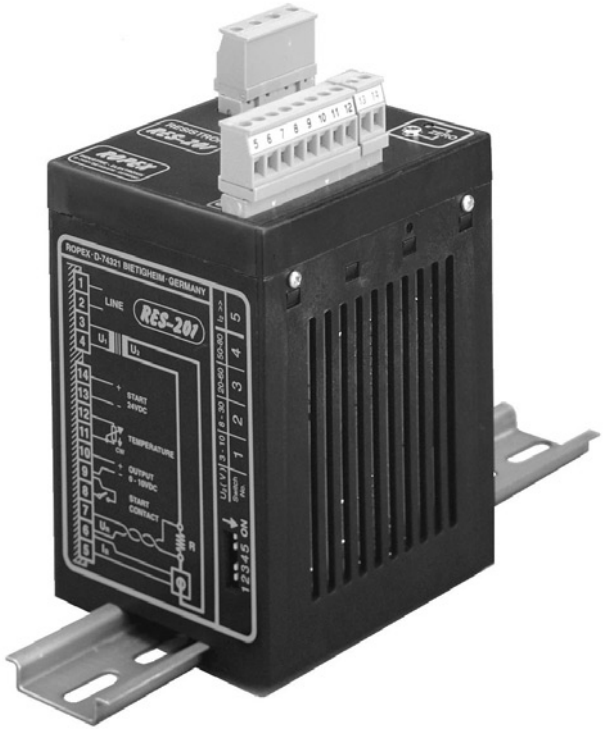
ROPEX INDUSTRIE – ELEKTRONIK

RESISTRON RES-201

TEMPERATURE CONTROLLER FOR HEATSEAL BANDS TO SEAL PLASTIC FILMS



FEATURES

- ★ Compact in size with easy DIN rail mounting for inside the control cabinet.
- ★ Analogue temperature output signal, 0-10VDC, to read actual value.
- ★ Snap on terminals.
- ★ High reliability through hybrid technology.
- ★ Jumper for easy selection of frequency (50 - 60Hz).
- ★ Easy installation and operation.
- ★ Cost effective - Improved production, less scrap.

TABLE OF CONTENTS

ROPEX Industrie - Elektronik GmbH · Gansäcker 21 · D-74321 Bietigheim-Bissingen
Telefon (07142) 7776-0 · Telefax (07142) 7776-19 ·

1. INTRODUCTION

The RES-201 Heatseal Controller is suitable for most heatseal applications. The compact control unit is mounted into the electrical cabinet, while the operating components temperature control dial and temperature indicator are mounted on the machine's operating panel.

As with all other RESISTRON regulators, this unit is used to control the temperature of heating elements (heatseal bands, beaded bands, cutting wires, etc) based upon the principle of measuring the changes of heating element resistance. High frequency of and precision measurement together with high response control produces perfect temperature control during film sealing processes. With a correctly installed system, temperature is controlled with accuracy of +/-3%.

Standard controllers can be used for systems with resistance ranging from a few milli-ohms to several ohms. Easy programming through DIP switches, makes this controller into a universal "building block" for temperature control in:

- vertical and horizontal plastic pouch packaging machines
- pouch form/fill/seal packaging machines
- wrapping machines
- empty pouch making machines
- fitment attachment
- other heatsealing applications

An external jumper facilitates the selection of 50 or 60 Hz. to conform to the power supplied. See "Operating Instructions".

2. PRINCIPLES OF OPERATION

As indicated in the name, RESISTRON controllers are in principle electrical resistance-measuring, regulating units. They are use the characteristics of certain heating element alloys that change their specific resistance with the change of temperature. This variable conductivity of the heating element is expressed by its temperature coefficient Tk.

The decisive advantage of this measuring method lies in the built in means of temperature detection and therefore instant reading of the actual temperature of the heatseal element.

The resistance is constantly read at the heating element by measuring the current and voltage, this is fed as the "actual value" to the controller, is supplied at the analog output, and displayed on the external temperature or other instrument.

After comparing this information with the "pre-set value" the controller adjusts the voltage output to the heating element so that it will always maintain the desired temperature. Voltage control is accomplished by phase "chopping" of the primary current going to the transformer. The high response feed back facilitates extremely fast changes in the "actual value", as well as nullifies "spikes" and other interferences.

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 to the application.

3. FUNCTIONS OF THE RES-201

3.1 Control Function

The controller can be used for two different functions - measuring or controlling. If there is no START signal (contact is open between 8 & 9) the controller only measures the resistance of the heating element without heating it up. It is in this condition that the calibration is performed. The controller measures resistance with small voltage impulses 5 or 6 times per second. When the "START" switch is closed (close contacts 8 & 9) the controller starts the controlling cycle by increasing the temperature of the heating element to its preset value as rapidly as possible. The maximum secondary voltage is supplied to the heating element and then subsequently reduced by the phase "chopping" action of the controller as soon as the preset temperature is reached. The high frequency of sampling together with virtually instant feedback gives the controller the high response control capability.

3.2 ZERO Calibration

The "ZERO calibration" is the adjustment of the controller to the resistance cold heatseal band. This calibration must be performed with the heatseal band at room temperature using the "ZERO" potentiometer. Proper calibration is indicated by the use of a two color LED (red-green) that is set to change colors exactly at 20°C. When the controller is calibrated, the LED turns "OFF" and the analog output is .66 volts which equals 20°C. If the temperature goes below 20°C, the LED turns red, when the temperature reaches more than 20°C, the LED turns green.

If properly calibrated the LED will not be turned on when the heatseal band is at ambient condition. When the machine is operating the LED will generally show green (temperature is above 20°C).

Under no circumstance should the LED show red since this would mean that the temperature is below 20°C., or not properly calibrated. When the zero mark is set too low, the heatseal band temperature will be higher than the preset point by the amount of the error in the calibration.

3.3 Setting Temperature

The desired temperature is preset by the use of the external potentiometer. The digital potentiometer "PXD" is especially good because the selected preset temperature is displayed on the dial in °C. (See Digital Potentiometer under Accessories)

NOTE: NEVER operate the controller without a proper potentiometer connected to terminals 11-12. An open circuit will produce uncontrolled heating up of the heatseal elements.

3.4. Analog Output (Actual temperature)

At terminals 9 and 10, the controller provides an analog voltage output of 0-10VDC that is proportional to the temperature of the heatseal element. With a properly designed system, the heatseal band temperature during controlled operation is equal to the pre-set value selected on the potentiometer.

A visual display of the heatseal band temperature strongly recommended because the rapid temperature changes, as in impulse sealing, can be monitored with a proper analog instrument and irregular performance can be easily recognized.

The analog temperature meter in °C "ATR" (see accessories) is ideal for this purpose. Of course, the analog output (max. 5mA) can also be used for other instrumentation, such as an printer, setting of value limits, tolerance limits, etc.

When connecting to external installations, ground free systems are essential since one end of the heatseal element over the measuring wire (terminal 6) and the mass of the external system (terminal 9) may be grounded.

4. INSTALLATION DIAGRAM RES-201

5. Operating Instructions RES-201

5.1 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 of the side of the unit must be set into its proper position.

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

5.3 Connect the controller according to 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 Important Precautions When Installing RES-Controllers (Section 11)

5.4. IMPORTANT

Make absolutely sure that there is no "Start" signal between terminals 8 and 9, they must be open.

5.5 Connect power, LED "ZERO" may be green or red.

5.6 Turn "ZERO" trimmer until the LED "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 clock-wise. When properly calibrated, the analog output will be .66V (20°C). If the analog temperature meter is connected, the needle should rest at "Z" (20°C).

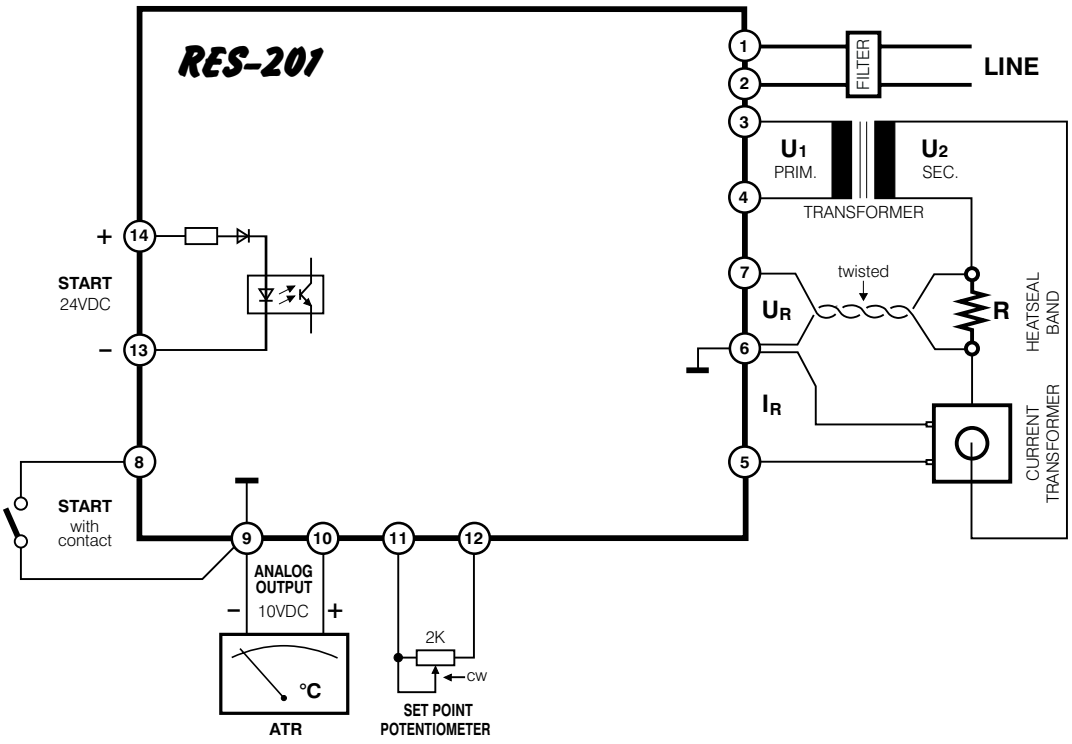
"Zero" calibration must only be performed with a heatseal band at ambient temperature (20°C. or 72°F.).

5.7 If the "ZERO" calibration is not possible, the LED "ZERO" is always green, the heatseal band wire must be threaded twice through the current transformer. This might be occur when the heatseal element is very long or thin (high resistance). Then, re-calibrate the controller. Re-calibration is also recommended after each heatseal element replacement.

5.8 Set the temperature, e.g. 150°C and activate the controller. The temperature rise can be observed at the analog temperature meter. The movement of the analog temperature meter needle must be a "calm" and rythmical, 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 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 before turning on the controller.

4. WIRING DIAGRAM



6. OPERATING MODES

Depending upon the use of the START signal, two completely different ways of operation can be chosen: Constant heat or Impulse.

Which operation to choose and the correct timing of the impulse sealing will be determined by practical tests with the machine, the product and the film.

6.1 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 pre-set temperature. During the sealing phases, the controller automatically compensates for the "lost" heat by adjusting the voltage supply. During pauses, only occasional controlling is necessary to maintain the preset temperature to offset the heat lost into the environment. When the jaws are open, the controller will compensate and overheating is not possible. The constant heat feature 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 the operation method is that the heatseal element must not constantly be reheated. Therefore the demand during the initial heating phase is not as drastic 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 open 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.

When using the "Constant Heat" feature, a fast cool down of the heatseal element is not important, therefore, there should be good thermal insulation between the heatseal element and the jaws. The heat flow into the jaws, and the heating of the jaws, will be reduced. Less total energy will be consumed. The result is less demand on the transformer and the controller.

6.2 IMPULSE SEALING

The so called impulse sealing method occurs when the start signal is synchronized with the machine rhythm, every heatsealing cycle is followed by a cooling phase with jaws closed. Cooling is effected under jaw pressure so that the seal has already set and has good strength and appearance when the jaws are opened. When sealing time is not critical, this approach is preferred since seam strength and appearance is better.

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

Here some basic rules for impulse heatsealing:

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

B. The system should be designed to drive the heatseal band to the pre-set temperature in the shortest time. The total system, principally the secondary voltage, must be optimized. (Our application service will give you the necessary data for your special application.)

C. The cool down of the heatseal band while still under pressure 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 feature, a constant heat flow between the sealing element and the jaws must be assured by using a thin, thermal conductive electrical insulators.

Under certain conditions, sealing is also possible with the so-called rest-heat procedure. During such a phase the remaining heat in a sealing element is calculated just to be enough for the sealing process. This means that in the timing process, phase 4 goes to zero in favor of phase 5. The current is cut off when the jaws touch. The heat flows into the film and "unloads" the heatseal band, which results in a fast cooling phase.

6.3 CURRENT FLOW

It is of interest to look at the secondary current flow during the impulse sealing method. Diagram D shows the rate of current flow during a sealing phase. This can be measured with an amp-meter.

Phase 1: Controller "OFF". Calibrating pulses are being supplied to the heatseal band by the controller. These pulses can only be measured with a high response amp-meter.

Phase 2: Controller "ON". Heating up with full secondary voltage, maximum power.

Phase 3: Controller "ON" and regulating. Reduced power is being supplied 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". Cooling, only calibrating pulses are being supplied.

If the secondary voltage is too high, temperature overshooting will occur. If the secondary voltage is too high the temperature rise of phase (2) will be too rapid and the power will be completely cut-off for a brief interval at the beginning of phase (3). This can be observed by using a high response amp-meter.

The controller is also capable of regulating low temperatures, such as 50°C. Depending upon the cooling phase and secondary voltage, the controller may go into an on - off mode of operation, becausée the current phase angle is too small and normal control is not possible. When this condition occurs it can be seen by use of an ampere meter. A small current will be detected that is cycling on and off rythmically.

When power cycling is observed at higher temperature ranges e.g. 150°C, the secondary voltage is too high and should be reduced.

A simple method to monitor the current flow is to install a light bulb at the controller's output, wired in parallel with the primary side of the transformer.

Changes of the light intensity will indicate the controlling process. Never install a light bulb on the secondary side of the transformer, parallel to the heatsealing element, since this would affect the measuring capability of the controller.

7. HEATSEALING ELEMENT

The heatsealing element is an important component within 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 here, however, some very important physical and electrical characteristics are emphasized here.

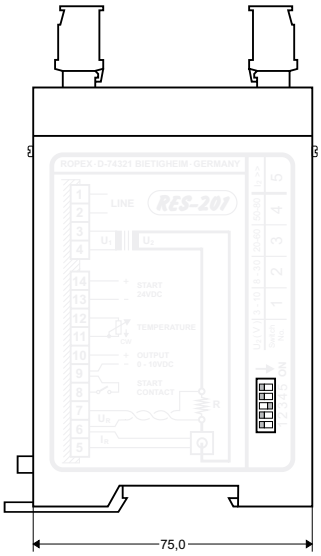
- The controlling principle demands that the alloy of the heatsealing element has a temperature coefficient of resistance,Tk. Therefore only certain alloy materials can be used with the RES controllers. RES controllers are calibrated for a Tk of approx. $+10x10^{-4}$ K^{-1}. With a lower Tk value, the controller will swing from extreme to extreme, or "run away". If the Tk is greater then the controller must be compensated.

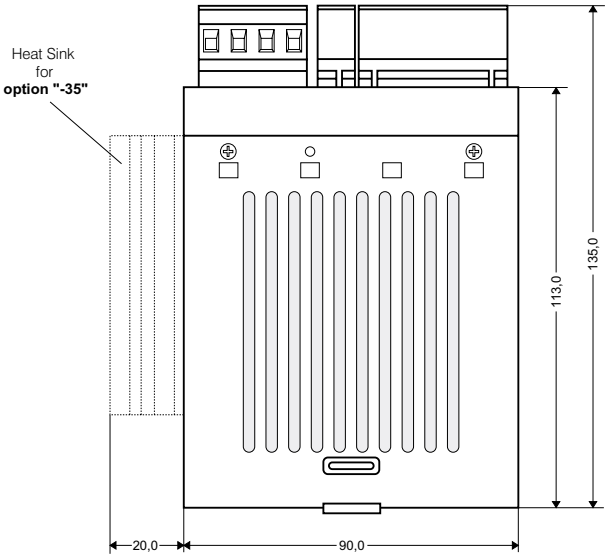
- During the very first heat up to 250-300°C of the sealing element, the alloy will experience a one time change in resistance (burn in effect). The resistance of the cold element is reduced by approx. 2-3%. This rather small change in resistance however results in a zero point discrepancy of 20-30°. Therefore, it is necessary to readjust the zero point after a few heating cycles.

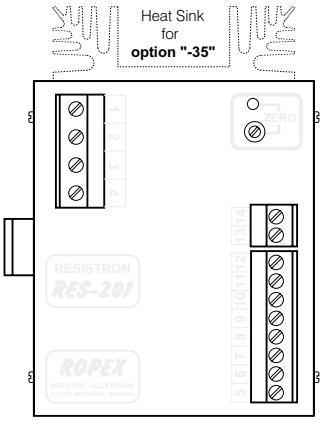
- A overheated (burned out) heatseal element cannot be used and must be replaced because of an irreversible Tk change at high temperatures.

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

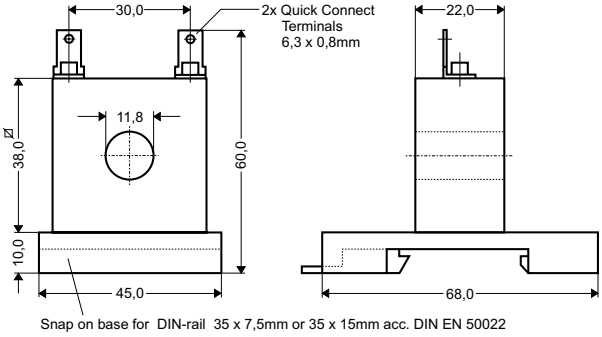
8. DIMENSIONS OF CONTROLLER







CURRENT TRANSFORMER



9. TECHNICAL DATA

Type of Construction:	Housing designed for mounting into the electrical control cabinet on a 35mm DIN rail.
Line Voltage:	Standard 230 VAC; 115 or 400 VAC optional (allowable deviation -10% +15%)
Frequency:	50 or 60 Hz; selectable with jumper (allowable deviation +/- 1 Hz.)
Selection of Temperature:	Potentiometer 2K (see Accessories)
Analog Output:	0-10VDC equals 0-300°C Internal resistance - 33 ohms max. output current, 5mA
Sampling frequency:	every tenth cycle of line voltage in the calibration mode. 200 msec at 50 Hz / 166 msec at 60 Hz every voltage cycle in controlling mode, 20ms at 50 Hz. / 16.6ms at 60 Hz.
Temperature Calibration:	Calibrated for heatseal element with $Tk = +10 \times 10^{-4} \times K^{-1}$
Max. Primary Current:	at impulse with 20% ED, 20A at constant heat, 5A
Ambient Temperature:	+5.... +45°C
Electrical Connector:	by terminal blocks
Protection:	IP 20
Weight:	Controller .7kg(1.54lbs), current transformer .15kg(.33lbs)

Current transformer and electrical connectors included with controller.

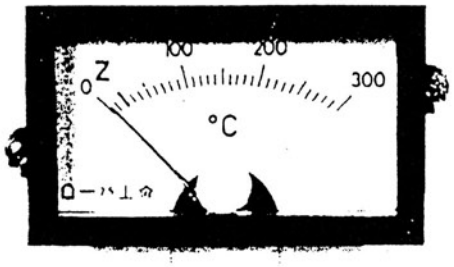
HOW TO ORDER

RES - 201 - X / 230V - 50/60Hz

- 50/60Hz — Frequency: 50Hz/60Hz selectable by moving the jumper on the side of the controller.
- 230V — Line Voltage: 230V Std. 115V or 400V available
- X — Temperature Range: 3 = 0-300°C, 5 = 0-500°C
- 201 — Model of controller

10. ACCESSORIES

ANALOG TEMPERATURE METER - to be mounted into control panel. Zero calibration at "Z"; available for temperature ranges of 0-300 and 0-500°C.



Size: 30 x 50mm front plate
Depth: 40mm
Panel cut-out: 28 x 48mm,

Model ATR-3 for 300°C
Model ATR-5 for 500°C

DIGITAL POTENTIOMETER - with dial for temperature setting. The value selected on the dial is the temperature in °C.

Diameter of the dial: 30mm
Mounting hole dia: 28mm
Solder lug connectors

Model P3D for 300°C
Model P5D for 500°C

INSTALLATION INSTRUCTIONS