K31D

ELECTRONIC TEMPERATURE CONTROLLER WITH DIFFERENTIAL CONTROL MODE

OPERATING INSTRUCTIONS
Vr01 (ENG) - Code: ISTR-MK31DENG1

Ascon Tecnologic S.r.l.
Via Indipendenza, 56 - 27029 Vigevano (PV) - ITALY
Tel.: +39 0381 69871 - **Fax:** +39 0381 698730
Internet site: http:\\www.ascontecnologic.com
E-mail: info@ascontecnologic.com

INTRODUCTION

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1- INSTRUMENT DESCRIPTION

1.1 - General description

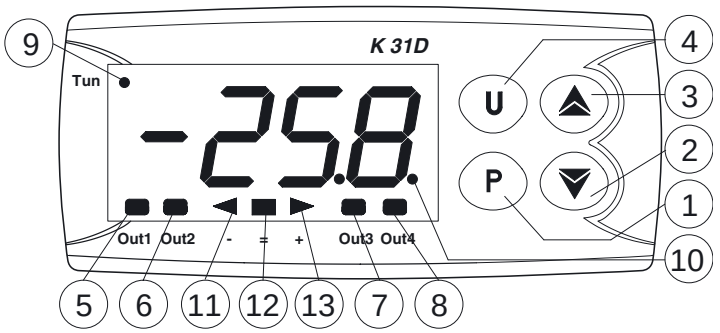
The K31D model is a digital temperature controller with a single loop microprocessor, with ON/OFF regulation, Neutral Zone ON/OFF, single or double action PID (direct and inverse) fitted with two inputs for PTC or NTC temperature probes by means of which it is possible to obtain differential temperature regulation. It can therefore be used in applications that require a control for the temperature difference between two different environments such as liquid coolers (chillers), natural air-conditioning systems through the recirculation of air, heating by solar panels or in many other applications where two temperature readings are needed.

Furthermore the controller is fitted with Fast and Oscillatory AUTOTUNING, SELFTUNING and FUZZY OVERSHOOT CONTROL for regulating the PID. Furthermore, the instrument allows for 2 digital inputs and RS485 serial communication using MODBUS-RTU communication protocol and a transmission speed up to 38400 baud. The process value is displayed on 4 red displays, while the outputs status is shown by 4 LEDs.

The controller is equipped with a programmable 3 LEDs shift display (◀■▶), stores 2 Set Points and can have up to 4 outputs [relay or solid state relays drive type (SSR)].
Other important available functions are:

Loop-Break Alarm function, reaching of the Set Point at controlled speed, ramp and dwell function, Soft-Start function, protection compressor function for neutral zone control, parameters protection on different levels.

1.2 - Front Panel Description



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

2 - Key (▼): 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. Outside the programming mode it permits visualisation of the current measured by the TAHB input.

3 - Key (▲): 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 (U): This is used to display the temperatures read by the probes (Pr1 and Pr2) and their difference (Pr1-Pr2). It can also be programmed through the "USrb" parameter for: Activating Autotuning or selftuning, setting the instrument to manual regulation, setting the alarm, changing the active Set Point and deactivating the regulation.

5 - Led OUT1: indicates the state of output OUT1.

6 - Led OUT2: indicates the state of output OUT2.

7 - Led OUT3: indicates the state of output OUT3.

8 - Led OUT4: indicates the state of output OUT4.

9 - Led SET: when flashes, indicates the access to the programming mode.

10 - Led Tun: indicates that the Self-tuning function is activated (light ON) or that Auto-tuning is in progress (flashing).

11 - Led ◀: ***Shift index -*** indicates that the process value is lower than the one programmed for parameter "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 for parameter "AdE".

2- PROGRAMMING

2.1 - Set Point Fast Programming

This procedure allows you to quickly set the active Set Point and, when required, the alarm thresholds (see par. 2.3).

Press and release the (P) key, the display the display will alternate between "**SP n**" and the set value ("**n**" is the number of the Set Point active at that moment).

To increase/decrease the Set Point value, press the (▲) / (▼) keys.

These keys change the value one digit a time but when pressed for more than one second, the value increases or decreases rapidly and, if pressed for more than two seconds, the changing speed increases further to allow the rapid achievement of the desired value.

Once the desired value has been reached, pressing key (P) it is possible to exit the Set Point fast programming mode or switch to the alarm thresholds display (see par. 2.3).

To exit the Set Point fast programming mode it is necessary to press the (P) key after the last Set Point has been displayed, alternatively, operating no keys for about 15 seconds the display will return to normal operation.

2.2 - Control Status and Parameter Selection

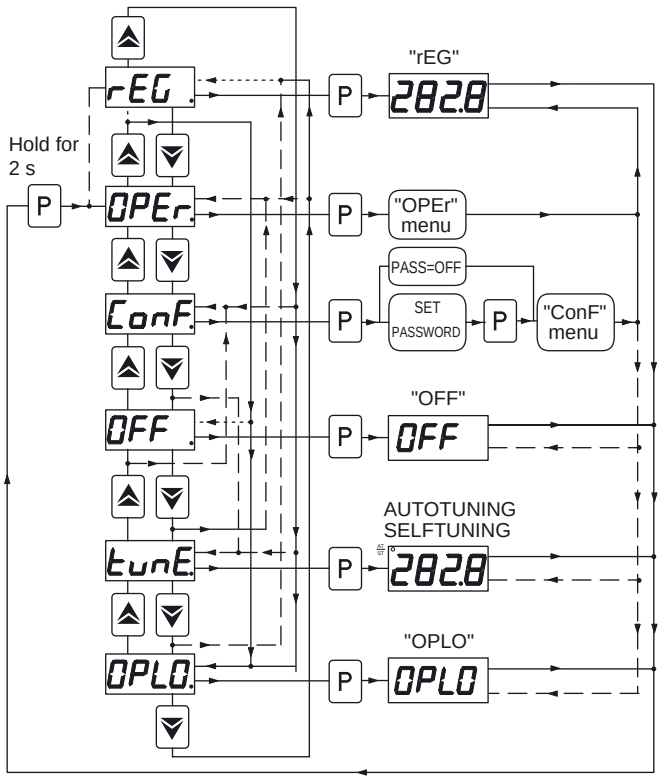
By pushing key and holding it down for approx. 2 s it is possible to enter into the main selection menu. Using the (▲) / (▼) keys, it is then possible to roll over the selections:

"OPEr"	to enter into the operating parameters menu
"ConF"	to enter into the configuration parameters menu
"OFF"	to swap the controller into the OFF state
"rEG"	to swap the controller into the automatic control state
"tunE"	to activate the Auto-tuning or Self-tuning function
"OPLO"	to swap the controller to the manual control state and therefore to program the % control value using the (▲) and (▼) 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 "**OPEr**", select the option "**OPEr**" and press (P).

The display will now show the code identifying the first group of parameters ("**SP**") and by pressing the (▲) and (▼) keys it will be possible to select the group of parameters to be modified.

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 (▲) and (▼) keys, it is possible to select the desired parameter and, if (P) is pressed, the display will alternatively show the parameter's code and its programming value, which can be modified by using the (▲) or (▼) keys.

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

By using the (▲) or (▼) 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 (▲) or (▼) key pressed for about 2 seconds, afterwards the display will return to visualise the code of the group of parameters.

Release the key and by using the (▲) and (▼) keys, it will be possible to select a new group (if present).

To exit the programming mode, no key should be pressed for about 20 seconds, or keep the (▲) or (▼) pressed until exit from the programming mode is obtained.

To bring up the "**ConF**" menu a personalized PASSWORD can be made necessary through the "**PASS**" parameter.

If this protection is required, set the password number desired in the "PASS" parameter and exit the programming parameters.

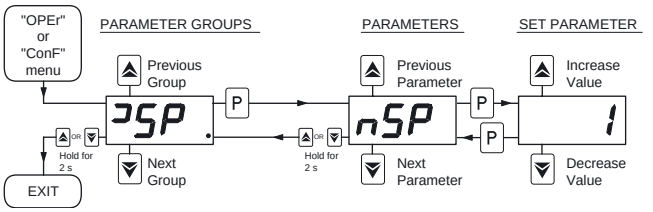
When the protection is activated, to be able to gain access to the parameters, it will be necessary to type in the programmed password from the "**ConF**" menu.

When the password is required type in, using the (▲) and (▼) keys, the number programmed at the "**PASS**" parameter and then press the (P) key.

If the wrong password is typed in the instrument returns to the regulatory state that it was previously in.

If the password is correct, the display will visualise the code identifying the first group of parameters ("**SP**") and with (▲) and (▼) it will be possible to select the desired group of parameters

The programming and exit modes for the "**ConF**" menu are the same as those described for menu "**OPEr**". This protection by password is deactivated by setting the "**PASS**" parameter = **OFF**.



Note: If the password is lost, turn OFF the instrument, press (P) and turn the instrument back ON keeping the key held down for about 5 seconds.
In this way access is made to all parameters of the "**ConF**" menu and it will therefore be possible to check and modify the "**PASS**" parameter.

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 paragraph 2.1, is instead subordinate to what is programmed in parameter "**Edit**" (contained in the group "**PAn**").

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 Satus

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 suing the keyboard;
- By using the key (U) on the keyboard; suitably programming parameter 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 parameter “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 and 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 status of the controller .

During automatic control it is possible to visualize the control power ON the display by pushing key (▲).

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” status, 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 (▲) and (▼) 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 parameter “nSP” located in the group of parameters “**]SP**”.

The active Set point can be selected:

- By parameter “SPAt” in the group of parameters “ **]SP**”;
- By key “U” if par. “USrb” = CHSP;
- By the digital inputs if “diF” = CHSP , = SP1.2 , =SP1.4 or = HE.Co;
- Automatically between SP1 and SP2 if a time “dur.t” (see par. 4.8) has been programmed.

Set Points “SP1”, “SP2”, “SP3”, “SP4” will be visible depending on the maximum number of Set Points selected on pararameter “nSP” and they can be programmed with a value that is between the value programmed in “SPLL” and the one programmed in “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- 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, thing or animals, please remember that the plant has to be equipped with additional devices which will guarantee safety.

3.2 - Mechanical Mounting

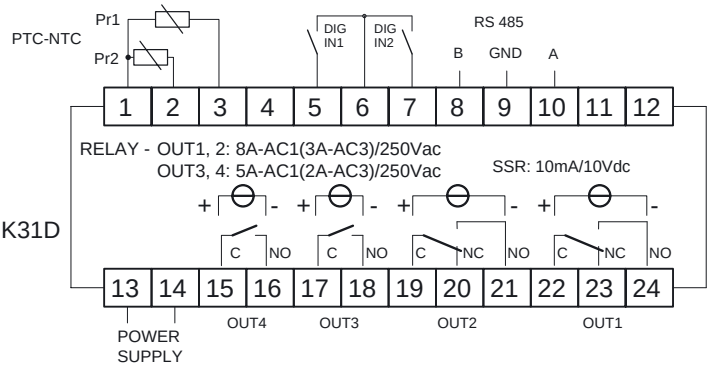
The instrument, in case 78 x 35 mm, is designed for flush-in panel mounting. Make a hole 71 x 29 mm and insert the instrument, fixing it with the provided special brackets. We recommend that the gasket is mounted in order to obtain the declared front protection degree. Avoid placing the instrument in environments with very high humidity levels or dirt that may create condensation or cause the 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 temperature higher 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 a built-in equipment with permanent connection inside housing, it is not equipped with either switches or internal devices to protect against current overloads: the installation must include 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 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 wiring cables are shielded is recommended to connect them to ground at one side only. For the electrical supply of the instrument it is recommended to use an external transformer TCTR, or with equivalent features, and to use only one transformer for each instrument because there is no insulation between 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 - Measurement and Display

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

Using parameter "SEnS", it is possible to select the type of input probe, which can be thermistors PTC KTY81-121 (Ptc) or NTC 103AT-2 (ntc).

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

Once the type of probe has been chosen through the "Unit" parameter it is possible to choose the temperature measurement unit (°C or °F) and through the "dP" parameter, the resolution of the measurement desired 0=1°; 1= 0.1°).

If the Pr2 probe is not used set the "Pr2" parameter = NO to avoid an error being indicated when the probe is not connected.

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:

"rot" = (D2-D1)/(M2-M1) **"OFSt" = D2 - ("rot" x 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 x "rot" + "OFSt"

Where:

DV = Displayed value MV = Measured Value.

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

Therefore: M1=20; D1=20; M2=200; D2=190;
"rot" = (190 - 20)/(200 - 20) = 0.944;
"OFSt" = 190 - (0.944 x 200) = 1.2.

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

Therefore: M1=0; D1=10; M2=500; D2=550;
"rot" = (550 - 10)/(500 - 0) = 1,08
"OFSt" = 550 - (1.08 x 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 , while for the ON/OFF controller s the cycle time is automatically considered to be equal to 20 s (e.g. In the event of probe error with ON/OFF control and "OPE"=50, the control output will be activated for 10 s, then it will be deactivated for 10 s and so on until the measurement error remains.).

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 break;

= Ur The condition occurs in case of under-range or probe break;

= Our The condition occurs in case of over-range or under-range or probe break.

Through the "diSP" parameter of the "**]PAn**" unit it is possible to decide what the display is to show normally- this could be the reading of probe Pr1 (Pr 1), the reading of probe Pr2 (Pr 2), the difference of temperature Pr1-Pr2 (P1-2), the regulation voltage (Pou), the active Set Point (SP.F), the operative Set Point when there are ramps activated (SP,o) or the alarm limit AL 1,2,3 (AL1, AL2 ,AL3).

Regardless of that set on the "diSP" parameter it is possible to show the variables Pr1, Pr2 and Pr1-Pr2 in rotation by pressing down and releasing the U key, the display will show the code that identifies the variable (P2 1, Pr2, P1-2) and its measurement.

After 15 seconds following the last time the U key is pressed, this type of display ends automatically.

Again in the group "**]PAn**" 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 - Output Configuration

The instrument outputs can be programmed by entering the group of parameters "**]Out**", where the relative parameters "O1F" , "O2F" ,"O3F" ,"O4F" (depending on the number of outputs available on the instrument) are located.

The outputs can be set for the following functions:

- Main control output (1.rEG);
- Secondary control output (2.rEG);
- Alarm output normally open (ALno);
- Alarm output normally closed (ALnc);
- Alarm output normally closed with led reverse indication (ALni);
- Output deactivated (OFF).

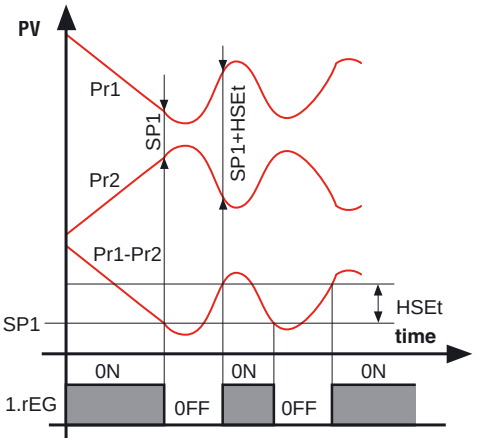
The coupling outputs number outputs – number alarms can be made in the group referring to the alarm to the alarm ("**]AL1**","**]AL2**" or "**]AL3**").

4.3 - Absolute or Differential Temperature Controller

Through the "PrrG" parameter it is possible to set the process variable used by the controller to operate.

In fact the controller can operate considering the process variable as the value measured at input 1 (Pr1), the value measured at input 2 (Pr2), the difference between the two inputs Pr1-Pr2 (P1-2) or can consider the difference between the two inputs Pr1-Pr2 but with a maximum limit and a minimum limit for the Pr2 measurement Pr2 (P1-L).

The "PrrG" choices = P1-2 or = P1-L make the controller operate as a differential controller.



Example of differential ON/OFF control (On.FA) with "Func"= CooL

Attention: The controller is already programmed in production to carry out differential regulation and display the temperature difference Pr1-Pr2.

In these cases the controller acts on the regulation outputs so it keeps the difference Pr1-Pr2 equal to the Set Point value.

The difference between the two modes lies in the fact that the P1-L mode activates a limit in the controller in terms of the calculation of the temperature difference according to the "P2HL" and "P2LL" parameters (both contained in the "[]**SP**") so that:

If Pr2 ≥ P2HL the process value considered by the controller is [Pr1-P2HL]

If Pr2 ≤ P2LL the process value considered by the controller is [Pr1-P2LL]

On exceeding the limits set "P2HL" and "P2LL" by the Pr2 temperature, regulation takes place as if the Pr2 temperature is the value of the limit regardless of the value actually read.

The aim of this function is to limit the differential regulation to within a maximum range of the Pr2 measurement.

With the differential regulation the working mode "Func"= CooL is used for applications with which the action of the actuator reduces the Pr1-Pr2 difference (thus countering the Pr1-Pr2 difference that naturally tends to increase).

Viceversa the "Func"= HEAt mode is used for applications with which the action of the actuator increases the Pr1-Pr2 difference thus countering the Pr1-Pr2 difference that naturally tends to decrease).

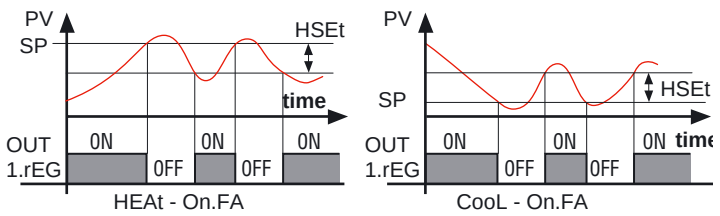
Obviously the Neutral Zone mode or the double action mode will set OFF both actions.

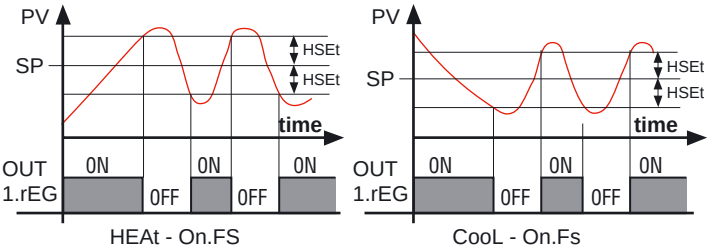
4.4 - ON/OFF Control (1.rEG)

All the parameters referring to the ON/OFF control are contained in the group "[]**rEG**".

This type of control can be obtained by programming par. "Cont" = On.FS or = On.FA and works on the output programmed as 1.rEG, depending on the measure, on the active Set Point "SP", on the functioning mode "Func" and on the hysteresis "HSEt".

The instrument carries out an ON/OFF control with symmetric hysteresis if "Cont" = On.FS or with asymmetrical hysteresis if "Cont" = On.Fa.





The control works in the following way: in the case of reverse action, or heating ("FunC"=HEAt), it deactivates the output, when the process value reaches [SP + HSEt] in case of symmetrical hysteresis, or [SP] in case of asymmetrical hysteresis and is then activated again when the process value goes below value [SP - HSEt].

Vice versa, in case of direct action or cooling ("Func"=CooL), it deactivates the output, when the process value reaches [SP - HSEt] in case of symmetrical hysteresis, or [SP] in case of asymmetrical hysteresis and is activated again when the process value goes above value [SP + HSEt].

4.5 - Neutral Zone ON/OFF Control (1.rEG - 2.rEG)

All the parameters referring to Neutral Zone ON/OFF control are contained in the group "[]**rEG**".

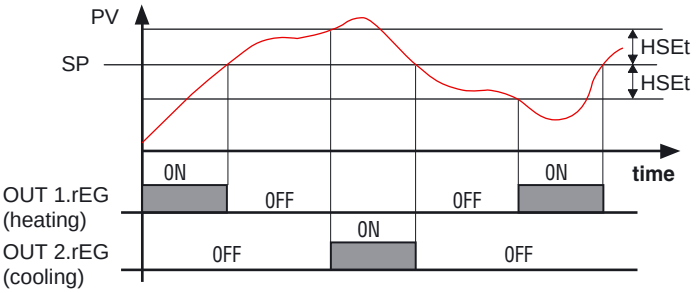
This type of control can be obtained when 2 outputs are programmed respectively as 1.rEG and 2.rEG and the par. "Cont" = nr.

The Neutral Zone control is used to control plants in which there is an element which causes a positive increase (ex. Heater, humidifier, etc.) and an element which causes a negative increase ex. Cooler, de-humidifier, etc).

The control functions works on the programmed outputs depending on the measurement, on the active Set Point "SP" and on the hysteresis "HSEt".

The control works in the following way: it deactivates the outputs when the process value reaches the Set Point and it activates the output 1.rEG when the process value goes below value [SP - HSEt], or it activates the output 2.rEG when the process value goes above [SP + HSEt].

Consequently, the element causing a positive increase has to be connected to the output programmed as 1.rEG while the element causing a negative increase has to be connected to the output programmed as 2.rEG.



If 2.rEG output is used to control compressor is possible to use the "Compressor Protection" function that has the meaning to avoid compressor "short cycles".

This function allows a control by time on the output 2.rEG activation, independently by the temperature control request.

The protection is a "delayed after deactivation" type.

This protection permits to avoid the output activation for a time programmable on par. "CPdt" (expressed in s); the output activation will occurs only after the elapsing of time "CPdt".

The time programmed on parameter “CPdt” is counted starting from the last output deactivation.

Obviously, whether during the time delay caused by the compressor protection function, the regulator request should stop, the output activation foreseen after time “CPdt” would be erased.

The function is not active programming “CPdt” =OFF.

The led relative to 2.rEG output blinks during the phases of output activation delay, caused by “Compressor Protection” function.

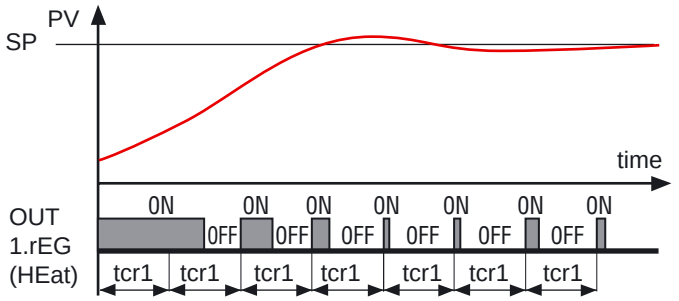
4.6 - Single Action PID Control (1.rEG)

All the parameters referring to PID control are contained in the group “]**rEG**”.

The Single Action PID control can be obtained by programming par. “Cont” = Pid and works on the output 1.rEG depending on the active Set Point “SP”, on the functioning mode “Func” and on the instrument’s PID algorithm with two degree of freedom.

In order to obtain good stability of the process variable, in the event of fast processes, the cycle time “tcr1” has to have a low value with a very frequent intervention of the control output.

In this case use of a solid state relay (SSR) is recommended for driving the actuator.

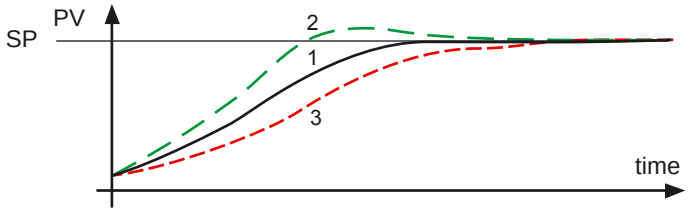


The Single Action PID control algorithm foresees the setting of the following parameters:

“**Pb**” – Proportional Band;
“**tcr1**” – Cycle time of the output 1.rEG;
“**Int**” – Integral Time;
“**rS**” – Manual Reset (if “Int =0 only);
“**dEr**” – Derivative Time;
“**FuOC**”– Fuzzy Overshoot Control.

This last parameter allows the variable overshoots at the start up of the process or at the changing of the Set Point to be avoided.

Please remember that a low value on this parameter reduces the overshoot while a high value increase it.



1) *Value “FuOC” OK;*
2) *Value “FuOC” too high;*
3) *Value “FuOC” too low.*

4.7 - Double Action PID Control (1.rEG - 2.rEG)

All the parameters referring to PID control are contained in the group “]**rEG**”.

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).

This type of control can be obtained when 2 outputs are programmed respectively as 1.rEG and 2.rEG and the par. “Cont” = Pid.

The element causing a positive increase has to be connected to the output programmed as 1.rEG while the element causing a negative increase has to be connected to the output programmed as 2.rEG.

The Double Action PID control works on the outputs 1.rEG and 2.rEG depending on the active Set Point “SP” and on the instrument’s PID algorithm with two degrees of freedom.

In order to obtain good stability of the process variable, in case of fast processes, the cycle times “tcr1” and “tcr2” have to have a low value with a very frequent intervention of the control outputs.

In this case use of solid state relays (SSR) to drive the actuators is recommended.

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

“**Pb**” – Proportional Band;
“**tcr1**” – Cycle time of the output 1.rEG;
“**tcr2**” – Cycle time of the output 2.rEG;
“**Int**” – Integral Time;
“**rS**” – Manual Reset (if “Int =0 only);
“**dEr**” – Derivative Time;
“**FuOC**”– Fuzzy Overshoot Control;
“**Prat**” – Power Ratio or relation between power of the element controlled by output 2.rEG and power of the element controlled by output 1.rEG.

If par. “Prat” = 0, the output 2.rEG is disabled and the control behaves exactly as a single action PID controller, through output 1.rEG.

4.8 - Autotuning and Selftuning Functions

All the parameters referring to the AUTO-TUNING and SELF-TUNING functions are contained in the group “]**rEG**”.

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

The AUTOTUNING function provides the calculation of the PID parameters through a FAST or OSCILLATORY 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 of the output 1.rEG;
“**Int**” – Integral Time;
“**dEr**” – Derivative Time;
“**FuOC**” – Fuzzy Overshoot Control;

and, for the Double Action PID control, also:

“**tcr2**” – Cycle time of the output 2.rEG;
“**Prat**” – Ratio P 2.rEG/ P 1.rEG.

To activate the AUTO-TUNING function proceed as follows:

1) Program and activate the desired Set Point.

2) Program par. “Cont” =Pid.

3) Program par. “Func” according to the process to be controlled through output 1.rEG.

4) Program an output as 2.rEG if the instrument controls a plant with double action

5) Program par. “Auto” as:

- **= 1** if FAST autotuning 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 FASTautotuning 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 FAST 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 is desired to activate the FAST 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|].
- **=- 1** If OSCILLATORY autotuning should be automatically activated every time the machine is turned ON.
- **=- 2** If OSCILLATORY autotuning should be automatically activated the next time the instrument is turned ON and, once the tuning is finished, the “Auto”=OFF parameter is automatically activated.
- **=- 3** If OSCILLATORY autotuning should be activated manually through the U key.
- **=- 4** If OSCILLATORY autotuning should be automatically activated with every modification to the regulation Set or at the end of the Soft-Start cycle programmed.

Note: The Fast-type Autotuning is particularly quick and shows no signs of having any effect on the regulation as it calculates the parameters of the regulator during the phase when the Set Point is reached.
For the correct execution of the Fast-type autotuning it is however necessary that at the cycle start-up there is a certain difference between the process variable and the Set Point. For this reason the instrument only activates the Fast autotuning when:
- For “Auto” = 1 or 2: The process value is less (for “Func”= HEAt) than [SP- |SP/2|] or greater (for “Func” =CooL) than [SP+ |SP/2|]
- For “Auto” = 3 or 4: the process value is less (for “Func”= HEAt) than [SP- |SP/5|] or greater (for “Func” =CooL) than [SP+ |SP/5|].

The FAST autotuning is not indicated when the Set point is close to the initial reading or when the variable measured varies in an irregular way during the tuning cycle (for reasons due to the process the variable rises or decreases).
In these cases it is advisable to use the Oscillatory-type Autotuning which implements some ON-OFF regulation cycles that make the process value oscillate around the Set point values that once finished pass to the PID-type regulation with parameters calculated by the Autotuning.

6) Exit from the parameter programming.

7) Connect the instrument to the controlled plant.

8) 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 Tun.

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 P.

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

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.

To activate the SELF-TUNING function proceed as follows

1) Program and activate the desired Set Point.;

2) Program par. “Cont” =Pid.;

3) Program par. “Func” according to the process to be controlled through output 1.rEG.;

4) Program an output as 2.rEG if the instrument controls a dual-action plant;

5) Program par. “SELF” = yES;

6) Exit from the parameter programming;

7) Connect the instrument to the controlled plant;

8) 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 Tun is permanently lit up and all the PID parameters (“Pb”, “Int”, “dEr”, etc.) are no longer visualized.

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.

4.9 - Rearching the set point at controlled speed and automatic switching between two set points (ramps an 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;

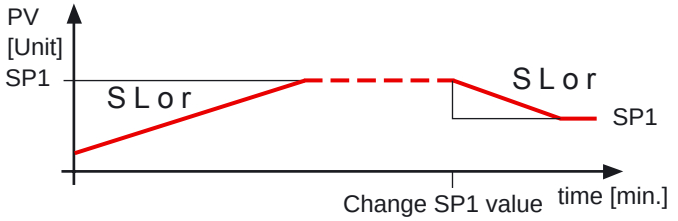
“**SLoF**”– Gradient of second ramp expressed in unit/minute;

"**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.

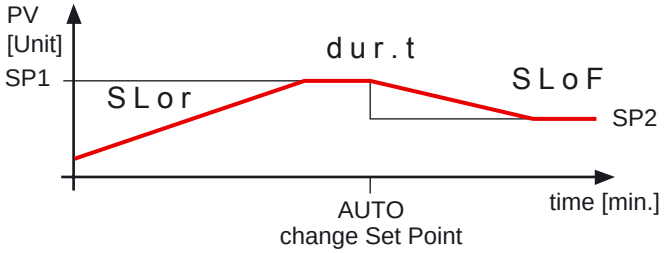
If is desired only one ramp (ex. to reach "SP1") it is enough to program on the par. "SLor" the desired value.

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 would not be more active.



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

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.

4.10 - Soft Start Function

All the parameters referring to the Soft -Start functioning are contained in the group "]**rEG**".

The Soft-Start function only works through PID control and allows the limitation of control power when the instrument is switched ON, for a programmable period of time.

This is useful when the actuator, driven by the instrument, may be damaged excess power supplied when the application is not yet in the normal rating. (ex. for certain heating elements).

The function depends on the following parameters:

"**St.P**" – Soft-Start power;

"**SSt**" – Soft-Start time (expressed in hh.mm);

"**HSEt**"– End Soft Start cycle threshold.

If both parameters are programmed with values other than OFF, when switched ON the instrument gives an output power as programmed on par. "St.P" for the time programmed on par. "SSt" or when is reached the absolute value programmed at par. "HSEt".

Practically, the instrument works in manual condition and switches to automatic control at the elapsing of time "SSt" or when is reached the absolute value programmed at par. "HSEt".

To disable the Soft-Start function simply program par. "SSt" = OFF.

Whenever, a measurement errors occurs during the Soft-Start execution, the function is interrupted and the instrument gives an output power as programmed on par. "OPE".

If the measurement is restored, the Soft-Start is still deactivated.

If it's desired to activate the Autotuning with Soft-Start set par. "Auto"=4.

The Autotuning will start automatically at the end of programmed Soft-Start cycle 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|].

4.11 - Alarms Output Functions (AL1, AL2, AL3)

The alarms (AL1, AL2, AL3) are depending on the process value and before to set his functioning it's necessary to establish to which output the alarm has to correspond to.

First of all it iss necessary to configure, in the parameters group "]**Out**", the parameters relative to the outputs required as alarm ("O1F" , "O2F" ,"O3F", "O4F") programming the parameter relative to the desired output as follows:

= ALno if the alarm output has to be ON when the alarm is active, while it is OFF when the alarm is not active

= ALnc if the alarm output has to be ON when the alarm is not active, while it is OFF when the alarm is active

= ALni if the alarm output has to be ON when the alarm is not active, while it is OFF when the alarm is active but with reverse led indication (led ON= alarm OFF).

Note: In all the following examples is made reference to the alarm AL1. Naturally the operation of the other alarms results analogous.

Have now access at the group "]**AL1**", and program on par. "OAL1", to which output the alarm signal has to be sent.

The alarm functioning is instead defined by parameters:

"**PrA1**" – 1 ALARM PROCESS MEASUREMENT;

"**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 s);

"**AL1i**" – ALARM BEHAVIOUR IN THE EVENT OF MEASUREMENT ERROR.

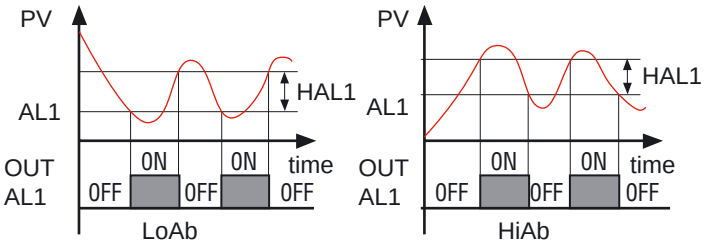
"PrA1" – ALARM PROCESS MEASUREMENT:
Through this parameter it is possible to set the process variable used by the alarm for operating. In fact the alarm can operate considering the process variable as the value measured at input 1 (Pr1), the value measured at input 2 (Pr2), the difference between the two inputs Pr1-Pr2 (P1-2) or can consider the difference between the two inputs Pr1-Pr2 but with a maximum limit and a minimum limit for the Pr2 measurement Pr2 (P1-L).

"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

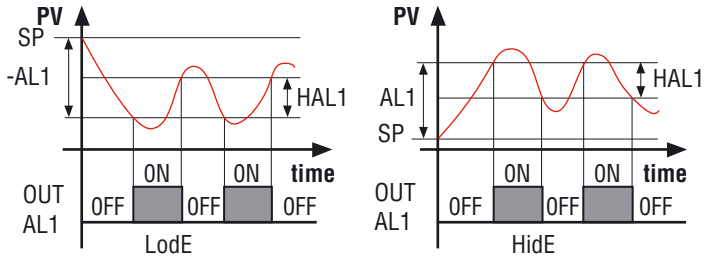
program the minimum and the maximum set of “AL1” by “AL1L” and “AL1H” parameters.

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.



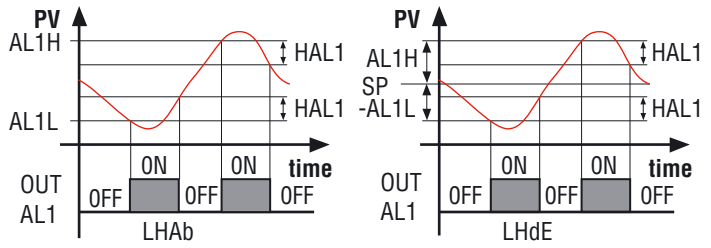
LodE *= DEVIATION LOW ALARM:*
The alarm is activated when the process value goes below the value [SP + AL1] and will be deactivated when it goes above the value [SP + AL1 + HAL1]. With this mode is possible to program the minimum and the maximum set of “AL1” by “AL1L” and “AL1H” parameters.

HidE *= DEVIATION HIGH ALARM:*
The alarm is activated when the process value goes above the value [SP + AL1] and will be deactivated when it goes below the value [SP + 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 [SP + AL1L] or goes above than the value [SP + AL1H] and will be deactivated when it goes below the value [SP + AL1H - HAL1] or when it goes above the value [SP + AL1L + HAL1].

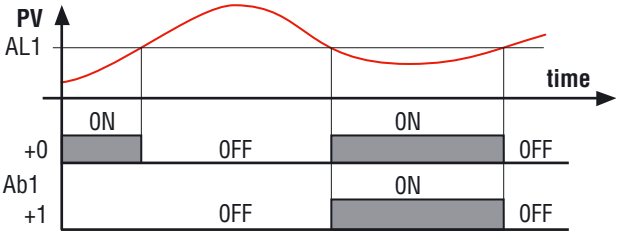


“Ab1” - ALARM CONFIGURATION:
This parameter can assume a value between 0 and 31. The number to be set, which will correspond to the function desired, is obtained by adding the values reported in the following descriptions:

ALARM BEHAVIOUR AT POWER ON:
the alarm output may behave in 2 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, at power 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.



Example with absolute low alarm

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

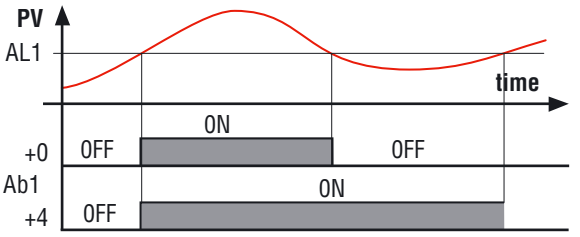
+0 = ALARM NOT DELAYED: The alarm is immediately activated when the alarm condition occurs.

+2 = ALARM DELAYED: When the alarm condition occurs, delay counting begins, as programmed on par. “AL1d” (expressed in s) 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.



Example with absolute high alarm

ALARM AKNOWLEDGEMENT: the alarm output may behave in two different ways depending on the value added to par. “Ab1”.

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

+ 8 = ALARM AKNOWLEDGED: 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.

ALARM BEHAVIOUR AT SET POINT CHANGE (DEVIATION ALARMS ONLY): 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.

+16 = ALARM NOT ACTIVATED AT SET POINT CHANGE: If, when Set Point change, 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.

“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).

4.12 - Loop Break Alarm Function

All the parameters referring to the Loop Break alarm function are contained in the group "]**LbA**".

The Loop Break alarm is available on all the instruments, which intervenes when, for any reason (short-circuit of a thermocouple, thermocouple inversion, load interruption), the loop control is interrupted.

First of all, it is necessary to establish to which output the alarm has to correspond.

To do this it is necessary to set the parameter relative to the output to be used ("O1F" , "O2F" ,"O3F", "O4F") in the group "]**Out**",

programming the parameter as:

= ALno if the alarm output has to be ON when the alarm is active while it is OFF when the alarm is not active.

= ALnc if the alarm output has to be ON when the alarm is not active while it is OFF when the alarm is active.

= ALni if the alarm output has to be ON when the alarm is not active, while it is OFF when the alarm is active but with reverse led indication (led ON= alarm OFF).

Enter group "]**LbA**" and program which output the alarm signal has to be addressed to on par. "OLbA".

The Loop Break alarm is activated if the output power remains at the 100% of the value for the time programmed on par. "LbAt" (expressed in s).

To avoid false alarms, the value of this parameter has to be set considering the time the plant takes to reach the Set point when the measured value is a long distance from it (for example at the plant start-up).

On alarm intervention, the instrument visualizes the message "LbA" and behaves as in the case of a measurement error giving a power output as programmed on par. "OPE" (programmable in the group "]**InP**").

To restore normal functioning after the alarm, select the control mode "OFF" and then re-program the automatic control ("rEG") after checking the correct functioning of probe and actuator.

To exclude the Loop Break alarm, set "OLbA" = OFF.

4.13 - Functioning of Key "U"

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

The parameter can be programmed as:

= noF No function;

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

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

= Aac Pushing the key for 1 s at least, it is possible to acknowledge the alarm. (see par. 4.10);

= ASi Pushing the key for 1 s at least, it is possible to acknowledge an active alarm (see par. 4.10);

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

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

4.14 - Digital Input

The instrument can be equipped with an digital input. The function of the digital input 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. 4.11)

= ASi Closing the contact connected to the digital input 1 it is possible to acknowledge an active alarm (see par. 4.11)

= 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 U.

= HE.Co Closing the contact connected to the digital input 1 it is possible to select as active the set point SP2 in "CooL" mode. Reopening the contact is select as active the set point SP1 in "HEAt" mode. This function is possible only when "nSP" = 2.

4.15 - RS485 Serial Interface

The instrument can be equipped with a RS 485 serial communications 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 K31D is a MODBUS RTU type, widely used in several PLC and supervision programs available on the market (the manual of the comminications protocol of the K31D series 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 120Ω 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 they must be interlaced with a double cable (telephonic type).

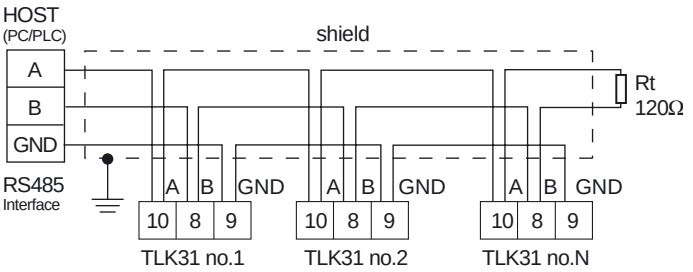
Nevertheless, particularly when the net results very long or noised, it is advisable to adopt a screened cable wired as in the drawing. If the instrument is equipped with a serial interface, the parameters to be programmed are the following, all present in the parameters group "]**SEr**":

"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.



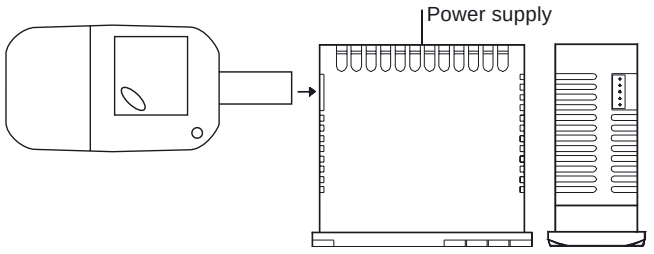
4.16 - Parameters configuration by "KEY01" and "A01"

The instrument is equipped with a connector that allows the transfer from and toward the instrument of the functioning parameters through the device TECNOLOGIC KEY01 or TECNOLOGIC A01 with 5 poles connector.

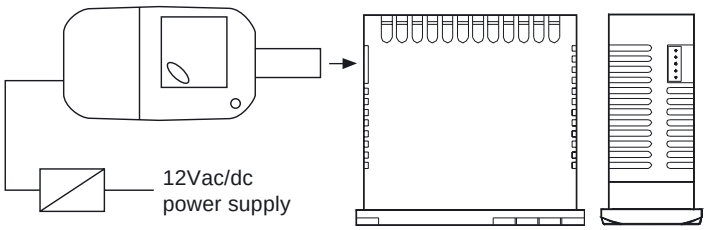
These device are used to program series of instruments that need to have the same configuration parameters or to copy the configuration of an instrument in order to allow its easy replication.

To use the device KEY01 or A01 it is necessary that the device or instrument are being supplied.

Instrument powered and device not powered



Instrument powered from the device



Note: For the instruments equipped with RS485 serial communications, it is mandatory that the parameter "PACS" is programmed as LorE.

For additional info, please have a look at the KEY01 or A01 instruction manual.

5- PROGRAMMABLE PARAMETERS

Here following are described all the parameters available on the instrument. Some of them could be not present or because they are depending on the type of instrument or because they are automatically disabled as unnecessary.

Group "SP" (parameters relative to the Set Point)

Par.		Description	Range	Def.	Note
1	nSP	Number of the programmable Set points	1... 2	1	
2	SPAt	Active Set point	1... nSP	1	
3	SP1	Set Point 1	SPLL... SPHL	0	
4	SP2	Set Point 2	SPLL... SPHL	0	
5	P2HL	Upper Pr2 measurement limit for differential control	-1999... 9999	9999	
6	P2LL	Lower Pr2 measurement limit for differential control	-1999... 9999	-1999	
7	SPLL	Low Set Point	-1999... SPHL	-1999	
8	SPHL	High Set Point	SPLL... 9999	9999	

Group "InP" (parameters relative to the measure input)

Par.		Description	Range	Def.	Note
9	SEnS	Probes type	Ptc/ntc	ntc	
10	Pr2	Probe Pr2 presence	yES/no	yES	
11	dP	Number of decimal figures	0/1	0	
12	Unit	Temperature unit of measurement	°C/°F	°C	
13	FiL	Input digital filter	OFF... 20.0 s	1.0	
14	OFS1	Measuring Offset Pr1	-1999... 9999	0	
15	OFS2	Measuring Offset Pr2	-1999... 9999	0	
16	rot	Rotation of the measuruing straigiht line	0.000... 2.000	1.000	
17	InE	"OPE" functioning in case of measuring error	Our/Or/Ur	OUr	
18	OPE	Output power in case of measuring error	-100... 100	0	
19	dIF	Digital inputs function: **noF** = No Function **Aac** = Reset Alarms latch **ASi** = Aknowledged Alarms **HoLd** = Hold Measure **OFF** = Control OFF **CHSP** = Sel. Set Point **SP1.2** = Sel. SP1/SP2 **HE.Co** = Sel. Heat-SP1/Cool - SP2	noF/AaC /ASi/ HoLd/OFF/ CHSP/SP1.2/ HE.Co	noF	

Group "Out" (parameters relative to the outputs)

Par.		Description	Range	Def.	Note
20	O1F	**1.rEG** = Control output 1 **2.rEG** = Control output 2 **ALno** = Alarm Out NO **ALnc** = Alarm Out NC **ALni** = Alarm Out NC with reverse led func.	1.rEG/2.rEG ALno/ALnc ALni/OFF	1.rEG	

Par.		Description	Range	Def.	Note
21	O2F	Functioning of output 2: see “O1F”	1.rEG/2.rEG ALno/ALnc ALni/OFF	ALno	
22	O3F	Functioning of output 3: see “O1F”	1.rEG/2.rEG ALno/ALnc ALni/OFF	ALno	
23	O4F	Functioning of output 4: see “O1F”	1.rEG/2.rEG ALno/ALnc ALni/OFF	ALno	

Group “AL1” (parameters relative to alarm AL1)

Par.		Description	Range	Def.	Note
24	OAL1	Output where alarm AL1 is addressed	Out1/Out2/ Out3/Out4/ OFF	Out2	
25	PrA1	AL1 alarm process measurement reference	Pr1/Pr2/P1-2/P1-L	Pr1	
26	AL1t	**LoAb**= Absolute Low **HiAb**= Absolute High **LHAb**= Absolute Band **LodE**= Deviation Low **HidE**= Deviation High **LHdE**= Deviation Band	LHAb/LodE HidE/LHdE	LoAb	
27	Ab1	Alarm AL1 functioning: **+1** = not activated at power ON **+2** = delayed **+4** = latch **+8** = aknowledged	0... 31	0	
28	AL1	Alarm AL1 threshold	AL1L... AL1H	0	
29	AL1L	Low threshold band alarm AL1 or Minimum set alarm AL1 for high or low alarm	-1999... AL1H	-1999	
30	AL1H	High threshold band alarm AL1 or Maximum set alarm AL1 for high or low alarm	AL1L... 9999	9999	
31	HAL1	Alarm AL1 hysteresis	OFF... 9999	1	
32	AL1d	Activation delay of alarm AL1	OFF... 9999 s	OFF	
33	AL1i	Alarm AL1 activation in case of measuring error	no/yES	no	

Group “AL2” (parameters relative to alarm AL2)

Par.		Description	Range	Def.	Note
34	OAL2	Output where alarm AL2 is addressed	Out1/Out2/ Out3/Out4/ OFF	OFF	
35	PrA2	AL2 alarm process measurement reference	Pr1/Pr2/P1-2/P1-L	Pr1	
36	AL2t	Alarm AL2 type: see “AL1t”	LHAb/LodE HidE/LHdE	LoAb	
37	Ab2	Alarm AL2 functioning: see “Ab1”	0... 31	0	
38	AL2	Alarm AL2 threshold	AL1L... AL1H	0	
39	AL2L	Low threshold band alarm AL2 or Minimum set alarm AL2 for high or low alarm	-1999... AL1H	-1999	
40	AL2H	High threshold band alarm AL2 or Maximum set alarm AL2 for high or low alarm	AL1L... 9999	9999	
41	HAL2	Alarm AL2 hysteresis	OFF... 9999	1	
42	AL2d	Activation delay of alarm AL2	OFF... 9999 s	OFF	
43	AL2i	Alarm AL2 activation in case of measuring error	no/yES	no	

Group “AL3” (parameters relative to alarm AL3)

Par.		Description	Range	Def.	Note
44	OAL3	Output where alarm AL3 is addressed	Out1/Out2/ Out3/Out4/ OFF	OFF	
45	PrA3	AL3 alarm process measurement reference	Pr1/Pr2/P1-2/P1-L	Pr1	
46	AL3t	Alarm AL3 type: see “AL1t”	LHAb/LodE HidE/LHdE	LoAb	
47	Ab3	Alarm AL3 functioning: see “Ab1”	0... 31	0	
48	AL3	Alarm AL3 threshold	AL1L... AL1H	0	
49	AL3L	Low threshold band alarm AL3 or Minimum set alarm AL3 for high or low alarm	-1999... AL1H	-1999	
50	AL3H	High threshold band alarm AL3 or Maximum set alarm AL3 for high or low alarm	AL1L... 9999	9999	
51	HAL3	Alarm AL3 hysteresis	OFF... 9999	1	
52	AL3d	Activation delay of alarm AL3	OFF... 9999 s	OFF	
53	AL3i	Alarm AL3 activation in case of measuring error	no/yES	no	

Group “LbA” (parameters relative to Loop Break Alarm)

Par.		Description	Range	Def.	Note
54	PLBa	Output where alarm LbA is addressed	Out1/Out2/ Out3/Out4/ OFF	OFF	
55	LbAt	Time necessary to activate alarm LbA	OFF... 9999 s	OFF	

Group “rEG” (parameters relative to the control)

Par.		Description	Range	Def.	Note
56	Cont	Control type: **Pid** = PID **On.FA** = ON/OFF asym. **On.FS** = ON/OFF sym. **nr** = Neutral Zone ON/OFF	Pid/On.FA/ On.FS/nr	Pid	
57	Func	Functioning mode output 1.rEG	HEAt/CooL	HEAt	
58	PrrG	Control process measurement reference	Pr1/Pr2 /P1-2/P1-L	Pr1	
59	HSEt	Hysteresis of ON/OFF control (or end Soft Start cycle threshold)	0... 9999	1	
60	CPdt	Compressor Protection time for 2.rEG	OFF... 9999 s	0	

Par.		Description	Range	Def.	Note
61	Auto	Autotuning enable **OFF** = Not active **1** = Start each power ON **2**= Start at first power ON **3** = Start manually **4** = Start after Soft Start or change Set Point	-4/-3/-2/-1/0/ 1/2/3/4	0	
62	SELF	Selftuning enable	no/yES	no	
63	Pb	Proportional band	0... 9999 s	50	
64	Int	Integral time	OFF... 9999 s	200	
65	dEr	Derivative time	OFF... 9999 s	50	
66	FuOc	Fuzzy overshoot control	0.00... 2.00	0.5	
67	tcr1	Cycle time of output 1.rEg	0.1... 130.0 s	20.0	
68	Prat	Power ratio 2.rEg/1.rEg	0.01... 99.99	1.00	
69	tcr2	Cycle time of 2.rEg	0.1... 130.0 s	10.0	
70	rS	Manual reset	-100.0... 100.0%	0.0	
71	SLor	Gradient of first ramp: **InF** = Ramp not active	0.00... 99.99/ InF unit/min.	InF	
72	dur.t	Duration time between 2 ramps: **InF** = Time not active	0.00... 99.59/ InF hrs.-min.	InF	
73	SLoF	Gradient of second ramp: **InF** = Ramp not active	0.00... 99.99/ InF unit/min.	InF	
74	St.P	Soft-Start power	-100... 100 %	0	
75	SSt	Soft-Start time	OFF/0.1... 7.59/ InF hrs.-min.	OFF	

Group "PAn" (parameters relative to the user interface)

Par.		Description	Range	Def.	Note
76	USrb	Funtion recalled by the "U" tey: **noF** = None **tune** = Auto-tune/self-tune start **OPLO** =Manual operation (open loop) **Aac** = Reset Alarm register **ASi** = Alarms Acknowledge **CHSP** = Active set point selection **OFF** = Control in OFF mode	noF/tunE/ OPLO/Aac/ ASi/CHSP/ OFF	noF	
77	diSP	Variable displayed: **Pr1** = Pr1 Value **Pr2** = Pr2 Value **P1-2** = Pr1-Pr2 Value **Pou** = Control Power **SP.F** = Active Set Value **SP.o** = Operative Set value **AL1** = AL1 threshold **AL2** = AL2 threshold **AL3** = AL3 threshold	Pr1/Pr2/P1-2/Pou/SP.F/ SP.o/AL1/ AL2/AL3	P1-2	
78	AdE	Shift value for the shift index functioning	OFF...9999	2	
79	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	
80	PASS	Password "ConF" menu	OFF... 9999	OFF	

Group "SEr" (parameters relative to the serial communication)

Par.		Description	Range	Def.	Note
81	Add	Station address in case of serial communication	0 … 255	1	
82	baud	Transmission speed (Baud rate)	1200/2400/ 38.4	9600	
83	PACS	Programmability through serial port: **LoCL** = No (Local only) **LorE** = Yes (Local and remote programmability)	LoCL / LorE	LorE	

6- PROBLEMS, MAINTENANCE AND WARRANTY

6.1 - Error Signalling

Error	Reason	Action
E1 -E1	The probe Pr1 may be interrupted or in short circuit, or may measure a value outside the allowed range	Check the correct connection of the probe with the instrument and check the probe works correctly
E2 -E2	The probe Pr2 may be interrupted or in short circuit, or may measure a value outside the allowed range	
- - - -	Process measurement not available	
ErAt	Auto-tuning not possible because the process value is too high or too low	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 EEPROM memory anomaly	Push key "P"

In error conditions, the instrument provides an output power as programmed on par. "OPE" and activates the desired alarm(s), if the relative parameters "ALni" have been programmed as **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 - Warranty and Repairs

The instrument is under warranty against manufacturing flaws or faulty material, that are found within 18 months from delivery date.

The warranty 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 Ascon Tecnologic with a detailed description of the faults found, without any fees or charge for Ascon Tecnologic, except in the event of different agreements.

7- TECHNICAL DATA

7.1 - Electrical data

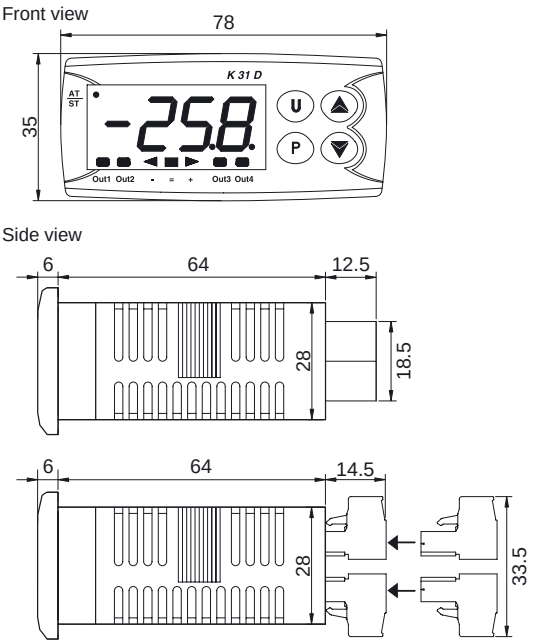
Power supply	12 Vac/Vdc, 24 Vac/Vdc, 100... 240 Vac ±10%
Frequency AC	50/60 Hz
Power consumption	4 VA approx.
Input/s	2 inputs for temperature probes PTC KTY 81-121 (990Ω at 25°C); NTC 103AT-2 (10kΩ at 25°C); 2 digital inputs for free voltage contacts
Output/s	Up to 4. 2 SPDT (8 A-AC1, 3 A-AC3/250 Vac) and 2 SPST-NO (5 A-AC1, 2 A-AC3/250 VAC) or in tension to drive SSR (10mA 10Vdc)
Electrical life for relay outputs	100000 operations
Installation category	II
Measurement category	I
Protection class against electric shock	Class II for Front panel
Insulation	Reinforced insulation between the low voltage section (relay outputs) and the front panel; Reinforced insulation between the low voltage section (relay outputs) and the extra low voltage section (inputs, SSR outputs); No insulation between power supply, inputs and SSR outputs; 50 V insulation between RS485 and extra low voltage section

7.2 - Mechanical data

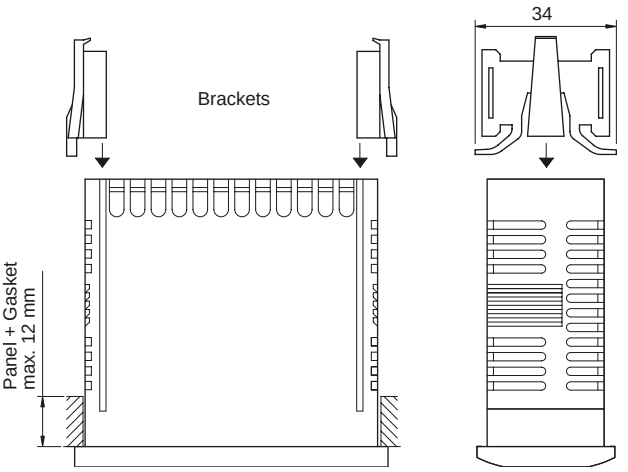
Housing	Self-extinguishing plastic, UL 94 V0
Dimensions	78 x 35 mm, depth 75,.5 mm
Weight	150 g approx.
Mounting	Flush in panel in 71 x 29 mm hole
Connections	2.5 mm^2 screw terminals block or removable terminals block with 2.5 mm^2 screw terminals
Protection degree (front panel)	IP65 mounted with gasket
Pollution degree	2
Operating temperature	0... 50°C
Operating humidity	30... 95 RH% without condensation
Storage temperature	-10... +60°C

7.3 - Installation

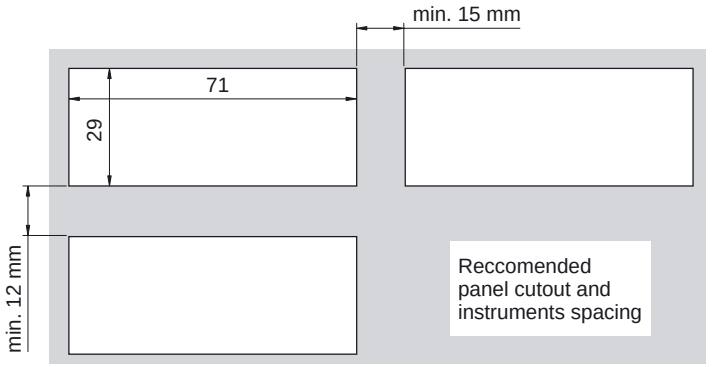
7.3.1 - Dimensions [mm]



7.3.2 - Mounting [mm]



7.3.3 - Panel Cut-Out [mm]



7.4 - Functional Features

Control	ON/OFF, Neutral zone, single and double action PID
Measurement range	According to the probe used (see range table)
Display resolution	According to the probe used 1°/0.1°
Overall accuracy	±(0.5% fs + 1 digit)
Sampling rate	130 ms
Serial Interface	RS485 insulated
Communications protocol	MODBUS RTU (JBUS)
Baud rate	Programmable between 1200... 38400 baud
Display	4 Digit, colour: red, heght: 12 mm
Compliance	ECC directive EMC 2004/108/CE (EN 61326), ECC directive LV 2006/95/CE (EN 61010-1)

7.5 - Measuring Range Table

Input	"dp" = 0	"dp" = 1
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

8- ORDERING CODE

K31D a b c d e f g h i j k ll mm

Code	Descriprion	Values
a	Power supply	**H** = 100... 240Vac
		L = 24Vac/dc
		F = 12Vac/dc
b	Inputs	**2** = Thermistors (PTC, NTC)
c	OUT1 output	**R** = Relay
		O = Vdc for SSR
d	OUT2 output	**R** = Relay
		O = Vdc for SSR
		– = None
e	OUT3 output	**R** = Relay
		O = Vdc for SSR
		– = None
f	OUT4 output	**R** = Relay
		O = Vdc for SSR
		– = None
g	Communications Interface	**S** = RS 485 Serial interface
		– = No interface
h	Connector Terminals	**–** = Screw terminals (standard)
		E =Removable socket with screw terminals
i, j, k	RESERVED CODES	
ll, mm	SPECIAL CODES	