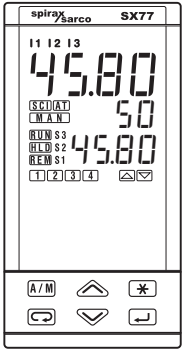
spirax sarco

SX77 Series Advanced Process Controller

Installation and Maintenance Instruction



Printed in the UK

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CE

NOTES ON ELECTRIC SAFETY AND ELECTROMAGNETIC COMPATIBILITY

Please, read carefully these instructions before proceeding with the installation of the controller.
Class II instrument, for indoor use only.

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 n° 89/336/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.
Repairs: this 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.

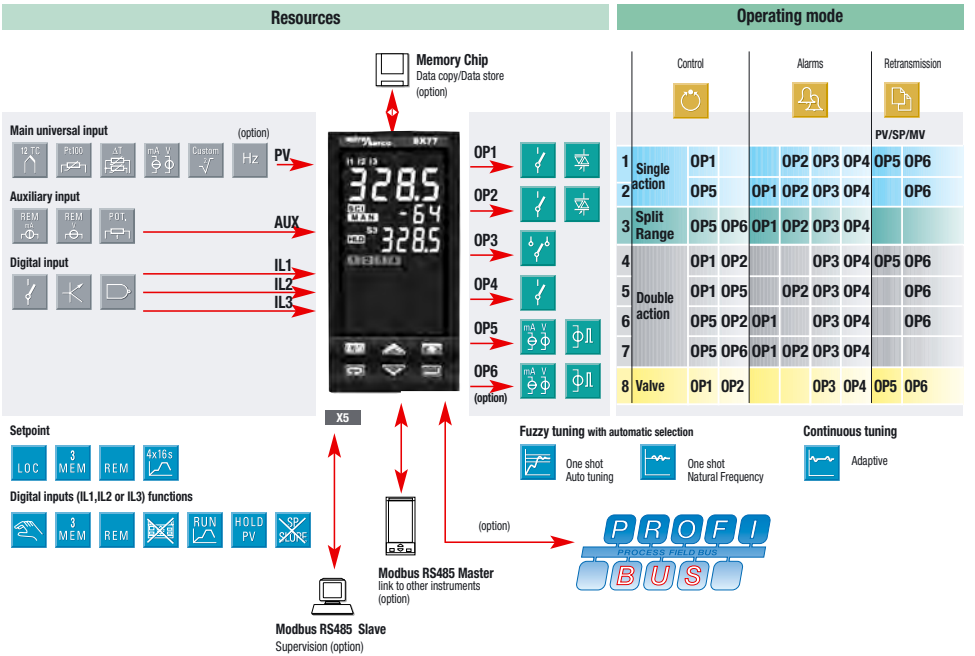
TABLE OF CONTENTS

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 X5 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

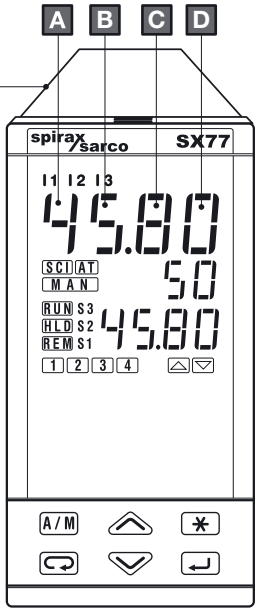
The complete code is displayed on the instrument label.

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

[1] Not available with split range control mode

Instrument label

Basic product code



Model: **A** **B** **C** **D** – **E** **F** **G** **0**

- A — Power Supply
- B — Outputs
- C — Serial + mathematical package (MP)
- D — Options
- E — Setpoint
- F — User manual
- G — Colour

Modello basic — Accessories

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

Outputs OP1 - OP2	B
Relay - Relay	1

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 [1]	E
Not fitted	0
4 programs with 16 segments	4

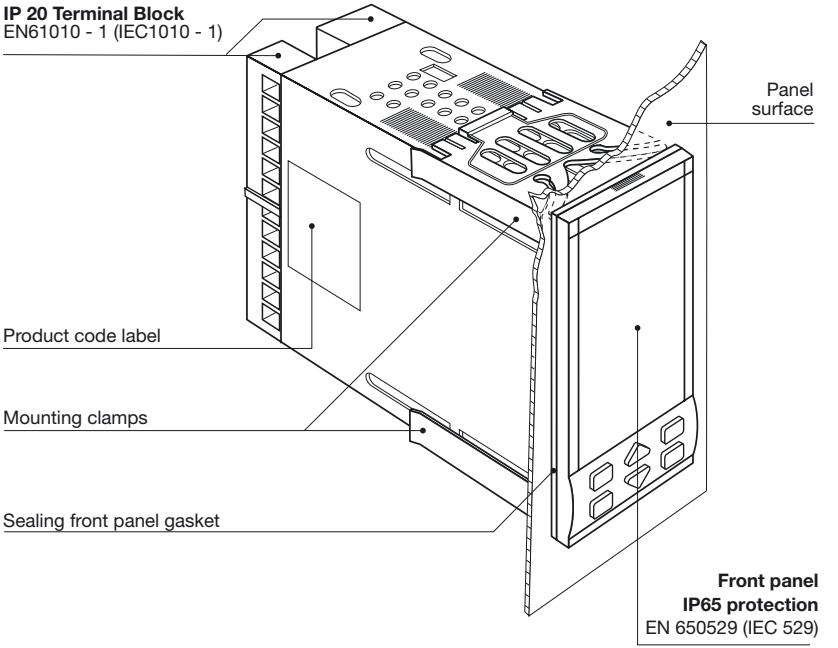
2 INSTALLATION

Installation must only be carried out by qualified personnel.

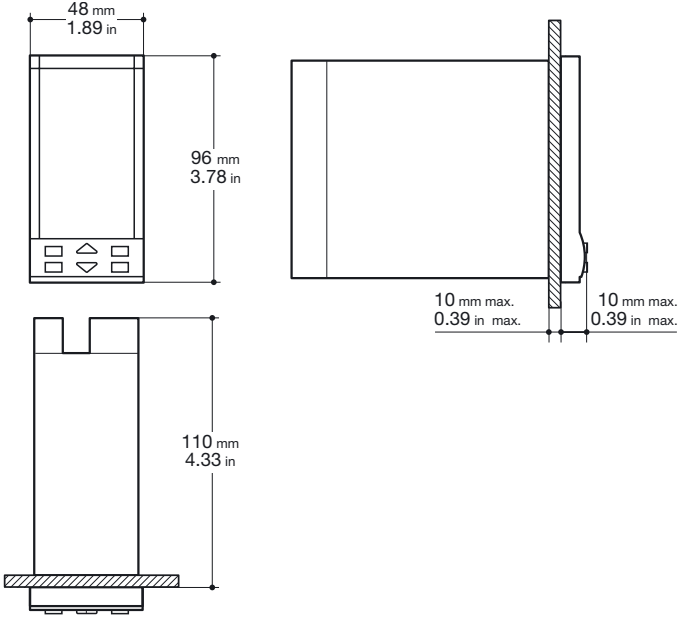
Before proceeding with the installation of this controller, follow the instructions illustrated in this manual and, particularly the installation precautions marked with the ⚠CE symbol, related to the European Community directive on electrical protection and electromagnetic compatibility.

⚠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.**

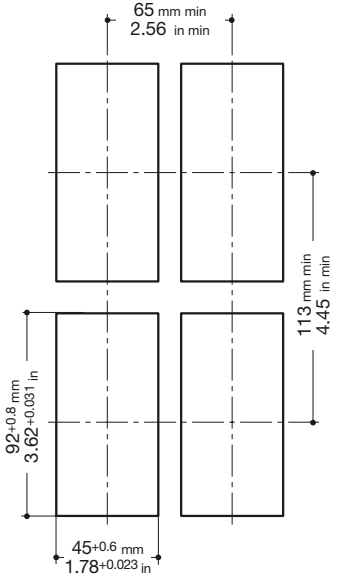
2.1 GENERAL DESCRIPTION



2.1.1 DIMENSIONAL DETAILS



2.1.2 PANEL CUT-OUT



2.2 ENVIRONMENTAL RATINGS

Operating conditions	
	Altitude up to 2,000 m
	Temperature 0…50°C
%Rh	Relative humidity 5…95 % non-condensing

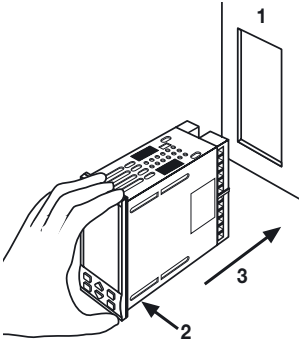
Special conditions		Suggestions
	Altitude > 2,000 m	Use 24Vac supply version
	Temperature >50°C	Use forced air ventilation
%Rh	Humidity > 95 %	Warm up
	Conducting atmosphere	Use filter

Forbidden Conditions	
	Corrosive atmosphere
	Explosive atmosphere

2.3 PANEL MOUNTING [1]

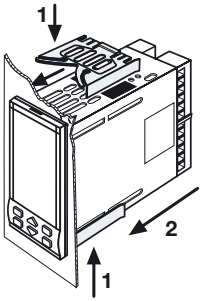
2.3.1 INSERT THE INSTRUMENT

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



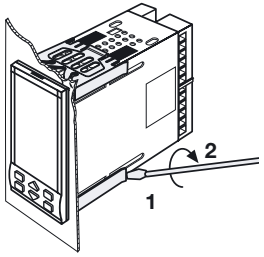
2.3.2 INSTALLATION SECURING

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.

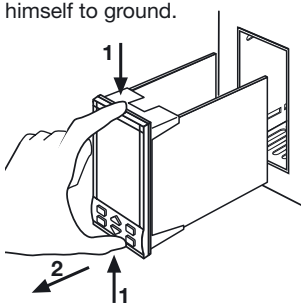


2.3.4 INSTRUMENT UNPLUGGING

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.

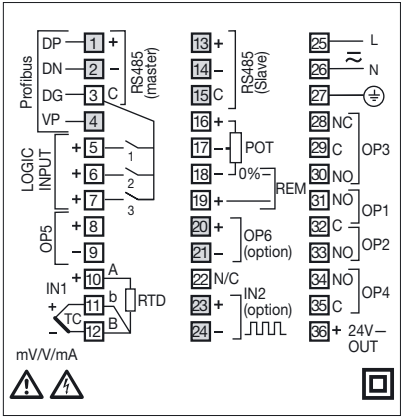


UL note

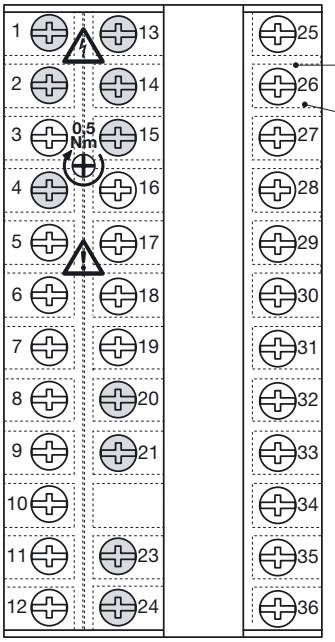
[1] For Use on a Flat Surface of a Type 2 and Type 3 'raintight' Enclosure.

3

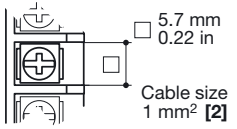
ELECTRICAL CONNECTIONS



3.1 TERMINAL BLOCK [1]



Rear terminal cover



	35 screw terminals M3
	Option terminals
	Holding screw 0.5 Nm
	Positive screw-driver PH1
	Negative screw-driver 0.8 x 4 mm

Terminals

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

UL notes

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

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

PRECAUTIONS

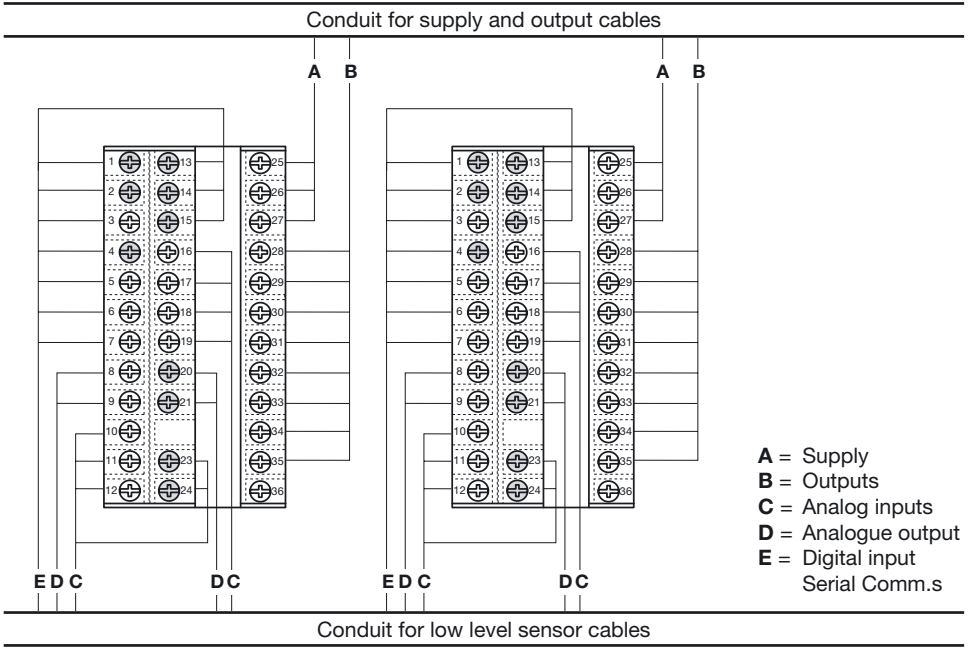
Despite the fact that the instrument has been designed to work in an harsh and noisy environmental (level IV of the industrial standard IEC 801-4), it is recommended to follow the following suggestions.

⚠

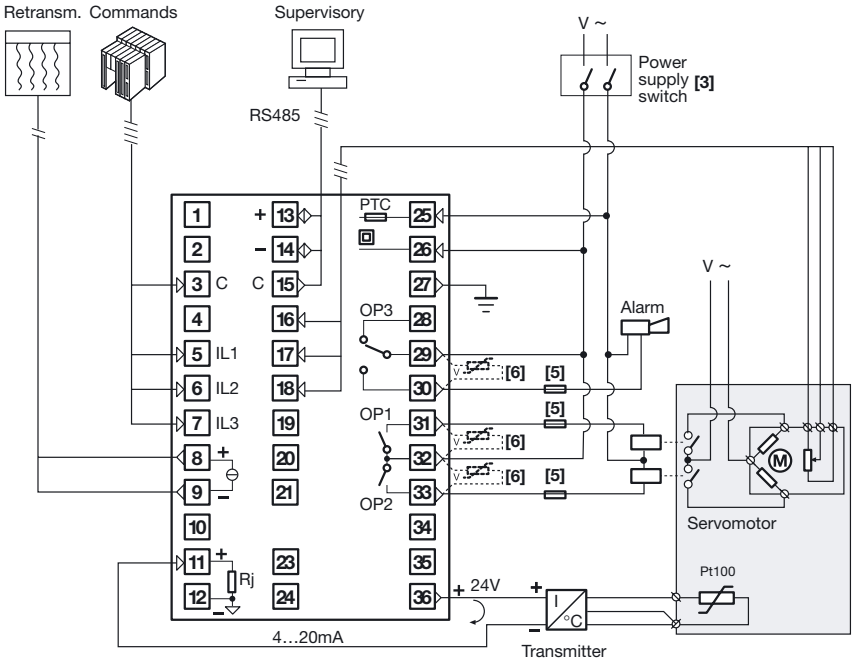
All the wiring must comply with the local regulations.
The supply wiring should be routed away from the power cables.
Avoid to use electromagnetic contactors, power Relays and high power motors nearby.
Avoid power units nearby, especially if controlled in phase angle

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

3.2 SUGGESTED WIRES 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.

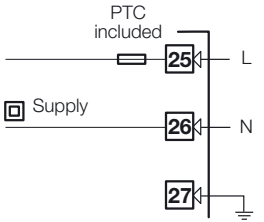
5] To protect the instrument internal circuits use:
- 2 AT fuse for Relay outputs (220 Vac)
- 4 AT fuse for Relay outputs (110 Vac)
- 1 AT fuse for Triac outputs

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.

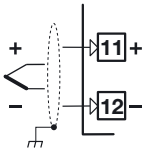
- **Standard version:**
  Nominal voltage:
  100... 240Vac (-15...+10%);
  Frequency 50/60Hz.
- **Low Voltage version:**
  Nominal voltage:
  24Vac (-25...+12%);
  Frequency 50/60Hz
  or 24Vdc (-15...+25%);
  Power consumption 5W max.



3.3.2 PV CONTROL INPUT

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

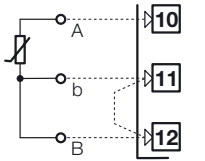
- Connect the wires with the polarity as shown;
- Use always compensation cable of the correct type for the thermocouple used;
- The shield, if present, must be connected to a proper earth.



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

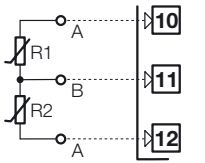


Only for two wires system, put a jumper between terminals 11 and 12.

C For ΔT (2x RTD Pt100) Special

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

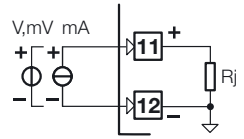
R1 + R2 must be <320Ω



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

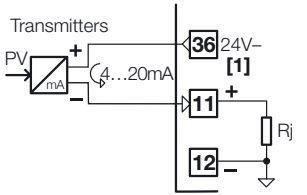
3.3.2 PV CONTROL INPUT

C For mA, mV

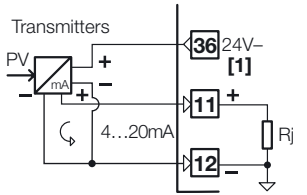


Input resistance = 30Ω per mA;
Input resistance > 10MΩ per mV;
Input resistance = 10kΩ per Volt;

C1 With 2 wires transducer



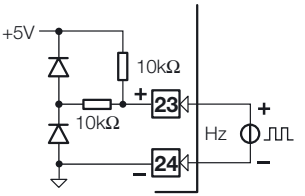
C2 With 3 wires transducer



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

3.3.3 PV CONTROL INPUT - IN2 FREQUENCY INPUT

Using the frequency input (IN2), the IN1 input is not yet available



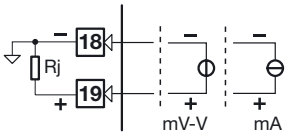
- Low level:
  0…2Volt /0.5mA max.
- High level:
  3…24Volt / ∼ 0 mA max..
- Frequency range:
  0…2kHz / 0…20kHz, selectable in configuration mode;
- Use sensors with an NPN output or a clean contact.

3.3.4 AUXILIARY INPUT

A - From Remote Setpoint

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

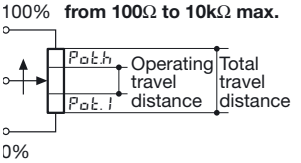
Voltage 1…5V, 0…5V, 0…10V;
Input resistance = 300kΩ.

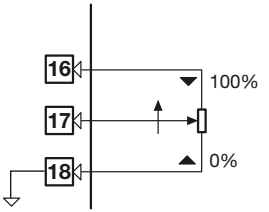


Not available with frequency input

B- From Potentiometer

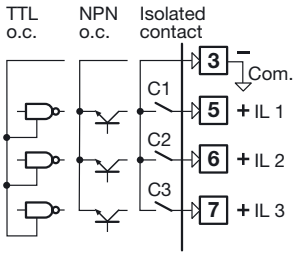
for the measure of the position of the motor or the valve.





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

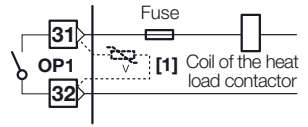
The functionality associated to each of the OP1, OP2, OP4, OP5 and OP6 output is defined during the configuration of the instrument.
The suggested combinations are:

		Control outputs		Alarms				Retransmission	
		Main (Heat)	Secondary (Cool)	AL1	AL2	AL3	AL4	PV / SP / MV	
A	Single action	OP1			OP2	OP3	OP4	OP5	OP6
B		OP5		OP1	OP2	OP3	OP4		OP6
C	Split range	OP5	OP6	OP1	OP2	OP3	OP4		
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

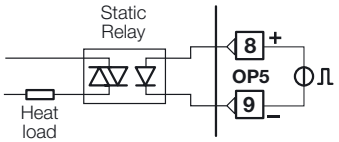
where:

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

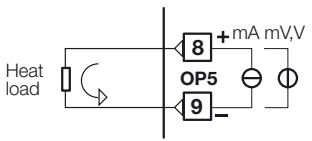
3.3.6-A SINGLE ACTION RELAY CONTROL OUTPUT



3.3.6-B1 SINGLE ACTION SSR DRIVE CONTROL OUTPUT

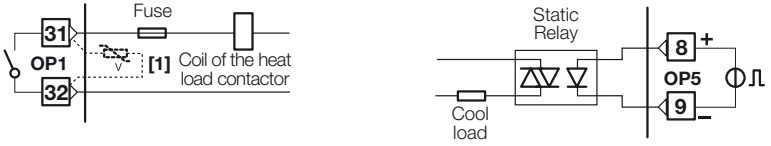


3.3.6-B2 SINGLE ACTION ANALOGUE OUTPUT



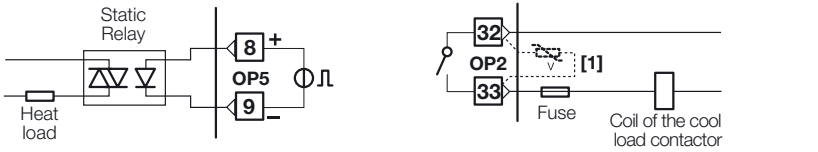
3.3.6-C DOUBLE ACTION RELAY/RELAY CONTROL OUTPUT

3.3.6-D1 DOUBLE ACTION RELAY/SSR DRIVE CONTROL OUTPUT

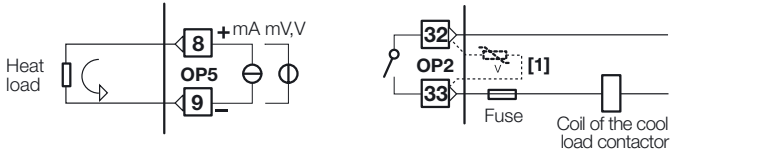


3.3.6-D2 DOUBLE ACTION CONTROL OUTPUT RELAY/ANALOGUE CONTROL OUTPUT

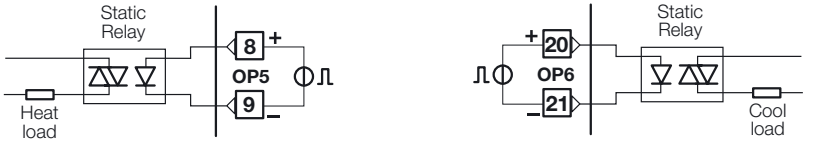
3.3.6-E1 DOUBLE ACTION
DIGITAL/RELAY CONTROL OUTPUT



3.3.6-E2 DOUBLE ACTION
ANALOGUE/RELAY 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 250V, 4AT at 110V.

Isolated digital outputs OP5-OP6

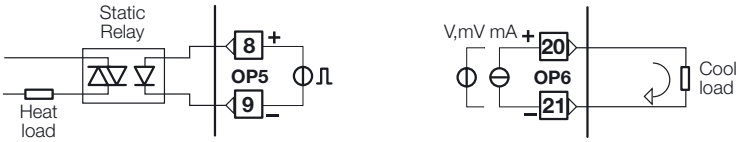
- 0…24Vdc, ±20%, 30 mA max.

Isolated analogue outputs OP5-OP6

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

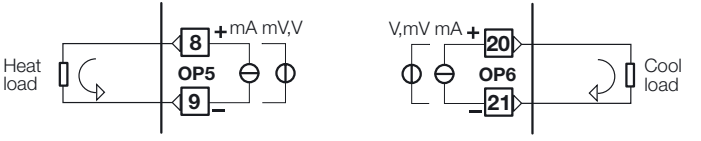
[1] Varistor for inductive load 24Vac only

3.3.6-F2 DOUBLE ACTION CONTROL OUTPUT DIGITAL / ANALOGUE



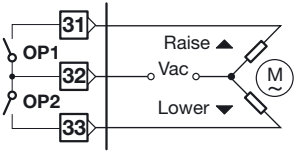
3.3.6-F3 DOUBLE ACTION CONTROL OUTPUT ANALOGUE / DIGITAL

3.3.6-F4 DOUBLE ACTION CONTROL OUTPUT OR SPLIT RANGE ANALOGUE / ANALOGUE

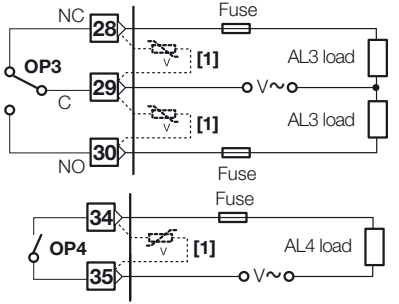


3.3.6-G MOTOR POSITIONER OUTPUT RELAY/RELAY

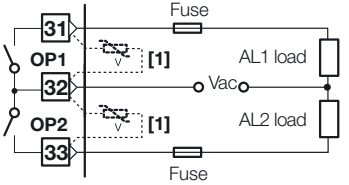
Valve drive PID
without potentiometer
3 pole output with N.O. contacts
(raise, lower, stop)



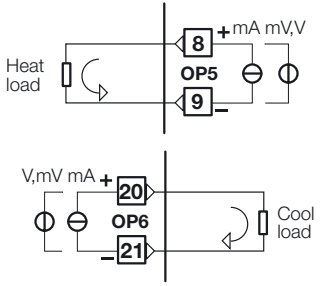
3.3.7 OP1-2-3-4 ALARM OUTPUTS



⚠ **The relay 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/MV retransmission:

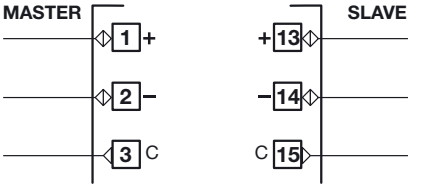
- Galvanic isolation 500Vac/1 min:
- 0/4…20mA, 750Ω / 15Vdc max. 0/1…5V, 0…10V, 500Ω / 20mA max..

Notes:

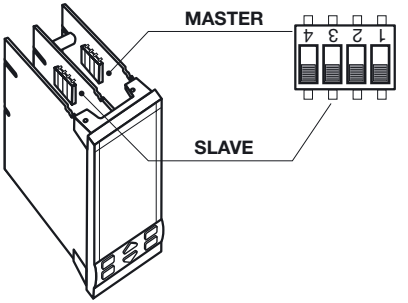
[1] Varistor for inductive load 24Vac only

[2] ⚠ Please, read the user manual: "Serial communications and configuration software".

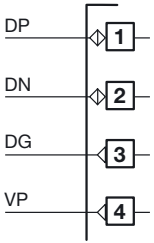
3.3.9 SERIAL COMMUNICATIONS (OPTION) [2]



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

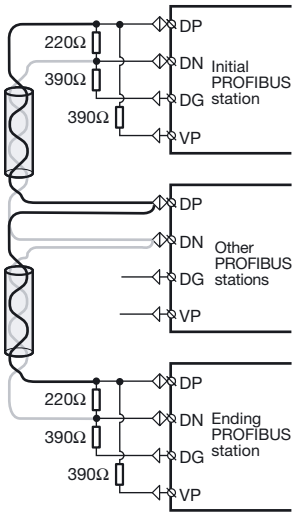


3.3.10 PROFIBUS DP (OPTION)

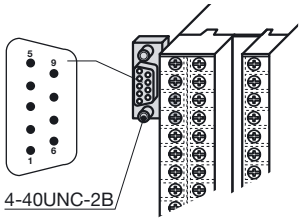


- Galvanic isolation 500 Vac/1 min
- Compliance to the EIA RS485 standard for PROFIBUS DP;
- Connecting cable: twisted pair cable as per PROFIBUS specifications (e.g. Belden B3079A);
- Max. lenght: 100 m at 12 Mb/s

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

Digital input status LEDs (yellows)

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

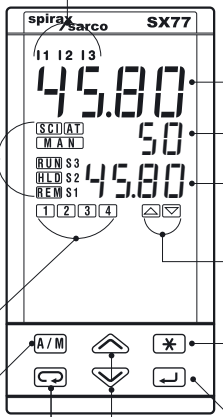
Status LEDs (greens)

SCI Communications running
AT Tuning running
MAN Manual operating mode
RUN Timer/Program running
HLD Program Waiting
REM Remote Setpoint active
S 1 First stored Setpoint active
S 2 Second stored Setpoint active
S 3 Third stored Setpoint active

Alarm status LEDs (reds)

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

Auto/Man



Over range

Under range

PV control input in engineering units

% Control output
or **Program status** (see page 64)

SP operating Setpoint
(Local/Remote or Stored)

Control output LEDs (red)
▲ OP1/OP4 ON - ▼ OP2/OP4 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

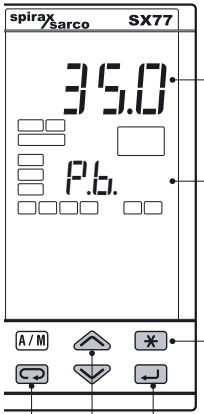
⚠

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.

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.



Parameter value

Parameter mnemonic

Back to the previous parameter

Entry key for selection and value setting confirmation

Value modification

Access to the menu for:
- Parameter setting
- Configuration
- Access selection

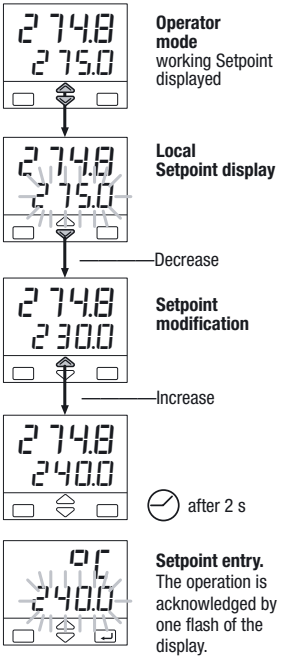
4.2 PARAMETER SETTING

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.

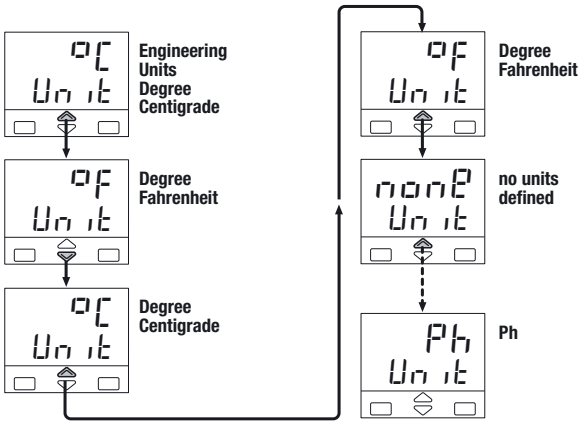
In case of Setpoint modification: press ⌃ or ⌄ once to display the local Setpoint instead of working Setpoint.
To evidence this change the display flashes once. Then the Setpoint can be modified



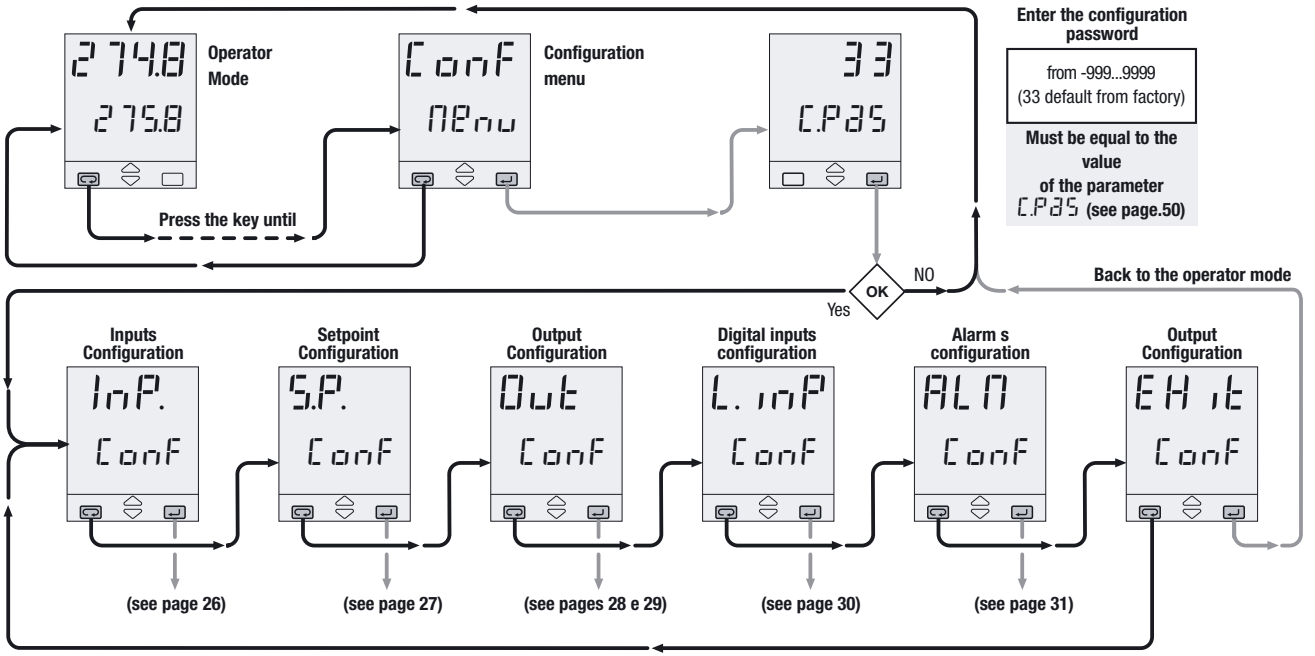
4.2.2 MNEMONIC CODES SETTING

(e.g. configuration see page 26)

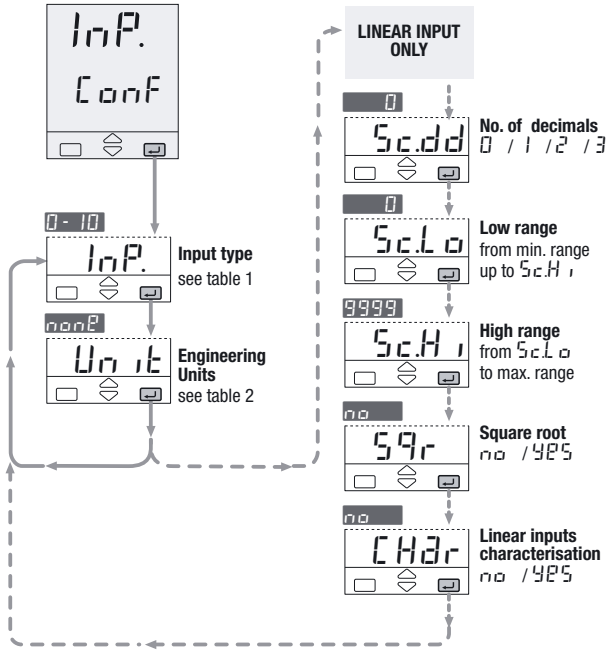
Press the ⌃ or ⌄ to display the next or previous mnemonic for the selected parameter.
Continued pressing of ⌃ or ⌄ will display further mnemonics at a rate of one mnemonic every 0.5 s. The mnemonic displayed at the time the next parameter is selected, is the one stored in the parameter.



4.3 CONFIGURATION PROCEDURE



4.3.1 INPUTS CONFIGURATION



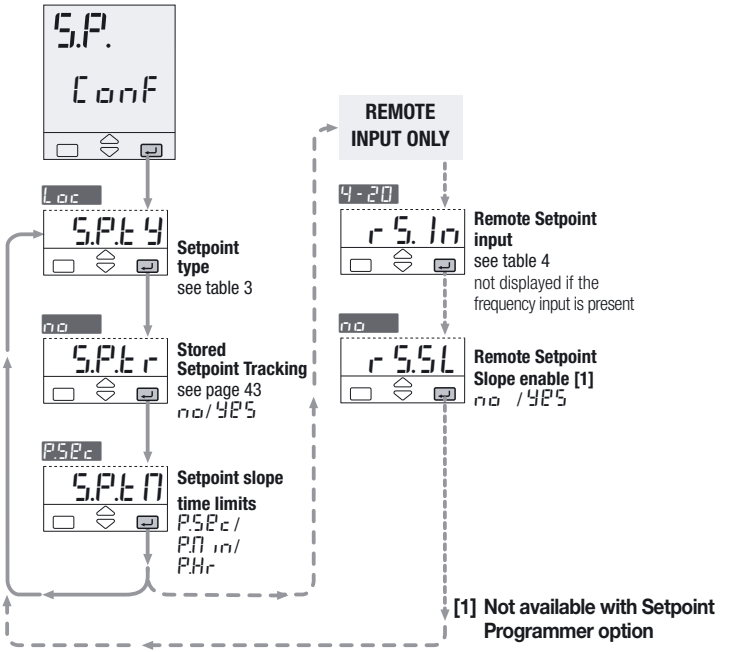
Tab. 1	Input type	
Value	Description	InP.
tc.J	0…600°C	32…1112°F
tc.K	0…1200°C	32…2192°F
tc.L	0…600°C	32…1112°F
tc.S	0…1600°C	32…2912°F
tc.r	0…1600°C	32…2912°F
tc.t	-200…400°C	-328…752°F
tc.b	0…1800°C	32…3272°F
tc.n	0…1200°C **[1]**	32…2192°F
tcn1	0…1100°C **[2]**	32…2012°F
tcU3	0…2000°C	32…3632°F
tcU5	0…2000°C	32…3632°F
tc.E	0…600°C	32…1112°F
cuSt	Custom range on request	
rtd1	-200…600°C	-328…1112°F
rtd2	-99.9...300.0°C	-99.9…572.0°F
dPLt	-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 Volt	
1-5	1…5 Volt	
0-10	0…10 Volt	
0-20	0…20 mA	
4-20	4…20 mA	
FrqL	0…2.000 Hz	Frequency (option)
FrqH	0…20.000 Hz	

Tab. 2	Engineering units
Value	Description Unit
nonE	None
°C	Degree centigrade
°F	Degree Fahrenheit
mA	mA
mU	mV
U	Volt
bar	bar
PSI	PSI
rh	Rh
Ph	Ph
Hz	Hertz

Notes:

[1] NiChroSil-NiSil thermocouple.
[2] Ni-Mo thermocouple.

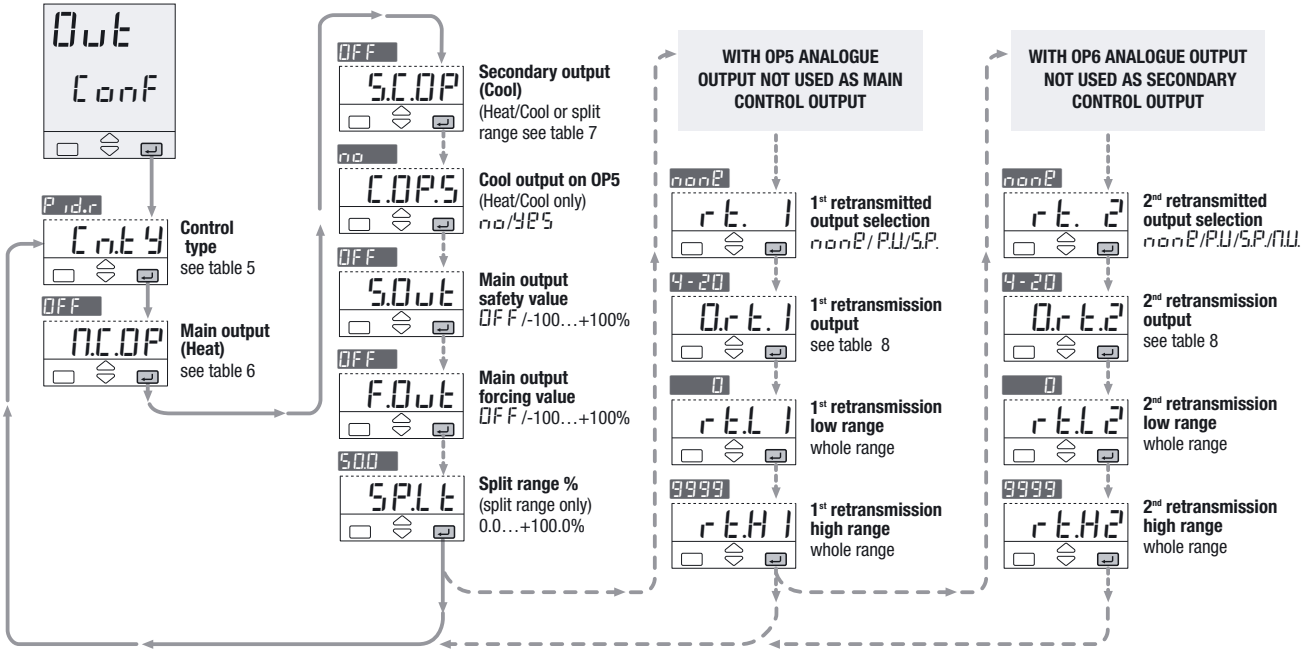
4.3.2 SETPOINT CONFIGURATION



Tab. 3	Setpoint type	
Value	Description	S.P.t.y
Loc	Local only	
rEM	Remote only	
L-r	Local/remote only	
Loc.t	Local - trim	
rEM.t	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 id.d	Direct action	P.I.D.
P id.r	Reverse action	
U.d ir	Direct action	Modul. valves
U.rEU	Reverse action	
H.C.Ln	Linear	Heat/ Cool
H.C.OL	Oil charac.	
H.C.H2	Water charac.	
SPL.1	Direct-Direct	Split range [1]
SPL.2	Direct-Reverse	
SPL.3	Reverse-Reverse	
SPL.4	Reverse-Direct	

Tab. 6	Main Output (Heat)	
Value	Description	M.C.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.C.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	
		0.rt.1
Value	Description	0.rt.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	

[1] Not available with Setpoint Programmer option

RETRANSMISSION

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

Retransmitted signals

rt. 1 **Main output**
noneP/P.U./S.P.

rt. 2 **Secondary output**
noneP/P.U./S.P /M.U.

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

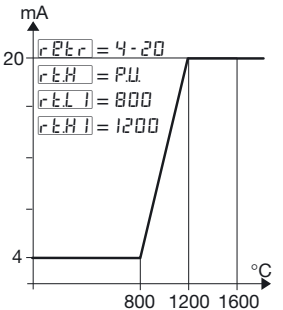
The following parameters define the low and high range.

rtL1 **Retransmission low range**
rtL2

rtH1 **Retransmission high range**
rtH2

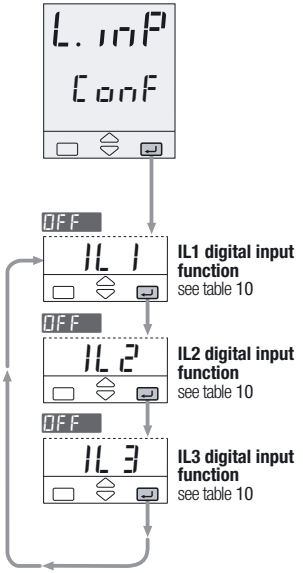
Example:

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



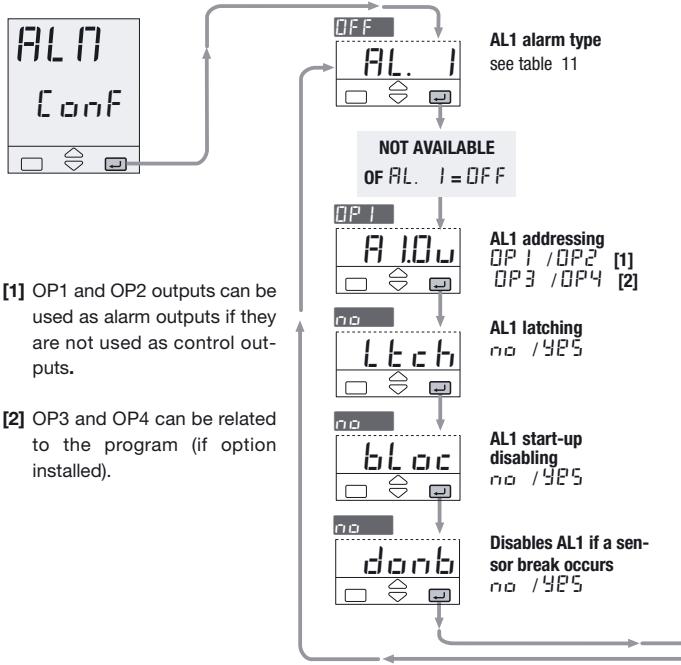
With rtL1 greater than rtH1 it is possible to obtain a reverse scale.

4.3.4 DIGITAL INPUTS CONFIGURATION



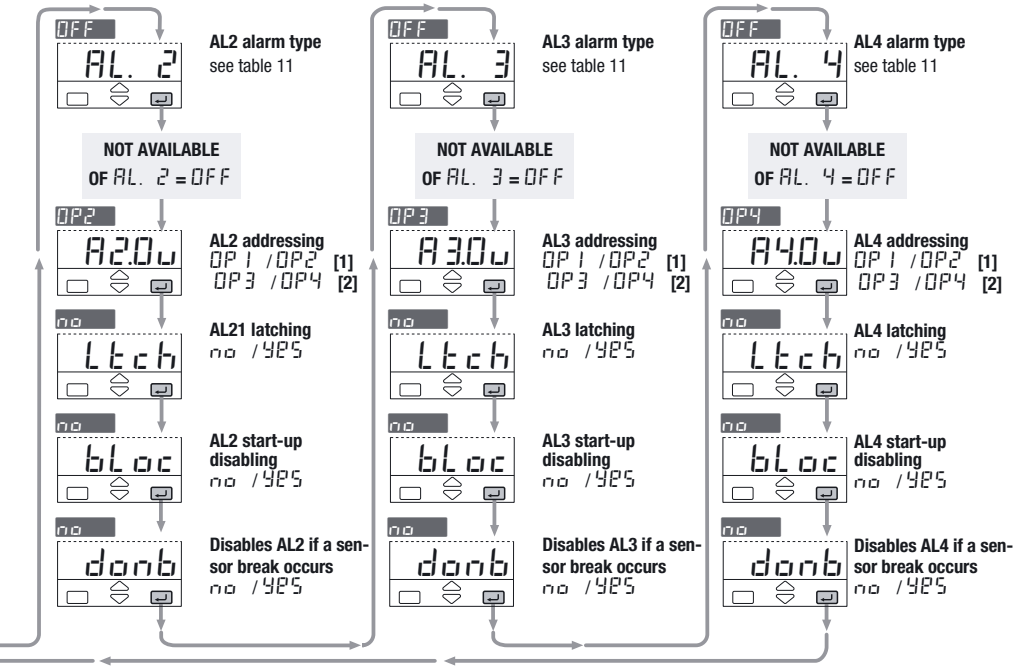
Tab. 10 Digital Inputs functions		IL 1 / IL2 / IL3	
Value	Description		
OFF	Not used		
L-r	Local/Remote		
AMAn	Auto/Man		
S.P. 1	1st stored Setpoint		
S.P. 2	2nd stored Setpoint		
S.P. 3	3rd stored Setpoint		
tEb.1	Keyboard lock		
SLo.1	S.P. slope disable		
HPU	Measure hold		
F.Out	Output forcing mode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

4.3.5 ALARM S CONFIGURATION



[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	Active High	Absolute
FS.L	Active Low	Absolute
dEU.H	Active High	Deviation
dEU.L	Active Low	Deviation
band	Active Out	Band
Lbd	Loop break alarm (AL1 only)	

4.3.6 AL1, AL2, AL3, AL4 ALARMS CONFIGURATION

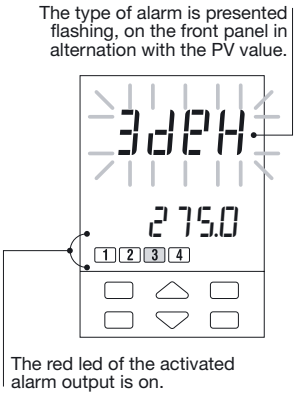
It is possible to configure up to 4 alarms: AL1, AL2, AL3, AL4 (see page 31) selecting, for each of them:

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 alarm inhibition on sensor break
E the physical output of the alarm OP1 OP2 OP3 OP4

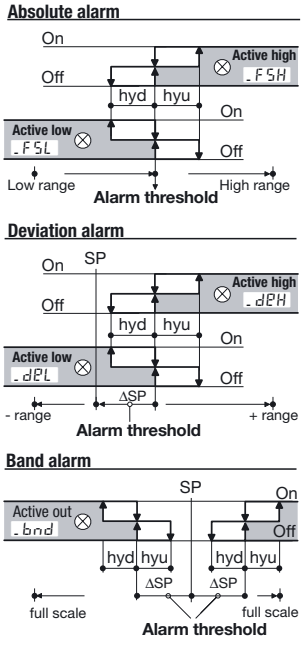
The outputs can be used for alarms if they are not used as control outputs

(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: **"**Serial communication and configuration software".



[A] OPERATING CONDITIONS

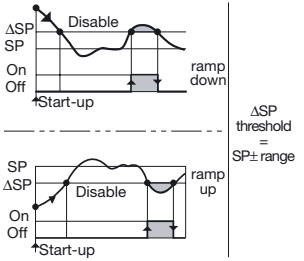


[B] ALARM ACKNOWLEDGE FUNCTION

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.

[C] START-UP DISABLING



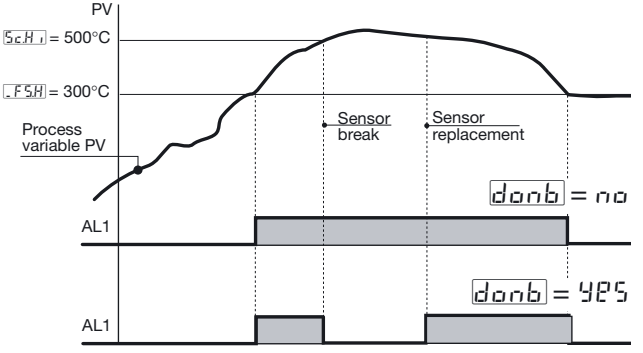
[D] ALARM DISABLING AT SENSOR BREAK

For those alarm that are configured to be different than LBA, is possible to set the parameter donb (disable on break).

Set:

no To maintain the alarm status when a sensor break is detected.

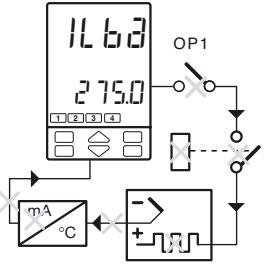
YES To disable the alarm intervention when a sensor break is detected. Once the sensor has been changed, the alarms that were active before the sensor break are activated again.



LOOP BREAK ALARM LBA

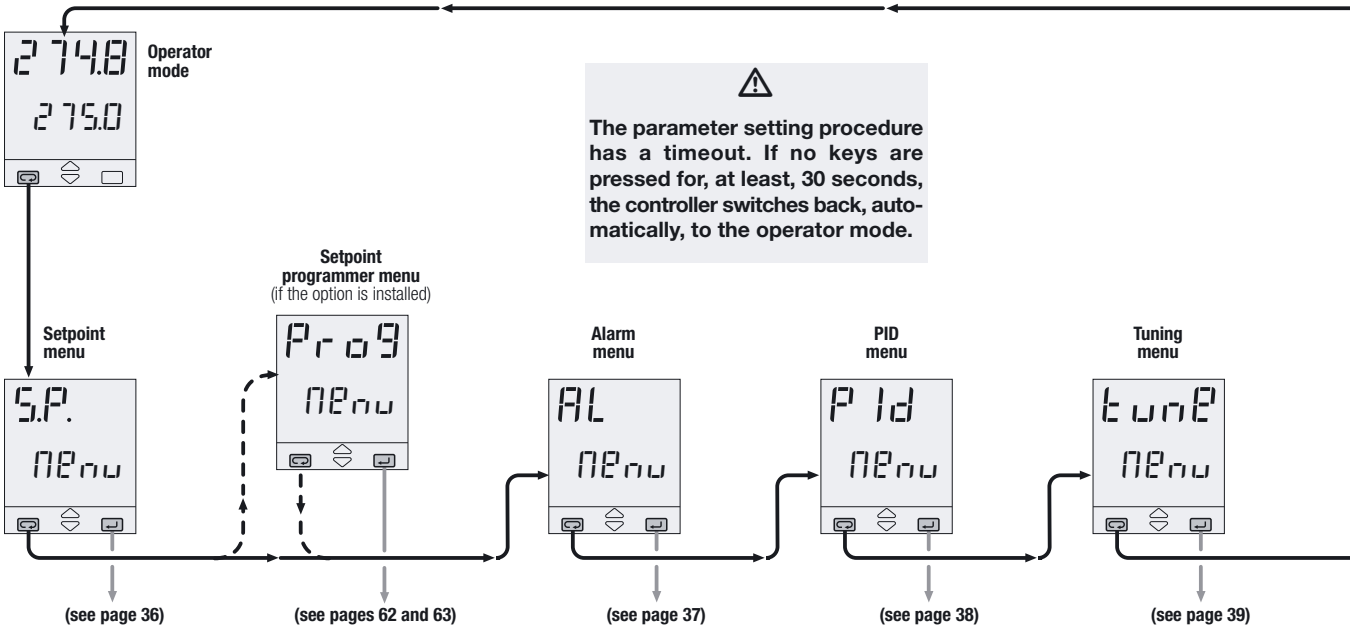
When the controller connection to the sensor is discontinued or other faults are detected in the control loop, the AL1 alarm becomes active, after a predefined time of 1... 9999 s, from the detection of the failure (see page 37)

When a sensor failure occours, the LBA interventrion is immediate. The alarm state ceases when the fault condition is no longer present.



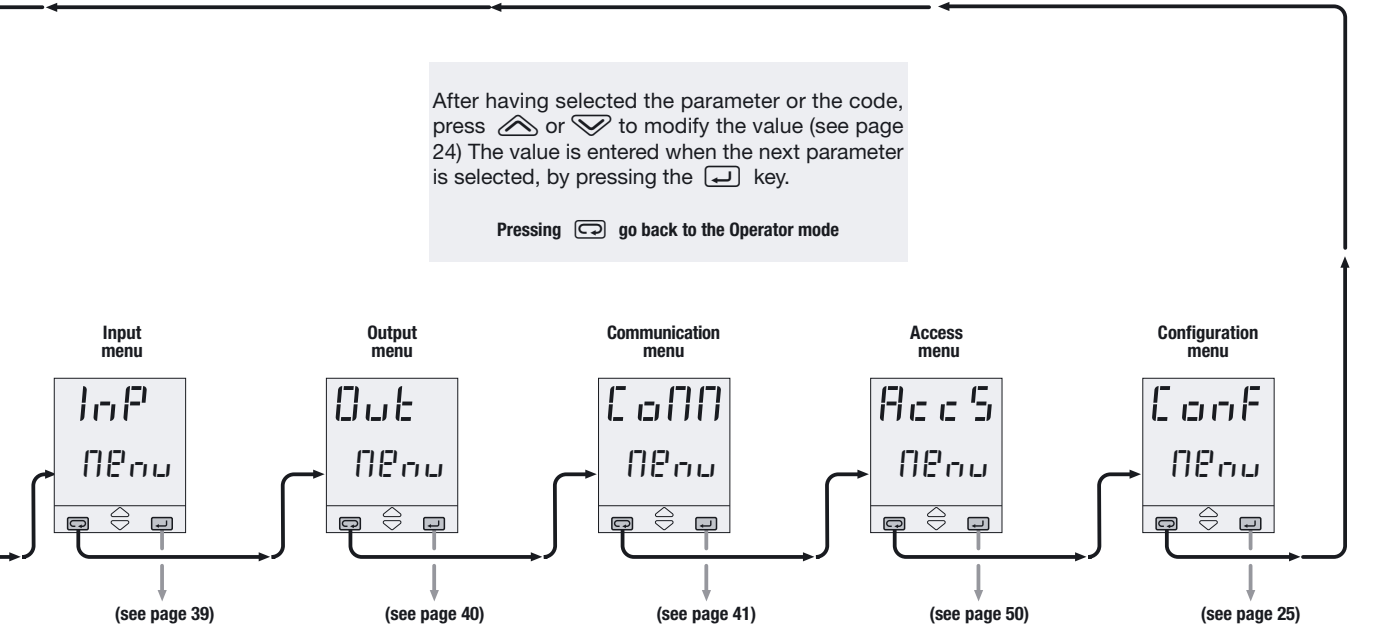
⚠ **In case of ON-OFF control, the LBA alarm is not active.**

4.4 PARAMETERISATION - MAIN MENU

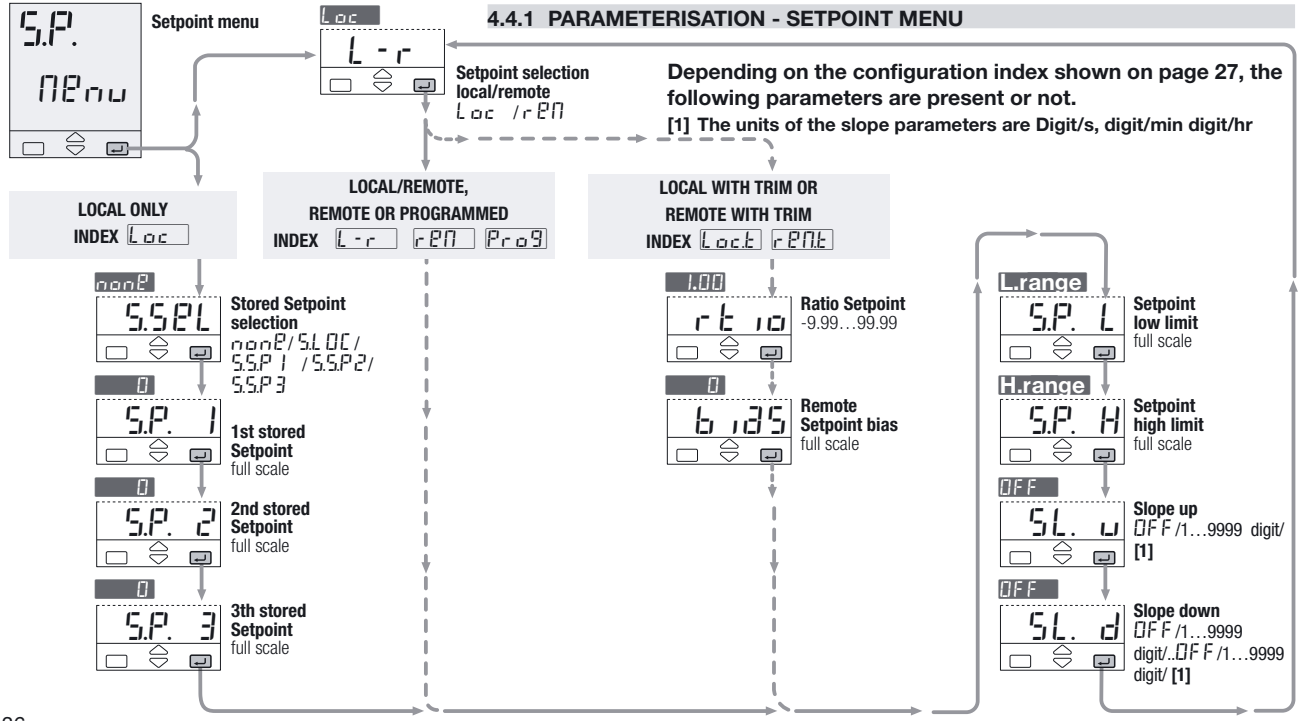


After having selected the parameter or the code, press ⌃ or ⌄ to modify the value (see page 24) The value is entered when the next parameter is selected, by pressing the ↵ key.

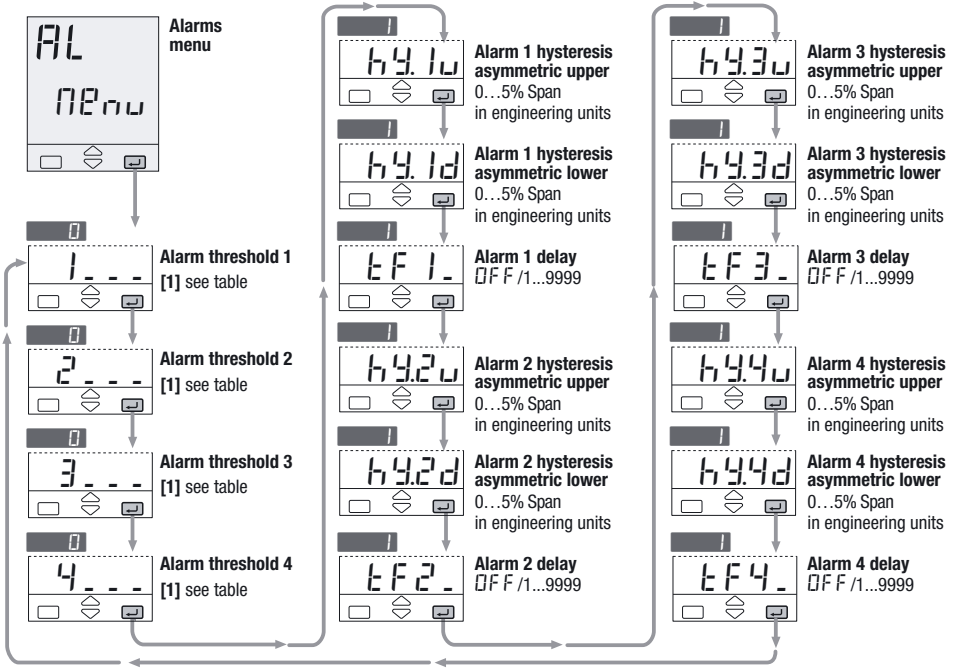
Pressing ↩ go back to the Operator mode



4.4.1 PARAMETERISATION - SETPOINT MENU



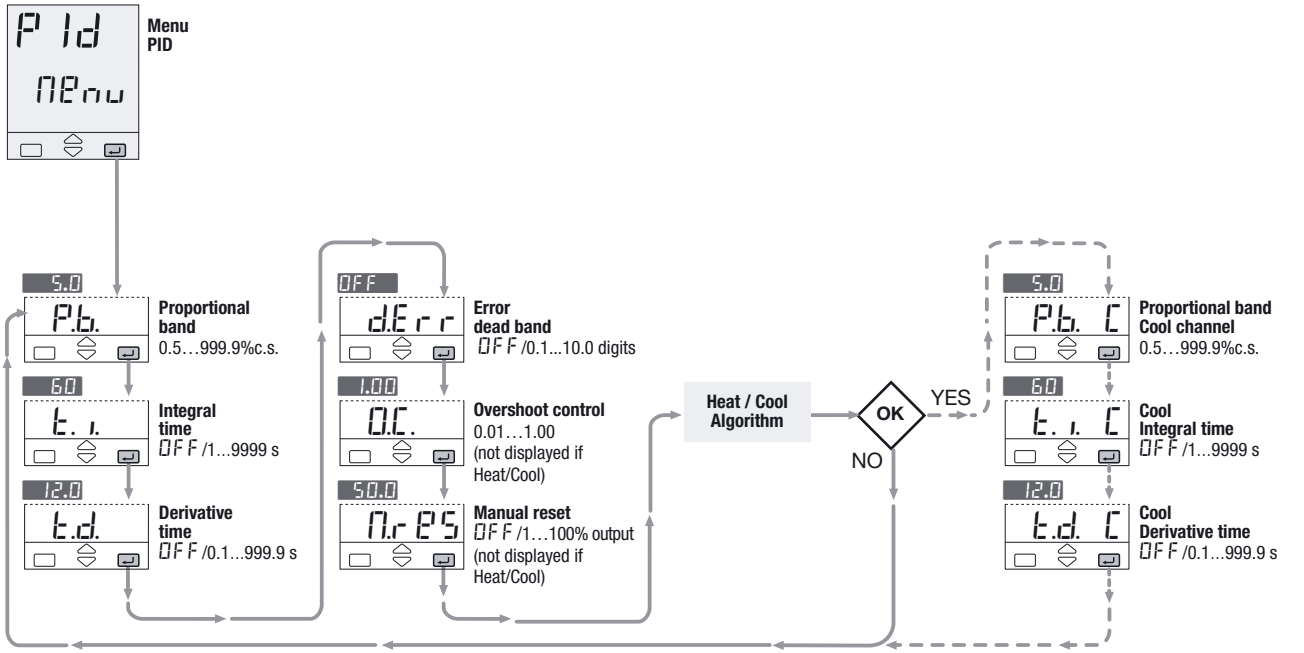
4.4.2 PARAMETERISATION - ALARMS MENU



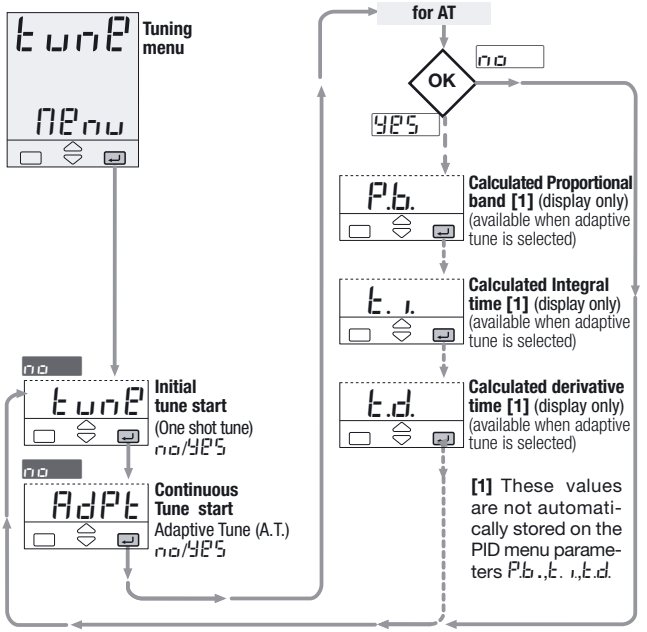
[1] A code, specifying the n° and the alarm type that has been configured (see page 31), is displayed. At this point, the user must enter the threshold value, according to the following table.

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	_LbA

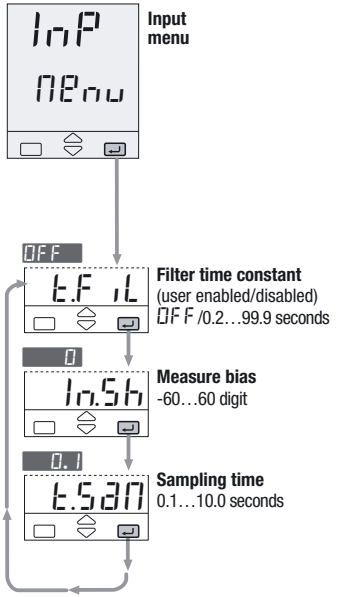
4.4.3 PARAMETERISATION - PID MENU (not shown for ON-OFF control action)



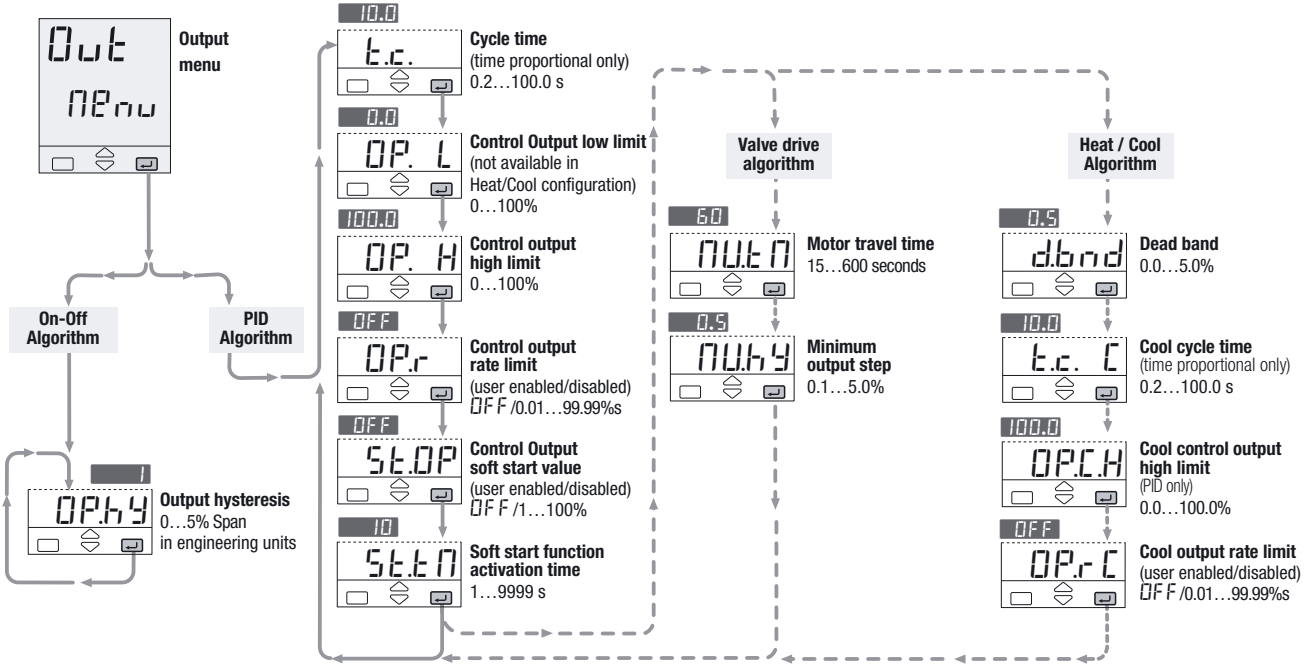
4.4.4 PARAMETERISATION
TUNING MENU (not shown for ON-OFF control action)



4.4.5 PARAMETERISATION
INPUT MENU

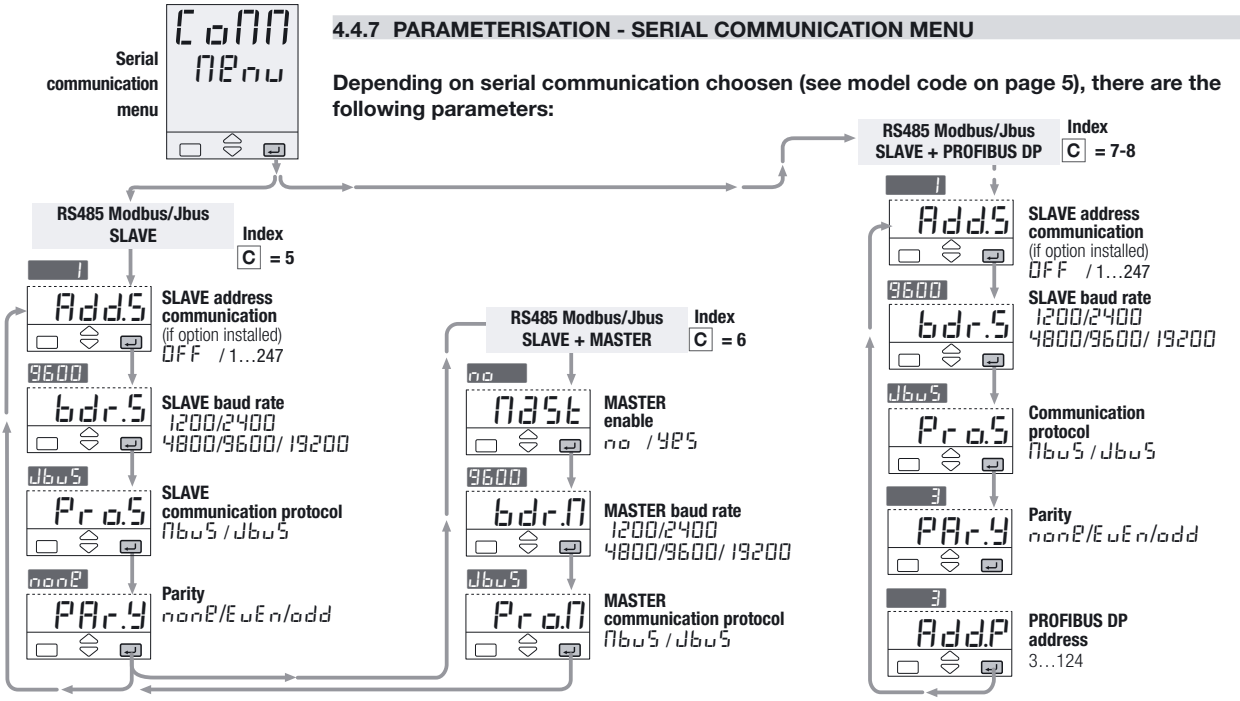


4.4.6 PARAMETERISATION - OUTPUT MENU



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

S.P. L **Setpoint low limit**

S.P. 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**

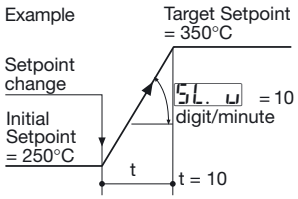
This parameter specifies the maximum rate of change of the Setpoint.
Adjustable in digit/s,digit/min and digit/hour (see page 27)

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.



S.P. 1 **1st stored Setpoint**

S.P. 2 **2nd stored Setpoint**

S.P. 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.

r SSL **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.

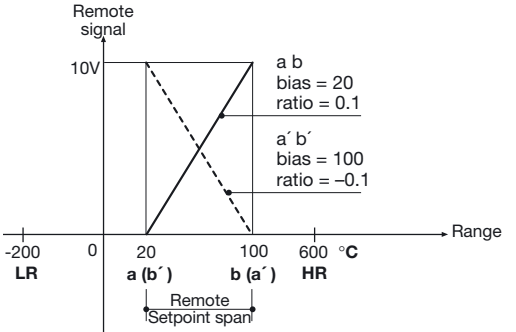
r t io — Remote Setpoint Ratio

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

b ias — 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

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

E.g.: $b\,ias = 20$

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

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

$b\,ias$ = starting point = a´

$$rt\,io = \frac{b´ - a´}{HR - LR}$$

E.g.: $b\,ias = 100$

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

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

Setpoint $Loc\,t$ (table 3, page 27)

$SP = SL + (rt\,io \bullet REM) + b\,ias$

Setpoint $rEMt$ (table 3, page 27)

$SP = REM + (rt\,io \bullet SL) + b\,ias$
SIGN = Remote signal %
SPAN = HR-LR

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

E.g.: Local Setpoint (SL) with an external Trim with multiplying coefficient of 1/10:
Setpoint type = $Loc\,t$
$rt\,io = 0.1$; $b\,ias = 0$

Remote Setpoint (SR) with an internal Trim with multiplying coefficient of 1/5:
Setpoint type = $rEMt$
$rt\,io = 0.2$; $b\,ias = 0$

Remote Setpoint range equal to the Input range:
Setpoint type = $Loc\,t$
$rt\,io = 1$; $b\,ias$=LR
$SL = 0$

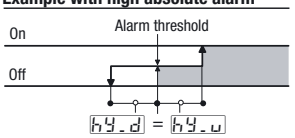
4.5.2 ALARM MENU

(see also pages 32 and 33)

Asymmetric upper alarm hysteresis

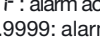
Asymmetric lower alarm hysteresis

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 $hy_d = hy_u$

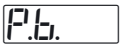


Alarm delay

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

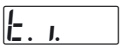
Not present with On-Off main output.



Proportional Band

Cool Proportional Band

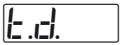
This parameter specifies the proportional band coefficient that multiplies the error (SP - PV)



Integral Time

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.



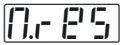
Derivative Time

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.

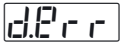
Overshoot control

(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.



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)

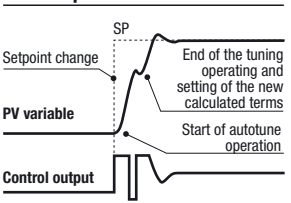
See page also 57

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.

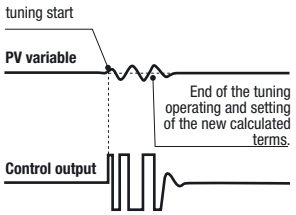
STEP response



4.5.4 TUNING MENU (Cont.)

Fuzzy-Tuning 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

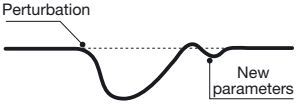


Natural frequency is selected when the PV is close to the SP Setpoint.
This method has the advantage of a better accuracy in the term calculation with a reasonable speed calculation.

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.

Continuous **adaptive tune**



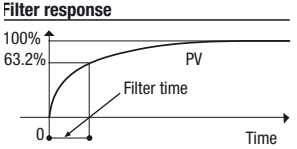
Continuous adaptive tune is particularly suitable for controlling process whose control characteristics change with time or are not linear in relation to the Setpoint values.
It doesn't require any operation by the user. It is simple and works fine: it samples continuously the process response to the 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

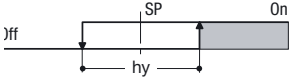
This value is added to the measured PV input value. Its effect is to shift the whole PV scale of its value (±60 digits).

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... 10 s.

4.5.6 OUTPUT MENU

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. Hyst. = 5% 800° = 40°C

Control output cycle time

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.

Control Output low limit

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

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.

Heat output maximum rate

Cool output maximum rate

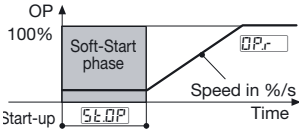
This value, specified in %/seconds, with range from 0.01 to 99.99%/s provides the maximum rate of change of the output. When set to OFF this function is disabled.

Soft start of the control output

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

Soft start time

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



Travel time

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

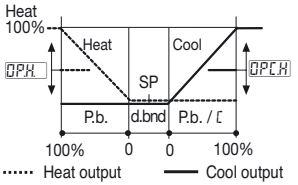
Minimum step

It specifies the minimum allowed time f 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.

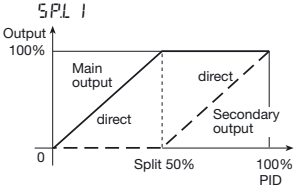
Heat / Cool Algorithm

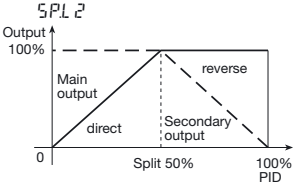


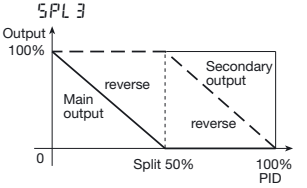
SPLt Split Range % (split range only)

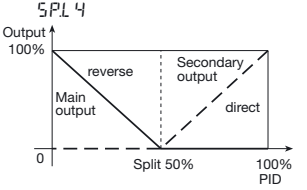
The SPLt parameter allows to adjust the percentage of the controller output (P.I.D. output) managed by main (OP1 or OP5) and secondary (OP2 or OP6) outputs.

The percent value adjusted as SPLt represents the percent of P.I.D. output managed by the main output. The balance to 100% is managed by the secondary output.









E.g.:

CnFG - SPL 1

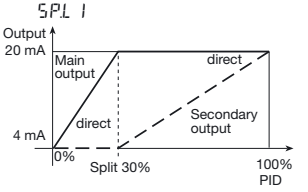
nCoP = 4...20 (OP5)

SCoP = 4...20 (OP6)

SPLt = 30%

OP5: 4 mA = 0% (PID output)
20 mA = 30% (PID output)

OP6: 4 mA = 30% (PID output)
20 mA = 100% (PID output)



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 1200 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:

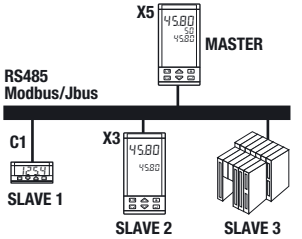
A - Modbus/Jbus SLAVE

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 comm.s.



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)

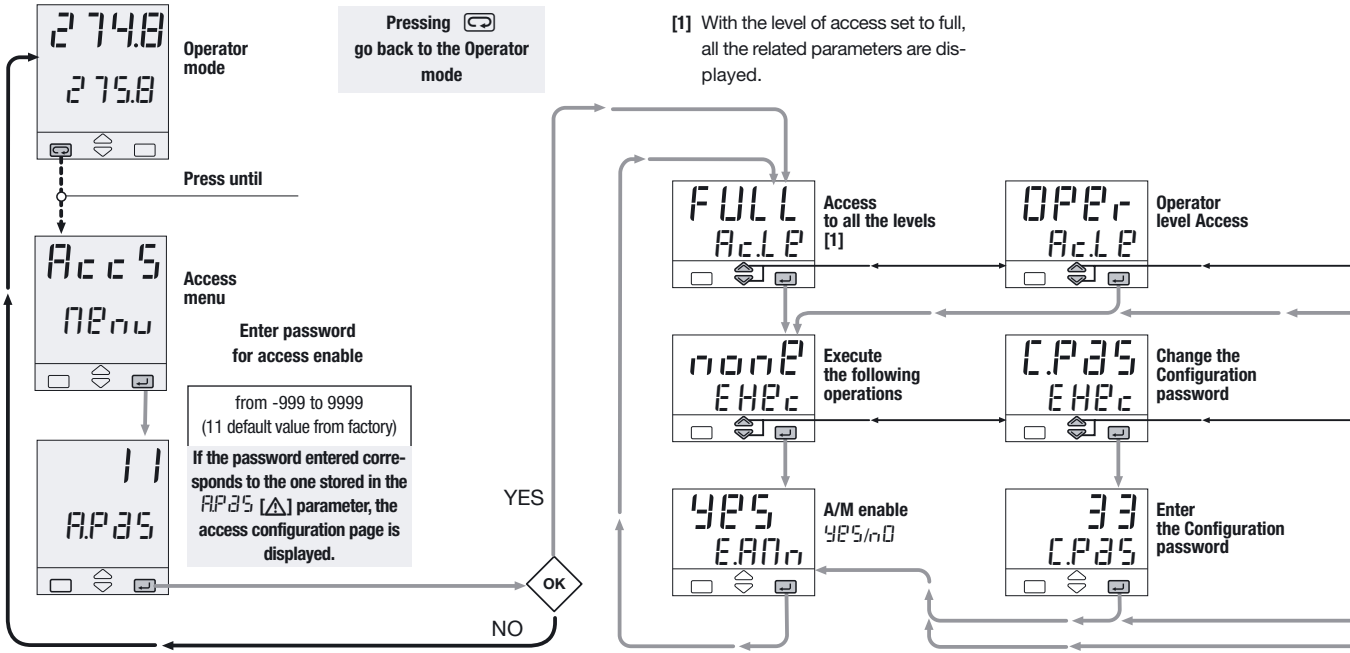
Industrial standard for peripheral devices connection to a machine in a plant.
The protocol installed in this controller, offers the following advantages against the standard normally supplied by other suppliers:

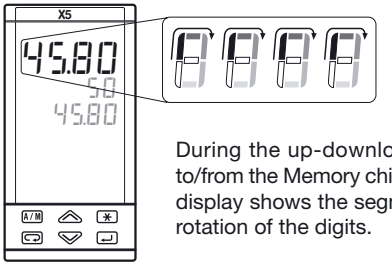
- Communications baudrate **Up to 12 Mb/s with electric isolation.**
- The list of data transfer (profile file) **is user configurable.** It can be set by means the configuration software **[1]**

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.

Edit
Ac.LE
Access to the edit level

11
A.PAS
Enter [⚠] the Access password

A.PAS
EHEc
Change the Access password

Load
EHEc
Load the data from Memory chip

Stor
EHEc
Download the data to Memory chip

Confirm and return back to the Operator mode

C.Pot
EHEc
Calibrate the potentiometer (if present)

0
Pot.L
The valve go to low scale

When the indication (the valve) is stopped, confirm the calibration value using ⌃ or ⌄

255
Pot.H
The valve go to full scale

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
	ALtr	Visible and changeable
	FASt	**Included in “Fast view”**
	rEAd	Visible only
	HIdE	Not visible and not changeable

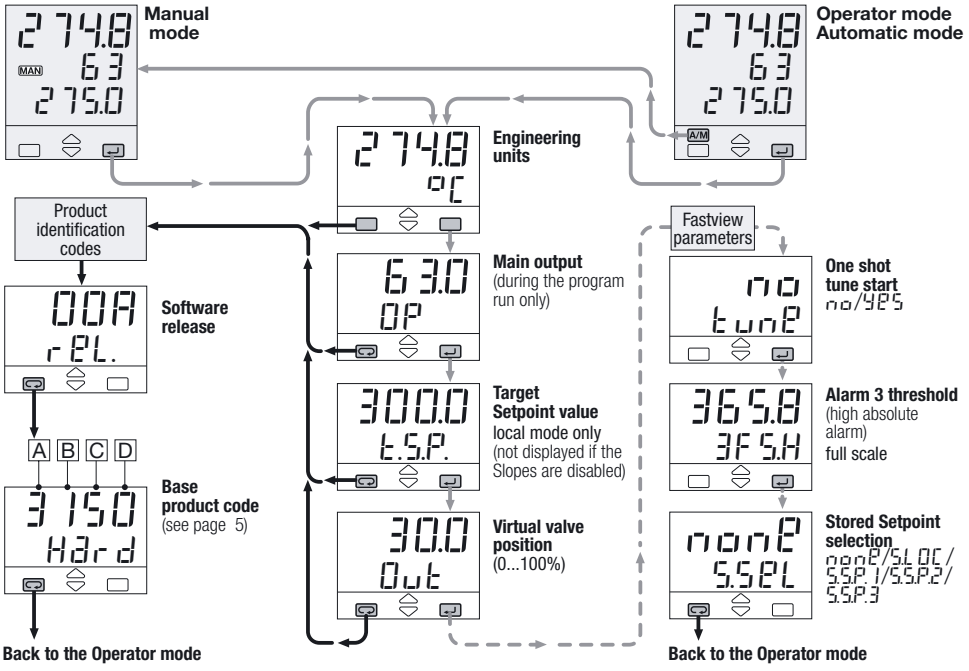
The parameters in the access level FASt are recalled on the front panel through the procedure of fast parameter access illustrated in par. 5.2 page 53. The maximum number of fast parameters is 10.

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:

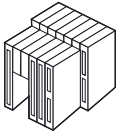
6.1 KEYPAD

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



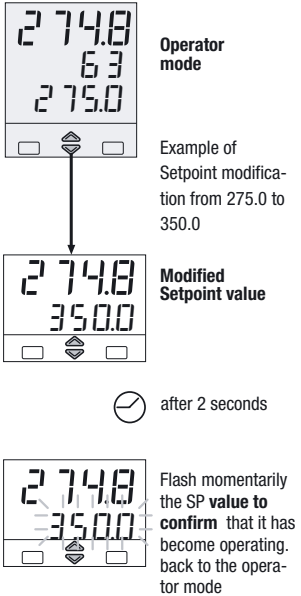
6.3 SERIAL COMMUNICATIONS

see the manual on this topic

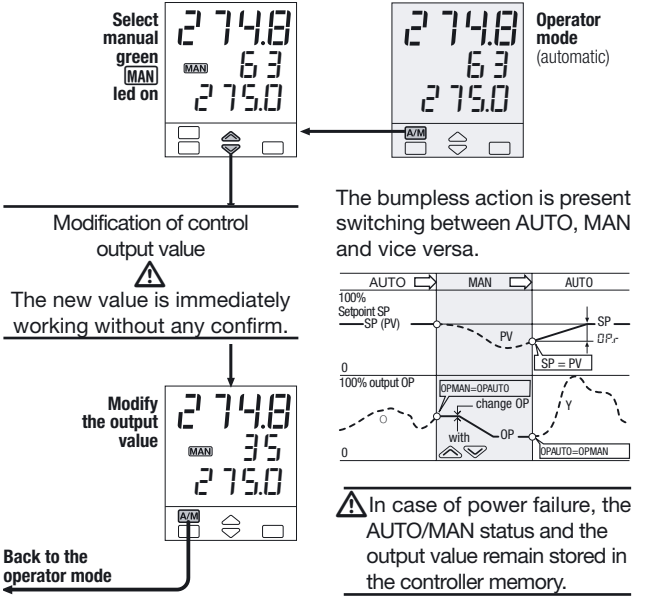
6.1 KEYPAD COMMANDS

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.



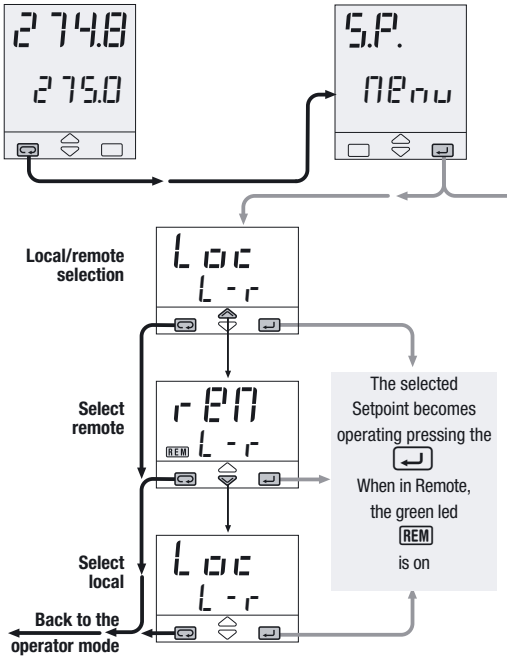
6.1.2 AUTO/MANUAL MODE



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

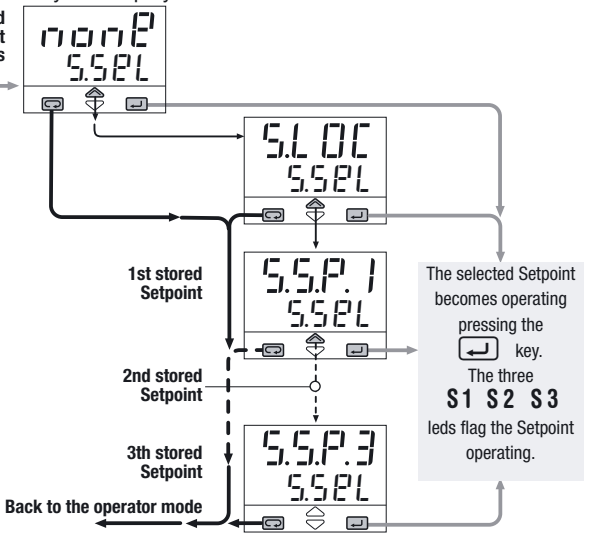
⚠ In case of power failure, the AUTO/MAN status and the output value remain stored in the controller memory.

6.1.3 LOCAL/ REMOTE SELECTION



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

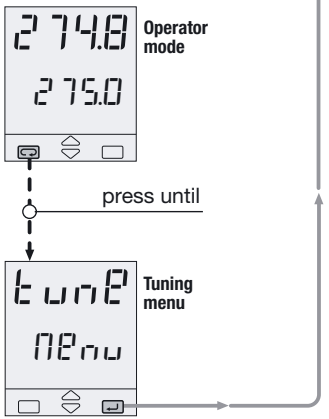
The Setpoint is directly modified with the keys.
Once entered, the new value is checked and becomes operating after 2 seconds. The end of this phase is flagged by flashing momentarily the display with SP.

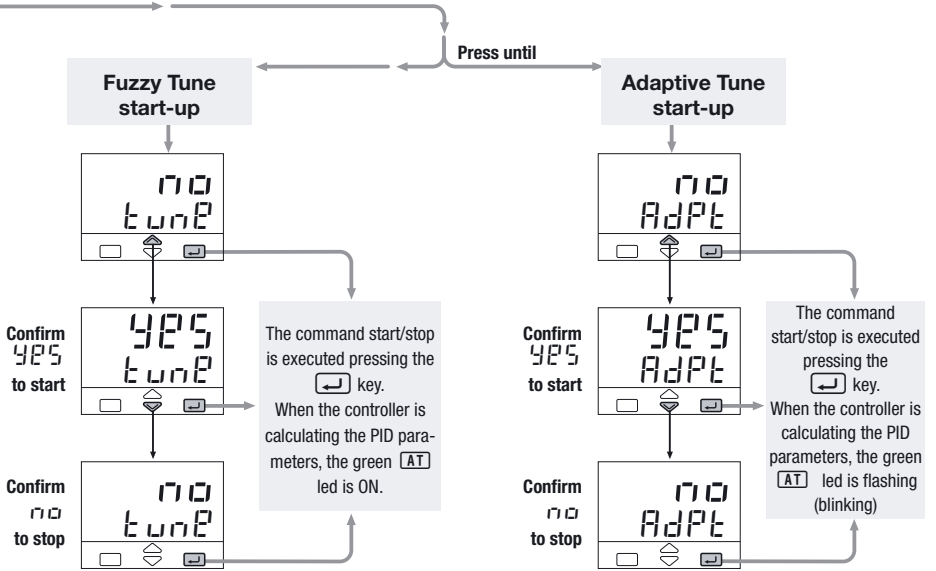


6.1.5 TUNE RUN / STOP

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.





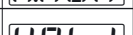
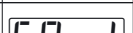
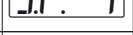
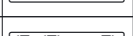
After the execution of the tuning, the calculated values are automatically presented in the PID menu.

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		–	–	Not used
Set manual mode		Automatic	Manual	
Keyboard lock		Unlock	Locked	With the keypad locked the commands from digital inputs and serial communications are still operating
PV measure hold		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		Rate limiting is active	Normal operation	When the input is in the on state, the Setpoint is changed in steps
Output forcing mode		Normal output	Forced output	With ON command the output is equal to the forced value (see page 28)
1st stored Setpoint		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		Local	2nd SP	
3th stored Setpoint		Local	3th SP	
Set Remote mode		Local	Remote	
Reactivation of blocking		–	Reactivation of blocking	The blocking function is activated on closing the command from digital inputs

7 PROGRAMMED SETPOINT

INTRODUCTION

When the Setpoint programmer option 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

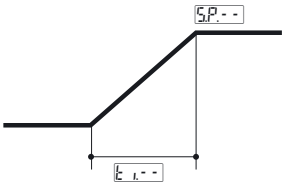
The program consists of a sequence of segments.

For each segment, it is specified:

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

} always present

- the state of the OP3 output



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.

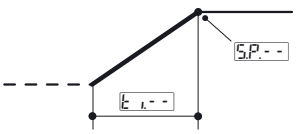
End segment - F

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.

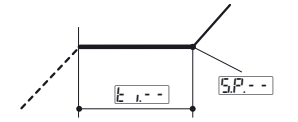
Normal segments - - - -

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

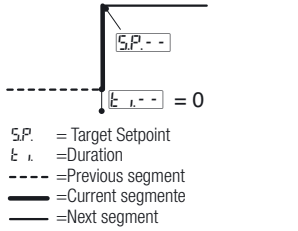
Ramp



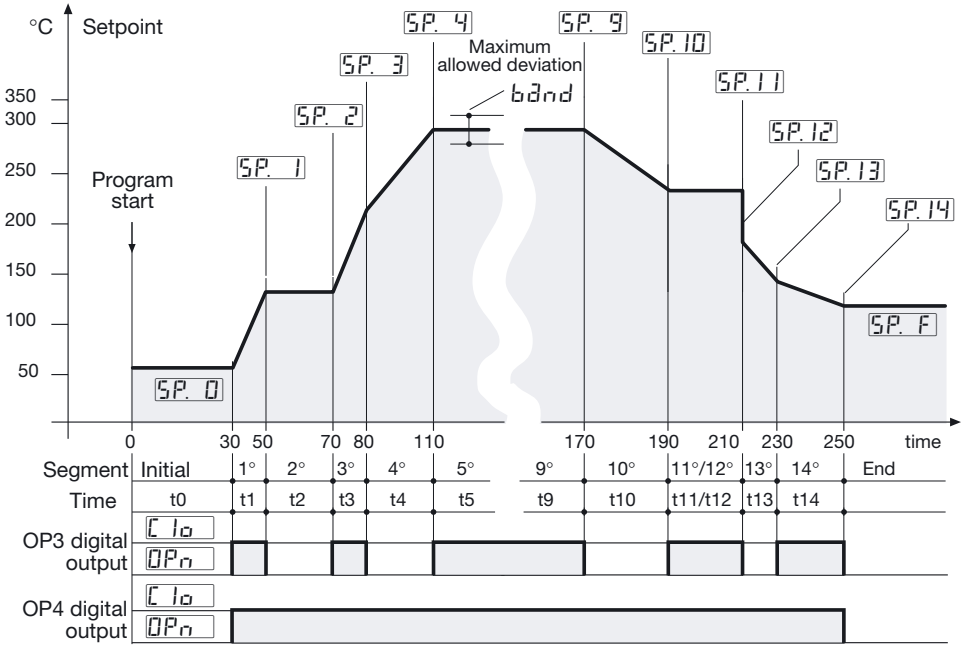
Dwell



Step



EXAMPLE OF SETPOINT PROFILE



7.2 SETPOINT PROGRAMMER

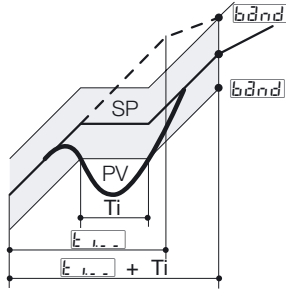
7.2.1 MAXIMUM ALLOWED DEVIATION (band)

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.

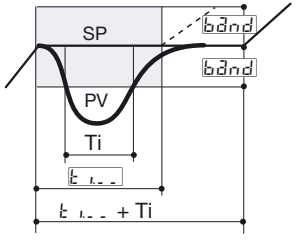
The actual segment period is calculated as t r - - +Ti

OPERATION

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:

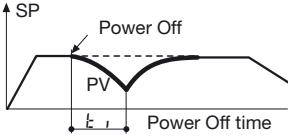
CONT **Continue**

rES **Reset**

rAMP **Ramp**

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

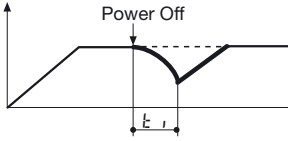
All the parameters, like Setpoint and the remaining time are restored at the values they had at power off.



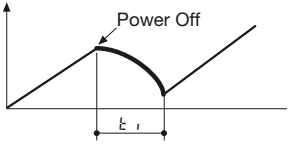
If rES is selected,
at power on the program ends and goes back to local mode.

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.

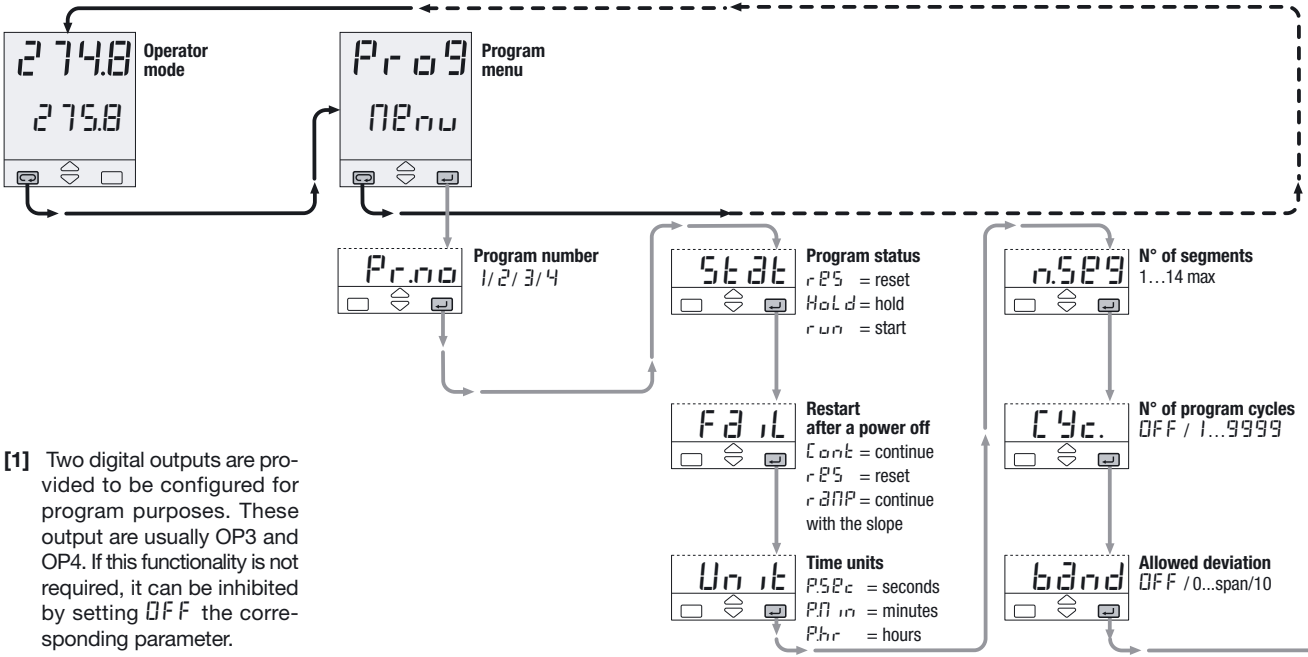
Power off during a dwell



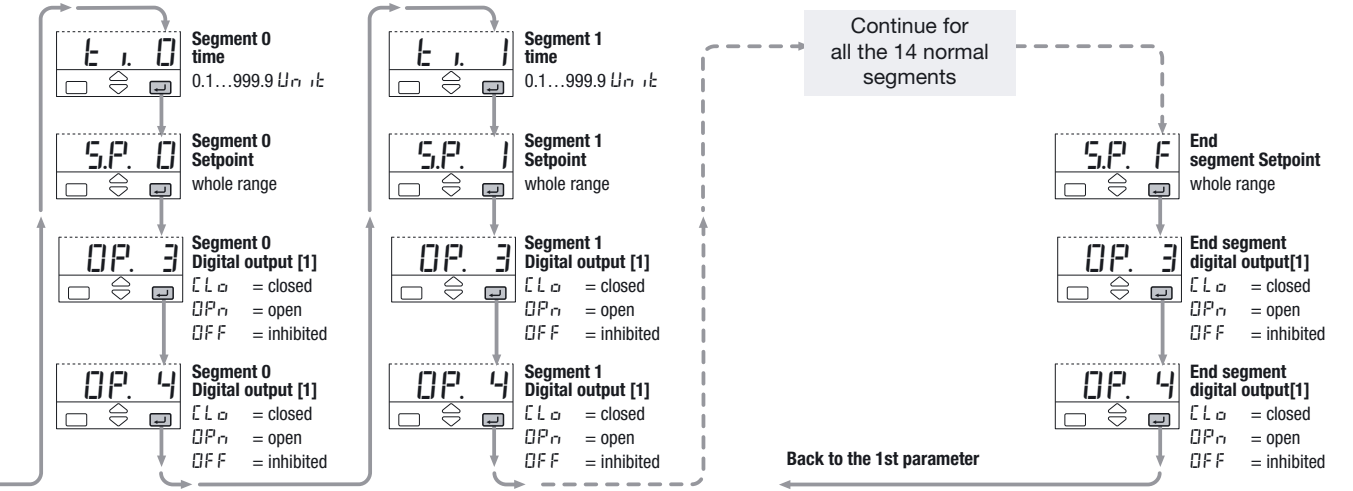
Power off during a ramp



7.3 PARAMETERISATION - PROGRAM MENU (OPTION)



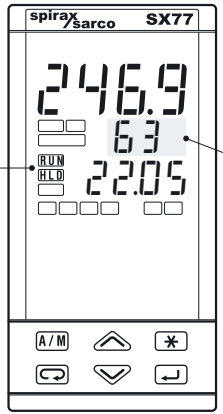
[1] Two digital outputs are provided to be configured for program purposes. These output are usually OP3 and OP4. If this functionality is not required, it can be inhibited by setting OFF the corresponding parameter.


t 1. 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 1. 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	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

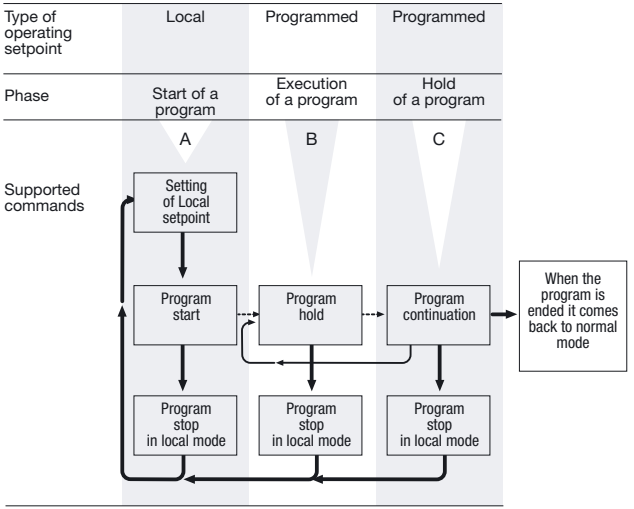
(Segment n°12) - dwell

(End segment) **Program end**

7.5 START/STOP OF A PROGRAM

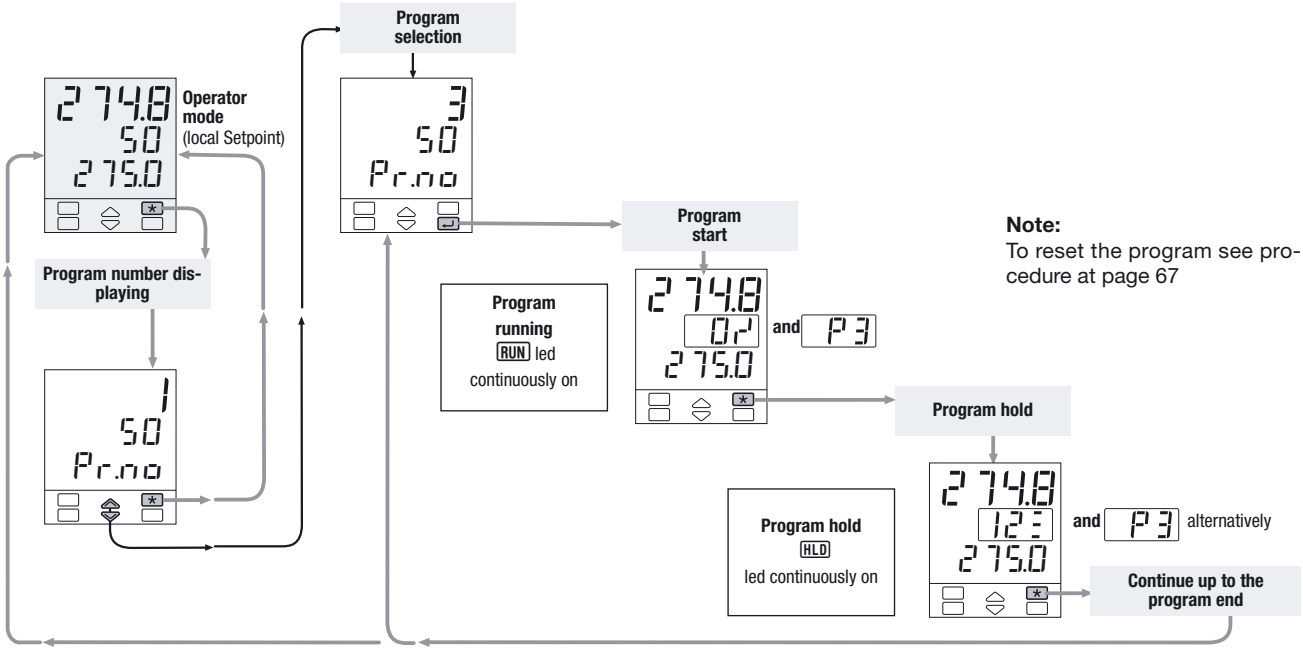
The various commands, supported by the controller, are different for each of the following operating phases:
A] when in Local Setpoint mode
B] during the execution of a program
C] when the program is in hold

Commands supported by the controllers

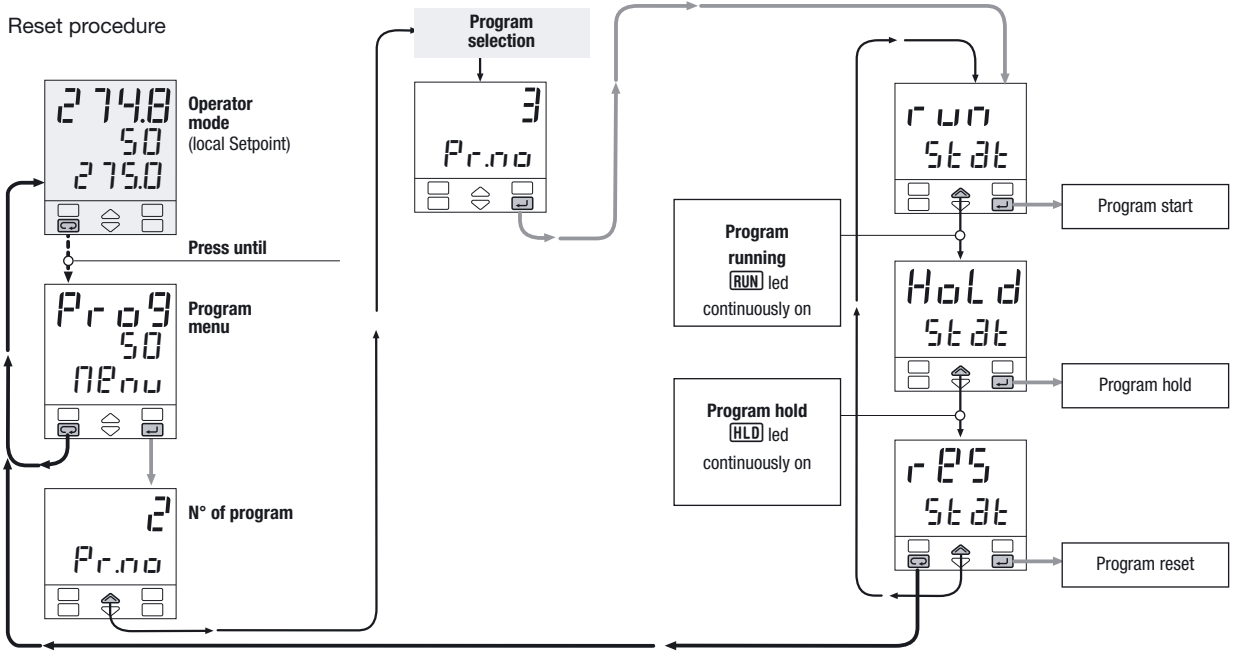


The different phase are displayed in a chained way, just for easing the understanding of the functionality.
Two different mode for starting and stopping a program are provided:
direct mode with the [*] key (see page 66)
through the parameter menu (see page 67)

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	bLcK	—	Reactivation of blocking	The blocking function is activated at the time the digital input goes to the close state
Next segment	nEHt	—	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: - the type of input - the type of Setpoint - the type of control algorithm - the type of output - the type and functionality of the alarms - control parameter values - access levels		
PV Input (see pages13,14 and page 26)	Common characteristics	A/D converter with resolution of 160,000 points Update measurement time: 50 ms Sampling time: 0.1… 10.0 s Configurable Input shift: - 60… + 60 digit Input filter with enable/disable: 0.1… 99.9 seconds	
	Accuracy	0.25% ±1 digits for temperature sensors 0.1% ±1 digits (for mV and mA)	Between 100…240Vac the error is minimal
	Resistance thermometer (forΔT: R1+R2 must be <320Ω)	Pt100Ω a 0°C (IEC 751) °C/°F selectable	2 or 3 wires connection Burnout (with any combination)	Max. wire Res: 20Ω max. (3 wires) Input drift: 0.1°C/10° T_{env} <0.1°C/10Ω Wire Res.
	Thermocouple	L,J,T,K,S, R, B, N, E, W3, W5 (IEC 584) Rj >10MΩ °C/°F selectable	Internal cold junction compensation con NTC Error 1°C/20°C ±0.5°C Burnout	Line: 150Ω max. Input drift: <2µV/°C. T_{env}. <5µV/10Ω Wire Res.
	DC input (current)	4... 20mA, 0... 20mA Rj =30Ω	Burnout. Engineering units conf. decimal point position with or without $\sqrt{}$ Init. Scale -999… 9999 Full Scale -999… 9999 (min. range of 100 digits)	Input drift: <0.1%/20°C T_{env}. <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 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	Bias in engineering units and ± range Ratio: -9.99… +99.99 Local + Remote Setpoint							
		Voltage: 1... 5, 0... -5, 0... 10V:	Rj = 300kΩ								
	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, split range or double action P.I.D. loop or On/Off with 1, 2,3 or 4 alarms		**Control output**		**Alarm**	**Alarm**	**Alarm**	**Alarm**	**Retransmission**		
			Main	**Secondary**	**AL1**	**AL2**	**AL3**	**AL4**	**PV / SP**		
		Single action	**OP1** Relay			**OP2** Relay	**OP3** Relay	**OP4** Relay	**OP5** Analog./Digital	**OP6** Analog./Digital	
			OP5 Analog./Digital		**OP1** Relay	**OP2** Relay	**OP3** Relay	**OP4** Relay		**OP6** Analog./Digital	
		Split range	**OP5** Analog./Digital	**OP6** Analog./Digital	**OP1** Relay	**OP2** Relay	**OP3** Relay	**OP4** Relay			
		Double action Heat/Cool	**OP1** Relay	**OP2** Relay			**OP3** Relay	**OP4** Relay	**OP5** Analog./Digital	**OP6** Analog./Digital	
			OP1 Relay	**OP5** Analog./Digital		**OP2** Relay	**OP3** Relay	**OP4** Relay		**OP6** Analog./Digital	
			OP5 Analog./Digital	**OP2** Relay	**OP1** Relay/Triac		**OP3** Relay	**OP4** Relay		**OP6** Analog./Digital	
			OP5 Analog./Digital	**OP6** Analog./Digital	**OP1** Relay/Triac	**OP2** Relay	**OP3** Relay	**OP4** Relay			
		Valve drive	**OP1** Relay	**OP2** Relay			**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				
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 outputs	Control or PV/SP/MV retransmission	Galvanic isolation: 500 Vac/1 min Short circuit protected Resolution 12 bit Accuracy: 0.1 %	Analogue: 0/1... 5V, 0…10V, 500Ω/20mA max., 0/4... 20mA, 750Ω/15V max. 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) Low limit: from low range to high limit 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) From 1 to 9999 cycles or continuous cycling (OFF)		
	Time values in seconds, minutes and hours 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 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, 1200, 2400, 4800, 9600, 19.200 bit/s, 3 wires RS485 isolated, MASTER Modbus/Jbus protocol, 1200, 2400, 4800, 9600, 19.200 bit/s, 3 wires 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 (PTC protected)	100... 240Vac (-15% +10%) 50/60Hz or 24Vac (-15% +25%) 50/60Hz and 24Vdc (-15% +25%)	Power consumption 5W 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 Approval	File 176452	
	Protection EN60529 (IEC 529)	IP65 front panel	
	Dimensions	1/8 DIN - 48 x 96, depth 110 mm, weight 380 g max.	

WARRANTY

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

ICONS TABLE

Main universal input

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

Auxiliary input

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

Digital input

	Isolated contact
	NPN open collector
	TTL open collector

Setpoint

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

Digital input connected functions

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

Output

	SPST Relay
	Triac
	SPDT Relay
mA	mA
mA V	mA mV
	Logic