![LUMEL logo — EVERYTHING COUNTS]

TEMPERATURE CONTROLLER
MOUNTED ON A 35 MM RAIL
RE60

USER'S MANUAL

$C \epsilon$

Contents

1. APPLICATION

The REC-ZK60 controller controls the temperature in objects through turning on and off the electrical controlling device according to the defined setting by the controller. It cooperates directly with RTD and TC.
It is destined for the temperature control in telecommunication cabinets in food and drying industries and everywhere, where there is the necessity to stabilize the temperature changes.
The controller has one output destined for the control and two alarm outputs.

2. CONTROLLER SET
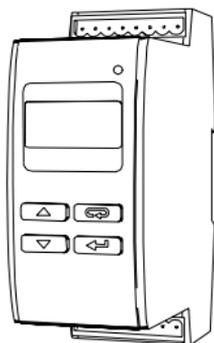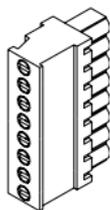
Controller - 1 pc   Plug - 2 pcs   User's manual - 1 pc
Warranty card - 1 pc

When unpacking the controller, please check whether the type and version code on the data plate correspond to the order.

3. PREPARING THE CONTROLLER FOR OPERATION

When unpacking the controller, please check whether the type and version code on the data plate correspond to the order.

3.1. Security

The REC-ZK60 controller fulfils requirements concerning the security of electrical measuring automation instruments acc. to EN 61010-1 standard requirements concerning the resistance against electromagnetic noise acc. to EN 61000-6-2 standard and emission of electromagnetic noise occurring in the industrial environment acc. to EN 61000-6-4 standard.

BASIC REQUIREMENTS, SAFETY INFORMATION

Symbols located in this service manual mean:

WARNING!
Warning of potential, hazardous situations.
Especially important. One must acquaint with this before connecting the instrument.
The non-observance of notices marked by these symbols can occasion severe injuries of the

personnel

and the damage of the instrument !

CAUTION!
Designates a general useful note. If you observe it, handling of the controller is made easier.
One must take note of this, when the instrument is working inconsistently to the expectations.
Possible consequences if disregarded !

In the security scope the REC-ZK60 controller meets the requirements of the EN 61010 -1 standard.
Remarks concerning the operator safety:
1. General
- The instrument is destined to be mounted on a 35 mm rail

- Non-authorized removal of the required housing, inappropriate use, incorrect installation or operation create the risk of injury to personnel or damage to equipment. For more detailed information, please study the present user's manual.
- All operations concerning transport, installation, and commissioning as well as maintenance must be carried out by qualified, skilled personnel and national regulations for the prevention of accidents must be observed.
- According to this basic safety information, qualified,skilled personnel are personswho are familiar with the installation, assembly, commissioning, and operation of the product and who have qualifications necessary for their occupation.

2. Transport, storage
Please observe the notes on transport, storage and appropriate handling.
Observe the climatic conditions given in technical data.

3. Installation
- The controller must be installed according to the regulation and instructions given in this user's manual
- Ensure proper handling and avoid mechanical stress.
- Do not bend any components and do not change any insulation distances.
- Do not touch any electronic components and contacts.
- Instruments may content electrostatically sensitive components, which can easily be damaged by inappropriate handling.

Do not damage or destroy any electrical components since this might endanger your heath!
4. Electrical connection
- Before switching the instrument on, one must check the correctness of connection to the network.
- In case of the protection terminal connection with a separate lead one must remember to connect it before the connection of the instrument to the mains.
- When working on live instruments, the applicable national regulations for the prevention of accidents must be observed.

- The electrical installation must be carried out according to the appropriate regulations (cable cross-sections, fuses, PE connection). Additional information can be obtained from the user's manual.
- The documentation contains information about installation in compliance with EMC (shielding, grounding, filters and cables). These notes must be observed for all CE-marked products.
- The manufacturer of the measuring system or installed devices is responsible for the compliance with the required limit values demanded by the EMC legislation.

5. Operation
- Measuring systems including REC-ZK60 controllers must be equipped with protection devices according to the corresponding standard and regulations for prevention of accidents.
- After the instrument has been disconnected from the supply voltage, live components and power connections must not be touched immediately because capacitors can be charged.
- The housing must be closed during operation.

6. Maintenance and servicing
- Please observe the manufacturer's documentation and read all product-specific safety and application notes in this user's manual.
- Before taking the meter housing out, one must turn the supply off.
- The removal of the instrument housing during the warranty contract period may cause its cancellation.

When unpacking the controller, please check whether the type and version code on the data plate correspond to the order.

3.2. Controller installation ⚠️?

Fix the controller on the 35 mm rail acc. to EN 60715.

The controller housing is made of a self-extinguishing plastics.

Dimensions of the controller and the fixing way is presented on the fig.1

Fig.1. Dimensions and fixing way of the controller

Fig.2. View of controller connection strips

When unpacking the controller, please check whether the type and version code on the data plate correspond to the order.
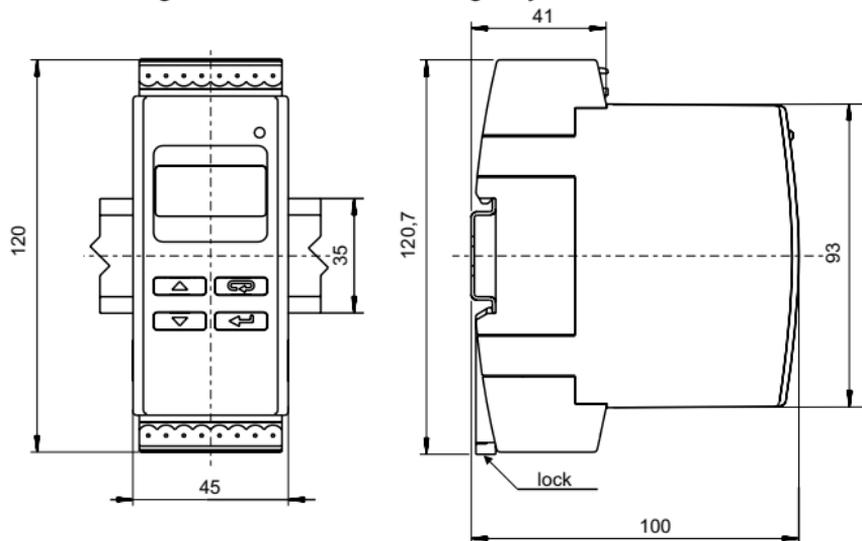
3.3. Electrical connections

Carry out electrical connections to the terminal strips and next insert strips into controller sockets.
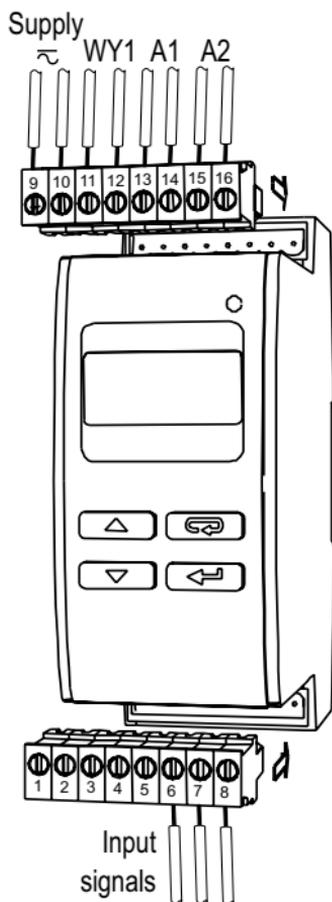
Fig.3. Connection of input signals

in a two-wire system Pt100 resistance thermometer	in a three-wire system Thermocouple	thermometer
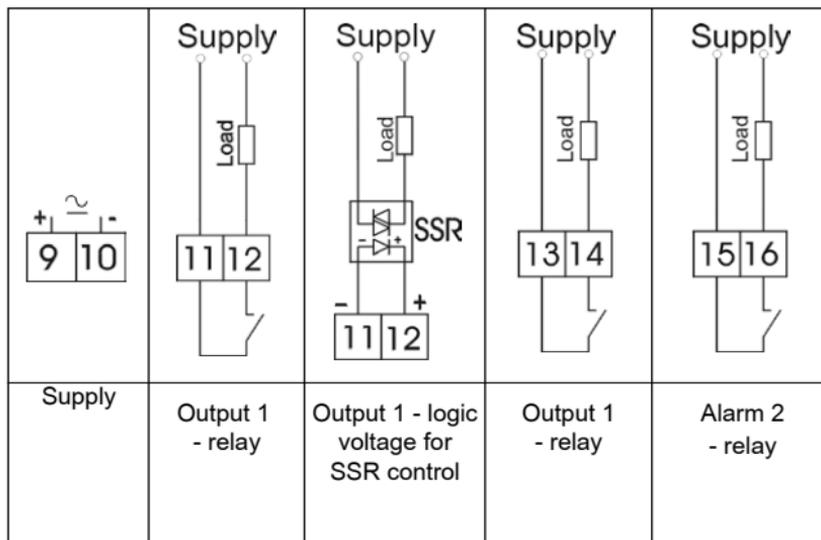
Fig.4. Connection of the supply and load circuit

When connecting the supply, one must remember that in the building installation a circuit-breaker should exist. This element should be placed near the device, be easy accessible for the operator and marked as the instrument disconnecting the device.

3.4. Installation recommendations ⚠

In order to obtain a full fastness against electromagnetic noise in an environment with unknown noise level, it is recommended to observe following principles:

- do not supply the controller from the network, in the proximity of devices generating high pulse noise and do not apply common earthing circuits,
- apply network filters,
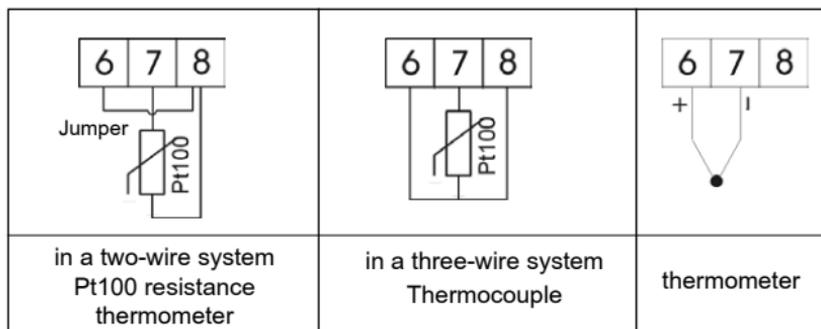- apply metallic shields in the shape of tubes or braids to conduct supplying wires,
- wires leading measuring signals should be twisted in pairs, and for resistance sensors in 3-wire connection, twisted of wires of the same length , cross-section and resistance, and led in a shield as above,
- all shields should be one-side earthed or connected to the protective wire, the nearest possible to the controller,
- apply the general principle, that wires leading different signals should be led at the maximal distance between them (no less than 30 cm), and the crossing of these group of wires made at right angle (90º).

4. STARTING TO WORK

After connecting the supply, what is signalled by the green diode, the controller displays the type and program version.

```
RE60
ver1.00
```
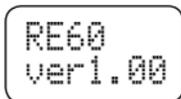
After ca three seconds, the controller transits to the control acc. to set parameters. The controller displays the measured value, the set point and annunciators of connected outputs.

The on-off control algorythm with hysteresis 2°C is set by the manufacturer.

A character message informing about abnormalities can be shown on the display (tab. 2).
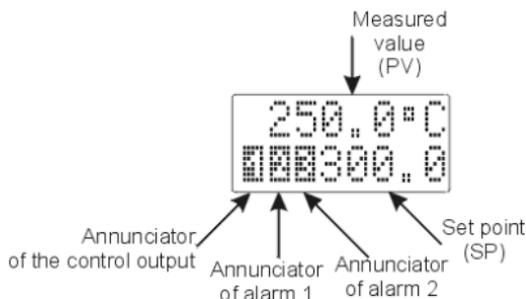
Change of the set point

The entry into the set point change mode follows after pressing the ▼ or ▲ push-button. The way to change the set point is shown on the fig. 5. If the set point is not accepted within 30 seconds from the last pressure of the ▼ or ▲ push-button, the controller transits automatically into the normal working mode without the introduction of a new set point.

Fig.5. Change of set point

Beginning of changes

Acceptation of changes

Cancellation of changes

Increase the value

Decrease the value
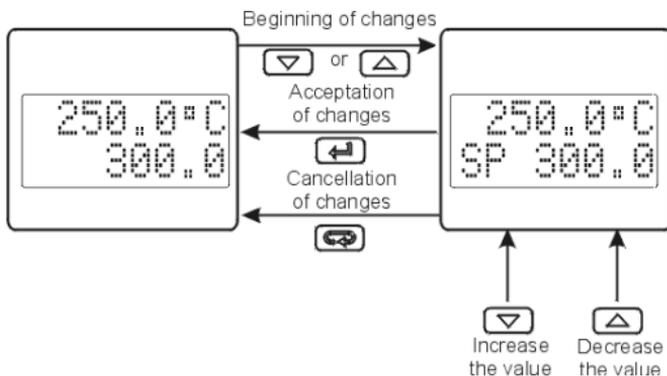
5. PROGRAMMING OF CONTROLLER PARAMETERS

5.1. Diagram of the controller menu

The controller service is presented on the fig.6. after pressing and holding the ⏎ push-button during at least 2 seconds, the programming of parameters is possible. The transition between parameters is carried out by means of ▼ and ▲ push-buttons. Some parameters can be invisible - it depends on the choice of the control algorythm or the alarm configuration. The table 1 includes the description of parameters. The return to the normal working mode follows after pressing the ⮂ push-button or automatically after 30 seconds from the last push-button pressure.

Monitoring of the control signal

Normal working mode

Set point change mode

Start of changes
▽ or △

Acceptance of changes
⏎

Cancellation of changes
⟳

Held up
⟳

Decrease of value ▽   Increase of value △

Active access code

T

N

EnterSec

0

Correct code?

T

N

ReadOnly
EnterSec

3sec

Next parameter △
Previous parameter ▽

Parameter change mode

1-DP
DecPoint

SP Low
SP High
CtrlAlg
Pb
Ti
Td
To
Hyst
Out1
Out1Fail
Al1-Type
Al1-SP
Al1-Dev
Al1-Hyst
Al1-Fail
Al2-Type
Al2-SP
Al2-Dev
Al2-Hyst
Al2-Fail
PV Shift
Unit
Security

Start of changes
⏎

Acceptance of changes
⏎

Cancellation of changes
⟳

1-DP
DecPoint

Decrease of value or previous evaluated parameter ▽   Increase of value or next evaluated parameter △

Fig.6. Diagram of controller servicing menu

5.2. List of parameters

The list of parameters in the menu is presented in the table 1.

List of configuration parameters   Table 1

Parameter symbol	Parameter description	Factory setting	Range of parameter changes
DecPoint	Position of decimal point	1-DP	0-DP: without decimal point 1-DP: 1 decimal point
SPLow	Lower limitation SP	Min. measuring range	Measuring range
SPHigh	Upper limitation SP	Max. measuring range	Measuring range
CtrlAlg	Control algorythm	ON-OFF	ON-OFF: ON-OFF control algorythm P: control algorythm P PD: control algorytm PD PID: control algorythm PID
Pb	Proportional band[1]	30.0	0.1...999.9 °C
Ti	Integration time-constant[2]	300	1...9999 s
Td	Differentiation time-constant [3]	60.0	0.1...999.9 s

Parameter symbol	Parameter description	Factory setting	Range of parameter changes
To	Pulse repetition period [1]	20.0	0.5...99.9 s
Hyst	Hysteresis[4]	2.0	0.2...99.9 °C
Out1	Configuration of the control output	INV	DIR: direct control (cooling) INV: inverse control (heating)
Out1Fail	Signal control of output1 when sensor is damaged	0.0	0.0...100.0%
AL1-Type	Alarm 1 typ	NONE	NONE: lack ABS-HI: absolute upper ABS-LO: absolute lower DEV-HI: relative upper DEV-LO: relative lower
AL1-SP	Set point of alarm 1	0.0	Measuring range
AL1-Dev	Deviation from set point for alarm 1	0.0	-199.9...199.9 °C
AL1-Hyst	Hysteresis for alarm 1	2.0	0.2...99.9 °C
AL1-Fail	Alarm output state when the sensor is damaged	OFF	OFF: output turned off ON: output turned on

Parameter symbol	Parameter description	Factory setting	Range of parameter changes
AL2-Type	Alarm 2 type	NONE	NONE: lack ABS-HI: absolute upper ABS-LO: absolute lower DEV-HI: relative upper DEV-LO: relative lower
AL2-SP	Set point of alarm 2	0.0	Measuring range
AL2-Dev	Deviation from set point for alarm 2	0.0	-199.9...199.9°C
AL2-Hyst	Hysteresis for alarm 2	2.0	0.2...99.9 °C
AL2-Fail	Alarm output state when the sensor is damaged	OFF	OFF: output turned off ON: output turned on
PVShift	Shift of the measured value	0.0	-99.9...99.9°C
Unit	Unit	oC	NONE: without unit oC: degree centigrade
Security	Security code	0	0...9999

[1] Parameter visible only for P, PD, PID. algorythms.

[2] Parameter visible only for PID algorythm.

[3] Parameter visible only for PD, PID algorythms.

[4] Parameter visible only for ON-OFF algorythm .

6. CONTROL

6.1. On-Off control

When a high precision of the temperature control is not required, especially for objects with a high time-constant and a small delay, one can apply the on-off control with hysteresis. Advantages of this control way are the simplicity and reliability, however its defect is the oscillation formation, even at small hysteresis values.
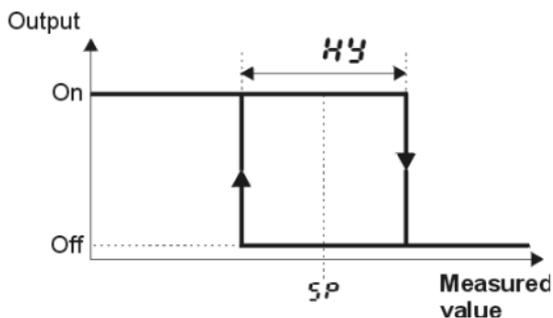
Fig. 7. Output operation way of heating type
for the on-off control

6.2. PID control

When we want to obtain a better accuracy of the temperature control, one must apply the PID algorythm. The controller tuning to the object consists on setting the value of the proportional element, integrating and differentiating elements, and the output pulse repetition period. The impulse period is the time which goes by between successive switchings of the output during the proportional control. The impulse period duration must be chosen depending on the dynamic object properties and suitably to the output device. For fast processes it is recommended to use SSR relays. The relay output is used to steer contactors in slow-changing processes - recommended impulse period higher than 20 sec.

6.2.1. Selection of PID settings by the object identification method

One must read out the object delay time To and the maximal temperature accretion speed from the dependence:
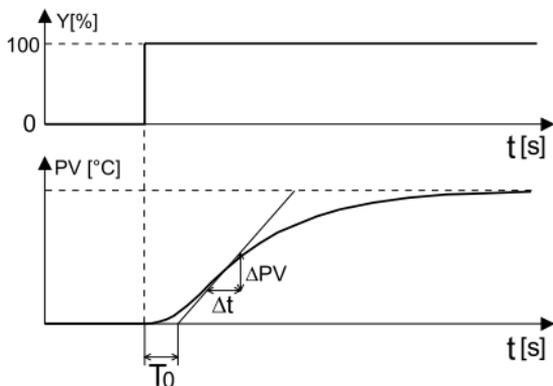
$$V_{max} = \frac{\Delta PV_{max}}{\Delta t}$$

Calculate the PID settings acc. to the given equations:

Pb=1.1 $V_{max} \cdot T_0$ - proportional band
t_i=2.4 $\cdot T_0$ - integration time-constant
t_d=0.4 $\cdot T_0$ - differentiation time-constant

6.2.2. Selection of PID settings by the object identification method

Set the on-off control with the minimal hysteresis. Set the set point on the normal work level (or on a lower level if overshoots could be cause damages) and on normal load conditions.
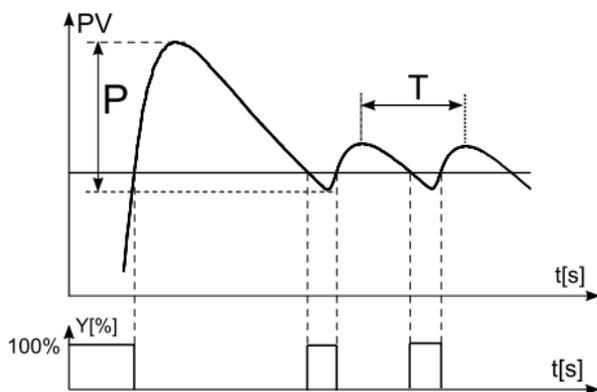
Fig.8. Selection of settings by the object identification method

Calculate controller settings acc. to the given equations:
Pb = P
ti = T
td = 0.25 * T

6.2.3. Correction of PID settings

The best is to choose parameters changing the value into a twice higher or twice lower.
During the change, one must refer to following principles:

a) Slow jump response:
   - decrease the proportional band,
   - decrease the integration and the differentiation time.
b) Overshoots:
   - increase the proportional band,
   - increase the differentiation time.
c) Oscillations:
   - increase the proportional band,
   - increase the integration time,
   - decrease the differentiation time.
d) Instability:
   - increase the integration time.

7. ALARMS

There are two alarm outputs in the controller. The signalling of any alarm is carried out through the lighting of the red LED diode. Moreover, there is information on the LCD display which alarm is active.

Fig.9. Kinds of alarms

Absolute upper (ABS-HI)	Absolute lower (ABS-LO)	Relative upper (DEV-HI)
Relative upper (DEV-HI)	Relative lower (DEV-LO)	Relative lower (DEV-LO)
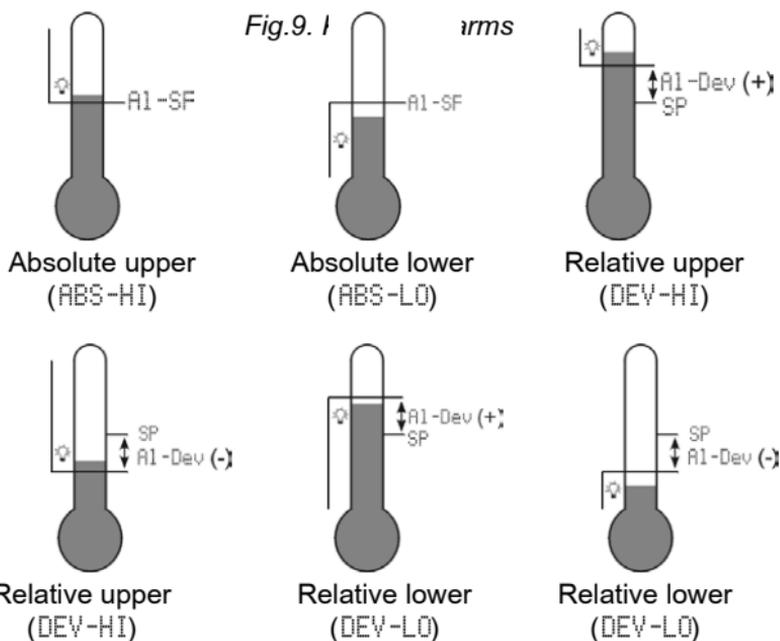
The alarm configuration requires the selection of the alarm kind through the AL1-Type and AL2-Type. Accessible types of alarms are given on the fig.9.

The set point for absolute alarms is the value defined by the AL1-SP, and AL2-SP parameter and for relative alarms it is the deviation from the set point in main circuit - AL1-Dev and AL2-Dev parameter. The alarm hysteresis, i.e. the zone around the set point, in which the output state is not changed, is defined by the AL1-Hyst and AL2-Hyst parameter

8. AUXILIARY FUNCTIONS

8.1. Displaying the control signal

After pressing and holding the ⏎ push-button, the value of the control signal (0.0...100%) is displayed on the lower display.

8.2. Controller behaviour after sensor damage

It is possible to configure the output state after a sensor damage in the controller.
The state for the output control is as follows:
- at the output configuration to the proportional control (CtrlAlg≠ON-OFF)   the value of the control signal is defined by the Out1Fail parameter
- at the configuration to the on-off control (CtrlAlg=ON-OFF), the output will be turned off - at the output operation as heating, or turned on - at the output operation as cooling.
The state of alarm output is set by AL1-Fail. and AL2-Fail. parameters

8.3. Factory settings

One can restore factory setting during the supply turn on, holding ▼ and ▲ push-buttons till the moment when the message below appears on the upper display.
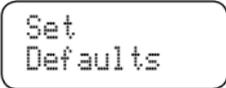
```
Set
Defaults
```

9. SIGNALLING OF ERRORS

Character messages signalling the incorrect controller operation.

Table 2

Error code (upper displ.)	Reason	Procedure
	Overflow of the measuring range downwards or lack of RTD	Check, if the type of selected sensor is compatible witrh the connected one. Check if input signal values is contained in the suitable range - If yes, check if the RTD is not shorted or the thermocouple is not inversely connected.
	Overflow of the measuring range or break in the sensor circuit	Check, if the type of selected sensor is compatible witrh the connected one. Check if input signal values is contained in the suitable range - If yes, check if there is no break in the sensor circuit.
	Input discalibrated	Connect the controller supply again. When this does not help, contact the nearest authorized workshop service.

10. TECHNICAL DATA

Input signals acc. table 3

Input signals and measuring ranges for inputs   Table 3

Sensor type/inputs	Marking	Range [°C]	Basic error [°C]
Pt100 acc.to EN 60751+A2	Pt100	-50...100	0.8
Pt100	Pt100	0...250	1.3
Pt100	Pt100	0...600	3.0
Fe-CuNi acc.to EN 60584-1	J	0...250	3.0
Fe-CuNi	J	0...600	4.0
Fe-CuNi	J	0...900	5.0
NiCr-NiAl acc.to EN 60584-1	K	0...600	4.0
NiCr-NiAl	K	0...900	5.0
NiCr-NiAl	K	0...1300	6.0
PtRh10-Pt acc.to EN 60584-1	S	0...1600	7.0

Current flowing through Pt100   220 µA

Measurement time   0,5 s

Detection of error in the measuring circuit:
- thermocouple, Pt100   overflow of the measuring range

Kinds of outputs:
- relay   voltageless make contacts
maximal load:
voltage: 250 V a.c., 150 V d.c.
current: 5 A 250 V a.c., 5 A 30 V d.c.
resistance load: 1250 VA, 150 W
- logic voltage   5 V
  (without isolation from the sensor side)   resistance limiting the current: 66 Ω

Way of output operation:
- reverse   for heating
- direct   for cooling

Signalling:
- active output   symbol on the LCD display
- active alarm   symbol on the LCD display
                                       and LED diode

Rated operating conditions:
- supply voltage   230 V a.c. ±10%
                                       110 V a.c. ±10%
                                       24 V a.c. ±10%
                                       18...72 V d.c.
- frequency of supply voltage   50/60 Hz
- ambient temperature   0...<u>23</u>...50 °C
- storage temperature   -20...+70 °C
- related air humidity   < 85 % (without condensation)
- external magnetic field   < 400 A/m
- preheating time   30 min
- work position   any

Power consumption   < 3 VA

Dimensions   45 x 100 x 120 mm

Weight   < 0,3 kg

Fixing   on a 35mm rail

**Protection degree ensuring
by the house**   IP40 acc. to EN 60529

Additional errors in rated operating conditions:
- changes of the ambient temperature   ≤100% of the basic
                                                  error /10 K.

Security requirements acc. to EN 61010-1

- installation category   III
- pollution level   2
- maximal phase-to-earth working voltage:
  - for the supplying circuit, outputs   300 V
  - for input circuits   50 V

Electromagnetic compatibility:

- immunity   acc. to EN 61000-6-2

- emissions   acc. to EN 61000-6-4

ORDERING EXAMPLE

The **REC-ZK60-05-1-2-3-0** code means:

REC-ZK60 - Temperature controller of REC-ZK60 type
          to be mounted on a 35 mm rail

05   - input: thermocouple J
1   - main input: relay
2   - alarm outputs: 2 relays
3   - supply: 24 V a.c. 50/60 Hz
8   - without additional quality inspection requirements

11. ORDERING CODES

The coding way is given in the table 4

Kinds of versions and ordering codes   Table 4

Temperature controller REC-ZK60 -	XX	X	X	X	X
Input:					
resist. thermometer Pt100 (-50...100°C) 01					
resist. thermometer Pt100 (0...250°C) 02					
resist. thermometer Pt100 (0...600°C) 03					
thermocouple J (0...250°C) 04					
thermocouple J (0...600°C) 05					
thermocouple J (0...900°C) 06					
thermocouple K (0...600°C) 07					
thermocouple K (0...900°C) 08					
thermocouple K (0...1300°C) 09					
thermocouple S (0...1600°C) 10					
as per order XX					
Main output:					
relay 1					
logic 0/5V for SSR control 2					
as per order...X					
Alarm outputs:					
without output...0					
1 relay output 1					
2 relays outputs..2					
as per order...X					
Supply					
230 V a.c. 50/60 Hz 1					
110 V a.c. 50/60 Hz.. 2					
24 V a.c. 50/60 Hz 3					
18...72 V d.c.. 4					
as per order...X					
Additional requirements:					
without additional requirements 8					
with an extra quality inspection certificate..................................... 7					
acc. to agreement with the user* X					

* The code number is established by the manufacturer.

12. MAINTENANCE AND WARRANTY

The REC-ZK60 controller does not require any periodical maintenance.
In case of some incorrect operations:

After the dispatch date and within the period stated in the warranty card:
One should return the instrument to the Manufacturer's Quality Inspection Dept.
If the instrument has been used in compliance with the user's manual, the Manufacturer warrants to repair it free of charge.
The disassembling of the housing causes the cancellation of the granted warranty.

After the warranty period:
One should send the instrument to repair it in a authorized service workshop.
Spare parts are available for the period of five years from the date of purchase.

> Our policy is one of continuous improvement and we reserve the right to make changes in design and specifications of any products as engineering advances or necessity requires and revise the