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Operating manual - Archive document -

Temperature-Relay TR 250

ATTENTION, new factory settings in Pr2

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Application and short description

Short Description

Thermostats TR 250 monitor up to 3 sensors at the same time. Output-relays and sensors can be associated freely. Basic settings like monitoring 3 sensors for the same switching point with common alarm (e.g. for monitoring motors or transformers) are preset.

Applications

- Protection of motors or generators against overload, also with simultaneous monitoring of temperatures in bearings
- Protection of dry transformers against overload, also with control of a forced cooling
- General protection of motors and machines against over-temperatures
- Temperature-controller, also for refrigerating systems
- Monitoring of differences in temperature
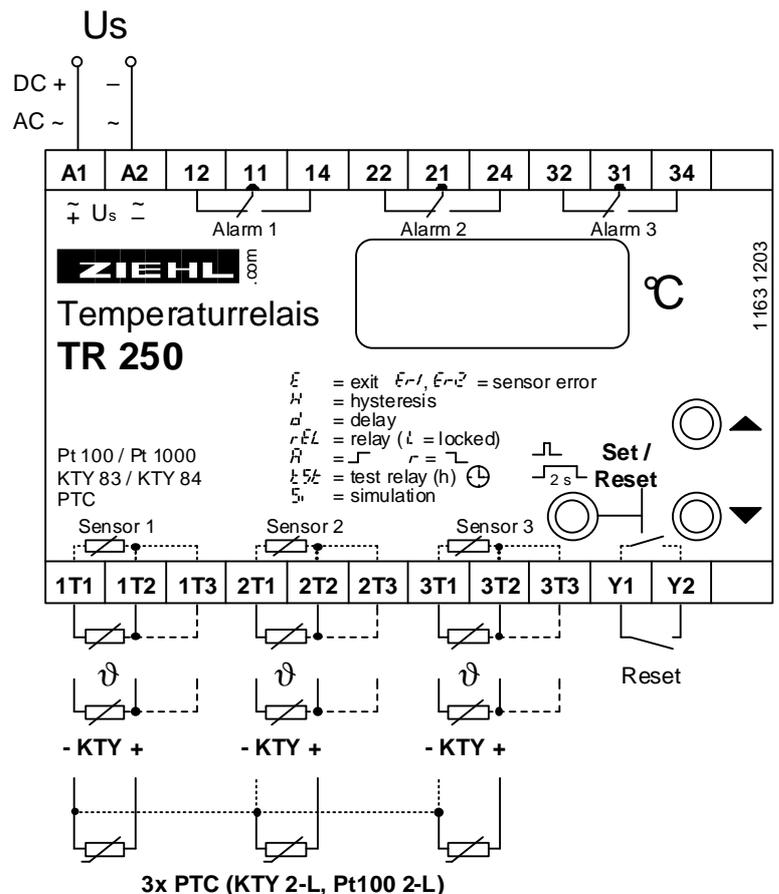- Resolution 0.1 °C for measuring range −19,9...99.9 selectable

Approval

USL, CNL Industrial Control Equipment 82VN

Function Overview

- 3 sensor-inputs, Pt 100 (RTD) or Pt 1000 in 2- or 3-wire-connection
- KTY 83, -84, PTC (thermistors)
- 3 relay-outputs (1 change-over-contact each)
- universal power-supply AC/DC 24-240 V

Displays

- Built-in 3 digit display for temperature
- 3 LEDs Alarm (state of relays)
- 3 LEDs Sensor
- Stored Values of MIN- and MAX- temperature can be displayed
- Programming

3x PTC (KTY 2-L, Pt100 2-L)

Function Diagram

t $_M$ = measuring time
ϑ1 = LIMIT
ϑ2 = LIMIT+Hysteresis
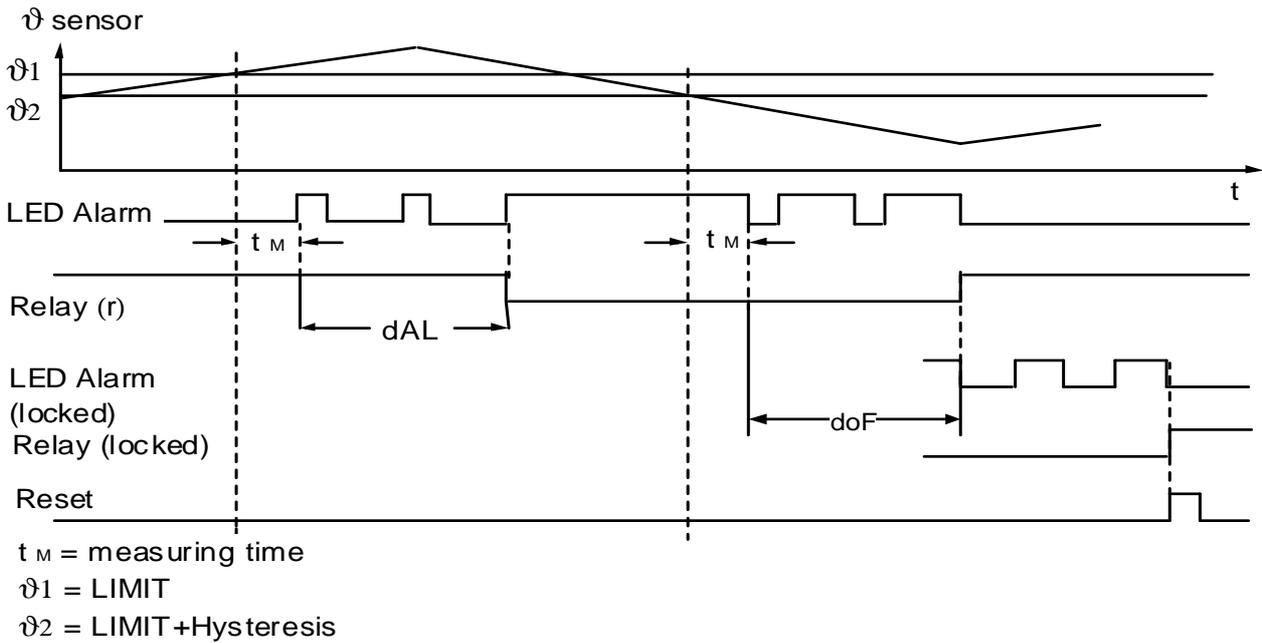
### Time of Response – Measuring-time t $_M$

The time of response depends on the number of connected sensors and the measuring function. At continuously change temperatures, measuring-time t $_M$ is app. 2 s. At rapidly changing temperature, such as appears when simulating temperatures with a potentiometer, measuring time t $_M$ is app. 4 … 6 s. At sensor-error the measuring time t $_M$ is up to 7…10 s.

Relay locked switching

In this mode, relay will only switch back, when switching-back-temperature has been reached, switching back delay time has passed and a reset has been made (button, contact Y1-Y2 or switching off and on of the TR 250). Readiness is displayed by flashing (1:1) of appropriate alarm-LED.

Display and operating elements

1 LED alarm 1
2 LED alarm 2
3 LED alarm 3
4 Display, 3 digits
5 push button up
6 push button down
7 push button Set/Reset
8 LED sensor 3
9 LED sensor 2
10 LED sensor 1
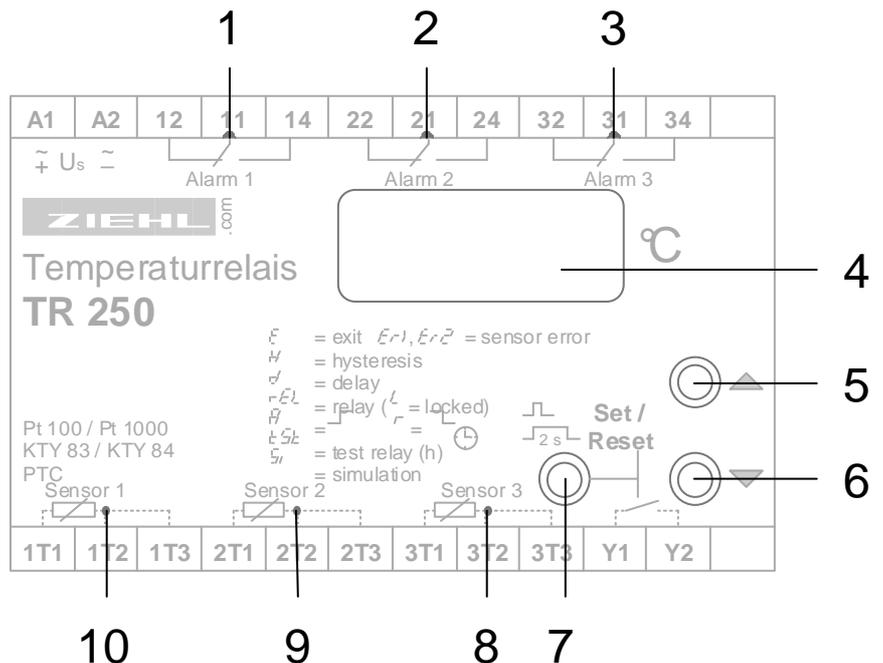
Detailed Description

Pre-Settings

Ex works, 4 programs are pre-set. Based on these settings, the relay can be easily adapted to the application. Normally only the temperatures of the alarms have to be changed.
Press button "SET" for 10 s when switching on supply voltage. After that the preset program (Pr 1 ... Pr4) can be selected with up/down and confirmed with "SET"

Pr 1: Protection of motors/generators with 3 sensors Pt 100. AL 1 = pre-alarm, AL2 = tripping, AL3 = sensor-alarm (all sensors). **Pr 1 is pre-set ex works.**

Pr2: Protection of transformers with 3 sensors Pt 100. AL 1 = forced cooling with a periodically test 1/week, AL2 = pre-alarm and sensor-alarm (all sensors), AL3 = tripping

Pr3: Protection of transformers with 1 sensor Pt 100 and 2 PTC-circuits. AL 1 = forced cooling with a periodically test 1/week (Pt 100), AL2 = pre-alarm and sensor-alarm (all sensors) (PTC), AL3 = tripping (PTC)

Pr 4: Single association S 1 – AL 1, S2 – AL2, S3 – AL3

Pr-Nr.		Pr 1 *	Pr2	Pr3	Pr4
Application	Explanation	Motor-protection 3x Pt 100	Transformer-protection 3x Pt 100	Transformer-protection 2xPTC +1xPt 100	1 Sensor/ 1 Relay
S 1/S2/S3	Sensor-type	100 (3-L)	100 (3-L)	100(3-L)/ PTC/PTC	100(3-L)
	Alarm	1+2	1+2+3	1/2/3	1/2/3
AL/ AL2/ AL3	Temperature (℃)	120/130/(250)	130/140/155**	90/PTC/PTC	50/50/50
H	Hysteresis (℃)	-5/-5/(-5)	-10/-5/5	-10/-/-	-2/-2/ -2
dAL	Switching-delay-time (s)	0	0	0	0
doF	Switching-back-delay (s)	0	999/0/0	999/0/0	0
rEL	Function of Relay	r	A/r/A	A/r/A	r
Err	Error (from sensor)	-/-/1+2+3	-/1+2+3/-	-/1+2+3/-	1/2/3
tSt	Periodically testing	-	1	1	-
AL 1/AL2/AL3	Alarm	-	(on)/-/-	(on)/-/-	-
don	Test period (h)	---	168/---/---	168/---/---	---
doF	Test time (h)	0.01	0,2/0,01/0,01	0,2/0,01/0,01	0.01
Si	Simulation	displays sensor values			
Cod	Code-lock on/off	oF	oF	oF	oF
	PIN-Code	504	504	504	504

* Factory settings

 ** ATTENTION, new factory settings in Pr2

Operation:

Display Mode
Indication of the actual temperature of the warmest sensor. LEDs (yellow) show, which sensor or group of sensors is selected. Change with Set.
Indication of the stored minimum- resp. maximun-value: Press up or down for 2 s. Reset min/max with Reset for 2 s.
Leave Display Mode with up/down.
Sensors type Pt ... resp. KTY ..:   indication of temperature in °C (optional °F)
Sensor type PTC (thermistor):   indication of resistance of sensor in kΩ

LEDs Sensor in Display Mode
ON	Value of this sensor is being displayed
Flash	Sensor Error
2 or more LEDs Sensor ON	warmest of those sensors in display

LEDs Alarm in Display Mode
OFF	Switching point not exceeded
ON	Switching point exceeded, relay switches
Flash ⎍‾‾‾‾‾⎍	Switching delay time dAL runs
Flash ⎍__‾‾__⎍	Switching back delay time doF runs.
Flash ⏌‾⏌‾⏌	Ready for Reset, switching interlocked.

Reset by button RESET or closing of a contact at terminals Y1-Y2. A continuously closed contact at Y1-Y2 doesn't result in a reset.
During periodical relay-test the appropriate LED lights up.

Programming Mode
Programming of sensors 1-3 (5 1/52/53):
Select menue item with up/down until 5 1 and type of sensor are alternating in the display , e.g. 5 1/ I00 for Pt 100.
Here it can be clearly read out, which type of sensor is selected and which alarms are effected by this sensor (red LED Alarm on).
Enter into programming with Set.
- Select type of sensor with up/down (d F can be selected at 53, if 5 1 and/or 52 are not PtC. with 53 = d F it is handled as difference sensor 2 minus sensor 1).
- Compensate line-resistance (enter value of resistance of line) or select 3-wire or nc (not connected, if no sensor is connected to this input). At setting PtC no compensation of line-resistance is necessary/possible.
- 2-wire, compensation of line-resistance:
  To compensate the line resistance schort-circuit the wires nearby the sensor and measure the line resistance.
  With 2-wire connection and a common line for all signals, all sensor measuring currents will be added on the common line. Thus the value of the compensation line resistance RK must be calculated as follows:
  RK=(n+1) x RL/2 (RL = line resistance of two wires, n = number of sensors)
  We recommend using 2 or bettering 3 wires for each sensor.
- Combination of sensor and Alarms (AL/E), **important:** Here it is programmed, which alerms (=relays) are affected by the sensor.. Select alarm with up/down. Set switches alarm on or off (see red LED at alarm-contacts). The LEDs of the activated alarms are alight.
  Leave menue item with button Set when E is in display (on to next menue item)

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Programming of Alarms 1-3 (AL 1/AL2/AL3):

Select menue item with up/down until AL 1 and Limit (value) alternate in display, e.g. AL 1 and 130 for 130 °C.

Here it can be clearly read out, which limit is programmed and of which sensors the alarm is effected (yellow LEDs sensor on).

Enter into programming with Set.

- Set limit with up/down. At sensors type PtC no limit can be programmed.
- Hysteresis. Negative hysteresis = MAX-alarm, the relay switches at the programmed limit and switches back after the temperature is below the limit by the value of the hysteresis. E.g limit 130 °C and hysteresis -5 °C: Relay switch es at 130 °C and back at 125 °C. Positive hysteresis everything inverted = MIN-limit . At sensors PTC no hysteresis can be programmed.
- Alarm delay dAL: An alarm is beeing suppressed for this time. Short exceedings of the limit do not result in an alarm.
- Switch-back delay doF: An alarm is switched off this time after the temperature is below the limit, e.g. a cooling fan can cool down a transformer for this additional time to ensure, that it needn't be started again after a short time.
- Function of relays:
    r-closed-circuit current mode, relay is picked up in GOOD condition (=limit not exceeded) and releases when the limit is reached. Advantage: Errors and malfunctions will normally result in an alarm. Disadvantage: with switched off device and shortly after switching on the supply voltage an alarm is reported. Disadvantageous when the supply-voltage of the device is created by the monitored transformer.
    A-operating current mode. Relay is released in GOOD condition and releases when the limit is exceeded. No alarm when supply-voltage is off. This mode is applied normally with heatings, fans or for tripping of transformers.
    rL/AL: Alarm switches interlocked. Reset only after the temperature is below the limit (+ hysteresis) and after switching-back delay time has passed.
- Error: At Err/SE it can be programmed, if the relay switches at troubles (short-circuit or interruption) at a sensor. (or error of device Er3/4). Select sensor with up/down. Set switches sensor on or off (yellow LED at the sensor input changes). LEDs of aktivated sensors light up. Leave menue item with button Set when E is in display (on to next menue item). We recommend to program this error message for a pre-allarm (Pr2 und Pr3) or a relay that bis not used for other purposes (Pr 1).

- **LEDs in Programming Mode**
    Sensor-programming   appropriate LED Alarm is alight
    Alarm-programming   appropriate LED Sensor is alight
    Err, Error at Sensor   appropriate LED Alarm is alight

Test Relay (tSt):

At this menue item it can be programmed, z´that a relay switches after a time don, e.g. 1 week (= 168 hours) for the time doF, e.g. 0,2 h (12 minutes) into alarm state, for starting a pump or a fan for a short time to make them move and thus to ensure, that bearings are not damaged by long lasting times without activity.

Select alarm with up/down. Set switches on to don and doF.

don = --- = test not avtive.

Leave menue item with button Set when E is in display.

At programs Pr2 and Pr3 a test is programmed for relay 1 (168h/0,2h).

Sensor Simulation (Si):

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At this menue item a sensor can be selected and with the buttons up/down a measured temperature can be simulated. All functions of the device act as if the temerature was measured in real.
15 minutes after the last button has been pushed, the device automatically returns to normal measuring mode.

Code (Cod):
After setting all parameters they can be protected by activating the code lock. After pushing Set, the display indicates Pin.
Adjust with buttons up/down Pin 504 (factory setting). After pushing Set, code lock can be activated or switched off. After pushing Set again, an individual Pin can be selected (write down).
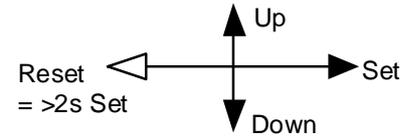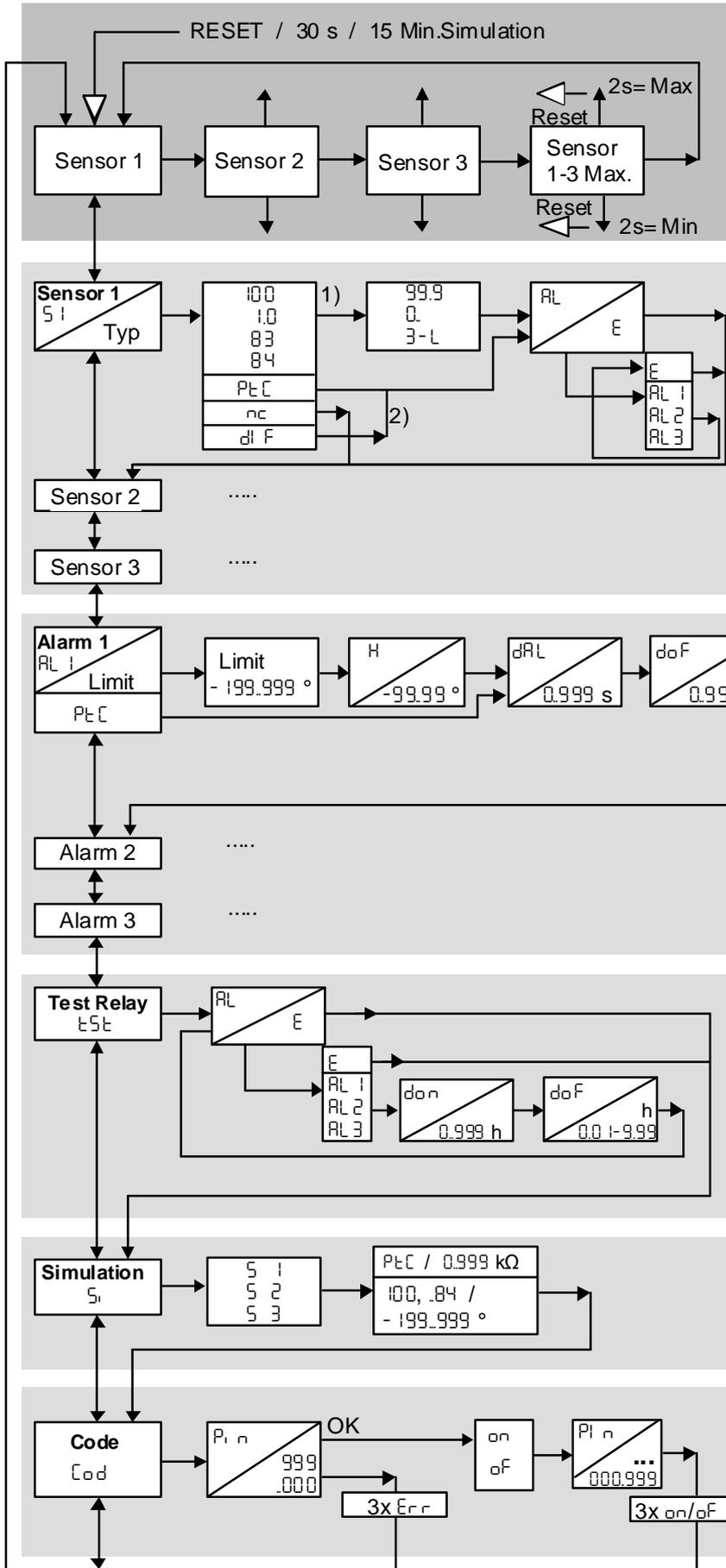When code lock is activated all parameters can be seen but not be changed anymore.
In case of problems with the code lock (forgotten Pin) the lock can be switched off and the Pin can be set back to 504, by pushing button set while connecting the device to supply-voltage until Code / ofF is indicated in the display.

Hints:
  - With programs Pr 1 to Pr4 the most important parameters can be pre-set for various applications. After that only slight changes should be necessary, e.g. setting of the limits for the alarms.
  - After a menue-item has been finished, it is automatically switched to the next menue-item. E.g. after programming the combination of sensor and alarm for sensor 1 it is switched to sensor 2 when set is pushed.
  - When the right decimal-point in the 7 segment-disply is alight, you have left the display-mode and you can select the different menue-items with up/down (left vertical column in flow chart).
  - When the right decimal-point in the 7 segment-disply is flashes, you are i a menue-item. Parameters can be changes with up/down in this mode (right side of flow chart).
  - Longer pushing of up or down accelerates the changes in the display.
  - Button up/down pushed at the same time sets actual programmed parameter to zero.
  - With a reset (push Set/Reset for 2 s) you return to display-mode from any position in the programming-mode (last programmed parameter is stored).

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Operation:

RESET / 30 s / 15 Min.Simulation

| Sensor 1 | Sensor 2 | Sensor 3 | Sensor 1-3 Max. |

2s= Max
Reset
Reset
2s= Min

Up
Reset ◁ ▶ Set
= >2s Set
Down

1) Change of sensor-type *Temp. / PTC* clears association sensors/alarms
2) Monitoring of difference in temperature selectable for sensor 3, only when type of sensor 1 and 2 are identical (dif = sensor 2 minus sensor 1)
3) 0,1 ℃ measuring range –19.9...99.9

LEDs on type-plate display appropriate inputs and outputs

Programming level 1/2: dot lights/flashes

Up/Down simultaneously sets value to *Zero*

Code-Reset = *2s* SET when switching on device (PIN = 504)
Pre-Settings = *10 s* SET when switching on device
Different pre-settings and ℃ / ℉ / 0.1 ℃ can be selected factory reset with Up/Down

Sensor 1 S1 Typ
100 1.0 83 84 / PtC / nc / dif 1)
99.9 0. 3-L 2)
AL E / E AL1 AL2 AL3

Sensor 2 .....

Sensor 3 .....

Alarm 1 AL1 Limit PtC
Limit - 199..999 °
H /-99.99 °
dAL /0.999 s
doF /0.999 s
rEL r A rL AL
Err/SE SE S1 S2 S3

Alarm 2 .....

Alarm 3 .....

Test Relay tSt
AL E / E AL1 AL2 AL3
don /0.999 h
doF /0.01-9.99 h

Simulation Si
S1 S2 S3
PtC / 0.999 kΩ 100, .84 / - 199..999 °

Code Cod
Pin 999 .000 / OK
3x Err
on oF
PIn ...000.999
3x on/oF

Legend:

3-L	= 3-wire-connection
AL	= alarm (or Relay-function)
Cod	= Code (PIN)
dAL	= delay until alarm
doF	= delay until switching back
dif	= measuring of difference in temperature
E	= exit (leave loop)
Err/SE	= association which relay reports / Sensor Exit
H	= hysteresis
on/oF	= on/off
rEL	= function of relay
r	= closed circuit current mode
A	= operating current mode
rL AL	= with locked switching
S	= sensor
100	= Pt 100 (RTD-sensor)
1.0	= Pt 1000
83 84	= KTY-sensor 83, 84
PtC	= Thermistor
nc	= not connected
Si	= simulation
tSt	= relay-test, periodical test after time *don* duration *doF* (both in hours) don = --- = *no test*

Error reports:
Er 1	= short-circuit in sensor or line
Er 2	= break of sensor or line
Er 3/4	= internal error of device
Err	= common error
EEE	= measured values too high
-EE	= measured values too low

Important notes

⚠ **ATTENTION**

Dangerous electrical voltage!
May lead to electrical shock and burn.
Before beginning of work switch unit and equipment free of voltage.

To use the equipment flawless and safe, transport and store properly, istall and start professionally and operate as directed.

Only let persons work with the equipment who are familiar with installation, start and use and who have appropriate qualification corresponding to their function. They must abserve the contents of the instructions manual, the information which are written on the equipment and relevant security instuctions for the setting up and the use of electrical units.

The equipments are built according to EN and checked and leave the plant according to security in perfect condition. To keep this condition, observe the security instructions with the headline „Attention" written in the instructions manual. Ignoring of the security instructions may lead to death, phyical injury or damage of the equipment itself and of other apparatus and equipment.

If, in any case the information in the instructions manual is not sufficient, please contact our company or the responsible representative.

Instead of the industrial norms and regulations written in this instructions manual valid for Europe, you must observe out of their geographical scope the valid and relevant regulations of the corresponding country.

⚠ **Attention!**
When all relays are programmed in operation current mode (= pick up at alarm), a loss of the supply voltage or an instrument failure can remain unidentified. When the relay is applied as control instrument, the operator must ensure, that this error is recognized by regular examinations. We recommend to program and accordingly evaluate at least one relay in the closed-circuit current mode.

Attention! Connection of Sensors
Temperature sensors must be connected to the plug-in terminals 1T1, 1T2, 1T3 .... To ensure proper operation this plug-in terminals have gold-plated contacts. Do not use these plugs for other terminals.

Universal power supply
The TR 250 universal power supply works within the range AC/DC 24-240 V. Before switching on make sure, that the rated supply voltage Us of the type- plate and the mains voltage are the same.

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Trouble-shooting and remedies

- **Pre-Set ex works (WE)**
  Press button "SET" for 10 s when switching on supply voltage. After that, the preset program (Pr 1 ... Pr4) can be selected (see pre-settings) and temperature display can be changed ºC <--> ºF.
  Ex works Pr 1 and ºC are selected.

- **Display**
  EEE   sensor interruption or over-range
  -EE   sensor short circuit or under -range

- **Relay cannot be programmed – Code Lock**
  The Code-lock can be activated as a protection against manipulation of the settings. The user can change the PIN-Code.
  You have forgotten the PIN? Make a code-reset by pressing button "SET" for 2 s when switching on supply voltage:
  Display: "888"; "Cod"; ""oF"; "888"
  Release button "SET": Code = off, PIN = 504.

- **Displayed Temperature is different from Sensor-Temperature**
  1. Unit ℃ / ℉ correct? When switching on power su pply ºC / 0.1C / 'ºF is displayed for a short moment. Change of unit see "Factory reset".
  2. Check connected types of sensors and programmed types

- **Display Error „Er 1 or Er2"**
  Er 1 Short-circuit in sensor or line
  Er2 Break of sensor or line
  Er3 and Er4 are internal errors. Switch off and on the device and if necessary reset to one of the programs Pr 1 ... Pr4. If the error cannot be cleared, the relay should be replaced and sent back to the factory.

- **Relay trips regularly without limit exceeded**
  Check if a time "don" is programmed for this relay at Test Relay "tSt".
  At Pre-Settings Pr 2 and Pr 3 for relay K1 don = 168 hours for testing an fan once a week.
  <u>Remedy</u>: change setting for don to 0.

Display of Software-Version: Press "SET" for 10 s in display mode.

HINT 1: To return to display mode from any position of programming press button "SET" for 2 s (last settings will be stored).

HINT 2: To set the actual programmed parameter to zero (000), press "up" and "down" simultaneously for 2 s.

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Technical Data

Rated supply voltage Us: AC/DC 24 – 240 V, 0 / 50 / 60 Hz   < 3 VA
   Tolerance   DC 20,4 - 297 V,   AC 20 - 264 V

Relay output: 3 x co (change-over)
   Switching voltage   max. AC 415 V
   Switching current   max. 5 A
   Switching power cos φ =1   max. 1250 VA (ohmic load)
                                  max. 48 W at DC 24 V

   Derating factor cos φ 0,7   0,5
   UL electrical ratings: 3 A Resistive, 240 VAC
                                  D300, 1A, 240 VAC

   Rated operational current Ie:
   AC15   Ie = 1 A   Ue = 400 V
                                  Ie = 2 A   Ue = 250 V
   DC13   Ie = 2 A   Ue = 24 V
                                  Ie = 0,2 A   Ue = 125 V
                                  Ie = 0,1 A   Ue = 250 V

   Recommended fuse for contacts T 3,15 A (gL)
   Expected contact life mechanical 1 x 10^7 operations
   Expected contact life electrical   1 x 10^5 operations with AC 250 V / 5 A
                                  2 x 10^5 operations with AC 250 V / 3 A
                                  6 x 10^5 operations with AC 250 V / 1 A

Test conditions: EN 60947, EN 50178
   Insulation   EN 60664 / AC 415 V / 2/ III
   Rated ambient temperature range - 20 ... + 65 ℃

Sensor connection :   Pt 100, Pt 1000 acc. to EN 60751

Sensor	Range ℃ min	Range ℃ max	Short-circuit Ohm <	Break Ohm >	Resistance of sensor + line Ohm max
Pt 100	-199	860	15	400	500
Pt 1000	-199	860	150	4000	4100
KTY 83	-55	175	150	4000	4100
KTY 84	-40	250	150	4000	4100
PTC			20	20000 *	
				* when no value 3800 ... 20000 ohm has been measured before	

Accuracy   ±0,5 % of value ±1 K (KTY ±5 K)
Sensor-current   ≤ 1 mA
Measuring time t $_M$ <2,5 s   (depending on number and type of connected sensors)
                                  <3,5 s at resolution 0,1 ℃

Housing: type V 4

Mounting height	55 mm
Width	4 TE
Dimensions (W x H x D)	70 x 90 x 58 mm
Line connection solid wire	each 1 x 1,5 mm^2
Stranded wire with insulated ferrules	each 1 x 1,0 mm^2
Torque	0,5 Nm (3,6 lb.in)
Protection class housing	IP 30
Protection class terminals	IP 20
Fitting position	any
Mounting	Snap mounting on 35 mm standard rail EN 60 715 or M4 screws
Weight	app. 200g

Subject to technical modifications

Design V4: dimensions in mm
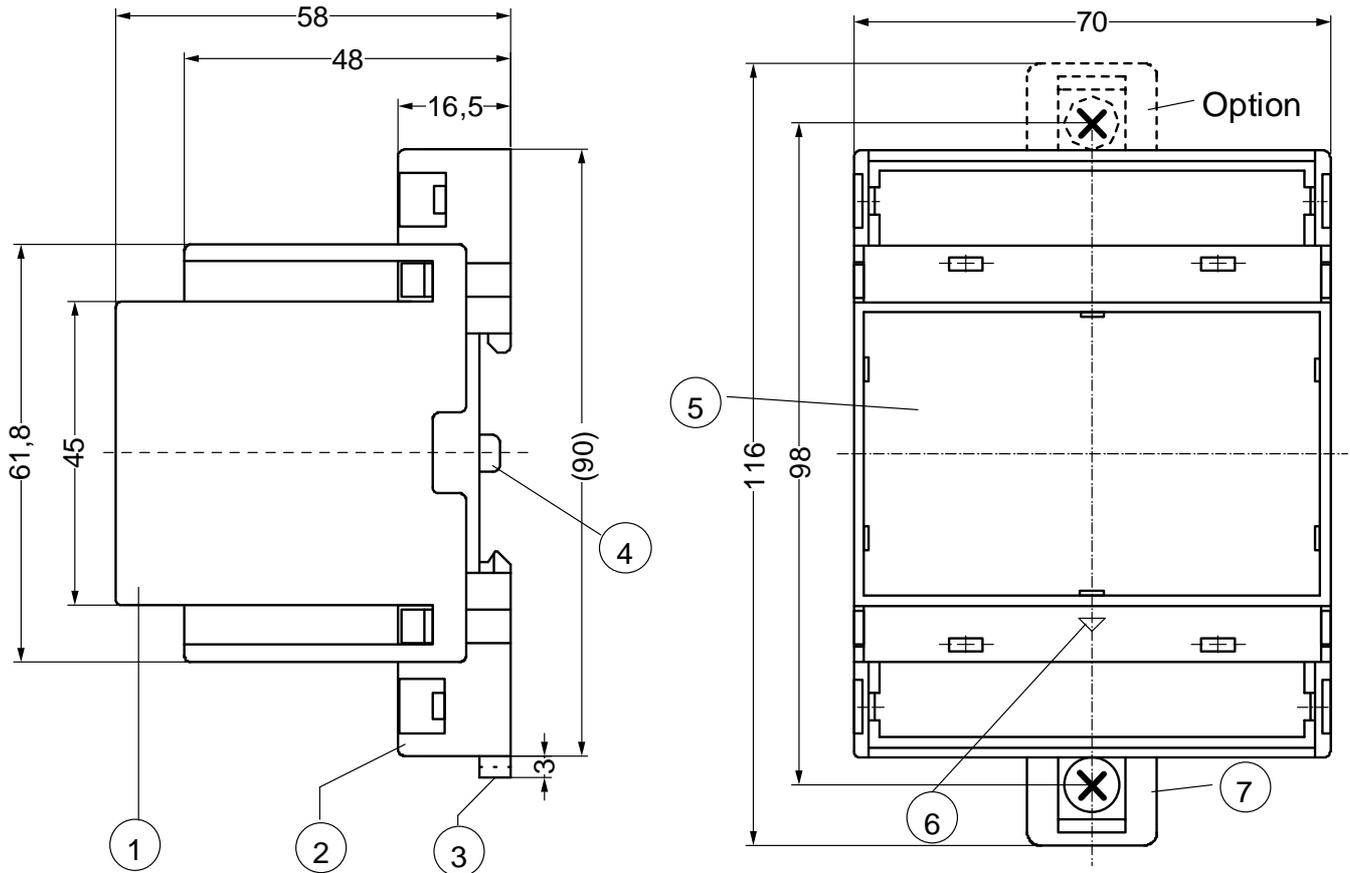
1   Oberteil / cover
2   Unterteil / base
3   Riegel / bar for snap mounting
4   Plombenlasche / latch for sealing
5   Frontplatteneinsatz / front panel
6   Kennzeichen für unten / position downward
7   Riegel bei Wandbefestigung mit Schrauben. Riegelbohrung Ø 4,2 mm / for fixing to wall with screws, Ø 4,2 mm.

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