LUMEL

TEMPERATURE CONTROLLER

RE71

USER'S MANUAL

CE

CONTENTS

1. APPLICATION

The RE71 controller is destined for the temperature control in plastics, food, dehydration industries and everywhere when the temperature stabilizing is necessary.

Main features of the RE71 controller:

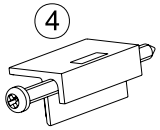
- direct co-operation with resistance thermometers (RTD) or thermocouple (TC) sensors,
- two-stage control acc. to the PID or ON-OFF algorithm,
- one control output or alarm, relay output with make-and-break configuration, allowing to the direct control of low power objects

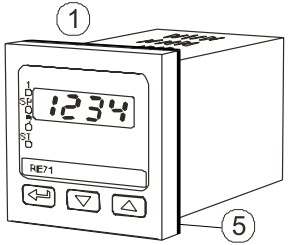
An innovative SMART PID algorithm has been implemented in the controller.

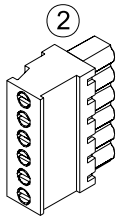
2. CONTROLLER SET

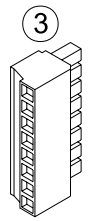
The delivered controller set is composed of:

1. RE71 controller ..... 1 pc
2. Plug with 6 screw terminals ..... 1 pc
3. Plug with 8 screw terminals ..... 1 pc
4. Screw clamp to fix the controller in the panel ... 4 pcs
5. Seal ..... 1 pc
6. User's manual ..... 1 pc









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

3. BASIC REQUIREMENTS, OPERATIONAL SAFETY

In the safety service scope, the controller meets to requirements of the EN 61010-1 standard.

Observations Concerning the Operational Safety:

- 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.
- Before switching the controller on, one must check the correctness of connections to the network.
- The removal of the controller casing during the guarantee contract period may cause its cancellation.
- The controller fulfills requirements related to electromagnetic compatibility in the industrial environment
- When connecting the supply, one must remember that a switch or a circuit-breaker should be installed in the room. This switch should be located near the controller, easy accessible by the operator, and suitably marked as an element switching the controller off.
- Non-authorized removal of the casing, inappropriate use, incorrect installation or operation, creates the risk of injury to personnel or meter damage.

For more detailed information, please study the User's Manual.

4. INSTALLATION

4.1. Controller Installation

Fix the controller in the panel, which the thickness should not exceed 15 mm, by means of four screw clamps acc. the fig. 1.

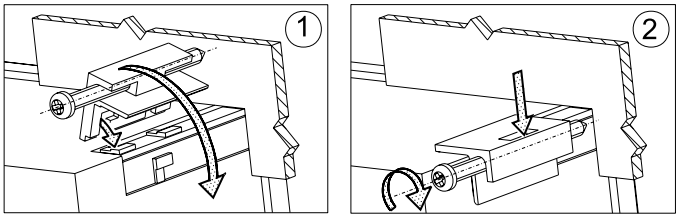


Fig. 1. Controller fixing

The panel cut-out should have $45^{+0,6}$ x $45^{+0,6}$ mm dimensions.

The controller must be introduced from the panel front with disconnected supply voltage. Before the insertion into the panel, one must check the correct placement of the seal.

After the insertion into the hole, fix the controller by means of screw clamps.

Controller overall dimensions are presented on the fig. 2.

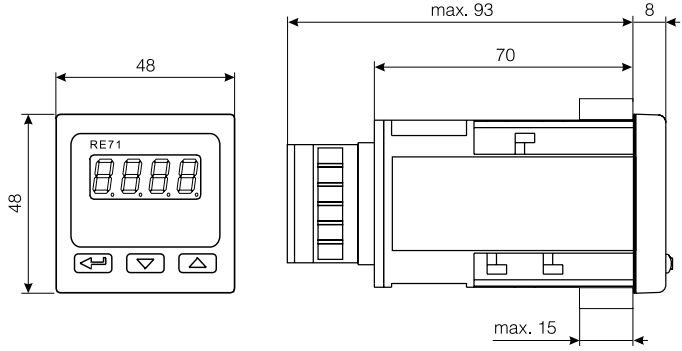


Fig. 2. Controller overall dimensions

4.2. Electrical Connections

Make electrical connections to terminal strip and next, insert strips into the controller sockets.

The controller has two separable terminal strips. One strip enables the connection of the supply and outputs by a wire of 2.5 mm^2 cross-section, the second strip enables input signal connections by a wire of 1.5 mm^2 cross-section.

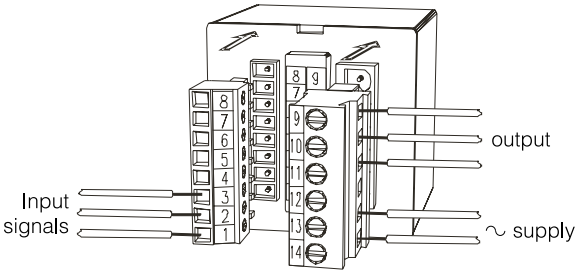


Fig. 3. View of controller connection strips.

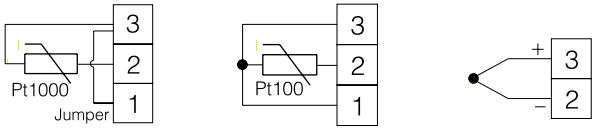


Fig. 4. Connection of input signals.

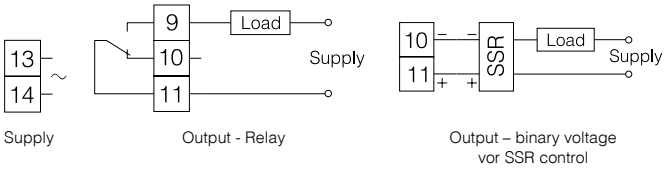


Fig. 5. Connection of the supply and load circuit.

4.3. 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 protection 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 groups of wires made at right angle (90°).

5. STARTING TO WORK

After switching the supply on, the controller carries out the display test, displays the rE71, inscription, the program version and next, displays the measured value.

A character message informing about abnormalities may appear on the display (table 4). The On-Off control algorithm with hysteresis given in the table 2 is set by the manufacturer.

Changing the Set Value

The set point value is displayed after pressing the ▼ or the ▲ button, then the SP diode is lighting. In order to change the set value, one must press the ▼ or ▲ button again (fig. 6). The beginning of the change is signaled by the dot flickering on the display. One must accept the new set point value by the ↵ button in the laps of 30 seconds from the last pressure of the ▼ or ▲ button, in the opposite case, the controller transits to display the measured value with the previously set up set point value.

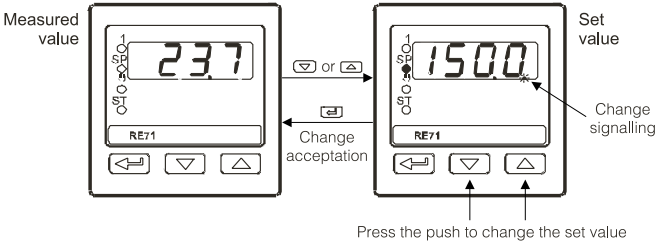


Fig. 6. Change of the set value.

6. SERVICE

The controller service is presented on the Fig. 7.

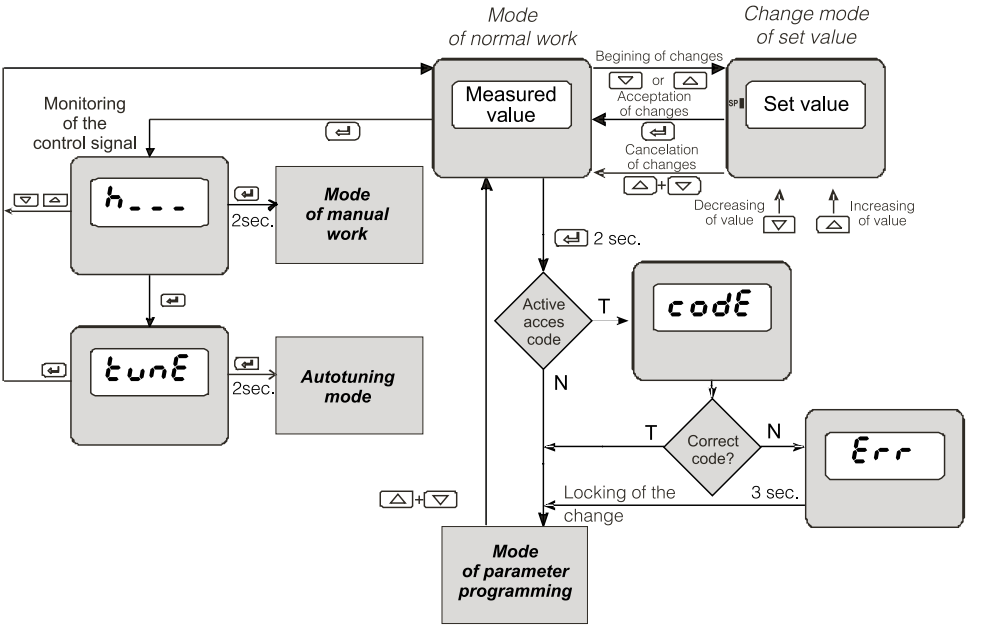


Fig. 7. Menu of controller service.

6.1. Programming Controller Parameters

The pressure and holding down the [↵] button during ca 2 seconds causes the entry in the programming matrix. The programming matrix can be protected by an access code. In case when giving a wrong value of the code, it is only possible to see settings through – without possibility of changes.

The fig 8. presents the transition matrix in the programming mode. The transition between levels is carrying out by means of the [▼] and [▲] buttons and the level choice by means of the [↵] button. After choosing the level, the transition between parameters is carried out by means of [▼] and [▲] buttons. In order to change the parameter setting, one must proceed acc. to the section 6.3. In order to exit from the selected level, one must transit between parameters until the symbol [. . .] appears and press the [↵] button. In order to exit from the programming matrix to the normal working mode, one must transit between levels until the symbol [. . .] appears and press the [↵] button.

Some controller parameters cannot be visible – it depends on the current configuration.

The table 1 includes the description of parameters. The return to the normal working mode follows automatically after 30 seconds since the last button pressure.

6.2. Programming Matrix

inP Input parameters	**dP** Position of decimal point	**SH.iF** Shift of measured value	. . . ↶ Transition to the higher level			
outP Output parameters	**out** Output configuration	. . . ↶ Transition to the higher level				
ctrL Control parameters	**ALG** Control algorythm	**tYPE** Kind of control	**HY** Hysteresis	. . . ↶ Transition to the higher level		
P id PID parameters	**Pb** Proportional band	**ti** Integration time constant	**td** Differentation time constant	**YO** Working point for P/PD	**to** Pulsing period	. . . ↶ Transition to the higher level
ALAr Alarm parameters	**AL.SP** Set value vor the absolute alarm	**AL.dv** Deviation from the set value of the relative alarm	**AL.HY** Alarm hysteresis	. . . ↶ Transition to the higher level		
SPP Set value parameters	**SPL** Lower limitation of the set value setting	**SPH** Upper limitation of the set value setting	. . . ↶ Transition to the higher level			
SErv Service parameters	**SECU** Acces code	**St.Fn** Autotuning function	. . . ↶ Transition to the higher level			
. . . ↶ Exit from the menu						

Fig. 8. Programming Matrix

6.3. Setting Change

The change of parameter setting begins after pressing the [↵] button during the display of the parameter name. The setting choice is carried out through [▼] and [▲] buttons, and accepted by the [↵] button. The change cancellation follows after the simultaneous pressure of [▼] and [▲] buttons or automatically after 30 sec since the last push pressure.

The way to change the setting is shown on the fig. 9.

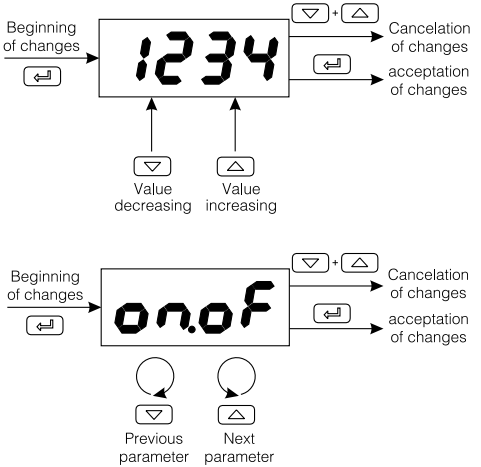


Fig. 9. Setting change of number and text parameters

6.4. Description 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	Manufacturer setting	Change range of the parameter
inP – Input parameters			
dP	Position of the decimal point	1-dP	0_dP: without decimal point 1_dP: 1 decimal point
Sh.F	Shift of the measured value	0.0	-99.9...99.9°C
outP – Output parameters			
out	Output configuration	y	oFF: control switched off y: control signal RHi: upper absolute alarm RLo: lower absolute alarm duHi: upper relative alarm duLo: lower relative alarm dui n: internal relative alarm duou: external relative alarm
ctrL – Control parameters [1]			
ALG	Control algorithm	onoF	onoF: On-Off control algorithm P.id: PID control algorithm
tYPE	Kind of control	inu	dir: direct control (cooling) inu: reverse control (heating)
HY	Hysteresis [4]	HY_FABR [6]	0.2...99.9°C

PID – Parameters PID [2]			
Pb	Proportional band	PB_FABR [6]	0.1...999.9°C
t I	Integration time constant	300	0...9999 s
t d	Differentiation time constant	60.0	0...999.9 s
y0	Correction of control signal for P or PID control type	0.0	0...100.0%
t o	Pulse period	20.0	0.5...99.9 s
ALAr – Alarm parameters [3]			
AL.SP	Set point value for absolute alarm	0.0	MIN...MAX [6]
AL.du	Deviation from the set value for the relative alarm	0.0	-199.9...199.9°C
AL.HY	Hysteresis for the alarm	2.0	0.2...99.9°C
SPP – Parameters of set point value			
SPL	Lower limitation of the set value	-199.0	MIN...MAX [6]
SPH	Upper limitation of the set value	850.0	MIN...MAX [6]
SErP – Service parameters			
SECU	Access code [5]	0	0...9999
St.Fn	Autotuning function	on	off: locked on: available

[1] Group of parameters visible only when setting the output on the control signal.
[2] Group of parameters visible only when setting the control algorithm on PID.
[3] Group of parameters visible only when setting the output on one of the alarm.
[4] Parameter visible only when setting the control algorithm on On-Off.
[5] Parameter hidden in the monitoring mode of parameters only for readout.
[6] Vide table 2.

Parameters depending on the measured range *table 2*

Sensor		MIN	MAX	PB_FABR	HY_FABR
Resist. thermom. Pt100	-50...100°C	-50.0	100.0	15.0	1.1
Resist. thermom. Pt100	0...250°C	0.0	250.0	20.0	1.8
Resist. thermom. Pt100	0...600°C	0.0	600.0	30.0	4.2
Thermocouple of J	0...250°C	0.0	250.0	20.0	1.8
Thermocouple of J	0...600°C	0.0	600.0	30.0	4.2
Thermocouple of J	0...900°C	0.0	900.0	40.0	6.3
Thermocouple of K	0...600°C	0.0	600.0	30.0	4.2
Thermocouple of K	0...900°C	0.0	900.0	40.0	6.3
Thermocouple of K	0...1300°C	0	1300	45.0	9.1
Thermocouple of S	0...1600°C	0	1600	50.0	11.2

7. CONTROL

7.1. On-Off Control

When a high accuracy of temperature control is not required, especially for objects with a high time constant and not big delay, one can apply the On-Off control with hysteresis.

Features of this method are simplicity and reliability. Disadvantage of this method is the occurrence of oscillations, even at small hysteresis values.

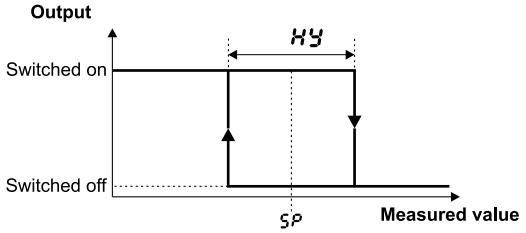


Fig. 10. Operation way of the heating output type for the On-Off control.

7.2. PID Control

When we want to obtain a higher accuracy of temperature control, one must use the PID algorithm.

The applied innovative SMART PID algorithm is characterized by an increased accuracy for the expanded range of control object classes.

The fine tuning of the controller to the object consists on the settlement of the proportional element, integration element, differentiation element and output pulsing period.

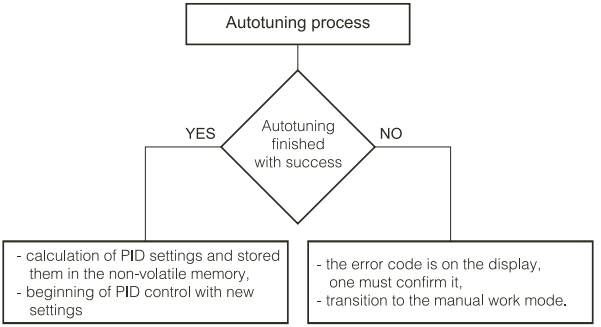
7.2.1. Autotuning

The controller has the function enabling the choice of PID settings. These settings ensure the optimal control in most of cases.

To begin the autotuning, one must transit to the **tunE** parameter (acc. to the fig. 7) and hold down the [↵] button during at least 2 sec. If the control algorithm is set on ON-OFF or the autotuning function is locked, then the **tunE** message is hidden.

The flickering AT symbol informs about the activity of the autotuning function. The autotuning duration time depends on dynamic properties of the object and can last maximally 10 hours. During the autotuning or directly after it, over-regulations can occur and for these reasons, one must set a less setpoint value, if it possible.

The autotuning is composed of following stages:



The autotuning process will be broken without PID settings calculations, if a controller supply decay occurs or the [↵] . button is pressed. In such a case, the control with current PID settings will begin.
If the autotuning experiment does not end with success, then an error code will be displayed acc. to the table 3.

Error codes for autotuning *Table 3*

Error code	Reason	Proceeding
E5.01	P lub PD control has been chosen.	One must choose PI, PID control, i.e. the TI unit must be higher than zero.
E5.03	The [↵] button has been pressed pressed .	
E5.04	The maximal autotuning duration time Has been exceeded.	Check, if the temperature sensor is correctly situated, if the set point value is not set too higher for the given object.
E5.05	The waiting time of switching has been exceeded.	
E5.06	The input measuring range has been exceeded.	Take note of the way to connect the sensor. Do not admit that the overflow results in exceeding of the input measuring range.
E5.20	Very non-linear object, unabling to obtain correct values of PID parameters, or an interference has occurred.	Carry out the autotuning again. If that does not help, choose PID parameters manually.

7.2.2. Proceeding Way in Case of an Unsatisfactory PID Control

It is recommended to choose PID parameters, changing the value in a twice higher or twice less. During the change, one must respect following principles.

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

b) Over-regulations
- – increase the proportional band,
- – increase the differentiation time.

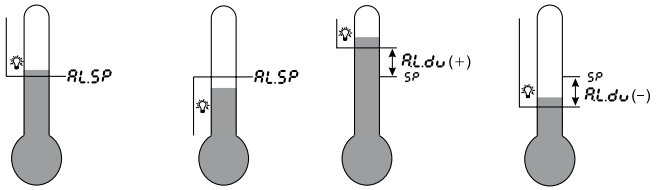
c) Oscillations
- – increase the proportional band,
- – increase the integration time,
- – decrease the differentiation time.

d) Instability
- – Increase the integration time.

8. ALARMS

One can configure the controller output as an alarm output. For this aim, one must set the **out** parameter as one of alarms.

Available types of alarms are given on the fig. 11.



Absolute upper (**out** = **AH**)

Absolute lower (**out** = **AL**)

Relative upper (**out** = **duH**)

Relative upper (**out** = **duH**)

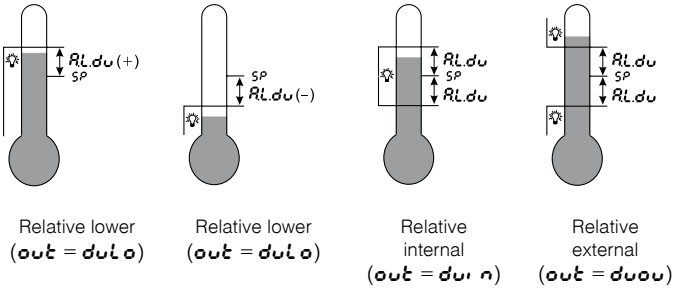


Fig. 11. Kind of alarms

The set point value for absolute alarms is the value defined by the **AL.SP** parameter, and for relative alarms, it is the deviation from the set point value - **AL.du** parameter.

Alarm hysteresis, i.e. the zone around the set point value in which the input state is not changed is defined by the **AL.HY** parameter.

9. ADDITIONAL FUNCTIONS

9.1. Displaying the Control Signal

After pressing the [↵] button, the value of the control signal (0...100%) is displayed on the display. On the first digit the **h** mark is displayed. The control signal can be displayed when the **out** parameter is set on **Y**.

9.2. Manual Control

The manual control gives the possibility to identify, test the object, or control it after a sensor damage. The entry to the manual control mode follows after holding the [↵] button down during the control signal display. The manual control is signalled by the pulsation of the diode with ✋ symbol.

The controller breaks the automatic control and begins the manual control of the output The value of the control signal, preceded by the **h** symbol, is on the display.

For the ON-OFF control – the control signal can be set up by [▼] and [▲] buttons on 0% or 100%.

For the PID control – the control signal can be set up by by [▼] and [▲] buttons on any optional value from the 0.0...100% range.

The exit to the normal work mode follows after a simultaneous pressure of by [▼] and [▲] buttons.

9.3. Manufacturer's Settings

One can restore manufacturer's settings holding down [▼] and [▲] buttons during the supply turning on, till the moment when the inscription FAbr appears on the display.

10. ERROR SIGNALING

Character messages signaling the incorrect controller operation *Table 4*

Error code (upper display)	Reason	Procedure
	Down overflow of the measuring range or lack of RTD.	Check, if the type of chosen sensor is in compliance with the connected one. Check if input signal values are situated in the appropriate range – If yes, check if there is not a short circuit in the RTD or the thermocouple is connected inversely.
	Upper overflow of the measuring range or break in the sensor circuit	Check, if the type of chosen sensor is in compliance with the connected one. Check if input signal values are situated in the appropriate range – If yes, check if there is no break in the sensor circuit.
	Input discalibrated	Connect the controller supply again and if that is not effective, contact the nearest service shop.
	Error in the controller configuration	Connect the controller supply again and if that is not effective, contact the nearest service shop.

11. TECHNICAL DATA

Input Signals

Input signals and measuring ranges for inputs *Table 5*

Sensor type	Range	Basic error
Resistance thermometer (acc. to EN 60751:2009), measuring current 0.25mA		
Pt100*)	-50...100	±0.8
	0...250	±1.3
	0...600	±3.0
Thermocouple of J type (acc. to EN 60584-1:1997)		
Fe-CuNi	0...250	±2.0
	0...600	±3.0
	0...900	±4.0
Thermocouple of K type (acc. to EN 60584-1:1997)		
NiCr-NiAl	0...600	±3.0
	0...900	±4.0
	0...1300	±6.0
Thermocouple of S type (acc. to EN 60584-1:1997)		
PtRh10-Pt	0...1600	±8.0

*) Resistance of the sensor line <10 Ω/wire; one must connect with wires of the same section and length.

Measurement time 0.33 s

Detection of error in the measurement circuit:

- termocouple, Pt100 — overflow of measuring range

Kinds of outputs:

- voltageless relay	switching contact, overload capacity: 5 A/230 V,
- binary voltage	voltage 6 V, resistance limiting the current: 10 Ω

Way of output operation:

- reverse	for heating
- direct	for cooling

Rated operating conditions:

- supply voltage	230 V a.c. ±10%
- supply voltage frequency	50/60 Hz
- ambient temperature	0...23...50°C
- storage temperature	-20...+70°C
- relative air humidity	< 85% (without water vapour condensation)
- external magnetic field	< 400 A/m
- warm-up time	30 min
- operating position	any
Power consumption	< 4 VA
Weight	< 0,25 kg
Protection grade ensured by the casing:	acc. to EN 60529 [1)]
- from frontal side	IP 65
- from terminal side	IP 20

Additional errors in rated operating conditions caused by:

- compensation of reference junction temperature changes	≤ 2°C,
- line resistance change of the thermocouple sensor	≤ 50% of the basic error value
- change of the ambient temperature	≤ 100% of the basic error/10 K

Safety requirements acc. to EN 61010-1 [1)]

- isolation between circuits	basic
- installation category	III
- pollution level	2
- maximal phase-to-earth operating voltage:	
- for supply circuit, outputs	300 V
- for input circuits	50 V
- altitude above sea level	2000 m

Electromagnetic compatibility:

- noise immunity	acc. to EN 61000-6-2[1)]
- noise emission	acc. to EN 61000-6-4[1)]

[1)] Current standard editions are in Conformity Declaration

12. ORDER CODES

The coding way is given in the table 6.

Ordering codes: Table 6

Temperature Controller RE71 -	XX	X	XX	X	X

Input:

RTD Pt100	(-50...100°C)	**01**
RTD Pt100	(0...250°C)	**02**
RTD Pt100	(0...600°C)	**03**
thermocouple J (Fe-CuNi)	(0...250°C)	**04**
thermocouple J (Fe-CuNi)	(0...600°C)	**05**
thermocouple J (Fe-CuNi)	(0...900°C)	**06**
thermocouple K (NiCr-NiAl)	(0...600°C)	**07**
thermocouple K (NiCr-NiAl)	(0...900°C)	**08**
thermocouple K (NiCr-NiAl)	(0...1300°C)	**09**
thermocouple S (PtRh10-Pt)	(0...1600°C)	**10**

Output:

relay	**1**
binary 0/6 V for SSR control	**2**

Version:

standard	**00**
custom-made*	**XX**

Language:

Polish	**P**
English	**E**
other*	**X**

Acceptance tests:

without additional requirements	**0**
with an extra quality inspection certificate	**1**
acc. to the customer's request*	**X**

* After agreement with the manufacturer.

Example of Order:

The code: **RE71 - 06 2 00 E 0** means:

RE71 – temperature controller of RE71 type
06 – input: TC J, (0...900°C)
2 – output: binary 0/6 V for SSR control
00 – standard version
E – English language
0 – without extra quality requirements

13. MAINTENANCE AND GUARANTEE

The RE71 controller does not require any periodical maintenance.
In case of some incorrect operations:

1. From the Shipping During the Period Given in the Annexed Guarantee Card

One should take the controller down from the installation and return it to the Manufacturer's Quality Control Dept.

If the unit has been used in compliance with the instructions, the Manufacturer warrants to repair it free of charge.

2. After the Guarantee Period

One should turn over the controller to repair it in a certified service workshop.

The disassembling of the casing causes the cancellation of the granted guarantee.

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 above specifications without notice.

LUMEL S.A.
ul. Słubicka 4, 65-127 Zielona Góra, Poland
tel.: +48 68 45 75 100, fax +48 68 45 75 508
www.lumel.com.pl

Informacja techniczna:
tel.: (68) 45 75 140, 45 75 141, 45 75 142, 45 75 145, 45 75 146
e-mail: sprzedaz@lumel.com.pl

Realizacja zamówień:
tel.: (68) 45 75 150, 45 75 151, 45 75 152, 45 75 153, 45 75 154, 45 75 155

Wzorcowanie:
tel.: (68) 45 75 163
e-mail: laboratorium@lumel.com.pl

Technical support:
tel.: (+48 68) 45 75 143, 45 75 141, 45 75 144, 45 75 140
e-mail: export@lumel.com.pl

Export department:
tel.: (+48 68) 45 75 130, 45 75 132
e-mail: export@lumel.com.pl

Calibration & Attestation:
e-mail: laboratorium@lumel.com.pl

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