LUMEL

MIKROPROCESSOR TEMPERATURE CONTROLLER

RE54

SERVICE MANUAL

CE

CONTENTS

Symbols located in this service manual mean:

Especially important, one must acquaint with this before connecting the meter.

One must take note of this, when the meter is working inconsistently to the expectations.

1. APPLICATION

The RE54 microprocessor temperature controller with an analogue setting and digital measurement of the true measured value is destined to control the temperature or other physical quantities e.g. pressure, humidity, level converted into current, voltage or resistance values. This controller enables the digital read-out of the set value, on/off type control, P- proportional control, PID - proportional control with programmed settings or PID with self-adaptive control. It has an alarm output (optionally) with operation signalling. In executions destined to co-operate with a potentiometric transmitter its calibration is possible on the object.

2. CONTROLLER SET

With the controller we deliver:

- two holders to fix the meter on a panel,
- a service manual,
- a guarantee certificate.

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

RE54 controllers are destined to be mounted into panels and cubicles. In the range of operational safety they are in conformity with IEC 1010 -1+A1:1996 standard requirements.

- The installation and meter connection should be operated by qualified personnel.
- One must take into consideration all accessible protection requirements
- Before switching the instrument on, one must check the correctness of the network lead connection - IEC 1010 - 1 p.6.10. and p.6.11.2.
- In case of the protection terminal connection with a separate lead one must remember to connect it before the connection of network leads.
- Do not connect the meter to the network through an autotransformer. Before taking the meter housing out one must turn the supply off. The removal of the meter housing during the guarantee contract period may cause its cancellation.

4. INSTALLATION

To fix the controller in the panel , one must prepare a 91 x 91 mm hole according to the fig.1. Introduce the controller from the front of the panel when the supply circuit is turned off and fasten it by means of holders, which are delivered together with the controller. Sensor leads, supply and load leads must be connected according to the fig.2. All connections must be made with accuracy after cleaning the lead ends. Leads connecting the controller with thermocouples should be in accordance with IEC standards. Interference levels practically occurring, often exceed values given in the standard and can

influence the controller in a continuous or impulse way from the side of the supply circuit (as the result of the action of other devices) and also superpose themselves on the measured signal or auxiliary circuits of the controller. Impulse interferences exceeding the values given in the standard are dangerous for the controller operation because they can cause sporadic wrong measurement results or accidental operations of alarms despite of the use of appropriate filters in the controller.

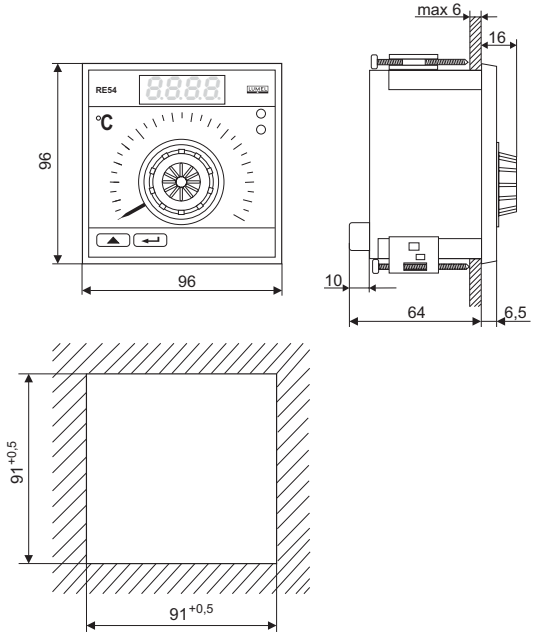


Fig.1. Overall controller dimension and panel cut-out dimensions

The level of these interferences should be reduced to a lower value than the fastness threshold of the controller, first of all through a suitable installation of the controller in the object. In order to obtain a full fastness of the controller against electromagnetic interferences in an environment with an unknown interference level, it is recommended to observe the following principles:

- do not supply controllers from the mains in proximity of devices generating strong impulse interferences,
- use network filters for the group of controllers servicing the same object,
- to lead conductors use metallic screens in the shape of tubes or braids in which one can also lead the earth conductor and alternatively conductors of the relay contact network supply of the given controller,
- conductors leading measuring signals to the controller should be twisted in pairs and for resistance thermometers connected through a three-wire line, twisted of conductors of the same length, cross-section and resistance, and led in a screen as described above.
- apply the general principle that conductors (group of conductors) leading different signals should be led in a maximal distance from each other. (not less than 30 cm) and crossings of such bundles executed under 90° angle.
- make electrical connections of the controller according the fig. 2.

The right position of the controller allows to avoid many problems in the control system. The sensor should be placed such that it will be possible to detect the smallest temperature changes with a minimal delay.

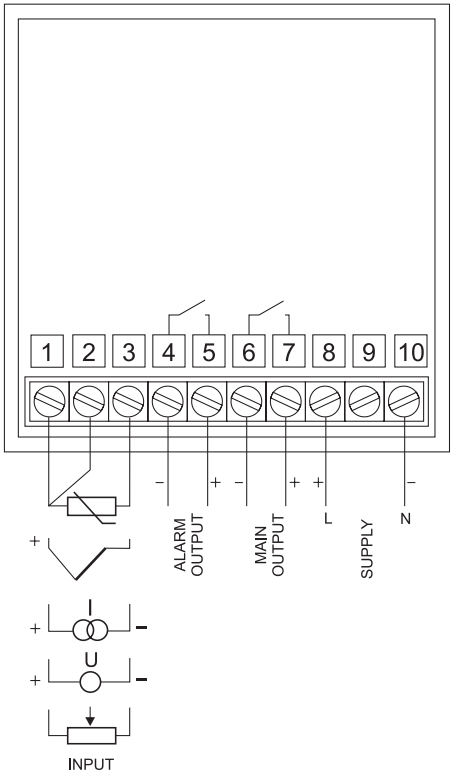


Fig.2. Electrical connection diagram

5. CONTROLLER SERVICING

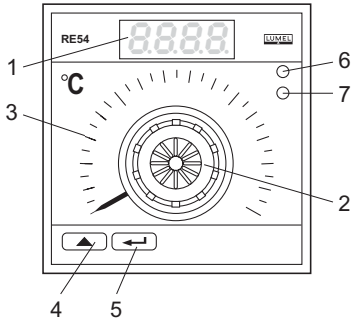


Fig.3 View of the controller frontal plate

On the controller frontal plate there is:
1 - the display of the measured value,
2 and 3 - the knob with the scale to set the set value,
4 and 5 - keys,
6 - red diode signalling the output state,
7 - green diode signalling the alarm state.

The keys fulfil following functions:

change of the parameter value, display of the next parameter,

acceptation of the parameter change,
change of the displayed value:
measured value - set value.

After switching the supply on, the program version number is displayed and then the display test is carried out. If the sensor is correctly connected, the controller will display the currently measured value. If not, a message about the error will appear acc. the table 4.

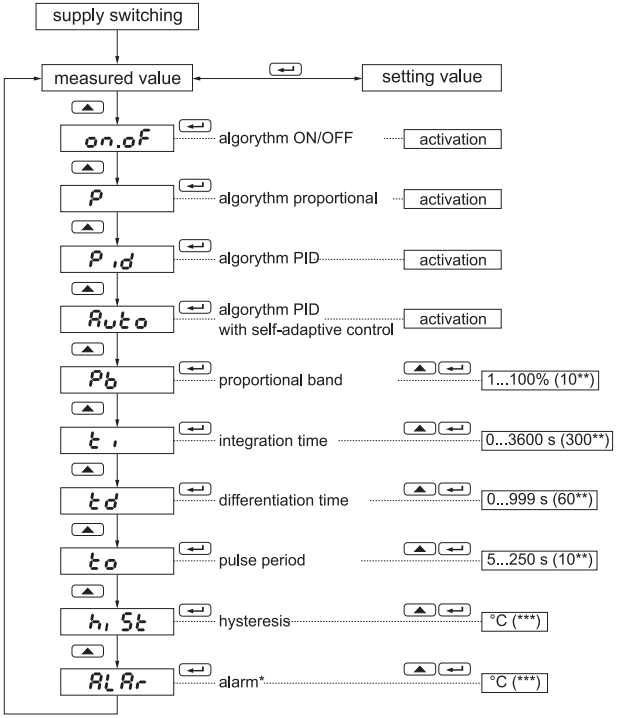
The table 1 includes the set of control algorythms, their symbols and setting ranges. The PID algorythm and settings set by the manufacturer are distinguished in the table 1.

CONTROL ALGORYTHMS

Table 1

Sort of algorythm	Symbol	Parameter, symbol	Change range of the parameter
ON / OFF	onoF	Hysteresis h , St	Acc. table 2
P	P	Proportional band, Pb	1...**10**...100 [%]
		Pulse period, to	5...**10**...250 [s]
PID	P,d	Proportional band, Pb	1...**10**...100 [%]
		Integration constant t ,	0; 1...**300**...3600 [s] t , = 0 → element switched off
		Differentiation constant td	0; 1...**60**...999 [s] td = 0 → element switched off
		Pulse period, to	5...**10**...250 [s]
PID with self-adaptive control	AuTo	As for the PID algorythm parameters are automatically selected	Allowable values as for the PID algorythm

Fig.4 presents the algorythm of the controller servicing.



* active parameter for executions with an alarm output
** manufacturer settings
*** setting range acc. table 2

Fig.4 Algorythm of the controller servicing

5.1 Setting of the set value

The setting value is displayed after pressing the ↵ key. During the display of the set value the display is pulsating. The setting of the set value is carried out by the potentiometer after pressing the internal part to the external part of the knob . The controller automatically displays the set values, in case of a movement of the potentiometer faster than 2% of the range/ second, the display pulsates. The return to the display of the measured value follows after a renewed pressure of the ↵ key, or after 40 seconds since to come to a stop the potentiometer movement.

5.2 Change of the controller parameters

The change begins by the ▲ key. The symbol onoF appears on the display, what means a control of ON/OFF type with hysteresis. The pulsation of the symbol of the given algorythm means that it is active at the given time . A further pressure of the ▲ key will cause a sequential display of the algorythm symbols and parameters according the Fig. 4. A change or reviewing of the currently displayed parameter begins by the ↵ key and is carried out according the fig. 5. The new settings will be stored in the non-volatile memory and the controller will display the next menu position. If the user do not use the keypad again in the next 40 seconds from the moment of entering in the programming mode, the controller will come back to the display of the measured value without changing settings that have been doing so far.

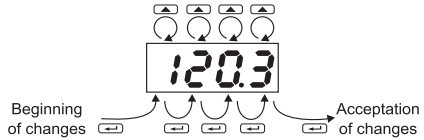


Fig. 5 Setting of a new parameter value.

5.3 Setting of the hysteresis

The H ,St hysteresis is set for the main output and the alarm, see fig. 6 and fig. 7. The hysteresis value is common for the operation of the main output acc. the ON/OFF algorythm and the alarm output. If the algorythm onoF is not active, the hysteresis concerns only the alarm. One can programme the upper absolute alarm as the AL Ar parameter. Then, the output state changes according the fig.7.

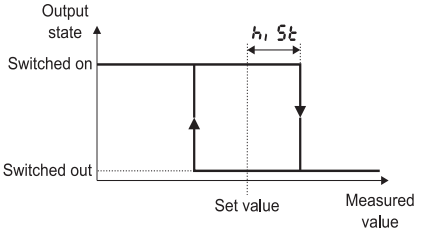


Fig. 6. Hysteresis of the main output

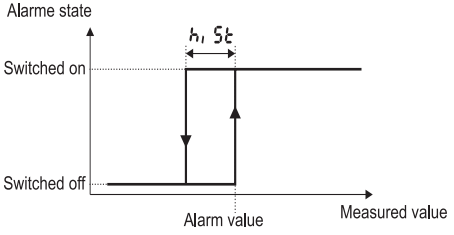


Fig.7 Alarm hysteresis

In the table 2, change ranges of hyteresis and alarm values are given.
Change ranges of hysteresis and alarm values in different executions:

Table 2

Measuring range of the controller [°C]	Change range of the parameter	
	Hysteresis H.SE	Alarm AL.Ar
-50...0	0,1...**0,1**...5,0 [°C]	-50,0...**-25,0**...0 [°C]
-30...20	0,1...**0,1**...5,0 [°C]	-30,0...**-5,0**...20,0 [°C]
-50...100	0,1...**0,3**...15,0 [°C]	-50,0...**25,0**...100 [°C]
0...50	0,1...**0,1**...5,0 [°C]	0...**25,0**...50,0 [°C]
0...100	0,1...**0,2**...10,0 [°C]	0...**50,0**...100,0 [°C]
0...150	0,1...**0,3**...15,0 [°C]	0...**75,0**...150,0 [°C]
0...250	0,1...**0,5**...25,0 [°C]	0...**125,0**...250,0 [°C]
0...400	0,1...**0,8**...40,0 [°C]	0...**200,0**...400,0 [°C]
0...600	0,2...**1,2**...60,0 [°C]	0...**300,0**...600,0 [°C]
0...900	0,2...**1,8**...90,0 [°C]	0...**450,0**...900,0 [°C]
0...1300	1...**2**...130 [°C]	0...**650**...1300 [°C]
0...1600	1...**3**...160 [°C]	0...**800**...1600 [°C]
Linear inputs	0,1...**0,2**...10,0 [%]	0...**50,0**...100,0 [%]

5.4. Manufacturer settings

In order to restore manufacturer settings (singled out in table 1 and 2), one must hold the pressure of the ↵ key during the switching of the controller supply and the display test on.

5.5. Self-adaptive control setting

The controller have the function of the automatic selection of PID settings, which carry out the approximate identification of the object and automatically mark settings, assuring in almost cases the optimal control.

The self-adaptive control setting is composed of 4 stages:

- switching of the heating power off and stabilising of the object temperature (from 2 minutes to 3 hours),
- switching the heating on and assignment of the object characteristic (max. Up to 10 hours),
- calculation of PID settings and storage them in the non-volatile memory,
- switching of the PID control on with new settings. The duration of the self-adaptive control setting depends on the dynamic properties of the object and can even lasts several hours. Longer the delay, longer is the setting selection time. An initial difference between the set value and the measured value, at least 10% of the controller range, is required to carry out the self-adaptive control. Overshoots can arise directly after finishing the self-adaptive control, for this reason one must adjust a lower set value, as far as it is possible.

To avoid an unnecessary object warm-up, what will prolong the duration of the self- adaptive control setting, one must switch the object supply off before the controller switching on. The start of the self-adaptive control follows after the activation of the **Auto** algorythm acc. The fig. 4. If the algorythm was active before the beginning of the self-adaptive control, one must switch it off and switch it on again. The **Auto** symbol begins to pulsate. The decimal point at the left side of the display will also pusate during the display of the measured value and the main output will be switched off for at least 2 minutes. Now, one must switch the object supply on.

The self-adaptive control can be broken off without the calculation of the PID setting, in case when:

- the **Auto** algorythm will be switched off by the user before the end of the self- adaptive control,
- the set value is too near of the measured value (the initial control deviation is smaller than 10% of the controller range),

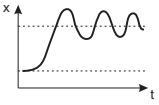
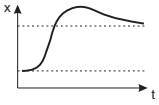
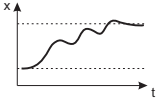
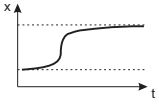
- the accessible heating power is too small to carry out the self-adaptive control,
- the maximal time of the object preliminary stabilisation or the allowable time of the object characteristic determination will be exceeded, - one of the error mentioned in the table 4 will appear,
- a fast change of the set value (greater than 2% of the range / sec) will follow,
- the voltage supply decay or the controller restart will occur.

In such cases, the PID algorythm with the previous user's settings will be automatically activated. After a correct end of the self-adaptive control, the decimal point will cease to pulsate and the AUTO algorythm remain active. In order to repeat the process of the setting selection one must switch the AUTO algorythm off and on again. The settings automatically selected can be read out or changed. The change of one of the parameters: Pb, t I, t d, t o will cause the switching of the PID algorythm on. After the change of the set value, it is recommended to make a renewed self-adaptive setting.

5.6 Correction of PID settings

In case of a dissatisfied control quality, one can make the correction of PID settings. PID parameters are interdependent and it is easy to lead to undesirable changes of the controlled signal and one must for this reason change only one of the parameter and observe the effect. Unfavourable runs of the controlled quantity are presented in the table 3 with proposed corrections of the PID settings (↑- parameter increase, ↓ - parameter decrease).

Table 3

Run of the controlled quantity	Algorythm of the controller operation			
	P (ti=0, td=0)	PD (ti=0, td≠0)	PI (ti≠0, td=0)	PID (ti≠0, td≠0)
	Pb ↑	Pb ↑ td ↓	Pb ↑	Pb ↑ t, ↑ td ↓
	Pb ↑	Pb ↑ td ↑	Pb ↑ t, ↑	Pb ↑ t, ↑ td ↑
		Pb ↓ td ↓		Pb ↓ t, ↓ td ↓
	Pb ↓	Pb ↓	t, ↑	Pb ↓ t, ↓

6. SIGNALLING OF ERRORS

Error codes, their cause which can appear during the controller operation and procedures are given in the table 4

Error signalling Table 4

Error code	Cause	Procedure
Err.1	Exceeding of the measuring range downwards or shortening in the resistance thermometer circuit.	Check whether input signal values are comprised in the appropriate range; if yes, check whether a short-circuit has not occurred in the sensor circuit.
Err.2	Exceeding of the measurement range upwards or break in the sensor circuit.	Check whether input signal values are comprised in the appropriate ranges; if yes, check whether a break has not occurred in the sensor circuit. In case of a resistance thermometer, check if the resistance of the line is not too higher.
Err.3	Exceeding of the set value range.	Check whether the setting potentiometer pointer is not out of the scale graduation range.
Err.E	Error of record verification into the non-volatile memory	It can occur during the acceptation of the being changed parameter and the trial to record into the non-volatile memory of the controller or during the self-adaptive process. One must switch the supply off and switch it on again then, try to change this same parameteror restore the manufacturer settings (p.4.4). If the controller does not still work correctly, it betokens about its damage. The exploitation of the controller in this state can cause its unforeseen conduct.

If after the elimination of the probable error cause mentioned in the table 4, the controller does not work correctly, one must send it to the nearest service workshop.

7. TECHNICAL DATA

Range, resolution and basic error for different executions

Table 5

Sensor type	Symbol	Range [°C]	Resolution [°C]	Basic error [°C]
Resistance thermometer (acc. EN 60751+A2) measuring current < 1 mA				
Pt100/1,3850*)	Pt	-50...100	0,1	± 0,8
		0...100	0,1	± 0,5
		0...150	0,1	± 0,8
		0...250	0,1	± 1,3
		0...400	0,1	± 2
		0...600	0,2	± 3
Ni100/1,617*)	Ni	-50...0	0,1	± 0,5
		-30...20	0,1	± 0,5
		0...50	0,1	± 0,5
		0...100	0,1	± 0,5
		0...150	0,1	± 0,8
Thermocouple (acc. EN 60751+A2)				
Fe-CuNi	J	0...250	0,1	± 1,3
		0...400	0,1	± 2
		0...600	0,2	± 3
		0...900	0,2	± 4
NiCr-NiAl	K	0...600	0,2	± 3
		0...900	0,2	± 4
		0...1300	1	± 6
PtRh10-Pt	S	0...1600	1	± 8
Linear input				
Input range		Range [%]	Resolution [%]	Basic error [% of the range]
0...20 mA		0...100	0,1	± 0,5
4...20 mA		0...100	0,1	± 0,5
0...5 V		0...100	0,1	± 0,5
0...10 V		0...100	0,1	± 0,5
0...100 Ω		0...100	0,1	± 0,5
0...1000 Ω		0...100	0,1	± 0,5

* Resistance of the sensor line ≤ 5 Ω/1 lead; the connector must be made of leads of the same cross-section and length.

Potentiometric setting of the set value:

- setting resolution of the set value	0.1% of the controller range
- difference between the displayed set value and the set on the graduation	≤ 2% of the controller range

Additional errors caused by:

- change of resistance of theof the resistance thermometric line	50% of the basic error value
- influence of the controller work temperature	≤ 100% of the basic error value/10K

Kind of outputs:

- voltageless relay output, make contact	for the main and alarm output (optionally) contact loading: 220 V, 2 A, cosφ = 0.4, S = 440 VA
- voltageless transistor output	for the main and alarm output (optionally) OC type, serial with the 200 Ω resistor, U max = 24 V, Imax = 20 mA

Rated operation conditions:

- supply voltage	90...115...230...254 V a.c. Hz, 20...24...40 V a.c./d.c.
- supply voltage frequency	40...50...440 HZ
- power consumption	< 5 VA
- work temperature	5...23...45°C
- relative humidity	25...85%
- external magnetic field	< 400 A/m.
- heating time	30 minutes
- work position	arbitrary

Weight of the controller	300 g
Protection degree ensured by the housing:	
- from the frontal side	IP40
- from the terminal side	IP20
Fulfilled standards:	
- safety requirements	acc.IEC1010-1+A1:1996
- insulation ensured by the housing	double
- insulation between circuits	basic
- installation category	II
- pollution level	2
- maximal voltage in respect to the earth:	
- supply circuits and relay outputs	300 V
- measuring circuit and OC outputs	50 V
- electromagnetic compatibility:	
- emision	acc. EN-50081-2:1996
- immunity	acc. EN-50082-2*
Overall dimensions	96 x 96 x 64 mm
Panel cut-out	92 x 92 mm (+0.5 mm)

** for the RE54-07XXXXXX and RE54-08XXXXXX executions, the maximal additional error caused by the occurrence of high frequency interference of 10 V/m intensity, and for conducted interference of radio frequency and 10 V rms value (acc. EN-50082-2) - can reach a value up to 300 % of the basic error.*

8. EXECUTION AND ORDER CODES

In case of a custom-made execution or need of more detailed technical information please contact our Export Department

RE54 CONTROLLER							
Input							
Pt100/1,3850	-50...100°C	**01**					
	0...100°C	**02**					
	0...150°C	**03**					
	0...250°C	**04**					
	0...400°C	**05**					
	0...600°C	**06**					
Fe-CuNi	0...250°C	**07**					
	0...400°C	**08**					
	0...600°C	**09**					
	0...900°C	**10**					
NiCr-NiAl	0...600°C	**11**					
	0...900°C	**12**					
	0...1300°C	**13**					
PtRh10-Pt	0...1600°C	**14**					
Voltage or current	0...5 V	**15**					
	0...10 V	**16**					
	0...20 mA	**17**					
	4...20 mA	**18**					
Ponentiometric	0...100 Ω	**19**					
transmitter	0...1000 Ω	**20**					
Ni100/1,617	- 50...0°C	**21**					
	- 30...20°C	**22**					
	0...50°C	**23**					
	0...100°C	**24**					
	0...150°C	**25**					
Custom-built execution *		**99**					
Main output	relay output		**1**				
OC 24 V DC type transistor output			**2**				
Alarm output	without alarm output			**1**			
	relay alarm output			**2**			
	OC 24 v type alarm output			**3**			
Supply voltage	90...115...230...254 V AC/DC				**1**		
	20...24...40 V AC/DC				**2**		
Kind of execution	standard					**00**	
	custom-built					**99**	
Additional acceptance test requirements	without additional requirements						**0**
	with an inspection test certificate						**1**
	acc. customer's requirements **						**X**

* After agreement with the manufacturer

** The code number is settle by the manufacturer

Order example:

RE54 02 1 1 1 00 0 means: a RE54 temperature controller, 0...100°C range, co-operating with a Pt100/1.3850 sensor, main output: relay output, without an alarm output, supply voltage: 90...115...230...254 V a.c./d.c., standard execution, without additional acceptance test requirements.

9. CONTROLLER CALIBRATION WITH THE INPUT FOR THE POTENTIOMETER TRANSMITTER .

The controller input is calibrated by the manufacturer in two points for rated resistances of the transmitter: 0 and 100 Ω/1000 Ω depending on the execution at a neglectable small resistance of connecting leads. The calibration on the object enables to assign the indications 0 and 100% of the measured value to the resistance values chosen by the user from the nominal range, e.g. 100% indication for the incomplete opening of the valve. The calibration must be carried out together with the leads connecting the transmitter to the controller. The calibration is carried on as follows:

- During the switching of the controller supply and the display test on, one must hold the pressure on the ▲ key. The pulsating Potc symbol appears on the display. The pressure of the ↵ key means the continuation of the calibration whereas in case of a 40 seconds' break of the key using , the controller returns to the normal work.

- When the pulsating P 0 symbol appears on the display, indicating the lower value of the transmitter resistance. Then, one must:

- set the transmitter on the position which will correspond to the indication of the measured value equal 0%,
- wait 5 seconds for the stabilisation of the signal and press the ▲ key.

- After a while, the pulsating P100 symbol will be displayed indicating the upper value of the transmitter resistance. Then, one must:

- set the transmitter in the position which will correspond to the indication of the measured value equal 100%,
- wait 5 seconds for the stabilisation of the signal and press the ↵ key.

- The calibration is finished, The restart of the controller and the display test follow and the controller displays the measured value. If one of the errors given on the table 4 occurs, one must take advantage of the directions included in the paragraph 5 or renew the calibration.

During the calibration, the controller outputs are remaining switched off and the control is stopped.

10. MAINTENANCE AND GUARANTEE

The RE54 temperature controller does not require any periodical maintenance. In case of some incorrect controller operations or failures one must contact the nearest authorized workshop.

1. In the period of 12 months from the date of purchase:
One should take the controller down the installation and return it to the LUMEL's Claim Section in the Quality Control Department . If the unit has been used in accordance with the instructions, LUMEL S.A. guarantees 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 housing causes the cancellation of the granted guarantee.
Spare parts are available for the period of ten years from the date of purchase.

LUMEL S.A. reserves the right to make changes in design and specifications of any products as engineering advances or necessity requires.

LUMEL

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