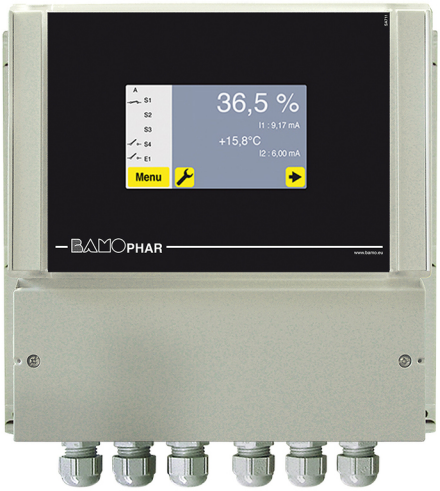
Dissolved oxygen monitor
BAMOPHAR 451 LOG



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

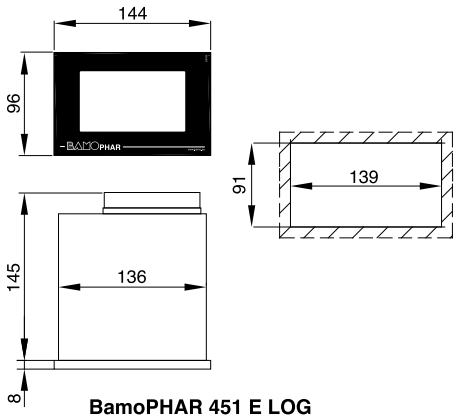
BAMOPHAR 451 offers a reliable and accurate measurement of dissolved oxygen (DO) concentration in water treatment process. It has a color touch screen for the display of a multilingual menu friendly and intuitive. The unit also displays the menu for setting the analog output, setting the thresholds and setting the operating mode. In order to facilitate its commissioning, a programming menu can simulate the measurement, acting on analogue outputs and thresholds

2. TECHNICAL FEATURES

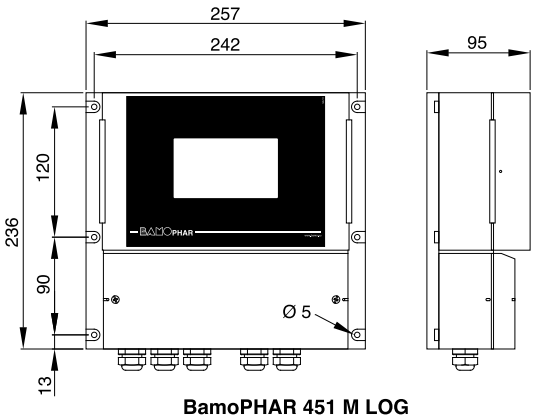
End-user interface	Color touch screen 4.3", resolution 480x272 pixels Display of measurements (D.O. concentration and temperature) and relay status Configuration - Keyword protected
Measuring scales	0... 500 % or 0.01 to 50 mg/l
Accuracy	According to probe AQUAPLUS features, 0to 20 mg/l: ±1 % of reading, 20 to 50 mg/l: ± 10 % of reading
Sensor signal input	Screw terminals - digital signal
Relay outputs	4 contacts N.O., voltage free
Configurable thresholds	S1, independent threshold, to set up for measurement or temperature S2, independent threshold, to set up for measurement or temperature S3, independent threshold, to set up for measurement or temperature or an external function S4, threshold, to set up for alarming function, out of range, temperature sensor defect, or probe 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 (variable according to switching frequency, environmental conditions, accuracy)
Impulse regulation	Cycle time setting from 0 to 9999 s, high and low proportional bandwidths, 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
Measurement output	0/4 - 20 mA (max. 600 Ω) proportional to measurement
Temperature output / PID	0/4-20 mA (max. 600 Ω), scaling 0...100°C This temperature output is not available when PID regulation function is operating.
Programme Testing	Simulation through the menu on measurement, temperature, PID and thresholds
Main power supply	230 V AC / 50-60 Hz (others on request) - Consumption 10 VA
Models	Panel mounting, 96x144 mm; screw terminals, Front IP65, rear IP40 Wall mounting, IP65, screw terminals, cable glands
Data Logger	Record of cycle average measurement (programmable) 150 000 records max. on memory card.

EC Conformity: The instrument meets the legal requirements of the current European Directives

3. DIMENSIONS



BamoPHAR 451 E LOG



BamoPHAR 451 M LOG

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Dissolved oxygen monitor
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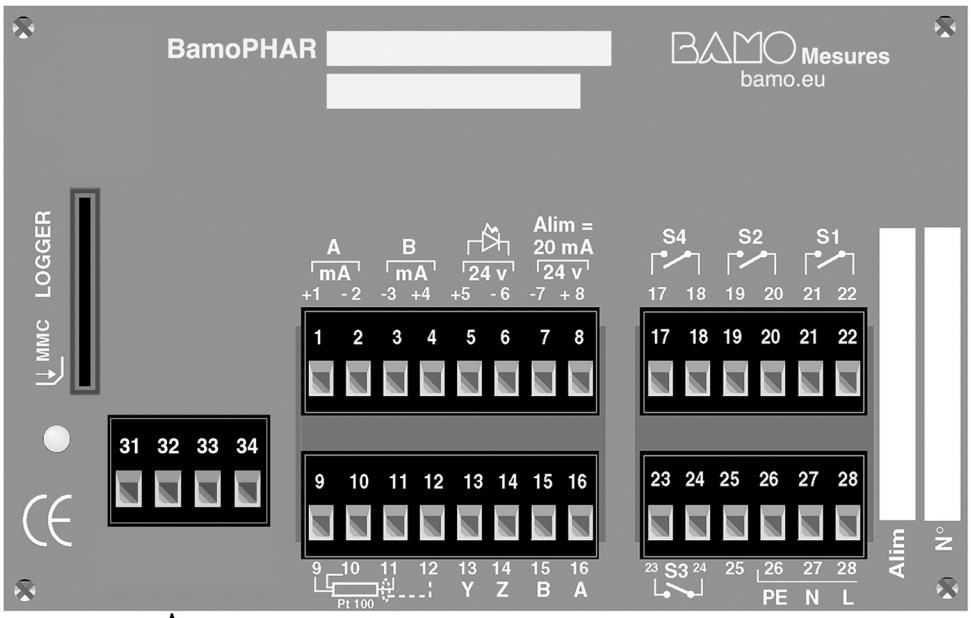
27-05-2019 M-451.03-EN-AD

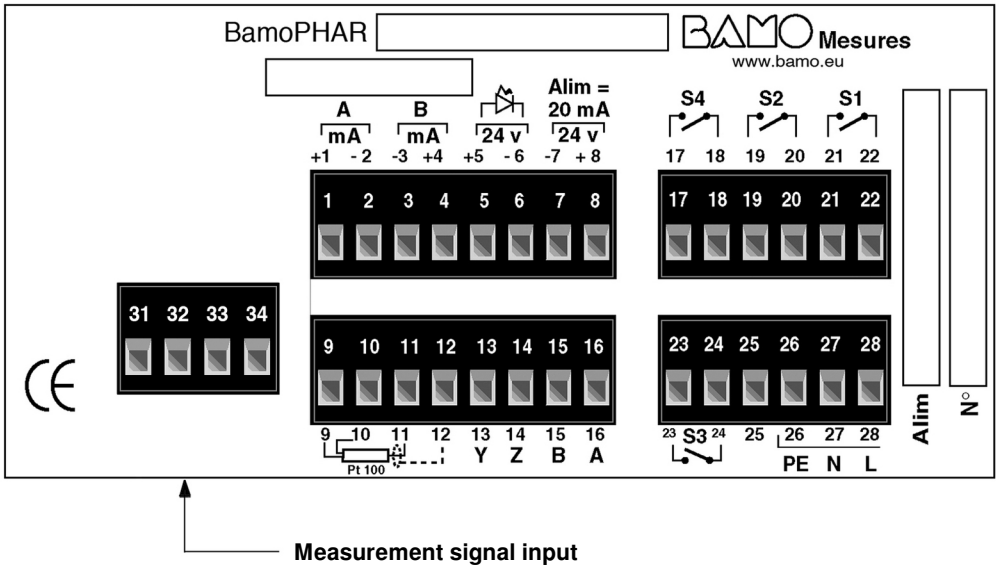
OXY

4. ELECTRICAL CONNECTIONS

PANEL MOUNT VERSION



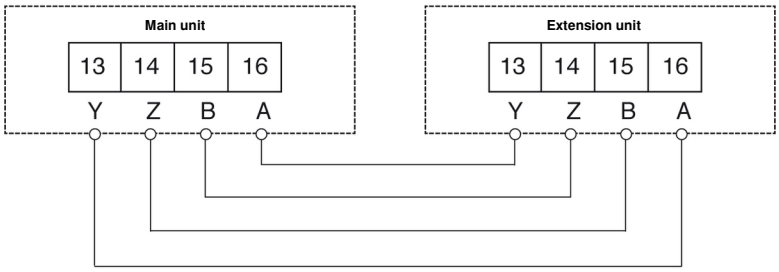
WALL MOUNT VERSION



4.1 VIEWS OF TERMINALS

Description		Terminal	Connection
Output mA, measurement		1	+ mA
		2	- mA
Output mA, temperature or PID regulation		3	- mA / PID
		4	+ mA / PID
Input for blocking the regulation	External sensor	5	+ 24 V
		6	- 24 V
Power supply to sensor	Power to AQUAPLUS probe	7	- 24 V
		8	+ 24 V
Input for Pt 100 sensor (3-wire)		9	+
		10	+
		11	-
		12	Shielding
Connections for an extension terminal (blind unit)		13	Y
		14	Z
		15	B
		16	A
Limit value S4 (N.O. contact) for Fault on Regulation, Temperature or for Cleaning routine		17	S4
		18	
Limit value S2 (N.O. contact) for measurement/ temperature		19	S2
		20	
Limit value S1 (N.O. contact) for measurement/ temperature		21	S1
		22	
Limit value S3 (N.O. contact) for measurement/ temperature Can be assigned to external function: becomes N.C. contact (see 9.2.3)		23	S3
		24	
Not used		25	
Main power supply		26	PE = Ground (equipotential)
		27	L = Neutral
		28	L = Live
Input signal from AQUAPLUS probe		31	
		32	
		33	
		34	

Raccordement au boîtier d'extension



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

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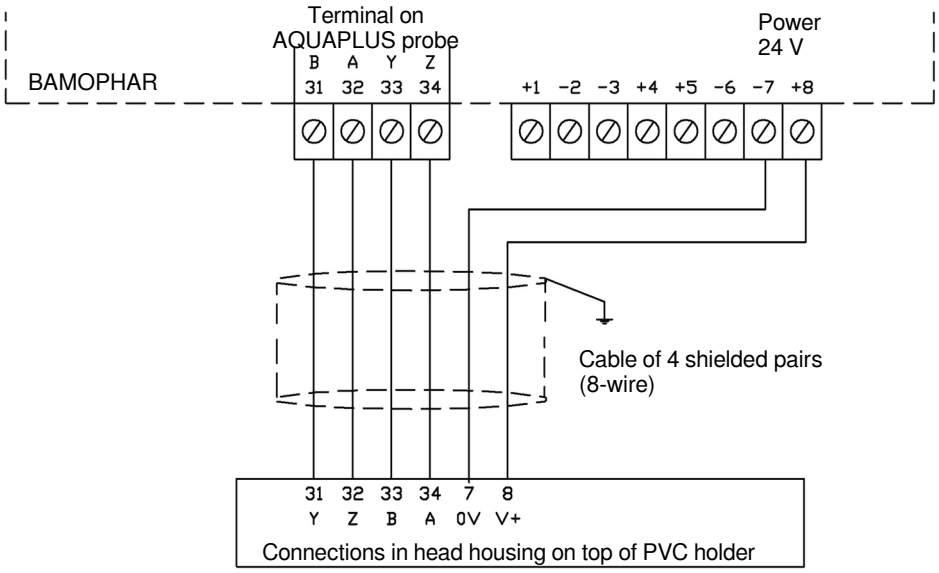
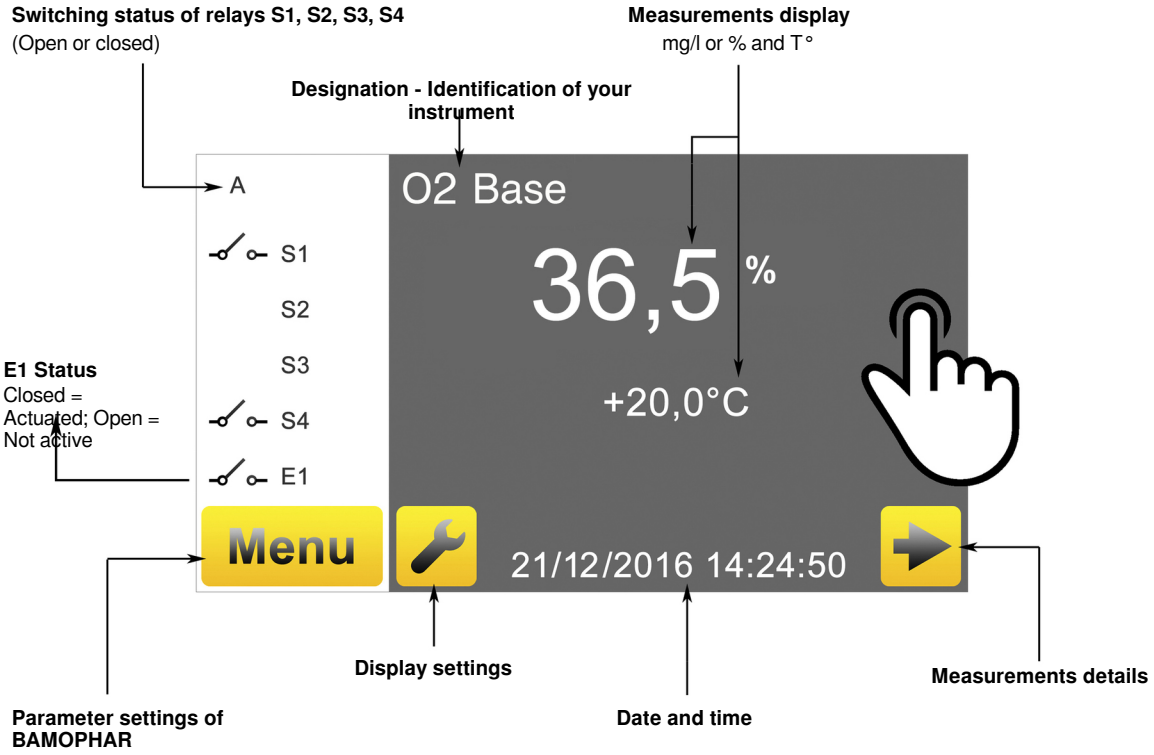
4.1.1 Connection of AQUAPLUS probe

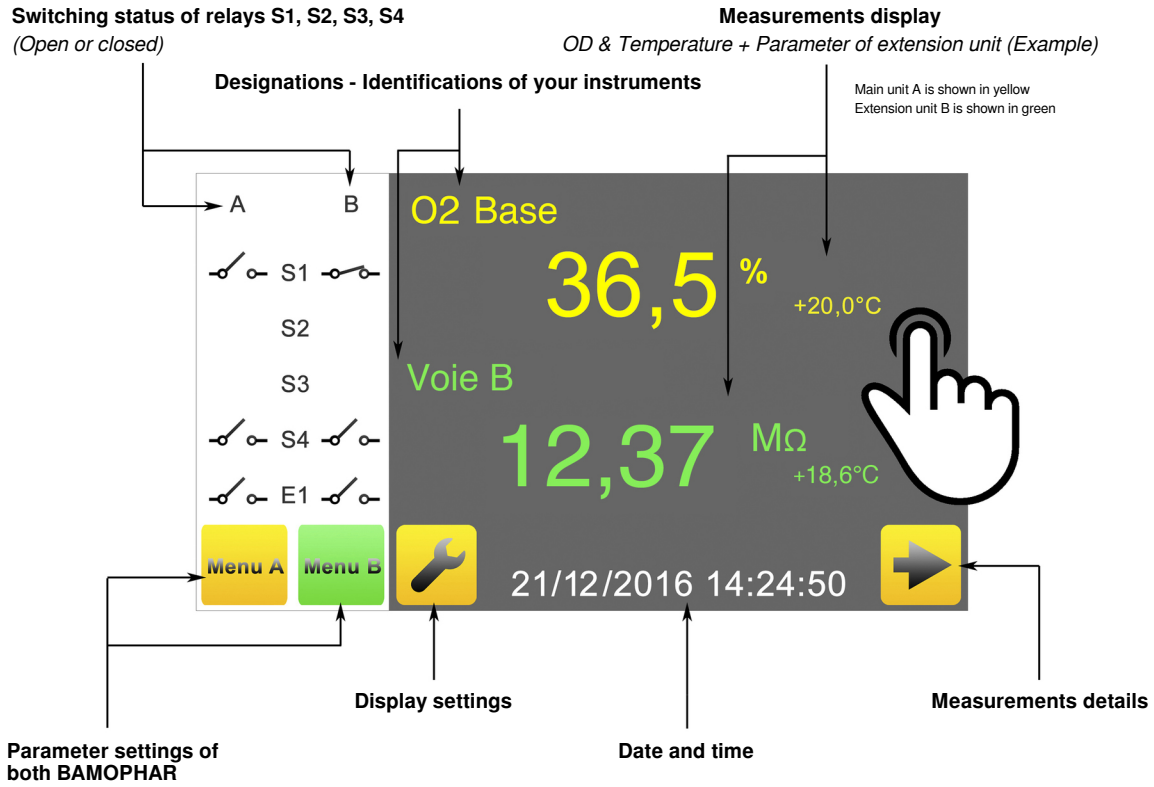


5. MAIN DISPLAY

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 parameters of current setting

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 (Open padlock)
If the entered keyword is wrong, an error message appears for 3 seconds.

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

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

9. DISSOLVED OXYGEN SETTINGS

9.1 AQUAPLUS PROBE CALIBRATION

Press MENU and choose ADJUST PROBE
(This program step is accessible only in MODIFICATION mode)
This function is used to calibrate the AQUAPLUS probe.
In order not to disturb the process, the measurement and regulation are frozen on BAMOPHAR when entering the calibration menu.
This blocking is effective during the whole time of the calibration, plus an adjustable delay entered at the end of the menu (DELAY).
This delay allows to install back all components and commissiononing of complete system.

CAUTION: Check and modify if necessary, the atmospheric pressure set in BAMOPHAR if it is different from the current pressure.
To modify it, go to menu AIR PRESSURE

ZERO ADJUST YES	Confirm YES (after replacemnt of the sensor end) Note : ZERO of dissolved oxygen is set in factory; However a new calibration is necessary when replacing the sensor end. Confirm to access to next parameter.
CAL BUFFER ZERO	Plunge the bottom of AQUAPLUS probe in a calibration buffer solution (sodium sulfite). Confirm to access to next parameter.
OXY. +000.0	Wait until display keeps steady on 000.0% Confirm to access to next parameter.
CALIBRATION ON	Probe and BAMOPHAR exchange data together. **Wait until appears new display CALIBRATION OK** Zero of DO concentration is done. Confirm to access to next parameter.
PROBE IN AIR	Rinse the probe, wipe out water drops on the sensor end; Then, surround AQUAPLUS probe with a clean, damp cloth. Confirm to access to next parameter.
OXY. +000.0	Wait until display keeps steady on 100.0% This step must delay at least more than 20 seconds. Confirm to access to next parameter.
CALIBRATION ON	Probe and BAMOPHAR exchange data together. **Wait until display CALIBRATION OK appears** 100,0 % of oxygen in the atmosphere is done. Confirm to access to next parameter.
DELAY 0015 Sec	Enter the delay in seconds, during which measurements, outputs and regulationctions, keep on stand-by on values existing before the calibration; Then confirm. To record the settings, press the icon SAVE.

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

9.2.1 REGULATION WITH BAMOPHAR, PRELIMINARIES

Before setting the thresholds or regulation mode, the operating mode must be set.

BAMOPHAR 451 LOG allows 3 operating modes:
1) On/OFF regulation through relays, thresholds S1, S2 and/ or S3
2) Impulse regulation with cycle time, high and low proportional bandwidths, dead zones (S1 and S2)
3) PID regulation with an output signal of 4-20 mA

Thresholds S3, specificities:
S3 may be assigned to an external signal from a sensor (e.g. inductive flow controller) to block the regulation mode (terminals 5 et 6).
In this case the relay S3 becomes N.C. and it opens when the regulation blocking is necessary.

In other words:
- Relay S3 is closed when no voltage applies between terminals 5 & 6
- Relay S3 opens when a voltage applies between terminals 5 & 6 (To block the regulation mode)

Blocking the regulation has the following consequences:
• For impulse regulation mode: relays S1 and S2 keep open (not actuating).
• Inhibition of regulation. – With PID mode, signal 4-20mA will frozen.
• With ON/OFF mode no action occurs on S1 and/ or S2.

9.2.2 SETTING 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

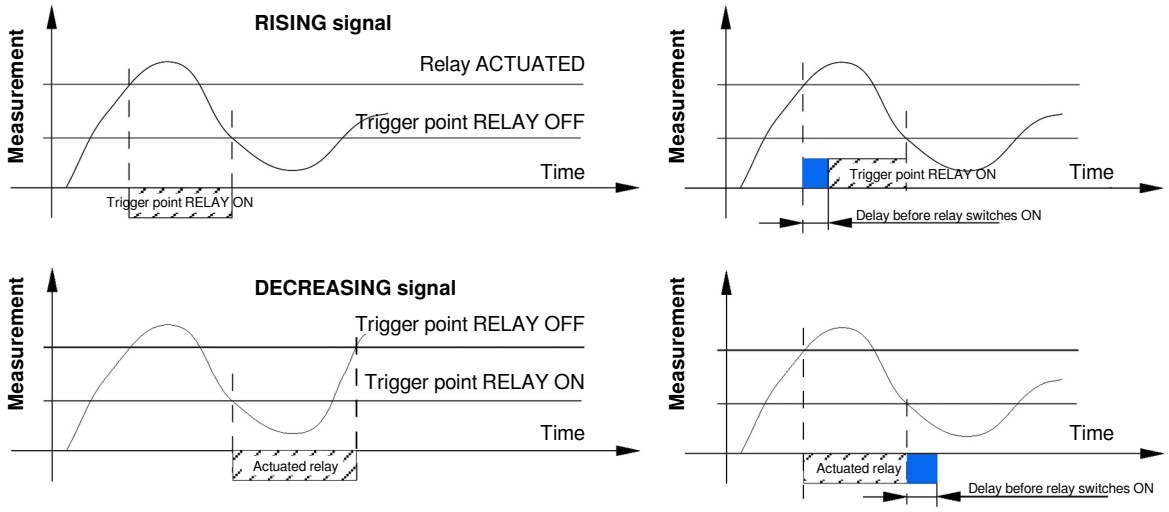
ALARM 1 ON / OFF	To set up output S1, select ON, then confirm. To disable the relay S1 select OFF mode, then confirm and save the setting.
ALARM 1 MEASURE / TEMP.	In ON mode, threshold S1 can be assigned to MEASUREMENT or to TEMPERATURE signal MEASURE = Threshold dedicated to mg/l or % D.O. TEMP. = Threshold dedicated to temperature measurement Select the appropriate mode, then confirm.
ALARM 1 HIGH / LOW	HIGH = Triggering when measurement rises over threshold S1 LOW = Triggering when measurement decreases below threshold S1 Select the appropriate actuating mode, then confirm.
ON 000.0 mg / % / °C	Enter the value at which relay S1 will actuate (closing), then confirm.
OFF 000.0 mg / % / °C	Enter the value at which relay S1 will be open, 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.

Settings for S2 and S3 are available respectively in ADJUST ALARM 2 and ADJUST ALARM 3 menus.

9.2.3 ASSIGNMENT OF S3 THRESHOLD ON AN EXTERNAL SIGNAL

Go to the menu ADJUST ALARM 3

ADJUST ALARM 3 ON / OFF	Select the ON mode to set up the triggering of 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 = Relay S3 is dedicated to input signal from external sensor Relay S3 is then a normally closed contact (N.C.) and will open when blocking regulation mode operates. Confirm the selection.
SAVE ?	To record the settings, press the icon SAVE.



9.3 SETTINGs OF OPERATING MEASUREMENT

Go to menu MEASURE DATA

DISPLAY: mg/l %	Select the unit mg/l or %, then confirm
SAVE ?	To record the settings, press the icon SAVE.

9.4 SETTINGS OF ANALOGUE OUTPUT FOR MEASUREMENT

Go to menu OUTPUT mA OXY.

HIGHER 10.00 mg	Enter the highest value at 20 mA output signal ; Then confirm.
LOWER 00,00 mg	Enter the lowest value for the output signal at 4 mA (or 0 mA); Then confirm.
OUTPUT 4/20 mA 0/20 mA	Enter the range of 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 +000.0 °C	Enter the highest value at 20 mA output signal ; Then confirm.
LOWER 00,00 °C	Enter the lowest value for the output signal at 4 mA (or 0 mA); Then confirm.
OUTPUT 4/20 mA 0/20 mA	Enter the range of 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.
Status of last one (S4) is OFF (non actuated) by default. Test begins with relay S1.
To test it, press the arrows SELECTION to switch the relay from OFF to ON.
Confirm to go to next relay.

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.

IMPULSE MODE:	To access the setting, first disable the relays S and/ or S2 through the menu ADJUST ALARM (1) and/or (2).

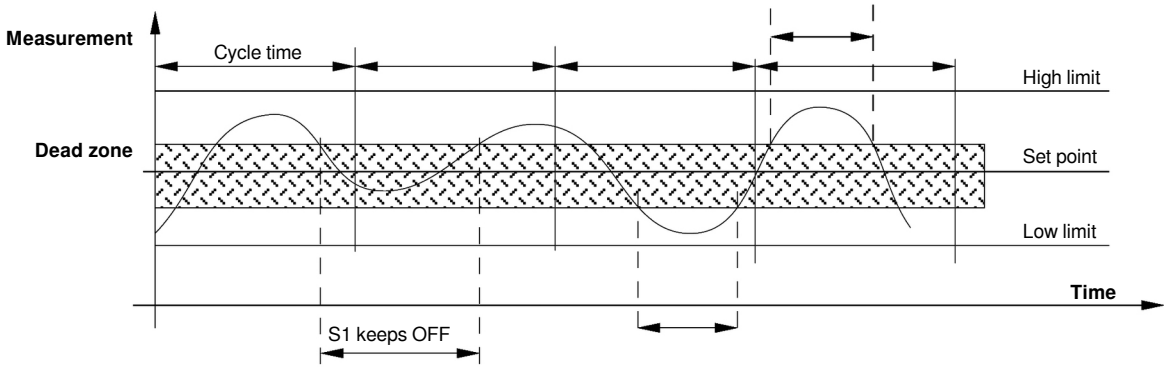
IMPULSE MODE is not available when PID mode is operating.

PID MODE:	To access to impulse 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 disabled.

REGULATION ON / OFF	Select ON mode to set up parameters, then confirm.
SET VAL 00.00 mg	Enter the threshold value, then confirm.
T. CYCLE 0060 Sec	Enter the cycle time according to the process, then confirm.
HIGH PB 00.00 mg	Enter the differential for upper bandwidth, then confirm. **Note: Output S2 is dedicated to upper bandwidth.**
LOW PB 00.00 mg	Enter the differential for lower bandwidth, then confirm. **Note: Output S1 is dedicated to lower bandwidth.**
HIGH DZ 00.00 mg	Enter the differential value for the upper dead zone, then confirm.
LOW DZ 00.20 mg	Enter the differential value for the lower dead zone, then confirm.
SAVE ?	To record the settings, press the icon SAVE.

NOTE : Relay S1 corresponds to lower bandwidth and S2 to the upper bandwidth.



9.8 SETTING ALARMS

This function activates relay S4 when the switch-on of relays S1 or S2 is delayed (too long time).
Go to the menu ADJUST ALARM

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

9.9 SETTINGS OF CLEANING ROUTINE

In order not to disturb the regulation, measurements are frozen during the cleaning routine.
This blocking is effective throughout the cleaning time, plus a delay.
This delay allows the dilution of cleaner agent without interfering in the process.
Go to the menu CLEANING PROBE.

CLEANING YES / NO	Select YES to set up the cleaning routine, then confirm.
PERIODE 0000 Sec	Enter the cycle time between two cleaning routines, then confirm.
TIME 0000 Sec	Enter the duration of cleaning routine, then confirm.
DELAY 0000 Sec	Enter the delay before the measurement is resumed; Then confirm.
SAVE ?	To record the settings, press the icon SAVE.

9.10 SETTING A PID REGULATION

It allows setting 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 parameters of PID; Then confirm.
REGUL. AUTO / MANU	Select AUTO to access to parameters, then confirm.
SET VAL 05.00 mg	Enter the value of set point, then confirm.
GAIN: 4.800	Enter the required proportional gain value, then confirm.
T.i : 0050 Sec	Enter the value for integral timer, then confirm.
Td : 0012 Sec	Enter the required value for derivative timer, then confirm.
ACTION DIRECT / REVERSE	Enter the right action, then confirm.
OUTPUT 4-20mA / 0-20mA	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.

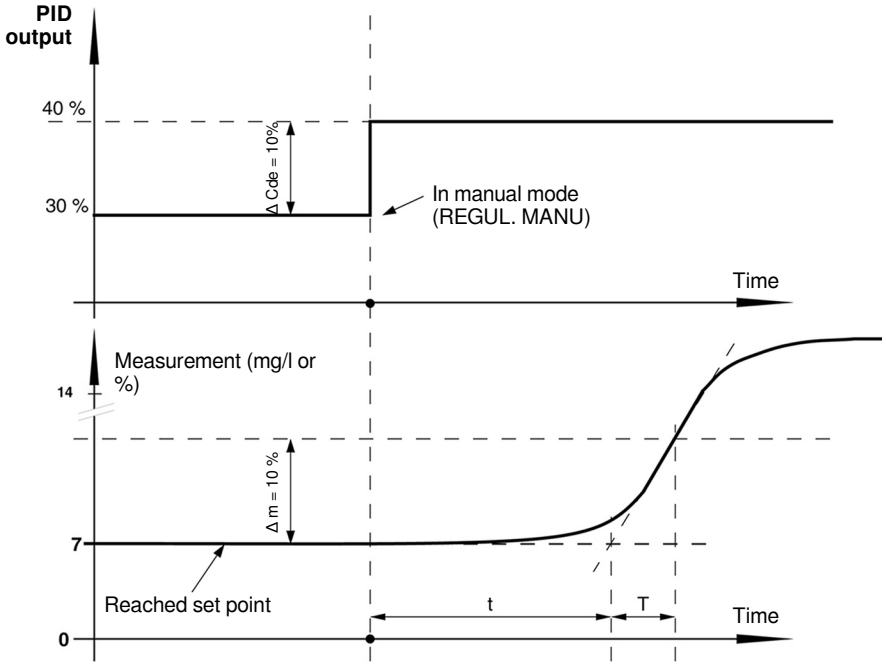
Proceed as follows:
- Connect a recorder to the analogue output or write the displayed values, then draw the diagram vs. time.
- Set the menu PID on MANUAL mode.
- Reach and keep the measurement close to the set point by adjusting the PID output.
- Reach and keep the measurement close to the set point 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 and 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 help of 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
PP	T/t	9999	00



9.11 FORCED MEASUREMENT - MEASUREMENT SIMULATION

Go to menu FORCED MEASUREMENT

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 %.

9.12 ATMOSPHERIQUE PRESSURE

This menu allows you to change the value of the atmospheric pressure, if it is different from the value of the calibration day.
Go to the menu AIR PRESSURE

P = 1013 hPa	*(in hectoPascal); Keeps this value by pressing RETURN icon, or* Enter the new value (in hPa); then confirm.
SAVE ?	To record the settings, press the icon SAVE.

9.13 DATA LOGGER

Last 3 menus: CLOCK, RECORD PERIOD, FORMAT MMC, correspond to parameters of the data logger.

For operating and to set up the data logger, please use the specif end-user manual "PHOXLOG".