3231365/1

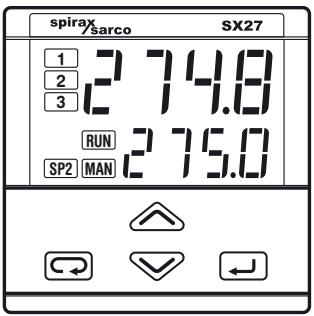
spirax sarco

IM-UK323-01

UK-Issue 1

SX27 Series Process Controller

Installation and Maintenance Instructions



Printed in the UK

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CE

NOTES ON ELECTRIC SAFETY AND ELECTROMAGNETIC COMPATIBILITY.

Please, read carefully these instructions before proceeding with the installation of the controller.
Class II instrument, real panel mounting.

This controller has been designed with compliance to:
Regulations on electrical apparatus (appliance, systems and installations) according to the European Community directive 73/23/EEC amended by the European Comunity directive 93/68/EEC and the Regulations on the essential protection requirements in electrical apparatus EN61010-1 : 93 + A2:95.

Regulations on Electromagnetic Compatibility according to the European Community directive n089/336/EEC, amended by the European Community directive n° 92/31/EEC, 93/68/EEC, 98/13/EEC
and the following regulations:

Regulations on RF emissions	
EN61000-6-3 : 2001	residential environments
EN61000-6-4 : 2001	industrial environments
Regulation on RF immunity	
EN61000-6-2 : 2001	industrial equipment and system

It is important to understand that it's responsibility of the installer to ensure the compliance of the regulations on safety requirements and EMC.
The device has no user serviceable parts and requires special equipment and specialised engineers. Therefore, a repair can be hardly carried on directly by the user. For this purpose, the manufacturer provides technical assistance and the repair service for its Customers.
Please, contact your nearest Agent for further information.
All the information and warnings about safety and electromagnetic compatibility are marked with the ⚠CE sign, at the side of the note.

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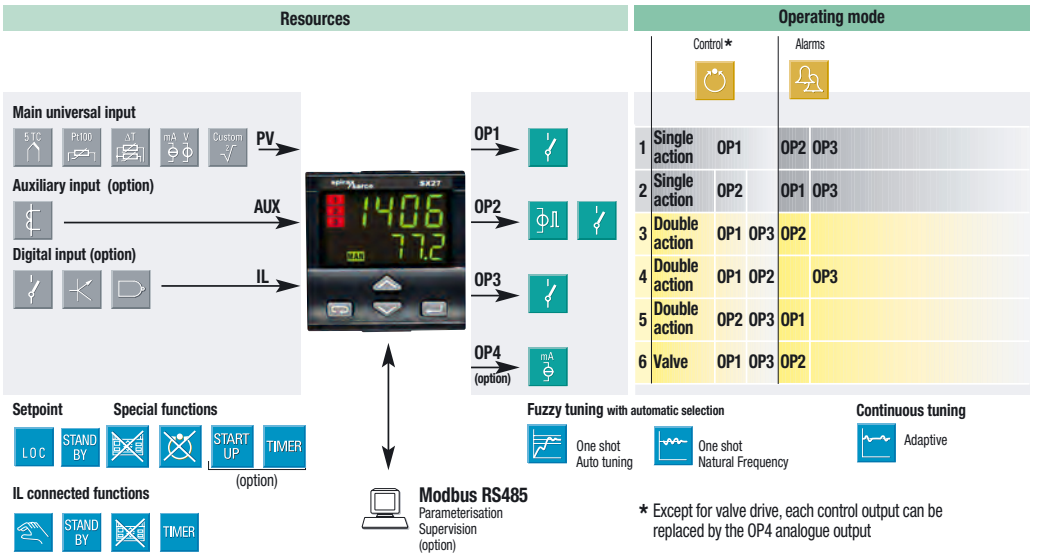


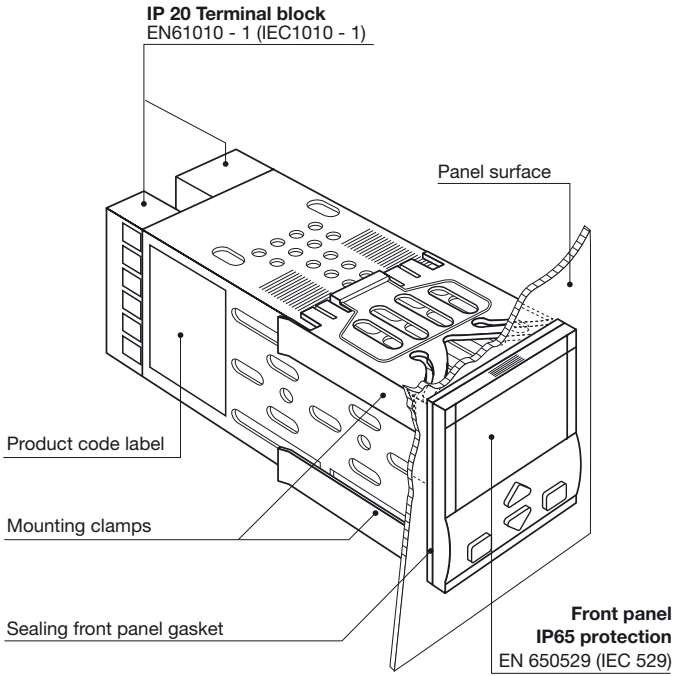
INSTALLATION

1.1 GENERAL DESCRIPTION

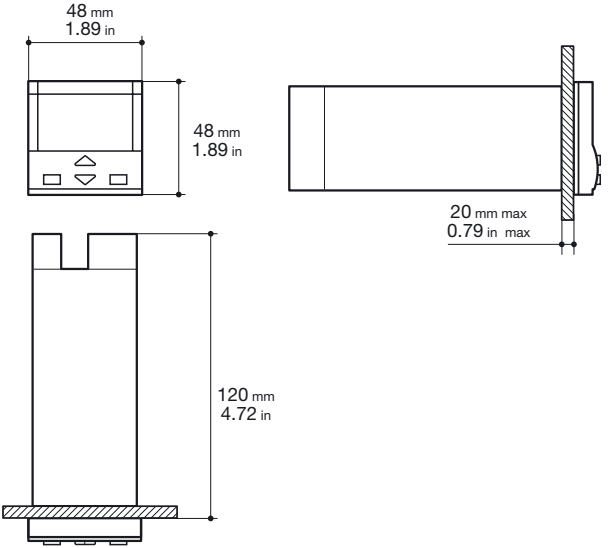
Installation must only be carried out by qualified personnel.

Before proceeding with the installation of this controller, follow the instructions illustrated in this manual and, particularly the installation precautions marked with the ⚠CE symbol, related to the European Community directive on electrical protection and electromagnetic compatibility.

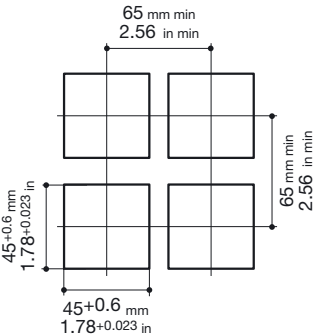
⚠CE
To prevent hands or metal touching parts that may be electrically live, **the controllers must be installed in an enclosure and/or in a cubicle.**



1.2 DIMENSIONAL DETAILS



1.3 PANEL CUT-OUT



1.4 ENVIRONMENTAL RATINGS

Operating conditions	
	Altitude up to 2000 m
	Temperature 0…50°C
%Rh	Relative humidity 5…95 % non-condensing

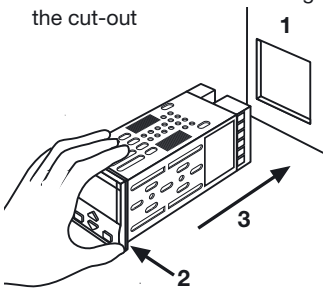
Special conditions		Suggestions
	Altitude > 2000 m	Use 24Vac supply version
	Temperature >50°C	Use forced air ventilation
%Rh	Humidity > 95 %	Warm up
	Conducting atmosphere	Use filter

Forbidden Conditions	
	Corrosive atmosphere
	Explosive atmosphere

1.5 PANEL MOUNTING [1]

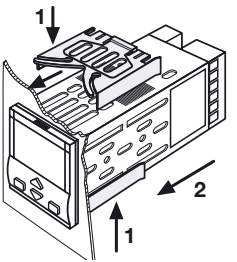
1.5.1 INSERT THE INSTRUMENT

1 Prepare panel cut-out
2 Check front panel gasket position
3 Insert the instrument through the cut-out



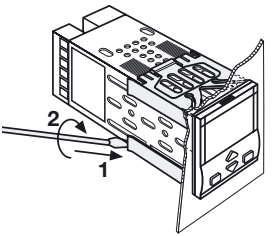
1.5.2 INSTALLATION SECURING

1 Fit the mounting clamps
2 Push the mounting clamps towards the panel surface to secure the instrument



1.5.3 CLAMPS REMOVING

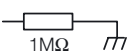
1 Insert the screwdriver in the clips of the clamps
2 Rotate the screwdriver

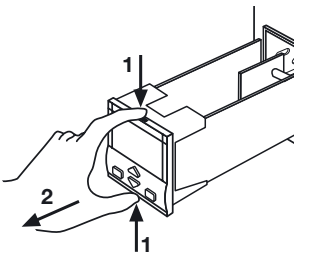


1.5.4 INSTRUMENT UNPLUGGING

1 Push and
2 pull to remove the instrument

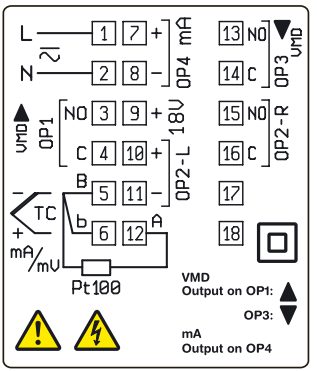
Electrostatic discharges can damage the instrument
Before removing the instrument the operator must discharge himself to ground



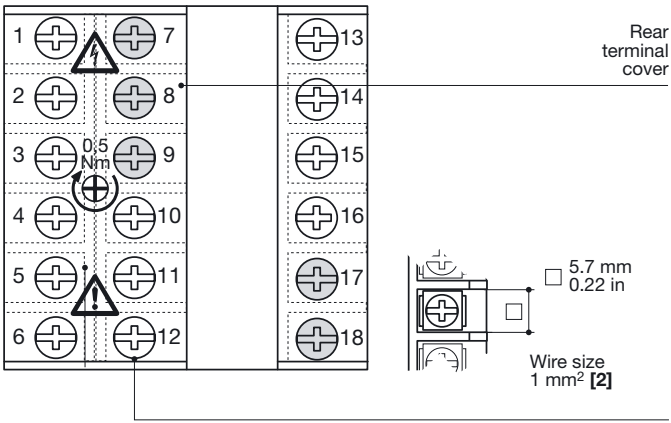


UL note
[1] For Use on a Flat Surface of a Type 2 and Type 3 'raintight' Enclosure.

2 ELECTRICAL CONNECTIONS



2.1 TERMINAL BLOCK [1]



	18 M3 screw terminals
	Option terminals
	Tightening torque 0.5 Nm
	Phillips screw driver PH1
	Flat blade screw driver 0.8 x 4 mm

Terminals

	Pin connector Ø 1.4 mm 0.055 in max.
Ø	Fork-shape AMP 165004 Ø 5.5 mm - 0.21 in
L	Stripped wire L 5.5 mm - 0.21 in

UL note

[1] Use 60/70 °C copper (Cu) conductors only.

[2] Wire size 1 mm² (18 AWG Solid/Stranded)

PRECAUTIONS

Despite the fact that the instrument has been designed to work in an harsh and noisy environmental (level IV of the industrial standard IEC 801-4), it is recommended to follow the following suggestions.

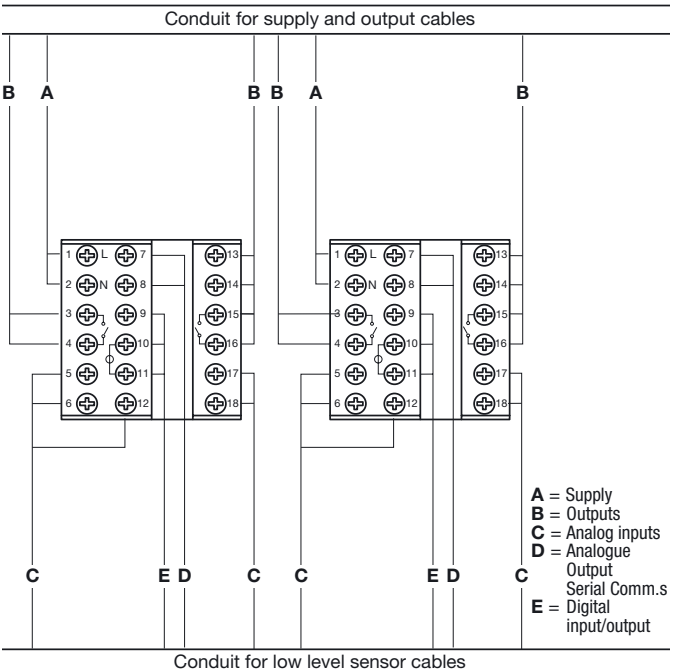
⚠

All the wiring must comply with the local regulations.

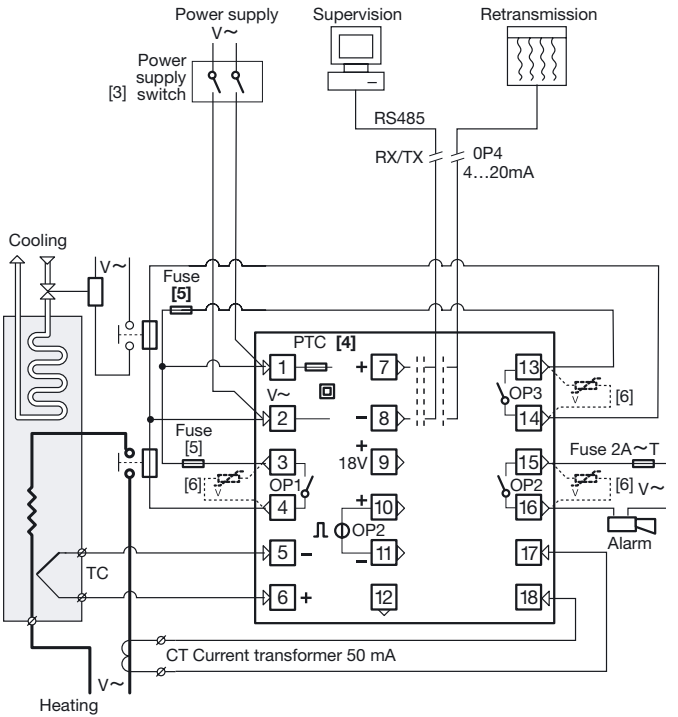
The supply wiring should be routed away from the power cables.
Avoid to use electromagnetic contactors, power Relays and high power motors nearby.
Avoid power units nearby, especially if controlled in phase angle

Keep the low level sensor input wires away from the power lines and the output cables.
If this is not achievable, use shielded cables on the sensor input, with the shield connected to earth.

2.2 SUGGESTED WIRE ROUTING



2.3 EXAMPLE OF WIRING DIAGRAM (HEAT COOL CONTROL)



Notes:

1] Make sure that the power supply voltage is the same indicated on the instrument.

2] Switch on the power supply only after that all the electrical connections have been completed.

3] In accordance with the safety regulations, the power supply switch shall bring the identification of the relevant instrument. The power supply switch shall be easily accessible from the operator.

4] The instrument is is PTC protected. In case of failure it is suggested to return the instrument to the manufacturer for repair.

5] To protect the instrument internal circuits use:
- 2AT fuse for 220Vac relay outputs;
- 4 AT fuse for 110vac relay outputs;

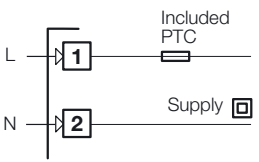
6] Relay contacts are already protected with varistors.

Only in case of 24 Vac inductive loads, use model A51-065-30D7 varistors (on request)

2.3.1 POWER SUPPLY

Switching power supply with multiple isolation and internal PTC

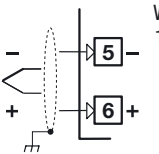
- Standard version:
  nominal voltage:
  100...240Vac (-15...+10%)
  Frequency 50/60Hz
- Low Voltage version:
  Nominal voltage:
  24Vac (-25...+12%)
  Frequency 50/60Hz or
  24Vdc (-15...+25%)
- Power consumption 1.6W max.



2.3.2 PV CONTROL INPUT

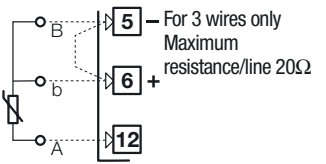
A For L-J-K-S-T thermocouple type

- Connect the wires with the polarity as shown
- Use always compensation cable of the correct type for the thermocouple used
- The shield, if present, must be connected to a proper earth.



B For Pt100 resistance thermometer

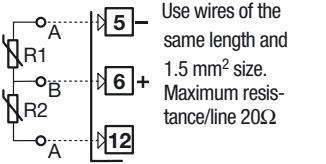
- If a 3 wires system is used, use always cables of the same diameter (1mm² min.) (line 20 Ω/lead maximum resistance)
- When using a 2 wires system, use always cables of the same diameter (1.5mm² min.) and put a jumper between terminals 5 and 6



C For ΔT (2x RTD Pt100) Special

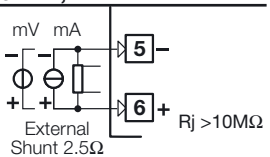
⚠ When the distance between the controller and the sensor is 15 m. using a cable of 1.5 mm² diameter, produces an error on the measure of 1°C (1°F).

R1 + R2 must be <320Ω

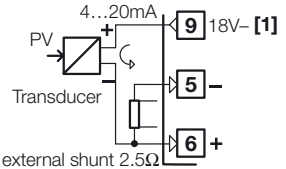


2.3.2 PV CONTROL INPUT

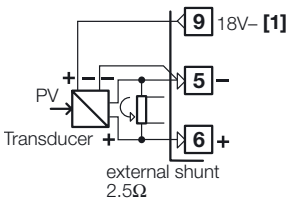
D For mA, mV



D1 With 2 wires transducer



D2 With 3 wires transducer



[1] Auxiliary power supply for external transmitter 18Vdc ±20% /30mA max. without short circuit protection

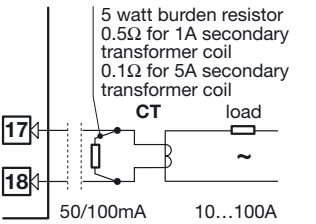
2.3.3 AUXILIARY INPUT

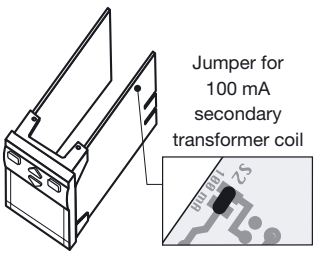
(option)

For current transformer CT
Not isolated

For the measure of the load current (see page 34)

- Primary coil 10A…100A
- Secondary coil 50mA default 100mA jumper selectable

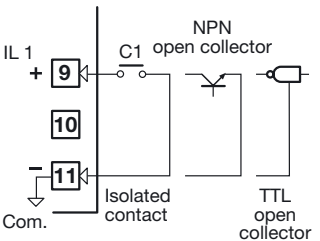




2.3.4 DIGITAL INPUT

(option) (page 37)

- The input is active when the logic state is ON, corresponding to the contact closed
- The input is inactive when the logic state is OFF, corresponding to the contact open



2.3.5 OP1 - OP2 - OP3 OUTPUTS

The functionality associated to each of the OP1, OP2 and OP3 input is defined during the configuration of the instrument index **L** (see page 18).
The suggested combinations are:

	Control outputs [1]			Alarms	
				AL2	AL3
A	Single action	OP1 Heat		OP2-R	OP3
B	Single action	OP2-L Heat		OP1	OP3
C	Double action	OP1 Heat	OP3 Cool	OP2-R **[2]**	
D	Double action	OP1 Heat	OP2-L Cool		OP3 **[2]**
E	Double action	OP2-L Heat	OP3 Cool	OP1 **[2]**	
F	Valve drive	OP1 Open	OP3 Close	OP2-R **[2]**	

OP1 - OP3	Relay output
OP2 - L	Logic output
OP2 - R	Relay output

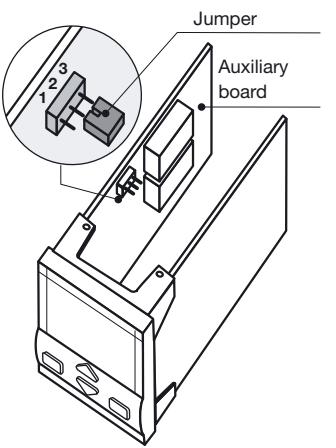
Notes

[1] Except for valve drive, each control output can be replaced by the OP4 analogue output. The replaced output is no more available.

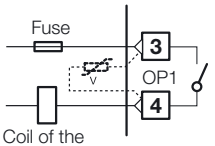
[2] With heat/cool control and with valve drive control AL2 and AL3 share in or mode the same output (the free one).

OP2 output can be Relay (Std) or logic.
The "jumper" on the auxiliary board selects the output type:

Link Pins 1-2 for OP2-Relay
Link Pins 2-3 for OP2-Logic

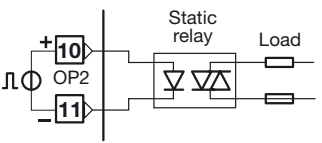


2.3.5-A SINGLE ACTION RELAY CONTROL OUTPUT



Varistor for inductive load 24Vac only

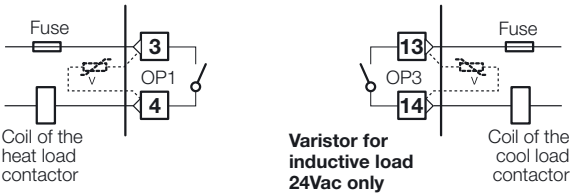
2.3.5-B SINGLE ACTION LOGIC CONTROL OUTPUT



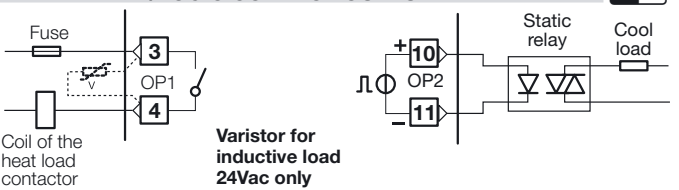
Relay output
- SPST Relay N.O., 2A/250Vac for resistive load, fuse 2AT

Logic output not isolated
- 0…5Vdc, ±20%, 30 mA max.

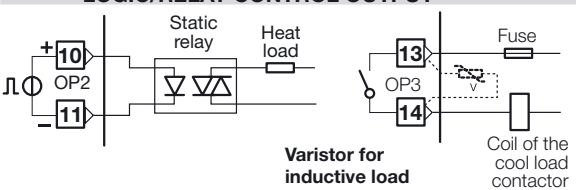
2.3.5-C DOUBLE ACTION RELAY/RELAY CONTROL OUTPUT



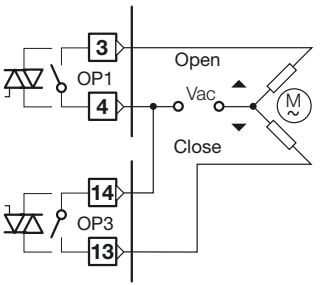
2.3.5-D DOUBLE ACTION RELAY/LOGIC CONTROL OUTPUT



2.3.5-E DOUBLE ACTION LOGIC/RELAY CONTROL OUTPUT



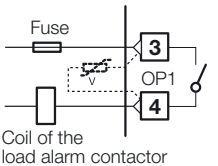
2.3.5.F VALVE DRIVE RELAY/ RELAY CONTROL OUTPUT

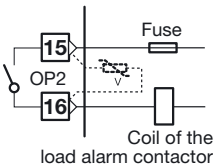


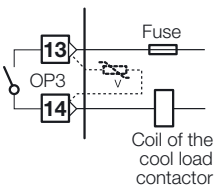
Valve drive P.I.D. without potentiometer (open, close, stop)

2.3.6 ALARMS OUTPUTS

⚠ **The outputs OP1, OP2 and OP3, can be used as alarm outputs only if they are not configured as control outputs.**



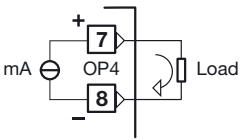




Varistor for inductive load 24Vac only

2.3.7 OP4 ANALOGUE CONTROL OUTPUT (option)

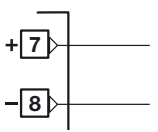
- Galvanic isolation 500Vac/1 min
- 0/4…20mA, (750Ω or 15Vdc max.)



2.3.8 SERIAL COMMUNICATIONS (option)

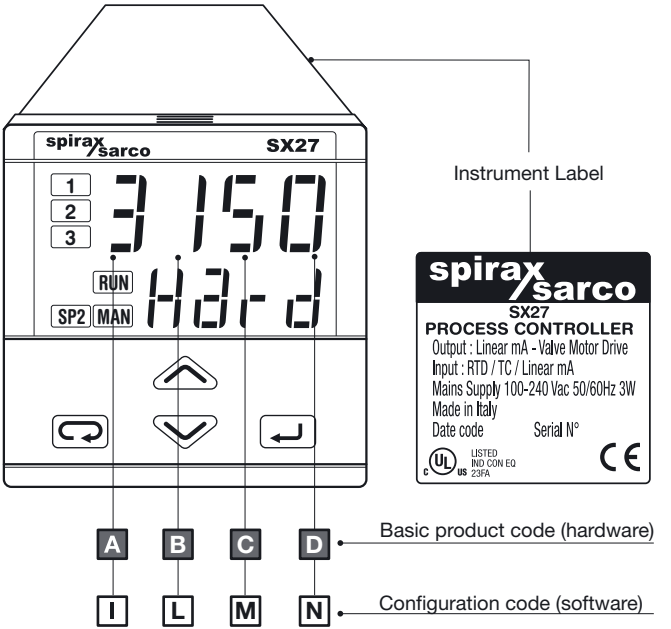
- Galvanic isolation 500Vac/1 min
- Compliance to the EIA RS485 standard for Modbus/Jbus

⚠ Please, read the user Manual: "Serial communication and configuration software".



3 PRODUCT CODING

The complete code is shown on the instrument label. The informations about product coding are accessible from the front panel by mean of a particular procedure described at section 4.2.2 page 21



3.1 MODEL CODE

The product code indicates the specific hardware configuration of the instrument, that can be modified, by specialized engineers only.

	Basic					Accessories					Configur.			
Model:	**A**	**B**	**C**	**D**	-	**E**	**0**	**0**	**0**	/	**I**	**L**	**M**	**N**

Power supply	**A**
100...240Vac (-15...+10%)	**3**
24Vac (-25...+12%) or 24Vdc (-15...+25%)	**5**

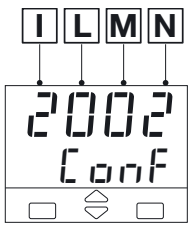
OP1 - OP3 Outputs	**B**
Relay - Relay	**1**

Serial Communications	**Options**	**C**	**D**
Not fitted	None	**0**	**0**
	Valve drive control output	**0**	**1**
	Current transformer input (CT)	**0**	**3**
	Transmitter Power Supply (P.S.)	**0**	**6**
	Transmitter P.S. + Cont. control output	**0**	**7**
	Transmitter P.S. + CT	**0**	**8**
	Transmitter P.S. + Cont. control + CT	**0**	**9**
RS485 Modbus/Jbus protocol	None	**5**	**0**
	Valve drive control output	**5**	**1**
	Transmitter Power Supply	**5**	**6**
	Transmitter P.S. + CT	**5**	**8**
Digital input	None	**9**	**0**
	Valve drive control output	**9**	**1**
	CT	**9**	**3**
	Analogue control output	**9**	**7**
	Analogue control output + CT	**9**	**9**

Special functions	**E**
Not fitted	**0**
Start up + Timer	**2**

3.2 CONFIGURATION CODING

The configuration code consists of 4 digits that identify the operating characteristic of the controller, as chosen by the user.
Section 4.6 at page 35 reports the instructions how to set a new configuration code.



The configuration code can be displayed on the front panel, following the instructions at page 21 section 4.2.2.

Input type and range			**I**
TR Pt100 IEC751	-99.9…300.0 °C	-99.9…572.0 °F	**0**
TR Pt100 IEC751	-200…600 °C	-328…1112 °F	**1**
TC L Fe-Const DIN43710	0…600 °C	32…1112 °F	**2**
TC J Fe-Cu45% Ni IEC584	0…600 °C	32…1112 °F	**3**
TC T Cu-CuNi	-200 …400 °C	-328…752 °F	**4**
TC K Chromel -Alumel IEC584	0…1200 °C	32…2192 °F	**5**
TC S Pt10%Rh-Pt IEC584	0…1600 °C	32…2912 °F	**6**
DC input 0…50 mV, linear	Engineering units		**7**
DC input 10…50 mV, linear	Engineering units		**8**
Custom input and range **[1]**			**9**

[1] For instance, other thermocouples types, ΔT (with 2 PT 100), custom linearisation etc.

Control mode	**Output configuration [2]**	**L**
PID	Control OP1 / alarm AL2 on OP2	**0**
	Control OP2 / alarm AL2 on OP1	**1**
On - Off	Control OP1 / alarm AL2 on OP2	**2**
	Control OP2 / alarm AL2 on OP1	**3**
Heat/Cool action	Control OP1- OP3 / alarm AL2 on OP2	**6**
	Control OP1- OP2 / alarm AL2 on OP3	**7**
	Control OP2- OP3 / alarm AL2 on OP1	**8**
P.I.D. valve drive	Control OP1-OP3/alarm AL2 on OP2	**9**

[2] Each control output can be replaced by the OP4 analogue output. The replaced output is not more available (see page 34).

Control action type		**M**
Reverse (single action)	Linear Cool (Heat/Cool double action)	**0**
Direct (single action)	On-Off Cool (Heat/Cool double action)	**1**

⚠

If, when the controller is powered up for the first time, the display shows the following message

it means that the controller has not been configured yet.

The controller remain in stand-by until the configuration code is set correctly (see chapter 4.6 page 35).

Alarm 2 type and function		**N**
Not active		**0**
Sensor break alarm / Loop Break Alarm		**1**
Absolute	active high	**2**
	active low	**3**
Deviation	active high	**4**
	active low	**5**
Band	active out	**6**
	active in	**7**
Heater break by CT **[3]**	active during ON output state	**8**
	active during OFF output state	**9**

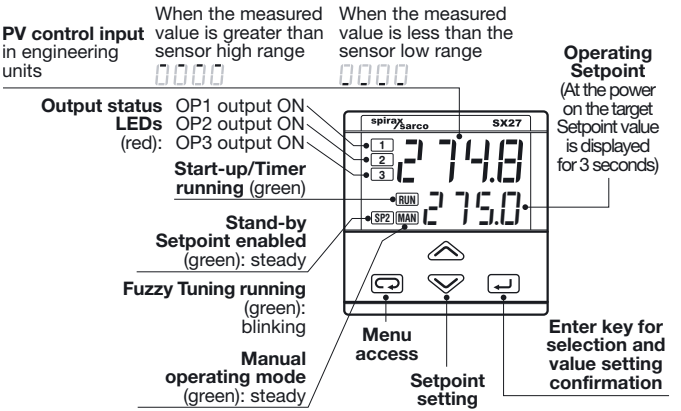
Alarm 3 type and function		**O**
Disabled or used by Timer		**0**
Sensor break alarm / Loop Break Alarm		**1**
Absolute	active high	**2**
	active low	**3**
Deviation	active high	**4**
	active low	**5**
Band	active out	**6**
	active in	**7**
Heater break by CT **[3]**	active during ON output state	**8**
	active during OFF output state	**9**

For alarm 3 type and function see page 34

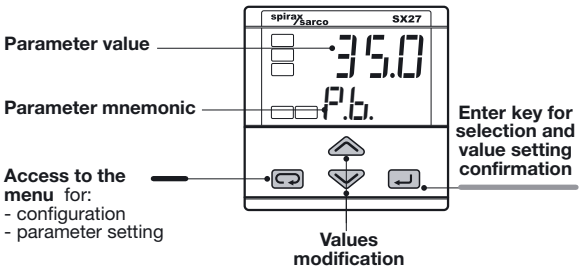
Note
[3] Only with CT options.

4 OPERATIONS

4.1.A KEYS FUNCTIONS AND DISPLAY IN OPERATOR MODE



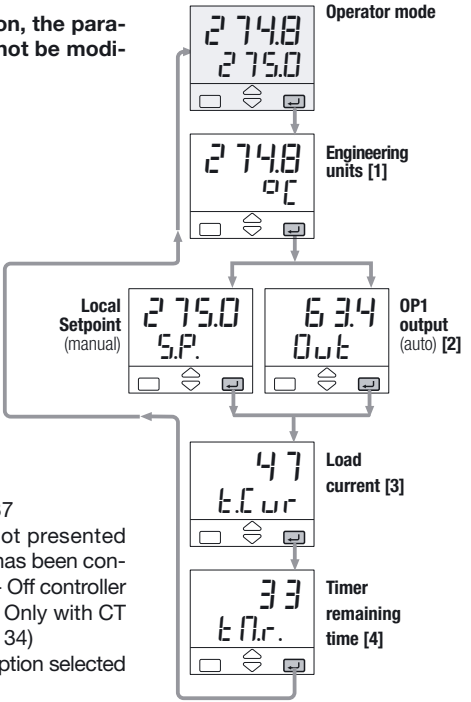
4.1.B KEYS FUNCTIONS AND DISPLAY IN PROGRAMMING MODE



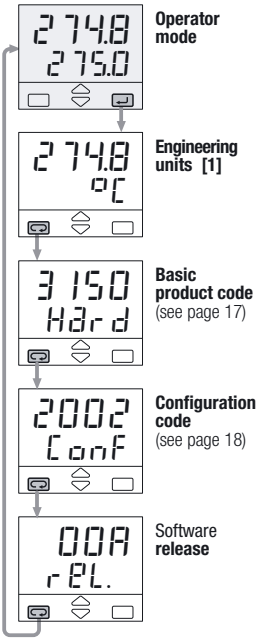
4.2 DISPLAY

During the operation, the parameters values cannot be modified by the user

4.2.1 OF THE PROCESS VARIABLES



4.2.2 OF THE CONFIGURATION CODES



Note

[1] See table page 37

[2] This display is not presented if the instrument has been configured as an On - Off controller

[3] Value in Ampere. Only with CT option (see page 34)

[4] Only with Timer option selected (see page 42)

4.3 PARAMETER SETTING

4.3.1 NUMERIC ENTRY

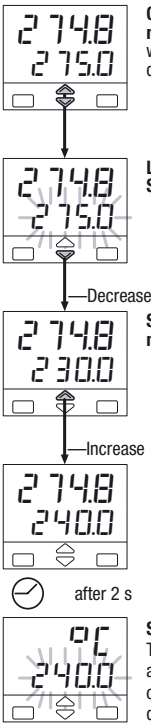
(i.e. the modification of the Setpoint value from 275.0 to 240.0)

Press ⌃ or ⌄ momentarily to change the value of 1 unit every push.

Continued pressing of ⌃ or ⌄ changes the value, at rate that doubles every second. Releasing the button the rate of change decreases.

In any case the change of the value stops when it has reached the max./min. limit set for the parameter.

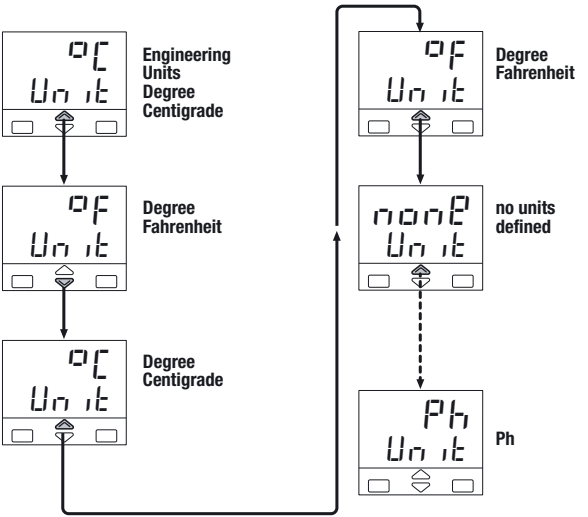
In case of Setpoint modification: press ⌃ or ⌄ once to display the local Setpoint instead of working Setpoint.
To evidence this change the display flashes once. Then the Setpoint can be modified



4.3.2 MNEMONIC CODES SETTING

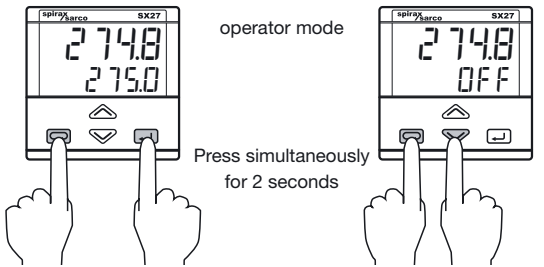
(e.g. configuration see page 35)

Press the ⌃ or ⌄ to display the next or previous mnemonic for the selected parameter.
Continued pressing of ⌃ or ⌄ will display further mnemonics at a rate of one mnemonic every 0.5 s. The mnemonic displayed at the time the next parameter is selected, is the one stored in the parameter.



4.3.3 KEYPAD LOCK

To lock/unlock the keypad press the keys [↵] and [↵] simultaneously for 2 seconds.
To confirm the keypad lock/unlock the display flashes once.



The keypad lock/unlock can be achieved by serial communications too.

⚠ The keypad lock is maintained in case of power failure.

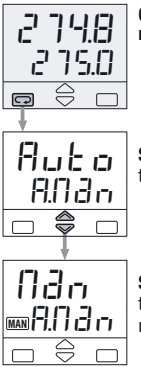
4.3.4 OUTPUTS LOCK

The outputs are switched to the OFF status by pressing the keys [↵] and [▽] together.
When the outputs are locked, the message [OFF] is displayed instead of the Setpoint value.
To unlock the outputs press again the keys simultaneously
(the Soft-start will be enabled).

The outputs lock/unlock can be achieved by serial communications too

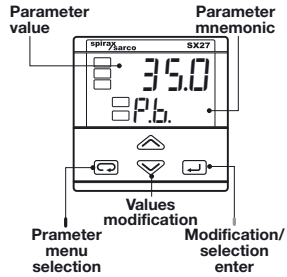
⚠ The outputs lock/unlock is maintained in case of power failure.

4.3.5 AUTO / MAN



- Press [↵] to confirm. Back to operator mode.
- The [MAN] led shows the manual mode status.
- When manual mode is active, the Setpoint display shows the output value, that can be modified by [△] [▽]

4.4 PARAMETERISATION

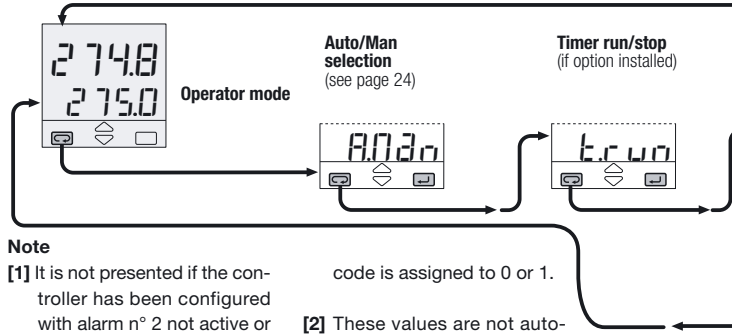


⚠

The parameter setting procedure has a timeout. If no keys are pressed for, at least, 30 seconds, the controller switches back, automatically, to the operator mode.

After having selected the parameter or the code, press ⌃ and ⌄ to display or modify the value (see page 22) The value is entered when the next parameter is selected, by pressing the ↵ key.

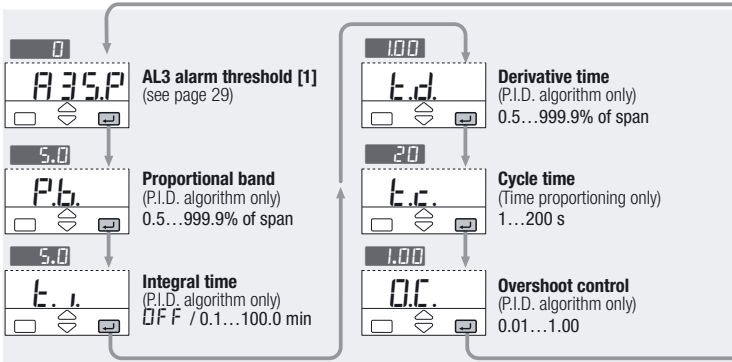
Pressing the ⟲ key, the next group of parameters is presented on the display.



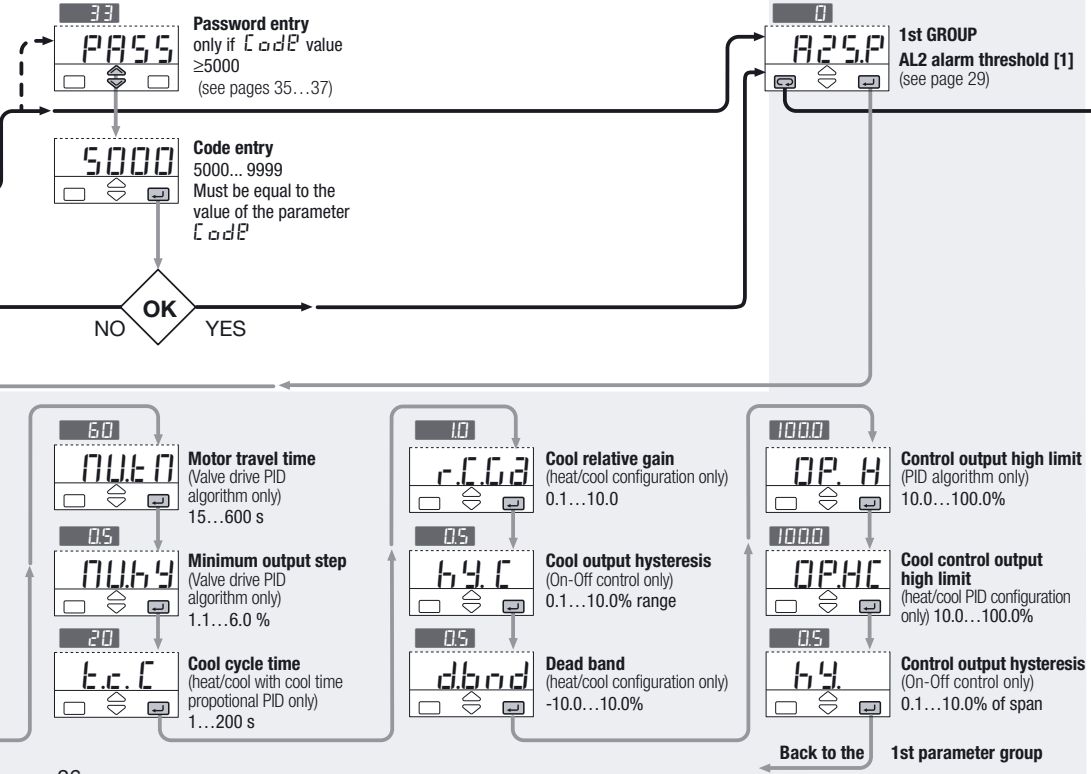
Note

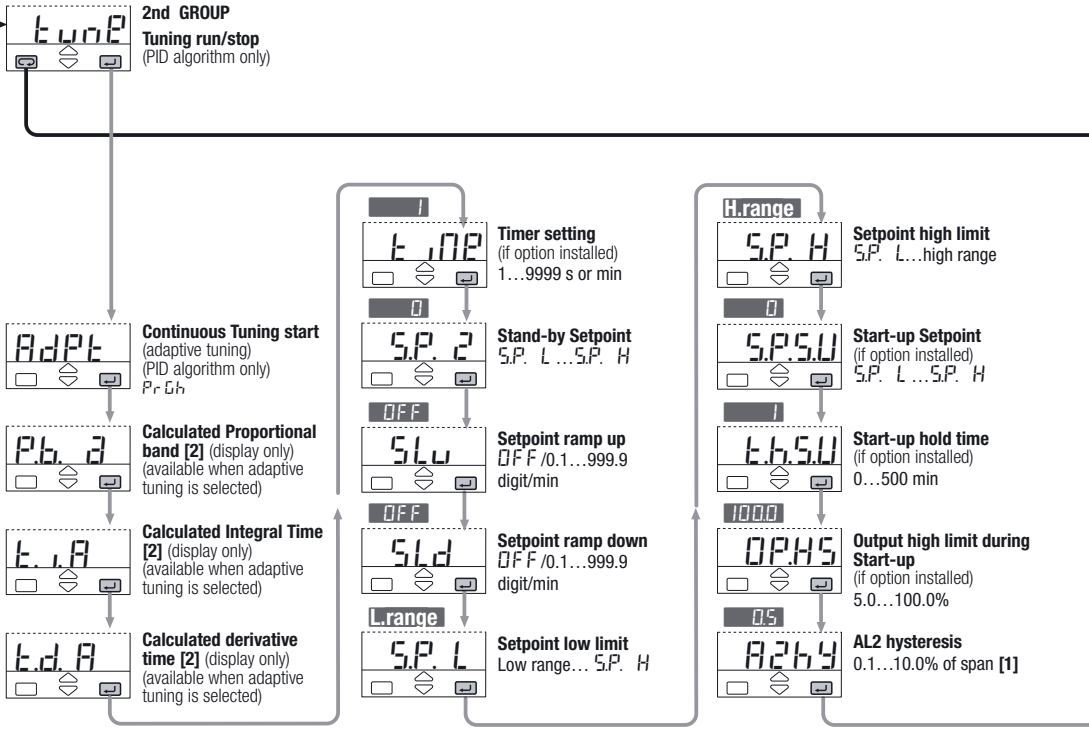
[1] It is not presented if the controller has been configured with alarm n° 2 not active or of sensor break type. Digit N/M of the configuration code is assigned to 0 or 1.

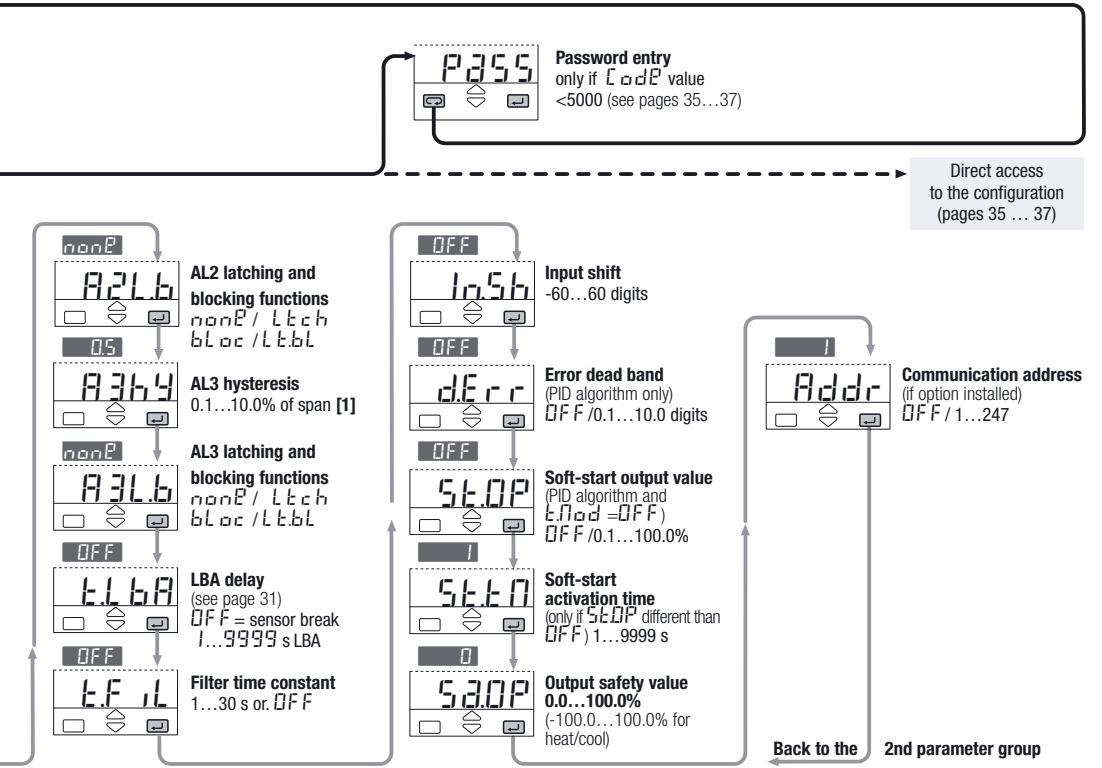
[2] These values are not automatically stored on the P.I.D. menu parameters P.b., t.i, t.d.



PARAMETER MENU




tunE
2nd GROUP
Tuning run/stop
(PID algorithm only)
AdPt
Continuous Tuning start
(adaptive tuning)
(PID algorithm only)
PrGk
Pb. a
Calculated Proportional band [2] (display only) (available when adaptive tuning is selected)
t. iA
Calculated Integral Time [2] (display only) (available when adaptive tuning is selected)
t.d. A
Calculated derivative time [2] (display only) (available when adaptive tuning is selected)
1
t. inE
Timer setting
(if option installed)
1…9999 s or min
0
S.P. 2
Stand-by Setpoint
S.P. L …S.P. H
OFF
SLu
Setpoint ramp up
OFF /0.1…999.9
digit/min
OFF
SLd
Setpoint ramp down
OFF /0.1…999.9
digit/min
L.range
S.P. L
Setpoint low limit
Low range… S.P. H
H.range
S.P. H
Setpoint high limit
S.P. L…high range
0
S.P.S.U
Start-up Setpoint
(if option installed)
S.P. L …S.P. H
1
t.h.S.U
Start-up hold time
(if option installed)
0…500 min
1000
OPHS
Output high limit during Start-up
(if option installed)
5.0…100.0%
0.5
A2hy
AL2 hysteresis
0.1…10.0% of span [1]


PASS
Password entry
only if CodP value
<5000 (see pages 35…37)
Direct access
to the configuration
(pages 35 … 37)
nonE
AL2L.b
AL2 latching and
blocking functions
nonE / Ltch
bLoc / LtbL
0.5
A3hy
AL3 hysteresis
0.1…10.0% of span [1]
nonE
A3L.b
AL3 latching and
blocking functions
nonE / Ltch
bLoc / LtbL
OFF
t.LbA
LBA delay
(see page 31)
OFF = sensor break
1…9999 s LBA
OFF
t.F iL
Filter time constant
1…30 s or. OFF
OFF
InSh
Input shift
-60…60 digits
OFF
d.Err
Error dead band
(PID algorithm only)
OFF /0.1…10.0 digits
OFF
St.OP
Soft-start output value
(PID algorithm and
t.Mod =OFF)
OFF /0.1…100.0%
1
St.tM
Soft-start
activation time
(only if St.OP different than
OFF) 1…9999 s
0
SA.OP
Output safety value
0.0…100.0%
(-100.0…100.0% for
heat/cool)
1
Addr
Communication address
(if option installed)
OFF / 1…247
Back to the
2nd parameter group

4.5 PARAMETERS

FIRST GROUP

The controller parameters have been organised in group, according to their functionality area.

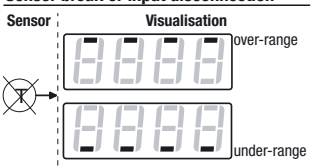
AL2 alarm threshold

AL3 alarm threshold

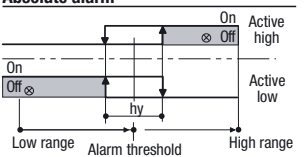
The alarm occurrences handle the OP1, OP2 and OP3 outputs, in different ways, according to the configured types of alarms, as illustrated.

With double action control output, AL2 and AL3 share in or mode the same output (the free one) (see table on page 13).

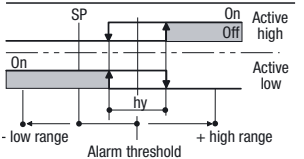
Sensor break or input disconnection



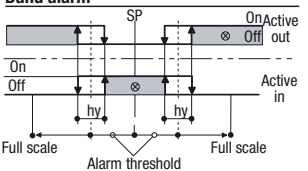
Absolute alarm



Deviation alarm



Band alarm



Proportional band

This parameter specifies the proportional band coefficient that multiplies the error (SP - PV)

Integral time

It is the integral time value, that specifies the time required by the integral term to generate an output equivalent to the proportional term. When OFF the integral term is not included in the control algorithm.

Derivative time

It is the time required by the proportional term P to repeat the output provided by the derivative term D. When OFF the derivative term is not included in the control algorithm.

Control output cycle time

Cycle time cool

It's the cycle time of the logic control output. The P.I.D. time proportional control output is provided through the pulse width modulation of the digital waveform.

Overshoot control

(Automatically disabled when the adaptive tuning is running).
This parameter specifies the span of

action of the overshoot control. Setting lower values (0.99 –> 0.01) the overshoot generated by a Setpoint change is reduced. The overshoot control doesn't affect the effectiveness of the P.I.D. algorithm. Setting 1, the overshoot control is disabled.

d.bnd **Heat/Cool dead band**

This parameter specifies the width of the deadband between the Cool and the Heat channel.

MOT.T **Motor travel time**

It provides the time required to the motor positioner to go from the 0% position to 100%

MO.hy **Minimum output step**

It specifies the minimum allowed time of activation of the output to a motor positioner that produces a sensible effect. It is related to the deadband of the positioner.

OP. H **Control output high limit**

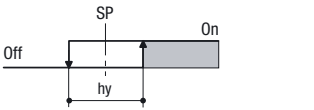
OP.HC **Cool output high limit**

It specifies the maximum value the control output can be set

hy. **Control output hysteresis**

hy. C **Cool output hysteresis**

Hysteresis of the threshold



Control or alarm output hysteresis span, set in % of the full scale.

SECOND GROUP

SP. 2 **Stand-by Setpoint**

Used by Timer function too.

SL. U **Setpoint ramp up**

SL. d **Setpoint ramp down**

This parameter specifies the maximum rate of change of the Setpoint in digit/min. When the parameter is OFF, this function is disabled.

A2hy **AL2 alarm hysteresis**

A3hy **AL3 alarm hysteresis**

Hysteresis of the threshold of both the alarms, that activate OP1 and OP2 control output. It is specified as a % of the full scale.

SP. L **Setpoint low limit**

SP. H **Setpoint high limit**

Low / high limit of the Setpoint value.

A2L.b **AL2, AL3 latching and blocking functions**

A3L.b

For each alarm it is possible to select the following functions

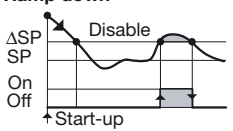
- none
- Ltch latching
- bLoc blocking
- Lt.bL both latching and blocking

LtcH ALARM ACKNOWLEDGE FUNCTION

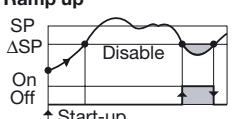
The alarm, once occurred, is presented on the display until to the time of acknowledge.
The acknowledge operation consists in pressing any key.
After this operation, the alarm leaves the alarm state only when the alarm condition is no longer present.

bLoc START-UP DISABLING

Ramp down



Ramp up



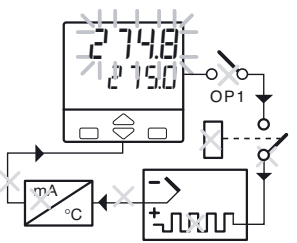
ΔSP Threshold = SP ± range

ALARMS WITH LBA (LOOP BREAK ALARM) AND SENSOR BREAK OPERATION

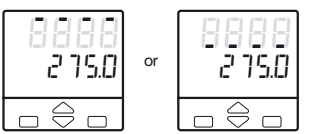
Select the code 1 on **N** or **O** configuration indexes (see pages 18 or 19). The following parameter is then available:

t.LbA LBA delay

Setting a value between 1 and 9999 s the alarm works as LBA+Sensor break with delay [1]
This condition is shown by means a red led as well as the blinking PV display.



Setting OFF the alarm works as Sensor break with immediate action.
This condition is shown by means the red led of the selected alarm as well as:

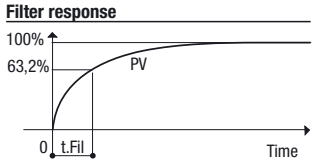


Note [1] In case of sensor break, condition, the alarm action is immediate.

When the cause of the alarm disappears, the alarm status stops.

t.FiL **Input filter time constant**

Time constant, in seconds, of the RC input filter applied to the PV input. When this parameter is set to OFF the filter is bypassed.



In.Sh **Input shift**

This value is added to the measured PV input value. Its effect is to shift the whole PV scale of up to ± 60 digits.

dEr **Error Dead Band**

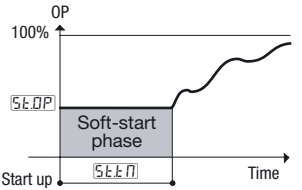
Inside this band for (PV - SP), the control output does not change to protect the actuator (output Stand-by).

St.OP **Soft-start control output value**

Value of the control output during the Soft-start activation time.

St.tM **Soft-start activation time**

Time duration (starting from the power on) of the Soft-start function.



SA.OP **Output Safety Value**

Output Value in case of input anomaly.

Addr **Controller address**

the address range is from 1 to 247 and must be unique for each controller on the communication bus to the supervisor.
When set to OFF the controller is not communicating

HEAT COOL CONTROL

By a sole P.I.D. control algorithm, the controller handles two different outputs, one of these performs the Heat action, the other one the Cool action.

It is possible to overlap the outputs.

The dead band parameter d.bnd, is the zone where it is possible to separate or overlap the Heat and Cool actions.

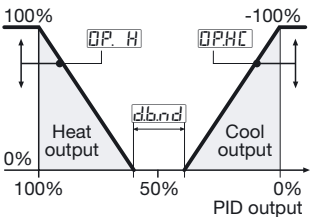
The Cool action can be adjusted using the relative cool gain parameter r.C.G.

To limit the Heat and Cool outputs the parameters OP. H and OP.HC can be used.

When there is an overlap, the displayed output OUt shows the algebric sum of the Heat and Cool outputs.

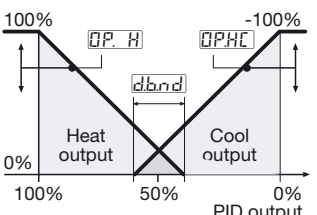
A Heat /Cool actions separated

Insert positive d.bnd value (0…10%)



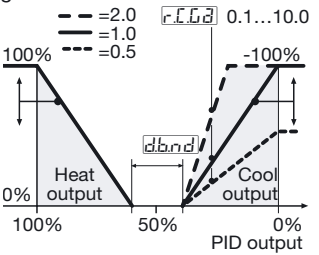
B Heat /Cool actions overlapped

Insert negative d.bnd value (-10…0%)

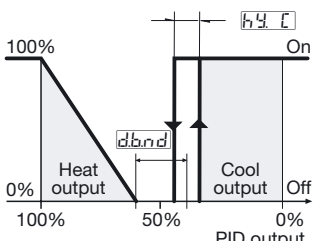


C Cool action adjusting

Example with different relative cool gains



D On-Off Cool action



ANALOGUE CONTROL OUTPUT OP4

When configured, the analogue control output excludes the corresponding time proportioning control output automatically.(see page18)
(e.g. if code [L] = 0 and [rEH] = nU. the OP1 is not yet available)

[rPEr] Analogue control output range

0-20 / 4-20

[rEH] Control output selection

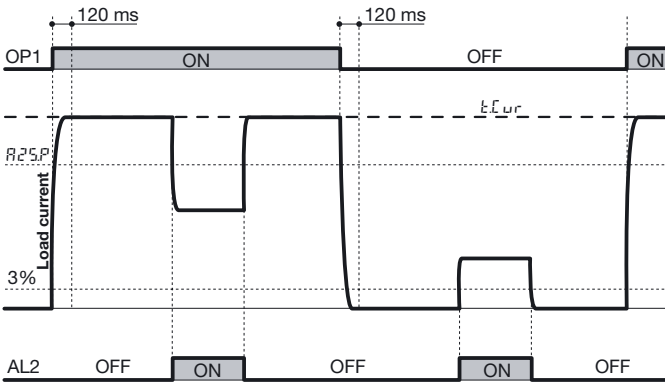
nonE **Not used**
nU. **Heat** (single action)
nU. C. **Cool**

With analogue control output [tc] or [tc C] are not present.

CURRENT TRANSFORMER INPUT

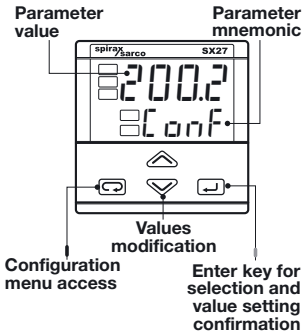
With CT option it is possible to display the load current and set an alarm threshold.
It is possible to set AL2 or AL3 (index 8 and 9) to have an alarm when, during the ON time of the time proportional output, the load current is less then the specified threshold or, during the OFF time, there is at least 3% of full scale load current
The alarm condition must be longer than 120 ms to set the alarm.
During the OFF time the parameter [tCur] latches the last on time current value

Example:
CT input on OP1, alarm on AL2 during on time (configuration digit N = 8)

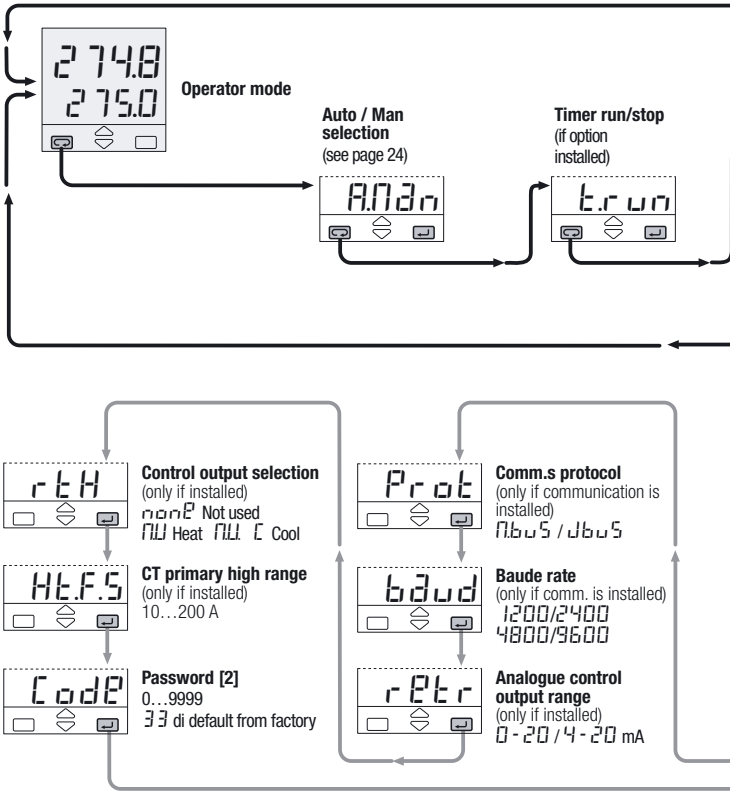


4.6 CONFIGURATION

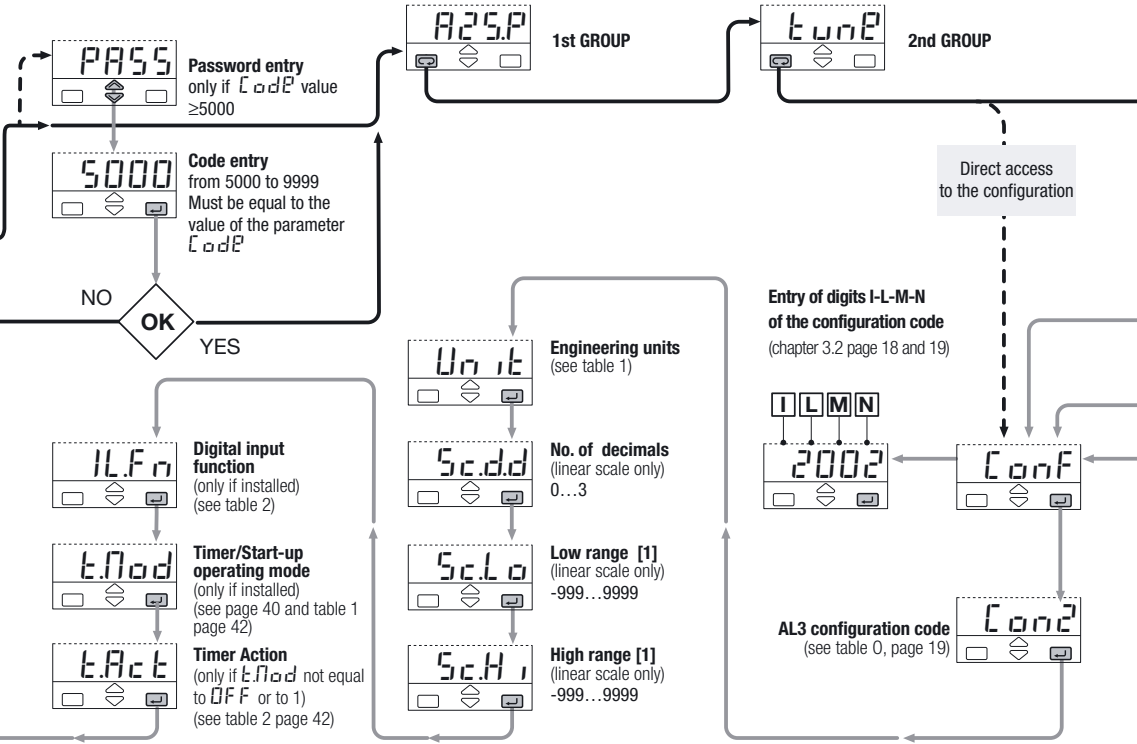
The configuration of the controller is specified through a 4 digit code that defines the type of input, of control output and of the alarms. (sect. 3.2 page 18)

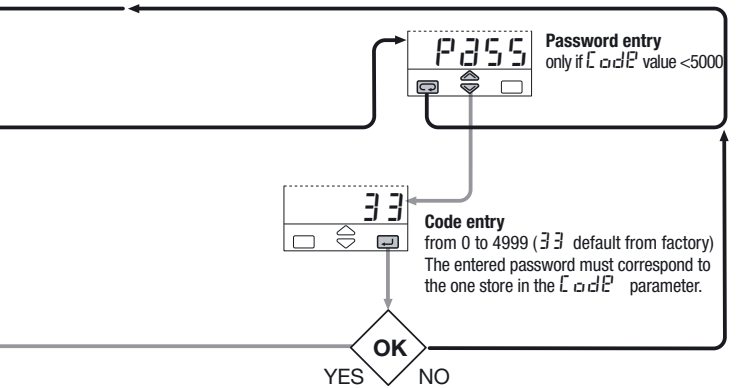


Press ⌃ or ⌄ to display the next parameter or the next code and change its value.
The new value entered is stored into the controller when the next parameter is selected by pressing ↵.
Pressing the ↻ the next group of parameters is displayed.



CONFIGURATION MENU





Direct access to the configuration

A From parameterisation (see page 28).

B At the first power on when the controller is not configured:

In this situation, the controller has its outputs and inputs not active.
This situation ends when a correct configuration code is entered.

Table 1 - Supported Engineering Units.

Centigrade degrees*	°C
Fahrenheit degrees *	°F
nessuna	none
mV	nU
Volt	U
mA	mA
Ampere	A
Bar	bAr
PSI	PSI
Rh	rh
pH	Ph

* For inputs from thermocouple or resistance thermometer, the choice is between °C and °F only.

Table 2- Digital input functions

Not used	OFF
Keypad lock	KEb.1
Auto/Man	AMAn
Stand-by Setpoint	SP. 2
Timer launch	Strt

Notes

[1] Minimum Range 100 digits.

[2] To avoid free parameter access insert 5000…9999

5 AUTOMATIC TUNING

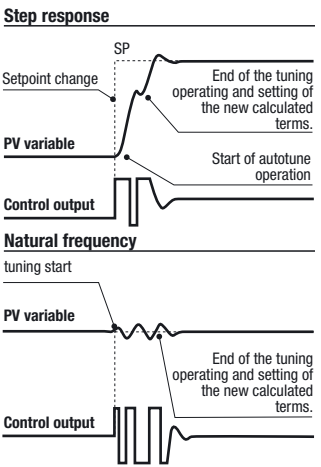
Two tuning methods are provided:
- Initial one shoot **Fuzzy-tuning**
- Continuous, self learning **Adaptive Tuning**

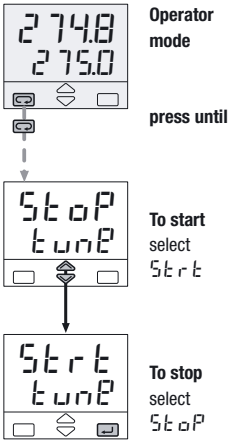
The Fuzzy-Tuning allows the calculation of the optimal P.I.D. terms parameters, monitoring the response of the process to disturbances.
The controller provides 2 types of "one shot" tuning algorithm, that are selected automatically according to the process condition when the operation is started.

Step response
This type is selected when, at the start of the autotune operation, the PV is far from the Setpoint of more than 5% of the span.
This method has the big advantage of fast calculation, with a reasonable accuracy in the term calculation.

Natural frequency
This type is selected when the PV is close to the SP Setpoint.
This method has the advantage of a better accuracy in the term calculation with a reasonable speed calculation.

The Fuzzy Tuning determines automatically the best method to use to calculate the P.I.D. term, according the process conditions.

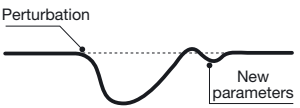




The green led MAN blinking goes on when the Fuzzy Tuning is in progress. At the end of this operation, the calculated P.I.D. terms parameter are stored and used by the control algorithm and the controller goes back to the operator mode. The green led MAN becomes off.

The self-learning **Adaptive Tuning** is not intrusive. It doesn't affect the process, at all, during the phase of calculation of the optimal terms parameters.

Continuous **Adaptive Tuning**

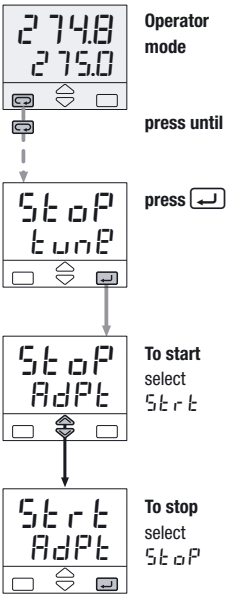


It is particularly suitable for controlling process whose control characteristics change with time or are not linear in relation to the Setpoint values.

It does not require any operation by the user. It is simple and works fine: it samples continuously the process response to the various perturbations, determining the frequency and the amplitude of the signals. On the basis of this data and their statistical values, stored in the instrument, it modifies automatically the P.I.D. term parameters.

It is the ideal for all applications where it is required to change continuously the P.I.D. terms parameters, in order to adjust the P.I.D. to the changes of the process dynamic conditions.

In case of power off with the Adaptive Tuning enabled, the values of the P.I.D. terms parameters are lost. At the power on the Adaptive Tuning starts automatically and computes again the values of the P.I.D. terms parameters.



6 SPECIAL FUNCTIONS

Two special functions are available:
6.1 Start-up
6.2 Timer

In order to have the above functions the product code digit **E** must be **2** (see page 17)

To select these functions use the parameter:

t.Mod **Timer/Start-up operator mode** (see page 36).

⚠ **Selecting Timer or Start-up, the Soft-start function is disabled, therefore the parameters SE.OP and SE.tU will not be shown** (see page 27)

6.1 START-UP FUNCTION

By means of this function it is possible to manipulate the control output when the controller is switched on.

To configure Start-up function the parameter "Timer/Start-up operating mode" must be set to 1.
Three parameters are associated to the Start-up function, they appear on the second group. (see page 27)

SP.SU **Start-up Setpoint** (SP. L ...SP. H)

t.hSU **Start-up hold time** (0…500 min.)

OPHS **Output high limit** (5.0%…100.0% min)

The Start-up function includes three phases:
1st "Limy" - The control output is limited to the OPHS

2nd "Hold" - The process variable is maintained to the Start-up Setpoint for the time fixed by the parameter t.hSU

3rd "Off" - When the t.hSU time is elapsed the process variable is maintained to the working Setpoint.

Whether the process variable, for any reason (e.g. load change), decreases at a value lower than (SP.SU - 40 digits), the Start-up function starts again from the "Limy" phase.

When the Start-up is in Hold phase, if the local Setpoint becomes lower than the Start-up Setpoint or if the operating mode changes to manual, the Start-up function passes to the "Off" phase.

There are two possibilities:

A Start-up Setpoint SP.SU lower than the local Setpoint. The "Hold" phase starts when the process variable PV achieves the SP.SU (with a tolerance of 1 digit).

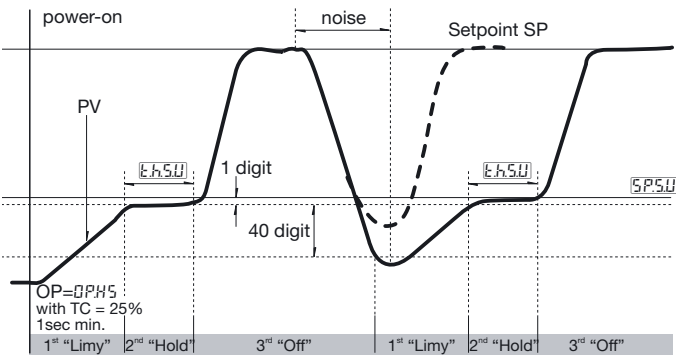
B Start-up Setpoint SP.SU greater than or equal to the local Setpoint.

When the process variable PV achieves the local Setpoint (with a tolerance of 1 digit), the Start-up function passes directly to the "Off" phase.

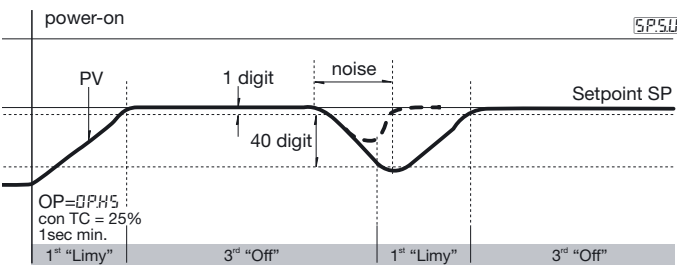
If, at the controller power-on, the process variable PV is greater than the lowest between the SP.SU and the working Setpoint , the next phase ("Hold" or "Off") will be executed instead of the "Limy" phase.

During the "Limy" and "Hold" phases the RUN led is on.

A SP.SU < local Setpoint SP



B SP.SU < local Setpoint SP



6.2 TIMER FUNCTION

To use AL3 in addition to this function, set the parameter [Con2] (AL3 configuration code) is set to [0..]

⚠ The Timer can't be enabled with Heat/Cool control.

The two following parameters (see page 36) must be set to select one of the six possible types of Timer.

[t.Mod] Timer/Start-up operating mode

By this parameter can be defined:
- the counting start time
- the control output status at the end of the counting

Table 1

Timer counting mode		Value
Counting start time	End mode	
When inside the band	Control mode	2
	Output to 0	3
When launched	Control mode	4
	Output to 0	5
When launched. Control disabled	Control mode	6
When launched stand-by Setpoint	Control mode	7

[t.Act] Timer Action

By this parameter can be defined:
- the time units
- the starting mode
- the OP3 status when the timer is running.

When the timer is not running, the OP3 takes the opposite status.

Table 2

Time units	Starting mode	[1]OP3 status	Value
Seconds	Manual by keypad	Off	0
		On	1
	Auto at the power on [2]	Off	2
		On	3
Minutes	Manual by keypad	Off	4
		On	5
	Auto at the power on [2]	Off	6
		On	7

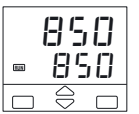
[1] If used by Timer
[2] Using this selection, manual starting mode is possible too.

After the Timer configuration the following parameters will be shown on the second parameters group. (see page 26)

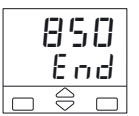
[t.mE] Timer setting (1…9999 s/min)

[SP. 2] Stand-by Setpoint (only for [t.Mod] = 7) ([SP. L …SP. H])

6.2.1. DISPLAY

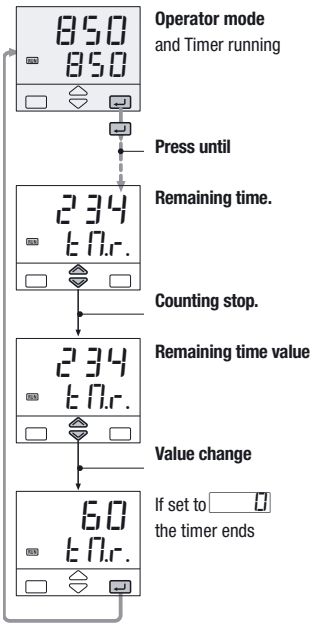


When the Timer is running, the led [RUN] is on.



When the Timer ends, the Setpoint display shows alternatively the message [End] and the Setpoint value until a key is pressed.

When the timer is running it is always possible to see the remaining time and to modify it.

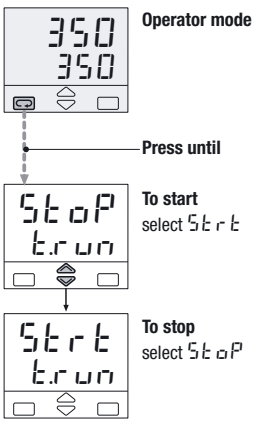


6.2.2 TIMER STARTING

Depending on the Timer action t.act selection, there can be two different starting ways:

- Automatic at the power on
- Manual by keypad, serial communications or digital input.

To start/stop the Timer:



Press the key ↵ to confirm

6.2.3 POWER FAILURE

If there is a power failure during the Timer execution, the value of the elapsed time is lost.

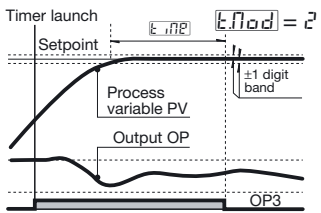
Depending on Timer action t.act selection, when the controller restarts you can have two different situations:

- with automatic mode (t.act = 2,3,6,7), the Timer function starts again and the counting time is reinitialised.
- with manual mode (t.act = 0, 1,4,5), the control output is forced to zero if tMod = 3 e 5; otherwise the control action restarts using the working Setpoint

6.2.4 TIMER COUNTING MODES

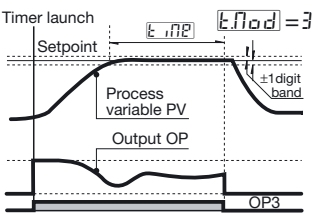
A Counting start time inside the band, end in control mode.

The time counting starts only when the error is inside a ± 1 digit band. The control action is not affected by the Timer function.



B Counting start time inside the band, end with control output forced to zero.

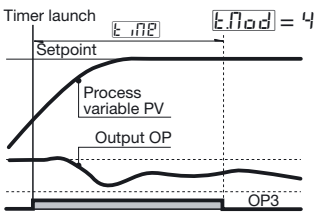
The time counting starts only when the error is inside a ± 1 digit band. At the end, the control output is forced to zero. [1]



[1] When the Timer is not running the control output is forced to zero, also before the Timer launch

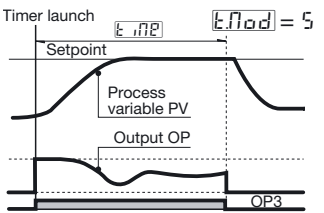
C Counting start time = timer launch time, end in control mode.

The time counting starts when the timer is launched. The control action is not affected by the Timer function.



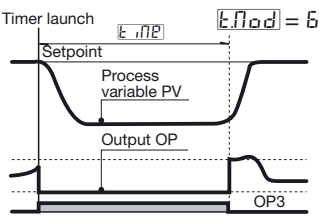
D Counting start time = timer launch time, end with control output forced to zero.

The time counting starts when the timer is launched. At the end, the control output is forced to zero. [1]



E No control action during the counting time.

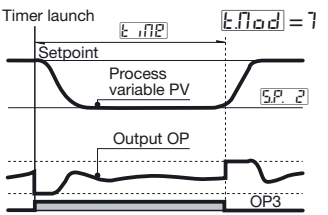
The time counting starts when the timer is launched and the control output is forced to zero. At the end, the control action starts.



[1] When the Timer is not running the control output is forced to zero, also before the Timer launch

F Control action with stand-by Setpoint during the counting time

The time counting starts when the timer is launched and the control action use the Stand-by Setpoint. At the end, the control action use the working Setpoint.



7 TECHNICAL SPECIFICATIONS

Features (at 25°C environmental temp.)	Description		
Total configurability (see par. 3.2 page 18 par. 4.6 page 35)	From keypad or serial communication the user selects: - the type of input - the type of control algorithm - the type and functionality of the alarms - the associated functions and the corresponding outputs - the type of output and the safe conditions - the values of all the control parameters.		
PV Input (see page11,12 and page 18)	Common characteristics	A/D converter with resolution of 50000 points Update measurement time: 0.2 seconds Sampling time: 0.5 seconds Input bias: -60…+60 digit Input filter with enable/disable: 1…30 seconds	
	Accuracy	0.25% ±1 digits for temperature sensors 0.1% ±1 digits (for mV and mA)	Between 100…240Vac the error is minimal
	Resistance thermometer (for ΔT: R1+R2 must be <320Ω)	Pt100Ω at 0°C (IEC 751) °C/°F selectable	2 or 3 wires connection Burnout (with any combination)	Wire Res: 20Ω max. (3 wires) Sensitivity: 0.35°C/10° E. T. <0.35°C/10Ω Wire Res.
	Thermocouple	L, J, T, K, S (IEC 584) Rj >10MΩ °C/°F selectable	Internal cold junction compensation con NTC Error 1°C/20°C ±0.5°C Burnout	Line: 150Ω max. Input drift: <2μV/°C.Env. Temp <5μV/10Ω Wire Res.
	DC input (current)	4…20mA,0...20mA with external shunt 2.5Ω Rj >10MΩ	Engineering units Conf. decimal point position Init. Sc -999…9999 Full Sc. -999…9999 (min. range of 100 digits)	Input drift: <0.1%/20°C Env. Temp.
	DC input (voltage)	10…50mV, 0...50mV Rj >10MΩ		

Features (at 25°C environmental temp.)	**Description**			
CT auxiliary input (option)	Current transformer (see page 12)	50 or 100 mA input hardware selectable	Current visualisation 10 … 200A With 1A resolution and HeaterBreak Alarm	
Digital input (option)	The closure of the external contact produces any of the following actions: Auto/Man mode change, Stored Setpoint activation, Keypad lock, Timer launch			

Operating mode and Outputs			**Control output**		**AL2 alarm**	**AL3 alarm**
One single or one double action or valve drive PID loop or On/Off with 1 or 2 alarms		Single action	OP1-Relay		OP2-Relay/logic	OP3-Relay
			OP2 -Logic/Relay		OP1-Relay	OP3-Relay
		Double action	OP1-Relay	OP3-Relay	OP2-Relay/logic	
			OP1-Relay	OP2 Logic/Relay		OP3-Relay
		Heat/cool	OP2 Logic/Relay	OP3-Relay	OP1-Relay	
		Valve drive	OP1-Relay	OP3-Relay	OP2-Relay/Logic	

Control mode				
Algorithm	PID with overshoot control or On-Off. PID withvalve drive algorithm for motorised actuators control			
Proportional band (P)	0.5…999.9%			PID algorithm
Integral time (I)	0.1…100.0 min	OFF = 0		
Derivative time (D)	0.01…10.00 min			
Error band	0.1…0.10 digit			
Cycle time	1…200 s			
Dead band	-10.0…10.0%			Heat / cool control action
Cool relative gain	0.1…10.0			
Cool cycle time	1…200 s			
Overshoot control	0.01…1.00			PID algorithm
High limit	100.0…10.0% (heat) -100.0…-10.0% (cool)			
Hysteresis	0.1…10.0%			On-Off algorithm
Motor travel time	15…600 s	Valve drive PID algorithm without position potentiometer		
Motor minimum step	0.1…5.0%			

Features (at 25°C environmental temp.)	**Description**				
OP1 output	SPST Relay N.O., 2A/250Vac (4A/120Vac) for resistive load				Protection by varistor for 220Vac and capacitor
OP2 output	Logic not isolated: 5Vdc, ±10%, 30mA max. SPST Relay N.O., 2A/250Vac (4A/120Vac) for resistive load			Jumper selectable (page 13)	
OP3 output	SPST Relay N.O., 2A/250Vac (4A/120Vac) for resistive load				
OP4 countinuous control output (option)	Galvanic isolation: 500 Vac/1 min Resolution: 12bit (0.025%) Accuracy: 0.1 %			In current: 0/4…20mA 750Ω/15V max.	
AL2 - AL3 alarms	Hysteresis 0.1…10.0% c.s.				
	Action	Active high	Action type	Deviation threshold	±range
		Active low		Band threshold	0…range
				Absolute threshold	whole range
		Sensor break, heater break alarm, Latching/Blocking, Loop Break Alarm			
Setpoint	Local and stand-by digital input or serial communications				
	Ramp up and down. User inhibited			0.1…999.9 digit/min	
	Low limit			from low range to high limit	
	High limit			from low limit to high range	
Tuning	**Fuzzy-Tuning** The controller selects automatically the best method according to the process conditions			Step response	
				Natural frequency	
	Adaptive Tuning self-learning, not intrusive, analysis of the process response to perturbations and continuously calculation of the P.I.D. parameters				
Auto/Man station	Standard with bumpless function, by keypad, digital input or serial communications				
Serial comm. (option)	RS485 isolated, Modbus/Jbus protocol, 1200, 2400, 4800, 9600 bit/s, two wires				
Auxiliary Supply	+18Vdc ±20%, 30mA max. for external transmitter supply				

Features (at 25°C environmental temp.)	**Description**		
Operational safety	Measure input	Detection of out of range, short circuit or sensor break with automatic activation of the safety strategies and alerts on display	
	Control output	Safety value: -100…100%	
	Parameters	Parameter and configuration data are stored in a non volatile memory for an unlimited time	
	Access protection	Password to access the configuration and parameters data, keypad lock, output lock	
General characteristics	Power supply (PTC protected)	100...240Vac (-15...+10%) 50/60 Hz or 24Vac (-25...+12%), 50/60 Hz and 24Vdc (-15...+25%)	Power consumption 1.6W max.
	Safety	Compliance to EN61010-1 (IEC 1010 – 1), installation class 2 (2.5kV) pollution class 2, **instrument class II**	
	Electromagnetic compatibility	Compliance to the CE standards (see page 2)	
	Protection EN60529 (IEC 529)	IP65 front panel	
	UL and cUL approval	File 176452	
	Dimensions	$^{1}/_{16}$ DIN - 48 x 48, depth 120 mm, weight 130 g approx.	

WARRANTY

We warrant that the products will be free from defects in material and workmanship for 3 years from the date of delivery.
The warranty above shall not apply for any failure caused by the use of the product not in line with the instructions reported on this manual.

ICONS TABLE

Main universal input	
TC	Thermocouple
Pt100	RTD (Pt100)
ΔT	Delta Temp (2x RTD)
mA V	mA and mV
Custom	Custom
Hz	Frequency

Auxiliary input	
	Current transformer
REM	mA Remote setpoint
REM V	Volt Remote setpoint
POT.	Feedback potentiometer

Digital input	
	Isolated contact
	NPN open collector
	TTL open collector

Setpoint	
LOC	Local
STAND BY	Stand-by
	Keypad lock
	Outputs lock
START UP	Start-up function
TIMER	Timer function
MEM	Memorized
REM	Remote
	Setpoint programmer

Digital input connected functions	
	Auto/Manual
RUN	Run, Hold, Reset and program selection
HOLD PV	PV hold
SP SLOPE	Setpoint slopes inhibition

Output	
	SPST Relay
	Triac
	SPDT Relay
mA	mA
mA V	mA mV
	SSR Drive