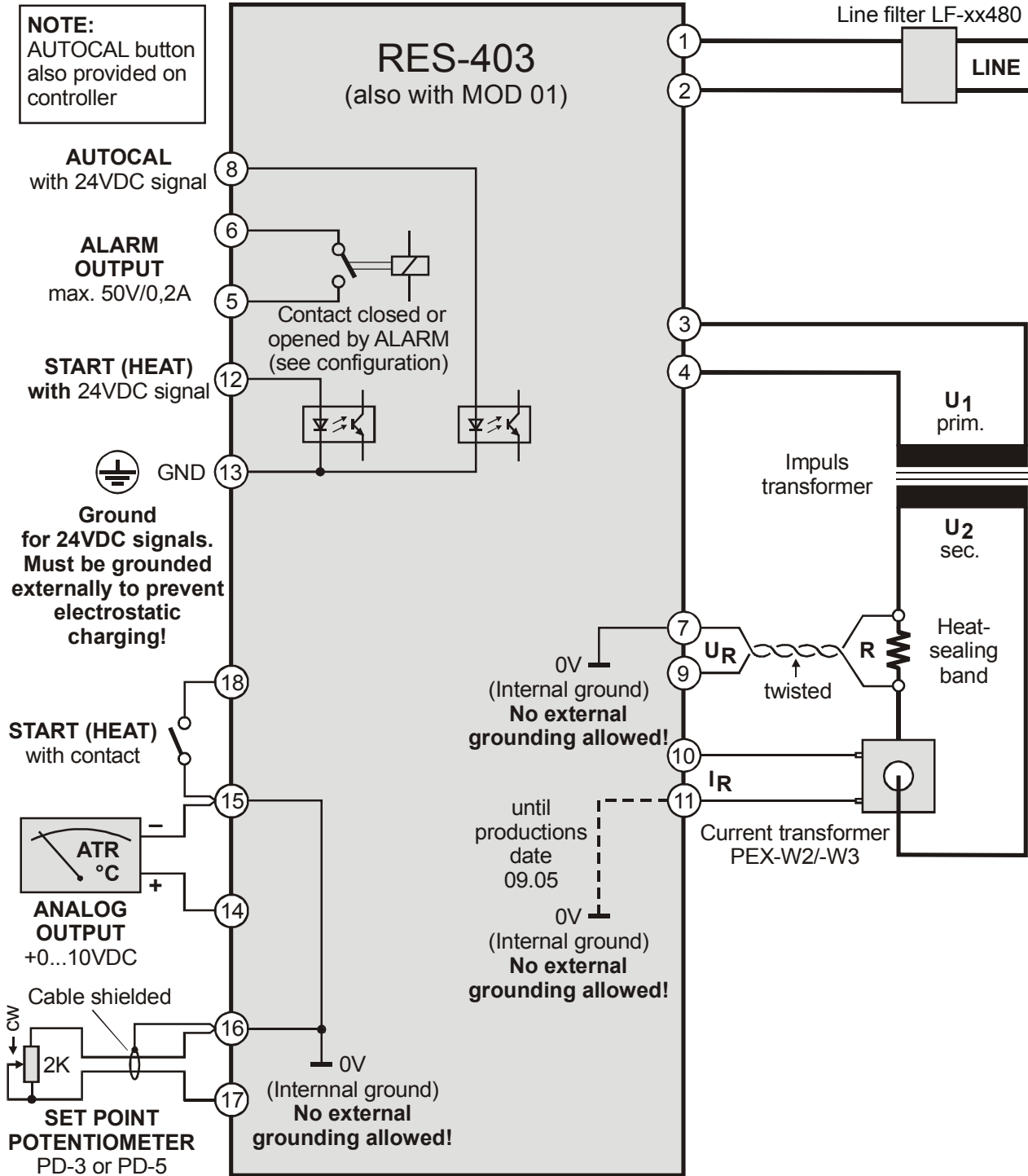

8.5 Current transformer PEX-W3

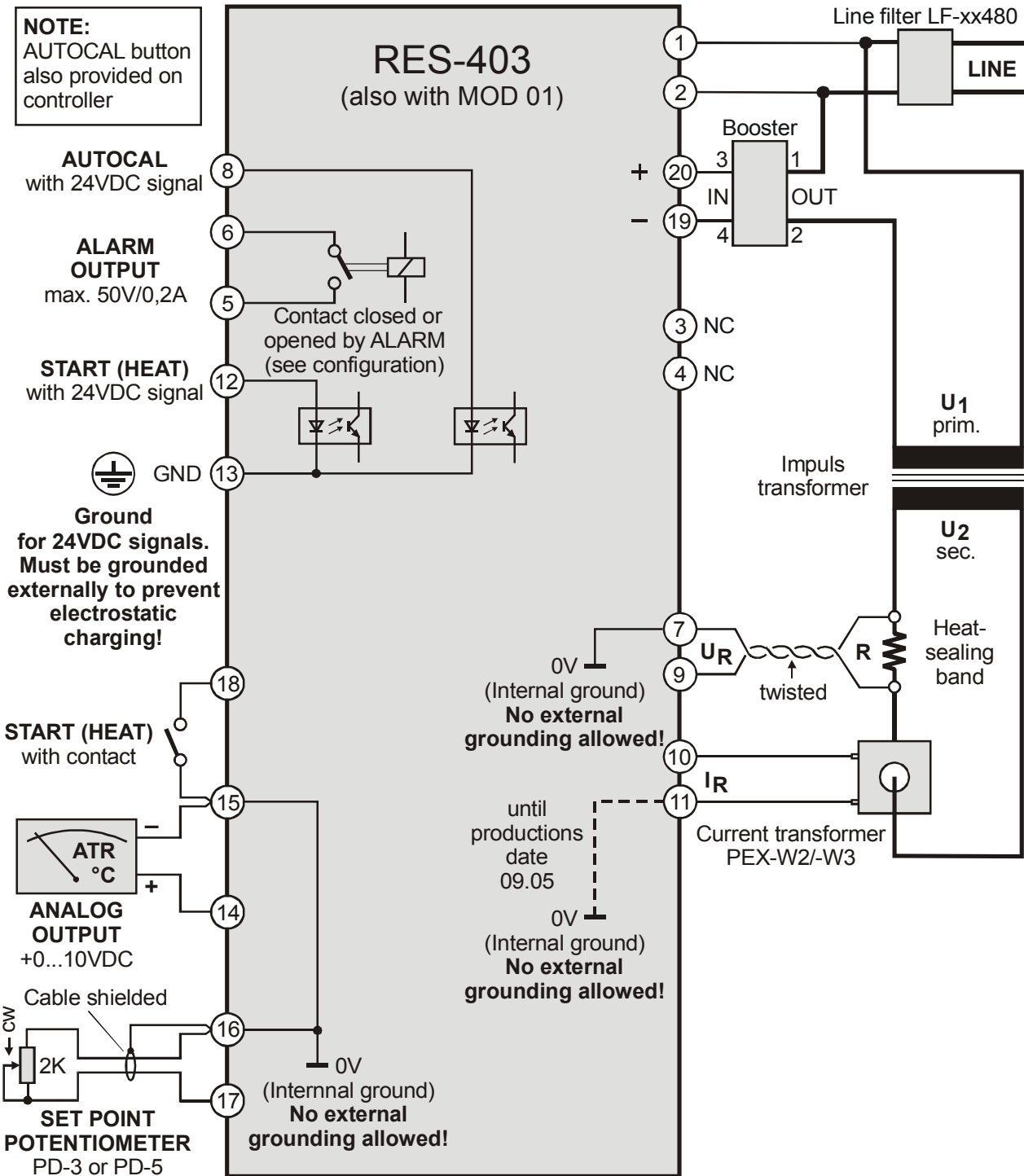The PEX-W3 current transformer supplied with the RESISTRON temperature controller is an integral part of the control system. The current transformer may only be operated if it is connected to the temperature controller correctly (↳ section 8.3 "Power supply" on page 13).
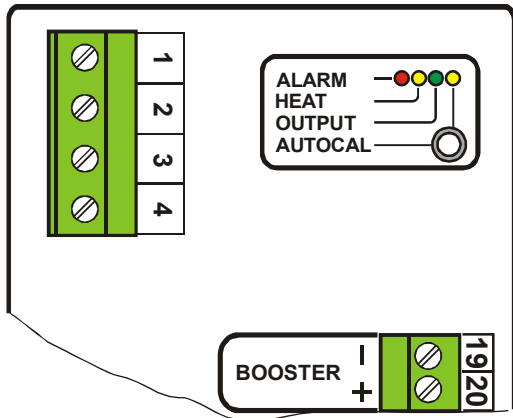

Snap-on for DIN-rail 35 x 7,5mm or 35 x 15mm (DIN EN 50022)

8.6 Wiring diagram (Standard)

NOTE:
AUTOCAL button also provided on controller

RES-403
(also with MOD 01)

Line filter LF-xx480
LINE
(1)
(2)

AUTOCAL
with 24VDC signal (8)

ALARM OUTPUT
max. 50V/0,2A (6) (5)
Contact closed or opened by ALARM (see configuration)

(3)
(4)
U₁
U_1 prim.

Impuls transformer

START (HEAT)
with 24VDC signal (12)

U_2 sec.

GND (13)

Ground for 24VDC signals. Must be grounded externally to prevent electrostatic charging!

Heat-sealing band

(7)
0V
(Internal ground)
No external grounding allowed!
U_R (9)
R
twisted

(18)

(10)
I_R
(11)

START (HEAT)
with contact

until productions date 09.05
0V
(Internal ground)
No external grounding allowed!

Current transformer PEX-W2/-W3

(15)
—
ATR °C
+
(14)

ANALOG OUTPUT
+0...10VDC

Cable shielded
CW
2K (16)
0V
(Internnal ground)
No external grounding allowed!

SET POINT POTENTIOMETER
PD-3 or PD-5 (17)

8.7 Wiring diagram with booster connection (MOD 26)

NOTE:
AUTOCAL button also provided on controller

RES-403
(also with MOD 01)

Line filter LF-xx480

LINE

Booster

AUTOCAL
with 24VDC signal — 8

ALARM OUTPUT
max. 50V/0,2A — 6, 5

Contact closed or opened by ALARM (see configuration)

START (HEAT)
with 24VDC signal — 12

GND — 13

Ground for 24VDC signals. Must be grounded externally to prevent electrostatic charging!

1, 2
+ 20 3 1
IN OUT
− 19 4 2

3 NC
4 NC

U_1 prim.

Impuls transformer

U_2 sec.

Heat-sealing band

18

START (HEAT)
with contact

15 −

ATR °C

14 +

ANALOG OUTPUT
+0...10VDC

Cable shielded

16

2K

17

SET POINT POTENTIOMETER
PD-3 or PD-5

0V (Internal ground) **No external grounding allowed!**

7
U_R
9
twisted R

10
I_R
11

until productions date 09.05

0V (Internal ground) **No external grounding allowed!**

Current transformer PEX-W2/-W3

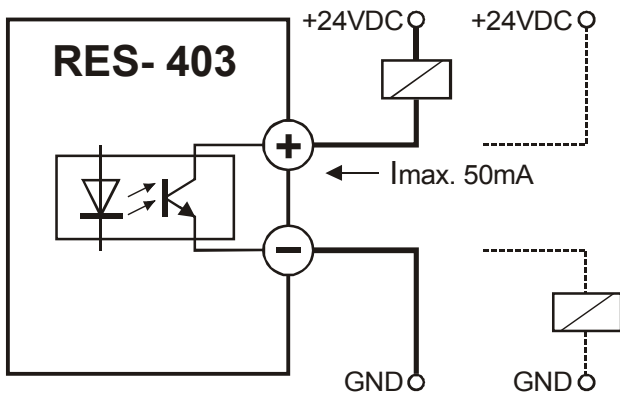0V (Internal ground) **No external grounding allowed!**

Additional terminals
in housing cover
for MOD 26 (Booster connection)

⚠ **MOD 26 cannot be used in combination with MOD 40 ("Temperature OK" signal) manufactured up to September 2005.**

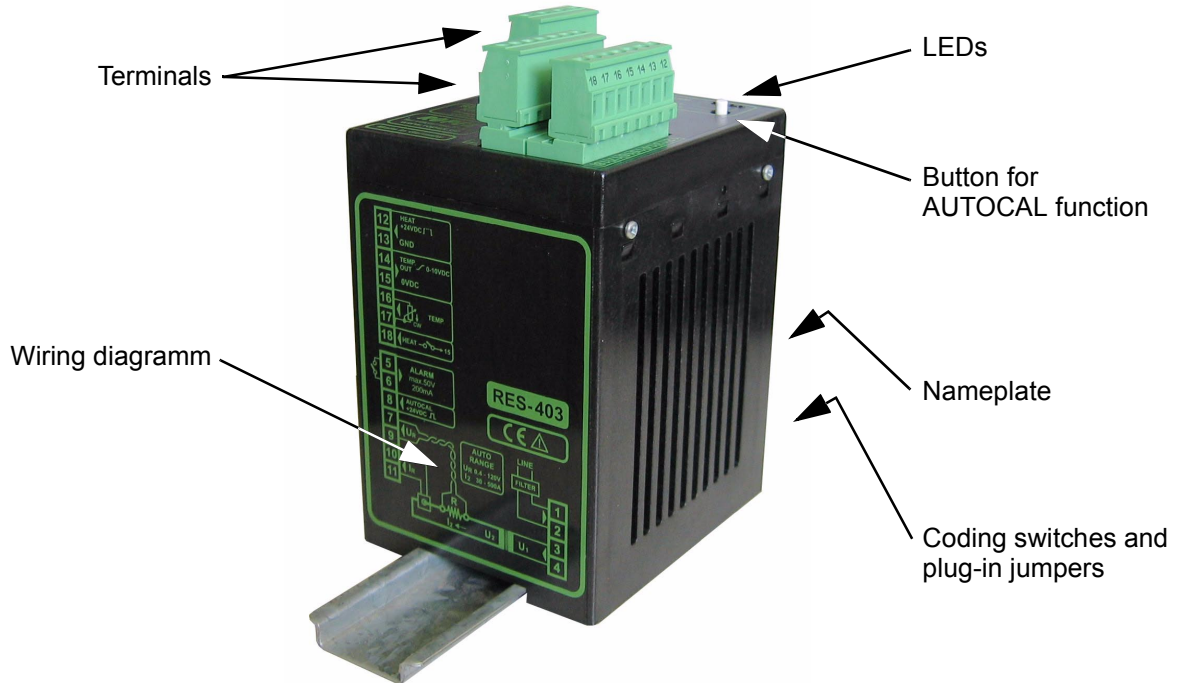## 8.8 Wiring diagram with "Temperature reached" signal (MOD 40) or „Temp. OK" signal (MOD 46)
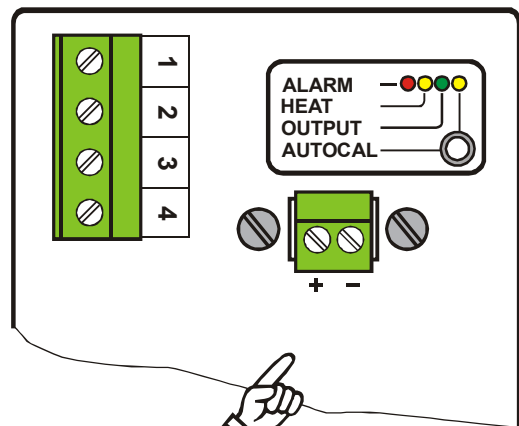
Additional terminals
in housing cover
for MOD 40 ("Temp. reached" signal)
or MOD 46 ("Temp. OK" signal)

⚠ **MOD 40 cannot be used in combination with MOD 26 (booster connection) manufactured prior to September 2005.**

⚠ **MOD 46 cannot be used in combination with MOD 40.**

8.9   Startup and operation

8.10   View of the controller

Terminals

LEDs

Button for
AUTOCAL function

Wiring diagramm

Nameplate

Coding switches and
plug-in jumpers

8.11   Controller configuration

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

8.11.1   Configuration of the DIP switches for secondary voltage and current

Automatic configuration (AUTORANGE)
(as of October 2005)

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

range from 30 A to 500 A. If the voltage and/or the current is outside the permissible range, a detailed error message appears on the controller (↳ see section 9.12 "Error messages" on page 31).

Configuration with coding switches
(up to September 2005)

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

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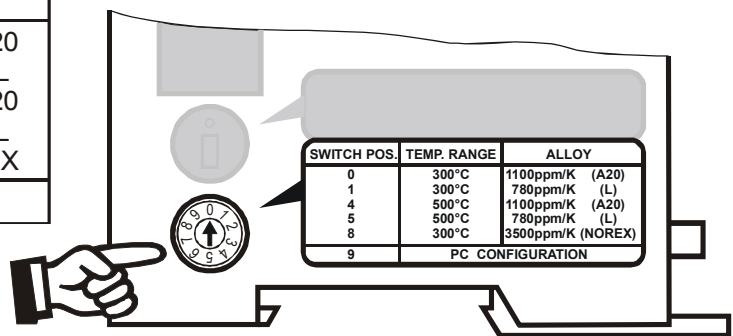
Factory settings

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 PEX-W2 or PEX-W3 current transformer must have two turns (⬚ ROPEX Application Report).

2x

8.11.2 Configuration of the rotary coding switch for the temperature range and alloy

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		

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	

0 = Factory settings

⚠ **The settings for a temperature coefficient of 780 ppm (switch position 1 and 5) are only available on controllers manufactured as of October 2003.**

If the switch is set to "9" (as of October 2005), more temperature ranges and alloys can be selected by means of the ROPEX visualization software (⬚ see section 9.10 "Diagnostic interface/visualization software (as of October 2005)" on page 30).

8.11.3 Configuration of the alarm relay

Alarm relay contact opened by alarm/PC-CONFIGURATION.

Alarm relay contact closed by alarm. (factory setting)

DE-ENERGIZED / PC AT ALARM
ENERGIZED

CONFIGURATION ALARM OUTPUT
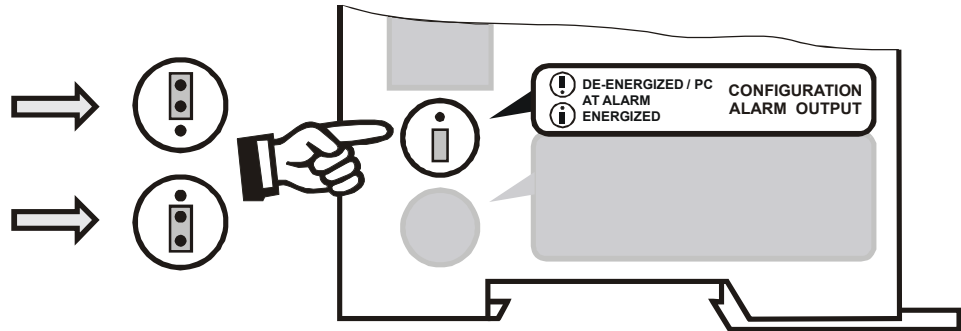
⚠ **If the plug-jumper is not inserted - or if it is incorrectly inserted - an error message appears when the controller is switched on (⤷ section 9.12 "Error messages" on page 31).**

If the "Alarm output opened by alarm/PC CONFIGURA-TION" position is selected (as of October 2005), the behavior of the alarm output can be configured in more detail by means of the ROPEX visualization software (⤷ see section 9.10 "Diagnostic interface/visualization software (as of October 2005)" on page 30).

8.12 Replacing and "burning in" the heatsealing band

8.12.1 "Burning in" the heatsealing band

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

The measuring principle applied for this system necessitates a heatsealing band alloy with a suitable tempe-

rature coefficient TCR. Too low a TCR leads to oscillation or uncontrolled heating.

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

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

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

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

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

RES-403

8.12.2 Replacing the heatsealing band

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

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

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

8.13 Startup procedure

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

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

8.13.1 Initial startup

Prerequisites: The controller must be correctly installed and connected (↳ section 8 "Installation" on page 11). Proceed as follows to start up the controller for the first time:

1. Switch off the line voltage and verify that all circuits are de-energized.

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

3. In the case of controllers manufactured up to September 2005, the settings of the DIP switches on the controller are indicated in the ROPEX Application Report and depend on the heatsealing band that is used (section 8.11 "Controller configuration" on page 18).

4. Make sure that no START signal is activated.

5. Switch on the line voltage.

6. When the voltage is switched on, the yellow "AUTOCAL" LED lights up for approximately 0.3 seconds to indicate that the controller is being powered up correctly.

⚠️ **As of SW-Revision 106:**
If the red "ALARM" LED lights up for 0.3 s in addition to the yellow "AUTOCAL" LED when the voltage is switched on, the configuration of this controller has been changed in the visualization software (↳ section 9.10 "Diagnostic interface/visualization software (as of October 2005)" on page 30). In order to avoid malfunctions, please check the controller configuration before continuing the startup procedure.

7. One of the following states then appears:

"ALARM" LED	"OUTPUT" LED	ACTION
OFF	Short pulses every 1.2 s	Go to 7
BLINKS fast (4 Hz)	OFF	Go to 7
Lit Continuously	OFF	Fault diagnosis (↳ sec. 9.12)

Activate the AUTOCAL function while the heatsealing band is still cold (either with the manual button on the controller or by applying an external signal to terminals 8+13). The yellow "AUTOCAL" LED lights up the duration of the calibration process (approx. 10…15 s). A voltage of app. 0 VDC appears at the same time at the actual value output (terminals 14+15). If an ATR-x is connected, it indicates 0…3 °C.

When the zero point has been calibrated, the "AUTOCAL" LED goes out and a voltage of 0.66 VDC (300 °C range) or 0.4 VDC (500 °C range) appears at the actual value output instead. If an ATR-x is connected, it must be set to "Z".

If the zero point has not been calibrated successfully, the red "ALARM" LED blinks slowly (1 Hz). In this case the controller configuration is incorrect (↳ section 8.11 "Controller configuration" on page 18 and ROPEX Application Report). Repeat the calibration after the controller has been configured correctly.

8. When the zero point has been calibrated successfully, set a defined temperature on the set point potentiometer and activate the "START" signal (HEAT). The "HEAT" LED then lights up. The heating and control process can be observed at the

actual value output:

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

If an error code is displayed, please proceed as described in section 9.12 "Error messages" on page 31.

9. Burn in the heatsealing band (⬥ section 8.12 "Replacing and "burning in" the heatsealing band" on page 20) and repeat the AUTOCAL function.

> **The controller is now ready**

8.13.2 Restart after replacing the heat-sealing band

To replace the heatsealing band, proceed as described in section 8.12 "Replacing and "burning in" the heatsealing band" on page 20.

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

Continue with section 8.13.1 steps 4 to 9.

9 Controller functions

See also section 8.6 "Wiring diagram (Standard)" on page 15.

9.1 Indicators and controls

Manufactured as of October 2005

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.

Button for manual activation of AUTOCAL function (zero calibration). Do not press unless heatsealing band is cold.

Manufactured up to September 2005

Button for manual activation of AUTOCAL function (zero calibration). Do not press unless heatsealing band is cold.

Yellow LED, remains lit for duration of AUTOCAL process.

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

Yellow LED, lit during heating phase.

Red LED, lights up or blinks to indicate ALARM.

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

LED	Blinks slowly (1 Hz)	Blinks fast (4 Hz)	Lit continuously
AUTOCAL (yellow)	RESET active, START and AUTOCAL functions are locked (as of October 2005)	AUTOCAL requested, but function disabled	AUTOCAL executing
HEAT (yellow)	—	START requested, but function disabled	START executing
OUTPUT (green)	In control mode the luminous intensity is proportional to the heating current.		
ALARM (red)	Configuration error, AUTOCAL not possible	Controller calibrated incorrectly, run AUTOCAL	Fault, ⮡ section 9.12

9.2 Temperature setting (set point selection)

The heatsealing temperature is set by means of a $2\,k\Omega$ potentiometer at terminals 16+17. The connecting wires between the controller and the potentiometer must be shielded (⮡ section 8.6 "Wiring diagram (Standard)" on page 15).
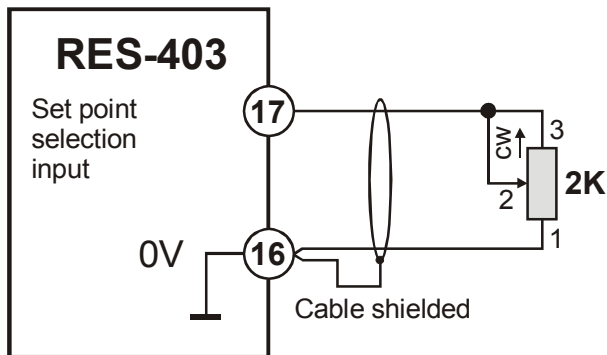
e.g. **PD-3**
Potentiometer P03
with
digital dial KD

Setting range:
$0\,\Omega$ → 0°C
$2\,k\Omega$ → 300°C or 500°C
(depending on the controller configuration).
The relationship between the potentiometer setting and the SET temperature is linear.

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

If a ROPEX PD-x precision potentiometer is used, the SET temperature can be adjusted exactly with the help of the digital display in the window of the dial. The number which appears on the display corresponds to the SET temperature in °C.
The set point that is selected for the heatsealing temperature must be greater than 40°C. If not, the heatsealing band will not be heated up when the "START" signal is activated.

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

9.3 Temperature indication (actual value output)

The RES-403 supplies an analog 0…10VDC signal, which is proportional to the real ACTUAL temperature, at terminals 14+15.

RES-403

Actual value output 0...10VDC

R=33Ohm

max. 5mA

14

0V

15

0...10VDC

− **+**

Temperature meter e.g. ATR-3
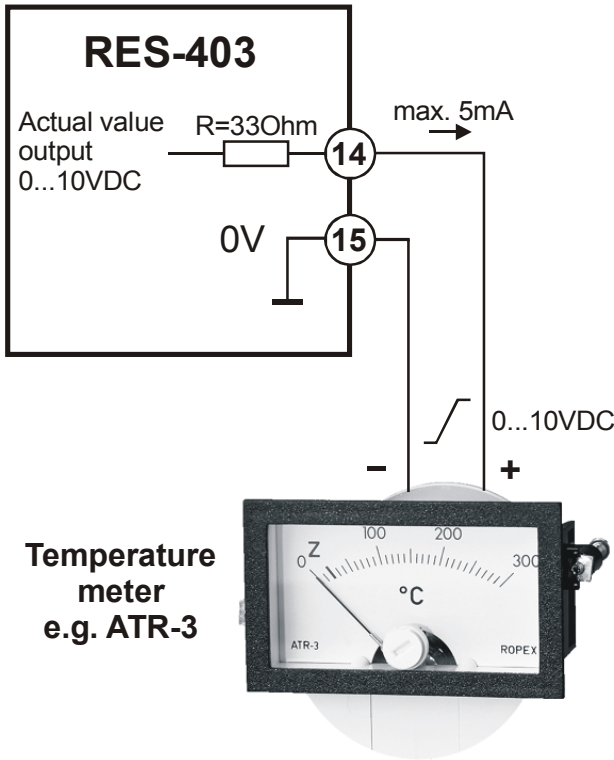
Voltage values:
0 VDC → 0 °C
10 VDC → 300 °C or 500 °C
(depending on the controller configuration)

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

0 - 300°C range

Temperature T °C / Voltage U VDC

20°C

0.66V "ZERO"

0 - 500°C range

Temperature T °C / Voltage U VDC

20°C

0.4V "ZERO"
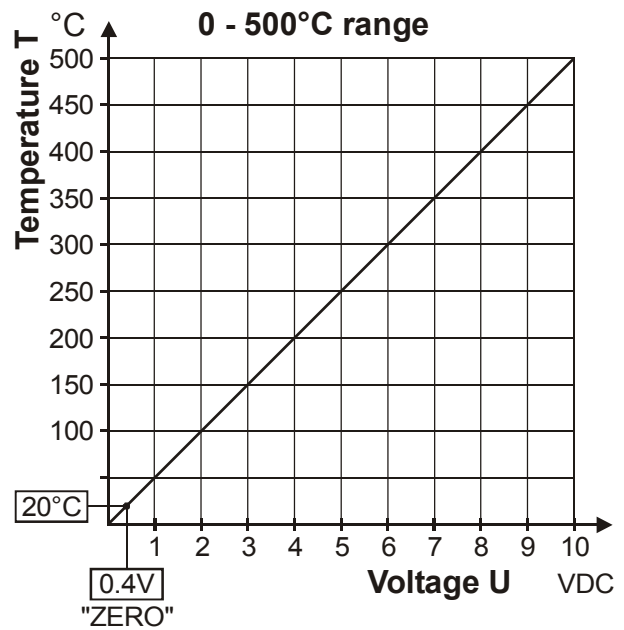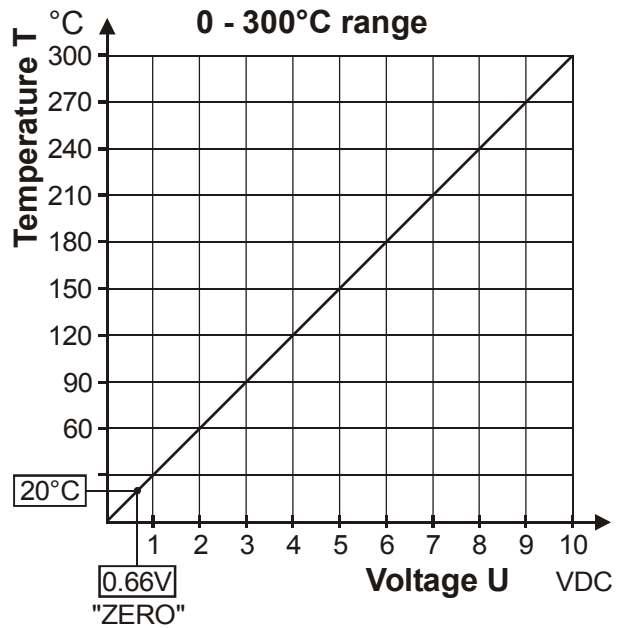
An indicating instrument can be connected to this output in order to visualize the temperature of the heat-sealing band.

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

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

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

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

If an alarm is signaled, the analog output at terminals 14+15 is used to display a selective error message (⇨ section 9.12 "Error messages" on page 31).

9.4 Automatic zero calibration (AUTOCAL)

Because of the automatic zero calibration (AUTOCAL) function, there is no need to adjust the zero point manually on the controller. This function matches the controller to the current and voltage signals that are present in the system. The zero point is calibrated in the factory to the initial temperature (ambient temperature, 20°C).

Variable initial temperature:
On controllers manufactured as of April 2005, the initial temperature for the "AUTOCAL" function can be set in the 0…+40°C range in the visualization software (⇨ section 9.10 "Diagnostic interface/visualization software (as of October 2005)" on page 30). This setting is remembered if the controller is switched off and then on again.
As of SW Revision 107, the "External calibration temperature" setting can also be selected in the visualization software. The initial temperature for this setting can be specified in the +3…+40°C range via the set point potentiometer (terminals 16+17; ⇨ section 9.2 "Temperature setting (set point selection)" on page 24). The value selected at the set point potentiometer must be present when the "AUTOCAL" function is activated.
If the specified value is too high (greater than 40°C) or if the selected value varies, an error message appears (error codes 115 and 116; ⇨ section 9.12 "Error messages" on page 31).
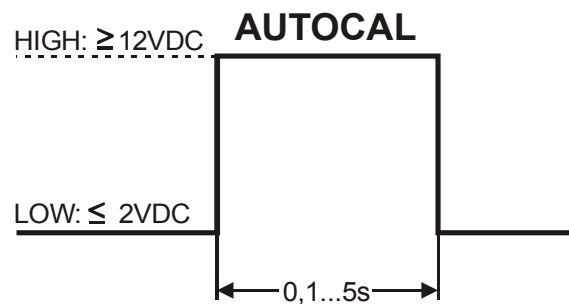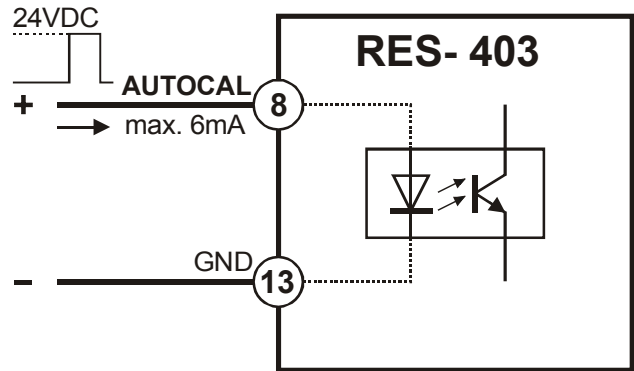
The AUTOCAL function is activated either by means of a 24VDC pulse at terminals 8+13 or by pressing the AUTOCAL button on the controller.

The automatic calibration process takes about 10…15 seconds. The heatsealing band is not heated during this process.
The yellow LED on the front panel lights up when the AUTOCAL function is active. The actual value output (terminals 14+15) is 0…3°C (corresponds to app. 0 VDC) during this process.
If the temperature of the heatsealing band varies on controllers manufactured as of October 2005, the "AUTOCAL" function is executed a maximum of three times. If the function still cannot be terminated successfully, an error message appears (⇨ section 9.12 "Error messages" on page 31).

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

Reasons for disabled AUTOCAL function:

1. The AUTOCAL function cannot be activated until 10 seconds after the controller is switched on. If you attempt to activate it sooner, it will not function.

2. The AUTOCAL function is not activated if the heatsealing band is cooling down at a rate of more than 0.1K/sec. If the control signal is activated, the function is activated automatically providing the cooling rate has fallen below the above mentioned value.

3. If the "START" signal (24VDC) is active, the AUTOCAL function is not executed ("HEAT" LED lit).

4. AUTOCAL cannot be activated if error codes 101…103, 201…203, 801 or 9xx (up to September 2005: error codes 1…3, 5…7) occur at start-up. AUTOCAL cannot be activated with error codes 201…203, 801 or 9xx (up to September 2005: error codes 5…7). If the controller has operated correctly, at least one time, after start-up (↳ section 9.12 "Error messages" on page 31).

⚠️ **If the AUTOCAL function is disabled and if you attempt to activate it then the "AUTOCAL" LED blinks.**

9.5 "START" signal (HEAT)

When the "START" signal is activated, the controller-internal set/actual comparison is enabled and the heatsealing band is heated up to the SET temperature. It remains at this temperature until the signal is deactivated.
The "HEAT" LED on the front panel of the RES-403 is lit continuously for the duration of the heating phase.
The "START" signal can be activated in two ways:

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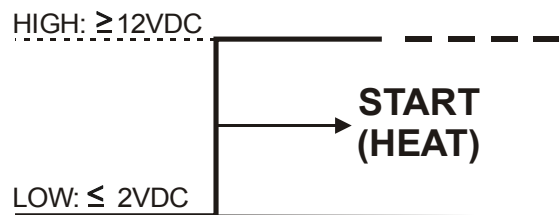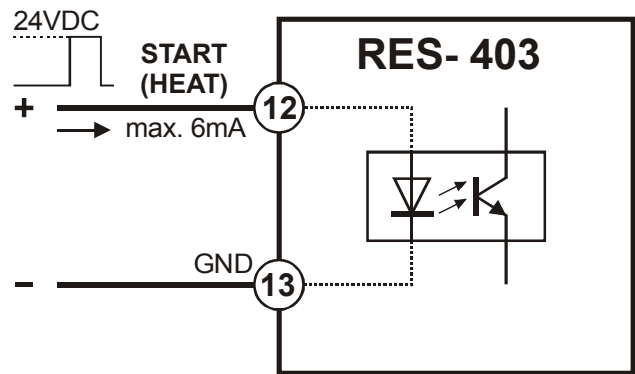
or

- By means of a control contact at terminals 15+18
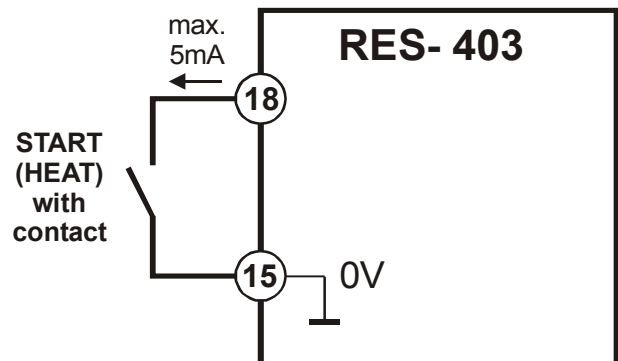
⚠️ **The "START" signal is disabled as long as the AUTOCAL function is executing ("AUTOCAL" LED lit, "HEAT" LED blinks).**

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

The set point that is selected for the heatsealing temperature must be greater than 40°C. If not, the heatsealing band will not be heated up ("HEAT" LED blinks).

The alarm output is switched if the "START" signal is activated while an alarm signal is indicating error codes 104…106, 111…114, 211, 302 or 303 (up to September 2005: error codes 8…12) (↳ section 9.12 "Error messages" on page 31). The heatsealing band is no longer heated up.

9.6 Measuring impulse duration (as of October 2005)

The length of the measuring impulses generated by the controller can be set with the 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 by means of the ROPEX visualization software (↳ section 9.10 "Diagnostic interface/visualization software (as of October 2005)" on page 30).**

9.7 Automatic phase angle compensation (AUTOCOMP) (as of October 2005)

It may be necessary to compensate the phase angle displacement between the U_R and I_R measuring signals for special heatsealing applications (↳ ROPEX Application Report). The "AUTOCOMP" function is provided for this purpose. It is executed whenever the "AUTOCAL" function (↳ section 9.12 "Error messages" on page 31) is run twice in quick succession. The interval between the end of the first "AUTOCAL" function and the start of the second "AUTOCAL" must be shorter than 2.0 s. The second "AUTOCAL" function only takes around 2.0 s and incorporates the "AUTOCOMP" function.

If the interval between the two "AUTOCAL" functions is longer than 2.0 s, "AUTOCAL" is executed normally again the second time.
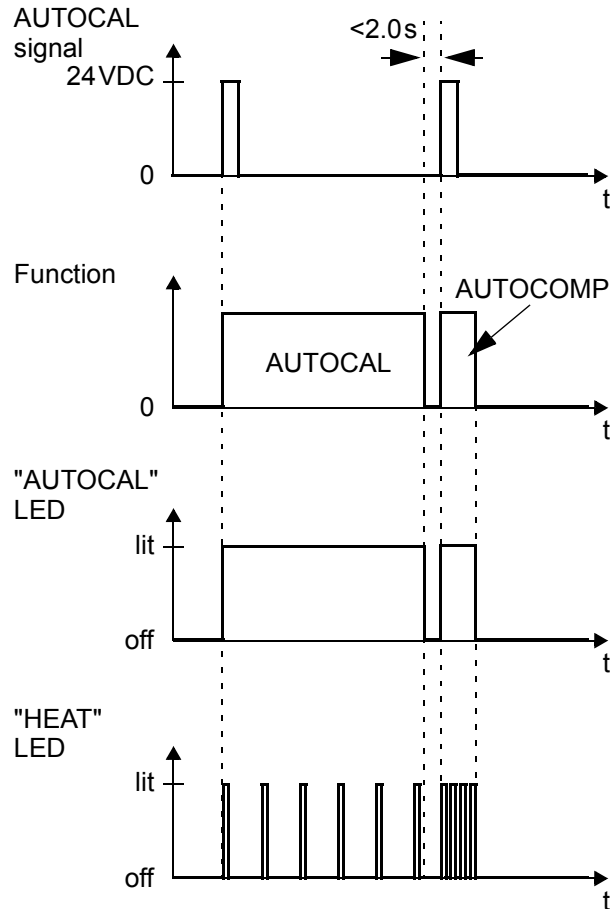
The "HEAT" LED blinks repeatedly when the "AUTOCOMP" function is executed and the actual value output (terminals 17+14) is set to 0…3 °C (i.e. app. 0 VDC).

⚠ **The "AUTOCOMP" function must be activated in the ROPEX visualization software (↳ section 9.10 "Diagnostic interface/ visualization software (as of October 2005)" on page 30) (default setting: AUTOCOMP off).**

9.8 Temperature diagnosis (as of October 2005)

An additional temperature diagnosis can be activated in the ROPEX visualization software (⤷ section 9.10 "Diagnostic interface/visualization software (as of October 2005)" on page 30). The RES-403 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 9.12 "Error messages" on page 31).
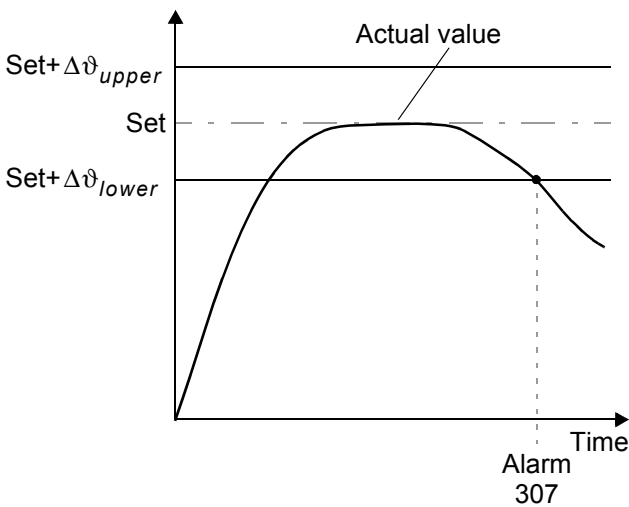
If the temperature diagnosis is not activated by the time the "START" signal is deactivated (i.e. if the ACTUAL temperature does not exceed the upper or lower tolerance band limit), the corresponding error code (309, 310) is indicated and the alarm relay is switched. An additional delay time (0…9.9s) 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 explicitly deactivated, e.g. if the temperature drops temporarily owing to the closure of the sealing jaws.

⚠ **The values that can be set in the ROPEX visualization software for the upper and lower tolerance band and the delay time are identical to those for the "Temperature OK" signal (MOD 46).**

9.9 Heatup timeout (as of October 2005)

An additional heatup timeout can be activated in the ROPEX visualization software (⤷ section 9.10 "Diagnostic interface/visualization software (as of October 2005)" on page 30).

This timeout starts when the START signal is activated. The RES-403 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 9.12 "Error messages" on page 31).
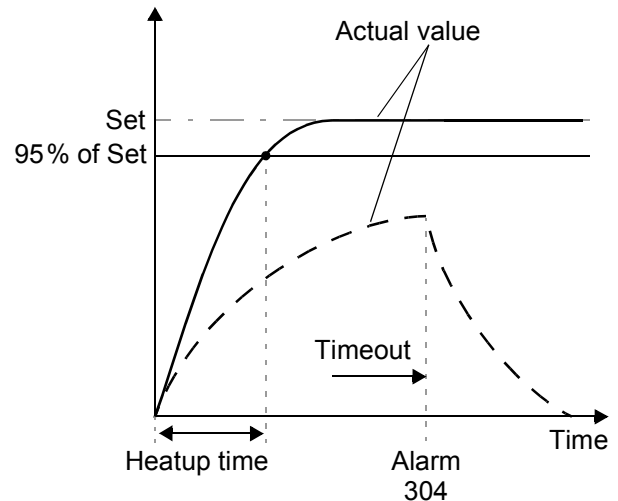
9.10 Diagnostic interface/visualization software (as of October 2005)

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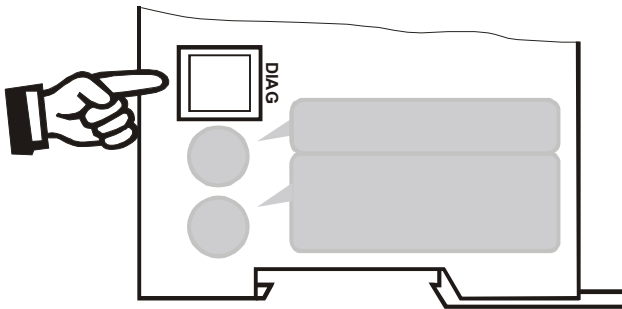
⚠ **Only a ROPEX comunication interface is allowed to be connected to the diagnostic interface. Connecting another device (e.g. a telephone cable) could result in malfunctions or damage to the controller.**

The ROPEX visualization software is described in a separate document.

9.11 System monitoring/alarm output

To increase operating safety and to avoid faulty heatsealing, this controller incorporates special hardware and software features that facilitate selective fault detection and diagnosis. Both the external wiring and the internal system are monitored.
These features assist the operator in identifying the cause of abnormal operations.
A system fault is reported or differentiated by means of the following indications.

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

1. **Blinks fast (4 Hz)**
   The AUTOCAL function should be executed (error codes 104…106, 211, 302, 303; up to September 2005: error codes 8+9).

2. **Blinks slowly (1 Hz)**
   The system configuration is incorrect and the zero calibration (AUTOCAL function) was unsuccessful (⬥ section 8.11 "Controller configuration" on page 18). It corresponds to error codes 110…114 (up to September 2005: error codes 10…12).

3. **Lit continuously:**
   This indicates that a fault is preventing the controller from being started (error codes 101…103, 107, 108, 201…203, 307, 308, 801, 9xx; up to September 2005: error codes 1…7).
   As a rule, it refers to an external wiring fault.

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

This contact is set in the factory as follows:

- **OPEN** in operating states A.1) and A.2), but closed if a "START" signal is activated in one of these states.

- **CLOSED** in operating state A.3)

If the alarm relay is configured opposite to the factory setting (⬥ section 8.11.3 "Configuration of the alarm relay" on page 20), these states are reversed.

C.) Error code output via the 0…10 VDC analog output (terminals 14+15):

Since a temperature indication is no longer necessary if a fault occurs, the analog output is used to display error messages in the event of an alarm.
13 voltage levels (up to September 2005: 12 voltage levels) are offered for this purpose in the 0…10 VDC range, each of which is assigned an error code (⬥ section 9.12 "Error messages" on page 31).
If a state that requires AUTOCAL occurs – or if the controller configuration is not correct – (error codes 104…106, 111…114, 211, 302, 303; up to September 2005: error codes 8…12), the signal at the analog output jumps back and forth at 1 Hz between the voltage value which corresponds to this error and the end of the scale (10 VDC, 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 9.12 "Error messages" on page 31).

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

⚠ **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.**

9.12 Error messages

The table below shows how the analog voltage values correspond with the faults that have occurred. It also describes the fault and the required corrective action.

The error messages are listed in two separate tables for controllers "up to September 2005" and "as of October 2005". The block diagram in section 9.13 "Fault areas and causes" on page 36 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 October 2005. The error messages are differentiated even more finely in the controller. The error codes described below can be displayed with the ROPEX visualization software (↪ section 9.10 "Diagnostic interface/visualization software (as of October 2005)" on page 30) 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 October 2005**

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 ②⑨
(107) (108)						Temperature step, down Temperature step, up	Fault area ④⑤⑥ (loose contact)	Fault area ④⑤⑥ (loose contact)
4 (307) (308) (309) (310)	2.66	80	133	Lit continuously	Closed	Temperature too low/high (↳ section 9.8)		
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 9.9)	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 October 2005

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 open). 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 closed.

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.
8 (104)	**5.33** / 10	**160** / 300		Warning: Blinks fast (4Hz)	Warning: Open	I_R signals incorrect, incorrect specification of impulse-transformer		
(105)		**266** / 500				U_R signals incorrect, incorrect specification of impulse-transformer	Run **AUTOCAL**, Check specification of transformer, Fault area ⑦⑧	
(106)	**6.00** / 10	**180** / 300	**300** / 500	Fault: Lit continuously	Fault: Closed (voltage value at actual value output then no longer changes)	U_R and/or I_R signals incorrect, incorrect specification of impulse-transformer		
(302)	**6.66** / 10	**200** / 300	**333** / 500			Temperature too low, AUTOCAL wasn't performed, loose contact, ambient temp. fluctuates	Run **AUTOCAL** and/or fault area ④⑤⑥ (loose contact)	Fault area ④⑤⑥ (loose contact)
(303)	**7.33** / 10	**220** / 300	**366** / 500			temperature too high, AUTOCAL wasn't performed, loose contact, ambient temp. fluctuates		
9 (211)	**8.00** / 10	**240** / 300	**400** / 500			Data error	Run **AUTOCAL**	---

Part 3 of 3: Error messages as of October 2005

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 open). 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 closed).

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 ↙			I_R signal incorrect, calibration not possible	Fehlerbereich ⑧, Konfiguration prüfen	---
11	(112)	↗ *7.33* ↖ / ↘ 10 ↙	↗ *220* ↖ / ↘ 300 ↙	↗ *366* ↖ / ↘ 500 ↙	Warning: Blinks slowly (1 Hz)	Warning: Open	U_R signal incorrect, calibration not possible	Fehlerbereich ⑦, Konfiguration prüfen	---
12	(113)	↗ *8.00* ↖ / ↘ 10 ↙	↗ *240* ↖ / ↘ 300 ↙	↗ *400* ↖ / ↘ 500 ↙			U_R and I_R signals incorrect, calibration not possible	Fehlerbereich ⑦⑧, Konfiguration prüfen	---
	(114)				Fault: Lit continuously	Fault: Closed (voltage value at actual value output then no longer changes)	Temperature fluctuates, calibration not possible		
13	(115)	↗ *8.66* ↖ / ↘ 10 ↙	↗ *260* ↖ / ↘ 300 ↙	↗ *433* ↖ / ↘ 500 ↙			Ext. calibration temperature too high, calibration not possible		
	(116)						Ext. calibration temperature fluctuates calibration not possible		

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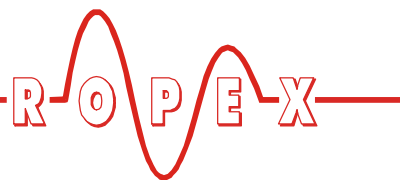
Error messages up to September 2005

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	0.66	20	33	Lit Continuously	Closed	I_R signal missing	Fault area ①	Fault area ①
2	1.33	40	66			U_R signal missing	Fault area ③	Fault area ③
3	2.00	60	100			U_R and I_R signals missing	Fault area ②	Fault areas ② ⑨
4	2.66	80	133			Temperature step	Fault areas ④ ⑤ ⑥ (loose contact)	Fault areas ④ ⑤ ⑥ (loose contact)
5	3.33	100	166			Frequency fluctuation, inadmissible line frequency	Check power supply	Check power supply
6	4.00	120	200			Internal fault	Run RESET	Run RESET
7	4.66	140	233			Internal fault, controller defective	Replace controller	Replace controller
8	5.33 / 10	160 / 300	266 / 500	Blinks fast (4 Hz)	Open, does not close until "START" signal (voltage value at analog output then no longer changes)	U_R and/or I_R signal incorrect	Run AUTOCAL	Fault areas ④ ⑤ ⑥
9	6.00 / 10	180 / 300	300 / 500			Data error	Run AUTOCAL	---
10	6.66 / 10	200 / 300	333 / 500	Blinks slowly (1 Hz)		I_R signal incorrect, calibration not possible	Fault area ⑧, check configuration	---
11	7.33 / 10	220 / 300	365 / 500			U_R signal incorrect, calibration not possible	Fault area ⑦, check configuration	---
12	8.00 / 10	240 / 300	400 / 500			U_R and I_R signals incorrect, calibration not possible	Fault areas ⑦ ⑧, check configuration	---

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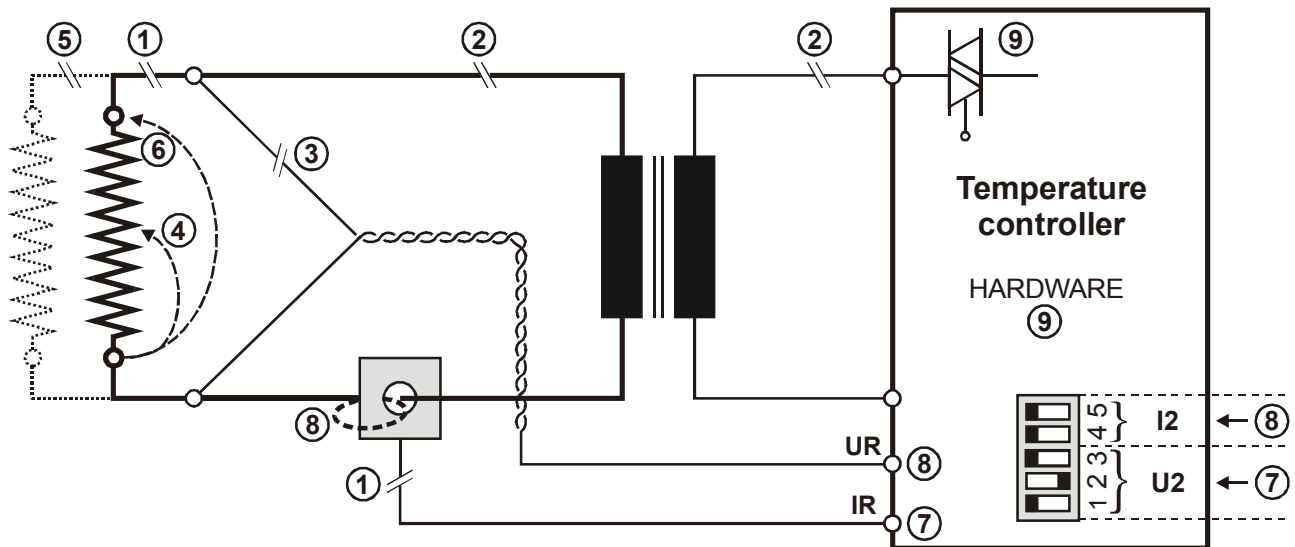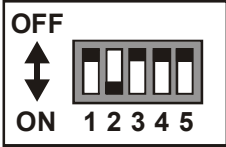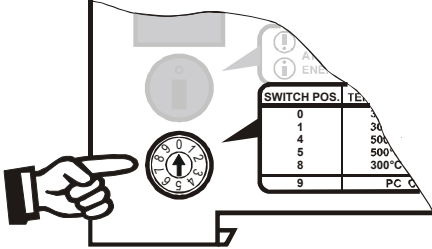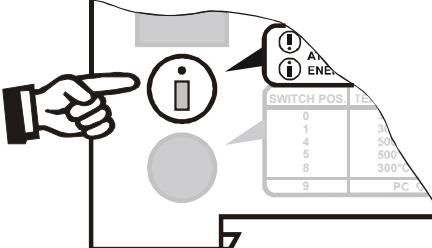
The table below explains the possible fault causes.

Fault area	Explanation	Possible causes
①	Load circuit interrupted after U_R pickoff point	- Wire break, heatsealing band break - Contact to heatsealing band defective
	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 wires interrupted
④	Partial short-circuit (delta R)	- Heatsealing band partially bypassed by conducting part (clamp, opposite heatsealing bar etc.)
⑤	Parallel circuit interrupted	- Wire break, heatsealing band break - Contact to heatsealing band defective
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 September 2005: DIP switches 1 - 3 configured incorrectly (U_2 range) - As of October 2005: U_2 outside permissible range from 0.4…120 VAC

Fault area	Explanation	Possible causes
⑧	I_R signal incorrect	- Up to September 2005: DIP switches 4 + 5 configured incorrectly (I_2 range) - As of October 2005: 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

10   Factory settings

The RESISTRON temperature controller RES-403 is configured in the factory as follows:

DIP switches for secondary voltage U_2 and current I_2 (up to September 2005)	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 October 2005.
Rotary coding switch for heatsealing band alloy and temperature range		Heatsealing band alloy: Alloy A20 Temperature range: 300 °C Maximum temperature: 300°C Rotary coding switch: "0" position
Plug-in jumper for alarm relay		Cobtact closes by alarm
Automatic phase angle compensation (AUTOCOMP) [X]		AUTOCOMP: OFF

Measuring impuse duration [X]		Measuring impulse length: 1,7ms
„Temp. OK" signal (as of October 2005: With MOD 46 only) [X]		Tolerance band: -10K…+10K
Temperature diagnosis [X]		Temperature diagnosis: OFF
Heatup timeout [X]		Heatup timeout: OFF

[X] As of October 2005:
With ROPEX visualization software only.

11 Maintenance

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

12   How to order

	Contr. RES - 403 / . . . VAC **115**: Power supply 115 VAC, Art. No. 740301 **230**: Power supply 230 VAC, Art. No. 740302 **400**: Power supply 400 VAC, Art. No. 740303 Scope of supply: Controller includes connector plug-in parts (without current transformer) **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) **40**: MOD 40, Art. No. 800040 ("Temperature OK" signal) Please indicate the article numbers of the controller and the required modifications (optional) in all orders, e.g. RES-403/400 VAC + MOD 26 (controller for 400 VAC power supply with booster connection) Art. No. 740303 + 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
	Communiction interface CI-USB-1 Art. No. 885650
	Potentiometer PD- . **3**: For 300 °C range, Art. No. 881103 **5**: For 500 °C range, Art. No. 881105 Scope of supply: Potentiometer with digital dial
	Temp. meter ATR- . **3**: 300 °C range, Art. No. 882130 **5**: 500 °C range, Art. No. 882150

Booster B- . . . 400

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

For more accessories: ☞"Accessories" leaflet

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