ELK22MP

MICROPROCESSOR DIGITAL ELECTRONIC REGULATOR

INSTRUCTIONS FOR USE
Ver. 04 (EN) – 02/22

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INTRODUCTION

This manual contains the information required for proper installation and the instructions for use and maintenance of the product. It is therefore recommended to read it carefully and to preserve it.

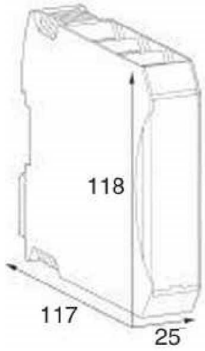
EL.CO. S.R.L. reserves the right to make aesthetic and functional changes at any time and without notice.

If a malfunction or failure of the device can create hazardous or dangerous situations for people, animals or property, the system must be equipped with additional security devices.

EL.CO. S.R.L. and its legal representatives do not assume any responsibility for any damage to people, things or animals deriving from tampering, improper use, incorrect use or otherwise not complying with the device's features.

1 – DIMENSION (mm)

1.1 – ELK22MP MODULE FOR DIN RAIL ASSEMBLY



2 - DEVICE DESCRIPTION

2.1 - GENERAL DESCRIPTION

The ELK22MP series is made up of digital microprocessor controllers, with ON / OFF, ON / OFF neutral zone, PID and with AUTOTUNING function for PID regulation.
The instrument can have up to 3 outputs, for settingstatic relays (SSR) or 2 relays. It is compatible with TC, J, K - RTD Pt 100 temperature probes; PTC KTY8 1-121; NTC 103AT-1 - For normalized signals 4… 20mA, 0… 10V.
It is designed for mounting on a din rail.

The ELK22MP series consists of 4 models. 3 of these act as a centralizer and one of them as a slave. The models of the ELK22MP series are:
- ELK22MP: Control unit equipped with programmable inputs and outputs with the ELK22DKP keyboard
- ELK22MPM: Centralizer equipped with programmable inputs and outputs via ELK22DKP keyboard andRS485
- ELK22MPE: Centralizer equipped with programmable inputs and outputs via RJ45 (Ethernet).
- ELK22MPS: Slave equipped with inputs and outputs, controlled via bus by ELK22MP or ELK22MPM or ELK22MPE

The configuration of the instrument foresees the connection of 1 centraliser product (ELK22MP, ELK22MPM) connected to 15 ELK22MPS via bus located on the back of the product, sold as an accessory (see Paragraph 10.6). Using the ELK22MPE centralizer it is possible to connect 31 ELK22MPS devices, again via the bus located on the back of the product, which can be sold as an accessory (see Paragraph 10.6).
Using an external device (for example ELK22DKP (see Paragraph 3.2), PLC, PC ...) it is possible to program the centralizer and the slave devices connected to it via the bus on the back (see Paragraph 4.6).
Throughout the manual we consider ELK22MP, ELK22MPM or ELK22MPE devices as “centralizing devices” and ELK22MPS devices as “slave devices”. If there are any particular functions then we will refer to the particular model.

3 - PROGRAMMING

3.1 – PROGRAMMABLE MODELS

The programming phase must take place when the product is switched on. According to what has been described, the configuration of a series of ELK22MP foresees the installation of a centralizing device with n slave devices connected through the bus (see Paragraph 4.6).
The various programming modes are:
- Via keypad ELK22DKP (only for ELK22MP and ELK22MPM)

- Via RS485 (only for ELK22MPM)
- Via Ethernet (only for ELK22MPE)

Programming with RS485 or Ethernet can be done via, for example, operator panel, PLC or computer.
We will indicate "external instrument" the set of all the instruments that can connect to the centralizing devices.
The programming phases must reflect these steps:

- Only one centralizing device
  - Power on the device
  - Programming the centralizing device with the external device
  - Use the device
- One centralizing devica with N slave device
  - Power on the centralizing deivce
  - Programming the centralizing device with the external device
  - Connect a slave to the centralizer via bus (, see Paragraph 4.6). Turn on the product and program it with the external device connected to the centralizer. **The external device cannot be connected to a slave device.**
  - Repeat the previous step for each slave in possession.
  - Use the devices

After having programmed the various devices, it is possible to control them with the external device connected **only** to the centralizing device. The slave devices are connected with the bus (see Paragraph 4.6) to the centralizing device but are controlled by the external device.

⚠ **The devices, if more than one, must be connected one by one and programmed one by one. Each device has the same default address. (see Paragraphs 3.2.1, 3.3.2 and 3.4.2)**

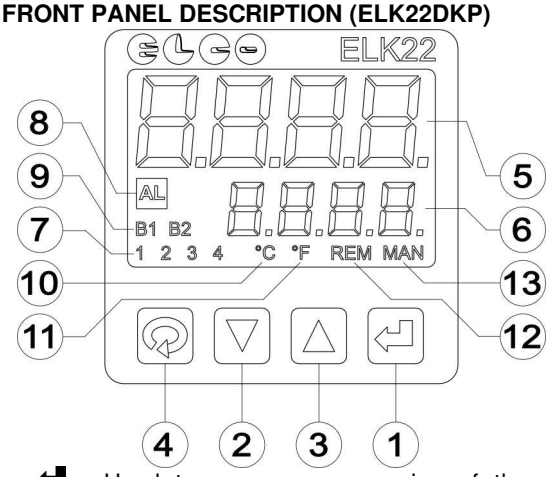
3.2 – PROGRAMMING BY ELK22DKP KEYBOARD (only for ELK22MP e ELK22MPM)

3.2.1 – DESCRIPTION

Only the ELK22MP and ELK22MPM models can be programmed via the ELK22DKP keypad. Through the bus connection (see Paragraph 4.6) it is possible to program the slave products ELK22MPS. The keyboard connected to the ELK22MP or ELK22MPM model can program and set the parameters of each ELK22MPS connected via bus.

The default MODBUS address is 100.

3.2.2 - FRONT PANEL DESCRIPTION (ELK22DKP)



1 – Key ↵ : Used to access programming of the operating parameters and to confirm the selection.
2 - Key ▼ : Used for decreasing setpoint setting, values to be set, and for parameter or module selection. Long pressed in full menu programming, it changes the access level of the selected parameter. (See para. 3.1, 3.3). Long pressed in the menu for the module selection performs the download of the parameters from the module to the programming keypad. (See para. 3.5).
3 - Key ▼ : Used for increasing setpoint setting, values to be set, and for parameter or module selection. Long pressed in full menu programming, it changes the access level of the selected parameter. (See para. 3.1, 3.3). Long pressed in the menu for the module selection performs the upload of the parameters from the programming keypad to the module. (See para. 3.5).
4 – Key ↺: When in programming mode, you can use it to quit programming or to cancel the change of a parameter. During normal operation, it enables the menu to select a module.
5 – 4 red digits: Process value during operation, parameter selected during programming.
6 – 4 green digits: Setpoint value during operation, value of the parameter selected during programming.
7 – LED 1 : It indicates OUT1 output status. **LED 2** : It indicates OUT2 output status.
8 – LED AL : It indicates the state of the alarm.
9 – LED B1 : In full programming mode, it indicates that the parameter is not visible in the operator menu. **LED B2** : In full programming mode, it indicates that the parameter is visible in the operator menu.
10 – LED °C : It indicates unit of measure in degrees centigrade.
11 – LED °F : It indicates measurement units in degrees Fahrenheit.
12 – LED REM : In parameters programming mode, it indicates that you are changing the selected parameter. In module selection programming mode, it indicates that you are selecting a remote module.
13 – Led MAN : In module programming mode, it indicates the download of a setting.

3.2.3- MODULE SELECTION

Pressing the button ↺ lights up the **REM** LED to indicate that you can select on which ELK22MP you want to connect to and interact with the programming keypad.. The 4-color display displays the read temperature while the 4-screen green display shows the address of the ELK22MP you are currently selecting. Use the ▲ and ▼ keys to select the desired ELK22MP depending on the address you set. Pressing the key ↵ confirms the selection of the ELK22MP with the displayed address.

3.2.4 - SETPOINTS FAST SETTING

The 4 green displays display always displays the setpoint set. Pressing the ▲ key increases the value and pressing the ▼ key decreases the value. These keys act at one-digit steps, but if pressed for more than half a second, the value increases or decreases rapidly to allow quick access to the desired value. The setpoint can be set with a value between the value programmed in para. **"SSP"** and the value programmed in para. **"FSP".**

3.2.5 - PROGRAMMING THE PARAMETERS

To have access to the operating parameters of the device in the installer mode, you must press the key ↵ and hold it for about 2 seconds, while pressing the key ↵ for user mode access. The display will show **"SET"** and then **"PASS"** if a password for the installer access is set. Use the ▲ and ▼ keys to enter the password and confirm with ↵. The red display shows the code that identifies the parameter, the green display shows the value set and with the ▲ and ▼ keys you can select the parameter you want to edit. Once the desired parameter is selected by pressing the key ↵, the **"REM"** LED lights up to indicate that you are changing the parameter setting using the ▲ and ▼ keys. After setting the desired value, press again the key ↵; the new value will be stored while, pressing the key ↺, the new value will not be stored, then the **"REM"** LED will switch off. By using the ▲ and ▼ keys, you can select another parameter and change it as described. To exit the programming mode, do not press any key for about 10 seconds if in user mode or 20 seconds if in the installer mode, or hold down the key ↺ until you exit the programming mode.

3.2.6 - PROTECTION OF PARAMETERS WITH PASSWORD

The device has two levels of access to the programming, installer, and user menu. The password can be customized via the **"PASS"** parameter**.** If you want to have this protection, set the **"PASS"** parameter with the desired password number and exit the parameter programming. If you do not want to protect the installer menu, set the parameter **"PASS"** on "0000'. By accessing the installer mode, each parameter will have the **B1** or **B2** LED on. **B1** indicates that the parameter is visible only in the installer menu; otherwise, **B2** indicates that it is also visible in the user menu. To enable a parameter to be visible on the user menu, hold down the ▲ key until **B1** turns off and **B2** lights up. To hide a parameter from the user menu, hold down the ▼ key until **B2** turns off and **B1** lights up.

Is possible from this parameter set the default factory default. From password value 0000 hold down the key ▼ two times. Display show **rSt dEF**, premere il tasto ↵, display show **rSt SurE**, at this time hold down the key ▲ for three seconds. In any time is possible cancel the reset request by hold down the key ↶.

3.2.7 - COPY OF PARAMETERS FROM AN ELK22MP TO ANOTHER

From the ELK22MP selection menu, you can copy the programming parameters of an ELK22MP to other ELK22MP.

You must download the parameters by pressing the ▼ button for a long time until the **MAN** LED lights up. The **MAN** LED indicates that you have a loaded configuration that can be copied to other ELK22MP. Use the ▲ and ▼ keys to select ELK22MP on which you want to copy the configuration and start uploading the parameters by pressing the ▲ key for a long time.. The 4-color display displays **"UP_C"**; confirm by pressing the key ↵ or cancel the copy by pressing the key ↶. To erase the parameters from the download zone, press and hold the key ↶ until the **MAN** LED turns off.

3.2.8 – DATA EXCHANGE

Data is exchanged via the bus commanded from the keyboard. Communication via bus takes place via an RS485 line.

The configurable parameters are found in Paragraph 6.

3.3 – PROGRAMMING BY RS485 MODBUS (only for ELK22MPM)

3.3.1 – DESCRIPTION

The ELK22MPM devices are equipped with an RS485 serial communication interface.

At rest, the module is in receiving condition and transmits after receiving and decoding a correct message addressed to it.

The connection between the ELK22MPM accelerator and the ELK22MPS slaves is via bus, which can be purchased as an accessory. (see Paragraph 10.6)

To keep the line at rest it is necessary to use a 120 Ohm termination resistor. The device does not mount this resistance. The termination of the RS485 line with the 120 Ohm resistor can be done using the terminal supplied as an accessory. (see Paragraph 10.6)

The communication speeds adopted range from 1200 to 38400 baudrates and allow very satisfactory performances, while remaining well below the limits imposed by the RS485 standard. This allows the line to be wired using a medium quality shielded twisted pair - the total line capacity should not exceed 200 nF.

⚠ **The poll rate during programming and in use must not be less than 50ms.**

In case of using a number greater than 8 ELK22MPS the recommended poll speed is greater than or equal to 80ms.

⚠ **The maximum length of an RS485 transmission is 400 meters.**

3.3.2 – COMMUNICATION PROTOCOL DESCRIPTION

The protocol is a subset of the widely used MODBUS RTU protocol. This choice guarantees ease of connection to many PLCs and to all commercial supervision programs.

The default MODBUS address is 100.

For those wishing to develop their own application software, all the necessary tips and information are available.

The MODBUS RTU protocol functions implemented in the EKL22MPM instruments are:

Function 1 - output status read
Function 3 - n word read
Function 6 - one word write
Function 7 - allarm status read

These functions (see Paragraph 7) allow the supervision program to read and modify any data of the module. The communication is based on messages sent from the centralization station (ELK22MPM) to a slave station (ELK22MPS) and vice versa. The slave station which recognizes its address in the message, analyzes its content and, if it finds it formally and semantically correct, generates a reply message for the master.

The communication process involves four types of messages:

From the centralizer to the slave:

- Function 1: output status read request
- Function 3: n word read request
- Function 6: one word write request
- Function 7: allarm status read request

From the slave to the centralizer:

- Function 1: output status read replay
- Function 3: n word read replay
- Function 6: one word write replay
- Funzione 7: allarm status read replay

Each message contains four fields:

- slave address: the values between 1 and 255 are valid; address 0 (zero) is reserved by MODBUS RTU for the diffusion of messages, but is not adopted in the ELK22MP series due to the implicit unreliability of this type of communication;
- function code: contains 1 or 3 or 6 or 7 depending on the specified function;
- information field: contains the addresses or the value of the words, as required by the function in use;
- control word: contains a Cyclic Redundancy Check (CRC) calculated according to the rules envisaged for CRC16.

The characteristics of asynchronous communication are: 8 bits, no parity, one stop bit.

The functions described for the RS485 protocol are found in Paragraph 7.

3.3.3 – DATA EXCHANGE

The data exchanged consists of a 16-bit word. All readable and writable data appear as 16-bit words allocated in the instrument's memory.

The operating and configuration parameters of the instrument can be read and written via serial communication.

The configurable parameters are found in Paragraph 6.

3.4 – PROGRAMMING VIA ETHERNET TCP / IP (only for ELK22MPE models)

3.4.1 – DESCRIPTION

ELK22MPE devices are equipped with an RJ45 Modbus TCP / IP communication interface. At rest, the module is in receiving condition and transmits after receiving and decoding a correct message addressed to it.

⚠ **The poll rate during programming and in use must not be less than 50ms.**
In case of using a number greater than 8 ELK22MPS the recommended poll speed is greater than or equal to 80ms.

3.4.2 – COMMUNICATION PROTOCOL DESCRIPTION

The protocol is a subset of the widely used MODBUS RTU protocol. This choice guarantees ease of connection to many PLCs and to all commercial supervision programs.
The connection between the ELK22MPE centralizer with the ELK22MPS slaves is via bus, which can be purchased as an accessory. (see Paragraph 10.6)

The default IP address is 10.10.10.50.
The default SUBNET MASK address is 255.255.255.0
The default GATEWAY address is 0.0.0.0

For those wishing to develop their own application software, all the necessary tips and information are available.
The MODBUS TCP / IP protocol functions implemented in the EKL22MPE instruments are:

Function 1 - output status read
Function 3 - n word read
Function 6 - one word write
Function 7 - allarm status read

These functions (see Paragraph 8) allow the supervision program to read and modify any data of the module. The communication is based on messages sent from the centralization station (ELK22MPE) to a slave station (ELK22MPS) and vice versa. The slave station which recognizes its address in the message, analyzes its content and, if it finds it formally and semantically correct, generates a reply message for the master.

The communication process involves four types of messages:

From the centralizer to the slave:

- Function 1: output status read request
- Function 3: n word read request
- Function 6: one word write request
- Function 7: allarm status read request

From the slave to the centralizer:

- Function 1: output status read replay
- Function 3: n word read replay
- Function 6: one word write replay
- Funzione 7: allarm status read replay

Each message contains six fields:

- header: 2 bytes of unique identification code
- control: 2 bytes always at 0
- length: length of the packet excluding the first 6 bytes
- slave address: the values between 1 and 255 are valid; address 0 (zero) is reserved by MODBUS RTU for the diffusion of messages, but is not adopted in the ELK22MP series due to the implicit unreliability of this type of communication;
- function code: contains 1 or 3 or 6 or 7 depending on the specified function;
- information field: contains the addresses or the value of the words, as required by the function in use;

The functions described for the TCP / IP protocol are found in Paragraph 8.

3.4.3 – DATA EXCHANGE

The data exchanged consists of a 16-bit word. All readable and writable data appear as 16-bit words allocated in the instrument's memory.
The operating and configuration parameters of the instrument can be read and written via serial communication.

The configurable parameters are found in Paragraph 6.

4 – WARNINGS FOR INSTALLATION AND USE

4.1 – PERMITTED USE

⚠ The device has been designed as a measurement and adjustment device in accordance with EN61010-1 for operation at altitudes up to 2000 m. The use of the device in applications not expressly provided for in the aforementioned standard must include all appropriate protective measures. The device CANNOT be used in hazardous (inflammable or explosive) environments without proper protection. It should be remembered that the installer must ensure that the electromagnetic compatibility rules are respected even after the device has been installed, possibly using special filters. If a failure or malfunction of the device can create hazardous or dangerous situations for persons, animals or property, the system must be equipped with additional electromechanical devices to ensure safety.

4.2 - MECHANICAL ASSEMBLY

The ELK22Mp module must be installed on the DIM rail. Avoid placing the inside of the device in places subject to high humidity or dirt that may cause condensation or introduction into the device of parts or conductive substances. Ensure that the device has adequate ventilation and avoid installation in containers where devices are located that can lead the device to operate outside the declared temperature limits. Install the device as far as possible from sources that may generate electromagnetic disturbances such as motors, contactors, relays, solenoid valves etc.
Only the frontal panel will be accessible after the installation.
The programming device, in a 50 x 50 mm container, is designed for panel-mounted mounting inside housing. Then make a 45 x 45 mm square hole or a 22 mm diameter hole and insert the keypad by fastening it with the supplied nut. It is recommended to mount the special gasket to obtain the degree of frontal protection stated.
An installation not complying with these instructions could compromise the protection declared.

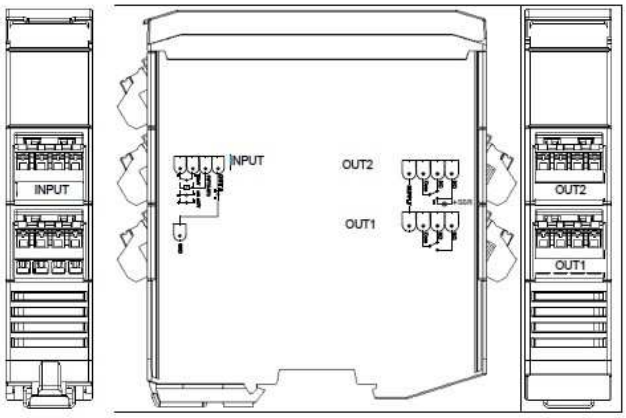
4.3 ELECTRICAL CONNECTIONS

Make the connections by connecting only one conductor for each clamp and following the diagram shown, checking that the supply voltage is that indicated on the device and the absorption of the actuators connected to the device is not higher than the maximum current allowed. The device, provided for permanent connection within an equipment, does not have either switch or internal overcurrent protection devices. It is therefore recommended to provide for the installation of an overcurrent protection device (500mA fuse for the 230∿ model or 2A fuse for the 24≂ model) and a bipolar switch/disconnecting switch, marked as a disconnecting device, which interrupts the power supply of the device. This switch must be positioned as close as possible to the device and in a place easily accessible by the user. It is also recommended to adequately protect the supply of all circuits connected to the device with suitable items (i.e. fuses) that are appropriate for circulating currents. It is recommended to use insulation cables suitable to the voltages, temperatures and operating conditions and to ensure that

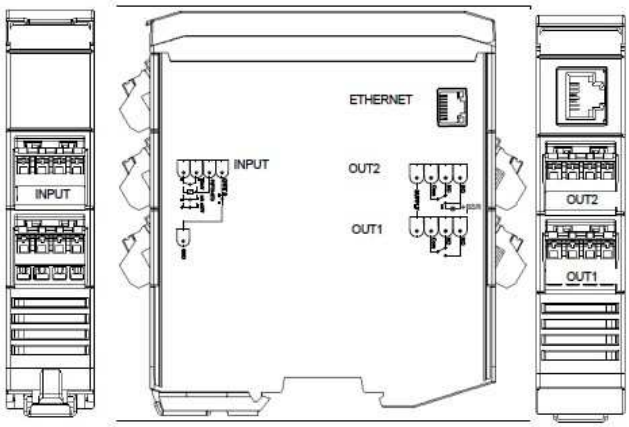
the cables for the input sensors are kept away from power cords and other power cables, in order to avoid induction of electromagnetic disturbances. Output SSRs and inputs are not electrically insulated. Connect on the input only insulated probes. If some wiring harness cables are shielded, it is recommended to connect them to one side on the ground. Finally, it is recommended to check that the set parameters are the desired ones and that the application works properly before connecting the outputs to the actuators in order to avoid system abnormalities that could cause damage to persons, things or animals.

4.4 – ELECTRICAL SCHEME CONNECTIONS

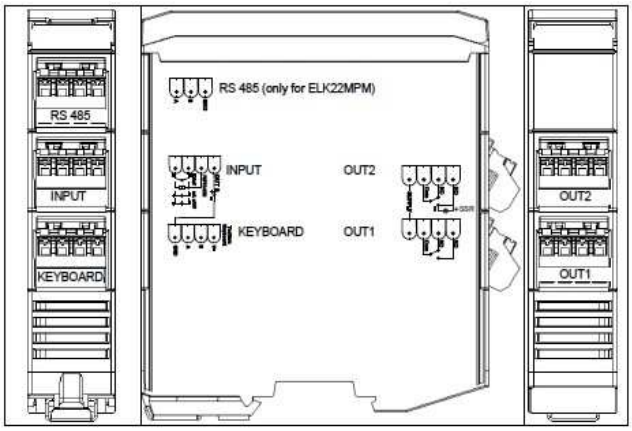
4.4.1 - ELK22MPS



4.4.2 - ELK22MPE



4.4.3 - ELK22MP e ELK22MPM



4.4 - ELECTRICAL SCHEME CONNECTIONS FOR ELK22DKP (only for ELK22MP or ELK22MPM)

Morsetti / *Terminal blocks*

1	2	3	4
□	□	□	□

1- V+ (Power suply)
2- RS485 - B
3- RS485 + A
4- V- (Power supply)

4.5 – CONNECTION FROM ONE DEVICE TO ANOTHER DEVICE

The ELK22MP series devices can be connected to each other via the bus connector supplied as an accessory. (see Paragraph 10.6). Slave devices must be connected to a centralization device to form a sequence.

⚠ A devices sequence that have ELK22MPE as a centralizer must consist of a centralizer device and a maximum of 1 to 31 slave devices.

⚠ A devices sequence that have ELK22MPM or ELK22MP as a centralizer must consist of a centralizer device and a maximum of 1 to 15 slave devices.

⚠ Two control units cannot be connected to each other via the bus but must be considered as two distinct devices. Two control units connected to each other via bus can cause a malfunction of the product.

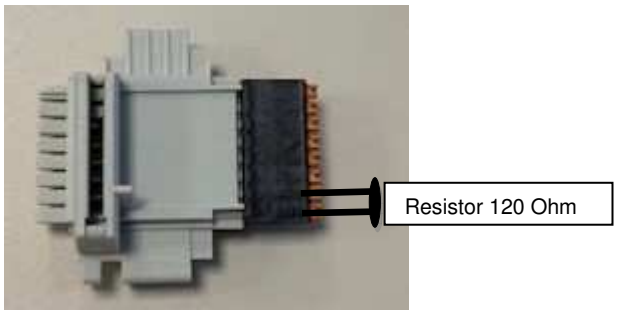
⚠ Be careful if you change the centralization device. If you switch from an ELK22MPE to an ELK22MPM or ELK22MP centralizer, pay attention to the number of ELK22MPS connected via bus.

4.6 – CONNECTION WITH TERMINAL RESISTOR

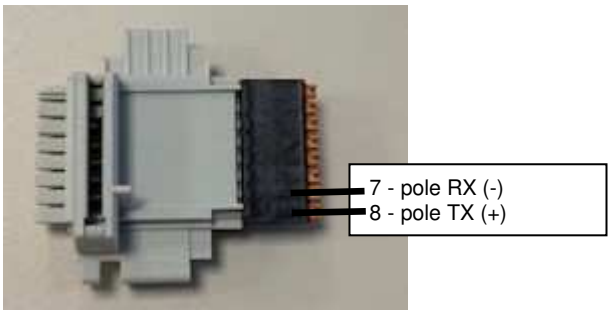
ELK22MP devices use RS485 via bus to communicate with each other. In particular, the centralizing device communicates via bus with the slave devices in order to program them.
The RS485 line requires a termination resistor to avoid disturbances. This resistance, 120 Ohm, must be placed at the end of an RS485 line. Through the connector (see paragraph 10.6) it is possible to mount the termination resistor directly on the bus at the end of the ELK22MP series device line.

⚠ **The termination resistor is mandatory for the operation of any RS485 line.**

Terminating a line of ELK22MP series devices with the connector (see Paragraph 10.6) and the 120 Ohm resistor gives the possibility to terminate an RS485 serial line. The accessory is already supplied with a 120Ohm resistor.

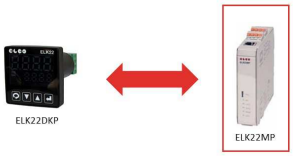


It is possible to continue the serial line using the same connector (see Paragraph 10.6). In this mode, the termination resistor will not be placed at the end of the battery of the ELK22MP devices but it must be the device to which the line is connected that must have the termination resistor. To do this, disconnect the resistance from the accessory and continue the line with the cables for RS485 as below screenshot shwon

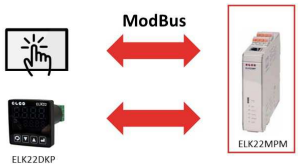


4.7 – IMAGE CONNECTION

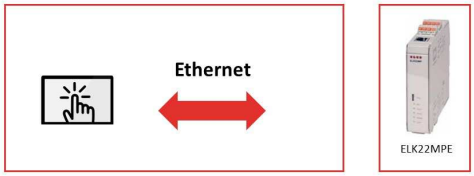
4.7.1 – ELK22MP Stand Alone



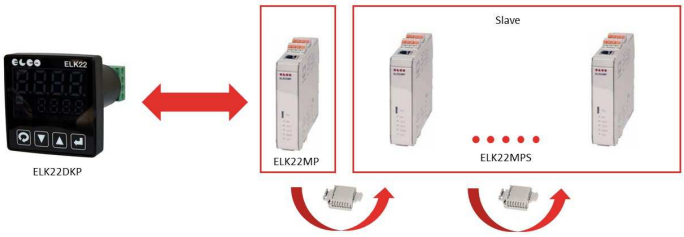
4.7.2 – ELK22MPM Stand Alone



4.7.3 – ELK22MPE Stand Alone

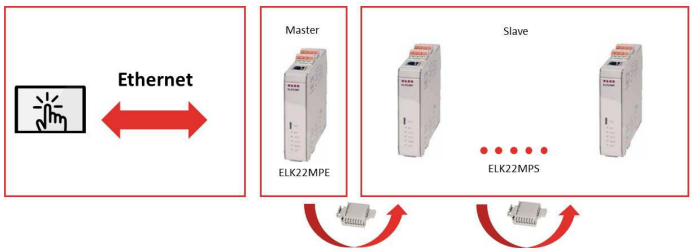


4.7.4 – ELK22MP with at most 15 ELK22MPS



4.7.5 – ELK22MPM with at most 15 ELK22MPS

4.7.6 – ELK22MPE with at most 31 ELK22MPS



5 – OPERATION

5.1 - MEASUREMENT AND DISPLAY

The thermoregulator handles the following sensors that can be set by the **"Sens"** parameter: thermocouple type (TCJ), K (TCK), S (TCS), PTC KTY81-121 (ptc), NTC 103AT-2 (ntc), PT100 (p100), 0-10V (0-10), 4-20mA (4-20)..

When changing this parameter, it is recommended that you turn the power off and on again to obtain a correct measurement.

You can set the measurement unit of temperature (°C, °F) by the **"Unit"** parameter and the desired measurement resolution (0=1; 1=0,1) by the **"dP"** parameter (for Pt100, 0-10V, 4-20mA).

The device allows the calibration of the measurement, which can be used for a new calibration of the device according to the needs of the application, by par. **"CA"**. You can set a positive or negative offset that is simply added to the value read by the probe before the display and that is constant for all measurements. You can define the temperature display range by setting the **"SSC"** and **"FSC"** parameters.

Using the **"FiL.d"** parameter, you can set the display update time..

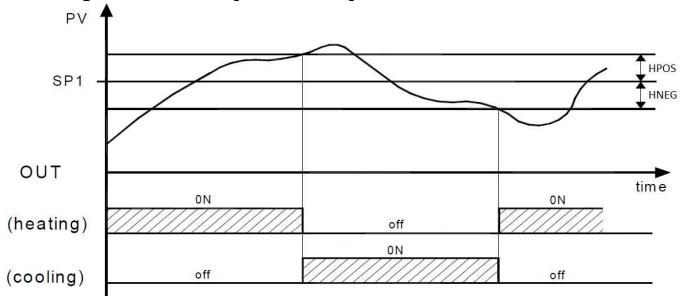
5.2 - ON/OFF REGULATOR

This adjustment mode can be achieved by setting the **"Cont" = On.F** parameter and can act on output 1 or output 2 or output 3 according to the measurement, of the Setpoint **"SP1"**, the operating mode **"O1F"**, **"O2F"**, **"O3F"**, and the hysteresis **"HPOS"** and **"HNEG"** programmed.

The device performs an ON/OFF adjustment with asymmetric hysteresis.

The regulators behave as follows: in case of reverse action or heating (**"OxF"**=H.REG), they disable the output when the process value reaches the [SP + HPOS] value and reactivate it when it falls below the [SP - HNEG] value.

Vice versa, the regulators behave as follows: in case of direct action or cooling (**"OxF"**=C.REG), they disable the output when the process value reaches the [SP - HNEG] value and reactivate it when it goes over the [SP + POS] value.



5.3 - NEUTRAL ZONE ON/OFF ADJUSTMENT

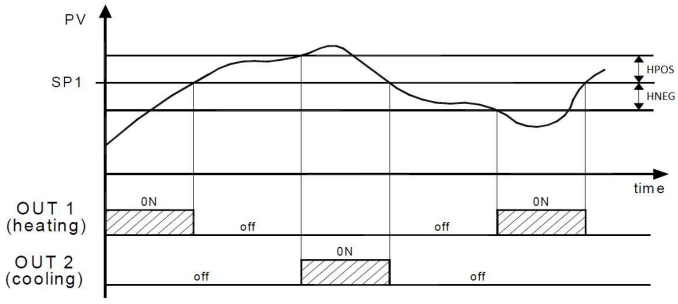
Neutral Zone operation is used to control systems that have an element that causes a positive increase (i.e. heating, humidifying, etc.) and an element that causes a negative increase (i.e. cooling, dehumidifying, etc.).

This operation can be carried out when there are 2 outputs and it's obtained by programming the parameter **"Cont" = ON.FN**, the parameter **"OxF" = H.REG**, the parameter **"OyF" = C.REG**.

The adjustment operation operates on outputs depending on the measurement of the setpoint **"SP1"** and hysteresis **"HPOS"** and **"HNEG"** programmed.

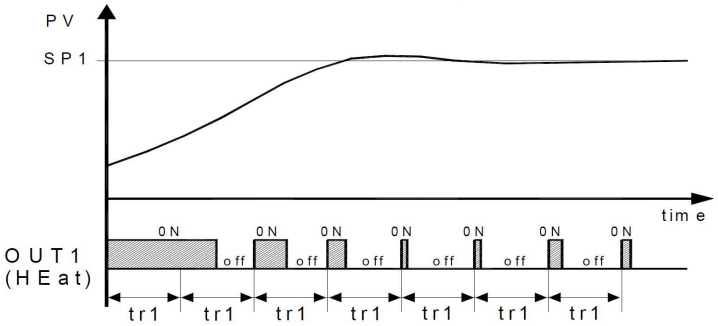
The regulator behaves as follows: it turns off the outputs when the process value reaches the **SP1** setpoint and activates the **OUT1** output when the process value is less than [**SP1-HNEG**],or turns on the OUT2 output when the process value is greater than [**SP1+HPOS**].

Consequently, the element causing the positive increase will be connected to the **OUT1** output while the negative increase element will be connected to **OUT2** output.



5.4 - PID REGULATOR

The PID single action adjustment mode can be implemented by setting the parameter **"Cont" = Pid** and acts on OUT1 or OUT2 or OUT3 output as a function of the **"SP1"**setpoint.



To obtain a good stability of the variable in fast processes, the **"tr1"** cycle time must have a low value with a very frequent intervention of the adjustment output.

In this case, it is recommended to use a static relay (SSR) for the actuator control.

The single-action PID adjustment algorithm provides the setting of the following parameters:

"Pb" - Proportional Band
"tI" - Integral Time
"td" - Derivative time
"tr1" - Output cycle time

5.5 - AUTOTUNING FUNCTION

The **AUTOTUNING** function calculates the PID parameters through an OSCILLATORY tuning cycle, after which the parameters are stored by the device and, during the adjustment, they remain constant.

Autotuning function automatically calculates the following parameters:

"Pb" - Proportional Band
"Int" - Integral Time
"dEr" - Derivative time

<u>To enable the AUTOTUNING function, proceed as follows:</u>

1) Set the desired **"SP1"** setpoint.
2) Set the **"Cont"** =Pid setpoint.
3) Set the **"O1F"** parameter depending on the process to be controlled through OUT1 output.
4) Set the **"Auto"** parameter as:

= 1 - if you want autotuning to start automatically every time you turn on the device.

= 2 - if you want autotuning to start automatically at the next power up of the device and, once tuning is completed, the par. **"Auto"**=OFF.

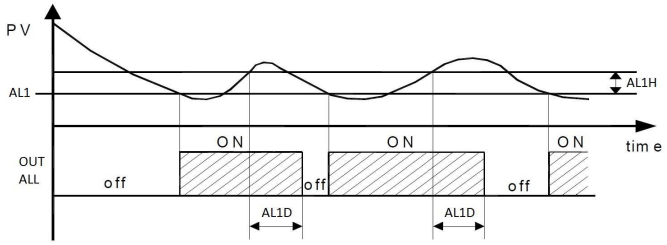
= 3 – manual start-up by hold down the key for 5 seconds

5) Quit programming parameters.
6) Connect the device to the controlled system.
7) Activate autotuning by turning the unit off and on again. At this point, the Autotuning function is activated and is reported through the "Auto" display on the green display.

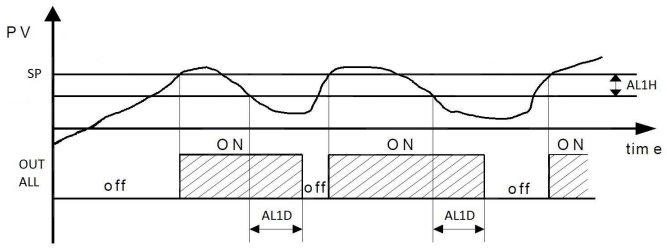
The regulator then performs a series of connected system operations to calculate the most suitable PID adjustment parameters.
The duration of the Autotuning cycle is limited to a maximum of 12 hours.
If the process is not completed within 12 hours, the parameters will not be changed and display show **"Fail Auto"**. Holding down the key return to normal operation.
Is possible stop the autotuning process by hold down the key for five seconds.
The values calculated by the AutoTuning will be automatically stored by the device at the end of the proper run of the Autotuning cycle in the PID adjustment parameters.

5.6 - ALARM FUNCTION

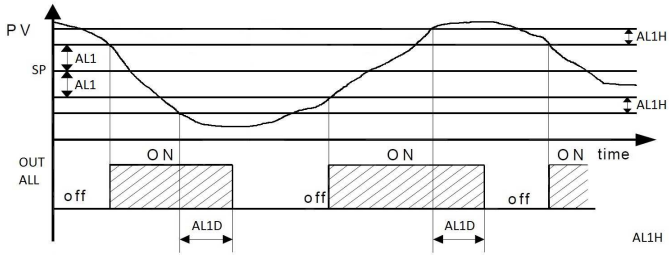
In the control mode, you can activate relative minimum or maximum, absolute minimum or maximum, relative window with activation inside or outside window alarms.
You can enter a hysteresis and a delay on the return of the alarm. Such functions may be useful in order to avoid frequent interventions of the outputs especially when they command compressors.
The delay function is deactivated by programming **"ALxD"** on 0.
The parameter **"ALx"** sets the alarm setpoint..
Set **"O1F"** = AL to associate output 1 with the alarm 1.
Set **"O2F"** = AL to associate output 2 with the alarm 2.



*Example of operation with **"AL1T"** = Loab (minimum alarm)*



*Example of operation with **"AL1T"** = HidE (relative maximum)*



*Example of operation with **"AL1T"** = LHdi (relative band in)*

5.7 – SETTING MODULE ADDRES

ELK22MP have 16 as default addres. At the startup of the system, ELK22DKP will be in communication with the lowest addres of the full system. During normal operation will be accepted value from 1 to 16. Connect one ELK22MP at time and set the ADR parameter before connect the next ELK22MP.
Example: connect and power up the first ELK22MP, program the ADR parameter to 0, and power off the system. Connect the second ELK22MP and power up the system (or only the ELK22MP), and set the ADR parameter at the next or prefer value, but it will be different of the last ADR set.

6 - PROGRAMMABLE PARAMETERS TABLE

Below are all the parameters that the device can be equipped with.

The hex address is only for ELK22MPE and ELK22MPM

The address in decimal is also avaiable for better reading.

Address 512 in decimal (0x200 in hex) is reserved for reading the product temperature.

Descrizione		Range	Def.	Indirizzo hex
SP1	SetPoint 1	SSP ÷ FSP	0	0x00-0
SENS	In-probe type: TCJ = Thermocouple J TCK = Thermocouple K TCS = Thermocouple S ntc= Thermistor NTC 103-AT2 Ptc= Thermistor PTC KTY81-121 P100= Thermal resistor Pt100 0-10= 0-10V 4-20= 4-20mA	1 = TCJ 2 = TCK 3 = TCS 4 = NTC 5 = PTC 6 = P100	TCJ	0x01-1
DP	Number of decimals	P100, 0-10, 4-20: 0 / 1	0	0x02-2
SSC	Minimum display	-999 ÷ 1000	-50	0x03-3
FSC	Maximum display	-999 ÷ 1000	1000	0x04-4
UNIT	Temperature measurement unit	0 = °C 1 = °F	°C	0x05-5
CA	Measure offset	-100 ÷ 100	0	0x06-6
FIL.D	Display adjustment time		0.5	0x07-7
CONT	Adjustment type: Pid= PID On.F= ON/OFF On.Fn= Neutral Zone (double action ON/OFF)	0 = Pid 1 = On.F 2 = On.Fn	On.F	0x08-8
AUTO	Enabling autotuning: OFF = Disabled 1 = Start-up upon each switching on 2 = Start-up upon the first switching on = Manual Start-up	OFF / 1 ÷ 3	OFF	0x09-9
BP	Proportional band (PID adj.)	1 ÷ 1000	40	0x0A-10
TD	Integral time (PID adj.)	0 ÷ 100.0 sec.	10.0	0x0B-11
TI	Derivative time (PID adj.)	0 ÷ 100.0 sec.	5.0	0x0C-12
TR1	Output time period	0.5 ÷ 20.0 sec.	20.0	0x0D-13
HPOS	Positive adjustment hysteresis	0 ÷ 100	2	0x0E-14
HNEG	Negative adjustment hysteresis	0 ÷ 100	2	0x0F-15
SSP	Setpoint setting lower limit	SSC ÷ FSC	-50	0x10-16

FSP	Setpoint setting upper limit	SSC ÷ FSC	1000	0x11-17
O1F	Operation mode of the OUT1 output: none: unused H.reg= Heating C.reg= Cooling Al= alarm On= Always on	0 = None 1 = H.reg 2 = C.reg 3 =Al 4 = On	H.reg	0x12-18
O2F	Operation mode of the OUT2 output: none: unused H.reg= Heating C.reg= Cooling Al= alarm On= Always on	0 = None 1 = H.reg 2 = C.reg 3 =Al 4 = On	None	0x13 -19
O3F	Operation mode of the OUT1 output: none: unused H.reg= Heating C.reg= Cooling On= Always on	0 = None 1 = H.reg 2 = C.reg 3 = On	None	0x14 -20
AL1T	Operation mode of the alarm: none= disabled LoAb= absolute minimum HiAb= absolut maximum LodE= relative minimum HidE= relative maximum LHdi= relative window in LHdo= relative window out	0 = None 1 = Loab 2 = Hiab 3 = LodE 4 = HidE 5 = LHdi 6 = LHdo	None	0x15 -21
AL1	Alarm threshold	SSP ÷ FSP	0	0x16 -22
HAL1	Hysteresis of alarm remedy	0 ÷ 100	1	0x17 – 23
AL1D	Delay of alarm remedy	0 ÷ 100.0 sec.	0	0x18 - 24
AL2T	Operation mode of the alarm: none= disabled LoAb= absolute minimum HiAb= absolut maximum LodE= relative minimum HidE= relative maximum LHdi= relative window in LHdo= relative window out	0 = None 1 = Loab 2 = Hiab 3 = LodE 4 = HidE 5 = LHdi 6 = LHdo	None	0x19 - 25
AL2	Alarm threshold	SSP ÷ FSP	0	0x1A - 26
HAL2	Hysteresis of alarm remedy	0 ÷ 100	1	0x1B – 27
AL2D	Delay of alarm remedy	0 ÷ 100.0 sec.	0	0x1C – 28
ADR	Module address	1 ÷ 16	16	0x1D - 29

For each model the additional parameters are:

Only for ELK22MP:

PASS	Menu password		0000	0x1E - 30
REV	Firmware revision		0x100	0x1F - 31

Only for ELK22MPM and ELK22MPS:

ADDRM	Modbus address		100	0x1E - 30
VELM	Modbus speed	0 = 1200 1 = 2400 2 = 9600 3 = 19200 4 = 38400	9600	0x1F -31
PASS	Menu password		0000	0x20 - 32
REV	Firmware revision		0x200	0x21 - 33

Only for ELK22MPE:

ADDRM	Indirizzo Modbus		100	0x1E - 30
VELM	Modbus speed	0 = 1200 1 = 2400 2 = 9600 3 = 19200 4 = 38400	9600	0x1F - 31
IP1	First set of 8-bit IP address	0-255	10	0x20 - 32
IP2	Second set of 8-bit IP address	0-255	10	0x21 - 33
IP3	Third set of 8-bit IP address	0-255	10	0x22 - 34
IP4	Fourth set of 8-bit IP address	0-255	50	0x23 - 35
SUB1	First set of 8-bit IP subnetmask	0-255	255	0x24 - 36
SUB2	Second set of 8-bit IP subnetmask	0-255	255	0x25 - 37
SUB3	Third set of 8-bit IP subnetmask	0-255	255	0x26 - 38
SUB4	Fourth set of 8-bit IP subnetmask	0-255	0	0x27 - 39
GAT1	First set of 8-bit IP gateway	0-255	0	0x28 - 40
GAT2	Second set of 8-bit IP gateway	0-255	0	0x29 - 41
GAT3	Third set of 8-bit IP gateway	0-255	0	0x2A - 42
GAT4	Fourth set of 8-bit IP gateway	0-255	0	0x2B – 43
PASS	Menu password		0000	0x2C - 44
REV	Firmware revision		0x300	0x2D - 45

7 - RS485 PROTOCOL

7.1 – FUNCTION 1 – READ OUTPUT STATUS

The address first word must be less of the number of the output and the number of the word to read, must be less or equal of the number of output minus address first word.
The request has the following frame:

Slave number	Function number	First word address MSB	LSB	Number of words MSB	LSB
byte 0	byte1= 0x01	byte 2	byte 3	byte 4	byte 5

The reply has the following frame:

Slave number	Function number	NB Number of read byte	Status output byte	CRC LSB	MSB
byte 0	byte1= 0x01	byte 2	byte 3	byte 4	byte 5

7.2 – FUNCTION 3 – READ N WORD

The number of words to be read must be less or equal twenty-eight.
The request has the following frame:

Slave number	Function number	First word address MSB	LSB	Number of words MSB	LSB	CRC LSB	MSB
byte 0	byte1= 0x03	byte 2	byte 3	byte 4	byte 5	byte 6	byte 7

The reply has the following frame:

Slave number	Function number	NB numero di bytes letti	Value of first word MSB	LSB	Following words	CRC LSB	MSB
byte 0	byte1= 0x03	byte 2	byte 3	byte 4	byte 5	byte NB+2	byte NB+3

7.3 – FUNCTION 6 – ONE WORD WRITE

The request has the following frame:

Slave number	Function number	First word address MSB	LSB	Value to write MSB	LSB	CRC LSB	MSB
byte 0	byte1= 0x06	byte 2	byte 3	byte 4	byte 5	byte 6	byte 7

The normal reply is merely an echo of the request message:

Slave number	Function number	First word address MSB	LSB	Value to write MSB	LSB	CRC MSB	LSB
byte 0	byte1= 0x06	byte 2	byte 3	byte 4	byte 5	byte 6	byte 7

7.4 – FUNCTION 7 – READ ALLARM STATUS

The request has the following frame:

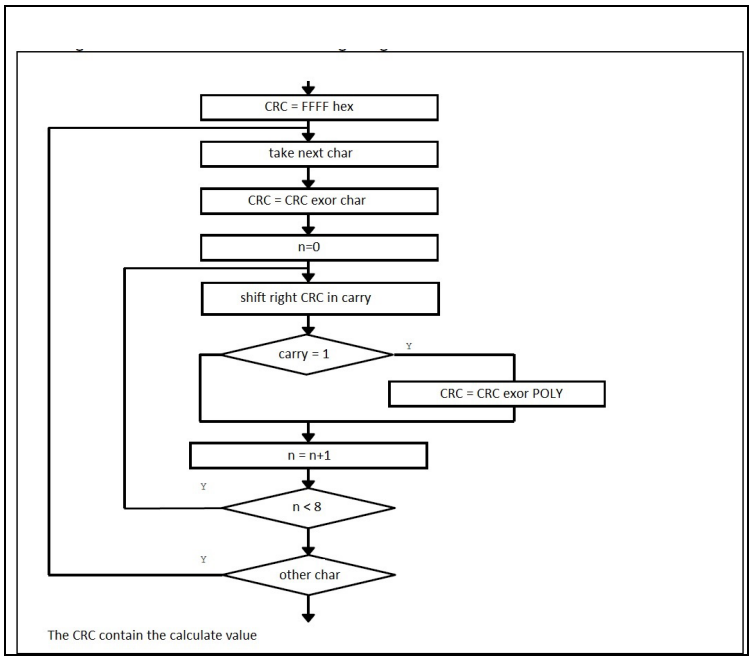
Slave number	Function number	CRC LSB	MSB
byte 0	byte1= 0x07	byte 6	byte 7

The reply has the following frame:

Slave number	Function number	Alarm Status	CRC LSB	MSB
byte 0	byte1= 0x07	byte 2	byte 3	byte 4

7.5 – CYCLIC REDUNDANCY CHECK (CRC) (Only for ELK22MPM)

CRC is a check word that premits to verify the integrity of a message.
Every message, sent or received, has in the two last characters the CRC check word.
After receiving a request, the controller checks the validity of the received message
comparing the received CRC with the calculated one.
When a reply is ready the controller calculates the CRC word and adds two characters to
the prepared message. CRC calculation is performed on every character of the message,
excluding the last two.
Being MODBUS RTU (JBUS) protocol compatible, ELK22S and ELK22MS controllers
adopt an identical algorithm for CRC calculation.



The polinomial adopted by MODBUS RTU (JBUS) is 1010 0000 0000 0001.
Note: the first transmitted character of the CRC word is the least significant between calculated bytes.

8 - TCP/IP PROTOCOL

8.1 – PROTOCOL PACKET

The TCP/IP protocol packet must consist of:

- 6 bytes di header
- Bytes relating to one of the functions described below

The construction of the packet foresees to append the other bytes relating to the function to be performed to the 6 header bytes.

For example, if you want to read the status of the outputs, you will have to create the packet by adding to the header the 6 bytes relating to the function of reading the status of the outputs. This would result in a 12-byte packet.

8.2 – HEADER TCP

The header consists of 6 bytes and is structured as follows:

Byte Univoco		Byte sempre a 0		Packet length without the length of the header	
byte 0	byte 1	byte 2	byte 3	byte 4	byte 5

The first 4 bytes are unique bytes generated by the host and to be replicated as they are to each function. The first 4 bytes are part of the standard TCP / IP protocol.

8.3 – FUNCTION 1 – READ OUTPUT STATUS

The address first word must be less of the number of the output and the number of the word
to read, must be less or equal of the number of output minus address first word.
The request has the following frame:

Slave number	Function number	First word address MSB LSB		Number of words MSB LSB	
byte 0	byte1= 0x01	byte 2	byte 3	byte 4	byte 5

The reply has the following frame:

Slave number	Function number	NB Number of read byte	Status output byte
byte 0	byte1= 0x01	byte 2	byte 3

8.4 – FUNCTION 3 – READ N WORD

The number of words to be read must be less or equal twenty-eight.
The request has the following frame:

Slave number	Function number	First word address MSB LSB		Number of words MSB LSB	
byte 0	byte1= 0x03	byte 2	byte 3	byte 4	byte 5

The reply has the following frame:

Slave number	Function number	NB numero di bytes letti	Value of first word MSB LSB		Following words
byte 0	byte1= 0x03	byte 2	byte 3	byte 4	byte 5

8.5 – FUNCTION 6 – ONE WORD WRITE

The request has the following frame:

Slave number	Function number	First word address MSB LSB		Value to write MSB LSB	
byte 0	byte1= 0x06	byte 2	byte 3	byte 4	byte 5

The normal reply is merely an echo of the request message:

Slave number	Function number	First word address MSB LSB		Value to write MSB LSB	
byte 0	byte1= 0x06	byte 2	byte 3	byte 4	byte 5

8.6 – FUNCTION 7 – READ ALLARM STATUS

The request has the following frame:

Slave number	Function number
byte 0	byte1= 0x07

The reply has the following frame:

Slave number	Function number	Alarm Status
byte 0	byte1= 0x07	byte 2

9 - LED TABLE

Thanks to the LEDs placed in front of the ELK22MP series products it is possible to observe if the product is powered, if the outputs are present and if the ethernet communication works.
(ethernet communication only for ELK22MPE).
Explanation: A = LED off, E = LED on steady, B = LED flashing

State	Description	PWS	OUT1	OUT2	OUT3	Link / Active (Only for ELK22MPE)
OFF	Device off	A	A	A	A	A
ON	Device on	E	A	A	A	A
ON, OUT1	Device on with output 1 connected	E	E	A	A	A
ON, OUT2	Device on with output 2 connected	E	A	E	A	A
ON, OUT3	Device on with output 3 connected	E	A	A	E	A
ON, OUT1, OUT2	Device on with output 1 and 2 connected	E	E	E	A	A
ON, OUT1, OUT3	Device on with output 1 and 3 connected	E	E	A	E	A
ON, OUT2, OUT3	Device on with output 2 and 3 connected	E	A	E	E	A
ON, OUT1, OUT2, OUT3	Device on with output 1,2 and 3 connected	E	E	E	E	A
ON, Link/Active	Device on with ethernet communication	E	A	A	A	E = Cable connected B = Comunication active
ON, Link/Active, OUT1	Device on with ethernet communication and output 1 connected	E	E	A	A	E = Cable connected B = Comunication active

ON, Link/Active, OUT2	Device on with ethernet communication and output 2 connected	E	A	E	A	E = Cable connected B = Comunication active
ON, Link/Active, OUT3	Device on with ethernet communication and output 3 connected	E	A	A	E	E = Cable connected B = Comunication active
ON, Link/Active, OUT1, OUT2	Device on with ethernet communication and output 1 and 2 connected	E	E	E	A	E = Cable connected B = Comunication active
ON, Link/Active, OUT1, OUT3	Device on with ethernet communication and output 1 and 3 connected	E	E	A	E	E = Cable connected B = Comunication active
ON, Link/Active, OUT2, OUT3	Device on with ethernet communication and output 2 and 3 connected	E	A	E	E	E = Cable connected B = Comunication active
ON, Link/Active, OUT1, OUT2, OUT3	Device on with ethernet communication and output 1,2 and 3 connected	E	E	E	E	E = Cable connected B = Comunication active

10 – TECHNICAL DATA

10.1 - ELECTRICAL CHARACTERISTICS

Power supply: 24V≂, 100…240V∿ +/- 10%
AC frequency: 50/60 Hz
Absorption: Approx. 4 VA
Input/s: 1 input for temperature probes: tc J, K, S ; RTD Pt 100 IEC; PTC KTY 81-121 (990 W @ 25 °C); NTC 103AT-2 (10KW @ 25 °C); 0-10V; 4-20mA.
Output/s: Up to 3 outputs. 2x Relay SPDT (6A-AC1, 3A-AC3 250 V∿, 1/2HP 250 V∿, 1/3HP 125V∿) or voltage output for piloting SSR (25mA/ 16V⎓), 1x voltage output for piloting SSR (25mA/ 16V⎓).
Auxiliary power output: 15 V⎓ not stab. / 20 mA Max
Electrical relay output life: 100000 operat.
Overtension category: II
Measurement category: I
Protection class against electric shock: Class II front
Isolation: Reinforced between low voltage parts ("24" and "240" power supply and relay outputs) and front; reinforced between low voltage parts ("24" and "240" power supply and relay outputs) and low voltage parts (static inputs and outputs); reinforced between power supply and relay outputs; reinforced between low voltage parts ("24" and "240" power supply and relay outputs) and ethernet port.
No insulation between the input and the static outputs.

10.2 - MECHANICAL CHARACTERISTICS

Container: Self-extinguishing plastic UL 94 V0
Dimensions: 50 x 50 mm, depth 118 mm
Weight ELK22MP: approx.. 150 g
Weight ELK22DKP: approx.. 60 g
Installation ELK22DKP: Panel mounting in 49,5 x 49,5 mm hole or 22 mm diameter hole
Installation ELK22MS: Omega DIN guide
Connections: 2,5 mm^2 screw terminal block
Front protection degree: IP 65 (ELK22DKP with gasket)
Pollution degree: 2
Ambience of usage: internal
Working ambient temperature: 0 ... 50 °C
Working ambient humidity: 30 ... 95 RH% with no condensation
Temperature for the transportation and storage -10 ... 60 °C

10.3 - OPERATING CHARACTERISTICS

Adjustment: ON/OFF, neutral zone ON/OFF, single action PID.
Measurement range: According to the probe used (see table)
Display resolution: According to the probe used. 1/0.1.
Total accuracy: +/- (0,5 % fs + 1 digit) ; tc S: +/- (1 % fs + 1 digit)
Measurement sampling time: 170 ms
Maximum cold joint compensation error (in tc): 0.1°C/°C at room temperature 0 ... 50°C after a warm-up time of 20 min.
Display: 4 red digits h 12 mm, 4 green digits h 7 mm
Conformity: Directive EEC EMC 89/336 (EN 61326), Directive EEC BT 73/23 and 93/68 (EN 61010-1).

10.4 - MEASUREMENT RANGE TABLE

INPUT	"dP" = 0	"dP"= 1
tc J "SEnS" = J	-50 ... 1000 °C -58 ... 1832 °F	- - - -
tc K "SEnS" = CrAl	-50 ... 1000 °C -58 ... 1832 °F	- - - -
tc S "SEnS" = PtRh10% - Pt	0... 1000 °C 32 ... 1832 °F	- - - -
Pt100 (IEC) "SEnS" = Pt1	-100 ... 400 °C -148 ... 752 °F	-100.0 ... 400.0 °C -148.0 ... 752.0 °F
PTC (KTY81-121) "SEnS" = Ptc	-50 ... 150 °C -58 ... 302 °F	
NTC (103-AT2) "SEnS" = ntc	-30 ... 110 °C -22 ... 230 °F	
0-10V "SEnS" = 0-10	-1000 … 1000	-100.0 … 100.0
4-20mA "SEnS" = 4-20	-1000 … 1000	-100.0 … 100.0

10.5 - DEVICE CODING

ELK22MP-A-B-C
ELK22MPS-A-B-C
ELK22MPM-A-B-C
ELK22MPE-A-B-C

A : SUPPLY
24 = 24 ≂ (VAC/VDC)
240 = 100... 240∿ (VAC)

B : OUTPUT OUT1
R = Relay

C : OUTPUT OUT2
2R = Relay
2S = Voltage output for SSR

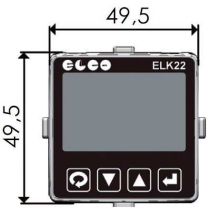
OUTPUT OUT3
For all models

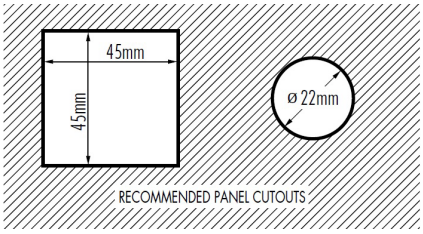
MODBUS COMMUNICATION
Only for ELK22MPM

MODBUS TCP COMMUNICATION
Only for ELK22MPE

10.6 – ACCESSORIES (Not supplied)

ELK22DKP = Keyboard





BC-8P = Connection cable for ELK22MP

TC-8P = Connector for RS485 line terminal resistor. This connector has the termination resistor already integrated

11 - PROBLEMS, MAINTENANCE AND WARRANTY

11.1 - ERROR REPORTING

Error	Reason	Action
Fail Auto	Autotuning not completed within 12 hours	Check connection probe and actuator, then restart autotuning
- - - -	Interruption of the probe	Check that the probe is correctly connected to the device, and then verify that the probe is working properly

11.2 - CLEANING

It is recommended to clean the device only with a slightly soaked cloth of water or non-abrasive detergent and not containing solvents.

11.3 - WARRANTY AND REPAIR

The device is guaranteed by manufacture defects or defects in material found within 12 months from the date of delivery.
Warranty is limited to repair or replacement of the product.
Possible opening of the container, tampering with the device, or improper use and installation of the product will automatically result in the warranty being decayed.
In case of defective product during warranty period or out of warranty period, contact the EL.CO. sales office. To get permission to ship.
The defective product, therefore, accompanied by the indications of the defect found, must be delivered by freight forwarding at the EL.CO. factory, unless otherwise agreed.