Temperature Controller
$^1/_{16}$ DIN - 48 x 48

Platinum™
SERIES

M400 line

CE

C **UL** US
LISTED

ATHENA
The Temperature Control Company

ATHENA CONTROLS, INC.

5145 Campus Drive
Plymouth Meeting
PA 19462 U.S.A.
Tel: (610) 828-2490
Fax: (610) 828-7084
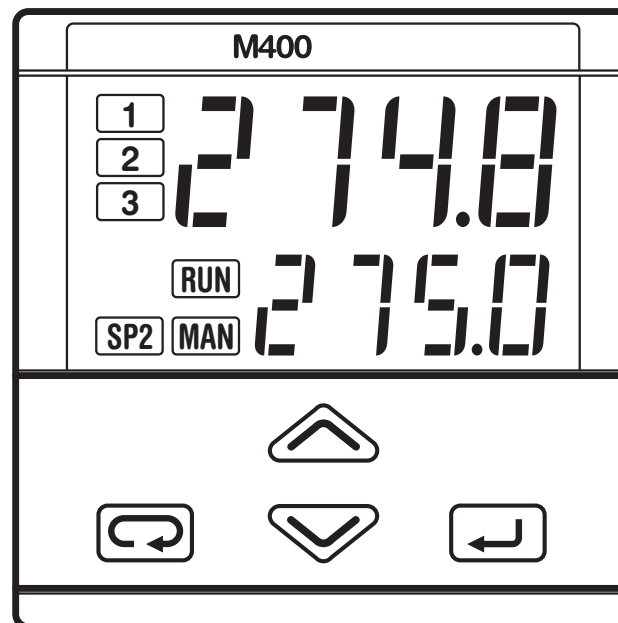**AthenaControls.com**

Temperature Controller
$^1/_{16}$ DIN - 48 x 48

M400 line

$\mathsf{C}\,\mathsf{E}$

C (UL) US
LISTED

C E

NOTES

**ON ELECTRIC
SAFETY AND
ELECTROMAGNETIC
COMPATIBILITY.**

Please, read carefully these instructions before proceeding with the installation of the controller.
Class II instrument, rear 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 CEE amended by the European Comunity directive 93/68 CEE and the Regulations on the essential protection requirements in electrical apparatus EN 61010-1 (IEC 1010 - 1) : 90 +A1:92 + A2:95.
Regulations on Electromagnetic Compatibility according to the European Community directive n089/336/CEE, amended by the European Community directive n° 92/31/CEE and the following regulations:
Regulations on RF emissions
EN50081 - 1   residential environments
EN50081 - 2   for industrial environments
Regulation on RF immunity
EN500082-2   for 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.
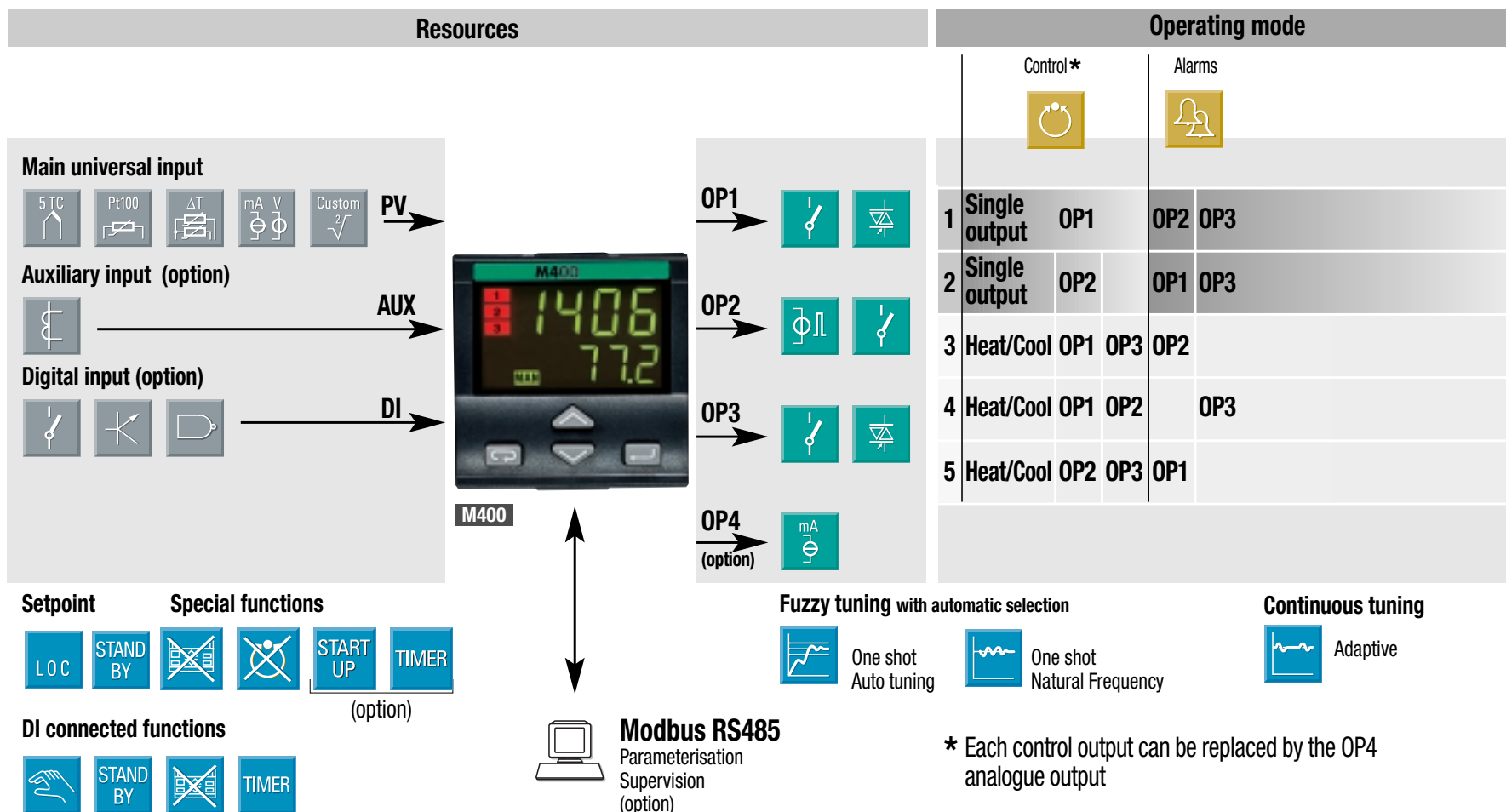
This device has no user serviceable parts and requires special equipment and specialised engineers. Therefore, a repair can be hardly carried on directly by the user. For this purpose, the manufacturer provides technical assistance and the repair service for its Customers. Please, contact your nearest 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

Resources

Operating mode

Control ✱   Alarms

Main universal input

5 TC | Pt100 | ΔT | mA V | Custom ²√   PV →

Auxiliary input (option)

AUX →

Digital input (option)

DI →

M400

OP1 →

OP2 →

OP3 →

OP4 (option) → mA

		Control ✱		Alarms	
1	Single output	OP1		OP2	OP3
2	Single output	OP2		OP1	OP3
3	Heat/Cool	OP1	OP3	OP2	
4	Heat/Cool	OP1	OP2		OP3
5	Heat/Cool	OP2	OP3	OP1	

Setpoint   **Special functions**

LOC | STAND BY | ✕ | ✕ | START UP | TIMER

(option)

DI connected functions

STAND BY | ✕ | TIMER

Modbus RS485
Parameterisation
Supervision
(option)

Fuzzy tuning with automatic selection

One shot Auto tuning   One shot Natural Frequency

Continuous tuning

Adaptive

✱ Each control output can be replaced by the OP4 analogue output

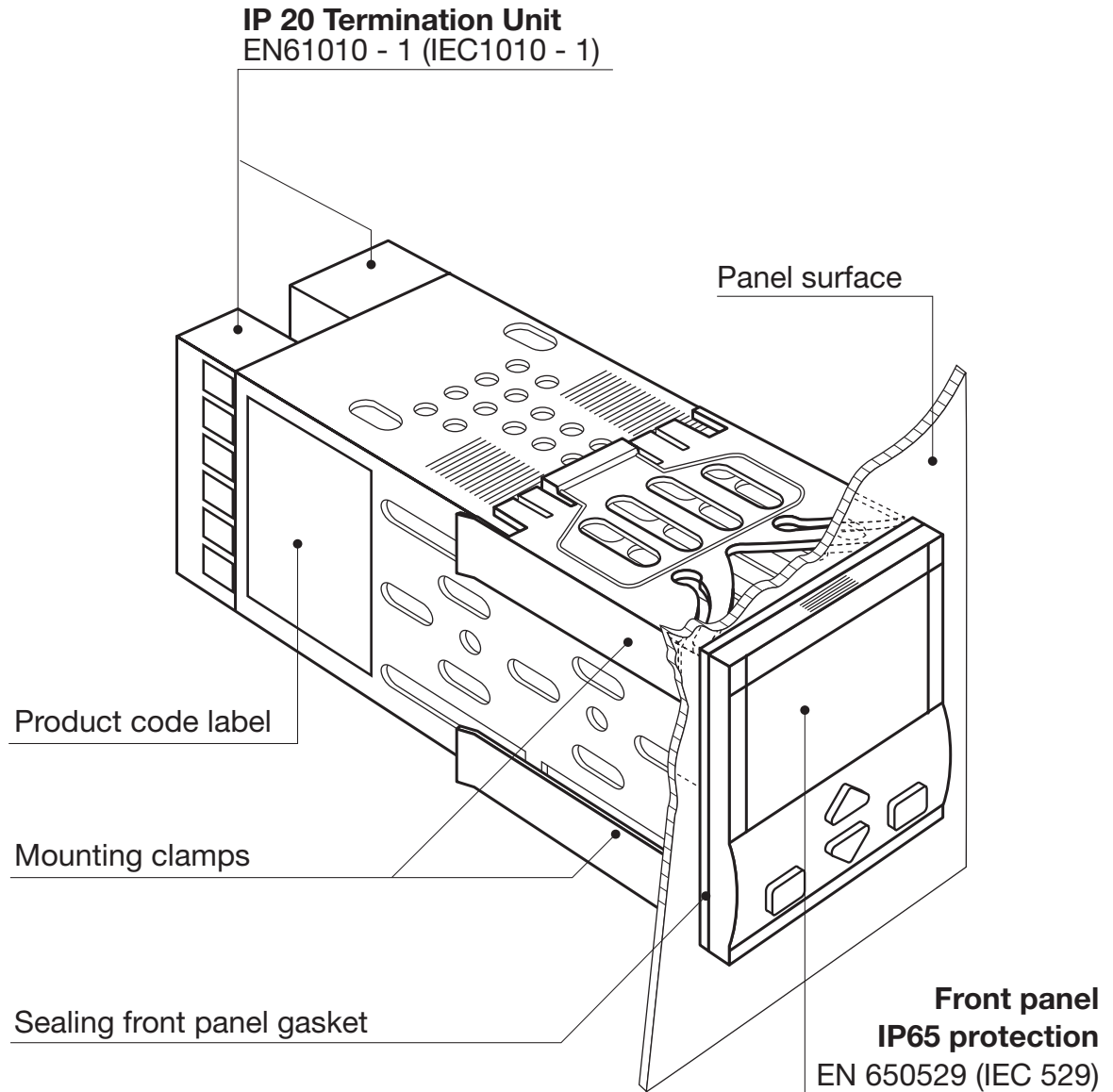3

1 ■ INSTALLATION

1.1 GENERAL DESCRIPTION

Installation must only be carried out by qualified personnel.

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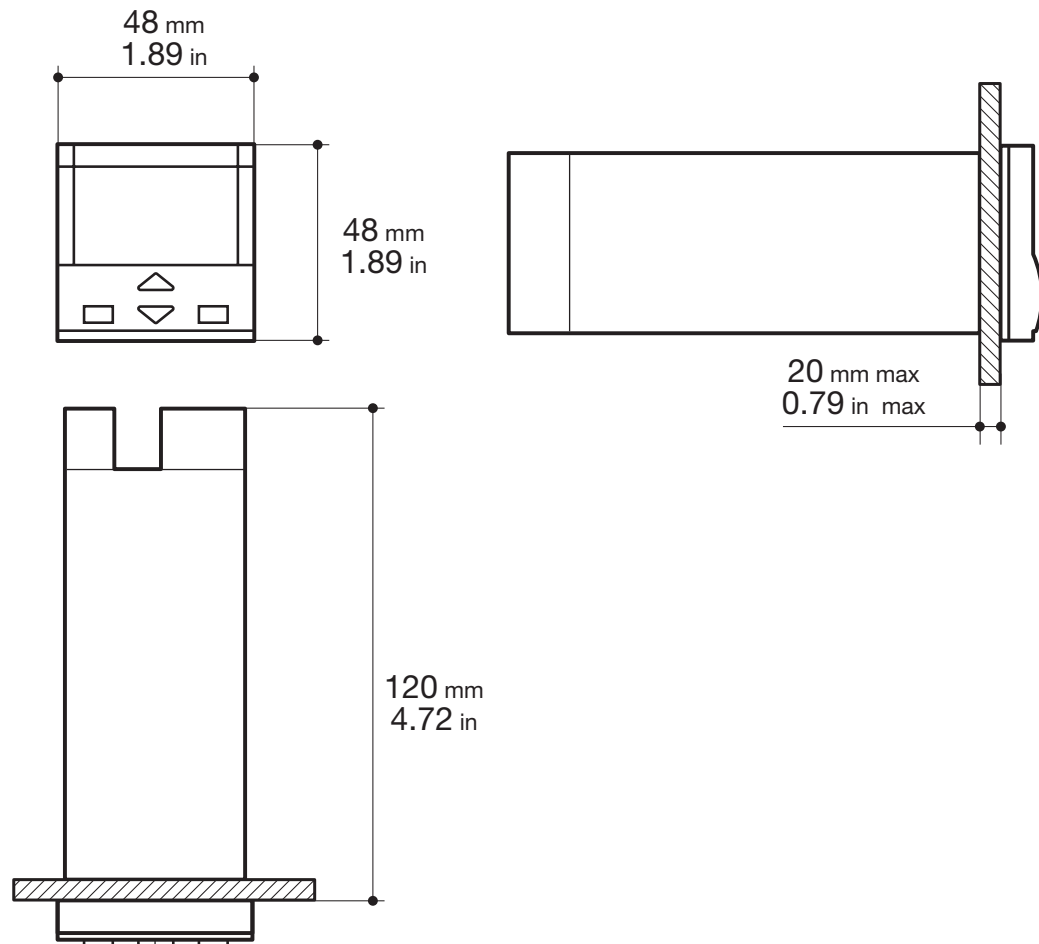
⚠CE

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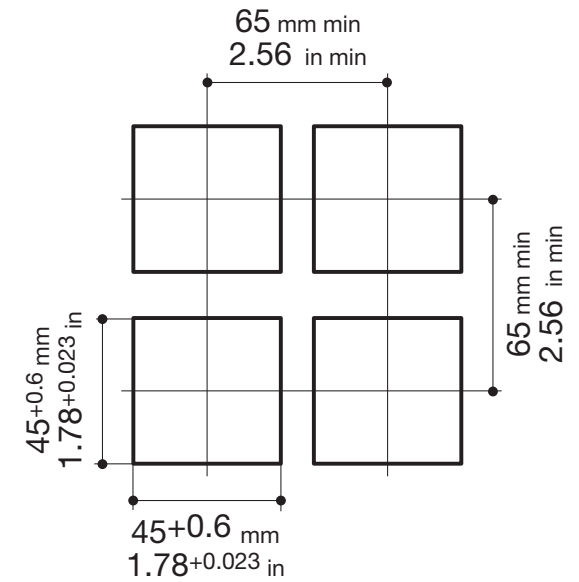

IP 20 Termination Unit
EN61010 - 1 (IEC1010 - 1)

Panel surface

Product code label

Mounting clamps

Sealing front panel gasket

**Front panel
IP65 protection**
EN 650529 (IEC 529)

1.2 DIMENSIONAL DETAILS

48 mm
1.89 in

48 mm
1.89 in

20 mm max
0.79 in max

120 mm
4.72 in

1.3 PANEL CUT-OUT

65 mm min
2.56 in min

65 mm min
2.56 in min

45+0.6 mm
1.78+0.023 in

45+0.6 mm
1.78+0.023 in

1.4 ENVIRONMENTAL RATINGS

Operating conditions

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

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

Forbidden Conditions

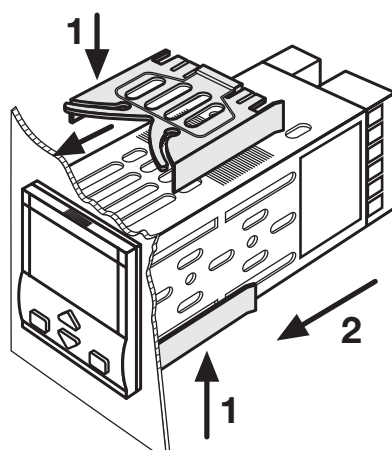|	
	Corrosive atmosphere
	Explosive atmosphere

1.5 PANEL MOUNTING

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
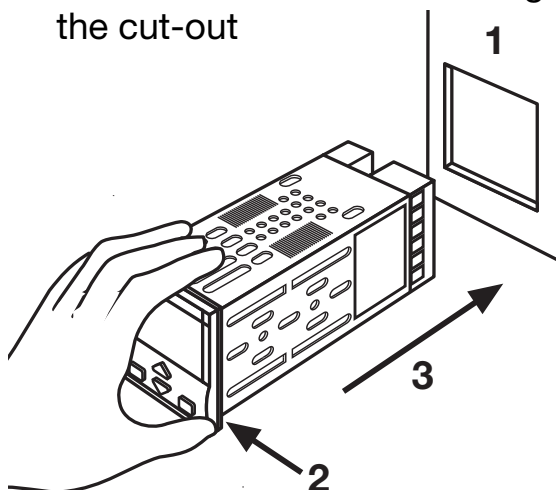
1.5.2 INSTALLATION SECURING

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

1.5.3 CLAMPS REMOVING

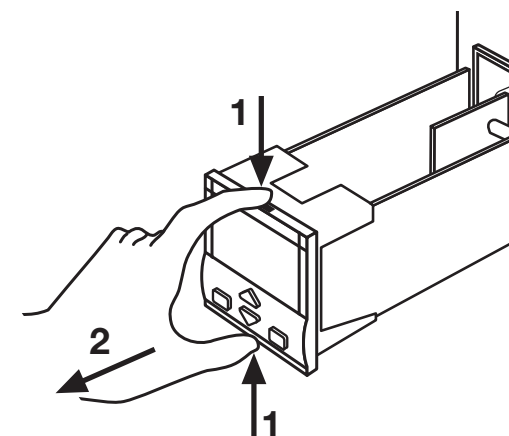1 Insert the screwdriver in the clips of the clamps
2 Rotate the screwdriver
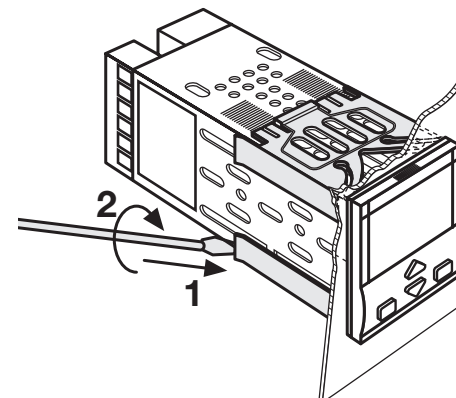
1.5.4 INSTRUMENT UNPLUGGING

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

1MΩ

2 ELECTRICAL CONNECTIONS

2.1 TERMINATION UNIT

⚠ CE

L — ≈
N —

OP1 [NO | C]

TC — / +

mA / mV

RTD

[1] [7] +
[2] [8] −
[3] [9] +
[4] [10] +
[5] [11] −
[6] [12] A

RS485 (OP4)
18V OUT
OP2-L
B
b

[13] NO
[14] C
[15] NO
[16] C
[17]
[18]

OP3
OP2-R
TA

[9] +
[11] −
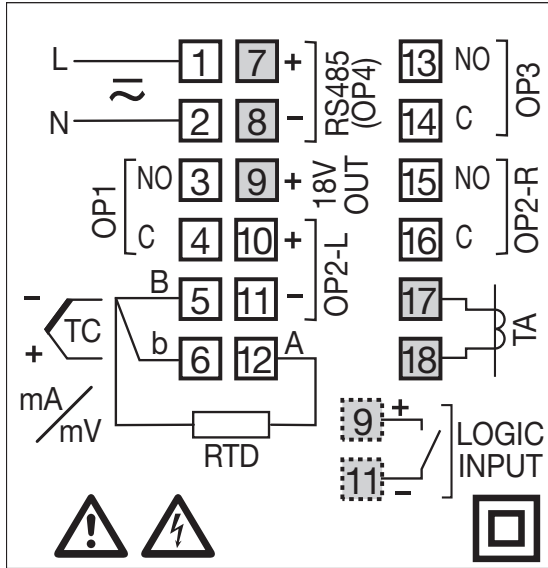
LOGIC INPUT
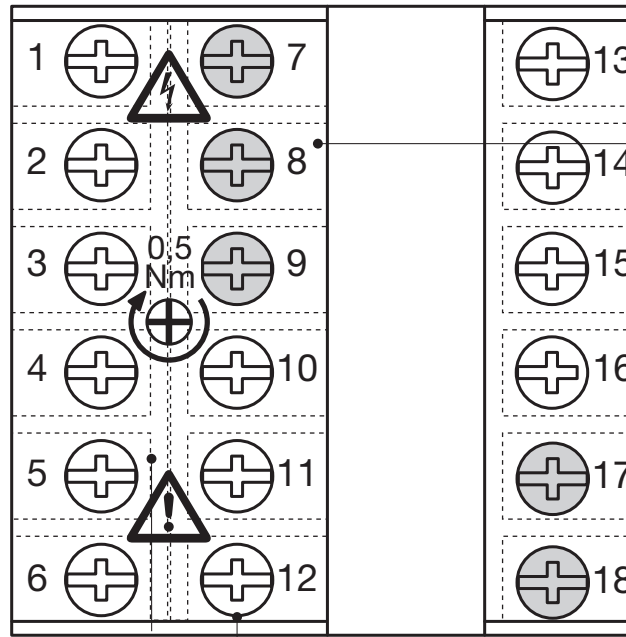
Rear terminal cover
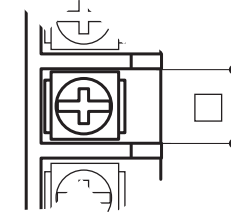
5.7 mm
0.22 in

Cable size
0,5…1,5 mm^2
(22 a 16 AWG)

18 screw terminals

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

PRECAUTIONS ⚠ CE

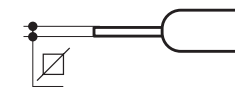Despite the fact that the instrument has been designed to work in an harsh and noisy environmental (level IV of the industrial standard IEC 801-4), it is recommended to follow the following suggestions.

⚠

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 PRECAUTIONS AND ADVISED CONDUCTOR COURSE ⚠ CE

Conduit for supply and output cables

A = Supply
B = Outputs
C = Analog inputs
D = Analogue
    Output
    Serial Comm.s
E = Digital
    input/output

Conduit for low level sensor cables
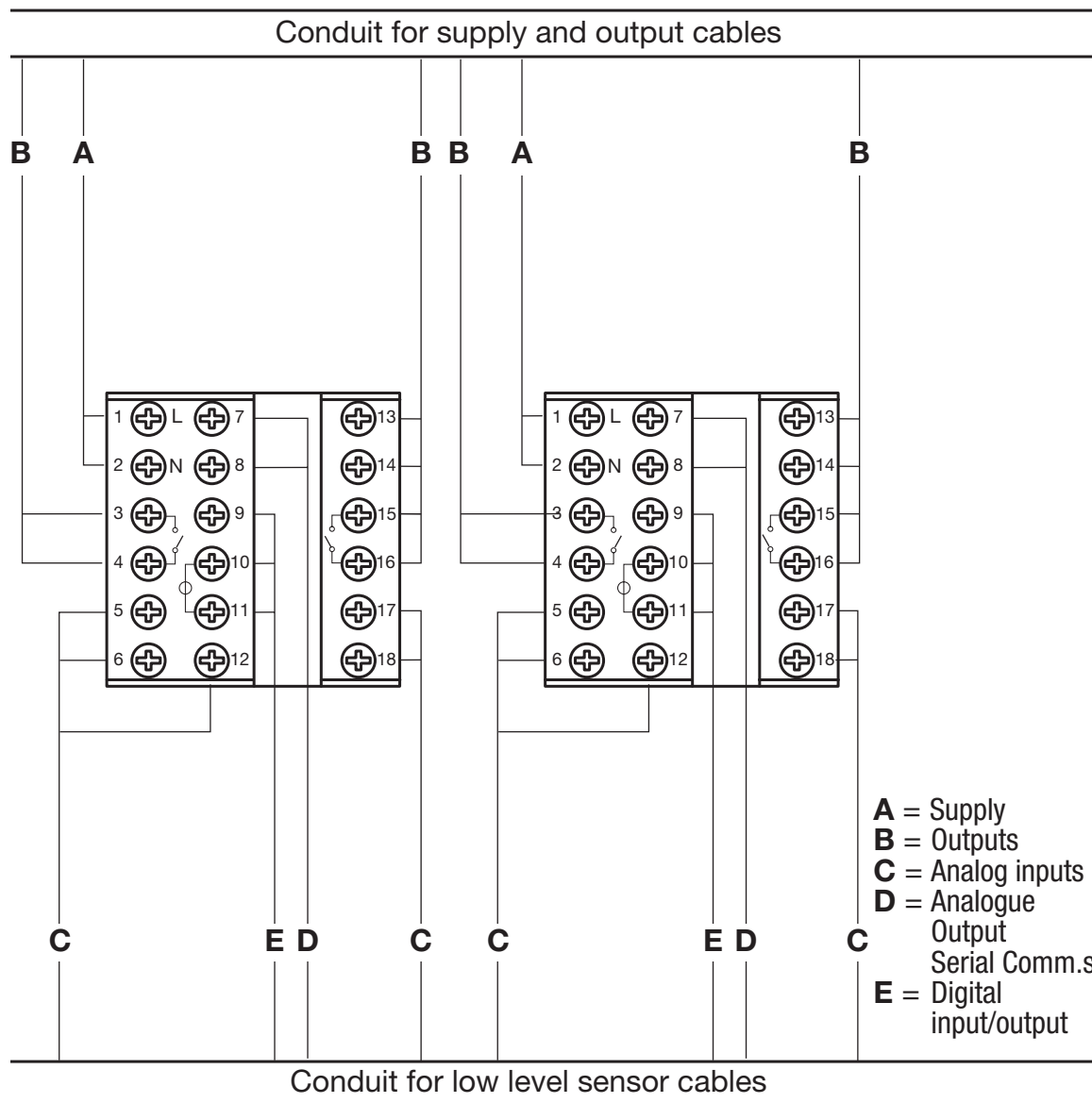
2.3 EXAMPLE OF WIRING DIAGRAM (HEAT COOL CONTROL)
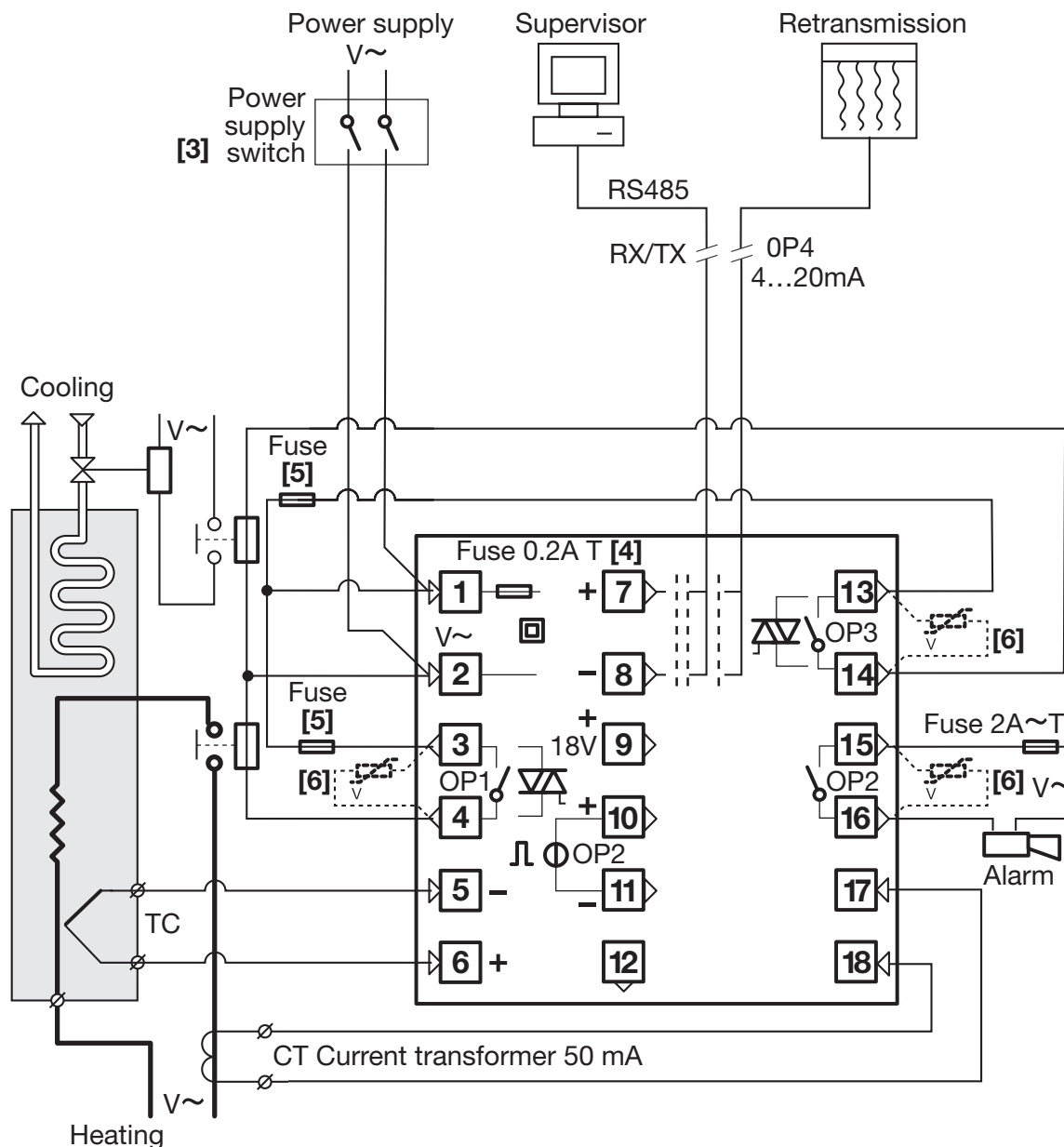
Notes:

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 protected with a 0.2 A~ T fuse. In case of failure it is suggested to return the instrument to the manufacturer for repair.

5] To protect the instrument internal circuits use:
   - 2 A~ T fuses for Relay outputs
   - 1 A~ T fuses for Triac outputs

6] Relay contacts are already protected with varistors.

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

2.3.1 POWER SUPPLY ⚠C€

Switching power supply with multiple isolation and internal fuse
- Standard version:
  nominal voltage:
  100 - 240V$\sim$ (- 15% + 10%)
  Frequency 50/60Hz
- Low Voltage version:
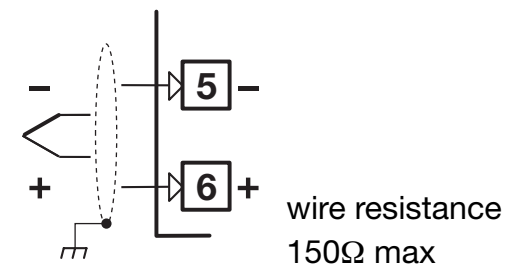 Nominal voltage:
  24V$\sim$ (- 25% + 12%)
  Frequency 50/60Hz
  or 24V– (- 15% + 25%)
- Power consumption 2.6W max
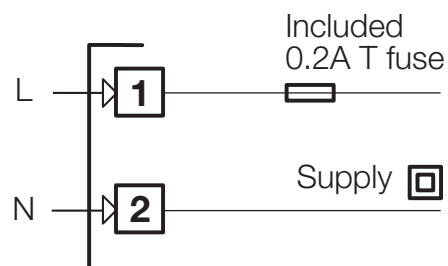
2.3.2 PV CONTROL INPUT ⚠C€

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

wire resistance 150Ω max

B For Pt100 resistance thermometer
- If a 3 wires system is used, use always cables of the same diameter (1mm² min.)   (line 20 Ω/lead maximum resistance)
- When using a 2 wires system, use always cables of the same diameter (1,5mm² min.) and put a jumper between terminals 5 and 6

For 3 wires only
20 Ω/lead maximum resistance
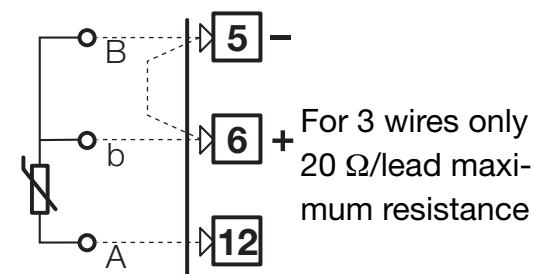
C For ΔT (2x RTD Pt100) Special
⚠ When the distance between the controller and the sensor is 15 mt. using a cable of 1.5 mm² diameter, produces an error on the measure of 1°C.

R1 + R2 must be <320Ω

Use wires of the same length and 1.5 mm² size. 20 Ω/lead maximum resistance.

2.3.2 PV CONTROL INPUT

⚠️CE

D   For mA, mV

mV   mA

5 –

6 +   Rj >10MΩ
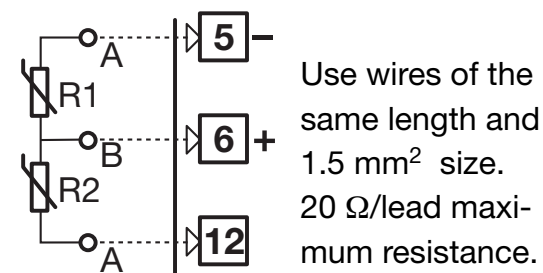
External
Shunt 2.5Ω

D1 With 2 wires transducer

4…20mA

9 18V– **[1]**

PV

Transducer

5 –

6 +

external shunt 2.5Ω
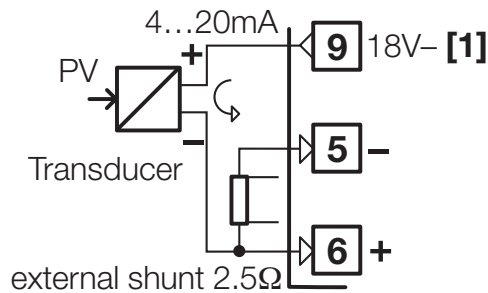
D2 With 3 wires transducer

9 18V– **[1]**

5 –

PV

Transducer

6 +

external shunt
2.5Ω
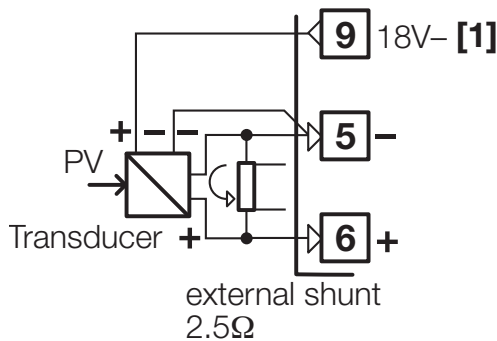
[1] Auxiliary power supply for external
transmitter 18V– ±20% /30mA max.
without short circuit protection

2.3.3 AUXILIARY INPUT
(option) ⚠️CE

For current transformer CT
Not isolated

For the measure of the load cur-
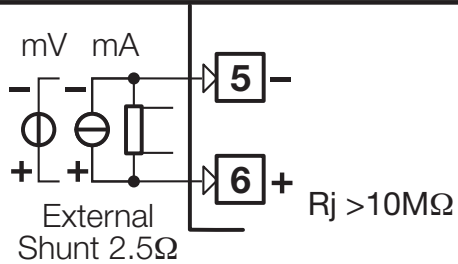rent (see page 34)

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

5 watt burden resistor
0.5Ω for 1A secondary
transformer coil
0.1Ω for 5A secondary
transformer coil

CT   load

17

18

~

50/100mA   10…100A

Jumper for
100 mA
secondary
transformer coil
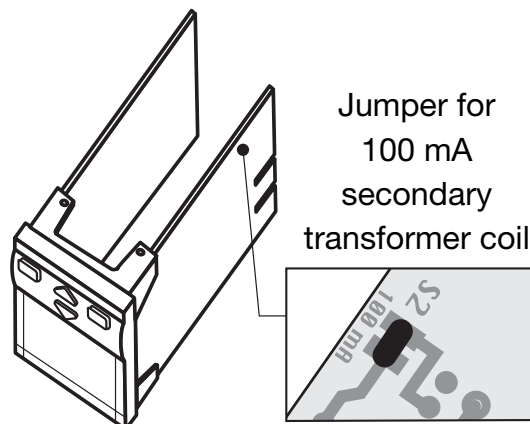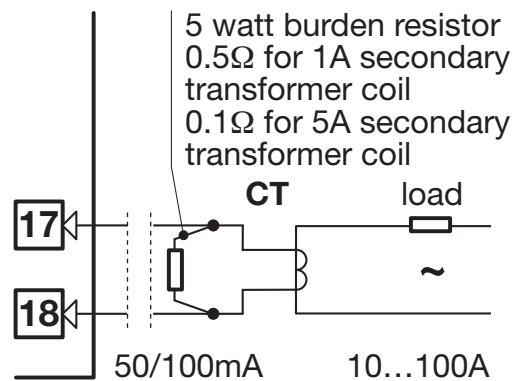
2.3.4 DIGITAL INPUT
(option) (page 37) ⚠️CE

- The input is active when the
  logic state is ON, correspond-
  ing to the contact closed

- The input is inactive when the
  logic state is OFF, correspond-
  ing to the contact open

NPN
open collector

DI 1   C1

+ 9

10

– 11

Com.   Isolated
contact

TTL
open
collector
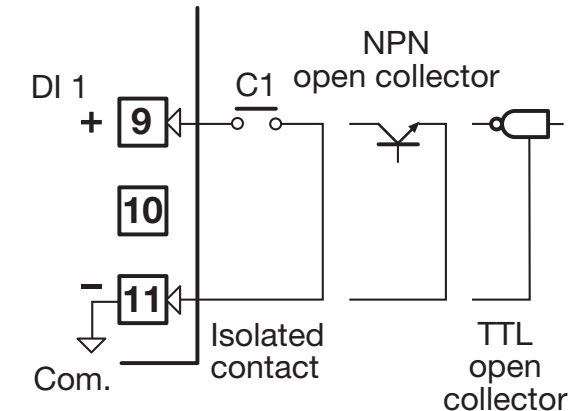
2.3.5 OP1 - OP2 - OP3 OUTPUTS

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

		Control outputs [1]		Alarms	
				AL2	AL3
A	Single output	OP1 Heat		OP2-R	OP3
B	Single output	OP2-L Heat		OP1	OP3
C	Heat/Cool	OP1 Heat	OP3 Cool	OP2-R [2]	
D	Heat/Cool	OP1 Heat	OP2-L Cool		OP3 [2]
E	Heat/Cool	OP2-L Heat	OP3 Cool	OP1 [2]	

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

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

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

Notes

**[1] Each control output can be replaced by the OP4 analogue output.
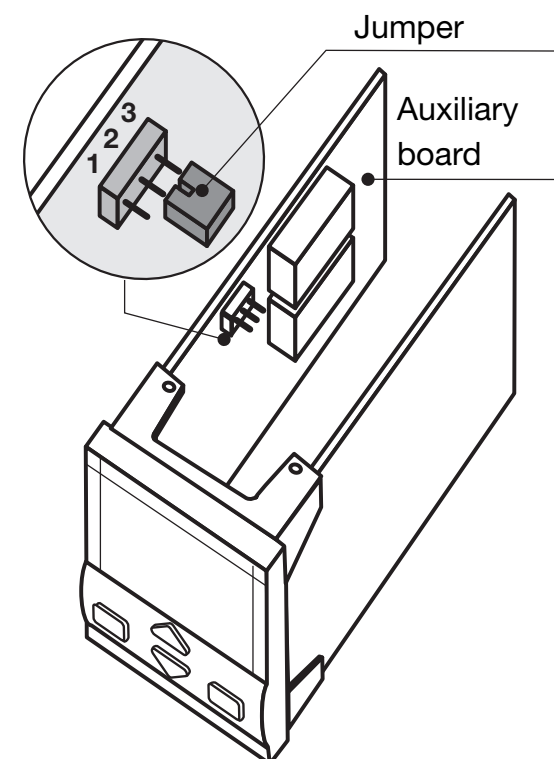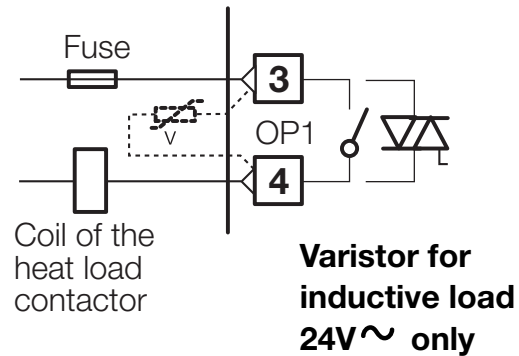The replaced output is not yet available.**

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

2.3.5-A SINGLE OUTPUT RELAY (TRIAC) CONTROL OUTPUT ⚠ CE

Fuse

3

OP1

4

Coil of the heat load contactor

Varistor for inductive load 24V∿ only

2.3.5-B SINGLE OUTPUT LOGIC CONTROL OUTPUT ⚠ CE

Static relay

Load

+ **10**

OP2

11

–
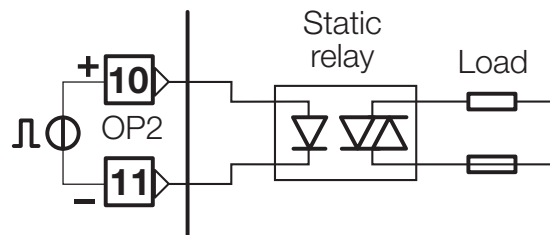
Relay output
• SPST Relay N.O., 2A/250 V∿ for resistive load, fuse 2A ∿ T

Triac output
• N.O. contact for resistive load of up to 1A/250 V∿ max, fuse 1A ∿ T

Logic output not isolated
• 0…5V–, ±20%, 30 mA max

2.3.5-C HEAT/COOL RELAY (TRIAC)/RELAY (TRIAC) CONTROL OUTPUT ⚠ CE

Fuse

3

OP1

4

Coil of the heat load contactor

13

OP3

14

Fuse

Coil of the cool load contactor

Varistor for inductive load 24V∿ only
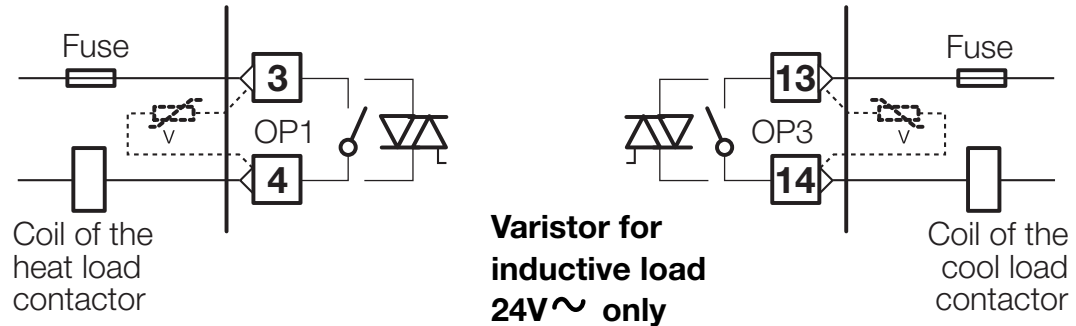
2.3.5-D HEAT/COOL RELAY (TRIAC)/LOGIC CONTROL OUTPUT ⚠ CE

Fuse

3

OP1

4

Coil of the heat load contactor

Varistor for inductive load 24V∿ only

Static relay

Cool load

+ **10**

OP2

11

–
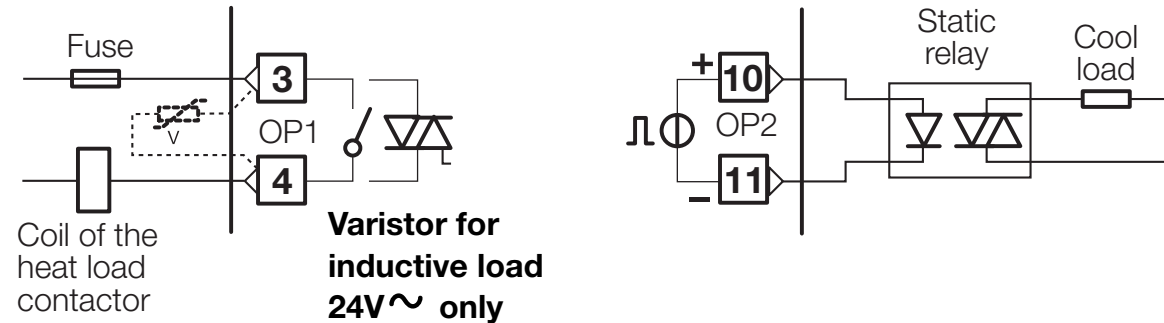
2.3.5-E HEAT/COOL LOGIC/RELAY (TRIAC) CONTROL OUTPUT ⚠ CE

Static relay

Heat load

+ **10**

OP2

11

–

13

OP3

14

Fuse

Varistor for inductive load 24V∿ only

Coil of the cool load contactor

14
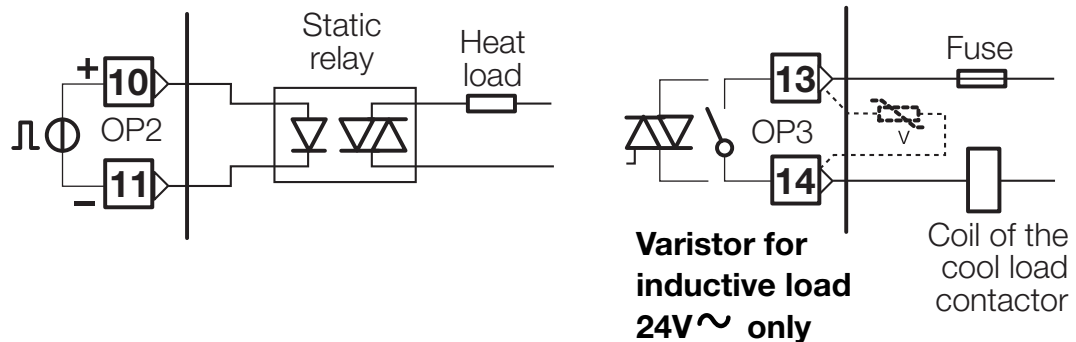
2.3.6 ALARMS OUTPUTS ⚠CE

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

Fuse

3

OP1

4

Coil of the
load alarm contactor

Fuse

15

OP2

16

Coil of the
load alarm contactor

Fuse

13

OP3

14

Coil of the
load alarm contactor
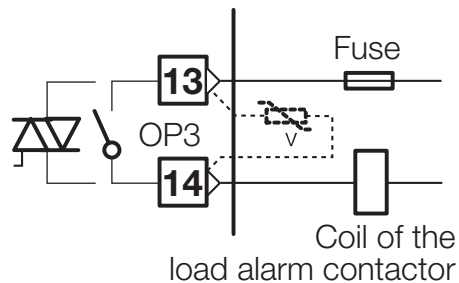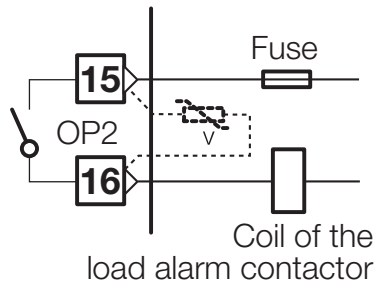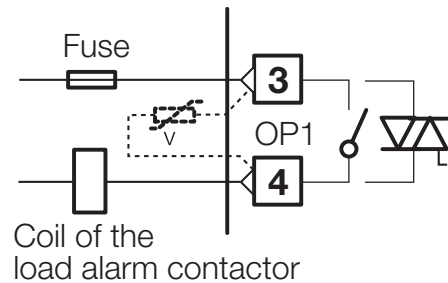
Varistor for inductive load 24V∿ only

2.3.7 OP4 ANALOGUE CONTROL OUTPUT (option) ⚠CE

- Galvanic isolation
  500V∿/1 min
- 0/4…20mA, (750Ω or 15V– max)

+

7

mA ⊖ OP4 Load

8

–
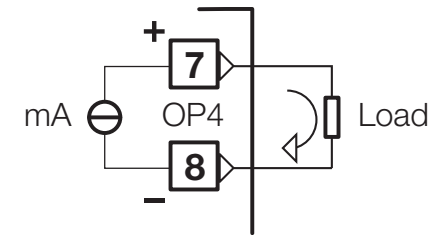
2.3.8 SERIAL COMMUNICATIONS (option) ⚠CE

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

⚠ **Please, read the user instructions on the "M400 controller MODBUS/JBUS protocol"**

+ **7**

– **8**

15
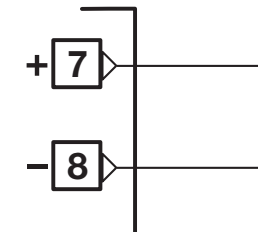
3 ▪ PRODUCT CODING

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

Instrument Label

M400

3150

Hard

RUN
SP2 MAN

P/N : M400-3150-0300
S/N : A0A-9909/0013
V~(L-N) : 100÷240V 50/60 Hz - 2.6W

IND. CON. EQ.
23 FA
LISTED

Made in Italy

| A | B | C | D | Basic product code (hardware) |
| I | L | M | N | Configuration code (software) |
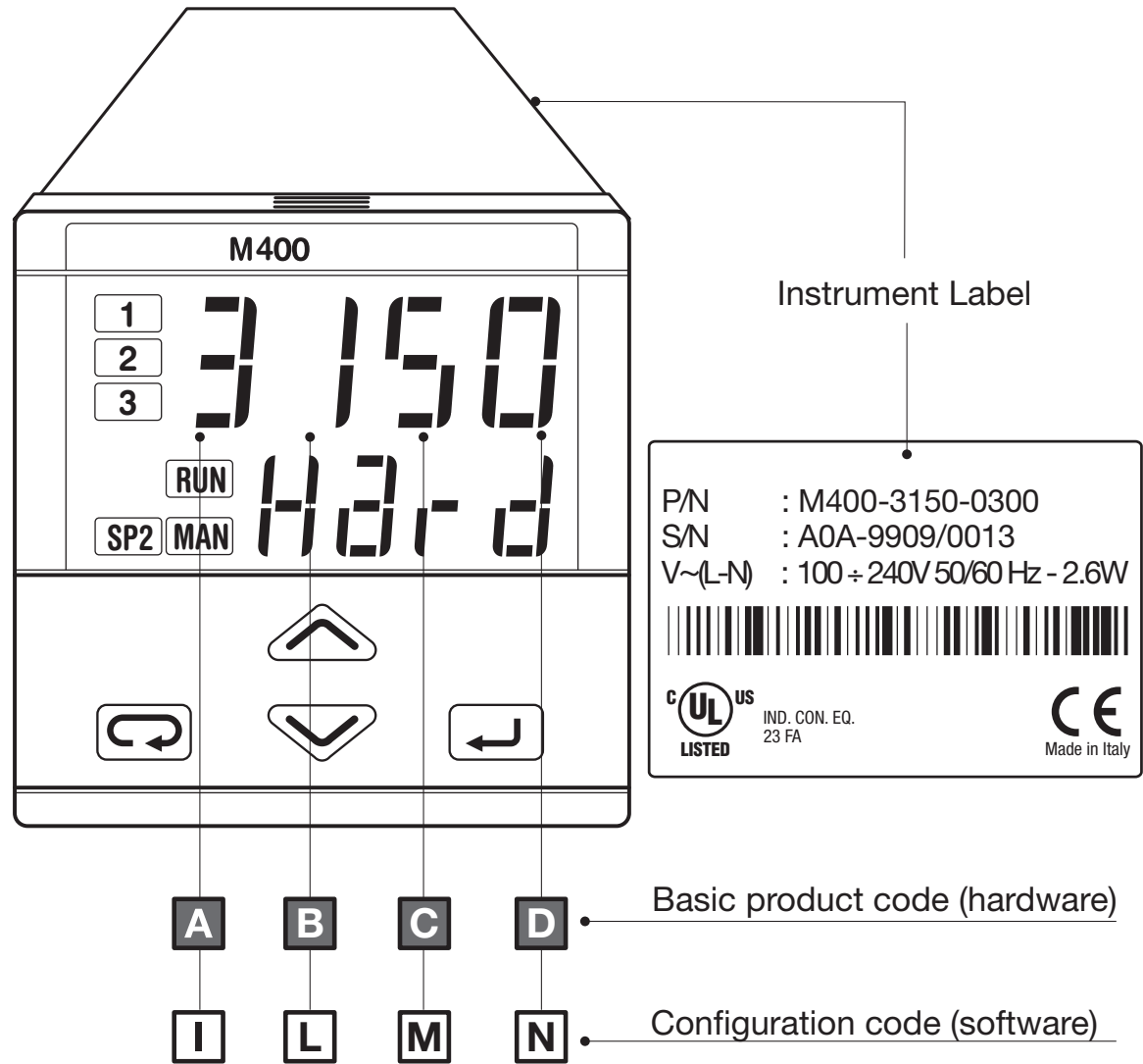
3.1 MODEL CODE

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

	Line	**Basic**	**Accessories**
Model:	M 400	A B C D -	E F G H

Line	M	400

Power supply	A
100 - 240V~ (- 15% + 10%)	3
24V~ (- 25% + 12%) or 24V– (- 15% + 25%)	5

OP1 [1]	OP2 [1]	OP3 [1]	B
Relay - Relay	Logic or Relay	Relay	1
Relay	Logic or Relay	Triac	2
Triac	Logic or Relay	Relay	4
Triac - Triac	Logic or Relay	Triac	5

Option 1 [2]	Option 2 [2]	C	D
Not provided	Not provided	0	0
	Current Transformer Input (CTI)	0	3
	Transmitter Power Supply (TPS)	0	6
	TPS + Analog Output 4	0	7
	TPS + CTI	0	8
	TPS + CTI + Analog output 4	0	9
RS485 Modbus/Jbus	Not provided	5	0
	Transmitter Power Supply	5	6
	TPS + CTI	5	8
Digital input	Not provided	9	0
	Current Transformer Input (CTI)	9	3
	Analog Output 4 Linear	9	7
	CTI + Analog Output 4	9	9

Option 3	User manual	E	F
Not provided	Standard English/Spanish manual	0	3
Start up + Timer	Standard English/Spanish manual	2	3

Front Bezel colour [3]	0/4-20mA Input Shunt Resistor [3]	G
Dark Grey (std)	Standard Resistor	0
Beige	Standard Resistor	1
Dark Grey	High accuracy resistor	2
Beige	High accuracy resistor	3

Mounting (DIN rail mounting does not include UL)	H
Panel (Standard)	0
DIN rail with display	1
DIN rail without display (requires CD option code 50, 56, or 58	2

Notes

[1] Relay SPST N.O. 2A/250V; Triac 1A/250V; Logic 5V 30mA; Output 2 field configurable via hardware jumper

[2] Analog Output 4 is field configurable for control or retransmission output as 0-20mA or 4-20mA

[3] Standard shunt resistor without field calibration will provide 1.10% input High accuracy shunt resistor without field calibration will provide 0.20% input accuracy for 0/4-20mA input. Either shunt resistor with field calibration will provide 0.10% input accuracy for 0/4-20mA input

3.2 CONFIGURATION CODING

The configuration code consists of 4 digits that identify the operating characteristic of the controller, as chosen by the user.
Section 4.6 at page 35 reports the instructions how to set a new configuration code.
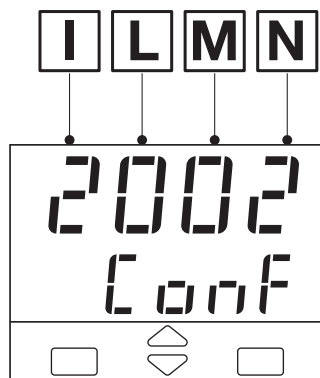
The configuration code can be displayed on the front panel, following the instructions at page 21 section 4.2.2.

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

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

[4] 0...20 & 4...20 mA with previded external 2.5 Ω resistor

Control mode	Output configuration [2]	L
PID	Control OP1 / alarm AL2 on OP2	0
	Control OP2 / alarm AL2 on OP1	1
On - Off	Control OP1 / alarm AL2 on OP2	2
	Control OP2 / alarm AL2 on OP1	3
Heat/Cool action	Control OP1- OP3 / alarm AL2 on OP2	6
	Control OP1- OP2 / alarm AL2 on OP3	7
	Control OP2- OP3 / alarm AL2 on OP1	8

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

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

⚠️

If, when the controller is powered up for the first time, the display shows the following message
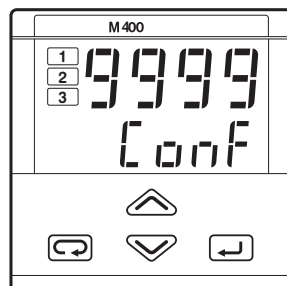
it means that the controller has not been configured yet.

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

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

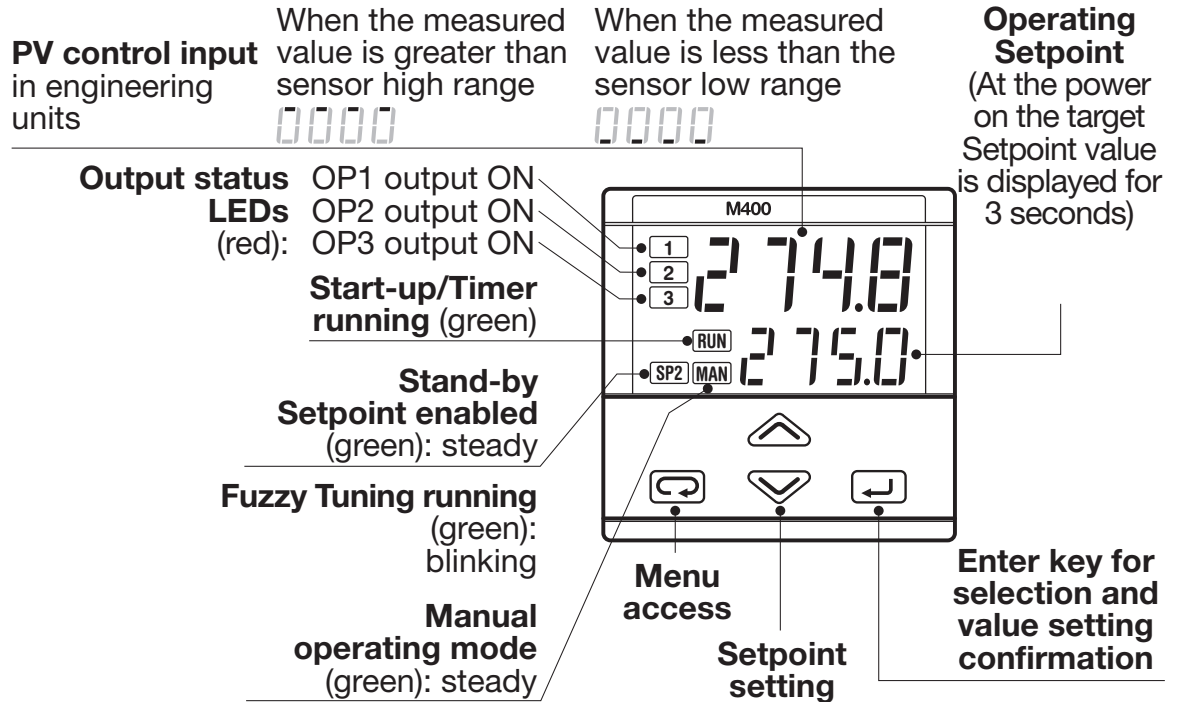| Alarm 3 type and function		O
Disabled or used by Timer		0
Sensor break alarm / Loop Break Alarm		1
Absolute	active high	2
	active low	3
Deviation	active high	4
	active low	5
Band	active out	6
	active in	7
Heater break by CT [3]	active during ON output state	8
	active during OFF output state	9

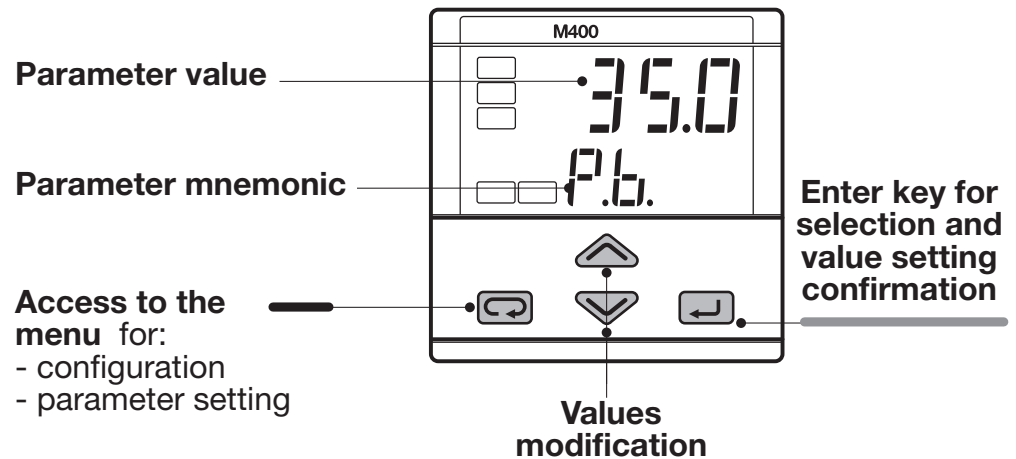For alarm 3 type and function see page 34

Note
[3] Only with CT options.

4 ▮ OPERATIONS

4.1.A KEYS FUNCTIONS AND DISPLAY IN OPERATOR MODE

PV control input in engineering units

When the measured value is greater than sensor high range
⌐⌐⌐⌐

When the measured value is less than the sensor low range
⌐⌐⌐⌐

Operating Setpoint (At the power on the target Setpoint value is displayed for 3 seconds)

Output status LEDs (red):
OP1 output ON
OP2 output ON
OP3 output ON

Start-up/Timer running (green)

Stand-by Setpoint enabled (green): steady

Fuzzy Tuning running (green): blinking

Manual operating mode (green): steady

Menu access

Setpoint setting

Enter key for selection and value setting confirmation

4.1.B KEYS FUNCTIONS AND DISPLAY IN PROGRAMMING MODE

Parameter value

Parameter mnemonic

Access to the menu for:
- configuration
- parameter setting

Values modification

Enter key for selection and value setting confirmation

4.2   DISPLAY

During the operation, the para-meters values cannot be modi-fied by the user

4.2.1 OF THE PROCESS VARIABLES

274.8 / 275.0 — **Operator mode**

274.8 °C — **Engineering units [1]**

275.0 S.P. — **Local Setpoint** (manual)

63.4 Out — **OP1 output** (auto) **[2]**

47 t.Cur — **Load current [3]**

33 tM.r. — **Timer remaining time [4]**

4.2.2 OF THE CONFIGURATION CODES

274.8 / 275.0 — **Operator mode**

274.8 °C — **Engineering units [1]**

3150 Hard — **Basic product code** (see page 16)

2002 ConF — **Configuration code** (see page 18)

00A rEL. — **Software release**

Example:
M400 - 3150 - 2002 / Release 00A
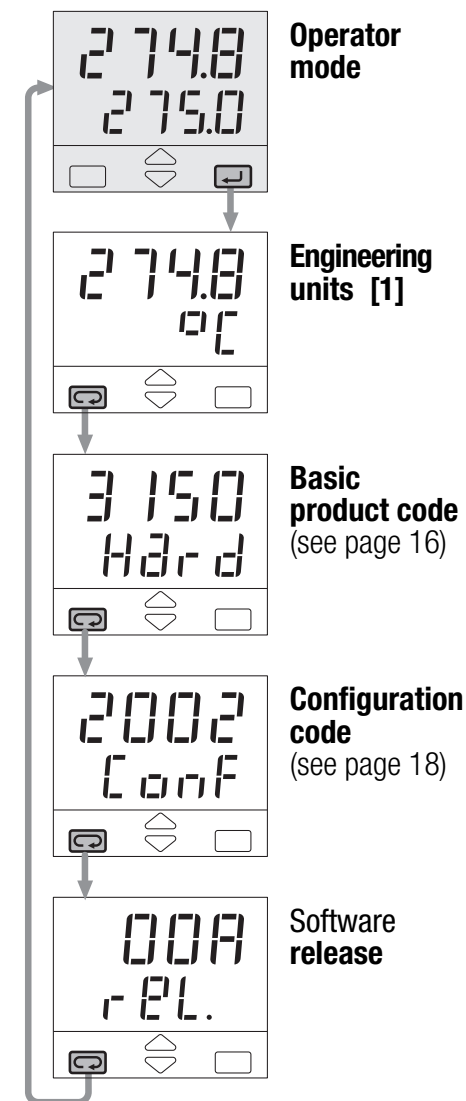
Note

[1] See table page 37

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

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

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

4.3 PARAMETER SETTING

4.3.1 NUMERIC ENTRY

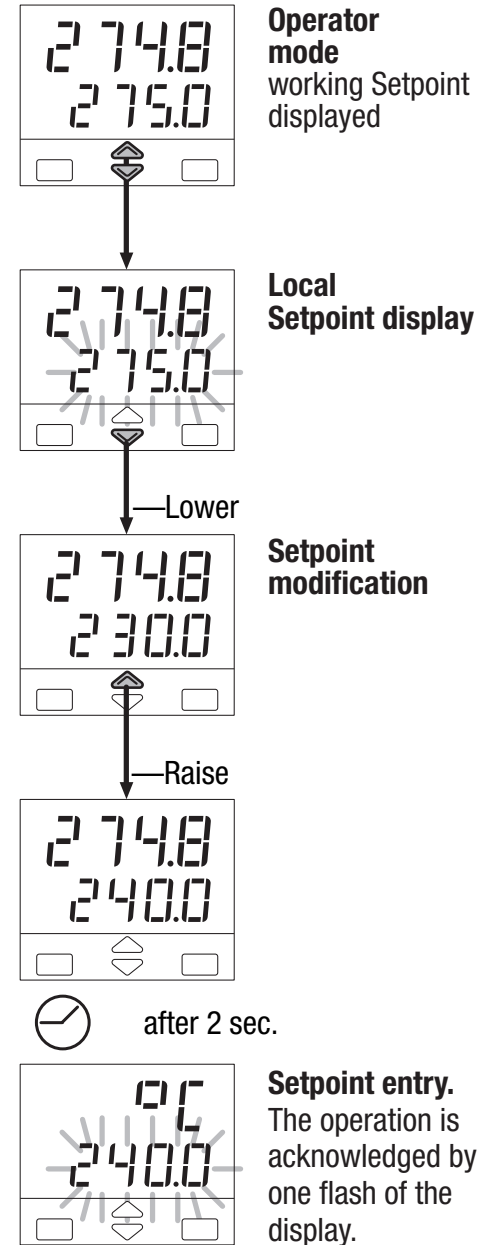**(i.e. the modification of the Setpoint value from 275.0 to 240.0)**

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

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

Operator mode
working Setpoint displayed

Local Setpoint display

—Lower

Setpoint modification

—Raise

after 2 sec.

Setpoint entry.
The operation is acknowledged by one flash of the display.

4.3.2 MNEMONIC CODES SETTING

(e.g. configuration see page 35)

Press the ⌃ or ⌄ to display the next or previous mnemonic for the selected parameter.

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

°C Unit	**Engineering Units Degree Centigrade**
°F Unit	**Degree Fahrenheit**
°C Unit	**Degree Centigrade**
°F Unit	**Degree Fahrenheit**
nonE Unit	**no units defined**
Ph Unit	**Ph**
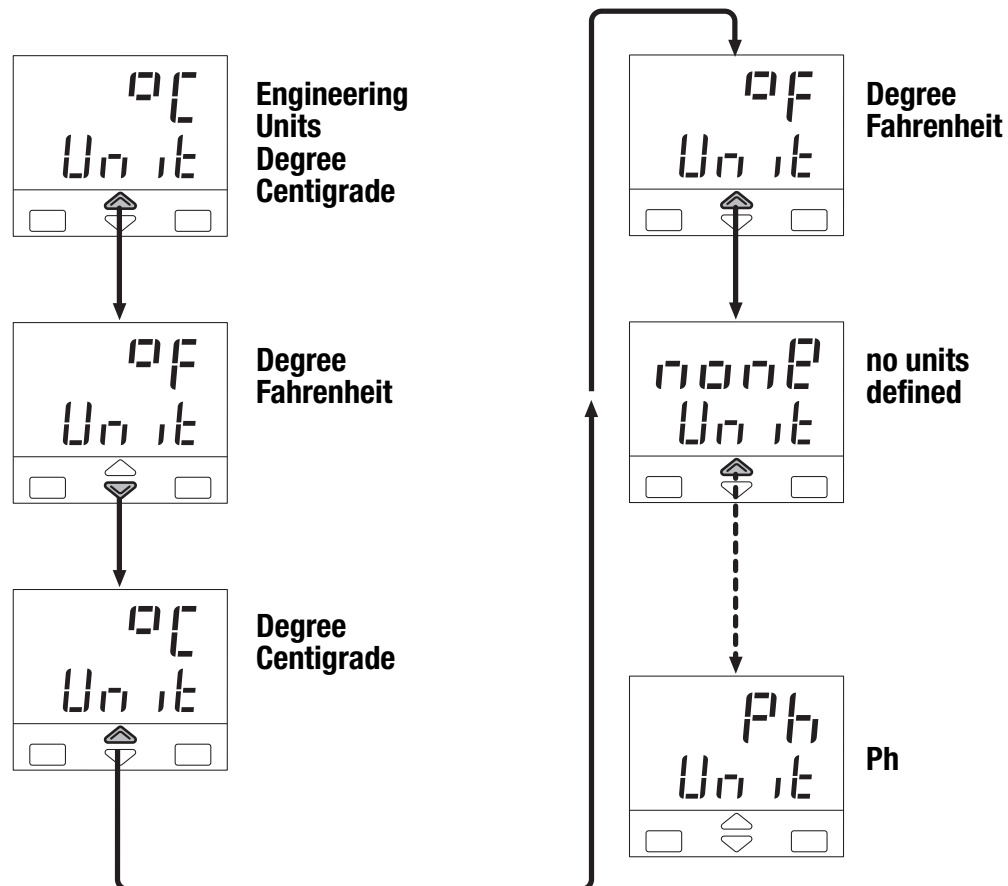
4.3.3 KEYPAD LOCK

To lock/unlock the keypad press the keys ⟳ and ⏎ simultaneously for 2 seconds.
To confirm the keypad lock/unlock the display flashes once.

operator mode

Press simultaneously for 2 seconds

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

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

4.3.4 OUTPUTS LOCK

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

The outputs lock/unlock can be achieved by serial communications too
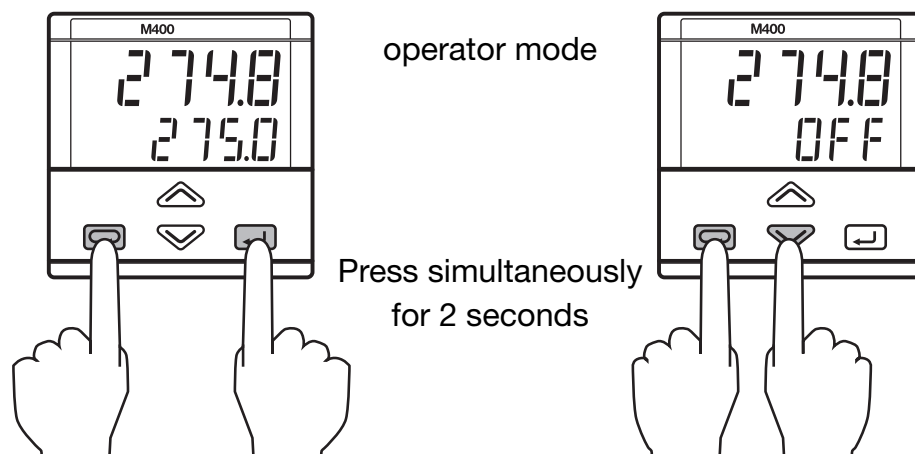
⚠ The outputs lock/unlock is maintained in case of power failure.

4.3.5 AUTO / MAN

Operator mode

Select ⌷ⁿ∃ⁿ⌷
to switch to manual mode

Select ⌷Auto⌷
to switch to automatic mode
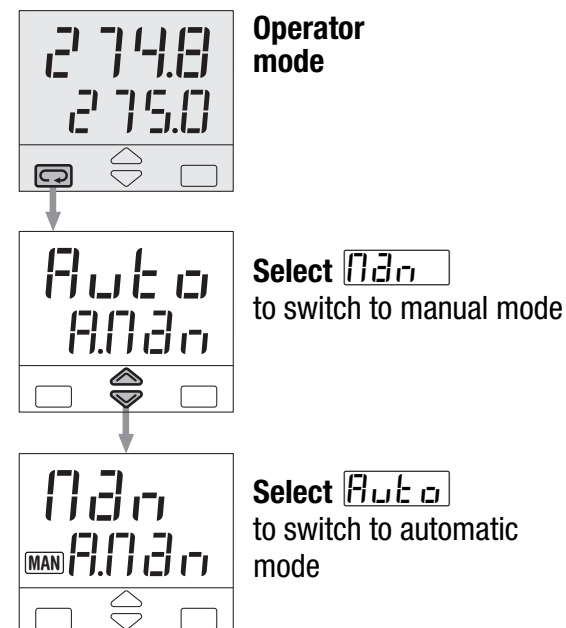
- Press ⏎ to confirm. Back to operator mode.
- The MAN led shows the manual mode status.
- When manual mode is active, the Setpoint display shows the output value, that can be modified by ⌃ ▽

24

4.4 PARAMETERISATION

Parameter value — **Parameter mnemonic**

M400

35.0

P.b.

Prameter menu selection — **Values modification** — **Modification/ selection enter**

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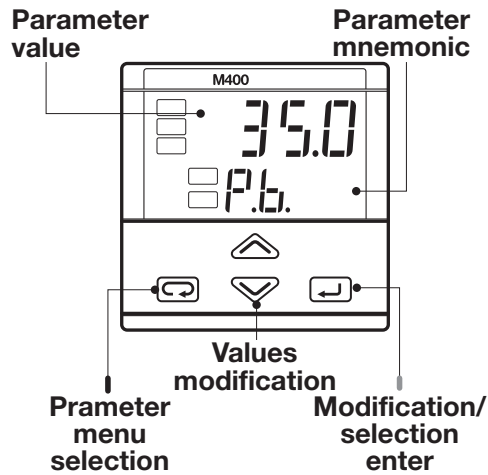
The parameter setting procedure has a timeout. If no keys are pressed for, at least, 30 seconds, the controller switches back, automatically, to the operator mode.

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

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

25

274.8
275.0
Operator mode

Auto/Man selection
(see page 24)

Timer run/stop
(if option installed)

A.Man

t.run
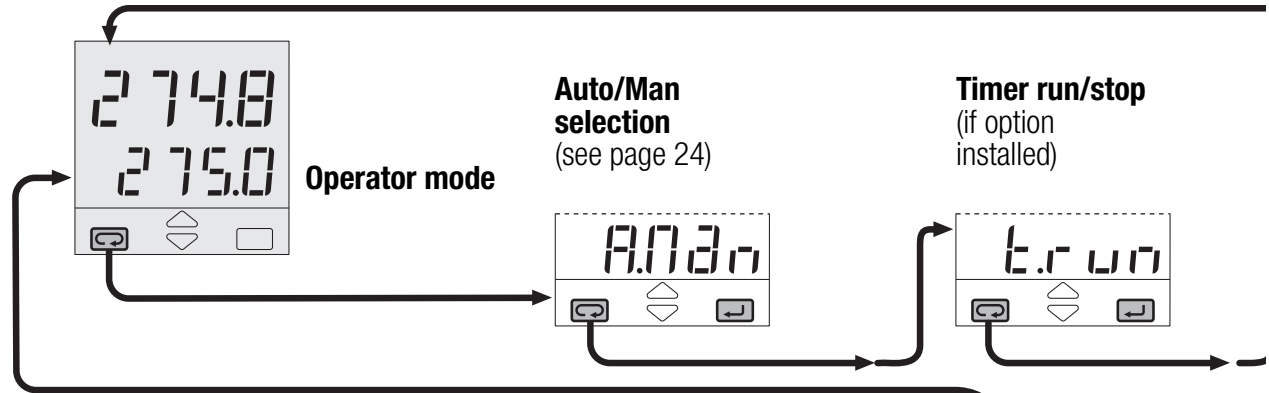
Note

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

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

0

A35.P
AL3 alarm threshold [1]
(see page 29)

5.0

P.b.
Proportional band
(PID algorithm only)
0.5…999.9% of span

5.0

t.i.
Integral time
(PID algorithm only)
OFF / 0.1…100.0 min

1.00

t.d.
Derivative time
(PID algorithm only)
0.5…999.9% of span

20

t.c.
Cycle time
(time proportional PID algorithm only)
1…200 sec

1.00

O.C.
Overshoot control
(PID algorithm only)
0.01…1.00

PARAMETER MENU

33

PASS

⇕

Password entry [3]
only if $Code$ value
≥5000
(see pages 35…37)

5000

⇕

Code entry [3]
from 5000 to 9999
Must be equal to the
value of the parameter $Code$

OK

NO   YES

0

A2S.P

⇕

1st GROUP
AL2 alarm threshold [1]
(see page 29)

tunE

⇕

2nd GROUP
Tuning run/stop
(PID algorithm only)

0.5

d.bnd

⇕

Dead band
(heat/cool configuration only)
-10.0…10.0%

100.0

OP. H

⇕

Control output high limit
(PID algorithm only)
10.0…100.0%

100.0

OP.HC

⇕

**Cool control output
high limit**
(heat/cool PID configuration only)
10.0…100.0%

0.5

hY.

⇕

Control output hysteresis
(On-Off control only)
0.1…10.0% of span

Back to the   1st parameter group

20

t.c. C

⇕

Cool cycle time
(heat/cool with cool time
propotional PID only)
1…200 sec

1.0

r.CGa

⇕

Cool relative gain
(heat/cool configuration only)
0.1…10.0

0.5

hY. C

⇕

Cool output hysteresis
(On-Off control only)
0.1…10.0% range

AdPt

⇕

Continuous Tuning start
(adaptive tuning)
(PID algorithm only)
$PrGh$

P.b. a

⇕

**Calculated Proportional
band [2]** (display only)
(available when adaptive
tuning is selected)

t. i. A

⇕

**Calculated Integral Time
[2]** (display only)
(available when adaptive
tuning is selected)

t.d. A

⇕

**Calculated derivative
time [2]** (display only)
(available when adaptive
tuning is selected)

1	
t.ine	**Timer setting** (if option installed) 1…9999 sec. or min.
0	
S.P. 2	**Stand-by Setpoint** *S.P. L …S.P. H*
OFF	
SL. u	**Setpoint ramp up** *OFF* /0.1…999.9 digit/min
OFF	
SL. d	**Setpoint ramp down** *OFF* /0.1…999.9 digit/min

L. range	
S.P. L	**Setpoint low limit** low range… *S.P. H*
H. range	
S.P. H	**Setpoint high limit** *S.P. L*…high range
0	
S.P.S.U	**Start-up Setpoint** (if option installed) *S.P. L …S.P. H*
1	
t.h.S.U	**Start-up hold time** (if option installed) 0…500 min.

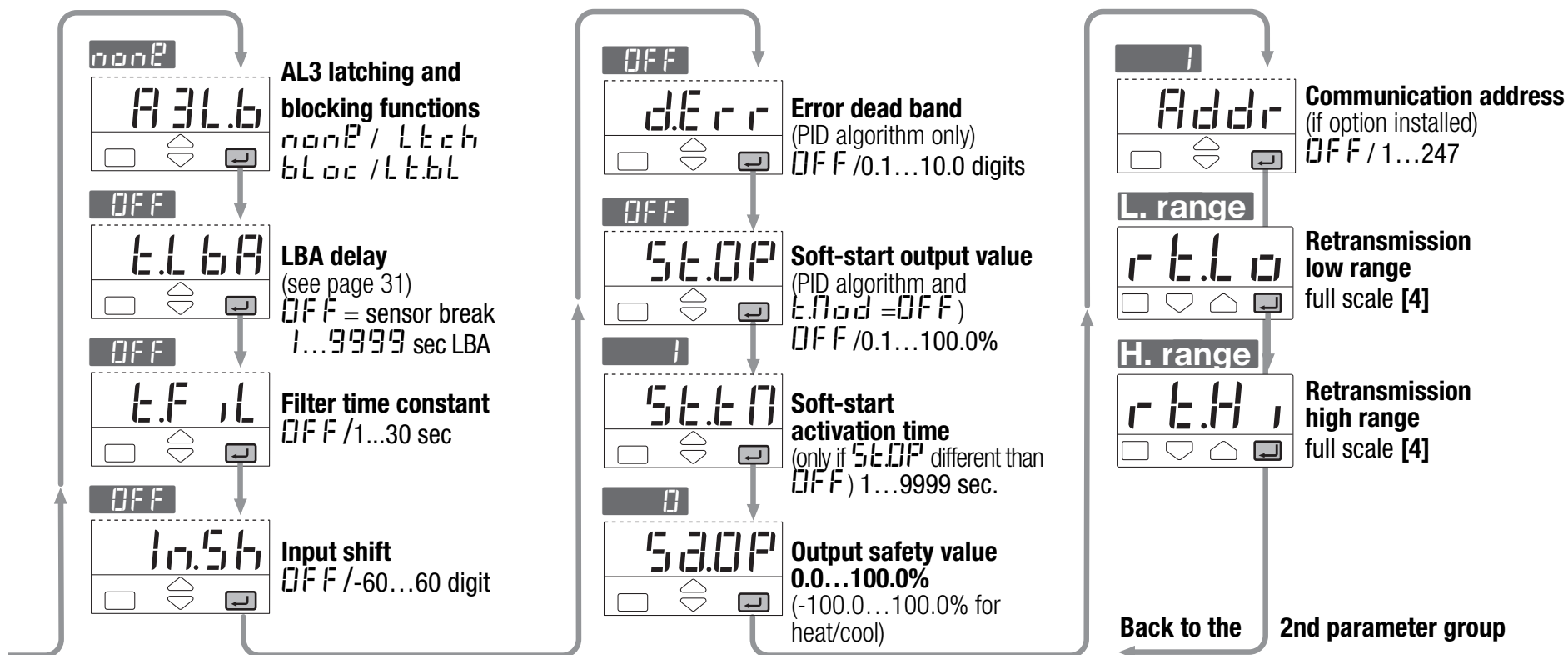|	
100.0	
OP.HS	**Output high limit during Start-up** (if option installed) 5.0…100.0%
0.5	
A2hy	**AL2 hysteresis** 0.1…10.0% of span **[1]**
nonE	
A2L.b	**AL2 latching and blocking functions** *nonE* / *Ltch* *bLoc* /*Lt.bL*
0.5	
A3hy	**AL3 hysteresis** 0.1…10.0% of span **[1]**

Password entry [3]
only if `CodE` value
<5000 (see pages 35…37)

Direct access
to the configuration
(pages 35 … 37)

[3] If password is 0000 to 4999, parameter setting will be available to the operator without entering this password number. If password is 5000 to 9999, parameter setting will only be available by entering this password number.

[4] If option installed and configured for retransmission.

`nonE`

`A 3L.b`
AL3 latching and blocking functions
`nonE` / `Ltch`
`bLoc` / `Lt.bL`

`OFF`

`t.LbA`
LBA delay
(see page 31)
`OFF` = sensor break
`1…9999` sec LBA

`OFF`

`t.F iL`
Filter time constant
`OFF` /1...30 sec

`OFF`

`In.Sh`
Input shift
`OFF` /-60…60 digit

`OFF`

`d.Err`
Error dead band
(PID algorithm only)
`OFF` /0.1…10.0 digits

`OFF`

`St.OP`
Soft-start output value
(PID algorithm and
`t.Mod` =`OFF`)
`OFF` /0.1…100.0%

`1`

`St.tM`
Soft-start activation time
(only if `St.OP` different than
`OFF`) 1…9999 sec.

`0`

`Sa.OP`
Output safety value
0.0…100.0%
(-100.0…100.0% for
heat/cool)

`1`

`Addr`
Communication address
(if option installed)
`OFF` / 1…247

L. range

`rt.Lo`
Retransmission low range
full scale **[4]**

H. range

`rt.Hi`
Retransmission high range
full scale **[4]**

Back to the **2nd parameter group**

4.5   PARAMETERS

FIRST GROUP

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

A2S.P   **AL2 alarm threshold**
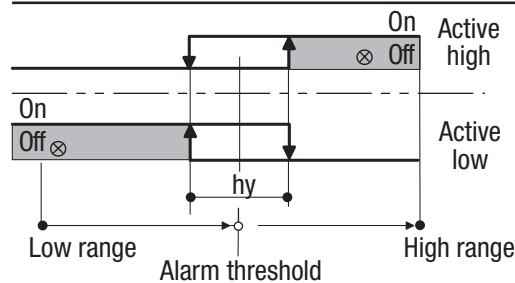
A3S.P   **AL3 alarm threshold**

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

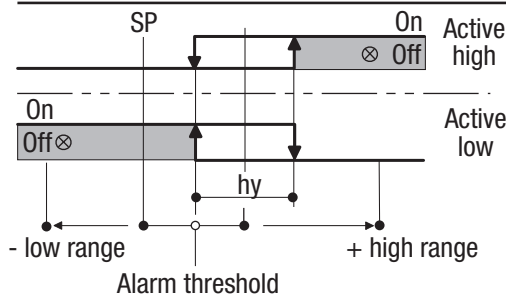**With Heath/Cool action control output, AL2 and AL3 share in or mode the same output (the free one)** (see table on page 13)

Sensor break or input disconnection
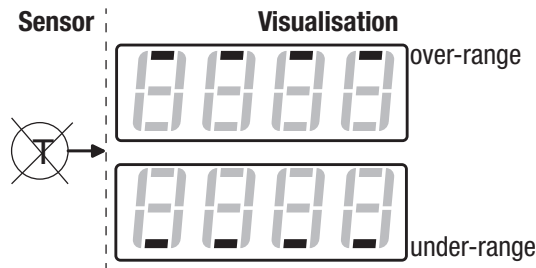
Sensor	Visualisation	
	8888	over-range
⊗	**8888**	under-range

Absolute alarm

On / ⊗ Off   Active high
On / Off ⊗   Active low

hy

Low range   High range
Alarm threshold

Deviation alarm

SP   On / ⊗ Off   Active high
On / Off⊗   Active low

hy

- low range   + high range
Alarm threshold

Band alarm

SP   On / ⊗ Off   Active out
On / Off   Active in

hy   hy

Full scale   Full scale
Alarm threshold

Proportional band

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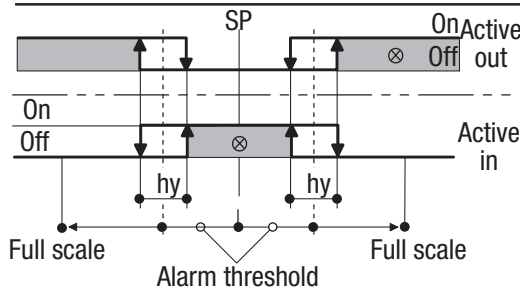
This parameter specifies the proportional band coefficient that multiplies the error (SP - PV)

Integral time

t.i.

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

t.d.

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

Control output cycle time

t.c.

Cycle time cool

t.c. C

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

⊡.⊏. **Overshoot control**

(Automatically disabled when the adaptive tuning is running).
This parameter specifies the span of action of the overshoot control. Setting lower values (0.99 –» 0.01) the overshoot generated by a Setpoint change is reduced. The overshoot control doesn't affect the effectiveness of the PID algorithm. Setting 1, the overshoot control is disabled.

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

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

OP. H **Control output high limit**

OP.HC **Cool output high limit**

It specifies the maximum value the control output can be set

hy. **Control output hysteresis**

hy. C **Cool output hysteresis**

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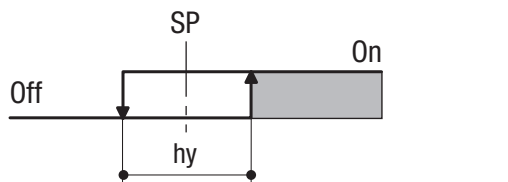
Control or alarm output hysteresis span, set in % of the full scale.

SECOND GROUP

S.P. 2 **Stand-by Setpoint**

Used by Timer function too.

SL. u **Setpoint ramp up**

SL. d **Setpoint ramp down**

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

SECOND GROUP

A2hy **AL2 alarm hysteresis**

A3hy **AL3 alarm hysteresis**

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

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

S.P. H **Setpoint high limit**

Low / high limit of the Setpoint value.

A2L.b **AL2, AL3 latching**

A3L.b **and blocking functions**

For each alarm it is possible to select the following functions
nonE none
Ltch latching
bLoc blocking
Lt.bL 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
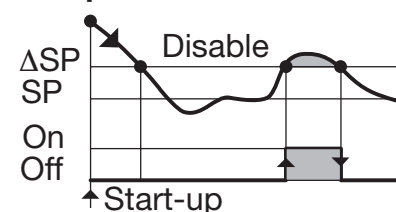
Ramp up
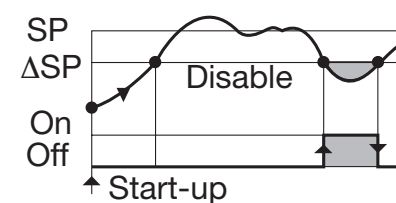
ΔSP Threshold = SP ± range

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

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

[t.LbA] LBA delay

Setting a value between 1 and 9999 sec the alarm works as LBA+Sensor break with delay [1]

This condition is shown by means a red led as well as the blinking PV display.

Setting OFF the alarm works as Sensor break with immediate action.

This condition is shown by means the red led of the selected alarm as well as:
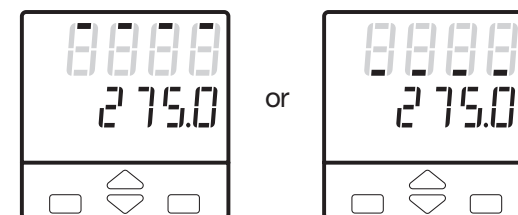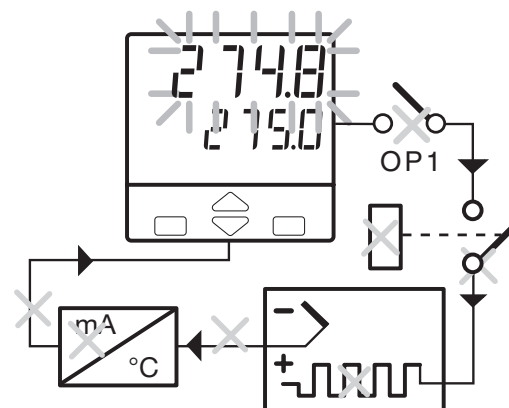
Note [1] In case of sensor break, condition, the alarm action is immediate.

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

SECOND GROUP

t.Fil **Input filter time constant**

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

Filter response
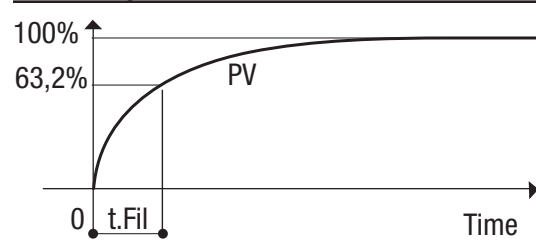
In.Sh **Input shift**

This value is added to the measured PV input value. Its effect is to shift the whole PV scale of up to ± 60 digits.
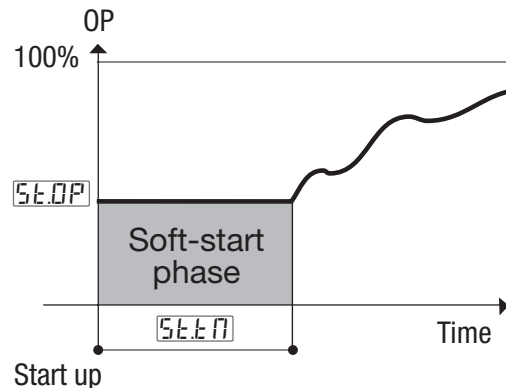
d.Err **Error Dead Band**

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

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

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

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

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

Sa.OP **Output Safety Value**

Output Value in case of input anomaly

Addr **Controller address**

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

HEAT COOL CONTROL

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

It is possible to overlap the outputs.

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

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

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

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

A   Heat /Cool actions separated

Insert positive `d.bnd` value (0...10%)
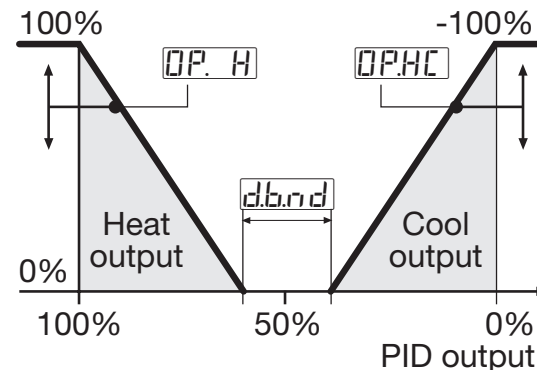
B   Heat /Cool actions overlapped

Insert negative `d.bnd` value (-10...0%)
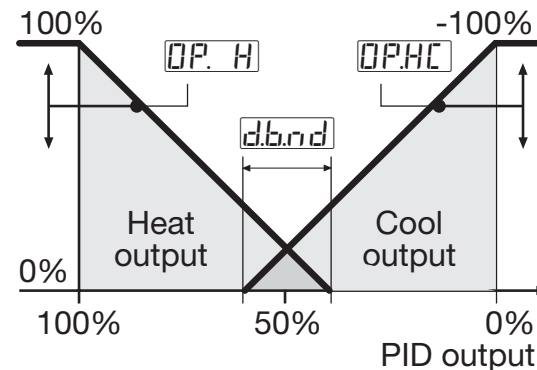
C   Cool action adjusting

Example with different relative cool gains
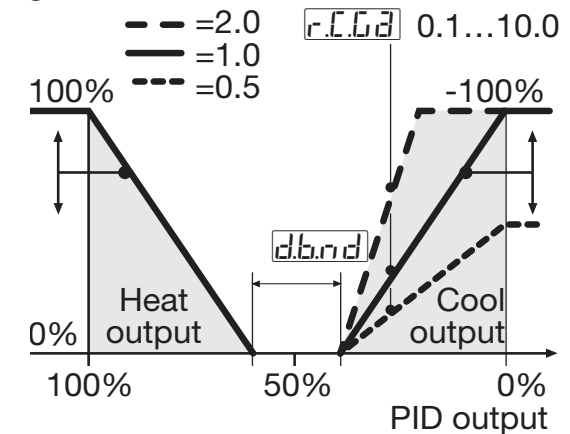
D   On-Off Cool action
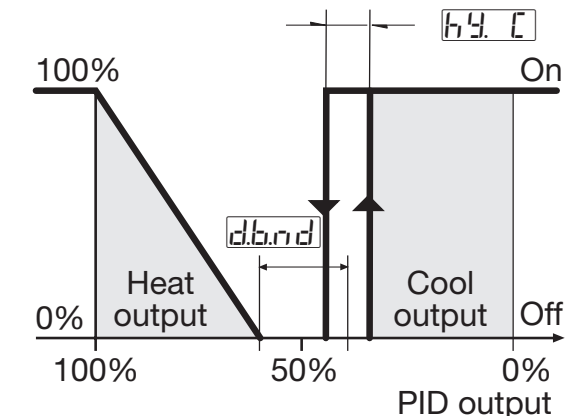
ANALOGUE CONTROL OUTPUT OP4

When configured, the analogue control output excludes the corresponding time proportioning control output automatically. (see page18)
(e.g. if code $\boxed{\text{L}}$ = 0 and $\boxed{r\,t.h}$ = $\Pi.\Pi.$. the OP1 is not yet available)

| $\boxed{r\,\Pi t\,r}$ | **Analogue output range** |

$0 - 20 / 4 - 20$

| $\boxed{r\,t.H}$ | **Analogue output selection** |

$\Pi.\Pi.$ **Heat** (single output)
$\Pi.\Pi.$ $\Gamma.$ **Cool**
$5.P.$ **Setpoint**
$P.\Pi.$ **Process variable**

With analogue control output $\boxed{t\,c}$ or $\boxed{t\,c\ \ \Gamma}$ are not present.

CURRENT TRANSFORMER INPUT

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

It is possible to set AL2 or AL3 (index 8 and 9) to have an alarm when, during the ON time of the time proportional output, the load current is less then the specified threshold or, during the OFF time, there is at least 3% of full scale load current

The alarm condition must be longer than 120 ms to set the alarm. During the OFF time the parameter $t\,\Gamma\,u\,r$ latches the last on time current value
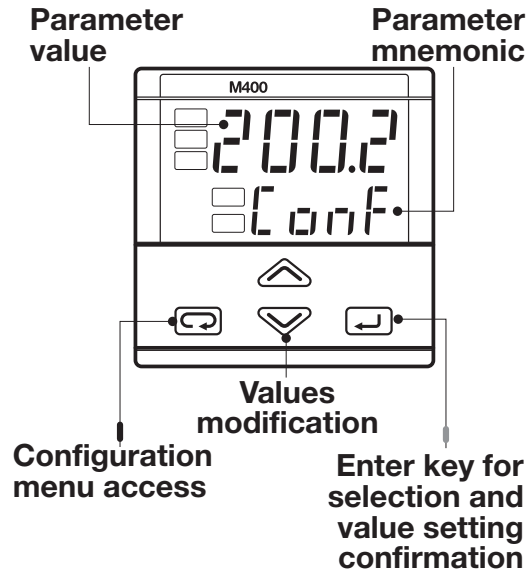
Example:
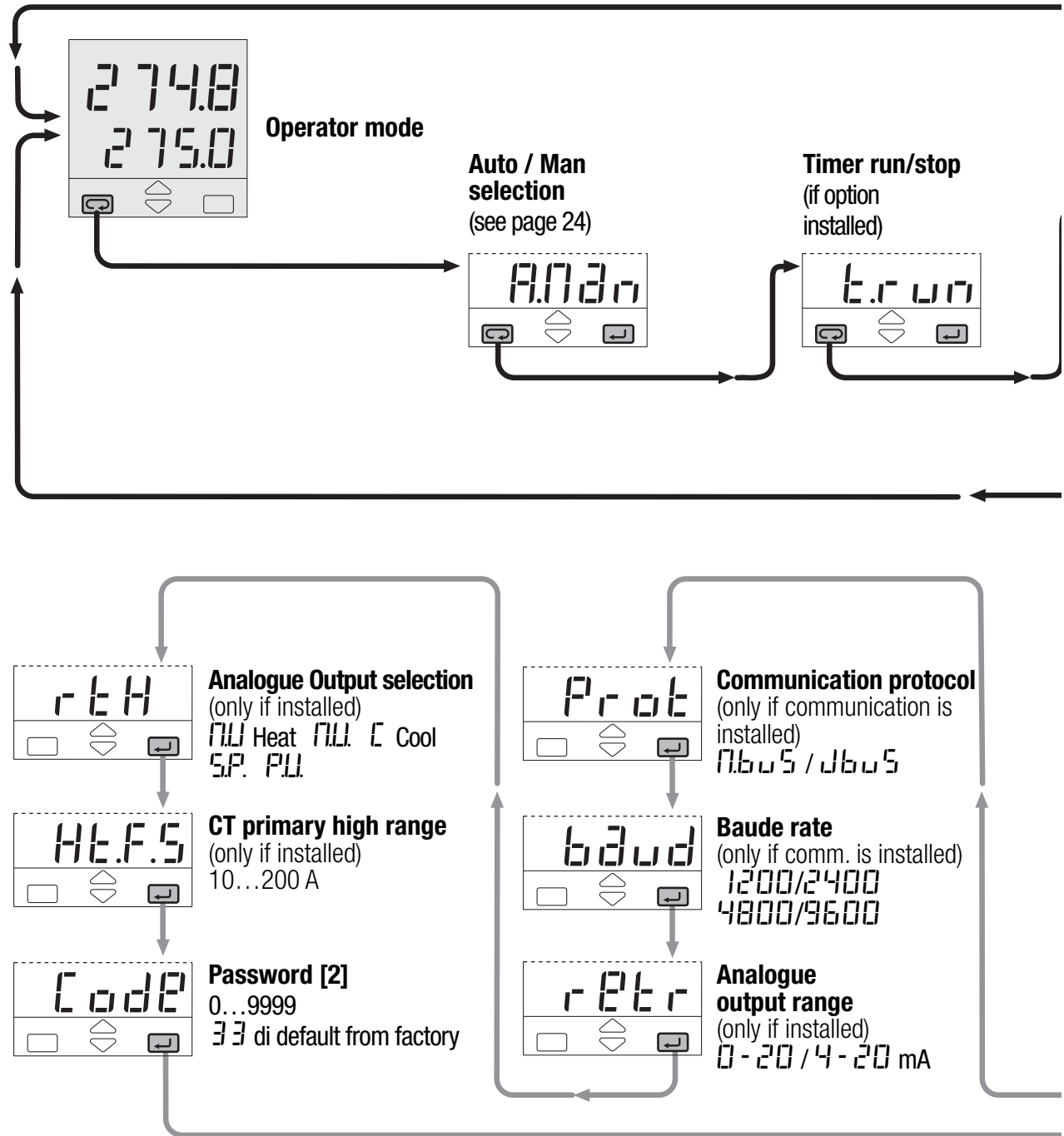CT input on OP1, alarm on AL2 during on time (configuration digit N = 8)
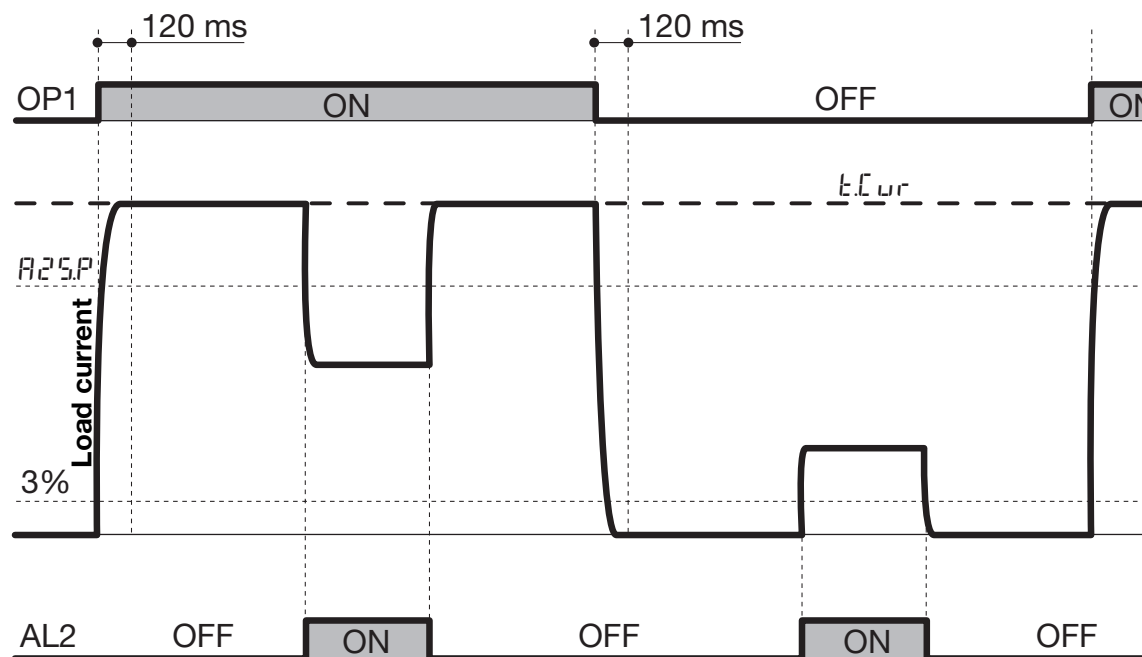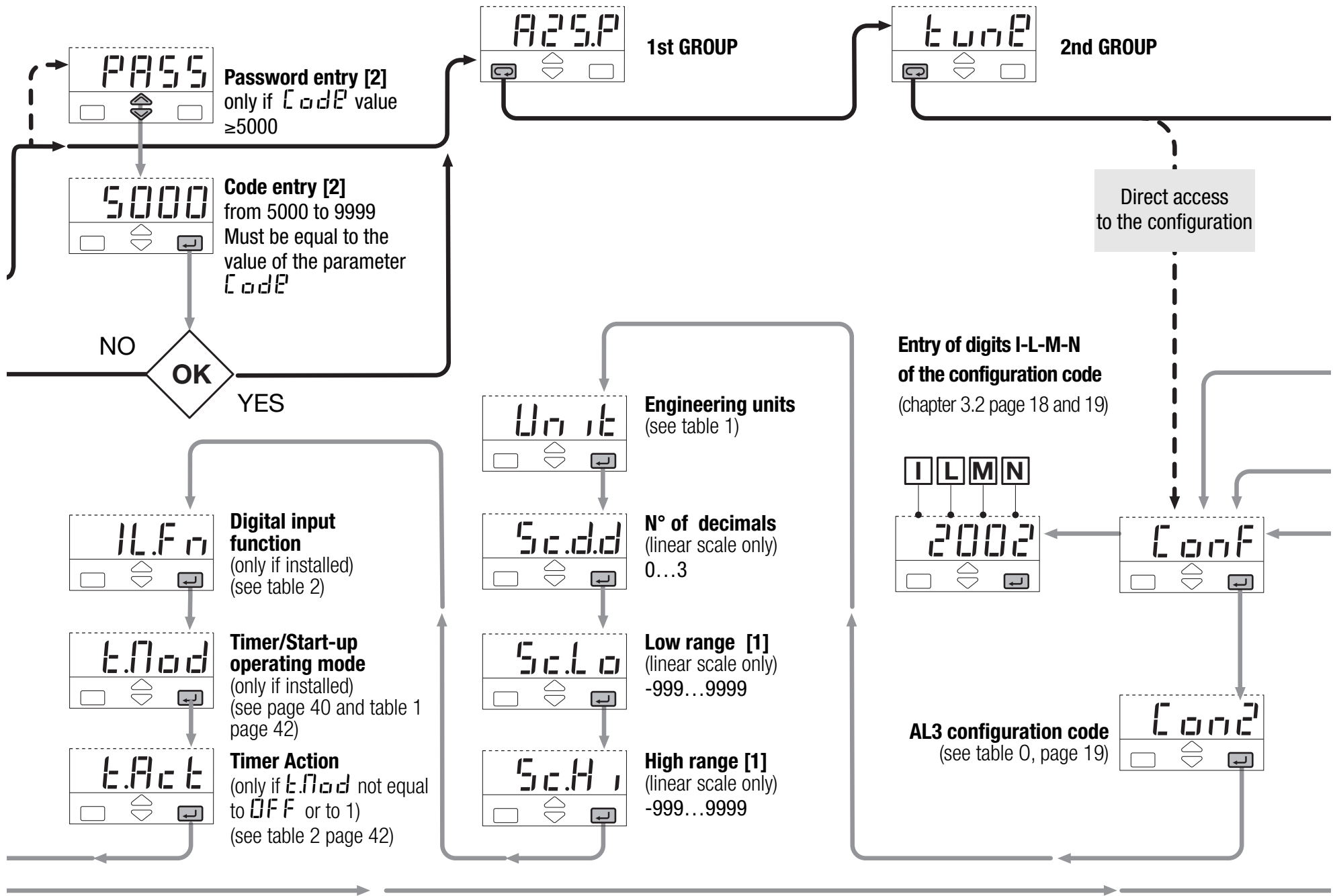
4.6 CONFIGURATION

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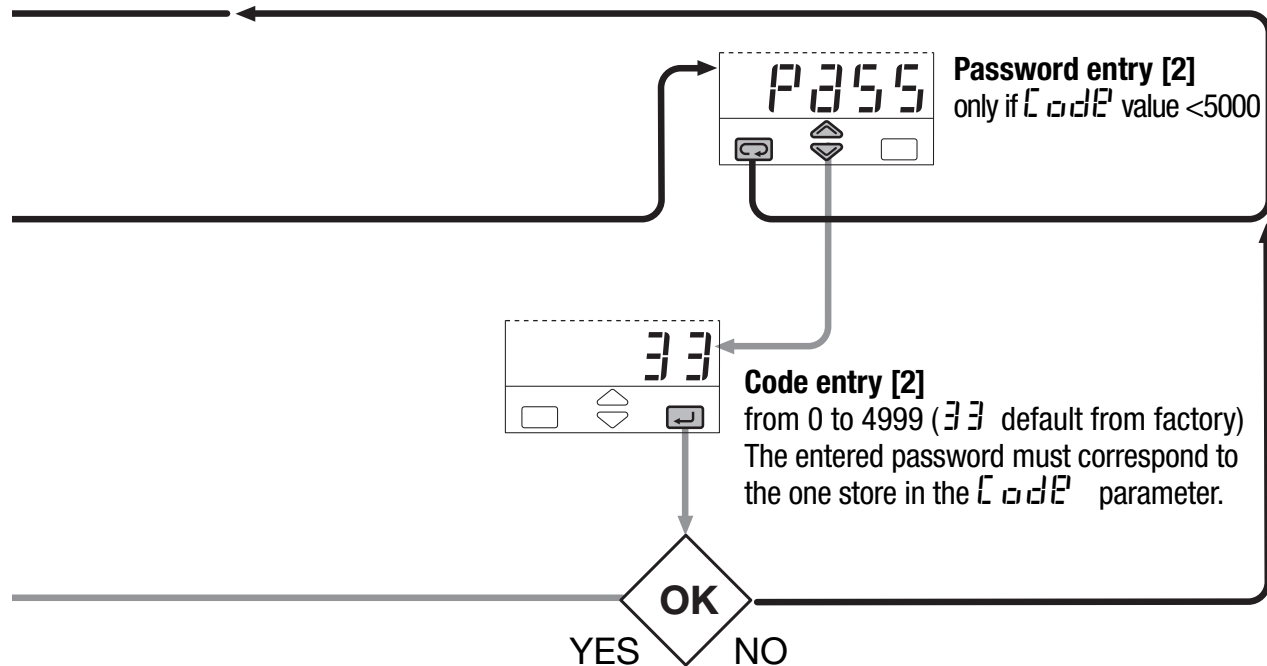
Parameter value — **Parameter mnemonic**

M400

Configuration menu access — **Values modification** — **Enter key for selection and value setting confirmation**

Press ⌃ or ⌄ to display the next parameter or the next code and change its value.

The new value entered is stored into the controller when the next parameter is selected by pressing ⏎.
Pressing the ⟳ the next group of parameters is displayed.

274.8
275.0 **Operator mode**

Auto / Man selection (see page 24)

Timer run/stop (if option installed)

A.MAn

t.run

rtH **Analogue Output selection** (only if installed) *N.W.* Heat *N.W. C* Cool *S.P. P.U.*

Ht.F.S **CT primary high range** (only if installed) 10…200 A

Code **Password [2]** 0…9999 *33* di default from factory

Prot **Communication protocol** (only if communication is installed) *N.buS / JbuS*

baud **Baude rate** (only if comm. is installed) *1200/2400 4800/9600*

rEtr **Analogue output range** (only if installed) *0 - 20 / 4 - 20* mA

PASS Password entry [2] only if `Code` value ≥5000

5000 Code entry [2] from 5000 to 9999 Must be equal to the value of the parameter `Code`

NO

OK

YES

A2SP 1st GROUP

tunE 2nd GROUP

Direct access to the configuration

Unit Engineering units (see table 1)

Sc.d.d N° of decimals (linear scale only) 0…3

Sc.Lo Low range [1] (linear scale only) -999…9999

Sc.HI High range [1] (linear scale only) -999…9999

IL.Fn Digital input function (only if installed) (see table 2)

t.Mod Timer/Start-up operating mode (only if installed) (see page 40 and table 1 page 42)

t.Act Timer Action (only if `t.Mod` not equal to `OFF` or to 1) (see table 2 page 42)

Entry of digits I-L-M-N of the configuration code (chapter 3.2 page 18 and 19)

| I | L | M | N |

2002

ConF

Con2 AL3 configuration code (see table 0, page 19)

Password entry [2]
only if $Code$ value <5000

Code entry [2]
from 0 to 4999 (33 default from factory)
The entered password must correspond to the one store in the $Code$ parameter.

OK

YES   NO

⚠️

Direct access to the configuration

A From parameterisation (see page 28).

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

9999
$Conf$

In this situation, the controller has its outputs and inputs not active.

This situation ends when a correct configuration code is entered.

Table 1 - Supported Engineering Units.

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

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

Table 2- Digital input functions

Not used	OFF
Keypad lock	$YEb.1$
Auto/Man	$A.NAn$
Stand-by Setpoint	$S.P. 2$
Timer launch	$Str.t$

Notes
[1] Minimum Range 100 digits.
[2] If password is 0000 to 4999, parameter setting will be available to the operator without entering this password number. If password is 5000 to 9999, parameter setting will only be available by entering this password number.

5 ▮ AUTOMATIC TUNING

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

The Fuzzy-Tuning allows the calculation of the optimal PID terms parameters, monitoring the response of the process to disturbances.

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

Step response

This type is selected when, at the start of the autotune operation, the PV is far from the Setpoint of more than 5% of the span.

This method has the big advantage of fast calculation, with a reasonable accuracy in the term calculation.

Natural frequency

This type is selected when the PV is close to the SP Setpoint.

This method has the advantage of a better accuracy in the term calculation with a reasonable speed calculation.

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

Step response

Natural frequency

Operator mode

press until

To start
select
Strt

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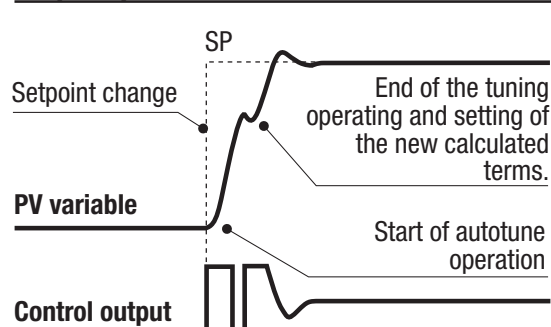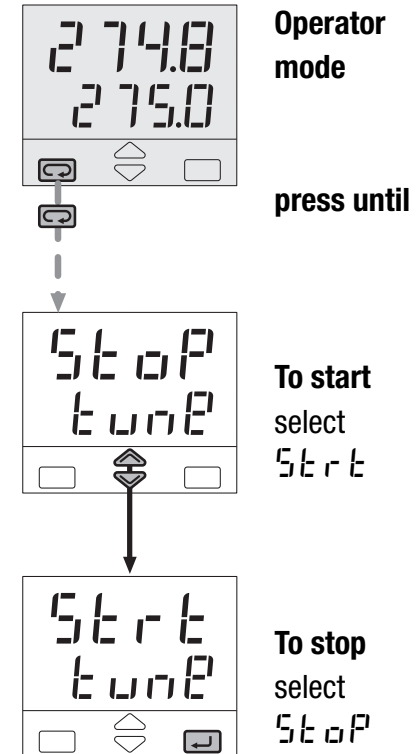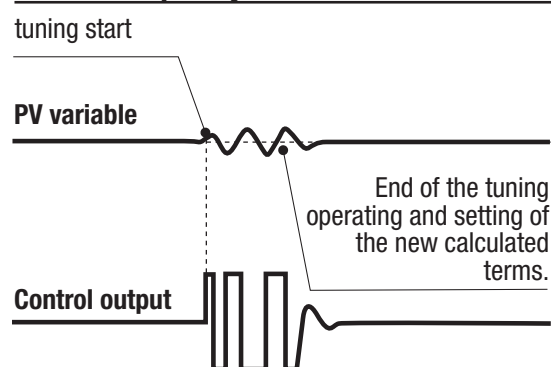
The green led MAN blinking goes on when the Fuzzy Tuning is in progress. At the end of this operation, the calculated PID terms parameter are stored and used by the control algorithm and the controller goes back to the operator mode. The green led MAN becomes off.

38

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

Continuous **Adaptive Tuning**

Perturbation

New parameters
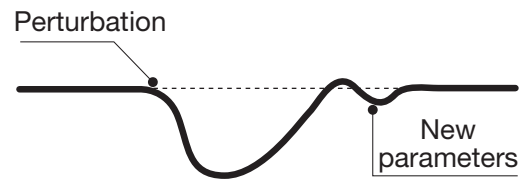
It is particularly suitable for controlling process whose control characteristics change with time or are not linear in relation to the Setpoint values.
It doesn't require any operation by the user. It is simple and works fine: it samples continuously the process response to the various perturbations, determining the frequency and the amplitude of the signals. On the basis of this data and their statistical values, stored in the instrument, it modifies automatically the PID term parameters. It is the ideal for all applications where it is required to change con-

tinuously 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 Tuning enabled, the values of the PID terms parameters are lost. At the power on the Adaptive Tuning starts automatically and computes again the values of the PID terms parameters.

Operator mode

press until

press ⏎

To start select `Strt`

To stop select `StoP`
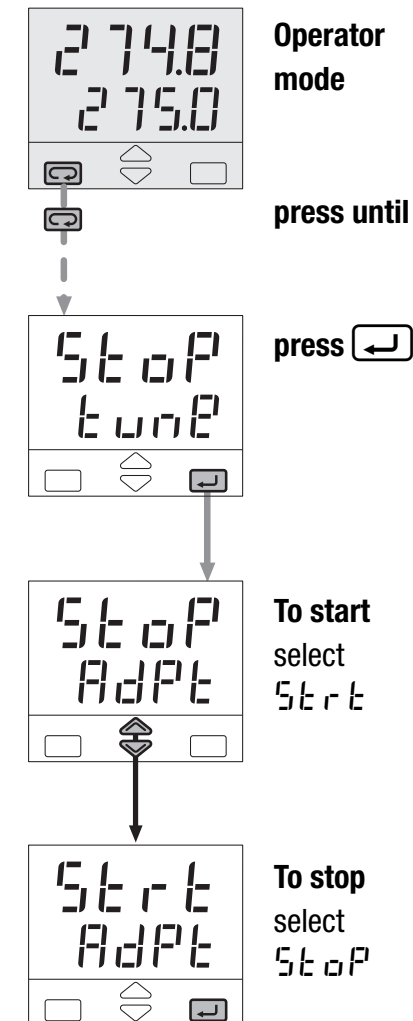
6 SPECIAL FUNCTIONS

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

In order to have the above functions the product code digit **E** must be **2** (see page 17)
For example: M400 3100-**2**000

To select these functions use the parameter:

$\boxed{\text{t.}\Pi\text{od}}$ **Timer/Start-up operator mode** (see page 36).

⚠ **Selecting Timer or Start-up, the Soft-start function is disabled, therefore the parameters $\boxed{\text{St.OP}}$ and $\boxed{\text{St.t}\Pi}$ will not be shown.** (see page 27)

6.1 START-UP FUNCTION

By means of this function it is possible to manipulate the control output when the controller is switched on.
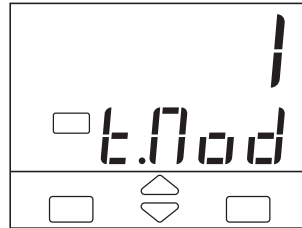
To configure Start-up function the parameter "Timer/Start-up operating mode" must be set to $\boxed{\qquad I}$.
Three parameters are associated to the Start-up function, they appear on the second group. (see page 27)

$\boxed{\text{S.P.SU}}$ **Start-up Setpoint** ($\text{SP. L} \ldots \text{SP. H}$)

$\boxed{\text{t.h.SU}}$ **Start-up hold time** (0…500 min.)

$\boxed{\text{OP.HS}}$ **Output high limit** (5.0%…100.0% min)

The Start-up function includes three phases:
1st "Limy" - The control output is limited to the $\boxed{\text{OP.HS}}$

2nd "Hold" - The process variable is maintained to the Start-up Setpoint for the time fixed by the parameter $\boxed{\text{t.h.S.U}}$

3rd "Off" - When the $\boxed{\text{t.h.S.U}}$ 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 ($\boxed{\text{S.P.SU}}$ - 40 digits), the Start-up function starts again from the "Limy" phase.

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

There are two possibilities:

A Start-up Setpoint `5P.5U` lower than the local Setpoint. The "Hold" phase starts when the process variable PV achieves the `5P.5U` (with a tolerance of 1 digit).

B Start-up Setpoint `5P.5U` 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 `5P.5U` and the working Setpoint , the next phase ("Hold" or "Off") will executed instead of the "Limy" phase.
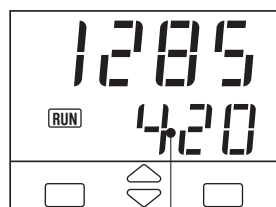
During the "Limy" and "Hold" phases the `RUN` led is on.

Start-up Setpoint

A `5.P.5U` < local Setpoint SP
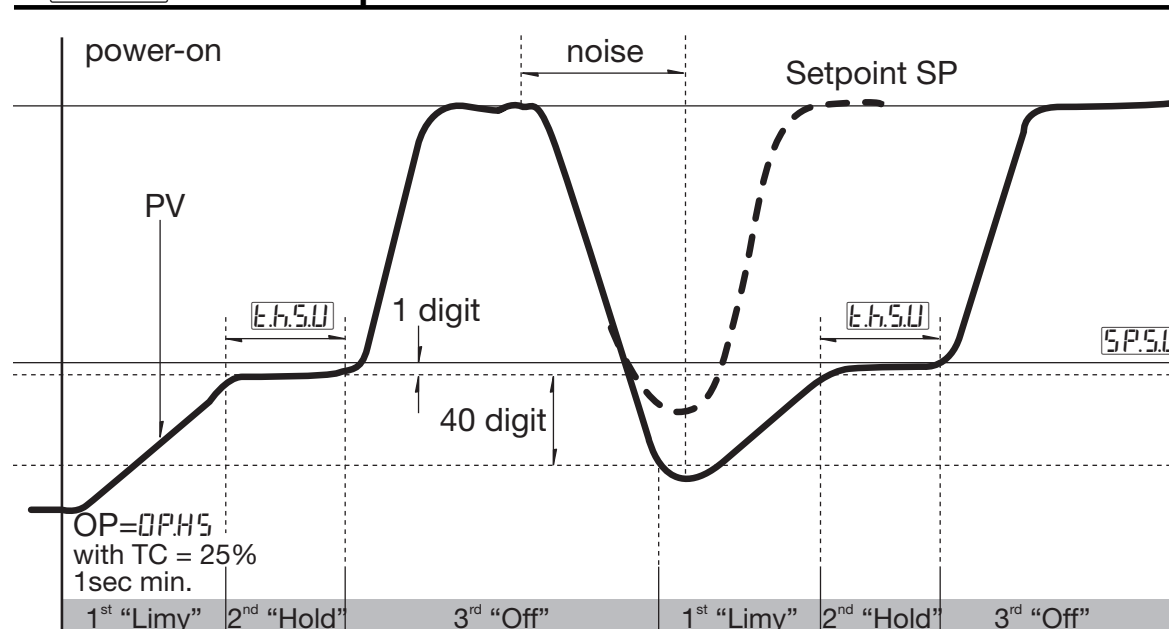
B `5.P.5U` < local Setpoint SP
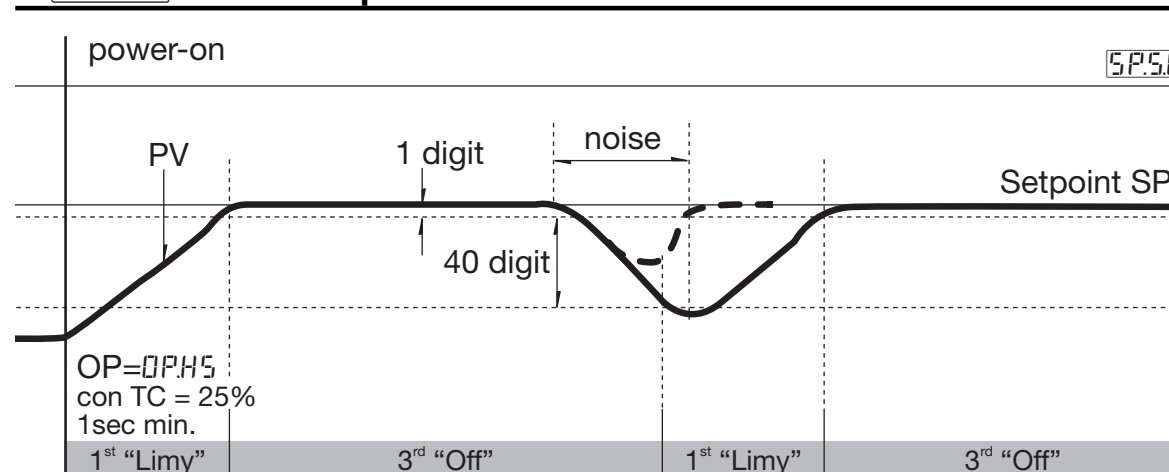
6.2 TIMER FUNCTION

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

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

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

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

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

Table 1

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

`t.Act` **Timer Action**

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

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

Table 2

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

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

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

`t.ME` **Timer setting** (1…9999 sec/min.)

`S.P. 2` **Stand-by Setpoint** (only for `t.Mod` = 7) (`SP. L …SP. H`)

6.2.1. DISPLAY
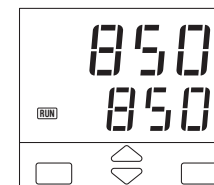
When the Timer is running, the led RUN is on.
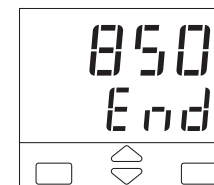
When the Timer ends, the Setpoint display shows alternatively the message `End` and the Setpoint

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

Operator mode
and Timer running

Press until

Remaining time.

Counting stop.

Remaining time value

Value change

If set to `0`
the timer ends
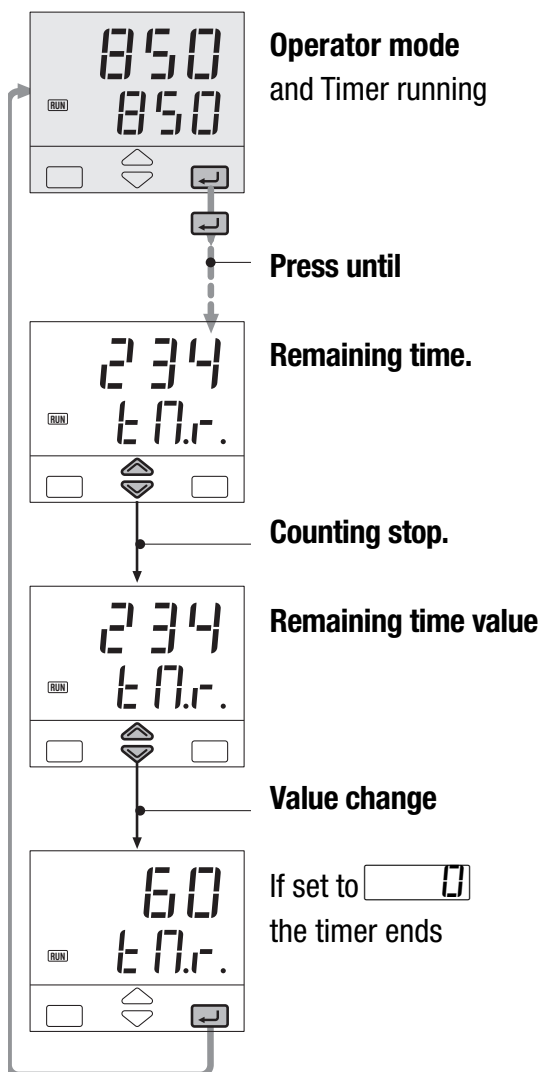
6.2.2 TIMER STARTING

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

To start/stop the Timer:

Operator mode

Press until

To start
select `Strt`

To stop
select `StoP`

Press the key `↵` to confirm
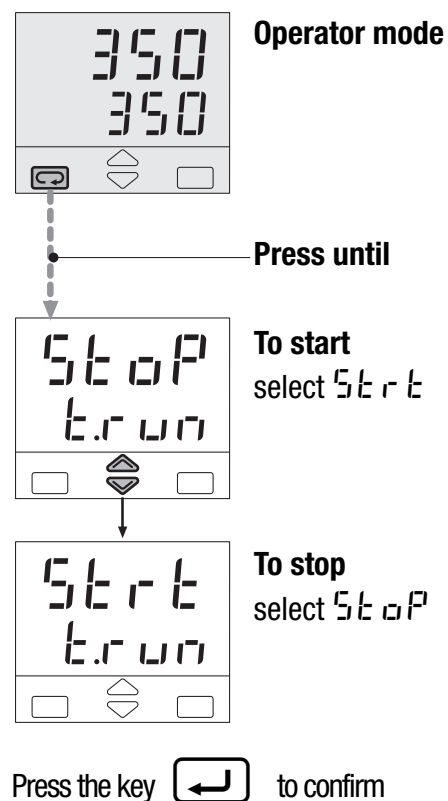
6.2.3 POWER FAILURE

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

Depending on Timer action `t.Act` selection, when the controller restarts you can have two different situations:
- with automatic mode (`t.Act` = 2, 3, 6, 7), the Timer function starts again and the counting time is reinitialised.
- with manual mode (`t.Act` = 0, 1, 4, 5), the control output is forced to `0` if `tMod` = 3 e 5; otherwise the control action restarts using the working Setpoint

6.2.4   TIMER COUNTING MODES

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

The time counting starts only when the error is inside a $\pm$ 1 digit band. The control action is not affected by the Timer function.
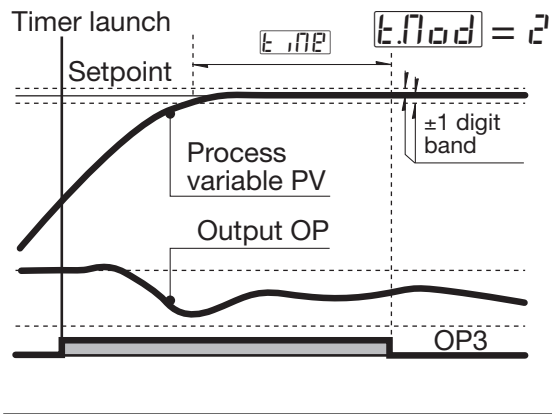
B Counting start time inside the band, end with control output forced to zero.

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

[1] When the Timer is not running the control output is forced to zero, also before the Timer launch
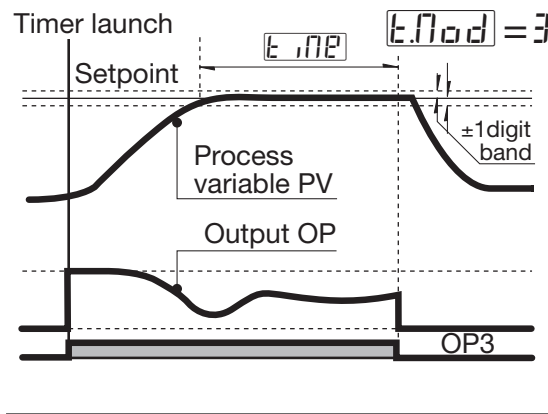
C Counting start time = timer launch time, end in control mode.

The time counting starts when the timer is launched. The control action is not affected by the Timer function.
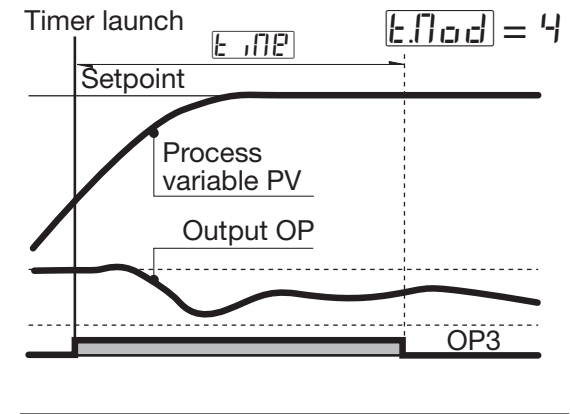
D Counting start time = timer launch time, end with control output forced to zero.

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

Timer launch $t.ih{E}$ $\boxed{t.\Pi od} = 5$

Setpoint

Process variable PV

Output OP

OP3
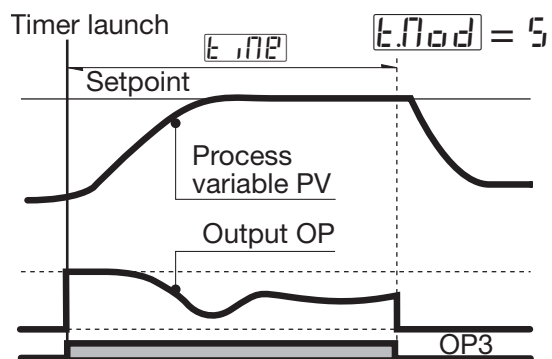
E No control action during the counting time.

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

Timer launch $t.ih{E}$ $\boxed{t.\Pi od} = 6$

Setpoint

Process variable PV

Output OP

OP3

[1] When the Timer is not running the control output is forced to zero, also before the Timer launch
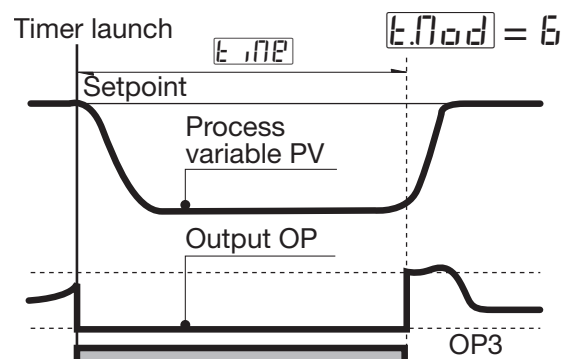
F Control action with stand-by Setpoint during the counting time

The time counting starts when the timer is launched and the control action use the Stand-by Setpoint. At the end, the control action use the working Setpoint.
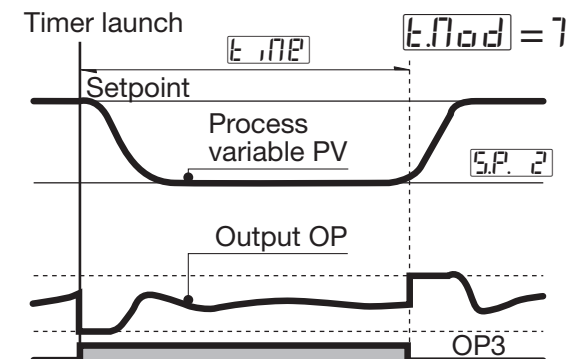
Timer launch $t.ih{E}$ $\boxed{t.\Pi od} = 7$

Setpoint

Process variable PV

$\boxed{5.P.\ 2}$

Output OP

OP3

7   TECHNICAL SPECIFICATIONS

Features (at 25°C environmental temp.)	Description			
Total configurability (see par. 3.2 page 18 par. 4.6 page 35)	From keypad or serial communication the user selects: - the type of input - the type of control algorithm - the type and functionality of the alarms	- the associated functions and the corresponding outputs - the type of output and the safe conditions - the values of all the control parameters.		
PV Input (see page11,12 and page 18)	Common characteristics	A/D converter with resolution of 50.000 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) 0.1% ±1 digits + accuracy of the used external shunt resistor (for mA)		Between 100…240V∼ 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: 0.3°C/10° Env. Temp. <0.1°C / 10Ω Wire Res.
	Thermocouple	L,J,T,K,S (IEC 584) Rj >10MΩ °C/°F selectable	Internal cold junction compensation con NTC Error 1°C/20°C ±0.5°C Burnout	Line: 150Ω max Input drift: <2µV/°C.Env. Temp <0.5µV / 10Ω Wire Res.
	DC input (current)	4…20mA,0-20mA with external shunt 2.5Ω Rj >10MΩ	Engineering units Conf. decimal point position Init. Sc -999…9999	Input drift: <0.1% / 20°C Env. Temp. <0.5µV / 10Ω Wire Res.
	DC input (voltage)	10…50mV, 0-50mV Rj >10MΩ	Full Sc. -999…9999 (min. range of 100 digits)	

Features (at 25°C environmental temp.)	Description				
CT auxiliary input (option)	Current transformer (see page 12)	50 or 100 mA input hardware selectable	Current visualisation 10 … 200A With 1A resolution and HeaterBreak Alarm		
Digital input (option)	The closure of the external contact produces any of the following actions:	Auto/Man mode change, Stored Setpoint activation, Keypad lock, Timer launch			
Operating mode and Outputs	1 Heat/Cool action PID loop or On/Off with 1 or 2 alarms	Single output	**Control output**		**AL2 alarm**	**AL3 alarm**
			OP1-Relay /Triac		OP2-Relay or logic	OP3-Relay/Triac
			OP2 -Logic		OP1-Relay /Triac	OP3-Relay/Triac
		Heat/cool	OP1-Relay /Triac	OP3-Relay /Triac	OP2-Relay or logic	
			OP1-Relay /Triac	OP2 Logic		OP3-Relay/Triac
			OP2 Logic	OP3-Relay /Triac	OP1-Relay /Triac	

Control mode				
	Algorithm	PID with overshoot control or On-off		
	Proportional band (P)	0.5…999.9%		PID algorithm
	Integral time (I)	0.1…100.0 min	OFF = 0	
	Derivative time (D)	0.01…10.00 min		
	Error band	0.1…10.0 digit		
	Cycle time	1…200 sec		
	Dead band	-10.0…10.0%		Heat / cool control action
	Cool relative gain	0.1…10.0		
	Cool cycle time	1…200 sec		
	Overshoot control	0.01…1.00		PID algorithm
	High limit	100.0…10.0% (heat) -100.0…-10.0%(cool)		
	Hysteresis	0.1…10.0%		On-Off algorithm

Features (at 25°C environmental temp.)	Description		
OP1 output	SPST Relay N.O., 2A/250V∼ for resistive load Triac, 1A/250V∼ for resistive load		Protection by varistor for 220V ∼ and capacitor
OP2 output	Logic not isolated: 5V–, ± 10%, 30mA max SPST Relay N.O., 2A/250V∼ for resistive load	Jumper selectable (page 13)	
OP3 output	SPST Relay N.O., 2A/250V∼ for resistive load Triac, 1A/250V∼ for resistive load		
OP4 countinuous control output (option)	Galvanic isolation: 500 V∼/1 min Resolution 12bit (0.025%) Accuracy: 0.1 %	In current: 0/4…20mA 750Ω/15V max	

AL2 - AL3 alarms	Hysteresis 0.1…10.0% c.s.				
	Action	Active high	Action type	Deviation threshold	±range
				Band threshold	0…range
		Active low		Absolute threshold	whole range
	Sensor break, heater break alarm, Latching/Blocking, Loop Break Alarm				

Setpoint	Local and stand-by digital input or serial communications	
	Ramp up and down. User inhibited	0.1…999.9 digit/min
	Low limit	from low range to high limit
	High limit	from low limit to high range

Tuning	**Fuzzy-Tuning** The controller selects automatically the best method according to the process conditions	Step response
		Natural frequency
	Adaptive Tuning self-learning, not intrusive, analysis of the process response to perturbations and continuously calculation of the PID parameters	

Auto/Man station	Standard with bumpless function, by keypad, digital input or serial communications
Serial comm. (option)	RS485 isolated, Modbus/Jbus protocol, 1200, 2400, 4800, 9600 bit/sec, two wires
Auxiliary Supply	+18V– ±20%, 30mA max for external transmitter supply

Features (at 25°C environmental temp.)	Description	
Operational safety	Measure input	Detection of out of range, short circuit or sensor break with automatic activation of the safety strategies and alerts on display
	Control output	Safety value: -100%…100%
	Parameters	Parameter and configuration data are stored in a non volatile memory for an unlimited time
	Access protection	Password to access the configuration and parameters data, keypad lock, output lock
General characteristics	Power supply (fuse protected)	100 - 240V $\sim$ (- 15% + 10%) 50/60 Hz or 24V $\sim$ (- 25% + 12%), 50/60 Hz and 24V– (- 15% + 25%) Power consumption 2.6W 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)
	Approvals	UL, cUL
	Protection EN60529 (IEC 529)	IP65 front panel
	Dimensions	$^1/_{16}$ DIN - 48 x 48, depth 120 mm, weight 130 gr. apx.

■ 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		Digital input		Digital input connected functions	
TC	Thermocouple		Isolated contact		Auto/Manual
Pt100	RTD (Pt100)		NPN open collector	RUN	Run, Hold, Reset and program selection
ΔT	Delta Temp (2x RTD)		TTL open collector	HOLD PV	PV hold
mA V	mA and mV			SP SLOPE	Setpoint slopes inhibition
Custom 2√	Custom	**Setpoint**			
Hz	Frequency	LOC	Local	**Output**	
		STAND BY	Stand-by		SPST Relay
Auxiliary input			Keypad lock		Triac
	Current transformer		Outputs lock		SPDT Relay
REM mA	mA Remote setpoint	START UP	Start-up function	mA	mA
REM V	Volt Remote setpoint	TIMER	Timer function	mA V	mA mV
POT.	Feedback potentiometer	MEM	Memorized		Logic
		REM	Remote		
			Setpoint programmer		