ASCON TECNOLOGIC

# Process controller with PROFIBUS DP and Modbus Master/Slave 1/4 DIN - 96 x 96

## Q5 line

δ2 SERIES

CE UK CA

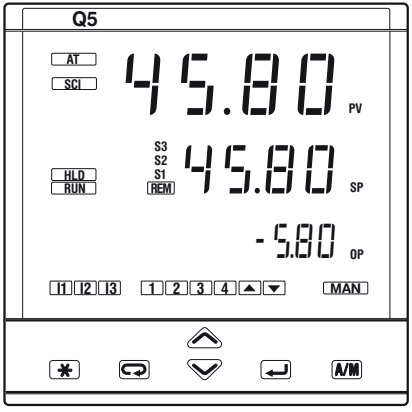
ISO 9001 Certified

User manual • 23/ 04 • Code: ISTR_M_Q5_E_07_--

c UL us LISTED


**Ascon Tecnologic srl**
**viale Indipendenza 56, 27029 Vigevano (PV)**
**Tel.: +39-0381 69 871 - Fax: +39-0381 69 8730**
**Sito internet:** www.ascontecnologic.com
**Indirizzo E-Mail:** sales@ascontecnologic.com

# Process controller
# with PROFIBUS DP
# and Modbus Master/Slave
# 1/4 DIN - 96 x 96
# Q5 line



**Please, read carefully these instructions before proceeding with the installation of the controller.**

## Declaration of conformity and manual retrieval

**Q5** is a Class II panel mount instrument designed to comply with European Directives.

All the details about the use of the instrument are included in this manual.

The Manual and the Declaration of Conformity of the instrument can be downloaded (free of charge) from the web-site:

**www.ascontecnologic.com**

Once connected to the web-site, search:

Q5

then click on Q5 on the search result list.

In the lower part of the product page (in any language) is present the download area with the links to the documents available for the requested intrument (in the available languages).

## NOTES ON ELECTRIC SAFETY AND ELECTROMAGNETIC COMPATIBILITY

**WARNING!**
Whenever a failure or a malfunction of the device may cause dangerous situations for persons, things or animals, please remember that the plant must be equipped with additional devices which will guarantee safety.

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 sign, at the side of the note.**

## Displosal

The appliance (or the product) must be disposed of separately in compliance with the local standards in force on waste disposal.

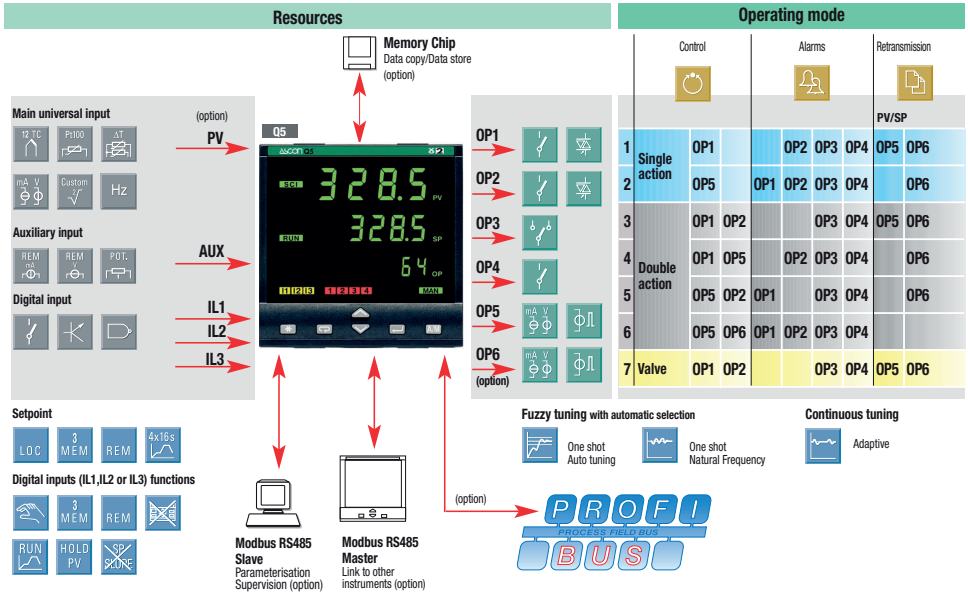
# TABLE OF CONTENTS

# 1 INTRODUCTION

## POWERFUL FEATURES AND A WIDE RANGE OF FUNCTIONALITIES

Congratulations for having chosen these universal controllers. They are the best result of our experience in designing and manufacturing of smart, powerful and high reliable controllers.
The process controllers of the Q5 series have been designed for the industrial environment, are provided with a complete set of functions, as a true universal instrument.

They can be used as Controllers-Programmers with 4 Setpoint profiles of 16 segments.

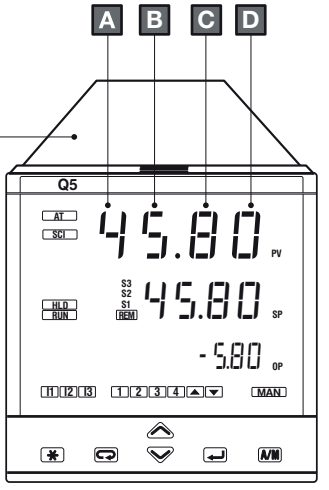


## 1.1 MODEL CODE

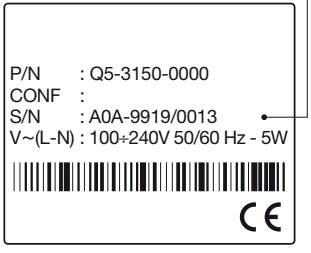
The complete code is displayed on the instrument label.

The information about product coding are accessible from the front panel by mean of a particular procedure described at section 5.1 page 53.

Basic product code




Instrument label




Model: **X5 – A B C D – E F G 0**

- Power Supply
- Outputs
- Serial + mathematical package (MP)
- Options
- Line
- Modello basic
- Accessories
- Colour
- User manual
- Setpoint

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

| Outputs OP1 - OP2 | B |
|---|---|
| Relay - Relay | 1 |
| Triac - Triac | 5 |

| Serial Communications | C |
|---|---|
| None | 0 |
| Mathematical package (MP) | 1 |
| RS485 Modbus/Jbus SLAVE + MP | 5 |
| RS485 Modbus/Jbus SLAVE + MASTER + MP | 6 |
| PROFIBUS DP SLAVE + MP | 7 |
| RS485 Modbus/Jbus SLAVE + PROFIBUS + MP | 8 |

| Options | D |
|---|---|
| None | 0 |
| Frequency input | 1 |
| 2nd SSR drive/analogue output (OP6) | 4 |
| Frequency input + OP6 | 6 |

| Setpoint Programmer | E |
|---|---|
| Not fitted | 0 |
| 4 programs with 16 segments | 4 |

| 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 |

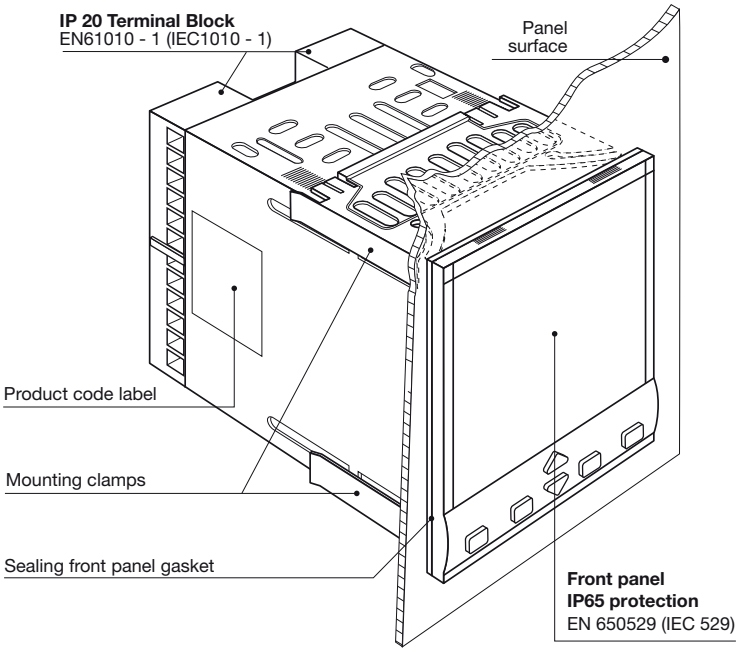
# 2 INSTALLATION

## 2.1 GENERAL DESCRIPTION

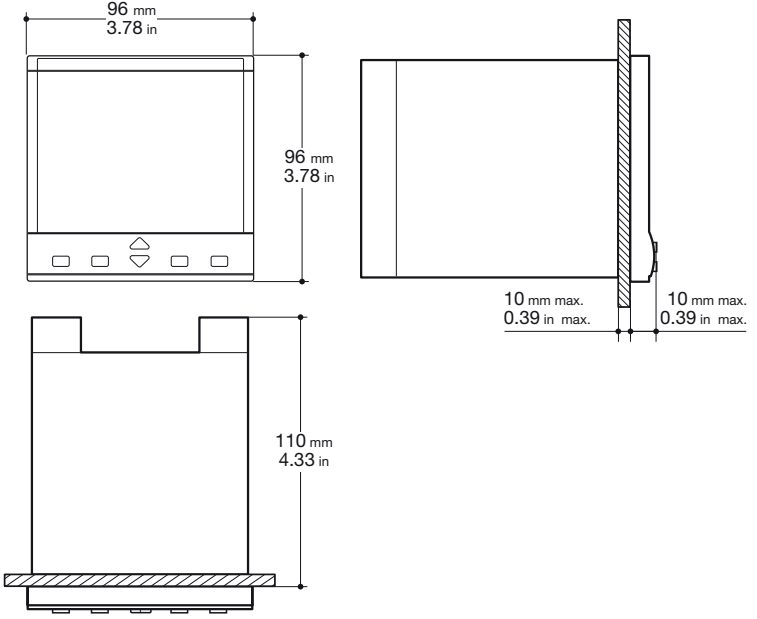
**Installation must only be carried out by qualified personnel.**

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.

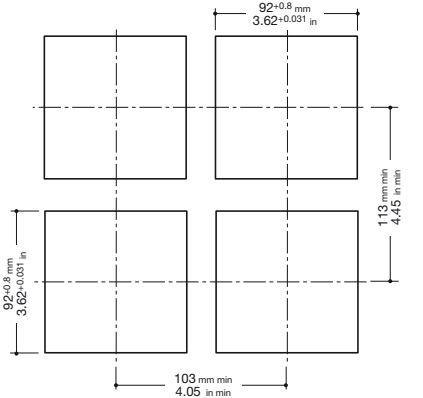
⚠CE
To prevent hands or metal touching parts that may be electrically live, **the controllers must be installed in an enclosure and/or in a cubicle.**



## 2.1.1 DIMENSIONAL DETAILS




## 2.1.2 PANEL CUT-OUT



## 2.2 ENVIRONMENTAL RATINGS

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

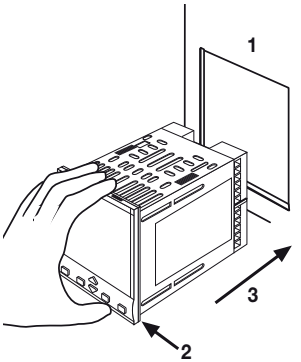
| Special conditions | | Suggestions |
|---|---|---|
|  | Altitude > 2,000 m | Use 24Vac supply version |
|  | Temperature >50°C | Use forced air ventilation |
| %Rh | Humidity > 95 % | Warm up |
|  | Conducting atmosphere | Use filter |

| Forbidden Conditions | |
|---|---|
|  | Corrosive atmosphere |
|  | Explosive atmosphere |

## 2.3 PANEL MOUNTING [1]

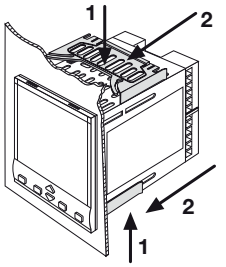
### 2.3.1 INSERT THE INSTRUMENT

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



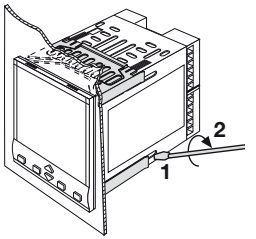

### 2.3.2 INSTALLATION SECURING

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




### 2.3.3 CLAMPS REMOVING

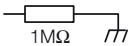
**1** Insert the screwdriver in the clips of the clamps;
**2** Rotate the screwdriver.



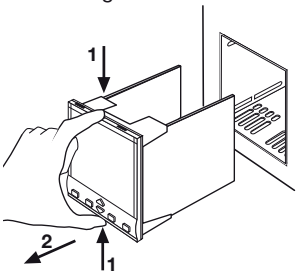

### 2.3.4 INSTRUMENT UNPLUGGING

**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.

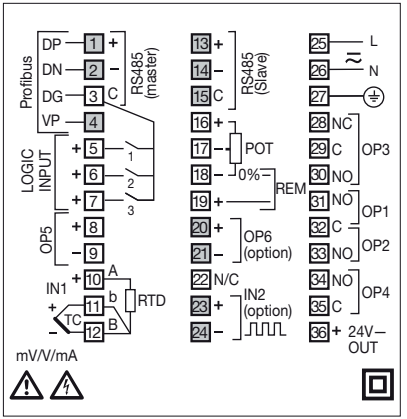



**UL note**

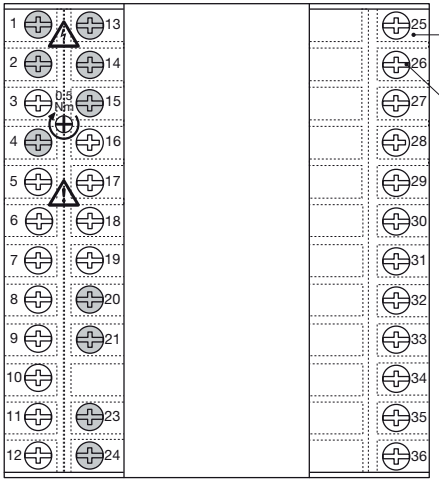
**[1] For Use on a Flat Surface of a Type 2 and Type 3 'raintight' Enclosure.**

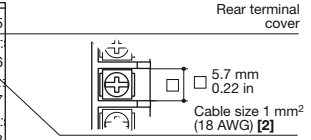
3

# ELECTRICAL CONNECTIONS




## 3.1 TERMINATION UNIT [1]




| | |
|---|---|
| | 35 screw terminals M3 |
| | Option terminals |
| | Holding screw 0.5 Nm |
| | Phillips screw-driver PH1 |
| | Flat blade screw-driver 0.8 x 4 mm |

**Terminals**

| | |
|---|---|
| | Pin connector<br>Ø 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 |

**UL note**

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

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

## PRECAUTIONS

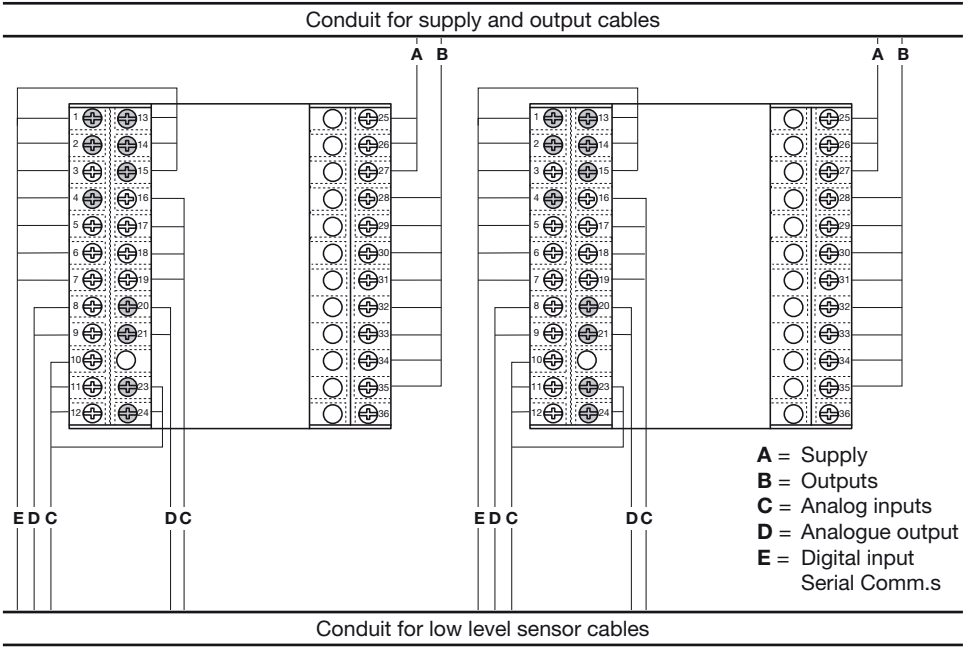
Despite the fact that the instrument has been designed to work in an harsh and noisy environmental (level IV of the industrial standard IEC 801-4), it is recommended to follow the following suggestions.

⚠

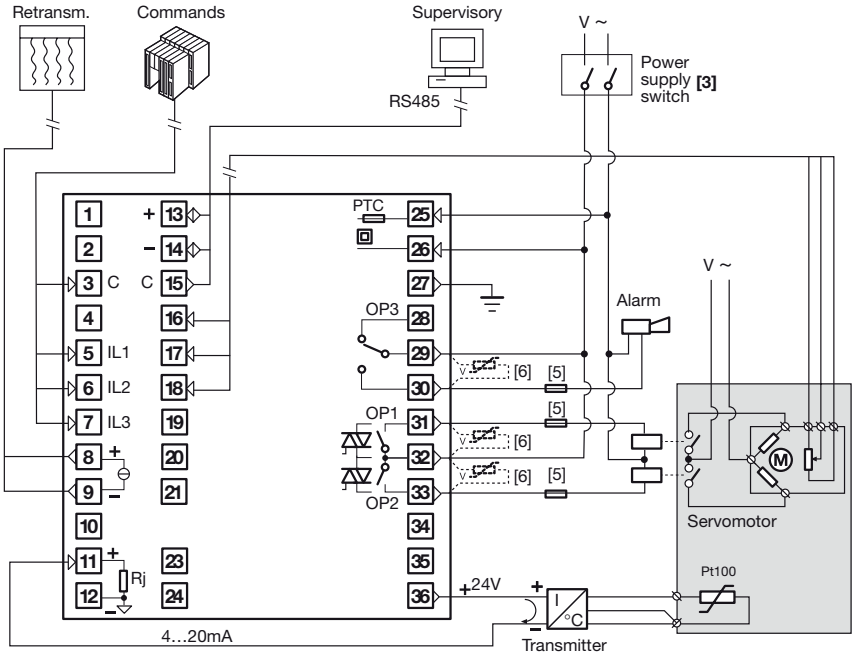
All the wiring must comply with the local regulations.
The supply wiring should be routed away from the power cables.
Avoid to use electromagnetic contactors, power Relays and high power motors nearby.
Avoid power units nearby, especially if controlled in phase angle.

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.

## 3.2 SUGGESTED WIRE ROUTING



## 3.3 EXAMPLE OF WIRING DIAGRAM (VALVE 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 PTC protected. In case of failure it is suggested to return the instrument to the manufacturer for repair.

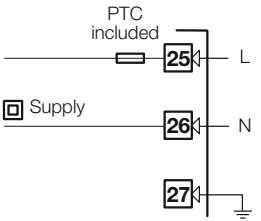
5] To protect the instrument internal circuits use:
- 2 A T fuse for Relay outputs (220 Vac);
- 4 AT fuse for Relay outputs (110 Vac);
- 1 AT fuse for Triac outputs.

6] Relay contacts are already protected with varistors.
**Only in case of 24 Vac inductive loads, use model A51-065-30D7 varistors (on request).**

### 3.3.1 POWER SUPPLY

Switching power supply with multiple isolation and PTC protection.

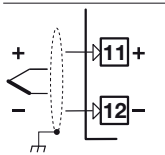
- **Standard version:**
  Nominal voltage:
  100...240Vac (-15...+10%);
  Frequency 50/60Hz.
- **Low Voltage version:**
  Nominal voltage:
  24Vac (-25...+12%);
  Frequency 50/60Hz
  or 24Vdc (-15...+25%).
  Power consumption 5W max.




### 3.3.2 PV CONTROL INPUT

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

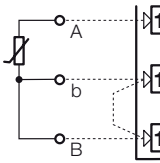
- Connect the wires with the polarity as shown.
- Use always compensation cable of the correct type for the thermocouple used.
- The shield, if present, must be connected to a proper earth.




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.).
  Maximum line resistance 20 Ω/lead.
- When using a 2 wires system, use always cables of the same diameter (1.5mm² min.) and put a jumper between terminals 11 and 12.

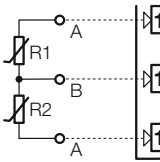



Only for two wires system, put a jumper between terminals 11 and 12.

**C For ΔT (2x RTD Pt100)** Special

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

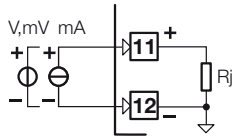
**R1 + R2 must be <320Ω**




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

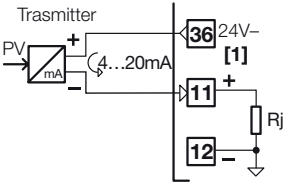
## 3.3.2 PV CONTROL INPUT

### C For mA, mV and Volt

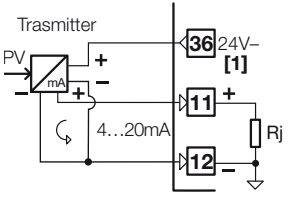



Input resistance = 30Ω for mA reading;
Input resistance > 10MΩ for mV reading;
Input resistance = 10kΩ for Volt reading.

### C1 With 2 wires transducer




### C2 With 3 wires transducer

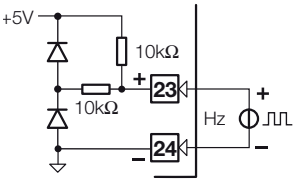



**Note:**

**[1]** Auxiliary power supply for external transmitter 24V– ±20%/30mA max. without short circuit protection.

## 3.3.3 PV CONTROL INPUT - IN2 FREQUENCY INPUT

**The usage of frequency input (IN2) inhibits input 1 (IN1)**



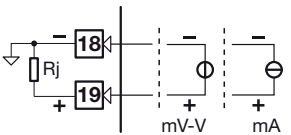

- Low level:
  0… 2 Volt /0.5 mA max.
- High level:
  3… 24 Volt/∼0 mA max.
- Frequency range: 0...500 Hz
  0… 2 kHz/0… 20 kHz selectable in configuration mode.
- Use sensors with an NPN output or a clean contact.

## 3.3.4 AUXILIARY INPUT

### A - From Remote Setpoint

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

Voltage 1… 5V, 0… 5V, 0… 10V;
Input resistance = 300kΩ.

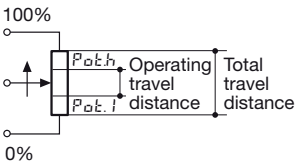


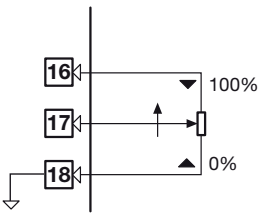

**Not available with frequency input.**

### B- From Potentiometer

or the measure of the position of the motor or the valve:

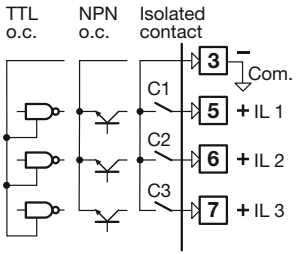
**from 100Ω to 10kΩ max.**




## 3.3.5 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.



### 3.3.6 OP1 - OP2 - OP3 - OP4 - OP5 - OP6 OUTPUTS (OPTION)

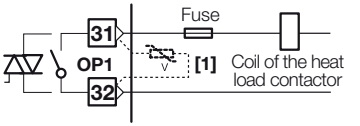
The functionality associated to each of the OP1, OP2, OP4, OP5 and OP6 output is defined during the configuration of the instrument.
The suggested combinations are:

| | | Control outputs | | Alarms | | | | Retransmission | |
|---|---|---|---|---|---|---|---|---|---|
| | | Main (Heat) | Secondary (Cool) | AL1 | AL2 | AL3 | AL4 | PV / SP | |
| A | Single action | OP1 | | | OP2 | OP3 | OP4 | OP5 | OP6 |
| B | | OP5 | | OP1 | OP2 | OP3 | OP4 | | OP6 |
| D | Double action | OP1 | OP2 | | | OP3 | OP4 | OP5 | OP6 |
| E | | OP1 | OP5 | | OP2 | OP3 | OP4 | | OP6 |
| F | | OP5 | OP2 | OP1 | | OP3 | OP4 | | OP6 |
| G | | OP5 | OP6 | | OP2 | OP3 | OP4 | | |
| L | Valve drive | OP1 ▲ | OP2 ▼ | | | OP3 | OP4 | OP5 | OP6 |

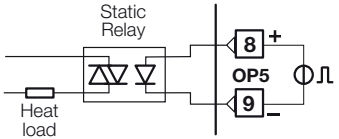
where:

| | |
|---|---|
| **OP1 - OP2** | Relay or Triac output |
| **OP3 - OP4** | Relay outputs |
| **OP5 - OP6** | Analogue/ digital control or retransmission outputs |

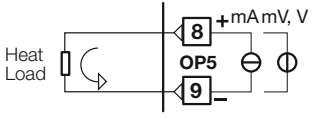
### 3.3.6-A SINGLE ACTION RELAY (TRIAC) CONTROL OUTPUT



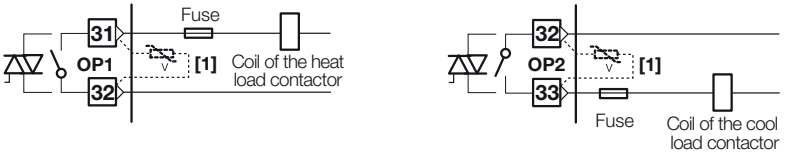

### 3.3.6-B1 SINGLE ACTION SSR DRIVE CONTROL OUTPUT



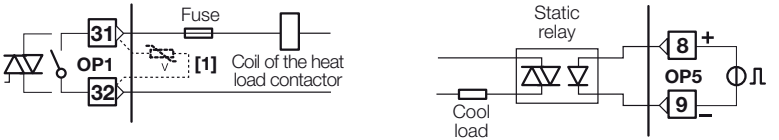

### 3.3.6-B2 SINGLE ACTION ANALOGUE OUTPUT




### 3.3.6-C DOUBLE ACTION RELAY (TRIAC)/RELAY (TRIAC) CONTROL OUTPUT

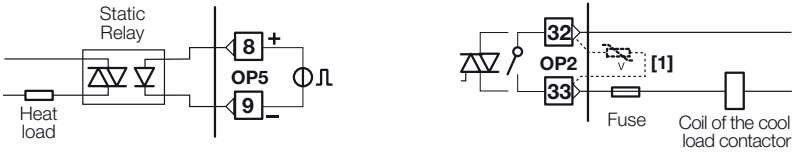



### 3.3.6-D1 DOUBLE ACTION RELAY (TRIAC)/SSR DRIVE CONTROL OUTPUT




### 3.3.6-D2 DOUBLE ACTION RELAY (TRIAC)/ANALOGUE CONTROL OUTPUT

### 3.3.6-E1 DOUBLE ACTION
### DIGITAL/RELAY (TRIAC) CONTROL OUTPUT




### 3.3.6-E2 DOUBLE ACTION
### ANALOGUE/RELAY(TRIAC) CONTROL OUTPUT


### 3.3.6-F1 DOUBLE ACTION
### DIGITAL/DIGITAL CONTROL OUTPUT


**Notes for pages 17 - 18 - 19**

**OP1 - OP2 Relay output**

- SPST Relay N.O., 2A/250 Vac (4A/120Vac) for resistive load,
- Fuse 2AT at 250Vac, 4AT at 110Vac.

**OP1 - OP2 Triac output**

- N.O. contact for resistive load up to 1A/250 Vac max.
- Fuse 1AT

**Isolated digital outputs OP5-OP6**

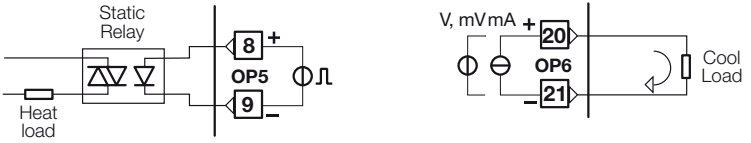
- 0…24Vdc, ±20%, 30 mA max.

**Isolated analogue outputs OP5-OP6**

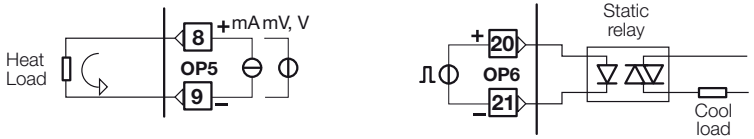
- 0/4… 20mA, 750Ω/15V max.; 0/1… 5V, 0… 10V, 500Ω/20mA max.

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

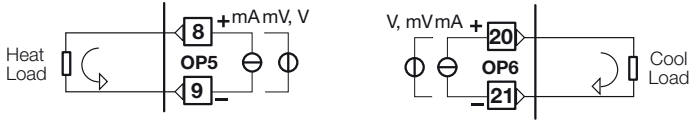
### 3.3.6-F2 DOUBLE ACTION DIGITAL/ANALOGUE CONTROL OUTPUT




### 3.3.6-F3 DOUBLE ACTION ANALOGUE/DIGITAL CONTROL OUTPUT

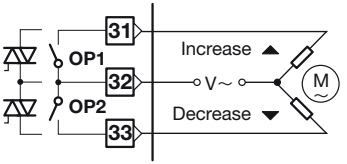



### 3.3.6-F4 DOUBLE ACTION ANALOGUE/ANALOGUE CONTROL OUTPUT

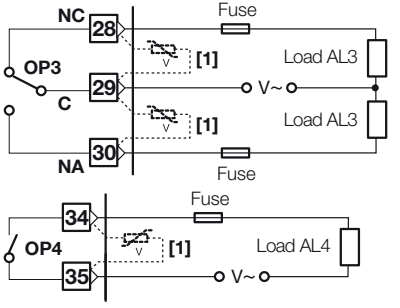



### 3.3.6-G MOTOR POSITIONER OUTPUT RELAY (TRIAC)/RELAY (TRIAC)

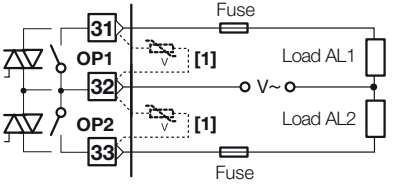
Valve drive PID **without** potentiometer 3 pole output with N.O. contacts (raise, lower, stop).



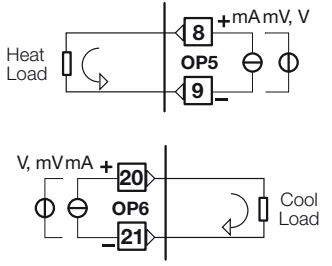
### 3.3.7 OP1-2-3-4 ALARM OUTPUTS




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




### 3.3.8 OP5 AND OP6 (OPTION) ANALOGUE CONTROL OUTPUTS




OP5 and OP6 outputs can be configured for control action or PV/SP retransmission:

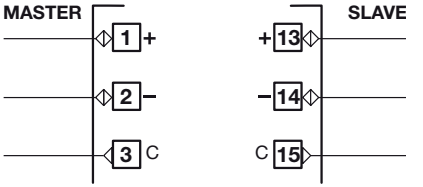
- Galvanic isolation 500Vac/1 min;
- 0/4… 20mA, 750Ω/15Vdc max.; 0/1… 5V, 0… 10V, 500Ω/20mA max..

**Notes:**

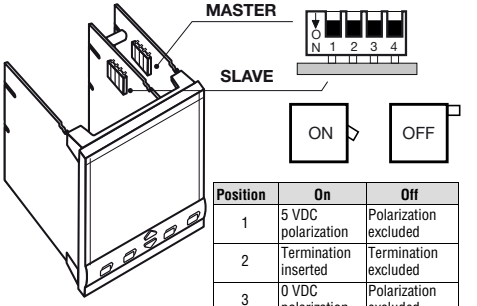
**[1] Varistor for inductive load 24Vac only**

**[2] ⚠ Please, read the user manual: "gammadue® and deltadue® controller series serial communication and configuration software".**

### 3.3.9 SERIAL COMMUNICATIONS (OPTION) [2]

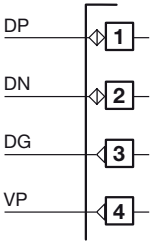



- Galvanic isolation: 500Vac/1 min; Compliance to the EIA RS485 standard for Modbus/Jbus;
- Termination setting dip switches.



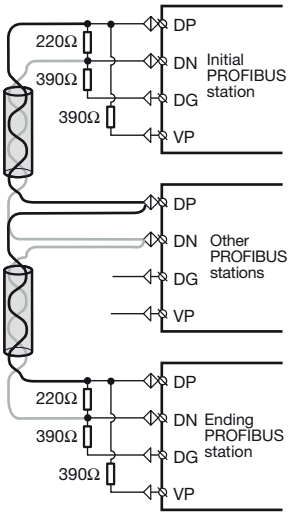

| Position | On | Off |
|---|---|---|
| 1 | 5 VDC polarization | Polarization excluded |
| 2 | Termination inserted | Termination excluded |
| 3 | 0 VDC polarization | Polarization excluded |
| 4 | - | - |

## 3.3.10 PROFIBUS DP (OPTION)

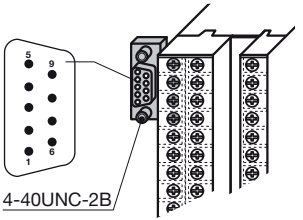



- Galvanic isolation 500 Vac/1 min;
- Compliance to the EIA RS485 standard for PROFIBUS DP;
- Connecting cable: twisted pair cable as per PROFIBUS specifications (e.g. Belden B3079A);
- Max. lenght: 100 m at 12 Mb/s.

Termination resistors 220Ω and 390Ω ($^1/_4$ W, ±5%) for external mounting on the initial and ending PROFIBUS stations only.




To make the connections easier, a D-Sub type (9 poles) connector: model **AP-ADP-PRESA-DSUB/9P**
Must be used with a 9PIN male ERNI type part no. 103648 or similar connector.

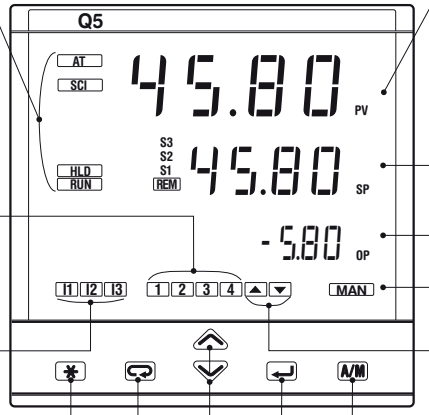



| X5 | D-SUB 9 poles | Signal | Description according to PROFIBUS specifications |
|---|---|---|---|
| 1 | 3 | RxD/TxD-P (DP) | Receive data/transmission data plus |
| 2 | 8 | RxD/TxD-N (DN) | Receive data/transmission data negative |
| 3 | 5 | DGND (DG) | Data transmission potential (ground to 5V) |
| 4 | 6 | VP (VP) | Supply voltage of the terminating resistance-P, (P5V) |

Detailed information concerning wiring and cables can be found on the PROFIBUS Product Guide or on Internet at:
**http://www.profibus.com/online/list**

# 4 OPERATION

## 4.1.1 KEY FUNCTIONS AND DISPLAYS IN OPERATOR MODE




**Status LEDs (green)**

- SCI Communications running
- AT Tuning running
- RUN Timer/Program running
- HLD Program Waiting
- REM Remote Setpoint active
- S1 First stored Setpoint active
- S2 Second stored Setpoint active
- S3 Third stored Setpoint active

**Alarm status LEDs (red)**

- 1 AL1 ON
- 2 AL2 ON
- 3 AL3 ON
- 4 AL4 ON

**Digital input status LEDs (yellow)**

- I1 - IL1 active
- I2 - IL2 active
- I3 - IL3 active

**Run/stop Timer or a program**

**Menu access**

**PV control input**

in engineering units

Over range 8888 Under range 8888

**SP operating Setpoint**

(Local/Remote or Stored)

**% Control output**

or **Program status** (see page 64)

**Status LEDs (green)**

MAN Manual operating mode

**Control output LEDs (red)**

▲ OP1/OP4 ON - ▼ OP2/OP4 OFF

**Auto/Man**

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

**Setpoint setting**

## 4.1.2 KEYS FUNCTIONS AND DISPLAY IN PROGRAMMING MODE

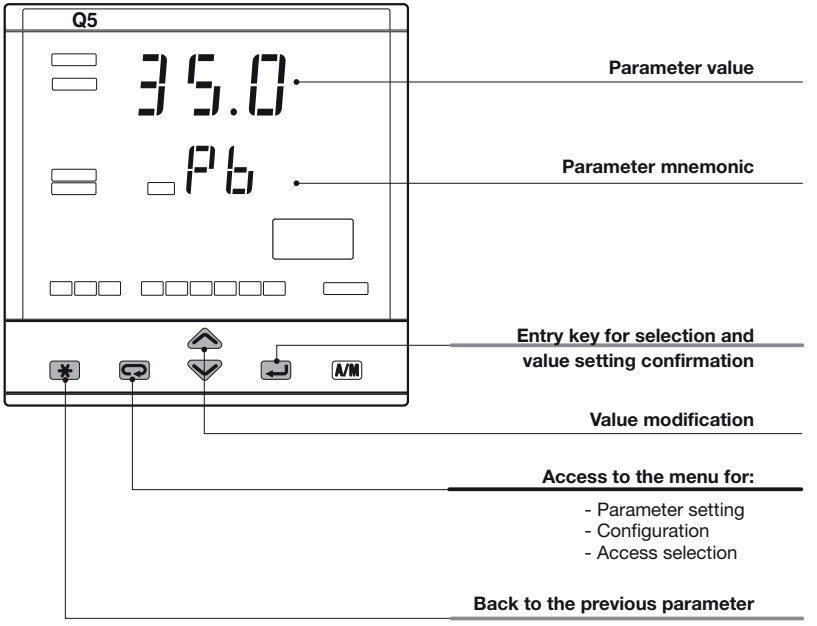
⚠

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.

The value is entered when the next parameter is selected, by pressing the ↵ key.
Pressing the back key ✱ or after 30 seconds from the last modification , the value doesn't change.

**From every parameter, pressing the ↩ key, the controller switches to the operator mode.**



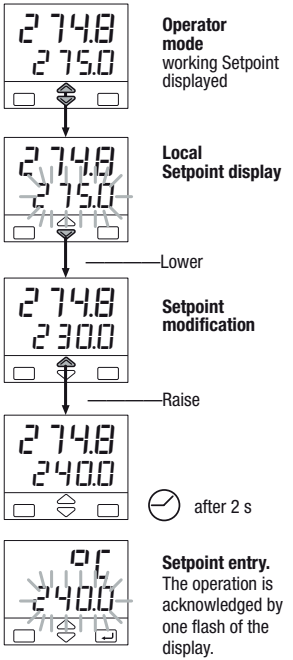
## 4.2 PARAMETER SETTING

### 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.

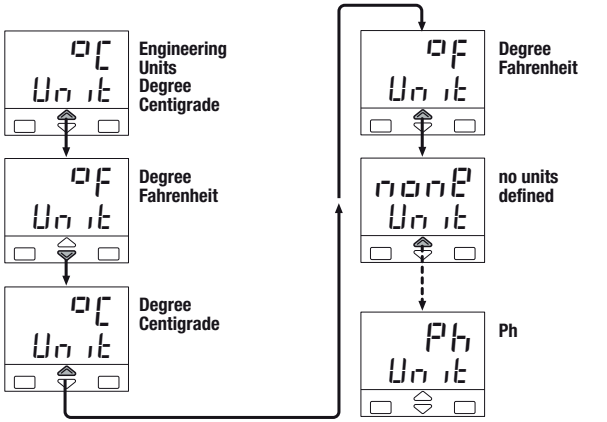
**In case of Setpoint modification: press ⌃ or ⌄ once to display the local Setpoint instead of working Setpoint.**
**To evidence this change the display flashes once. Then the Setpoint can be modified**



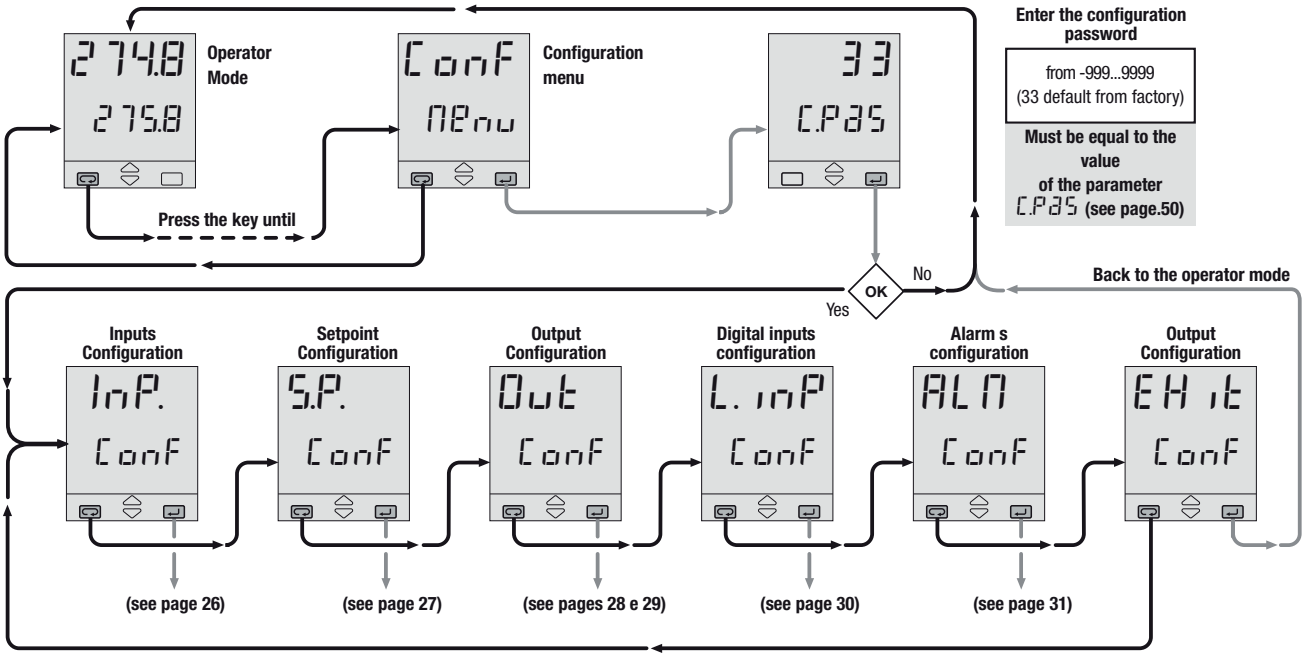

### 4.2.2 MNEMONIC CODES SETTING

**(e.g. configuration see page 26)**

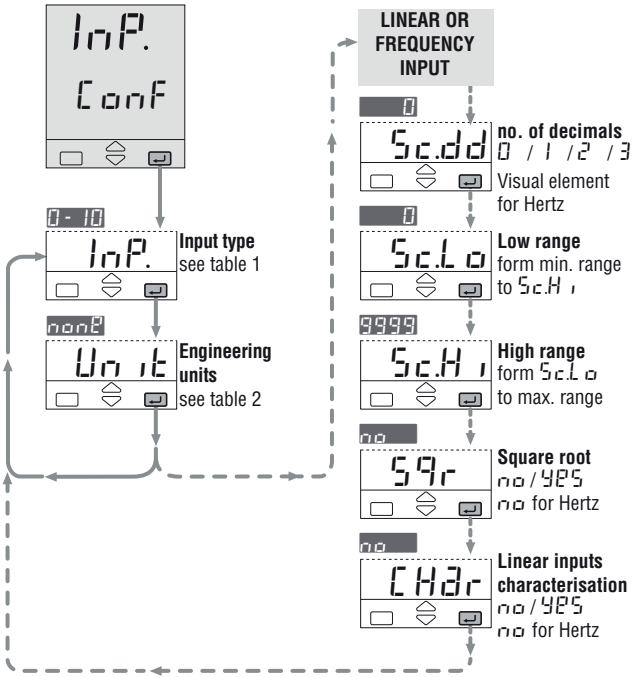
Press the ⌃ or ⌄ to display the next or previous mnemonic for the selected parameter.
Continued pressing of ⌃ or ⌄ will display further mnemonics at a rate of one mnemonic every 0.5 s. The mnemonic displayed at the time the next parameter is selected, is the one stored in the parameter.



## 4.3 CONFIGURATION PROCEDURE



## 4.3.1 INPUTS CONFIGURATION




| Tab. 1 | Input type | |
|---|---|---|
| Code | Description | InP. |
| tc. J | 0...600°C | 32...1112°F |
| tc. U | 0...1200°C | 32...2192°F |
| tc. L | 0...600°C | 32...1112°F |
| tc. S | 0...1600°C | 32...2912°F |
| tc. r | 0...1600°C | 32...2912°F |
| tc. t | -200...+400°C | -328...752°F |
| tc. b | 0...1800°C | 32...3272°F |
| tc. n | 0...1200°C **[1]** | 32...2192°F |
| tcn1 | 0...1100°C **[2]** | 32...2012°F |
| tcU3 | 0...2000 | 32...3632°F |
| tcUS | 0...2000 | 32...3632°F |
| tc. E | 0...600 | 32...1112°F |
| cuSt | Custom range on request | |
| rtd1 | -200...+600°C | -328...+1112°F |
| rtd2 | -99.9...+300°C | -99.9...+572.0°F |
| dELt | -50.0...+50.0°C | -58.0...+122.0°F |
| 0.50 | 0...50 mV | Engineering units |
| 0.300 | 0...300 mV | |
| 0-5 | 0...5 V | |
| 1-5 | 1...5 V | |
| 0-10 | 0...10 V | |
| 0-20 | 0...20 mA | |
| 4-20 | 4...20 mA | |
| Fr 2 | 0...2 kHz | Frequency |
| Fr20 | 0...20 kHz | |
| Fr0.5 | 0...500 Hz | |

| Tab. 2 | Engineering Units | |
|---|---|---|
| Code | Description | Unit |
| nonE | None | |
| °C | Celsius degrees (centigrade) | |
| °F | Fahrenheit degrees | |
| mA | mA | |
| mU | mV | |
| U | Volt | |
| bar | bar | |
| PSI | PSI | |
| rh | RH | |
| Ph | PH | |
| Hz | Hertz | |

**Notes [1]** Thermocuple NiCroSil-NiSil;

**[2]** Thermocuple Ni-Mo.

## Frequency Input

If the controller is to be used with a **Frequency input**, the input signal must be applied to **Input 2** (**IN2** at terminals **23** and **24**). The usage of the **IN2** Input **inhibits** the functioning of Input 1 (**IN1**).

During configuration, `inP` parameter is used to select the operating frequency:

`Fr2` 0... 2 kHz,
`Fr20` 0... 20 kHz,
`Fr05` 0... 500 Hz.

Engineering unit (`unit`) is only a label and can be set to `Hz` if the displayed value is a frequency or `nonE` in all other cases.

Other parameters:

`Sc.dd` Number of decimals (visual element),
`ScLo` Range start,
`ScHi` Range end.

`Sgr` and `CHar` must be set to `no`.

Below are 2 examples of how to configure the frequency input.

**1.** The frequency (in **kHz**) of a signal reaching **1200 Hz** (max.) must be displayed.

The parameters must be set as follows:

`InP = Fr 2`;
`unit = Hz`;
`Sc.dd = 3`;
`ScLo = 0`;
`ScHi = 2.000`;
`Sgr = no`;
`CHar = no`.

**2.** The rotational speed of a shaft equipped with a 10-tooth gear wheel must be displayed.

The shaft can reach **2000 rpm** so at maximum rotation speed the input will receive **20000 pulses per minute** equal to:
20000/60 s = `3333` pulses per second (**Hz**).

The parameters must be set as follows:

`InP = Fr05`;
`unit = nonE`;
`Sc.dd = 0`;
`ScLo = 0`;
`ScHi` = [Fr0.5/(pulses/revolution) x 60] or
500/10 x 60 = `3000`;
`Sgr = no`;
`CHar = no`.

When the shaft rotates at **1000 rpm** the instrument receives **1000 x 10/60 = 166.6 Hz** and displays `1000`.

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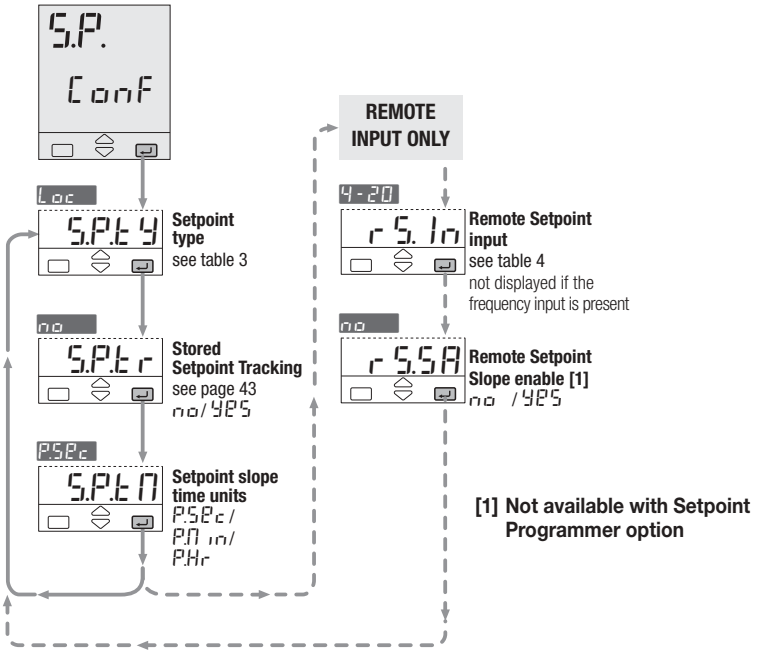
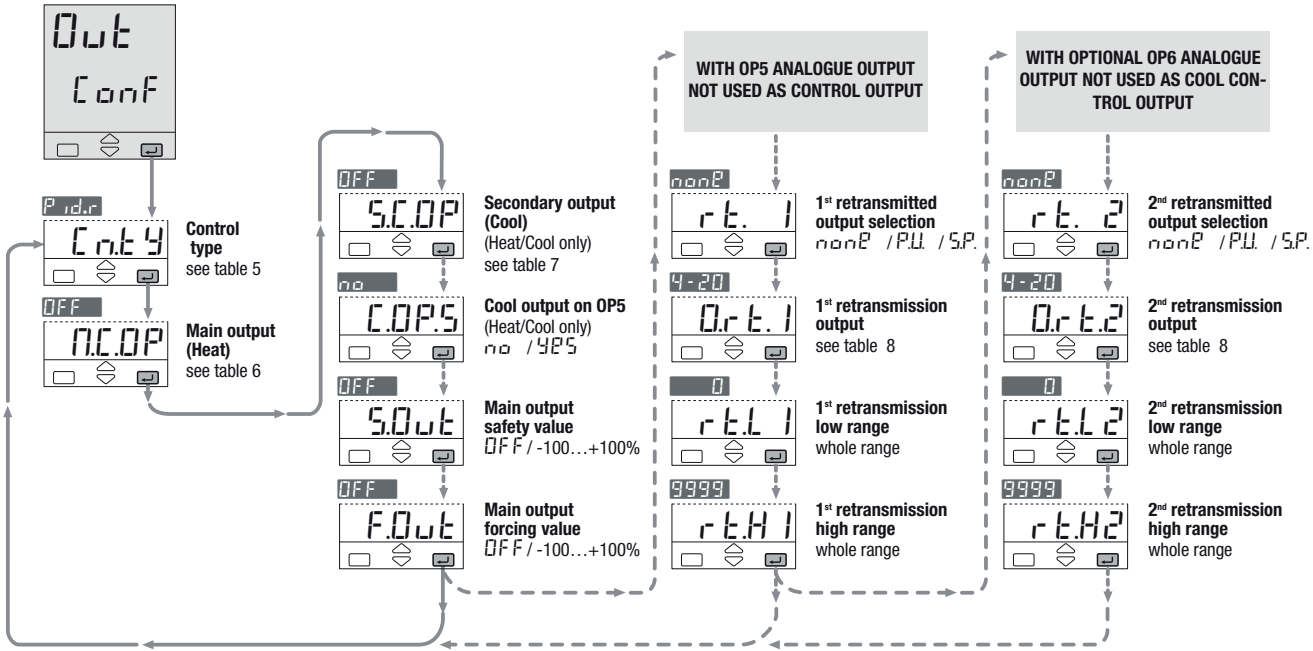
## 4.3.2 SETPOINT CONFIGURATION




| Tab. 3 | Setpoint type | |
|---|---|---|
| Value | Description | S.Pt y |
| Loc | Local only | |
| rEn | Remote only | |
| L-r | Local/remote only | |
| Loct | Local - trim | |
| rEnt | Remote - trim | |
| Prog | Programmed (option) | |

| Tab. 4 | Rem. Setpoint | r S. In |
|---|---|---|
| Value | Description | |
| 0-5 | 0…5 Volt | |
| 1-5 | 1…5 Volt | |
| 0-10 | 0…10 Volt | |
| 0-20 | 0…20 mA | |
| 4-20 | 4…20 mA | |

### 4.3.3 OUTPUT CONFIGURATION



| Tab. 5 | Control mode | |
|---|---|---|
| Value | Description | cnty |
| OF.rE | Reverse action | On - Off |
| OF.d i | Direct action | |
| P idd | Direct action | P.I.D. |
| P idr | Reverse action | |
| U.d ir | Direct action | Modul. valves |
| U.rEU | Reverse action | |
| HC.Ln | Linear | Heat/ Cool |
| HC.OL | Oil charac. | |
| HC.H2 | Water charac. | |

| Tab. 6 | Main Output (Heat) | |
|---|---|---|
| Value | Description | nC.OP |
| OFF | Not used | |
| OP 1 | Relay / Triac | Digital signal |
| Lo9 | Digital | |
| 0-5 | 0…5 Volt | DC signal |
| 1-5 | 1…5 Volt | |
| 0-10 | 0…10 Volt | |
| 0-20 | 0…20 mA | |
| 4-20 | 4…20 mA | |

| Tab. 7 | Secondary output (Cool) | |
|---|---|---|
| Value | Description | S.OP |
| OFF | Not used | |
| OP 2 | Relay / Triac | Digital signal |
| Lo9 | Digital | |
| 0-5 | 0…5 Volt | DC signal |
| 1-5 | 1…5 Volt | |
| 0-10 | 0…10 Volt | |
| 0-20 | 0…20 mA | |
| 4-20 | 4…20 mA | |

| Tab. 8 | Retransmission outputs | |
|---|---|---|
| | | Ort.1 |
| Value | Description | Ort.2 |
| 0-5 | 0…5 Volt | |
| 1-5 | 1…5 Volt | |
| 0-10 | 0…10 Volt | |
| 0-20 | 0…20 mA | |
| 4-20 | 4…20 mA | |

## RETRANSMISSION

When OP5 and OP6 outputs are not configured as control output, they can retransmit the PV or SP linearised value.

rt. 1 / rt. 2 — **Retransmitted signal** — noneP.U. / SP

Ort.1 / Ort.2 — **Output range** — 0-5 / 1-5 / 0-10 / 0-20 / 4-20

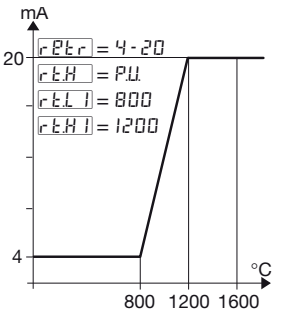
The following parameters define the low and high range.

rtL1 / rtL2 — **Retransmission low range**

rtH1 / rtH2 — **Retransmission high range**

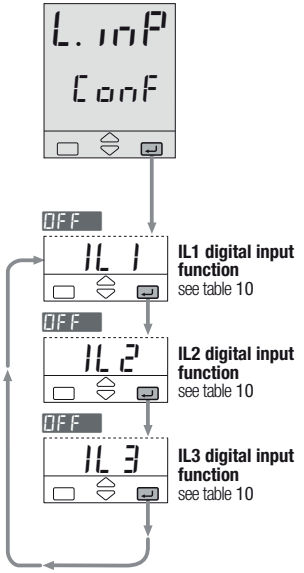
Example:

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



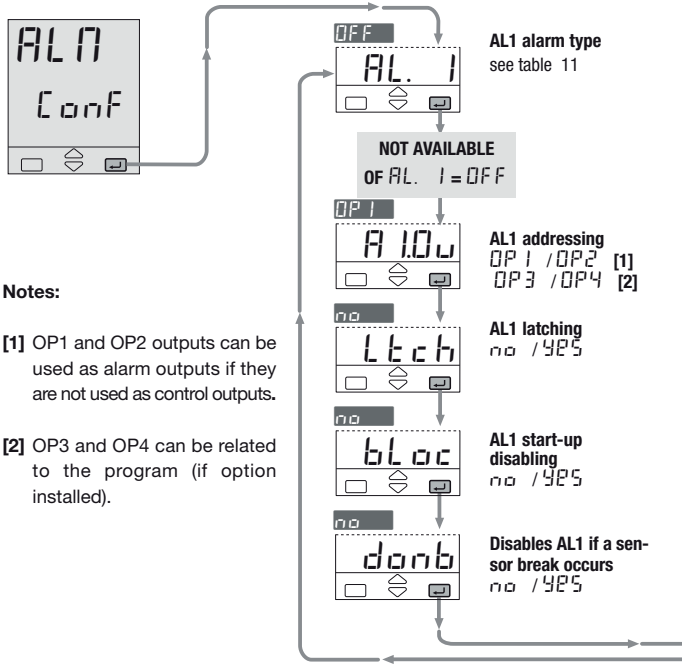

**With rtL1 greater than rtH1 is possible to obtain a reverse scale.**

### 4.3.4 DIGITAL INPUTS CONFIGURATION




| Tab. 10 Digital Inputs functions | | IL1 / IL2 / IL3 |
|---|---|---|
| Value | Description | |
| OFF | Not used | |
| L-r | Local/Remote | |
| AMAn | Auto/Man | |
| S.P. 1 | 1st stored Setpoint | |
| S.P. 2 | 2nd stored Setpoint | |
| S.P. 3 | 3rd stored Setpoint | |
| tEb.1 | Keyboard lock | |
| SLo.1 | S.P. slope disable | |
| HPU | Measure hold | |
| F.Out | Output forcing mode | |
| Pr9.1 | 1st program | up to 3 |
| Pr9.2 | 2nd program | up to 3 |
| Pr9.3 | 3rd program | up to 3 |
| Pr9.4 | 4th program | up to 3 |
| r.-H. | Program Run/Stop | |
| rSt | Program reset | |
| bLcU | Reset blocking | |

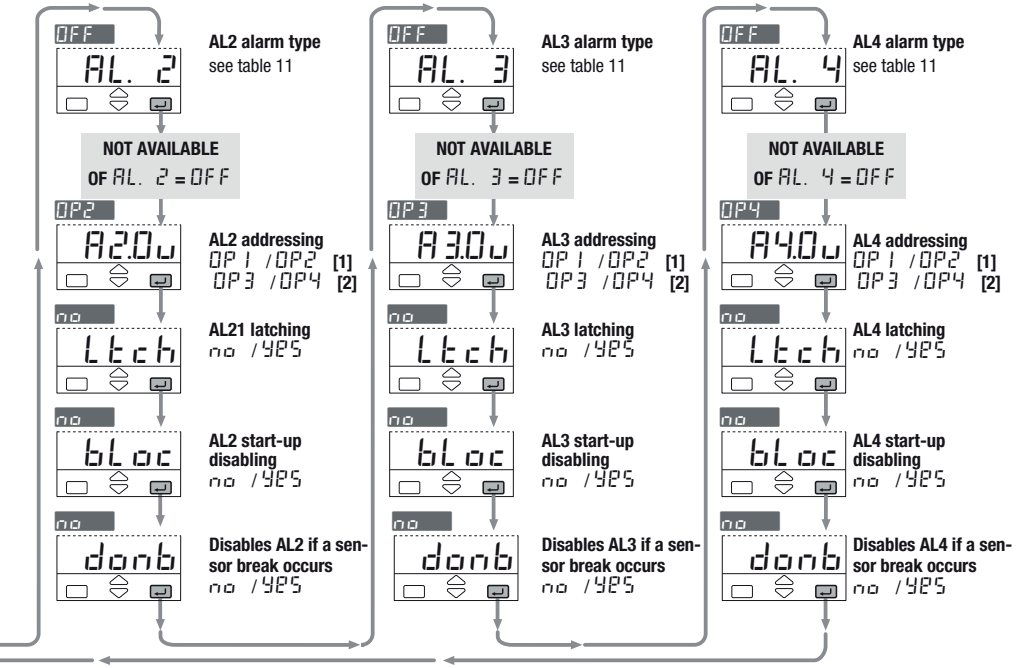
### 4.3.5 ALARMS CONFIGURATION




**Notes:**

**[1]** OP1 and OP2 outputs can be used as alarm outputs if they are not used as control outputs.

**[2]** OP3 and OP4 can be related to the program (if option installed).




| Tab. 11 | Alarm type | |
|---|---|---|
| Value | Description | AL 1 / AL 2 / AL 3 / AL 4 |
| OFF | Not used or used by the programme (AL3/AL4) | |
| FS.H | High active | Absolute |
| FS.L | Low active | Absolute |
| dEU.H | High active | Deviation |
| dEU.L | Low active | Deviation |
| band | Out active | Band |
| Lbd | Loop break alarm (AL1 only) | |

## 4.3.6 AL1, AL2, AL3, AL4 ALARMS CONFIGURATION

It is possible to configure up to 4 alarms: AL1, AL2, AL3, AL4 (see page 31) selecting, for each of them:

**A** the type and the operating condition of the alarm (table 11 page 31);

**B** the functionality of the alarm acknowledge (latching) LtCh

**C** the start-up disabling (blocking) bLoc ;

**D** the physical output of the alarm OP1 OP2 OP3 OP4 ;

**The outputs can be used for alarms if they are not used as control outputs (see par. 3.3.7 page 20).**

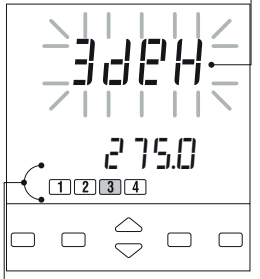
It is possible to route up to 4 alarm to a single output (OR of the alarms).

**Alarm occurrence display**

This function can be enabled by the configuration software.

Please, read the user manual: "gamma**due®** and delta**due®** controller series serial communication and configuration software".

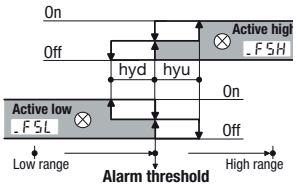
The type of alarm is presented flashing, on the front panel in alternation with the PV value.



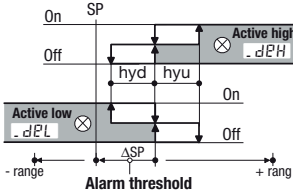

The red led of the activated alarm output is on.

## [A] OPERATING CONDITIONS

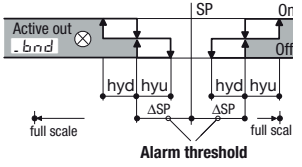
**Absolute alarm**




**Deviation alarm**




**Band alarm**

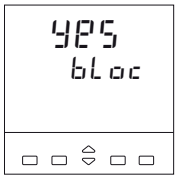


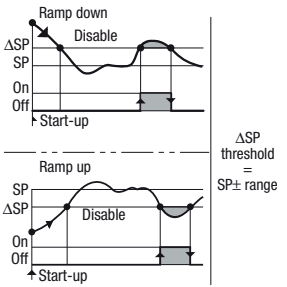

## [B] ALARM ACKNOWLEDGE FUNCTION (LATCHING)

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.

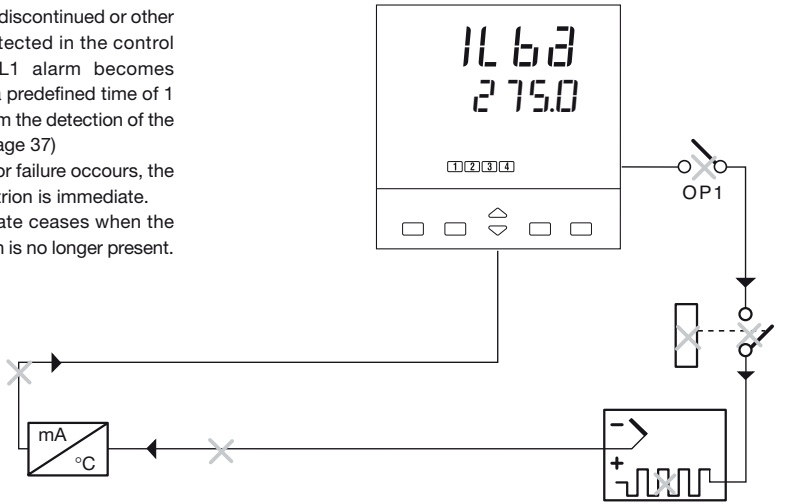
## [C] START-UP DISABLING (BLOCKING)



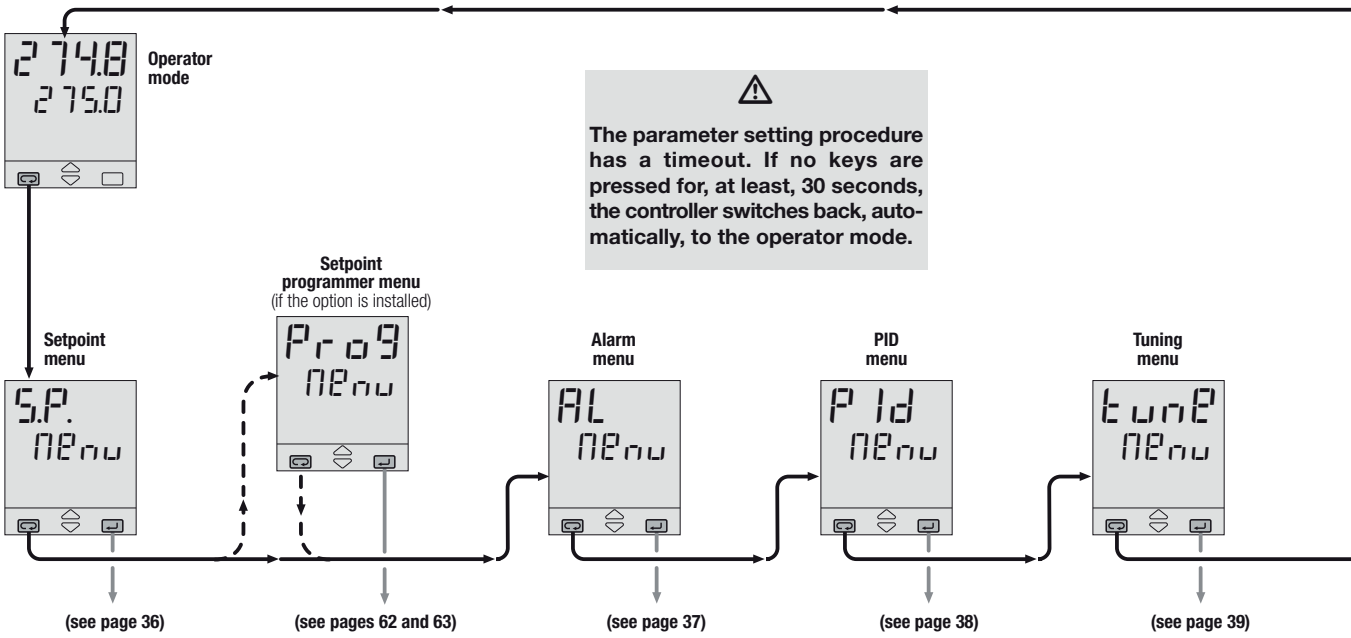

## [D] LOOP BREAK ALARM (LBA)

When the controller connection to the sensor is discontinued or other faults are detected in the control loop, the AL1 alarm becomes active, after a predefined time of 1 to 9999 s, from the detection of the failure (see page 37)
When a sensor failure occours, the LBA interventrion is immediate.
The alarm state ceases when the fault condition is no longer present.



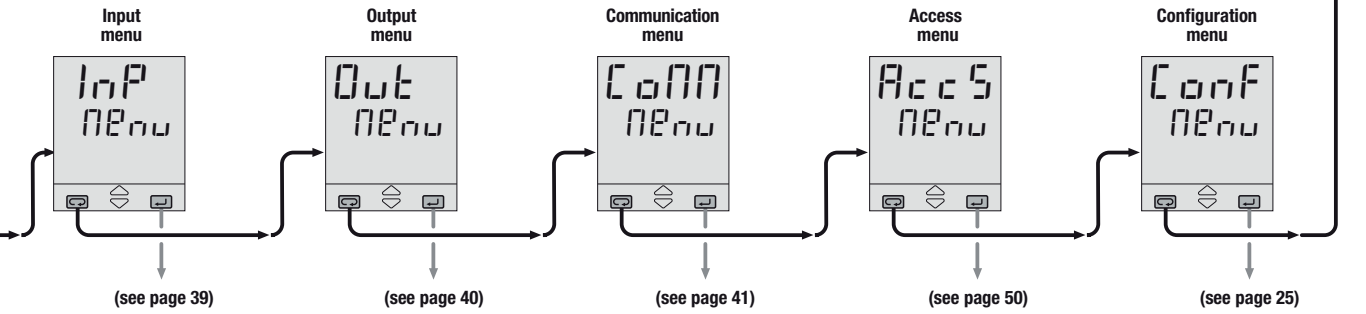

**⚠ In case of ON-OFF control, the LBA alarm is not active.**

## 4.4 PARAMETERISATION - MAIN MENU

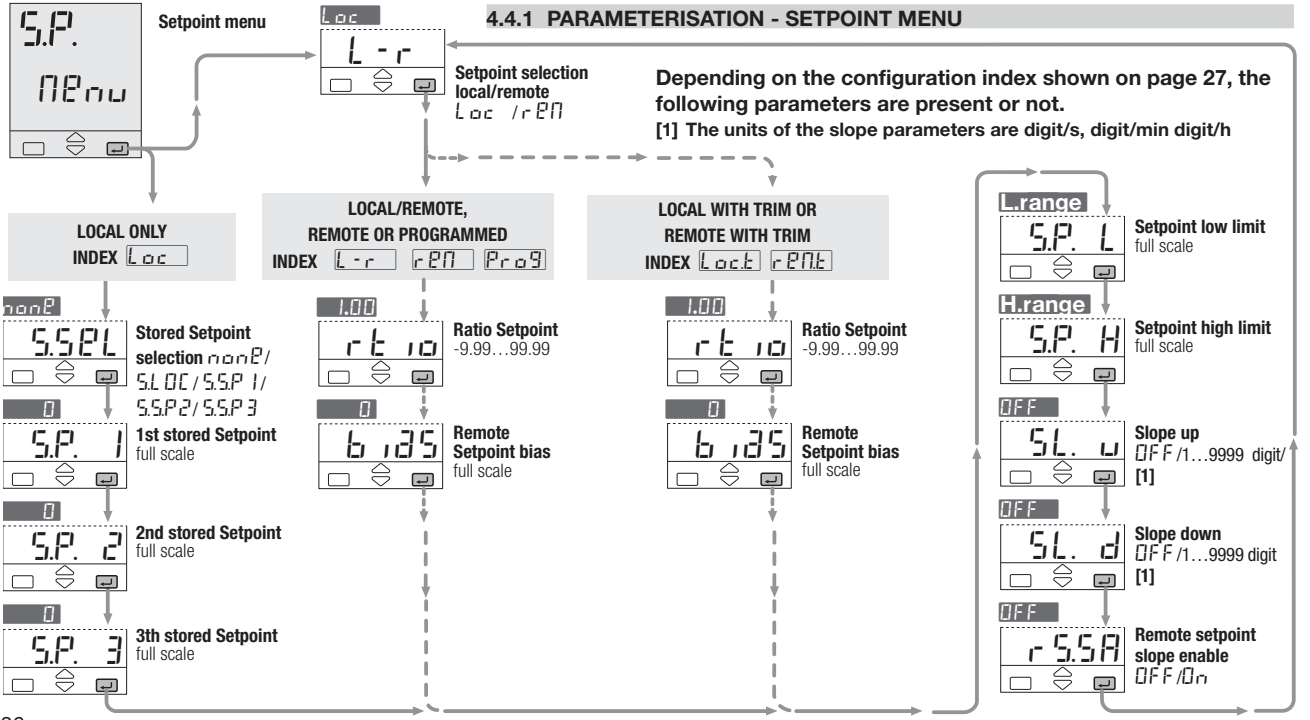


After having selected the parameter or the code, press ⌃ or ⌄ to modify the value (see page 24) The value is entered when the next parameter is selected, by pressing the ↵ key.

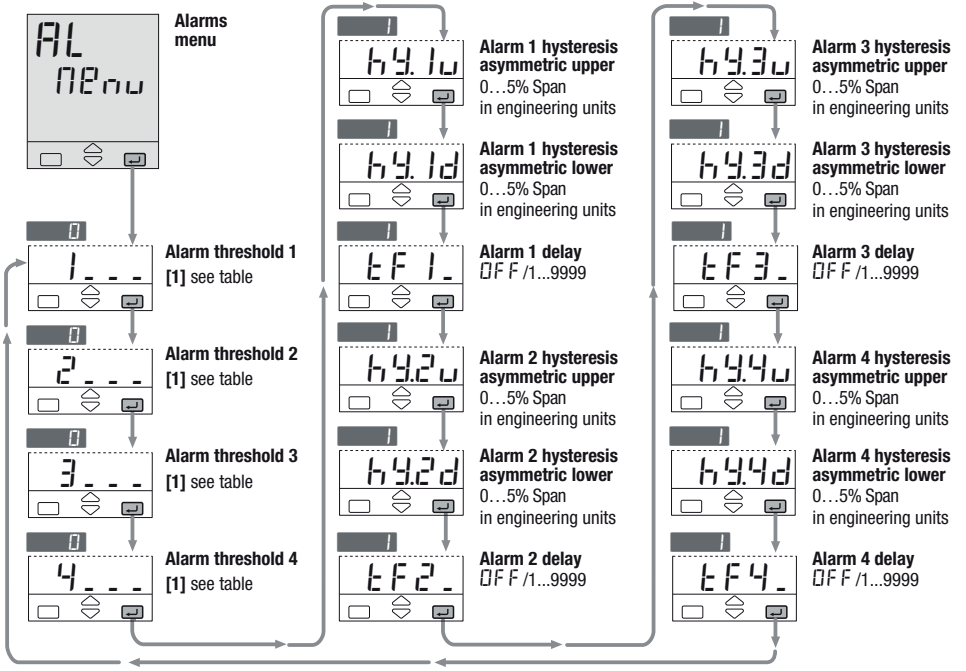
**Pressing ↩ go back to the Operator mode**



## 4.4.1 PARAMETERISATION - SETPOINT MENU



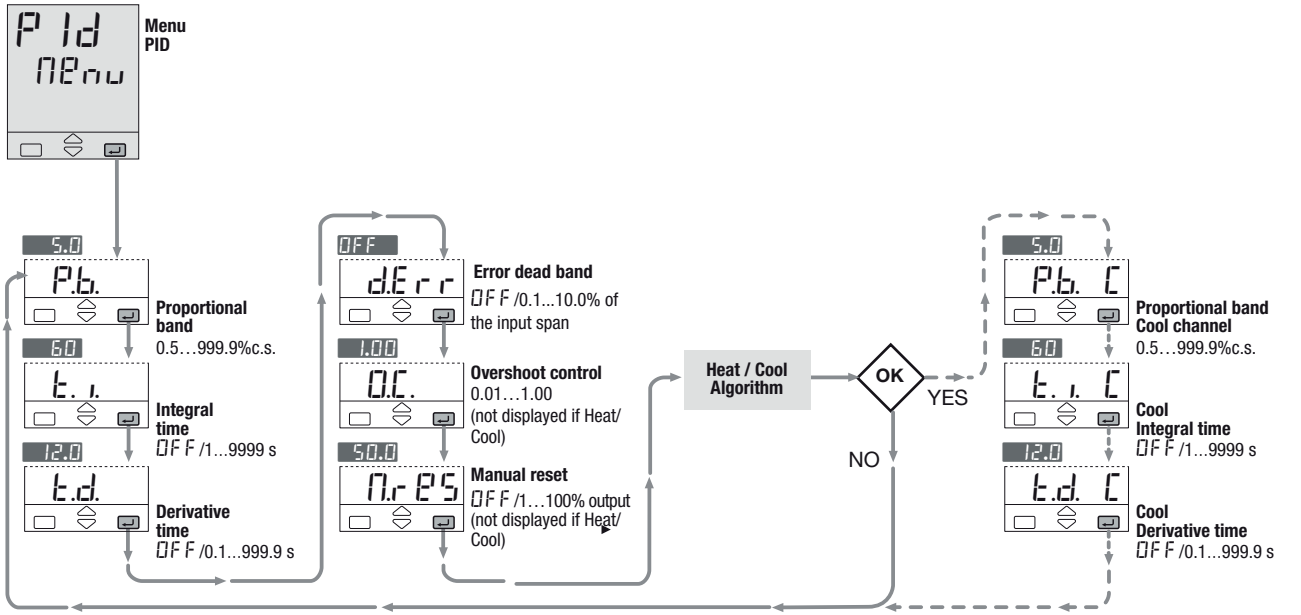
## 4.4.2 PARAMETERISATION - ALARMS MENU



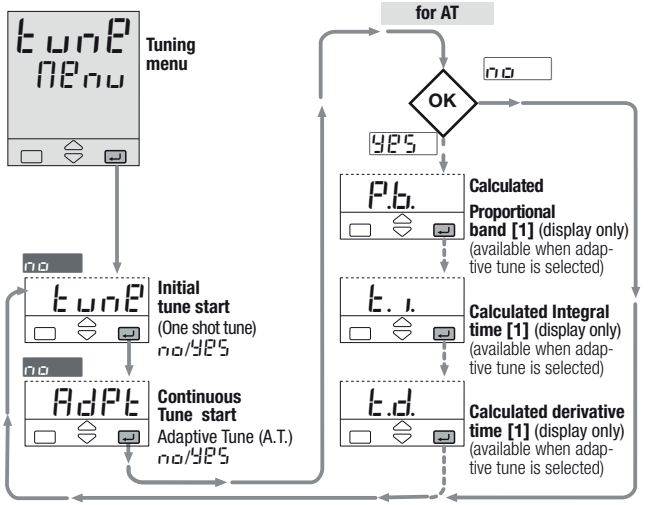

**[1]** A code, specifying the alarm Number and the alarm type that has been configured (see page 31), is displayed. At this point, the user must enter the threshold value, according to the following table.

| Type and value | Mode | N° and Param. |
|---|---|---|
| **Absolute** full scale | Active high | _FS.H |
| | Active low | _FS.L |
| **Deviation** full scale | Active high | _dE.H |
| | Active low | _dE.L |
| **Band** full scale | Active out of band | -bnd |
| **L.B.A.** 1…9999 s | Active high | _Lbd |

### 4.4.3 PARAMETERISATION - PID MENU (not shown for ON-OFF control action)

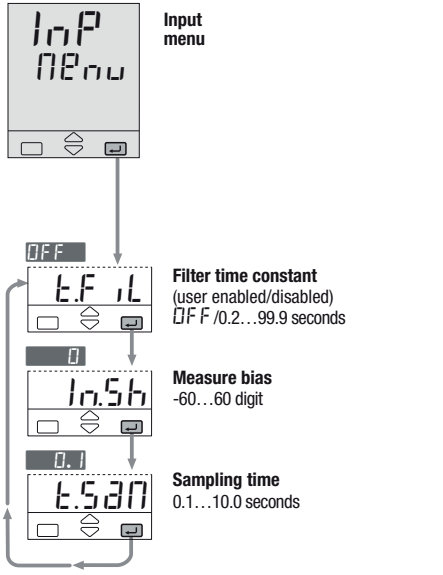


### 4.4.4 PARAMETERISATION
### TUNING MENU (not shown for ON-OFF control action)

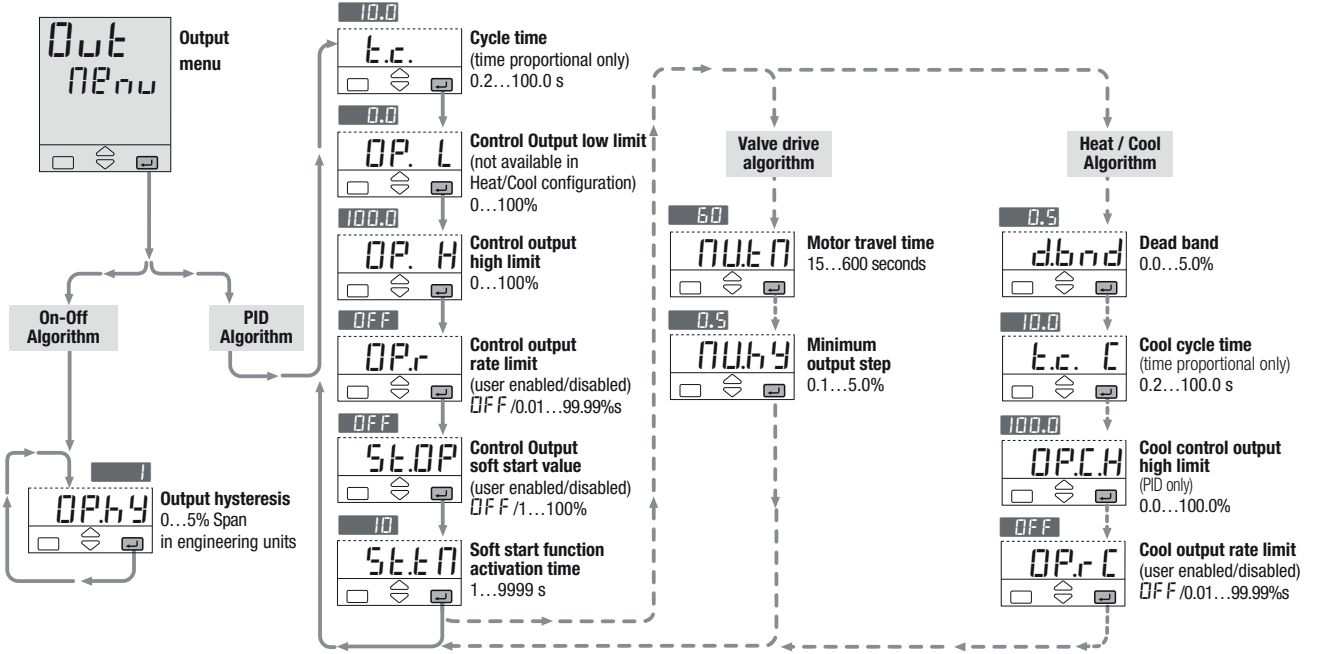



**[1]** These values are not automatically stored on the PID menu parameters *P.b.*,*t. i.*,*t.d.*

### 4.4.5 PARAMETERISATION
### INPUT MENU

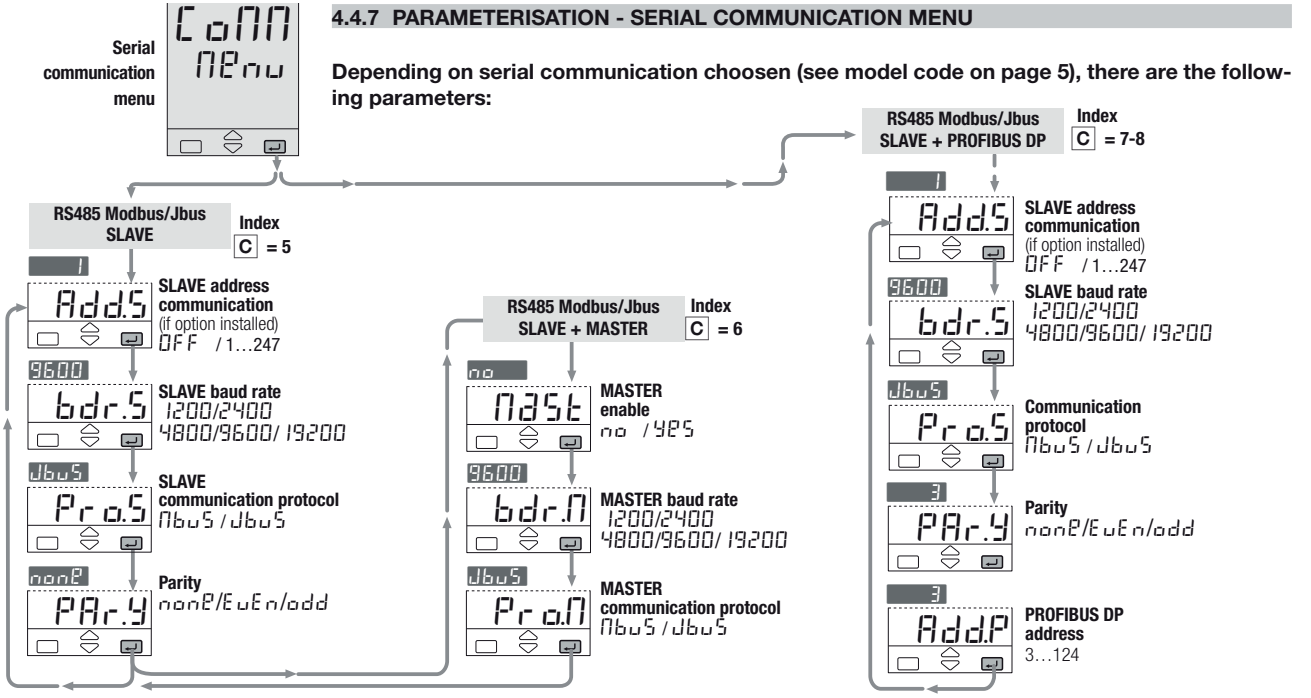


## 4.4.6 PARAMETERISATION - OUTPUT MENU



## 4.4.7 PARAMETERISATION - SERIAL COMMUNICATION MENU

**Depending on serial communication choosen (see model code on page 5), there are the following parameters:**



## 4.5 PARAMETERS

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

### 4.5.1 SETPOINT MENU

**SP.L Setpoint low limit**

**SP.H Setpoint high limit**

High and low limit of the Setpoint SP.
The minimum span (S.P.L - S.P.H) must be greater than 100 digit.

**SL.u Setpoint ramp up**

**SL.d Setpoint ramp down**

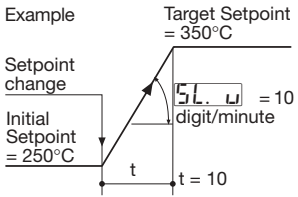
This parameter specifies the maximum rate of change of the Setpoint.
Adjustable in digit/s,digit/min and digit/hour (see page 27)

**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 53).

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




**SP.1 1st stored Setpoint**

**SP.2 2nd stored Setpoint**

**SP.3 3th stored Setpoint**

Values of the three Setpoints, that are activated by mean of logic inputs, communication parameters, and keyboard. The Setpoint active is indicated by the **S1**, **S2** or **S3** green led.

See also page 56.

**rSSA Remote Setpoint Slope enable**

To enable or disable slopes when the remote Setpoint is active.

**S.P.t r** **Stored Setpoint tracking**

(see chapter 4.3.2 at page 27)

Two different operation mode can be set:

A- Stand-by mode **no**

The memorised Setpoint is active until its command is active too. Then the controller goes back to the Local Setpoint which becomes the operating one.

B- Tracking mode **YES**

Once the memorised Setpoint is active, it remains operating also when it command is not active anymore.

**The previous Local Setpoint value will be lost.**

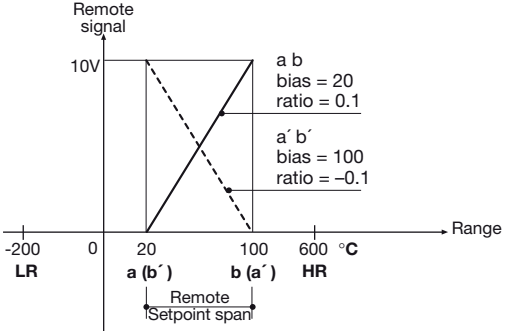
**r t io** **Remote Setpoint Ratio**

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

**b i AS** **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

### 4.5.1 SETPOINT MENU

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

b iAS = starting point = a

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

Example:
b iAS = 20
rt io =

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

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

b iAS = starting point = a´

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

Example:
b iAS = 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
(table 3, page 27)
SP = SL + (rt io • REM) + b iAS

Setpoint type rEMt
(table 3, page 27)
SP = REM + (rt io • SL) + b iAS

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
b iAS = 0

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

Remote Setpoint range equal to the Input range:
Setpoint type = Loct
rt io = 1
b iAS = LR
SL = 0

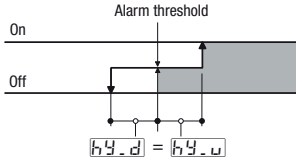
## 4.5.2 ALARM MENU

(see also pages 32 and 33)

**hy_u** **Asymmetric upper alarm hysteresis**

**hy_d** **Asymmetric lower alarm hysteresis**

**Example with high absolute alarm**




The parameter can be set between 0 and 5% of the configured Span and set in Engineering units. e.g.
Range = -200…600°C;
Span = 800°C;
Max Hysteresis = 5% 800°= 40°C;

**For symmetrical hysteresis set** hy_d = hy_u

**tF1** **Alarm delay**

Delay time for alarm activation.
OFF: alarm activated immediately.
1...9999: alarm activated only if the condition persists for the set time.

## 4.5.3 PID MENU

**Not present with On-Off main output.**

**Pb.** **Proportional Band**

**Pb. C** **Cool Proportional Band**

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

**t. i.** **Integral Time**

**t. i. C** **Cool 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.

**t.d.** **Derivative Time**

**t.d. C** **Cool Derivative Time**

It is the time required by the proportional term P to reach the level of D. When OFF it is not included.

**O.C.** **Overshoot control**

(Automatically disabled when the adaptive tune is running).
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 PID algorithm.
Setting 1, the overshoot control is disabled.

## 4.5.3 PID MENU

**Manual reset**

This term specifies the value of the control output 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).

## 4.5.4 TUNING MENU (not shown for ON-OFF main control output)

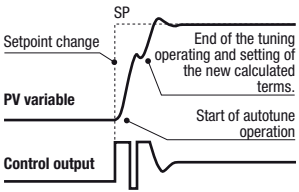
**See page also 57**

Two tuning method are provided:

- Initial one shoot **Fuzzy-Tuning.**
- Continuous, self learning **Adaptive Tuning.**

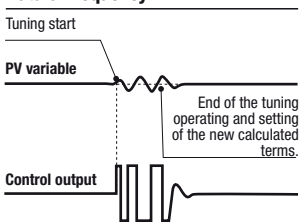
**The Fuzzy-Tuning** determines automatically the best PID term with respect to the process behaviour. The controller provides 2 types of "one shot" tuning algorithm, that are selected automatically according to the process condition when the operation is started.

**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.

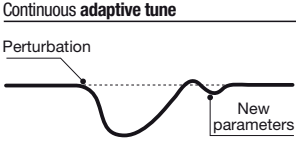
**Natural frequency**




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 PID term, according the process conditions.**

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



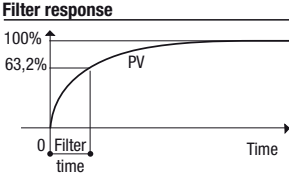

**It is particularly suitable for controlling process whose control characteristics change with time or are not linear in relation to the Setpoint values.** It doesn't require any operation by the user. It is simple and works fine: it samples continuously the process response to the various perturbations, 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 PID term parameters.
It is the ideal for all applications where it is required to change continuously the PID terms parameters, in order to adjust the PID to the changes of the process dynamic conditions.

**In case of power off with the Adaptive Tune enabled, the values of the PID terms parameters are stored, in order to be reused at the next power on. At power on the Adaptive Tune starts automatically.**

## 4.5.5 INPUT MENU

**Input filter**

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




**Measure Bias**

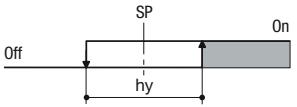
This value is added to the measured PV input value. Its effect is to shift the whole PV scale of its value (±60 digits).

**Sampling Time**

Sampling time, in seconds, of the instrument. This parameter is normally used when controlling slow process, increasing the sampling time from 0.1 to 10 seconds.

## 4.5.6 OUTPUT MENU

**OPHY Control output hysteresis**




The parameter can be set between zero and 5% of the configured Span and set in Engineering units.
e.g.
Range = -200…600°C
Span = 800°C
Max Hysteresis = 5% 800°= 40°C

**t.c. Control output cycle time**

**t.c. C Cool cycle time**

It's the cycle time of the logic control output. The PID control output is provided by the pulse width modulation of the waveform.

**OP. L Control Output low limit**

It specifies the minimum value of the control output signal.
It is applied in manual mode, too.

**OP. H Control output high limit**

**OPCH Cool output high limit**

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

**OPr Heat output maximum rate**

**OPrC Cool output maximum rate**

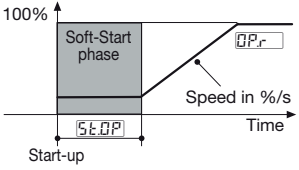
This value, specified in %/seconds, with range from 0.01 to 99.99%/s provides the maximum rate of change of the output. When set to OFF this function is disabled.

**StOP Soft start of the control output**

It specifies the value at which the control output is set during the start up phase.

**StTM Soft start time**

This value specifies the time the start up phase lasts. The start up phase starts at power up of the controller.




**MOTM Travel time**

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

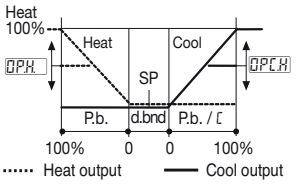
**MOHY Minimum step**

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.

**d.bnd Heat/Cool deadband**

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

**Heat / Cool Algorithm**



## 4.5.7 SERIAL COMMUNICATION MENU (OPTION)

**Add.S** **SLAVE address communication**
- 1…247

**Add.P** **SLAVE Profibus DP address**
- 3…124

All the instrument connected to the same supervisor must have different addresses.
If set **OFF** the serial comm.s is not active.

**bdr.S** **SLAVE Baud rate**

**bdr.M** **MASTER Baud rate**

It provides the baud rate in the range from 1.200 to 19.200 bit/s.

**PAr.y** **Parity**

May be set even **EuEn** or odd **odd**.
If **nonE** is set, parity will be excluded.

**Three serial comm.s options are available:**

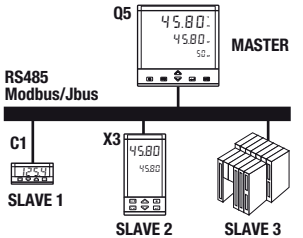
### A - Modbus/Jbus SLAVE

The parameters value can be read and when possible modified.

### B - Modbus/Jbus MASTER with Mathematical package

Mathematical package.
The transmission and inquiry of parameters value to all the devices using Modbus/Jbus SLAVE (e.g. PLC, etc.) is allowed.

The mathematical package can manipulate the received data by means the serial communications.




Example:
The MASTER (X5) reads the process variable from SLAVE 1 (C1) and SLAVE 2 (X3). It compairs the two values and send the higher to the SLAVE 3 (PLC).

**The available math. operations are:**

| + | - | * | / | > | < |
|---|---|---|---|---|---|

To define the controller operations of this option, the configuration software must be used **[1]**.

### C - PROFIBUS DP SLAVE

(**Pro**cess **Fi**eld **bus** protocol)

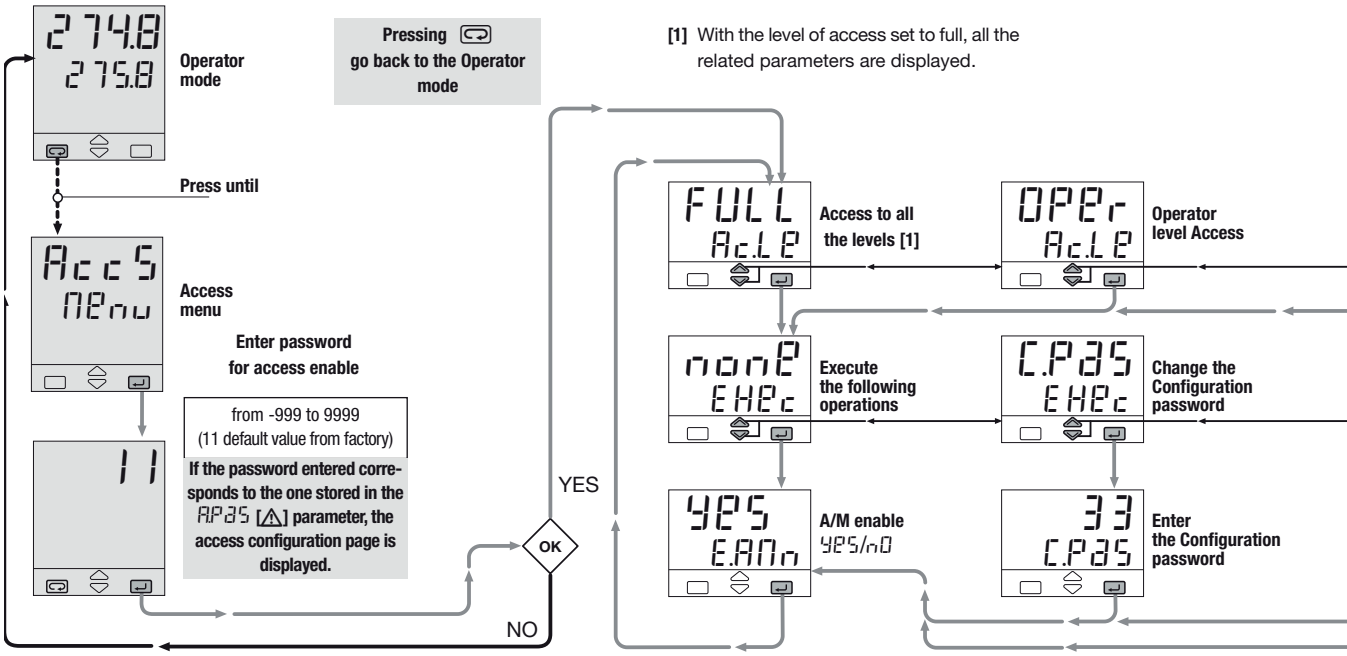
Industrial standard for peripheral devices connection to a machine in a plant.
The protocol installed in this controller, offers the following advantages against the standard normally supplied by other suppliers:

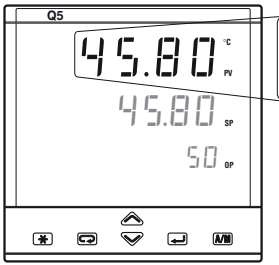
- Communications baudrate.
  **Up to 12 Mb/s with electric isolation.**
- The list of data transfer (profile file) **is user configurable.**
  It can be set by means the configuration software **[1].**

Notes:

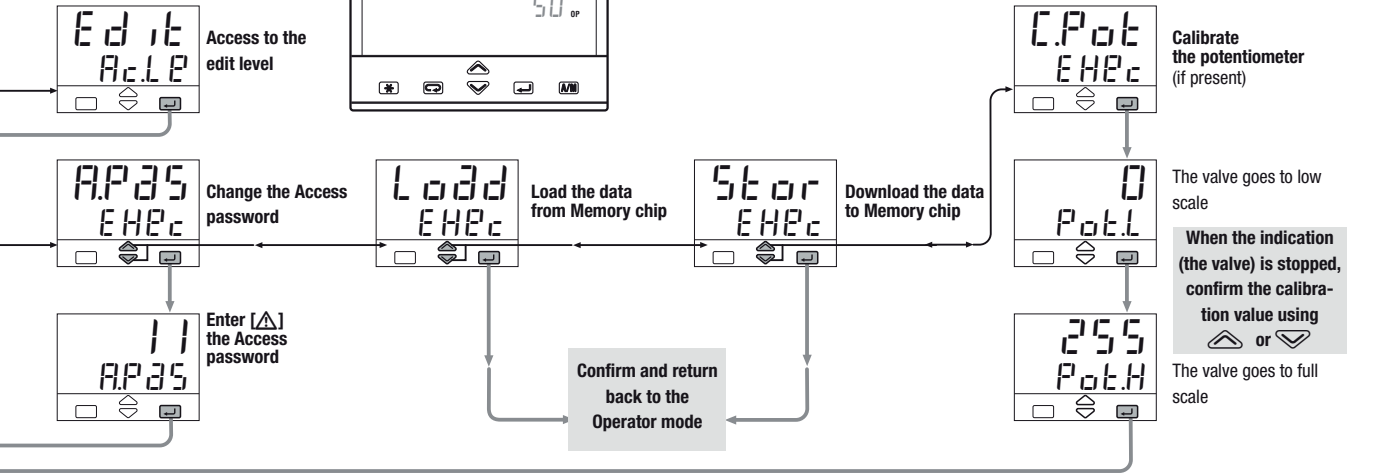
[1] ⚠ **Please, read the user manual:**
"gamma**due®** **and** delta**due®** **controller series serial communication and configuration software".**

## 4.6 PARAMETERISATION - ACCESS MENU - PASSWORD - CALIBRATION






During the up-download of the data to/from the Memory chip, the controller display shows the segment clockwise rotation of the digits.



## 4.6 PARAMETERISATION - ACCESS MENU - PASSWORD - CALIBRATION

**With the access level Edit, the user defines which groups and parameters are accessible to the operator**

After selecting and confirming the access level Edit, enter in the parameters menu.
The code of the access level is displayed on the front panel.

Press the ⌃⌄ keys to select the proper level.


| Group of parameters | Code | Access level |
|---|---|---|
| | rEAd | Visible |
| | HIdE | Not visible |


| Group of parameters | Code | Access level |
|---|---|---|
| | AltE | Visible and changeable |
| | FASt | **Included in “Fast view”** |
| | rEAd | Visible only |
| | HIdE | Not visible and not changeable |

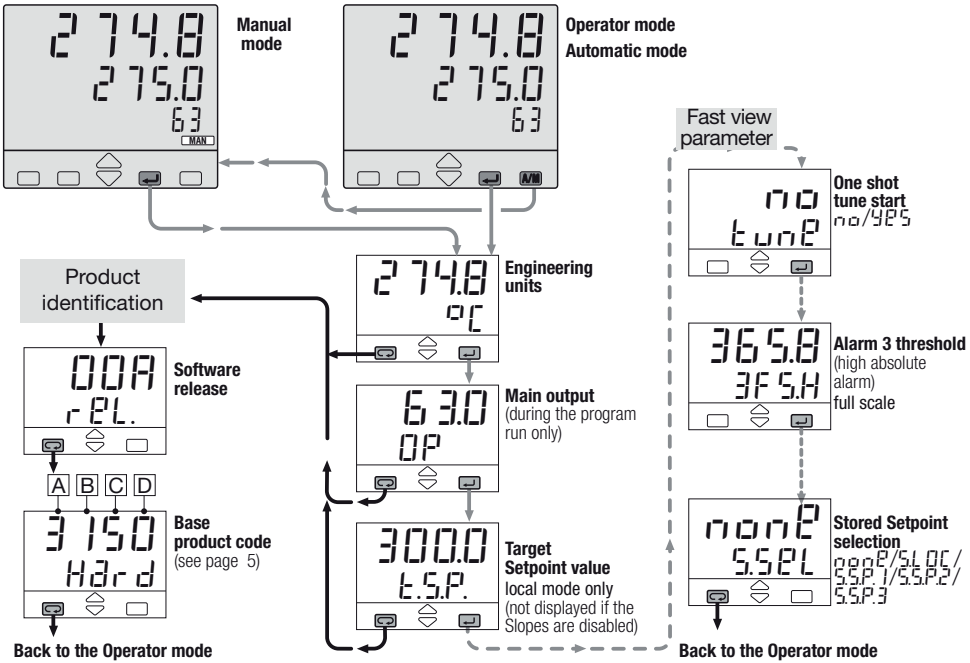
**The parameters in the access level FASt are recalled on the front panel through the procedure of fast parameter access** illustrated in par. 5.2 page 53. The maximum number of fast parameters is 10.

At the end of the parameter list of the selected group, the controller quits from the Edit access level.
**Therefore, the Edit level must be selected for each group of parameters**

The access level of groups and parameters, is activated through

# 5 DISPLAYS

## 5.1 STANDARD DISPLAY




## 5.2 FAST VIEW
**(fast access to the parameters)**

With this procedure, simple and fast, up to 10 parameters, selected through the fast view (see par 4.6 page 52) **are displayed and can be modified by the operator without requiring the standard parameter setting procedure.**

Press ⌃⌄ in order to modify the parameters

The value is entered by pressing ↵ key.

On left side, please find as an example a list of parameters on Fast view menu.

# 6 COMANDS

## COMMANDS TO THE CONTROLLER AND OPERATING PHASES

The commands can be entered in 3 ways:

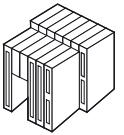

### 6.1 KEYPAD

see page 55

- Setpoint modification;
- Manual mode;
- Local/remote selection;
- Stored Setpoint display;
- Tune Run / Stop;
- Program start/stop (see page 66).

### 6.2 DIGITAL INPUTS

see page 58



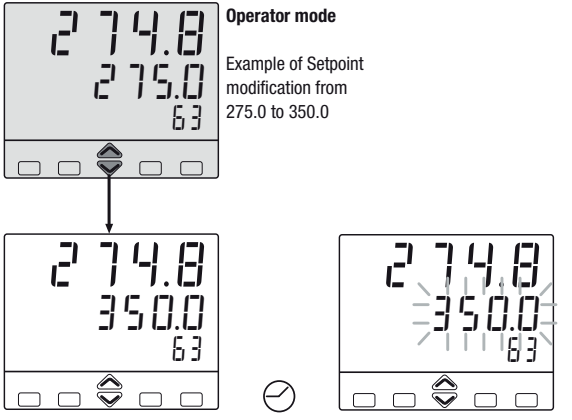
### 6.3 SERIAL COMMUNICATIONS

see the manual on this topic

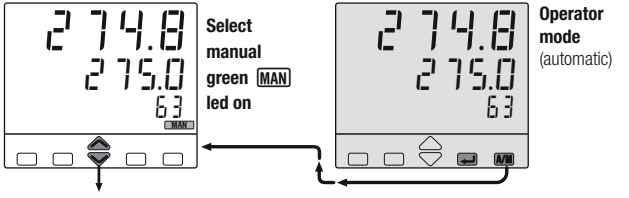
## 6.1 KEYPAD COMMANDS

### 6.1.1 SETPOINT MODIFICATION

**The Setpoint is directly modified with the ⌃⌄ 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.



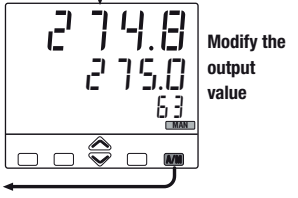

### 6.1.2 AUTO/MANUAL MODE



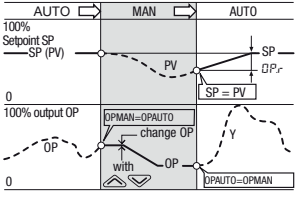

Modification of control output value

⚠

The new value is immediately working without any confirm.

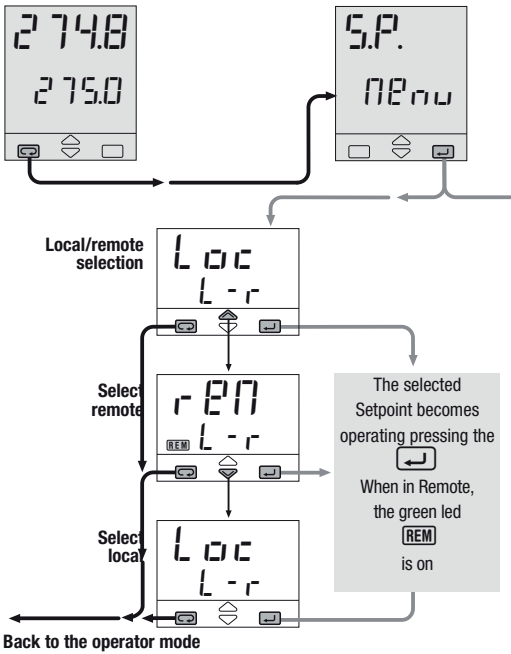



The bumpless action is present switching between AUTO, MAN and vice versa.



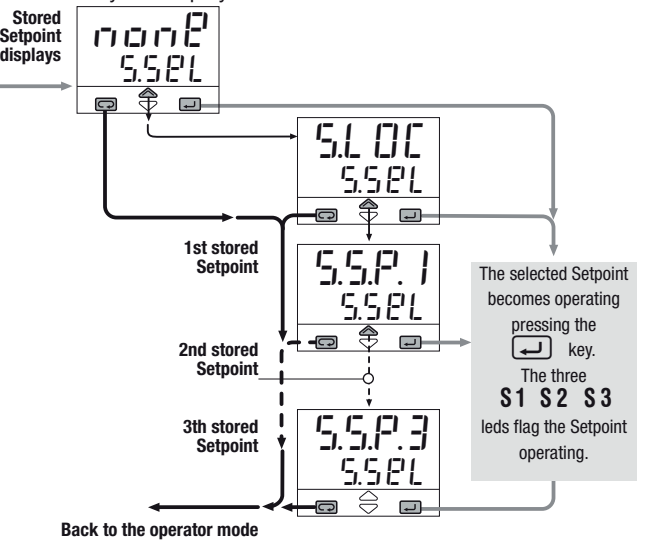

⚠ In case of power failure, the AUTO/MAN status and the output value remain stored in the controller memory.

### 6.1.3 LOCAL/ REMOTE SELECTION




### 6.1.4 STORED SETPOINTS SELECTION (see also pages 42, 43)

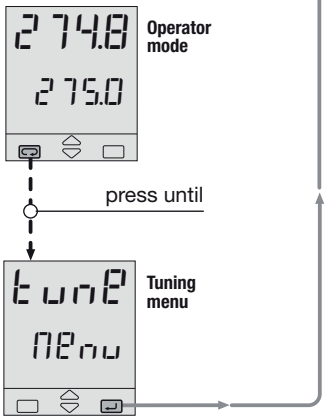
The Setpoint is directly modified with the keys.
Once entered, the new value is checked and becomes operating after 2 seconds. The end of this phase is flagged by flashing momentarily the display with SP.

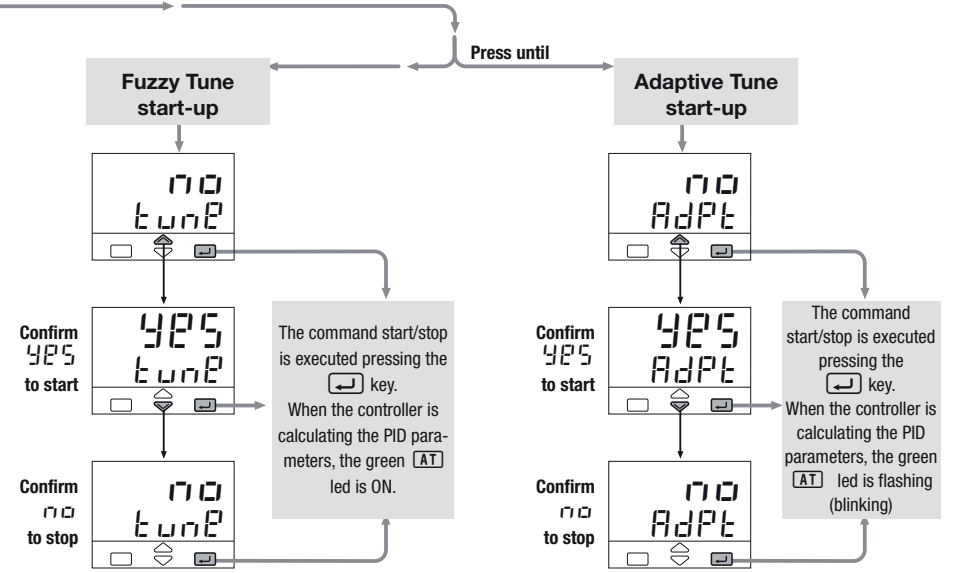


### 6.1.5 TUNE RUN / STOP

This controller is provided with 2 different Tuning algorithm:

- **Fuzzy tune (one shot tune)** for calculating the optimal PID terms parameters.
- **Adaptive Tune** (continuous tune) for a continuous calculation of the PID terms parameters.




After the execution of the tuning, the calculated values are automatically presented in the PID menu.

When this function is in progress, the calculated values are visible in the Tuning menu but cannot be modified.

## 6.2 DIGITAL INPUTS COMMANDS

A function is assigned, through the configuration procedure to each IL1, IL3 and IL3 digital input. (see the parameters setting at tab. 10 at page 30).
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.

### 6.2.1 DIGITAL INPUTS COMMANDS FOR LOCAL-REMOTE SETPOINT

| Function | Parameter value | Performed operation Off | Performed operation On | Notes |
|---|---|---|---|---|
| None | OFF | – | – | Not used |
| Set manual mode | A.Man | Automatic | Manual | |
| Keyboard lock | PEb.1 | Unlock | Locked | With the keypad locked the commands from digital inputs and serial communications are still operating |
| PV measure hold | H.PV | Normal operation | PV is hold | The value of PV is “frozen” at the time the digital input goes to the close state |
| Setpoint slopes inhibition | SLo.1 | Rate limiting is active | Normal operation | When the input is in the on state, the Setpoint is changed in steps |
| Output forcing mode | F.Out | Normal output | Forced output | With ON command the output is equal to the forced value ( see page 28) |
| 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. (see page 43) |
| 2nd stored Setpoint | SP. 2 | Local | 2nd SP | |
| 3th stored Setpoint | SP. 3 | Local | 3th SP | |
| Set Remote mode | L-r | Local | Remote | |
| Reactivation of blocking | bLcE | – | Reactivation of blocking | The blocking function is activated on closing the command from digital inputs |

# 7 PROGRAMMED SETPOINT

## INTRODUCTION

When the Setpoint programmer option (mod. Q5-3… **4** ) is present, up to four programs are available.

## MAIN CHARACTERISTICS

- 4 program, 16 segments max/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;
- two digital outputs (OP3 and OP4) related to the program;
- setting of the maximum allowed deviation from the Setpoint.

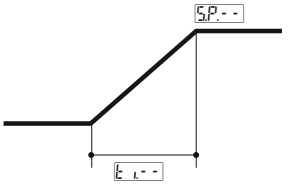
## 7.1 PROGRAM STRUCTURE

The program consists of a sequence of segments.

For each segment, it is specified:

- the Setpoint to reach SP
- the duration of the segment tim
- the state of the OP3 output.

(always present)




The program consists of:

- 1 initial segment named 0;
- 1 end segment named F;
- 1…14 normal segments.

**Initial segment - 0**

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

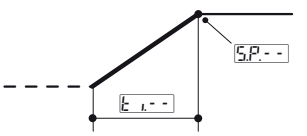
**End segment - F**

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.

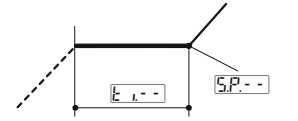
**Normal segments - ---**

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

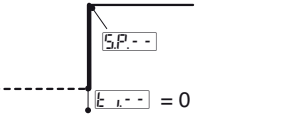
**Ramp**




**Dwell**

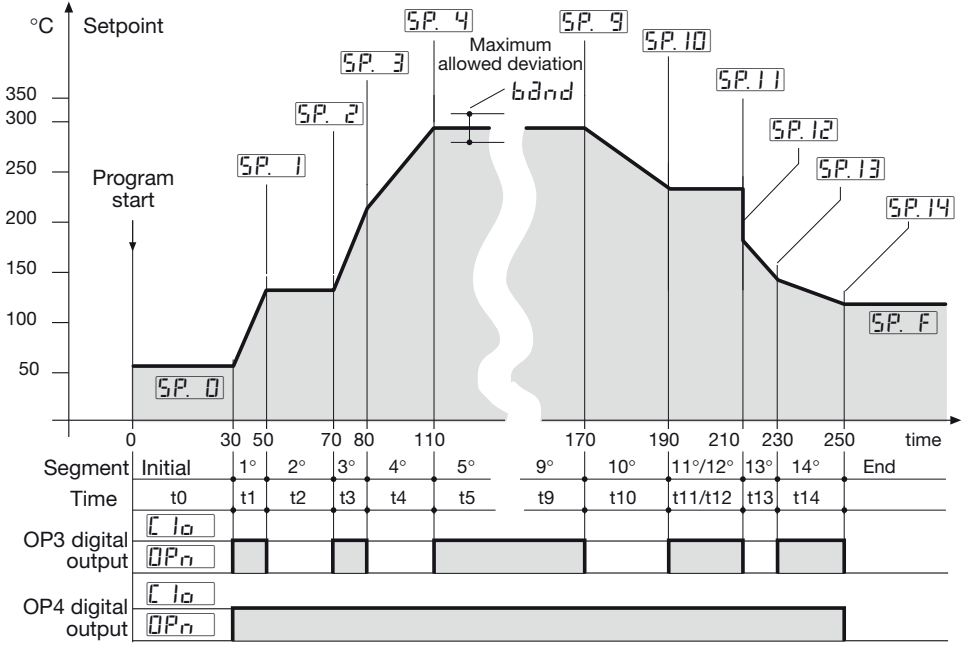



**Step**




SP. = Target Setpoint
tim =Duration
---- =Previous segment
━━ =Current segmente
—— =Next segment

## EXAMPLE OF SETPOINT PROFILE

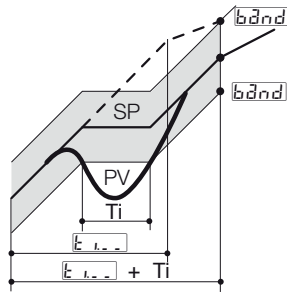



## 7.2 SETPOINT PROGRAMMER

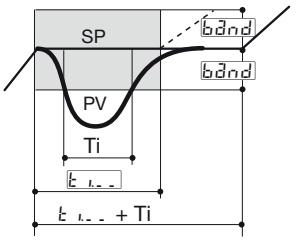
### 7.2.1 MAXIMUM ALLOWED DEVIATION (band)

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 r - - +Ti.

**A. Ramp**




**B. Dwell**




## 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 62). Selected between the following 3 choices:

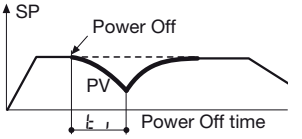
**CONT** **Continue**

**rES** **Reset**

**rAMP** **Ramp**

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

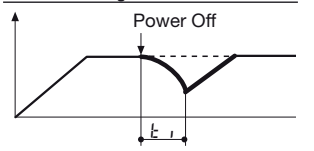
**All the parameters, like Setpoint and the remaining time are restored at the values they had at power off.**



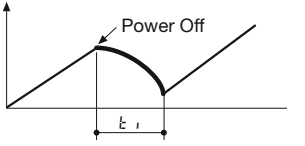

**If rES is selected,**
at power on the program ends and goes back to local mode.

**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 SP with a ramp, whose slope corresponds to the one of the segment running at the power off.**

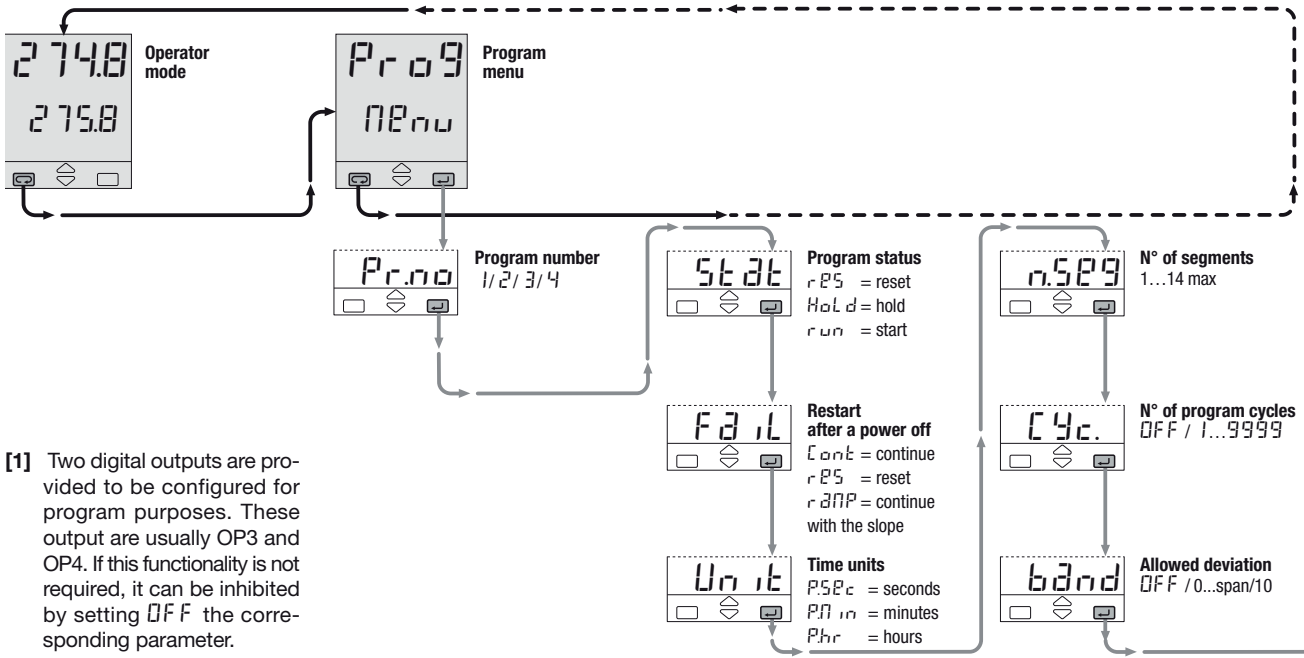
**Power off during a dwell**



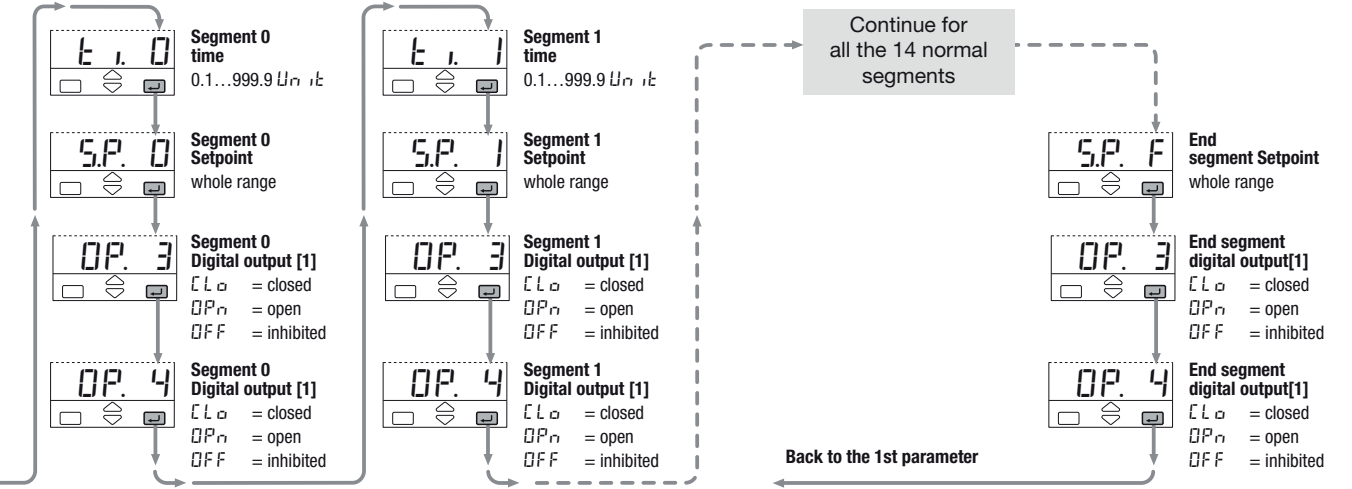

**Power off during a ramp**



## 7.3 PARAMETERISATION - PROGRAM MENU (OPTION)



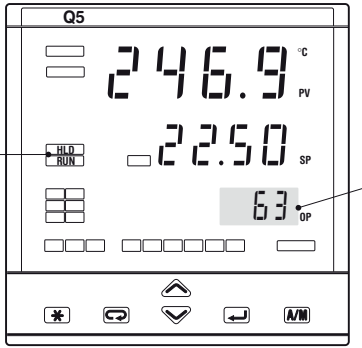

**[1]** Two digital outputs are provided to be configured for program purposes. These output are usually OP3 and OP4. If this functionality is not required, it can be inhibited by setting OFF the corresponding parameter.


t i. 0
Segment 0
time
0.1…999.9 Unit
S.P. 0
Segment 0
Setpoint
whole range
OP. 3
Segment 0
Digital output [1]
CLo = closed
OPn = open
OFF = inhibited
OP. 4
Segment 0
Digital output [1]
CLo = closed
OPn = open
OFF = inhibited
t i. 1
Segment 1
time
0.1…999.9 Unit
S.P. 1
Segment 1
Setpoint
whole range
OP. 3
Segment 1
Digital output [1]
CLo = closed
OPn = open
OFF = inhibited
OP. 4
Segment 1
Digital output [1]
CLo = closed
OPn = open
OFF = inhibited
Continue for
all the 14 normal
segments
S.P. F
End
segment Setpoint
whole range
OP. 3
End segment
digital output[1]
CLo = closed
OPn = open
OFF = inhibited
OP. 4
End segment
digital output[1]
CLo = closed
OPn = open
OFF = inhibited
Back to the 1st parameter

## 7.4 PROGRAM STATUS DISPLAYING

The function mode of the program as well its status is displayed clearly by means the RUN and HLD; leds as follows:

| Function | Status | Led RUN | Led HLD |
|---|---|---|---|
| Local | Reset | OFF | OFF |
| Program run | Run | ON | OFF |
| Program hold | Hold | ON | ON |
| Program hold for PV outside Error band | Hold back | ON | ON |
| Program end (reset) | End | ON | OFF |




On program run mode, each 3 s the display shows alternatively:
- number of running program;
- number of operating segment as well its status.

The control output value can be displayed during the program run using the procedure at page 53.


**Number of running Program** (program n° 3)

each 3 s **Operating segment and its status**

(Segment n°12) - ramp up

(Segment n°12) - ramp down

(Segment n°12) - dwell

(End segment) **Program end**

## 7.5 START/STOP OF A PROGRAM

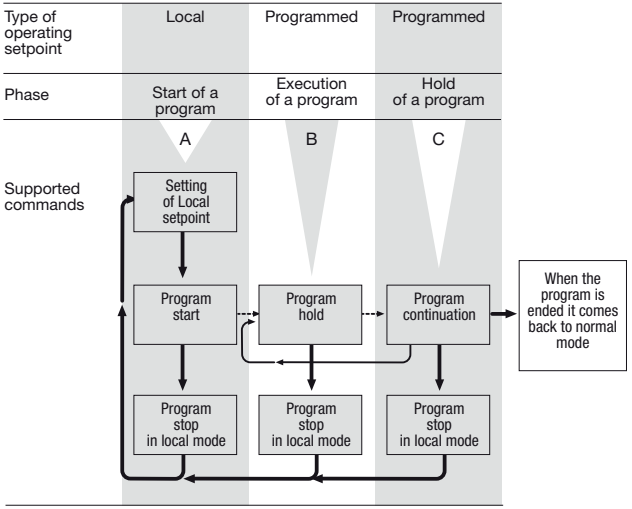
The various commands, supported by the controller, are different for each of the following operating phases:

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.

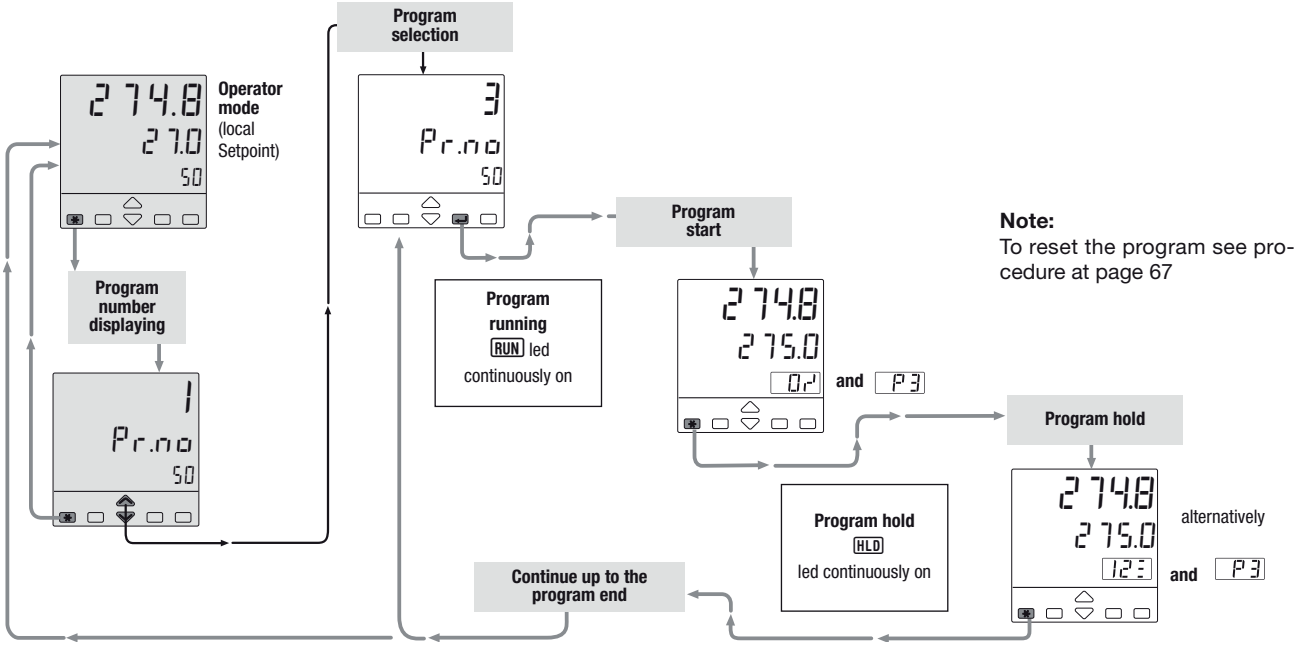



The different phase are displayed in a chained way, just for easing the understanding of the functionality.

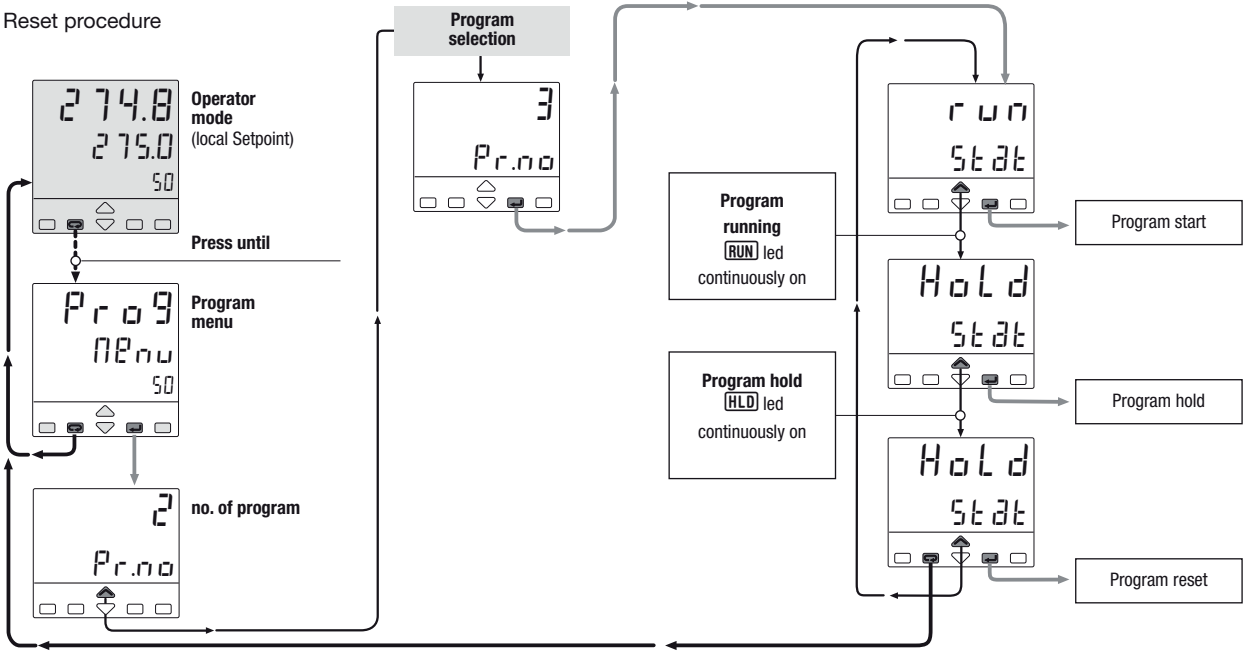
Two different mode for starting and stopping a program are provided:

- direct mode with the ✱ key (see page 66).
- through the parameter menu (see page 67).

## 7.5.1 START/STOP OF A PROGRAM BY DIRECT MODE WITH ✳



## 7.5.2 START/HOLD/STOP OF A PROGRAM THROUGH THE PARAMETER MENU



### 7.5.3 DIGITAL INPUT COMMANDS FOR SETPOINT PROGRAMMER FUNCTION (OPTION)

| Function | Parameter value | Performed operation | | Notes |
|---|---|---|---|---|
| | | Off | On | |
| None | OFF | – | – | Not used |
| Set manual mode | A.Man | Automatic | Manual | |
| Keyboard lock | LPb.1 | Unlock | Locked | With the keypad locked the commands from digital inputs and serial communications are still operating |
| PV measure hold | H.PV | Normal operation | PV is hold | The value of PV is “frozen” at the time the digital input goes to the close state |
| Setpoint slopes inhibition | SLo.1 | Rate limiting is active | Normal operation | When the input is in the on state, the Setpoint is changed in steps |
| Output forcing | F.Out | Normal operation | Forced output value | Digital input ON means activation forcing output value (see page 28) |
| 1st Program selection | Pr9.1 | Local | 1st program | Program selection by permanent closure of the digital input |
| 2nd Program selection | Pr9.2 | Local | 2nd program | |
| 3rd Program selection | Pr9.3 | Local | 3rd program | |
| 4th Program selection | Pr9.4 | Local | 4th program | |
| Program Start/Hold | r.-H. | 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. |
| Program reset | rSt | Normal operation | Program reset | Digital input ON means program reset and control switching to Local setpoint |
| Deactivation of blocking | bLcP | – | Reactivation of blocking | The blocking function is activated at the time the digital input goes to the close state |
| Next segment | nPHt | – | Skips to the next segment | The program skips to the next segment of the program at the time the digital input goes to the close state |

# 8 TECHNICAL SPECIFICATIONS

| **Features** at 25°C env. temp. | **Description** | | |
|---|---|---|---|
| **Total configurability** (see chapter 4.3 page 25) | From keypad or serial communication the user selects:<br>- the type of input<br>- the type of Setpoint<br>- the type of control algorithm<br>- the type of output<br>- the type and functionality of the alarms<br>- control parameter values<br>- access levels | | |
| **PV Input** (see pages13,14 and page 26) | Common characteristics | A/D converter with resolution of 160,000 points<br>Update measurement time: 50 ms<br>Sampling time: 0.1… 10.0 s Configurable<br>Input shift: -60…+60 digit<br>Input filter with enable/disable: 0.1… 99.9 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$\Delta$T: R1+R2 must be <320Ω) | Pt100Ω a 0°C (IEC 751)<br>°C/°F selectable | 2 or 3 wires connection<br>Burnout (with any combination) | Max. wire Res: 20Ω max. (3 wires)<br>Input drift: 0.1°C/10° $T_{env}$<br><0.1°C/10Ω Wire Res. |
| | Thermocouple | L,J,T,K,S, R, B, N, E, W3, W5 (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: <2µV/°C. $T_{env.}$<br><5µV/10Ω Wire Res. |
| | DC input (current) | 4... 20mA, 0... 20mA Rj =30Ω | Burnout. Engineering units conf. decimal point position with or without $\sqrt{}$<br>Init. Scale -999… 9999<br>Full Scale -999… 9999<br>(min. range of 100 digits) | Input drift: <0.1%/20°C $T_{env.}$<br><5µV/10Ω Wire Res. |
| | DC input (voltage) | 0... 50mV, 0... 300mV Rj >10MΩ | | |
| | | 1... 5, 0-5, 0... 10V Rj>10KΩ | | |
| | Frequency (option) 0... 2,000/0... 20,000Hz | Low level ≤2V<br>High level 4... 24V | | |

| **Features** at 25°C env. temp. | **Description** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Auxiliary inputs** | **Remote Setpoint** Not isolated accuracy 0.1% | Current 0/4...20mA: Rj = 30Ω<br>Voltage 1... 5, 0...5, 0...10V: Rj = 300kΩ | | | Bias in engineering units and ± range<br>Ratio: -9.99… +99.99<br>Local + Remote Setpoint | | | | | |
| | **Potentiometer** | 100Ω... 10KΩ | | | Feedback valve position | | | | | |
| **Digital inputs** 3 logic | The closure of the external contact produces any of the following actions: | Auto/Man mode change, Local/Remote Setpoint mode change, 3 Stored Setpoint activation, keyboard lock, measure hold, slope inhibit and output forcing | | | | | | | | |
| | | Program Hold/Run (if option installed), Program Selection and Skip to Next Segment | | | | | | | | |
| **Operating mode and Outputs** | 1 single or double action PID loop or On/Off with 1, 2, 3 or 4 alarms | | **Control output** | | **Alarm** | **Alarm** | **Alarm** | **Alarm** | **Retransmission** | |
| | | | **Main (Heat)** | **Secondary (Cool)** | **AL1** | **AL2** | **AL3** | **AL4** | **PV / SP** | |
| | | Single action | **OP1** Relay/Triac | | | **OP2** Relay/Triac | **OP3** Relay | **OP4** Relay | **OP5** Analog./Digital | **OP6** Analog./Digital |
| | | | **OP5** Analog./Digital | | **OP1** Relay/Triac | **OP2** Relay/Triac | **OP3** Relay | **OP4** Relay | | **OP6** Analog./Digital |
| | | Double action Heat / Cool | **OP1** Relay/Triac | **OP2** Relay/Triac | | | **OP3** Relay | **OP4** Relay | **OP5** Analog./Digital | **OP6** Analog./Digital |
| | | | **OP1** Relay/Triac | **OP5** Analog./Digital | | **OP2** Relay/Triac | **OP3** Relay | **OP4** Relay | | **OP6** Analog./Digital |
| | | | **OP5** Analog./Digital | **OP2** Relay/Triac | **OP1** Relay/Triac | | **OP3** Relay | **OP4** Relay | | **OP6** Analog./Digital |
| | | | **OP5** Analog./Digital | **OP6** Analog./Digital | **OP1** Relay/Triac | **OP2** Relay/Triac | **OP3** Relay | **OP4** Relay | | |
| | | Valve drive | **OP1** Relay/Triac | **OP2** Relay/Triac | | | **OP3** Relay | **OP4** Relay | **OP5** Analog./Digital | **OP6** Analog./Digital |

| Features at 25°C env. temp. | Description | | | |
|---|---|---|---|---|
| **Control mode** | Algorithm | PID with overshoot control or On-off - PID with valve drive algorithm, for controlling motorised positioners | | |
| | Proportional band (P) | 0.5…999.9% | | Single action PID algorithm |
| | Integral time (I) | 1…9999 s | OFF = 0 | |
| | Derivative time (D) | 0.1…999.9 s | | |
| | Error dead band | 0.1…10.0 digit | | |
| | Overshoot control | 0.01…1.00 | | |
| | Manual reset | 0…100% | | |
| | Cycle time (Time proportional only) | 0.2…100.0 s | | |
| | Min./Max output limits | 0…100% separately adjustable | | |
| | Control output rate limit | 0.01…99.99%/s | OFF = 0 | |
| | Soft-start output value | 1…100% - Time 1…9999 s | | |
| | Output safety value | -100…100% | | |
| | Control output forcing value | -100…100% | | |
| | Control output hysteresis | 0…5% Span in engineering units | | On-Off algorithm |
| | Dead band | 0.0…5.0% | | Double action PID algorithm (Heat / Cool) |
| | Cool proportional band (P) | 0.5…999.9% | | |
| | Cool integral time (I) | 1…9999 s | OFF = 0 | |
| | Cool derivative time (D) | 0.1…999.9 s | | |
| | Cool cycle time (Time proportional only) | 0.2…100.0 s | | |
| | Control output high limit | 0…100% | | |
| | Cool output max. rate | 0.01…99.99%/s | OFF = 0 | |
| | Motor travel time | 15…600 s | | Valve drive PID algorithm Raise/Stop/Lower |
| | Motor minimum step | to 0.1…5.0% | | |
| | Feedback potentiometer | 100Ω …10KΩ | | |

| **Features** at 25°C env. 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** | SPST relay N.O. 2A/250Vac (4A/120Vac) for resistive load | | | | |
| **Analogue/digital OP5 and OP6** (option) **outputs** | Control or PV/SP retransmission | Galvanic isolation: 500Vac/1 min<br>Short circuit protected<br>Resolution: 12 bit<br>Accuracy: 0.1 % | | Analogue: 0/1... 5V, 0…10V, 500Ω/20mA max.,<br>0/4... 20mA, 750Ω/15V max.<br>Digital: 0/24Vdc ±10%; 30mA max. for solid state relay | |
| **AL1 - AL2 - AL3 - AL4 alarms** | Hysteresis 0…5% Span in engineering units | | | | |
| | 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) (only OP3-OP4) | | |
| **Setpoint** | Local + 3 memorised | | Up and down ramps 0.1...999.9 digit/min or digit/hour (OFF=0)<br>Low limit: from low range to high limit<br>High limit: from low limit to high range | | |
| | Remote only | | | | |
| | Local and Remote | | | | |
| | Local with trim | | | | |
| | Remote with trim | | | | |
| | Programmable | If option installed | | | |

| **Features** at 25°C env. temp. | **Description** | | |
|---|---|---|---|
| **Programmable Setpoint** (optional) | 4 programs, 16 segments (1 initial and 1 end)<br>From 1 to 9999 cycles or continuous cycling (oFF) | | |
| | Time values in seconds, minutes and hours<br>Start, stop, hold, etc. activated from the keypad, digital input and serial communications | | |
| **Tuning** | **Fuzzy-Tuning type** . The controller selects automatically the best method according to the process conditions | Step response<br>Natural frequency | |
| | **Adaptive Tune** self-learning, not intrusive, analysis of the process response to perturbations and continuously calculation of the PID parameters | | |
| **Auto/Man station** | Standard with bumpless function, by keypad, digital input or serial communications | | |
| **Serial comm.** (option) | RS485 isolated, SLAVE Modbus/Jbus protocol, 1,200, 2,400, 4,800, 9,600, 19,200 bit/s, 3 wires<br>RS485 isolated, MASTER Modbus/Jbus protocol, 1,200, 2,400, 4,800, 9,600, 19,200 bit/s, 3 wires<br>RS485 asynchronous/isolated, PROFIBUS DP protocol, from 9600 bit/s at 12MB/s selectable, max lenght 100m (at 12 Mb/s) | | |
| **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 and forcing value -100...100% separately adjustable | |
| | 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 - Fast wiew | |
| **General characteristics** | Power supply (fuse protected) | 100... 240Vac (-15...+10%) 50/60Hz or<br>24Vac (-25...+12%) 50/60Hz and<br>24Vdc (-15...+25%) | Power consumption 5W 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) | |
| | UL and cUL Approval | File 176452 | |
| | Protection EN60529 (IEC 529) | IP65 front panel | |
| | Dimensions | 1/4 DIN - 96 x 96, depth 110 mm, weight 500 g max. | |

## WARRANTY

We warrant that the products will be free from defects in material and workmanship for 18 months 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**

- 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