

RESISTRON

TEMPERATURE CONTROLLER
FOR HEATSEAL BANDS
TO SEAL PLASTIC FILMS



RES-210

Option:

RES-211
(digital display)

Features

- ★ Easy mounting into the control panel
- ★ Temperature indicator in °C
analog (RES-210) or
digital with HOLD feature (RES-211)
- ★ Easy Installation and Operation
- ★ Perfect for Large Variety of Application



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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.

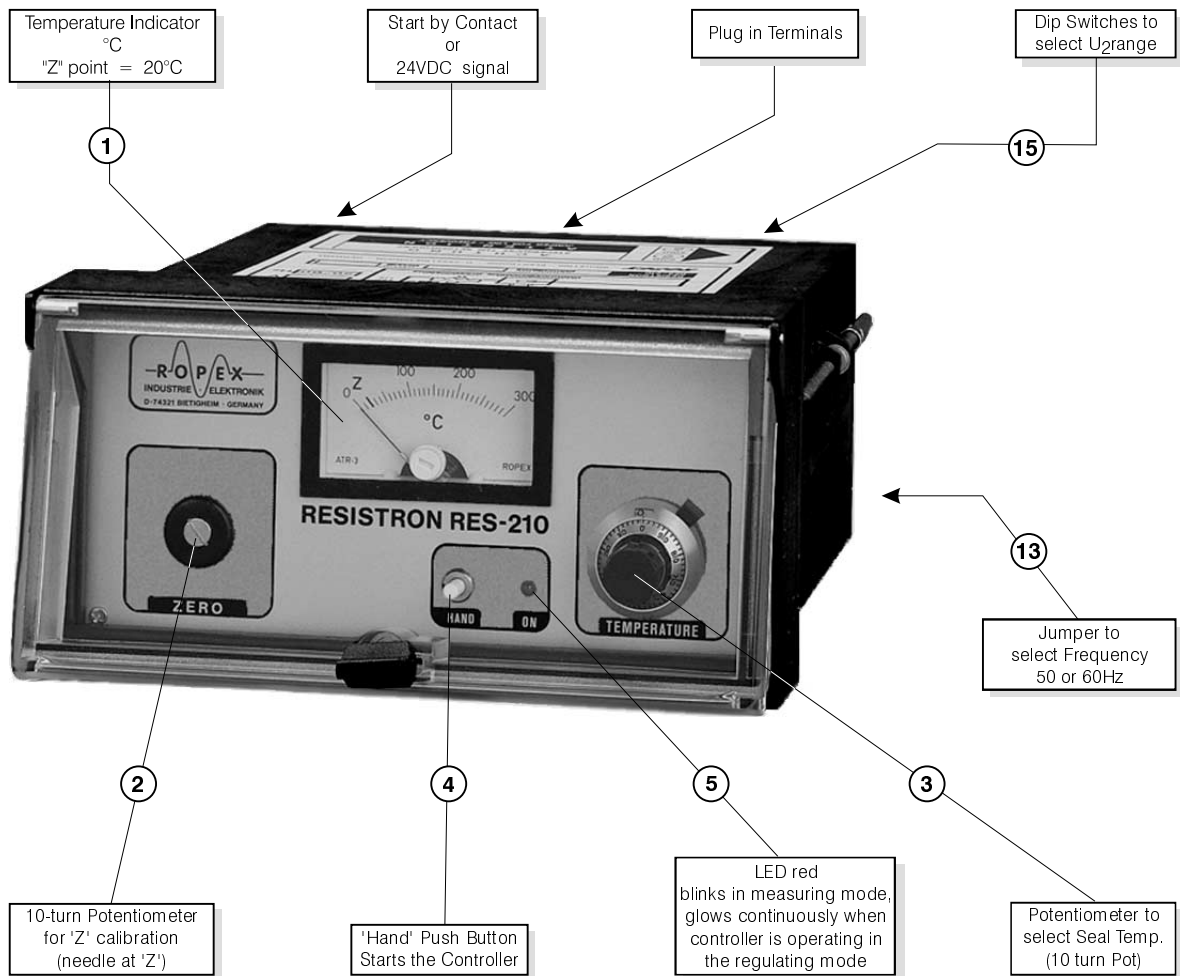
Precision measurement together with high sampling rate produces a fast response and a perfect temperature control during the heatsealing process. With a correctly installed system, the temperature can be controlled with an accuracy of +/-3%.

This controller can be used in a large variety of applications since it can be set for a few milli-ohms or several ohms by means of dip switches, as well as high output voltage for a short time up to 10KVA (at 400V).

This unit is excellent for

- horizontal and vertical packaging machines
- form/fill/seal machines
- bag filling and closing machines
- wrapping machines
- bag making machines, etc.

The electronic components are mounted in a compact housing to be installed into the control panel (72x144mm). The front of the controller displays all of the operating and output functions. Wiring is kept to a bare minimum. The front panel is protected by means of a clear plastic latchable cover.



2. PRINCIPLES OF OPERATION

RES controllers are electrical resistance-measuring, temperature regulating units. They use the characteristics of certain heatseal elements that change their resistance in a fixed ratio to the change in temperature.

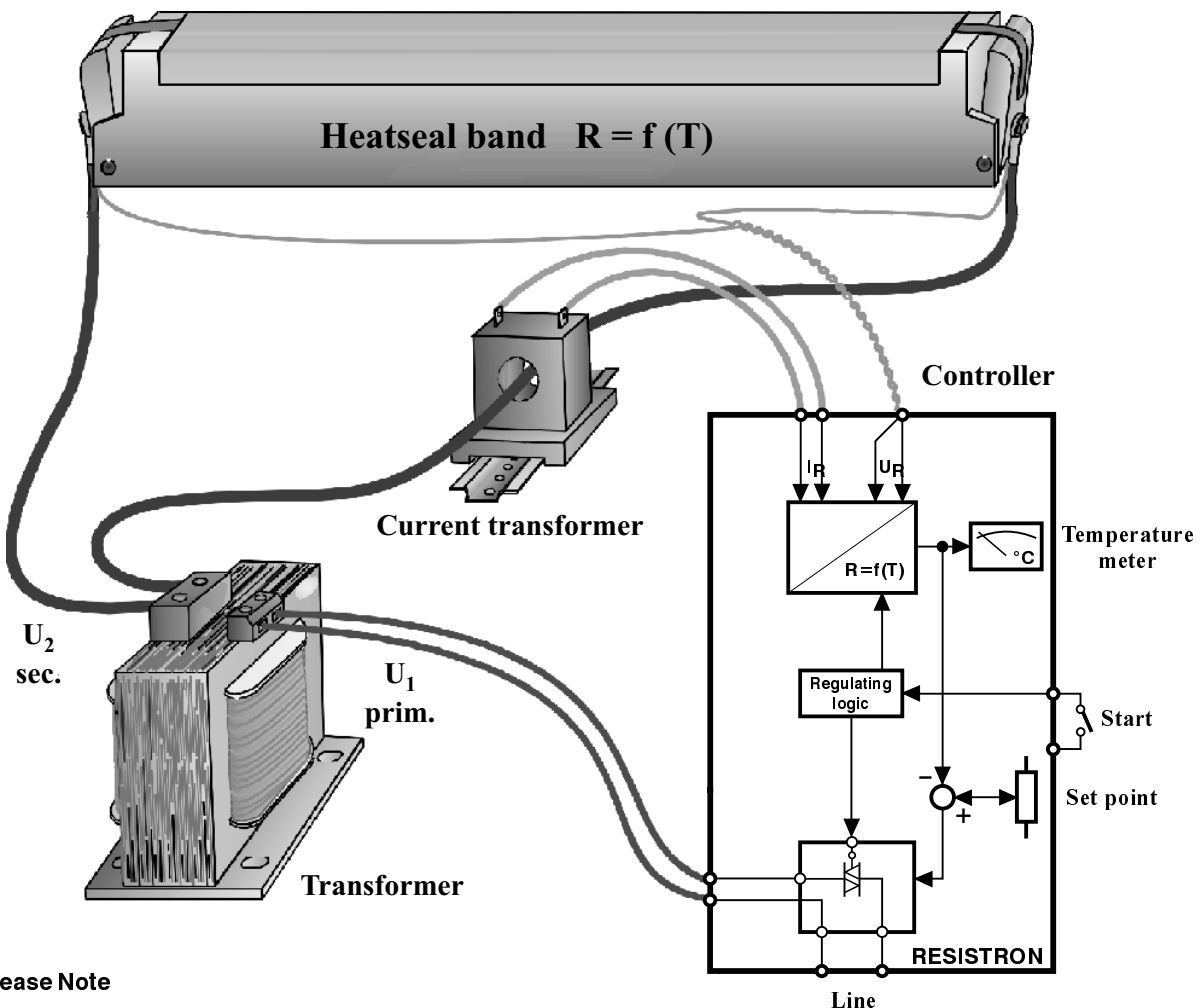
This characteristic of the heating element is expressed by its temperature coefficient T_k

For a dependable temperature control the heating element must have a coefficient of $T_k \geq +8 \times 10^{-4} \text{K}^{-1}$.

The resistance is constantly monitored (50 times per second with 50 Hz; 60 times/second with 60 Hz) 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 for display on the temperature meter. 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.



Please Note

The **RES temperature controllers** are important components for modern machines with higher speeds. The technical possibilities offered by this control system however, can only be achieved by optimizing the **complete system**. The heatseal element, the heatseal transformer, the wiring, the signaling, and the controller **must be perfectly matched for best results**.

We will be happy to help you optimize your system with the right design and selection of components. Many years of experience are at your disposal.

3. FUNCTIONS

3.1 Measuring or Regulating Mode

With power supplied to the controller, the **measuring mode** is active when there is **NO** start signal. The controller sends short, low energy pulses (every 10 cycles) to the heatseal element. This measuring pulse constantly monitors the actual heatseal band temperature without significantly raising its temperature.

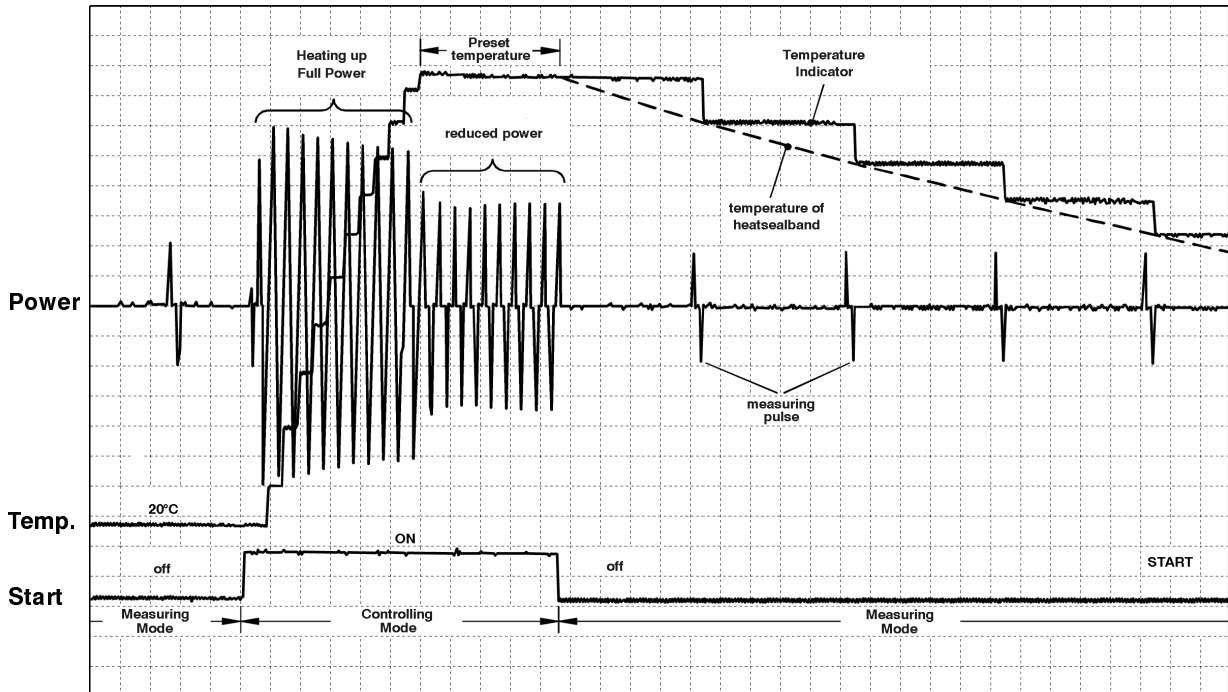
In the measuring mode the LED "ON" blinks with a frequency of 5 or 6 Hz in synchronism with the calibration pulse.

When the **START signal** is activated, the controller goes

into the **regulating mode** increasing the temperature of the heatseal element to the desired set point as rapidly as possible using the maximum available power ($P_{max} U_2^2 / R$).

Concurrently, the measuring rate increases by 10 times to 50 times/sec at 50Hz, or 60 times/sec at 60Hz. The maximum secondary voltage is supplied to the heating element and then subsequently reduced by the phase control function as the preset temperature is approached.

The LED "ON" is constantly illuminated.



3.2

Zero Calibration

The 'zero calibration' is the adjustment of the controller to the resistance of the cold heatseal band at room temperature (20°C, 68°F), assuming that the heatseal band and the heatseal jaws are at room temperature, using the "ZERO" potentiometer to set the needle of the analog meter to "Z". Theoretically one could use another reference point as long as the temperature of the heatseal band is known.

Since the 'Z' point depends upon the size of the heatseal element (length and cross section), the "Z" point should be readjusted after each change of heatseal band, especially when the heatseal band size is changed.

Also please see - Heatseal Element; Burn in Effect; Operating Instruction

Zero calibration is always performed in the measuring mode; NO "START" signal may be given, and the LED "ON" must be blinking!

3.3

Start Signal

With the "START" signal activated, the regulating mode (preset temperature vs. actual temperature) starts; the controller switches from the measuring mode to the regulating mode, heats up the heatseal element to the preset temperature, and will maintain this precise temperature as long as the "START" signal is on.

The controller has **START BLOCK** feature which will prevent overheating of the heatseal element if the controller has not been properly zero calibrated.

This happens if the meter needle is below the electrical zero point. The heatseal band will not heat up even though the "ON" LED indicates that the controller is in the regulating mode.

When the "START" signal is turned off, the controller reverts to the measuring mode, and the heatseal element will cool down. The cooling can be observed at the analog meter.

The controller remains blocked, until the Z-Point has been readjusted.

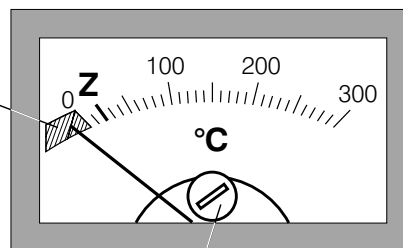
The "START" signal can be given in three different ways:

- pushing the "HAND" button on the front panel
- closing a relay contact between terminals 2 and 7
- applying a 24VDC signal across terminal 3 and 4

ATTENTION:

New heatseal elements will reduce their resistance after the first burn-in. When the element is cooled off completely, the needle may fall below the "Z" point, please recalibrate, or the controller may not start. (also see Heatseal Element; Burn in Effect)

NO START
when needle
in this area.



Mechanical "0" point, **DO NOT CHANGE!**

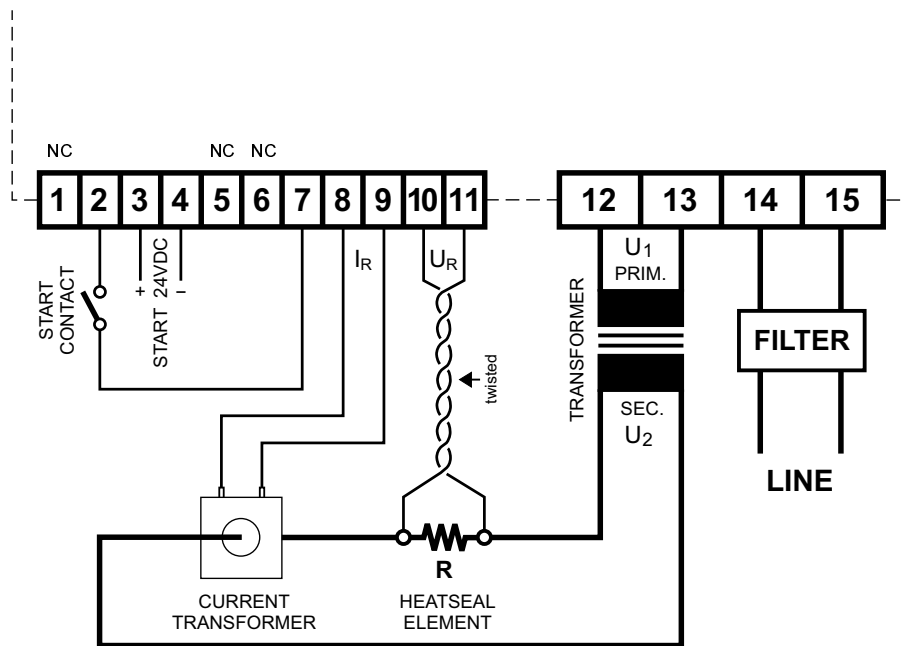
3.4

Monitoring

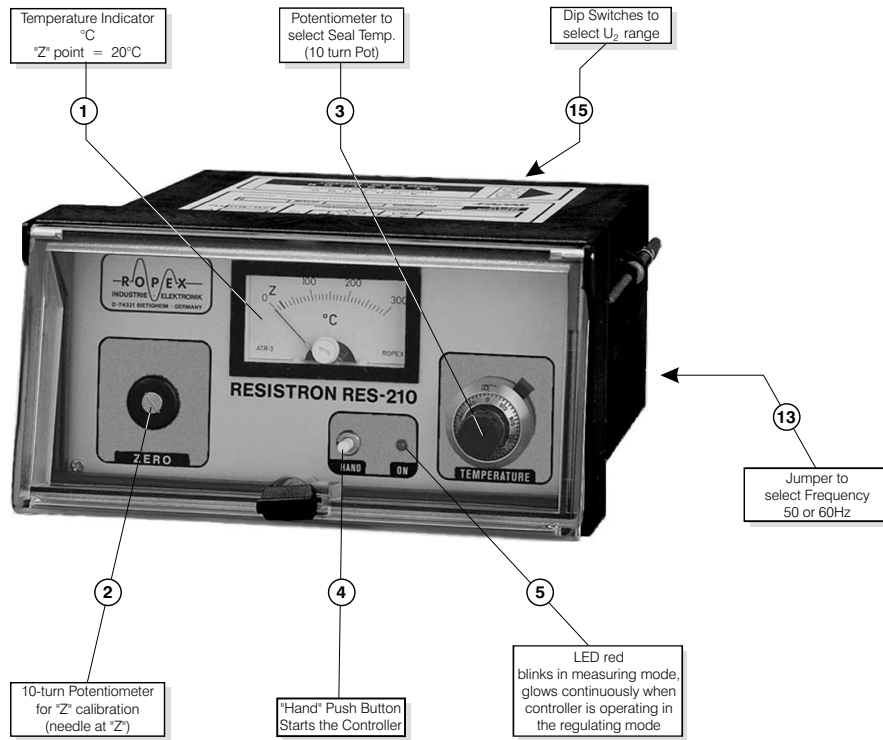
To increase operating safety and to avoid missing seals, the measuring wires are monitored for breaks or damage. When the measuring wire U_R is interrupted, the controller will automatically be blocked, the element(s) will not be heated.

The "ON" LED will be on indicating the START-Signal but the controller remains blocked. This will also occur when only one of two parallel mounted heatseal elements is broken.

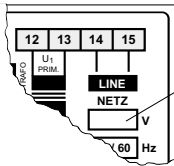
4. WIRING DIAGRAM



5. OPERATING INSTRUCTIONS

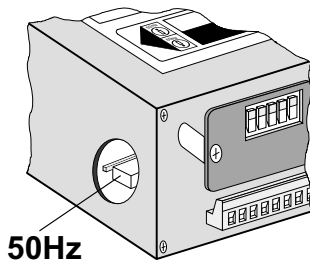


5.1

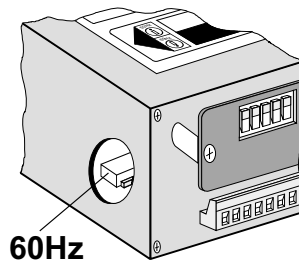


Examine the controller and determine that the power to be supplied to the controller is in agreement with the controller's voltage specification.

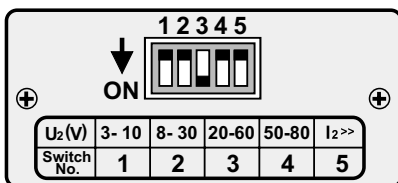
5.2



Position the Jumper (13) to select 50 or 60Hz frequency

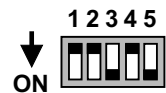


5.3



Set the DIP switch (15) to the proper secondary voltage range.
NOTE: With extremely high secondary currents (larger than 80A) DIP switch No.5 must also be on.

Example: With a secondary voltage of 42V and a start up current of 120A ($I_{2max} = U_2 / R_{HL}$) the DIP switch 3 and 5 must be on.



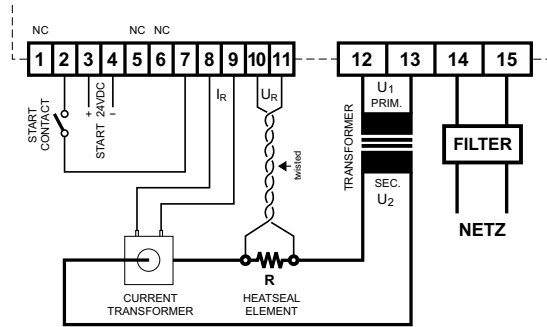
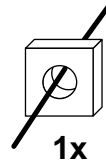
5.4

Connect the controller as shown in the wiring diagram. No special attention need be given to the polarity of the measuring wires for current and voltage nor for the transformer's primary or secondary wires.

Please see "General Installation Instruction."

IMPORTANT:

Make sure that there is **NO** "START" signal, **NO** connection between 2 and 7; **NO** potential on 3.



5.5

Connect power. LED "ON" (5) blinks.

5.6

"ZERO" calibration must only be performed with a heatseal band at ambient temperature.

With the heatseal band at ambient temperature, adjust the Temperature indicator to "Z" by slowly turning the ZERO Potentiometer (2). CW to raise, CCW to lower.

If "ZERO" calibration is not possible, (the meter needle remains high), pass the wire through the current transformer a second time; in very extreme cases even a third time. This situation might occur when the heatseal

element is very long or thin (high resistance). After creating additional passes through the current transformer, **recalibrate** the controller.

If calibration is still not possible, recheck all wiring of the complete system for possible errors.



5.7

Set temperature potentiometer to "0". Push "HAND" button (4) to activate the controller. LED "ON" will change from blinking to constant illumination. Slowly increase temperature. The increase in temperature can be observed at the meter. The needle must rise steady and smoothly in response to the temperature changes of the heatseal element both in heating and cooling. After a few heating cycles to approx 250°C, let the element

cool down completely and readjust the "Z" calibration point. (Also see Heatseal Element; Burn in Effect). 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 starting the controller.

6. 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. Therefore only Alloy - 20 heatseal bands can be used with the RES controllers. With other heatseal band materials the controller may swing from extreme to extreme, or "run away".**
- 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 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 change in the temperature co-efficient at high temperatures.
- A very important option is to copper plate or silver alloy coat the ends of the heatseal elements. Treated ends remains cold and will result in better temperature control and extend "life" of the heatseal element as well as of the teflon cover or coating.

6.1

Change of Heatseal Elements

After each change of the heatseal element the "Z" point calibration should be readjusted, if necessary, to

compensate for possible deviations due to allowable manufacturing tolerances.

7. 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.

7.1 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 increasing the current through the heatseal element. During pauses, only reduced current 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 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.

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.

7.2 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 impulse heat sealing is a thermodynamic reversible procedure, and is often influenced by time restraints, 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 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 over-stressing of the ends (phase ②).

B. The system should be designed to drive the heatseal band to the pre-set temperature in minimum time. However, the maximum rate of temperature rise should

not exceed 1°C./mSec. 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.

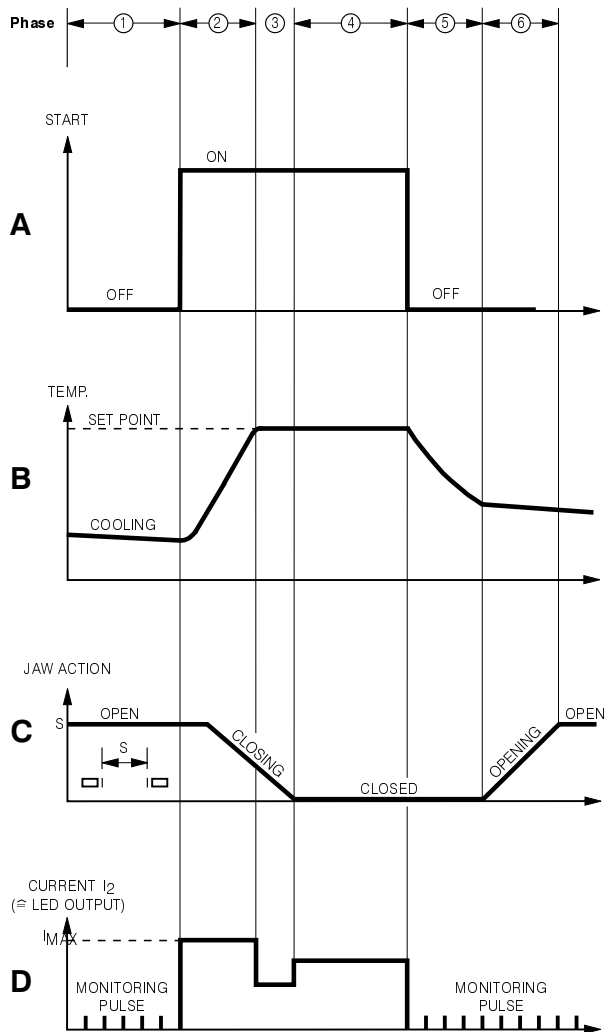
C. The cool down of the heatseal band while still under the force of the jaws is the main advantage of impulse sealing (phase ⑤). After turning off the energy most of the excess heat is absorbed by the jaws. Cooling of the jaws is sometimes recommended so that they can absorb enough heat from the heatseal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

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 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 heatseal band, which results in a fast cooling phase. 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.

Timing

The high thermo-dynamic response of this process demands very exact timing between the controller operation and the heatseal jaws for best results.

Timing chart



Phase :

- ① **Start Signal is "off".**
Jaws are open and heatseal band is cooling from the previous cycle.
- ② **Start "on" -** Heatseal band temperature rises to the "set point" while jaws are closing. Preferably, the set temperature is reached before jaws totally close.
- ③ Power output is controlled. Temperature remains at "set point". Jaws become completely closed.
- Sealing Phase -** Sealing time is necessary to achieve a good seal. Power output is controlled. Jaws are closed. Heat is being transferred into the material being sealed.
- ④
- Cooling Phase -** Cooling time is needed to achieve a strong seal. Power "off". Heatseal band cools as remaining heat is drawn off into the mass of the jaws. Jaws remain closed.
- ⑤
- ⑥ Jaws are opening. Heatseal band continues to cool.

Diagram D shows the magnitude of current flow during a sealing cycle.

Phase ① : Controller "OFF". LED ⑤ blinks (measuring mode)

Phase ② : Heating up with maximum power

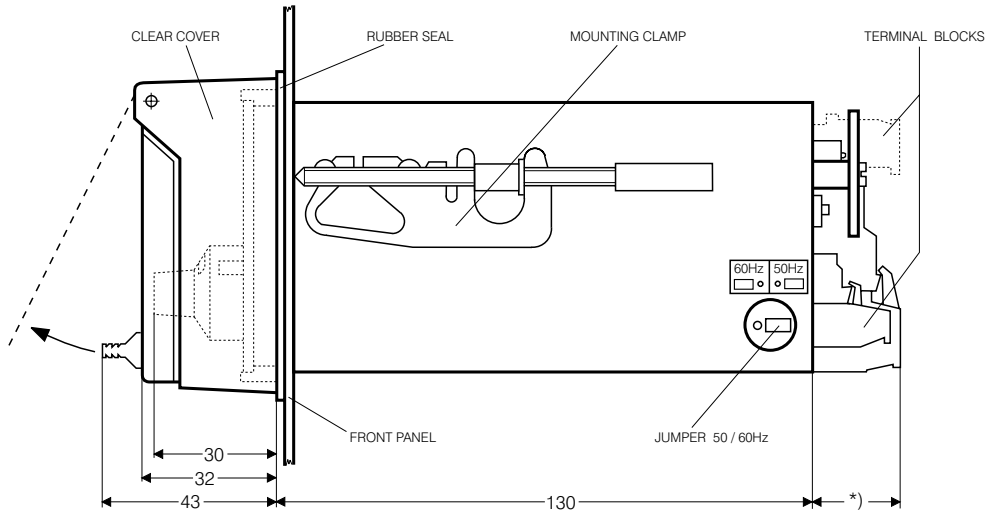
Phase ③ : Regulating to medium power to reach the pre-set temperature before jaws close

Phase ④ : Regulating to higher power to maintain the pre-set temperature when heat is drawn from band (sealing)

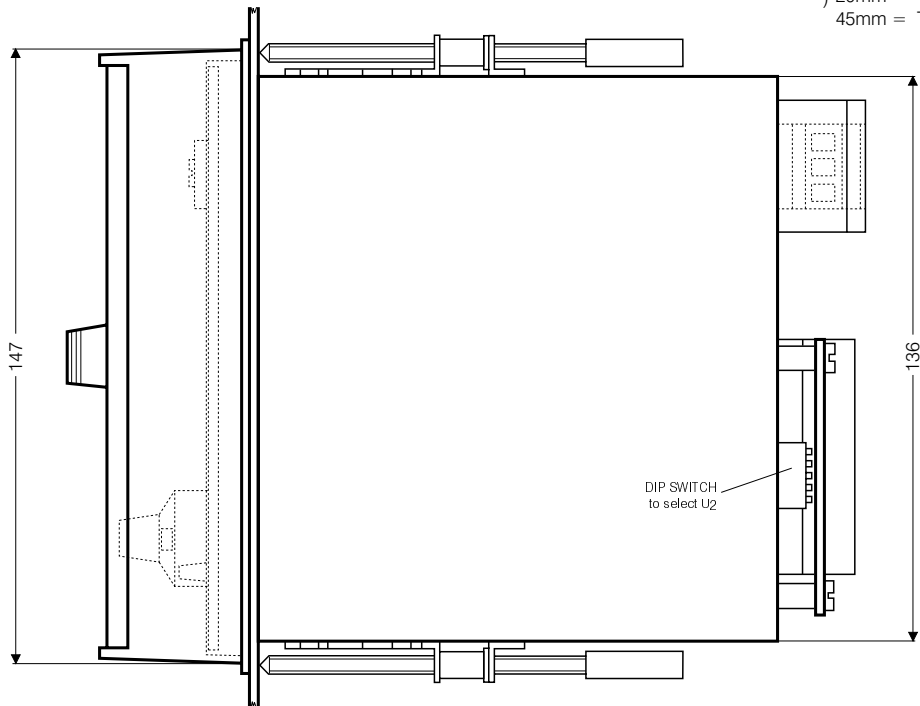
Phase ⑤ : Power turned off (cooling); LED ⑤ blinks (measuring mode)

Phase ⑥ :

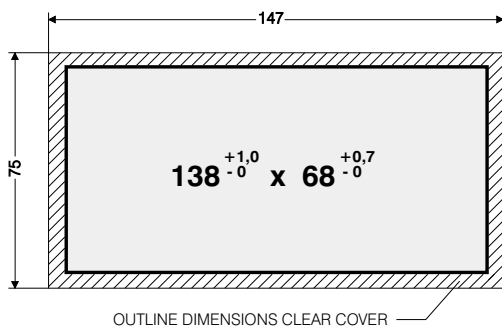
10. PHYSICAL DIMENSIONS



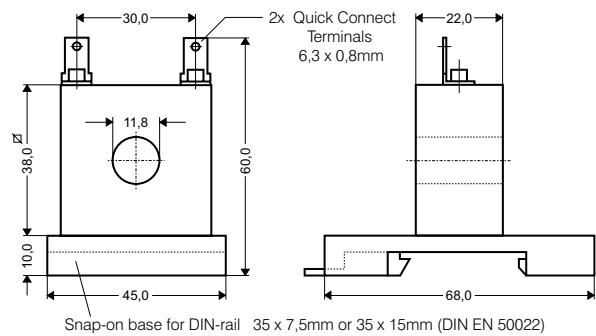
*) 20mm = TYPE RES-XXX - 0
45mm = TYPE RES-XXX - 1



PANEL CUTOUT



CURRENT TRANSFORMER



9. TECHNICAL SPECIFICATIONS

- Type of Construction : Housing designed for mounting into the front panel
- Line Voltage : Standard 230 VAC; 115 or 400VAC optional
(allowable deviation -10% +15%)
- Frequency : 50 or 60Hz; selected with jumper
(allowable deviation ± 1 Hz)
- Temperature Control : 10 Turn potentiometer, temperature range 0 - 300°C (0 - 500°C)
- Start Signal : Voltage level across 3 and 4 : OFF: 0-2 VDC; ON: 5-30VDC; typ. 8mA / 24VDC
or
Contact between 2 and 7: OFF: Contact open; ON: Contact closed; typ.0.13mA
- Sampling rate : Every tenth cycle of line voltage in the calibration mode.
200msec at 50Hz / 166msec at 60Hz

Every voltage cycle in controlling mode
20msec at 50Hz / 16.6msec at 60Hz
- Calibration : Calibrated for Heatseal Bands with $T_k = +10 \times 10^{-4} K^{-1}$

Max. Primary Current :

Operating Mode	TYPE	
	RES-21X-0 (Standard)	RES-21X-1
Constant heat	5A	15A
Impulse with 20% Duty cycle	25A	20A



Main Application

- Ambient Temperature : +5°C...+45°C (+41°F...+113°F)
- Electrical connection : terminal blocks, with plug in connectors
- Protective Cathegory : IP 20
- Weigth : RES-210 Controller 1.0 kg (2.2 lbs)
RES-211 Controller 1.2 kg (2.64 lbs)
Current transformer 0.15 kg (0.33 lbs)

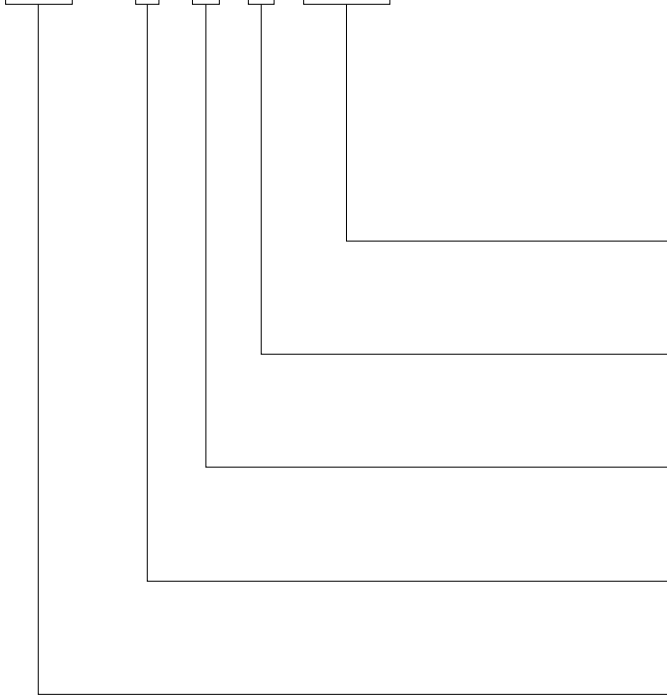
Current transformer and electrical connectors included with controller

9.1

HOW TO ORDER

EXAMPLE:

RES - 21X - X - X / 230V - 50/60 Hz



Line Frequency

50Hz easy switch over to 60Hz with jumper

Line Voltage

Standard : 230 VAC

Option : 115 VAC or 400VAC

Temperature Range

X = 3 ≙ 0 - 300°C

X = 5 ≙ 0 - 500°C

Max. Primary Current

X = 0

X = 1 (see Technical Specifications)

Temperature Display

X = 0 ≙ Analog

X = 1 ≙ Digital

Model of Controller

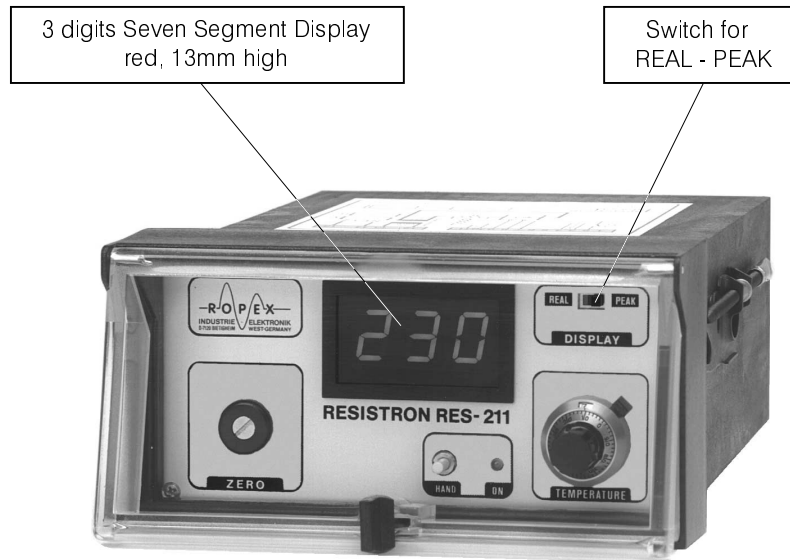
- Supply:**
- Controller with clear front panel, rubber seal and mounting clamps
 - Current Transformer

10. OPTION with DIGITAL DISPLAY, RES - 211

The controller RES-210 is also available with a digital temperature display.

This model is the **RES-211**.

Both controllers are identical with following exceptions.



With the switch on the front panel, two display modes can be chosen.

"REAL", the temperature is continuously shown as it is. This mode is preferred when the controller operates in the "Constant Heat" mode. It is also used when performing the calibration.

"PEAK", or "HOLD" mode to capture the fast changing peak temperatures during the impulse sealing.

When using "PEAK" mode, the display responds as follows:

- when the "START" signal is activated (LED "ON" is red), the display shows the real values.
- when the START signal is turned off, at the end of a sealing cycle, (LED "ON" blinks) the display becomes "frozen" and will display the temperature at the very moment of turn off. It will hold this display until the next start signal is given.

This mode of display facilitates the reading of the temperature and allows easy control of the temperature from one impulse to the next.

Notice:

Since the resolution of the display (1 digit = 1 degree) is higher than that of the total system, the display may vary by some digits from impulse to impulse.

Attention:

To perform the calibration, **the switch must be on "REAL"**; then adjust the "ZERO" point to 20°C on the display (cold heatseal element).

All other functions, descriptions, instructions and technical specifications are identical to the RES-210 controller.

INSTALLATION - INSTRUCTIONS

