pH/ mV monitors
BAMOPHAR 107

USER MANUAL

BAMO INTERNATIONAL
22, Rue de la Voie des Bans · Z.I. de la gare · 95100 ARGENTEUIL
Tel **+33 (0)1 30 25 83 20** **Web** **www.bamo.eu**
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SUMMARY

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1. DESCRIPTION

BAMOPHAR 107 is designed for pH and ORP measurements. It is equipped with a color touch screen for the display of a multilingual menu friendly and intuitive. The reading is easy at the same time for measurement, temperature and relay status. It displays a menu with all parameters for configuration of analogue outputs, thresholds and regulation mode. In order to facilitate its commissioning, a programming menu can simulate the measurement, acting on themeasurement analog outputs and P.I.D, as well as on the thresholds.

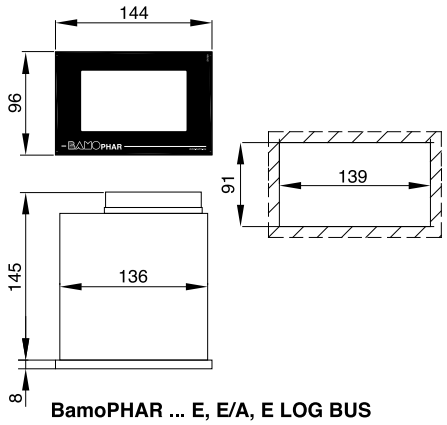
2. TECHNICAL FEATURES

End-user interface	Color touch screen 4.3", resolution 480x272 pixels Display of measurements, menus, temperature, relay status Configuration: password protected
Measuring scales	0... 14 pH or -1000 ... +1000 mV
Accuracy	± 0.03 pH or ± 3 mV
Input impedance	> 10^{13} Ω
Sensor signal connection	For coaxial connector (9054) on panel and rail mount devices Screw terminals on wall mount instrument
Temperature compensation	Automatic, input for sensor Pt 100 Ω at 0 °C, range 0 to 100 °C Manual, between 0 and 100 °C, by configuration
Relay outputs	4 contacts N.O., voltage free
Configurable thresholds	2 independent thresholds, to set up for measurement or temperature 1 independant threshold to set up for measurement or temperature, or for an external signal (E1) 1 threshold for alarm (too long injection, measurement out of range, faulty Pt100 sensor or cleaning mode)
Contact Initial resistance	100 mΩ max. (voltage drop 6 V DC 1 A)
Switching power	831 VA AC / 3 A / 277 V AC 90 W / 3 A / 30 V DC
Switching capacity (min.)	100 mA, 5 V DC (depending of frequency, ambient conditions)
ON/ OFF Regulation	Adjustable cycle time from 0 to 9999 s, High and low proportional bandwidths, high and low dead zones
PID Regulation	Adjustable proportionality from 0 to 200%; Integrant and Derivative: 0 to 999 s
Calibration routine	Relay outputs inhibited; Analogue outputs on standby at latest values
Auto-cleaning menu	Settings of frequency and duration; Relay outputs inhibited, analogue outputs on standby at latest values
Measurement output	0/4 ... 20 mA (max. 600 Ω) proportional to measurement value of pH or ORP
Temperature output or PID	0/4 ... 20 mA (max. 600 Ω), scaling within 0 ... 100°C
Program testing	Simulation through the menu on measurement output, temperature, PID and thresholds
Main power supply	230 V AC - 50/60 Hz - consumption 10 VA (other supplies on request)
Models	Panel mount, 96x144 mm; Front IP 65, rear IP 40 Wall mount, IP65; Cable glands
Temperature limits	Operating: -5 ... +50 °C; Storage: -10 ... +70 °C

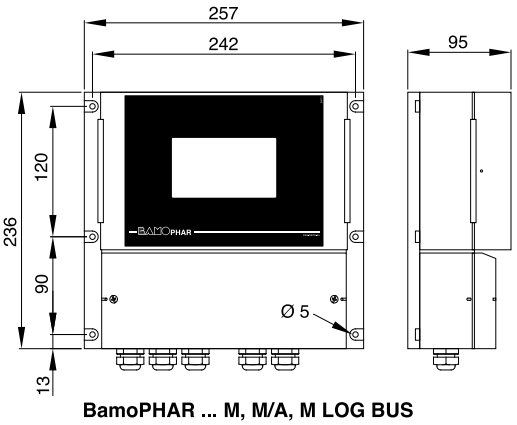
OPTION (RS 422 + data logger)

Interface	RS422 output, J-BUS link; Binary slave mode; 2400 to 9600 bauds
Data Logger	Record of cycle average measurement; 150 000 records max. on memory card, reading on external driver.

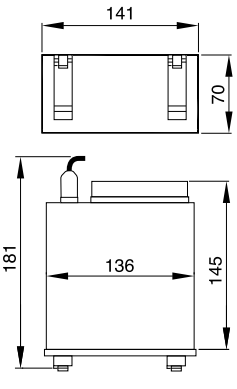
3. DIMENSIONS



BamoPHAR ... E, E/A, E LOG BUS



BamoPHAR ... M, M/A, M LOG BUS



BamoPHAR ... D/A

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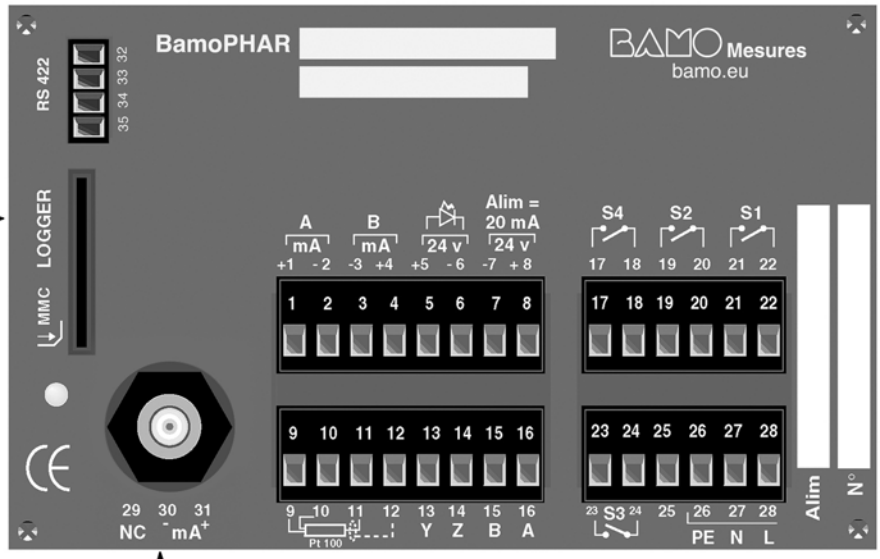
4. ELECTRICAL CONNECTIONS

4.1 VIEWS OF TERMINALS

PANEL MOUNTING MODEL

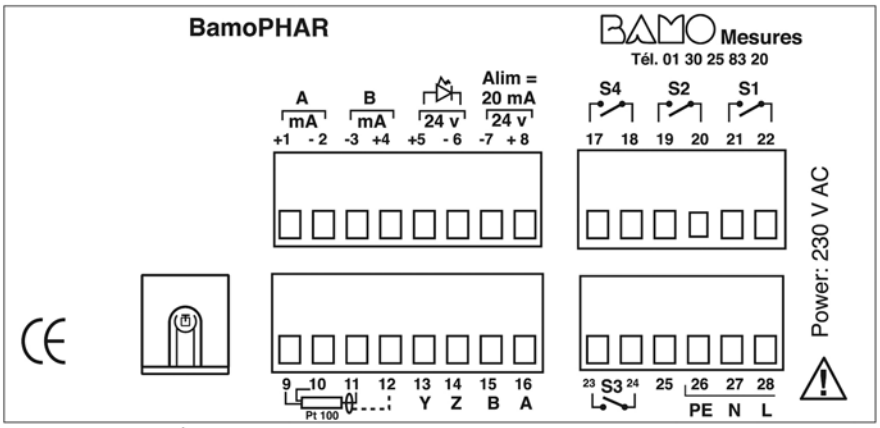


SIGNAL INPUT
(for coaxial connector 9054)

OPTION: RS422 AND DATA LOGGER

Wall mounting model: Access to memory card by opening the top cover

WALL MOUNTING MODEL



32 33 34 35
RS 422

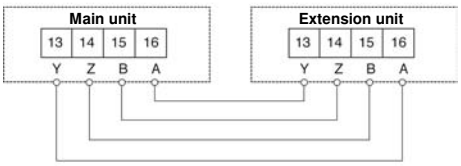
Measurement input
Screw connector for pH cable type 9060

Note: Signal input on screw connector for 9060 cable type.
(Only for wall mount models - codes 107520, 107521, 107523 and 107524)

4.2 TERMINAL STRIP ASSIGNMENTS

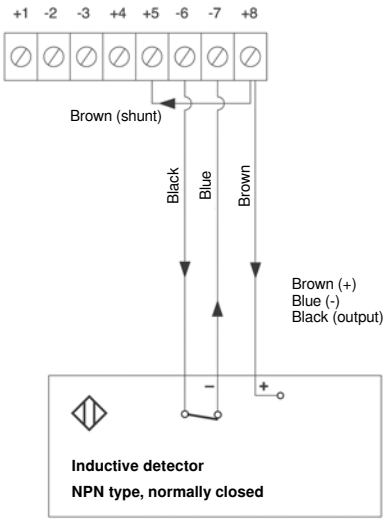
Description	Terminal	Connection
Output [mA], pH or Redox measurement	1	+ mA
	2	- mA
Output [mA] of temperature or PID	3	- mA / PID
	4	+ mA / PID
Input E1 (external contact)	5	+ 24V
Whith voltage occurs between terminals 5 & 6: regulation is set on stand-by (see § 9.2.1)	6	0V
Power supply to 4-20 mA sensor (2-wire)	7	0V
	8	+ 24V
Input for Pt 100 sensor (2- or 3-wire)	9	+
	10	+
	11	-
	12	Shielding
Connections for an extension terminal (blind unit)	13	Y
	14	Z
	15	B
	16	A
Relay S4 (N.O. contact) for Fault alarm/ Regulation/ Cleaning routine	17	S4
	18	
Relay S2 (N.O. contact) for measurement/ temperature	19	S2
	20	
Relay S1 (N.O. contact) for measurement/ temperature	21	S1
	22	
Relay S3 (N.O. contact) for measurement or temperature	23	S3
May be assigned to the external signal: becomes NC contact (see § 9.2.3)	24	
	25	
Main power supply	26	PE = Earth (equipotential)
	27	N = Neutral
	28	L = Live

Connection of an extension unit



Cable length max..	**500 m**
Cable type	Network cable or 4-wire shielded cable, ≥ 0,25 mm²

Example of connecting on E1 input a flow controller, NPN type, Normally closed (code 194831)



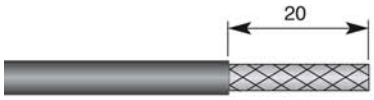
4.3 CONNECTION OF pH CABLE 9060 TO WALL MOUNT BAMOPHAR

Only for wall mount models - codes 107520/ 21/ 22/ 23/ 24

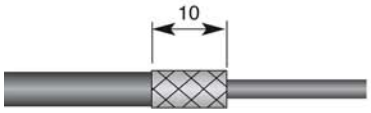
Measuring signal is safely transmitted through a special low noise cable (Ref. 9060)
The insulation must be perfect between the core and the shield. Humidity traces are prohibited.

IMPORTANT: a defect on insulation or a short-circuit will be displayed as pH 7.

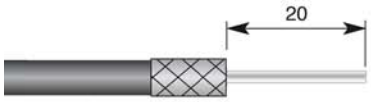
4.3.1 9060 coaxial cable preparation



1. Remove the outer insulation by 20 mm.

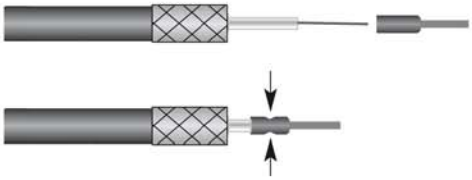


2. Fold back the shield (copper mesh)



3. Remove the 2nd sheath (black layer) over 20 mm.

4. Strip the core of the coaxial cable for 10 mm



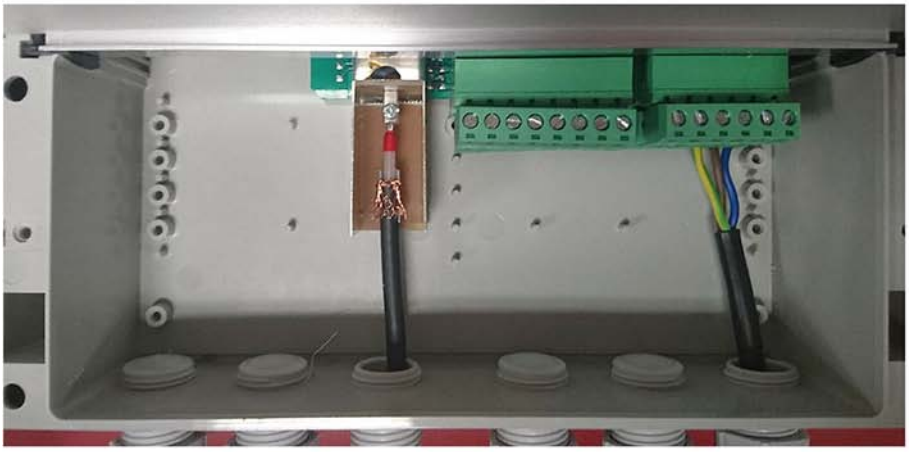
5. Recommended: Crimp a wiring tip (1 mm^2, length 8 mm, red color)

6. Shorten the tip (length of 4 mm is necessary).

4.3.2 Connection of pH cable 9060 to terminal of BAMOPHAR

1°) Remove the BAMOPHAR lower cover to access to the terminal block.
2°) Remove the lid of the terminal, sliding it downwards or upwards.

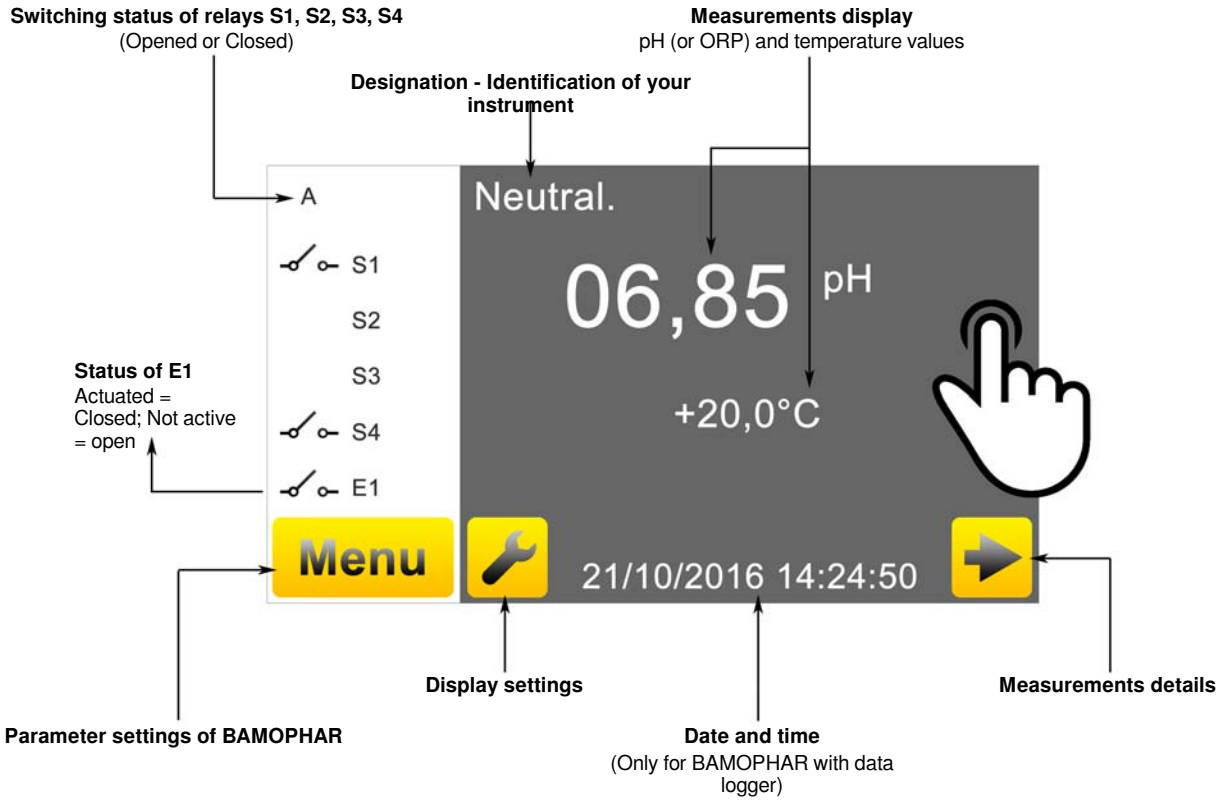
3°) Pass the prepared cable through the cable gland.
4°) Insert the tip in the screw connector
5°) Be sure that the electrical contact between the copper shield and the 2 brackets will be perfect.
6°) Press on the cable to insert it properly in the brackets.
7°) Screw on tightly to block the tip in its connector.



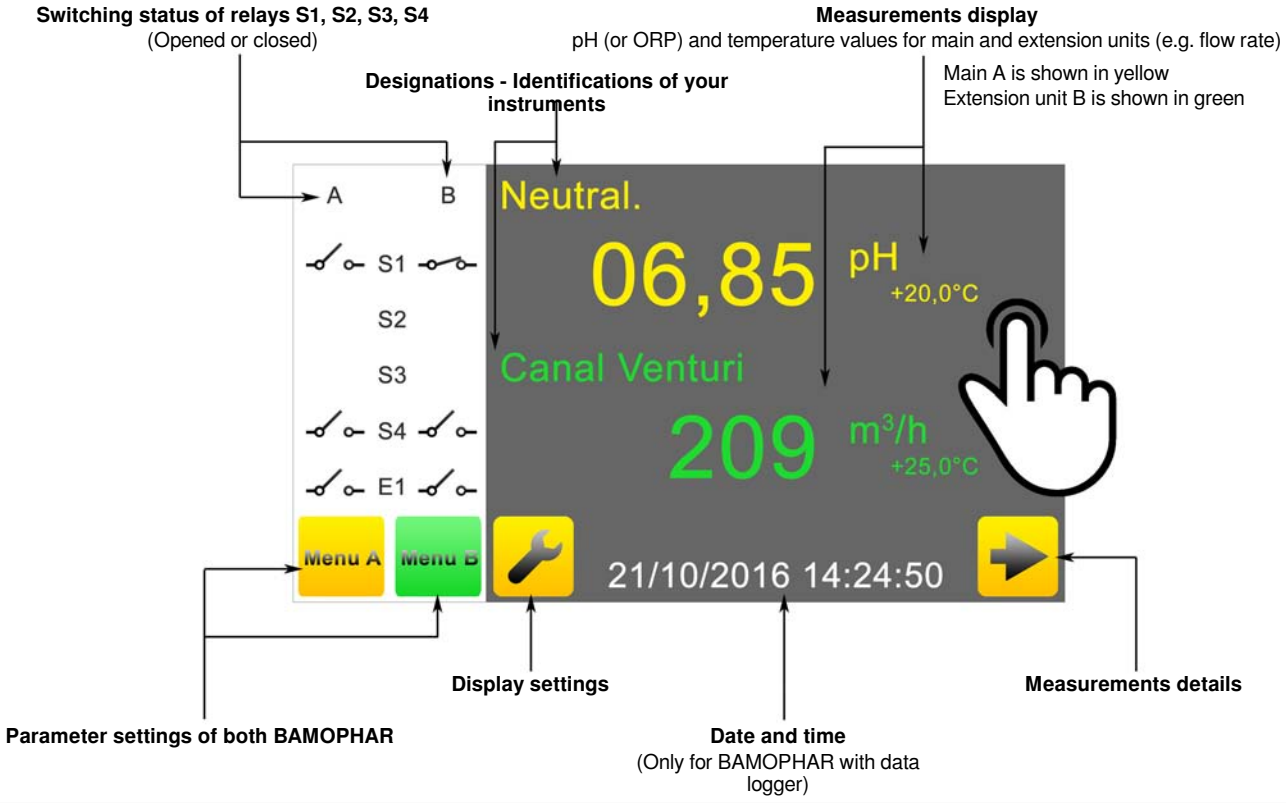
8°) Replace the lid of the terminal in its initial position.
10°) Fit back the lid of the BAMOPHAR.
9°) Tightly screw on the cable gland to assure a watertight connection.

5. MAIN DISPLAY

5.1 WITHOUT EXTENSION UNIT



5.2 WITH AN EXTENSION UNIT



6. DESCRIPTION OF ICONS

The touch screen allows you to navigate within the menus and set up the display according your application.
To each yellow icon dedicated to main unit A corresponds a green icon dedicated to the extension unit B.

HOME
Return to main display
e.g. Green icon for extension unit

DISPLAY SETTINGS
Access to parameters of display (language and identification of the monitor)

LANGUAGES
Language selection

MENU
Access to parameter settings of the monitor

INFORMATION
Access to serial number and version of your BAMOPHAR

PADLOCK
Open: means MODIFICATION mode
Closed: means CONSULTATION (review) mode

RETURN
To go back to the previous screen

ARROWS
Cursors to navigate within the menus

SELECTION
Scroll through the selection list

CONFIRMATION
Confirm setting and go to the next parameter

SAVE
To save the parameters

7. DISPLAY SETTINGS

Note : To access to the display settings, BAMOPHAR must be in MODIFICATION mode (See § CONSULTATION/ MODIFICATION).

7.1 SCREEN INFORMATION

Screen identification number and its version are available in this menu.

7.2 SCREEN SAVER

Screen saver brightness is adjusted by moving the cursor: decreased (to the left) or increased (to the right).

7.3 LANGUAGE SELECTION

Select the flag according to your choice.
The display automatically returns to previous view.
Press icon "HOME" to go back to the main display.

7.4 DESIGNATION

it is recommended to name each channel (main unit A and Extension unit B) for an easiest reading:

1) Press on icon A or B according to the instrument you wish to rename.
2°) A keyboard appears, enter the new name.
3°) Save the new designation.

8. CONSULTATION/ MODIFICATION

CONSULTATION mode let the operator to check out all working parameters.
This mode is represented by the closed padlock icon.

To change the settings of the BAMOPHAR, you need to enter in the MODIFICATION mode.
This mode is protected by a password identical to the last 4 digits of the serial number.

On the main display, press MENU icon.
Press the padlock icon and type the 4 last digits of Serial Number.
To validate it, press "OK"; Device is now in MODIFICATION mode (padlock is open).
If the entered keyword is wrong, BAMOPHAR stays in the mode CONSULTATION.

After 30 minutes the mode MODIFICATION switches back to CONSULTATION mode.

Where can we find the serial number?
The serial number (SN) is written on the identification label of the device.
It appears as well in MENU, icon " i " (INFORMATION).

9. pH/ ORP SETTINGS

9.1 ELECTRODE CALIBRATION

For calibration routine, temperature displayed on main menu should be close to the real temperature of buffers.

- To avoid the mixing of buffer solutions, rinse the pH electrode with water each time you change the buffer.
- **Never wipe the electrode.**
- For a correct calibration, choose the buffer value in relation with the process (e.g. buffer pH 4.00 for a process with acids).

Press MENU and choose ADJUST ELECTRODE.

STANDARD 7.00 pH	Plunge the tip of the electrode in the pH 7.00 buffer solution (Ref 9011), then confirm. *Do not forget to remove the electrode protection (translucent cap).*
ASYM. +00.00pH	Leave the solution for about 5 minutes in order to stabilize the pH 7 measurement, then confirm. If the measurement for ASYM. (asymmetry) is too high, a message ERROR appears: - Verify that the buffer in use is the right one. - Verify all connections and cable. - In case the trouble persists, change the electrode.
BUFFER 4 pH or 10pH	Once the pH measurement with buffer 7.00 is correct, rinse the electrode and plunge the electrode tip in other buffer solution, or pH 4.00 (Reference 9012) or pH 10 (reference 9013). Type the pH buffer value, then confirm.
SLOPE 100.0 %	Wait a moment for the slope measurement to stabilize, then confirm. If the slope is weak (<70%), a message “ERROR“ appears. In such a case, if the buffer is the right one and not obsolete, change the electrode.
DELAY 0000 Sec	When the slope is valid (70 to 110%), enter the delay while measurement and outputs stay blocked at values, previous to calibration routine; then confirm.
SAVE ?	To record the calibration parameters, press the icon SAVE. Do not forget to set up the temperature mode to its previous setting: manual mode (fluid temperature) or automatic mode (Pt 100 sensor connected), see the menu TEMPERATURE.

9.2 SETTING THE RELAY OUTPUTS S1, S2 AND S3 AS THRESHOLDS

9.2.1 COMMENTS ABOUT REGULATION WITH BAMOPHAR

Before to set up or to choose the regulation mode, it is necessary to define the operating mode.

BAMOPHAR 107 allows you to choose between 3 operating modes:

1) ON/ OFF regulation mode with thresholds values S1, S2 and/ or S3
2) Relay regulation mode with proportional bandwidth and dead zones (relays S1 and S2)
3) P.I.D. regulation mode using the 4-20 mA output signal of BAMOPHAR

Specificity of threshold S3:

May be assigned to the external signal (E1): to block the regulation (terminals 5 and 6, see wiring diagram).
In this case, relay S3 becomes a normally closed contact (N.C) and E1 is not active; S3 opens when blocking regulation operates (E1 active).

This means:
- Relay S3 is normally closed (N.C.) if no voltage applies between terminal 5 and 6 (E1 not active).
- Relay S3 will open when voltage applies between terminals 5 and 6 (E1 active)

Consequences of blocking the regulation:

- When working in ON/ OFF regulation mode, there is no additional action on relays S1 and/ or S2.
- However, it is possible for the user to connect the relays S1 and S3 in series to secure the injection (if relay S1 manages the injection of reagent). When working in relay regulation mode, relays s1 and s2 are opened (non actuated); regulation is inhibited.
- When working in PID regulation mode, the 4-20 mA signal is frozen.

9.2.2 ADJUSTMENT OF THRESHOLDS S1, S2 AND S3 IN MODE ON/OFF REGULATION

Below is a detailed description of the steps to set the threshold S1:

Enter to the menu ADJUST ALARM 1

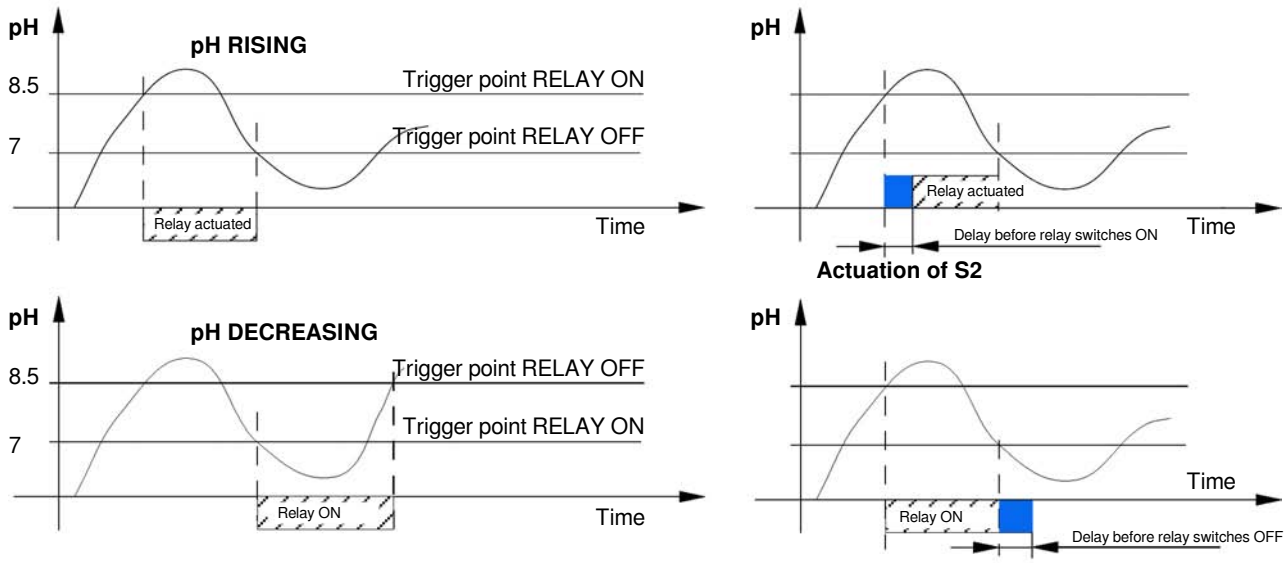
ALARM 1 ON / OFF	To set up output S1, select ON, then confirm. To disable the relay S1 select OFF mode, then confirm and save the setting.
ALARM 1 MEASURE / TEMP.	In ON mode, threshold S1 can be set in MEASUREMENT or TEMPERATURE mode: MEASURE mode = threshold dedicated to pH or mV (ORP) measurements TEMP. mode = threshold dedicated to temperature measurement Select the appropriate mode, then confirm.
ALARM 1 HIGH / LOW	HIGH = Trigger when measurement rises over threshold S1 LOW = Trigger when measurement decreases below threshold S1 Select the appropriate actuating mode, then confirm.
ON 08.00 pH / °C	Enter the value at which relay S1 will actuate (closing), then confirm.
OFF 07.50 pH / °C	Enter the value at which relay S1 will be opened, then confirm.
DELAY UP ON / OFF	With or without delay to actuate the relay S1.
TIME 0000 Sec	Enter the duration of delay before actuating S1, then confirm.
DELAY DOWN ON / OFF	With or without delay to open relay S1
TIME 0000 Sec	Enter the duration of delay before opening S1, then confirm.
SAVE ?	To record the settings, press the icon SAVE.

All settings for S2 and S3 are available respectively in ADJUST ALARM 2 and ADJUST ALARM 3 menus, identical to S1.

9.2.3 ASSIGNMENT OF S3 THRESHOLD TO EXTERNAL SIGNAL (E1)

Go to the menu ADJUST ALARM 3.

ADJUST ALARM 3 ON / OFF	Select the ON mode to set up the output S3, then confirm.
EXTERN. YES / NO	If NO : the sequence of settings are same as for S1 or S2 in ON/ OFF regulation mode If YES = external signal (E1) is assigned to relay S3 Relay S3 becomes a normally closed contact (E1 not active) and will open when blocking of regulation operates (E1 active). Confirm the selection.
SAVE ?	To record the settings, press the icon SAVE.



9.3 SETTING OF TEMPERATURE

Go to the menu TEMPERATURE

MEASURE: AUTO / MANUAL	AUTO : With signal from a sensor Pt 100 Ohm at 0°C MANUAL : Without sensor Pt 100 Ω; temperature value is entered manually. Confirm the selection.
FLUID T. + 025.0°C	If the MANUAL mode is selected, enter the temperature value of the fluid, in °C, then confirm.
SAVE ?	To record the settings, press the icon SAVE.

9.4 SETTINGS OF ANALOGUE OUTPUT FOR MEASUREMENT

Go to menu OUTPUT mA pH (or RH for ORP)

HIGHER 14.00 pH	Enter the highest value for pH (or ORP) for the output signal at 20.00 mA, then confirm.
LOWER 00.00 pH	Enter the lowest value for pH (or ORP) for the output signal at 4.00 mA (or 0.00 mA), then confirm.
OUTPUT 4/20 mA or 0/20 mA	Select the right scale 4...20 mA or 0...20 mA for output signal, then confirm.
SAVE ?	To record the settings, press the icon SAVE.

9.5 SETTINGS OF ANALOGUE OUTPUT FOR TEMPERATURE

Go to menu OUTPUT mA TEMP.

HIGHER +160.0°C	Enter the temperature value in °C for output signal value at 20.00 mA, then confirm.
LOWER +000.0°C	Enter the temperature value in °C for output signal value output signal at 4.00 mA (or 0.00 mA), then confirm.
OUTPUT 0/20 mA or 4/20 mA	Select the right scale 4...20 mA or 0...20 mA for output signal, then confirm.
SAVE ?	To record the settings, press the icon SAVE

9.6 FORCED RELAY

This menu allows to test manually the relays S1, S2, S3 and S4 through simulations.
Status of last one (S4) is OFF (non actuated) by default. Test begins with threshold S1 with status relay OFF.
To test it, press the arrows SELECTION to switch relay to ON status (activated).
Confirm to go to next threshold; Same routine for testing S2, S3 and S4.

9.7 SETTING OF THE RELAY REGULATION MODE

Go to the menu RELAY REGULATION

- There is no access to settings of relay regulation mode if relays S1 and/ or S2 are operating; So, go to::

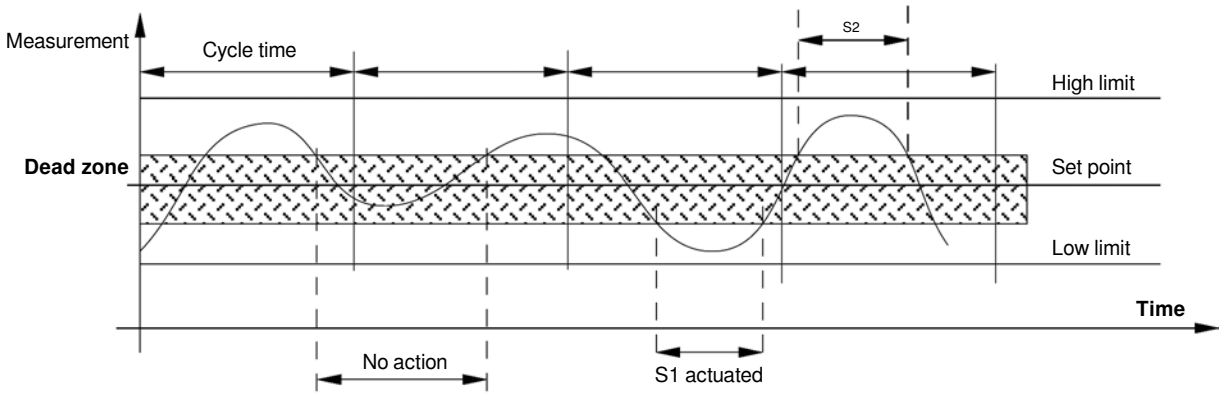
ON / OFF MODE	To access to this mode, first go back to menus ADJUST ALARM S1 and S2 to set them in OFF mode.

- There is no access to relay regulation mode when PID regulation is operating; So go to:

PID MODE	To access to relay regulation mode, go to to the menu REGUL. PID to switch it OFF.

- Regulation mode is thus accessible if, and only if, the THRESHOLD and PID modes are deactivated.

REGULATION ON / OFF	Select ON mode to set up parameters, then confirm.
SET VAL 07.00 pH	Enter the threshold value, then confirm.
T. CYCLE 0060 Sec	Enter the cycle time according to the process, then confirm.
HIGH PB 00.80 pH	Enter the differential for upper bandwidth, then confirm. **Note: Output S2 is dedicated for upper bandwidth.**
LOW PB 00.50 pH	Enter the differential for lower bandwidth, then confirm. **Note: Output S1 is dedicated to lower bandwidth.**
HIGH DZ 00.50 pH	Enter the differential value for the upper dead zone, then confirm.
LOW DZ 00.20 pH	Enter the differential value for the lower dead zone, then confirm.
SAVE ?	To record the settings, press the icon SAVE.



EXAMPLE:

For settings such as following:
- Set point: pH 7.00
- Cycle time: 10 s
- Upper bandwidth: 3 pH (i.e. high limit is pH 10.00)
- Lower bandwidth: 1 pH (i.e. lower limit is pH 6.00)
- High dead zone: 0.3 pH (from pH 7.00 to 7.30)
- Lower dead zone: 0.7 pH (from pH 6.30 to 7.00)

Results for operating regulation:

- Above the High limit, between pH 10 and 14, output S2 is continuously activated (continuous injection of base, pH will decrease).
- Below the Low limit, between pH 0 and 6, output S1 is continuously activated (continuous injection of acid, pH will increase).
- Within the Dead zones, between pH 6.3 and 7.3, the outputs S1 and S2 are not actuated.
- When measurement is above Dead zone and below High limit (pH 7.3 to 10), or below Dead zone and above the Low limit (pH 6 to 6.3), the outputs S1 or S2, are actuated during a time proportional to the difference between set point and measurement.

Actuation time = Cycle time x (Measurement - Set point) / High or Low bandwidth

Caution:

According to the above example, if measurement is pH 7.80, actuation time = 3 s: 2.66 = 10 x (7.8 - 7) / 3

9.8 OUTPUT S4 SETTINGS

9.8.1 DEFAULT SETTING

By default, relay S4 is dedicated to alarms on pH and temperature faults:
- The contact closes, if the measurement is less than pH 0.10
- The contact closes if the measurement is above pH 14.10.
- The contact closes if the sensor Pt 100 is faulty (damaged cable).

Otherwise, relay S4 can be dedicated to another function:
- Either in alarm (relay fault S1 or S2): See § ADJUST ALARM
- Or cleaning function: See § CLEANING PROBE

9.8.2 ADJUST ALARM

This function activates relay S4 when the switch-on time of relays S1 or S2 is too long (e.g. injection time too long).

Go to the menu ADJUST ALARM

- This ALARM function is not available if the CLEANING PROBE mode is activated; So, go to:

CLEANING PROBE MODE	Deactivate first the cleaning function in CLEANING PROBE menu before to access to ADJUST ALARM menu..

- If the CLEANING PROBE mode is disabled, the ADJUST ALARM function is available:

WITH ALARM / WITHOUT ALARM	Select WITH ALARM to activate the relay S4, then confirm.
TIME S1 0005 Sec	Enter the holding time max. for relay S1, then confirm.
TIME S2 0020 Sec	Enter the holding time max. for relay S2, then confirm.
SAVE ?	To record the settings, press the icon SAVE.

9.8.3 CLEANING PROBE

This function actuates the S4 relay when automatic cleaning of the electrode is required.
In order not to disturb the regulation, measurements are frozen during the cleaning routine.

Go to the menu CLEANING PROBE.

- If alarms are set up in ADJUST ALARM, the cleaning mode menu is not available; So, go to:

ADJUST ALARM	To access to the CLEANING PROBE menu, switch alarms mode to WITHOUT ALARM in menu ADJUST ALARM.

- If the ALARM mode is not activated, the CLEANING PROBE function is available.

CLEANING YES / NO	Select YES to set up the cleaning routine, then confirm.
PERIOD 2300 Sec	Enter the cycle time between two cleaning routines, then confirm.
TIME 0010 Sec	Enter the duration of cleaning routine, then confirm.
DELAY 0010 Sec	Enter the delay before the measurement is resumed.
SAVE ?	To record the settings, press the icon SAVE.

9.9 PID REGULATION

REGUL. PID allows seting of a PID regulation through analogue output (0...20 or 4...20 mA) between terminals 3 and 4.
This output is no more dedicated to the copy of temperature measurement.

Go to the menu REGUL. PID

REGULATION ON / OFF	Select ON to set up the function PID REGULATION, then confirm.
REGUL. AUTO / MANU	Select AUTO to access to parameters, then confirm.
SET VAL 07.00 pH	Enter the value of desired trigger point, then confirm.
GAIN : 4.800	Enter the required proportional gain value, then confirm.
Ti : 0050 Sec	Enter the value for integral timer, then confirm.
Td : 0012 Sec	Enter the required value for derivative timer, then confirm.
ACID INJECTION / BASE INJECTION	Select the right chemical, then confirm.
OUTPUT 4/20 mA or 0/20 mA	Select the required output signal range, then confirm.
SAVE ?	To record the settings, press the icon SAVE.

Note: To block the PID regulation, set a voltage of 24V DC (=20 mA)between terminals 5 (+) and 6 (0).

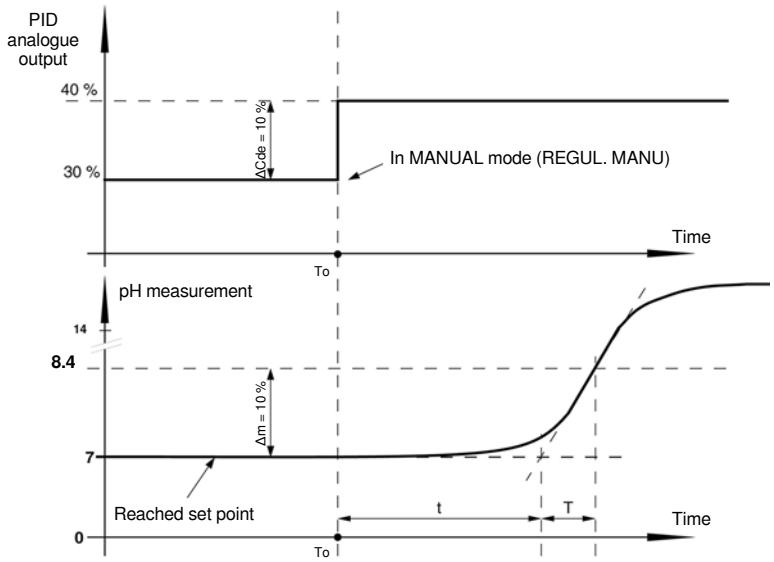
METHOD FOR ADJUSTMENT OF PID PARAMETERS

In order to setup values for start-up on PID, we recommend to use the Ziegler-Nichols open loop method.

Proceed as follows:

- Connect a recorder to the analogue output or write the displayed values, then draw the diagram pH vs. time.
- Switch on MANUAL the PID regulation mode.
- Reach and keep the measurement close to the set point by adjusting the PID output.
- Apply a step (ΔCde) of 10 % for instance, on the analogue output (e.g. If preset value was 30%, apply 40%).
- Note on the diagram the corresponding time for this event (step of +10%).
- Find out on this diagram both times t and T:
  - t = delay of response
  - T = Time corresponding to a variation Δm of measurement equal to percentage of variation ΔCde of output (Δm = ΔCde)
  - This value may be found out from the slope at the beginning of measurements.
- Set up the PID parameters with the values from the following table:

Regulation	Gain	Ti [s]	Td [s]
PID	1,2 x T/t	2 x t	0,5 x t
PI	0,9 x T/t	3,3 x t	00
P	T/t	9999	00



9.10 TYPE OF INSTRUMENT

pH / RH CHOICE — Choose your application, then confirm
pH - METER for pH monitoring
RH - METER for ORP applications

SAVE ? — To record the settings, press the icon SAVE.

9.11 FORCED MEASURE

It is possible to force the measurement or the PID.

The first line shows the current measurement.
Confirm to access to the keyboard.
Enter the value you need to simulate.
Note: The value is immediately considered by BAMOPHAR (thresholds, regulation, 4-20mA outputs ...)

To exit this menu, press icon RETURN KEY.

Note : It is possible to force the output 4-20 mA for PID when PID regulation is in manual mode (REGUL. MANU).
If PID regulation is operating, the display of analogue output is in %.