**ASCON spa**

ISO 9001
Certified

**ASCON spa**
**20021 Bollate**
**(Milan) Italy**
**via Falzarego, 9/11**
**Tel. +39 02 333 371**
**Fax +39 02 350 4243**
**http://www.ascon.it**
**e-mail sales@ascon.it**

# Double action controller with analogue output 1/8 DIN - 48 x 96

δ2 SERIES

## X3 line

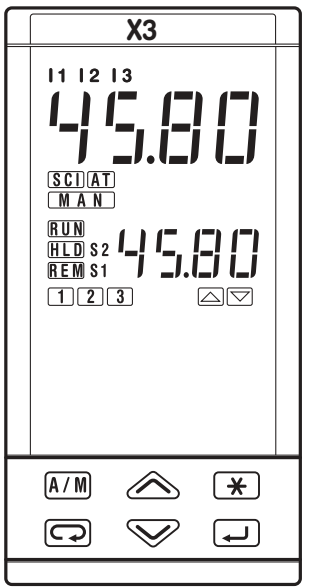
CE

User Manual • M.I.U.X3 -4/04.02 • Cod. J30-478-1AX3 IE

c UL us LISTED

# Double action controller with analogue output
# $^1/_8$ DIN - 48 x 96

## X3 line



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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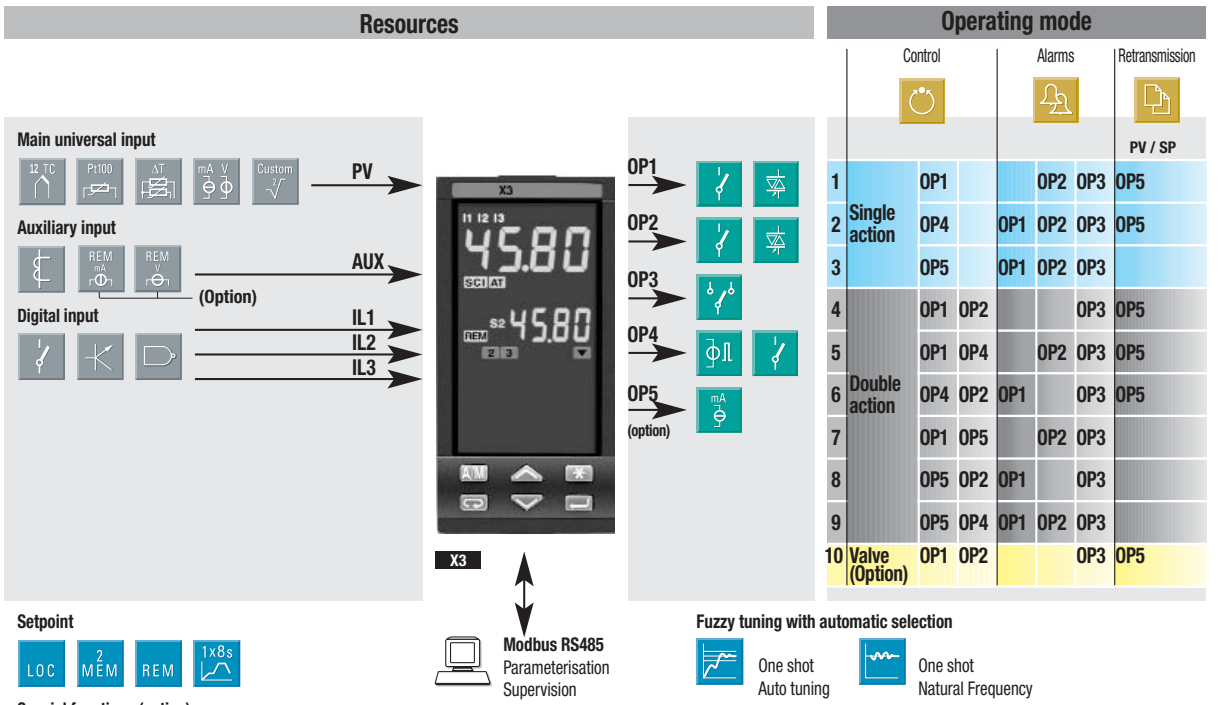


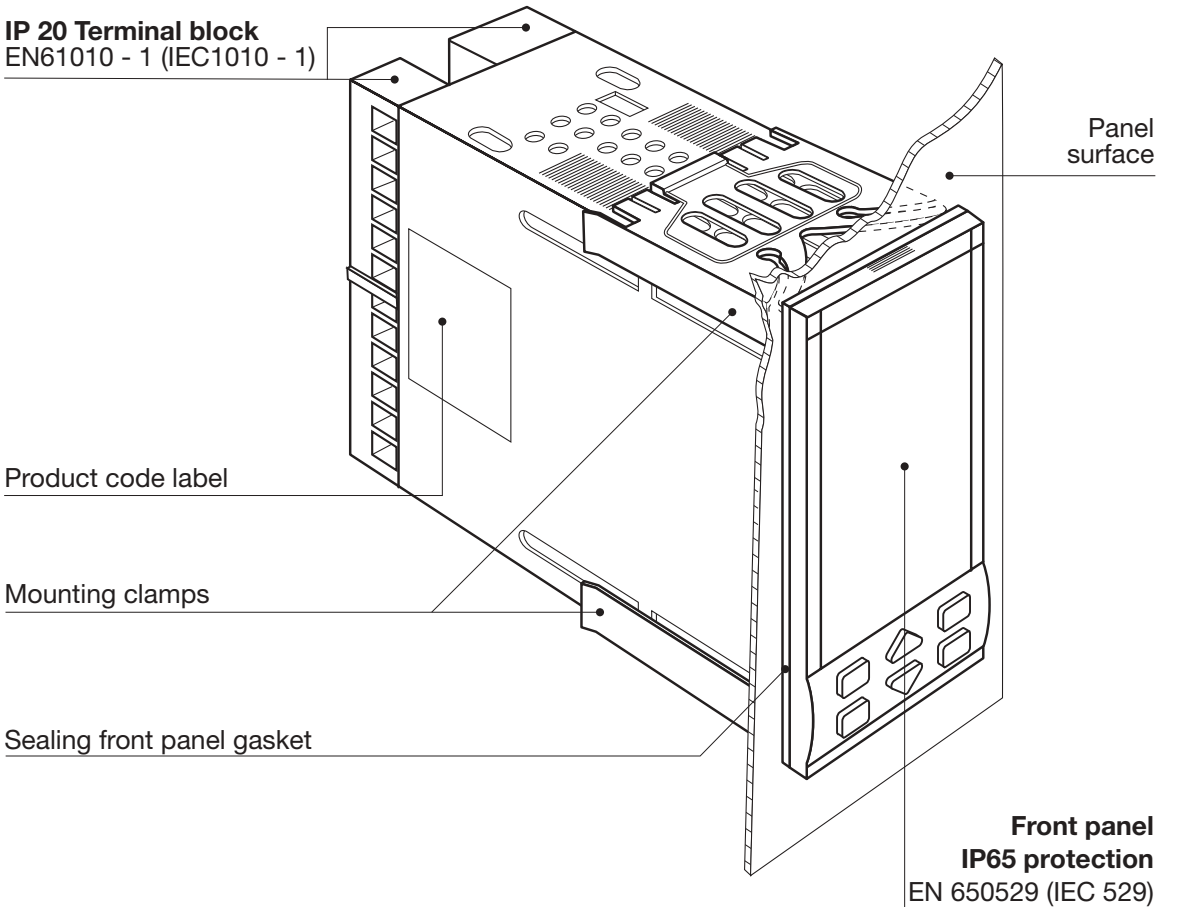
# 1 INSTALLATION

**Installation must only be carried out by qualified personnel.**

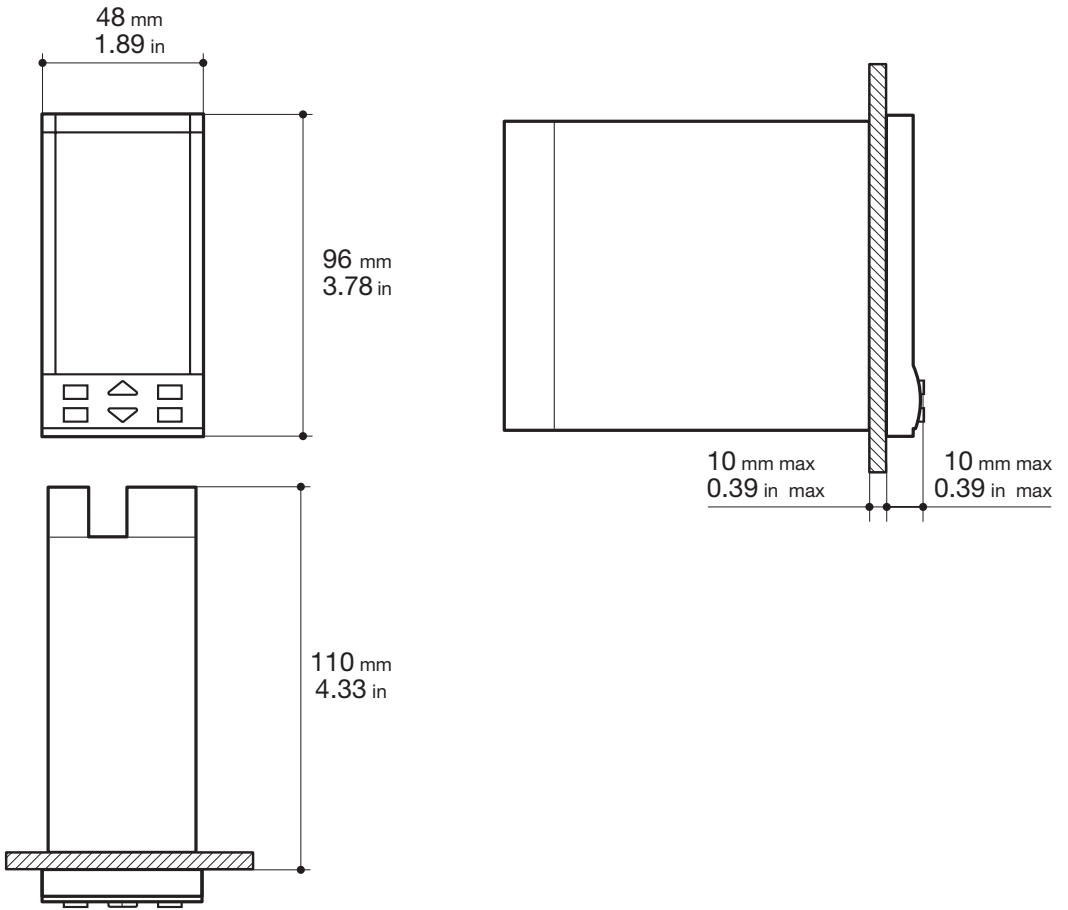
Before proceeding with the installation of this controller, follow the instructions illustrated in this manual and, particularly the installation precautions marked with the CE symbol, related to the European Community directive on electrical protection and electromagnetic compatibility.

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.**

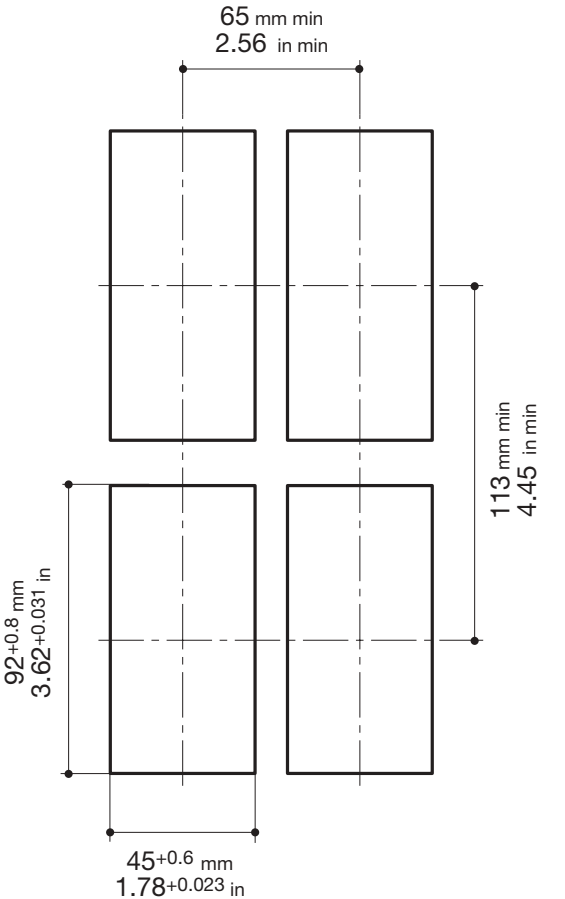
## 1.1 GENERAL DESCRIPTION



## 1.2 DIMENSIONAL DETAILS




## 1.3 PANEL CUT-OUT



## 1.4 ENVIRONMENTAL CONDITIONS

| 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 |

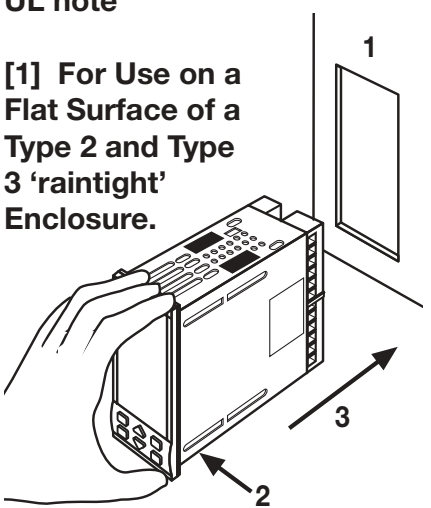
## 1.5 PANEL MOUNTING [1]

### 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

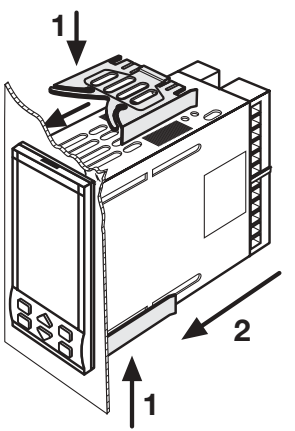
**UL note**

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



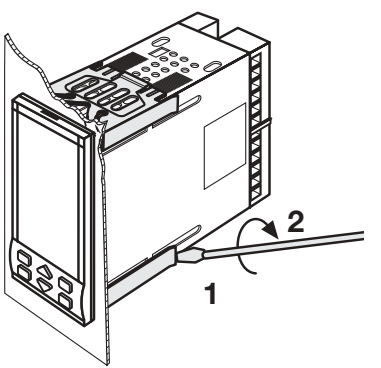

### 1.5.2 INSTALLATION SECURING

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




### 1.5.3 CLAMPS REMOVING

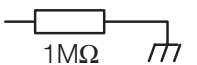
**1** Insert the screwdriver in the clips of the clamps
**2** Rotate the screwdriver



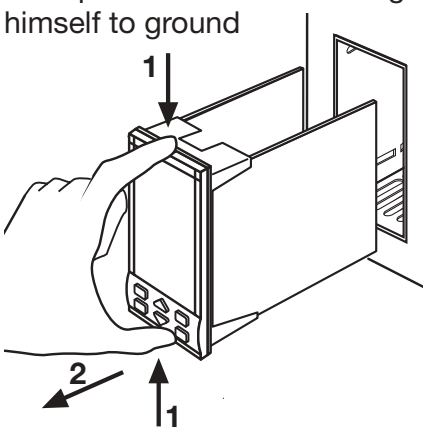

### 1.5.4 INSTRUMENT UNPLUGGING

**1** Push and
**2** Pull to remove the instrument

Electrostatic discharges can damage the instrument

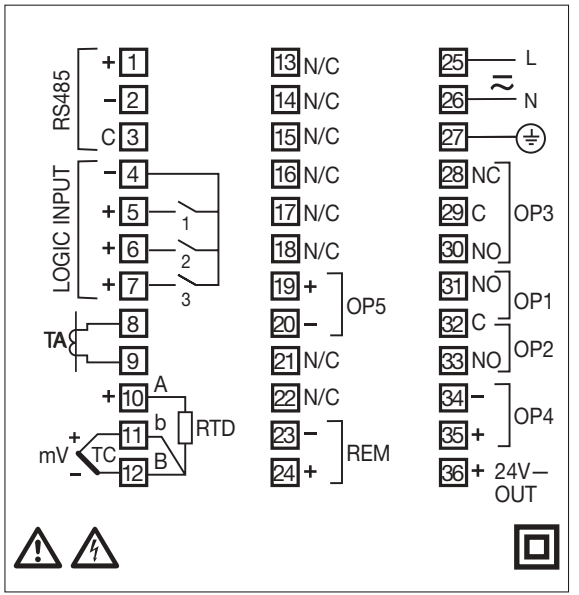



Before removing the instrument the operator must discharge himself to ground



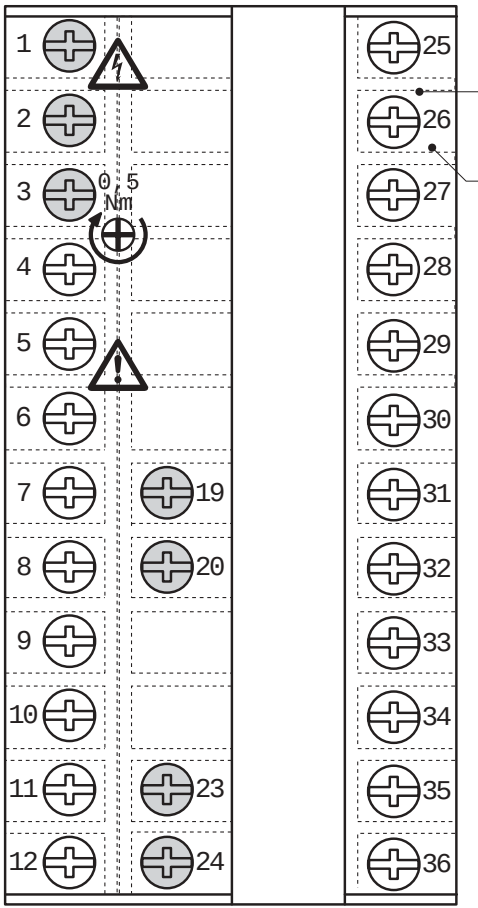
2

# ELECTRICAL CONNECTIONS

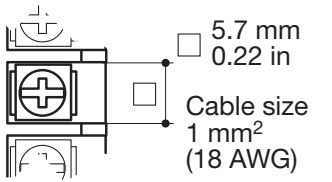



**UL note**
**[1] Use 60/70 °C copper (Cu) conductor only.**

## 2.1 TERMINATION UNIT [1]




Rear terminal cover




| | |
|---|---|
| | 28 screw terminals M3 |
| | Option terminals |
| | Tightening torque 0.5 Nm |
| | Positive screw-driver PH1 |
| | Negative screw-driver 0,8 x 4 mm |

**Terminals**

| | |
|---|---|
| | Pin connector<br>⌀ 1.4 mm 0.055 in max. |
| | Fork-shape AMP 165004<br>Ø 5.5 mm - 0.21 in |
| | Stripped wire<br>L 5.5 mm - 0.21 in |

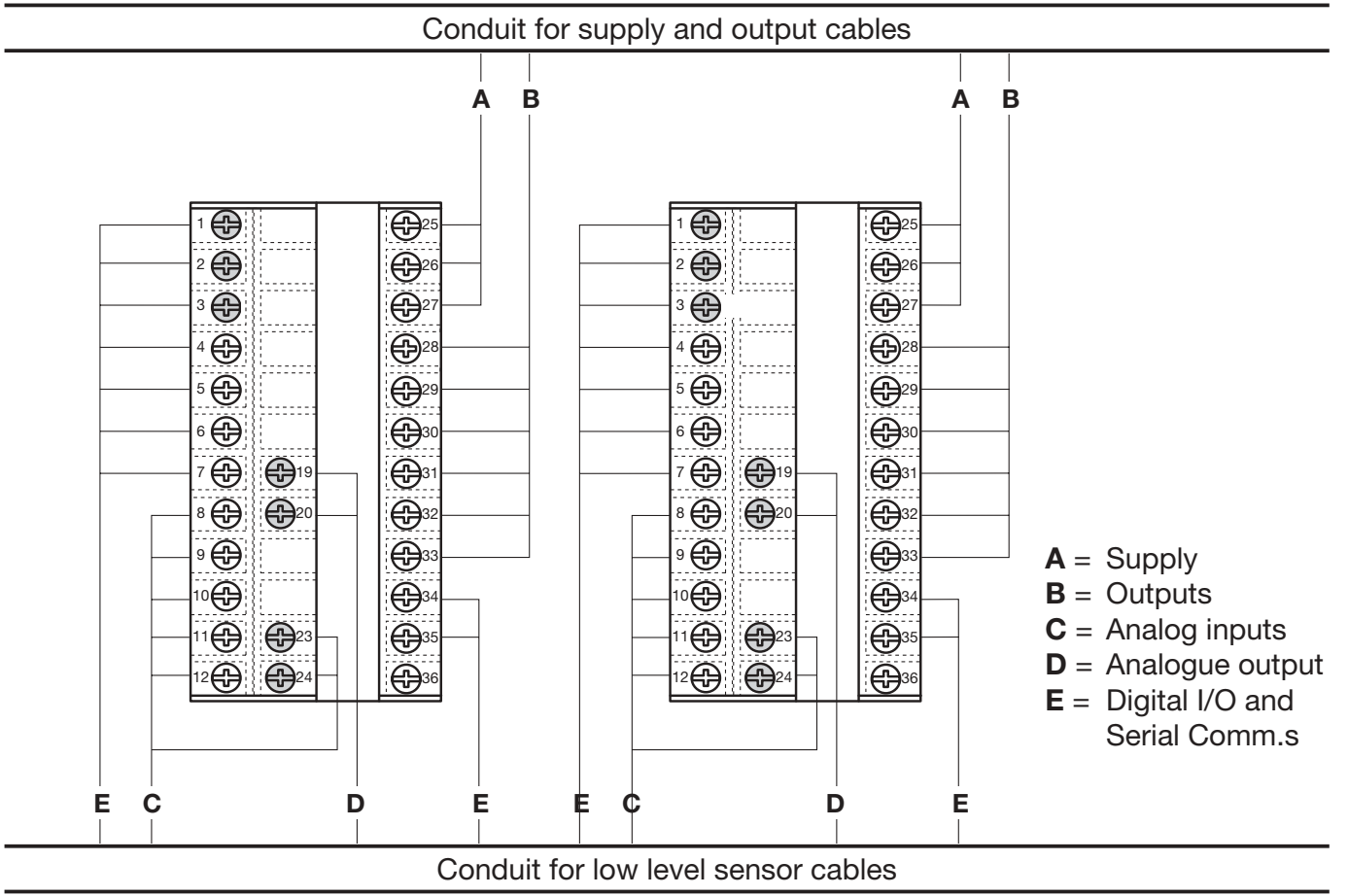
## PRECAUTIONS

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.

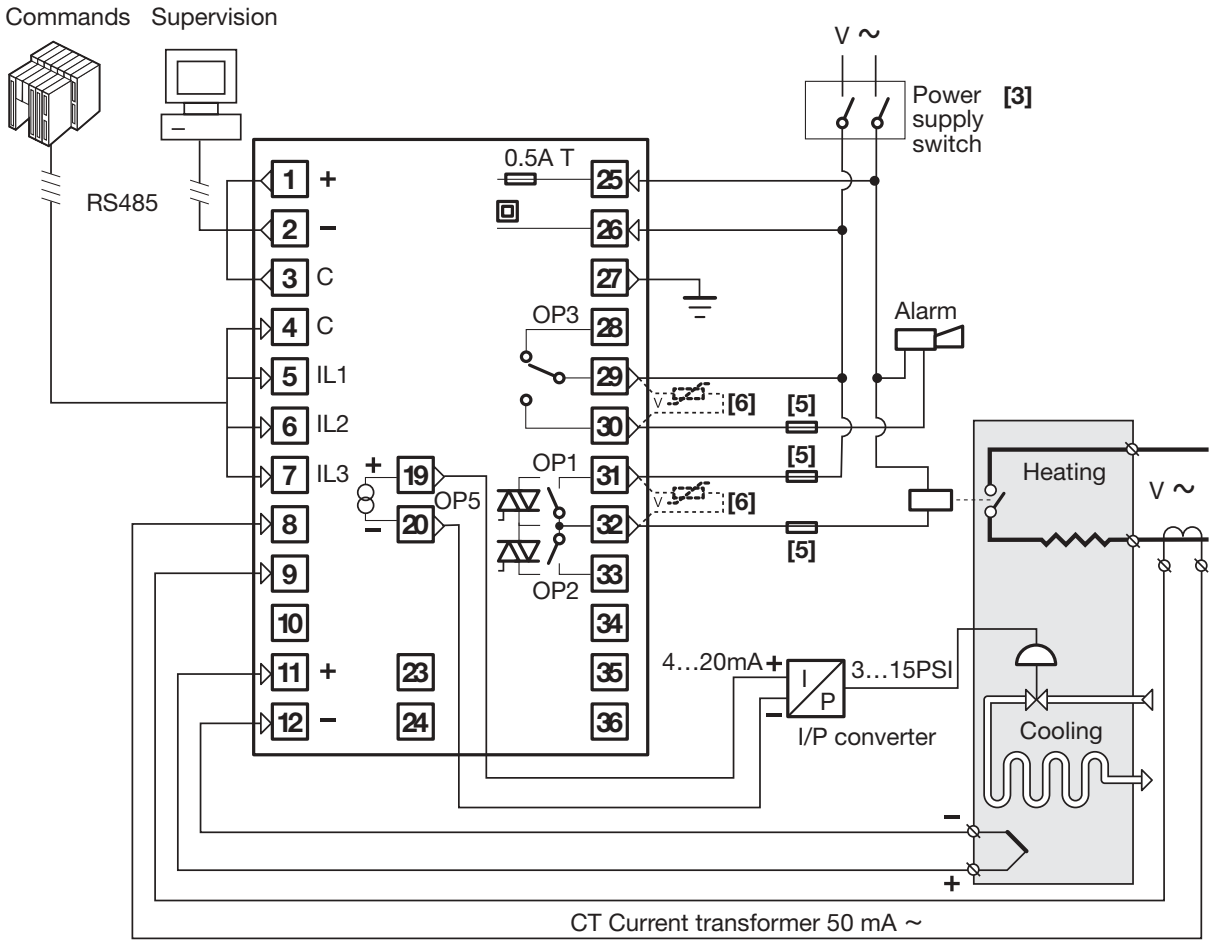
All the wiring must comply with the local regulations.
The supply wiring should be routed away from the power cables.
Avoid to use electromagnetic contactors, power Relays and high power motors nearby.
Avoid power units nearby, especially if controlled in phase angle

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 WIRES 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.

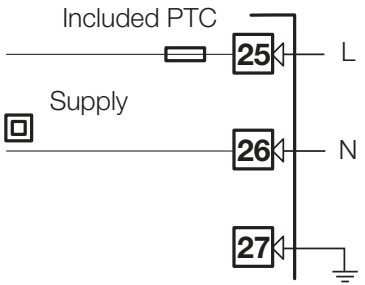
5] To protect the instrument internal circuits use:
- 2 AT fuse for Relay outputs (220 Vac);
- 4 AT fuse for Relay outputs (110 Vac);
- 1 AacT fuse for Triac outputs.

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%)

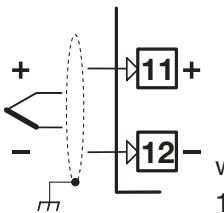



**For better protection against noise, it is recommended not to connect the earth clamp provided for civilian installations.**

## 2.3.2 PV CONTROL INPUT

### A L-J-K-S-R-T-B-N-E-W thermocouple type

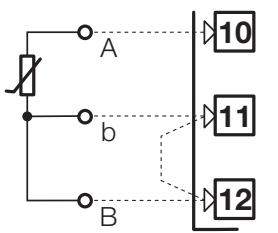
- Connect the wires with the polarity as shown
- Use always compensation cable of the correct type for the thermocouple used
- The shield, if present, must be connected to a proper earth.




wire resistance
150Ω max.

### 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 size (1,5mm² min.) and put a jumper between terminals 11 and 12

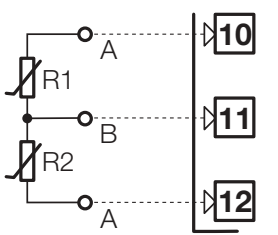



For 3 wires only.
Maximum line resistance: 20Ω/line

### 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 size, produces an error on the measure of 1°C (1°F).

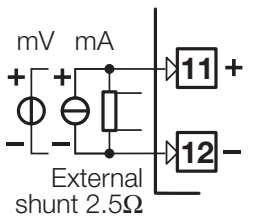
**R1 + R2 must be <320Ω**




Use wires of the same length and 1.5 mm² size.
Maximum line resistance: 20Ω/line

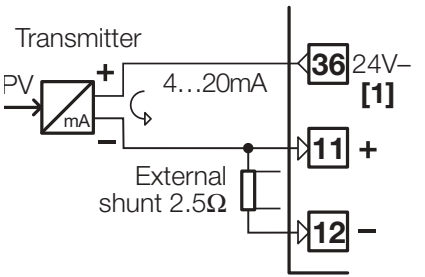
## 2.3.2 PV CONTROL INPUT

### D For mA, mV

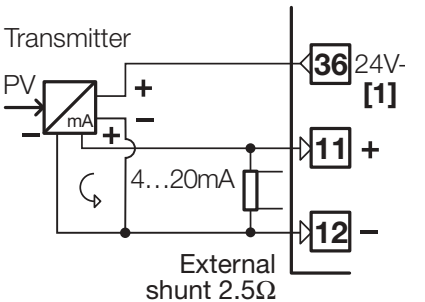



Rj >10MΩ

### D1 With 2 wires transmitter




### D2 With 3 wires transmitter



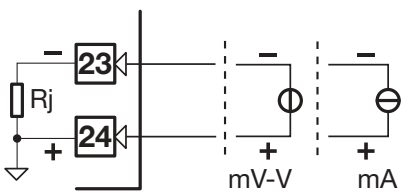

**[1]** Auxiliary power supply for external transmitter 24Vdc ±20% /30mA max. with no short circuit protection

## 2.3.3 AUXILIARY INPUT (OPTION)

### A - From Remote Setpoint

Current 0/4…20mA
Input resistance = 30Ω

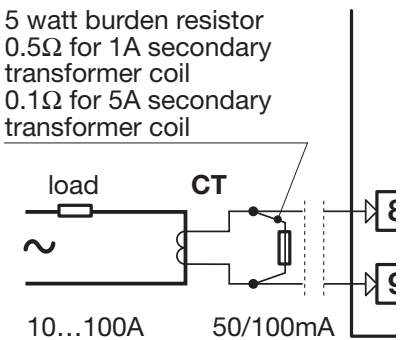
Voltage
1…5V, 0…5V, 0…10V
Input resistence = 300KΩ

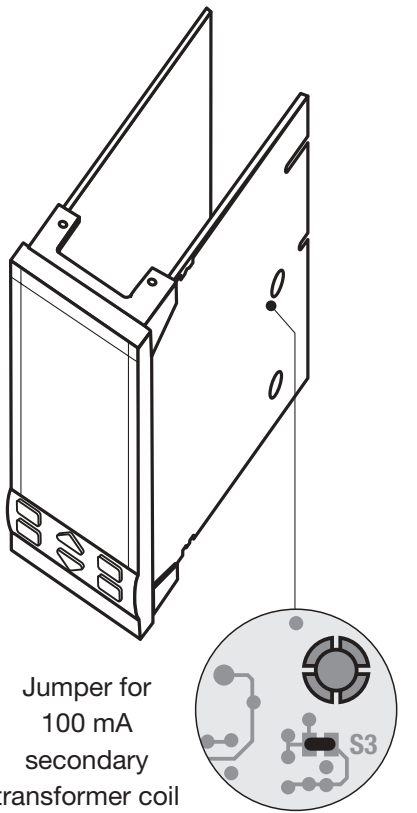



### B- For current transformer CT - Not isolated

For the measure of the load current (see page 47)

- Primary coil10A…100A
- Secondary coil 50mA default 100mA **S3** internal jumper selectable

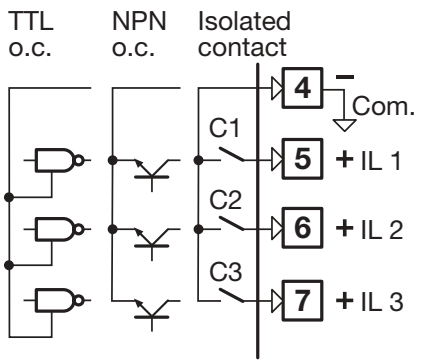



Jumper for 100 mA secondary transformer coil

## 2.3.4 DIGITAL INPUT

- 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 - OP4 - OP5 OUTPUTS (OPTION)

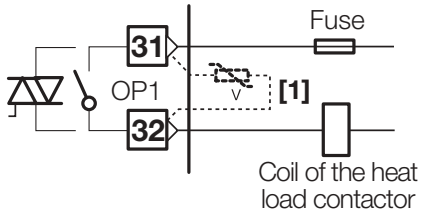
The functionality associated to each of the OP1, OP2, OP4 and OP5 output is defined during the configuration of the instrument index **N** (see page 21).
The suggested combinations are:

| | | Control outputs | | Alarms | | | Retransmission |
|---|---|---|---|---|---|---|---|
| | | Heat | Cool | AL1 | AL2 | AL3 | PV / SP |
| **A** | Single action | OP1 | | | OP2 | OP3 | OP5 |
| **B** | | OP4 | | OP1 | OP2 | OP3 | OP5 |
| **C** | | OP5 | | OP1 | OP2 | OP3 | |
| **D** | Double action | OP1 | OP2 | | | OP3 | OP5 |
| **E** | | OP1 | OP4 | | OP2 | OP3 | OP5 |
| **F** | | OP4 | OP2 | OP1 | | OP3 | OP5 |
| **G** | | OP1 | OP5 | | OP2 | OP3 | |
| **H** | | OP5 | OP2 | OP1 | | OP3 | |
| **I** | | OP5 | OP4 | OP1 | OP2 | OP3 | |
| **L** | Valve drive | OP1 ▲ | OP2 ▼ | | | OP3 | OP5 |

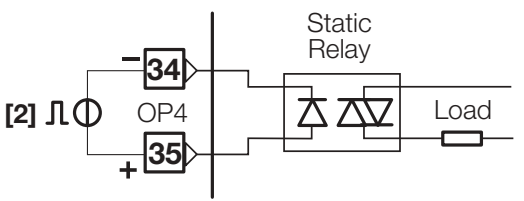
where:

| | |
|---|---|
| **OP1 - OP2** | Relay or Triac output |
| **OP3** | Relay output (for AL3 only) |
| **OP4** | SSR drive control or Relay output |
| **OP5** | Control or retransmission analogue output |

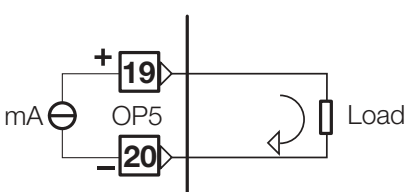
## 2.3.5-A SINGLE ACTION RELAY (TRIAC) CONTROL OUTPUT



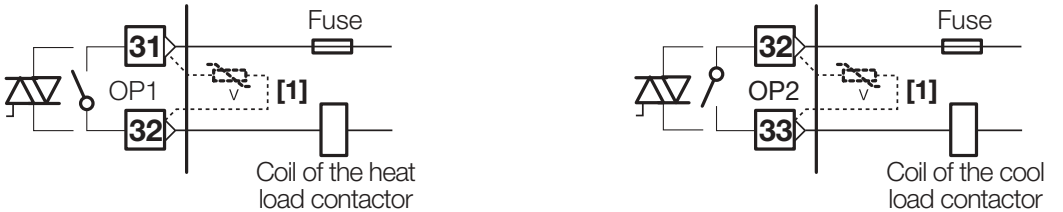

## 2.3.5-B SINGLE ACTION SSR DRIVE CONTROL OUTPUT



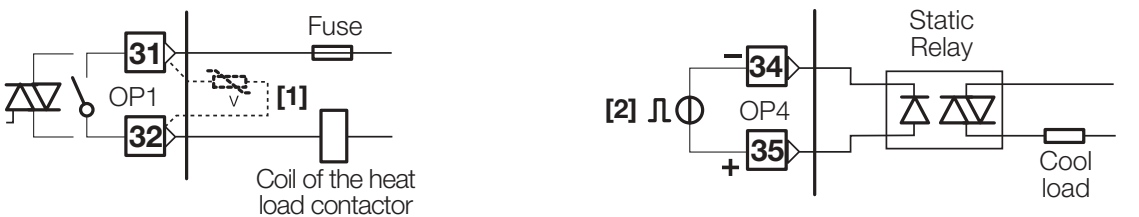

## 2.3.5-C SINGLE ACTION ANALOGUE OUTPUT



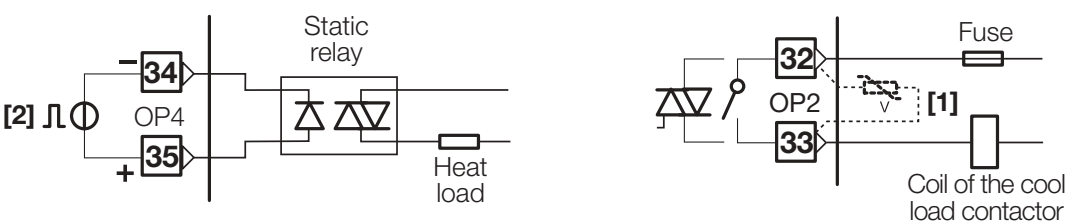

## 2.3.5-D DOUBLE ACTION RELAY (TRIAC)/RELAY (TRIAC) CONTROL OUTPUT




## 2.3.5-E DOUBLE ACTION RELAY (TRIAC)/SSR DRIVE CONTROL OUTPUT

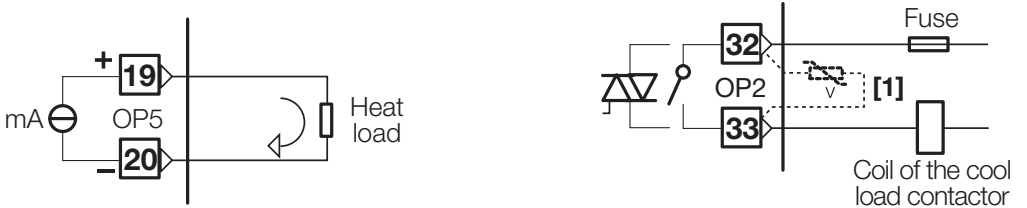



## 2.3.5-F DOUBLE ACTION SSR DRIVE /RELAY (TRIAC) CONTROL OUTPUT

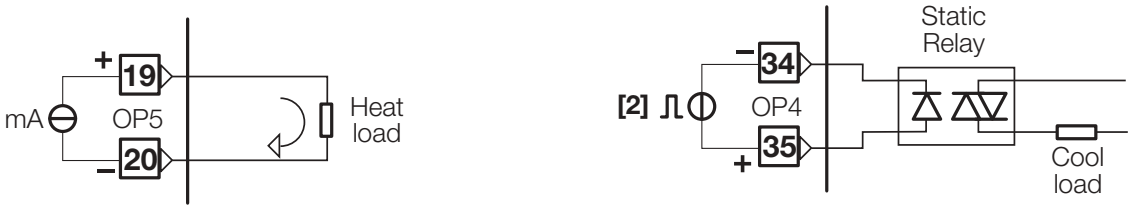


## 2.3.5-G HEAT / COOL CONTROL OUTPUT RELAY (TRIAC)/ANALOGUE


## 2.3.5-H HEAT / COOL CONTROL OUTPUT ANALOGUE/RELAY(TRIAC)




## 2.3.5-I HEAT / COOL CONTROL OUTPUT ANALOGUE/SSR DRIVE



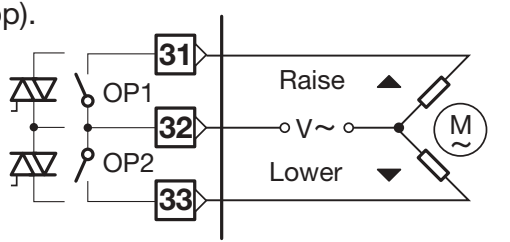

Notes:

**[1] Varistor for inductive load 24Vac only.**

**[2] When basic product code B = 9, OP4 (terminals 34, 35) is a Relay output.**

## 2.3.5-L VALVE DRIVE OUTPUT RELAY (TRIAC) / RELAY (TRIAC)

Valve drive P.I.D. **without** potentiometer 3 pole output with NO contacts (open, close, stop).




Notes:

**OP1 - OP2 Relay output**

- SPST Relay N.O., 2A/250Vac for resistive load, fuse 2AT at 250Vac, (4A/120Vac, fuse 4AT at 120Vac).

**OP1 - OP2 Triac output**

- N.O. contact for resistive load of up to 1A/250 Vac max., fuse 1Aac T.

**OP4 not isolated SSR drive output**

- 0…5Vdc, ±20%, 30 mA max.

**OP4 Relay output**

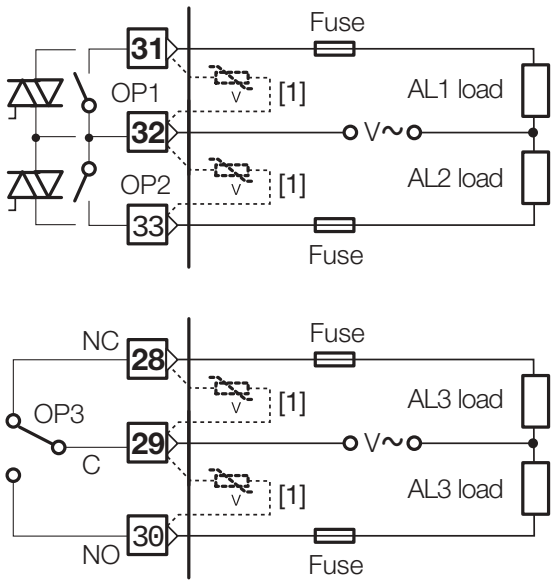
- SPST Relay N.O., 2A/250Vac for resistive load, fuse 2AT at 250Vac (4A/120Vac, fuse 4AT at 120Vac).

**OP5 isolated analogue output**

- 0/4…20mA, 750Ω / 15V max.

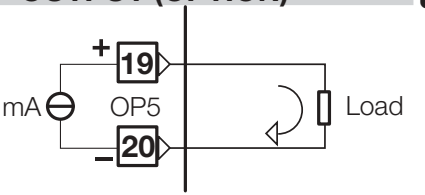
## 2.3.6 ALARM OUTPUTS

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




**[1] Varistor for inductive load 24Vac only**

## 2.3.7 OP5 ANALOGUE CONTROL OUTPUT (OPTION)

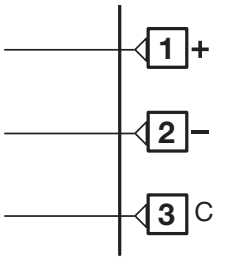



For control or PV/SP retransmission

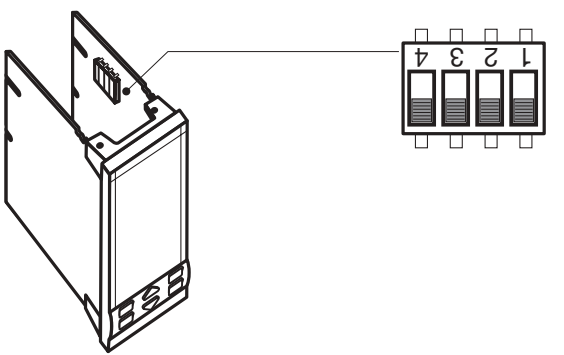
- Galvanic isolation 500Vac/1 min.
- 0/4…20mA, (750Ω or 15Vdc max.)

⚠ Please, read: gamma**due**® and delta**due**® controller series serial communication and configuration software

## 2.3.8 SERIAL COMMUNICATIONS (OPTION)

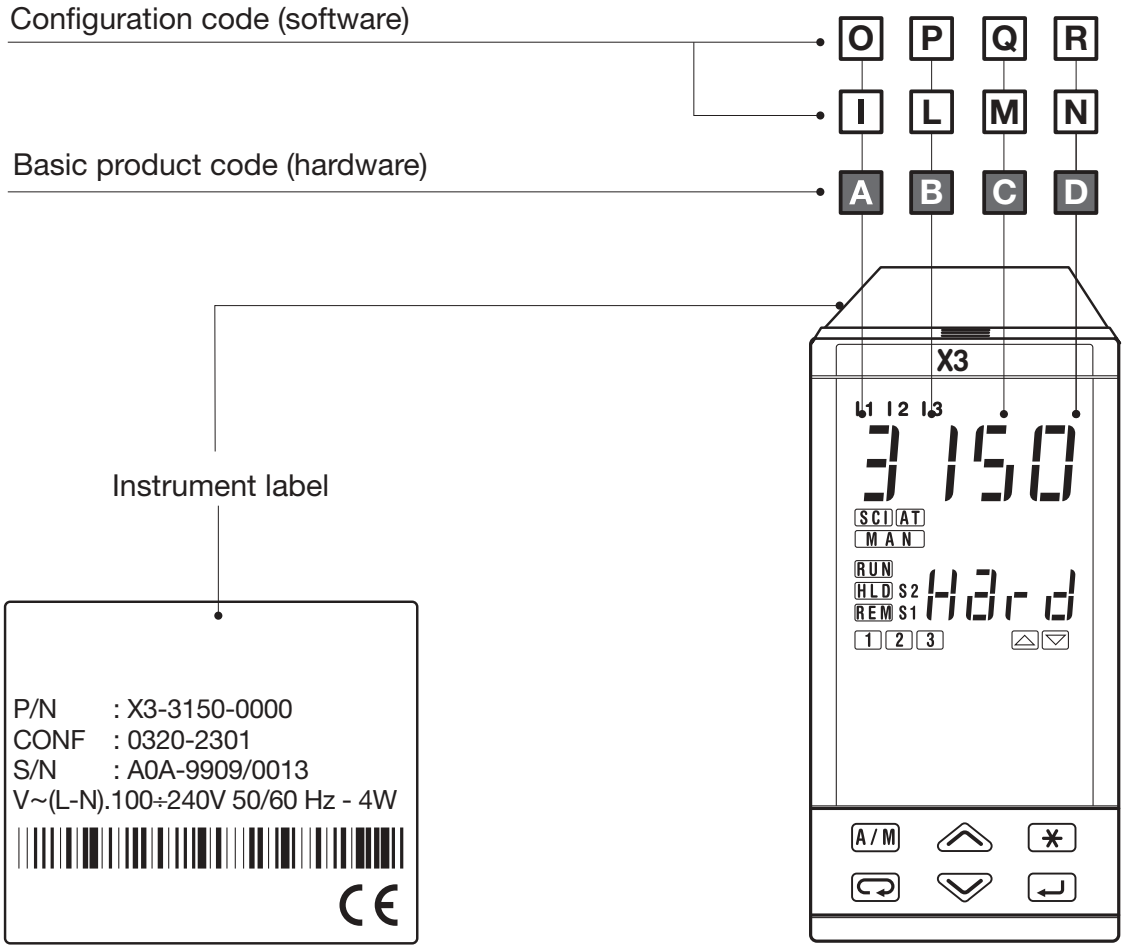



- Galvanic isolation 500Vac/1 min.
- Compliance to the EIA RS485 standard for Modbus/Jbus
- Setting dip switches



# 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 5.2 page 49.



## 3.1 MODEL CODE

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

| | Line | Basic | Accessories | Configuration 1st part | Configuration 2nd part |
|---|---|---|---|---|---|
| **Model:** | X 3 | A B C D | - E F G 0 | / I L M N | - O P Q R |

| Line | X 3 |
|---|---|

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

| Outputs OP1 - OP2 - OP4 | B |
|---|---|
| Relay - Relay - SSR Drive | 1 |
| Triac - Triac - SSR Drive | 5 |
| Relay - Relay - Relay | 9 |

| Serial Communications | C |
|---|---|
| None | 0 |
| RS485 Modbus/Jbus SLAVE | 5 |

| Options | D |
|---|---|
| None | 0 |
| Valve drive output | 2 |
| Analogue output + Remote Setpoint | 5 |
| Valve drive output + Analogue output (retr.) + Remote Setpoint | 7 |

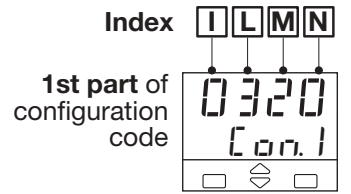
| Setpoint Programmer - special function | E |
|---|---|
| Not fitted | 0 |
| Start-up + Timer | 2 |
| One "8 segments" program | 3 |

| User manual | F |
|---|---|
| Italian/English (std) | 0 |
| French/English | 1 |
| German/English | 2 |
| Spanish/English | 3 |

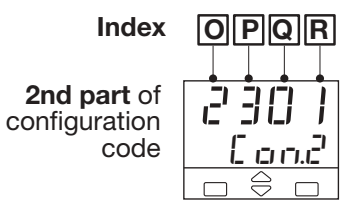
| Front panel colour | G |
|---|---|
| Dark (std) | 0 |
| Beige | 1 |

## 3.2 CONFIGURATION CODING

**A 4+4 index code follows the model of the controller.**
**The code has to be set to configure the controller**
**(see chapter 3.1 page 19)**




E.g. Enter the code 0320 to choose:
- T/C type J input with range 0...600°C
- Single P.I.D. control algorithm , reverse action
- Relay output




E.g. Enter the code 2301 to choose:
- AL1 absolute, active high
- AL2 absolute, active low
- AL3 Used by Timer
- Local + 2 Stored Setpoints with tracking function

| Input type and range | | | I | L |
|---|---|---|---|---|
| TR Pt100 IEC751 | -99.9…300.0 °C | -99.9…572.0 °F | 0 | 0 |
| TR Pt100 IEC751 | -200…600 °C | -328…1112 °F | 0 | 1 |
| TC L Fe-Const DIN43710 | 0…600 °C | 32…1112 °F | 0 | 2 |
| TC J Fe-Cu45% Ni IEC584 | 0…600 °C | 32…1112 °F | 0 | 3 |
| TC T Cu-CuNi | -200 …400 °C | -328…752 °F | 0 | 4 |
| TC K Chromel-Alumel IEC584 | 0…1200 °C | 32…2192 °F | 0 | 5 |
| TC S Pt10%Rh-Pt IEC584 | 0…1600 °C | 32…2912 °F | 0 | 6 |
| TC R Pt13%Rh-Pt IEC584 | 0…1600 °C | 32…2912 °F | 0 | 7 |
| TC B Pt30%Rh Pt6%Rh IEC584 | 0…1800 °C | 32…3272 °F | 0 | 8 |
| TC N Nicrosil-Nisil IEC584 | 0…1200 °C | 32…2192 °F | 0 | 9 |
| TC E Ni10%Cr-CuNi IEC584 | 0…600 °C | 32…1112 °F | 1 | 0 |
| TC Nl-NiMo18% | 0…1100 °C | 32…2012 °F | 1 | 1 |
| TC W3%Re-W25%Re | 0…2000 °C | 32…3632 °F | 1 | 2 |
| TC W5%Re-W26%Re | 0…2000 °C | 32…3632 °F | 1 | 3 |
| Dc input 0…50mV linear | Engineering and units | | 1 | 4 |
| Dc input 10…50mV linear | Engineering and units | | 1 | 5 |
| Custom input and range **[1]** | | | 1 | 6 |

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

| Control mode | | M |
|---|---|---|
| ON-OFF reverse action | | 0 |
| ON-OFF direct action | | 1 |
| P.I.D. single reverse action | | 2 |
| P.I.D. single direct action | | 3 |
| P.I.D. double action | Linear cool output | 4 |
| | ON-OFF cool output | 5 |
| | Water cool output **[2]** | 6 |
| | Oil cool output **[2]** | 7 |

| Output configuration | | N |
|---|---|---|
| **Single action** | **Double action** | |
| Relay (OP1) | Heat OP1, Cool OP2 | 0 |
| SSR drive (OP4) | Heat OP1, Cool OP4 | 1 |
| Analogue (OP5) | Heat OP4, Cool OP2 | 2 |
| Valve drive (OP1 and OP2) | Heat OP1, Cool OP5 | 3 |
| | Heat OP5, Cool OP2 | 4 |
| | Heat OP4, Cool OP5 | 5 |
| | Heat OP5, Cool OP4 | 6 |

**[2]** In consideration of the thermal characteristics of the different cooling liquids, 2 different correcting methods of the control output are available. One for water and the other for oil

OP water = $100 \bullet (OP2/100)^{2}$ OP oil = $100 \bullet (OP2/100)^{1,5}$

**[3]** Only possible whether "Output configuration" **N** = 0 or 1) and HE.F.S. parameter is different to OFF , see page 31)

| Alarm 1 type and function | | O |
|---|---|---|
| Disabled | | 0 |
| Sensor break/Loop break alarm (LBA) | | 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 |

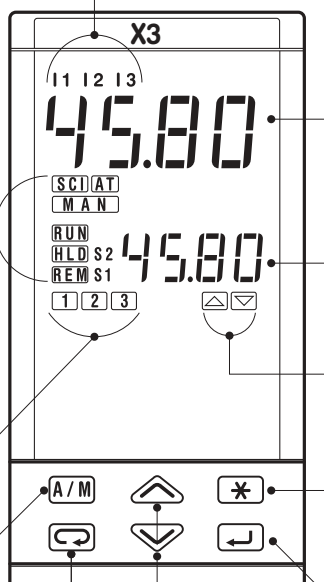
| Alarm 2 type and function | | P |
|---|---|---|
| Disabled | | 0 |
| Sensor break/Loop break alarm (LBA) | | 1 |
| Absolute | active high | 2 |
| | active low | 3 |
| Deviation | active high | 4 |
| | active low | 5 |
| Band | active out | 6 |
| | active in | 7 |
| Heater break by CT **[3]** | active during ON output state | 8 |
| | active during OFF output state | 9 |

| **Alarm 3 type and function** | | **Q** |
|---|---|---|
| Disabled or used by Timer or related to the program | | **0** |
| Sensor break/Loop break alarm (LBA) | | **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** |

| **Setpoint type** | **R** |
|---|---|
| Local only | **0** |
| Local and 2 tracking stored Setpoints | **1** |
| Local and 2 Stand-by stored Setpoints | **2** |
| Local and Remote (only if option is installed) | **3** |
| Local with trim (only with remote Setpoint) | **4** |
| Remote with trim (only if option is installed) | **5** |
| Time programmable (if option installed) | **6** |

# 4 OPERATIONS

## 4.1.1 KEYS FUNCTIONS AND DISPLAY IN OPERATOR MODE




**Digital input status LEDs (yellows)**

**I 1** - IL1 active
**I 2** - IL2 active
**I 3** - IL3 active

**8 Status LEDs (greens)**

SCI Communications running
AT Tuning running
MAN Manual operating mode
RUN Timer/Program running
HLD Program Waiting
REM Remote Setpoint active
**S1** First stored Setpoint active
**S2** Second stored Setpoint active

**Alarm status LEDs (reds)**

1 AL1 ON
2 AL2 ON
3 AL3 ON

**Auto/Man**

**PV control input** in engineering units

Over range

Under range

**SP operating Setpoint** (Local/Remote or Stored)

**Control output LEDs (red)**

▲ OP1 ON - ▼ OP2 OFF

**Run/stop Timer or a program**

**Entry key for selection and value setting confirmation**

**Setpoint setting**

**Menu access**

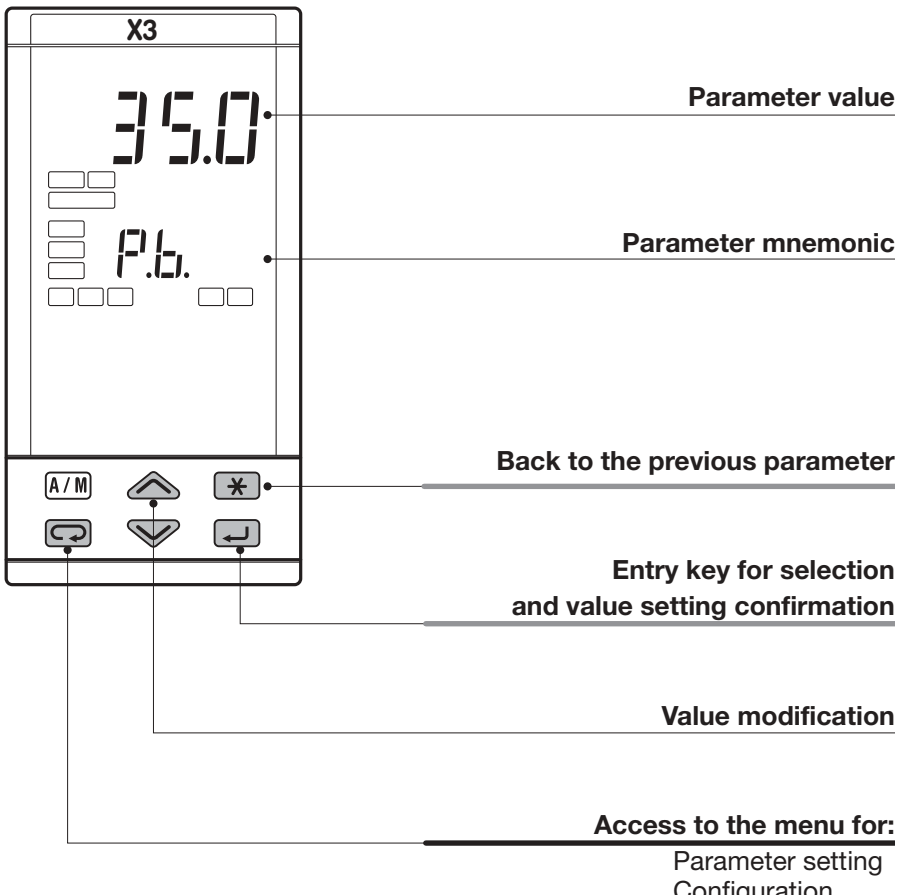
## 4.1.2 KEYS FUNCTIONS AND DISPLAY IN PROGRAMMING MODE

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 25)
The value is entered when the next parameter is selected, by pressing the key.

Until the or are pressed or if you wait for 30 seconds the parameter value is not inserted

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



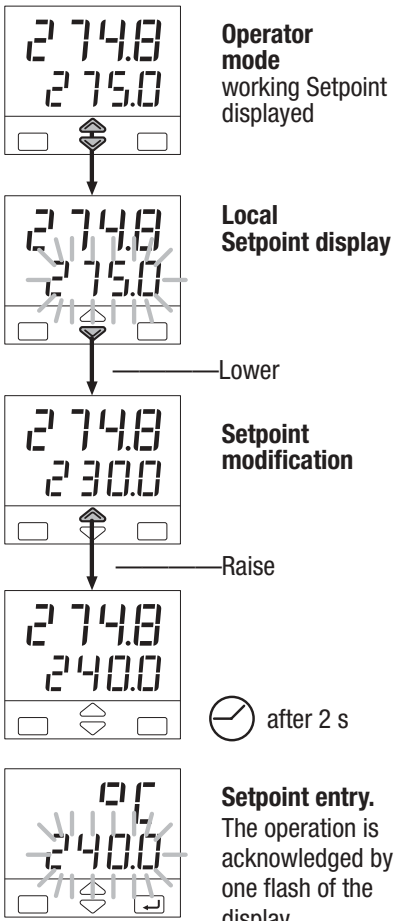
## 4.2 PARAMETER SETTING

### 4.2.1 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.

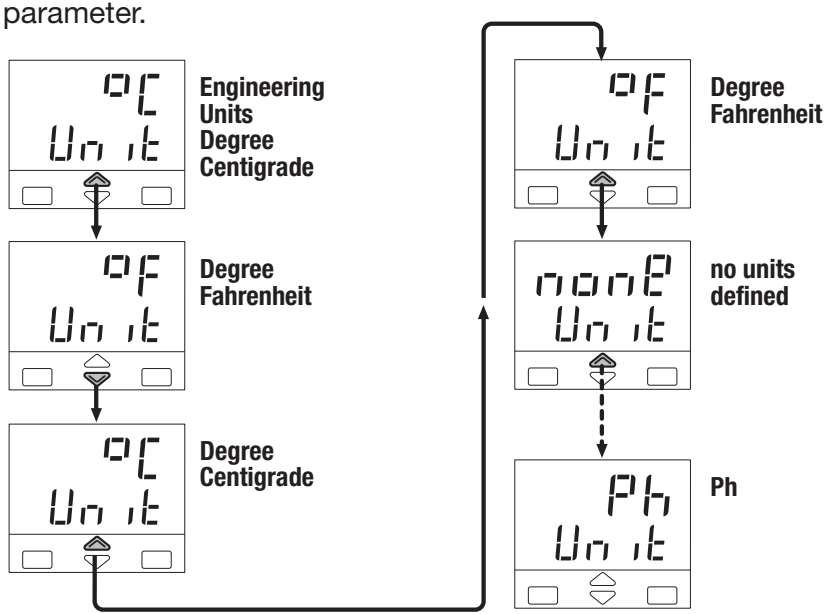
**In case of Setpoint modification: press ⌃ or ⌄ once to display the local Setpoint instead of working Setpoint.**
**To evidence this change the display flashes once. Then the Setpoint can be modified**



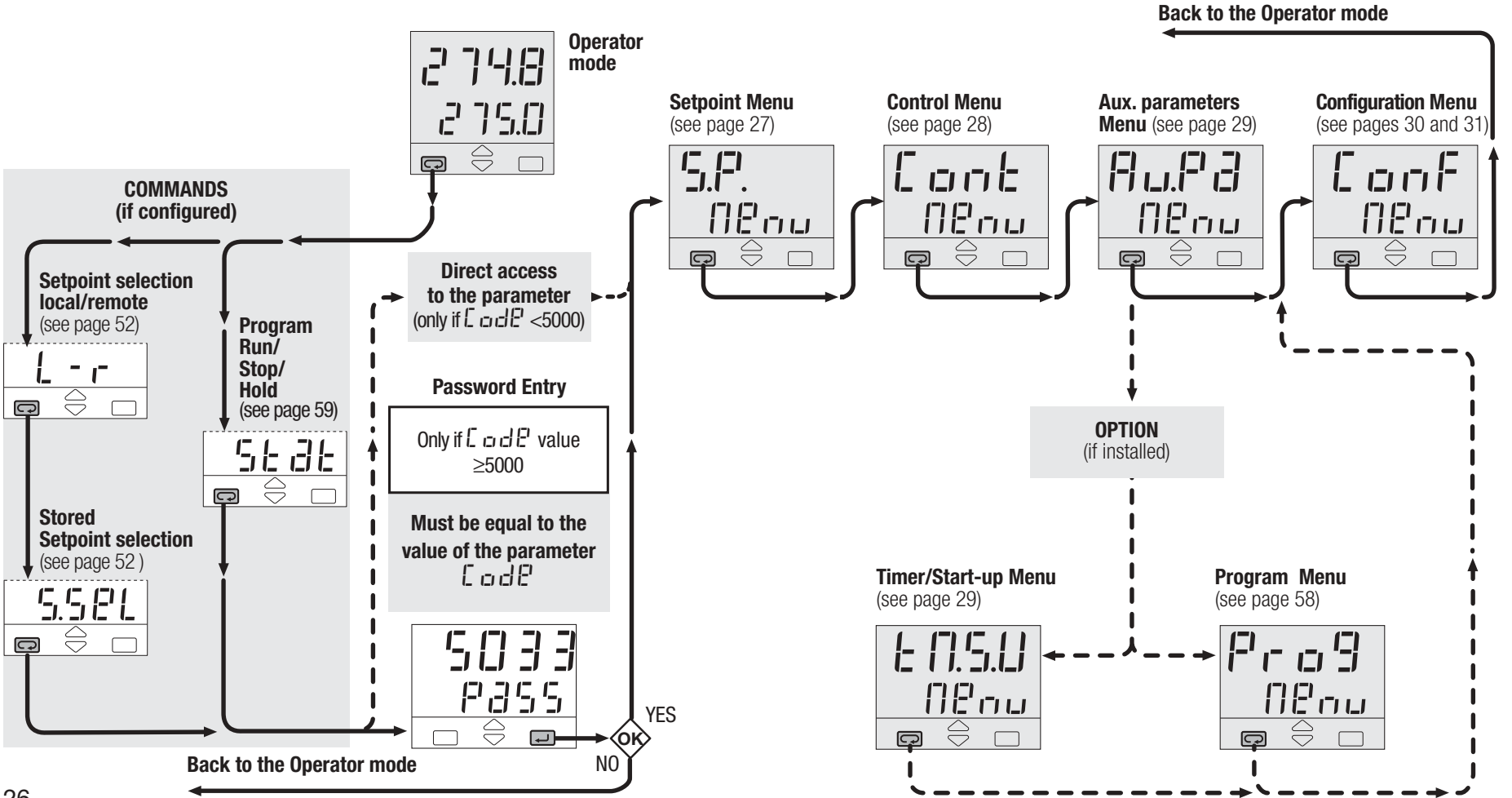

### 4.2.2 MNEMONIC CODES SETTING

**(e.g. configuration see page 30)**

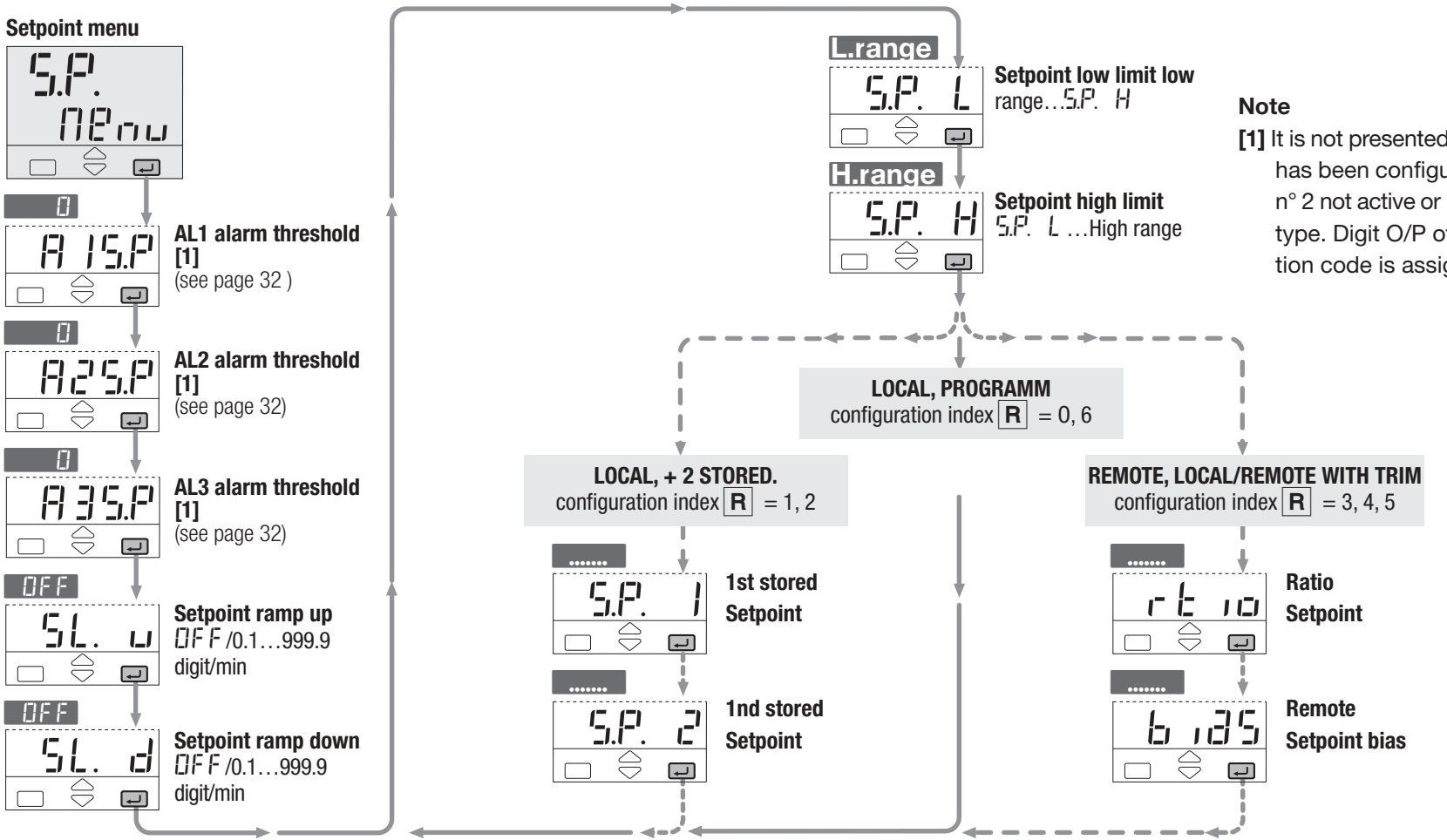
Press the ⌃ or ⌄ to display the next or previous mnemonic for the selected parameter.
Continued pressing of ⌃ or ⌄ will display further mnemonics at a rate of one mnemonic every 0.5 s. The mnemonic displayed at the time the next parameter is selected, is the one stored in the parameter.



## 4.3 PARAMETERISATION - MAIN MENU



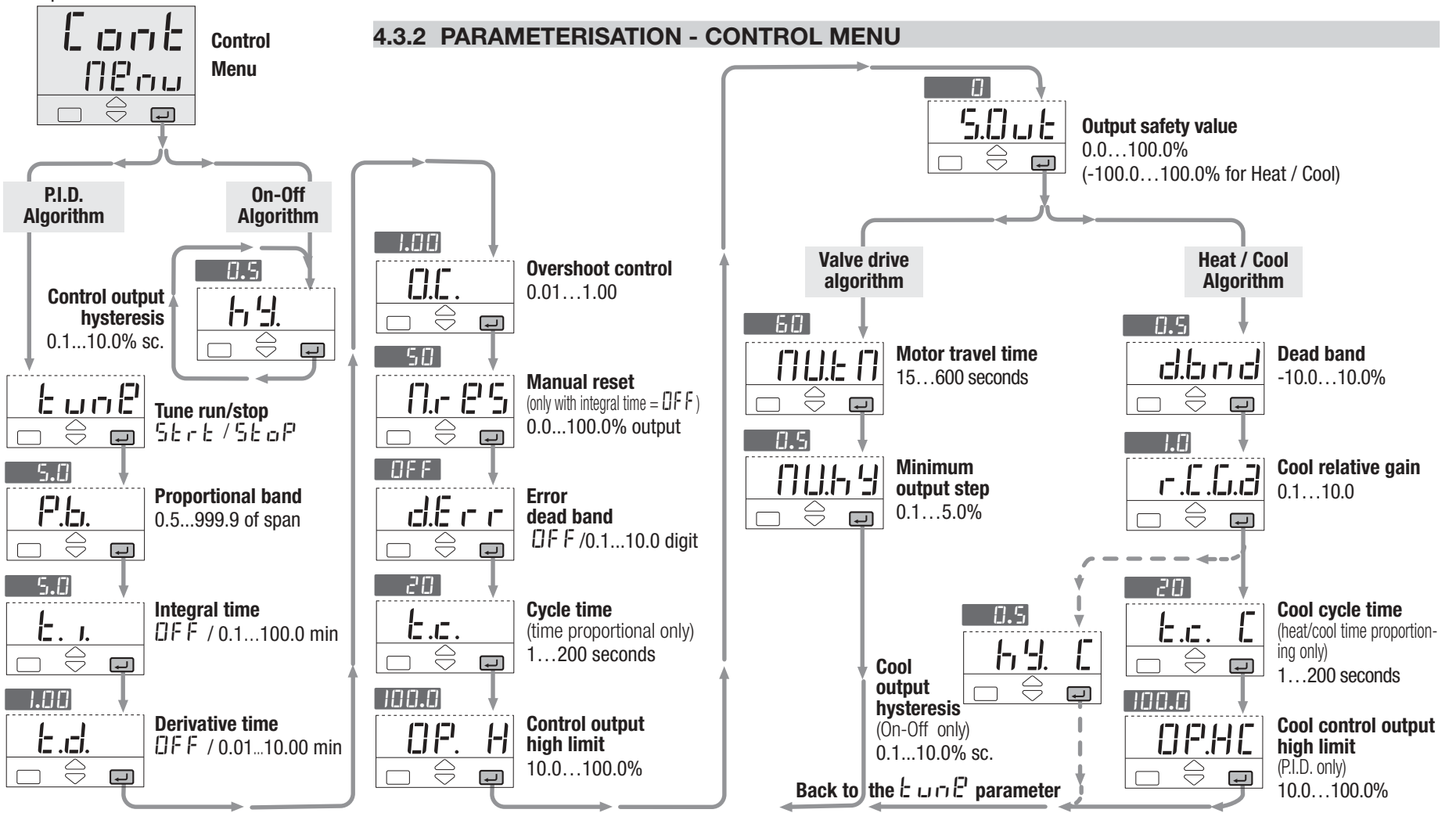
## 4.3.1 PARAMETERISATION - SETPOINT MENU



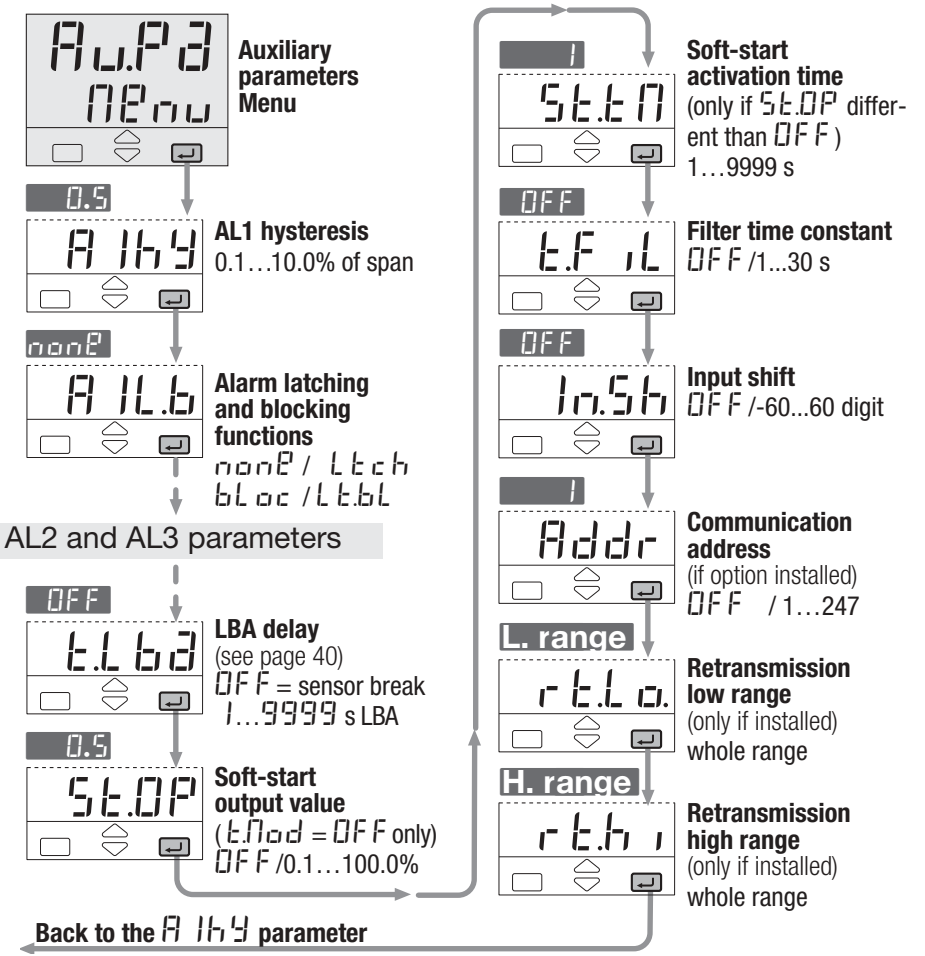

**Note**

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

## 4.3.2 PARAMETERISATION - CONTROL MENU

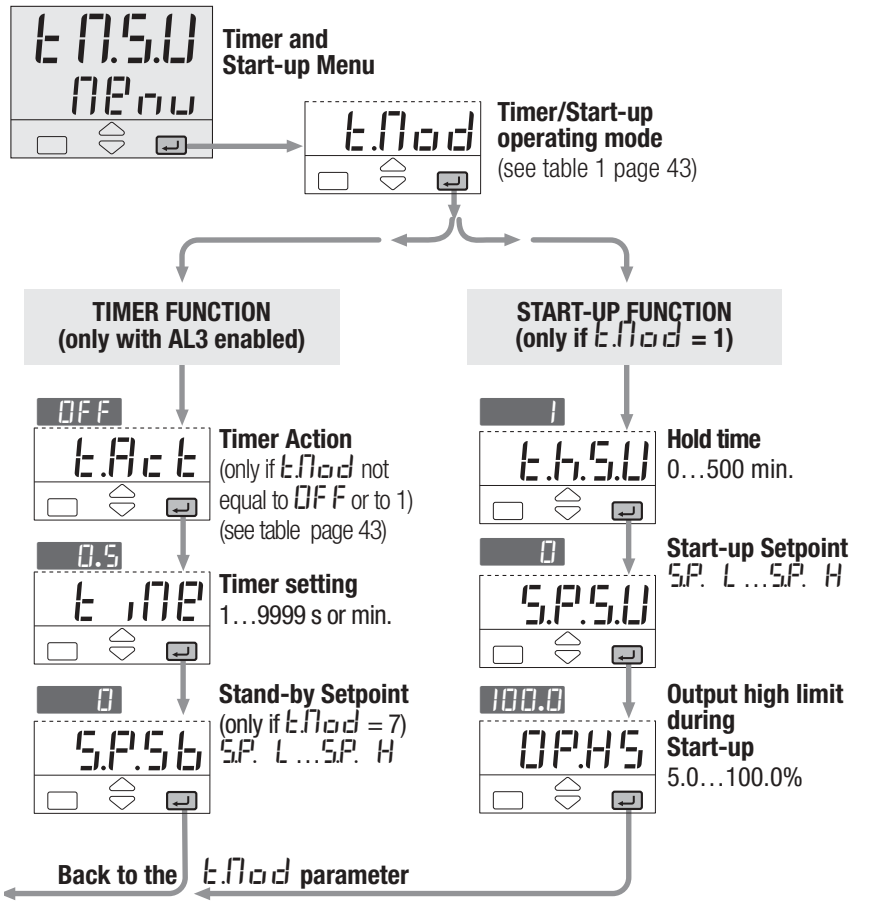


## 4.3.3 PARAMETERISATION - AUXILIARY PARAMETERS MENU




## 4.3.4 PARAMETERISATION - TIMER AND START-UP MENU

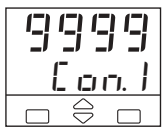
### If options installed



## 4.3.5 CONFIGURATION MENU

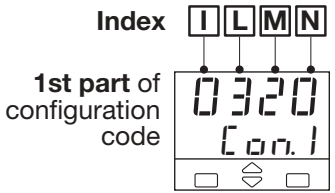
**Enter the password before accessing to the configuration menu.**

If a not configured controller is supplied, when powered up for the first time, the display shows:

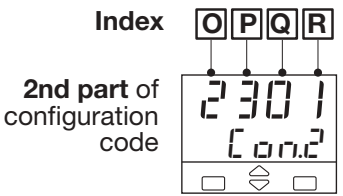



Until the configuration code is set correctly, the controller remains in stand-by with input and output deactivated.

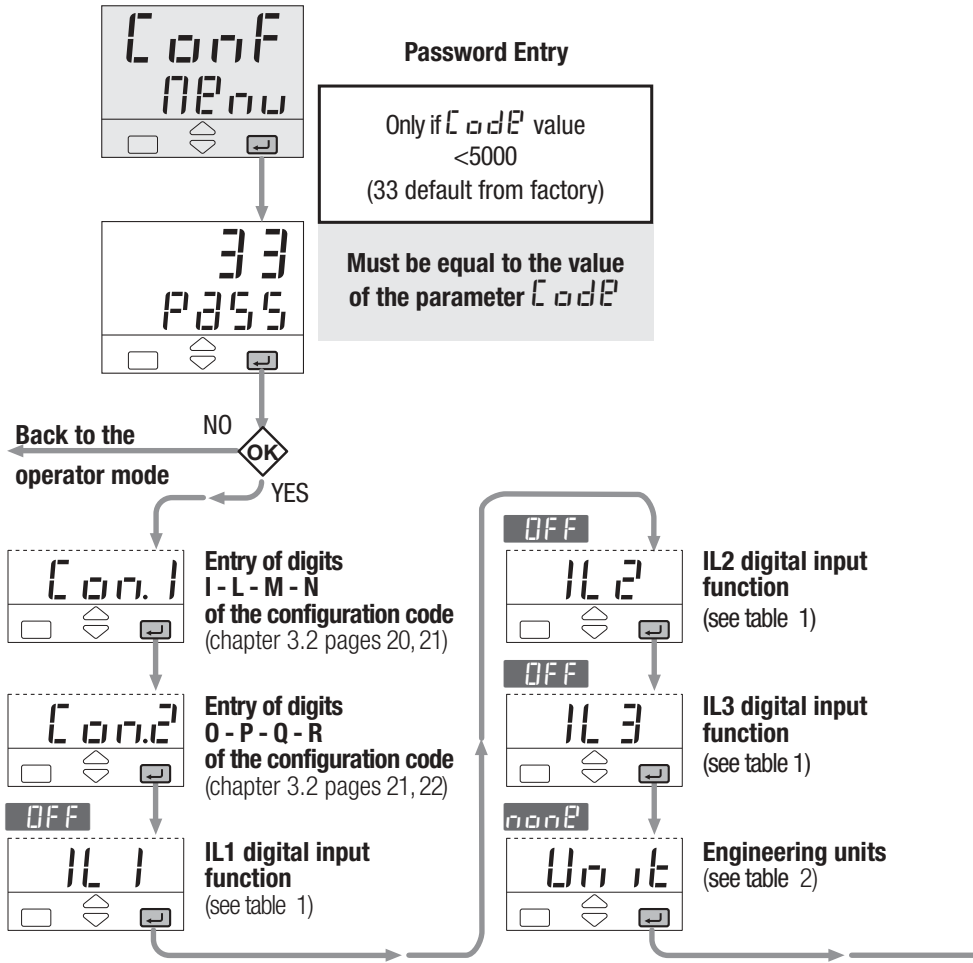
**A 4+4 index code follows the model of the controller.**
**It has to be set to configure the controller.**
**(see chapter 3.1 page 19)**




E.g. Enter the code 0320 to choose:
- T/C type J input with range 0...600°C
- Single P.I.D. control algorithm , reverse action
- Relay output




E.g. Enter the code 2301 to choose:
- AL1 absolute, active high
- AL2 absolute, active low
- AL3 Used by Timer
- Local + 2 Stored Setpoints with Tracking function



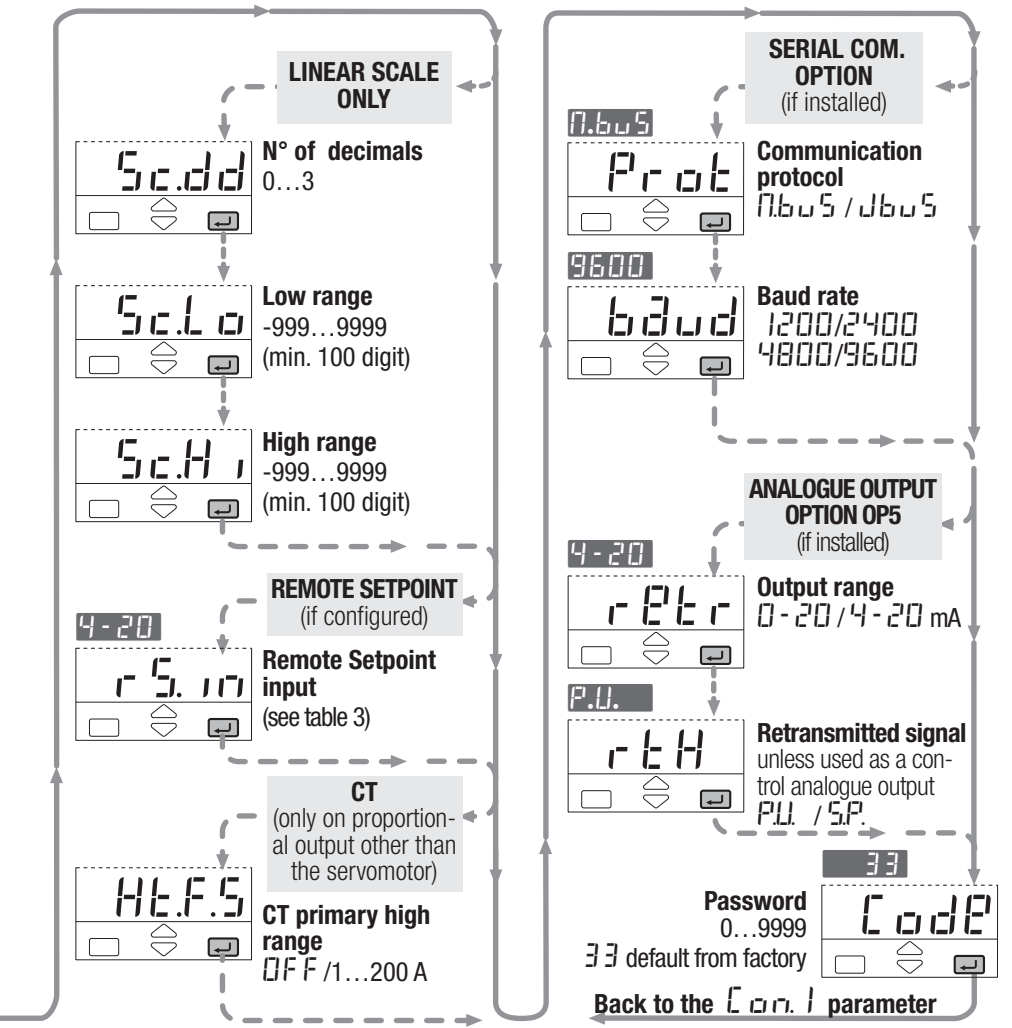



**Table 1 - Digital input functions**

| IL 1 | | IL 2 | | IL 3 |
|---|---|---|---|---|
| Value | Description | Value | Description |
| nonE | Not used | S.P. 1 | 1st stored Setpoint |
| KEY.I | Keyboard lock | S.P. 2 | 2st stored Setpoint |
| H.PU | Measure Hold | Strt | Run Timer |
| A.Man | Auto/Man | r.-H. | Run/stop of a program |
| L-r | Local/Remote | | |

**Table 2 - Engineering units**

| unit | | | |
|---|---|---|---|
| Value | Description | Value | Description |
| °C | degree centigrade | A | Ampere |
| °F | degree Fahrenheit | bar | Bar |
| nonE | none | PSI | PSI |
| mV | mV | rh | Rh |
| V | Volt | Ph | pH |
| mA | mA | | |

**Table 3 - Remote Setpoint input type**

| rS. In | | | |
|---|---|---|---|
| Value | Description | Value | Description |
| 0-5 | 0…5 Volt | 0-20 | 0…20 mA |
| 1-5 | 1…5 Volt | 4-20 | 4…20 mA |
| 0-10 | 0…10 Volt | | |

## 4.4 PARAMETERS

For a simpler use of the controller, its parameters have been organised in groups (menu), according to their functionality area.

### 4.4.1 SETPOINT MENU

**The OP1, OP2 or OP3 outputs, can be used for alarms if they are not used as control outputs**

It is possible to configure up to 4 alarms: AL1, AL2, AL3, AL4 (see pages 21 and 22), selecting, for each of them:

**A** the type and the operating condition of the alarm

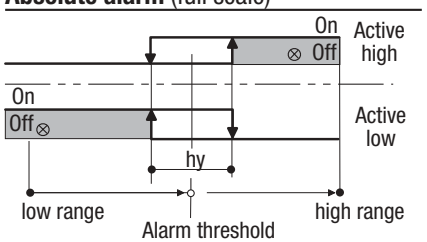
**B** the functionality of the alarm acknowledgement (latching) LtcH (see page 39)

**C** The blocking function is activated on start up (see p. 39)

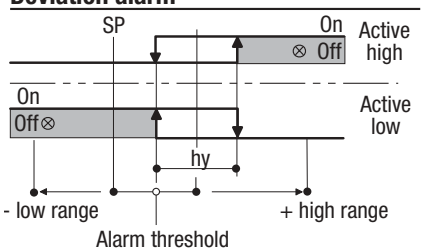
**D** Loop break or sensor break (see page 40)

**A ALARM TYPE AND OPERATION CONDITIONS**

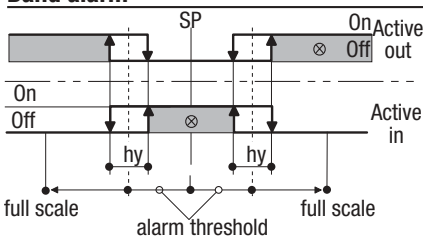
**Absolute alarm** (full scale)




**Deviation alarm**




**Band alarm**




A 1S.P **AL1 alarm threshold**

A2S.P **AL2 alarm threshold**

A3S.P **AL3 alarm threshold**

Alarm occurrences of OP1,OP2 and OP3 outputs, respectively linked to AL1, AL2 and AL3.

The range of the alarm threshold correspond to the whole span and it is not limited by the SP Setpoint span.

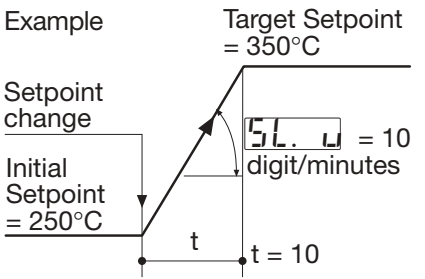
When the event occures, the display will shows the red leds 1, 2 or 3, respectively on.

**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 and the new Setpoint is reached immediately after being entered.**
Otherwise, the Setpoint value is reached according to the configured rate of change.
The new Setpoint value is called "Target Setpoint". It can be displayed by means the parameter t.SP.
(see procedure at page 49).

When Remote Setpoint is configured, we suggest to disable SL. u and SL. d parameters OFF.




**SP. L Setpoint low limit**
**SP. H Setpoint high limit**

Low / high limit of the Setpoint value.

**SP. 1 1st stored Setpoint**
**SP. 2 2nd stored Setpoint**

Values of the two Setpoints, that are activated by mean of digital inputs, communication parameters, and keypad. The Setpoint active is indicated by the S1 or S2 green led.

**If index R = 1** (tracking),
the previous Local Setpoint value will be lost, when the stored Setpoint is selected.

**If index R = 2** (Stand-by),
the Local Setpoint value will not be lost, when the Stand-by Setpoint is selected. It will operate again when back to Local.

See stored Setpoint selection procedure at page 52

## 4.4.1 SETPOINT MENU

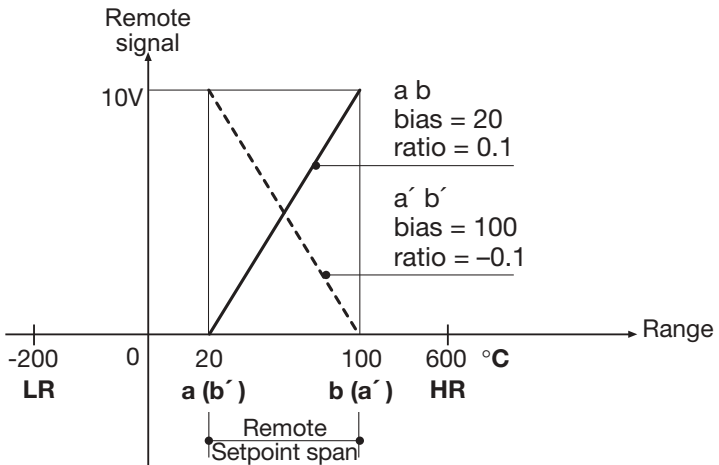
**rtio** **Remote Setpoint Ratio**

Ratio is the coeff. which defines the remote Setpoint span with respect to the input span.

**bIAS** **Remote Setpoint**

Bias defines the starting point of analogue Remote Setpoint in eng. units corresponding to the low limit (current or voltage) of the remote signal.

**Remote Setpoint Bias and Ratio**




PV = process variable
LR = PV low limit
HR = PV high limit
SR = Remote Setpoint
a (a´) = SR starting point
b (b´) = SR ending point

If SR starting point is **lower** then the ending point, both expressed in engineering units:

bIAS = starting point = a

$$rtio = \frac{b - a}{HR - LR}$$

Example:
bIAS = 20
rtio =

$$\frac{100 - 20}{600 - (-200)} = \frac{80}{800} = 0.1$$

If SR starting point is **higher** then the ending point, both expressed in engineering units

bIAS = starting point = a´

$$rt\ io = \frac{b' - a'}{HR - LR}$$

Example:
bIAS = 100
rt io =

$$\frac{20 - 100}{600 - (-200)} = \frac{-80}{800} = -0.1$$

**Working Setpoint (SP) as combination of Local Setpoint (SL) and remote signal**

Setpoint type LOCt
(configuration index **R** = 4 )
SP = SL + (rt io • REM) + bIAS

Setpoint type rEMt
(configuration index **R** = 5 )
SP = REM + (rt io • SL) + bIAS

SIGN = Remote signal percentage
SPAN = HR-LR

$$REM = \frac{SIGN * SPAN}{100}$$

Examples:
Local Setpoint (SL) with an external Trim with multiplying coeff. of 1/10:
Setpoint type = LOCt
rt io = 0.1
bIAS = 0

Remote Setpoint (SR) with an internal Trim with multiplying coeff. of 1/5:
Setpoint type = rEMt
rt io = 0.2
bIAS = 0

Remote Setpoint range equal to the Input range:
Setpoint type = LOCt
rt io = 1
bIAS = LR
SL = 0

## 4.4.2 CONTROL MENU

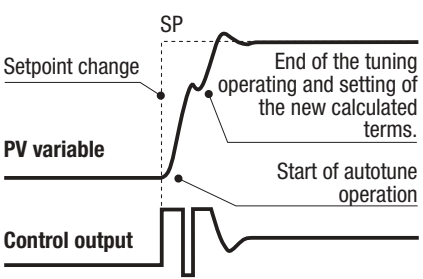
**Run Tuning**

### 4.4.2.1 AUTOMATIC TUNE

**The Fuzzy-Tuning** determines automatically the best P.I.D. term with respect to the process behaviour.

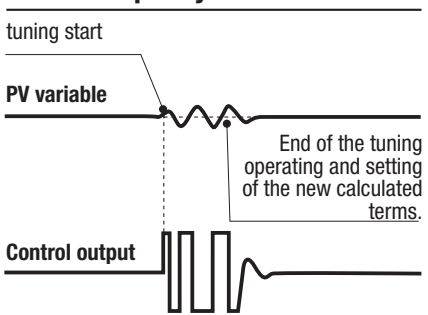
The controller provides 2 types of "one shot" tuning algorithm, that are selected automatically according to the process condition when the operation is started.

**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**



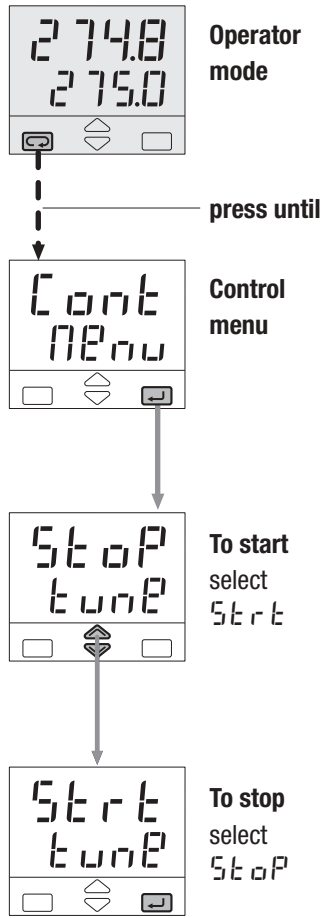

This type is selected when the PV is close to the SP Setpoint.
This method has the advantage of a better accuracy in the term calculation with a reasonable speed calculation.

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

**FUZZY-TUNING START/STOP PROCEDURE**

**Start/stop of the Fuzzy Tuning The Tuning operation can be started or stopped any time.**

The green led AT is 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 AT becomes off.



**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.

**Overshoot control**

This parameter specifies the span of action of the overshoot control. Setting lower values (1.00 –> 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.

**Manual Reset**

This specifies the control output value when PV = SP, in a PD only algorithm (lack of the integral term).

**Error Dead Band**

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

**Control output cycle time**

**Cool cycle time**

It's the cycle time of the time proportioning control output. The P.I.D. control output is provided by the pulse width modulation of the waveform.

**Control output high limit**

**Cool output high limit**

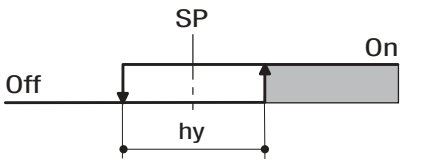
It specifies the maximum value the control output can be set. It is applied in manual mode, too.

**Output Safety Value**

Output Value in case of input anomaly

**Control output hysteresis**

**Cool output hysteresis**




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

**Travel time**

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

**Minimum 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

## 4.4.2 CONTROL MENU

### 4.4.2.2 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 dbnd, is the zone where it is possible to separate or overlap the Heat and Cool actions.

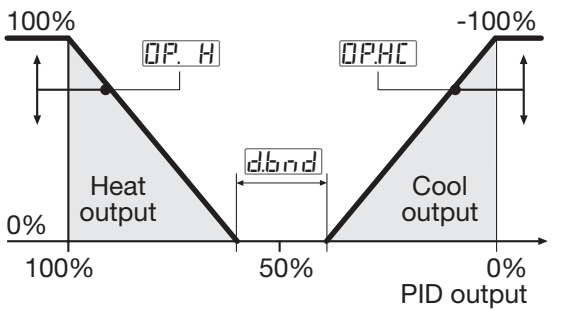
The Cool action can be adjusted using the relative cool gain parameter r.CGa.

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.

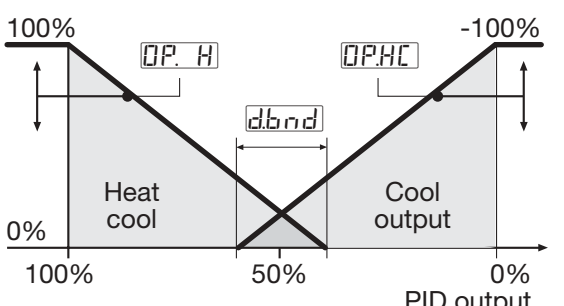
**A Heat /Cool actions separated**

Insert positive dbnd value (0…10%)



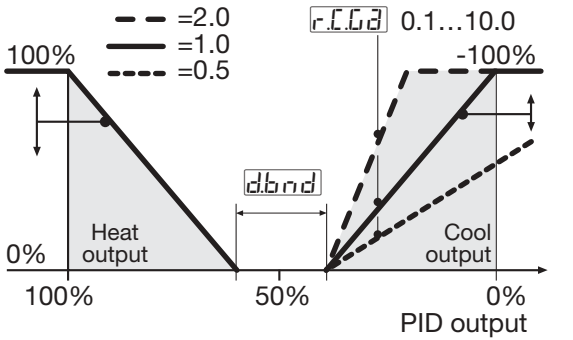

**B Heat /Cool actions overlapped**

Insert negative dbnd value (-10…0%)

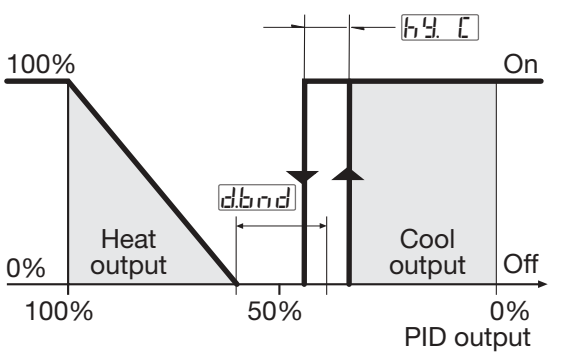



**C Cool action adjusting**

Example with different relative cool gains




**D On-Off Cool action**



## 4.4.3 AUXILIARY PARAMETERS MENU

**AL1 alarm hysteresis**
**AL2 alarm hysteresis**
**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.

**AL1, AL2, AL3 latching and blocking functions**

For each alarm it is possible to select the following functions

- none
- latching
- blocking
- both latching and blocking

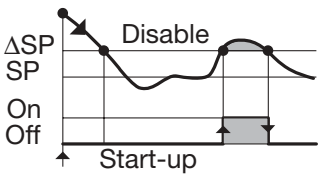
### ALARM ACKNOWLEDGE FUNCTION

The alarm, once occurred, is presented on the display until to the time of acknowledge. The acknowledge operation consists in pressing any key.

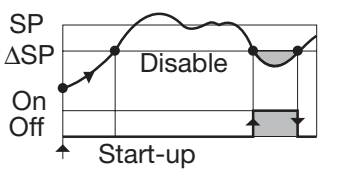
**After this operation, the alarm leaves the alarm state only when the alarm condition is no longer present.**

### START-UP DISABLING

**Ramp down**




**Ramp up**




ΔSP Threshold = SP ± range

## 4.4.2 CONTROL MENU

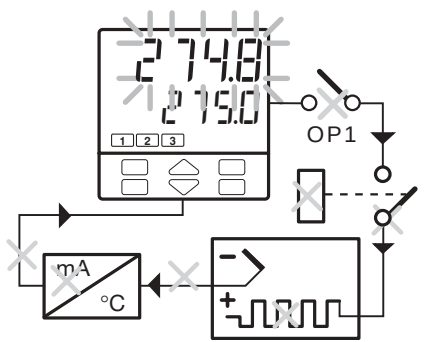
### ALARMS WITH LBA (LOOP BREAK ALARM) AND SENSOR BREAK OPERATION

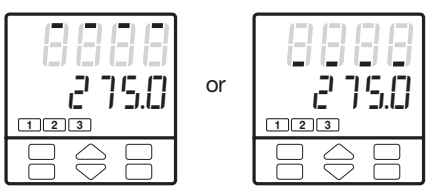
Select the code 1 on O , P or Q configuration indexes (see pages 21 or 22). The following parameter is then available:

**t.Lbd** **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:



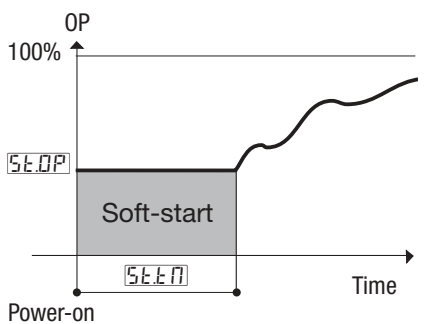




**Note [1]** In case of sensor break, condition, the alarm action is immediate.

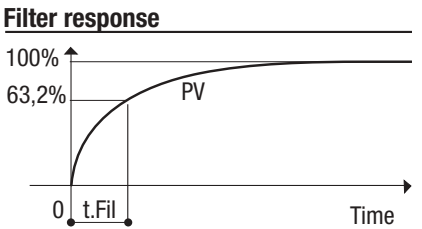
**When the cause of the alarm disappears, the alarm status stops.**

**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.




**t.F iL** **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.

**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

**rtLo** **Retransmission low range**

**rtHi** **Retransmission high range**

## 4.4.4 TIMER AND START-UP MENU (OPTION)

To improve the instrument performances and to reduce the wiring and installation costs, two special functions are available:

**4.4.4.1 Start-up**
**4.4.4.2 Timer**

In order to have the above functions the product code digit **E** must be **2** (see page 19)

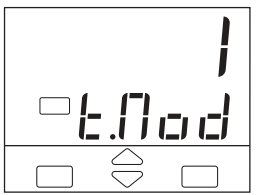
For example: X3 3100-**2**000
To select these functions use the parameter: (see page 43).

**tMod** **Timer/Start-up operator mode**

⚠ **Selecting Timer or Start-up, the Soft-start function is disabled, therefore the parameters StOP and StEn will not be shown.** (see page 29)

### 4.4.4.1 START-UP FUNCTION (OPTION)

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.
(see page 43)
Three parameters are associated to the Start-up function.

**tHSU** **Start-up hold time**
0…500 min.

**SPSU** **Start-up Setpoint**
(SP. L …SP. H)

**OPHS** **Control output high limit**
5.0%…100.0%

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 tHSU

3rd "Off" - When the tHSU 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 (SPSU - 40 digits), the Start-up function starts again from the "Limy" phase.

### 4.4.4.1 START-UP FUNCTION (OPTION)

**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).

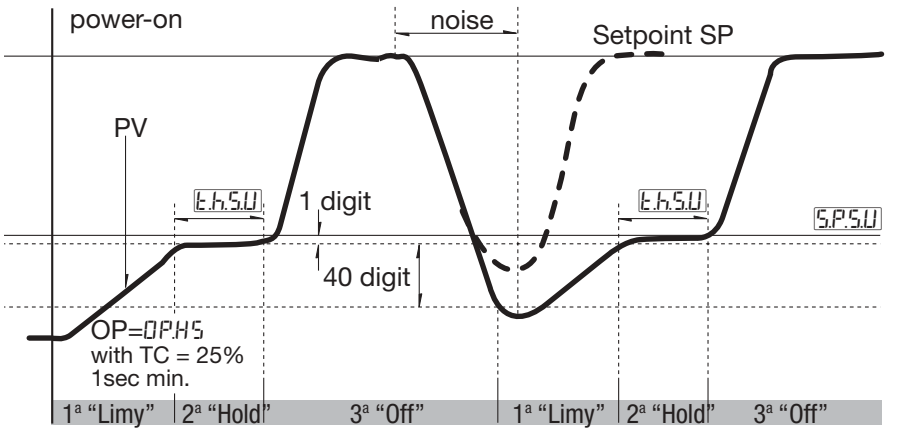
**B Start-up Setpoint SP.SU greater than or equal to the local Setpoint.**

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.

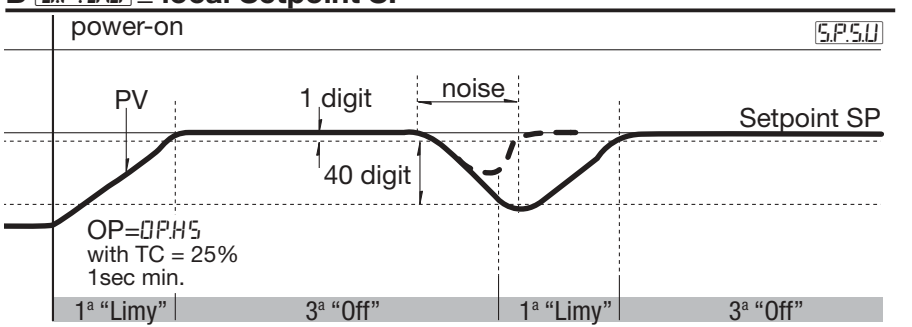
If, at the controller power-on, the process variable PV is greater than the lowest between the SP.SU and the working Setpoint , the next phase ("Hold" or "Off") will be executed instead of the "Limy" phase.


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

**A SP.SU < local Setpoint SP**




**B SP.SU ≥ local Setpoint SP**



### 4.4.4.2 TIMER FUNCTION (OPTION)

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

To enable this function do the following:

1 In order to use this AL3 function, index **Q** must be set to 0 in configuration (see page 22)
2 To select one of the 6 possible functioning modes of the Timer, set the value of the 2 following parameters in parameterisation (see p. 29).

**t.Mod Timer/Start-up operating mode**

By this parameter can be defined: (see table 1)
- the counting start time
- the control output status at the end of the counting

**table 1**

| Timer/Start-up counting mode | | Value |
|---|---|---|
| Disabled | | OFF |
| Start-up function | | 1 |
| 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 |

Now the other parameter values can be entered:

**t.Act Timer Action**

By this parameter can be defined:(see table 2)
- 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 | On | 0 |
| | | Off | 1 |
| | Auto at power ON [2] | On | 2 |
| | | Off | 3 |
| Minutes | Manual by keypad | On | 4 |
| | | Off | 5 |
| | Auto at power ON [2] | On | 6 |
| | | Off | 7 |

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

**t.tm Timer setting**

(1…9999 s/min.)

**SP.SB Stand-by Setpoint**

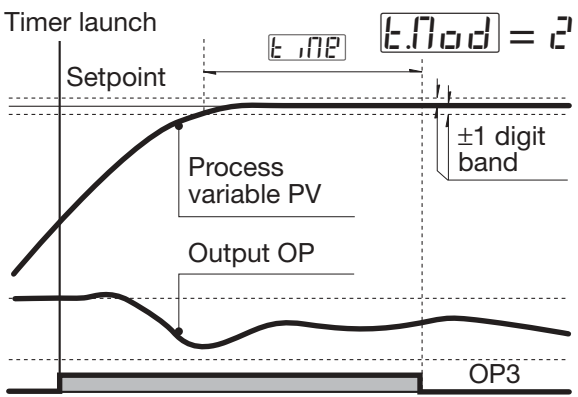
(only for t.Mod = 7)
(SP. L …SP. H)

### 4.4.4.2 TIMER FUNCTION (OPTION)

## TIMER COUNTING MODES

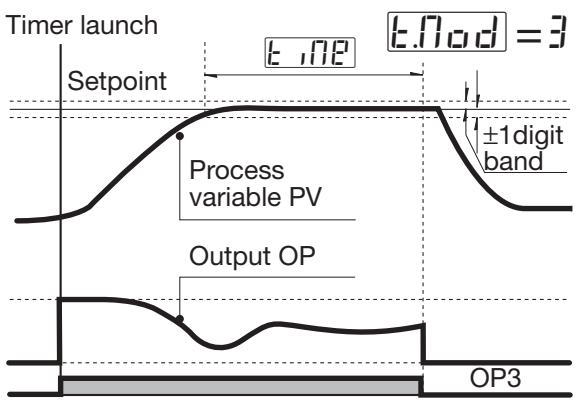
**A - Counting start time inside the band, end in control mode.**

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.**

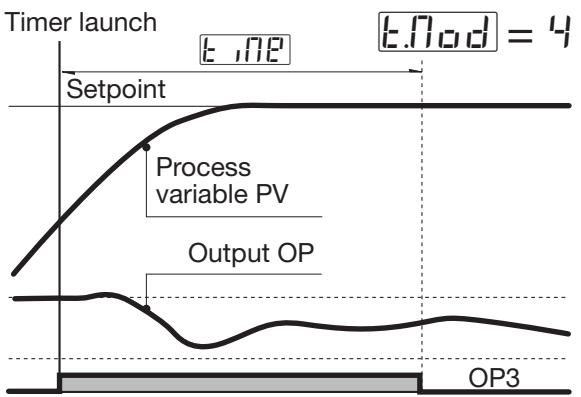
The time counting starts only when the error is inside a ± 1 digit band. At the end, the control output is forced to zero. [1]




[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.**

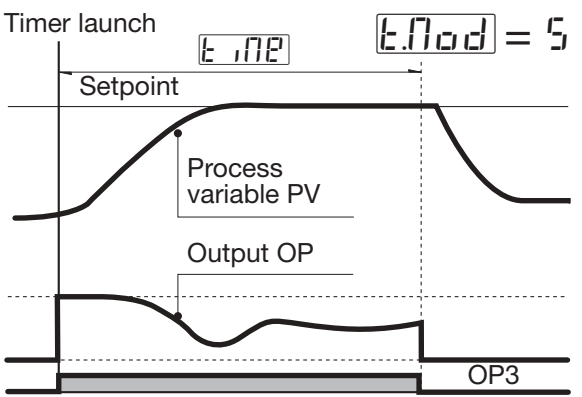
The time counting starts when the timer is launched. The control action is not affected by the Timer function.



## TIMER COUNTING MODES

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

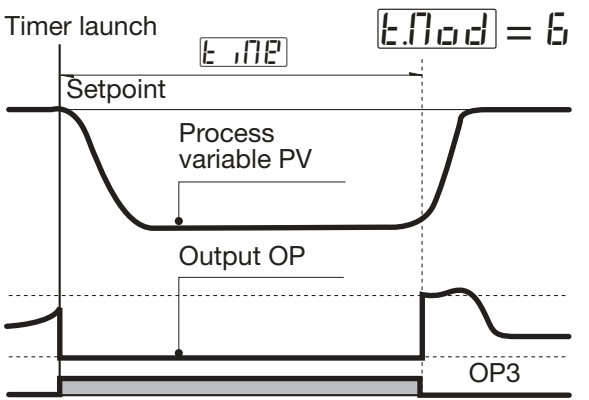
The time counting starts when the timer is launched. At the end, the control output is forced to zero. [1]




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

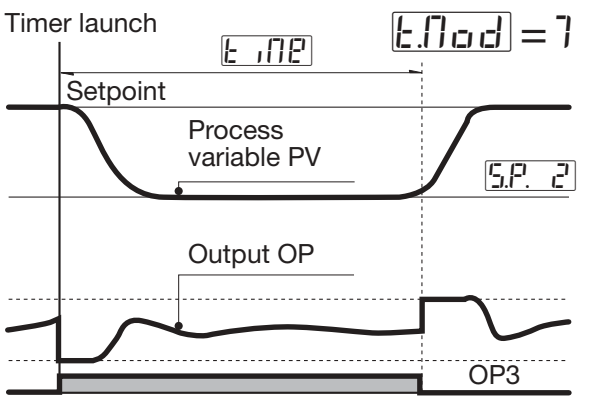
### E - No control action during the counting time.

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




### 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.



## 4.4.4.2 TIMER FUNCTION (OPTION)

### POWER FAILURE

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

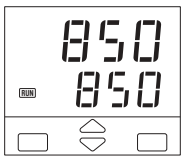
Depending on Timer action [t.dct] selection, when the controller restarts you can have two different situations:

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

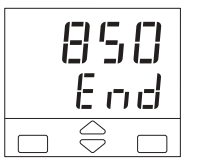
### TIMER STARTING

See the Timer starting procedure at page 50 (chapter 6.2.2)

### DISPLAY



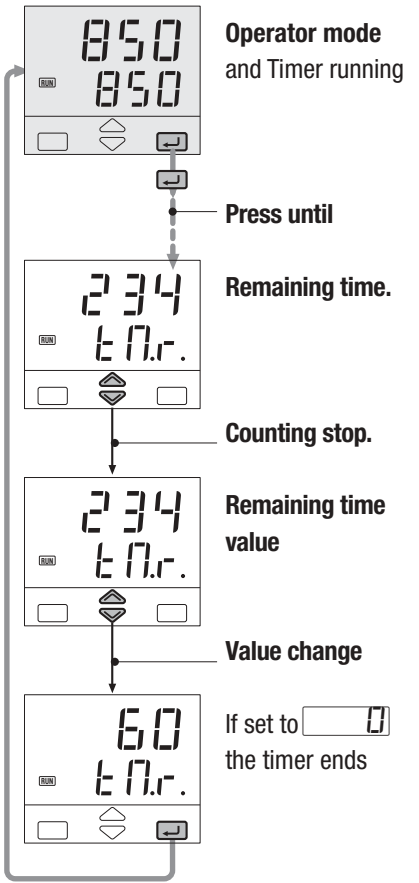

When the Timer is running, the led [RUN] is on.




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

### TIMER REMAINING TIME

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



## 4.4.5 CONFIGURATION MENU

### RETRANSMISSION

When OP5 output is present and not configured as control output, it retransmits linearised PV or SP.
On configuration (see page 31) it is possible to set

**rEtr** **Analogue range**
0-20 / 4-20

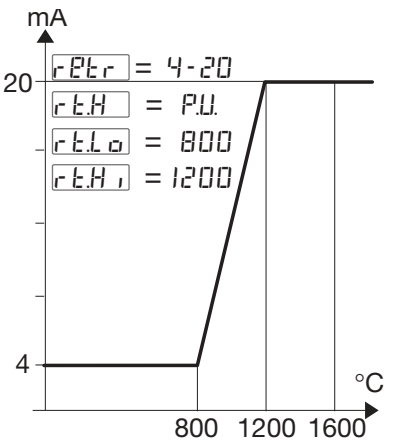
**rtH** **Retransmitted signal**
nonE PV. / SP.

The following parameters define the low and high range of the OP5 retransmission output corresponding to 0…4mA or 20mA (see page 29):

**rtLo** **Retransmission low range**

**rtH** **Retransmission high range**

Example:
- T/C S, range 0…1600°C
- Output range, 4…20 mA
- Retransmitted signal PV on 800…1200°C range




**With rtLo greater than rtH it is possible to obtain a reverse scale.**

### CURRENT TRANSFORMER INPUT

With CT option, it is possible to display the load current and set an alarm threshold.

The setting can be done by means the 8 or 9 configuration index of the codes O, P or Q (see pages 21 and 22).
It is possible to set one of the alarms (see pages 21 and 22) to have an alarm when, during the ON time of the time proportional output, the load current is less then the specified threshold (index 8), or during the OFF time there is a value > 3% of full scale load current.

The alarm condition must be longer than 120 ms to set the alarm.
By the parameter

**HtFS** **CT primary high range**
OFF / 1…200A

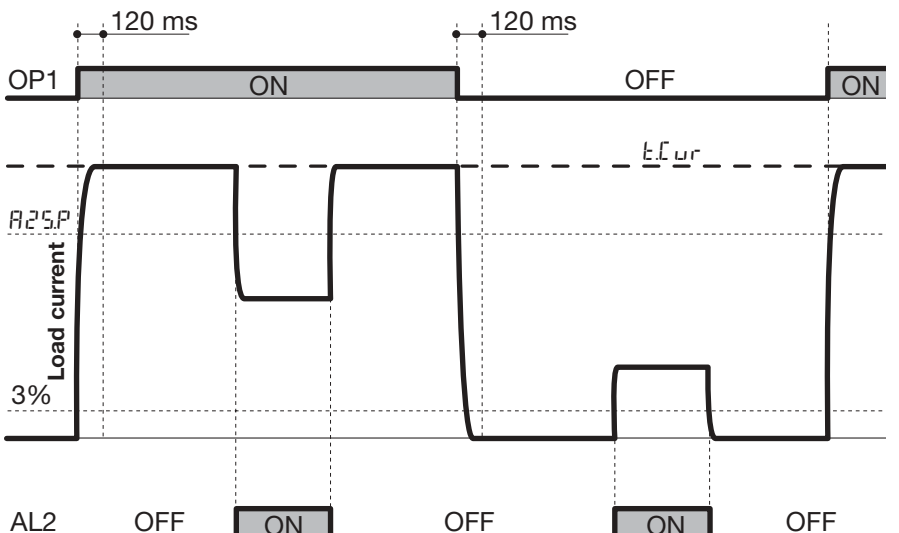
the load current display can be adapted to the transformer characteristics. (OFF means disabled)

During the OFF time the parameter tCur latches the last on time current value

## 4.4.5 CONFIGURATION MENU

### CURRENT TRANSFORMER INPUT

**Example:**
CT input on OP1, alarm on AL2 during on time (configuration digit **P** = 8 , see page 21)



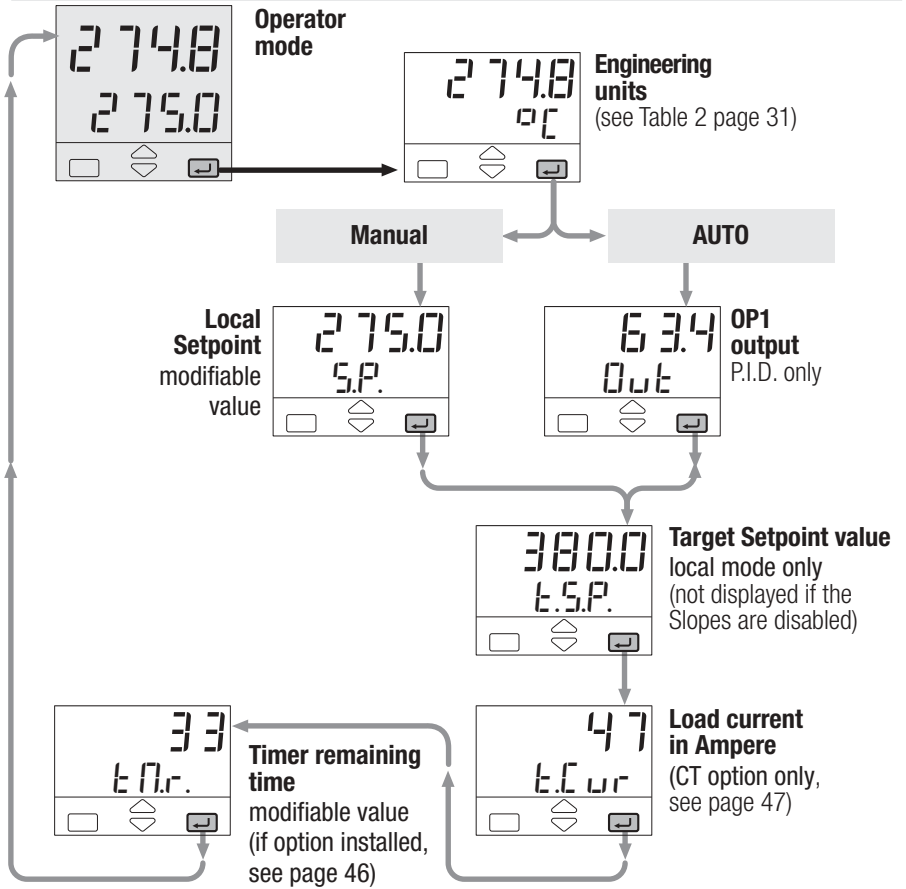

### SERIAL COMMUNICATIONS

**Communication protocol**
Modbus/Jbus

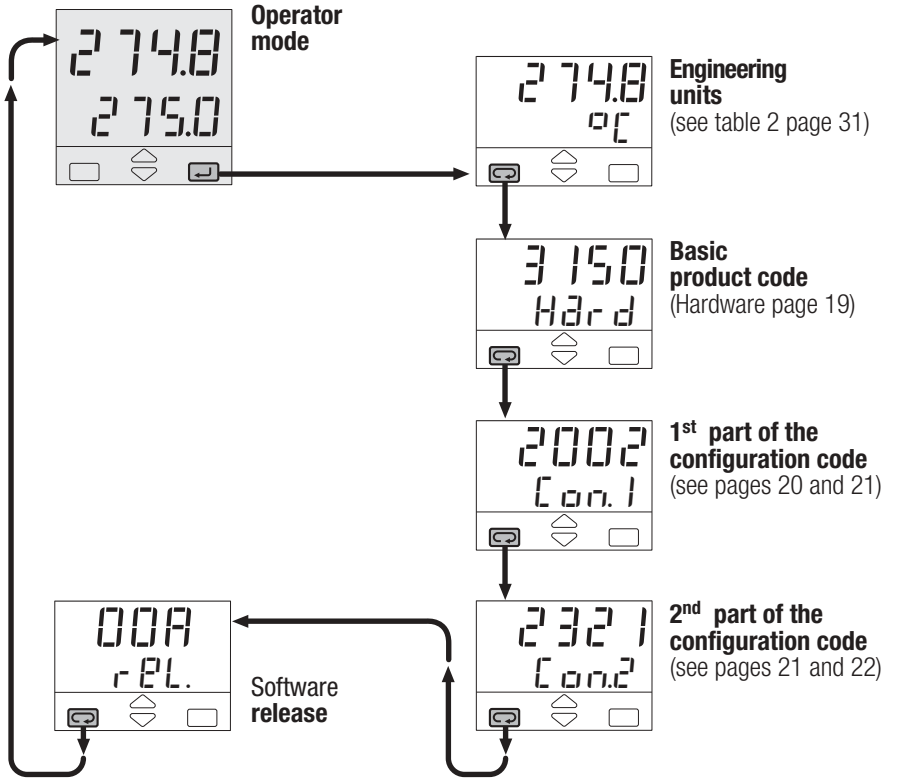
**Baud rate**
1200/2400
4800/9600

# 5 DISPLAYS

## 5.1 OF THE PROCESS VARIABLES



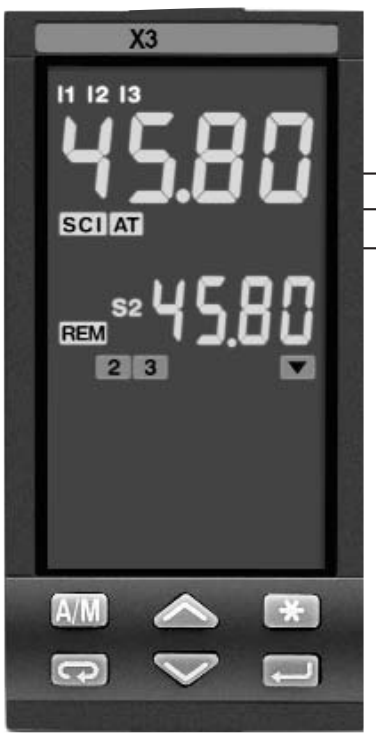

## 5.2 OF THE CONFIGURATION CODES



# 6 COMMANDS

## COMMANDS TO THE CONTROLLER AND OPERATING PHASES

The commands can be entered in 3 ways:



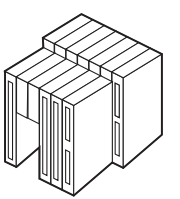

### 6.1 KEYPAD

see page 51

- Setpoint modification
- manual mode
- Timer start
- Program start/stop
- local/remote selection
- stored Setpoint display
- Keypad lock
- Outputs lock

### 6.2 DIGITAL INPUTS

see page 54



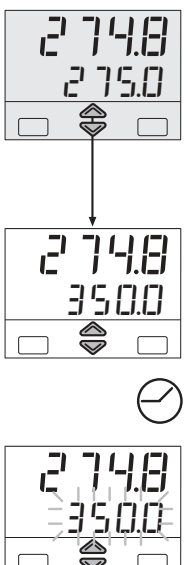
### 6.3 SERIAL COMMUNICATIONS

see the manual on this topic

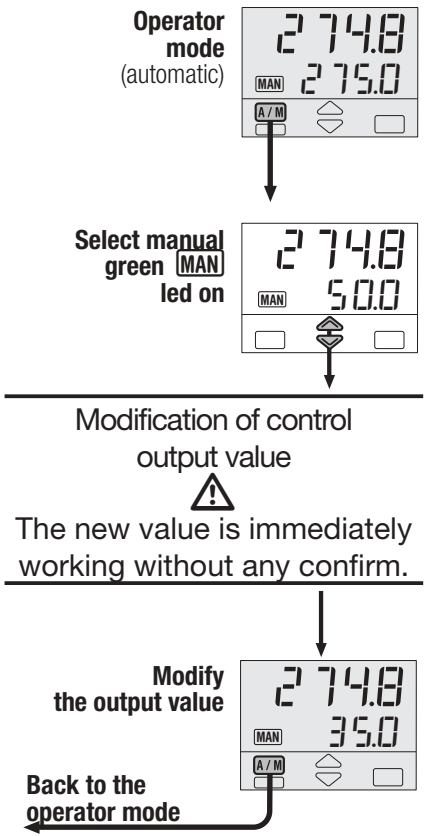
## 6.1 KEYPAD COMMANDS

### 6.1.1 SETPOINT MODIFICATION

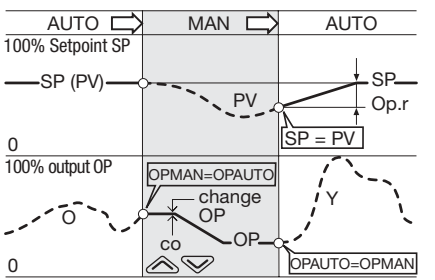
The Setpoint is directly modified with the ^ v keys.
Once entered, the new value is checked and becomes operating after 2 seconds.. The end of this phase is flagged by flashing momentarily the display with SP.




### 6.1.2 AUTO/MANUAL MODE




For Setpoint access and modification from Manual status, see the procedure on chapter 5 (see page 49).
The bumpless action is present switching between AUTO, MAN and vice versa.

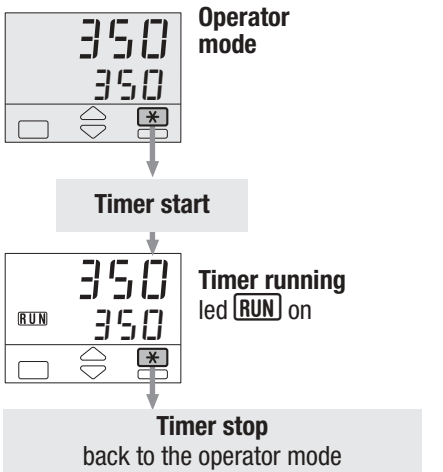



In case of power failure, the AUTO/MAN status and the output value remain stored in the controller memory.

### 6.1.3 TIMER STARTING (option)

Depending on the Timer action t.act selection, there can be two different starting ways:
- Automatic at the power on
- Manual by keypad, digital inputs or serial communications.

To start/stop the Timer:



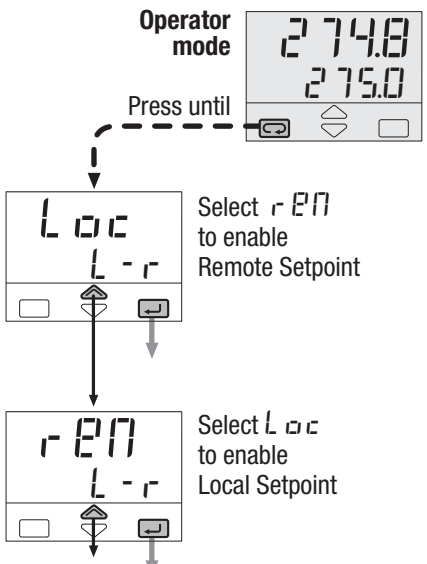
## 6.1 KEYPAD COMMANDS

### 6.1.4 PROGRAM STARTING

(see chapter 7, page 55)

### 6.1.5 LOC/ REM SELECTION

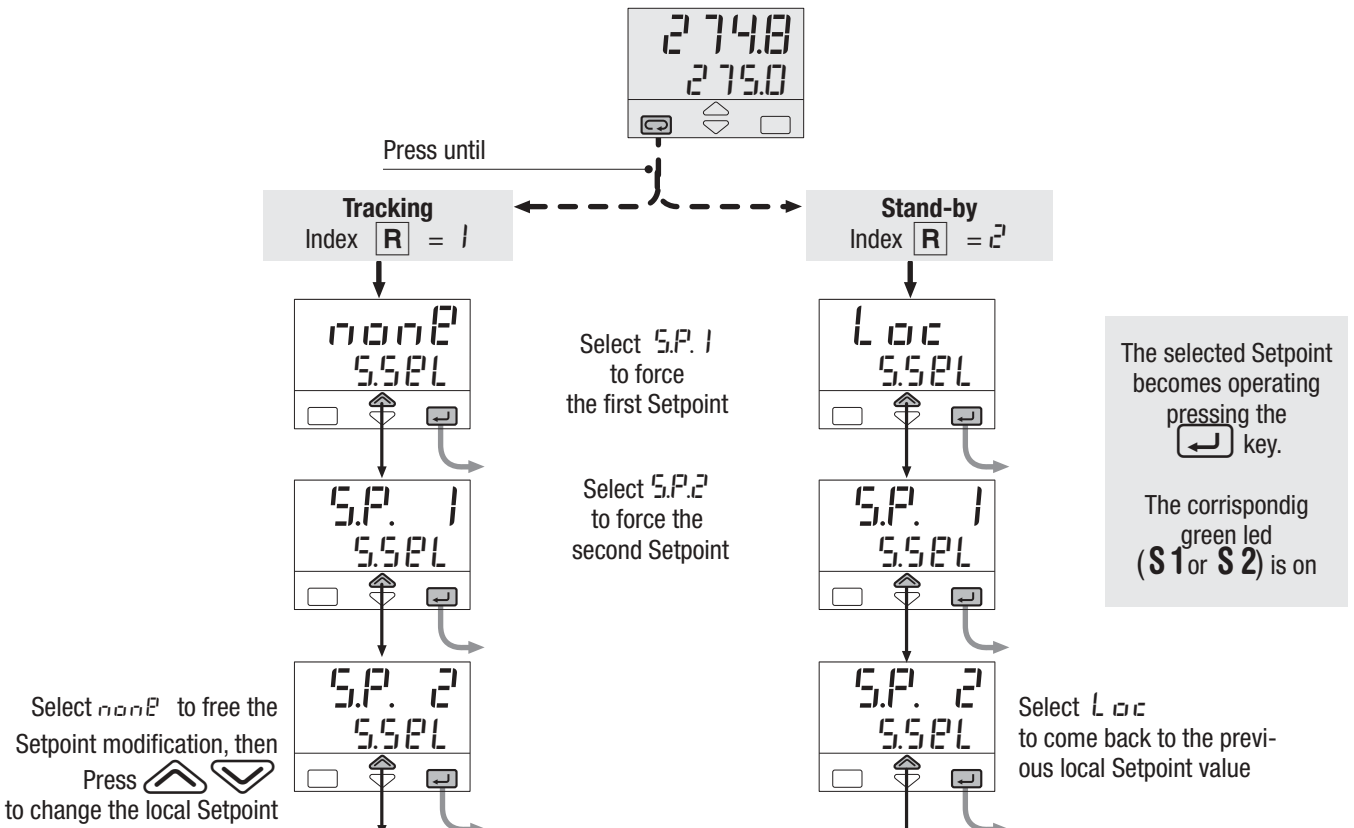
configuration index **R** = 4 or 5)




The selected Setpoint becomes operating pressing the ↵
When in Remote, the green led REM is on

### 6.1.6 STORED SETPOINTS SELECTION

(configuration index **R** = 1 or 2)



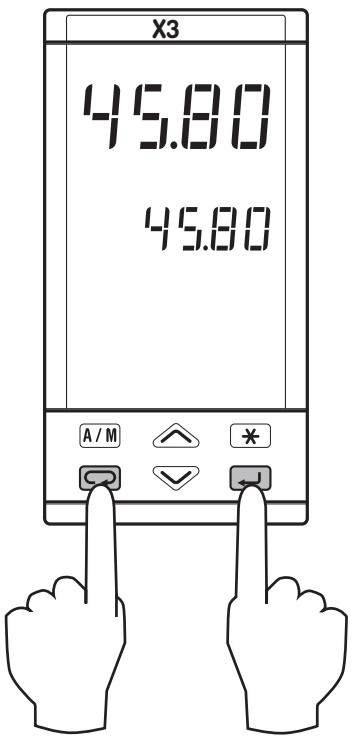
### 6.1.7 KEYPAD LOCK

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.

operator mode




Press simultaneously
for 2 seconds

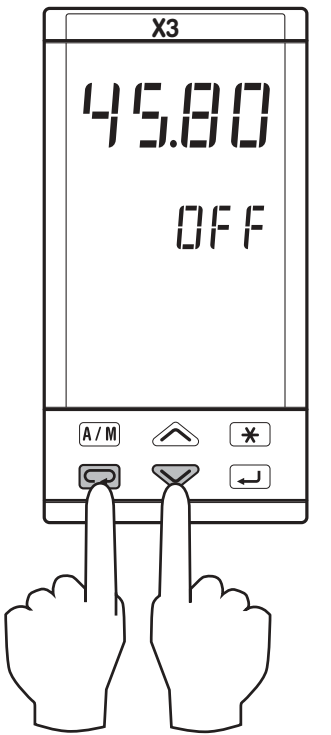
### 6.1.8 OUTPUTS LOCK

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.

operator mode




Press simultaneously
for 2 seconds

## 6.2 DIGITAL INPUT COMMANDS

A function is assigned, through the configuration procedure to each IL1, IL2 and IL3 digital input. (see the parameters setting at tab. 1 at page 31).
The configured function is activated when the digital input (free voltage contact or open collector output) is in the On state (closed). It is deactivated by setting the input to the Off state (open).
The activation of the function through the digital input has the highest priority than through the keypad or through the serial communication.

| Function | | Parameter value | Performed operation: Off | Performed operation: On | Notes |
|---|---|---|---|---|---|
| None | | nonE | – | – | Not used |
| Keypad lock | | tEY.1 | Unlock | Locked | With the keypad locked the commands from digital inputs and serial communications are still operating |
| PV measure hold | | H.PU | Normal operation | PV is hold | The value of PV is “frozen” at the time the digital input goes to the close state |
| Set manual mode | | A.Man | Automatic | Manual | |
| Standard Setpoint | 1st stored Setpoint | SP.1 | Local | 1st SP | The permanent closure **forces** the chosen stored value. Setpoint modification is not possible. The impulsive closure, **selects** the stored value. Setpoint modification is allowed. If more than one digital input is selecting a Setpoint, the last to be activated is the operating one. |
| Standard Setpoint | 2nd stored Setpoint | SP.2 | Local | 2nd SP | |
| Set Remote mode | | L-r. | Local | Remote | |
| Timer | | Strt | – | Timer start | The impulsive closure is enough to start the Timer |
| Programmed Setpoint | Start/stop of a program | H.-r. | Hold | Run | When the input is in the On state, the program is executed up to the end. When off, the program is forced in hold. |

# 7 PROGRAMMED SETPOINT

## INTRODUCTION

The controller supplied with the Setpoint programmer option (mod. X3-3… 1 ) offers the functionality to define, store, display and execute a program consisting in the Setpoint profile in time.

## MAIN CHARACTERISTICS

- 1 program, 8 segments/program
- start, stop, hold etc, commands from the keypad
- time base in seconds, minutes or hours
- continuous or up to 1…9999 time cycling of the program
- 1 OP3 digital output with the state profile defined by the program
- setting of the maximum allowed deviation from the Setpoint

## 7.1 PROGRAM STRUCTURE

The program consists of a sequence of segments.

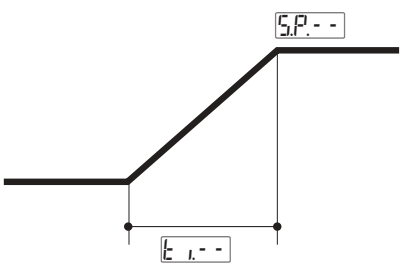
For each segment, it is specified:

- the Setpoint to reach (SP)
- the duration of the segment (t.1)

  } always present
- the state of the OP3 output

The program consists of:

- 1 initial segment named 0
- 1 end segment named F
- 1…6 normal segments




**Initial segment - 0**

Its main purpose is to define the value the process variable has to maintain before starting the program.

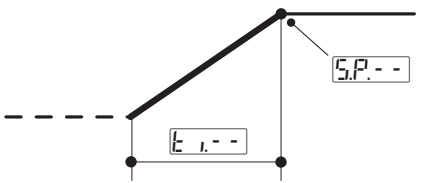
**End segment - F**

Its main purpose is to define the value the process variable has to maintain at the end of the program and until further changes of Setpoint.

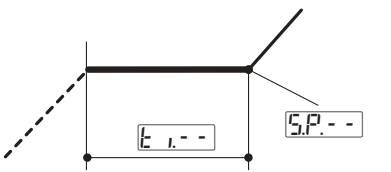
**Normal segments - - - -**

These segments build up the profile program. There are 3 types of segments:

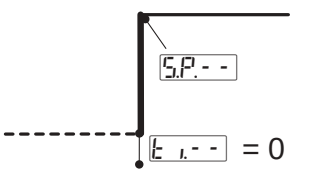
**Ramp**




**Dwell**

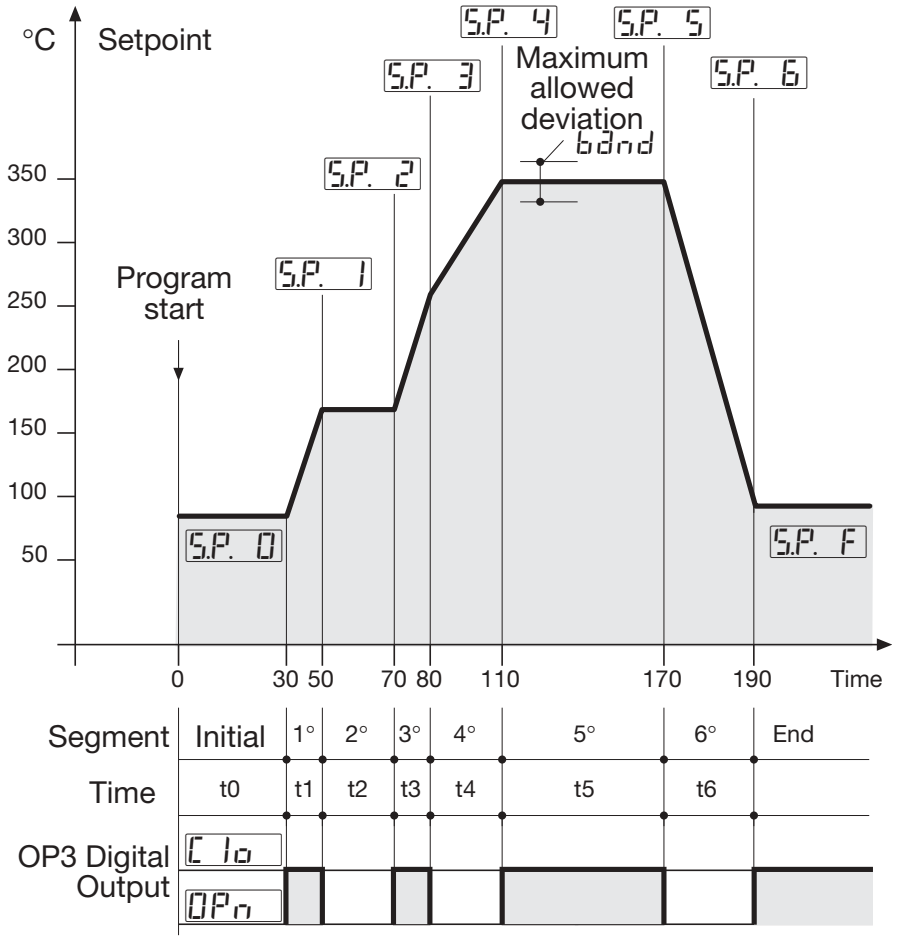



**Step**




SP. = Target Setpoint
t.1. =Duration
---- =Previous segment
——— =Current segmente
——— =Next segment

## EXAMPLE OF SETPOINT PROFILE

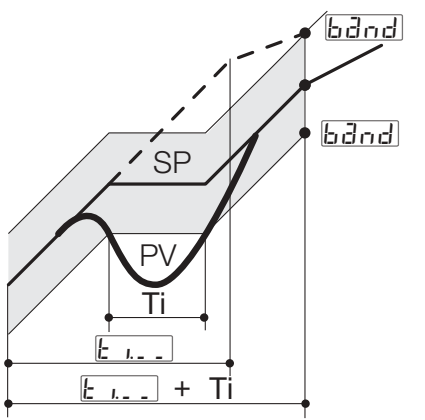



## 7.2 SETPOINT PROGRAMMER OPERATION

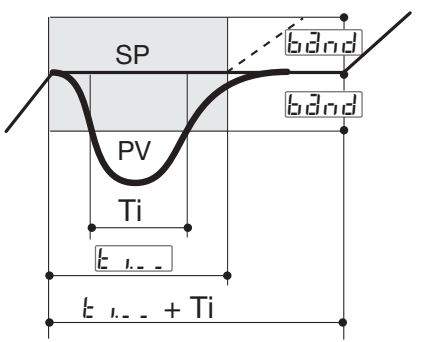
### 7.2.1 MAXIMUM ALLOWED DEVIATION ( bAnd )

If the PV controlled input value exceeds the band, centred around the SP, the segment time is extended of the same time the PV input stays out of the band. The band width is defined in a parameter of the program segment.
The actual segment period is calculated as t i - - +Ti

**A. Ramp**




**B. Dwell**



## 7.2 SETPOINT PROGRAMMER OPERATION

### 7.2.2 RE-START OF A PROGRAM AFTER A POWER FAILURE

The parameter FAIL . specifies the behaviour of the programmer at power up (see page 58). Selected between the following 3 choices:

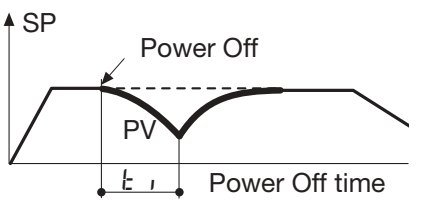
**CONT** **Continue**

**rES** **Reset**

**rAMP** **Ramp**

**If CONT is selected,**
the execution of the program starts from the point reached at the power failure time.

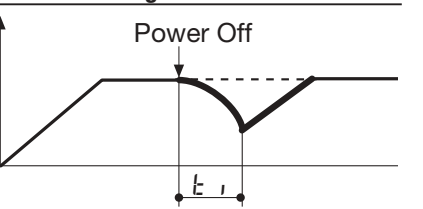
**All the parameters, like Setpoint and the remaining time are restored at the values they had at power off.**



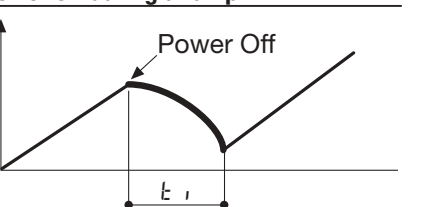

**If rES is selected,**
at power on the program ends and goes back to local mode.

**If rAMP is selected,**
the execution of the program starts from the point reached at the power failure time.
**In this case, the programs continue with PV reaching SV with a ramp, whose slope corresponds to the one of the segment running at the power off.**

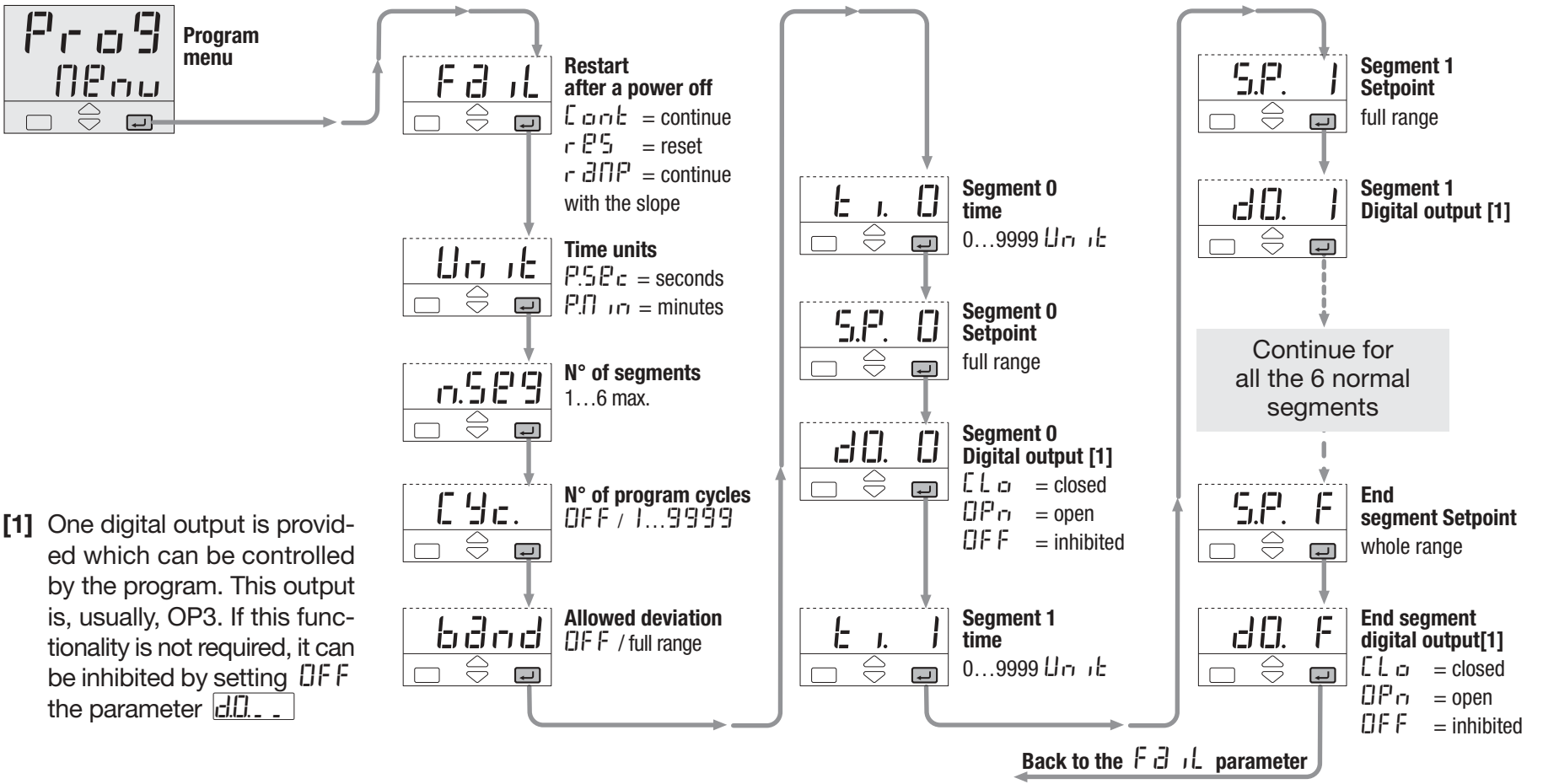
**Power off during a dwell**




**Power off during a ramp**



## 7.3 PARAMETERISATION - PROGRAM MENU (OPTION)




**[1]** One digital output is provided which can be controlled by the program. This output is, usually, OP3. If this functionality is not required, it can be inhibited by setting OFF the parameter dO. _

## 7.4 START/STOP OF A PROGRAM

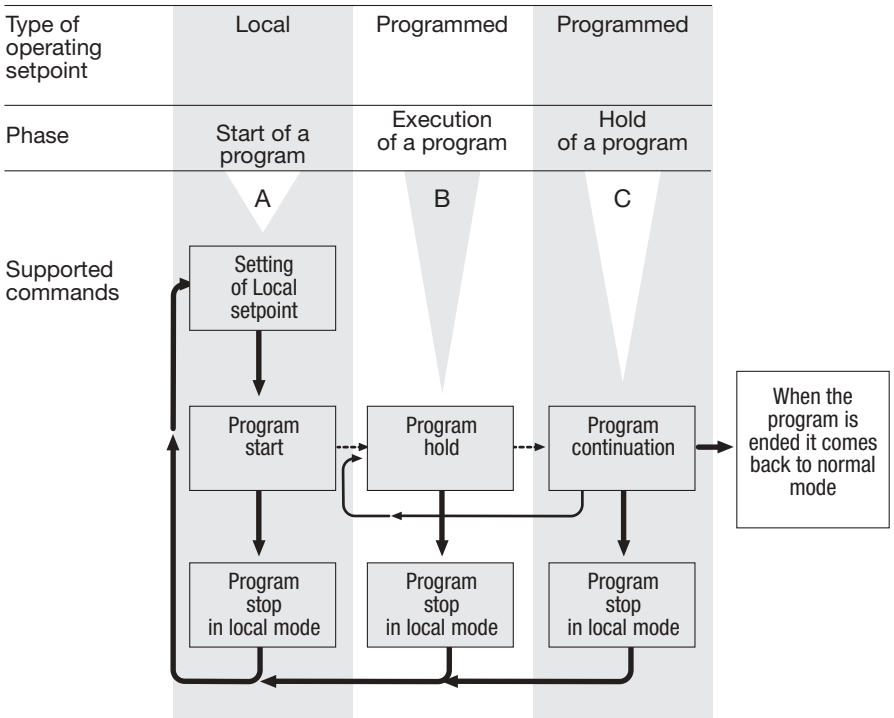
The various commands, supported by the controller, are different for each of the following operating phases:

A] when in Local Setpoint mode

B] during the execution of a program

C] when the program is in hold

Commands supported by the controllers

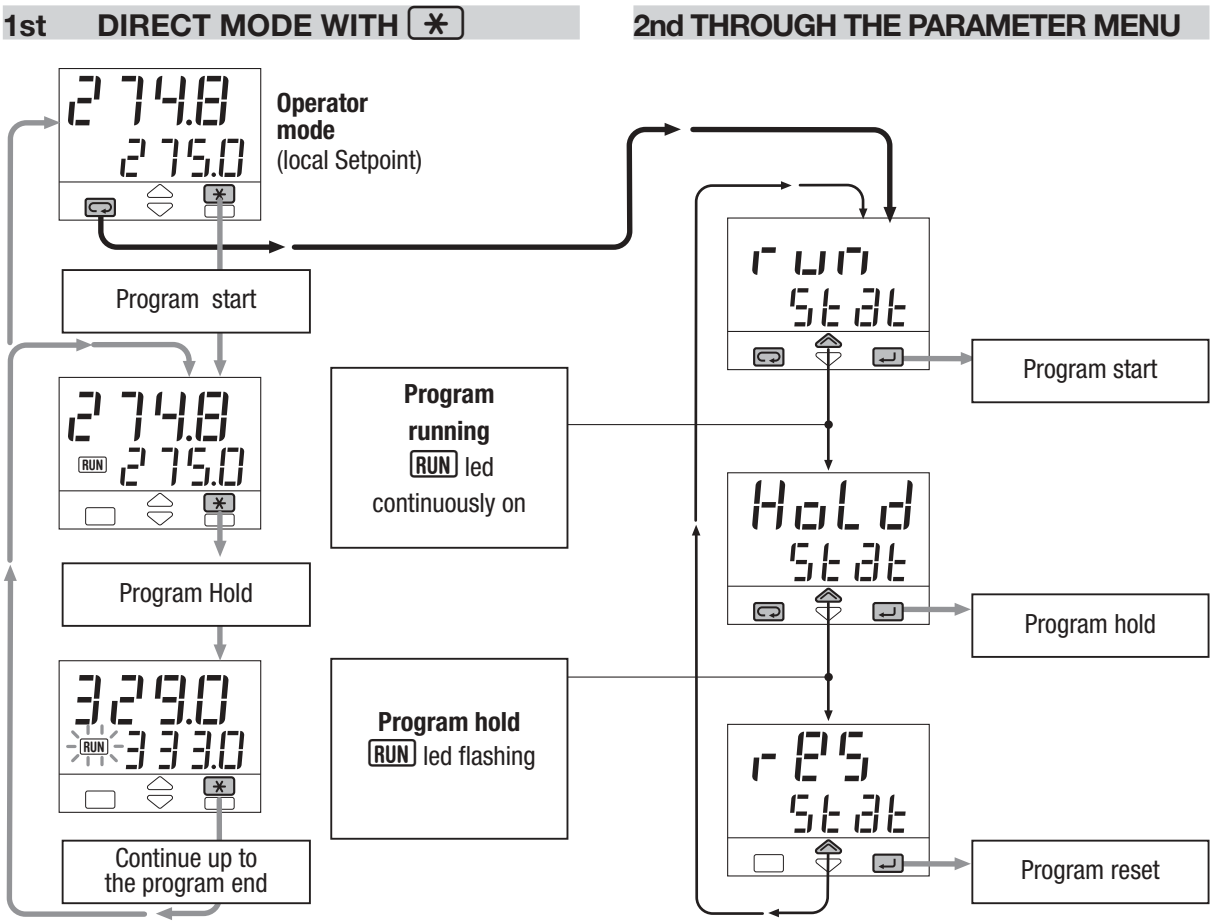



The different phase are displayed in a chained way, just for easing the understanding of the functionality.

Two different mode for starting and stopping a program are provided:

direct mode with the ✱ key

through the parameter menu




**The RUN green led is flashed at high rate when the controlled variable is out of the allowed deviation band**
**The current time of a segment is hold up to the time the variable re-enter in the band.**

# 8 TECHNICAL SPECIFICATIONS

| Features (at 25°C environmental temp.) | Description | | |
|---|---|---|---|
| **Total configurability** (see chapter 3.2 page 20 chapter 4.3.5 page 30) | From keypad or serial communication the user selects:<br>- the type of input<br>- the type of control algorithm<br>- the type of output<br>- the type and functionality of the alarms<br>- the type of Setpoint<br>- control parameter values | | |
| **PV Input** (see pages 11,12 and page 20) | Common characteristics | A/D converter with resolution of 50,000 points<br>Update measurement time: 0.2 seconds<br>Sampling time: 0.5 seconds<br>Input bias: -60…+ 60 digit<br>Input filter with enable/disable: 1…30 seconds | |
| | Accuracy | 0.25% ±1 digits for temperature sensors<br>0.1% ±1 digits (for mV and mA) | Between 100…240Vac<br>the error is minimal |
| | Resistance thermometer (for ΔT: R1+R2 must be <320Ω) | Pt100Ω at 0°C<br>(IEC 751)<br>°C/°F selectable | 2 or 3 wires connection<br>Burnout (with any combination) | Max. wire Res:<br>20Ω max. (3 wires)<br>Input drift: 0.35°C/10° Env. Temp.<br><0.35°C/10Ω Wire Res. |
| | Thermocouple | L,J,T,K,S, R, B, N, E, W3, W5<br>(IEC 584)<br>Rj >10MΩ<br>°C/°F selectable | Internal cold junction compensation con NTC<br>Error 1°C/20°C ±0.5°C<br>Burnout | Line: 150Ω max.<br>Input drift:<br><2μV/°C Env. Temp.<br><5μV/10Ω Wire Res. |
| | DC input (current) | 4…20mA,0...20mA<br>with external shunt 2.5Ω<br>Rj >10MΩ | Burnout. Engineering units<br>Conf. decimal point position<br>Init. Scale -999…9999<br>Full Scale -999…9999<br>(min. range of 100 digits) | Input drift:<br><0.1%/20°C Env. Temp. |
| | DC input (voltage) | 10…50mV, 0...50mV<br>Rj >10MΩ | | |

| **Features** (at 25°C environmental temp.) | **Description** | | |
|---|---|---|---|
| **Auxiliary inputs** | **Remote Setpoint** (option)<br>Not isolated<br>accuracy 0.1% | Current<br>0/4…20mA<br>Rj = 30Ω | Bias in engineering units and ± range<br>Ratio from -9.99…+99.99<br>Local + Remote Setpoint |
| | | Voltage<br>1...5/0...5/0...10V<br>Rj = 300KΩ | |
| | **CT current transformer**<br>(see pages13 and 47) | 50 or 100 mA<br>input hardware<br>selectable | Current visualisation 10...200A<br>With 1A resolution<br>and Heater Break Alarm |
| **Digital inputs**<br>3 logic | The closure of the external contact produces any of the following actions: | Auto/Man mode change, Local/Remote Setpoint mode change, Stored Setpoints activation, keypad lock, measure hold | |
| | | Timer activation, program run/hold (if options installed) | |

| **Operating mode and Outputs** | | **Control output** | | **AL1 alarm** | **AL2 alarm** | **AL1 alarm** | **Retransmiss.** |
|---|---|---|---|---|---|---|---|
| 1 single or double action P.I.D. loop or On/Off with 1, 2 or 3 alarms | Single action | **OP1**-Relay/Triac | | | **OP2**-Relay/Triac | **OP3**-Relay | **OP5**-Analogue |
| | | **OP4**-SSR drive-Relay | | **OP1**-Relay/Triac | **OP2**-Relay/Triac | **OP3**-Relay | **OP5**-Analogue |
| | | **OP5**-Analogue | | **OP1**-Relay/Triac | **OP2**-Relay/Triac | **OP3**-Relay | |
| | Double action Heat / Cool | **OP1**-Relay/Triac | **OP2**-Relay/Triac | | | **OP3**-Relay | **OP5**-Analogue |
| | | **OP1**-Relay/Triac | **OP4**-SSR drive-Relay | | **OP2**-Relay/Triac | **OP3**-Relay | **OP5**-Analogue |
| | | **OP4**-SSR drive-Relay | **OP2**-Relay/Triac | **OP1**-Relay/Triac | | **OP3**-Relay | **OP5**-Analogue |
| | | **OP1**-Relay/Triac | **OP5**-Analogue | | **OP2**-Relay/Triac | **OP3**-Relay | |
| | | **OP5**-Analogue | **OP2**-Relay/Triac | **OP1**-Relay/Triac | | **OP3**-Relay | |
| | | **OP5**-Analogue | **OP4**-SSR drive-Relay | **OP1**-Relay/Triac | **OP2**-Relay/Triac | **OP3**-Relay | |
| | Valve drive | **OP1**-Relay/Triac | **OP2**-Relay/Triac | | | **OP3**-Relay | **OP5**-Analogue |

| **Features** (at 25°C environmental temp.) | **Description** | | | |
|---|---|---|---|---|
| **Control mode** | Algorithm | P.I.D. with overshoot control or On-off - P.I.D. with valve drive algorithm, for controlling motorised positioners | | |
| | Proportional band (P) | 0.5…999.9% | | Single action P.I.D. algorithm |
| | Integral time (I) | 0.1…100.0 min | OFF = 0 | |
| | Derivative time (D) | 0.01…10.00 min | | |
| | Error dead band | 0.1…10.0 digit | | |
| | Overshoot control | 0.01…1.00 | | |
| | Manual reset | 0.0…100.0% | | |
| | Cycle time (Time proportional only) | 1…200 s | | |
| | Control output high limit | 10.0…100.0% | | |
| | Soft-start output value | 0.1…100.0% | OFF = 0 | |
| | Output safety value | 0.0…100.0% (-100.0…100.0% for Heat / Cool) | | |
| | Control output hysteresis | 0.1…10.0% | | On-Off algorithm |
| | Dead band | -10.0…10.0% | | Double action P.I.D. algorithm (Heat / Cool) with overlap |
| | Relative cool gain | 0.1…10.0 | | |
| | Cycle time (Time proportional only) | 1…200 s | | |
| | Control output high limit | 10.0…100.0% | | |
| | Cool output hysteresis | 0.1…10.0% | | |
| | Motor travel time | 15…600 s | | Valve drive P.I.D. algorithm without feedback potentiometer |
| | Motor minimum step | to 0.1…5.0% | | |

| **Features** (at 25°C environmental temp.) | **Description** | | | | |
|---|---|---|---|---|---|
| **OP1-OP2 outputs** | SPST Relay N.O., 2A/250Vac (4A/120Vac) for resistive load<br>Triac, 1A/250Vac for resistive load | | | | |
| **OP3 output** | SPDT relay N.O., 2A/250Vac (4A/120Vac) for resistive load | | | | |
| **OP4 output** | Logic not isolated: 0/5Vdc, ±10% 30mA max. - SPST Relay N.O., 2A/250Vac (4A/120Vac) for resistive load | | | | |
| **OP5 analogue output** (option) | Control or PV/SP retransmission | Galvanic isolation: 500 Vac/1 min<br>Resolution 12bit (0.025%)<br>Accuracy: 0.1 % | | In current: 0/4…20mA 750Ω/15V max. | |
| **AL1 - AL2 - AL3 alarms** | Hysteresis 0.1…10.0% c.s. | | | | |
| | Action | Active high | Action type | Deviation threshold | ±range |
| | | | | Band threshold | 0…range |
| | | Active low | | Absolute threshold | whole range |
| | | Special functions | Sensor break, heater break alarm | | |
| | | | Acknowledge (latching), activation inhibit (blocking) | | |
| | | | Connected to Timer or program (if options installed) | | |
| **Setpoint** | Local | | Up and down ramps 0.1…999.9 digit/min. (OFF=0)<br>Low limit: from low range to high limit<br>High limit: from low limit to high range | | |
| | Local plus two stored (tracking or STAND-BY) | | | | |
| | Local and Remote | If option installed | | | |
| | Local with trim | | | | |
| | Remote with trim | | | | |
| | Programmable | | | | |

| **Features** (at 25°C environmental temp.) | **Description** | | |
|---|---|---|---|
| **Programmable Setpoint** (optional) | 1 program, 8 segments (1 initial and 1 end) - From 1 to 9999 cycles or continuous cycling (OFF)<br>Start, stop, hold, etc. activated from the keypad, digital input and serial communications | | |
| **Special functions** (option) | **Timer** (see page 43) | Automatic start at the power on, manual start by keypad, Digital inputs or serial comm.s | |
| | | Setting time: 1…9999 s/min. | |
| | | Stand-by Setpoint: from Setpoint low limit to Setpoint high limit | |
| | **Start-up** (see page 41) | Start-up Setpoint: from Setpoint low limit to Setpoint high limit | |
| | | Hold time: 0…500min. | |
| | | Control output high limit: 5.0…100.0% | |
| **Fuzzy-Tuning one shoot** | The controller selects automatically the best method according to the process conditions | Step response | |
| | | Natural frequency | |
| **Auto/Man station** | Standard with bumpless function,<br>by keypad, digital input or serial communications | | |
| **Serial comm.** (option) | RS485 isolated, Modbus/Jbus protocol, 1200, 2400, 4800, 9600 bit/s, 3 wires | | |
| **Auxiliary Supply** | +24Vdc ±20% 30mA max. - for external transmitter supply | | |
| **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, outputs lock | |
| **General characteristics** | Power supply (PTC protected) | 100...240Vac (-15...+10%) 50/60 Hz or<br>24Vac (-25...+12%), 50/60 Hz and 24Vdc (-15...+25%) | Power consumption 4W max. |
| | Safety | Compliance to EN61010-1 (IEC 1010 – 1), installation class 2 (2500V) pollution class 2, **instrument class II** | |
| | Electromagnetic compatibility | Compliance to the CE standards (see page 2) | |
| | UL and cUL Omologation | File 176452 | |
| | Protection EN60529 (IEC 529) | IP65 front panel | |
| | Dimensions | 1/8 DIN - 48 x 96, depth 110 mm, weight 250 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.

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# ICONS TABLE

| Main universal input | |
|---|---|
|  | Thermocouple |
|  | RTD (Pt100) |
|  | Delta Temp (2x RTD) |
|  | mA and mV |
|  | Custom |
|  | Frequency |
| **Auxiliary input** | |
|  | Current transformer |
|  | mA Remote setpoint |
|  | Volt Remote setpoint |
|  | Feedback potentiometer |

| Digital input | |
|---|---|
|  | Isolated contact |
|  | NPN open collector |
|  | TTL open collector |
| **Setpoint** | |
|  | Local |
|  | Stand-by |
|  | Keypad lock |
|  | Outputs lock |
|  | Start-up function |
|  | Timer function |
|  | Memorized |
|  | Remote |
|  | Setpoint programmer |

| Digital input connected functions | |
|---|---|
|  | Auto/Manual |
|  | Run, Hold, Reset and program selection |
|  | PV hold |
|  | Setpoint slopes inhibition |
| **Output** | |
|  | SPST Relay |
|  | Triac |
|  | SPDT Relay |
|  | mA |
|  | mA mV |
|  | Logic |