Device Description:
Resistance Temperature controller TPRA

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The TPRA Resistance Temperature controller is applied for the temperature control of heat conductors or wires, in connection with transformers as used in fill and seal packaging machinery.
As the heat conductors used have positive temperature coefficients, the resistance of the heat conductor increases with increasing temperature. This effect is used for temperature measurement and control. In effect the temperature controller measures the resistance of the heat conductor and calculates the real temperature value itself.
The temperature controller operates as a pure proportional control unit. He determines independently of manually maintenance the proportional Amplification factor, for the welding transformer and heat conductor combination being used.
To obtain the temperature Actual Value, the resistance of the heat conductor is determined by measuring the voltage and current of the heat conductor and calculated together with the Temperature coefficient.

The TPRA can be set for heat conductors with temperature coefficients **7.46**$*10^{-4}$ 1/°K, **10.8**$*10^{-4}$ 1/°K (Alloy A20) and **42**$*10^{-4}$ 1/°K (Norex). It can be operated in temperature ranges from 0...300°C or 0...500°C depending on the temperature range setting. During the calibration, the controller set himself to the voltage and current range of the heat conductor. The voltage of the heat conductor can be in a range from 1...80V. The current flowing through the heat conductor which is measured using a current transformer can be in a range from 20 to 400A. The calibration values can be stored, so that an calibration setting, each time after switching Power on, is not required.
High quality welding transformers, such as toroidal core transformers, are switched by the temperature controller on the primary side without inrush currents peaks by the use of a patented ‘smooth transformer switching’ procedure. So called remanence setting procedure. After the line switching on and calibrating automatically an initial remanence setting procedure is set for 300ms at 50 Hz Line frequency. Thereafter a short remanence setting procedure for 40-60ms for every welding action, and during welding for approximately 40ms is set. During temperature control a phase angle cutting control is used.

Application:
in connection with welding transformers as used in packaging machinery for bag sealing.

Contents:

State conditions:

Calibration:

During calibration the resistance temperature controller adjusts itself to the actual welding transformer and the heat conductor combination. First and stepwise the current Ic and voltage Uc measure amplifiers are adjusted. Then the resistance of the heat wire is calculated. This procedure is referenced as the R_{20} resistance of the heat conductor, the resistance of the heat conductor at 20°C ambient temperature. This R_{20} value is measured again after the end of the calibration comparision time. When changing because of cooling down, the calibration R_{20} will be discarded and the calibration procedure starts again. This will be repeated maximal 5 times before the TPRA stops with alarm error. During the initial Remanence setting focusing the successful calibration procedure, the P factor will be determined.
For the correct measuring of the R_{20} value the heater resistor must have about 20 degr. C.
In calibration state the yellow “Calibration” LED shining and the Actual Value Output displays alternating with 1 HZ the actual current and voltage measured values. In the Range of 0 to 5V the current value and in the range of 5 to 10V the Voltage measured value is displayed. The zero point of the displayed values is set on 5V.
At the beginning of the calibration the amplifiers are adjusted with max. amplification. Therefore the displayed values have the maximum swing. At the end of calibration procedure the range for the displayed current value is from 1,66 … 3,33V and the range for the displayed voltage value is from 6,66, … 8,33 V.
The time for the calibration procedure depends also from the voltage of transformer, the polarity and level of current and of the amount of calibration comparision time. For the calibration comparision time cn chosen 15 or 30 sec.
So the calibration process by the controller requires a maximum of 27s or 42s, depending on which calibration comparison time is chosen.
In the event of unsuccessful calibration, for example in the case of the heat conductor is still being to hot, four times further attempts to calibration are taken by the controller. Thus the maximum calibration time can amount to 135s or 210s depending of the calibration comparision time.
If the calibration type “New Parameters” is chosen, the controller switches to calibration immediately after line switching on, or after a reset. If the calibration type “Storage” is chosen, the controller switches to calibration if, prior or after to line switching on or resetting, also in the off state, a “High” Signal is present at the control input “ calibration start”. At this type of calibration the measured calibration values are stored in a nonvolatile memory an are loaded immediately after a power on or a reset.

Controller Off State,:

In the Off-state the TPRA regularly measures the resistance of the heat conductor and from this value determines the temperature and forwards this to the Actual Value display. The resistance measurement is not continually carried out rather in regular periods whereby for each measurement a power line half-wave always of the same polarity with a fix angle with 1.8ms at 50Hz-supply frequency is applied to the

transformer. The duration of the periods depends on the temperature of the heat conductor. If the temperature of the heat conductor has cooled down to 20°C, the period between measurements is 1.5s. At a temperature of 300°C the period between measurements is only 100ms.
The heat conductor warms up somewhat a little bit during the resistance measurement as energy is introduced during the measurement. Therefore a meaningful application of the temperature controller is only for temperatures of ahead 50°C in an ambient temperature of 20°C.
The controller switches from the Off-state to the On-state as soon as a high-signal is applied to the “Start” input. The controller switches from the Off-state to the calibration-state as soon as a High-signal is applied to the “calibration start” input and returns to the off state after the end of successful calibration.

Controller On State:

In the On-state the TPRA sets and holds the temperature of the heat conductor to the desired value after setting the initial Remanence setting procedure. Phase angle control is used.
As soon as the High-signal is no longer applied to the control input “Start”, the controller returns to the Off-state.

Error State:

The error state is indicated on the TPRA only when a error occurs. The controller monitors the line voltage value, the temperature of the heat conductor and the voltage and current measurement values at the heat conductor. The Alarm output contact is delayed closing, 1 second after the error occur. The Alarm output is going to a low resistance state.
The error state can be reset only by switching off the line voltage or by applying a High-signal to the control input “Reset”. In the OFF state the errors number 7 ….12 are only signaling, but the TPRA don’t go to the error state. That’s for going to the calibration state without give a reset.
In the error state the LED´s “Alarm” and “Calibration”, depending of the error, are illuminated in a different manner. The “Actual Value” output indicates a voltage, depending on the error type. See following Table.
In the error state, the Error indication LED´s and the actual Value output are made topical all 2 seconds.
The value of the actual value output is alternating. The frequency is 0,5 Hz.

<table>
<tr><th rowspan="2">Nr.</th><th rowspan="2">Failure Type</th><th rowspan="2">Actual value-Output</th><th rowspan="2">Alarm-LED</th><th rowspan="2">Calibr.-LED</th><th colspan="2">Alarm-contact</th></tr>
<tr><th>After reset</th><th>After start signal.</th></tr>
<tr><td>1</td><td>Hardware Error</td><td>4.66/0V</td><td>on</td><td>off</td><td colspan="2">closed</td></tr>
<tr><td>2</td><td>Internal-error, error of the nonvolatile Memory or Start-Signal while calibration state</td><td>4.00V</td><td>on</td><td>off</td><td colspan="2">closed</td></tr>
<tr><td>3</td><td>Power Line error, Under-/overvoltage or Line frequency error</td><td>3.33V</td><td>on</td><td>4Hz</td><td colspan="2">closed</td></tr>
<tr><td>4</td><td>Current or voltage Signals to low</td><td>2.00V</td><td>on</td><td>1Hz</td><td colspan="2">closed</td></tr>
<tr><td>5</td><td>Voltage signal Ur to low</td><td>1.33V</td><td>on</td><td>1Hz</td><td colspan="2">closed</td></tr>
<tr><td>6</td><td>Current signal Ir to low</td><td>0.66V</td><td>on</td><td>1Hz</td><td colspan="2">closed</td></tr>
<tr><td>7</td><td>Current and /or Voltage signal to high</td><td>5.33<>10V</td><td>4Hz</td><td>1Hz</td><td>open</td><td>closed</td></tr>
<tr><td>8</td><td>Temperature to low or to high, (heating wire error)</td><td>2.66V</td><td>on</td><td>on</td><td>open</td><td>closed</td></tr>
<tr><td>9</td><td>Dataerror, stored calibration values not fit to Dip Switch selection</td><td>6.00<>10V</td><td>4Hz</td><td>4Hz</td><td>open</td><td>closed</td></tr>
<tr><td>10</td><td>Self calibration not possible because Ur and Ir is to low or to high, or detection of R_{20} is not possible.</td><td>8.00<>10V</td><td>1Hz</td><td>4Hz</td><td>open</td><td>closed</td></tr>
<tr><td>11</td><td>calibration not possible because Ur is to low or to high</td><td>7.33<>10V</td><td>1Hz</td><td>1Hz</td><td>open</td><td>closed</td></tr>
<tr><td>12</td><td>calibration not possible because Ir is to low or to high</td><td>6.66<>10V</td><td>1Hz</td><td>1Hz</td><td>open</td><td>closed</td></tr>
</table>

settings:

All manually settings of the controller can carried out on eight DIP switches. The TPRA automatically takes on the voltage and current values matched by the heat conductor and the transformer voltage as well as the P-factor (control amplification).
Adjusting the settings of the DIP switches 3 to 8 should only be carried out the **when the controller is switched off from the power line.** Adjusting the settings of the DIP switches 1 and 2 can be carried out when the controller is in the OFF state.

Switch.	Funktion	Position		
2 / 1	Heat up ramp	2	1	Heat up ramp for slow raising of temperature
		Off	Off	Without ramp
		Off	On	2s
		On	Off	3s
		On	On	5s
4 / 3	Temperature coefficient	4	3	Temperature coefficient of the heat wire
		Off	Off	Tc1= 7.46×10^{-4} 1/°K, Tc2= 0
		Off	On	Tc1= 10.8×10^{-4} 1/°K, Tc2= 0 (Alloy A20)
		On	Off	Tc1= 42×10^{-4} 1/°K, Tc2= -3.99×10^{-6} 1/°K² (NOREX)
		On	On	Not used
5	Calibration Comparision time	Off		15s
		On		30s
6	Temperature range	Off		0...300°C, overtemperature 360°C, undertemperature –10°C
		On		0...500°C, overtemperature 600°C, undertemperature –10°C
7	Type of calibration	Off		New calibration
		On		Calibration storage
8	Type of Transformer	Off		Transformer with EI- oder UI-iron core
		On		Transformer with toroidal Iron core

Heat up Ramp:
With both DIP switches 1 and 2 for the heat-up ramping, the time value for the heat up ramp can be adjusted.

Tc-Settings:
Using the DIP switches 3 and 4 the temperature coefficient Tc of the heat conductor being used is set. The temperature coefficient is a material constant depending on the metal alloy of the heat conductor.
Warning: If the chosen temperature coefficient is to high, overheating or even melting of the heat conductor can occur.

Calibration comparison time:
Dip switch 5 is used to set the calibration comparison time either to 15 or 30s. The R_{20} resistance is set during calibration of the heat conductor after calibration of the measuring amplifier for current and voltage measurements. To ensure that the R_{20} resistance value determined is correct the resistance of the heat conductor is remeasured after the calibration comparison time setting, and compared to the determined R_{20} resistance measured before. If these values are to far apart, the determined R_{20} value is discarded and the calibration procedure is repeated. This ensures that calibration of the TPRA does not take place during cooling down of the heat conductor. By increasing the calibrating comparison time setting, the greater chance that changes in resistance of the heat conductor while cooling down are detected by the controller.

Temperature range:
The Dip switch 6 is used to set the temperature range in which the controller operates. In accordance with these settings, the limits for the over temperatures are chosen. (See table settings.)

Calibration type:
New calibrating: If the calibration type “new-calibration“ is chosen, the TPRA performs a calibration after every power-on or reset. The calibration values are not stored. With a high signal on calibration start input and in the off state, the calibration procedure can even to start.
Calibrating storage:
The calibration can only be start with a high signal on calibration start input in the off state. The calibration values are stored in a nonvolatile memory an are used after power on or after reset for calibration setup This implies that after a change in the welding transformer – heat conductor configuration, a new calibration must be carried out and then the new determined values are automatically be stored in the nonvolatile memory.

Transformer-Type:
Using DIP switch 8 the Remanence setting procedure is matched to the transformer type. During Remanence setting a unipolar phase control is applied to the transformer. The current flow angle of the phase control must be matched to the transformer type.
High quality welding transformers, are switched by the temperature controller on the primary side without inrush currents peaks.

Leds:
Power on: The green LED “Power-On” indicates that the controller is connected to the power line.

Heat: The yellow LED "Heat" is directly connected to the Thyristor output. The brightness of this LED is directly proportional to the energy in the heating conductor.

calibration: The yellow LED „Calibration" lights continuously during calibration and is used for indicating errors.

Alarm: The red LED "Alarm" together with the yellow LED „Calibration" indicates the different error conditions of the TPRA.

In- and Outputs:

Start-Input:

The welding process is initiated by applying a High-Signal to the start input (X6). The controller begins to set the temperature of the heat conductor to the desired value temperature and maintains this temperature as long as a High-Signal is applied to the start input.

Calibration-Start-Input:

The calibration start input (X5) is operable only if the TPRA is in the off state. Calibrating adapts the TPRA automatically to the Transformer and heating wire.

Reset-Input:

Application of a High Signal to the Reset input (X7) resets the TPRA to the state after power on. In this manner the controller can be reset after a error without having to switch off the power line voltage.

Temperature desired value Input:

Applicating an analogue signal to the input (X16) is used to set the desired nominal temperature value of the controller. The voltage desired value range is 0...10V. The voltage range of the desired value input is valid on both temperature ranges, 300°C or 500°C, i.e 10V on the desired value input corresponds to 300°C or 500°C respectively.

Either a variable voltage supply or a potentiometer tap, whose CW connection is connected to the V_{ref} output (X15) and the CCW connection is connected to the matching GND_t connection (X13), can be connected directly to the desired value input. Note the phase-sequence when connecting the desired value potentiometer: clockwise rotation (CW) of the desired value potentiometer implies an increase in positive voltage at the desired value input.

Uref-Output:

The U_{ref} output (X15) provides a reference voltage of 10V so as to obtain the desired value using a potentiometer without an external DC power supply. Should the TPRA be operated without an additional power supply, the switches for the digital control inputs can also be connected to the Vref output (see application sheets). The V_{ref} output can supply a maximum current of 25mA.

Actual Value of Temperature, Output:

The Actual Value output (X17) supplies a voltage in the range 0...+10V, proportional to the measured temperature of the heat conductor, at its output.

The voltage range of the Actual Value output correspond to the selected temperature range, that means: 10V Range at 300°C or 500°C.

Alarm-Output:

The Alarm output (X12/X18) is an reed relay contact. The contact is closed in the event of a error, 1 second after the error occure.

Safety precautions and information:

General safety note:

The safety notes and informations given in these description must be followed to guarantee safe operation of the equipment. The equipment can be operated without impairment of the operational reliability by following the directions given in the technical data information. The equipment should be installed and commissioned by suitably trained personal.

Corrective maintenance and repair of the equipment should be carried out only by suitable competent personnel, trained in the relevant safety and guaranty or warranty agreements.

Applications:

The TPRA should be used only for heating and temperature control specified heat conductors in accordance with the safety note, rules and regulations for such applications. Non-observance or misuse of such rules and note can result in impairment of the safety of the equipment which can result in overheating of the heat conductor, electrical wiring or the transformer.

Warning note for the heat conductor:

A basic precaution for the function and safe operation of the complete heating system is the application of suitable heat conductors.

The temperature coefficient of the heat conductor must be equal or greater than one of the three settable positive temperature coefficients: The appropriate temperature coefficient of the heat conductor must be set on the DIP switches 3 and 4 of the TPRA.
The use of heating wires with a temperature coefficient to small or the adjusting of the Controller with a temperature coefficient to high, can result in an uncontrolled overheating or melting of the heat conductor.

Warning note for the welding transformer:

The welding transformer must be configured according to EN 60742 (isolating transformer with reinforced isolation).
Should the transformer be installed in a machine frame and not in a switch cabinet, sufficient protection against accidental contact should be taken. Furthermore ensure that water, cleaning liquids or conducting liquids do not reach the transformer.
The conductor wiring cross section should be suitably matched to the currents flowing in the equipment.
Non-observance of these precautions can result in impairment of the electrical safety of the equipment.

Warning note for the current transformer:

The current transformer is an essential part of the control system. Only a FSM- current transformer may be used. The current transformer should not be used without an ohmic ballast resistance as otherwise over voltages may arise. The ballast resistance is integrated in the controller. Also a current measure shunt can be used. His output signal must be in the range of 0,1 to 2 V.

General installation instructions:

The TPRA is suitable exclusively for use in a switch cabinet. Open operation is not permitted.
The device as well as the current transformer are mounted on 35mm-top-hat rails according to DIN EN 50022. On mounting the controller on the top-hat rails ensure that at least 20mm spacing to the next device is maintained.
Heat dissipation from neighbouring device must be taken into account, (note the ambient temperature specification).

Maintenance:

The TPRA does not require special maintenance. An occasional checking or tightening of the connections is recommended. Dust deposits on the controller can be removed using pressurised air after first switching the power off.

Initialisation:

First check that the described line voltage of the TPRA matches the power line voltage being used, and that the amplitude of the Transformer primary current is matched to the loading current capability of the controller. (The TPRA type with external Solid state relay or Thyristors has a much greater current capability than the TPRA with internal Thyristors. See schematic drawings on bottom.)

Configuration of the DIP switches:

Following Setting of the DIP switches 1 .. 8 can be chosen. See settings. Heat ramp, temperature range, temperature coefficient, calibration type, calibration comparision time, transformer type.
Prior to initial operation the correct temperature coefficient Tc for the heat conductor being used must be set. Using a larger temperature coefficient than the correct value can lead to overheating or melting of the heat conductor. In addition the calibration comparison time, the calibration type and the transformer type settings must be set.
The heat-up ramp settings can either be set before of after calibration.

Connecting the TPRA:

The TPRA must be connected according to the circuit plan, depend of the power control element. It is not necessary to observe the polarity of current Ir and voltage Ur instrument leads to the heat conductor, or to the connection of the welding transformer for the primary or secondary side.
On connecting the desired value potentiometer the correct phase-sequence must be set, for the 0°C setting the resistance between X13 and X16 must be 0Ω. If in doubt recheck this setting.
The measurement leads for voltage measurements should be twisted (≥50 twists/m) and directly connected to the heat conductor. The leads from the welding transformer should be connected to the heat conductor using cable lugs and not plug-type connections. Ensure that the conductor cross section of the wiring is adequate. There should be no additional resistances such as fuses, switches or contactors in the secondary circuit between the welding transformer and the heat conductor.

Control inputs:

Prior to initial operation of the controller ensure that the control signals „Reset“ and „Start“ are switched off.

Connecting to the line voltage:

On connection the TPRA to the power supply the green LED “Power On” is illuminated.

If new calibration are chosen, the TPRA goes after power on or reset in the calibration procedure and adapt the controller to the welding transformer and the heat wire combination. The Led calibration is shining and the led heat is flashing. After the successfully calibration, the TPRA return to the off – state and is ready for work.
For the setting combination calibration type “Storage” (DIP switch 7 On), the signal “calibration” not activated and no start signal, the TPRA goes in the Off state. The Led: Alarm and calibration, can be off or flashing. While the Led Alarm is off or flashing, the calibration can be activated. If the Alarm led is continuous on, there is an error and no calibration procedure can start. See error state.

Burning-in of the heat conductor:

Burn-in of the heat conductor is best carried out with the signal “Start” switched on, and by slowly increasing the temperature setting. Thereby the heat conductor should be observed. A calibration should be carried out again after burn-in.
A slow increase of the desired value is also recommended in the case of thermally pre aged heat conductors which do not require burn-in. In this manner the correct temperature conductance of the heat conductor can be controlled, and errors arising during calibration as well as the choice of temperature coefficient checked without overheating or melting of the heat conductor occurring.

The heat conductor:

The heat conductor is an important component of the control circuit as it is both temperature sensor and heating element at the same time. Due to the variety of types of heat elements, this issue will not be discussed here. However some issues regarding physical and electrical properties will be addressed.
The measurement principle of the TPRA requires that the heat conductor has a positive temperature coefficient, corresponding nearly to one of the temperature coefficient values. Using a heat conductor with a smaller temperature coefficient than adjusted on the TPRA can result in overheating or melting of the heating element.
During the initial heating up of the heat conductor to 250...300°C the cold resistance of the heat conductor experiences a variation of 2...3% (burn-in effect). This resistance variation results in a zero point error of 20...30°C . After a few heat up cycles this zero point error should be corrected by a new calibration.
Overheated or burnt-out heat conductor should not be used because of irreversible changes of the temperature coefficients.
A constructive measure to improve the exact temperature control and to increase the lifetime of the heat conductor is to copper-plate or silver-plate the heat conductor contacts. This ensures that the heat conductor contacts remain cold.
On exchanging the heat conductor, a calibration of the TPRA is recommended in order to correct for manufacturing tolerances of the heat conductor. Burn-in is again required for new heat conductors.

Technical Data:

(Soft switch on procedure correspond Patent No.: DE 42 17 866, EP 05 75 715 B1, US 005 517 380A)

Nominal Voltage:				
Standard:	**230 V:** 195 VAC – 253 VAC; peak voltage max. 800 V			
Option:	**110 V:** 93 VAC – 121 VAC; peak voltage max. 600 V			
Option	**400 V:** 340 VAC – 440 VAC; peak voltage max. 1200 V			
Frequency:	45-65 Hz			
Over voltage categorie:	III			
Self Power consumption:	5 W			
Power Control element type:				
Standard ext. solid state relay.:	Solid state relay, random switching, 2,5 kV Test Voltage between Control and Load .			
	Desired values for the solid state relay:			
	Control Voltage. DC:			U_{HiLo}= 5 V
	DC- Input resistance:			R_{vh}=120 Ohm
	Max. Control Input current:			I_{HiLo}=10 mA
	Max. switch on delay:			T_{on} =0,2 ms
	Max. switch off delay:			t_{off}=0,25 ms
Option ext. Thyristors:	firing with opto triac and resistor R_{VG} inside TPRA			
	With Unom.	110 V	230 V	400 V
	R_{VG}	33 Ohm	68 Ohm	120 Ohm
	Desired values for Thyristors:			
	Max. supplied Gate ignition current from TPRA:			I_{gt}=220 mA
	Max. allowable delay to Ignition.:			t_{gd}=0,2 ms
	Max. allowable time until turn off.:			t_q=0,25 ms
	Gate cathode Resistor:			R_{GK}=120 Ohm/ 0,25 W
	Gate cathode diode::			D_{GK}= z.B.: 1N4004
Option int. Thyristors:	antiparallel Thyristors on a heat sink inside TPRA			
	At permanent heating:			I_{rms}=5 A
	At Impulse heating at 20% turn on/off ratio:			I_{imp}=25 A
	Max. Peak current (t_{peak} =10ms):			I_{TSM}=500 A
	Leakage current at 230V:			I_D=11 mA
	Limit load integral (t=10ms)			I^2t=1250 A^2s

	Fusing:	The Fuse must consider to described values on above.	
Temperature-coefficient:	Three different values selectable with DIP 3 an 4.		
	Temperature coeffic. 1: $Tc1= 7{,}46x10^{-4}$ 1/°K	TC2= 0	
	Temperature coeffic. 2: $Tc1= 10{,}8x10^{-4}$ 1/°K	TC2= 0	(Alloy A20)
	Temperature coeffict 3: $Tc1= 42x10^{-4}$ 1/°K	$TC2= -3{,}99x10^{-6}$ 1/°K²	(NOREX)
Temperature range:	DIP-Switch 6 = Off: 0...300°C	Undertemperature –10°C	Overtemperature 360°C
	DIP-switch 6 = On: 0...500°C	Undertemperature –10°C	Overtemperature 600°C
Time Values (50Hz):	Initialisation:	After power on or reset signal:	4s
	Power line interrup-tion:	On power line interruption goes TPRA in the error state or after returning of power TPRA starts with self reset	≥80 ms
	Start (heating):	Switch on delay:	1...21 ms
		Switch off delay:	1...21 ms
	Remanence-setting:	After power on, reset or calibration:	300 ms
		After time in the off state ≥ 1s	60 ms
		After time in the on state < 1s	40 ms
		Current flow angle EI - Transformer:	3,1 ms
		Current flow angle Toroid - Transformer:	1,8 ms
	calibrating-Start:	Switch on delay:	1...21 ms
	calibrating:	Max calibration time at calibrating comparision time =15 s.:	135 s
		Max calibration time at calibrating comparision time =30s:	210 s
		calibrating comparision time DIP-Switch 5 =Off:	15 s
		calibrating comparision time DIP-Switch 5 =On:	30 s
	Heat up ramp:	Selecting of heat up ramp with DIP-Switch 1 and 2:	Withou t/ 2 s / 3 s / 5 s
Control inputs, digital:	Start- (X6) calibr.-Start- (X5)and Reset-Input (X7) are potential separated with Optocouplers inside TPRA		
	Control Voltage:	U_{contr}=4 to 32 VDC (bipolar)	
	Max. Control Voltage:	$U_{contr.rmax}$=±40 V	
	Control current:	$I_{comntr.}$=1 - 12 mA	
Desired value Input.:	The input (X16) is potential separated by isolation amplifier and protected against mismatch of polar-ity		
	Desired value Voltage:	$U_{des.val.}$=0...10 VDC correspond 0...300°C or 0...500°C	
	Max. Desired value Volt.	$U_{des.val.max}$=±20 V	
	Input resistance:	R_{ein}=1 Mohm	
Voltage measure Input:	Measure voltage (X8/X9):	U_R=1...80V	
	Max. measure Voltage:	U_{Rmax}=120V	
	Input resistance:	sector 1: R_{ein}=6,4 kOhm at U_R=1...8,9 V	
		sector 2: R_{ein}=60 kOhm at U_R=8,7...80 V	
Current measure Input:	Signal current (X10/X11):	I_R=20...400 mA U_{IR}=0.1...2 V	
	Max. signal current:	I_{Rmax}=500 mA U_{IRmax}=2,5 V	
	Input resistor:	$R_{inp.}$=5 Ohm (ballast-resistor)	
Uref-Output:	The reference output (X15) is potential separated from other outputs and overload protected.		
	Reference-Voltage:	U_{ref}=9,9 – 10,1 VDC	
	Max. Output current:	I_{refmax}=25 mA, by isolation amplifier	
actual value Output:	The Output (X17) is potential separated from other Outputs and protected toward incorrect polarity.		
	Desired value Voltage:	$U_{act.val.}$=0...10 VDC correspond 0...300°C or. 0...500°C	
	Max. Output current:	$I_{act.val.}$=10 mA	
	Output resistance:	R_i=10 Ohm	
Alarm-Output:	Reed-Relays contact n.o. (X12/X18), potential separated		
	Max. switch capacity (ohmic Load):	15 W	
	Max. switch voltage:	200 VDC	
	Max. Switch current:	1 A	
	Nominal Load (ohmic):	500 mA/20 V	
	Life time electrical	$1x10^7$ at nominal load	
EMC (CE):	Interference immunity:	EN 50082-2	
	Interference emission:	EN 50081-1 Only with additional line filter	
Terminals:	Plug in type srew terminals, clamp range 0,2-2,5 mm², torque 0,5-0,6 Nm		
	Material Polyamid not reinforced, flammability class UL94 V0		
Housing type:	Encapsulated in isolating case		
	Material Polycarbone fibre reinforced PC-F, flammability class UL94 V0		
Safety class:	Protection class II		
Pollution class:	3		
Degree of protection:	IP20		
Mounting:	Fast fixable on 35 mm top hat rail correspond DIN EN 50 022		
Dimensions (WxHxD):	75x102,5x105,5 mm		
Distances:	Minimal distance to other components who send out heat is 20 mm		
Weight:	Type with external Thyristors or solid state re-lay:470 gr Type with internal Thyristors: 520 gr		
Shock proof:	10 g		
Humidity:	95 %, no condensation		
Operation temperature:	5 °C bis 50 °C		
Storage temperature:	-10 C bis 70 °C		

Current Transformer:

Typ:	ZKB 465 501 max. nom. Current 400 A,

Transformation ratio:	1 : 1000
clamps:	Faston 6,3x0.,8mm
case:	Material Polyamid fibre reinforced PA-F, sealing compound: Polyurethan, flammability class UL94 V0
Monting plate	Material Polyamid PA, flammability class UL94 V0
Pollution degree:	3
degree of protection:	IP00
mounting:	Fast fixable on 35mm top hat rail correspond DIN EN 50 022
Dimensions (WxHxD):	40x42,5x68,5 mm
Weight:	70 gr, r
Shock proof:	10 g
Humidity:	95 %, no condensation
Operation temperature:	0°C bis 50 °C
Storage temperature:	-10 C bis 70 °C

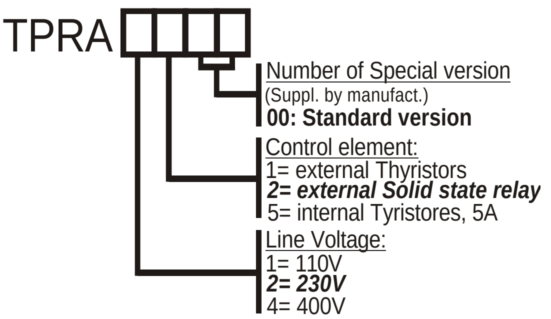
Potentiometer:

Temperature Range:	0 .. 300 °C
Resistance:	2,5 k Ohm + - 5 %, Lin: + - 0,25 %, Temp. coeff.: 50 ppm / °C
Power:	1,0 W
Turning angle:	1080 °
Terminals:	Pins for soldering
Typ of protection:	open
Housing:	Fibre reinforced compound plastic
Mounting hole:	28,45 – 28,90 mm diameter
degree of protection:	IP00
Pollution degree:	3
Weight:	51 gr
Dimensions:	57,4 * 32 mm
Humidity:	95 %, no condensation
Operation temperature:	0°C bis 50°C
Storage temperature:	-10C bis 70 °C

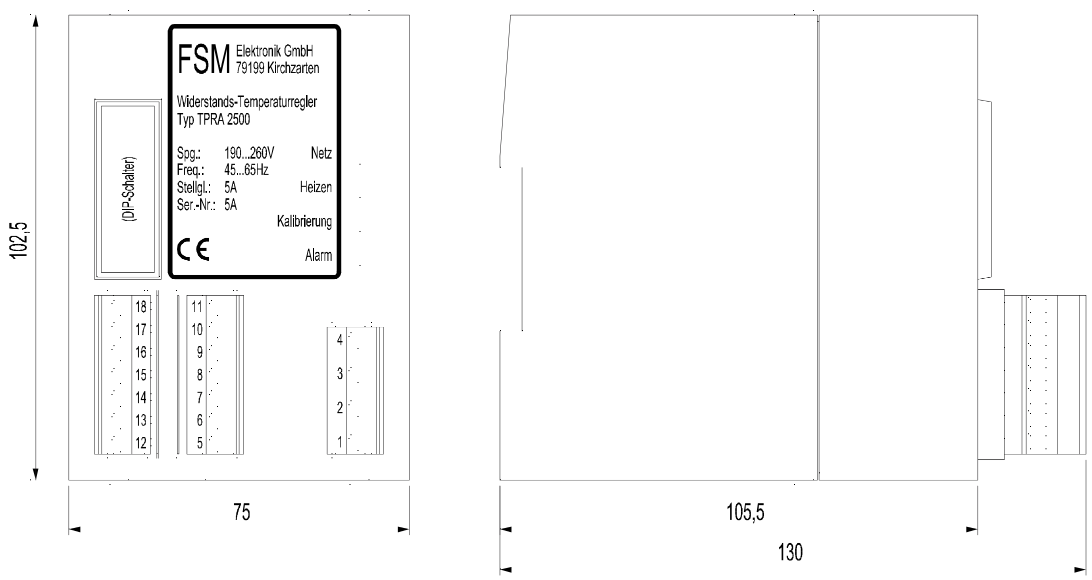
Welding Transformer:

Welding transformer must correspond to EN 60742 (Separation transformer with reinforced Isolation).

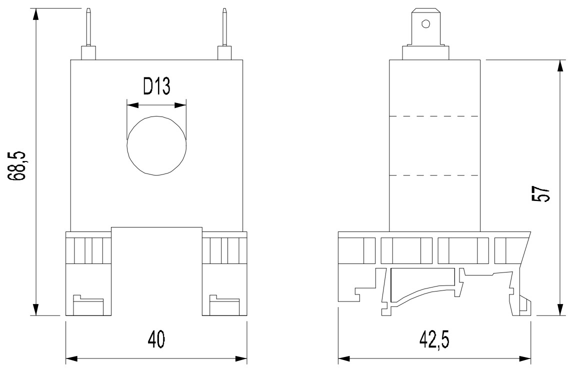
Ordering key:



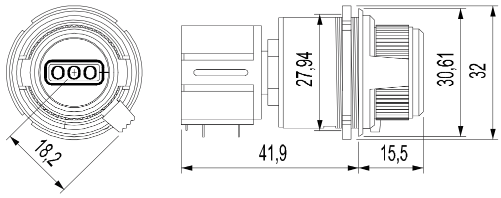
Housing Dimensions TPRA:



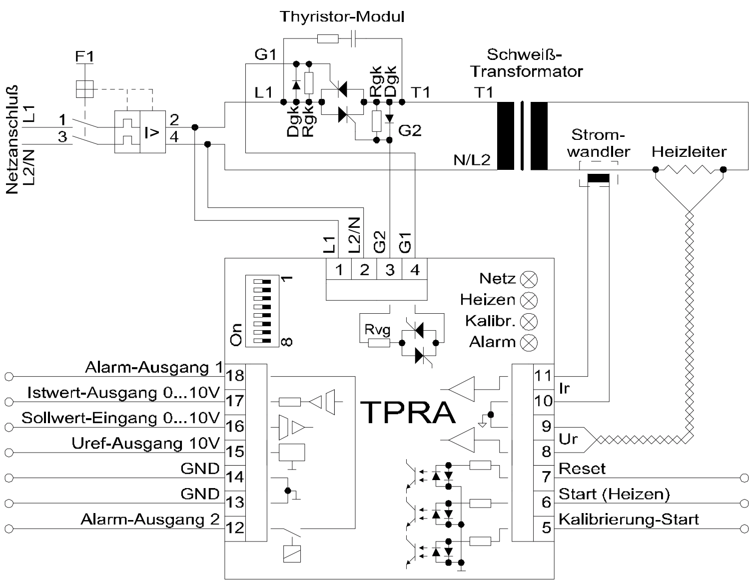
Housing Dimensions current transformer:



Housing dimensions Potentiometer:

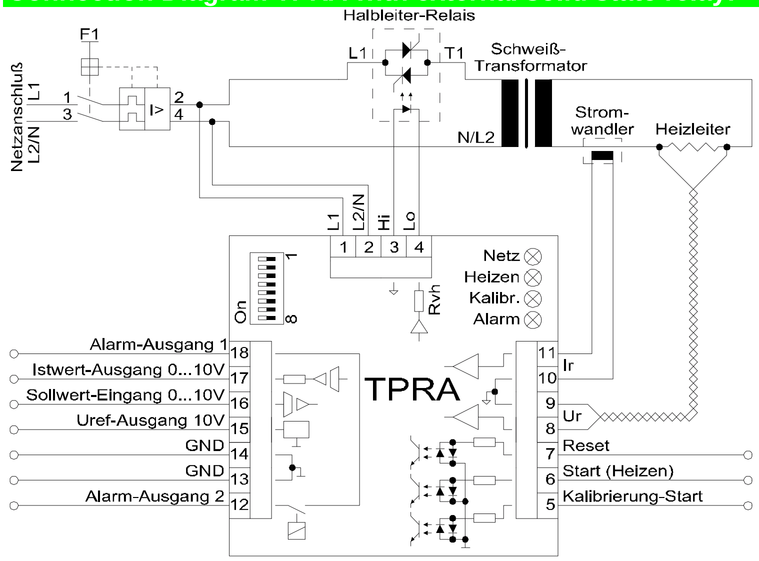


Connection Diagram TPRA with external Thyristors:



english description:
see in text.

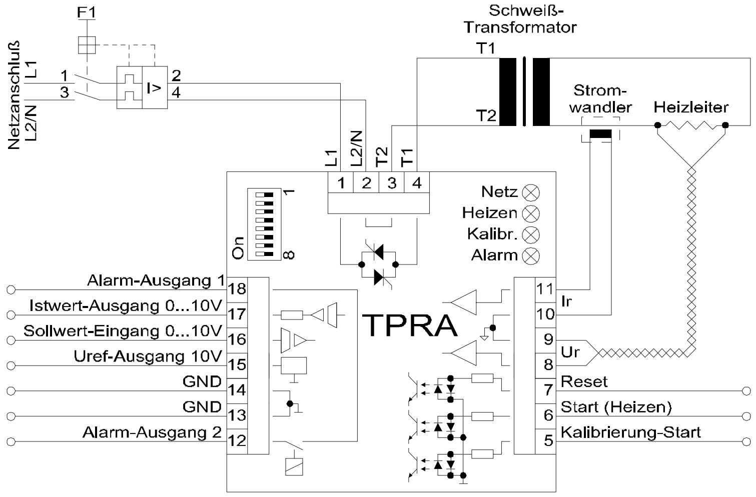
Connection Diagram TPRA with external solid state relay:



english description:
see in text.

Connection Diagram TPRA with internal Thyristors, (mostly used):

english description:
see in text.



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