ELCO S.r.l.
Via Lago di Molveno, 20
36015 SCHIO (VI) ITALY
TEL. +39 0445 661722
FAX+39 0445 661792
internet http://www.elco-italy.com
e-mailinfo@elco-italy.com
support@elco-italy.com

ELK4C

Thermocontroller

User manual

ELK4C-GB-0-5-A

1 GENERAL INFORMATIONS

This instruction manual is an integral part of the Thermocontroller ELK4C and users should always make reference to it.

- The Thermocontroller ELK4C, also referred herein as "product" or "device", to which this document refers, is provided for use by persons trained in its use. The instruction must provide for the knowledge of the product and of the manoeuvrers to be performed during the use, to allow its use in safe conditions.
- All persons trained to work with the product should carefully read this manual in all its sections and understand its contents.
- It is especially important that staff are informed on security with regard to general practices for the protection of people, the product and the surrounding environment.
- Only the correct use of the product as recommended will ensure its lasting and effective use, in full safety for the operators and for the product itself.
- EL.CO. S.r.l. reserves the right to make any formal or functional changes at any time without prior notice.
- The electrical installation where the component is installed must meet the safety requirements in force.
- EL.CO. S.r.l. and its legal representatives do not assume any responsibility for any damage to people, things or animals deriving from violation, misuse, wrong use or otherwise not in accordance with the device features.
- All rights to this documentation are reserved. Translations, reprints and copies of this manual, even if partial and/or otherwise expressly require the consent of EL.CO. S.r.l.

2 INTENDED RECIPIENTS OF THE MANUAL

- This manual is intended for all authorized users and suitable to use the Digital electronic thermocontroller with defrosting function.
- All users must read and understand the contents of this manual, which they have to follow while working with the product.
- This manual is an integral part of the product to which it relates and shall be kept throughout its life cycle.
- In the event of transfer or sale of the product, the manual and all accompanying documentation, or connected one, shall be maintained and delivered with it.

3 WARRANTY

The warranty provided by the manufacturer on the product is valid for one year. The following conditions will void the product warranty provided by EL.CO. S.r.l.:

- Improper use of the product, which is different than the expected one;
- Use by unauthorized or untrained personnel;
- Total or partial disregard of these instructions;
- Power supply defects;
- Pollution coming from the outside;
- Changes and unauthorized repairs;
-
- In the event of a faulty instrument, either within the period of warranty, or further to its expiry, please contact our sales department to obtain authorisation for sending the instrument to our company.

The faulty product must be shipped to EL.CO. S.r.l. with a detailed description of the faults found, without any fees or charge for EL.CO. S.r.l., except in the event of alternative agreements.Opening of the housing, manumission of the thermoconverter, improper installation and operation.

4 INSTALLATION

4.1 MECHANICAL INSTALLATION

The controller must be fastened on a panel, following the sequence of steps described below:

- Prepare a panel cut-out according to *8.2 Mechanical data*
- Remove the mounting clamps from the controller
- Insert the controller into the panel cut-out
- Slide the mounting clamp from the rear to a firm grip at the panel.

4.2 ELECTRICAL CONNECTION

- All electrical connections are made to the screw terminals at the rear of the controller
- To minimize the pick-up of electrical noise, the low voltage DC connections and the sensor input wiring should be routed away from high-current power conductors. If this is impractical, use shielded cables. In general, keep cable lengths to a minimum
- All electronic instruments must be powered by a clean mains supply, proper for instrumentation
- Install RC'S FILTERS (noise suppressor) to contactor coils, solenoids, etc. In any application it is essential to consider what can happen when any part of the system fails. The controller features by themselves can not assure total protection.

4.2.1 ELECTRICAL WIRING DIAGRAM

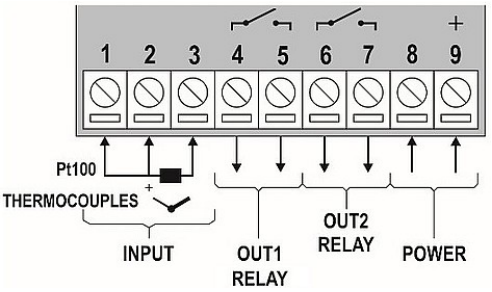


Figure 1- Connection of the back panel

5 FUNCTIONS

5.1 INPUT TYPE SELECTION

Table 1 - shows the sensor types accepted and their respective codes and ranges. Access the parameter TYPE in the INPUT level to select the appropriate sensor.

TYPE	CODE	RANGE OF MEASUREMENT
Thermocouple J	tc J	Range: -110 to 950 ºC (-166 to 1742 ºF)
Thermocouple K	tc K	Range: -150 to 1370 ºC (-238 to 2498 ºF)
Thermocouple T	tc t	Range: -160 to 400 ºC (-256 to 752 ºF)
Pt100	Pt	Range: -200 to 850 ºC (-328 to 1562 ºF)

Table 1 - Input types

The input type should be the first parameter to be configured on the controller. Any modifications on the input type will automatically change other related parameters. The user must verify the configuration every time that an input type modification occurs.

5.2 OUTPUTS

The controller has two outputs. The user can configure these outputs to operate as **Control Output (CtrL)** or **Alarm Output (AL)**.

OUT1 - Output Relay SPST-NO

OUT2 - Output Relay SPST-NO

5.2.1 CONTROL OUTPUT (CtrL)

The control strategy can be **ON/OFF** (when Pb = **0.0)** or **PID**. The PID parameters can be automatically determined enabling the auto-tuning function (AtUn).

5.2.2 ALARM OUTPUT (AL)

The controller contains 2 alarms that can be directed (assigned) to any output channel. The alarm functions are described in Table 2 -

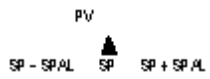
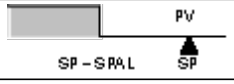
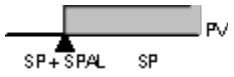
oFF	Output is not used as alarm.	
Lo	Alarm of Absolute Minimum Value. Triggers when the value of measured PV is **below** the value defined for alarm *Set point (SPAL)*	
HI	Alarm of Absolute Maximum Value. Triggers when the value of measured PV is **above** the value defined for alarm Set point.	
dIF	Alarm of Differential. In this function the parameters, SPAL represent the deviation of PV in relation to the SP of CONTROL	
		
	Positive SPAL	Negative SPAL
dIFL	Alarm of Minimum Differential Value. It triggers when the value of PV is **below** the defined point by SP-SPAL	
		
	Positive SPAL	Negative SPAL
dIFH	Alarm of Maximum Differential. Triggers when the value of PV is **above** the defined point by SP+SPAL	
		
	Positive SPAL	Negative SPAL
tErr	Alarms of the Sensor Break (Sensor *Break Alarm*). It is activated when the Input presents problems such as interrupted sensor, bad connection, etc	

Table 2 - Alarm functions

Important note: Alarms configured with the **HI**, **dIF**, and **dIFH** functions also trigger their associated output when a sensor fault is identified and signalled by the controller. A relay output, for example, configured to act as a High Alarm (**HI**), will operate when the SPAL value is exceeded and also when the sensor connected to the controller input is broken.

5.2.3 INITIAL BLOCKING OF ALARM

The **initial blocking** option inhibits the alarm from being recognized if an alarm condition is present when the controller is first energized (or after a transition from run YES → NO). The alarm will be enabled only after the occurrence of a non alarm condition followed by a new occurrence for the alarm.

The initial blocking is useful, for instance, when one of the alarms is configured as a minimum value alarm, causing the activation of the alarm soon upon the process start-up, an occurrence that may be undesirable.

The initial blocking is disabled for the sensor break alarm function **tErr**.

5.2.4 OFFSET

Allows fine adjustments to the PV reading for compensation of sensor error.

6 OPERATION

The controller's front panel, with its parts, can be seen in Figure 2-

Figure 2- Front panel

Display of PV / Programming (top display, red colour): Displays the current value of PV (*Process Variable*). When in configuration mode, it shows the parameters names.

Display of SP / Parameters (bottom display, green colour)**:** Displays the value of SP (*Set point*). When in configuration mode, it shows the parameters values.

TUNE Indicator: Stays ON while the controller is in tuning process.

OUT Indicator: For relay or pulse control output; it reflects the actual state of the output.

A1 and A2 Indicators: signalize the occurrence of alarm situation.

P Key: used to walk through the menu parameters.

▲ **Increment key and** ▼ **- Decrement key**: allow altering the values of the parameters.

◄ **Back key**: used to retrocede parameters.

When the controller is powered up, it displays its firmware version for 3 seconds, after which the controller starts normal operation. The value of PV and SP is then displayed and the outputs are enabled.

In order for the controller to operate properly in a process, its parameters need to be configured first, such that it can perform accordingly to the system requirements. The user must be aware of the importance of each parameter and for each one determine a valid condition.

The parameters are grouped in levels according to their functionality and operation easiness. The 3 levels of parameters are

1 – Tuning / 2 – Input / 3 – Calibration

The "**P**" key is used for accessing the parameters within a level.

Keeping the "**P**" key pressed, at every 2 seconds the controller jumps to the next level of parameters, showing the first parameter of each level:

PV >> **AtUn** >> **tYPE** >> **PASS** >> **PV**...

To enter a particular level, simply release the "**P"** key when the first parameter in that level is displayed. To walk through the parameters in a level, press the "**P"** key with short strokes. To go back to the previous parameter in a level, press ◄:

Each parameter is displayed with its prompt in the upper display and value/condition in the lower display. Depending on the level of parameter protection adopted, the parameter **PASS** precedes the first parameter in the level where the protection becomes active. See section *6.2 Configuration protection*.

6.1 DESCRIPTION OF THE PARAMETERS

6.1.1 INDICATION SCREEN

PV + SP: PV Indication screen. On the higher display (red) the value of the measured variable (**PV**) temperature is shown. On the lower display (green), the control setpoint (**SP**) is shown.

6.1.2 PROGRAMMABLE PARAMETERS TABLE

N.	Parameter	Description	Default
	Tuning cycle		
1	AtUn	**AUTO-TUNE**: enables the auto-tuning function for the PID parameters (**Pb, Ir, dt**). Defines the control strategy to be taken: **oFF** - Turned off (no PID tuning) **FASt** - Automatic tuning **FULL** - More accurate automatic tuning	off
2	Pb	Proportional Band - Value of the term **P** of the control mode PID, in percentage of the maximum span of the input type. Adjust between 0 and 500.0 %. When set to zero (0), control action is ON/OFF.	1.5
3	Ir	Integral Rate - Value of the term **I** of the PID algorithm, in repetitions per minute (Reset). Adjustable between 0 and 99.00. Displayed only if proportional band ≠ 0.	0.60
4	dt	Derivative Time - Value of the term **D** of the control mode PID, in seconds. Adjustable between 0 and 300.0 seconds. Displayed only if proportional band ≠ 0.	20
5	Ct	**Level time**: Pulse Width Modulation (PWM) period in seconds. Adjustable between 0.5 and 100.0 seconds. Displayed only if proportional band ≠ 0.	5.0
6	HYSt	**Control hysteresis**: Is the hysteresis for ON/OFF control (set in temperature units). This parameter is only used when the controller is in ON/OFF mode (**Pb**=**0**).	1.0
7	ACt	Action Control: **rE** Control with **Reverse Action**. Appropriate for **heating**. Turns control output on when PV is below SP. **dIr** Control with **Direct Action**. Appropriate for **cooling**. Turns control output on when PV is above SP.	rE
8	Out 1 Out 2	Assign functions to the Output channels OUT1, OUT2 **oFF** - Not used. **CtrL** - Control output. **AL** - Alarm output.	Ctrl off
	Input cycle		
9	tYPE	Input Type: Selects the input signal type to be connected to the process variable input. Refer to **Table 1 -** for the available options.	Pt
10	dPPo	Selects the decimal point position to be viewed in both PV and SP.	0.0
11	unit	Selects display indication for degrees Celsius or Fahrenheit: **C** - Indication in Celsius. **F** - Indication in Fahrenheit.	C
12	OFFS	Sensor Offset: Offset value to be added to the PV reading to compensate sensor error. Default value: zero.	0.0
13	SPLL	SP Low Limit. Defines SP lower limits. It defines the minimum PV indication range. This parameter does not limit the Alarm SP configuration.	see Table 1 -
14	SPHL	SP High limit. Defines SP upper limit. This parameter does not limit the Alarm SP configuration.	
15	FuAL	Functions of Alarms. Defines the functions for the alarms among the options of the **Table 2 -** .	off
16	SPAL	Alarm SP: Value that defines the point of activation of the alarm outputs. For the alarms programmed with the functions of the type **Differential**, these parameters represent the deviations.	0.0

N.	Parameter	Description	Default
		For the iErr alarm function, this parameter has no meaning.	
17	bLAL	Blocking Alarm. This function blocks the alarms. YES - enables initial blocking no - inhibits initial blocking	no
18	HYAL	Hysteresis of Alarm. Defines the difference between the value of PV at which the alarm is triggered and the value at which it is turned off.	0.0
	Calibration level		
19	PASS	Password. This parameter is presented before the protected levels. See item Protection of Configuration.	0
20	CAL	Calibration. Enables the possibility for calibration of the indicator. When the calibration is not enabled, the related parameters are hidden.	no
21	InLC	Input Low Calibration. Enter the value corresponding to the low scale signal applied to the analog input.	
22	InHC	Input High Calibration. Enter the value corresponding to the full scale signal applied to the analog input.	
23	rStr	Restore. Restores the factory calibration for all inputs and outputs, disregarding modifications carried out by the user.	
24	PASC	Password Change. Allows defining a new access password, always different from zero.	0
25	Prot	Protection. Sets up the Level of Protection. See **Table 3 -** .	1

All types of input are calibrated in the factory. In case a recalibration is required; it shall be carried out by a specialized professional. In case this level is accidentally accessed, do not perform alteration in its parameters.

6.2 CONFIGURATION PROTECTION

The controller provides means for protecting the parameters configurations, not allowing modifications to the parameters values, avoiding tampering or improper manipulation. The parameter **Protection** (Prot), in the Calibration level, determines the protection strategy, limiting the access to particular levels, as shown by the **Table 3 - .**

PROTECTION LEVEL	PROTECTION LEVELS
1	Only the Calibration level is protected.
2	Calibration and Input levels.
3	Calibration, Input and Tuning levels.
4	All levels are protected, including SP.

Table 3 - Protection levels for the configuration

6.2.1 ACCESS PASSWORD

The protected levels, when accessed, request the user to provide the **Access Password** for granting permission to change the configuration of the parameters on these levels.

The prompt PASS precedes the parameters on the protected levels. If no password is entered, the parameters of the protected levels can only be visualized.

The Access Password is defined by the user in the parameter *Password Change* (PASC), present in the Calibration Level. **The factory default for the password code is 1111**

6.2.2 PROTECTION ACCESS PASSWORD

The protection system built into the controller blocks for 10 minutes the access to protected parameters after 5 consecutive frustrated attempts of guessing the correct password.

6.2.3 MASTER PASSWORD

The Master Password is intended for allowing the user to define a new password in the event of it being forgotten. The Master Password doesn't grant access to all parameters, only to the *Password Change* parameter (**PASC**). After defining the new password, the protected parameters may be accessed (and modified) using this new password.

The master password is made up by the last three digits of the serial number of the controller **added** to the number 9000. As an example, for the equipment with serial number 07154321, the master password is 9 3 2 1.

Controller serial number is displayed by pressing ◄ for 3 seconds.

6.3 DETERMINATION OF PID PARAMETERS

During the process of determining automatically the PID parameters, the system is controlled in **ON/OFF** in the programmed Setpoint. The auto-tuning process may take several minutes to be completed, depending on the system. The steps for executing the PID auto-tuning are:

- Select the process Setpoint.
- Enable auto-tuning at the parameter "AtUn", selecting FASt or FULL.

The option FASt performs the tuning in the minimum possible time, while the option FULL gives priority to accuracy over the speed.

The sign TUNE remains lit during the whole tuning phase. The user must wait for the tuning to be completed before using the controller.

During auto tuning period the controller will impose oscillations to the process. PV will oscillate around the programmed set point and controller output will switch on and off many times.

If the tuning does not result in a satisfactory control, refer to **Table 4 -** for guidelines on how to correct the behavior of the process.

PARAMETER	VERIFIED PROBLEM	SOLUTION
Band Proportional	Slow answer	Decrease
	Great oscillation	Increase
Rate Integration	Slow answer	Increase
	Great oscillation	Decrease
Derivative Time	Slow answer or instability	Decrease
	Great oscillation	Increase

Table 4 - Guidance for manual adjustment of the PID parameters

7 MAINTENANCE

7.1 PROBLEMS WITH THE CONTROLLER

Connection errors and inadequate programming are the most common errors found during the controller operation. A final revision may avoid loss of time and damages.

The controller displays some messages to help the user identify problems.

Message	Description of the Problem
----	Open input. No sensor or signal.
Err 1 Err6	Connection and/or configuration problems. Check the wiring and the configuration.

Other error messages may indicate hardware problems requiring maintenance service.

7.2 PROCESS VARIABLE INPUT CALIBRATION

All inputs are factory calibrated and recalibration should only be done by qualified personnel. If you are not familiar with these procedures do not attempt to calibrate this instrument.

a- Set the type parameter according to the input **tYPE**.
b- Configure the lower and upper limits of indication for the maximum span of the selected input type.
c- Access the calibration level.
d- Enter the password.
e- Enable the calibration setting YES in the parameter **CAL Ib**.
f- With the aid of an electrical signals simulator, apply a signal level close the lower limit of the measuring range of the input, on the corresponding terminals.
g- Access the parameter " **InLc**". With the keys ▲ and ▼ adjust the display reading such as to match the applied signal. Then press the P key.
h- Inject a signal that corresponds to a value a little lower than the upper limit of indication.
i- Access the parameter " **InHC**". With the keys "▲" and "▼", adjust the display reading such as to match the applied signal. Then press the key "P " until return to the Display PV screen.
j- Validate the calibration performed.

Note: When checking the controller calibration with a Pt100 simulator, pay attention to the simulator minimum excitation current requirement, which may not be compatible with the 0.170 mA excitation current provided by the controller.

8 TECHNICAL DATA

8.1 ELECTRICAL DATA

Power supply	100 to 240 Vac (±10 %), 50/60 Hz 48 to 240 Vdc (±10 %)
Optional 24 V	12 to 24 Vdc / 24 Vac (-10 %/+20%)
Power consumption max.	5 VA
Input	Thermocouples J; K; T and Pt100 (according to Table 1 -)
Internal Resolution	12000 levels (from -1999 up to 9999)
Rate of input reading	up to 10 per second (*)
Accuracy	
Thermocouples J, K, T	0.25 % of the span ± 1 °C (**)
Pt100	0.2 % of the span
Input Impedance	
Pt100 and thermocouples:	> 10 MΩ
Measurement of Pt100	3-wire type, (α=0.00385)
With compensation for cable length	excitation current of 0.170 mA
OUTPUTS	
OUT1	Relay SPST; 1.5 A / 240 Vac / 30 Vdc
OUT2	Relay SPST; 1.5 A / 240 Vac / 30 Vdc

(*) Value adopted when the Digital Filter parameter is set to 0 (zero) value. For Digital Filter values other than 0, the Input Reading Rate value is 5 samples per second.

(**) The use of thermocouples requires a minimum time interval of 15 minutes for stabilization.

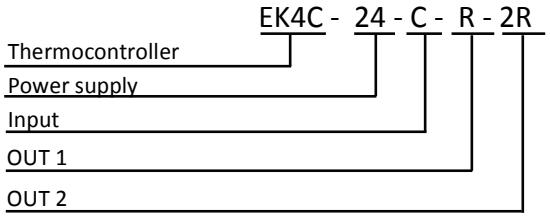
8.2 MECHANICAL DATA

Environmental conditions	
Operation Temperature	0 to 50 °C
Relative Humidity	80 % @ 30 °C For temperatures above 30 °C, reduce 3 % for each °C
Others	Internal use Category of installation II Degree of pollution 2 Altitude < 2000 meters
Dimensions	48 x 48 x 35 mm (1/16 DIN)
Cutout in panel	45.5 x 45.5 mm (+0.5 -0.0 mm)
Approximate weight (24 V / 240 V)	60 g / 75 g
Front panel	IP65, Polycarbonate (PC) UL94 V-2
Enclosure	IP20, ABS+PC UL94 V-0
Connections	Specific connections for fork terminals

8.3 FUNCTIONAL FEATURES

Electromagnetic compatibility	IEC 61326-1:2013 and IEC 61326-1:2012
Emission	CISPR11/EN5501
Immunity	EN61000-4-2, EN61000-4-3, EN61000-4-4, EN61000-4-5, EN61000-4-6, and EN61000-4-11
Safety	UL 61010-1
Programmable level of PWM	from 0.5 up 100 seconds
Start-up operations	after 3 seconds connected to the power
Certification	CE and cULus

9 ORDERING CODE



Power supply	24	12…24 Vdc / 24Vac (-10%...+20%)
	240	100…240Vac / 48…240 Vdc (±10%)
Input	C	J, K, T, PT100
OUT 1 Output	R	Relay SPST-NO 1,5A (240Vac / 30Vdc)
OUT 2 Output	2R	Relay SPST-NO 1,5A (240Vac / 30Vdc)