ASCON TECNOLOGIC

Heat / Cool temperature controller 1/8 DIN - 48 x 96

SERIES

X1 line

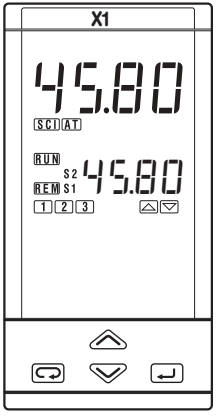
User Manual • 09/02 • Code: ISTR_M_X1_E_07_--

ISO 9001
Certified

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

Heat / Cool
temperature controller
$^1/_8$ DIN - 48 x 96

X1 line



CE

NOTES ON ELECTRIC SAFETY AND ELECTROMAGNETIC COMPATIBILITY

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

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

Regulations on Electromagnetic Compatibility according to the European Community directive n089/336/EEC, amended by the European Community directive No. 92/31/EEC, 93/68/EEC, 98/13/EEC and the following regulations:

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

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

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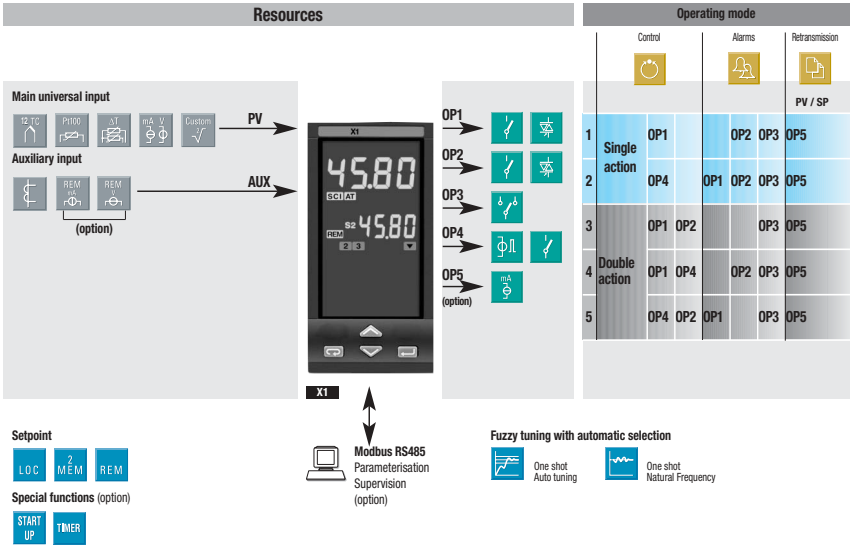


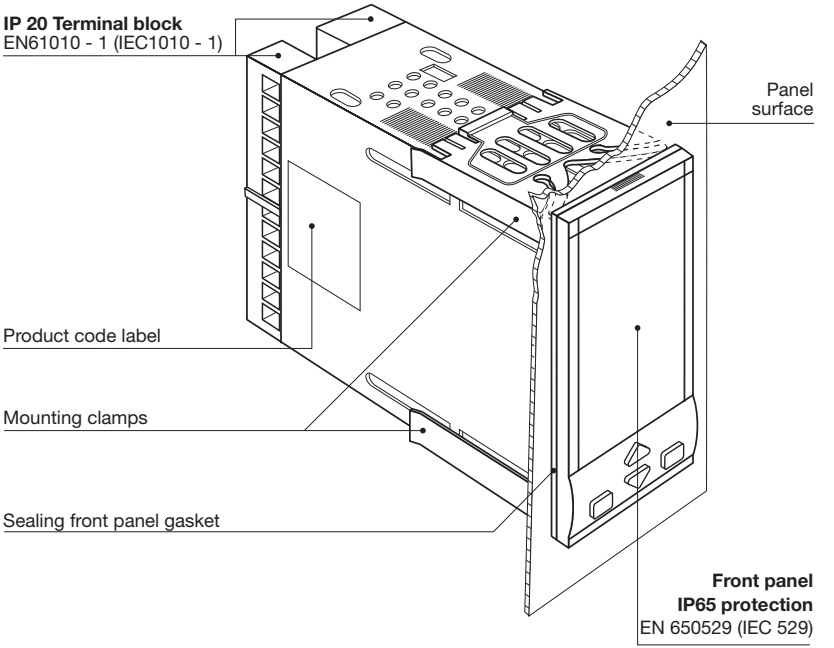
INSTALLATION

Installation must only be carried out by qualified personnel.

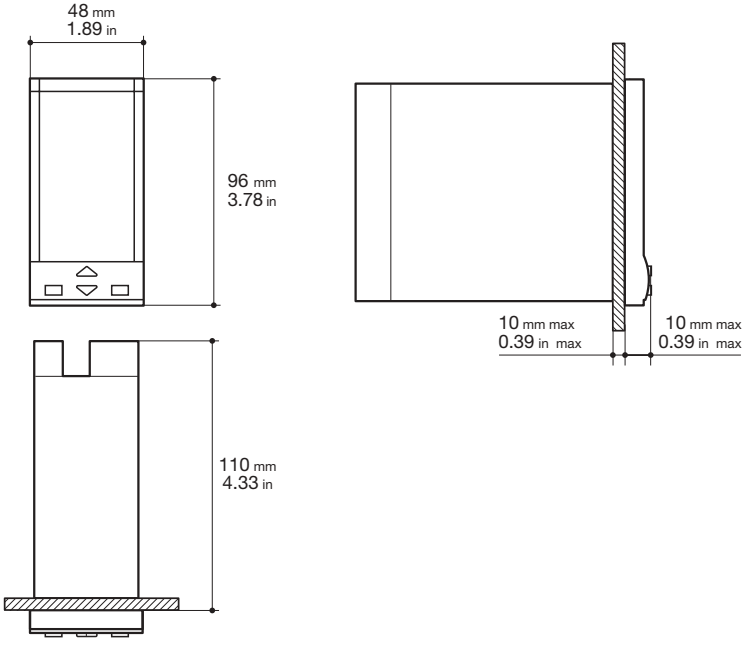
Before proceeding with the installation of this controller, follow the instructions illustrated in this manual and, particularly the installation precautions marked with the ⚠CE symbol, related to the European Community directive on electrical protection and electromagnetic compatibility.

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

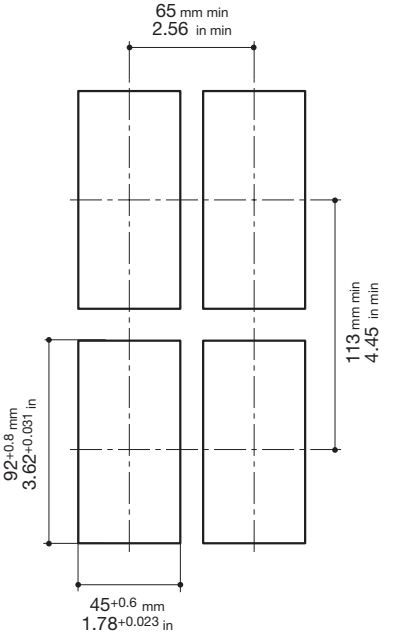
1.1 GENERAL DESCRIPTION



1.2 DIMENTIONAL DETAILS



1.3 PANEL CUT-OUT



1.4 ENVIRONMENTAL RATINGS

Operating conditions	
2000	Altitude up to 2000 m
°c	Temperature 0…50°C **[1]**
%Rh	Relative humidity 5…95 % non-condensing

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

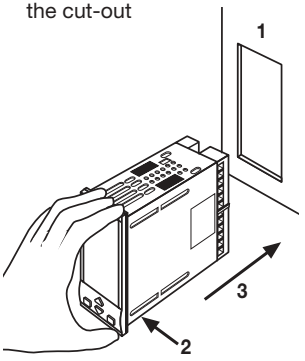
Forbidden Conditions	
	Corrosive atmosphere
	Explosive atmosphere

UL notes
[1] Operating surrounding temperature 0…50°C

1.5 PANEL MOUNTING [1]

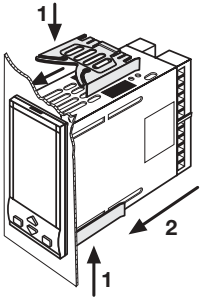
1.5.1 INSERT THE INSTRUMENT

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



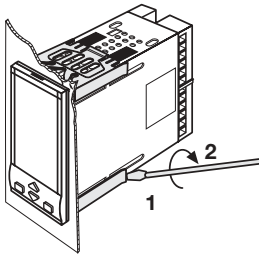
1.5.2 INSTALLATION SECURING

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



1.5.3 CLAMPS REMOVING

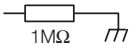
1 Insert the screwdriver in the clips of the clamps
2 Rotate the screwdriver



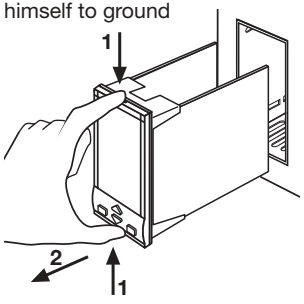
1.5.4 INSTRUMENT UNPLUGGING

1 Push and
2 pull to remove the instrument

Electrostatic discharges can damage the instrument

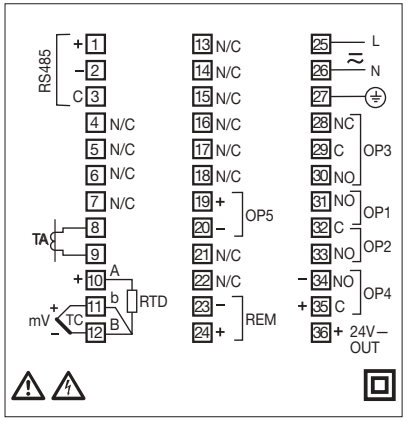


Before removing the instrument the operator must discharge himself to ground

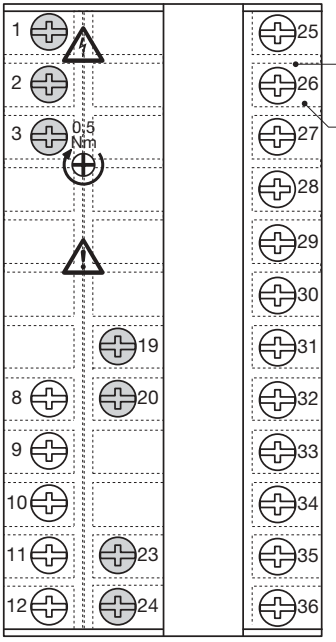


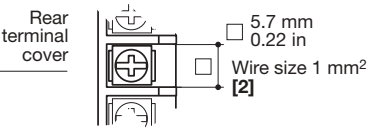
UL note
[1] For Use on a Flat Surface of a Type 2 and Type 3 'raintight' Enclosure.

2 ELECTRICAL CONNECTIONS



2.1 TERMINATION UNIT [1]





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

Terminals

	Pin connector Ø 1.4 mm 0.055 in max.
	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 1mm² (18 AWG Solid/Stranded)

PRECAUTIONS

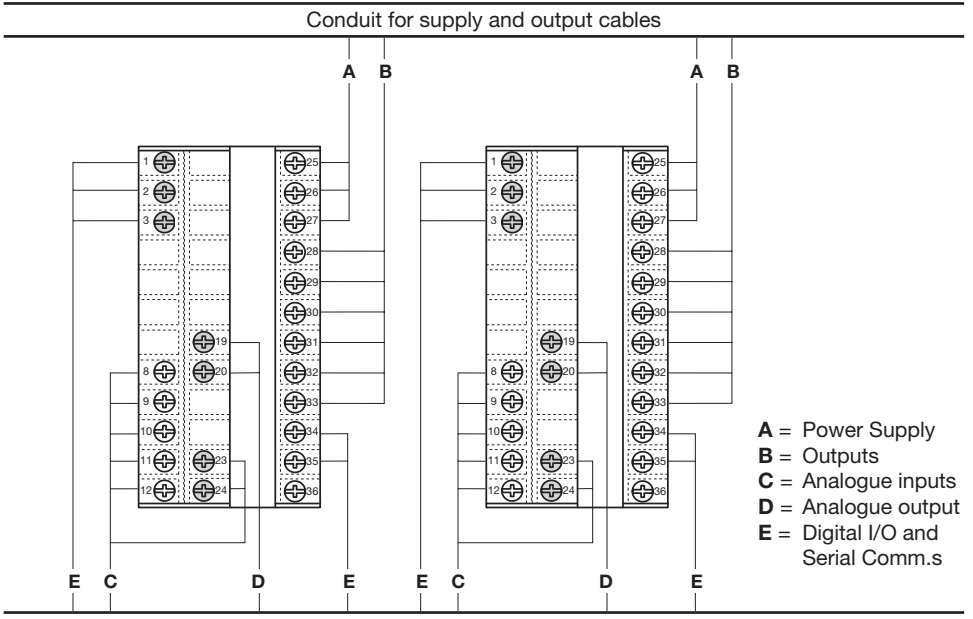
Despite the fact that the instrument has been designed to work in an harsh and noisy environmental (level IV of the industrial standard IEC 801-4), it is recommended to follow the following suggestions.

⚠

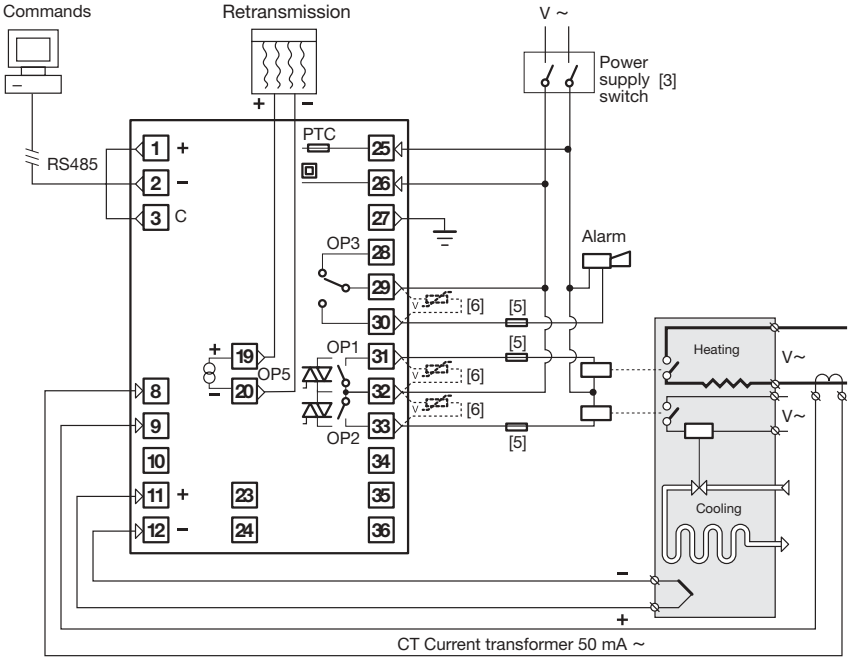
All the wiring must comply with the local regulations.
The supply wiring should be routed away from the power cables.
Avoid to use electromagnetic contactors, power Relays and high power motors nearby.
Avoid power units nearby, especially if controlled in phase angle

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.

2.2 SUGGESTED WIRES ROUTING



2.3 EXAMPLE OF WIRING DIAGRAM (HEAT / COOL CONTROL)



Notes:

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

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

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

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

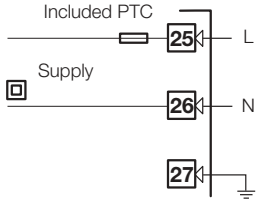
5] To protect the instrument internal circuits use:
- 2 AT fuse for Relay outputs (220 Vac);
- 4 AT fuse for Relay outputs (110 Vac);
- 1 AacT fuse for Triac outputs.

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

2.3.1 POWER SUPPLY

Switching power supply with multiple isolation and internal PTC

- **Standard version:**
  nominal voltage:
  100...240Vac (-15...+10%)
  Frequency 50/60Hz
- **Low Voltage version:**
  Nominal voltage:
  24Vac (-25...+12%)
  Frequency 50/60Hz
  or 24Vdc (-15...+25%)
  Power consumption 4W max.

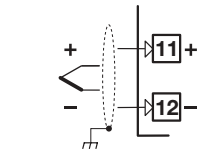


For better protection against noise, it is recommended not to connect the earth clamp provided for civilian installations.

2.3.2 PV CONTROL INPUT

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

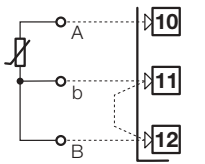
- Connect the wires with the polarity as shown
- Use always compensation cable of the correct type for the thermocouple used
- The shield, if present, must be connected to a proper earth.



Wire resistance
150Ω max.

B For Pt100 resistance thermometer

- If a 3 wires system is used, use always cables of the same section (1mm² min.) (line 20 Ω/lead maximum resistance)
- When using a 2 wires system, use always cables of the same diameter (1,5mm² min.) and put a jumper between terminals 11 and 12

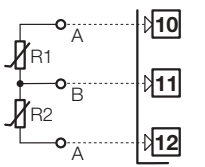


For 3 wires only
Maximum line resistance: 20Ω/line

C For ΔT (2x RTD Pt100) Special

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

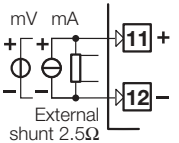
R1 + R2 must be <320Ω



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

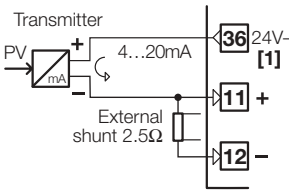
2.3.2 PV CONTROL INPUT

D For mA, mV

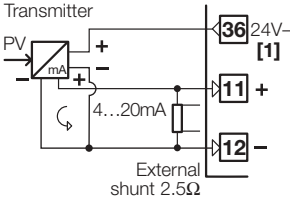


Rj >10MΩ

D1 With 2 wires transmitter



D2 With 3 wires transmitter



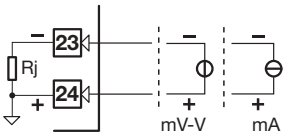
[1] Auxiliary power supply for external transmitter 24Vdc ±20%/30mA max. with no short-circuit protection

2.3.3 AUXILIARY INPUT

A - From Remote Setpoint (option)

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

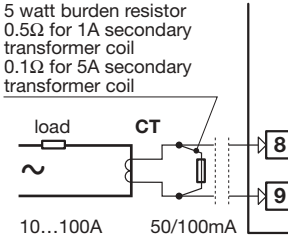
Voltage
1…5V, 0…5V, 0…10V
Input resistance = 300kΩ

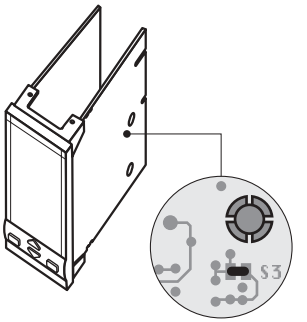


B- For Current Transformer CT not isolated

For the measure of the load current (see page 45)

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





Jumper for 100 mA secondary transformer coil

2.3.5 OP1 - OP2 - OP3 - OP4 - OP5 OUTPUTS (OPTION)

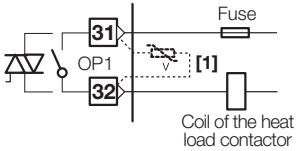
The functionality associated to each of the OP1, OP2 and OP3 output is defined during the configuration of the instrument index **N** (see page 19).
The suggested combinations are:

		Control outputs		Alarms			Retransmission
		Heat	Cool	AL1	AL2	AL3	PV / SP
A	Single action	OP1			OP2	OP3	OP5
B		OP4		OP1	OP2	OP3	OP5
C	Double action	OP1	OP2			OP3	OP5
D		OP1	OP4		OP2	OP3	OP5
E		OP4	OP2	OP1		OP3	OP5

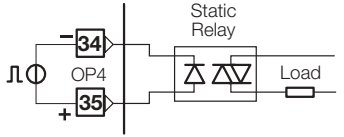
where:

OP1 - OP2	Relay or Triac output
OP3	Relay output (for AL3 only)
OP4	SSR drive control or Relay output
OP5	Retransmission analogue output

2.3.5-A SINGLE ACTION RELAY (TRIAC) CONTROL OUTPUT



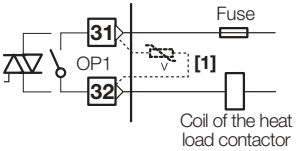
2.3.5-B SINGLE ACTION SSR DRIVE CONTROL OUTPUT

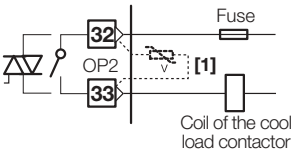


Relay output
- SPST Relay N.O., 2A/250 Vac (4A/120Vac) for resistive load;
- Fuse 2AT at 250Vac, 4AT at 110Vac.

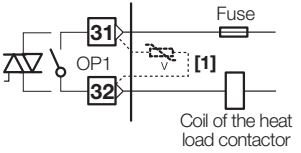
Logic output not isolated
- 0…5Vdc, ±20%, 30 mA max.

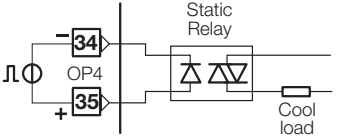
2.3.5-C SINGLE ACTION ANALOGUE OUTPUT



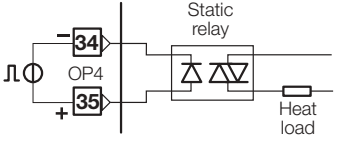


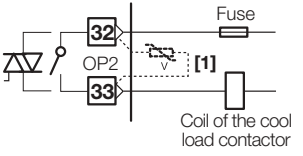
2.3.5-D DOUBLE ACTION RELAY (TRIAC)/RELAY (TRIAC) CONTROL OUTPUT





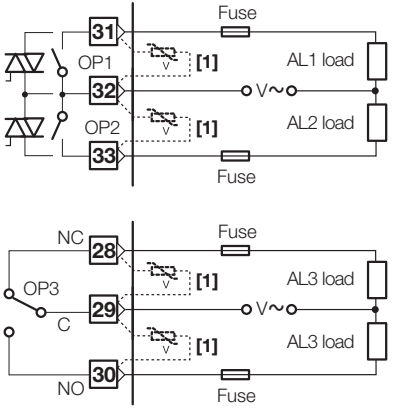
2.3.5-E DOUBLE ACTION RELAY (TRIAC)/SSR DRIVE CONTROL OUTPUT





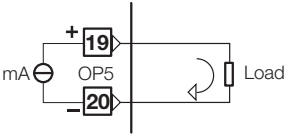
2.3.6 ALARM OUTPUTS

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



[1] Varistor for inductive load 24Vdc only

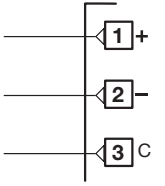
2.3.7 OP5 ANALOGUE RETRANSMISSION OUTPUT (OPTION)



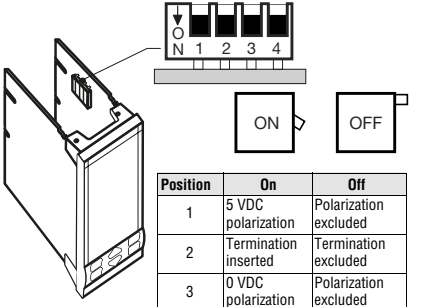
For PV/SP retransmission only:
- Galvanic isolation 500Vac/1 min
- 0/4…20mA, (750Ω or 15Vdc max.)

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

2.3.8 SERIAL COMMUNICATIONS (OPTION)



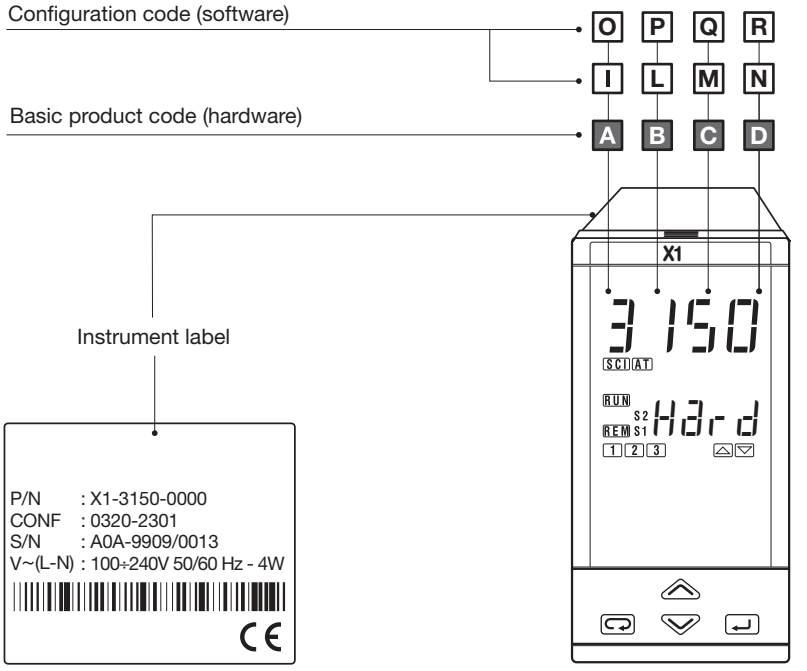
- Galvanic isolation 500Vdc/1 min Compliance to the EIA RS485 standard for Modbus/Jbus
- Setting dip switches



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

3 PRODUCT CODING

The complete code is shown on the instrument label. The informations about product coding are accessible from the front panel by mean of a particular procedure described at section 5.2 page 47



3.1 MODEL CODE

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

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

Line	X 1

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

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

Serial Communications	C
None	0
RS485 Modbus/Jbus SLAVE	5

Options	D
None	0
Retransmission output + Remote Set point input	5

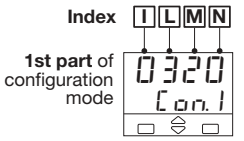
Special function	E
Not fitted	0
Start-up + Timer	2

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

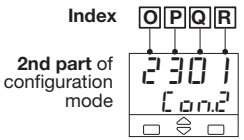
Front panel colour	G
Dark (std)	0
Beige	1

3.2 CONFIGURATION CODING

A 4+4 index code follows the model of the controller.
The code has to be set to configure the controller (see chapter 3.1 page 17)



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



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

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

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

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

Output configuration		N
Single action	**Double action**	
Relay (OP1)	Heat OP1, Cool OP2	0
SSR drive or relay (OP4)	Heat OP1, Cool OP4	1
-	Heat OP4, Cool OP2	2

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

OP water = $100 \bullet (OP2/100)^{2}$ OP oil = $100 \bullet (OP2/100)^{1.5}$

[3] Only possible whether "Output configuration" **N** = 0 or 1) and HEAT parameter is different to OFF , see page 29)

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

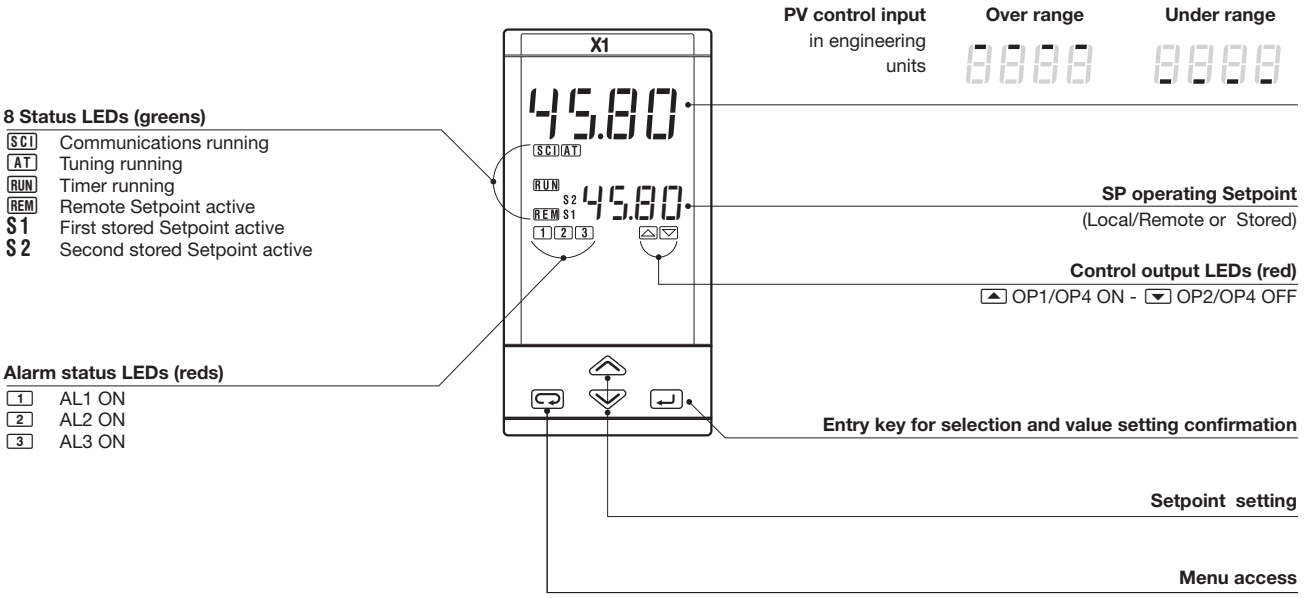
Alarm 2 type and function		P
Disabled		0
Sensor break/Loop break alarm (LBA)		1
Absolute	active high	2
	active low	3
Deviation	active high	4
	active low	5
Band	active out	6
	active in	7
Heater break by CT **[3]**	active during ON output state	8
	active during OFF output state	9

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

Setpoint type	**R**
Local only	**0**
Local and 2 tracking stored Setpoints	**1**
Local and 2 Stand-by stored Setpoints	**2**
Local and Remote	**3**
Local with trim	**4**
Remote with trim	**5**

4 OPERATIONS

4.1.1 KEYS FUNCTIONS AND DISPLAY IN OPERATOR MODE



4.1.2 KEYS FUNCTIONS AND DISPLAY IN PROGRAMMING MODE

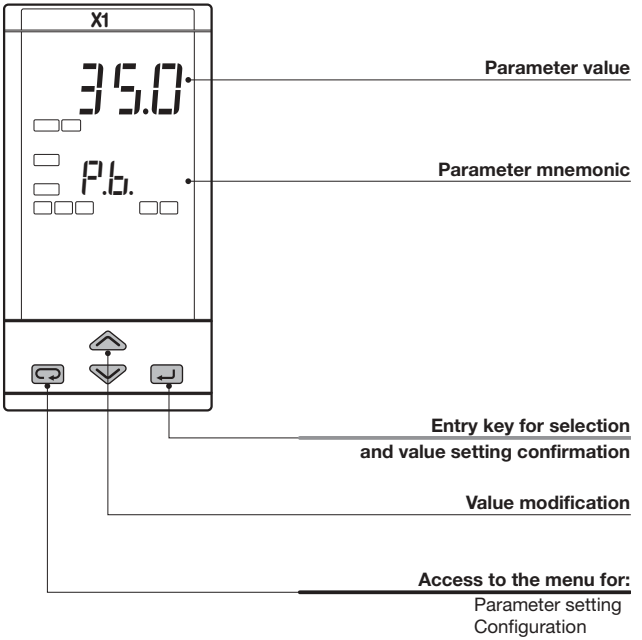
⚠

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

After having selected the parameter or the code, press ∧ and ∨ to display or modify the value (see page 23)
The value is entered when the next parameter is selected, by pressing the è key.

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

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



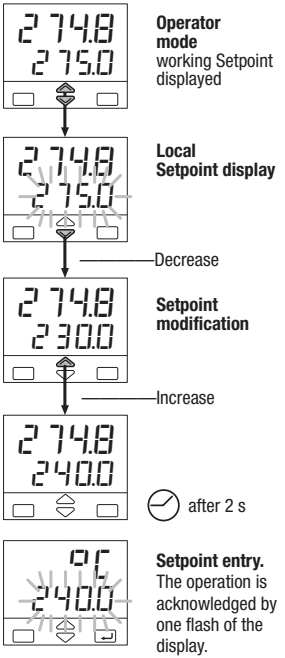
4.2 PARAMETER SETTING

4.2.1 NUMERIC ENTRY

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

Press ⌃ or ⌄ momentarily to change the value of 1 unit every push
Continued pressing of ⌃ or ⌄ changes the value, at rate that doubles every second. Releasing the button the rate of change decreases.
In any case the change of the value stops when it has reached the max./min limit set for the parameter.

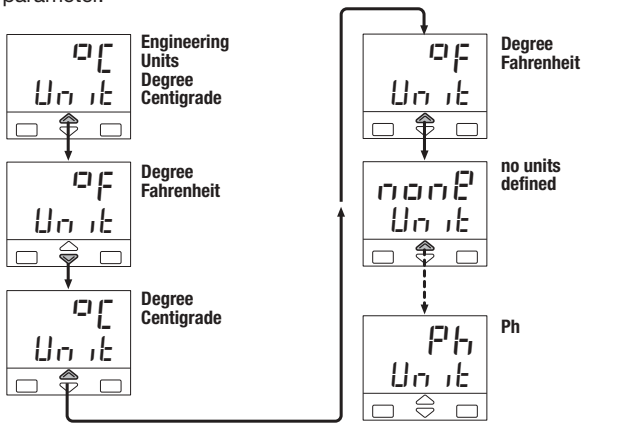
In case of Setpoint modification: press ⌃ or ⌄ once to display the local Setpoint instead of working Setpoint.
To evidence this change the display flashes once. Then the Setpoint can be modified



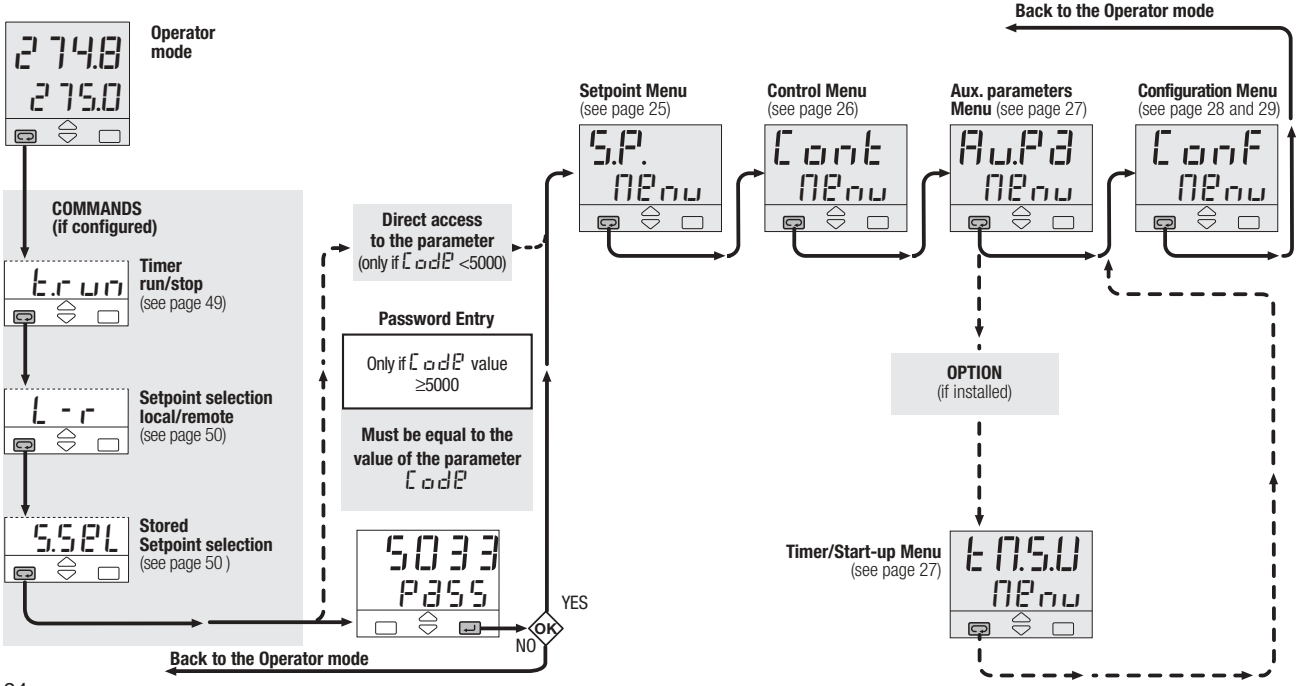
4.2.2 MNEMONIC CODES SETTING

(e.g. configuration see page 28)

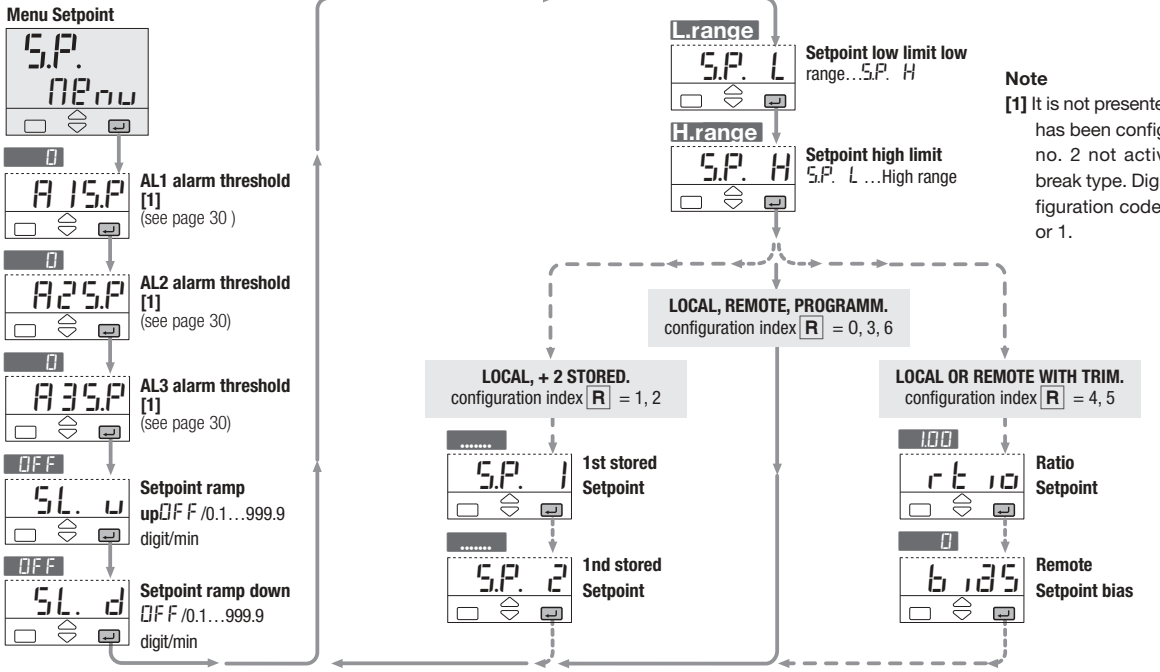
Press the ⌃ or ⌄ to display the next or previous mnemonic for the selected parameter.
Continued pressing of ⌃ o r⌄ will display further mnemonics at a rate of one mnemonic every 0.5 s. The mnemonic displayed at the time the next parameter is selected, is the one stored in the parameter.



4.3 PARAMETERISATION - MAIN MENU



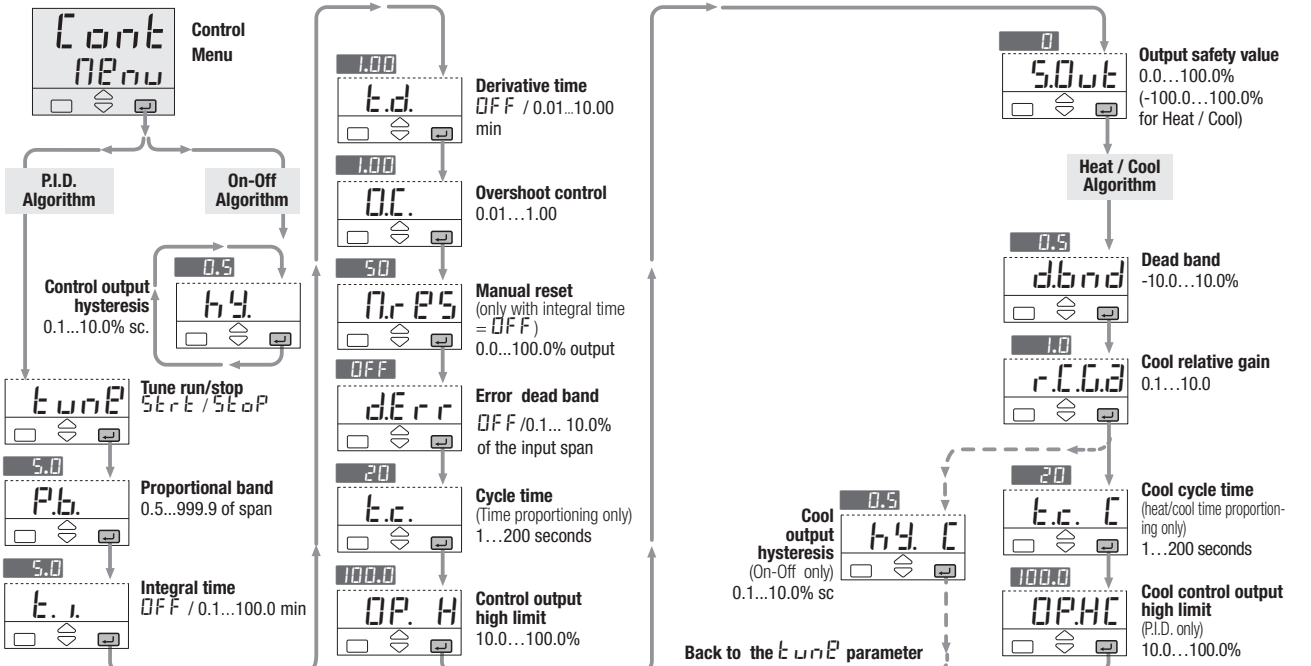
4.3.1 PARAMETERISATION - SETPOINT MENU



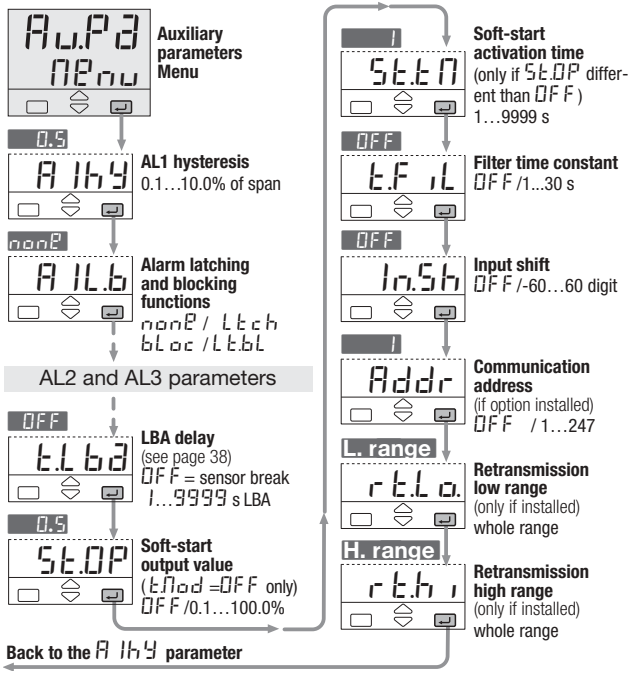
Note

[1] It is not presented if the controller has been configured with alarm no. 2 not active or of sensor break type. Digit O/P of the configuration code is assigned to 0 or 1.

4.3.2 PARAMETERISATION - CONTROL MENU

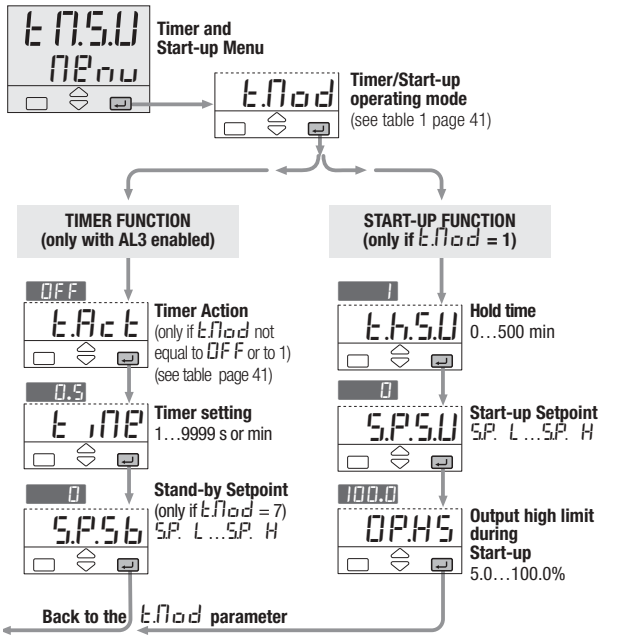


4.3.3 PARAMETERISATION - AUXILIARY PARAMETERS MENU



4.3.4 PARAMETERISATION - TIMER AND START-UP MENU

If options installed



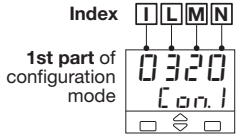
4.3.5 CONFIGURATION MENU

Enter the password before accessing to the configuration menu.

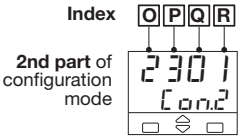
If a not configured controller is supplied, when powered up for the first time, the display shows:

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

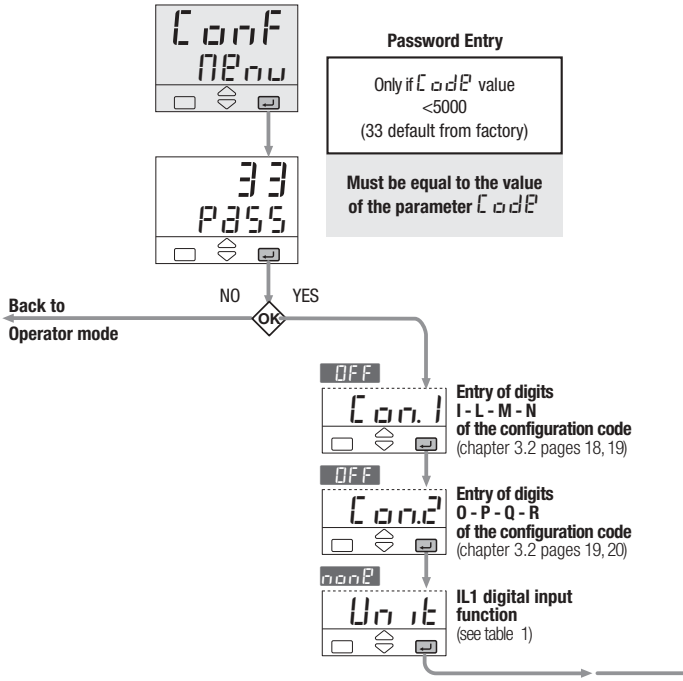
A 4+4 index code follows the model of the controller.
It has to be set to configure the controller.
(see chapter 3.1 page 17)



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



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



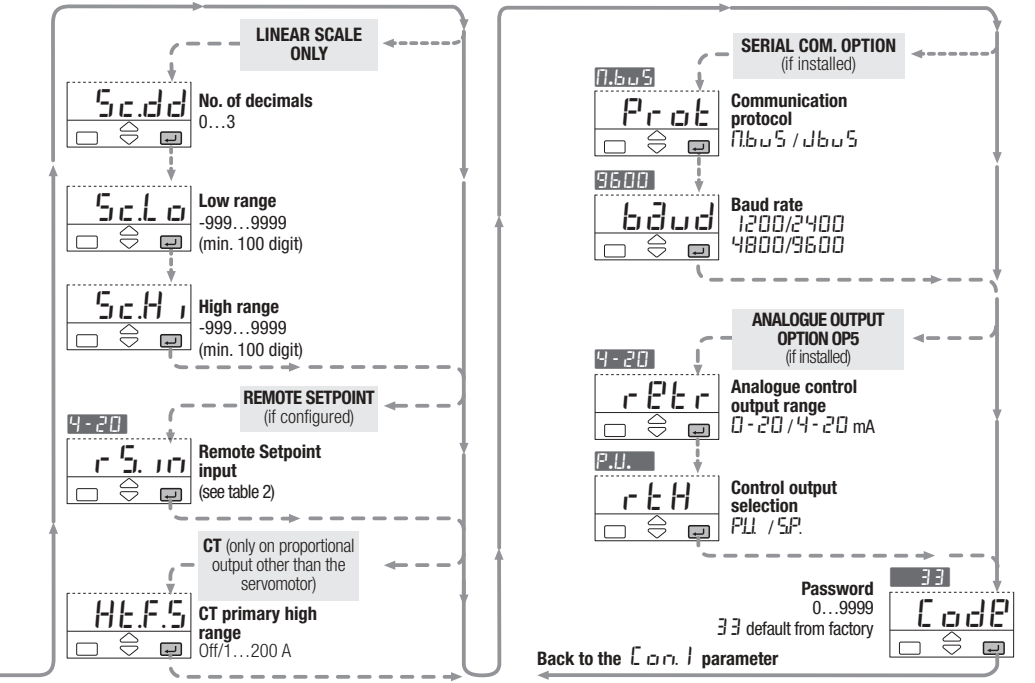


Table 1 Engineering units

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

Table 2 Remote Setpoint input type

rS.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

4.4 PARAMETERS

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

4.4.1 SETPOINT MENU

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

It is possible to configure up to 4 alarms: AL1, AL2, AL3, AL4 (see page 19 and 20), selecting, for each of them:

A the type and the operating condition of the alarm

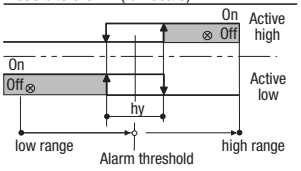
B the functionality of the alarm acknowledge (latching) [LtcH] (see page 37)

C the start-up disabling (blocking) [bLoc] (see page 37)

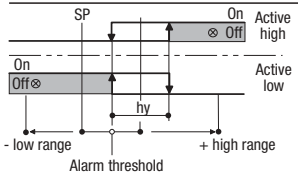
D Loop break or sensor break (see page 38)

A ALARM TYPE AND OPERATION CONDITIONS

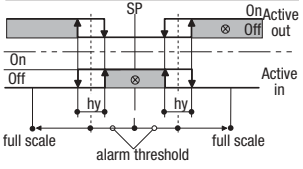
Absolute alarm (full scale)



Deviation alarm



Band alarm



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

[A 2S.P] **AL2 alarm threshold**

[A 3S.P] **AL3 alarm threshold**

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

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

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

Setpoint ramp up

Setpoint ramp down

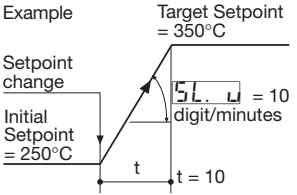
This parameter specifies the max.imum rate of change of the Setpoint in digit/min.

When the parameter is OFF, this function is disabled and the new Setpoint is reached immediately after being entered.

Otherwise, the Setpoint value is reached according to the configured rate of change.

The new Setpoint value is called "Target Setpoint". It can be displayed by means the parameter t.S.P.
(see procedure at page 47).

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



Setpoint low limit

Setpoint high limit

Low / high limit of the Setpoint value.

1st stored Setpoint

2nd stored Setpoint

Preset Set values can be set from the keyboard and serial communication. The Setpoint active is indicated by the **S1** or **S2** green led.

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

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

See stored Setpoint selection procedure at page 50

4.4.1 SETPOINT MENU

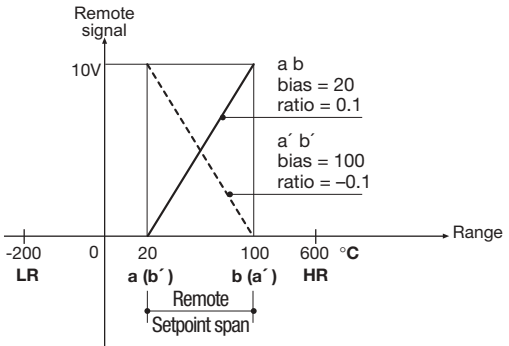
rt io **Remote Setpoint Ratio**

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

b ıAS **Remote Setpoint**

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

Remote Setpoint Bias and Ratio



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

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

b ıAS = starting point = a

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

Example:
b ıAS = 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

bIAS = starting point = a´

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

Example:
bIAS = 100
rtio =

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

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

Setpoint type Loct
(configuration index **R** = 4)
SP = SL + (rtio • REM)
+ bIAS

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

SIGN = Remote signal percentage
SPAN = HR-LR

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

Examples:
Local Setpoint (SL) with an external Trim with multiplying coefficient of 1/10:
Setpoint type = Loct
rtio = 0.1
bIAS = 0

Remote Setpoint (SR) with an internal Trim with multiplying coefficient of 1/5:
Setpoint type = rEMt
rtio = 0.2
bIAS = 0

Remote Setpoint range equal to the Input range:
Setpoint type = Loct
rtio = 1
bIAS = LR
SL = 0

4.4.2 CONTROL MENU

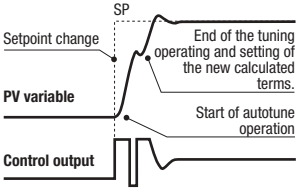
tunE **Run Tune**

4.4.2.1 AUTOMATIC TUNE

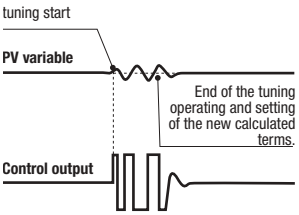
The Fuzzy-Tuning determines automatically the best P.I.D. term with respect to the process behaviour.

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

STEP response



Natural frequency



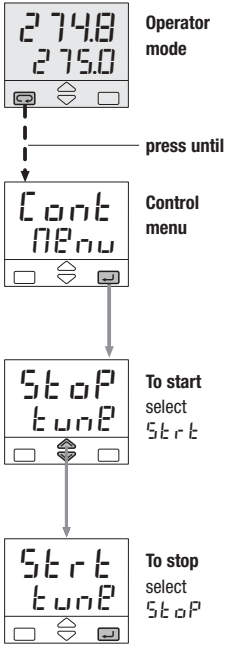
This type is selected when the PV is close to the SP Setpoint.
This method has the advantage of a better accuracy in the term calculation with a reasonable speed calculation.

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

FUZZY-TUNING START/STOP PROCEDURE

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

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



P.b. Proportional band

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

t. i. 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

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

O.C. Overshoot control

This parameter specifies the span of action of the overshoot control. Setting lower values (1.00 → 0.01) the overshoot generated by a Setpoint change is reduced. The overshoot control doesn't affect the effectiveness of the P.I.D. algorithm. Setting 1, the overshoot control is disabled.

n.r E5 Manual Reset

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

d.Err Error Dead Band

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

t.c. Control output cycle time

t.c. C Cool cycle time

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

OP. H Control output high limit

OPC.H Cool output high limit

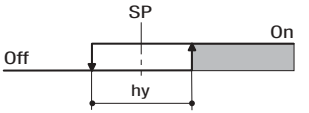
It specifies the maximum value the control output can be set. It is applied in manual mode, too.

S.Out Output Safety Value

Output Value in case of input anomaly

hy. Control output hysteresis

hy. C Cool output hysteresis



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

4.4.2 CONTROL MENU

4.4.2.2 HEAT/COOL CONTROL

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

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

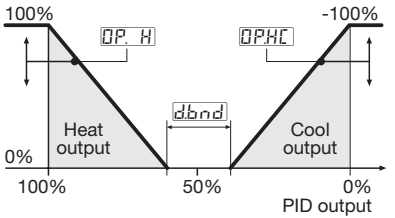
The Cool action can be adjusted using the relative cool gain parameter rCGa.

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

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

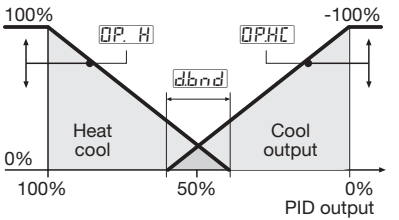
A Heat /Cool actions separated

Insert positive dbnd value (0…10%)



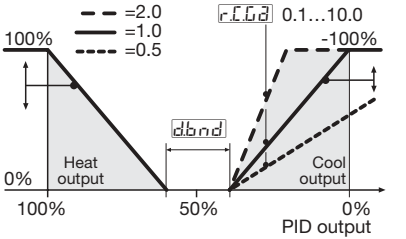
B Heat /Cool actions overlapped

Insert negative dbnd value (-10…0%)

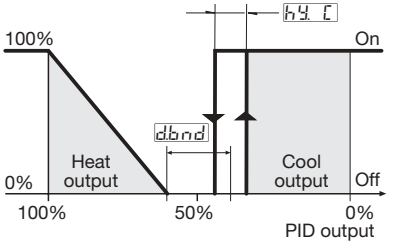


C Cool action adjusting

Example with different relative cool gains



D On-Off Cool action



4.4.3 AUXILIARY PARAMETERS MENU

AL1 alarm hysteresis

AL2 alarm hysteresis

AL3 alarm hysteresis

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

AL1, AL2, AL3 latching and blocking functions

For each alarm it is possible to select the following functions

- none
- latching
- blocking
- both latching and blocking

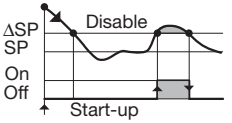
ALARM ACKNOWLEDGE FUNCTION

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

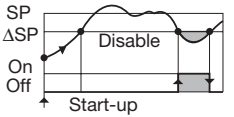
After this operation, the alarm leaves the alarm state only when the alarm condition is no longer present.

START-UP DISABLING

Ramp down



Ramp up



ΔSP Threshold = SP ± range

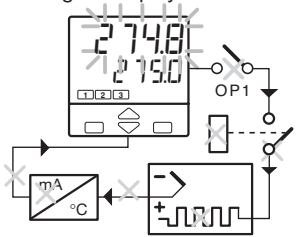
4.4.3 AUXILIARY PARAMETERS MENU

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

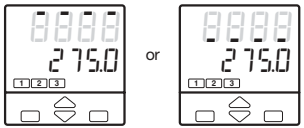
Select the code 1 on **O** , **P** or **Q** configuration indexes (see pages 21 or 22). The following parameter is then available:

t.Lbd **LBA delay**

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



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

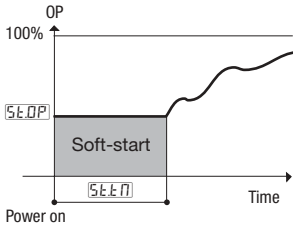


Note [1] In case of sensor break, condition, the alarm action is immediate.

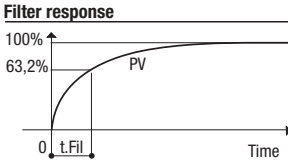
When the cause of the alarm disappears, the alarm status stops.

St.OP **Soft-start control output value**
Value of the control output during the Soft-start activation time.

St.tn **Soft-start activation time**
Time duration (starting from the power on) of the Soft-start function.



t.F iL **Input filter time constant**
Time constant, in seconds, of the RC input filter applied to the PV input.
When this parameter is set to OFF the filter is bypassed.



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

Addr **Controller address**

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

rtLo **Retransmission low range**

rtHi **Retransmission high range**

4.4.4 TIMER AND START-UP MENU (OPTION)

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

4.4.4.1 Start-up
4.4.4.2 Timer

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

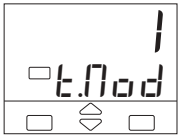
For example: X3 3100-**2**000
To select these functions use the parameter: (see page 41).

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

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

4.4.4.1 START-UP FUNCTION (OPTION)

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



To configure Start-up function the parameter "Timer/Start-up operating mode" must be set to **1**.
(see page 41)
Three parameters are associated to the Start-up function.

tHSU **Start-up hold time**
0…500 min

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

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

The Start-up function includes three phases:

1st "Limy" - The control output is limited to the **OPHS**

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

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

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

4.4.4.1 START-UP FUNCTION (OPTION)

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

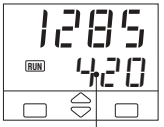
There are two possibilities:

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

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

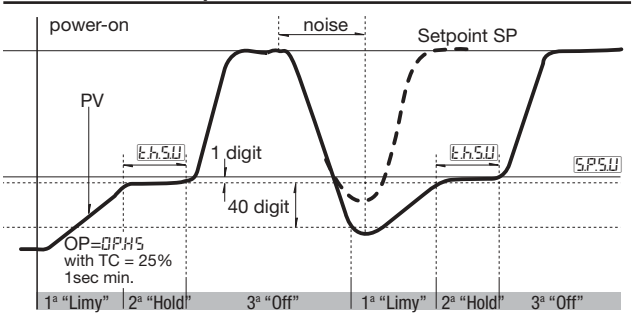
When the process variable PV achieves the local Setpoint (with a tolerance of 1 digit), the Start-up function passes directly to the "Off" phase.

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

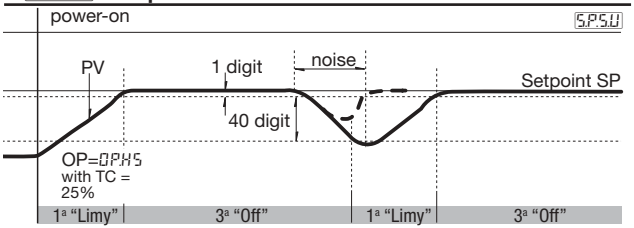


During the "Limy" and "Hold" phases the RUN led is on.

A SP.SU < local Setpoint SP



B SP.SU ≥ Setpoint locale SP



4.4.4.2 TIMER FUNCTION (OPTION)

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

To enable this function do the following:

1 In order to use this AL3 function, index [Q] must be set to [0] in configuration (see p. 20).

2 To select one of the 6 possible functioning modes of the Timer, set the value of the 2 following parameters in parameterisation (see p. 27).

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

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

table 1

Timer/Start-up counting mode		Value
Disabled		OFF
Start-up function		1
Counting start time	End mode	
When inside the band	Control mode	2
	Output to 0	3
When launched	Control mode	4
	Output to 0	5
When launched. Control disabled	Control mod	6
When launched stand-by Setpoint	Control mod	7

Now the other parameter values can be entered:

t.Act **Timer Action**

By this parameter can be defined:(see table 2)
- the time units
- the starting mode
- the OP3 status when the timer is running.

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

table 2

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

[1] If used by Timer

[2] Using this selection, manual starting mode is possible too.

t.tME **Timer setting**

(1…9999 s/min)

SP.SB **Stand-by Setpoint**

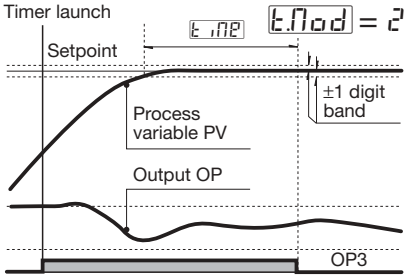
(only for t.Mod = 7)
(SP. L …SP. H)

4.4.4.2 TIMER FUNCTION (OPTION)

TIMER COUNTING MODES

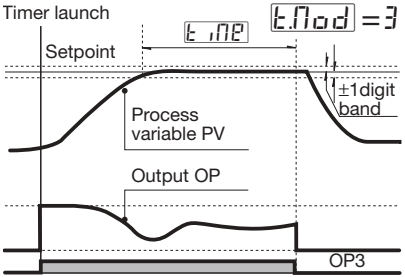
A - Counting start time inside the band, end in control mode.

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



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

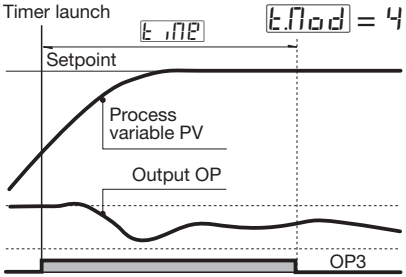
The time counting starts only when the error is inside a ± 1 digit band. At the end, the control output is forced to zero. [1]



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

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

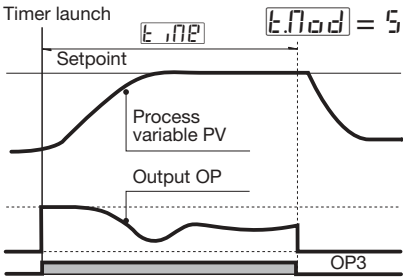
The time counting starts when the timer is launched. The control action is not affected by the Timer function.



TIMER COUNTING MODES

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

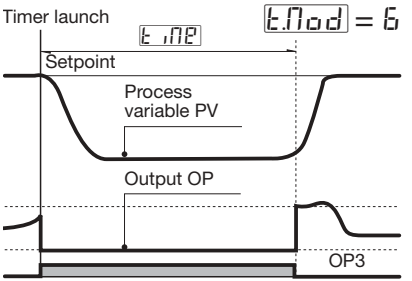
The time counting starts when the timer is launched. At the end, the control output is forced to zero **[1]**.



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

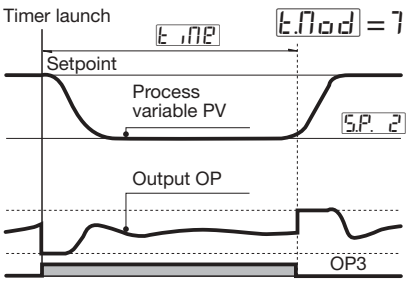
E - No control action during the counting time.

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



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

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



4.4.4.2 TIMER FUNCTION (OPTION)

POWER FAILURE

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

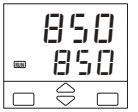
Depending on Timer action [t.dct] selection, when the controller restarts you can have two different situations:

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

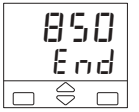
TIMER STARTING

See the Timer starting procedure at page 49.

DISPLAY



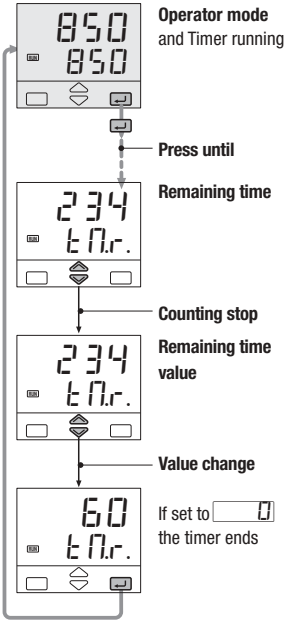
When the Timer is running, the led [RUN] is on.



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

TIMER REMAINING TIME

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



4.4.5 CONFIGURATION MENU

RETRANSMISSION

When OP5 output is present, it retransmits linearised PV or SP. On configuration (see page 29) it is possible to set

rPtr **Output range**
0-20 / 4-20

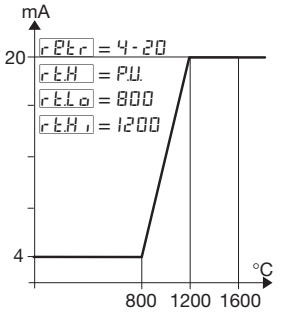
rtH **Retransmitted signal**
nonE P.U. / S.P.

The following parameters define the low and high range of the OP5 retransmission output corresponding to 0…4mA or 20mA (see page 27):

rt.Lo **Retransmission low range**

rt.H1 **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 rt.Lo greater than rt.h1 it is possible to obtain a reverse scale.

CURRENT TRANSFORMER INPUT

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

The setting can be done by means the 8 or 9 configuration index of the codes O, P or Q (see pages 19 and 20).
It is possible to set one of the alarms (see pages 19 and 20) to have an alarm when, during the ON time of the time proportional output, the load current is less then the specified threshold (index 8), or during the OFF time there is a value > 3% of full scale load current.

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

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

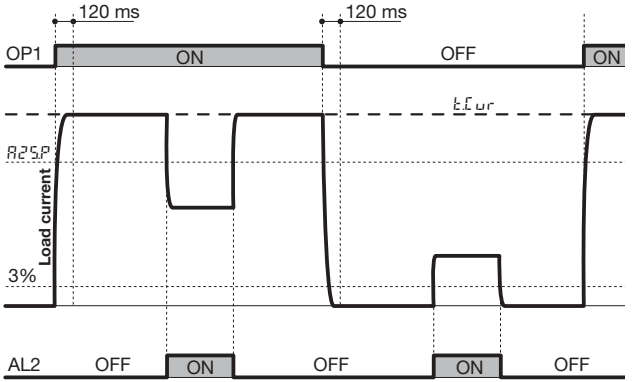
the load current display can be adapted to the transformer characteristics. (OFF means disabled)

During the OFF time the parameter **t.Cur** latches the last on time current value

4.4.5 CONFIGURATION MENU

CURRENT TRANSFORMER INPUT

Example:
CT input on OP1, alarm on AL2 during on time (configuration digit **P** = 8, , see page 19)



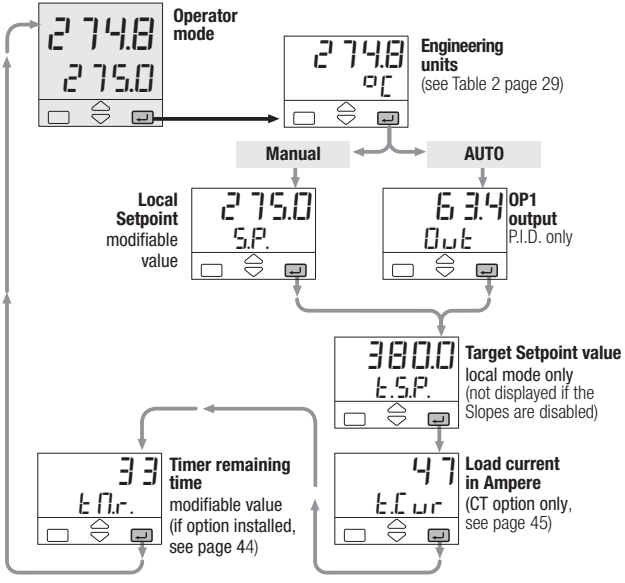
SERIAL COMMUNICATIONS

Communication protocol
Modbus/Jbus

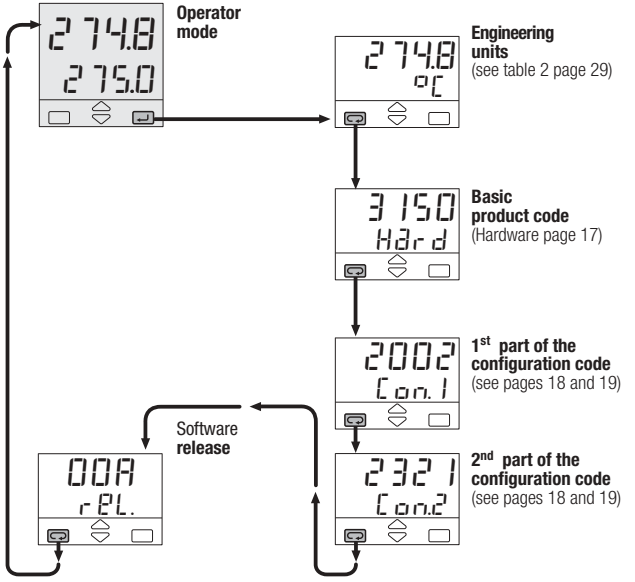
Baud rate
1200/2400
4800/9600

5 DISPLAYS

5.1 OF THE PROCESS VARIABLES



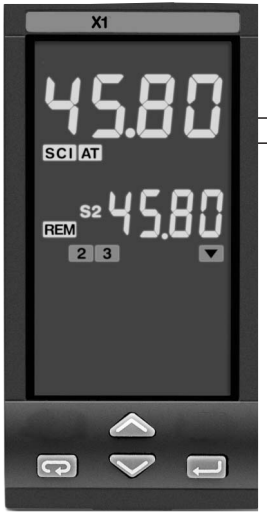
5.2 OF THE CONFIGURATION CODES



6 COMMANDS

COMMANDS TO THE CONTROLLER AND OPERATING PHASES

The commands can be entered in 2 ways:



6.1 KEYPAD

see page 49

- Setpoint modification
- Timer start
- Local/remote selection
- Stored Setpoint display
- Keypad lock
- Outputs lock

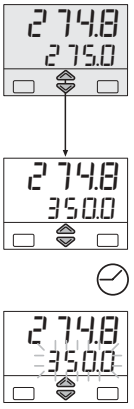
6.2 SERIAL COMMUNICATIONS

see the manual on this topic

6.1 KEYPAD COMMANDS

6.1.1 SETPOINT MODIFICATION

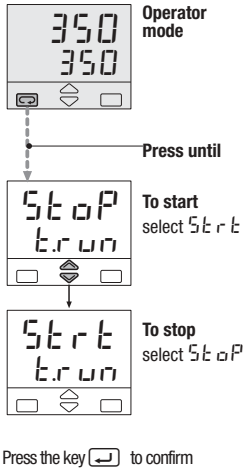
The Setpoint is directly modified with the ∧ ∨ keys.
Once entered, the new value is checked and becomes operating after 2 seconds.. The end of this phase is flagged by flashing momentarily the display with SP.



6.1.2 TIMER STARTING (option)

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

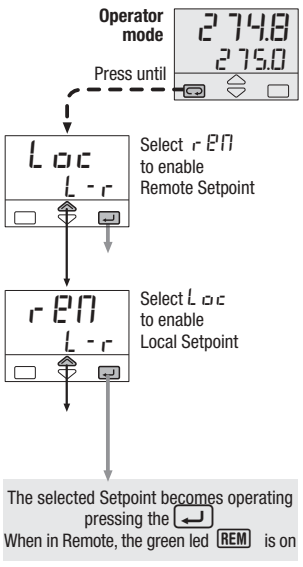
To start/stop the Timer:



6.1 KEYPAD COMMANDS

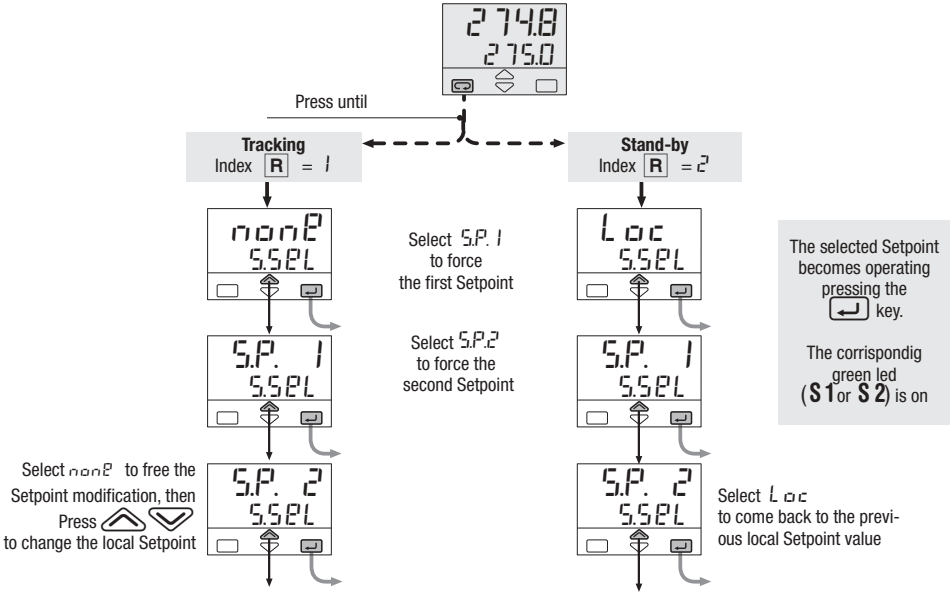
6.1.3 LOC/ REM SELECTION

configuration index R = 4 or 5)



6.1.4 STORED SETPOINTS SELECTION

(configuration index R = 1 or 2)



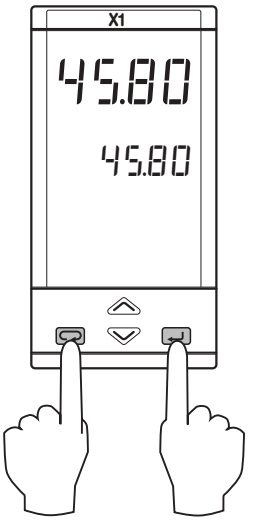
6.1.5 KEYPAD LOCK

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

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

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

operator mode



Press simultaneously
for 2 seconds

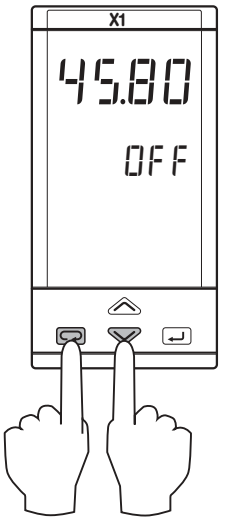
6.1.6 OUTPUTS LOCK

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

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

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

operator mode



Press simultaneously
for 2 seconds

7 TECHNICAL SPECIFICATIONS

Features (at 25°C environmental temp.)	**Description**			
Total configurability (see chapter 3.2 page 18 chapter 4.3.5 page 28)	From keypad or serial communication the user selects: - the type of input - the type of control algorithm - the type of output - the type and functionality of the alarms - the type of Setpoint - control parameter values			
PV Input (see pages 11,12 and page 18)	Common characteristics	A/D converter with resolution of 50000 points Update measurement time: 0.2 seconds Sampling time: 0.5 seconds Input bias: - 60…+ 60 digit Input filter with enable/disable: 1…30 seconds		
	Accuracy	0.25% ±1 digits for temperature sensors 0.1% ±1 digits (for mV and mA)		Between 100…240Vac the error is minimal
	Resistance thermometer (for ΔT: R1+R2 must be <320Ω)	Pt100Ω at 0°C (IEC 751) °C/°F selectable	2 or 3 wires connection Burnout (with any combination)	Max. wire Res: 20Ω max. (3 wires) Input drift: 0.35°C/10° Env. Temp. <0.35°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 Input drift: <2μV/°C Env. Temp. <5μV/10Ω Wire Res.
	DC input (current)	4…20mA,0...20mA with external shunt 2.5Ω Rj >10MΩ	Burnout. Engineering units Conf. decimal point position Init. Scale -999…9999 Full Scale -999…9999 (min. range of 100 digits)	Input drift: <0.1%/20°C Env. Temp.
	DC input (voltage)	10…50mV, 0...50mV Rj >10MΩ		

Features (at 25°C environmental temp.)	**Description**		
Auxiliary inputs	**Remote Setpoint** (option) Not isolated accuracy 0.1%	Current 0/4…20mA Rj = 30Ω Voltage 1...5/0...5/0...10V Rj = 300kΩ	Bias in engineering units and ±range Ratio from -9.99…+99.99 Local + Remote Setpoint
	CT current transformer (see pages12 and 45)	50 or 100 mA input hardware selectable	Current visualisation 1...200A With 1A resolution and Heater Break Alarm

			Control output		**AL1 alarm**	**AL2 alarm**	**AL3 alarm**	**Retransmiss.**
Operating mode and Outputs	1 single or double action P.I.D. loop or On/Off with 1, 2 or 3 alarms	Single action	**OP1**-Relay/Triac			**OP2**-Relay/Triac	**OP3**-Relay	**OP5**-Analogue
			OP4- SSR drive-Relay		**OP1**-Relay/Triac	**OP2**-Relay/Triac	**OP3**-Relay	**OP5**-Analogue
		Double action Heat / Cool	**OP1**-Relay/Triac	**OP2**-Relay/Triac			**OP3**-Relay	**OP5**-Analogue
			OP1-Relay/Triac	**OP4**- SSR drive-Relay		**OP2**-Relay/Triac	**OP3**-Relay	**OP5**-Analogue
			OP4- SSR drive-Relay	**OP2**-Relay/Triac	**OP1**-Relay/Triac		**OP3**-Relay	**OP5**-Analogue

Features (at 25°C environmental temp.)	**Description**			
Control mode	Algorithm	- P.I.D. with overshoot control or ON-OFF - P.I.D. with valve drive algorithm, for motorised actuators control		
	Proportional band (P)	0.5…999.9%		Single action P.I.D. algorithm
	Integral time (I)	0.1…100.0 min	OFF = 0	
	Derivative time (D)	0.01…10.00 min		
	Error dead band	0.1…10.0 digit		
	Overshoot control	0.01…1.00		
	Manual reset	0.0…100.0%		
	Cycle time (Time proportional only)	1…200 s		
	Control output high limit	10.0…100.0%		
	Soft-start output value	0.1…100.0%	OFF = 0	
	Output safety value	0.0…100.0% (-100.0…100.0% for Heat / Cool)		
	Control output hysteresis	0.1…10.0%		On-Off algorithm
	Dead band	-10.0…10.0%		Double action P.I.D. algorithm (Heat / Cool) with overlap
	Relative cool gain	0.1…10.0		
	Cycle time (Time proportional only)	1…200 s		
	Control output high limit	10.0…100.0%		
	Cool output hysteresis	0.1…10.0%		

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

Features (at 25°C environmental temp.)	**Description**		
Special functions (option)	**Timer** (see page 41)	Automatic start at the power on, manual start by keypad, Digital inputs or serial comm.s	
		Setting time:	1…9999 s/min
		Stand-by Setpoint:	from Setpoint low limit to Setpoint high limit
	Start-up (see page 39)	Start-up Setpoint:	from Setpoint low limit to Setpoint high limit
		Hold time:	0…500min
		Control output high limit:	5.0…100.0%
Fuzzy-Tuning one shoot	The controller selects automatically the best method according to the process conditions	Step response	
		Natural frequency	
Serial comm. (option)	RS485 isolated, Modbus/Jbus protocol, 1200, 2400, 4800, 9600 bit/s, 3 wires		
Auxiliary Supply	+24Vdc ±20% 30mA max. - for external transmitter supply		
Operational safety	Measure input	Detection of out of range, short circuit or sensor break with automatic activation of the safety strategies and alerts on display	
	Control output	Safety value: -100…+100%	
	Parameters	Parameter and configuration data are stored in a non volatile memory for an unlimited time	
General characteristics	Access protection	Password to access the configuration and parameters data, keypad lock, outputs lock	
	Power supply (fuse protected)	100/240Vac (-15...+10%) 50/60Hz or 24Vac (-15...+25%) 50/60Hz and 24Vdc (-15...+25%)	Power consumption 4W 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 (IEC529): IP65 front panel	
	Dimensions	$^1/_8$ DIN - 48 x 96, depth 110 mm, weight 250 g approx.	

WARRANTY

We warrant that the products will be free from defects in material and workmanship for 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
	SSR Drive