BAMOPHOX 194

Amperometric sensors signal monitor

INSTRUCTIONS MANUAL

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Amperometric signal monitor
BAMOPHOX 194
08-11-2012 194 M1 01 C

MES
194-01/1

Amperometric signal monitor

BAMOPHOX 194

(Technical information and Manual for LOGGER /RS422 version are on a specific document)

Table of contents

1. TECHNICAL FEATURES

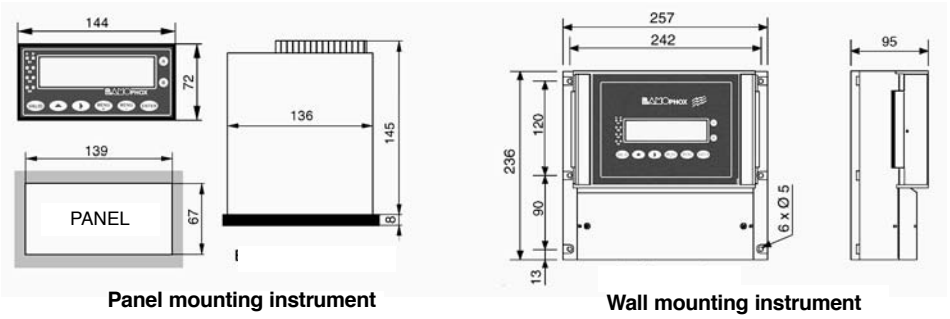
Displayed parameters:	Measured values - Configuration Menu - Temperature
Display:	Back lighted - 2 lines of 16 alphanumerical characters ; 9 mm high
Indication:	LED alarms status
Configuration:	8 push buttons keyboard on front board - Keyword protected
Sensor input:	For amperometric sensors 4-20 mA *(2 wire technique)* or 0/-2 V *(4 wire technique)*
Scales:	Configuration within the sensor in use, from 0.001 to 9999 ppm or g/L
Accuracy:	depending of the sensor in use *(see technical features of sensor)*
Flow control	Input for inductive sensor type NPN *(making contact if present flow rate)*
Temperature:	±3.0 °C
Relay outputs:	4 contacts (Silver alloy), voltage free
Thresholds:	3 programmable independent thresholds - with adjustable hysteresis 0…100 % ***** threshold S3 available in copy of external input signal *(example: flow sensor)* and adjustable, timer from 0 to 9999 sec
Output relay (S4)	Common alarm signal for: Too long injection, Temperature out of range etc.
Contact:	Initial resistance 0.1 Ohm as a maximum (voltage drop 6 V DC 1 A) Rated at 831 V AC / 3 A / 277 V AC ; 90 W / 3 A / 30 V DC Switching capacity *(minimum)* 100 mA, 5 V DC *(depending of switching frequency, ambient conditions, accuracy)* Mechanical life time *(minimum)* 5 x10^6 operations *(180 commutation /min)* Electrical life time *(minimum)* 2 x10^5 *(20 comm./min)* [3 A, 125 V AC], [3 A, 30 V DC] and 10^5 (evaluated charge) for 3 A, 125 V AC
ON/OFF Regulation:	Pulse time 0…9999 sec - High and low proportional bandwidth, high and low dead zone.
Calibration sequence:	Regulation on standby, relay outputs inhibited, analogical outputs stand on last values
Measurement output:	0/4-20 mA (maxi 600 Ohm) proportional to measurement, galvanic insulated
Temperature output:	0/4-20 mA (max 600 Ohm), scaling -20 to +160°C, galvanic insulated
Program Testing:	simulation through the menu on measurement, temperature, and relay outputs
Main power supply:	230 V AC / 50-60 Hz (other on request) - Consumption 10 VA
Models:	Panel mounting, IP65, 72 x 144 mm, connections on screw terminal IP40 Idem DIN Rail mounting, only for blind monitor Wall mounting, IP65, cable glands, connections on screw terminal

OPTION (RS 422 + Logger)

Communication:	RS422 output, J-BUS link, binary slave mode, 2400 to 9600 bauds
Data Logger:	Cycle average measurement record, with a programmable period, 150 000 records on memory card / External driver necessary for reading

2. DIMENSIONS

Extension terminal:
identical to the panel
or wall mounting

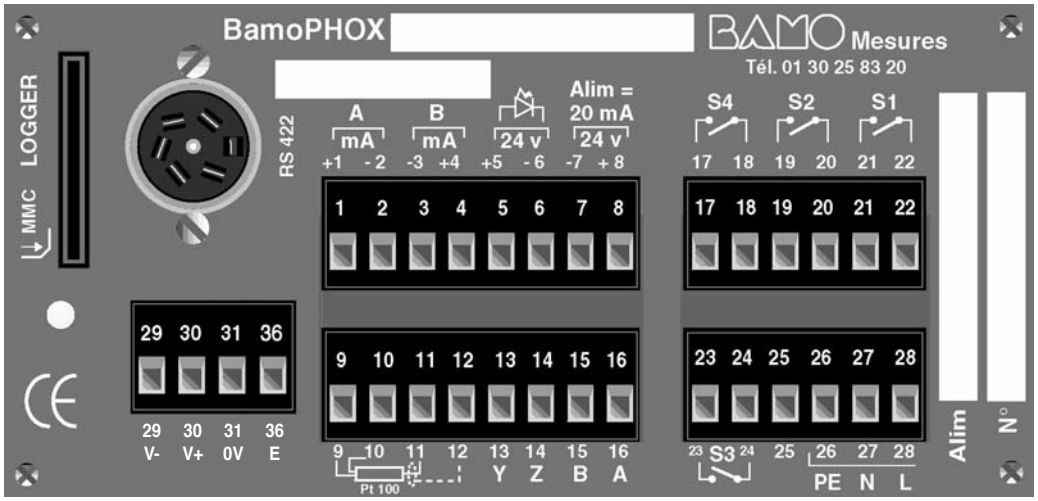


Panel mounting instrument **Wall mounting instrument**

3. WIRING

PANEL MOUNTING INSTRUMENT

OPTION:
LOGGER
&
RS 422



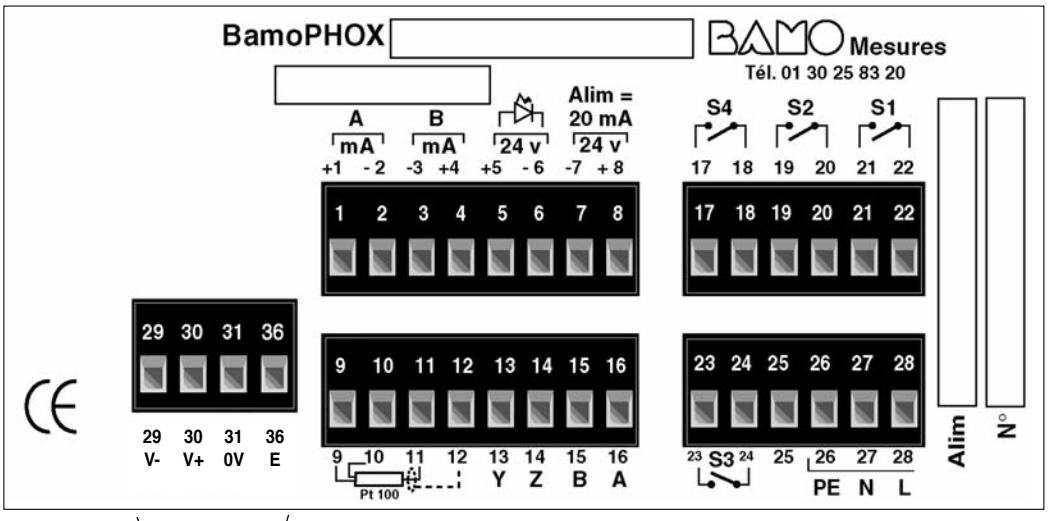
Signal input

WALL MOUNTING INSTRUMENT

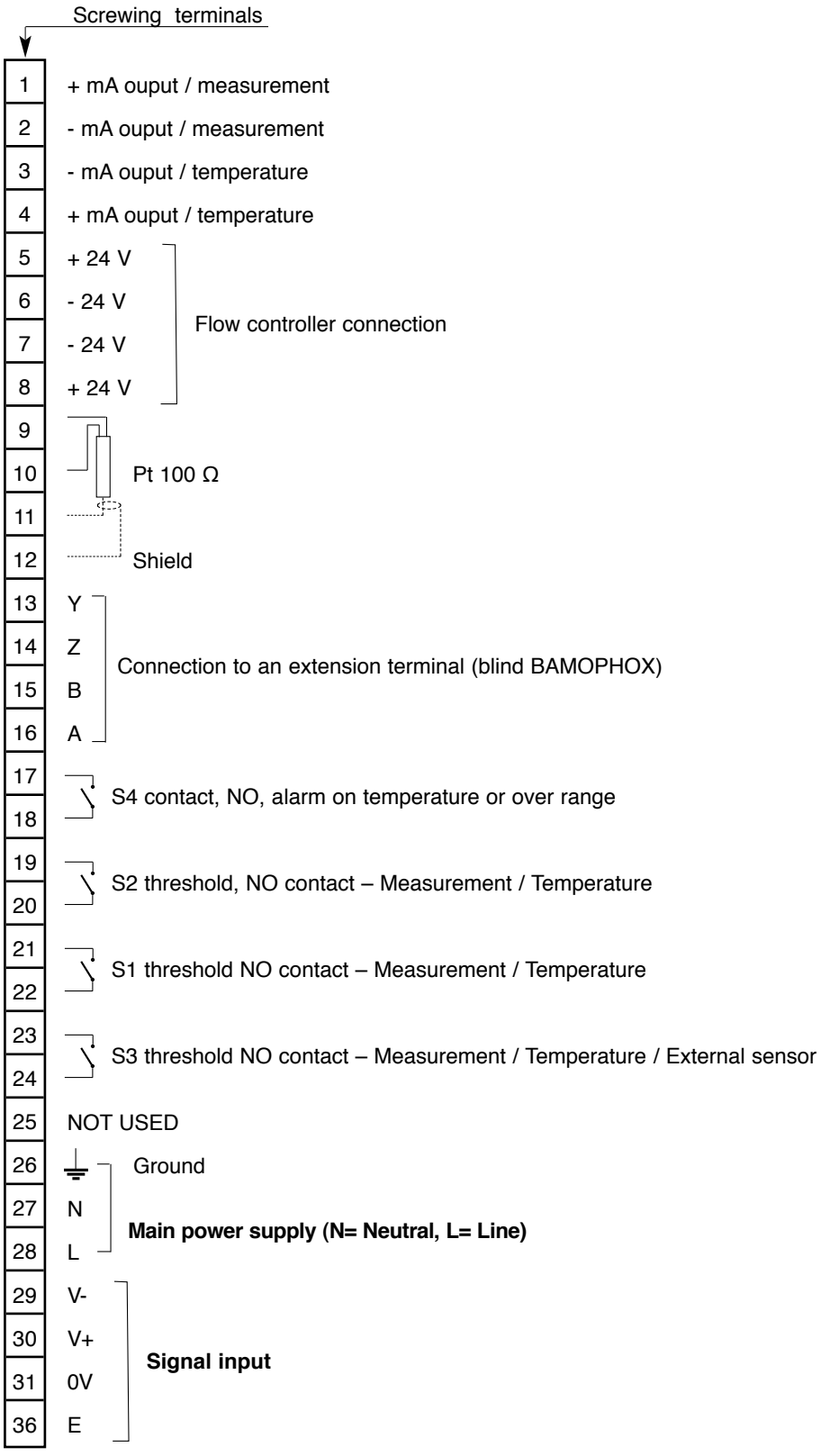
OPTION:
LOGGER
(access by upper cover)
&
RS 422

RS 422

32 33 34 35



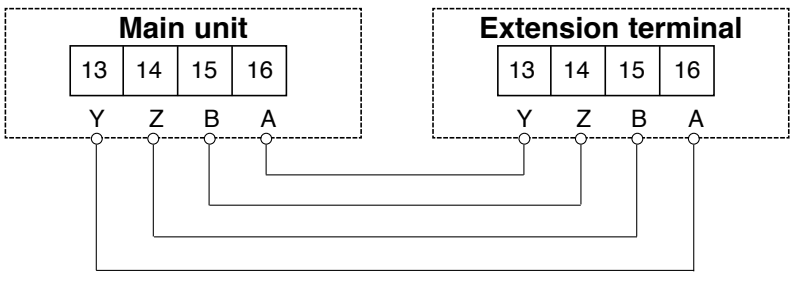
Signal input



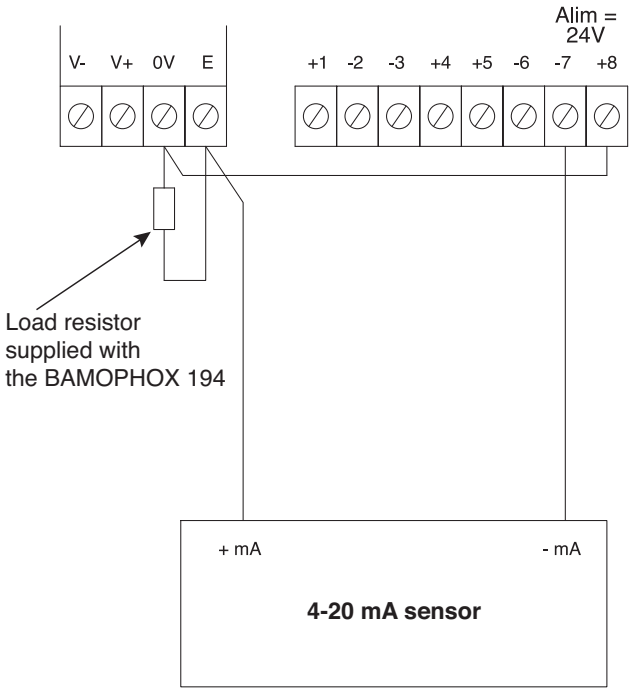
Wiring from wall or panel mounting BAMOPHOX to an Extension terminal BAMOPHOX

- Maximum length cable:
  500 m

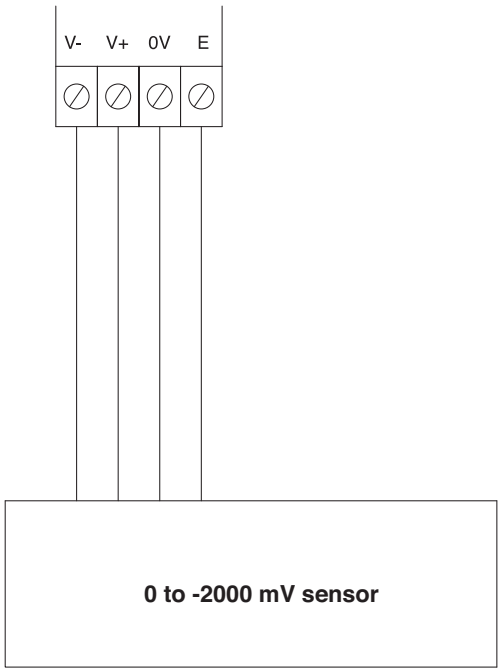
- Wire specifications:
  Mains cable or 4 wires shielded cable
  ≥ 0,25 mm² cross section

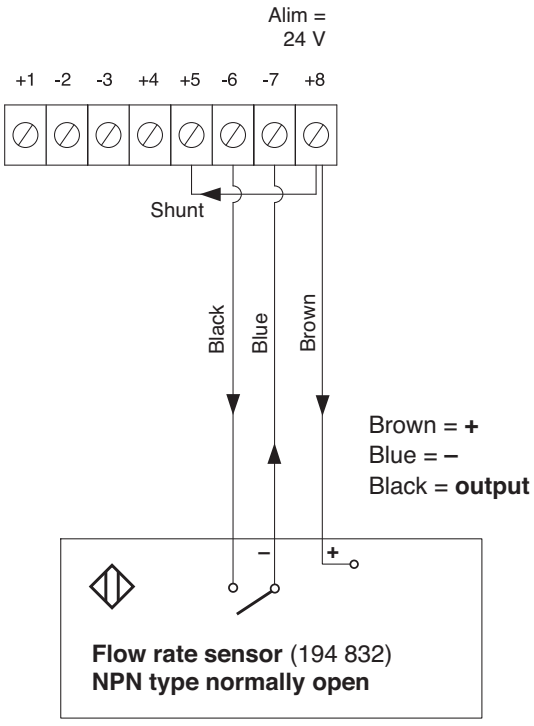


TERMINAL FOR SENSOR CONNECTION



TERMINAL FOR SENSOR CONNECTION





4. FRONT PANEL

S1, S2, S3, and S4
indicate relays status:

LED lighting = contact ON
LED OFF = contact OFF
LED flashing = Timer in use

2 lines /16 alphanumeric characters
9.22 mm high - Back lighted

Key **"A"**
To display the parameters of upper line.
(main BAMOPHOX)

Key **"B"**
To display the parameters of lower line.
(Extension blind BAMOPHOX)

"VALID" key
To save the parameters on EPROM
when it asks:

SAVING ?

Caution, when you press this key,
all parameters are saved.
(previous data programmation
will be overwrited).
If you are not sure of any modification,
do not press the VALID key,

"ENTER" key
To change the step displayed menu.
At the last step, it comes back to the
first line.

"MENU - " key
To move the cursor during configuration.
At the last digit, comes back on the first one.

To change parameters of data capture:

Numéric input increase the
flashing digit (loop 0 after 9).

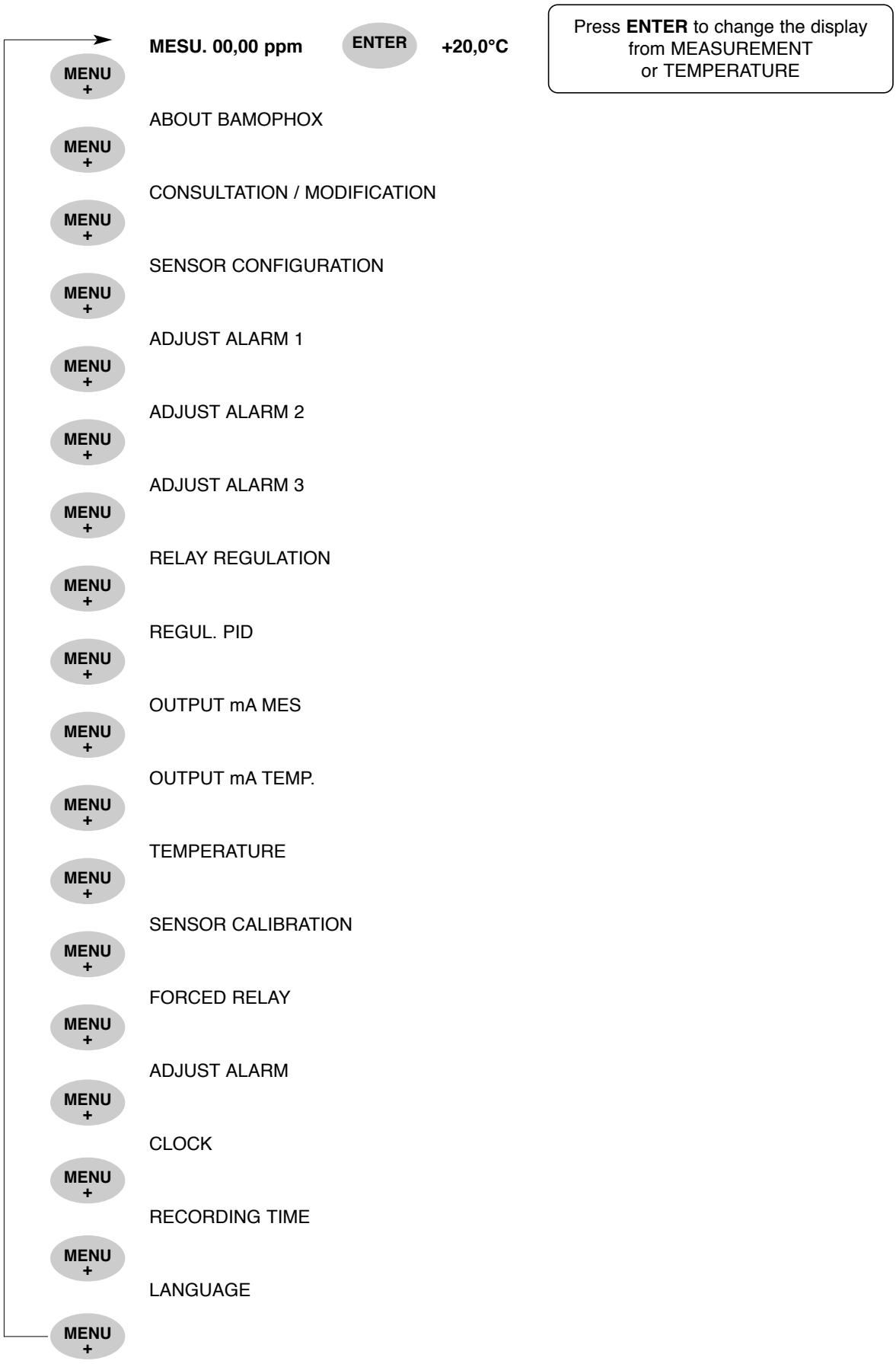
Reverse the choice Yes / No,
Up/Down, 0-20 mA / 4-20 mA etc.

"MENU +" key
To go to the next menu.

Pushing simultaneously both keys
"**MENU +**" and "**ENTER**"
allows a fast return to measurement display.

To go to the next display or to change a value.

I/ PRESENTATION ET DEFILEMENT DU MENU



ABOUT Bamophox

ENTER — ABOUT BAMOPHOX

ENTER — VERSION 2.04

ENTER — SERIAL N°

ENTER — 20451 05

CONSULTATION / MODIFICATION

CONSULTATION

▲

MODIFICATION

ENTER

CODE ? 0000 ▲ ▶

ENTER

CODE ? 5105

ENTER

TIME : 30 mn

MENU +

The last 4 digits (of serial number) are the key code to access to the MODIFICATION menu.
When wrong code is entered, a message "ERROR" appears during 3 seconds

After 30 minutes, the display returns automatically to the measurement mode

From this mode: MODIFICATION, for testing the relay outputs and regulation mode: reach measurement display (last screen) and press ENTER

ENTER

FORCED MEASURE

ENTER

00.00 ppm ▲ ▶

(one digit is flashing) Modify the value. Immediately the instrument acts within the configuration (thresholds, regulation, analog outputs ...).

When PID regulation is activated, the display shows the PID %

ENTER

FORCED PID

ENTER

00.00 ppm 00.00 % ▲ ▶

(One digit is flashing) Modify the value. Immediately the instrument acts within the configuration.

To test the analog output (mA) on PID mode: the PID should be active and in MANUAL mode.

ENTER

Press ENTER to cancel the test mode and to go back to the measurement mode.

SENSOR CONFIGURATION

Next menu: MENU + → *ADJUST ALARM 1*

ENTER		
PRODUCT	▲	Select corresponding sensor for: free chlorine, total chlorine, chlorine dioxide, ozone, hydrogen peroxide, peracetic acid
ENTER		
UNIT	▲	Choose between: ppm / g/L
ENTER		
x-x.xxx ppm		Decimal point (coma) position
ENTER		
SCALE		
ENTER		
MAXI: 00.00	▲ ▶	Maximal value of the measuring scale
ENTER		
SENSOR	▲ ▶	mA or mV
ENTER		
SAVING ?		
ENTER		

INTRODUCTION TO BAMOPHOX CONTROL

Before setting up alarms or way of control, the running way has to be defined.

Bamophox 194 allows you three ways:

- Single alarms with alarms S1 and/or S2
- Relay regulation with set point, proportional bands and dead zones
- P.I.D. regulation with the 4-20 mA signal

There is a specificity of alarm 3 in Bamophox 194. It can be setup for an external sensor. Signal is coming from an inductive flow rate sensor type NPN. This sensor is mounted in the flow cell.
Sensor signal entering Bamophox 194 activates or deactivates S3 alarm:

- In case of flow rate, alarm 3 is closed (active)
- In miss of flow rate, alarm 3 is open (inactive)

This signal will act on the regulation like following:

- If the user is running with single alarms, there will be no more action on alarms S1 and/or S2.
  However user can wire alarms S1 and S3 in serial way in the aim of securing the injection (if alarm 1 deals with the reagent injection)
- If the user is running in relay regulation, alarms S1 and S2 become open (inactive).
  The regulation is inhibited.
- If the user is running P.I.D regulation, 4-20mA signal become locked.

ADJUST ALARM 1

Next menu: MENU + → *ADJUST ALARM 2*

ENTER

ALARM 1 **ON/OFF** ▲

ENTER

ALARM 1 **MEASURE/TEMP** ▲ **MEASURE**= Threshold against measured value
TEMP.= Threshold against temperature measured value

ENTER

ALARM 1 LOW/HIGH ▲ **HIGH**= Contact closes when value goes over the limit
LOW= Contact closes when the value goes under the limit

ENTER

ON **00.00** ppm ▲ ▶ To close the contact S1 at this value

ENTER

OFF **00.00** ppm ▲ ▶ To open the contact S1 at this value

ENTER

DELAY UP **ONI/OFF** ▲ Delay (or no delay) before to close the contact S1

ENTER

TIME **0000** SEC ▲ ▶ Delay time to close the contact S1

ENTER

DELAY DOWN **ON/OFF** ▲ Delay (or no delay) before to open the contact S1

ENTER

TIME **0000** SEC ▲ ▶ Delay time to open the contact S1

ENTER

SAVING ?

VALID

ADJUST ALARM 2

Next menu: MENU + → *ADJUST ALARM 3*

ENTER

ALARM 2 **ON/OFF** ▲

ENTER

ALARM 2 **MEASURE/TEMP** ▲ **MEASURE**= Threshold against measured value
TEMP.= Threshold against temperature measured value

ENTER

ALARM 2 LOW/HIGH ▲ **HIGH**= Contact closes when value goes over the limit
LOW= Contact closes when the value goes under the limit

ENTER

ON **00.00** ppm ▲ ▶ To close the contact S2 at this value

ENTER

OFF **00.00** ppm ▲ ▶ To open the contact S2 at this value

ENTER

DELAY UP **ONI/OFF** ▲ Delay (or no delay) before to close the contact S2

ENTER

TIME **0000** SEC ▲ ▶ Delay time to close the contact S2

ENTER

DELAYDOWN **ON/OFF** ▲ Delay (or no delay) before to open the contact S2

ENTER

TIME **0000** SEC ▲ ▶ Delay time to open the contact S2

ENTER

SAVING ?

VALID

ADJUST ALARM 3

Next menu: MENU + → *RELAY REGULATION*

ENTER

ALARM 3 **ON/OFF** ▲

ENTER

EXTERN **NO/YES** ▲

NO= set up (ALARM 3 MEASURE/TEMP)

YES= flow rate sensor wired

SAVING ?

VALID

ENTER

ALARM 3 **MEASURE/TEMP** ▲

MEASURE= Threshold against measured value
TEMP.= Threshold against temperature measured value

ENTER

ALARM 3 LOW/HIGH ▲

HIGH= Contact closes when value goes over the limit
LOW= Contact closes when the value goes under the limit

ENTER

ON **00.00** ppm ▲ ▶

To close the contact S3 at this value

ENTER

OFF **00.00** ppm ▲ ▶

To open the contact S3 at this value

ENTER

DELAY UP **ONI/OFF** ▲

Delay (or no delay) before to close the contact S3

ENTER

TIME **0000** SEC ▲ ▶

Delay time to close the contact S3

VALID

DELAYDOWN **ON/OFF** ▲

Delay (or no delay) before to open the contact S3

ENTER

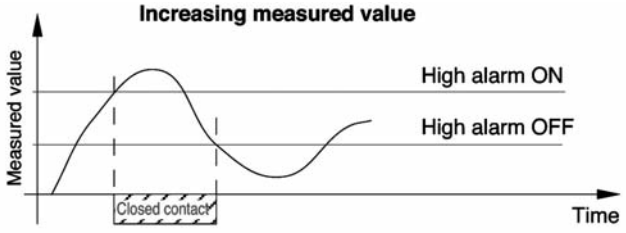
TIME **0000** SEC ▲ ▶

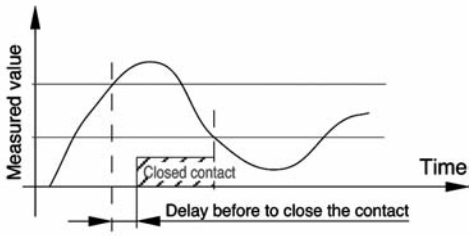
Delay time to open the contact S3

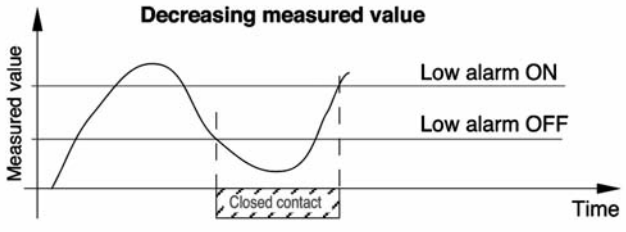
ENTER

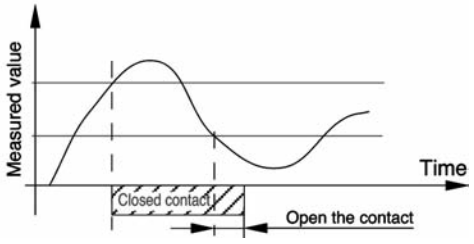
SAVING ?

VALID









RELAY REGULATION

Next menu: MENU + → *REGUL PID*

ENTER

ON/OFF MODE

ENTER

Indicates when S1 or S2 are "ON"
Back to "ADJUST ALARM" to switch OFF S1 or S2

ENTER

REGUL. PID

ENTER

Indicates when "REGUL. PID" is operating
Back to "REGUL. PID" menu to switch it OFF

REGUL **ON/OFF** ▲

ENTER

SET VAL. **0,000** ppm ▲ ▶ Set point

ENTER

T. CYCLE **0000** SEC ▲ ▶ Cycle time

ENTER

HIGH PB **00.00** ppm ▲ ▶ Highest limit for proportional bandwith

ENTER

LOW PB **00.00** ppm ▲ ▶ Lowest value for proportional bandwith

ENTER

H IGH DZ **00.00** ppm ▲ ▶ Highest value for dead zone

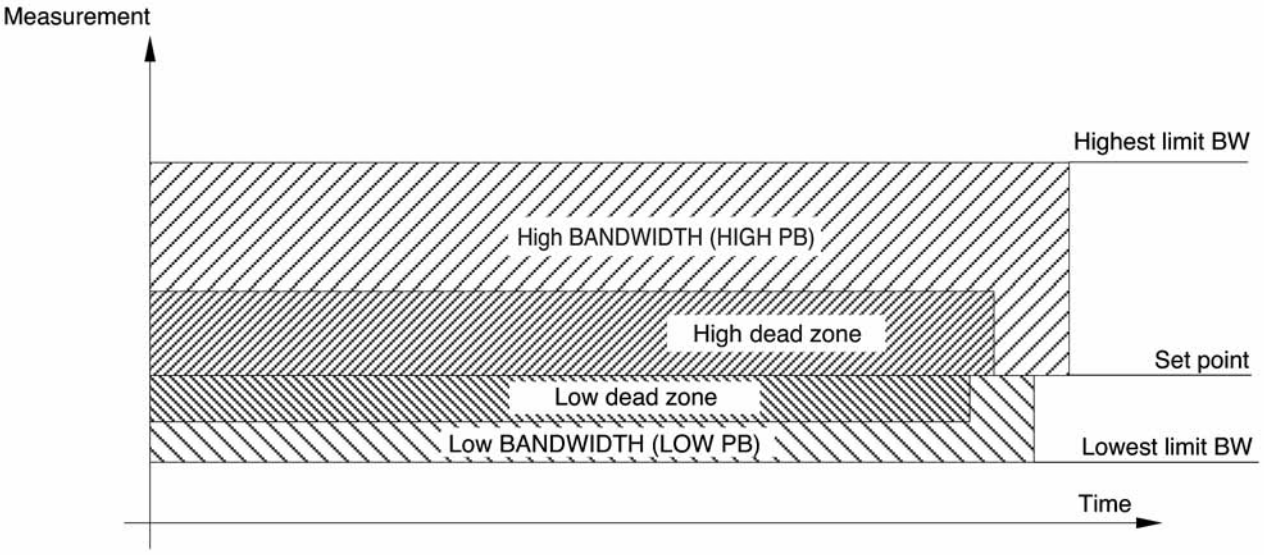
ENTER

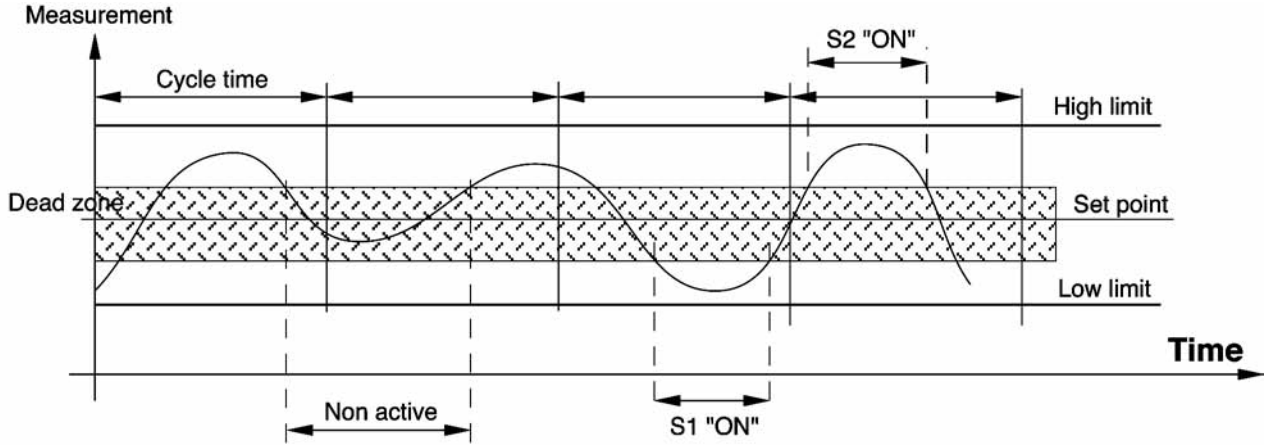
LOW DZ **00.00** ppm ▲ ▶ Lowest value for dead zone

ENTER

SAVING ?

VALID





Example

With process configuration:

- Set point: 1.5 ppm
- High dead zone: 0.4 ppm between 1.5 and 1.9 ppm
- Low dead zone : 0.1 ppm between 1.4 and 1.5 ppm
- High BANDWIDTH: 3.5 ppm (that is a limit of 5 ppm for the maximum)
- Low BANDWIDTH: 0.5 ppm (that is a limit of 1 ppm for the minimum)

- Over the highest limit (>5 ppm), S2 is “ON” for a continuous injection (contact S2 is closed)
- Under the lowest limit (<1 ppm), S1 is “ON” for a continuous injection (contact S1 is closed)
- Inside the dead zone (between 1.4 & 1.9 ppm), S1 and S2 are “OFF”, no injection at all (contacts S1 and S2 are opened)
- If the measurement value is between the dead zone and the highest limit (between 1.9 & 5 ppm) or between the dead zone and the lowest limit (between 1.0 & 1.4 ppm), the contact S1 or S2 are “ON” only for a time proportional to the step between measurement and desired value.

$$\text{Closing contact time /S1} = \frac{\text{Cycle time x (measure - set point)}}{\text{Low proportional BANDWIDTH}}$$

CAUTION: The minimum closing time of a relay is 1 second.

If the measurement M=1.42 and if the cycle time is 10 seconds,

the closing contact time is: $\frac{10 \times (1.5-1.42)}{0,4} = 2$ sec

REGUL PID

Next menu: MENU + → *Output mA MEASUREMENT*

This operating mode allows a PID regulation through an analog output 0/20 or 4/20 mA

	REGUL **ON/OFF**	▲	To switch ON or OFF the regulation mode
ENTER			
	REGUL **AUTO/MANU**	▲	MANU=MANUAL to be able to check the relays output
ENTER			
	SET VAL **00.00 ppm**	▲ ▶	Set point value
ENTER			
	GAIN : **00.000**	▲ ▶	Gain setup (see also ADJUST PID PARAMETERS)
ENTER			
	T.i : **0050** Sec	▲ ▲	Integral timing
ENTER			
	Td : **0012** Sec	▲ ▶	Derivative timing
ENTER			
	ACTION: **DIRECT/REVERSE**	▲	Direct action or Reverse action for PID regulation
ENTER			
	OUTPUT **4/20 mA** / **0/20 mA**	▲	Signal output
VALID			
	SAVING ?		

To switch the PID regulation on stand-by, input 24 V= 20 mA on terminals 5(+) and 6(-).

ADJUST PID PARAMETERS

In order to determinate the setup values for PID regulation, we recommend to use the Ziegler-Nichols open loop method

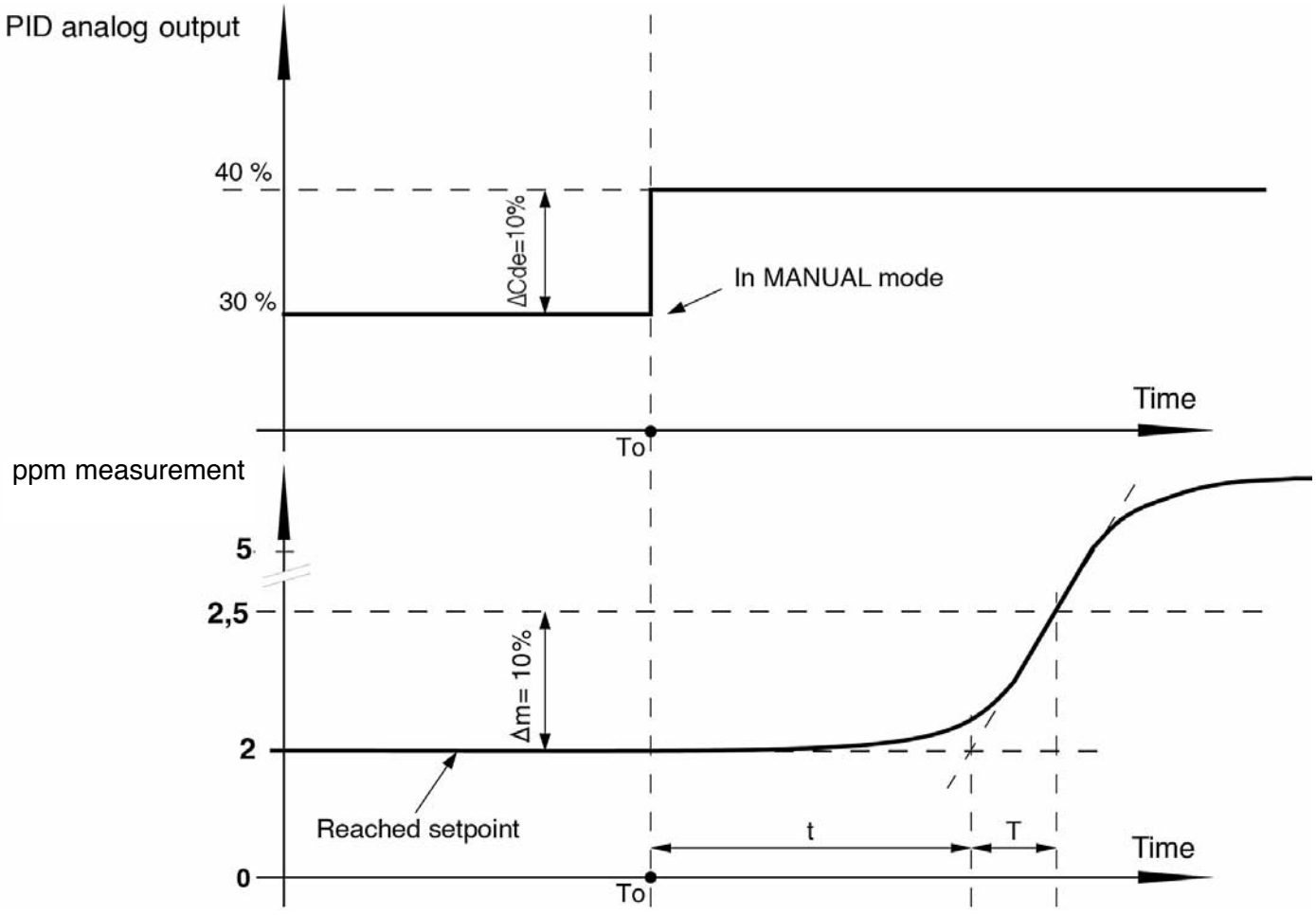
Proceed as following:

- Connect a recorder to the analogic measurement output or write the reading measurement values for then to draw the graph $f_{(time)}$
- Switch on the PID regulation in MANUAL mode
- Reach to and keep close the measurement value to the set point, adjusting the PID output
- Apply on ΔCde a step of 10 % (for instance) on the analog output (Cde).

Example: if the value is 30%, apply 40%

- Note on the graph the corresponding timing T_0
- Find on the graph both times t ant T such as Δm= ΔCde:
  - t = delay of response
  - T = Time corresponding to the same variation in % of measurement (Δm) and the analog output (ΔCde), Δm= ΔCde. This value may be found out on the slope.
- Modify the PID parameters as following:

Regulation	Gain	Ti(s)	Td(s)
PID	1.2 x T/t	2 x t	0.55 x t
PI	0.9 x T/t	3.3 x t	0
P	T/t	9999	0


PID analog output
40 %
30 %
ΔCde=10%
In MANUAL mode
Time
To
ppm measurement
5
2,5
2
0
Δm= 10%
Reached setpoint
t
T
Time
To

Output mA MEASUREMENT

Next menu: MENU + → *Output mA TEMP.*

Measurement signal copy on the analog output

ENTER

HIGHER **00.00** ppm — ▲ ▶ — Value corresponding to 20,00 mA

ENTER

LOWER **00.00** ppm — ▲ ▶ — Value corresponding to 0.00 or 04,00 mA

ENTER

OUTPUT **4/20 mA** / **0/20 mA** — ▲ — Output type

ENTER

SAVING ?

VALID

Output mA TEMP.

Next menu: MENU + → *TEMPERATURE*

Caution: When PID regulation is active, this step menu does not appears

ENTER

HIGHER **0000** °C — ▲ ▶ — Value corresponding to 20.00 mA

ENTER

LOWER **0000** °C — ▲ ▶ — Value corresponding to 00.00 or 04.00 mA

ENTER

OUTPUT **4/20 mA** / **0/20 mA** — ▲ — Output type

ENTER

SAVING ?

VALID

To switch the PID regulation on stand-by, input 24 V= 20 mA on terminals 5(+) and 6(-).

TEMPERATURE

Next menu: MENU + → *SENSOR CALIBRATION*

ENTER

MEASURE : **AUTO / MANUAL** — ▲ —

AUTO: A Pt 100 probe should be connected

MANUAL: Without Pt 100 probe
Manualy entered temperature value

ENTER

FLUIDE T. + **0000** °C — ▲ ▶ — *(In MANUAL Mode only)*

ENTER

SAVING ?

VALID

ELECTRODE CALIBRATION

Next menu: MENU + → *FORCED RELAY*

CAUTION - Temperature compensation:
set up the instrument on MANUAL mode at 20°C

During calibration in mode "MODIFICATION", measurement value is on stand-by on the last reading value, the regulation is on stand-by. A delay after ending the calibration allows a restart of the complete system before to automatically restart the regulation mode.

ENTER

STANDARD. ZERO **YES/NO** ▲ ▶

Choose **NO**, the sensor is a non adjusting zero required
NO will send to the display "**SLOPE**"

ENTER

STANDARD. SLOPE **YES/NO** ▲ ▶

Choose **YES** to proceed to a sensor calibration
NO will send to the display "**DELAY**"

ENTER

Proceed to a test to know the standard value according to the sensor in use.

STANDARD **00.00** ppm ▲ ▶

Enter the result value

(For good calibration, value has to be as closed as the sensor full range)

ENTER

SLOPE xxx,x %

Sensor gain is displayed.

ENTER

CAUTION:

If the slope value is >200% or <50%, do not valid this calibration step. Check the dirtiness of the sensor; do a maintenance on it and proceed to a second calibration.

If the slope value is between 50 and 200%, proceed to a second test to confirm the previous test

DELAY 0015 Sec

Set up the time during the measuring and status regulation previous to the calibration, will be displayed after saving the calibration.

SAVING ?

VALID

CAUTION - Temperature compensation: if a PT100 probe is connected, reset the temperature compensation in "AUTO"

FORCED RELAY

Next menu: MENU + → *ADJUST ALARM*

ENTER

ALARM 1 ON / OFF ▲

ENTER

ALARM 2 ON / OFF ▲

ENTER

ALARM 3 ON / OFF ▲

ENTER

ALARM 4 ON / OFF ▲

ENTER

Diagnostic mode to test manually the threshold configurations

ADJUST ALARM

Next menu: MENU + → *LANGUAGE* *or* *CLOCK*

ENABLES or DISABLES the S4 relay

(In case of malfunction of the control relay)

This mode allows detecting a malfunction on S1 and S2 contacts ; an overtime contact could be set up.

ENTER

WITH / WHITHOUT ALARM ▲

ENTER

TMAX. S1 **0000** Sec ▲ ▶ Over timing on S1 closed contact *(maximum time for active relay)*

ENTER

TMAX. S2 **0000** Sec ▲ ▶ Over timing on S2 closed contact *(maximum time for active relay)*

ENTER

SAVING ?

VALID

LANGUAGE

ENTER

FRENCH / ENGLISH / ITALIAN GERMAN ▲

ENTER

SAVING ?

VALID

NOTE:
To complete the configuration of a **BAMOPHOX Logger** (option) follow the corresponding manual.