

OK 33-PEL

DIGITAL MICROPROCESSOR-BASED ELECTRONIC CONTROLLER WITH DIRECT COMMAND FOR PELTIER DEVICE



OPERATING INSTRUCTIONS Vr. 01 (ENG)

FOREWORD



This manual contains the information necessary for the product to be installed correctly and also instructions for its maintenance and use; we therefore recommend that the utmost attention is paid to the following instructions and to save it.

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1 - INSTRUMENT DESCRIPTION

1.1 - GENERAL DESCRIPTION

OK 33-PEL is a single-loop digital microprocessor-based controller for **PELTIER ELEMENTS** with PID dual action (direct and reverse) control and with **AUTO-TUNING FAST** function, **SELF-TUNING** function and automatic calculation of the **FUZZY OVERSHOOT CONTROL** parameter for PID control.

The PID control has a particular algorithm with **TWO DEGREES OF FREEDOM** that optimises the instrument's features independently in the event of process disturbance and Set Point variations.

The instrument has an output with automatic reverse polarity for the direct command of PELTIER devices at 12 to 24 Volts DC, a maximum current absorption of 7 Amps and can also have up to 2 alarm outputs to pilot static relays (SSR).

Furthermore, the instrument allows for 2 digital inputs and RS485 serial communication using MODBUS-RTU communication protocol and a transmission speed up to 38.400 baud.

The process value is visualized on 4 red displays, while the output status is indicated by 4 LED displays.

The instrument is equipped with a 3 LED programmable shift indexes.

The instrument provides for the storage of 4 Set Points and can have up to 4 outputs: relay type or can drive solid state relays type (SSR).

Depending on the model required the input accept:

D: Thermoresistances PT100, Thermocouples temperature probes (J,K,S and OSAKA IRS Infrared sensors), mV signals (0..50/60 mV, 12..60 mV),

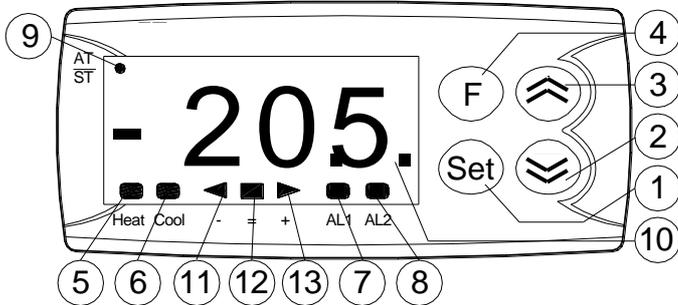
E : Thermistors PTC and NTC, Thermocouples temperature probes (J,K,S and OSAKA IRS Infrared sensors), mV signals (0..50/60 mV, 12..60 mV),.

I : normalized analogue signals 0/4..20 mA

V : normalized analogue signals 0..1 V, 0/1..5 V, 0/2..10 V

Other important available functions are: reaching of the Set Point at controlled speed, ramps and dwell function, parameters protection on different levels, configuration of parameters via the KEY 01 device.

1.2 - FRONT PANEL DESCRIPTION



1 - Key SET : This is used to access the programming parameters and to confirm selection.

2 - Key DOWN : This is used to decrease the values to be set and to select the parameters. If the key is held down, the user returns to the previous programming level until he exits the programming mode.

3 - Key UP : This is used to increase the values to be set and to select the parameters. If the key is held down, the user returns to the previous programming level until he exits the programming mode. Outside the programming mode it permits visualisation of the output control power.

4 - Key F : This is a key with a function programmable by par. "USrb". It can be set to : Activate Auto-tuning and Self-tuning functions, swap the instrument to manual control, silence the alarm, change the active Set Point, deactivate control.

5 - Led Heat : indicates the HEAT mode

6 - Led Cool : indicates the COOL mode

7 - Led AL1 : indicates the state of output AL1

8 - Led AL2 : indicates the state of output AL2

9 - Led AT/ST : indicates that the Self-tuning function is activated (light on) or that Auto-tuning (flashing) is in progress.

10 - Led SET : when flashing, it indicates access to the programming mode.

11 - Led - Shift index: indicates that the process value is lower than the one programmed on par. "AdE".

12 - Led = Shift index: indicates that the process value is within the range [SP+AdE ... SP-AdE]

13 - Led + Shift index: indicates that the process value is higher than the one set on par. "AdE".

2 - PROGRAMMING

2.1 - FAST PROGRAMMING OF THE SET POINT

This procedure permits rapid programming of the active Set Point and possibly the alarm thresholds (see par 2.3)

Push key "P", then release it and the display will visualise "SP n" (where n is the number of the Set Point active at that moment) alternatively to the programmed value.

To modify the value, press "UP" key to increase it or the "DOWN" key to decrease it.

These keys change the value one digit at a time but if they are pressed for more than one second, the value increases or decreases rapidly and, after two seconds in the same condition, the changing speed increases in order to allow the desired value to be reached rapidly.

Once the desired value has been reached, by pushing Key SET it is possible to exit by the fast programming mode or it is possible to visualise the alarm thresholds (see par. 2.3).

To exit the fast Set programming it is necessary to push Key SET, after the visualisation of the last Set Point, or alternatively, if no key is pressed for approx. 15 seconds, the display will return to normal functioning automatically.

2.2 - SELECTION OF THE CONTROL STATE AND PARAMETER PROGRAMMING

By pushing key "P" and holding it down for approx. 2 sec. it is possible to enter into the main selection menu.

Using the "UP" or "DOWN" keys, it is then possible to roll over the selections:

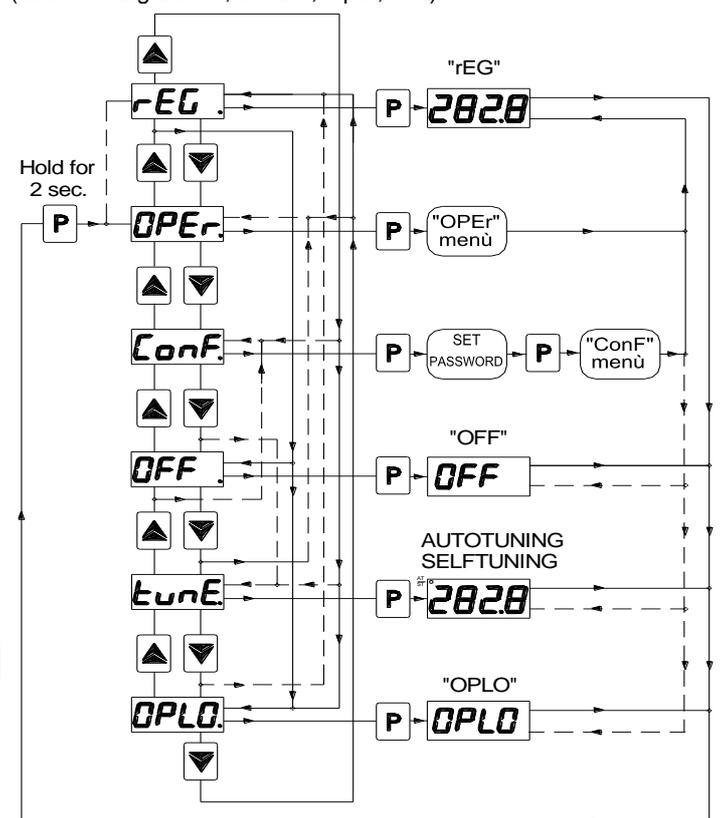
"OPEr"	to enter into the operating parameters menu
"ConF"	to enter into the configuration parameters menu
"OFF"	to swap the regulator into the OFF state
"rEG"	to swap the regulator into the automatic control state
"tunE"	to activate the Auto-tuning or Self-tuning function
"OPLO"	to swap the regulator to the manual control state and therefore to program the % control value using the "UP" and "DOWN" keys

Once the desired item has been selected, push key "P" to confirm.

Selecting "OPEr" and "ConF" gives the possibility of accessing other menus containing additional parameters and more precisely :

"OPEr" - Operating parameters Menu: this normally contains the Set Point parameters but it can contain all the desired parameters (see par. 2.3).

"ConF" - Configuration parameters Menu: this contains all the operating parameters and the functioning configuration parameters (alarm configuration, control, input, etc.)



To enter the menu "ConF" select the option "ConF", press the key "P" and the display will show "0".

At this request, enter, using keys "UP" and "DOWN", the number reported on the last page of this manual and push key "P".

If an incorrect password is entered, the instrument exit from programming mode.

If the password is correct, the display will visualise the code identifying the first group of parameters ("1SP") and with keys "UP" and "DOWN" it will be possible to select the desired group of parameters.

Once the desired group of parameters has been selected, the code identifying the first parameter of the selected group will be visualised by pushing the "P" key.

Again using the "UP" and "DOWN" keys, it is possible to select the desired parameter and, if the key "P" is pressed, the display will alternatively show the parameter's code and its programming value, which can be modified by using the "UP" or "DOWN" keys.

Once the desired value has been programmed, push key "P" once more: the new value will be memorised and the display will show only the code of the selected parameter.

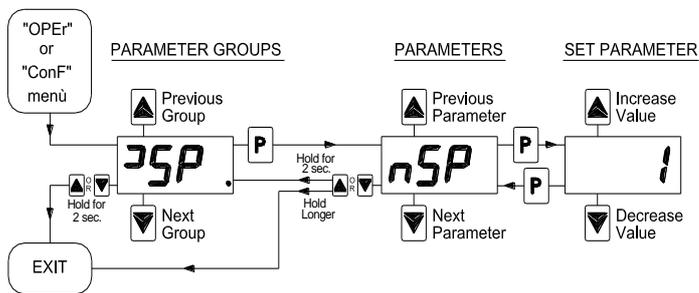
By using the "UP" or "DOWN" keys, it is then possible to select a new parameter (if present) and modify it as described above.

To select another group of parameters, keep the "UP" or "DOWN" Key SETressed for approx. 2 sec., afterwards the display will return to visualise the code of the group of parameters.

Release the key and by using the "UP" and "DOWN" keys, it will be possible to select a new group.

To exit the programming mode, no key should be pressed for approx. 20 seconds, or keep the "UP" or "DOWN" pressed until exit from the programming mode is obtained.

The programming and exit modes for the "OPER" menu are the same as those described for menu "ConF" with the difference that to access the menu "OPER" the Password is not required.



ATTENTION: The instrument is programmed in factory with all the parameters, to exception of the Set Point "SP1" (and 2,3,4), programmable in the menu "ConF" to the purpose to prevent wrong accidental programming from non experienced consumers.

2.3 - PARAMETERS PROGRAMMING LEVELS

The menu "OPER" normally contains the parameters used to program the Set Point; however it is possible to make all desired parameters appear or disappear on this level, by following this procedure:

Enter the menu "ConF" and select the parameter to be made programmable or not programmable in the menu "OPER".

Once the parameter has been selected, if the LED SET is switched off, this means that the parameter is programmable only in the menu "ConF", if instead the LED is on, this means that the parameter is also programmable in the menu "OPER".

To modify the visibility of the parameter, push key "U": the LED SET will change its state indicating the parameter accessibility level (on = menu "OPER" and "ConF"; off = menu "ConF" only).

The active Set Point and the alarm thresholds will only be visible on the Set Point fast programming level (described in par. 2.1) if the relative parameters are programmed to be visible (i.e. if they are present in the menu "OPER").

The possible modification of these Sets, with the procedure described in par. 2.1, is instead subordinate to what is programmed in par. "Edit" (contained in the group "1PAN").

This parameter can be programmed as:

=SE: The active Set Point can be modified while the alarm thresholds cannot be modified.

=AE: The active Set Point cannot be modified while the alarm thresholds can be modified

=SAE: Both the active Set Point and the alarm thresholds can be modified

=SAnE: Both the active Set Point and the alarm thresholds cannot be modified

2.4 - CONTROL STATES

The controller can act in 3 different ways: automatic control (rEG), control off (OFF) and manual control (OPLO).

The instrument is able to pass from one state to the other:

- by selecting the desired state from the main selection menu using the keyboard.

- By using the key "U" on the keyboard; suitably programming par. "USrb" ("USrb" = tunE; "USrb" = OPLO; "USrb" = OFF) it is possible to pass from "rEG" state to the state programmed on the parameter and vice versa.

- By using the digital input 1 suitably programming par. "diF" ("diF" = = OFF) it is possible to pass from "rEG" state to the state OFF and vice versa.

- Automatically (the instrument swaps into "rEG" state at the end of the auto-tuning execution)

When switched on, the instrument automatically reassumes the state it was in when it was last switched off.

AUTOMATIC CONTROL (rEG) – Automatic control is the normal functioning state of the controller.

During automatic control it is possible to visualize the control power on the display by pushing key "UP".

The range of the power values goes from H100 (100% of the output power with reverse action) to C100 (100% of the output power with direct action).

CONTROL OFF (OFF) – The instrument can be swapped into the "OFF" state, i.e. the control and the relative outputs are deactivated.

The alarm outputs are instead working normally.

BUMPLESS MANUAL CONTROL (OPLO) – By means of this option it is possible to manually program the power percentage given as output by the controller by deactivating automatic control.

When the instrument is swapped to manual control, the power percentage is the same as the last one supplied and can be modified using the "UP" and "DOWN" keys.

As in the case of automatic control, the programmable values range from H100 (+100%) to C100 (-100%).

To return to automatic control, select "rEG" in the selection menu.

2.5 - ACTIVE SET POINT SELECTION

This instrument permits pre-programming of up to 4 different Set points ("SP1", "SP2", "SP3", "SP4") and then selection of which one must be active. The maximum number of Set points is determined by the par. "nSP" located in the group of parameters "1SP".

The active Set point can be selected:

- by parameter "SPAt" in the group of parameters "1SP".

- by key "U" if par. "USrb" = CHSP

- by the digital inputs if diF = CHSP, = SP1.2, = SP1.4

- Automatically between SP1 and SP2 if a time "dur.t" (see par. 4.4) has been programmed.

Set Points "SP1", "SP2", "SP3", "SP4" will be visible depending on the maximum number of Set Points selected on par. "nSP" and they can be programmed with a value that is between the value programmed on par. "SPLL" and the one programmed on par. "SPHL".

Note: in all the following examples the Set point is indicated as "SP", however the instrument will act according to the Set point selected as active.

3 - INFORMATION ON INSTALLATION AND USE



3.1 - PERMITTED USE

The instrument has been projected and manufactured as a measuring and control device to be used according to EN61010-1 for the altitudes operation until 2000 ms.

The use of the instrument for applications not expressly permitted by the above mentioned rule must adopt all the necessary protective measures.

The instrument CANNOT be used in dangerous environments (flammable or explosive) without adequate protection.

The installer must ensure that EMC rules are respected, also after the instrument installation, if necessary using proper filters. Whenever a failure or a malfunction of the device may cause dangerous situations for persons, things or animals, please remember that the plant has to be equipped with additional devices which will guarantee safety.

3.2 – MECHANICAL MOUNTING

The instrument, in case 33 x 75 mm, is designed for flush-in panel mounting.

Make a hole 29 x 71 mm and insert the instrument, fixing it with the provided special bracket.

We recommend that the gasket is mounted in order to obtain the front protection degree as declared. Avoid placing the instrument in environments with very high humidity levels or dirt that may create condensation or introduction of conductive substances into the instrument.

Ensure adequate ventilation to the instrument and avoid installation in containers that house devices which may overheat or which may cause the instrument to function at a higher temperature than the one permitted and declared.

Connect the instrument as far away as possible from sources of electromagnetic disturbances such as motors, power relays, relays, solenoid valves, etc.

3.3 - ELECTRICAL CONNECTION

Carry out the electrical wiring by connecting only one wire to each terminal, according to the following diagram, checking that the power supply is the same as that indicated on the instrument and that the load current absorption is no higher than the maximum electricity current permitted.

As the instrument is built-in equipment with permanent connection inside housing, it is not equipped with either switches or internal devices to protect against overload of current: the installation will include an overload protection and a two-phase circuit-breaker, placed as near as possible to the instrument, and located in a position that can easily be reached by the user and marked as instrument disconnecting device which interrupts the power supply to the equipment.

It is also recommended that the supply of all the electrical circuits connected to the instrument must be protect properly, using devices (ex. fuses) proportionate to the circulating currents.

It is strongly recommended that cables with proper insulation, according to the working voltages and temperatures, be used.

Furthermore, the input cable of the probe has to be kept separate from line voltage wiring. If the input cable of the probe is screened, it has to be connected to the ground with only one side.

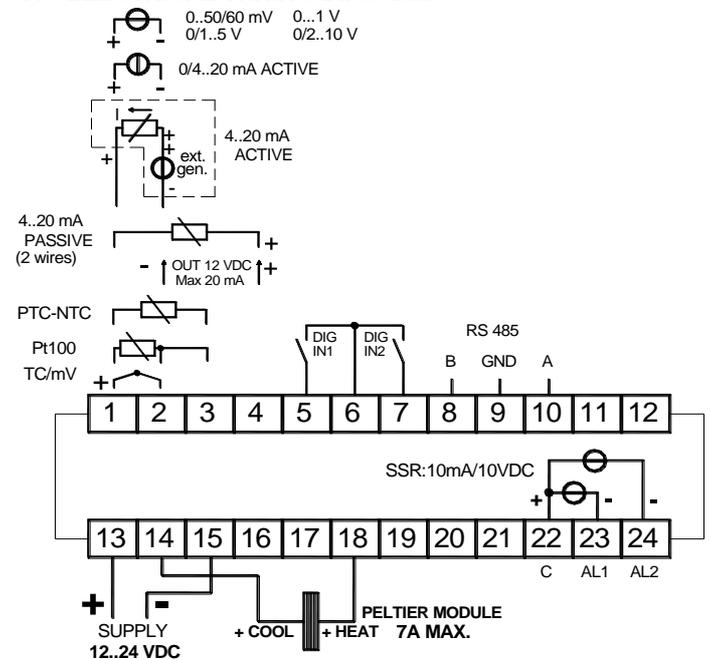
The power supply for the instrument must be between 12 to 24 Volts DC and with enough power to pilot the instrument and Peltier device.

The instrument has no isolation between the power supply, input and output, therefore make sure that the probe is isolated with respect to the power supply and outputs.

For applications that install more than one instrument, use a different power supply for each instrument, as there is no isolation between the power supply and input.

We recommend that a check should be made that the parameters are those desired and that the application functions correctly before connecting the outputs to the actuators so as to avoid malfunctioning that may cause irregularities in the plant that could cause damage to people, things or animals.

3.4 - ELECTRICAL WIRING DIAGRAM



4 - FUNCTIONS

4.1 - MEASURING AND VISUALIZATION

All the parameters referring measurements are contained in the group "InP".

Depending on the model required the input accept:

D: Thermoresistances PT100, Thermocouples temperature probes (J,K,S and OSAKA IRS Infrared sensors), mV signals (0..50/60 mV, 12..60 mV),

E: Thermistors PTC and NTC, Thermocouples temperature probes (J,K,S and OSAKA IRS Infrared sensors), mV signals (0..50/60 mV, 12..60 mV),.

I: normalized analogue signals 0/4..20 mA

V: normalized analogue signals 0..1 V, 0/1..5 V, 0/2..10 V

Depending on the model, using par. "SEnS", it's possible to select the type of input probe, which can be:

- for thermocouples J (J), K (CrAL), S (S) or for infrared sensors serie OSAKA IRTC1 with linearization J (Ir.J) or K (Ir.CA)

- for thermoresistances Pt100 IEC (Pt1) or thermistors PTC KTY81-121 (Ptc) or NTC 103AT-2 (ntc)

- for normalised signals in current 0..20 mA (0.20) or 4..20 mA (4.20)

- for normalised signals in tension 0..1 V (0.1), 0..5 V (0.5), 1..5 V (1.5), 0..10 V (0.10) or 2..10 V (2.10).

- for normalised signals in tension 0..50 mV (0.50), 0..60 mV (0.60), 12..60 mV (12.60).

We recommend to switch on and off the instrument when these parameters are modified, in order to obtain a correct measuring.

For the instruments with input for temperature probes (tc, rtd) it's possible to select, through par. "Unit", the unit of measurement (°C, °F) and, through par. "dP" (Pt100, PTC and NTC only) the desired resolution (0=1°; 1=0,1°).

Instead, with regards to the instruments with normalised analogue input signals, it is first necessary to program the desired resolution on par. "dP" (0=1; 1=0,1; 2=0,01; 3=0,001) and then, on par. "SSC", the value that the instrument must visualise at the beginning of the scale (0/4 mA, 0/12 mV, 0/1 V o 0/2 V) and, on par. "FSC", the value that the instrument must visualise at the end of the scale (20 mA, 50 mV, 60 mV, 5 V or 10 V).

The instrument allows for measuring calibration, which may be used to recalibrate the instrument according to application needs, by using par. "OFSt" and "rot".

Programming par. "rot"=1,000, in par. "OFSt" it is possible to set a positive or negative offset that is simply added to the value read by the probe before visualisation, which remains constant for all the measurements.

If instead, it is desired that the offset set should not be constant for all the measurements, it is possible to operate the calibration on any two points.

In this case, in order to decide which values to program on par. "OFSt" and "rot", the following formulae must be applied :

$$\text{"rot"} = (D2-D1) / (M2-M1) \quad \text{"OFSt"} = D2 - (\text{"rot"} \times M2)$$

where:

M1 =measured value 1

D1 = visualisation value when the instrument measures M1

M2 =measured value 2

D2 = visualisation value when the instrument measures M2

It then follows that the instrument will visualise :

$$DV = MV \times \text{"rot"} + \text{"OFSt"}$$

where: DV = visualised value MV= measured value

Example 1: It is desired that the instrument visualises the value effectively measured at 20° but that, at 200°, it visualises a value lower than 10° (190°).

Therefore : M1=20 ; D1=20 ; M2=200 ; D2=190

$$\text{"rot"} = (190 - 20) / (200 - 20) = 0,944$$

$$\text{"OFSt"} = 190 - (0,944 \times 200) = 1,2$$

Example 2: It is desired that the instrument visualises 10° whilst the value actually measured is 0°, but, at 500° it visualises a 50° higher value (550°).

Therefore : M1=0 ; D1=10 ; M2=500 ; D2=550

$$\text{"rot"} = (550 - 10) / (500 - 0) = 1,08$$

$$\text{"OFSt"} = 550 - (1,08 \times 500) = 10$$

By using par. "Fil" it is possible to program time constant of the software filter for the input value measured, in order to reduce noise sensitivity (increasing the time of reading).

In case of measurement error, the instrument supplies the power as programmed on par. "OPE".

This power will be calculated according to cycle time programmed for the PID controller.

By using par. "InE" it is also possible to decide the conditions of the input error, allowing the instrument to give the power programmed on par. "OPE" as output.

The possibilities of par. "InE" are :

= Or : the condition occurs in case of over-range or probe breakage

= Ur : the condition occurs in case of under-range or probe breakage

= Our : the condition occurs in case of over-range or under-range or probe breakage

Using par. "diSP", located in the group "jPAN", it is possible to set normal visualization of the display which can be the process variable (dEF), the control power (Pou), the active Set Point (SP.F) the Set Point operating when there are active ramps (SP.o) or alarm threshold AL1, AL2 (AL1, AL2).

Again in the group "jPAN" the par. "AdE" is present that defines the 3 led shift index functioning.

The lighting up of the green led = indicates that the process value is within the range [SP+AdE ... SP-AdE], the lighting up of the led - indicates that the process value is lower than [SP-AdE] and the lighting up of the led + indicates that the process value is higher than [SP+AdE].

4.2 - DOUBLE ACTION PID CONTROL

All the parameters referring to PID control are contained in the group "jREG".

The Double Action PID control is used to control plants where there is an element which causes a positive increase (ex. Heating) and an element which causes a negative increase (ex. Cooling).

The double action PID controller is used to control plants equipped with an actuator that causes both a positive increment (e.g. Heating) and a negative increment (e.g. Cooling).

This is the case of temperature control using a PELTIER device where it is possible to obtain a heating effect polarizing in one direction and a cooling effect when polarizing in the other direction.

The Double Action PID control works on the output depending on the active Set Point "SP" and on the instrument's PID algorithm with two degrees of freedom.

The Double Action PID control algorithm needs the programming of the following parameters :

"Pb" - Proportional Band

"tcr1" - Cycle time for HEAT action

"tcr 2" - Cycle time for COOL action

"Int" - Integral Time

"rS" - Manual Reset (if "Int =0 only)

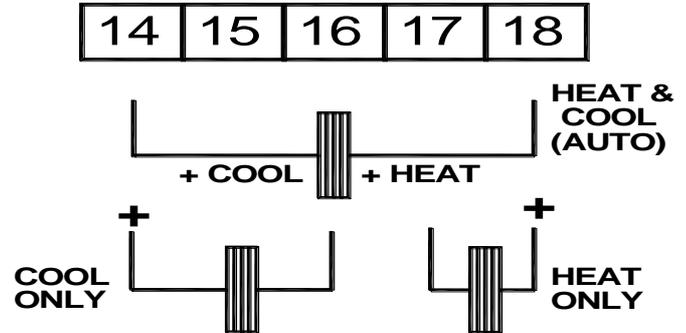
"dEr" - Derivative Time

"FuOC" - Fuzzy Overshoot Control

"Prat" - Power Ratio or relation between Cooling power and Heating power

The connection of the Peltier device to the instrument indicated on the wiring diagram always foresees a double action control, as it is the instrument that automatically commands and polarizes the Peltier device depending on the action to be effected (HEATING or COOLING).

In the case that the actuator must carry out only one action, the Peltier device can be connected to the instrument in such a way to command only activation and not polarization.



4.3 - AUTOTUNING AND SELFTUNING FUNCTIONS

All the parameters referring to the AUTO-TUNING and SELF-TUNING functions are contained in the group "jREG".

The AUTO-TUNING and SELF-TUNING functions permit the automatic tuning of the PID controller.

The **AUTO-TUNING** function permits the calculation of the PID parameters by means of a FAST type tuning cycle and, at the end of this operation, the parameters are stored into the instrument's memory and remain constant during control.

The **SELF-TUNING** function (rule based "TUNE-IN") instead allows control monitoring and the continuous calculation of the parameters during control.

Both functions automatically calculate the following parameters :

"Pb" - Proportional Band

"tcr1" - Cycle time for HEAT action

"tcr 2" - Cycle time for COOL action

"Int" - Integral Time

"dEr" - Derivative Time

"FuOC" - Fuzzy Overshoot Control

"Prat" - Power Ratio or relation between Cooling power and Heating power

To activate the AUTO-TUNING function proceed as follows :

1) Program and activate the desired Set Point.

2) Program par. "Auto" as:

- "1" - if auto-tuning is desired automatically, each time the instrument is switched on, on the condition that the process value is lower (with "Func" =HEAT) than [SP- |SP/2|] or higher (with "Func" =Cool) than [SP+ |SP/2|].

- "2" - if auto-tuning is desired automatically, the next time the instrument is switched on, on the condition that the process value is lower (with "Func" =HEAT) than [SP- |SP/2|] or higher (with "Func" =Cool) than [SP+ |SP/2|], and once the tuning is finished, the par. "Auto" is automatically swapped to the OFF state

- "3" - if manual auto-tuning is desired, by selecting par. "tunE" in the main menu or by correctly programming key "U" as "USrb" = tunE. The Autotuning will start at the condition that the process value is lower (with "Func" =HEAT) than [SP- |SP/5|] or higher (with "Func" =Cool) than [SP+ |SP/5|].

- "4" - if it's desired to activate the autotuning automatically to every change of Set Point, or at the end of programmed Soft-Start cycle. The Autotuning will start at the condition that the process value is lower (with "Func" =HEAT) than [SP- |SP/5|] or higher (with "Func" =Cool) than [SP+ |SP/5|].

- 3) Exit from the parameter programming.
- 4) Connect the instrument to the controlled plant.
- 5) Activate the Auto-tuning by switch off and turn on the instrument if "Auto"=1 or 2, or by selecting par. "tunE" in the main menu (or by correctly programming key "U").

At this point the Auto-tuning function is activated and is indicated by the flashing led AT/ST.

The regulator carries out several operations on the connected plant in order to calculate the most suitable PID parameters.

If, at the Auto-tuning start, the condition for the lower or higher process value is not found the display will show "ErAt" and the instrument will be swapped to normal control conditions according to the previously programmed parameters.

To make the error "ErAt" disappear, press Key SET.

The Auto-tuning cycle duration has been limited to 12 hours maximum.

If Auto-tuning is not completed within 12 hours, the instrument will show "noAt" on the display.

In case of probe error, the instrument automatically stops the cycle in progress.

The values calculated by Auto-tuning are automatically stored in the instrument's memory at the end of the correct PID parameters tuning.

Note: The instrument is already programmed in our factory to carry out auto-tuning at the first instrument switch on ("Auto" = 2).

To activate the SELF-TUNING function proceed as follows

- 1) Program and activate the desired Set Point.
- 2) Program par. "SELF" = yES
- 3) Exit from the parameter programming.
- 4) Connect the instrument to the controlled plant.
- 5) Activate Self-tuning selecting par. "tunE" in the main menu (or by correctly programming key "U").

When the Self-tuning function is active, the led AT/ST is permanently lit up and all the PID parameters ("Pb", "Int", "dEr", etc.) are no longer visualized.

Note: It's always preferable tuning the instrument using the Autotuning and to activate the Selftuning after because the tuning through Selftuning is more slow.

To stop the Auto-tuning cycle or deactivate the Self-tuning function select one of the control types: "rEG", "OPLO" or "OFF" from the menu "SEL". If the instrument is switched off during Auto-tuning or with the Self-tuning function activated, these functions will remain activated the next time it is switched on.

4.8 - REACHING OF THE SET POINT AT CONTROLLED SPEED AND AUTOMATIC SWITCHING BETWEEN TWO SET POINTS (RAMPS AND DWELL TIME)

All the parameters referring to the ramps functioning are contained in the group "rEG".

It is possible to reach the set point in a predetermined time (in any case longer than the time the plant would naturally need). This could be useful in those processes (heating or chemical treatments, etc.) where the set point has to be reached gradually, in a predetermined time.

Once the instrument has reached the first Set Point (SP1) it is possible to have automatic switching to the second Set Point (SP2) after a set time, thus obtaining a simple automatic process cycle.

These functions are available for all the programmable controls (PID single and double action, ON/OFF and Neutral Zone ON/OFF).

The function is determined by the following parameters:

"SLor" - Gradient of first ramp expressed in unit/minute

"SLoF" - Gradient of second ramp expressed in unit/minute.

"dur.t" - Dwell time of Set Point "SP1" before automatic switching to Set Point "SP2" (expressed in hrs. and min.).

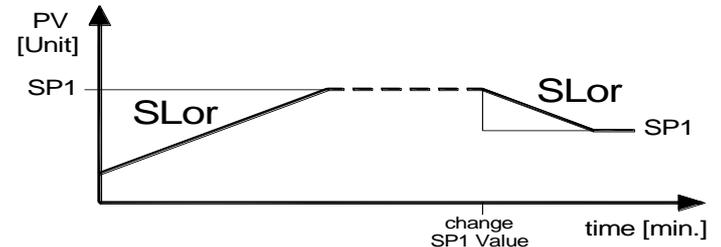
The functions are deactivated when the relative parameters are = InF.

Note: In case of PID control, if Auto-tuning is desired whilst the ramp function is active, this will not be carried out until the tuning cycle has been completed. It is therefore recommended that Auto-

tuning be started avoiding activating the ramp function and, once the tuning is finished, deactivate Auto-tuning ("Auto" = OFF), program the desired ramp and, if it automatic tuning is desired, enable the Self-tuning function.

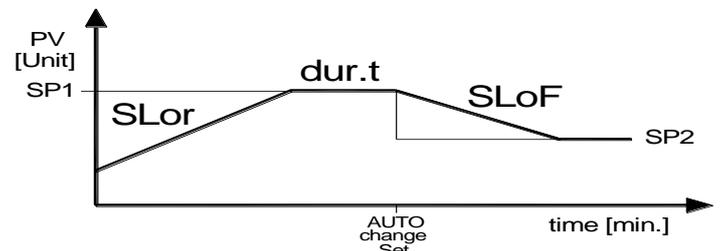
If is desired only one ramp (ex. to reach "SP1") it is enough to program on the par. "SLor" the desired value.

The ramp "SLor" it will always active at power on and when the Active Set Point value is changed.



If it is desired an automatic cycle from the power on instead it is necessary to program the par. "nSP" = 2, to program the two Set Point values "SP1" and "SP2" and naturally to program the par. "SLor", "dur.t" and "SLoF" with the desired values.

In this case at the end of the cycle all the ramps won't be more active.



Examples with starts from values lower than SP and with decreasing of SP.

4.5 - ALARMS OUTPUTS FUNCTIONS (AL1, AL2)

The instrument can have up to 2 alarm outputs to drive solid state relays type (SSR).

All the parameters referring to the alarms functioning are contained in the groups "AL1" and "AL2".

Note: In all the examples that follow is made reference to the alarm AL1. Naturally the operation of the alarm AL2 results analogous.

The alarm functioning is instead defined by parameters:

"AL1t" - ALARM TYPE

"Ab1" - ALARM CONFIGURATION

"AL1" - ALARM THRESHOLD

"AL1L" - LOW ALARM THRESHOLD (for band alarm) OR MINIMUM SET OF AL1 ALARM THRESHOLD (for low or high alarm)

"AL1H" - HIGH ALARM THRESHOLD (for band alarm) OR MAXIMUM SET OF AL1 ALARM THRESHOLD (for low or high alarm)

"HAL1" - ALARM HYSTERESIS

"AL1d" - ALARM ACTIVATION DELAY (in sec.)

"AL1i" - ALARM BEHAVIOUR IN THE EVENT OF MEASUREMENT ERROR

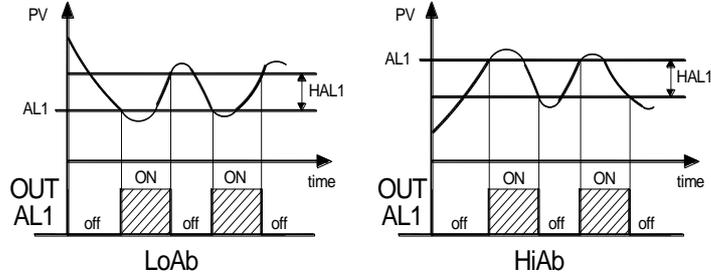
"AL1t" - ALARM TYPE: the alarm output can behave in six different ways.

LoAb = ABSOLUTE LOW ALARM: The alarm is activated when the process value goes below the alarm threshold set on parameter "AL1" and will be deactivated when it goes above the value [AL1+HAL1].

With this mode is possible to program the minimum and the maximum set of "AL1" by "AL1L" and "AL1H" parameters.

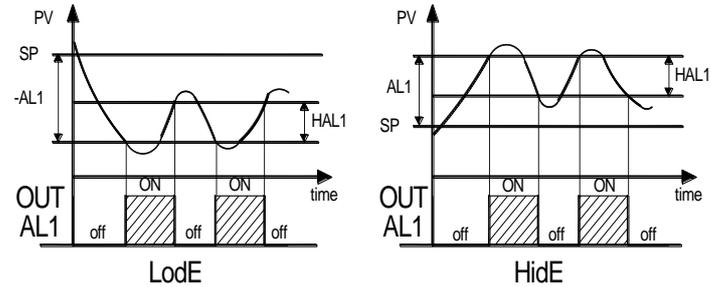
HiAb = ABSOLUTE HIGH ALARM: The alarm is activated when the process value goes higher than the alarm threshold set on parameter "AL1" and will be deactivated when it goes below the value [AL1 - HAL1].

With this mode is possible to program the minimum and the maximum set of "AL1" by "AL1L" and "AL1H" parameters.



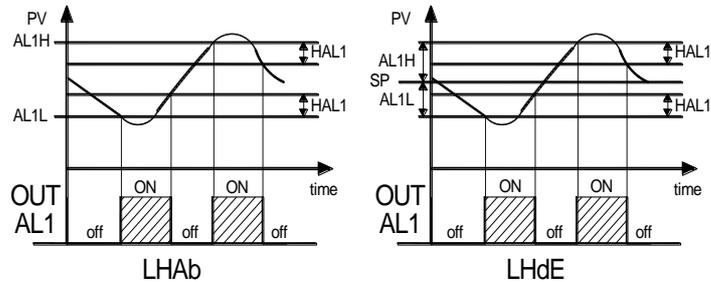
LodE = DEVIATION LOW ALARM: The alarm is activated when the process value goes below the value $[SP1 + AL1]$ and will be deactivated when it goes above the value $[SP1 + AL1 + HAL1]$. With this mode is possible to program the minimum and the maximum set of "AL1" by "AL1L" and "AL1H" parameters.

HidE = DEVIATION HIGH ALARM: The alarm is activated when the process value goes above the value $[SP1 + AL1]$ and will be deactivated when it goes below the value $[SP1 + AL1 - HAL1]$. With this mode is possible to program the minimum and the maximum set of "AL1" by "AL1L" and "AL1H" parameters.



LHAb = ABSOLUTE BAND ALARM: The alarm is activated when the process value goes under the alarm threshold set on parameter "AL1L" or goes higher than the alarm threshold set on parameter "AL1H" and will be deactivated when it goes below the value $[AL1H - HAL1]$ or when it goes above the value $[AL1L + HAL1]$.

LHdE = DEVIATION BAND ALARM: The alarm is activated when the process value goes below the value $[SP1 + AL1L]$ or goes above than the value $[SP1 + AL1H]$ and will be deactivated when it goes below the value $[SP1 + AL1H - HAL1]$ or when it goes above the value $[SP1 + AL1L + HAL1]$.



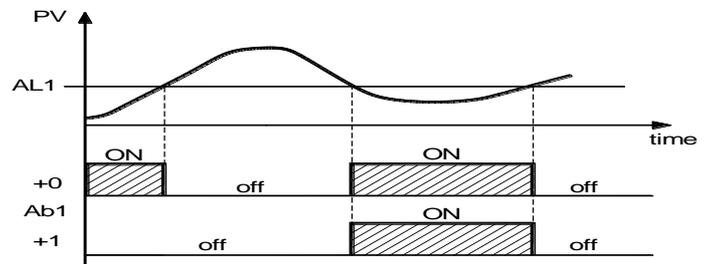
"Ab1" - ALARM CONFIGURATION: This parameter can assume a value between 0 and 15.

The number to be set, which will correspond to the function desired, is obtained by adding the values reported in the following descriptions :

ALARM BEHAVIOUR AT SWITCH ON: the alarm output may behave in two different ways, depending on the value added to par. "Ab1".

+0 = NORMAL BEHAVIOUR: The alarm is always activated when there are alarm conditions.

+1 = ALARM NOT ACTIVATED AT SWITCH ON: If, when switched on, the instrument is in alarm condition, the alarm is not activated. It will be activated only when the process value is in non-alarm conditions and then back in alarm conditions.



exemple with absolute low alarm

ALARM DELAY: the alarm output may behave in two different ways depending on the value added to par. "Ab1".

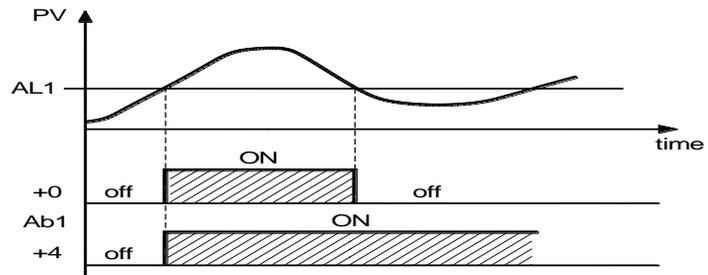
+0 = ALARM NOT DELAYED: The alarm is immediately activated when the alarm condition occurs.

+2 = ALARM DELAYED: When the alarm condition occurs, delay counting begins, as programmed on par. "AL1d" (expressed in sec.) and the alarm will be activated only after the elapsing of that time.

ALARM LATCH: : the alarm output may behave in two different ways depending on the value added to par. "Ab1".

+0 = ALARM NOT LATCHED: The alarm remains active in alarm conditions only.

+4 = ALARM LATCHED: The alarm is active in alarm conditions and remains active even when these conditions no longer exist, until the correctly programmed key "U", ("USrb"=Aac) has been pushed.



exemple with absolute high alarm

ALARM ACKNOWLEDGEMENT: : the alarm output may behave in two different ways depending on the value added to par. "Ab1".

+0 = ALARM NOT ACKNOWLEDGED: The alarm always remains active in alarm conditions.

+8 = ALARM ACKNOWLEDGED: The alarm is active in alarm conditions and can be deactivated by key "U" if properly programmed ("USrb"=ASi), and also if alarm conditions still exist.

"AL1i" - ALARM ACTIVATION IN CASE OF MEASUREMENT

ERROR: This allows one to establish how the alarm have behave in the event of a measurement error (yES=alarm active; no=alarm deactivated).

4.6 - FUNCTIONING OF KEY "U"

The function of key "U" can be set through par. "USrb" contained in the group "iPAN".

The parameter can be programmed as :

= noF : no function

= tunE : Pushing the key for 1 sec. at least, it is possible to activate/deactivate Auto-tuning or Self-tuning

= OPLO : Pushing the key for 1 sec. at least, it is possible to swap from automatic control (rEG) to manual one (OPLO) and vice versa.

= Aac : Pushing the key for 1 sec. at least, it is possible to acknowledge the alarm. (see par. 4.5)

= ASi : Pushing the key for 1 sec. at least, it is possible to acknowledge an active alarm (see par. 4.5)

= CHSP : Pushing the key for 1 sec. at least, it is possible to select one of the 4 pre-programmed Set Points on rotation.

= OFF : Pushing the key for 1 sec. at least, it is possible to swap from automatic control (rEG) to OFF control (OFF) and vice versa.

4.7 - DIGITAL INPUTS

The instrument can be equipped with 2 digital inputs.

The function of the digital inputs can be set through par. "diF" contained in the group "InP".

The parameter can be programmed as :

= **noF** : no function

= **Aac** : Closing the contact connected to the digital input 1 it is possible to acknowledge the alarm. (see par. 4.5)

= **Asi** : Closing the contact connected to the digital input 1 it is possible to acknowledge an active alarm (see par. 4.5)

= **HoLd** : Closing the contact connected to the digital input 1 there is the hold of the measure in that instant (P.A.: not the reading on the display, therefore the indication could settle with a proportional delay to the filter of measure). With the function hold the instrument operate the control in base to the memorized measure.

Reopening the contact the instrument come back to the normal acquisition of the measure.

= **OFF** : Closing the contact connected to the digital input 1 it is possible to select the OFF control (OFF).

= **CHSP** : Closing and opening the contact connected to the digital input 1 it is possible to select one of the 4 pre-programmed Set Points on rotation.

= **SP1.2** : Closing the contact connected to the digital input 1 it is possible to select as active the set point SP2. Reopening the contact is select as active the set point SP1. This function is possible only when "nSP" = 2, and when is selected it disables the selection of the active set through the parameter "SPAt" and through the Key F.

= **SP1.4** : The following combination of the connected contacts to the two digital entries allows the activation of one of the 4 memorized set points.

DIG IN1	DIG IN2	SET POINT
off	off	SP1
on	off	SP2
off	on	SP3
on	on	SP4

when this function is selected it disables the selection of the active set through the parameter "SPAt" and through the Key F.

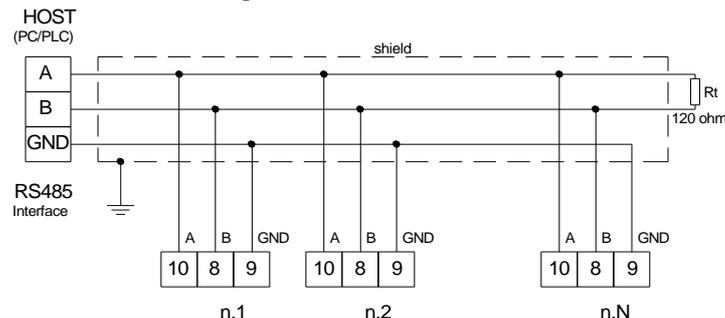
4.8 - RS 485 SERIAL INTERFACE

The instrument can be equipped with a RS 485 serial communication interface, by means of which it is possible to connect the regulator with a net to which other instruments (regulators of PLC) are connected, all depending typically on a personal computer used as plant supervisor. Using a personal computer it is possible to acquire all the function information and to program all the instrument's configuration parameters. The software protocol adopted for OK 33-PEL is a MODBUS RTU type, widely used in several PLC and supervision programs available on the market (TLK series protocol manual is available on request).

The interface circuit allows the connection of up to 32 instruments on the same line.

To maintain the line in rest conditions a 120 Ohm resistance (Rt) must be connected to the end of the line.

The instrument is equipped with two terminals called A and B which have to be connected with all the namesake terminals of the net. For the wiring operation it is advisable to adopt a screened cable wired as in the drawing.



If the instrument is equipped with a serial interface, the parameters to be programmed are the following, all present in the parameters group "SER" :

"**Add**" : Address of the station. Set a different number for each station, from 1 to 255.

"**baud**" : Transmission speed (baud-rate), programmable from 1200 to 38400 baud. All the stations have to have the same transmission speed.

"**PACS**" : Programming access. If programmed as "LoCL" this means that the instrument is only programmable from the keyboard, if programmed as "LorE" it is programmable both from the keyboards and serial line.

If an attempt is made to enter the programming from the keyboard whilst a communication through the serial port is in progress the instrument will visualise "**buSy**" to indicate the busy state.

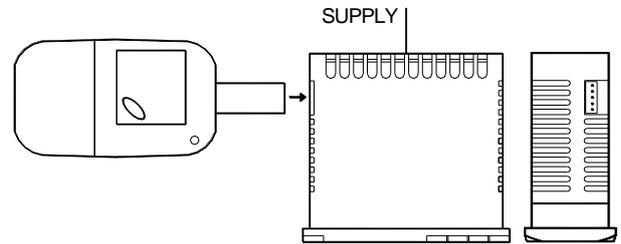
4.9 - PARAMETERS CONFIGURATION BY "USB KEY"

The instrument is equipped with a connector that allows the transfer from and toward the instrument of the functioning parameters through the device **OSAKA USB KEY** with 5 poles connector.

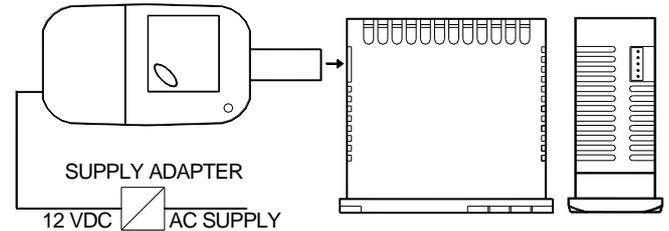
This device it's mainly useable for the serial programming of the instruments which need to have the same parameters configuration or to keep a copy of the programming of an instrument and allow its rapid retransmission.

To use the device USB KEY it's necessary that the device or instrument are being supplied.

Instrument supplied and device not supplied



Instrument supplied from the device



P.A.: For the instruments equipped with RS485 serial communication, it's indispensable that the parameter "PACS" is programmed = LorE.

To transfer the configuration of an instrument into the device (**UPLOAD**) it is necessary to proceed in the following way:

- 1) position both dip switch of KEY 01 in the **OFF** mode.
- 2) connect the device to the instrument TLK plugging the special connector.
- 3) verify that the instrument or the device are supplied
- 4) observe the indication led on the device KEY 01: if it results green this means that a configuration is already loaded on the device while if it results green blinking or red blinking this means that it has not been loaded any valid configuration on the device .
- 5) press the button placed on the device.
- 6) observe the indication led : after having pressed the button, the led becomes red and therefore, at the end of the data transfer, it becomes green.
- 7) now it is possible to disconnect the device.

To transfer the configuration loaded on the device onto an instrument of the same family (**DOWNLOAD**), it is necessary to proceed in the following way:

- 1) position both dip switch of KEY 01 in the **ON** mode.
- 2) connect the device to an instrument TLK having the same features of the one from which has been downloaded the desired configuration, plugging the special connector.
- 3) verify that the instrument or the device are supplied
- 4) observe the indication led on the device KEY 01: it has to result green, because if the led results green blinking or red blinking, this

		on 3= Start manually 4= Start after Soft Start or change Set Point			
37	SELF	Selftuning enable	no / yES	no	
38	Pb	Proportional band	0 ÷ 9999	50	
39	Int	Integral time	OFF ÷ 9999 sec.	200	
40	dEr	Derivative time	OFF ÷ 9999 sec.	50	
41	FuOc	Fuzzy overshoot control	0.00 ÷ 2.00	0,5	
42	tcr1	Cycle time of HEATING output	0.1 ÷ 130.0 sec.	0.1	
43	Prat	Power ratio Cooling / Heating	0.01 ÷ 99.99	1.00	
44	tcr2	Cycle time of COOLING output	0.1 ÷ 130.0 sec.	0.1	
45	rS	Manual reset	-100.0 ÷ 100.0 %	0.0	
46	SLor	Gradient of first ramp: InF= Ramp not active	0.00 ÷ 99.99 / InF unit/min.	InF	
47	dur.t	Duration time between two ramps InF= Time not active	0.00 ÷ 99.59 / InF hrs.-min.	InF	
48	SLoF	Gradient of second ramp: InF= Ramp not active	0.00 ÷ 99.99 / InF unit / min.	InF	

Group "1 PAN" (parameters relative to the user interface)

Par.	Description	Range	Def.	Note
49	USrb Functioning of key "U" : noF = No Function tune= Start Autotuning or Selftuning OPLO= Manual Control (open loop) Aac= Reset Alarms latch ASi= Acknowledged Alarms OFF= Control OFF	noF / tunE / OPLO / Aac / ASi / CHSP / OFF	noF	
50	diSP Variable visualized on the display: dEF= Process Value Pou= Control Power SP.F= Active Set Value SP.o = Operative Set value AL1 = AL1 threshold AL2 = AL2 threshold AL3 = AL3 threshold	dEF / Pou / SP.F / SP.o / AL1 / AL2 / AL3	dEF	
51	AdE Shift value for the shift index functioning	OFF...9999	2	
52	Edit Fast progr. Active Set and alarms: SE= Active Set can be modified while the alarm thresholds cannot be modified AE= Active Set cannot be modified while the alarm thresholds can be modified SAE= Active Set and alarm thresholds can be modified SAnE= Active Set and alarm thresholds cannot be modified	SE / AE / SAE / SAnE	SAE	

Group "2 SER" (parameters relative to the serial communication)

Par.	Description	Range	Def.	Note
------	-------------	-------	------	------

53	Add	Station address in case of serial communication	0 ... 255	1	
54	baud	Transmission speed (Baud rate)	1200 / 2400 / 9600 / 19.2 / 38.4	9600	
55	PACS	Access at the programming through serial port: LoCL = No (Local only) LorE = Yes (Local and remote progr.)	LoCL / LorE	LorE	

6 - PROBLEMS, MAINTENANCE AND GUARANTEE

6.1 - ERROR SIGNALLING

Error	Reason	Action
---	Probe interrupted	Verify the correct connection between probe and instrument and then verify the correct functioning of the probe
uuuu	The measured variable is under the probe's limits (under- range)	
oooo	The measured variable is over the probe's limits (over- range)	
ErAt	Auto-tuning not possible because the process value is too higher or too lower	Push key "P" in order to make the error message disappear. Once the error has been found, try to repeat the auto-tuning.
noAt	Auto-tuning not finished within 12 hours	Check the functioning of probe and actuator and try to repeat the auto-tuning.
LbA	Loop control interrupted (Loop break alarm)	Check the working of probe and actuator and swap the instrument to (rEG) control
ErEP	Possible anomaly of the EEPROM memory	Push key "P"

In error conditions, the instrument provides an output power as programmed on par. "OPE" and activates the desired alarms, if the relative parameters "ALni" have been programmed = yES.

6.2 - CLEANING

We recommend cleaning of the instrument with a slightly wet cloth using water and not abrasive cleaners or solvents which may damage the instrument.

6.3 - GUARANTEE AND REPAIRS

The instrument is under warranty against manufacturing flaws or faulty material, that are found within 12 months from delivery date. The guarantee is limited to repairs or to the replacement of the instrument. The eventual opening of the housing, the violation of the instrument or the improper use and installation of the product will bring about the immediate withdrawal of the warranty's effects. 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 OSAKA with a detailed description of the faults found, without any fees or charge for OSAKA, except in the event of alternative agreements.

7 - TECHNICAL DATA

7.1 - ELECTRICAL DATA

Power supply: 12...24 VDC +/- 10%

Frequency AC: 50/60 Hz

Power consumption (instrument only): 5 VA approx.

Input/s: 1 input for temperature probes: tc J,K,S ; infrared sensors OSAKA IRS J e K; RTD Pt 100 IEC; PTC KTY 81-121 (990 Ω @ 25 °C); NTC 103AT-2 (10KΩ @ 25 °C) or mV signals 0...50 mV, 0...60 mV, 12 ...60 mV or normalized signals 0/4...20 mA, 0..1 V, 0/1...5 V , 0/2...10 V. 2 digital inputs for free voltage contacts.

Normalized signals input impedance: 0/4..20 mA: 51 Ω; mV and V: 1 MΩ

Output/s: 7 A max Power Static output 12...24 VDC (the same of power supply) to drive directly Peltier elements; up to 2 alarm outputs in tension to drive SSR (10mA/ 10VDC).

Auxiliary supply output: 12 VDC / 20 mA Max.

Installation category: II

Measurement category: I

Protection class against electric shock: Class II for Front panel

Insulation: No insulation between supply, outputs and input; 50 V insulation between RS485 and supply.

Max cold junction compensation drift (in tc) : 0,1 °C/°C with operating temperature 0 ... 50 °C after warm-up of 20 min.

Sampling rate: 130 ms.

Serial Interface : RS485 insulated

Communication protocol: MODBUS RTU (JBUS)

Baud rate: Programmable from 1200 ... 38400 baud

Display: 4 Digit Red h 12 mm

Compliance: ECC directive EMC 2004/108/CE (EN 61326), ECC directive LV 2006/95/CE (EN 61010-1)

7.2 – MECHANICAL DATA

Housing: Self-extinguishing plastic, UL 94 V0

Dimensions: 35 x 78 mm, depth 75,5 mm

Weight: 130 g approx.

Mounting: Flush in panel in 29 x 71 mm hole

Connections: 2,5 mm² screw terminals block

Degree of front panel protection : IP 65 mounted in panel with gasket

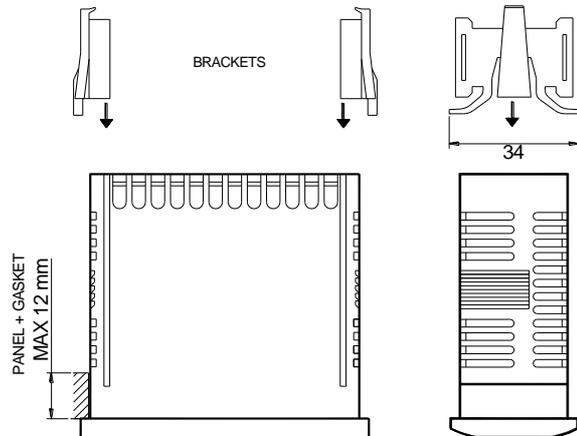
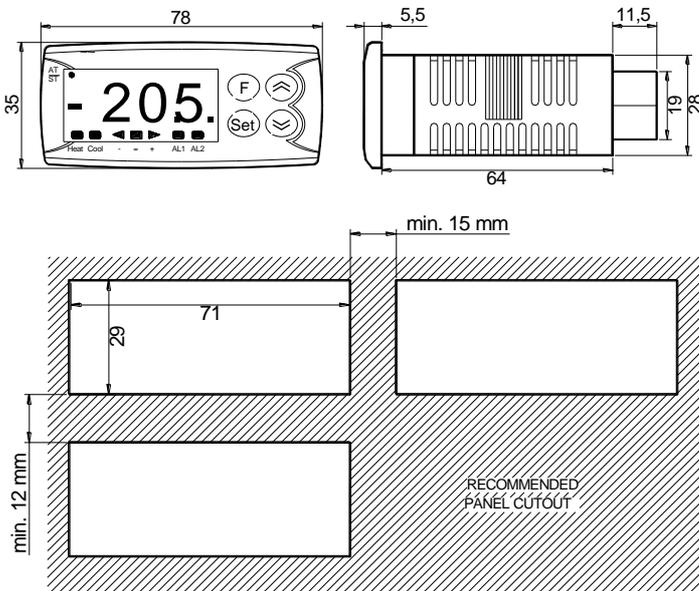
Pollution situation: 2

Operating temperature: 0 ... 50 °C

Operating humidity: 30 ... 95 RH% without condensation

Storage temperature: -10 ... +60 °C

7.3 – MECHANICAL DIMENSIONS, PANEL CUT-OUT AND MOUNTING [mm]



7.4 - FUNCTIONAL FEATURES

Control: PID double action.

Measurement range: according to the used probe (see range table)

Display resolution: according to the probe used 1/0,1/0,01/0,001

Overall accuracy: +/- 0,5 % fs (tc S: +/- 1 % fs)

7.5 - MEASURING RANGE TABLE

INPUT	"dP" = 0	"dP" = 1, 2, 3
tc J "SEnS" = J	0 ... 1000 °C 32 ... 1832 °F	----
tc K "SEnS" = CrAl	0 ... 1370 °C 32 ... 2498 °F	----
tc S "SEnS" = S	0 ... 1760 °C 32 ... 3200 °F	----
Pt100 (IEC) "SEnS" = Pt1	-200 ... 850 °C -328 ... 1562 °F	-99.9 ... 850.0 °C -99.9 ... 999.9 °F
PTC (KTY81-121) "SEnS" = Ptc	-55 ... 150 °C -67 ... 302 °F	-55.0 ... 150.0 °C -67.0 ... 302.0 °F
NTC (103-AT2) "SEnS" = ntc	-50 ... 110 °C -58 ... 230 °F	-50.0 ... 110.0 °C -58.0 ... 230.0 °F
0..20 mA "SEnS" = 0.20		
4..20 mA "SEnS" = 4.20		
0 ... 50 mV "SEnS" = 0.50		
0 ... 60 mV "SEnS" = 0.60		
12 ... 60 mV "SEnS" = 12.60	-1999 ... 9999	-199.9 ... 999.9 -19.99 ... 99.99 -1.999 ... 9.999
0 ... 1 V "SEnS" = 0.1		
0 ... 5 V "SEnS" = 0.5		
1 ... 5 V "SEnS" = 1.5		
0 ... 10 V "SEnS" = 0.10		
2 ... 10 V "SEnS" = 2.10		

OK 33-PEL PASSWORD = 381