

## Operating instructions

# Temperature-Relay TR 250



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# Table of contents

Page

1.	Application and short description.....	3
2.	Function Overview.....	3
3.	Function Diagram .....	4
4.	Display and operating elements.....	4
5.	Important notes.....	5
6.	Installation.....	6
7.	Detailed Description .....	7
8.	Putting into operation .....	8
9.	Operation: .....	11
10.	Trouble-shooting and remedies .....	12
11.	Technical Data .....	13
12.	Design V4 .....	15

# 1. 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

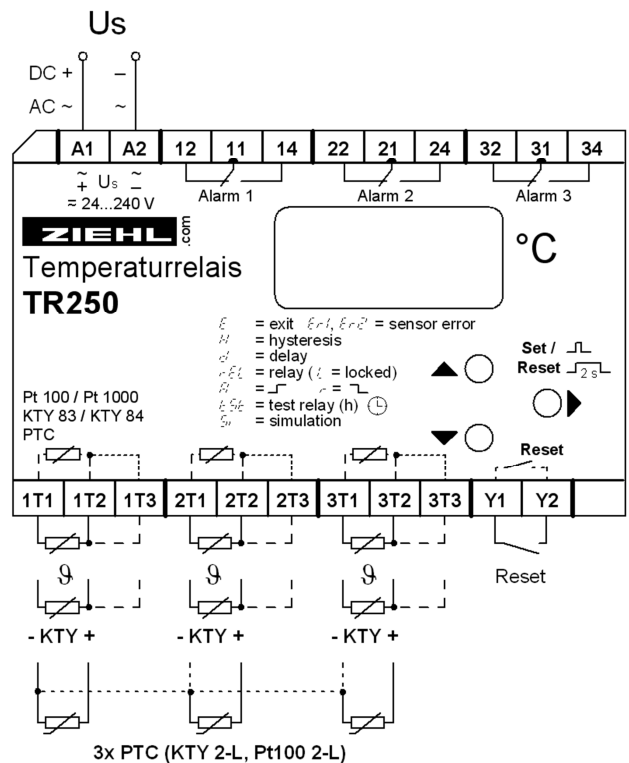
- Protection of motors or generators against overload, also with simultaneous monitoring of temperatures in bearings
- Protection of dry transformers against overload, also with control of a forced cooling
- General protection of motors and machines against over-temperatures
- Temperature-controller, also for refrigerating systems
- Monitoring of differences in temperature
- Resolution 0.1 °C for measuring range -19.9...99.9 selectable

# 2. Function Overview

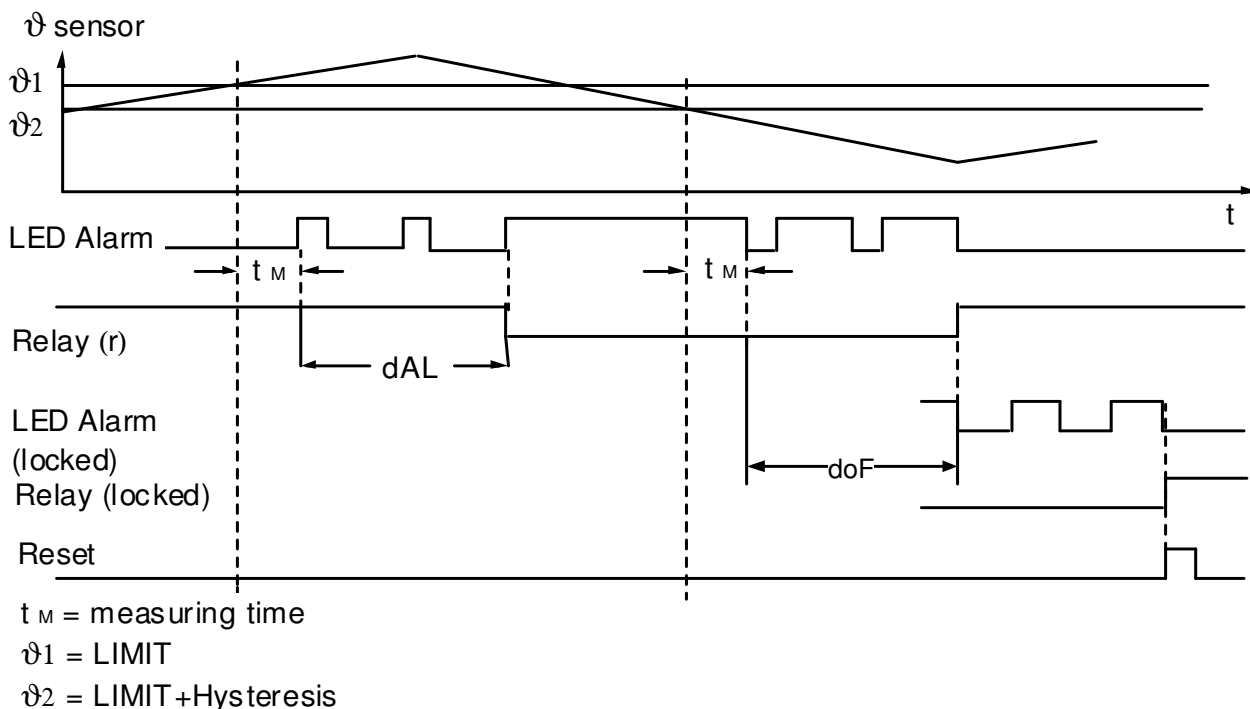
- 3 sensor-inputs, Pt 100 (RTD) or Pt 1000 in 2- or 3-wire-connection
- KTY 83, -84, PTC (thermistors)
- 3 relay-outputs (1 change-over-contact each)
- universal power-supply AC/DC 24-240 V

## 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



### 3. Function Diagram



#### Time of Response – Measuring-time $t_M$

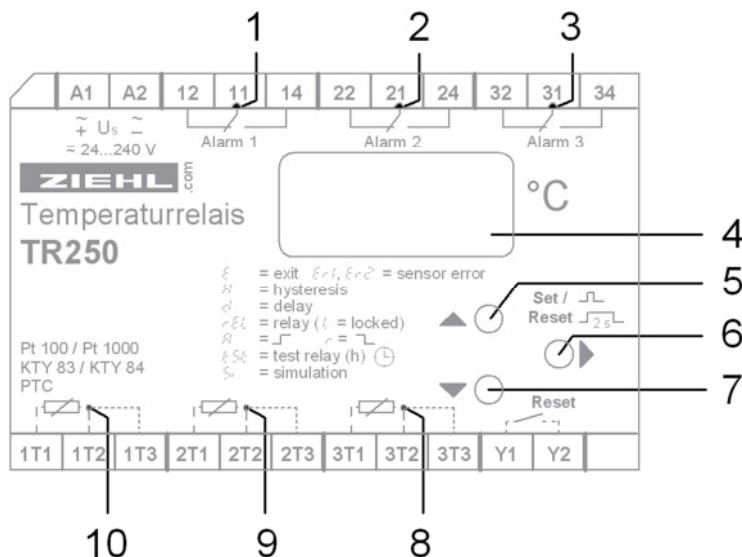
The time of response depends on the number of connected sensors and the measuring function. At continuously change temperatures, measuring-time  $t_M$  is app. 2 s. At rapidly changing temperature, such as appears when simulating temperatures with a potentiometer, measuring time  $t_M$  is app. 4 ... 6 s.

#### Relay locked switching

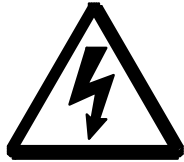
In this mode, relay will only switch back, when switching-back-temperature has been reached, switching back delay time has passed and a reset has been made (button, contact Y1-Y2 or switching off and on of the TR 250). Readiness is displayed by flashing (1:1) of appropriate alarm-LED.

### 4. 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 Set/Reset
- 7 push button down
- 8 LED sensor 3
- 9 LED sensor 2
- 10 LED sensor 1



## 5. Important notes



### **DANGER!**

**Hazardous voltage!**

**Will cause death or serious injury. Turn off and lock out all power supplying this device before working on this device.**

To use the equipment flawless and safe, transport and store properly, install 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 observe the contents of the instructions manual, the information which are written on the equipment and the relevant security instructions for the setting up and the use of electrical units.

The equipment is built according to DIN/EN/IEC and checked and leave the plant according to security in perfect condition. To keep this condition, observe the security instructions with the headline „Attention” in the instructions manual. Ignoring of the security instructions may lead to death, physical 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 etc. 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  $U_s$  of the type- plate and the mains voltage are the same.

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## 6. Installation

The unit can be installed as follows:

- Installation in switchgear cabinet on 35 mm mounting rail according to EN 60715
  - With screws M4 for installation on walls or panel. (additional latch included in delivery)
- Connection according to connection plan or type plate.



**A circuit-breaker or switch must be situated within easy reach of the unit and fused. Installation excess current protection should be  $\leq 10$  A.**

## 7. Detailed Description

### Default Settings

Ex works, 4 programs are preset. 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 ... Pr 4) and/or the display value (°C / Ω / °F) 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, AL 2 = tripping, AL 3 = sensor-alarm (all sensors). **Pr 1 is pre-set ex works.**

Pr 2: Protection of transformers with 3 sensors Pt 100. AL 1 = forced cooling with a periodically test 1/week, AL 2 = pre-alarm and sensor-alarm (all sensors), AL 3 = tripping

Pr 3: Protection of transformers with 1 sensor Pt 100 and 2 PTC-circuits. AL 1 = forced cooling with a periodically test 1/week (Pt 100), AL 2 = pre-alarm and sensor-alarm (all sensors) (PTC), AL 3 = tripping (PTC)

Pr 4: Single association S 1 – AL 1, S 2 – AL 2, S 3 – AL 3

Pr-Nr.		Pr 1*	Pr 2	Pr 3	Pr 4
Application	Explanation	Motor-protection 3x Pt 100	Transformer-protection 3x Pt 100	Transformer-protection 2xPTC +1xPt 100	1 Sensor/ 1 Relay
S 1 / S 2 / S 3	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 1 / AL 2 / AL 3	Temperature (°C)	120/130/(250)	130/140/155**	90/PTC/PTC	50/50/50
H	Hysteresis (°C)	-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	R/r/R	R/r/R	r
Err	Error (from sensor)	-/-1+2+3	-/1+2+3/-	-/1+2+3/-	1/2/3
tSt	Periodically testing	-	1	1	-
AL 1 / AL 2 / AL 3	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
S <sub>i</sub>	Simulation	displays sensor values			
cod	Code-lock on/off	oF	oF	oF	oF
	PIN-Code	504	504	504	504

\* Factory settings

\*\* New factory settings in Pr 2 (from 09/30/2010)

## 8. Putting into 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. maximum-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

Alternating illumination

All sensor values are displayed for 2s each consecutively

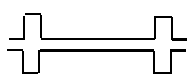
### LEDs Alarm in Display Mode

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 (S1/S2/S3):

Select menu item with up/down until S1 and type of sensor are alternating in the display, e.g. S1/100 for Pt 100.

Here it can be clearly read out, which type of sensor is selected and which alarms are affected 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 S3, if S1 and/or S2 are not PTC. with S3 = 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 n.c (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 short-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  $R_K$  must be calculated as follows:

$$R_K = (n+1) \times R_L / 2 \quad (R_L = \text{line resistance of two wires, } n = \text{number of sensors})$$

We recommend using 2 or bettering 3 wires for each sensor.

- Combination of sensor and Alarms ( $R_L/E$ ), **important:** Here it is programmed, which alarms (=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 menu item with button Set when  $E$  is in display (on to next menu item)

## Programming of Alarms 1-3 ( $R_L1/R_L2/R_L3$ ):

Select menu item with up/down until  $R_L1$  and Limit (value) alternate in display, e.g.  $R_L1$  and  $130$  for  $130\text{ }^\circ\text{C}$ .

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  $130\text{ }^\circ\text{C}$  and hysteresis  $-5\text{ }^\circ\text{C}$ : Relay switches at  $130\text{ }^\circ\text{C}$  and back at  $125\text{ }^\circ\text{C}$ . Positive hysteresis everything inverted = MIN-limit . At sensors  $PTC$  no hysteresis can be programmed.

- Alarm delay  $d_{RL}$ : An alarm is being suppressed for this time. Short exceeding of the limit does not result in an alarm.

- Switch-back delay  $d_{oF}$ : 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.

$R$ -operating current mode. Relay is released in GOOD condition and picks up 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.

$rL/R_L$ : Alarm switches interlocked. Reset only after the temperature is below the limit (+ hysteresis) and after switching-back delay time has passed.

- Error: At  $E_{rr}/SE$  it can be programmed, if the relay switches at troubles (short-circuit or interruption) at a sensor. (or error of device  $E_{r3/4}$ ). Select sensor with up/down. Set switches sensor on or off (yellow LED at the sensor input changes). LEDs of activated sensors light up. Leave menu item with button Set when  $SE$  is in display (on to next menu item). We recommend to program this error message for a pre-alarm ( $P_{r2}$  und  $P_{r3}$ ) or a relay that is not used for other purposes ( $P_{r1}$ ).

## LEDs in Programming Mode

Sensor-programming

appropriate LED Alarm is alight

Alarm-programming

appropriate LED Sensor is alight

$E_{rr}$ , Error at Sensor

appropriate LED Alarm is alight

### Test Relay (t5t):

At this menu item it can be programmed, 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 active.

Leave menu 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 (5r):

At this menu 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 temperature 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).

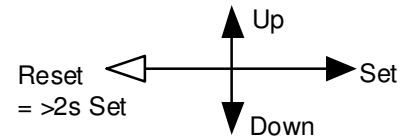
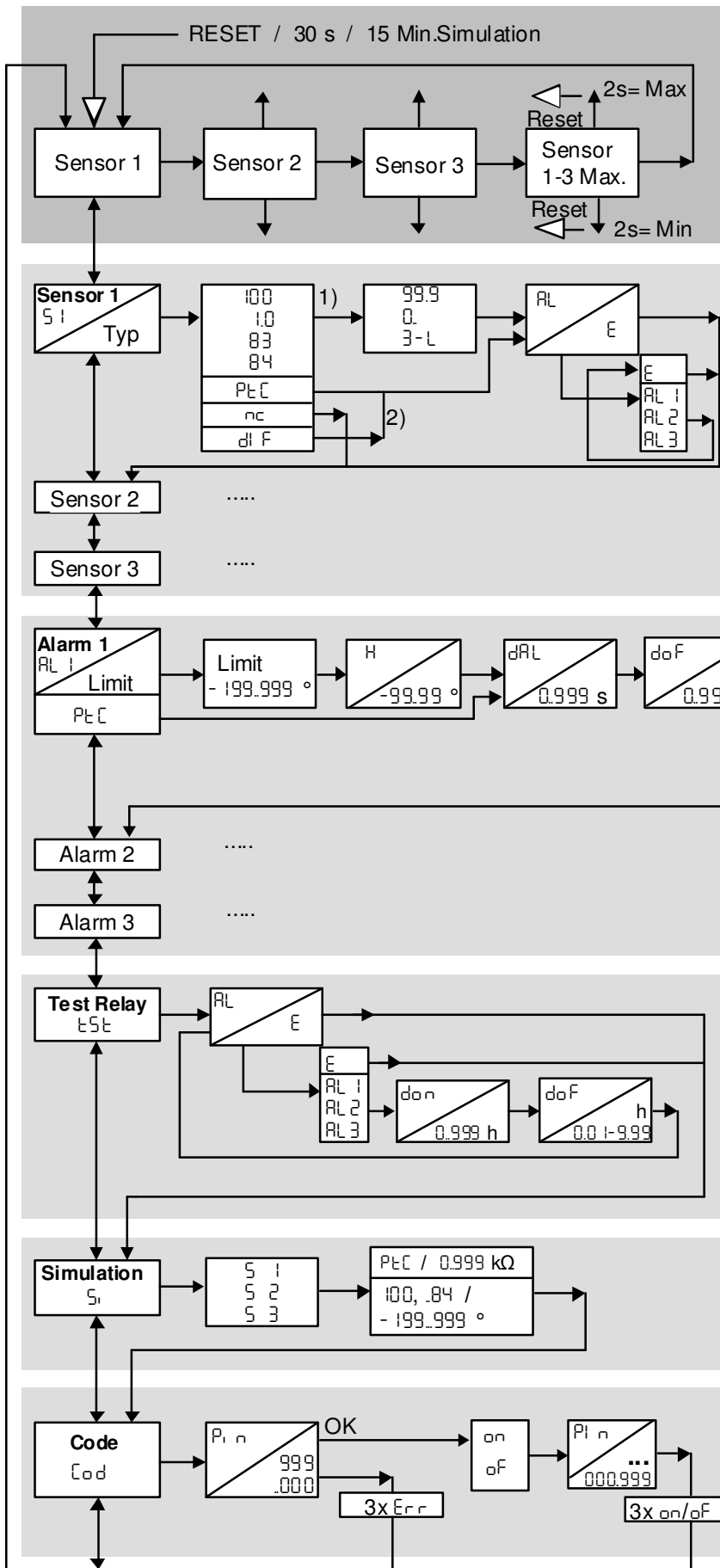
When code lock is activated all parameters can be seen but not be changed anymore.

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 / oF is indicated in the display.

### **Hints:**

- With programs Pr1 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 menu-item has been finished, it is automatically switched to the next menu-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-display is alight, you have left the display-mode and you can select the different menu-items with up/down (left vertical column in flow chart).
- When the right decimal-point in the 7 segment-display is flashes, you are in a menu-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).

# 9. Operation



- 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 °C 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 °C / °F / 0.1 °C can be selected factory reset with Up/Down

### Legend:

- 3-L = 3-wire-connection
- AL = alarm (or Relay-function)
- [Cod] = Code (PIN)
- dAL = delay until alarm
- doF = delay until switching back
- di F = measuring of difference in temperature
- E = exit (leave loop)
- Err/SE = association which relay reports / Sensor Exit
- H = hysteresis
- on/off = 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)
- 10 = Pt 1000
- 83 84 = KTY-sensor 83, 84
- PTC = Thermistor
- nc = not connected
- S<sub>i</sub> = 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

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## 10. 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... Pr 4) can be selected (see pre-settings) and temperature display can be changed 1 °C <--> 0.1 °C <--> °F.

Ex works Pr 1 and 0.1 °C 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"; "" °F"; "888". Release button "SET": Code = off, PIN = 504.

- **Displayed Temperature is different from Sensor-Temperature**

1. Unit °C / °F correct? When switching on power supply °C / °F 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 Er 2“**

Er 1 Short-circuit in sensor or line

Er 2 Break of sensor or line

Er 3 and Er 4 are internal errors. Switch off and on the device and if necessary reset to one of the programs Pr1 ... 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 "t5t".

At Pre-Settings Pr 2 and Pr 3 for relay K1 don = 168 hours for testing an fan once a week.

Remedy: 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.

## 11. Technical Data

<u>Rated supply voltage <math>U_s</math>:</u>	AC/DC 24 – 240 V
Tolerance	DC 20, 4 - 297 V      AC 20 - 264 V 50/60 Hz
Power consumption	< 3 W                      < 7 VA
<u>Relay output:</u>	3 x co (change-over)
Switching voltage	max. AC 415 V
Switching current	max. 5 A
Switching power	max. 1250 VA (resistive load) max. 120 W at DC 24 V
UL electrical ratings:	250 V ac, 5 A, resistive
E214025	240 V ac, 1/2 hp 120 V ac, 1/4 hp B 300 – pilot duty, UL 508
Rated operational current $I_e$ :	
AC15	$I_e = 3 \text{ A}$ $U_e = 250 \text{ V}$
DC13	$I_e = 2 \text{ A}$ $U_e = 24 \text{ V}$ $I_e = 0,2 \text{ A}$ $U_e = 125 \text{ V}$ $I_e = 0,1 \text{ A}$ $U_e = 250 \text{ V}$
Recommended fuse for contacts	T 3,15 A (gL)
Expected contact life mechanical	$3 \times 10^7$ operations
Expected contact life electrical	$1 \times 10^5$ operations with AC 250 V / 6 A
<u>Test conditions</u>	EN 61010-1
Rated impulse voltage	4000 V
Overtoltage category	III
Contamination level	2
Rated insulation voltage $U_i$	300 V
On-time	100 %
<u>EMC-tests</u>	EN 61326-1
emitted interference	EN 61000-6-3
Burst	EN 61000-4-4 +/-4 kV Pulse 5/50 ns, f = 5 kHz, t = 15 ms, T = 300 ms
SURGE	IEC 61000-4-5 +/-4 kV Impulse 1,2/50 $\mu\text{s}$ (8/20 $\mu\text{s}$ )
discharge of static electricity	IEC 61000-4-2 +/-4 kV contact, +/- 8kV air
<u>Environmental conditions</u>	
Ambient temperature range	-20 °C ... +65 °C
Storage temperature range	-20 °C ... +70 °C
Altitude	Up to 2000 m
Climatic conditions	5 – 85 % rel. humidity, no condensation
External wiring temperature range	-5 °C ... +70 °C
Vibration resistance EN 60068-2-6	2...25 Hz $\pm 1,6 \text{ mm}$ 25 ... 150 Hz 5 g

Sensor connection :

Pt 100, Pt 1000 acc. to EN 60751

Sensor	Range °C		Short-circuit Ohm	Break Ohm	Resistance of sensor + line Ohm
	min	max	<	>	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<sub>M</sub>

&lt;2,5 s (depending on number and type of connected sensors)

Housing:

Mounting height

type V 4

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<sup>2</sup>

Stranded wire with insulated ferrules

each 1 x 1,0 mm<sup>2</sup>

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

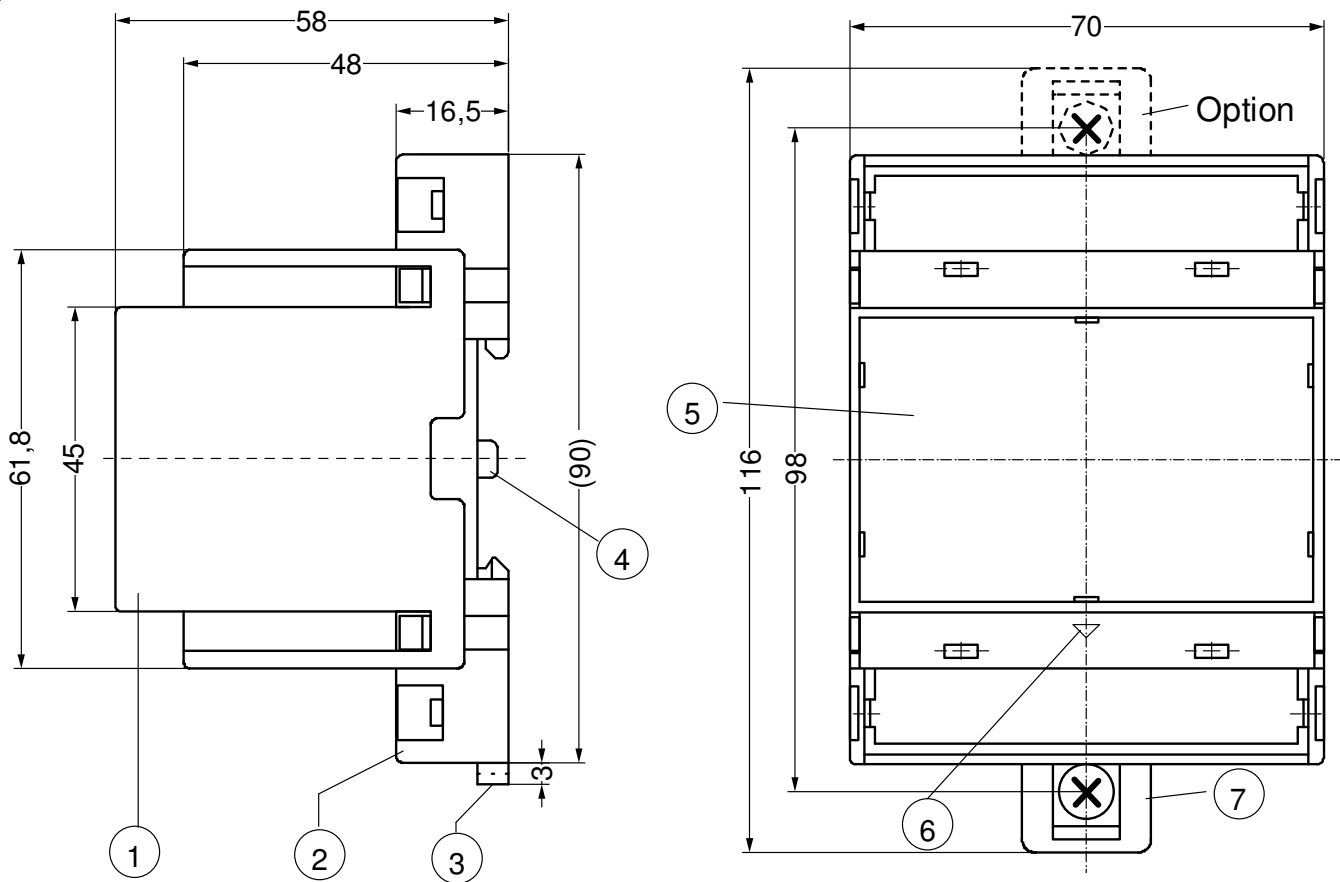
Weight

app. 200g

**Subject to technical modifications**

## 12. Design V4

dimensions in mm



- 1 Oberteil / cover
- 2 Unterteil / base
- 3 Riegel / bar for snap mounting
- 4 Plomben Lasche / latch for sealing
- 5 Frontplatteneinsatz / front panel
- 6 Kennzeichen für unten / position downward
- 7 Riegel bei Wandbefestigung mit Schrauben. Riegelbohrung  $\varnothing$  4,2 mm / for fixing to wall with screws,  $\varnothing$  4.2 mm.

You'll find this and other user manuals also in English written in the internet under [www.ziehl.com](http://www.ziehl.com)