PROCESS CONTROLLERS
Akros Series

Instruction Manual

INDEX

1. INTRODUCTION

This instruction manual describes how to install and start up the different models of the Akros series of process controllers.

You must read the instruction manual before starting up the equipment.

1.1. General specifications

The Akros series is a range of high-performance process controllers. The options for configuration of their variables and their different formats available make the Akros series an excellent range of process controllers, ideal for any kind of industrial control application. Their most outstanding features are as follows:

Standard:

- Fully configurable input for thermocouple, RTD, voltage or current loop (no need for any external component).
- User-configurable control output as SPDT relay or DC pulses for solid state relay.
- PID or PI+D (PI with automatic derivative) control type with 2 different types of autotuning algorithms that the user can choose depending on the application, or ON/OFF control output.
- Automatic or Manual working mode.
- Digital input with configurable function (keyboard lock or secondary Set Point). (AK49 and AK96 only).
- One alarm as standard. A second alarm can optionally be fitted.
- Double, large 4 digit display.

As options:

- Second, fully configurable alarm.
- Cooling output configurable as proportional or ON-OFF with variable hysteresis.
- Linear control output 0..20, 4..20 mA (max. 500 Ohm), 0..5 or 0..10V (max. 20 mA).

- Output for servomotor. (AK49 and AK96 only).
- Analog output proportional to the variable of 0..20, 4..20 mA (max. 500 Ohm), 0..5 or 0..10V (max. 20 mA) with user-configurable range. (AK49 and AK96 only).
- Supply for transmitter of 0..20 or 4..20 mA (@13,5 Vdc).
- Remote signal input (0..20, 4..20 mA, 0..5 or 0..10 V) with user-configurable range. (AK49 and AK96 only).
- RS485 serial communications. (AK49 and AK96 only).

Format:

AK48: 1/16 DIN43700 (48x48 mm). Frontally removable.
AK49: 1/8 DIN43700 (48x96 mm, vertical). Frontally removable.
AK96: 1/4 DIN43700 (96x96 mm). Frontally removable.

Supply: 85..265 Vac 50/60 Hz (optionally, 21..53 Vac/Vdc)

Dimensions:

AK48: 48 x 48 x 109 mm
AK49: 48 x 96 x 98 mm
AK96: 96 x 96 x 98 mm

Panel cutout:

AK48: 45.5 x 45.5 mm (±0.5)
AK49: 45.5 x 91.5 mm (±0.5)
AK96: 94 x 91.5 mm (±0.5)

Display:

4 digits of 10 mm for the process variable (13 mm in the AK96).
4 digits of 7 mm for the Set Point (10 mm in the AK96).

Inputs: User-configurable as:

L : 0..600°C (Fe-CuNi, DIN43710)
J : 0..600°C (Fe-CuNi, IEC584)
K: 0..1200°C (NiCr-NiAl, IEC584)
N: 0..1200°C (NiCrSi-NiSi, IEC584)
T: 0..400°C (Cu-CuNi, IEC584)
R: 0..1600°C (Pt/13%Rh-Pt, IEC584)
S: 0..1600°C (Pt/10%Rh-Pt, IEC584)
RTD, Pt100: 0..600°C (IEC751)
RTD, Pt100: -99.9..200.0°C (IEC751)
Current loop 0..20 , 4..20 mA (load 10 Ohm)
Voltage Vdc 0..5 , 0..10 V (Impedance >5 KOhm)

Control output: Output via SPDT relay (2A @ 250 Vac, resistive load) or pulses of 9 Vdc (open collector, max. 40 mA) user-

configurable. Optionally, loop output of 0..20 mA, 4..20 mA (500 Ohm max.), 0..5 V, 0..10 V (20 mA max.).
The control output for servomotor (two SPDT relays, open/close), excludes the cooling output.

Cooling output (AK49 and AK96 only): Output via SPDT relay (2A @ 250 Vac, resistive load), configurable as ON/OFF (with programmable hysteresis) or proportional.

Alarms: One alarm as standard, optionally 2 alarms. Fully configurable. SPST output (1A @ 250 Vac, resistive load). In AK48 model, they share one point in common.

Type of regulation: PID or PI+D, with 2 autotuning user-selectable algorithms, or ON/OFF con configurable hysteresis.

Weight: AK48: 140 grs.
AK49: 220 grs.
AK96: 260 grs.

1.2. How to order

AK48

Model	Control output	Basic options	Power Supply	Manual Language
	1: Relay or Vdc pulses. **3: 0..20 mA** **4: 4..20 mA** **6: 0..5 Vdc** **7: 0..10 Vdc**	**1: One SPST alarm (as standard)** **3: Two SPST alarms** **9: Supply at 13 Vdc for transmitter**	**1: 85..265 Vac, 50/60 Hz** **2: 21..53 Vac/Vdc**	**D: German** **E: English** **F: French** **S: Spanish**
AK48	1	1	1	S

AK49

Model	Control output	Basic options	Auxiliary output (*)	Interface	Power Supply	Manual Language
	1: Relay or Vdc pulses. 3: 0..20 mA 4: 4..20 mA 5: Servomotor (*) 6: 0..5 V 7: 0..10 V	1: One alarm (as standard) 2: Cooling + one alarm 3: Two Alarms 4: Cooling + two Alarms	0: No options 3: 0..20 mA 4: 4..20 mA 6: 0..5 Vdc 7: 0..10 Vdc 9: 13 Vdc supply for transmitter	0: No options 2: RS485 3: RSP (**) 0..20 mA 4: RSP (**) 4..20 mA 6: RSP (**) 0..5 Vdc 7: RSP (**) 0..10 Vdc 9: 13 Vdc supply for transmitter	1: 85..265 Vac (50/60 Hz) 2: 21..53 Vac/Vdc	D: German E: English F: French S: Spanish
AK49	5	1	3	1	1	S

AK96

Model	Control output	Basic options	Auxiliary output (*)	Interface	Power Supply	Manual Language
	1: Relay or Vdc pulses. 3: 0..20 mA 4: 4..20 mA 5: Servomotor (*) 6: 0..5 V 7: 0..10 V	1: One alarm (as standard) 2: Cooling + one Alarm 3: Two Alarms 4: Cooling + two Alarms	0: No options 3: 0..20 mA 4: 4..20 mA 6: 0..5 Vdc 7: 0..10 Vdc 9: 13 Vdc supply for transmitter	0: No options 2: RS485 3: RSP (**) 0..20 mA 4: RSP (**) 4..20 mA 6: RSP (**) 0..5 Vdc 7: RSP (**) 0..10 Vdc 9: 13 Vdc supply for transmitter	1: 85..265 Vac (50/60 Hz) 2: 21..53 Vac/Vdc	D: German E: English F: French S: Spanish
AK96	5	1	3	1	1	S

(*) These options exclude the cooling output.

2. INSTALLATION

2.1. Preliminary aspects

The connections must be made with the instrument installed in its definitive place of operation. In order to prevent electric discharges whilst making the connections, connect the instrument to the mains in the last wiring operation. The installation must be fitted with a double-pole switch of at least 1A, 250V, which must be close to the instrument and offer the operator easy access. It must be marked as the instrument's switch. Similarly, a 200 mA, 250V fuse must be fitted in the supply wiring (wiring insulation at least 1000V).

It is advisable to be guided by the following recommendations wherever possible:

- The instrument must be connected without mains voltage.
- Do not install the instrument near moving parts, contactors or motor starters.
- Endeavour to prevent mechanical vibrations.
- Do not wire the signal lines together with the power lines.
- For the signal lines, it is advisable to use a shielded wire with the earth connection at one single point.
- It is important to check the configuration of the instrument (inputs and outputs), in the event any problem occurs when starting operation.

Installation or use of the equipment other than specified in this manual may reduce the levels of protection provided in the equipment.

2.2. Configuration of inputs and outputs

Akros series instruments are fully configurable; it is therefore necessary to confirm that the configuration of the instrument corresponds to the application it will be used for, prior to starting up.

To change the configuration of the input signal or sensor, follow the steps described in chapter 3.

2.3. Panel mounting

The instrument should be installed on a panel a maximum of 8 mm. thick. Its must be sited in a place subject to the less possible vibrations, and it must be ensured that the atmospheric temperature will be kept between 0 and 50ºC.

Insert the instrument into the panel hole and hold it firm while tightening the mounting brackets onto the inner wall of the panel, using a screwdriver. To install more than one instrument, a space must be left of at least 20 mm. vertical separation and 10 mm. horizontal separation between instruments.

3. INPUTS / OUTPUTS

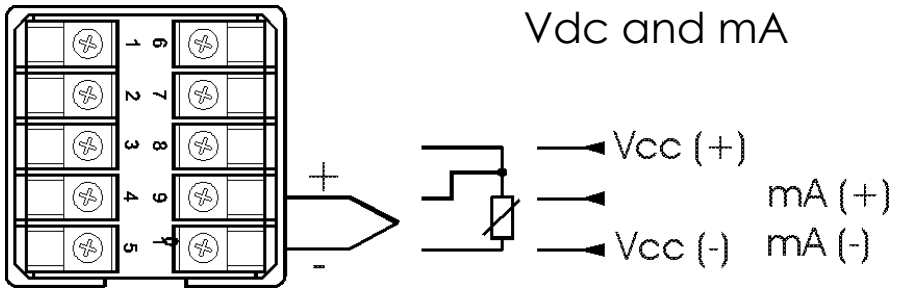
Linear mA input with internal source and Remote Set Point

3.1. Options of the signal input. Examples.

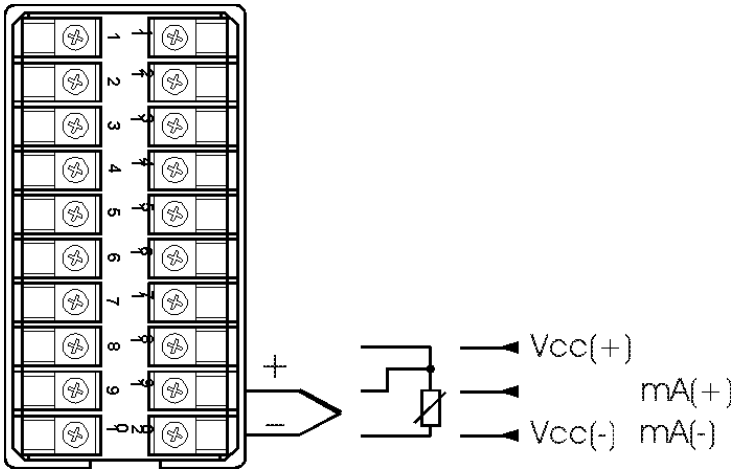
This chapter uses diagrams to describe the connections of the different options for the input signal.

Model AK48:

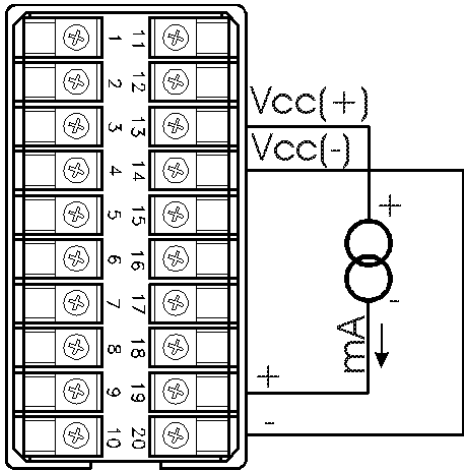
Inputs for thermocouple, Pt100, Vdc and mA



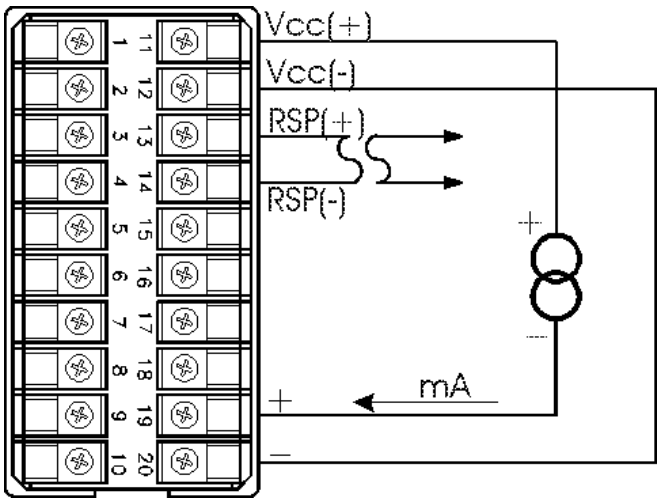
Model AK49:



Inputs for thermocouple, Pt100, Vdc and mA

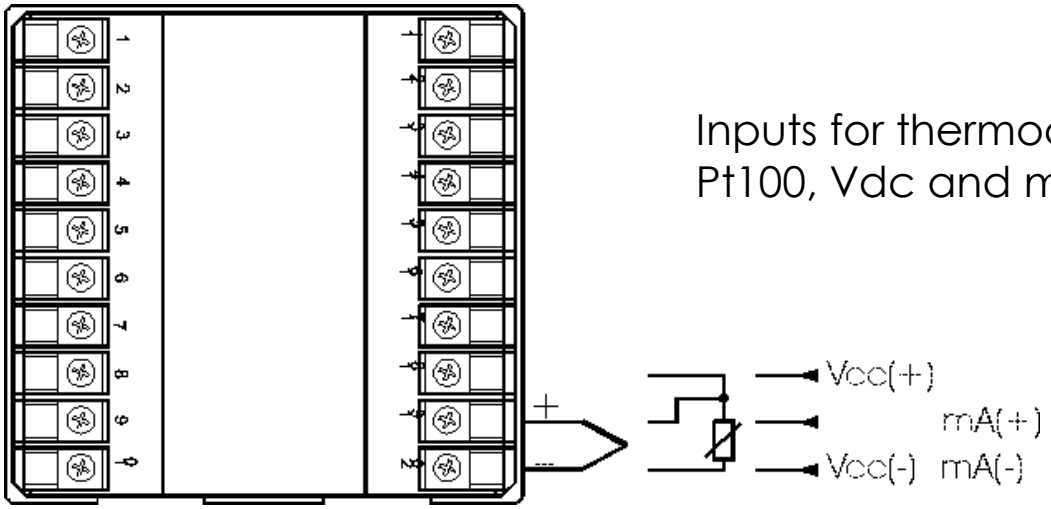


Linear mA input with internal source

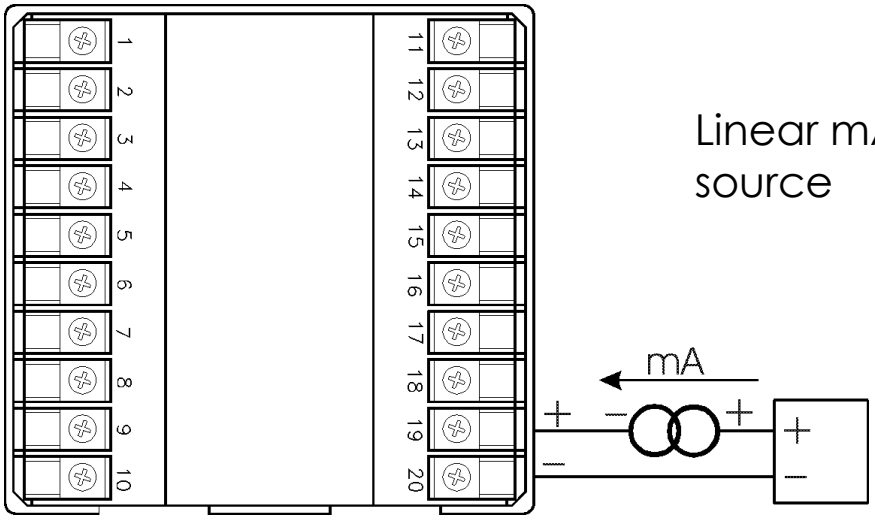


Linear mA input with internal source

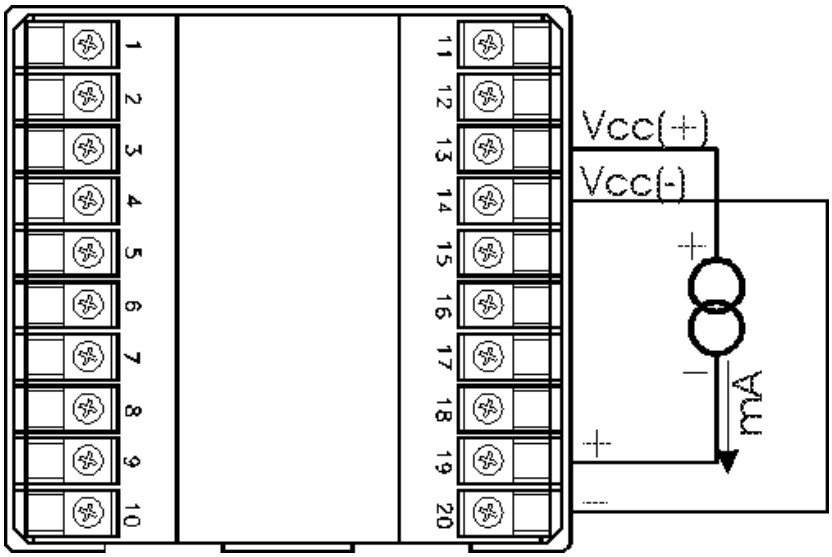
Model AK96:

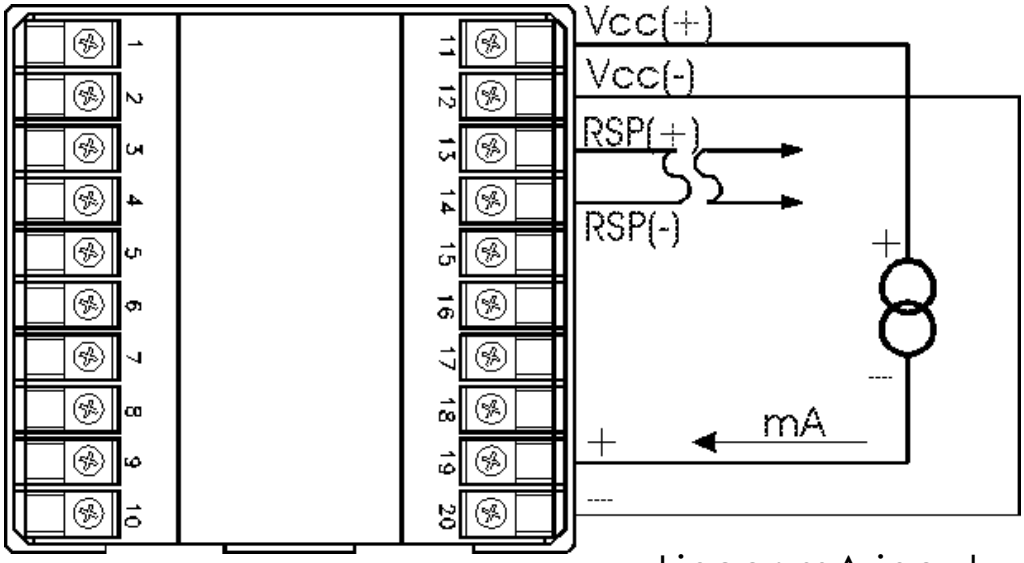


Inputs for thermocouple, Pt100, Vdc and mA



Linear mA input with external source





Linear mA input with internal source and Remote Set Point

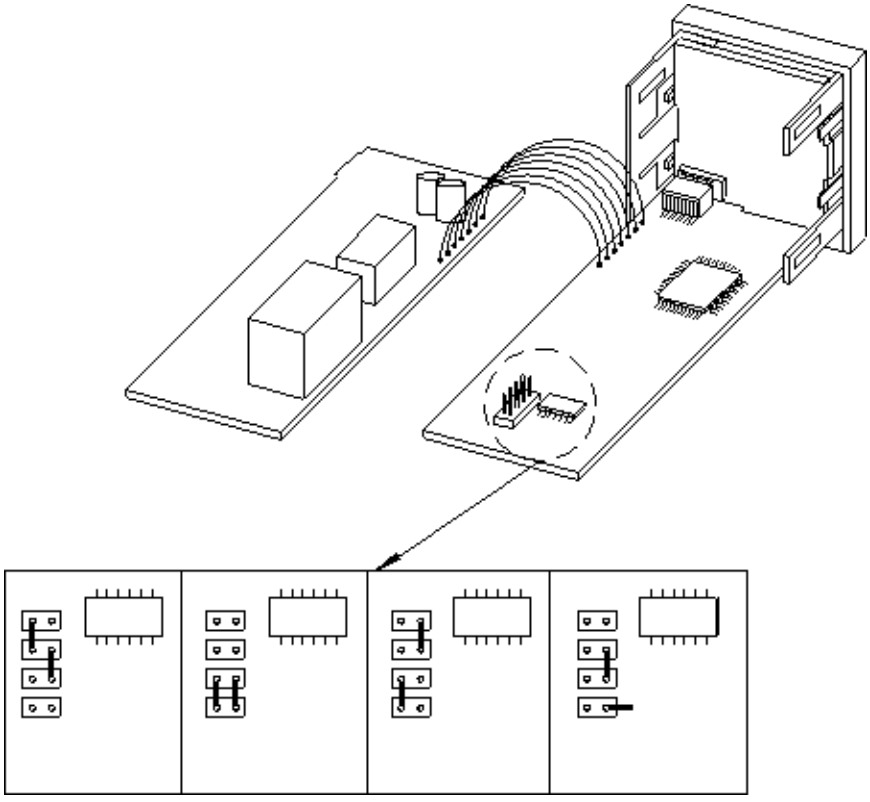
3.2. Configuration of the different inputs.

Each instrument is configured by default for J type input (Fe-CuNi) and it is possible to configure any thermocouple or Pt100 (in either of their two scales), simply by changing the inP parameter. The models with output for motorized valve are supplied configured by default for Pt100 input.

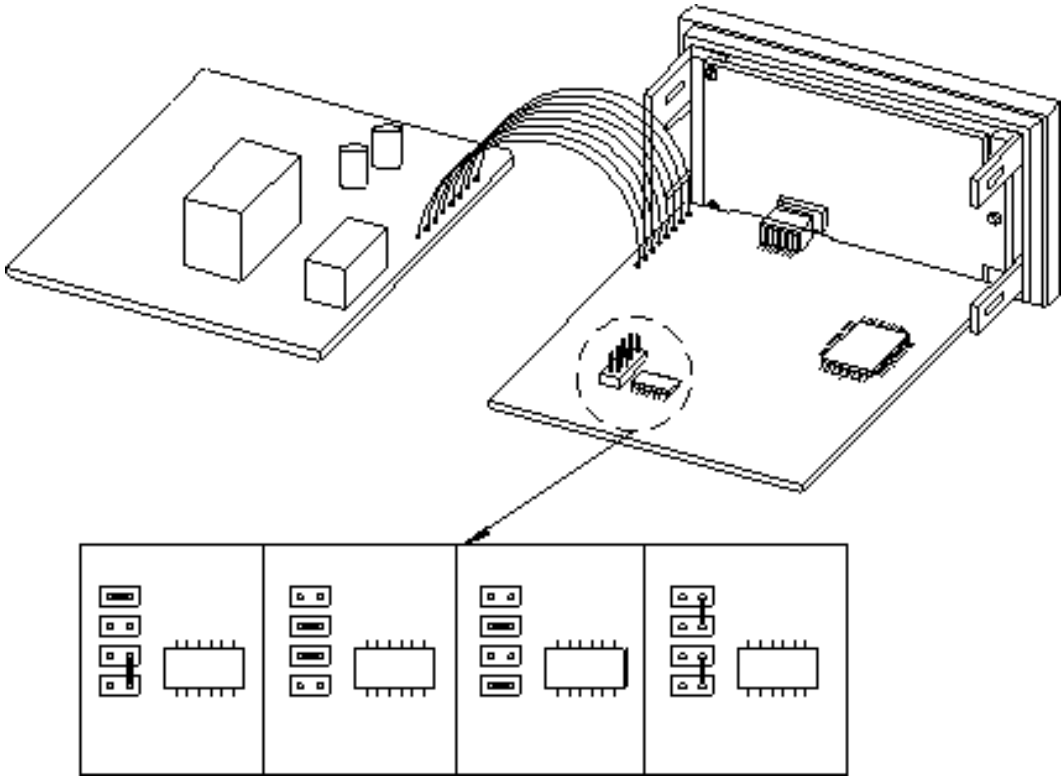
To configure the input signal for voltage 0..5 Vdc, 0..10 Vdc, 0..20 mA or 4..20 mA, proceed as follows:

1) Disconnect the power supply from the instrument.
2) Remove the instrument through the front, releasing it using the flange located on the bottom of the front panel.
3) Open the instrument, separating the supply circuit from the front panel situated to the right as seen from the front.
4) In the circuit attached to the front of the instrument, there are four bridges which need to be changed, depending on the type of input, as is shown in the figures below.

AK48

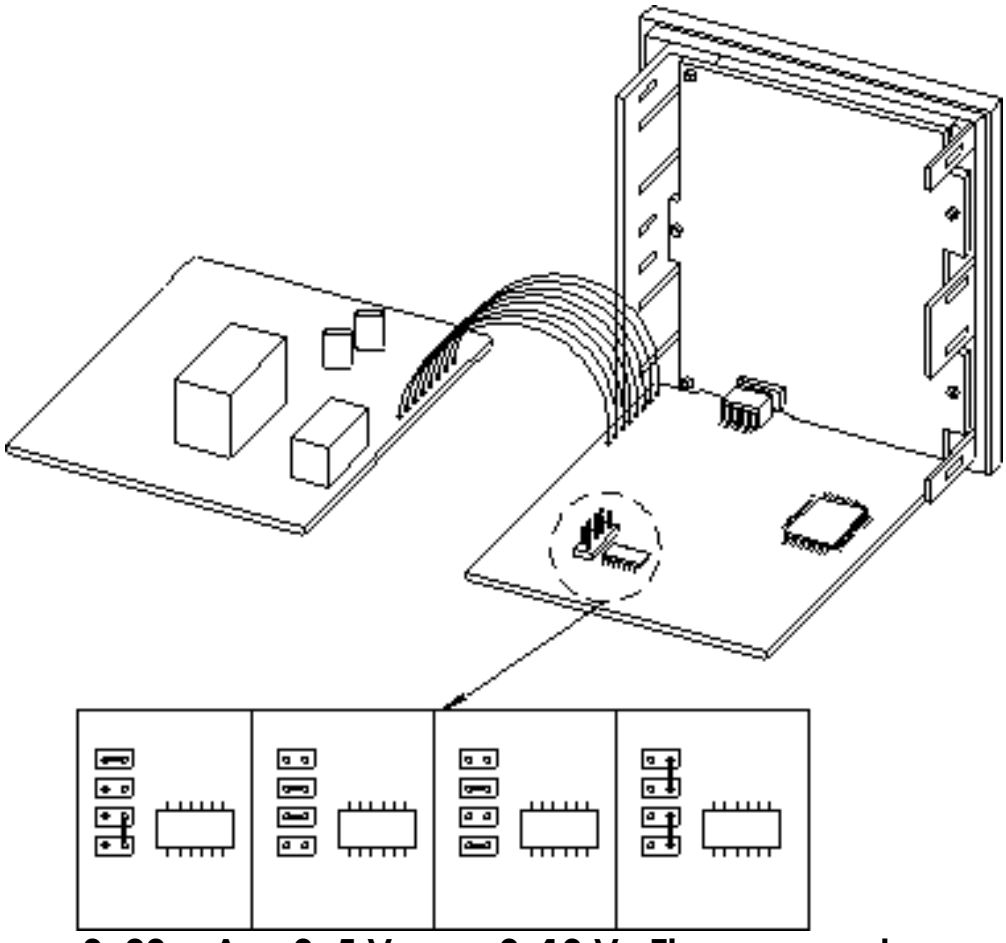


AK49



0..20 mA **0..5 V** **0..10 V** **Thermocouple**
4..20 mA **Pt100**

AK96



0..20 mA **0..5 V** **0..10 V** **Thermocouple**
4..20 mA **Pt100**

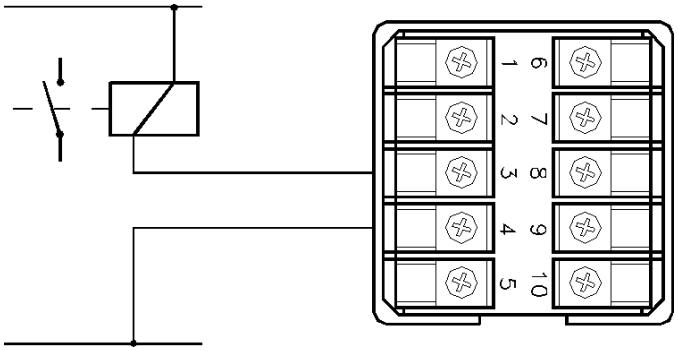
ATTENTION: It is very important to ensure that the value of the inP parameter corresponds to the configuration of the bridges in this circuit.

Special care must be taken to :

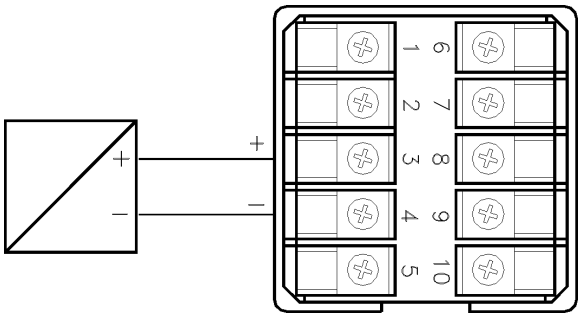
a) Ensure the front circuit is firmly connected to the basic circuit of the instrument, before reassembling it.
b) When reassembling the unit in its case, place it on the right position.

3.3. Options of the control output. Examples.

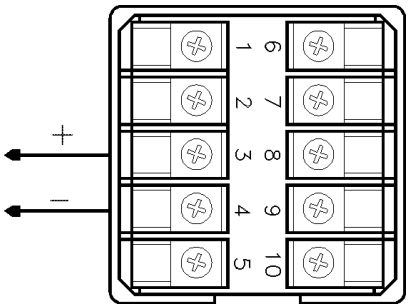
This chapter uses diagrams to describe the connections of the different options for the different control outputs.



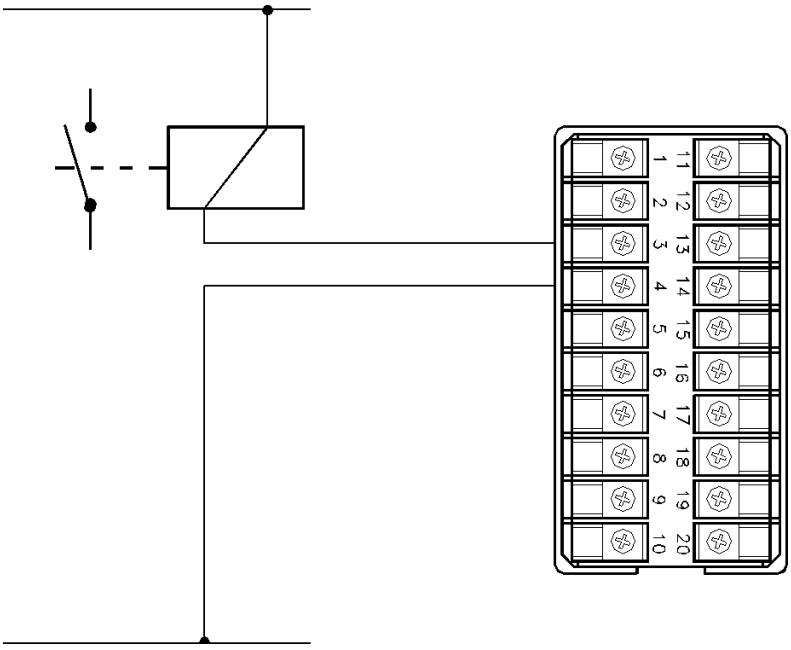
AK48: Output for contactor



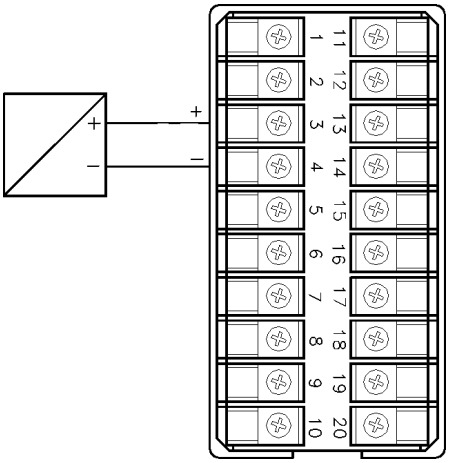
AK48: Output for solid state relay



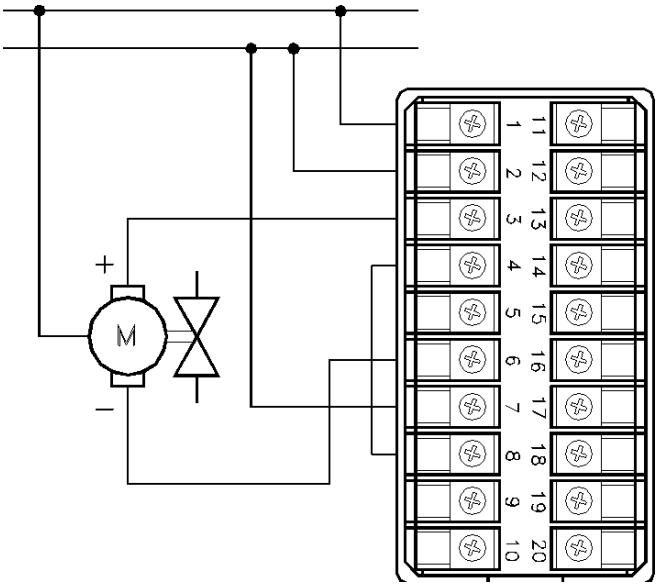
AK48: Linear control output



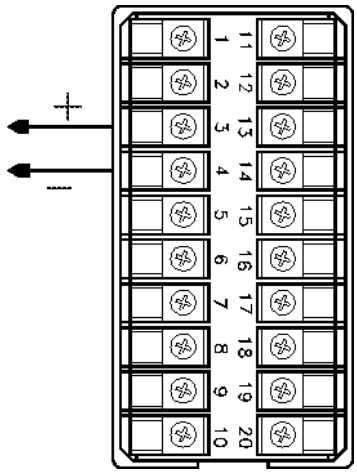
AK49: Output for contactor



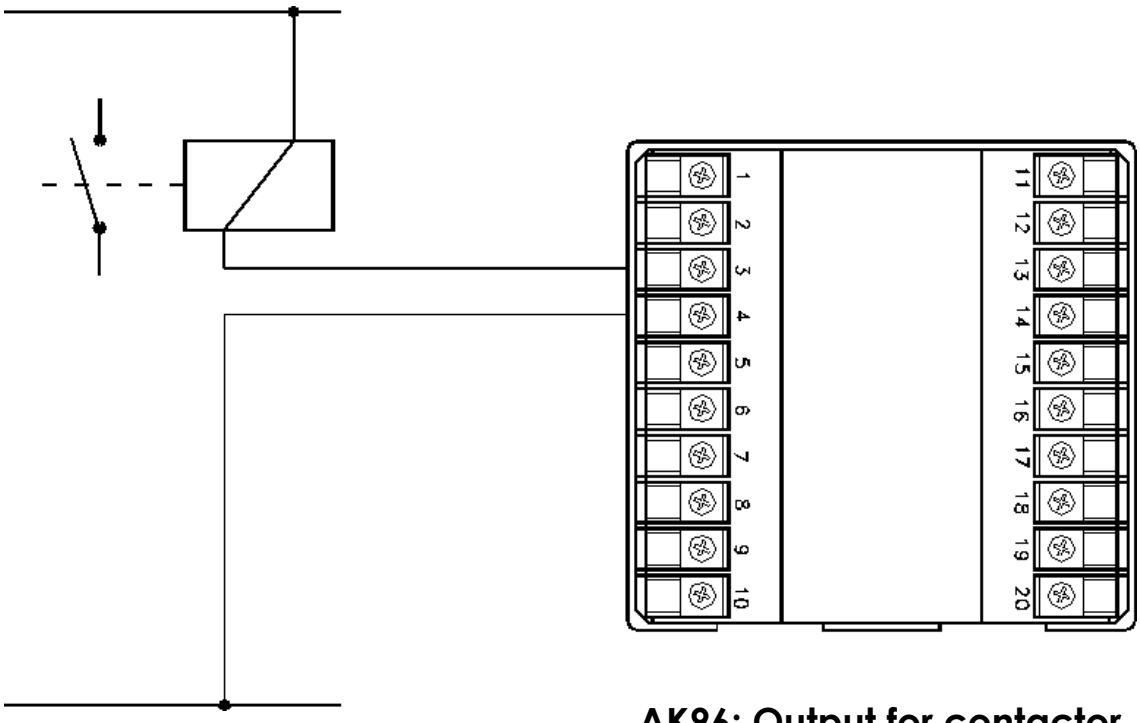
AK49: Output for solid state relay



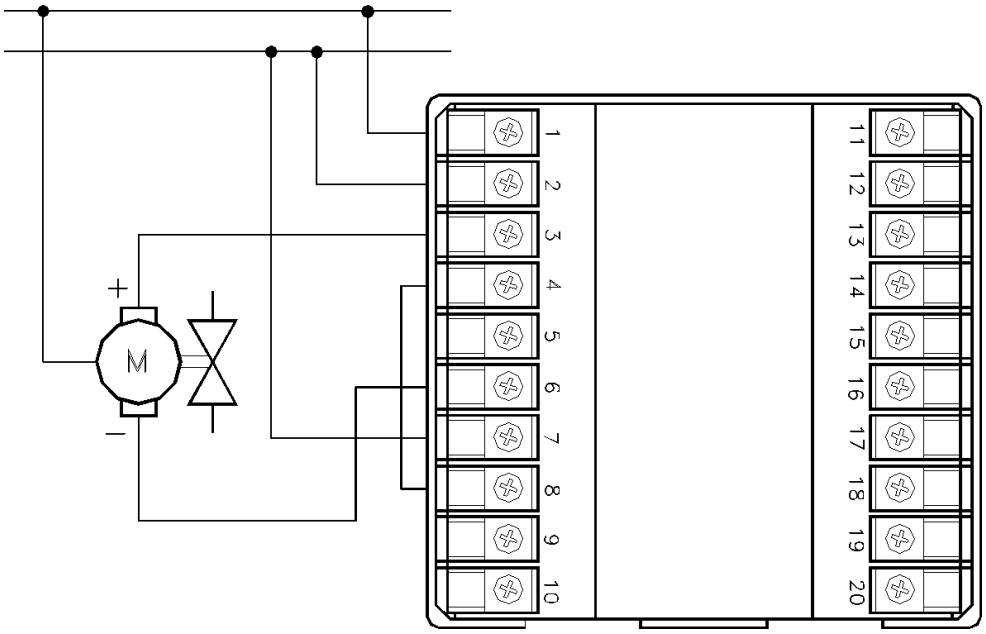
AK49: Output for servomotor



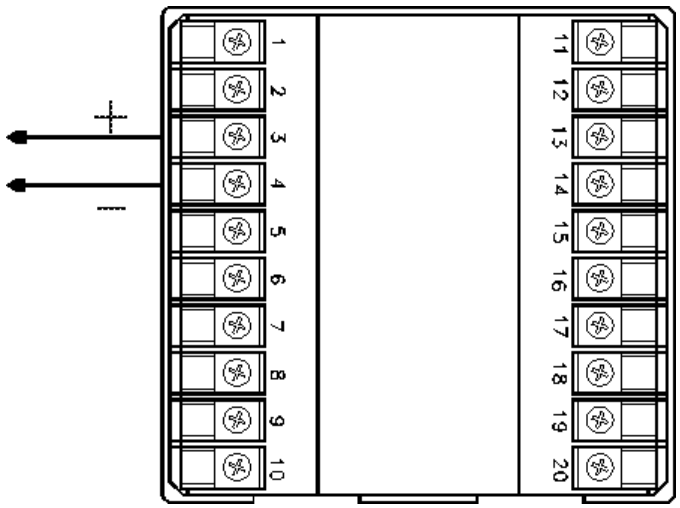
AK49: Linear control output



AK96: Output for contactor



AK96: Output for servomotor



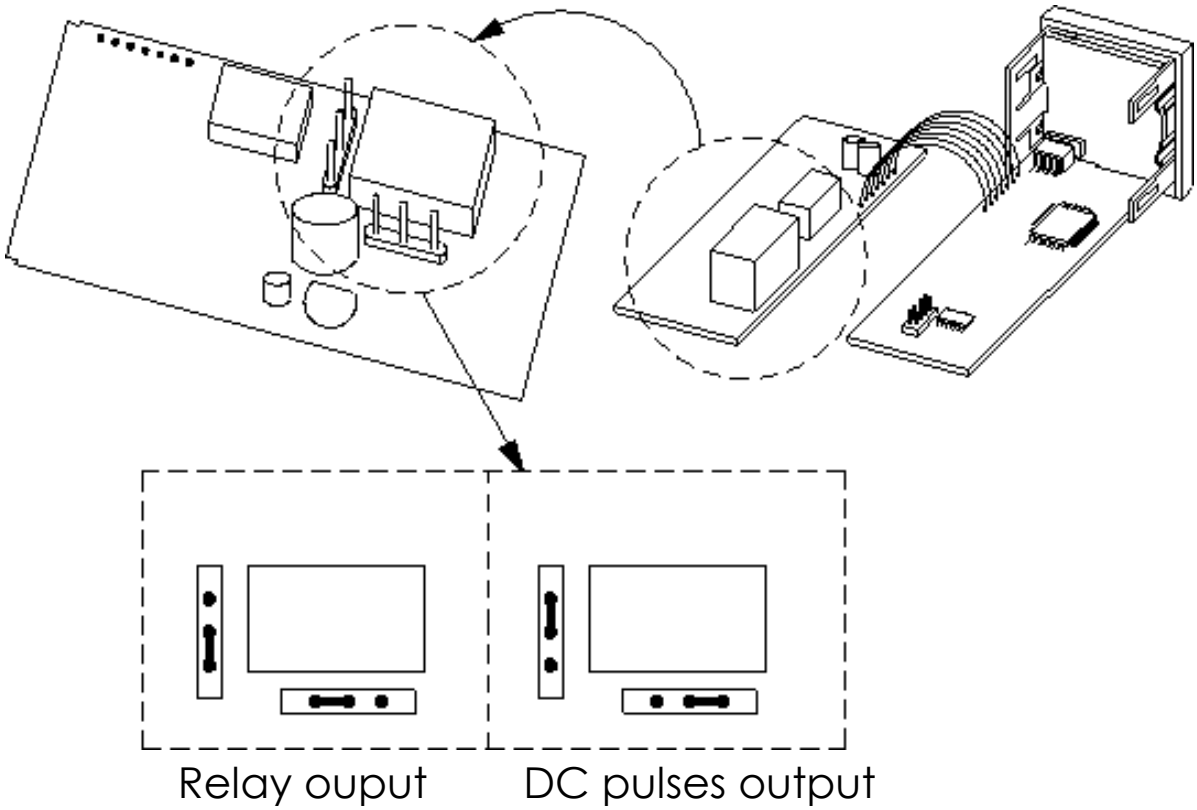
AK96: Linear control output

3.4. Configuration as relay or voltage pulse output.

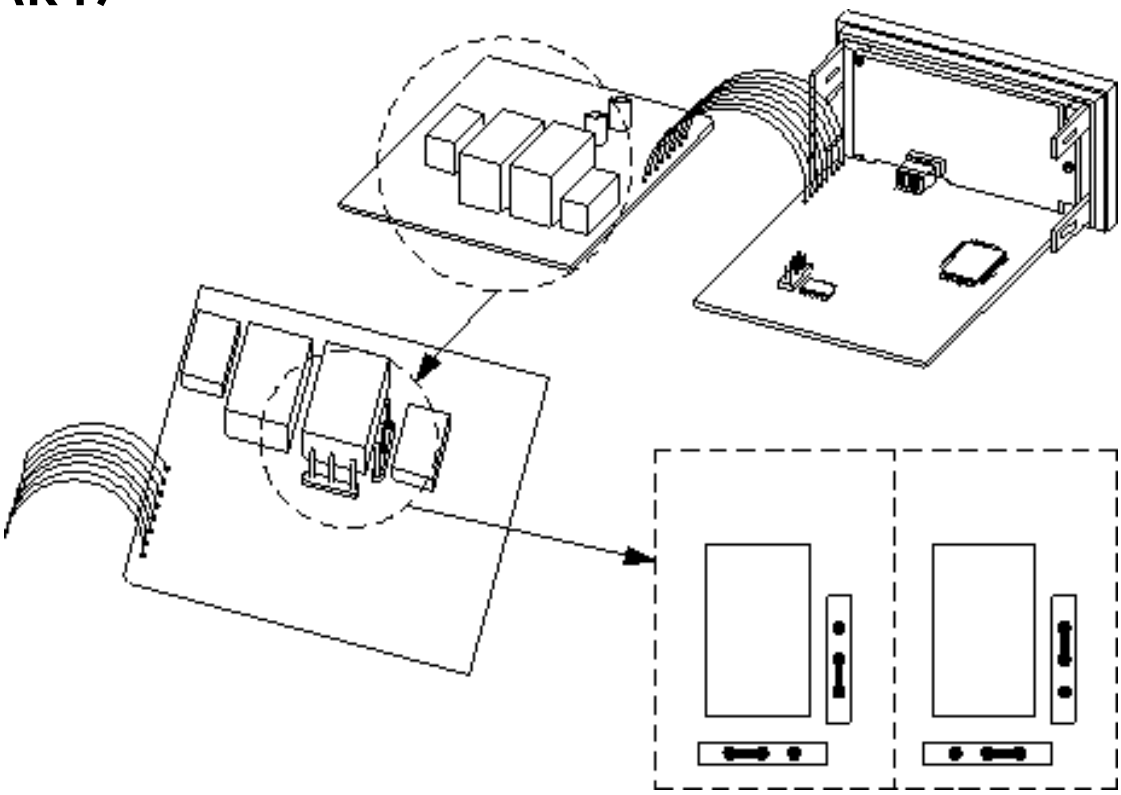
All the models in the Akros series are equipped with the heating output configurable as a relay or voltage pulses (except for linear or servomotor outputs). To change one output type to another, proceed as follows:

1) Disconnect the power supply from the instrument.
2) Remove the instrument through the front, releasing it using the flange located on the bottom of the front panel.
3) Open the instrument, separating the supply circuit from the front panel, located to the right as seen from the front.
4) Make the changes of the bridges in the circuit, as indicated in the figures below.

AK48

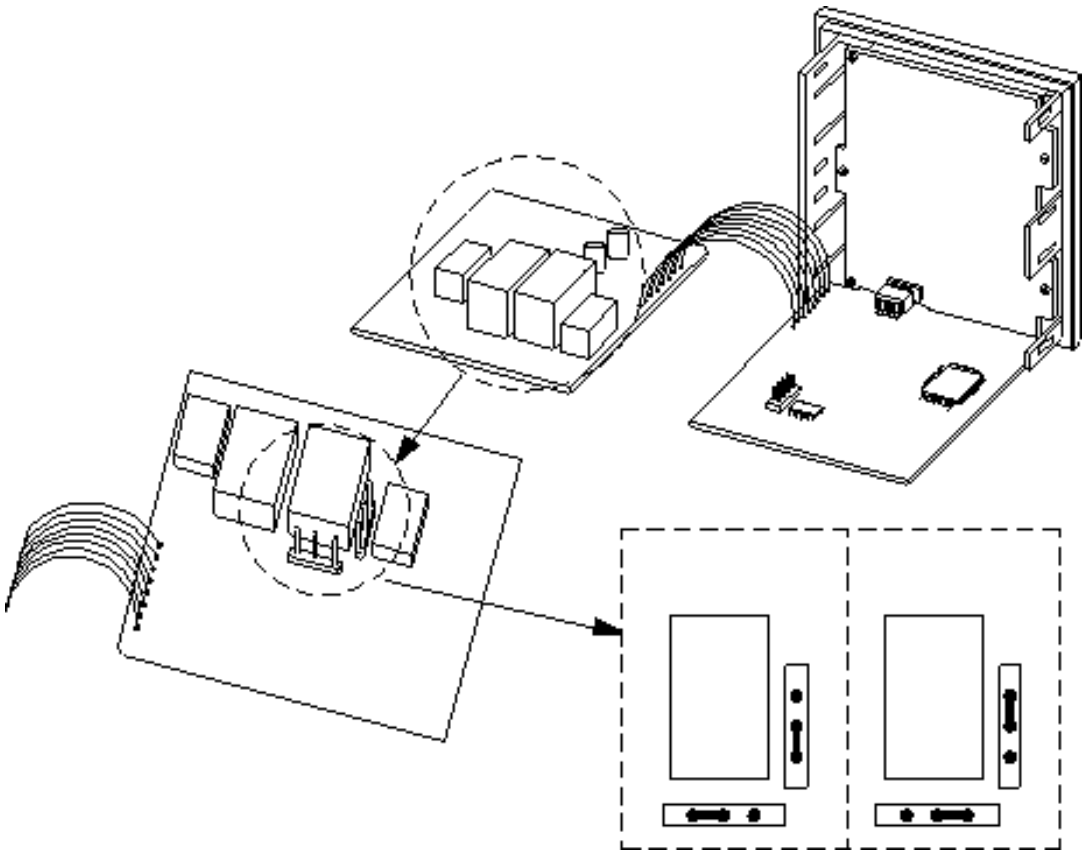


AK49



Relay ouput DC pulses output

AK96

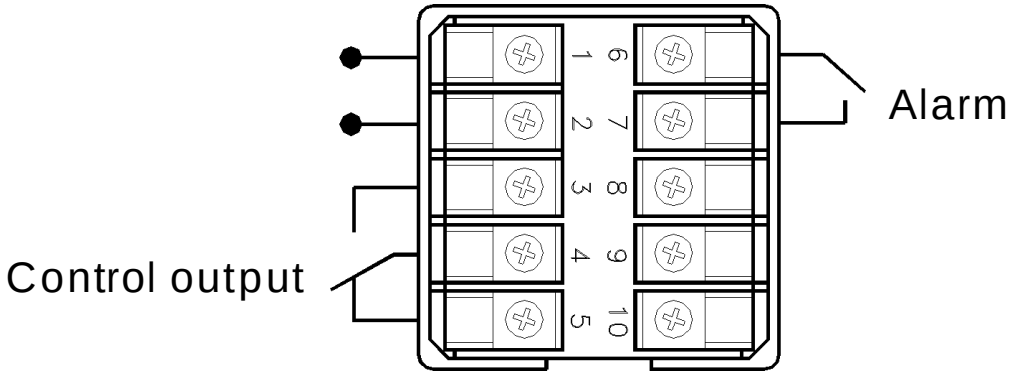


Relay ouput DC pulses output

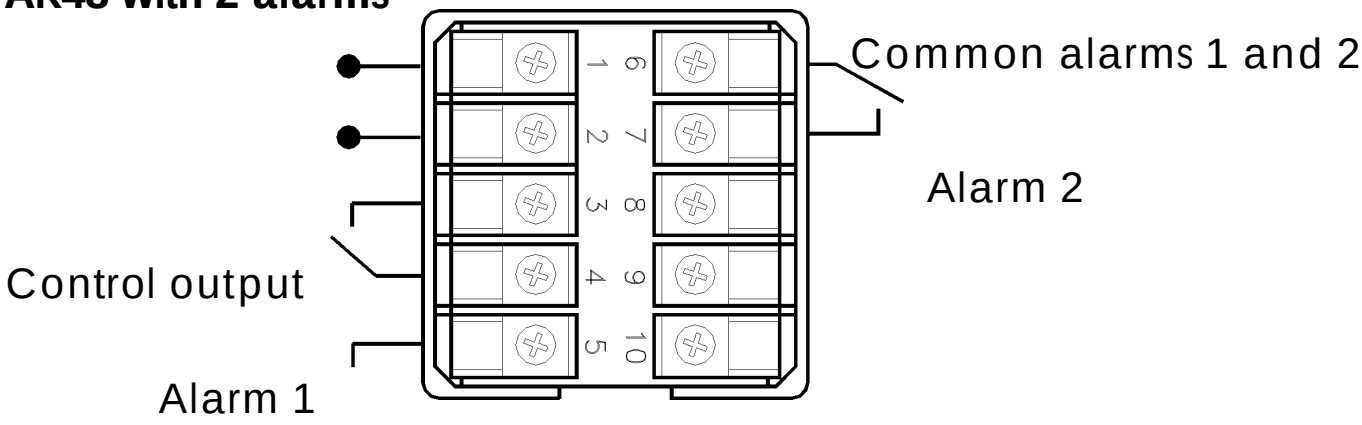
3.5. Options of the alarms.

All the models in the Akros series can be fitted with 2 alarms, the first being supplied as standard. The alarm output is by relay with SPST contacts (a voltage-free contact). The alarm outputs are as follows:

AK48 with 1 alarm

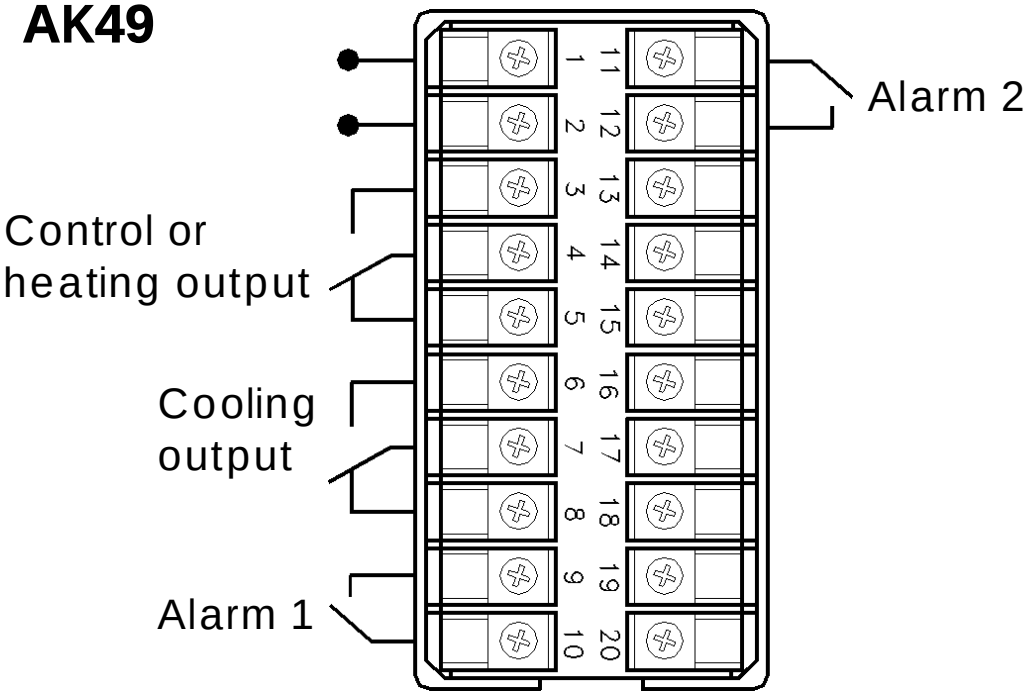


AK48 with 2 alarms



In this case, the alarms share a contact in common.

AK49


Alarm 2
Control or heating output
Cooling output
Alarm 1
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2
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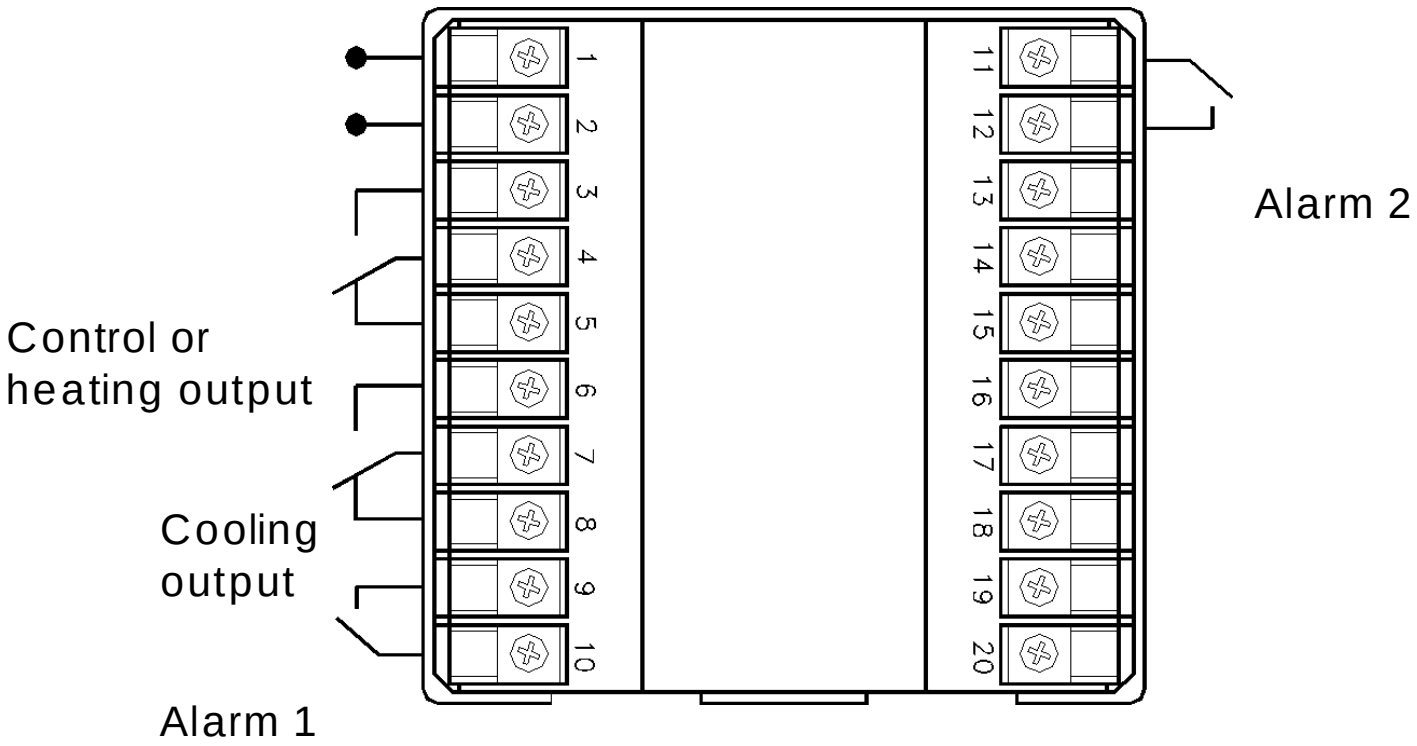
AK96


Alarm 2
Control or heating output
Cooling output
Alarm 1
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Their working configuration is a result of the combination of the following parameters (Parameters C.A1 y C.A2).

1) Set Point.

Absolute Set Point (SP.A1 and SP.A2): The activating / deactivating point of the alarm is independent of the value of the process set point. For example, if an alarm Set Point of 200ºC is configured, the alarm will change status at that temperature, regardless of the value of the pre-set temperature for the process (process Set Point).

Relative Set Point (r.A1 and r.A2): The activating / deactivating point of the alarm is always linked to the value of the process set point. For example, if a relative Set Point of 20ºC is configured, the alarm's status change point will always be 20ºC higher than the Set Point of the process. With a Set Point of 100ºC for the process, the alarm is set at 120ºC. With a Set Point of 650ºC, the alarm will be set at 670ºC.

Window Set Point: The activating / deactivating point of the alarm becomes a symmetrical value, both above and below the process Set Point. For example, with a window Set Point of 10º for the alarm and a process Set Point of 50ºC, the alarm will change status at 40ºC and 60ºC. With a process Set Point of 850ºC, the alarm will change status at 840ºC and 860ºC.

2) Enabling type.

High alarm: The alarm is triggered when the process variable is greater than the alarm set point. For example, if the alarm's Set Point is at 450ºC, the alarm will remain activated as long as the process is above this temperature.

Low alarm: The alarm is triggered when the process variable is less than the alaram set point. For example, if the alarm's Set Point is at 450ºC, the alarm will remain activated as long as the process is below this temperature.

Window alarm: The alarm remains activated as long as the process variable is outside a certain value around the process Set Point, both above and below it. For example, if the process has a Set Point of 500°C and the alarm a window signal of 30°C, the alarm will be triggered whenever the process is below 470°C and above 530°C.

3) Type of action.

Direct Action: The output relay is normally disactivated and is enabled when the enabling condition of the alarm occurs.

Reverse alarm: The output relay is normally activated and is disabled when the enabling condition of the alarm occurs.

By combining the Set Point, the enabling type and the action type, the following operating modes of the alarms can be configured:

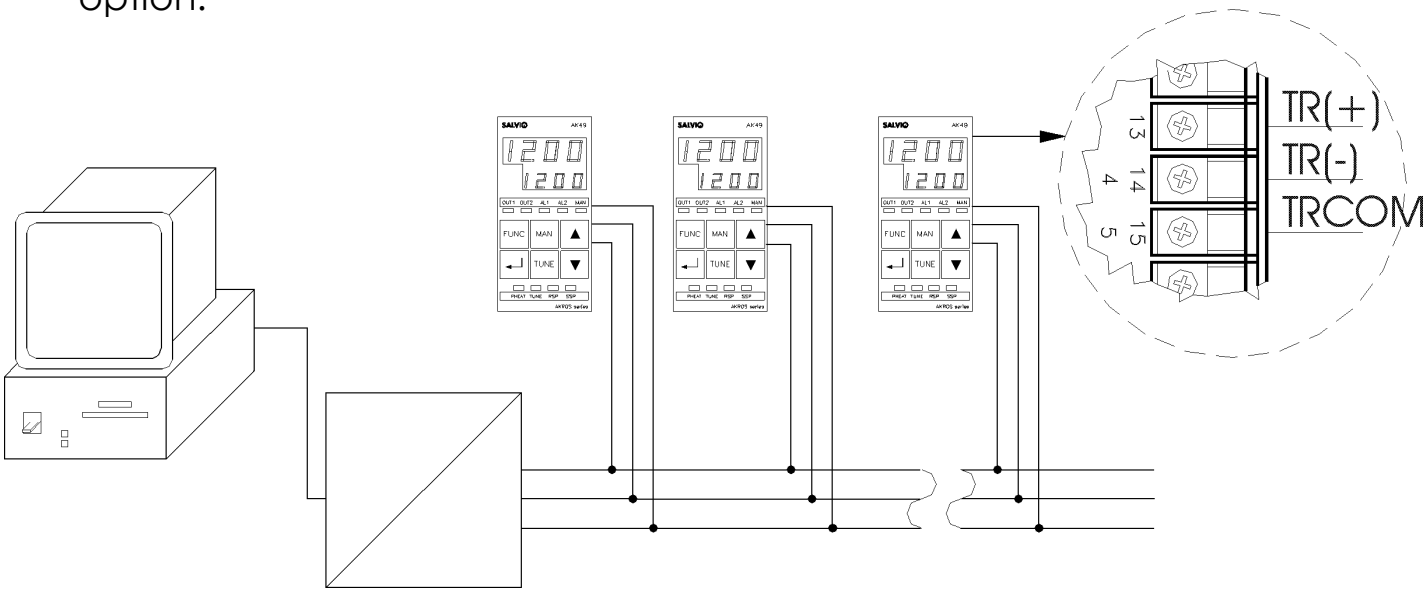
Configuration	Working mode
0	Alarm disabled
1	Absolute Set Point, high, direct action
2	Absolute Set Point, high, reverse action
3	Absolute Set Point, low, direct action
4	Absolute Set Point, low, reverse action
5	Relative Set Point, high, direct action
6	Relative Set Point, high, reverse action
7	Relative Set Point, low, direct action
8	Relative Set Point, low, reverse action
9	Window alarm, direct action
10	Window alarm, reverse action

3.6. Serial communications

The serial communications interface is RS485, 3-wire, half duplex.

There is a specific instructions manual for the interface and communications protocol.

The AK48 model does not have the serial communications option.



3.7. Auxiliary Analog Output.

The auxiliary analog output can be: 0..20 mA, 4..20 mA, 0..5 Vdc or 0..10 Vdc, and the option should be selected when placing the order.

The analog output can be configured as direct or reverse, and the margin of variation of this signal can also be user-configured.

Direct output (Lrt=1) means that the value of the output signal increases as the process variable increases.

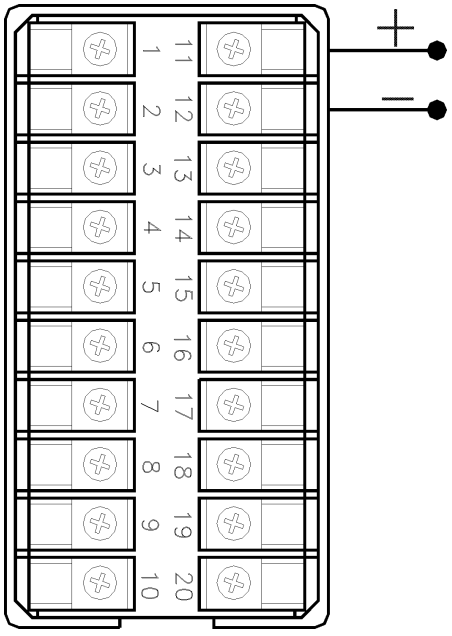
Reverse output (Lrt=0) means that the value of the output signal decreases as the process variable increases.

Similarly, the minimum value (Lrt.L) and maximum value (Lrt.H) of the process variable between which the analog output will vary between its minimum and maximum, can be configured.

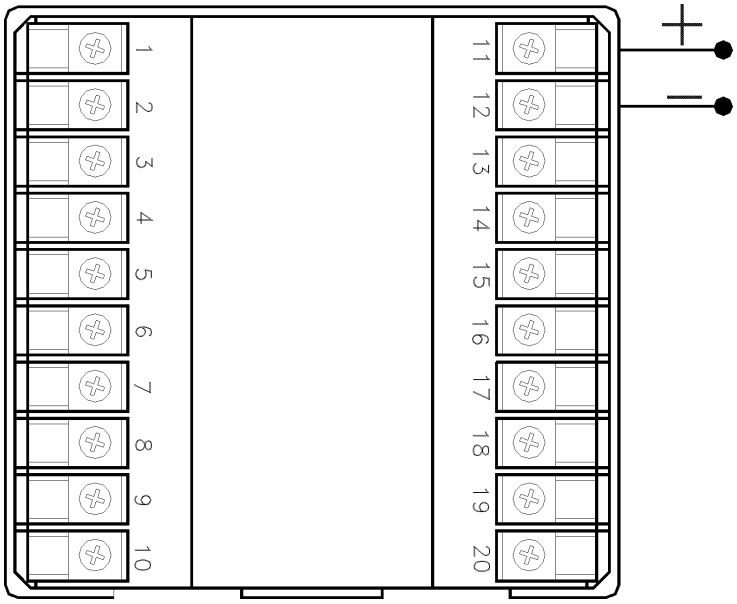
For example, an instrument with thermocouple input type J has a scale from 0..600°C. If this instrument has an analog output of 4..20 mA, you can configure Lrt.L= 100°C and Lrt.H= 500°C, whereby the analog output will take on the following values:

Process (°C)	Direct analog output (mA)	Reverse analog output (mA)
0	4.0	20.0
100	4.0	20.0
200	8.0	16.0
300	12.0	12.0
400	16.0	8.0
500	20.0	4.0
600	20.0	4.0

AK49



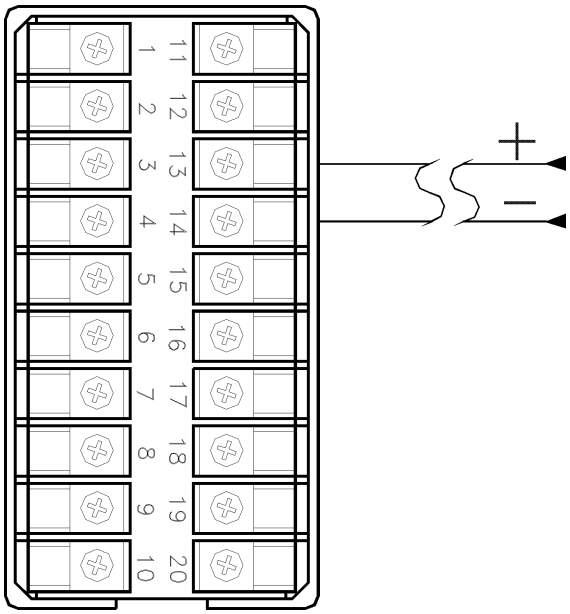
AK96



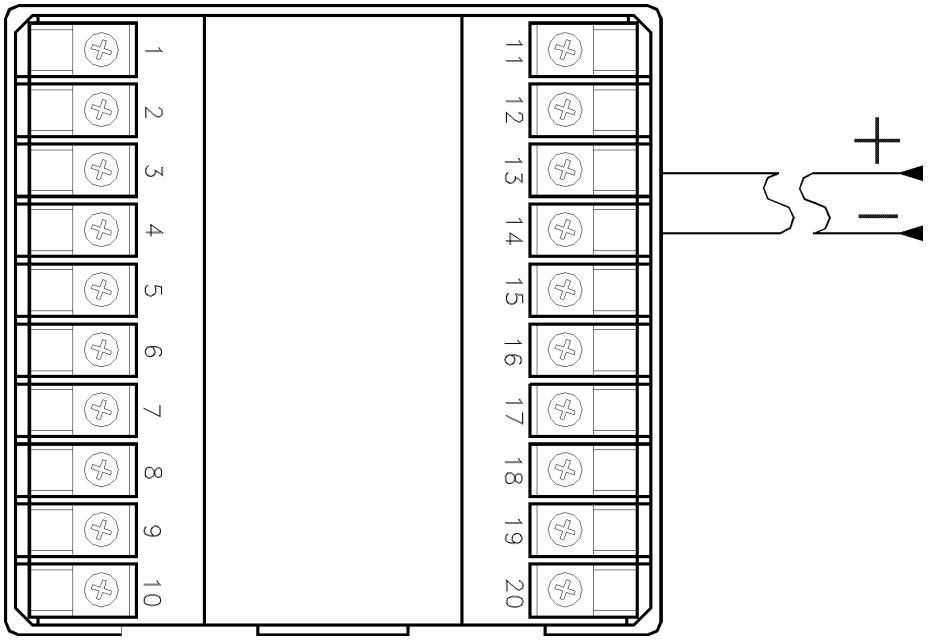
3.8 Remote Set Point.

Models AK49 and AK96 can be equipped with an analog input so that the process Signal or Set Point can be configured remotely. The analog input signal can be: 0..20 mA, 4..20 mA, 0..5 Vdc or 0..10 Vdc. The connections are as follows:

AK49



AK96



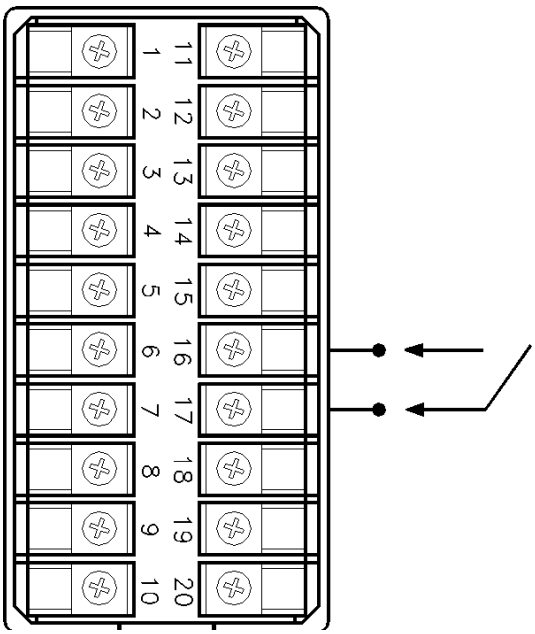
The margin of variation of the Set Point value which will be configured with the analog input is defined between a minimum value (rSP.L) and a maximum value (rSP.H). For example, with an input of 0..10 Vdc and values of rSP.L= 0°C and rSP.H= 200°C, the value of the process Set Point in accordance with the input signal would be as follows:

Input signal (Vdc)	Process Set Point
0.0	0°C
2.5	50°C
5.0	100°C
7.5	150°C
10.0	200°C

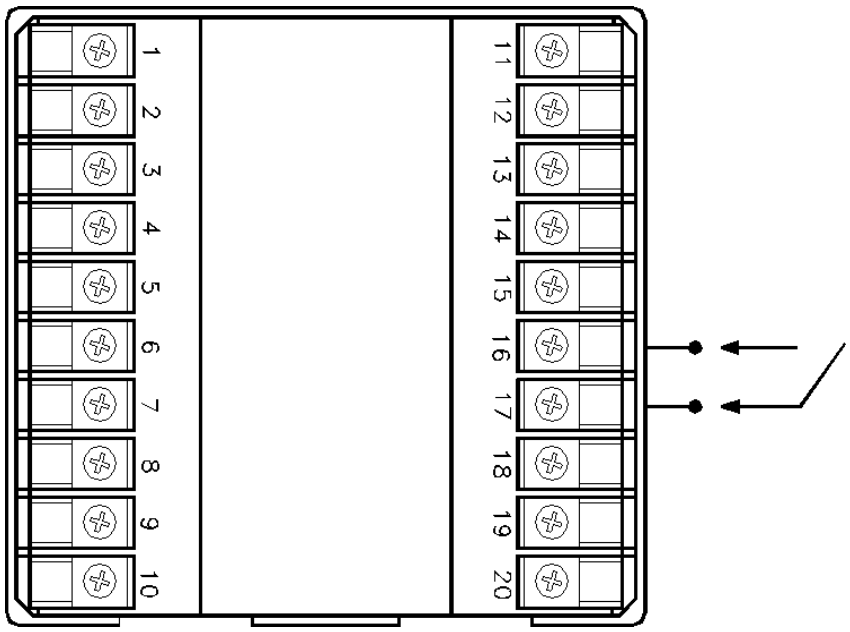
3.9 Digital input

Models AK49 and AK96 have a digital input, which can be allocated 2 actions in accordance with parameter **d.in**. The digital input is enabled by joining terminals 16 and 17 at the back of the instrument, as is shown in the diagram below:

AK49



AK96



The function the digital input can perform can be:

SSP (Secondary Set Point): This is enabled when the parameter **d.in=0** and the instrument changes the process Set Point it is working with and starts working with the Set Point configured in the parameter **S.SP**.

Keylock (Keyboard lock): This is enabled when the parameter **d.in=1** and the keyboard of the instrument is locked.

4. TYPES OF CONTROL

4.1. Introduction.

This chapter describes very briefly the different control modes the instruments can be configured with. Before describing the control modes, it is important to clarify certain concepts concerning the controller output.

ON/OFF output: When a controller has an ON/OFF control output, this means that the output only accepts two values: 0% (no output) and 100% (permanent output). On the whole, this type of output is performed by a relay.

Modulated or Pulse Width Modulated output: A controller with modulated output calculates the quantity of power to be supplied to the process between 0% and 100%. The modulated output may be:

1) *Relay-modulated output:* When needing to dosify the power supplied to the process with a device such as a relay or a solid state relay, this is achieved by varying a connection time on a fixed cycle, which is configured by the parameter Cy in the controller.

   For example, with a cycle of 30 seconds output, the power supplied to the process can be dosified between 0% and 100% in fractions of 0.3 seconds (30sec./100). See the table below, supposing a cycle of 30 seconds:

To supply to the process...	the output must be enabled for...	...and disabled for...	Total cycle (in seconds)
...10% power	3 seconds	27 seconds	3+27=30"
...25% power	7.5 seconds	22.5 seconds	7.5+22.5=30"
...50% power	15 seconds	15 seconds	15+15=30"
...80% power	24 seconds	6 seconds	24+6=30"
...100% power	30 seconds (no disconnection of the output)	0 seconds	30+0=30"

This means that, every 30 seconds, the controller enables the output but, depending on the percentage it has to supply to the process, it will vary in the time it takes to make the disconnection ("ON" Time).

2) *Output modulated by continuous analog output:* In this case, the analog output varies between 0% and 100% of the value of the output signal range. For example, a controller with output 0..10 Vdc will accept the following values:

To supply to the process...	the output needs to be...
...10% power...	1.0 Vdc
...25% power...	2.5 Vdc
...50% power...	5.0 Vdc
...80% power...	8.0 Vdc
...100% power...	10.0 Vdc

3) *Output modulated for servomotor or servovalve:* In this case, the controller is equipped with a relay to open and another to close the valve.

In this case, the value to be taken by the parameter Cy must be the time the valve takes to travel its full stroke.

For example, with a valve with a stroke of 60 seconds, to open 10%, the open output needs to be enabled for 6 seconds (10% of the cycle). To close the valve 30%, the close output needs to be enabled for 18 seconds (30% of the cycle).

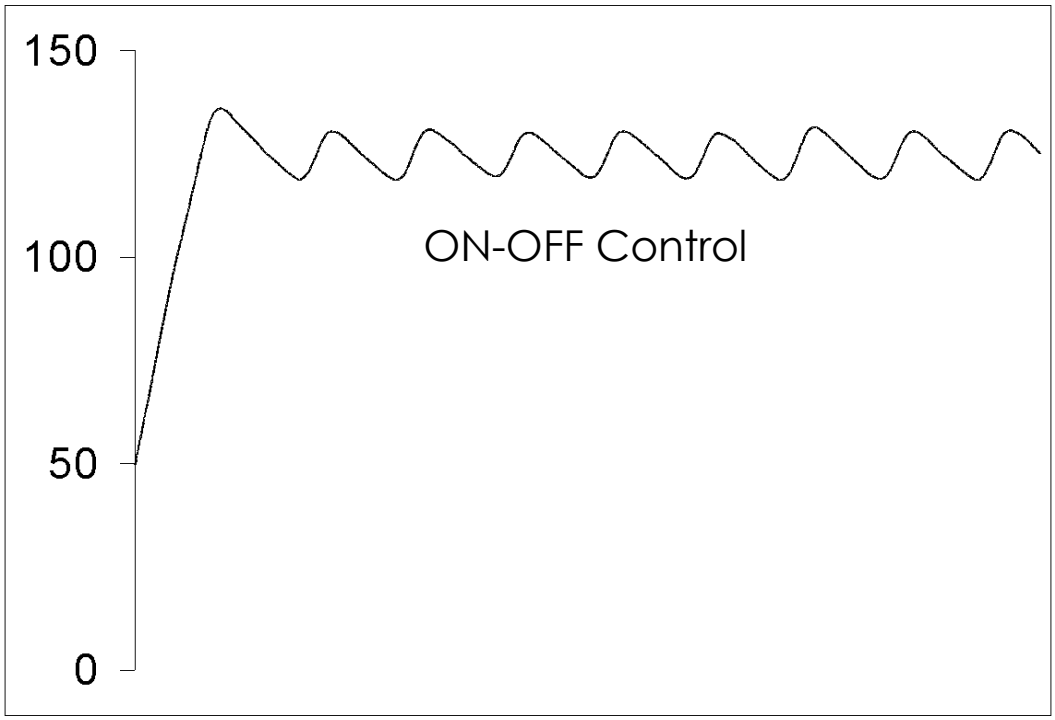
This means that, when a controller displays the percentage of power supplied to the process, it is displaying the dosification in any of these three types of output.

4.2. ON/OFF control.

When the controller is configured to work in ON/OFF mode, the controller output takes just two values: 0% and 100%. For example, in a temperature control process, the output takes the value of 100% when the process is below the set point, and 0% when the process is

above the set point. The graph below shows the "serrated tooth" shape the process reacts with in this type of control.

In this control mode, the user can program a hysteresis between connections and disconnections.



4.3. PID Control.

The PID control mode is the combination of three control actions, the effect of which is added together. So, the controller output will vary between 0% and 100% as a result of the combination of the **P**roportional, **I**ntegral and **D**erivative actions.

Explaining the concept of the PID action could take up numerous sessions in a control course. In this chapter, how the controller reacts in accordance with each of the actions (P, I and D) is described very briefly.

Proportional action: The importance of the proportional action is established with the parameter Pb (Proportional Band). The proportional band is the area around the signal point in which the controller output varies from 100% to 0%.

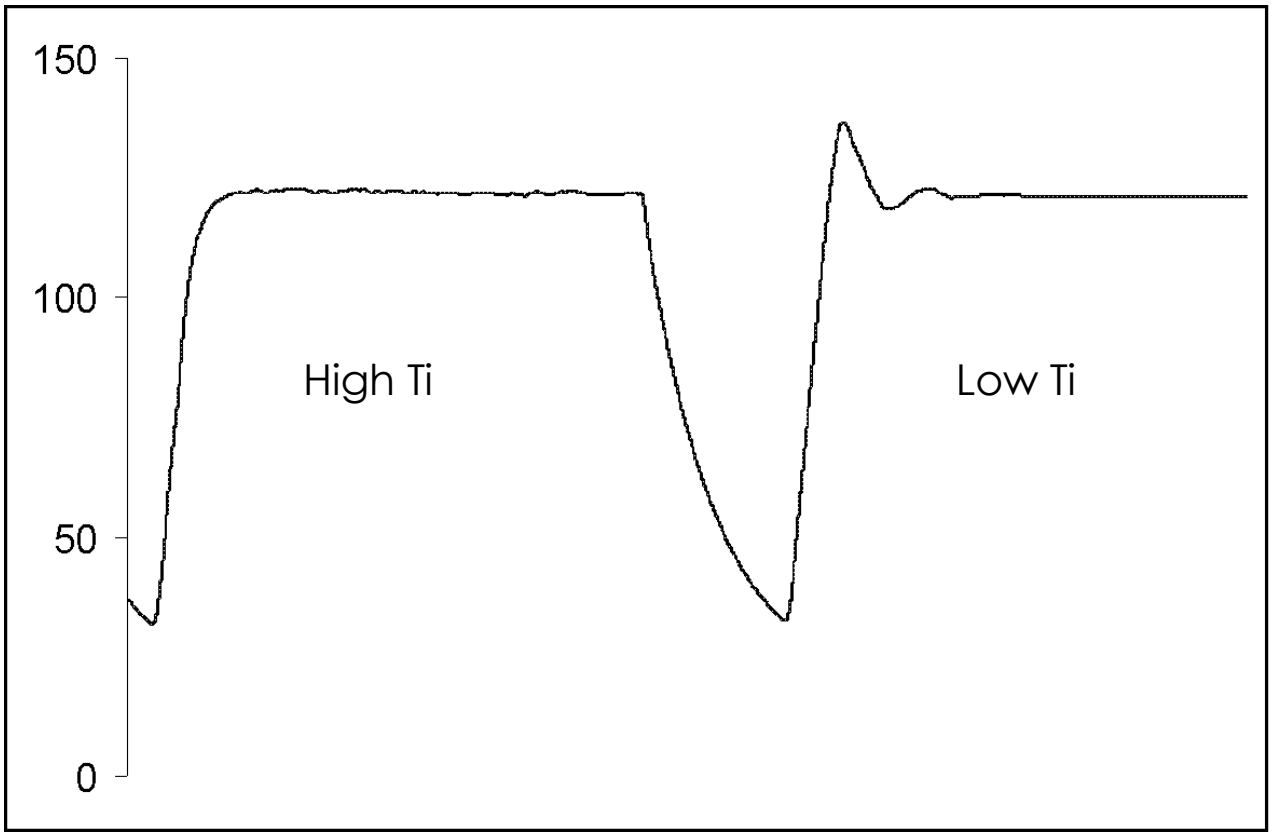
What effect does the parameter Pb have? The lesser the parameter Pb, the lesser the proportional band and, therefore, with a

certain variation of the process variable, the more abrupt the controller's response is. In sum, the lesser the value of Pb, the more abrupt the controller will be in its variations between 0% and 100%.

Integral action: The importance of the integral action is established with the parameter Ti (Integral Time). The integral action determines the "speed" with which the process approaches the set point.

What effect does the parameter Ti have? The parameter Ti acts reversely, as follows. The lesser the parameter Ti. the greater the integral action and the greater the "speed" of approach of the process to the set point. This can cause there to be an excess inertia or the signal to be overshot.

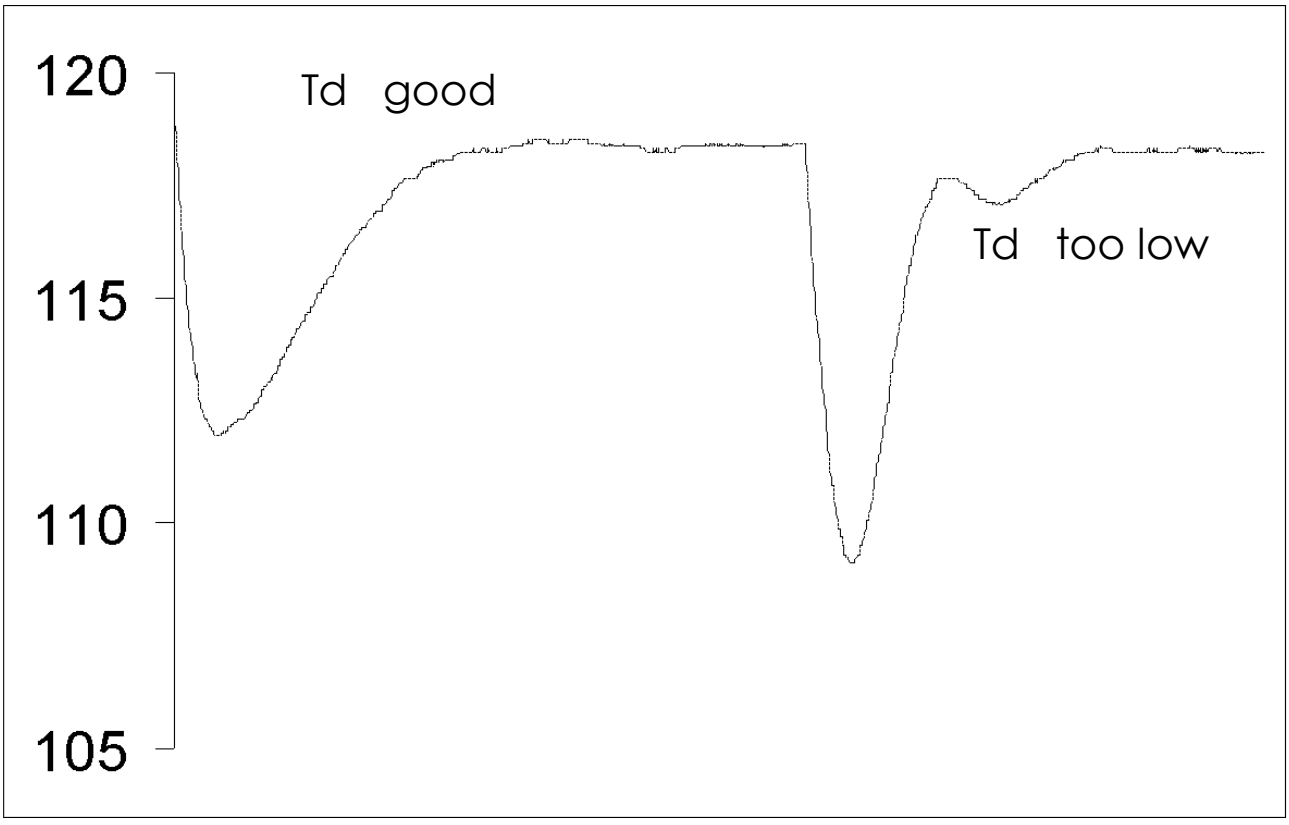
The following graph shows an example of the behaviour of the same process, in accordance with the integral action.



The greater the parameter Ti, the slower the approach of the process to the set point and, therefore, the less the overshoot that will take place.

Derivative action: The importance of the derivative action is established with the parameter Td (Derivative Time). The derivative action determines the "abruptness" with which the controller will react faced with a disturbance in the process. A disturbance could be, for example, opening a furnace door, inlet of cold water into a boiler, start-up of a cooling unit in a process (fan, refrigeration unit, etc...).

What effect does the parameter Td have? The higher the value of Td, the greater the derivative action and, therefore, the faster the controller reacts to a disturbance.



IMPORTANT: As a general rule, a proportion should be maintained between the parameter Ti and Td, so that Td takes the value of a quarter of the Ti value. i.e. Td = Ti/4 (example: Ti=240, Td=60).

So, the controller output will vary from 0% to 100%, depending on the sum of the Proportional, Integral and Derivative actions.

With a view to tuning the values of Pb, Ti and Td, it is advisable to use the autotuning functions described in point 4.5 and 4.6.

4.4. PI + D control.

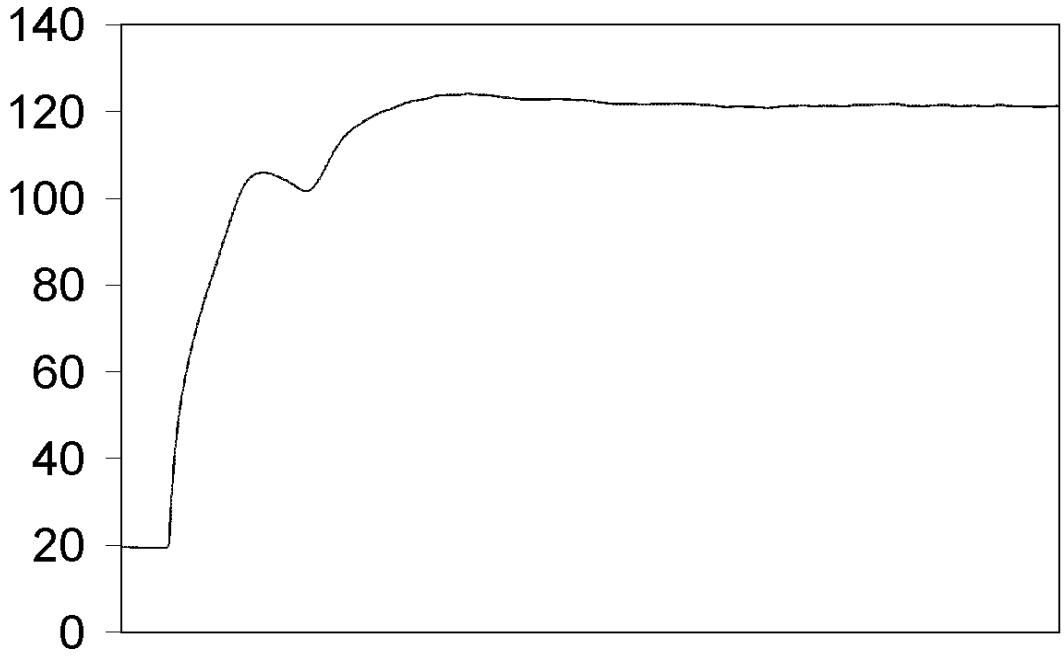
The control type PI + D is the same as the PID mode, except that only the parameters Pb and Ti are configured, whilst the derivative action is automatic.

This type of control has proven more stable when the controller needs to regulate the process with very small output values (less than 10%).

4.5. Step Response autotuning.

The autotuning process is a very useful function for determining the values of Pb, Ti and Td which will give the process the greatest stability.

Step Response autotuning takes place below the set point and can only be enabled if the process variable is less than 50% of the set point value. This process consists of supplying 100% power and disabling the output when the process is at around 80% of the signal. Next, the controller measures the inertia of the process and deduces the values of the PID parameters for the process in question.



4.6. Relay Feedback autotuning.

Relay feedback autotuning has the advantage that it takes place on the set point and can be enabled at any time. However, it has the drawback that, to perform the tuning, the process has to exceed the signal several times and there may be cases where this is unwise, due to damages that could occur in the process.

5. OPERATION

5.1. Introduction

Akros series instruments are fully configurable. This feature means there are a large number of configuration parameters. In order to make it easier to program the parameters, for each instrument, only those parameters which, because of their configuration, are available, appear, except those referring to the second alarm.

Point 5.5 describes all the configurable parameters and point 5.7 sets out the route to be followed to access each of the parameters in graphic form.

The configuration menus have been arranged in 3 levels of difficulty, from 1 to 3.

Level 1: The configuration parameters of the work mode appear, but not those affecting the instrument's configuration.

Level 2: At this level, the instrument's configuration parameters not depending on the physical configuration (inputs and outputs) are configured.

Level 3: At this level, the instrument is configured by specifying values affecting the input and output signals.

Point 5.5 describes the parameters that can be configured at each level.

Operation of the instrument is arranged with 6 keys, the functions of which are as follows:

FUNC : Function key. Used to enter the configuration of a parameter and to move on to subsequent ones. If it is kept pressed for 3 seconds, the instrument will move on to configure the parameters of the next level.

: Acts to increase the value of a parameter. If it is kept pressed, the variation speed of the parameter increases. In normal

operating mode, it acts to show the percentage of power supplied to the load.


: Acts to decrease the value of a parameter. If it is kept pressed, the variation speed of the parameter decreases.


: Enter key. It should be pressed to confirm or validate the change made to a parameter.

MAN : Auto/Man key. It should be pressed to switch from automatic to manual work mode and vice versa. In manual work mode, the output can be changed with the keys  and 

TUNE : It should be pressed to activate the autotuning process. It will only be effective when it is possible to enable the autotuning in accordance with the parameter At.ty.

5.2. Description of the front panel

There are also the following indicator lights:

OUT1: Control or heating output (except linear control output).
OUT2: Cooling output.
AL1: Alarm 1
AL2: Alarm 2
MAN: Lights up when the instrument is working in manual mode
PHEAT: This light is only used in one application. It lights up when the instrument is performing the pre-heating of the heating resistances in plastic injection moulding systems.
TUNE: Lights up when the autotuning algorithm is enabled.
RSP: Lights up when the remote Set Point is enabled.
SSP: Lights up when the secondary Set Point is enabled via the digital input.

5.3. Start-up

When connecting the power supply voltage, the instrument displays the message "TEST ON" while the controller initiates all the internal parameters.

5.4. Power loss

When the instrument loses the power supply voltage, all the parameters remain stored in the instrument's internal memory. When the power is restored, the controller will re-start control of the process.

In the case of a controller with output for servomotor, when the process is started, the instrument will put the servomotor in the closed/minimum position before re-starting control.

5.5. Description of all the configurable parameters

Set Point of the process to be controlled.
Minimum Value:..... SP.LL
Maximum Value:..... SP.HL

Proportional band of the PID controller.
Minimum Value:.....0.1 %
Maximum Value:.....100.0 %

Integral time of the PID controller.
Minimum Value:..... 1 s
Maximum Value:..... 4000 s

Derivative time of the PID controller.
Minimum Value:..... 1 s
Maximum Value:..... 4000 s

Cycle of the heating action or control output. This must be configured when the output is via relay or voltage pulses for static relay. In the case of a controller for servomotor, CY is the time the servo takes to go through a full stroke.
Minimum Value:..... 1 s
Maximum Value:..... 120 s

Hysteresis of the control action when the control type is ON/OFF.
Minimum Value:..... 1
Maximum Value:..... 9999

Dead band for the servomotor output. Used so that the controller does not overact on the servomotor. It is the percentage of the controller output not acting on the servovalve.
Minimum Value:.....1 %
Maximum Value:.....20 %

Set point of the cooling action.
Minimum Value:..... -999
Maximum Value:..... 9999

Proportional band of the cooling action.
Minimum Value:0 % (ON-OFF action)
Maximum Value:.....100 %

Cycle of the cooling action when configured as proportional action (P.C. > 0).
Minimum Value:..... 1 s
Maximum Value:..... 120 s

Hysteresis of the cooling action when in ON/OFF mode.

Minimum Value:..... 1
Maximum Value:..... 9999

Configuration of the work mode of alarm 1.
Minimum Value:..... 0
Maximum Value:..... 10

Set Point of alarm 1.

Set Point of alarm 1 when in relative mode to the process Set Point.
Minimum Value:..... -999
Maximum Value:..... 9999

Hysteresis of alarm 1.

Configuration of the work mode of alarm 2.
Minimum Value:..... 0
Maximum Value:..... 10

Set Point of alarm 2.

Set Point of alarm 2 when in relative mode to the process Set Point.
Minimum Value:..... -999
Maximum Value:..... 9999

Hysteresis of alarm 2.

Secondary Set Point. Becomes the process Set Point when the digital input is enabled, provided parameter d.in=0.

Minimum Value:..... SP.LL
Maximum Value:..... SP.HL

Indication deviation from process read value. For example, if the instrument takes a reading of 200 and BiAS = 20, the indication will be 220 (200 + 20).

Minimum Value:..... -999
Maximum Value:..... 9999

Temperature measurement units (°C or °F).

Minimum Value:..... 0
Maximum Value:..... 1

Control output top limit.

Minimum Value:.....0 %
Maximum Value:.....100 %

Low limit of the Set Point value. A process set point lower than the value of SP.LL. cannot be set.

Minimum Value: Low limit of the input signal
Maximum Value:..... SP.HL-1

High limit of Set Point value. A process set point greater than the value of SP.HL cannot be set.

Minimum Value:..... SP.LL+1
Maximum Value: High limit of the input signal.

Initial autotuning. Can be used to enable the autotuning process automatically when the controller is started up.

Minimum Value:..... 0
Maximum Value:..... 1

Autotuning type. This is to select beetween “Step Response” or “Relay Feedback” type.

Minimum Value:..... 0
Maximum Value:..... 1

Type of control. To select the ON/OFF, PID or PI+D mode.
Minimum Value:..... 0
Maximum Value:..... 2

To select whether the control output should be in heating or cooling mode.
Minimum Value:..... 0
Maximum Value:..... 1

Input signal. The sensor type of the process is selected. This parameter must be accompanied by the configuration described in point 3.2.
Minimum Value:..... 0
Maximum Value:..... 12

Decimal point for linear inputs. 1 or 2 digits after the decimal point can be selected.
Minimum Value:..... 0
Maximum Value:..... 2

Bottom value for the scale of the linear signal inputs (0..5V, 0..10V, 0..20 mA or 4..20 mA).
Minimum Value:..... -999
Maximum Value:.....inH-1

Top value for the scale of the linear signal inputs (0..5V, 0..10V, 0..20 mA or 4..20 mA).
Minimum Value:.....inL+1
Maximum Value:..... 9999

Enabling remote Set Point. If rSP = 1, the process Set Point is given by an external analog signal.
Minimum Value:..... 0
Maximum Value:..... 1

Bottom limit of the scale for the remote Set Point.
Minimum Value:..... SP.LL
Maximum Value:.....rSP.H-1

Top limit of the scale for the remote Set Point.
Minimum Value:.....rSP.L+1
Maximum Value:..... SP.LH

Configuration of the auxiliary analog output. It can be configured as direct or reverse.
Minimum Value:..... 0
Maximum Value:..... 1

Bottom limit of the analog output scale.
Minimum Value: Start of range of input signal.
Maximum Value:.....Lrt.H-1

Top limit of the analog output scale.
Minimum Value:.....Lrt.L+1
Maximum Value: End of range of input signal.

Configuration of the digital input.
Minimum Value:..... 0
Maximum Value:..... 1

Access code to unlock the keyboard.
Minimum Value:..... 0
Maximum Value:..... 9999

Level of protection of the keyboard.
Minimum Value:..... 0
Maximum Value:..... 2

5.6. Configurable values of the parameters and initial value.

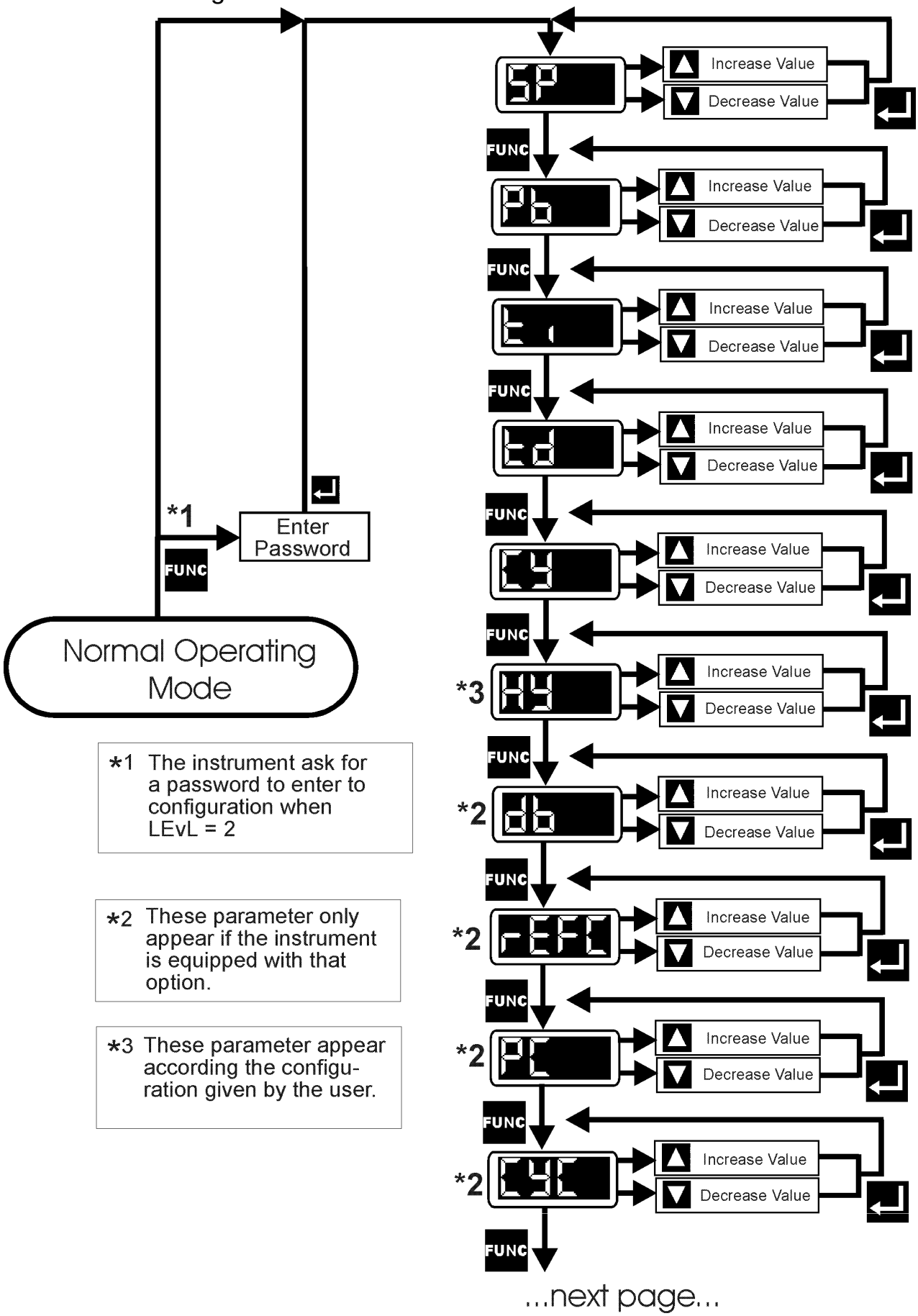
Parameter	Meaning			Initial value
LEVEL 1				
SP	Set Point			150
Pb	Proportional Band			2.5 %
Ti	Integral Time			240 s
Td	Derivative Time			60 s
Cy	Heating Cycle			20 s
Hy	Heating hysteresis (in ON/OFF mode)			2
Db	Dead band of the servomotor			2 %
REF.C	Cooling set point			5
P.C.	Band / Configuration of cooling action			
	Value	*0 %*	*Action ON/OFF*	0
		1..100 %	*Proportional Band*	
Cy.C	Cooling action cycle			20
Hy.C	Cooling hysteresis in ON/OFF mode			2
C.A1	Configuration of Alarm 1			0
	Value	*0*	*Alarm disabled*	
		1	*Alarm Absolute, High, Direct*	
		2	*Alarm Absolute, High, Reverse*	
		3	*Alarm Absolute, Low, Direct*	
		4	*Alarm Absolute, Low, Reverse*	
		5	*Alarm Relative, High, Direct*	
		6	*Alarm Relative, High, Reverse*	
		7	*Alarm Relative, Low, Direct*	
		8	*Alarm Relative, Low, Reverse*	
		9	*Window alarm, Direct*	
		10	*Window alarm, Reverse*	
SP.A1	Absolute Set Point Alarm 1			155
r.A1	Relative Set Point Alarm 1			5
Hy.A1	Hysteresis of Alarm 1			1
C.A2	Configuration Alarm 2			0
	Value	*0*	*Alarm disabled*	0
		1	*Alarm Absolute, High, Direct*	
		2	*Alarm Absolute, High, Reverse*	
		3	*Alarm Absolute, Low, Direct*	
		4	*Alarm Absolute, Low, Reverse*	
		5	*Alarm Relative, High, Direct*	
		6	*Alarm Relative, High, Reverse*	
		7	*Alarm Relative, Low, Direct*	

		8	*Alarm Relative, Low, Reverse*	
		9	*Window Alarm, Direct*	
		10	*Window Alarm, Reverse*	
SP.A2	Absolute Set Point Alarm 2			155
r.A2	Relative Set Point Alarm 2			5
Hy.A2	Hysteresis of Alarm 2			1

LEVEL 2				
S.SP	Secondary Set Point			100
BiAS	Deviation of the input variable			0
unit	Temperature measurement units			1
	Value	*0*	*°F*	
		1	*°C*	
out.L	Controller output limit			100
SP.LL	Bottom limit of Set Point			0
SP.HL	Top limit of Set Point			600
in.At	Initial autotuning YES/NO			0
	Value	*0*	*No*	
		1	*Yes, enabled*	
At.Ty	Type of autotuning			1
	Value	*0*	*Relay Feedback (On Set Point)*	
		1	*Step Response (Initial)*	
Ct.ty	Type of control			1
	Value	*0*	*ON-OFF*	
		1	*PID*	
		2	*PI+D*	
HEAt	Type of primary action			1
	Value	*0*	*Cooling*	
		1	*Heating*	

LEVEL 3				
inP	Type of input			0
	Value	*0*	*J (0..600°C)*	
		1	*L (0..600°C)*	
		2	*K (0..1200°C)*	
		3	*N (0..1200°C)*	
		4	*T (0..400°C)*	
		5	*R (0..1600°C)*	
		6	*S (0..1600°C)*	
		7	*Pt100 (0..600°C)*	
		8	*Pt100 (-99.9..200.0°C)*	
		9	*0..5 Vdc*	
		10	*0..10 Vdc*	
		11	*0..20 mA*	
		12	*4..20 mA*	
dP	Decimal points of the linear input			0
inL	Start of scale for linear input			0
inH	End of scale for linear input			500
rSP	Enable / Disable Remote Set Point			0
	Value	*0*	*Remote Set Point disabled*	
		1	*Remote Set Point enabled*	
rSP.L	Start of scale for Remote Set Point			0
rSP.H	End of scale for Remote Set Point			600
Lrt	Direct / Reverse auxiliary analog output			1
	Value	*0*	*Reverse output*	
		1	*Direct output*	
Lrt.L	Start of scale for analog output			0
Lrt.H	End of scale for analog output			600
d.in	Configuration of digital input			0
	Value	*0*	*Secondary Set Point*	
		1	*Keyboard locked*	
CodE	Unlock code for keyboard			0
LevL	Level of protection of keyboard			0
	Value	*0*	*Only the Set Point can be modified and displayed the rest*	
		1	Free acces to all parameters but they can only be modified with password	
		2	It is not possible to see and modify any parameter without password	

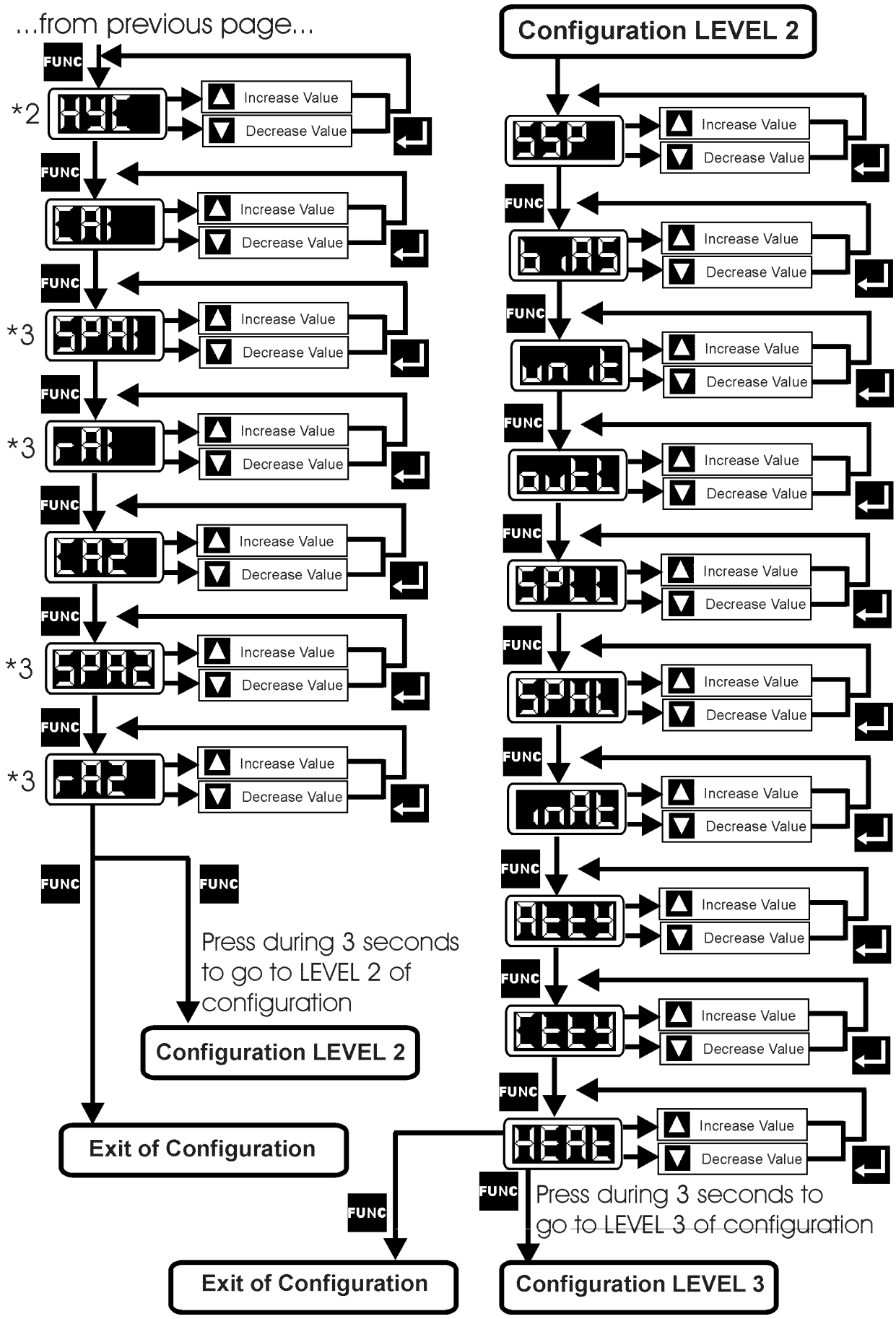
5.7. General diagram of menus

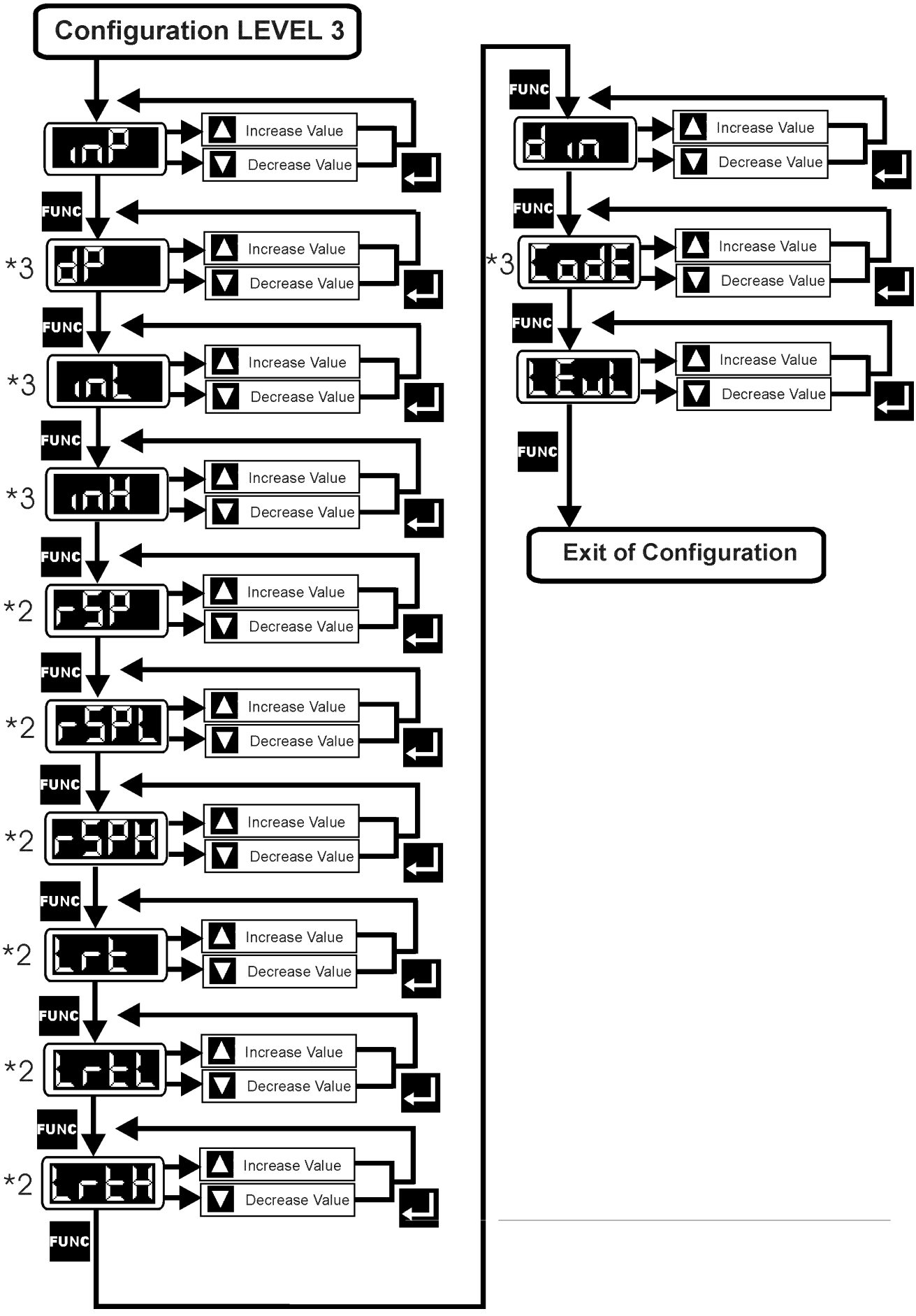


*1 The instrument ask for a password to enter to configuration when LEvL = 2

*2 These parameter only appear if the instrument is equipped with that option.

*3 These parameter appear according the configu-ration given by the user.


...from previous page...
FUNC
*2
HYC
Increase Value
Decrease Value
CA1
*3
SPA1
rA1
CA2
SPA2
rA2
Press during 3 seconds to go to LEVEL 2 of configuration
Configuration LEVEL 2
Exit of Configuration
SSP
bIAS
unit
outL
SPLL
SPHL
mAt
Atby
Cthy
HEAt
Press during 3 seconds to go to LEVEL 3 of configuration
Exit of Configuration
Configuration LEVEL 3


Configuration LEVEL 3
inP
dP
inL
inH
rSP
rSPL
rSPH
Lrt
LrtL
LrtH
dIn
CodE
LEvL
FUNC
*3
*2
Increase Value
Decrease Value
Exit of Configuration

5.8 Keyboard lock

There are two ways to lock the keyboard.

Locking with the digital input: When the parameter d.in = 1, the keyboard is locked when the digital input is enabled.

Locking by password: The instrument can have three types of keyboard locking with password, in accordance with the parameter LEvL. For this type of locking to be enabled, the parameter d.in must be d.in = 0

LEvL = 0: Only the Set Point can be modified and displayed the rest.

LEvL = 1: Free acces to all parameters but they can only be modified with password.

LEvL = 2: It is not possible to see and modify any parameter without password

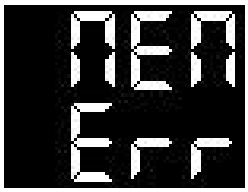
6. TECHNICAL SPECIFICATIONS

Format	AK48	1/16 DIN43700 (48 x 48 mm). Frontally removable
	AK49	1/8 DIN43700 (48 x 96 mm, vertical). Frontally removable
	AK96	1/4 DIN43700 (96 x 96 mm). Frontally removable
Power supply		85..265 Vac 50/60 Hz (optionally 21..53 Vac/DC)
Consumption		8 VA
Atmos. Temp.		0..50°C (interior use)
Relative humidity		max. 80%, non condensing
Altitude		max. 2000 m
Installation cat.		II as per EN61010-1
Degree of pollution		I as per EN61010-1
Case		ABS self-extinguishing
Dimensions	AK48	(48 x 48 x 109 mm)
	AK49	(48 x 96 x 98 mm)
	AK96	(96 x 96 x 98 mm)
Panel drill-hole	AK48	45.5 x 45.5 mm (±0.5)
	AK49	45.5 x 91.5 mm (±0.5)
	AK96	94 x 91.5 mm (±0.5)
Display	AK48 AK49	4 digits of 10 mm for the process variable. 4 digits of 7 mm for the signal
	AK96	4 digits of 13 mm for the process variable. 4 digits of 10 mm for the signal
Inputs		User configurable as: L : 0..600°C (Fe-CuNi, DIN43710) J : 0..600°C (Fe-CuNi, IEC584) K: 0..1200°C (NiCr-NiAl, IEC584) N: 0..1200°C (NiCrSi-NiSi, IEC584) T: 0..400°C (Cu-CuNi, IEC584) R: 0..1600°C (Pt/13%Rh-Pt, IEC584) S: 0..1600°C (Pt/10%Rh-Pt, IEC584) RTD, Pt100: 0..600°C (IEC751) RTD, Pt100: -99.9..200.0°C (IEC751) Current loop 0..20 , 4..20 mA (load 10 Ohm)

		Voltage Vdc 0..5 , 0..10 V (Impedance >100 Mohm)
Precision		± 0.25% v.f.e
Control output		Output via SPDT relay (2A @ 250 Vac, resistive load) or pulses of 9Vdc (open collector, max. 40 mA). user-configurable. Optionally, output via loop of 0..20 mA, 4..20 mA (500 Ohm max.), 0..5 V, 0..10 V (20 mA max.). The control output for servomotor (AK49 and AK96 only) (two SPDT relays, open/close) excludes cooling output.
Cooling output	AK49 AK96	Output via SPDT relay (2A @ 250 Vac, resistive load) configurable as ON/OFF or proportional.
Alarms		One alarm as standard, optionally 2 alarms. Fully configurable. SPST output (1A @ 250 Vac, resistive load).
Power supply for transmitter		13.5Vdc (max. 22mA)
Type of control		PID or PI+D, with 2 autotuning algorithms, user-selectable or ON/OFF.
Weight		140 grs.(AK48), 220 grs.(AK49), 260 grs.(AK96)
CE certification (for both industrial and commercial environments)		• Safety: EN61010 • EMI susceptibility: EN50082-1 - EN61000-4-2, static discharges - EN61000-4-3, radiated fields - EN61000-4-4, transients - EN61000-4-5, shock wave - EN61000-4-6, injected currents - EN61000-4-8, magnetic field - EN61000-4-11, voltage breaks • EMI emission: EN50081-1 - EN55022-b, conducted emissions - EN55022-b, radiated emissions • Harmonics: EN61000-3-2 • Voltage fluctuations: EN61000-3-3

7. ERROR AND ALARM MESSAGES

The Akros series of controllers displays three error messages.



Error in the unit's internal memory. If this message appears, the instrument must be sent to your nearest distributor for repair.

The circuit of the input signal has been broken or else the input signal is over the top limit.

The input signal is below the bottom limit of the scale, or else the connections are inverted.