LUMEL

MICROPROCESSOR PROGRAMMER-CONTROLLER RE20

USER'S MANUAL

CE

CONTENTS

1. CONTROLLER DESCRIPTION

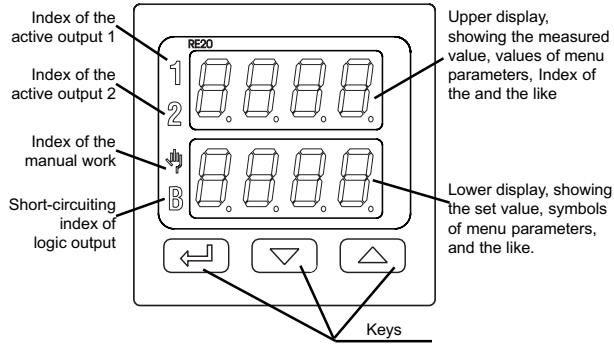
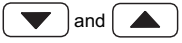
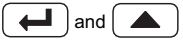


Fig.1 View of the controller frontal plate.

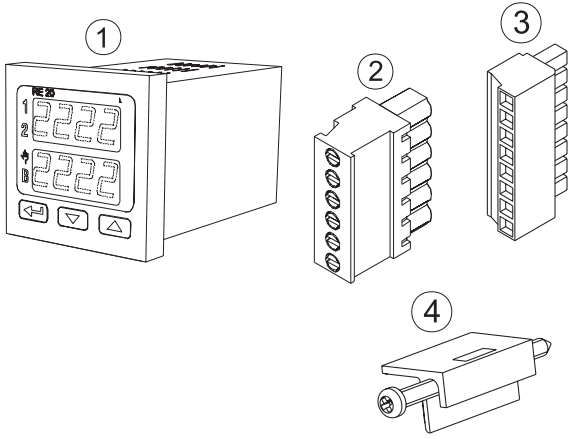
The RE20 controller is destined to control temperature, pressure, humidity, flow level, and others, in a wide range of applications in industries such as food, glass, plastics, ceramics, etc.
Main functional features:

- dual 4-digit LED displays (upper - red, lower - green),
- three keys with functions described in table 1,
- measuring input for resistance thermometers, thermocouples and linear standard signals,
- output 1 - relay, logic and continuous,
- output 2 - relay, logic and continuous,
- automatic/manual control,
- selection of control parameters in self-adaptation mode,
- soft start,
- programmable digital filter,
- different kinds of alarms , selected from the menu,
- protection when opening the measuring circuit,
- two settings of SP/PID parameters switched by the logic input,
- retransmission signal,
- RS-485 serial interface (MODBUS ASCII or RTU),
- interlocking of parameter changes by means of a password.

Function of keys Table 1

Key	Function
	- increase of the SP1 set value - transition to the next parameter from the list - increase of the parameter value or change of the textual parameter
	- decrease of the SP1 set value - transition to the previous parameter from the list - decrease of the parameter value or change of the textual parameter
	- start of the parameter setting - acceptation of the new setting - entry to the menu of user's parameters
 Pressed during 3 s	- entry to the control menu
	- cancellation of the setting change - transition to the display of the measured value from the menu - erasing of the alarm memory
	- call of controller special functions and entry to the configuration menu

2. CONTROLLER SET



The controller set is composed of:

1. controller ..... 1 pc
2. plug with 6 screw terminals ..... 1 pc
3. plug with 8 screw terminals ..... 1 pc
4. holder to fix in the panel ..... 2 pcs
5. user's manual ..... 1 pc
6. guarantee card ..... 1 pc

3. PREPARATION OF THE CONTROLLER TO WORK

3.1. SAFETY

The RE20 controller fulfils requirements concerning the electrical safety of measuring instruments in automation acc. to EN 61010-1, and requirements concerning immunity against electromagnetic interference acc. to EN 61000-6-2 and emission of electromagnetic interference occurring in industrial environment acc. EN 61000-6-4

3.2. CONTROLLER INSTALLATION INTO A PANEL

Basic assembling dimensions are presented on the fig 2.

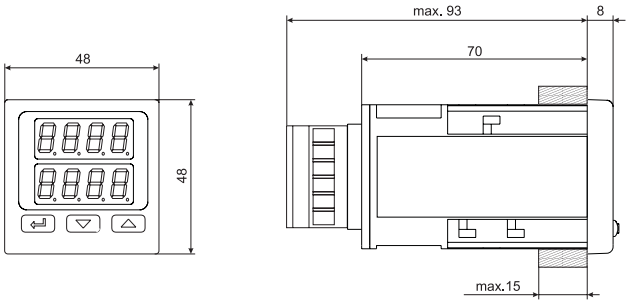


Fig.2. Overall dimensions of the controller.

The controller is fixed to the panel by two screw holders including in the standard accessory set, acc. to the fig. 3. The panel hole should be $45^{+0.6}$ x $45^{+0.6}$ mm.
The material tickness which the panel is made of cannot exceed 15 mm.

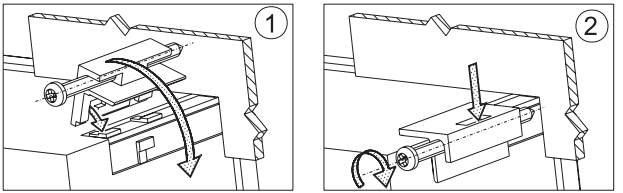


Fig.3. Way of controller fixing.

3.3. CONNECTION OF SIGNALS

In the rear part of the controller there are two sockets of the terminal strip with plugs to which supply and external circuits are connected. Electrical connections should be executed in compliance with following designs.

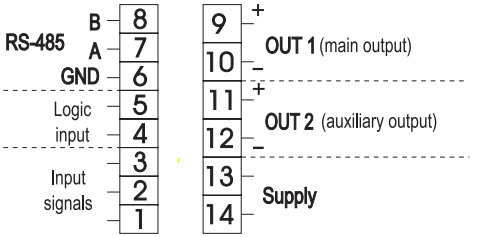
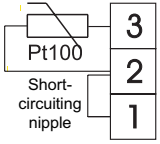
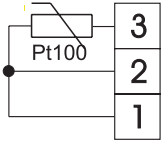


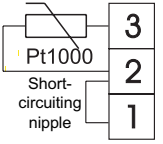
Fig. 4. Description of the controller terminal strip.



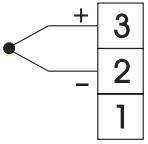
Pt100 resistance termometer in 2-wire system



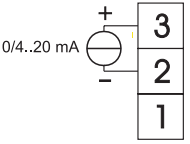
Pt1000 resistance termometer in 3-wire system



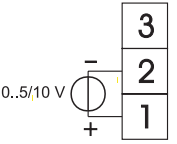
Pt1000 resistance termometer



Thermocouple



Current input 0/4..20 mA



Voltage input 0..5/10 V

Fig.5. Connection of input signals.

3.4. INSTALLATION RECOMMENDATIONS

In order to obtain a full immunity of the controller against electromagnetic interference in an unknown environment interference level it is recommended to observe following principles:

- do not supply the controller from the network near devices generating high impulse interference and do not use common earthing circuits with them.
- apply network filters,
- apply metallic screens in the shape of tubes or braided screens to conduct supplying wires,
- wires supplying the measuring signal should be twisted in pairs, and for resistance thermometers in a 3-wire connection, twisted from wires with the same length, cross-section and resistance, and led in a screen as above,
- wires of the logic input should be twisted in pairs and led in a screen as above,
- wires of the continuous output should be twisted in pairs and led in a screen as above,
- all screens should be one side earthed, and led the nearest possible to the controller,
- apply the general principle that wires leading different signals should be led the farthest possible between them (not less than 30 cm), and their crossing executed at a right angle,
- when connecting the supply, one must remember that a circuit-breaker should be installed in the building. This switch should be situated near the device, easily accessible for the operator and marked as a device diconnecting the controller.

4. STARTING TO WORK

4.1. CONTROLLER CONNECTION TO THE NETWORK

After the correct installation and supply connection, the controller carries out the display test and displays the type of controller on the upper display and the program version on the lower display. Next, the measured value is shown on the upper display and the set value of the controlled quantity on the lower display.
The character message can appear on the upper display. Notations are given in the table 11.

4.2. FAST STARTING OF THE CONTROLLER

After connecting the supply one should set the input type to enable the correct display of the measured value by the controller.

Setting of the input type
One must press simultaneously [↵] and [▲] keys, the inscription HAnd appears on the upper display. After pressing the [▲] key, the inscription Conf appears on the upper display. The pressure of the [↵] causes the entry into the configuration mode, where the first parameter is the input type. The symbol of the -inPt, parameter appears on the lower display and the selected kind of input on the upper display (kinds of inputs are given in the table 2). The setting change is activated by the [↵] key. After setting the appropriate input by means of [▼] and [▲] keys, the setting is accepted by the [↵] key. The transition of the measured value into the display follows after the simultaneous pressure of [▼] and [▲]. The detailed description is given in the item 6.1.

4.3. CHANGE OF THE SET VALUE DURING THE NORMAL WORK

The way to change the set value during the normal operation is shown on the fig.6. The change limitation is set by SP1L and SP1H parameters.

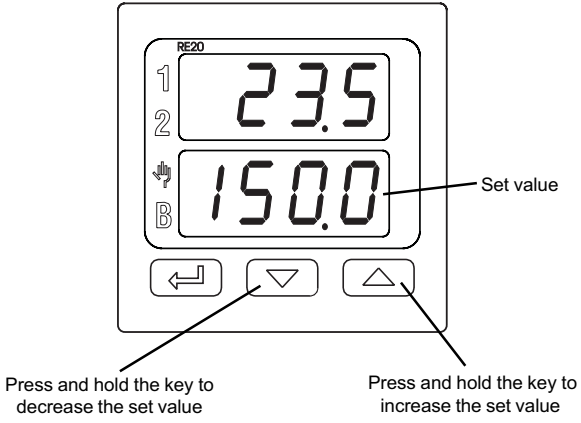


Fig. 6. Change of the set value during the normal operation.

5. PROGRAMMING OF CONTROLLER PARAMETERS

5.1. MENU SCHEME OF THE CONTROLLER SERVICING

The scheme to move along the controller menu has been presented on the fig.7. The return to the normal working mode from any menu level takes place after a simultaneous pressure of ▼ and ▲ keys or automatically after the laps of 30 seconds since the last key pressure.

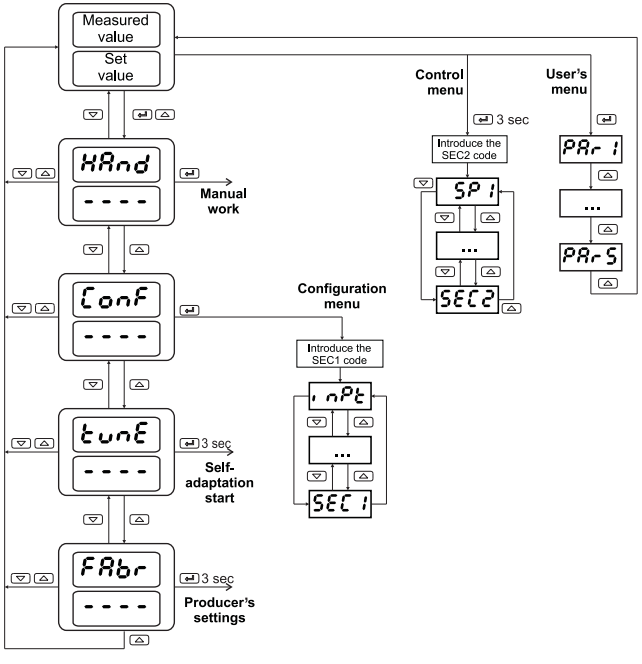


Fig. 7. Servicing menu of the controller.

Parameters of the controller have been divided into three groups. First group - configuration parameters of the controller, concerns mainly the controller equipment configuration. Second group - control parameters. Third group - set of five parameters which the user can choose optionally from the group of control parameters. In the frame of the controller configuration, one can make among others, the choice of measuring input parameters, the definition of input and output ranges, functions of individual driving outputs

and inputs, transmission parameters, and so like.
These parameters are usually set only once by the user during the control installation. The first parameter is inPt, and the last one is SEC 1.
During the control parameter programming, following parameters are set: kind of control, process and alarm settings. The first parameter is SP 1, and the last one is SEC2.
The access to the group of configuration and control parameters can be protected by a code. If the safety code is set (the SEC 1 or SEC2 parameter is higher than zero), one must give it. During its setting on the lower display, the codE inscription is displayed. If the value have not been given or is incorrect, the inscription rEAd onLY, appears on the displays and the user can only review values of parameters. The introduction of the safety code is shown on the fig.8.

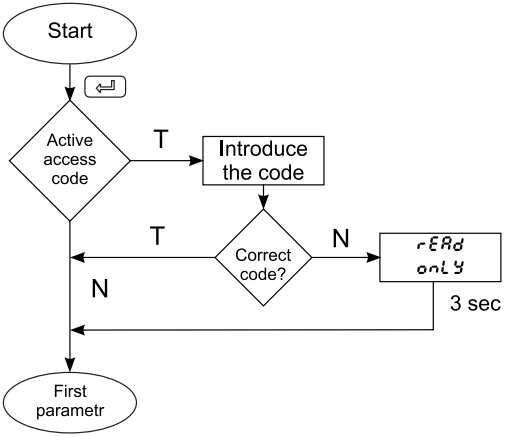


Fig.8. Introduction of the access code.

The process of parameter programming must be carried out one after the other, according to the list, because some parameters are depending on others.

5.2. CHANGE OF SETTINGS.

The setting change begins after the pressure of the ↵ key. The change is carried out by ▼ and ▲ keys. The pulsation of the setting means the possibility of its change. The new setting will be written in the non-volatile memory after accepting it by the ↵ key. The change cancellation is carried out by a simultaneous pressure of ▼ and ▲ keys or automatically after 30 sec from the last key pressure. The setting change for numerical parameters is shown on the fig. 9 and for textual parameters on the figure 10.

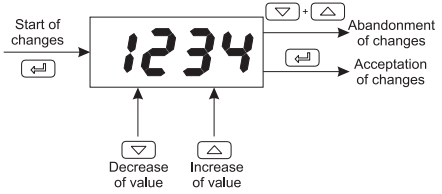


Fig. 9. Setting change for numerical parameters.

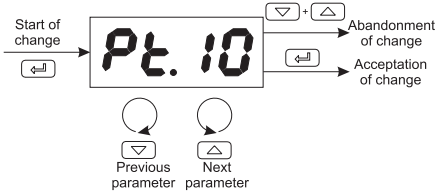


Fig.10. Setting change for textual parameters.

5.3. LIST OF PARAMETERS.

The controller parameter list is presented in the tables 2 and 3. Producer's values for textual parameters are written in bold face, and for numerical parameters they are given in curly brackets.

List of configuration parameters Table 2

Parameter symbol	Parameter description	Parameter change range		
		Resistance thermometers	Thermocouples	Linear signals
inPt	Kind of input (description in table 4)	Pt 1 Pt 10	t-J t-t t-U t-S t-r t-b t-E t-n	0-20 4-20 0-5 0-10
r-Li	Resistance of 2-wire line for Pt100 sensor [1]	0.0...20.0 Ω [0.0]	—	—
CJC	Way of cold ends compensation for thermocouples [2]	—	Auto: compensation automatic HAnd: compensation manual	—
CJC.t	Temperature of cold ends at manual compensation [°C x 10] [2]	—	0.0...50.0 °C [0.0]	—
rESo	Position of decimal point on the display	0_dP: without decimal point 1_dP: 1 decimal point 2_dP: 2 decimal points [3]		
inLo	Indication for the lower threshold of the analog input [3]	—	—	-1999...9999 [4] [0.0]
inHi	Indication for the lower threshold of the analog input [3]	—	—	-1999...9999 [4] [100.0]
SP1L	Lower limitation of the SP1 setting from keyboard	acc. to the table 4 [4] [-199.0]	acc. to the table 4 [4] [-100.0]	acc. to the table 4 [4] [0.0]
SP1H	Upper limitation of the SP1 setting from keyboard	acc. to the table 4 [4] [850.0]	acc. to the table 4 [4] [999.0]	acc. to the table 4 [4] [100.0]

Table 2

Parameter symbol	Parameter description	Parameter change range		
		Resistance thermometers	Thermocouples	Linear signals
out 1	Configuration of output 1	dir: direct control - cooling rev: inverse control - heating		
o1.ty	Kind of output 1[5]	rELy: relay output SSr: voltage logic output 0/15 V 4-20: continuous current output 4 - 20 mA 0-20: continuous current output 0 - 20 mA 0-5: continuous voltage output 0 - 5 V 0-10: continuous voltage output 0 - 10 V		
to1	Impulse period of input 1[6]	0.5...99.9 s [20.0]		
o1.FL	Driving signal of the output 1 for continuous control in the case of sensor damage	0...100.0 % [0.0]		
out2	Configuration of output 2	none: without function Cool: control - cooling ALAr: alarm[7] rEtr: retransmission[8]		
o2ty	Type of output 2[5]	none: without output rELy: relay output SSr: voltage logic output 0/15 V 4-20: continuous current output 4 - 20 mA 0-20: continuous current output 0 - 20 mA 0-5: continuous voltage output 0 - 5 V 0-10: continuous voltage output 0 - 10 V		
to2	Impulse period of output 2[6]	0.5...99.9s [20.0]		
o2FL	Driving signal of the output 2 for PID control in the case of sensor damage[9]	0...100.0 % [0.0]		
ALty	Alarm type[10]	AHi: absolute upper ALo: absolute lower dbHi: relative upper dbLo: relative lower dbin: relative internal dbou: relative external		

Table 2

Parameter symbol	Parameter description	Parameter change range		
		Resistance thermometers	Thermocouples	Linear signals
ALLt	Alarm memory[10]	oFF: switched off on: switched on		
ALFL	State of alarm output in case of sensor damage[10]	oFF: alarm output switched off on: alarm output switched on		
AoFn	Quantity retransmitted on the continuous output	Pu: measured value PV SP: set value SP1 or SP2 du: control deviation (SP - PV)		
AoLo	Lower signal limit for retransmission[11]	acc. table 4[4] [-199.0]	acc. table 4[4] [-100.0]	-1999...9999[4] [0,0]
AoHi	Upper signal limit for retransmission[11]	acc. table 4[4] [850.0]	acc. table 4[4] [999.0]	-1999...9999[4] [100.0]
binFn	Function of logic input	nonE : without function StoP : control stop rSAL : alarm erasing Locb : interlocking of parameter change SP2 : switching SP1 into SP2 P1 d2 : switching PB1, TI1, TD1, Y01 into PB2, TI2, TD2, Y02 SPP2 : switching SP1, PB1, TI1, TD1, Y01 into SP2, PB2, TI2, TD2, Y02		
inte	Transmission mode[12]	8An1 : ASCII 8n1 A7E1 : ASCII 7E1 A7o1 : ASCII 7o1 rBn2 : RTU 8n2 rBE1 : RTU 8E1 rBo1 : RTU 8o1 rBn1 : RTU 8n1		
Addr	Controller address in the network[12]	1...247 [1]		
bAud	Baud rate[12]	24: 2400 bit/s 48: 4800 bit/s 96: 9600 bit/s 192: 19200 bit/s		

Table 2

Parameter symbol	Parameter description	Parameter change range		
		Resistance thermometers	Thermocouples	Linear signals
d. SP	Displayed quantity on the lower display in the normal working mode	SP: SP1 or SP2 Y-h: control signal of output 1 Y-c: control signal of output 2		
SP.rr	Time unit for the set value rate-of-rise	mi n: minute hour: hour		
ALGt	Self-adaptation algorytm	oFF: interlocking of self-adaptation i dEn: method of object identifying OSCY: method of oscillation		
F. tt	Time constant of the filter	OFF: filter switched off 0S: time constant 0.5 s 1: time constant 1 s 2: time constant 2 s 5: time constant 5 s 10: time constant 10 s 20: time constant 20 s 50: time constant 50 s 100: time constant 100 s		
PAr. 1	First parameter of the user's menu	nonE Pb 1 t. 1 td 1 HY 1 Y0 1 AL SP AL du AL HY Hn Pb C t. C td C SP2 Pb2 t. 2 td2 Y02 rAnP Sh. F		
PAr.2	Second parameter of the user's menu	as for PAr 1		

c.d. Tablica 2

Parameter symbol	Parameter description	Parameter change range		
		Resistance thermometers	Thermocouples	Linear signals
PAr 3	Third parameter of the user's menu	as for PAr 1		
PAr 4	Fourth parameter of the user's menu	as for PAr 1		
PAr 5	Fifth parameter of the user's menu	as for PAr 1		
SEC 1	Safety code[8)]	0...9999 [0]		

List of control parameters Table 3

Parameter symbol	Parameter description	Parameter change range		
		Resistance thermometers	Thermocouples	Linear signals
SP 1	Set value for the main line	acc. table 4[4)] [0.0]	wg tablicy 4[4)] [0.0]	wg tablicy 4[4)] [0.0]
Pb 1	Proportional band for the main line	0...999.9 °C [30.0]	0...999.9 °C [30.0]	0...9999[3)] [30.0]
t, 1	Integration time-constant for the main line	0...9999 s [300]	0...9999 s [300]	0...9999 s [300]
td 1	Differentiation time-constant for the main line	0...9999 s [60]	0...9999 s [60]	0...9999 s [60]
HY 1	Hysteresis for the main line	0.2...99.9 [2.0]	0.2...99.9 [2.0]	2...999[4)] [20.0]
Y0 1	Correction of the control signal for P or PID control	0...100.0 % [0.0]	0...100.0 % [0.0]	0...100.0 % [0.0]
AL.SP	Set value for the alarm in the auxiliary line[10)]	acc. table 4[4)] [0.0]	acc. table 4[4)] [0.0]	-1999...1999[4)] [0.0]

Table 3

Parameter symbol	Parameter description	Parameter change range		
		Resistance thermometers	Thermocouples	Linear signals
AL.du	Deviation from the set value for the relative alarm in the auxiliary line[10]	-199.9...199.9°C [0.0]	-199.9...199.9°C [0.0]	-1999...1999[4] [0.0]
AL.HY	Hysteresis for the alarm in the auxiliary line[10]	0.2...99.9°C [2.0]	0.2...99.9°C [2.0]	2...999[4] [20.0]
Hn	Displacement zone for heating-cooling control[9]	0...99.9°C [1.0]	0...99.9°C [1.0]	0...999[4] [1.0]
Pbc	Proportional band for the auxiliary line[9]	0.1...999.9°C [30.0]	0.1...999.9°C [30.0]	1...9999[4] [30.0]
t.c	Integration time-constant for the auxiliary line[9]	0...9999 s [300]	0...9999 s [300]	0...9999 s [300]
tdc	Differentiation time-constant for the auxiliary line[9]	0...9999 s [60]	0...9999 s [60]	0...9999 s [60]
SP2	Second set value for the main line[13]	acc. table 4[4] [0.0]	acc. table 4[4] [0.0]	-1999...1999[4] [0.0]
Pb2	Second proportional band for the main line[13]	0.1...999,9°C [10.0]	0.1...999.9°C [10.0]	1...9999[4] [100.0]
t.2	Second integration time-constant for the main line[13]	0...9999 s [0]	0...9999 s [0]	0...9999 s [0]
td2	Second differentiation time-constant for main line[13]	0...9999 s [0]	0...9999 s [0]	0...9999 s [0]
y02	Second correction of the control signal, for P or PID control type for the main line [13]	0...100.0% [0.0]	0...100.0% [0.0]	0...100,0% [0.0]

Table 3

Parameter symbol	Parameter description	Parameter change range		
		Resistance thermometers	Thermocouples	Linear signals
rAnP	Rate-of-rise of SP1 and SP2 set value	0...999.9 /unit [0.0]	0...999.9 /unit [0.0]	0...9999[4]/unit [0.0]
Sh.F	Displacement of indicated value	-99.9...99.9°C [0.0]	-99.9...99.9°C [0.0]	-999...999[4] [0.0]
PL1	Limitation of the control signal on the output 1	0...100.0% [100.0]	0...100.0% [100.0]	0...100.0% [100.0]
PL2	Limitation of the control signal on the output 2[9]	0...100.0% [100.0]	0...100.0% [100.0]	0...100.0% [100.0]
SEC2	Safety code[14]	0...9999 [0]	0...9999 [0]	0...9999 [0]

1) The parameter is visible only for Pt100 resistance thermometer.
2) The parameter is visible only for the execution with thermocouple inputs.
3) The parameter is visible only for the execution with linear inputs.
4) The resolution of the given parameter which is shown depends on the rESo parameter - position of the decimal point.
5) The parameter value depends on the execution code, the change is possible only for the current input.
6) The parameter is visible for a discontinuous input type.
7) The ALAr parameter setting is interlocked when the output 2 is of a continuous type.
8) The rEtr parameter setting is interlocked when the output 2 is of a discontinuous type.
9) The parameter is visible after choosing the PID control of cooling type in the auxiliary line.
10) The parameter is visible after choosing the alarm in the auxiliary line.
11) The parameter is visible after choosing the retransmission in the auxiliary line.
12) The parameter is visible in the execution with the interface.
13) The parameter is visible after the appropriate configuration of the logic input.
14) The parameter is hidden in the parameter review mode only for readout. (read only).

Measuring ranges for inputs Table 4

Symbol	Input/sensor	Minimum	Maximum
Pt 1	Resistance thermometer Pt100	-199°C	850°C
Pt 10	Resistance thermometer Pt1000	-199°C	850°C
t-J	Thermocouple of J type	-100°C	1200°C
t-t	Thermocouple of T type	-100°C	400°C
t-K	Thermocouple of K type	-100°C	1372°C
t-S	Thermocouple of S type	0°C	1767°C
t-r	Thermocouple of R type	0°C	1767°C
t-b	Thermocouple of B type	300°C	1820°C
t-E	Thermocouple of E type	-100°C	1000°C
t-n	Thermocouple of N type	-100°C	1300°C
0-20	Linear current 0-20 mA	-1999	9999
4-20	Linear current 4-20 mA	-1999	9999
0-5	Linear voltage 0-5 V	-1999	9999
0-10	Linear voltage 0-10 V	-1999	9999

6. INPUTS AND OUTPUTS OF THE CONTROLLER

6.1. MEASURING INPUT

The controller has one measuring input to which on can connect different types of sensors or standard signals. The choice of the input is performed by the inPt parameter.
For different types of inputs one should give additional parameters depending on the execution code.
The compensation of the line resistance goes on automatically for Pt100 resistance thermometers in a three-wire connection. In a two-wire connection, one can give additionally the line resistance, One should give the way of temperature compensation of cold ends for thermocouples - automatic or manual, and at manual compensation - the temperature of cold ends.
For linear inputs one should give the indication for the lower and upper threshold of the analog input.
The additional parameter is the number of digits after the decimal point. For temperature sensors it defines whether the measured temperature and the set temperature is to be shown with the position after the decimal point. For linear inputs that means the reso-

lution with which the measured value and values of some parameters are shown.The correction of the measured value indication is carried out by the SHIF parameter.

6.2. LOGIC INPUT

The logic input can have several functions, depending on the inFn parameter setting.
Functions of the logic input:
- **without functions** - the logic input state does not influence the control operation,
- **control stop** - the control is interrupted and control outputs behave as after the sensor damage, the alarm or retransmission operates independently,
- **alarm erasing** - the short-circuiting of contacts causes the switch of the alarm output on and the erasing of alarm memory,
- **interlocking of parameter change** - the short-circuiting of contacts causes the interlocking of all parameter changes,
- **switching on SP2** - change of set value during control,
- **switching on PID2** - change of PID value during control,
- **switching on SP2 and PID2** - change of set value and PID during control.

6.3. OUTPUT

The control has two outputs in maximum. The setting of different functions is possible for both outputs. Additionally, for the discontinuous output types, the pulse repetition period is set.
The pulse repetition period is the time which expires between successive connections of the output during the proportional control. The length of the pulse repetition period should be chosen depending on dynamic properties of the object and appropriate to the output device.
For fast processes, it is recommended to use SSR relays.
The relay output is used to drive contactors in slow-moving processes. The use of a high pulse repetition period to steer high-speed processes. The use of a high pulse repetition period to steer high-speed processes can give undesirable effects in the form of oscillations. Theoretically, the smaller the pulse repetition

period is, the better the control is, however for relay output the pulse repetition period should be as higher as it possible in order to elongate the relay life.

Recommendations concerning the pulse repetition period Table 5

Output	Pulse repetition iperiod to	Load
Electromagnetic relay	recommended > 20 s min. 10 s	2 A/230 V a.c. or contactor
	min. 5 s	1 A/230 V a.c.
Transistor output	1...3 s	Solide state relay (SSR)

7. CONTROL

7.1. SET VALUE

The control set value is defined by the SP 1 or SP2 parameter. The switching of the set value can be made by the logic input.
One can additionally define the admissible change rate of the set value, i.e. soft start. This allows to a gentle access to the in-coming set value without over-regulation.

7.2. ON-OFF CONTROL

The ON-OFF control denotes a high reliability and simplicity to choose the setting. This control ensures also a fast removal of interference influence. However, the defect is the occurrence of oscillations even at small hysteresis values.
Object predisposed to use this control have high time-constants and no large delays.
In order to choose the ON-OFF control of heating type one should set the parameter out 1=, nu. Next set the Pb 1 parameter on 0. The HY 1 parameter serves to settle the switching hysteresis, to settle the switching hysteresis (it is only accessible when Pb 1=0). The exchange of the kind of control into cooling is possible after setting the parameter out 1=d, r.

7.3. PID CONTROL

To choose the PID control of heating type one should set the parameter out1=nu. Dependind on whether we choose the P, PI, PD or PID control, we set only the Pb1 parameter or also ti1 and td1. If the main output is discontinuous one should also set the output pulse repetition period (to1 parametr). The change of kind of control into cooling is possible after setting the parameter out1=dir.

7.4. CONTROL WITH TWO HEATING-COOLING CHANNELS

In control with two-channels of heating-cooling type one should set the reverse control (heating) on the output 1 parameter out1=nu, and on the output 2 the control of non-reverse type (cooling) - parameter out2=CooL. For the main channel one should set PID parameters: Pb1, ti1, td1, and for the auxiliary channel one should set PID parameters: PbC, tiC, tdC.Next, set the zone of the channel separation - Hn parameter(displacement from the set value). The pulse repetition period for discontinuous outputs is set independently for the main channel and the auxiliary one (to1 and to2 parameters).
If there is the necessity to use PID control in one channel and ON-OFF control in the second channel, then the output 1 should be configured on the PID control, and the output 2 as the higher relative alarm.

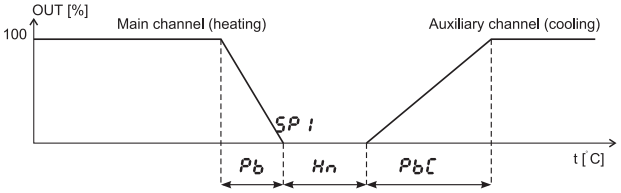
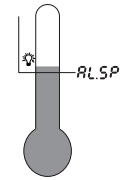


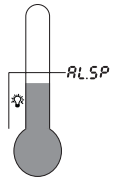
Fig.11. Control with two channels - heating-cooling type.

8. ALARM

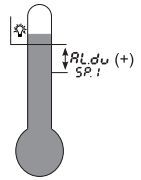
Designs below illustrate different accessible alarms.



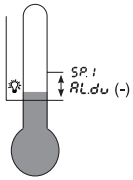
absolute upper
(AL.tY = AbS)



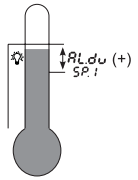
absolute lower
(AL.tY = AL.o)



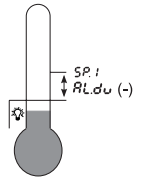
relative upper
(AL.tY = dbS)



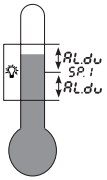
relative upper
(AL.tY = dbS)



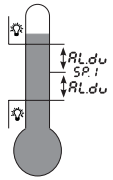
relative lover
(AL.tY = dbL.o)



relative lover
(AL.tY = dbL.o)



relative internal
(AL.tY = dbS.n)



relative external
(AL.tY = dbOU)

Fig.12. Kinds of alarms.

To configure the alarm, one should set the output 2 as alarming (parameter out2 = ALAr). Next, one should choose the kind of alarm through setting the AL.tY parameter. Accessible types of alarms are given on the fig.12.
The set value for absolute alarms is the value defined by the AL.SP parameter, and for relative alarms, the deviation from the set value in the main channel - AL.du parameter. The alarm hysteresis, i.e. the zone around the set value, in which the output state is not changed, is defined by the AL.HY parameter.
One can set the alarm snaping, i.e. the storage of the alarm state after the withdrawal of alarm conditions (parameter AL.Lt = on). The erasing of alarm storage can be made by the simultaneous pressure of ▼ and ▲ keys in the normal working mode, through the logic input or interface logic output, the interface or switching off for a while the voltage supplying the controller.

9. ADDITIONAL FUNCTION

9.1. MANUAL CONTROL

The manual control gives the possibility, among other things, to identify the object through recording of the measured value during feeding specific increases in power. Another function is testing the object or steering it after the sensor damage.
The entry into the manual control mode follows after pressing (↵) and (▲) , keys and next the (↵) key. The controller breaks the automatic control and the manual control of each of outputs is possible. A short pressure of the (↵) key causes the transition between the steering of the output 1 and 2. Output 1 is marked by the symbol h, and the output 2 by the symbol c, on the first digit of the lower display.
(▼) and (▲) keys serve to change the steering signal, which is displayed on the lower display. The exit to the normal working mode follows after the simultaneous pressure of (▼) and (▲) keys.
After setting the ON-OFF control on the output 1 (parameter PB1=0) one can set the steering signal on 0% or 100% of power, however when the PB1 parameter is greater than zero, the steering signal can be set on any value from 0...100% range. One can steer only by means of the output 2 when it is configured on the PID control of cooling type.

9.2. SIGNAL RETRANSMISSION

The continuous output can be used to retransmit the chosen quantity ,e.g. in order to record the temperature in the object or duplicate the set value in multizone furnaces.
The signal retransmission is possible if the output 2 is of a continuous type. The retransmission configuration begins by the setting of the **out2** parameter on **rEtr**. Additionally, one can set the higher and lower signal limit for retransmission (**RoLo** and **RoHi**). The choice of the retransmission signal is realised by the **RoFn** parameter.
The method of the retransmitted parameter recalculation into an appropriate analog signal is shown on the fig. 13.

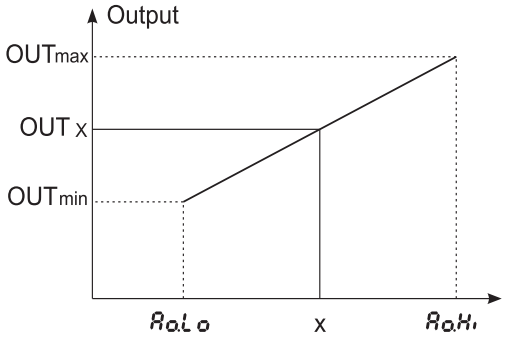


Fig.13 signal recalculation for retransmission.

The output signal is calculated acc. to the following formula:

$$wy_x = wy_{min} + (x\text{-}Ao.Lo)\,\frac{wy_{max} - wy_{min}}{Ao.Lo - Ao.Hi}$$

The **Ao.Lo** parameter can be set as higher than **Ao.Hi** , but then, the output signal will be inverted.

9.3. CONTROLLER RESPONSE AFTER SENSOR DAMAGE

After sensor damage, it is possible to configure the output state in the controller. The state is as follows:

For the output 1:
- at the output configuration for the proportional control (PB1>0), the value of the steering signal is defined by the parameter **o1FL** ,
- at the output configuration for the ON-OFF control (PB1 = 0), the output will be switched off - when the output operates as heating, or switched on - when the output operates as cooling.

For the output 2 set as cooling (**out2=Cool**) the steering signal value is defined by the **o2FL** parameter.
For the output 2 set as alarm (**out2=ALAr**) it is possible to set the output state as ON or OFF (**AL.FL** parameter).

9.4. CHANGE RATE OF THE SET VALUE - SOFT START

The limitation of the temperature accretion rate is performed through the gradually change of the set value. This function is activated after switching the controller supply on and during the set value change. This function allows to reach in a gentle way the achievement from the current temperature to the set value. One should write the accretion value to the rAnP, parameter and the time unit to the SPrr parameter. An accretion value equal to zero means that the soft start is switched off.

9.5. LIMITATION OF THE STEERING SIGNAL

In order to protect the object against the supply of a too higher power, one can define the output signal limitation from 0 to 100%, (PL 1 i PL 2parameters). If the ON-OFF control is chosen, the limitation is not active and parameters are hidden.

9.6. DIGITAL FILTER

In case when the measured value is unstable, one can switch the programmed low-pass digital filter on. The time-constant is defined to reach 99.9% of the measured value.
A high time-constant can cause a control instability.

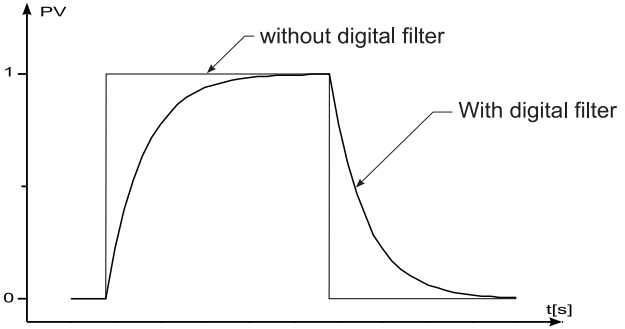


Fig.14. Filter time characteristic.

9.7. DISPLAY OF OTHER QUANTITIES ON THE LOWER DISPALY

As a standard, the SP1 or SP2 set value is shown on the lower display. The display of the output 1 steering signal is possible through the d1 SP parameter setting (first character on the lower display - h) or output 2 (first character on the lower display - c).

9.8. PRODUCER'S SETTINGS

In order to restore producer's values, one should transit to the FAbr (acc. to the fig.7.). After holding the ↵ key during 3 s, the donE symbol appears on the lower display. Producer's settings have been restored.

10. CHOICE OF PID PARAMETER SETTINGS

10.1. SELF-ADAPTATION

The controller has the function of the automatic PID setting choice. These settings ensure in the majority of cases an optimal control. Two self-adaptation methods are accessible. The method to determine the characteristic of the inert object after giving the unitary jump (AtUSt=1dEn parameter), and the oscillation method around the set value (AtUSt=oSCY parameter).
To begin the self-adaptation one should transit to the tunE parameter (acc. to the fig. 7) and hold the ↵ key during 3 s at least .
The flickering upper display informs about the activity of the self-adaptation function. The duration of the self-adaptation depends on the dynamic properties of the object and can last maximum 10 hours. In the middle of the self-adaptation or directly after it, over-regulations can occur and therefore one must set a smaller set value, if it is possible.

The self-adaptation by the unitary jump method is composed of following stages:
- switch the steering signal off and stabilize the object temperature (from 2 minutes till 3 hours),
- switch the steering signal (100%) on and determine the object characteristic (max 10 hours),
- calculate the PID setting and remember them in the non-volatile memory,
- switch the PID control on with new settings.

The self-adaptation process may not start or be interrupted without PID setting calculation, if:
- the algorythm has not been chosen (parameter At.AtU=oFF),
- the proportional band is set on 0,
- the set value is too near to the measured value, i.e. the control deviation is smaller than 7% of the range (for the unitary jump method),
- the set value has been changed,
- the time of the preliminary object stabilizing or the admissible self-adaptation duration exceeds,
- controller supply decay occurs,

- the ↵ key has been pressed.

In such cases, the control with previous user's settings will begin.

10.2. MANUAL CHOICE OF PID PARAMETER SETTINGS

Method of object identifying

This is a graphical method of object dynamic identification.

This method requires the recording of temperature and time, e.g. by means of a recorder or a temperature meter with interface to the computer.

The object answer is defined after giving the steering unitary jump (full heating rated power). However, one should take into consideration whether the maintenance of the full power state switching on will not cause the object or sensor damage.

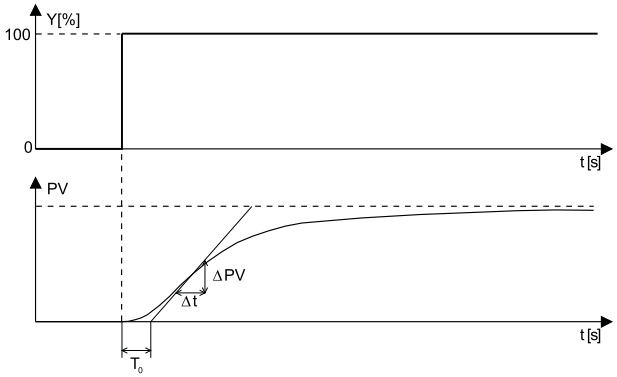


Fig. 15. Characteristic of the inert object after switching the 100% power on.

At first, the temperature accrues slowly till it reaches the accretion limit value: $V_{max}=\frac{\Delta PV_{ma}}{x\ \Delta t}$ (w °C/sek), and next increases more slowly, till it reaches the maximal value. However the object can be already switched off after reaching the maximal accretion.
On the object characteristic , one should draw a line which is the extrapolation of the nominal slope, to the intersection with the time axis. One should read the delay value T_0 and the maximal temperature accretion rate.

Settings of the controller are calculated from following formulae.

$Pb = 1.1.V_{max} \cdot T_o$ - proportional band

$t_i = 2.4 \cdot T_o$ - integration time-constant

$t_d = 0.4 \cdot T_o$ - differentiation time-constant

Oscillation method around the set value

In the oscillation method around the set value one should choose the ON-OFF control with the minimal hysteresis (see item 7.2.)
Set the set value on the normal working level (or on a lower level if over-regulations would cause damages) and normal load conditions.
One should measure the maximal change of the measured value - P, (difference between the highest and the lowest value of the first over-regulation) and the oscillation period T.

Settings of the controller are calculated from following formulae.

$Pb = P$
$t_i = T$
$t_d = 0.25 * T$

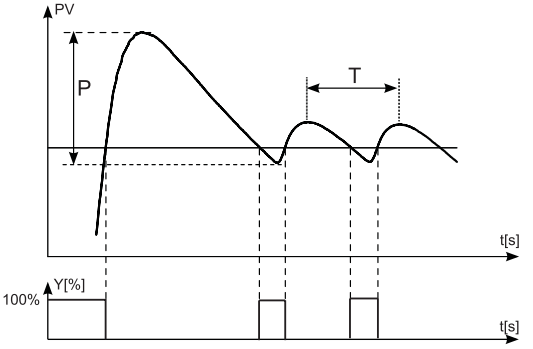


Fig.16. Choice of settings by the oscillation method.

Correction of PID settings

The setting choice by one of above methods gives approximate parameter values and sometime the necessity exists to change some settings. Since parameters interact between them, one should introduce changes only for one parameter.The best is to choose the parameter changing the value into a twice greater or twice smaller one.

During changes, one should be guided by following principles.

a) Slow jump answer:
- decrease the proportional band,
- decrease the integration and differentiation time.

b) Over-regulations:
- 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.

11. RS-485 INTERFACE WITH MODBUS PROTOCOL

11.1. INTRODUCTION

This paragraph concerns the RE20 controller equipped with a serial interface. The serial interface is in RS-485 standard, with implemented MODBUS asynchronous communication protocol.

Set of RE20 controller serial interface parameters:
- device address: 0...247
- baud rate: 2400, 4800, 9600, 19200 bit/s,
- working mode: ASCII, RTU,
- information units: ASCII: 8N1, 7E1, 7O1;
  RTU: 8N2, 8E1, 8O1, 8N1,
- maximal response time: 500 ms,

11.2. DESCRIPTION OF TRANSMISSION PROTOCOL FUNCTIONS

Following functions has been implemented in the RE20 controller:

Code	Meaning
03 (03 Hex)	Readout of n-registers
06 (06 Hex)	Writing of a single register
16 (10 Hex)	Writing of n-registers
17 (11 Hex)	Identification of slave devices

The address of the chosen device is always in the first frame field, and in the next one, the number of the chosen function.
The device address equal 0 means the broadcasting address. Then, the device does not send the answer.

Readout of n-registers (code 03)

The function enables the readout of values included in registers in the addressed slave device. Registers are 16-bit units which can contain numerical values related to process variables, and the like. The request frame defines the 16-bit register initial address and the number of registers to readout.
The meaning of the register contents with given addresses can be different for various types of devices.

Register data are packed into the frame beginning from the smallest address: first, the older byte; next, the younger register byte. The function is not accessible in the broadcasting mode.

Example.
Readout of 2 registers beginning from the register with the address 4010 (0x0FAA)

Request:

Address	Function	Register address		Number of registers		Checksum (LRC)
		Hi	Lo	Hi	Lo	
01	03	0F	AA	00	02	41

Answer:

Address	Function	Number of bytes	Value in reg. 4010		Value in reg. 4011		Checksum (LRC)
			Hi	Lo	Hi	Lo	
01	03	04	11	22	33	44	4E

Writing of a single register (kod 06)
The function enables the modification of the register contents. It is accessible in the broadcasting mode.

Example.
Writing of a value into the register with the address 4010 (0x0FAA)

Request:

Address	Function	Register address		Value		Checksum (LRC)
		Hi	Lo	Hi	Lo	
01	06	0F	AA	00	02	3E

Answer:

The correct answer to the request of writing the value into the register is the transmission of the request message.

Writing of n-registers (kod 16)

The function enables the modification of the contents of several registers. It is accessible in the broadcasting mode.

Example.

Writing of a value into 2 registers beginning from the register with the address 4010

Request:

Address	Function	Register address		Number of registers		Number of bytes	Value in register 4010		Value in register 4011		Check-sum (LRC)
		Hi	Lo	Hi	Lo		Hi	Lo	Hi	Lo	
01	10	0F	AA	00	02	04	00	11	22	33	CA

Answer:

Address	Function	Register address		Number of registers		Checksum (LRC)
		Hi	Lo	Hi	Lo	
01	10	0F	AA	00	02	34

Device identification (kod 17)

The function enables the user to obtain information about the type and status of the device.

Example. Device identification

Request:

Address	Function	Checksum (LRC)
01	11	EE

Answer**:**

The field „device identification" in the answer frame means the unique identifier of the given class of devices.

Address	Function	Number of bytes	Device identifier	Device status	Checksum (LRC)
01	11	2	84	0	68

11.3. ERROR CODES

When the master device sends a request to the slave device then, except messages in the broadcasting mode, it is waiting for a correct answer.
After sending the request of the master unit, one of the four possible events can occur:

- if the slave unit receives the request without transmission errors and can realize it correctly, then it returns the correct answer,
- if the slave unit does not receive the request, none answer is returned; timeout conditions for the request are fulfilled in the master device program,
- if the slave unit receives the request, but with transmission errors (parity error, LRC or CRC checksum), none answer is returned, timeout conditions for the request are fulfilled in the master device program,
- if the slave unit receives the request without transmission errors but cannot realize it correctly (e.g. if the request is the readout of a non-existing register), then it returns the answer including the error code, informing the master device about the error reason.

The message with the erroneous answer includes two fields differentiating it from the correct answer:
Field of the function code: In the correct answer, the slave unit retransmits the function code from the request message on the field of the answer function code. All function codes have the most significant bit (MSB) equal zero (code values are below 80h). In the erroneous answer, the slave device sets the MSB bit of the function code on 1. This causes that the value of the function code in an erroneous answer is exactly of 80h higher than it would be in a correct answer. On the base of the function code with a set MSB bit, the master device program can recognize an erroneous answer and can check the error code on the data field.
Data field: In a correct answer, the slave device can return data on the data field (sure information required by the master device). In the erroneous answer, the slave device returns the error code on the data field. It defines the slave device conditions which occasion the error.

The example of a master device request and erroneous answer of the slave device are presented below:

Request

Address	Function	Variable address		Number of variables		Checksum (LRC)
		Hi	Lo	Hi	Lo	
0A	01	04	A1	00	01	4F

Answer

Address	Function	Number of bytes	Checksum (LRC)
0A	81	01	73

In this example, the master device addresses the request to the slave device with the 10 (0Ah) number. The function code (01) serves to the readout operation of the bit output state.
This frame means the request of the status readout of one-bit output with 1245 (04A1h) address. If there is no bit output with the given address in the slave device, then the device returns the erroneous error with the error code Nr 02 which denotes a forbidden data address in the slave device.

Possible error codes and their meaning are presented in the table 6.

Error codes Table 6

Code	Meaning
01	Forbidden function
02	Forbidden data address
03	Forbidden data value

11.4. Register map of the RE20 controller

11.4. REGISTER MAP OF THE RE20 CONTROLLER

Data are placed in the controller, in 16-bit registers. The list of registers for writing and readout is presented in the table 7. The „R" operation means the possibility of readout, and the „RW" operation means the possibility of readout and writing.

Register map Table 7

Register address	Symbol	Operations	Parameter range	Description
4000		RW	0..0xFFFF	Register of commands 1 - input in the automatic control mode 2 - input in the manual control mode 3 - start of self-adaptation 4 - erasing of alarm memory 5 - restoration of producer's settings (except of interface settings)
4001		R-	100..999	Program version number
4002		R-	0..0xFFFF	Controller status - description in table 9
4003		R-	0..0xFFFF	Error status - description in table 10
4004		R-	acc. table 4[1)]	PV measured value
4005		R-	acc. table 4[1)]	SP1 current set value
4006		RW	0..1000	Steering signal of output 1 [% x10][2)]
4007		RW	0..1000	Steering signal of output 2 [% x10][2)]
4008	inpt	RW	0..13	Kind of input: 0 - Resistance thermometer Pt100 1 - Resistance thermometer Pt1000 2 - thermocouple of J type 3 - thermocouple of T type 4 - thermocouple of K type 5 - thermocouple of S type 6 - thermocouple of R type 7 - thermocouple of B type 8 - thermocouple of E type 9 - thermocouple of N type 10 - current input 0-20 mA 11 - current input 4-20 mA 12 - voltage input 0-5 V 13 - voltage input 0-10 V

Table 7

Register address	Symbol	Opera-tions	Parameter range	Description
4009	r-li	RW	0..200	Line resistance for Pt 100 resistance thermometer in a 2-wire line [Ohm * 10]
4010	CJC	RW	0..1	Compensation way of cold ends for thermocouples: 0 - automatic compensation 1 - manual compensation
4011	CJCT	RW	0..500	Temperature of cold ends at manual compensation [°C x10]
4012	reso	RW	0..1[3) 4)] 0..2[5)]	Position of decimal point on the display: 0 - without decimal point 1 - 1 decimal place 2 - 2 decimal places
4013	inLo	RW	-999..9999[1)]	Indication for the lower analog input threshold
4014	in-Hi	RW	-999..9999[1)]	Indication for the upper analog input threshold
4015	SP1L	RW	acc. table 4[1)]	Lower limitation of the SP1 setting from the keyboard
4016	SP1H	RW	acc. table 4[1)]	Upper limitation of the SP1 setting from the keyboard
4017	out1	RW	0..1	Configuration of output 1: 0 - direct control - cooling 1 - reverse control - heating
4018	o1tY	R	1..6	Type of output 1: 1 - relay output 2 - voltage logic output 3 - current output 4-20 mA 4 - current output 0-20 mA 5 - voltage output 0-5 V 6 - voltage output 0-10 V
		RW	3..4 [6)]	
4019	to1	RW	5...999	Impulse period of output 1 [s x 10]
4020	o1FL	RW	0..1000	Steering control of output 1 for the continuous control in case of sensor damage [% x10]
4021	out2	RW	0..3	Configuration of output 2: 0 - without function 1 - control - cooling 2 - alarm[7)] 3 - retransmission[8)]

Table 7

Register address	Symbol	Opera-tions	Parameter range	Description
4022	o2ty	R	0..6	Type of output 2: 0 - without output 1 - relay output 2 - voltage logic output 3 - current output 4-20 mA 4 - current output 0-20 mA 5 - voltage output 0-5 V 6 - voltage output 0-10 V
		RW	3..4[6)]	
4023	to2	RW	5...999	Impulse period of output 2 [sek x 10]
4024	o2FL	RW	0..1000	Steering signal of output 2 for continuous control in case of sensor damage [% x10]
4025	AltY	RW	0..5	Alarm type: 0 - upper absolute 1 - lower absolute 2 - upper relative 3 - lower relative 4 - internal relative 5 - external relative
4026	ALLt	RW	0..1	Alarm memory: 0 - switched off 1 - switched on
4027	ALFL	RW	0..1	State of alarm output in case of sensor damaged: 0 - switched off 1 - switched on
4028	AoFn	RW	0..4	Retransmitted quantity on the continuous output: 0 - measured value PV 1 - SP1 or SP2 set value 2 - deviation between SP-PV
4029	AoLo	RW	acc. table 4[1)]	Lower limit of signal to retransmission
4030	AoHi	RW	acc. table 4[1)]	Upper limit of signal to retransmission
4031	bnFn	RW	0..5	Function of logic input: 0 - without function 1 - stop of control 2 - alarm erasing 3 - interlocking of parameter changes 4 - switching of SP1 and SP2 5 - switching of PB1, TI1, TD1, Y01 into PB2, TI2, TD2, Y02 5 - switching of SP1, PB1, TI1, TD1, Y01 into SP2, PB2, TI2, TD2, Y02

Table 7

Register address	Symbol	Opera-tions	Parameter range	Description
4032	diSP	RW	0..2	Displayed quantity on the lower display: 0 - SP1 or SP2 1 - steering signal for heating 2 - steering signal for cooling
4033	ALGt	RW	0..1	Self-adaptation algorythm: 0 - interlocking of self-adaptation 1 - object identification method 2 - oscillation method
4034	FiLt	RW	0...8	Filter time-constant: 0 - OFF 1 - 0.5 sec 2 - 1 sec 3 - 2 sec 4 - 5 sec 5 - 10 sec 6 - 20 sec 7 - 50 sec 8 - 100 sec
4035	Par1	RW	0..19	First parameter to the user's menu
4036	Par2	RW	0..19	Second parameter to the user's menu
4037	Par3	RW	0..19	Third parameter to the user's menu
4038	Par4	RW	0..19	Fourth parameter to the user's menu
4039	Par5	RW	0..19	Fifth parameter to the user's menu
4040	SEC1	RW	0..9999	Safety code to the controller configuration menu
4041	SP1	RW	acc. table 4[1)]	SP1 set value
4042	Pb1	RW	0..9999[1)]	PB1 proportional band
4043	ti1	RW	0..9999	TI1 integration time-constant [sec]
4044	td1	RW	0..9999	TD1 differentiation time-constant [sec]
4045	HY1	RW	2..999[1)]	HY1 hysteresis
4046	Y01	RW	0..1000	Correction of Y01 steering signal (for P or PD control) [% x 10]
4047	ALSP	RW	acc. table 4[1)]	Set value for ALSP alarm
4048	ALdv	RW	-1999..1999[1)]	Deviation from SP1 set value for the ALDV relative alarm
4049	ALHY	RW	2..999[1)]	Hysteresis for ALHY alarm
4050	Hn	RW	0..999[1)]	Displacement zone for heating-cooling control

Table 7

Register address	Symbol	Opera-tions	Parameter range	Description
4051	PbC	RW	1..9999[1)]	PBC proportional band
4052	tiC	RW	0..9999	TIC integration time-constant [sec]
4053	tdC	RW	0..9999	TDC differentiation time-constant [sec]
4054	SP2	RW	acc. table 4[1)]	SP2 set value
4055	Pb2	RW	0..9999[1)]	PB2 proportional band
4056	ti2	RW	0..9999	TI2 integration time-constant [sec]
4057	td2	RW	0..9999	TD2 differentiation time-constant [sec]
4058	Y02	RW	0..1000	Correction of Y02 steering signal (for P or PD control) [% x 10]
4059	ramP	RW	0..9999[1)]	Accretion rate of SP1 and SP2 set values during the soft start
4060	SPrr	RW	0...1	Time unit for the accretion rate of the set value: 0 - minute 1 - hour
4061	ShiF	RW	-999..999[1)]	Displacement of the indicated value
4062	PL1	RW	0..1000	Limitation of the steering signal on the output 1 [% x10]
4063	PL2	RW	0..1000	Limitation of the steering signal on the output 2 [%x10]
4064	SEC2	RW	0..9999	Safety code for the menu of control parameters

[1)] The value with the decimal point position defined by bits 5 and 6 in the register 4002
[2)] Parameter for writing only in the manual control mode
[3)] Concerns inputs of resistance thermometers
[4)] Concerns inputs of thermocouples
[5)] Concerns linear inputs
[6)] Range for writing for current continuous output
[7)] Concerns the output 1 of logic type
[8)] Concerns the output 1 of continuous type

Measuring ranges for inputs Table 8

Input/sensor	Parameter range	Corresponding range
Pt100 resistance thermometer	-1990..8500	-199.. 850°C
Pt1000 resistance thermometer	-1990..8500	-199.. 850°C
Thermocouple of J type	-1000..12000	-100..1200°C
Thermocouple of T type	-1000..4000	-100..400°C
Thermocouple of K type	-1000..13720	-100..1372°C
Thermocouple of S type	0..17670	0..1767°C
Thermocouple of R type	0..17670	0..1767°C
Thermocouple of B type	3000..18200	300..1820°C
Thermocouple of E type	-1000..10000	-100..1000°C
Thermocouple of N type	-1000..13000	-100..1300°C
Linear input	-1999.. 9999	-1999.. 9999

Register 4002 - controller status Table 9

Bit	Description
15	Controller error - check the register of errors
14	Value measured beyond the measuring range
13	State of the logic input 1 - shorted, 0 - open
12	State of alarm output 1 - active, 0 - inactive
11	Active function of mild accretion
10	Self-adaptation ended by a failure
9	Controller in self-adaptation mode
8	Controller in automatic control mode
7	Controller in manual control mode
6-5	Position of the decimal point for parameter transmitted through the interface (0...2)[1)]
4-0	Reserved

[1)] For sensor inputs the value is equal 1, for linear inputs it is depended on reso parameter (register 4012)

Register 4003 Table 10

Bit	Description
15	Input discalibrated
14	Analog output 1 discalibrated
13	Analog output 2 discalibrated
12-0	Reserved

12. SIGNALLING OF ERRORS

Character messages signalling the incorrect controller work.

Table 11

Error code (upper display)	Reason	Procedure
LErr	Exceeding of the measuring range downwards or short-circuiting in the sensor circuit.	Check if the type of chosen sensor is in compliance with the connected one. Check if values of input signals are situated in the appropriate range. If so, check whether there is no short-circuiting in the sensor circuit.
HErr	Exceeding of the measuring range upwards or short-circuiting in the sensor circuit.	Check if the type of chosen sensor is in compliance with the connected one. Check if values of input signals are situated in the appropriate range. If so, check whether there is no short-circuiting in the sensor circuit.
Er.01	Incorrect configuration of the controller.	After choosing the non-reverse control (cooling) on the output 2, one should chose the reverse control (heating) on the output 1 and the PID algorythm (PB1≠0 and PB2≠0)
Er.Ad	Discalibrated input	Connect again the controller supply and if it cannot help, contact the nearest authorized service shop.
Er.dA	Discalibrated output.	Connect again the controller supply and if it cannot help, contact the nearest authorized service workshop.

13. TECHNICAL DATA

Input signals acc. to the table 12

Input signals and measuring ranges for inputs

Table 12

Sensor type / inputs	Notation	Range
Pt100 acc. PN-EN 60751+A2:1997	Pt100	-199...850°C
Pt1000 acc. PN-EN 60751+A2:1997	Pt1000	-199...850°C
Fe-CuNi	J	-100...1200°C
Cu-CuNi	T	-100...400°C
NiCr-NiAl	K	-100...1372°C
PtRh10-Pt	S	0...1767°C
PtRh13-Pt	R	0...1767°C
PtRh30-PtRh6	B	300...1820°C
NiCr-CuNi	E	- 100...1000°C
NiCrSi-NiSi	N	-100...1300°C
Linear current	I	0...20 mA
Linear current	I	4...20 mA
Linear voltage	U	0...5 V
Linear voltage	U	0...10 V

Basic measurement accuracy of the measured value (in % of the measuring range):

- resistance thermometers Pt100, Pt1000 0.1 %
- thermocouples J, K, E, N 0.1 %
- thermocouples B, R, S, T 0.2 %
- linear inputs 0.1%

Time of measurement 0.167 s

Input resistance

- voltage input 227 kΩ
- current input 6.2 Ω

Error detection in the measuring circuit:

- termocouples, Pt100, PT1000	measuring range exceeding
- 0...10 V	above 11 V
- 0...5 V	above 5.5 V
- 0...20 mA	above 22 mA
- 4...20 mA	under 1mA and above 22 mA
Logic input:	non-voltage
- shorting resistance	$\leq$ 10 kΩ
- opening resistance	$\geq$ 100 kΩ
Kinds of outputs:	
- relay non-voltage	make contact, load 2 A/230 V,
- transistor voltage	0/15 V, serial resistance 250 Ω
- voltage continuous	0...5 V, 0...10 V at $R_{load} \geq$ 1 kΩ
- current continuous	0...20 mA, 4...20 mA at $R_{load} \leq$ 500 Ω
Action of outputs:	
- reverse	for heating
- direct	for cooling
Accuracy of analog outputs	0.2% for the range
Digital interface:	RS-485
- protocol	Modbus
- baud rate	2400, 4800, 9600, 19200 bit/s
- mode	ASCII - 8N1, 7E1, 7O1, RTU - 8N2, 8E1, 8O1, 8N1
- address	1...247
- maximal response time	500 ms

Signalling:
- active output 1
- active output 2
- manual mode
- shorting of logic input

Rated service conditions:

- supply voltage	85...253 V a.c./d.c 20...40 V a.c./d.c.
- supply voltage frequency	40...440 Hz
- ambient temperature	0...23...50°C
- storage temperature	-20...+70°C
- relative humidity	< 85 % (no condensing)
- external magnetic field	< 400 A/m
- preliminary heating time	30 min
- work position	any
Power consumption	< 9 VA
Weight	< 0.3 kg
Panel cut-off dimensions	$45^{+0.6}$ x $45^{+0.6}$ mm
IP protection ensured through the housing acc. to EN 60529:	
- from the frontal side	IP40
- from terminals	IP20
Additional errors in rated working conditions caused by:	
- compensation of the thermocouple cold junction	≤ 2 K,
- ambient temperature change	≤ 100% of the basic error /10 K.

Security requirements acc. to EN 61010-1

- installation category: III,
- pollution degree: 2,
- maximal working voltage in relation to ground:
  - supply circuit - 300 V a.c.
  - other circuits - 50 V a.c.

Electromagnetic compatibility

- immunity EN 61000-6-2
- emission EN 61000-6-4

14. ORDERING CODES

Table 13

RE20 CONTROLLER	X	X	X	X	X	XX	X

Input

resistance thermometers	1
thermocouples	2
linear current signal 0/4...20 mA or linear voltage signal 0...5/10V	3
as per order	X

Main output

relay	1
logic, voltage 0/15 V	2
continuous, current 0/4...20 mA	3
continuous, voltage 0...5 V	4
continuous, voltage 0...10 V	5

Auxiliary output

without output	0
relay	1
logic, voltage 0/15 V	2
continuous, current 0/4...20 mA	3
continuous, voltage 0...5 V	4
continuous, voltage 0...10 V	5

Interface

without interface	0
RS-485 with MODBUS protocol	1

Supply voltage

85...253 V a.c./d.c	1
20...40 V a.c./d.c.	2

Kind of option

catalog	00
custom-made*	XX

Acceptance tests

without an extra quality inspection certificate	0
with an extra quality inspection certificate	1
acc. to user's agreement**	X

* The code will be established by the manufacturer

** After agreeing with manufacturer

15. MAINTENANCE AND GUARANTEE

The RE20 controller does not require any periodical maintenance.

In case of some incorrect operations:

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

2. **After the guarantee period:**
   One should turn over the instrument to repair it in a certified service workshop.
   Spare parts are available for the period of five years from the date of purchase.

> **The Manufacturer's** reserves the right to make changes in design and specifications of any products as engineering advances or necessity requires.

LUMEL S.A. RE20/January 2006

Lubuskie Zakłady Aparatów Elektrycznych - LUMEL S.A.
ul. Sulechowska 1, 65-022 Zielona Góra, Poland

Tel.: (48-68) 32 95 100 (exchange)
Fax: (48-68) 32 95 101
www.lumel.com.pl
e-mail:lumel@lumel.com.pl

Export Department:
Tel.: (48-68) 329 53 02 or (48-68) 329 53 04
Fax: (48-68) 325 40 91
e-mail: export@lumel.com.pl