ROPEX
INDUSTRIE – ELEKTRONIK

RESISTRON

RES-207

TEMPERATURE CONTROLLER FOR HEATSEAL BANDS TO SEAL PLASTIC FILMS

FEATURES

- ★ Analog Input 0 - 10VDC (**S**et **P**oint) and Analog Output 0 - 10VDC (**P**rocess **V**ariable)
- ★ All control signals galvanically isolated
- ★ Comprehensive self monitoring with "Alarm Signal"
- ★ SSR (**S**olid **S**tate **R**elay) Function
- ★ Compact sized, snap on mounting on DIN rail
- ★ Plug in connectors
- ★ Easy installation and operation

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1. APPLICATION AND SHORT DESCRIPTION

As all other **RES controllers**, this unit is used to control the temperature of heating elements (heatseal bands, beaded bands, cutting wires, etc.) by measuring the resistivity of the heating element. Precision measurement together with high response produces perfect temperatures control during film sealing processes. With a correctly installed system, temperature is controlled with an accuracy of ± 3 %.

The controller **RES-207** has been especially designed for Form-Fill-Seal-Machines that are computer operated. Two isolated analog interfaces permits communication with the machine processor through 0-10VDC-signals for setpoint and process variable. For all other functions 24VDC logic-signals are used. An extremely high operating reliability is achieved by this controller with the complete isolation from all other signals.

The **SSR function** (solid state relay) makes it possible to use the controller as an solid state power-switch taking the nature of the transformer load into consideration. This is an advantage for machines that are designed for either impulse or constant heat sealing jaws.

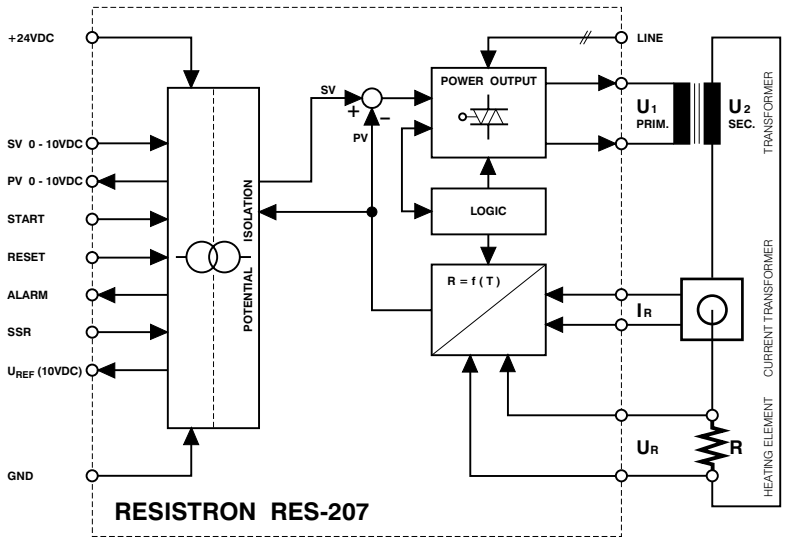
By using the reference voltage "U_{REF}" (10 VDC) the heatseal band temperature can also be preset with an external potentiometer.

Comprehensive self-monitoring of the internal and external circuits provides additional operating reliability ("ALARM").
→
An external jumper facilitates the selection of 50 or 60 Hz to conform to the power supplied. Please refer to "Operating Instructions".

2. PRINCIPLES OF OPERATION

RES controllers are electrical resistance-measuring, temperature regulating units. They use the characteristics of certain heatseal elements that changes its resistance in a fixed ratio to the change in temperature. This reaction of the heating element is expressed by its temperature coefficient T_K.
The advantage of this control method is the instant feed-back of the heating element temperature (resistance) without any additional sensor with thermal inertia. The restistance is constantly monitored with a high sampling rate by measuring the current through the element and the applied voltage; this information is fed back to the controller as the process variable "PV". It is also supplied at the analog output, for display on the external temperature meter or other instrument.

After comparing this information with the set point "SP" the controller adjusts the voltage output to the heating element so that it will always maintain the desired temperature (resistance). Voltage control is accomplished by phase-angle-control of the primary current going to the transformer. The high response feed back facilitates extremely fast temperature changes.
A wide range of secondary voltages can be selected for the system because control is exercised on the primary side of the transformer. This allows optimum "fitting" of the transformer's secondary voltage to the application.



RESISTRON RES-207

3. DESCRIPTION OF THE RES-207 CONTROLLER

The components of this controller are mounted in a box 90x70mm base x 135 high, able to be mounted onto a DIN rail (35 mm).
On the top of the unit are 2 connector blocks for the electrical connection as well as several LEDs.
At one side of the unit is the opening that allows access to the DIP switches. On the opposite side is the jumper for the frequency selection.
The controller is always supplied with the special current transformer that can easily be mounted separately onto the DIN rail. We recommend that only the **original Ropex current transformer** be used.

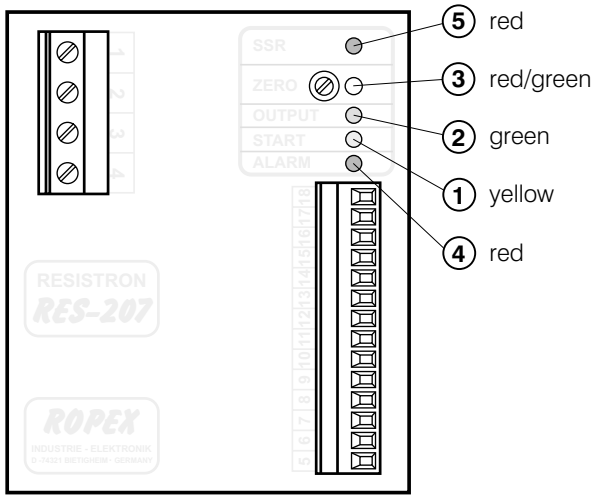
4. FUNCTIONS OF THE RES-207

4.1 CONTROL FUNCTION

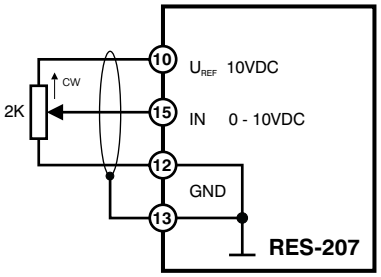
The controller performs two different mode: measuring or controlling. If there is no START signal (LED ① "START" is OFF) the controller only measures the resistance of the heating element without raising the temperature. It is in this measuring mode that the "Z" calibration is performed. In the measuring mode LED ② "OUTPUT" blinks with a frequency of 5 or 6Hz in synchronism with the calibration impulses.

If there is a START signal (LED ① "START" is ON) the controller goes into the regulating mode increasing the temperature of the heating element to the desired set point as rapidly as possible. The maximum secondary voltage is supplied to the heating element and then subsequently reduced by the phase control as soon as the preset temperature is reached. The high sampling rate together with virtually instant feedback gives the controller a high response control capability.

The controlling action is indicated by LED ② "OUTPUT" which changes its intensity with the change in output voltage. When more heat is needed, as in heating up or sealing, the LED is brighter (→ LED "OUTPUT").



4.1.1 Temperature Setting with Potentiometer



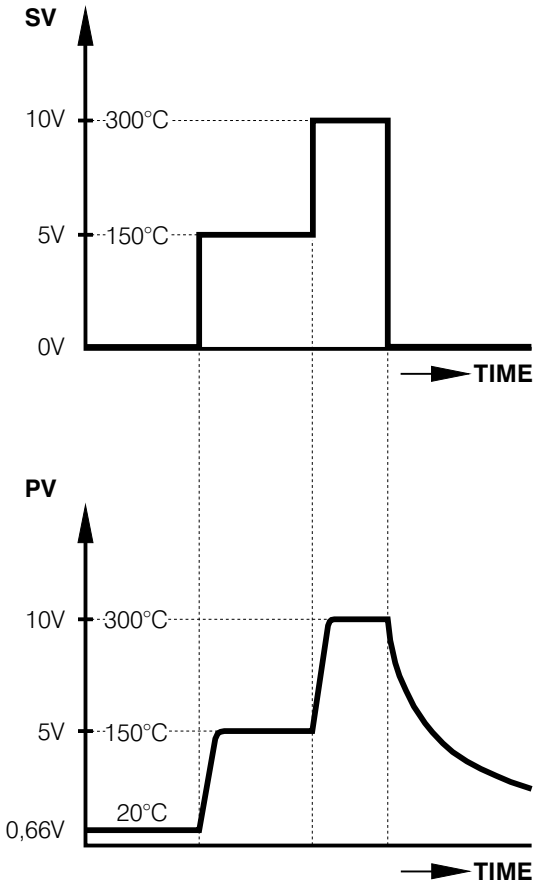
In cases when there is no analog voltage available, the temperature can be preset with an external potentiometer (2kOhm). Terminal 10 is used as the refence voltage of 10V. The digital potentiometer, P3D (P5D) offered as an accessory, is of great value since the selected preset temperature, is visible in **°C** in the dial window.

4.1.2 Analog Input (Set Variable)
Analog Output (Process Variable)

The desired temperature of the heatseal element can be set between 0-300°C through an external analog voltage of 0-10V. The relationship between voltage and temperature is linear. The controller responds to the preset value with high response and further provides an output of 0-10V that is proportional and linear to the actual temperature of the heatseal element. 10V equals 300°C.

By programming the preset temperature input signal, various temperature profiles may be achieved, e.g. a preset base temperature with a superimposed impulse. By modifying the temperature input signal, the actual temperature can be modified to compensate for a speed change of the machine. A constant preset temperature signal (voltage) will result in a constant heatseal element temperature independent of the demands on the heatseal element, e.g. constant heat for high speed operations.
The analog output signal of the actual temperature can be used in different ways, e.g. to visually indicate the temperature, to set temperature limits, to maintain tolerances etc. Since the controller monitors temperatures continuously, even during the cooling process, programs can be set-up that utilize this data for control and recording purposes.

Analog input and output are galvanically separated by isolation-amplifiers.



4.1.3 ZERO Calibration

The "zero calibration" is the adjustment of the controller to the resistance of the cold heatseal band. This calibration must be performed with the heatseal band at room temperature (20°C /68°F) using the "ZERO" potentiometer. Proper calibration is indicated by the use of the two color (red-green) LED ③ that is set to change colors exactly at 20°C. When the controller is properly calibrated, LED ③ will be "OFF" and the a analog output will be 0.66 volts which equals 20°C. If the zero point is below 20°C the LED turns red; when it is above 20°C the LED turns green.

If properly calibrated LED ③ will not be "ON" when the heatseal band is at ambient condition. When the machine is operating LED ③ will show green because the temperature will be above 20°C. Under no circumstance should the LED show red since this would mean a suppression of the zero point.

If the controller is improperly calibrated and set below the mark "0 °C" and a "START" is attempted, the alarm function will activate and the controller will shut down (→Alarm Function)**.**

4.2 ALARM FUNCTION

4.2.1 Alarm Signal

To increase reliability of operation and to assure adequate seals, the **RES-207** controller contains a comprehensive monitoring system that will send an alarm signal (LED ④ "ALARM" will turn red) and activate the alarm relay when:

a) Heatseal element breaks (one of the bands when two bands are mounted parallel), or any discontinuity in the secondary circuit occurs

b) Any discontinuity occurs in the monitoring wiring U_R

c) Any discontinuity occurs in the monitoring wiring I_2 of the current transformer

d) A short circuit occurs at the heatseal band

e) Heatseal element overheats by 20% over the maximum temperature (hotter than 360°C)

f) Calibration was performed incorrectly (suppression of the "Z" point). When the "Z" point lies electrically under "0" LED ZERO ③ will be red, then the controller will ignore the Start signals and go into "Alarm".
NOTE: In order to permit a proper calibration functions a),e) and f)are activated only when there is an start signal.

Other reasons for an alarm signal could be:

- Incorrect voltage range chosen (DIP switch)
- Incorrect frequency rating selected (jumper)
- Incorrect voltage supply (e.g. 230V vs 115V)
- Internal malfunction

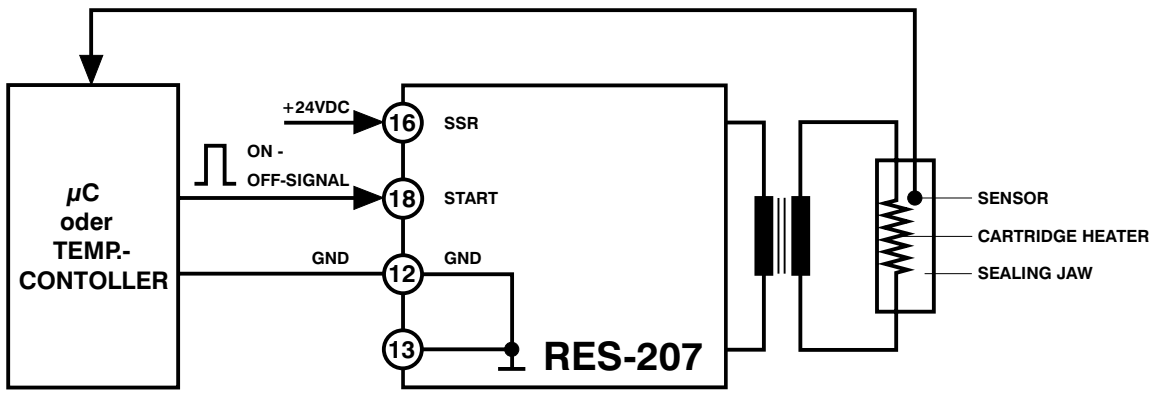
In case of alarm LED ④ "ALARM" will turn red, the controller output is disabled, the alarm output goes HIGH, and will remain in this state.

4.2.2 Reset

The controller can be reset - after the cause of the malfunction has been corrected - by a positive signal of 24VDC at the RESET input for at least a 0.3 second, or by turning off the main power.

4.3 SSR-FUNCTION (**S**OLID-**S**TATE-**R**ELAIS)

The **RES-207** can be used as **S**olid **S**tate **R**elay for machines that are set up to use both impulse or constant heat, to switch ON/OFF the cartridge heaters.



(cont. page 6)

This mode can be activated by a HIGH signal (+24VDC) at terminal ⑯ "IMP/SSR".
The LED "SSR" will glow red.
The output signal of a conventional temperature controller or of the PC unit must be connected to the START input.
This output signal will then switch the RES-207 "ON" and "OFF" as required.
In the SSR mode the analog ouput will be 0.0 V.

When switching from impulse to constant heat a change in the secondary voltage supply might be necessary. This may also be achieved easily on the primary side.

When in SSR mode it is not necessary to have the U_R wiring connected since it is not being used and the alarm function has been disabled. The current transformer circuit **must remain connected**.

5. INDICATORS AND SIGNALS

5.1 LED INDICATIONS during the different operating modes

LED ↓	IMPULS MODE		SSR MODE
	MEASURING MODE	REGULATING MODE	
SSR	OFF	OFF	RED
ZERO	OFF : ZERO =20°C RED : ZERO <20°C GREEN : ZERO >20°C	GREEN	RED
OUTPUT	BLINKING GREEN	GREEN	GREEN : HEATING BLINKING: REGULATING OR STAND BY
START	OFF	YELLOW	YELLOW : HEATING OFF : REGULATING OR STAND BY
ALARM	OFF : OK RED : TROUBLE	OFF : OK RED : TROUBLE	—

5.2 TRUTH TABLE

INPUT / OUTPUT	STATUS	FUNCTION
→ START	HIGH LOW	Controller ON (REGULATING MODE) Controller OFF (MEASURING MODE)
→ RESET	HIGH LOW	RESET NORMAL OPERATION
→ IMP - SSR	HIGH LOW	SSR - MODE IMP - MODE
← ALARM	HIGH LOW	ALARM OK
→ SET POINT	0 - 10VDC	0 - 300°C *)
← PROCESS VARIABLE	0 - 10VDC	0 - 300°C *)

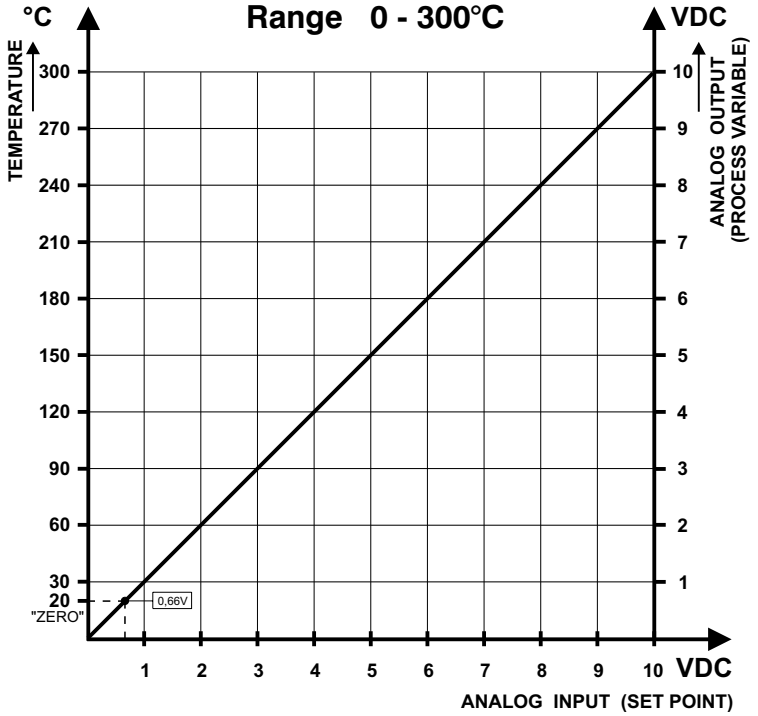
AUXILIARY VOLTAGE :
24VDC, +20%, -10%

SIGNAL LEVELS :
HIGH : 7....30VDC
LOW : 0.... 2VDC

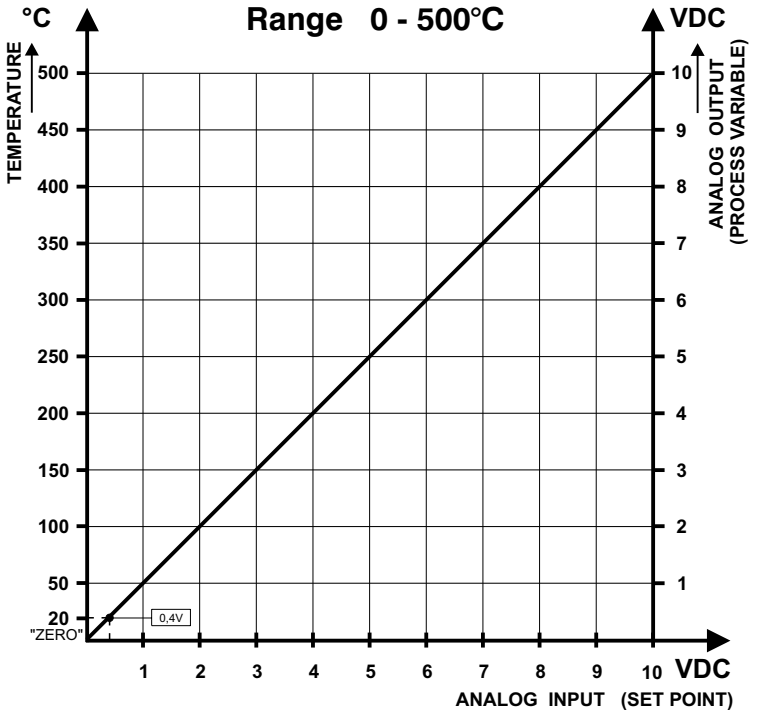
*) OPTIONAL RANGE 0 - 500°C

5.3 INPUT / OUTPUT CHARTS

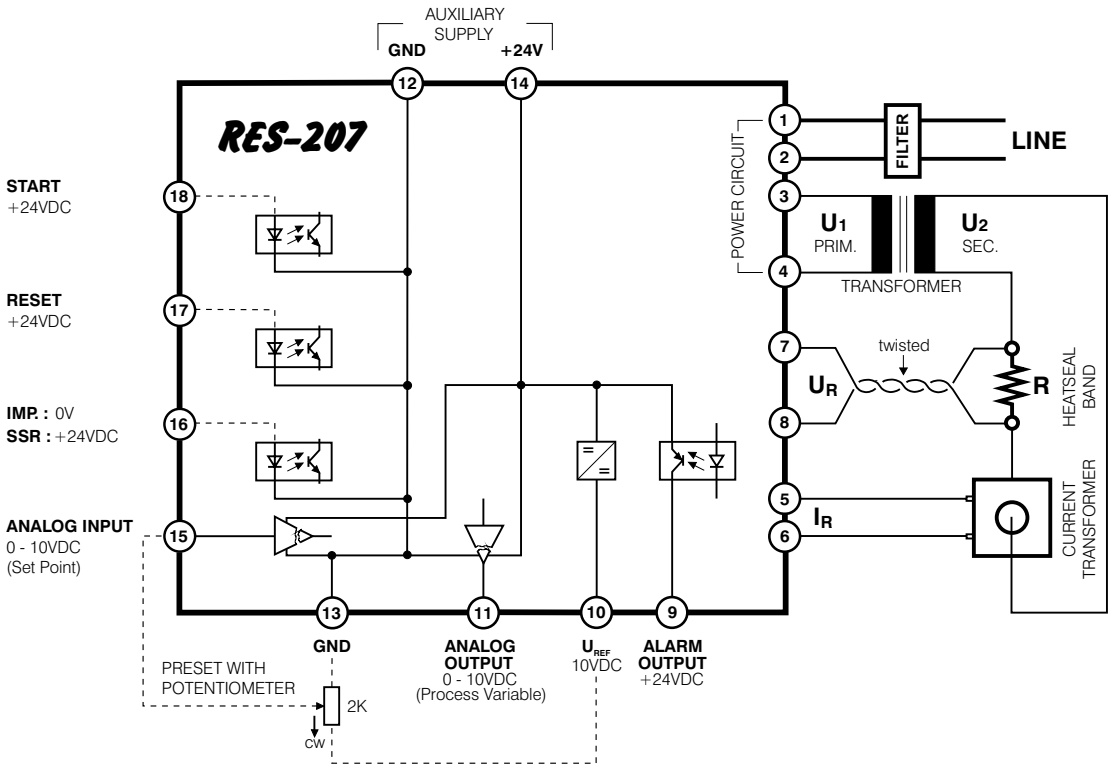
Relationship between analog input, temperature and analog output



Relationship between analog input, temperature and analog output



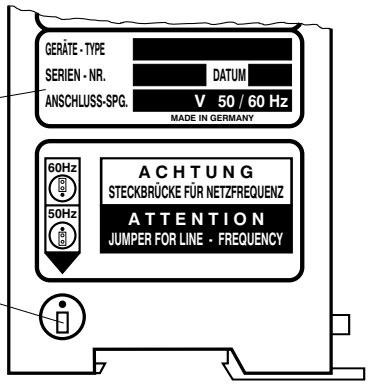
6. WIRING DIAGRAM



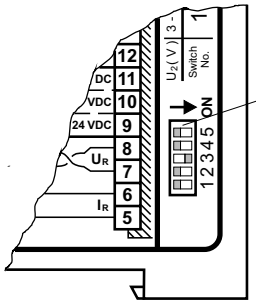
7. OPERATING INSTRUCTIONS RES-207

7.1

Examine the controller and determine that the power to be supplied to the controller is in agreement with the controller specifications in both voltage and frequency. If the unit has frequency options (50/60Hz) the jumper on the side of the unit must be set into its proper position.



7.2



Set the DIP switch to select the secondary voltage range that will be used. With extreme low resistance heatseal elements (less than 100 mOhm) or with extremely high secondary currents (larger than 80 A) additional switch No.5 must be ON.

U_2 (V)	3 - 10	8 - 30	20 - 60	50 - 80	I_2 > 80A
Switch No.	1	2	3	4	5

7.3

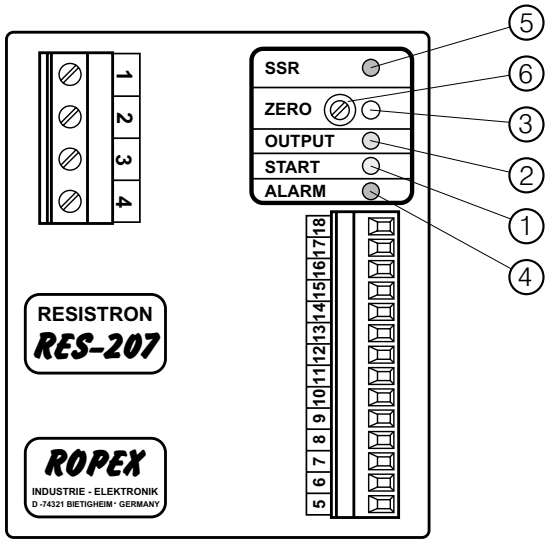
Connect the controller as shown into the wiring diagram. No special attention must be given to the polarity of the measuring wires for current and voltage as well as the transformer's primary or secondary. See General Installation Instructions (Section 13).

7.4

IMPORTANT
Make sure that there is **no** "START" signal. LED ①

7.5

Connect power, LED ② "OUTPUT" will blink at 5 or 6Hz, due to the calibration pulses.
LED ③ "ZERO" may be red or green. All other LEDs should be OFF.



7.6

Turn the "Zero" trimmer ⑥ until LED ③ "ZERO" is OFF (neither green nor red). Which way to turn? If the LED is red turn the trimmer clockwise; if the LED is green turn counter clockwise. When properly calibrated LED ③ "ZERO" will be OFF and the analog output will be 0.66V (= 20°C). If the analog temperature meter type ATR is connected the needle should rest at "Z" (= 20°C).

Important:
"ZERO" calibration must only be performed with a heatseal band at ambient temperature (20°C or 68°F).

7.7

If the "ZERO" calibration is not possible because LED ③ "ZERO" remains green, pass the wire through the current transformer a second time. This situation might occur when the heatseal element is very long or thin (high resistance). After creating the second pass through the current transformer **re-calibrate** the controller. **Recalibration** is also recommanded after each heatseal element replacement.

7.8

Set the desired temperature, e.g. 150°C and activate the controller, LED ① "START" will turn ON yellow. The temperature will rise and can be observed at the analog temperature meter. The movement of the analog temperature meter needle must be smooth and continous, equivalent to the gradual increase and decrease in the temperature of the heatseal element. After a few heating cycles check the "ZERO" calibration again, and re-adjust if necessary. The controller is now ready for operation.
NOTE:
When turning on the controller, follow the correct sequence. FIRST-Power, **THEN** the START signal. **NEVER** both together or in reverse sequence. However, the temperature may be pre-set befor starting the controller.

8. OPERATING MODES

Depending upon the use of the START signal, two completely different modes of operation can be chosen: Constant heat or Impulse. The choice of mode and the correct timing of the impulse sealing will be determined by practical tests with the machine, the product, and the film.

8.1 CONSTANT HEAT

The START signal is turned on for the duration of the machine use, and the heatseal element is constantly monitored and maintained at the preset temperature. During the sealing phases, the controller automatically compensates for the "lost" heat by adjusting the voltage supply.
During pauses the current is reduced as far to maintain the preset temperature and offset the heat lost into the environment. When the jaws are open the controller will compensate and overheating is not possible. The constant heat mode is usually used for speeds over 50-60 cycles/minute when the interval between seals is short and cool down time is minimal.

The advantage of this operation method is that the heatseal element must not constantly be reheated. Therefore the demand during the initial heating phase is not as great as during an impulse process. Also there is less demand upon the heatseal element (less expansion and contraction) the band remains in its expanded condition. The disadvantage of the constant heat is the loss of controlled cool down time while the jaws hold the seal. When the jaws are opened in the warm status, seals tend to shrink or deform. Generally when operating with constant heat the seal is cooled immediately after jaw opening by use of cooling air or a quenching jaw.

8.2 IMPULSE SEALING

The impulse sealing method occurs when the start signal is synchronized with the machine rhythm, every heating phase is followed by a cooling phase **with jaws closed**. Cooling is effected with jaws closed so that the seal has already set and has good strength and appearance when the jaws are opened. This method is preferred when sealing time is available because seam strength and appearance are better.

Since the heat sealing is a thermodynamic reversible procedure and is often influenced by time constraints, it is very important that the relevant parameters - temperature, time and pressure - are very carefully synchronized. The following diagram shows an example of the timely setting of temperature and jaw movement.

Basic rules for impulse heatsealing:

A. The preset temperature should always be attained when the sealing jaws are still open. This allows the sealing element to expand without interference and avoids overstressing of the ends (phase ②).

B. The system should be designed to drive the heatseal band to the preset temperature in minimum time. The total system, principally the secondary voltage, must be optimized to achieve the best result. (Our application service will give you the necessary data for your special application.)

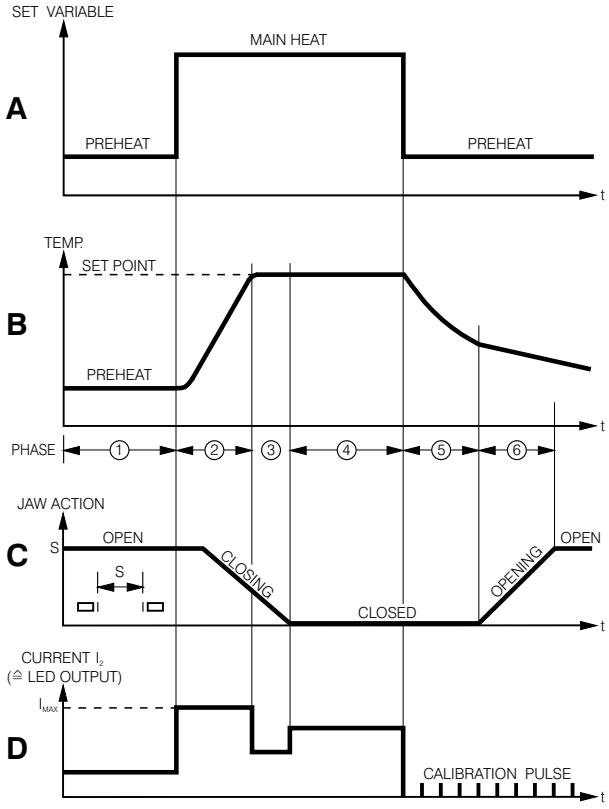
C. The cool down of the heatseal band while still under the force of the jaws is the main advantage of impulse sealing (phase ⑤). After turning off the energy most of the excess heat is absorbed by the jaws. Cooling of the jaws is sometimes recommended so that they can absorb enough heat from the heatseal band quickly. -- Contrary to the constant heat mode, good thermal conductivity between the sealing element and the jaws must be assured by using a thin backup material behind the heatseal band.

Under certain conditions, sealing is also possible with the so-called rest-heat procedure. In this mode, the remaining heat in a sealing element is calculated to be just enough for the sealing process. This means that in the timing process, the temperature drops in phase ④. The current is cut off when the jaws touch. The heat flows into the film and "unloads" the heat stored in the heatseal band, which results in a faster cooling. For this method to be effective the thickness, therefore the mass, of the heatseal band must be great enough to hold the required total heat.

PREHEAT
Occasionally, in spite of the high response of the controller, the first seal at start up may not be hot enough. This is because there is not enough time for the heatseal element to reach its preset temperature from ambient temperature in the time allowed. This can be avoided by pre-heating the heatseal band to a moderate (80...100°C) preheat before starting . This will help compensate for the first cycle. Subsequent cycles will never return to ambient temperature due to the remaining heat in the heatseal element from the preceeding cycle.

Timing Chart of Impulse Heatsealing

Example for the Timing sequence of the set variable, temperature, jaw movement and current flow.



Phase :

① START signal on. SET VARIABLE for PREHEAT is shown.

② While jaws are closing, the heatseal band temperature rises to the set point so that full temperature is reached before the jaws closed.

③ Power output is controlled.

④ Temperature remains at set point.

④ Heatseal process: Start of sealing time. Time must be allowed for the heat to fully penetrate the material to be sealed.

⑤ Cooling phase: Start of cooling time. Time must be allowed for the seal to 'set-up' before jaws are opened.

⑥ Jaws are opening.

8.3 CURRENT FLOW INDICATION

Current flow may be observed by watching LED ② "OUTPUT" during the impulse sealing. The LED indicates the change in current by a variation in light intensitiy. Diagram D shows the rate of current flow during a sealing phase. This can also be measured with an amp-meter.

Phase ① : Pre-heat with low energy

Phase ② : Heating up with full secondary voltage, maximum power

Phase ③ : Controller "ON" and regulating to maintain the preset temperature while the jaws are still open.

Phase ④ : Controller "ON" and regulating. Increased power is being supplied to maintain the preset temperature during the sealing process.

Phase ⑤+⑥: Controller "OFF" and the heatseal band is cooling, LED ② "OUTPUT" is blinking

LED ② "OUTPUT" is useful in detecting temperature "overshoot". After phase ② the LED may turn OFF for a brief period. This is an indication that the controller has shut off to compensate a temperature overshoot. In this case the secondary voltage is too high and must be reduced for proper operation.

The controller is also capable of regulating low temperatures, such as 50°C. Depending upon the heat dissipation and secondary voltage, the controller may go into an on-off mode of control, because the current phase angle is too small and normal control is not possible. When this condition occurs the LED will blink more or less rhythmically. If power cycling is observed while at higher sealing temperatures, e.g. 150°C, the secondary voltage is too high and should be reduced.

9. HEATSEAL ELEMENTS

The heatsealing element is an important component of the control system since it is simultaneously the sealing element and the temperature sensor. There are so many different shapes and sizes of heatsealing elements that we cannot discuss them all here, however, some very important physical and electrical characteristics are emphasized here.

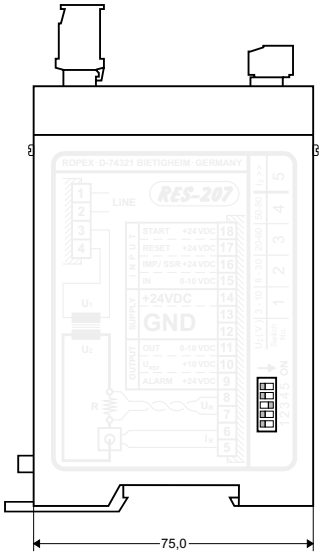
- The controlling principle demands that the alloy of the heatsealing element has the proper temperature co-efficient.

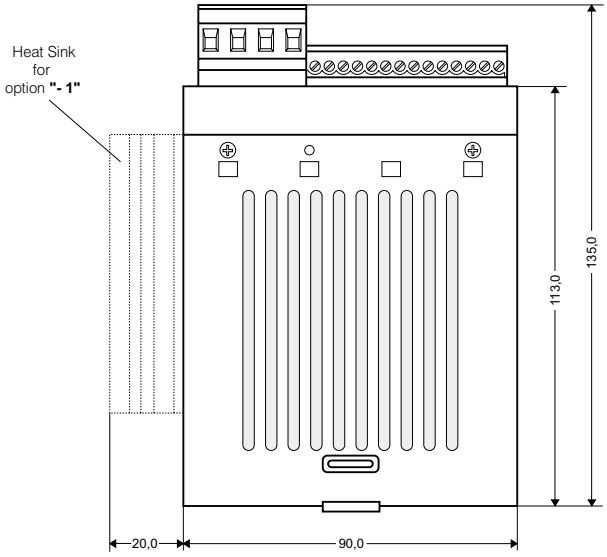
- During the first heat up to 200-250°C the heatseal band will experience a one time change in resistance (burn in effect). The resistance of the cold element is reduced by approx. 2-3%. This rather small change in resistance however results in a zero point discrepancy of 20-30°. Therefore, it is necessary to re-adjust the zero point after a few heating cycles.

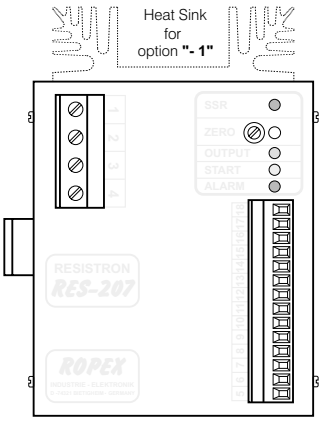
- A overheated (burned out) heatseal element cannot be used and must be replaced because of an irreversible change in the temperature co-efficient at high temperatures.

- A very important option is to copper plate or c/a coat the ends of the heatseal elements. Protected ends will result in better temperature control and extended "life" of the heatseal element as well as of the teflon cover or coating.

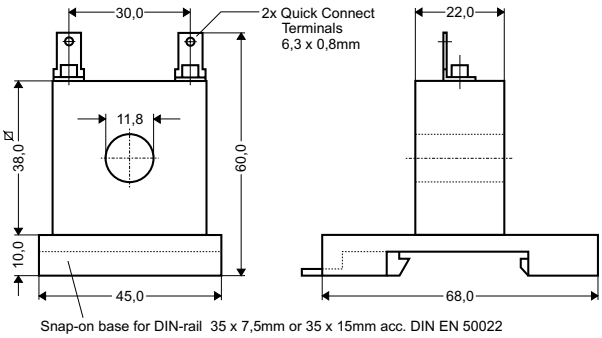
10. OUTLINE DIMENSIONS







CURRENT TRANSFORMER



11. SPECIFICATIONS

Type of Construction:	Housing designed for mounting into the electrical control cabinet on a 35mm DIN rail
Line Voltage:	Standard: 230VAC; (operating range +10% / -15%) Option : 115VAC or 400VAC
Frequency:	50 or 60 Hz; selected with jumper (operating range ± 1Hz)
Control Voltage:	24 VDC, +20% / -10%, reverse polarity protected
Control Current:	50 mA, max.
Temperature range:	Standard: 0 - 300°C Option : 0 - 500°C
Analog Input: (Set point)	0 - 10 VDC equals 0 - 300°C. (0 - 500°C) Input resistance, 200 kOhm polarity protected
Analog Output:	0 - 10 VDC equals 0 - 300°C. (0 - 500°C) Output resistance, 33 Ohm max. output current, 5mA
Logic Thresholds : Terminals 9,16,17.18	LOW : 0.....2 VDC HIGH : 7...30 VDC reverse polarity protected
Reference Voltage:	10 VDC ±5%, 5mA max., 33 Ohm
Input Current: Terminals 16,17,18	Typ. 8mA
Alarm Output:	24 VDC, 40mA max., short circuit protected
Sampling Rate:	Every tenth cycle of line voltage in the measuring mode. 200 msec at 50 Hz / 166 msec at 60 Hz Every voltage cycle in controlling mode 20 msec at 50 Hz / 16.6 msec at 60 Hz.
Calibration:	Calibrated for heating elements with $T_K = +10 \times 10^{-4}\ K^{-1}$

Maximum Load Current:
(=primary current of the heatseal transformer)

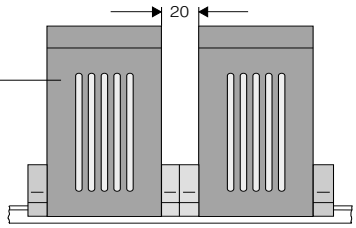
Operating Mode	TYPE	
	RES-207-0 (Standard)	**RES-207-1**
Constant (average)	**5A**	**15A**
Impulse 20% duty cycle	**25A**	**20A**

Main Application

SPECIFICATIONS (Continuation)

Ambient Temperature: +5...+45°C (41...113°F)

NOTE:
When installing several controllers on one DIN rail, allow a distance of 20mm between units.



Electrical Connector: Terminal blocks, with plug in connectors

Protective Cathegory: IP20

Weight: Controller : 0.7kg (1.54 lbs)
Current transformer : 0.15kg (0.33 lbs)

11.1 HOW TO ORDER

EXAMPLE:

RES-207 - X - X / 230 V - 50/60 Hz

Line Voltage
Standard : 230 VAC
Option : 115 VAC oder 400VAC

Temperature Range
X = 3 ≙ 0 - 300°C
X = 5 ≙ 0 - 500°C

X = 0 **Maximum Load Current**
X = 1 (see Specifications)

Model of controller

SERIES " RESISTRON"

Supply: Controller with current transformer and electrical connectors

12. ACCESSOIRES (see also Leaflet "ACCESSOIRES")

ANALOG TEMPERATURE METER
to be mounted into control panel. Zero calibration at "Z"; available for temperature ranges of 0 - 300 °C and 0 - 500 °C.
Size: 30 x 50 mm front plate
Panel cutout: 28 x 48 mm
Depth: 40 mm
Electrical Connection: Screw terminals

Catalog No.:
ATR-3 für 300°C
ATR-5 für 500°C

DIGITAL POTENTIOMETER
with dial for temperature setting. The value selected on the dial represents the temperature in °C.
Diameter of the dial: 30 mm
mounting hole: 28 mm
connections by soldering.

Catalog No.:
P3D für 300°C
P5D für 500°C

INSTALLATION INSTRUCTIONS