PROCESS CONTROLLERS
Akros Series

Instruction Manual

senso

SUMMARY

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:

- Input:
  - Thermocouple type L : 0..600°C (Fe-CuNi, DIN43710)
  - Thermocouple type J : 0..600°C (Fe-CuNi, IEC584)
  - Thermocouple type K: 0..1200°C (NiCr-NiAl, IEC584)
  - Thermocouple type N: 0..1200°C (NiCrSi-NiSi, IEC584)
  - Thermocouple type T: 0..400°C (Cu-CuNi, IEC584)
  - Thermocouple type R: 0..1600°C (Pt/13%Rh-Pt, IEC584)
  - Thermocouple type S: 0..1600°C (Pt/10%Rh-Pt, IEC584)
  - Thermorresistance, Pt100: -200..600°C (IEC751)
  - Thermorresistance, Pt100: -99,9..200,0°C (IEC751)
  - Voltage 0 a 5Vdc
  - Voltage 0 a 10Vdc
  - Current loop 0 a 20mA
  - Current loop 4 a 20mA
- Control output: 9 Vdc pulses(open collector, max. 40 mA)/SPDT relay/Linear control output 0 to 20mA, 4 to 20 mA (max. 500 ohm), 0 to 5V or 0 to 10V (max. 20 mA)/Output for servomotor
- ON/OFF, PID or PI+D (PI with automatic derivative) control types wit 2 different types of autotune procedures user selectable depending the application

- Automatic or Manual mode.
- Digital input to activate secondary setpoint, lock keyboard or stop control.
- Double large 4 digits display.
- 1 or 2 fully configurable alarms with SPST output (1A @ 250 Vac, resistive load).
- Supply: 85..265 Vac 50/60 Hz.
- Physical information:

AK48	Format:	1/16 DIN43700. Frontally removable
	Dimensions:	48 x 48 x 98 mm
	Panel cutout:	45.5 x 45.5 mm (±0.5)
	Weight:	140 grs.
AK49	Format:	1/8 DIN43700. Frontally removable
	Dimensions:	48 x 96 x 98 mm
	Panel cutout:	45.5 x 91.5 mm (±0.5)
	Weight:	220 grs.
AK96	Format:	1/4 DIN43700. Frontally removable
	Dimensions:	48 x 96 x 98 mm
	Panel cutout:	94.0 x 91.5 mm (±0.5)
	Weight:	260 grs.

- ON/OFF with hysteresis, proportional or PID Cooling output.
- Analog output of 0 to 20mA, 4 to 20mA (max. 500 ohm), 0 to 5V or 0 to 10V (max. 20 mA) proportional to process variable with user configurable range.
- Supply for transmitter of 0..20 or 4..20 mA (@13 Vcc).
- Remote setpoint input(0..20, 4..20 mA, 0..5 or 0..10 V) with user configurable range.
- RS485 serial communication

1.2. Ordering guide

AK48

Model	Input	Control Output	Base Options	Supply
AK48	**T**: TC/Pt100 **U**: TC/Pt100/Linear	**1:** Relay/Vdc pulses **3:** 0..20 mA* **4:** 4..20 mA* **6:** 0..5 Vcc* **7:** 0..10 Vcc*	**1:** One SPST alarm **2:** Two SPST alarms **3:** LRT 0..20 mA **4:** LRT 4..20 mA **6:** LRT 0..5 Vcc **7:** LRT 0..10 Vcc **9:** TPS 24 Vcc	**1:** 85 a 265V, 50/60Hz **2:** 21 a 53 Vca/dc

* Only allowed for base options 1 and 2

AK48	T	1	1	1

Abbreviations: TC=Thermocouple, LRT=Linear retransmission, RSP=Remote setpoint, TPS=Transmitter power supply

AK49/AK96

Model	Input	Control Output	Base Options	Auxiliary output	Auxiliary Options	Interface	Supply
AK49 AK96	**T**: TC/Pt100 **U**: TC/Pt100/Linear	**1:** Relay/Vdc pulses **3:** 0..20 mA **4:** 4..20 mA **5:** Servomotor** **6:** 0..5 Vcc **7:** 0..10 Vcc	**1:** One SPST alarm **2:** Two SPST alarms **3:** Cooling + one alarm **4:** Cooling + 2 alarms	**0:** None **3:** LRT 0..20 mA* **4:** LRT 4..20 mA* **6:** LRT 0..5 Vcc* **7:** LRT 0..10 Vcc* **9:** TPS 24 Vcc*	**N:** None **T:** Current sensing **D:** Digital input **B:** Options T and P **V:** TPS 24 Vcc	**0:** None **2:** RS485 **3:** RSP 0..20 mA **4:** RSP 4..20 mA **6:** RSP 0..5 Vcc **7:** RSP 0..10 Vcc	**1:** 85 a 265V, 50/60Hz **2:** 21 a 53 Vca/dc

* Only allowed for base options 1 and 3

** Only allowed for base options 1 and 2

AK49	T	1	1	1	N	0	1

Abbreviations: TC=Thermocouple, LRT= Linear retransmission, RSP=Remote setpoint,, TPS=Transmitter power supply

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. Panel mounting

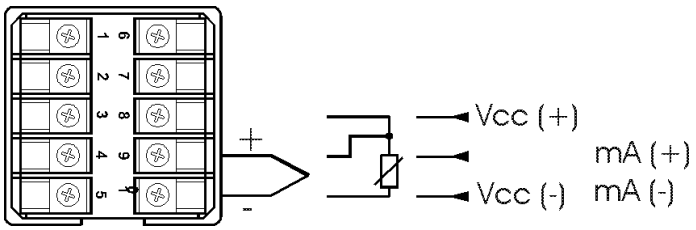
The instrument should be installed on a panel a maximum of 8 mm. thick. Its must be sited in a place subject to the less possible vibrations, and it must be ensured that the atmospheric temperature will be kept between 0 and 50ºC.

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.

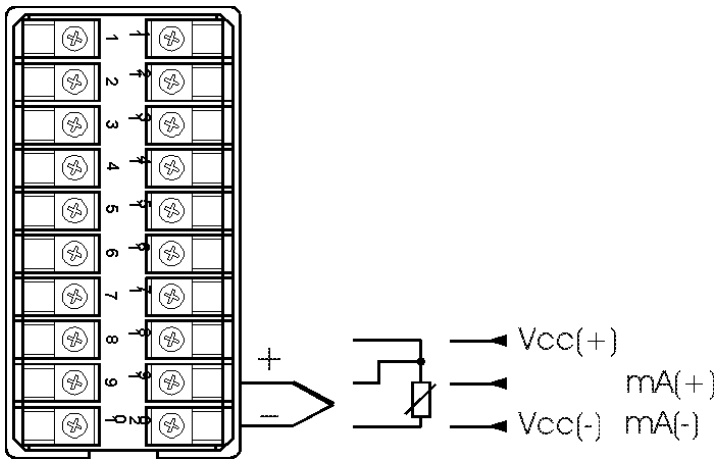
3. INPUTS / OUTPUTS

3.1. Options of the signal input.

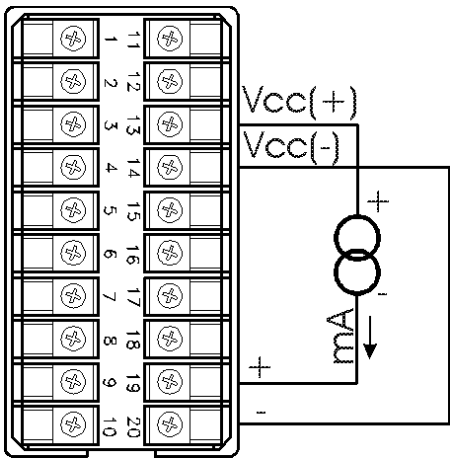
Model AK48



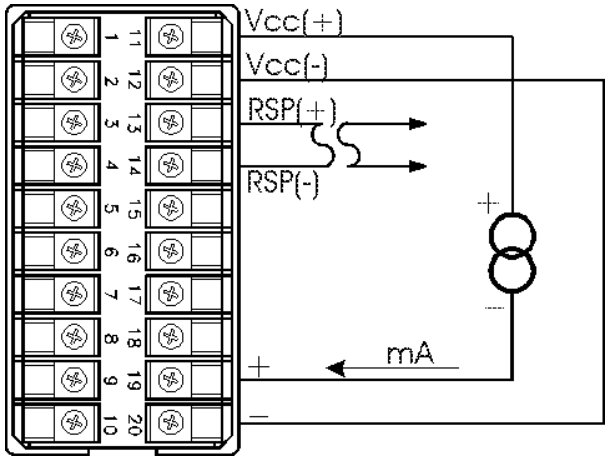
Model AK49



Thermocouple , Pt100, Vdc y mA

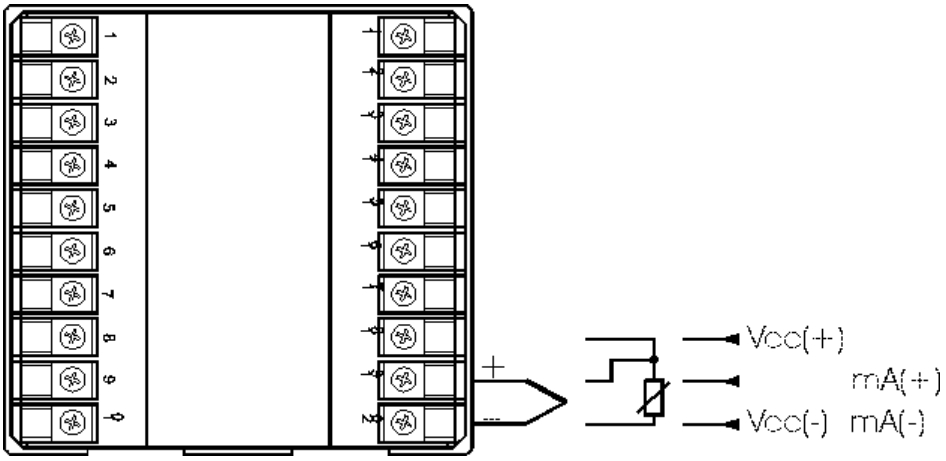


Linear mA input with internal source

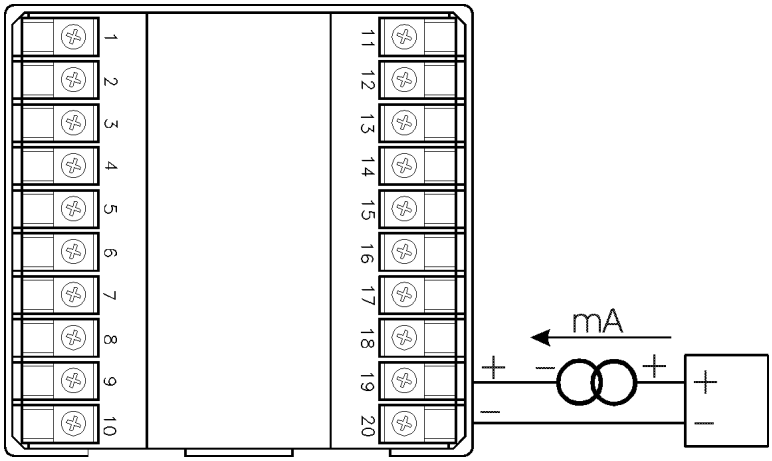


Linear mA input with internal source and Remote Set Point

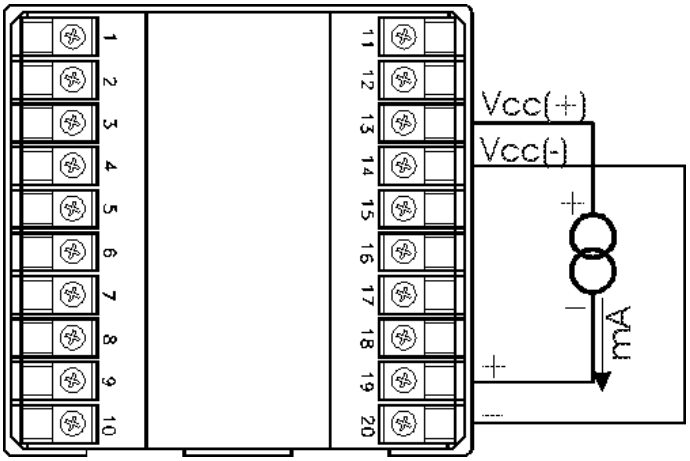
Model AK96



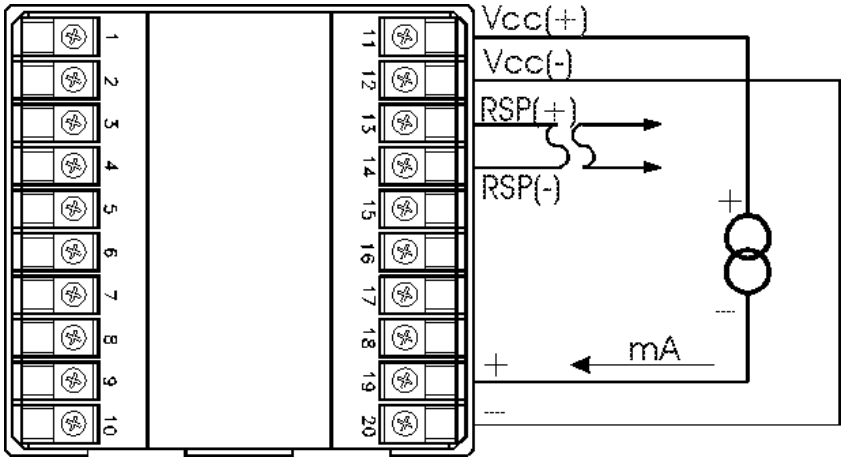
Inputs for thermocouple, Pt100, Vdc and mA



Linear mA input with external source



Linear mA input with internal source

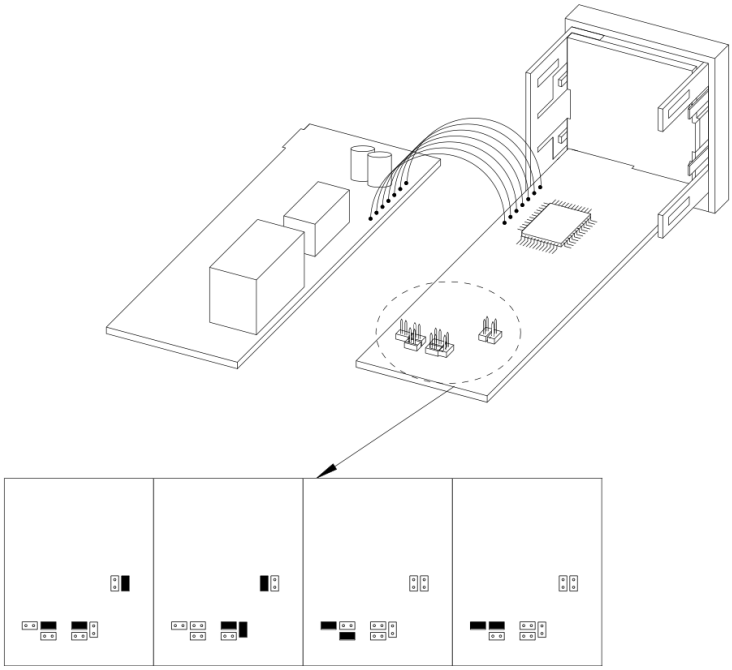


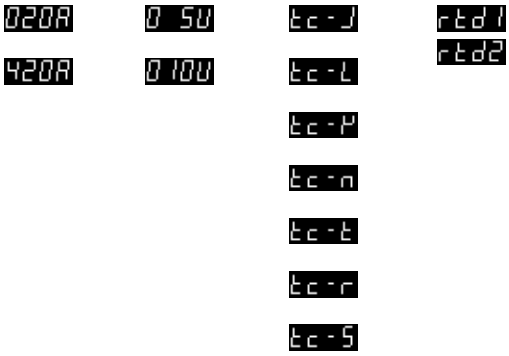
Linear mA input with internal source and Remote Set Point

3.2. Configuration of the different inputs

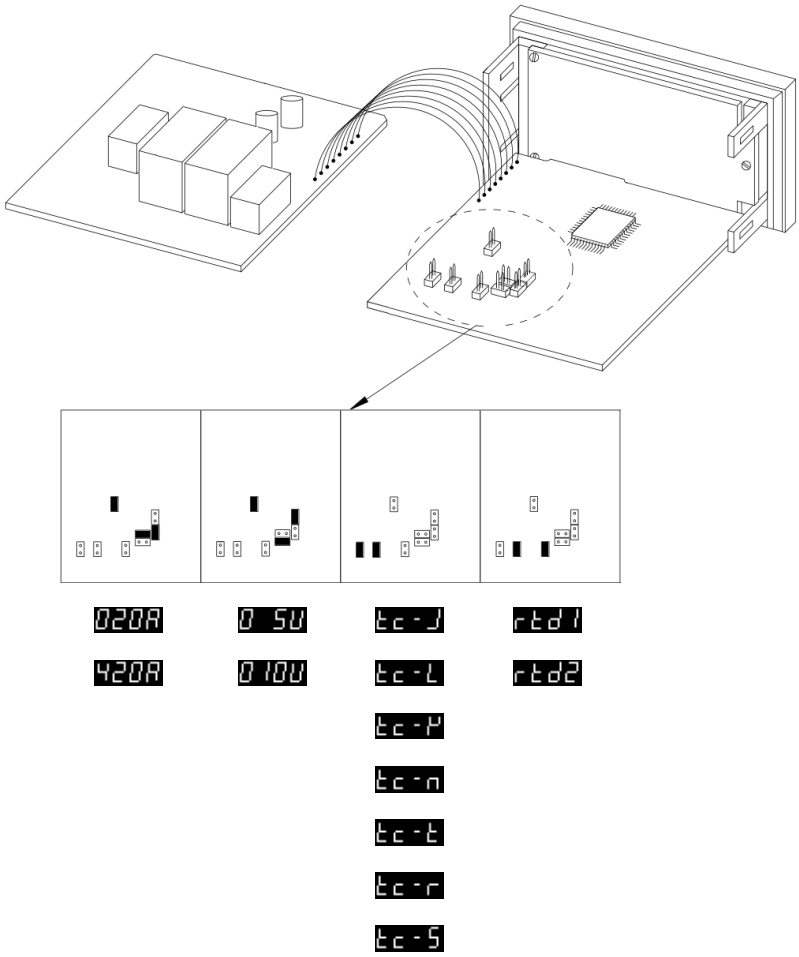
Input signal must be selected setting the parameter inP inside the module menus and connecting corresponding jumpers inside the main board. Special care must be taken to ensure the front circuit is connected in the correct position because setting the module upside down into it's box may produce electrical damage.

Model AK48

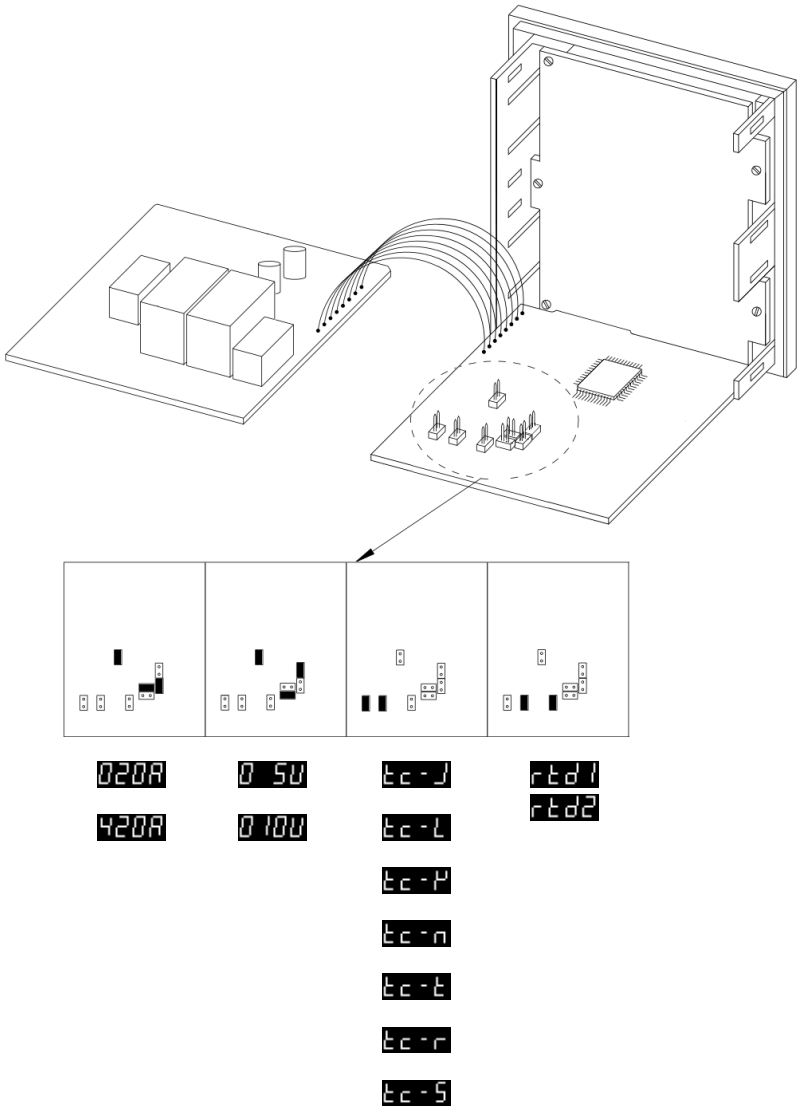




Model AK49



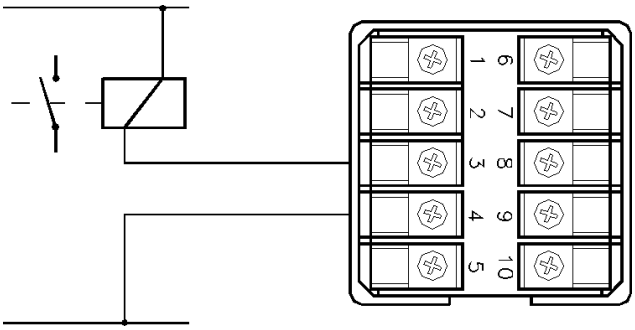
Model AK96



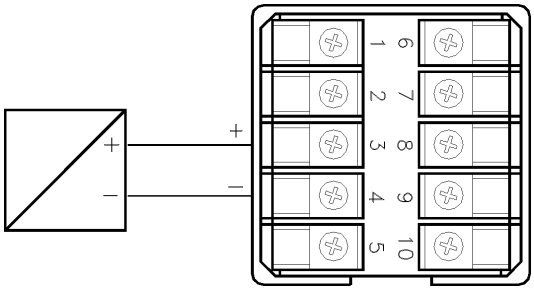
The value range and decimal point position shown in the display for linear input types (0 20A ,4 20A ,0 5U or) 0 10U can be selected setting the parameters in L (bottom value), in H (top value) y dP (decimal point position)

3.3. Options of the control output. Examples.

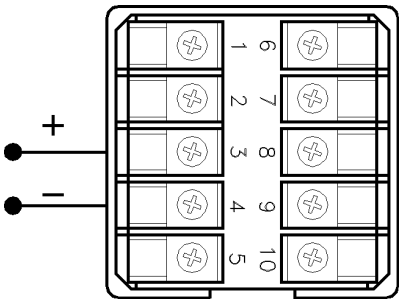
This chapter uses diagrams to describe the connections of the different options for the different control outputs.



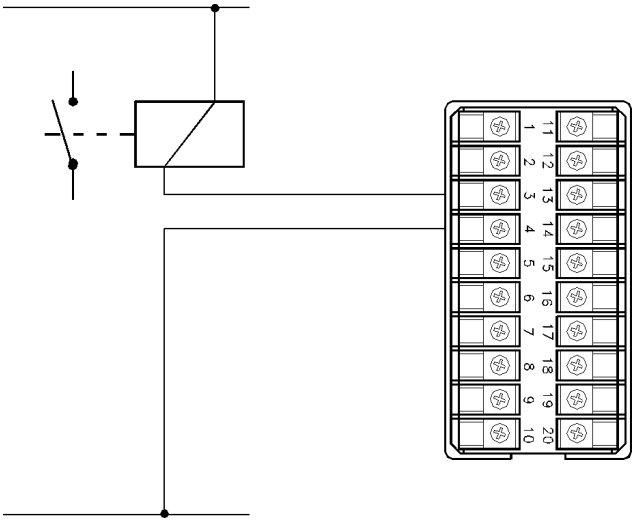
AK48: Output for contactor



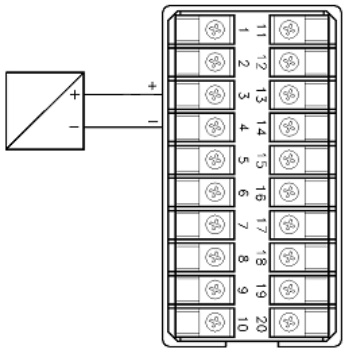
AK48: Output for solid state relay



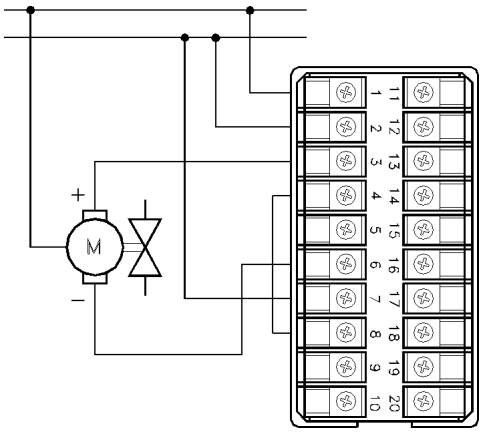
AK48: Linear control output

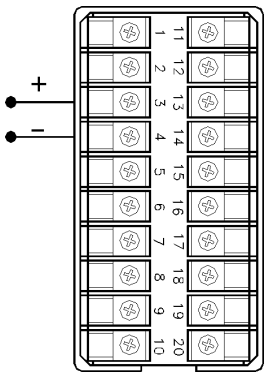


AK49: Output for contactor

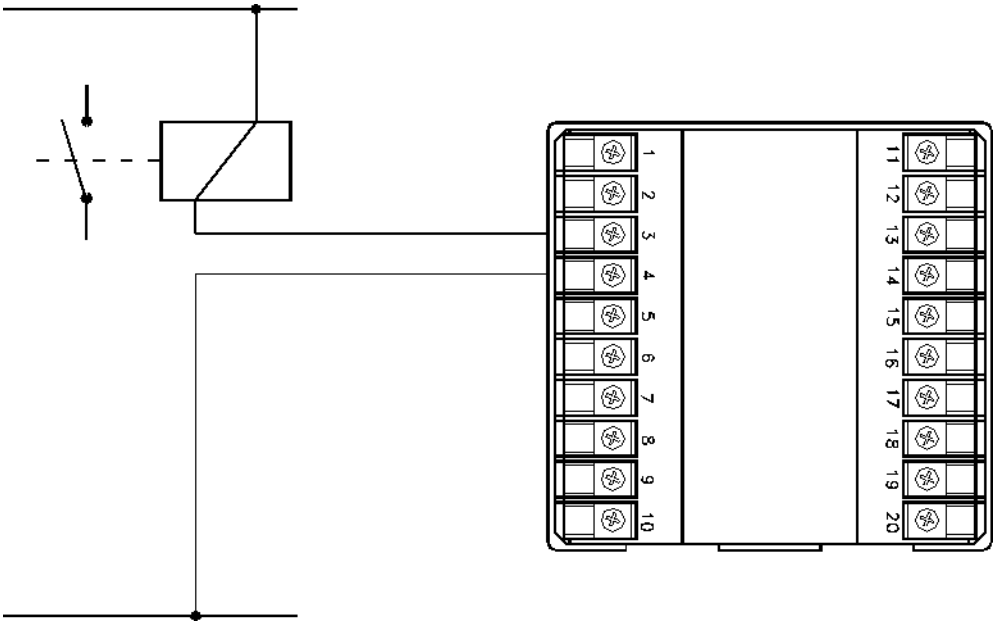


AK49: Output for solid state relay

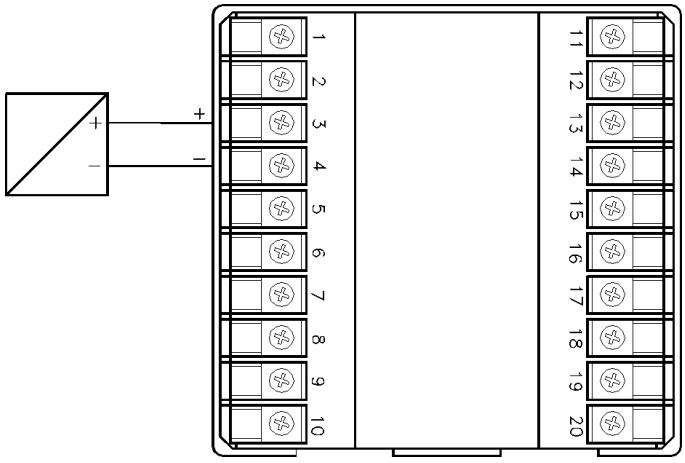




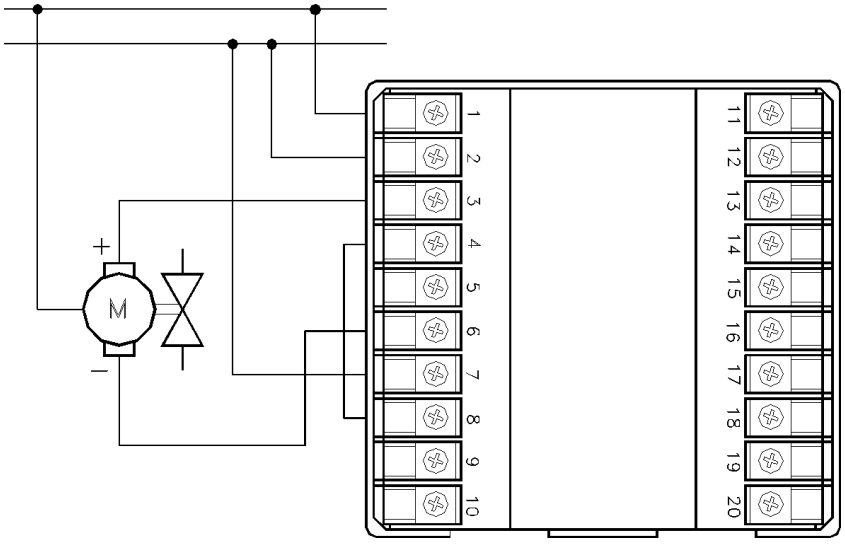
AK49: Output for servomotor



AK49: Linear control output

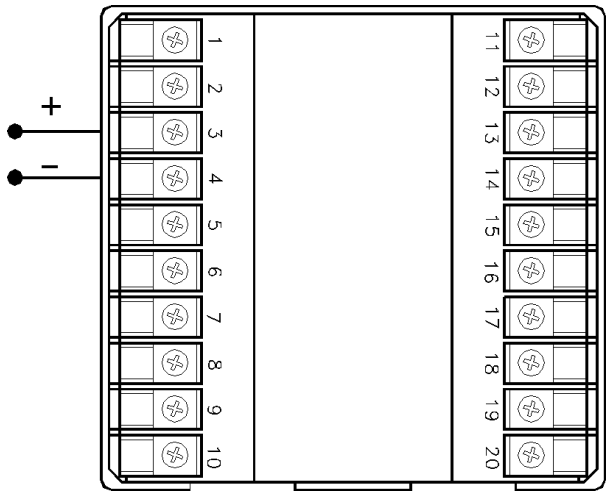


AK96: Output for contactor



AK96: Output for solid state relay

AK96: Output for servomotor



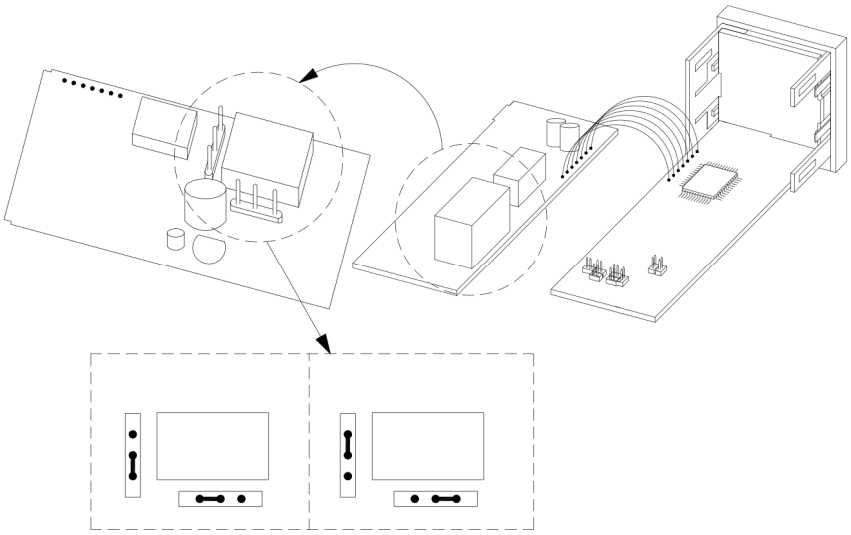
AK96: Linear control output

3.4. Configuration as relay or voltage pulse output.

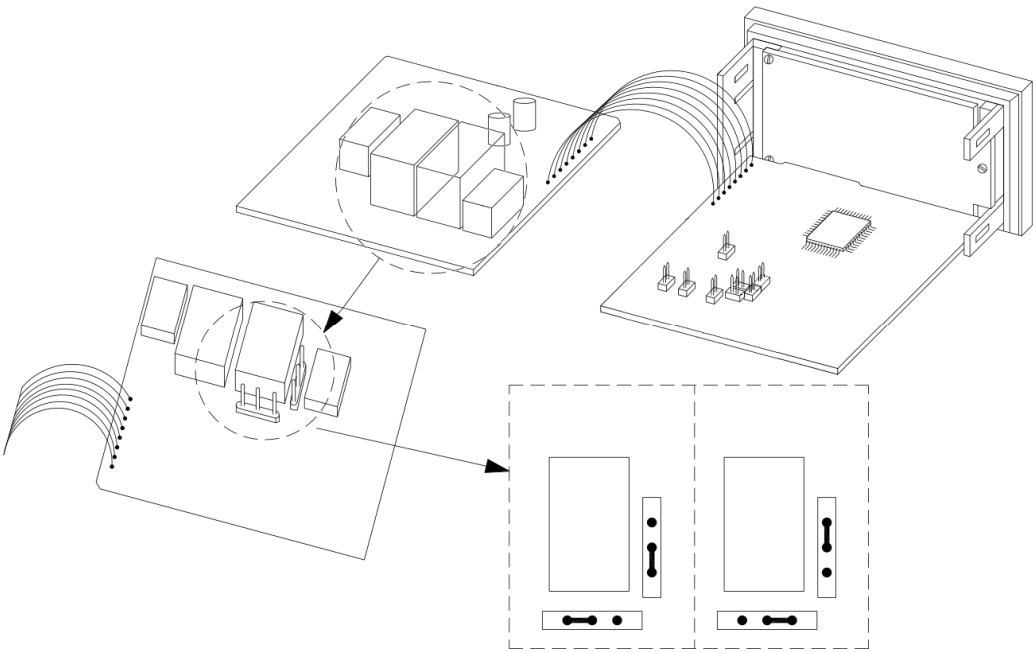
All the models in the Akros series are equipped with the heating output configurable as a relay or voltage pulses (except for linear or servomotor outputs). To change one output type to another, proceed as follows:

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.

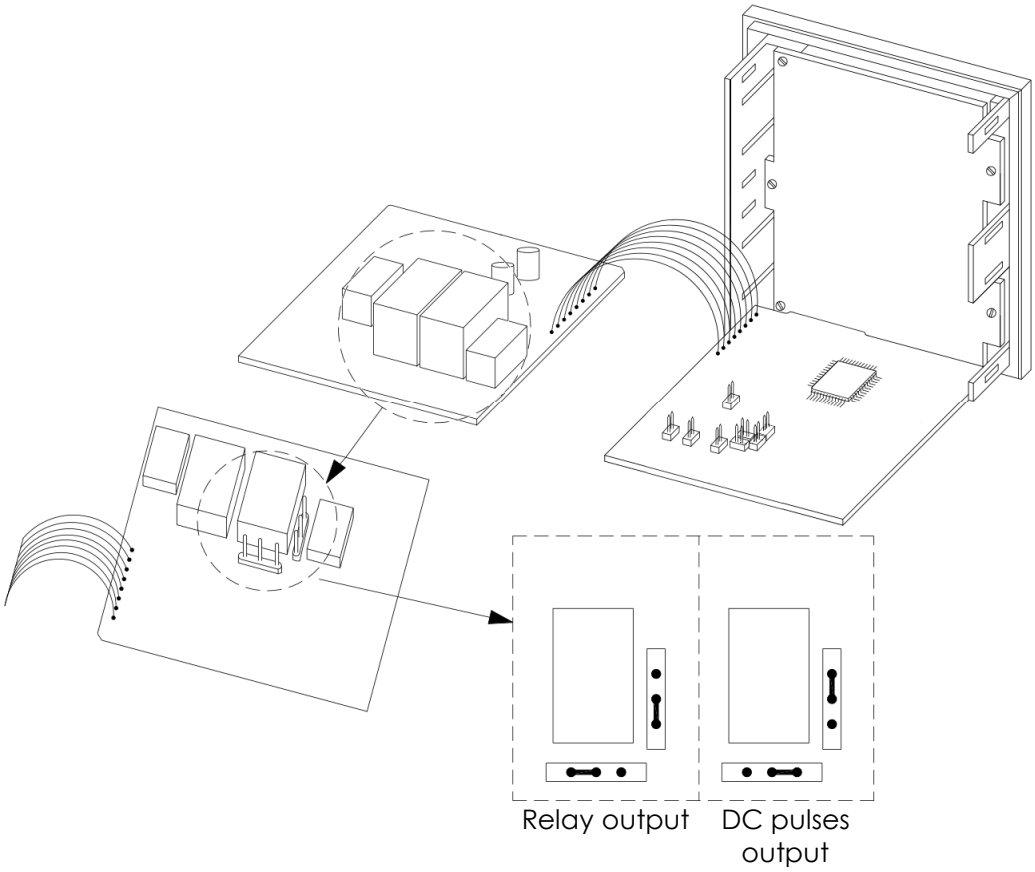
Model AK48


Relay output
DC pulses output

Model AK49


Relay output
DC pulses output

Model AK96

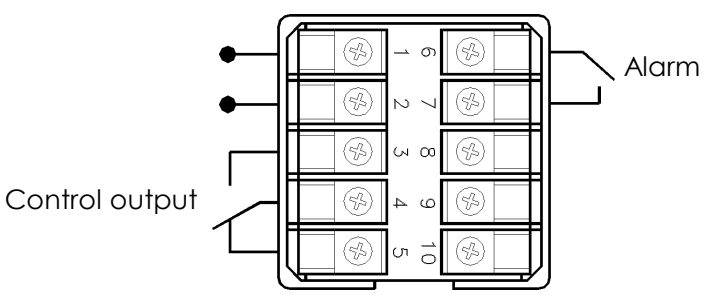


3.5. Options of the alarms

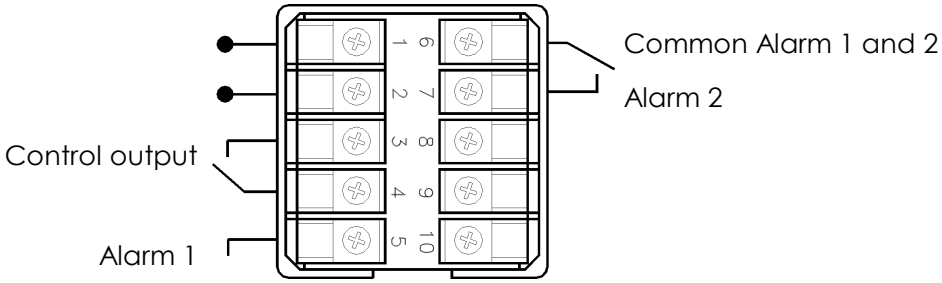
All the models in the Akros series can be fitted with 2 alarms, the first being supplied as standard. The alarm output is by relay with SPST contacts (a voltage-free contact). The alarm outputs are as follows:

AK48

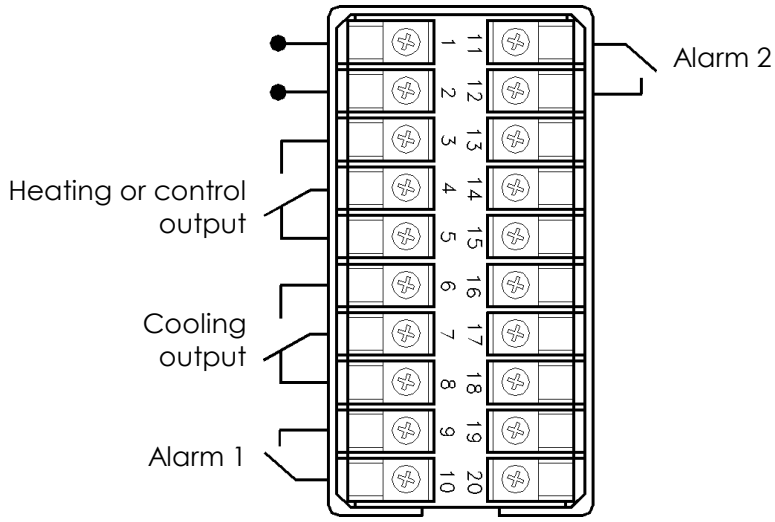
AK48 with 1 alarm



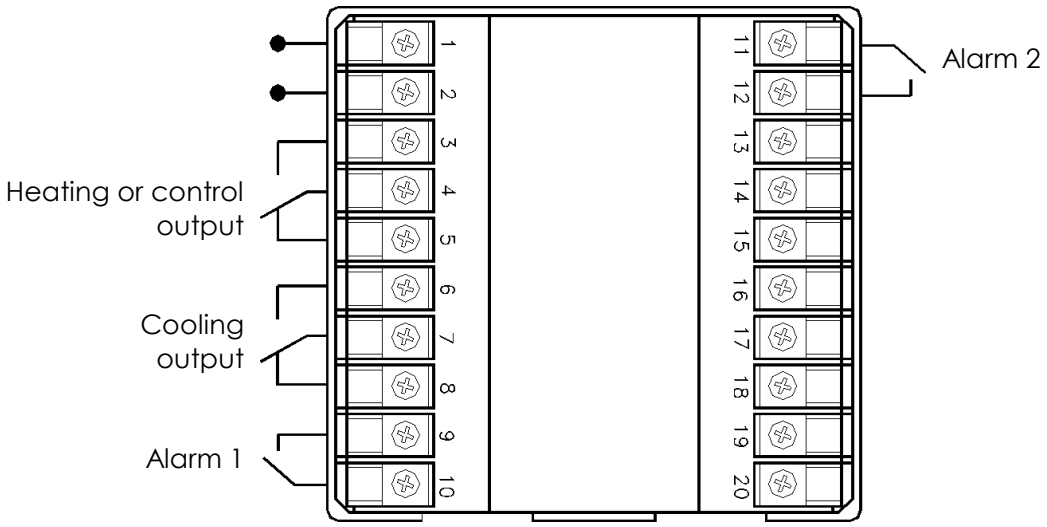
AK48 with 2 alarms(the alarms share a contact in common)



AK49



AK96



heir working configuration depends on parameters CA1 and CA2.

1) Set Point.

Absolute Set Point (SPA1 y SPA2): 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).

Current setpoint(CSP1, Cr1, CSP2, Cr2): The activating / deactivating point of the alarm is referred to the current measured at the heating element. If this value is out of the range [CSPx-Crx,CSPx+Crx] alarm is activated. All those values are independent on the working setpoint. For instance if CSP1 is set to 1,2A and Cr1 is set to 0.3A, alarm will change it's state if current measured is over 1.5A or under 0.9A. All those parameters are only shown for AK49 y AK96 modules with current measurement option installed.

Relative Set Point (rA1 y rA2): 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 250ºC, the alarm will be set at 270ºC.

Window Set Point (rA1 y rA2): 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 250ºC, the alarm will change status at 240ºC and 260ºC.

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 150ºC, 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 alarm set point. For example, if the alarm's Set Point is at 150ºC, the alarm will remain activated as long as the process is below this temperature.

CA1 / CA2	Working mode
OFF	Deactivated alarm
Hi	Absolute setpoint, high
Lo	Absolute setpoint, low
r.Hi	Relative setpoint, high
r.Lo	Relative setpoint, low
UUnd	Window alarm
Curr	Current window alarm

Type of action is set using parameters Act1 y Act2:

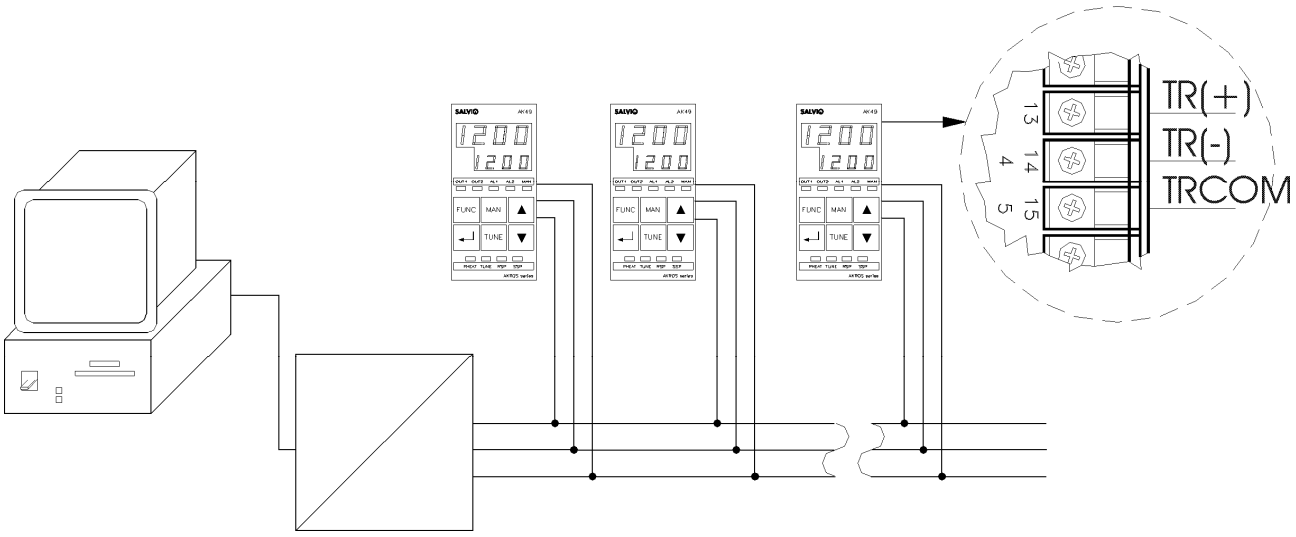
Direct Action:(dir): The output relay is normally deactivated and is enabled when the enabling condition of the alarm occurs.

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

The alarm hysteresis can be changed setting parameters HyA1 y HyA2.

3.6. Serial communications (Optional)

AK49 and AK96 models have an optional 3 wires half duplex, RS485 communication interface.



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

3.7. Auxiliary Analog Output (Optional).

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 using parameter **LrE** and the margin of variation of this signal can also be user-configured.

Direct output (**dir**) means that the value of the output signal increases as the process variable increases.

Reverse output (**rEU**) means that the value of the output signal decreases as the process variable increases.

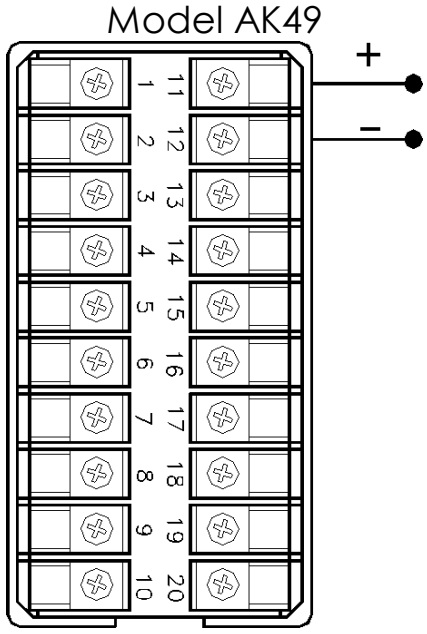
Similarly, the minimum value (**LrtL**) and maximum value

(LrtH) of the process variable between which the analog output will vary between its minimum and maximum, can be configured.

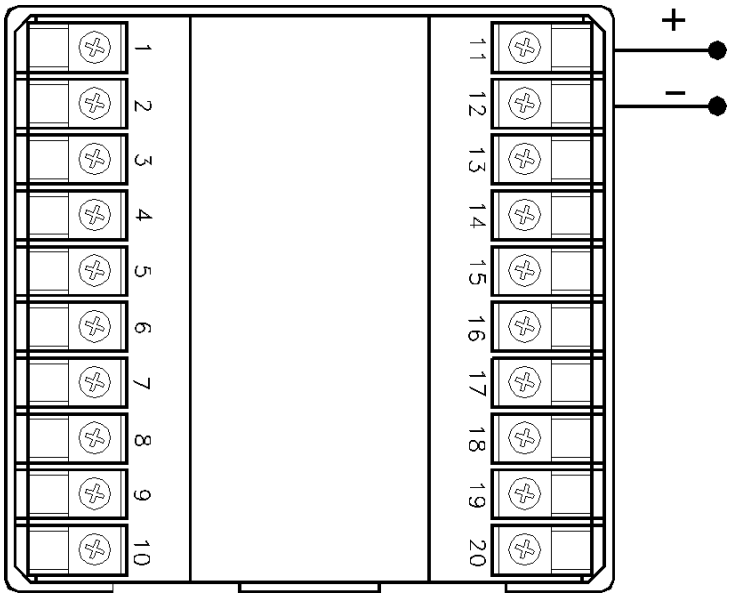
For example, an instrument with thermocouple input type J has a scale from 0..600°C. If this instrument has an analog output of 4..20 mA, you can configure LrtL= 100°C and LrtH= 500°C , whereby the analog output will take on the following values:

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

Wiring of analog output is as follows:



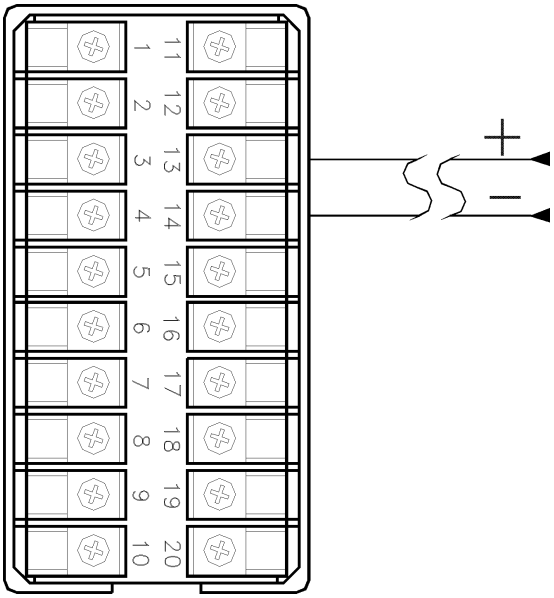
Model AK96



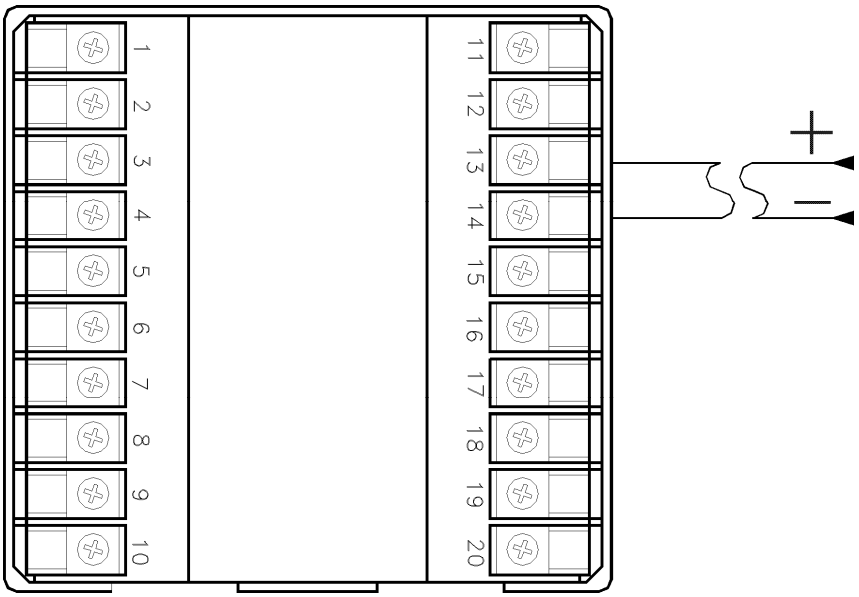
3.8 Remote Set Point (Optional).

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. Remote setpoint input is activated using the parameter rSP and its wiring is as follows:

Model AK49



Model AK96



The margin of variation of the Set Point value which will be configured with the analog input is defined between a minimum value (**r5PL**) and a maximum value (**r5PH**). For example, with an input of 0..10 Vdc and values of **r5PL** = 0°C and **r5PH** = 200°C, the value of the process Set Point in accordance with the input signal would be as follows:

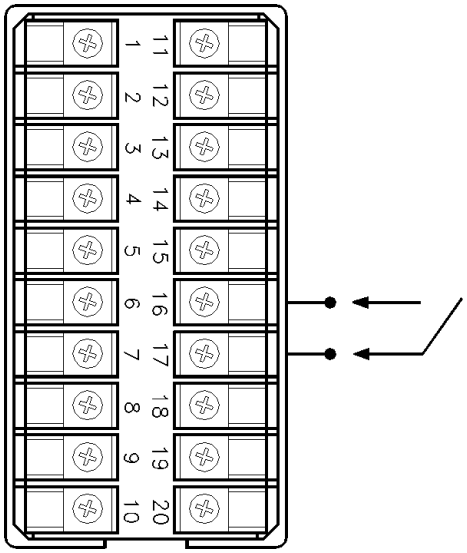
Input signal (Vdc)	Process Set Point
0,0	0°C
2,5	50°C
5,0	100°C

7,5	150°C
10,0	200°C

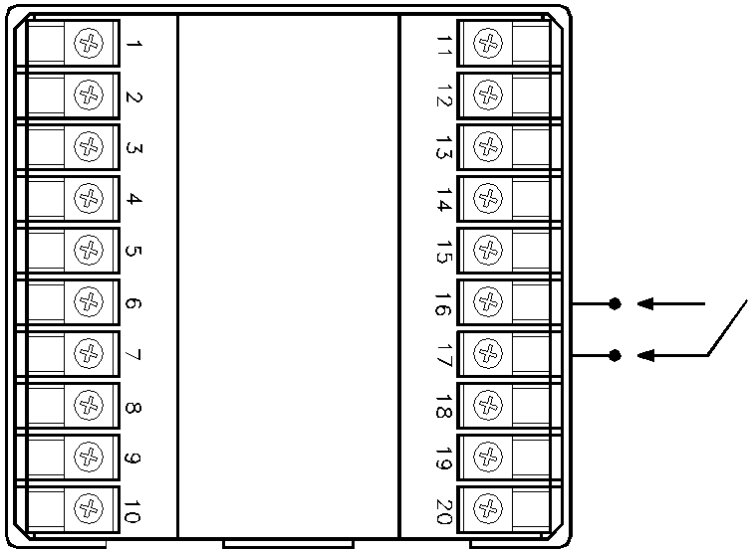
3.9. Digital input (Optional)

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

Model AK49



Model AK96



The function the digital input can perform can be::

Value	Meaning	Description
nonE	Disabled	Digital input has no function
SSP	Secondary setpoint	When digital input is activated the instrument changes the process Set Point it is working with and starts working with the secondary setpoint value
LoCP	Lock	When digital input is activated keyboard is locked according to parameter LEBL
OFF	Off	When digital input is activated control is stopped and power output is deactivated

3.10. Current sensing (Optional)

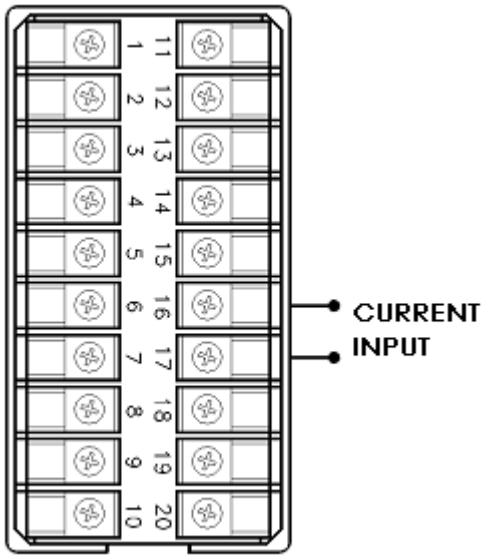
Controllers AK49 and AK96 are able to measure power or current consumption using a torus transformer. Current measure can be activated setting parameter AAP to On. Once done, current measurement parameters will be available.

The torus transformer end of scale can be set to 25A or 50A using parameter SCLA. If the current measured is quite small, then the power wire can be looped many times trough the torus transformer wire. To obtain an accurate measure, set the parameter nUMA to the number of times the wire pass across the transformer.

Akros

To be able to measure current, AK49H needs to supply output pulses of at least 300ms. If output power provides output pulses shorter than this for more time than CYA x (Control Cycle), a 300ms pulse will be forced to allow a valid measure.

The parameter dSP allows to setup which value is shown on display. Values available are AMP(current) and PWR (power). If power is selected, the line voltage can be setup trough parameter LinE.



3.11. Setpoint ramp

Akros series modules can be configured to smoothly ramp setpoint when it is changed or when device is powered up. The ramp should be configured to start at startup setting value rAMP to parameter StFn. Parameter rAMP can be set to onE, to get only a single ramp on startup from measured temperature to setpoint, or to Cont to ramp on any setpoint change. The ramp increase/decrease setpoint value rAtE degrees per minute.

3.12. Cooling(Optional)

Modules wit cooling option installed can use 3 types of control : On/Off, Proportional and PID.

3.12.1 On/Off cooling

On/Off cooling control activates control output when process variable is over (SP + rFSP). To avoid non needed connections and disconnections a hysteresis value can be set on parameter rFHY. For instance, if SP=200 and rFSP = 5, cooling output will be active if temperature is over 205 degrees, and will be inactive if temperature is under 205.

To use this control type set ProP to parameter rFtY and 0.0 to rFPb

3.12.2 Proportional cooling

Proportional cooling is less aggressive than On/Off. This control type uses time modulated output pulses with a cycle of rFCY. It also allows to use a margin over (SP + rFSP) where output power will increase when temperature get further away. rFPb parameter set the input span ratio used as the margin. For example, a value of 5.0% in rFPb while using J thermocouple input (it has 0 a 600º range) corresponds to a margin of 30ºC. So, if SP=200, rFSP = 5 and rFCY=15, cooling output will be:

Temperature	Cooling output active time by cycle	Cooling output inactive time by cycle
<=205ºC	0s	15s
210	2,5s	12,5s
220	7,5s	7,5s
>=235	15s	0s

To use this control type set ProP to parameter rFtY and a value different than 0.0 to rFPb

3.12.3 PID cooling

Cooling PID type uses the same PID algorithm than heating output. In the case variations produced by cooling output are too different than produced by heating output, parameter rFCr can

be set to a value to modulate cooling output. This parameter sets a multiplicator to cooling output. If rFCr is greater than 1.00 cooling output will be amplified. Otherwise it will be attenuated. Setpoint and other control parameters are shared between heating and cooling.

4. TYPES OF CONTROL

4.1. Introduction.

his chapter describes very briefly the different control modes the instruments can be configured with. If primary control action is cooling, value Cool must be set to parameter HEAt

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"

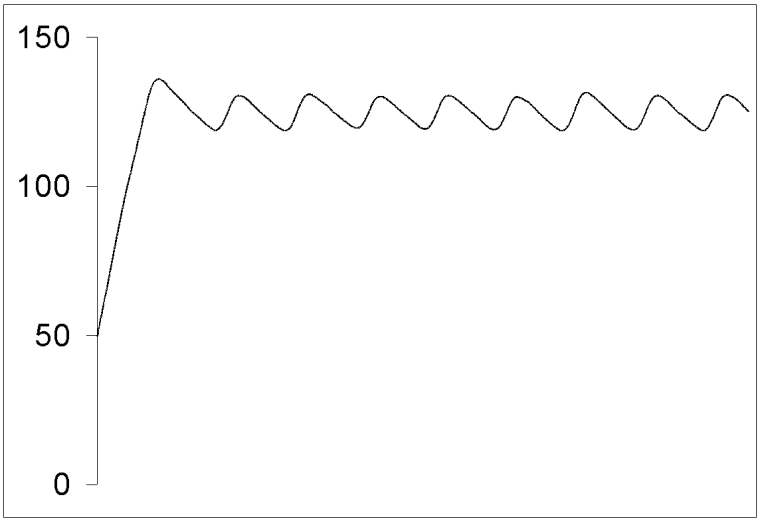
2) *Output modulated by continuous analog output:* In this case, the analog output varies between 0% and 100% of the value of the output signal range. For example, a controller with output 0..10 Vdc will accept the following values:

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 **Ct** 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.

To enable this control mode, set parameter **Pb** to 0.0%. 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 using parameter HY.

4.3. PID Control.

To enable this control mode, set parameter Pb to a value different to 0.0%. and parameter CtrY to Pid. 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.

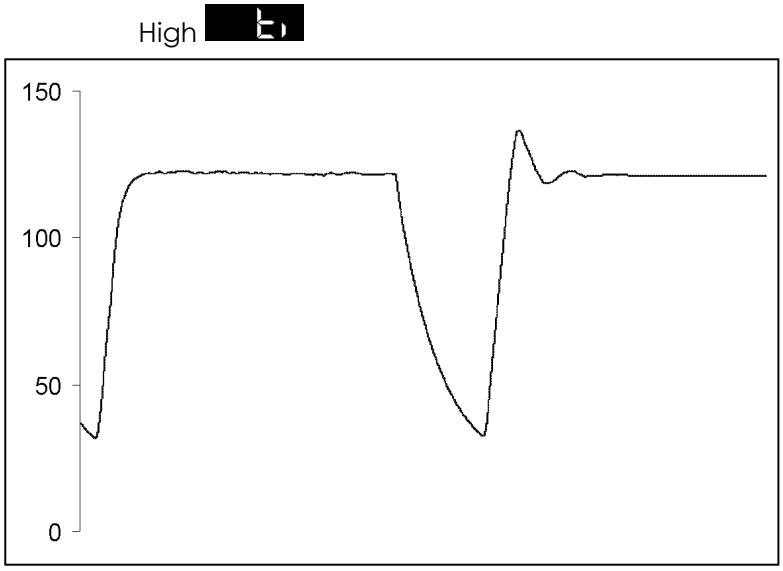
Proportional action: The importance of the proportional action is established with the parameter Pb (Proportional Band). The proportional band is the area around the signal point in which the controller output varies from 100% to 0%.

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.

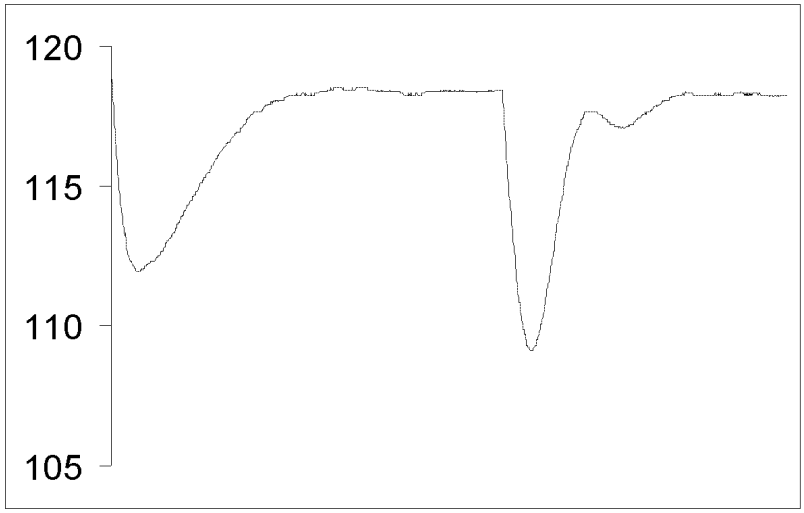


he greater the parameter , the slower the approach of the process to the set point and, therefore, the less the overshoot that will take place.

Derivative action: The importance of the derivative action is established with the parameter (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 ?. The higher the value of , the greater the derivative action and, therefore, the faster the controller reacts to a disturbance.

good too low



IMPORTANT: As a general rule, a proportion should be maintained between the parameter t1 and td so that td takes the value of a quarter of the t1. i.e. td = t1/4 (example: t1=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, t1 and td it is advisable to use the autotuning functions described in point 4.5.

4.4. PI + D control.

To enable this control mode, set parameter Pb to a value different to 0.0%. and parameter CtrL to PI d. The control type PI + D is the same as the PID mode, except that only the parameters Pb and t1 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%).

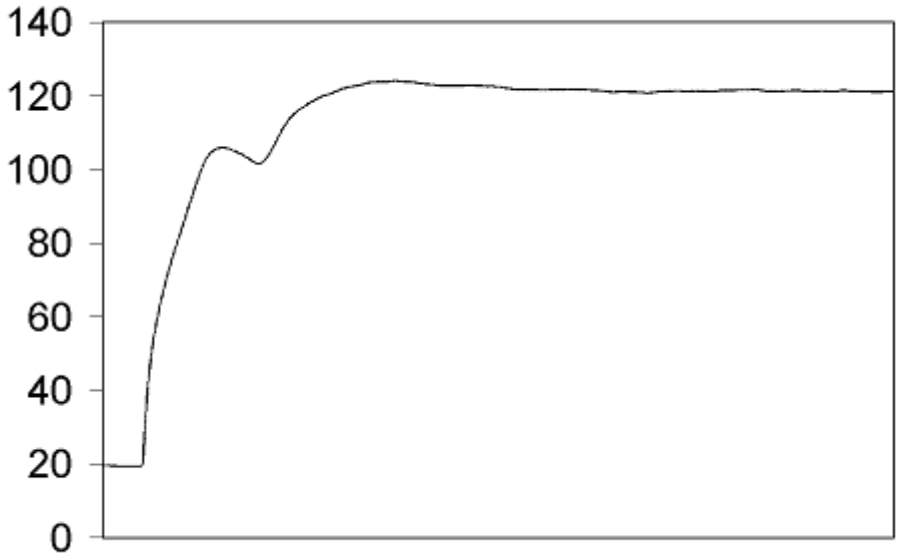
4.5. Autotuning

The used autotuning procedure can be selected setting parameter AtUn

4.5.1. Step Response autotuning.

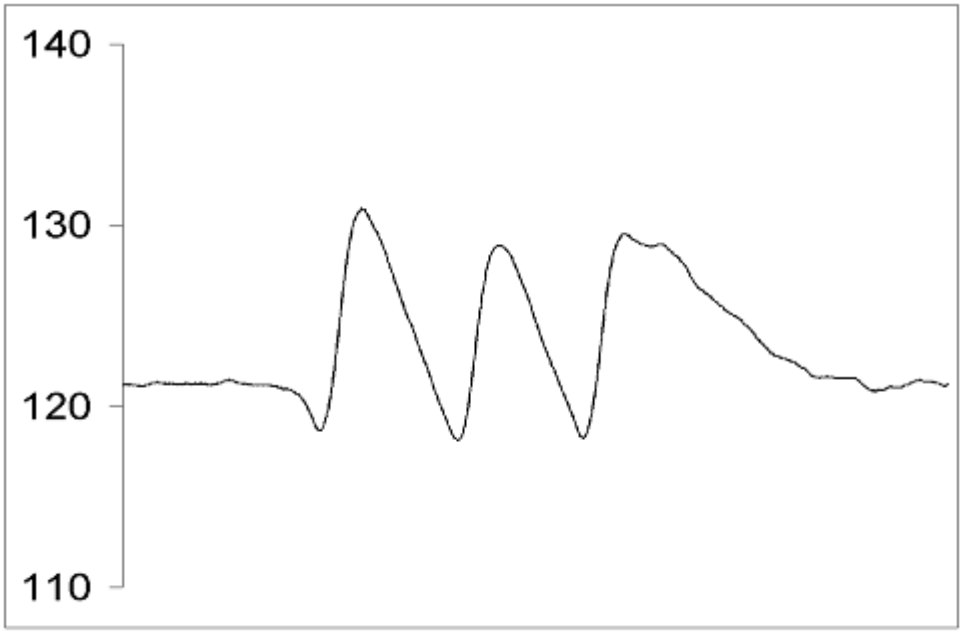
The autotuning process is a very useful function for determining the values of Pb, ti and td which will give the process the greatest stability.

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.



4.5.2. 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.


140
130
120
110

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 5.6 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 complexity, from 1 to 3.

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

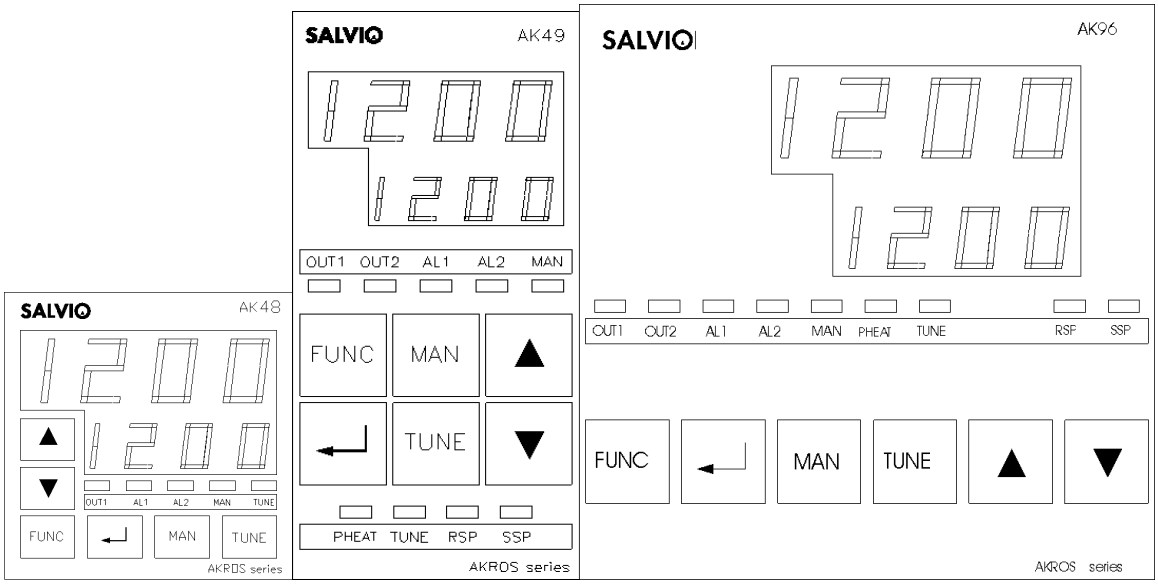
Level 2 At this level, the instrument's configuration parameters not depending on the physical configuration (inputs and outputs) are configured.

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

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

Key	Function
FUNC	unction 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 change value shown in the second display between setpoint, power and current/power measured
▼	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. In normal operation mode, it should be pressed to unlock manual reset alarms
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 ▼ or ▲
TUNE	t 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 AtEn.

5.2. Front panel Description



There are also the following indicator lights:

OUT1 Control or heating 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 power is restablished, controller will start process control using the function configured in parameter StFn (nonE, tunE, MAn, rAMP)

5.5. Description of all the configurable parameters

Symbol	Description	Value	Factory
SP	Process setpoint	From SP.LL To SP.HL	150
Pb	Proportional band	From 0.1% To 100.0%	2,5
t i	Integral time	From 1s To 4000s	320
td	Derivative time	From 1s To 4000s	60
Cy	Heating output cycle	From 1s To 120s	1
HY	On/Off control hysteresis	From 1 To 9999	2
db	Dead band for servomotor output. Output power variations lesser than this value are not applied	From 0 To 20	2
CA1	Alarm 1 configuration	OFF : disabled Hi : Absolute high alarm Lo : Absolute low alarm r.Hi : Relative high alarm r.Lo : Relative low alarm WInd : Window alarm Curr : Window current sensing alarm	OFF
Act1	Alarm 1 actuation direction	dir : Direct alarm rEV : Reverse alarm	dir
SPA1	Alarm 1 absolute setpoint	From SP.LL To SP.HL	155
rA1	Alarm 1 relative setpoint	From -999 To 9999	5
CSP1	Alarm 1 current measured setpoint	Can only be set to the last measured value	0
Cr1	Alarm 1 relative setpoint used in window current sensing alarm	From 0,1 To 50,0	0,5
HyA1	Alarm 1 hysteresis	From 0 To 9999	1

	Alarm 2 configuration	 : : disabled  : Absolute high alarm  : Absolute low alarm  : Relative high alarm : Relative low alarm  : Window alarm : Window current sensing alarm	

Symbol	Description	Value	Factory
	Alarm 2 actuation direction	 : Direct alarm  : Reverse alarm	
	Alarm 2 absolute setpoint	From  To 	155
	Alarm 2 relative setpoint	From -999 To 9999	5
	Alarm 2current measured setpoint	Can only be set to the last measured value	0
	Alarm 2 relative setpoint used in window current sensing alarm	From 0,1 To 50,0	0,5
	Alarm 2 hysteresis	From 0 To 9999	1
	Secondary setpoint	From  To 	100
	Indication deviation from process read value(value internally added to process variable)	From -999 To 9999	0
	Temperature units	 	
	Heating output limit	From 0 To 100	100
	Setpoint low limit	From minimum input value To  -1	0
	Setpoint high limit	From  +1 To maximum input value	600
	Cooling type	 : No cooling  : Proportional or ON/OFF cooling : PID cooling	
	Cooling relative setpoint	From -999 To 9999	10
	Cooling proportional band	From 0.0% (0.0% to set On/Off cooling) To 100.0%	0,0%

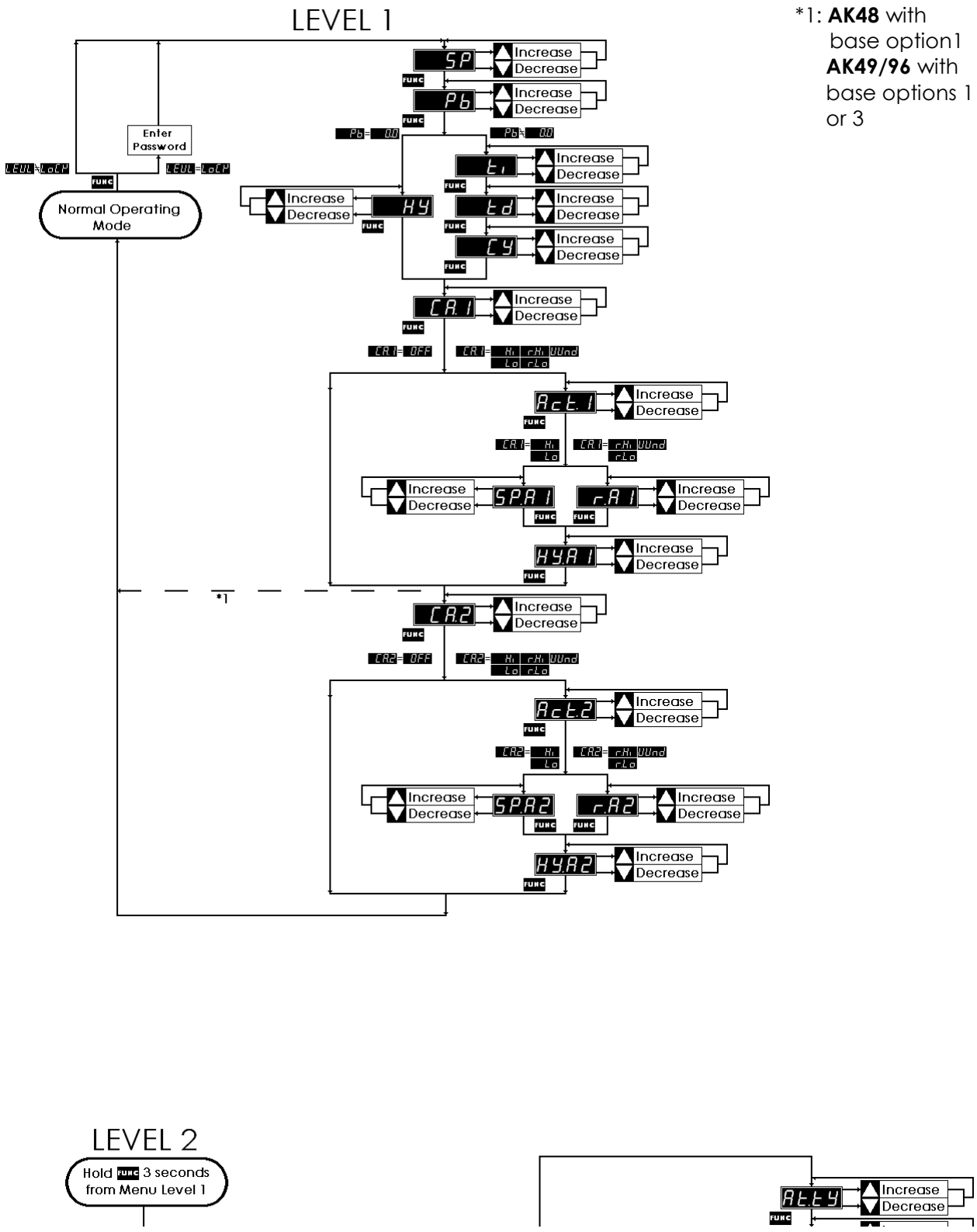
rFHy	cooling hysteresis	From 1 To 9999	1
rFCr	Cooling/heating ratio	From 0,01 To 99,99	1.00
rFCy	cooling output cycle	From 1 To 120	20
rFOL	cooling output limit	From 0 To 100	100%
AtTy	Autotune type	rLAy : Relay feedback StEP : Step response	rLAy

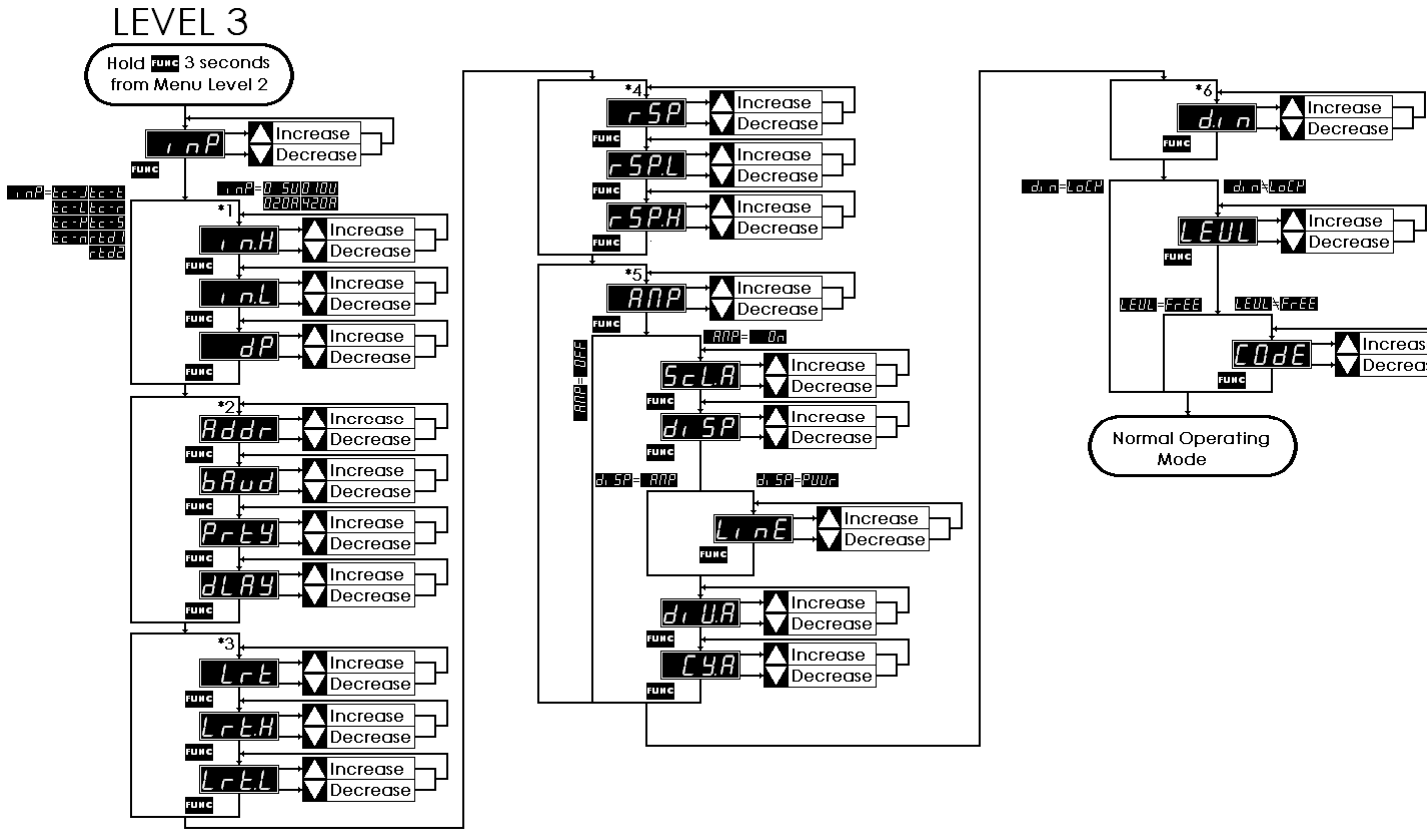
Symbol	Description	Value	Factory
StFn	Start-up function	nOnE : No function tunE :Autotune on startup MAn :Manual mode on startup rAMP :Ramp enabled	nOnE
OutS	Output value to be set on start-up if startup function is set to MAn	From 0 To OutL	100
CtTy	Control type	Pid : control PID Pi d : control PI+D	Pid
rAMP	Ramp type	onE : One shot Cont : On each setpoint change	Cont
rAtE	Degrees/minute used by the ramp function	From 0.1 To 999.9	5.0
HEAt	Primary action	HEAt : Heating Cool : Cooling	HEAt
inP	Input type	tc-J :Thermocouple J tc-L : Thermocouple L tc-P Thermocouple K tc-n : Thermocouple N tc-t : Thermocouple T tc-r : Thermocouple R tc-S : Thermocouple S rtd1 :Pt100 -200 a 600°C rtd2 :Pt100 -99.9 a 200.0°C 0 5U :Linear 0 a 5Vcc 0 10U :Linear 0 a 10Vcc 020A :Linear 0 a 20mA 420A :Linear 4 a 20mA	tc-J
dP	Decimal point shown in display if input type is linear(0 5U ,0 10U ,020A ,420A)	From 0 To 3	0
inL	Low value shown in display if input type is linear (0 5U ,0 10U ,020A ,420A)	From -999 To inH -1	0

	High value shown in display if input type is linear (, , ,)	From  +1 To 9999	500
	Modbus address	From 1 To 255	1
	Modbus baud rate	 : 2400 bps  : 4800 bps : 9600 bps  : 19200 bps	
	Modbus parity	 : No parity  : Even parity : Odd parity	
	Modbus delay	From 0ms To 10ms	5
Symbol	Description	Value	Factory
	Analog output direction	 : Direct retransmission  : Reverse retransmission	
	Analog output low limit	From minimum input value To  -1	0
	Analog output high limit	From  +1 To maximum input value	600
	remote setpoint enabled	 : Enabled : Disabled	
	Remote setpoint low scale limit	From  To  -1	0
	Remote setpoint high scale limit	From  +1 To 	600
	Current measurement enabled	 : Enabled : Disabled	
	Line voltage	From 100 To 265	220
	Current measure scale	 	
	Shown value	:Show current :Show power	
	Current divider	From 1 To 25	1
	Maximum number of output cycles between current measurements	From 0 To 120	30
	Digital input setup	: Disabled : Secondary setpoint : Keyboard lock : Control stop	

LEvL	Keyboard protection level	FrEE : Unlocked SP : Only allowed setpoint SP A : Only allowed setpoint and alarm setpoint LoCP :Locked	FrEE
CodE	Protection keyboard lock code	From 0 To 9999	0

5.6. General menu diagram




LEVEL 3
Hold FUNC 3 seconds from Menu Level 2
inP
Increase
Decrease
FUNC
*1
in.H
in.L
dP
*2
Addr
bAud
Prty
dLAY
*3
Lrt
Lrt.H
Lrt.L
*4
rSP
rSP.L
rSP.H
*5
ANP
ScL.A
diSP
LinE
diU.A
CY.A
*6
di.n
LEUL
CodE
Normal Operating Mode

5.7 Keyboard lock

The keyboard can be locked entering a password to the CodE parameter or trough the digital input. If keyboard lock is configured using digital input code will not be available. Keyboard can be locked. Level of protection is selected with parameter LEVL:

FrEE	Unlocked
SP	Only the Set Point can be modified. Password is required to access the rest of parameters
SP A	Only the Set Point and alarm setpoint can be modified. Password is required to access the rest of parameters
LoCP	It is not possible to see and modify any parameter without password

If keyboard lock is setup using parameter CodE, controller will ask for password. When password is required, message PASS is shown and code can be set digit by digit. To select next digit use key ↵. Once desired code is set press **FUNC**. Next parameter will be shown if code is correct. LoCP message will be shown if password is not correct.

6. TECHNICAL SPECIFICATIONS

Format	AK48	1/16 DIN43700 (48 x 48 mm). Frontally removable
	AK49	1/8 DIN43700 (48 x 96 mm, vertical). Extraíble frontalmente
	AK96	1/4 DIN43700 (96 x 96 mm). Frontally removable
Power supply		85..265 Vca 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 process variable 4 digits of 7 mm
	AK96	4 digits of 13 mm for process variable 4 digits of 10 mm
Inputs		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) Pt100: -200..600°C (IEC751) Pt100: -99,9..200,0°C (IEC751)
Precision		± 0,25% v.f.e
Control output	AK48 AK49 AK96	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.).
	AK49 AK96	The control output for servomotor (two SPDT relays, open/close) excludes cooling output. mA).
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 ON/OFF.
Weight	AK48	140 grs.
	AK49	220 grs.
	AK96	260 grs.

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

Akros series modules can show different error or warning messages.

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

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.

There is no current measurement sample acquired. This message can be shown for instance, while autotune is on because current sensing is suspended in order to don't interfere with the process

8. GUARANTEE AND SERVICE

This instrument is guaranteed against all kinds of manufacturing defect or faults in its component parts for one year as from the date of purchase. This guarantee includes repair or replacement of the faulty parts in our factory, free of charge, unless the fault is caused by mishandling of the equipment or any component of it has been changed.

Instruments requiring service or repair should be sent to your nearest distributor.

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