HORIBA

ONLINE WATER ANALYZER

OPERATING MANUAL

EL200

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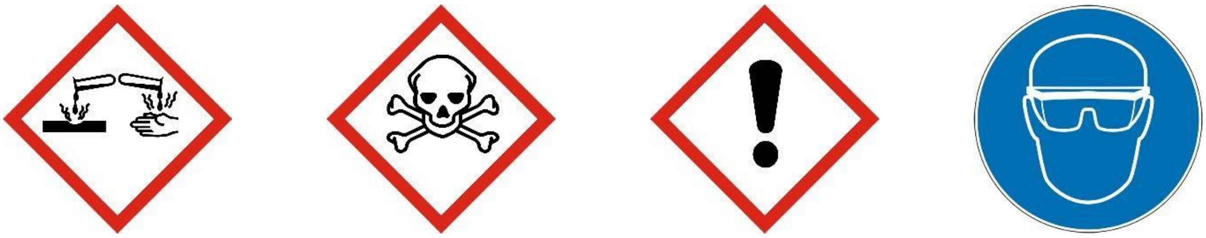
Safety warning and liability



Chemicals used as reagent or used as cleaning solution or used to prepare calibration solutions might be toxic, corrosive or irritant. Refer to the material safety data sheets (MSDS) for each chemical. Wear protection glass and gloves.

The documentation and/or Product are provided on an “as is” basis only and may contain deficiencies or inadequacies. The Documentation and/or Product are provided without warranty of any kind, express or implied.

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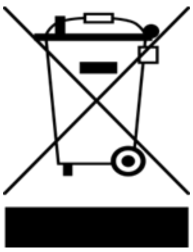
This equipment meets the requirements of all relevant European safety directives. The equipment carries the CE mark.

To prevent electric shock:

- Unplug the power cord before any servicing, wiring or any operation inside the instrument.
- Connect this instrument only at a properly grounded power socket.
- Keep the screws well tight.

This instrument must be earthed!
In order to prevent any electric shock, verify that the power socket used for this instrument has an earth connection in accordance with regulations.

The security provided by this product is only assured for the intended use.
Maintenance can only be performed by qualified personnel.



Do not dispose of this product as household waste. Use an approved organization that collects and/or recycles waste electrical and electronic equipment.

CONTENTS

1. Quick Start

Step 1

Unpack the controller, check that nothing has been damaged during the transportation and fix it on a wall. The dimensions are given on chapter 2.

Step 2

Connect the probes provided with the controller.

Step 3

Connect the power cable to a grounded power socket.

To avoid electric shock, the controller must be connected to the earth via the power socket.
The controller must be connected to a standard electrical network protected by a circuit breaker that complies with the safety standards of each specific country, i.e. 16A circuit breaker.

Step 4

Set date and time. This step is optional. It is useful only to download the measurements through the USB port. Refer to chapter 3 for that.

Step 5

Refer to chapter 3 to configure the optional interface (4-20 mA or RS232 or RS485).

Step 6

Probes are factory tested, but some probes and applications might need an on-site calibration. For checking and recalibration, refer to chapter 4 for each individual probe.

As soon as the controller is switched on, it will start recording the measurements. If EL200 controller is powered off, measurements recorded in the graph process screen in the memory will be lost.

2. Installation

The EL200 is a configurable water controller to measure physico-chemical parameter of water. It can be used with many different probes and can handle several configurations. It can be implemented as mono or multi-channel controller with pH, ORP, dissolved oxygen, conductivity, chlorine, turbidity, total suspended solids (TSS), UV absorbance (COD equivalent) and temperature among the most demanded measurements.

2.1. Fixing

Make 4 holes in the panel or in the wall according to the pattern below. Screw diameter ≤ 6 mm and ≥ 25 mm long.

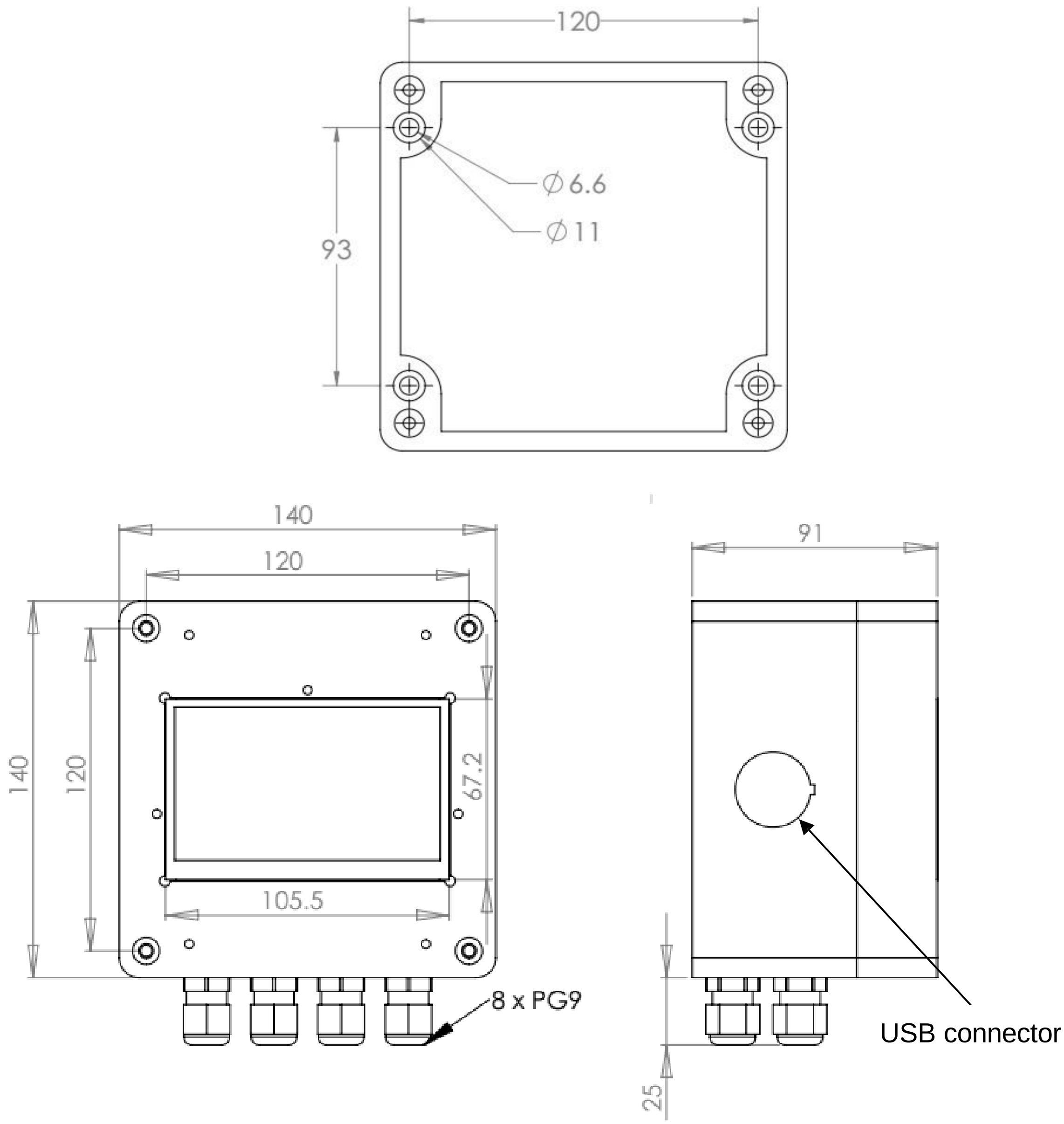


Figure 1. Drawing of the EL200 enclosure

2.2. Electrical Connections

All cables must be installed using the glands below the enclosure. Glands must be well tight so that the cable is well locked when pushing or pulling to avoid disconnection of the cable. When connecting electrical cable from probes, use a cable clamp (figure 3) to keep wires together in order to avoid damage of the electronic circuit or controller if one of the wires loses. Put the cable clamp as close to the plastic connector as possible.

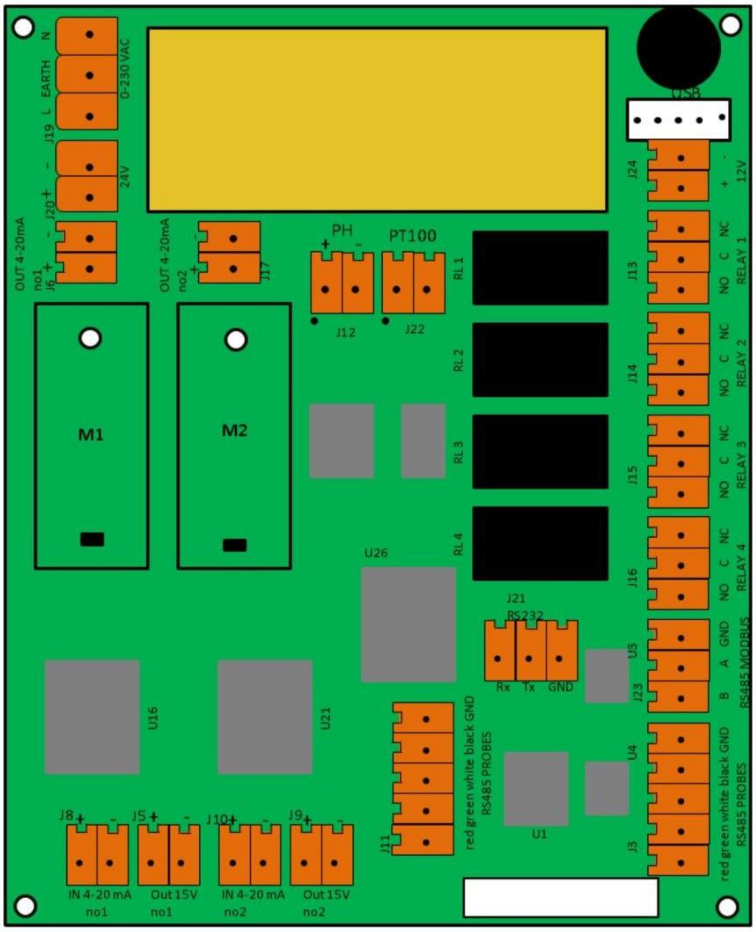


Figure 2. Drawing of the EL200 board

2.2.1. Mains Connection

To avoid electric shock, the controller must be connected to the earth via the power socket. Check that the power socked is earthed.

Disconnect the power cord or mains before any wiring, connection or servicing inside the controller.

If all the conditions above are satisfied, plug the power cord into a grounded power socket.

If the power cord needs to be changed or removed, the mains must be disconnected to the screen board EL200 on the screw terminal J19 as indicated on figure 4.

The EL200 board can also be powered with 24DC at screw terminal J20.

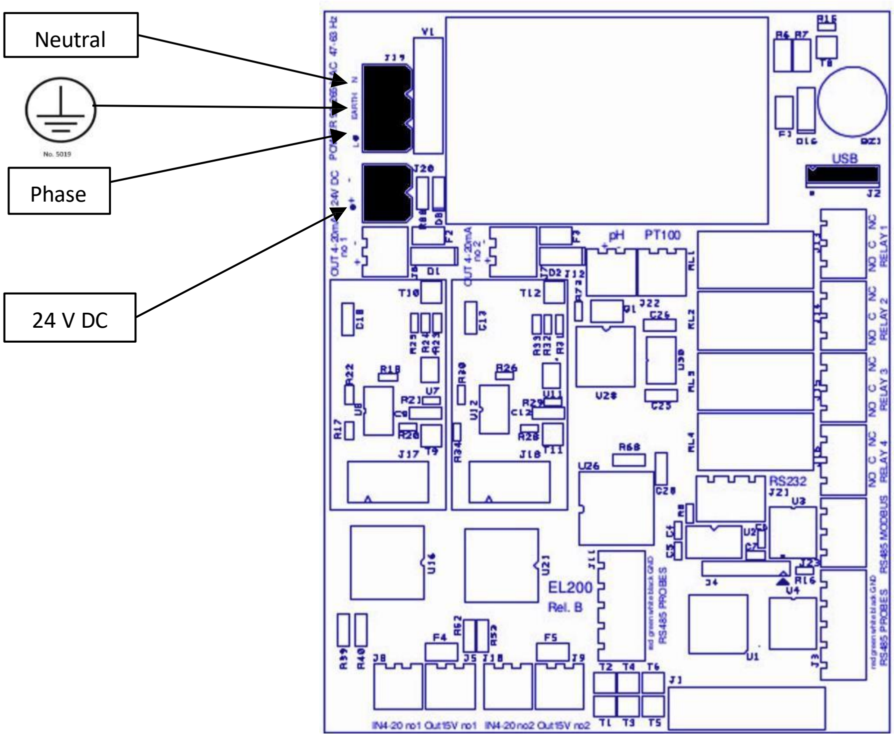


Figure 3. Schematic of the EL200 board

2.2.2. USB

A USB key (memory stick) can be connected on the USB connector type A, represented on the drawing of figure 2, for measurements download, configuration download or upload, screen captures, or for upgrading the analyser software. Refer to chapter 3 for using the USB key.

Disconnect the USB key as soon as the operation is finished as USB connection is not watertight and as it may block the analyser normal operation.

2.2.3. pH Electrode Input

Terminal J12 accepts a direct connection of a pH electrode. For automatic temperature compensation, a Pt100* sensor of the electrode must be connected to J22.

Note 1: if J22 stays unconnected, the temperature is preset at 25 °C.
Note 2: the maximal recommended length for the cable is 10 meters (30 feet).
(*) platinum resistive element of 100 ohm at 0° C.

2.2.4. Analogue 4-20 mA Input

The EL200 board is equipped with two independent analogue inputs J8 and J10 that accept the connection of a 4-20 mA output from a probe or external measuring system. The floating input is insulated by optocouplers.

A 15 V DC output (insulated, max 20 mA) is available on the connectors J5 and J9. This output must be used for any probe with electrical contact to the water sample (example: chorine probe).

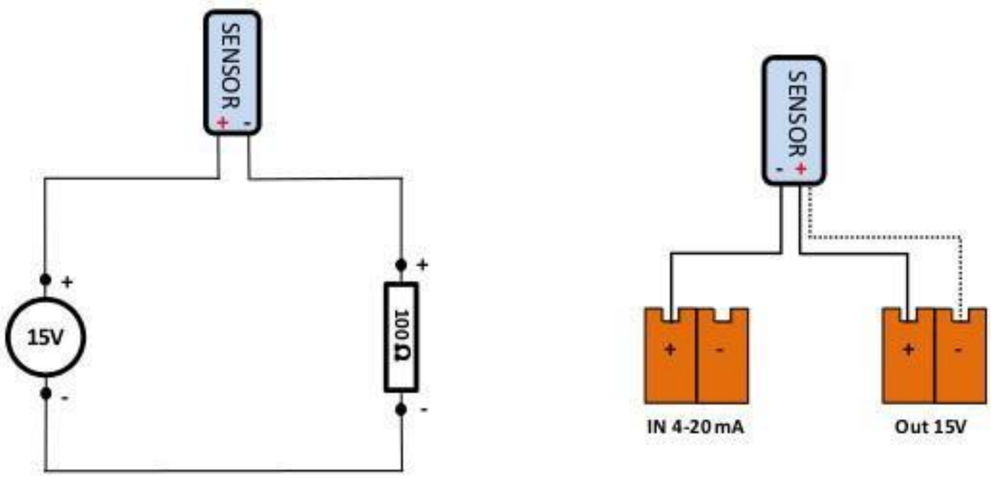


Figure 4. a) General schema of electronics for 4-20 mA analogue inputs. b) Schematics of the sensor's wiring to the 4-20 mA input screw terminals. The shielding cable is identified as the dotted line.

Screw terminal J8&J10	
Pin 1	4-20 mA input (+)
Pin 2	4-20 mA input (-)

Note: pin 1 on left side

Input impedance: 100 Ω

Screw terminal J5&J9	
Pin 1	+15 V
Pin 2	0 V (floating)

Note: pin 1 on left side

Max current: 20 mA

2.2.5. Analogue 4-20 mA Output

The EL200 board is equipped with two independent analogue output pins, J6 and J7. Each connector delivers an active 4-20 mA signal for PLC, recorders or SCADA system and it is affected to one measuring channel.

The maximum allowed charge is 500 ohm.

No voltage must be applied on the 4-20 mA output.

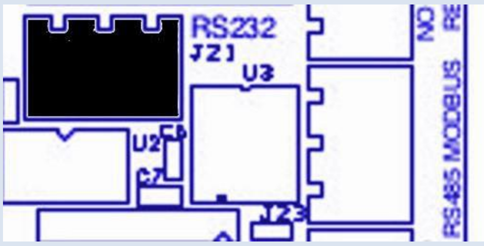
The output has a galvanic insulation by optocouplers up to 1 KV DC.

2.2.6. RS232 Port

The RS232 port has 3-pin connector, position J21.

Refer to chapter 3 (communications) to select the communication mode and the baud rate.
The format is always 8 bit, no parity, 1 bit stop.

See the following table for pin assignments.



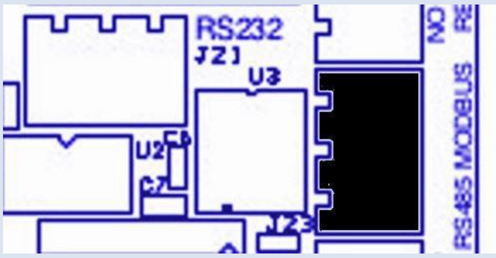
RS232 port

Pin 1	RX	Receive data
Pin 2	TX	Transmit data
Pin 3	GND	Ground

2.2.7. RS485 Port

The RS485 port has 3-pin connector, position J23.

Refer to chapter 3 (communications) to select the communication mode and the baud rate.
The format is always 8 bit, no parity, 1 bit stop.



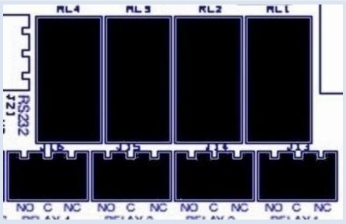
RS485 port

Pin 1	B	D-
Pin 2	A	D+
Pin 3	GND	Ground

2.2.8. Relays

EL200 board is equipped with four relay connections J13, J14, J15, and J16 which are connected to relay1, relay2, relay3 and relay4, respectively.
Each connector has a normally closed (NC) and a normally open (NO) relay contacts for different functions. Refer to chapter 3 to select the right function, threshold, etc...

To prevent electromagnetic interferences, it is highly recommended to switch only low voltage loads (12 or 24 VAC or DC). Connect only SELV circuits to relay outputs.
Contact rating: 5A @ 24 VAC or DC

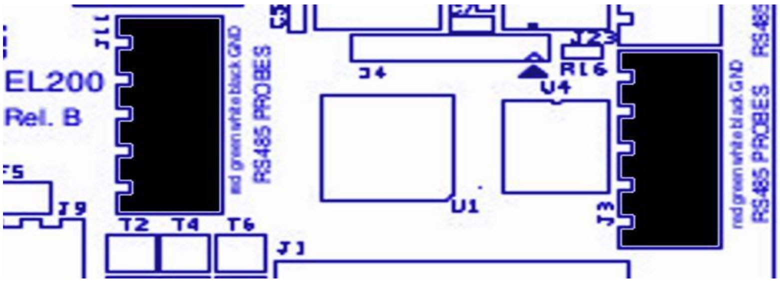


Pin 1	NO contact
Pin 2	Common
Pin 3	NC contact

Note: pin 1 on left side

2.2.9. RS485 Port for Probes Communication

There are two RS485 ports 5-pin screw terminals on the EL200 board, J3 and J11. The colour of the wiring in indicated on the PCB board. The EL200 can handle up to 4 sensors which communicate through the RS485 port. Wiring is done in parallel; two probes can be connected to the same connector.



See the following table for pin assignments. Wire connection of RS485 probes is also described in chapter 4.
Pin 5 may be used to connect the RS485 shielding cable.

RS485 port – Pin assignment

Pin 1	+12 V	Red	Power supply for probe
Pin 2	D-	Green	Data B
Pin 3	D+	White	Data A
Pin 4	GND	Black	Ground
Pin 5	EARTH	EARTH	Earth for shielding

Note: pin 1 on left side

Multifunctional Modules

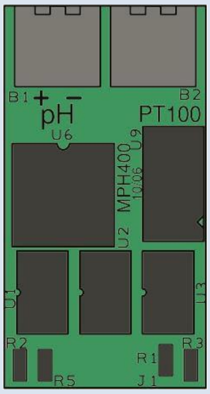
EL200 board is equipped with two slots (M1 and M2), where different modules (Out 4-20 mA module, pH module, COND module...) can be added. In the following section, these modules are described.

pH Module

The module MPH500 accepts the direct connection of a pH electrode on the screw terminal B1.

For automatic temperature compensation, a Pt100* sensor of the electrode must be connected on B2.

Note 1: if B2 stays unconnected, the temperature is preset at 25 °C.
Note 2: the maximal recommended length for the cable is 10 meters (30 feet).
(*) platinum resistive element of 100 ohm at 0° C.



Screw terminal B1

Pin 1	pH input (+)
Pin 2	pH input (-)

Note: pin 1 on left side

Screw terminal B2

Pin 1	Pt100 input
Pin 2	Pt100 input

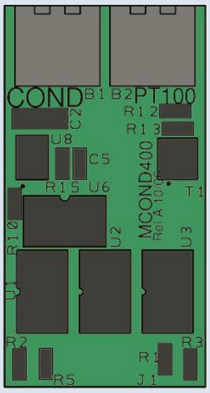
Note: pin 1 on left side

Conductivity Module (Optional)

The module MCOND500 accepts the direct connection of a conductivity electrode on the screw terminal B1. Conductivity constant of K=0.01, K=0.1, K=1 and K=10 are accepted, refer to chapter 4 to setup the right constant.

For automatic temperature compensation, a Pt100* sensor of the electrode must be connected on B2. Refer to chapter 4 to adjust the temperature coefficient.

Note 1: if B2 stays unconnected, the temperature is preset at 25 °C.
Note 2: the maximal recommended length for the cable is 10 meters (30 feet).
(*) platinum resistive element of 100 ohm at 0° C.



Screw terminal B1

Pin 1	Cond. input
Pin 2	Cond. input

Note: pin 1 on left side

Screw terminal B2

Pin 1	Pt100 input
Pin 2	Pt100 input

Note: pin 1 on left side

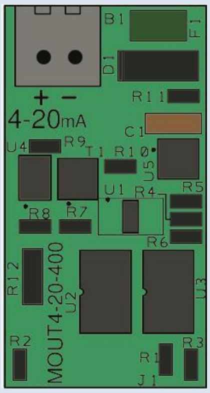
Analogue 4-20 mA Output Module (Optional)

OUT4-20-500 can be added to the EL200 board (M1 or M2) if more 4-20 mA output channels are needed. OUT4-20-500 also delivers an active 4-20 mA signal for PLC, recorders or SCADA system. Each OUT4-20-500 module is affected to one measuring channel.

The maximum allowed charge is 500 ohm.

No voltage must be applied on the 4-20 mA output.

The output has a galvanic insulation by optocouplers up to 1 KV DC.



MODULE OUT 4-20-500

Pin 1	4-20 mA output (+)
Pin 2	4-20 mA output (-)

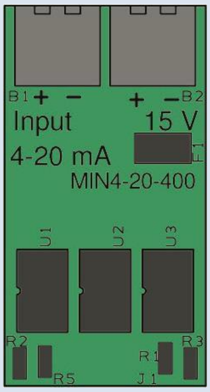
Note: pin 1 on left side

Max load: 500 Ω

Analogue 4-20 mA Input Module (Optional)

The module MIN4-20-400 accepts the connection of a 4-20 mA output from any probe or external measuring system. The floating input is insulated by optocouplers.

A 15 V DC output (insulated, max 20 mA) is available on the connector B2. This output must be used for any probe with electrical contact to the water sample.



Screw terminal B1

Pin 1	4-20 mA input (+)
Pin 2	4-20 mA input (-)

Note: pin 1 on left side

Input impedance: 100 Ω

Screw terminal B2

Pin 1	+15 V
Pin 2	0 V (floating)

Note: pin 1 on left side

Max current: 20 mA

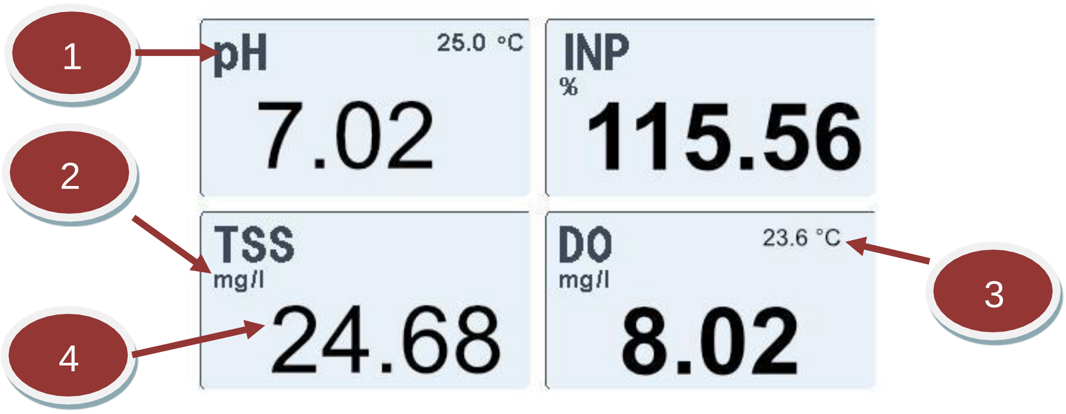
3. Operating

When powered on, the controller displays the last process screen. Then measurements automatically start, and process values and graphs are updated within a few seconds. There is a new recorded measurement each 5 minutes.

3.1. Values Process Screen

The value process screen is the "default" running screen of the controller and is one of the two running screens (together with the graph screen) of the controller. It is displayed a few seconds after power on and remains displayed all the time unless another screen has been selected.

This screen displays the very last measurement for all active channels.



1 Label of the measuring channel

The label is automatically set when the channel is created. It can be modified in the channel parameters screen.

2 Unit of the measuring channel

The unit is automatically set when the channel is created. It can be modified in the channel parameters screen.

3 Temperature

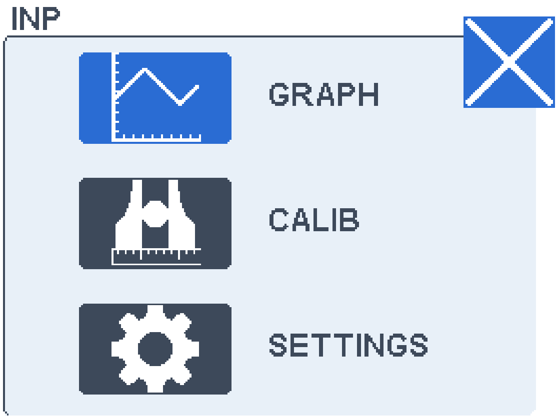
Display the auxiliary temperature measurement of the channel. It only concerns the channels with automatic temperature compensation.

4 **Channel value**

This value is the very last measurement done for each channel. The number of digit can be modified in the channel parameters screen. By default, negative values resulting from normal measuring fluctuations or from a wrong zero are displayed. They can be eliminated and replaced by zero by changing a setting on the channel parameters screen.

3.2. Main Menu Screen

To change the screen from the main process screen, press on one parameter. Immediately, a main menu window will appear showing GRAPH, CALIBRATION and SETTINGS options. This menu is particular to the selected parameter.



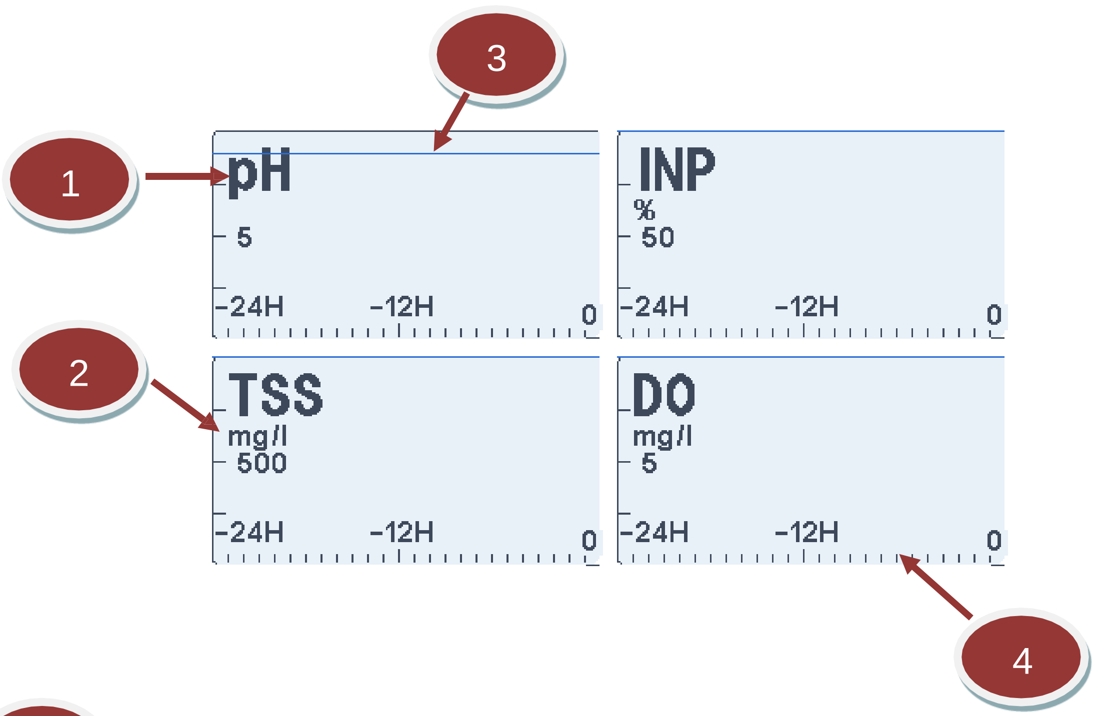
No password is required by default, but it is recommended that the user create one. Refer to the general parameters screens.

3.2.1. Process Graph Screen

The process graph screen is one of the two running screens of the controller. It is displayed when the graph option is activated and remains displayed all the time unless another screen has been selected.

This screen displays the measurements of the last 24 hours.

If EL200 controller is powered off, measurements recorded in the graph process screen and in the memory will be lost.



1 Label of the measuring channel

The label is automatically set when the channel is created. It can be modified in the channel parameters screen.

2 Unit of the measuring channel

The unit is automatically set when the channel is created. It can be modified in the channel parameters screen.

3 High alarm threshold line

This line corresponds to the high alarm threshold. This threshold is also used to define the default Y scale. The Y scale is automaticaly increased in case of higher values.

4 Time scale

The time scale of the graph is set to 24 hours.

3.2.2. Calibration Screen

This screen allows calibrating the selected channel. Each calibration window is specific to the parameter (see chapter 4). The following screen shows an example of a calibration screen.

1 Last calibration window

This window displays the 5 last calibrations done with the date, time and the new calibration factor.

2 Calibration factor

This field allows changing manually the calibration factor of the channel. The default value is 1.0.

3 Offset

This field shows the internal offset applied for zeroing.
It is updated at each zeroing and has normally not to be changed.

4 Zero

This button is used for zeroing the measurement.

⚠ Put first pure water on the electrode and wait for stabilization (up to a few minutes) before pressing this button.

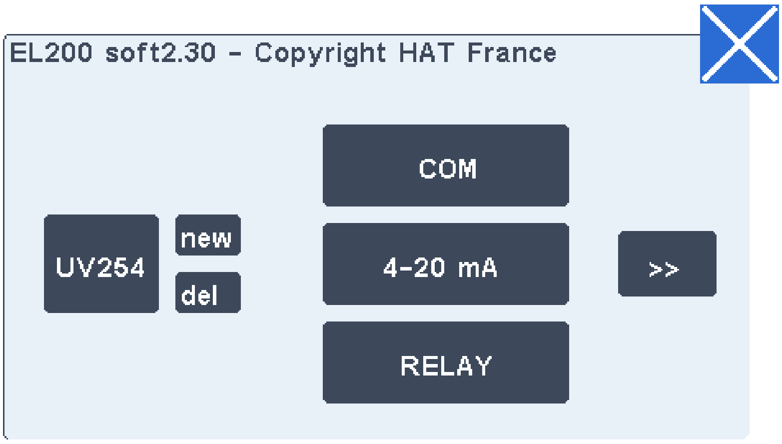
3.2.3. Settings Screen

This screen allows selecting different screens to check and change the general configuration of the controller. General settings are split into two different screens. In the first screen one can reach:

- Communication options
- 4-20 mA communication
- Relay fonctions

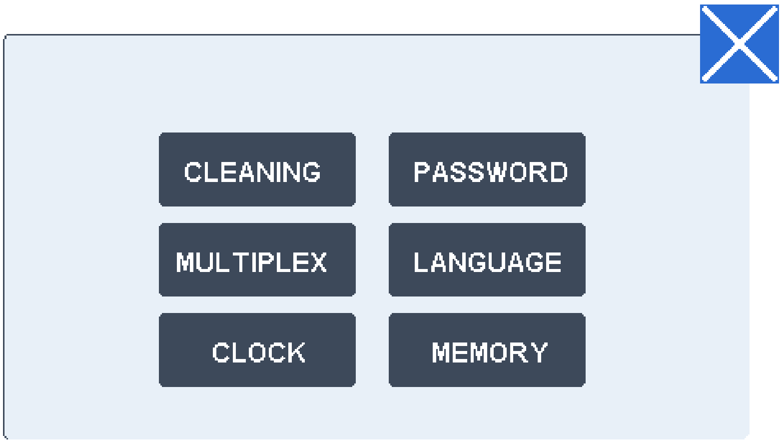
In the second one:

- Time and date update
- Password
- Language
- Multiplexing mode
- Cleaning
- Memory



In the first setting screen, new measuring channels can be created by pressing the "new" button. The "del" key allows suppressing an existing channel.
"Parameters screen" of the selected channel can be reached by pressing on the parameter key.

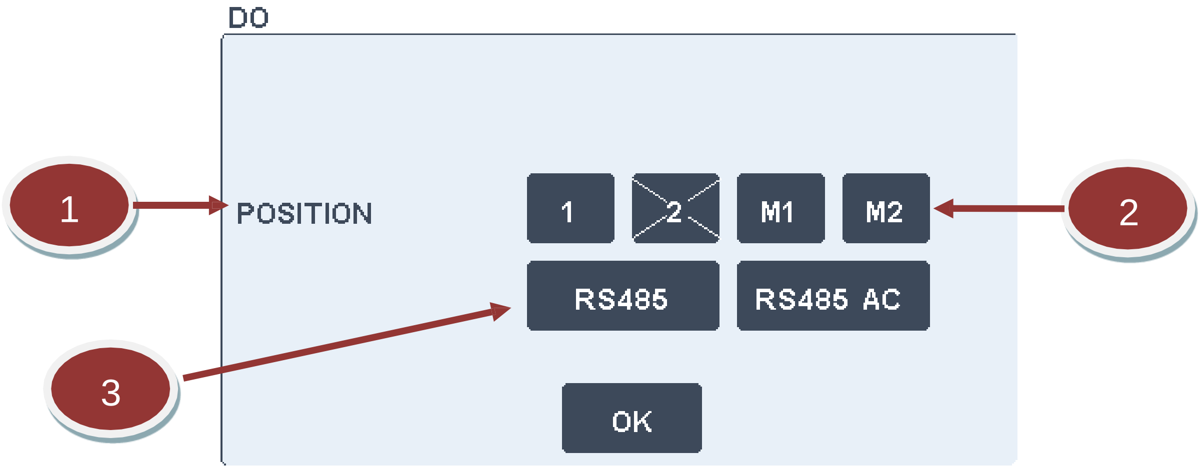
Second settings screen:



Channel Creation and Positions

This screen allows declaring a parameter. It is normally only used by the manufacturer. Press key "new" to declare a parameter. A password must be entered. The default password is 3333.

This screen displays the position of the probe or the position of the module linked to that probe.



1 Position

Specifies the position of the probe. Electrodes like pH, ORP can be connected directly. As well as probes with 4-20 mA outputs (1 or 2 position).

2 Modules

The EL200 electronic card has two module positions that can be used for different standard modules, 4-20 mA output module, 4-20 mA input module, pH module, conductivity module...

3 RS485

RS485 ports for probes using RS485 connection: TSS, DO with auto-cleaning.

Parameters Screen

Press on the parameter key and the parameter screen (for that specific channel) will appear. The settings are displayed in the two following screens. The screens shown below are examples for pH parameter. In chapter 4 specific parameters for different channels will be presented.

First screen:

1 Label

This field allows changing the channel label displayed with the measurement. The label size is limited to 6 characters.

2 Unit

This field allows changing the channel unit displayed with the measurement. The unit size is limited to 6 characters.

3 High alarm value

The high alarm level can be changed by pressing on this field. A default value is preset when the channel is created. The high alarm level is primary used to fix the high limit represented by a red line on the recorded measurement graph. The limit is used as the minimum graph scale.

The secondary use is to drive a high alarm relay if the relay has been selected for this function. In this case, the relay will be activated as soon as the measurement overpasses the high alarm value and will stay activated until the measurement goes down below this value after subtracting the boundary value.

Refer to installation section for the relay wiring. Both functions NO (Normally Open) and NC (Normally

Closed) are available.

4 Low alarm value

The low alarm level can be changed by pressing on this field. A default value is preset when the channel is created. The low alarm level is primary used to fix the low limit represented by a green line on the recorded measurement graph.

The secondary use is to drive a low alarm relay if the relay has been selected for this function. In this case, the relay will be activated as soon as the measurement underpasses the low alarm value and will stay activated until the measurement goes down below this value after adding the boundary value.

Refer to installation section for the relay wiring. Both functions NO (Normally Open) and NC (Normally Closed) are available.

5 Number of decimals

This field allows changing the number of decimals displayed for the measurement value to adjust the display to significant decimals only.

Note: this choice does not affect the measurements stored in the internal memory or the MODBUS registers.

6 Boundaries

The purpose of boundary is avoiding too frequent changes of state of the alarm relays that can harm process devices like pumps or electric-valves. The boundary value is subtracted from the high level value before leaving the high alarm state and reciprocally added to the low alarm level before leaving the low alarm state. More details including a schematic are provided in the relay section.

7 Negative values displayed

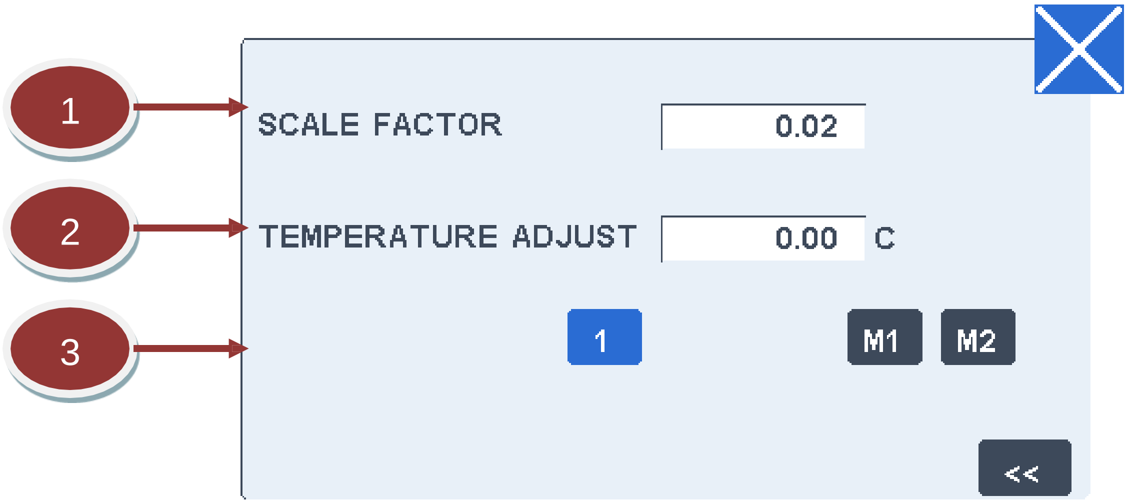
Negatives values are normal for most of the measurements as they result from normal fluctuations if the measurement is close to zero.

By default, the display of negative values is allowed as negative values may also result from a wrong zeroing. Consequently, it may be useful to be aware of such problem when observing strongly negative values.

But as negative values have no theoretical meaning, it is possible to replace them by zero by selecting "NO" for this function.

Note that this function does not apply to the recorded measurements or to the MODBUS registers.

<u>Second screen:</u>



1 Scale factor

This field allows changing the scale factor of the channel.
Precautions must be taken before changing this value.

This factor is normally determined in factory to transform the basic measurement to a scaled value in the final unit. There is no reason to change it except if elements are replaced.

2 Temperature adjustment

The temperature of the sample given by the internal temperature probe can be adjusted by this field if it differs from the real temperature read on an accurately calibrated thermometer.

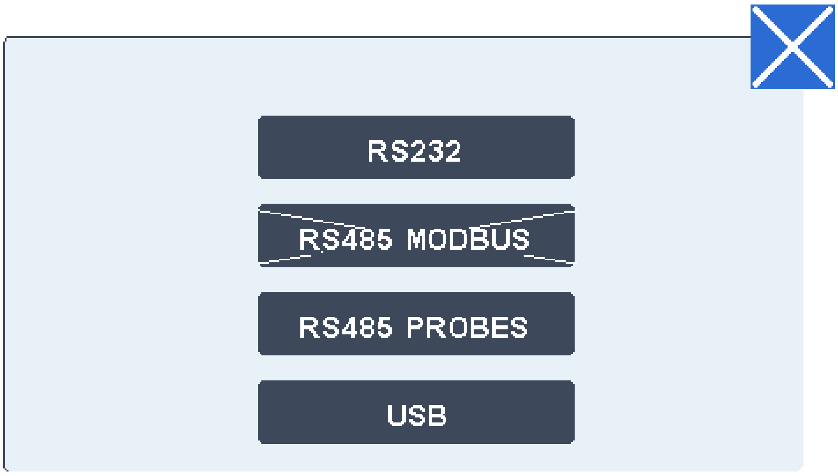
This adjustment is not really important as a difference of temperature is taken into account during the calibration. The adjustment is supposed to stay within ± 4 °C.

3 Channel Position

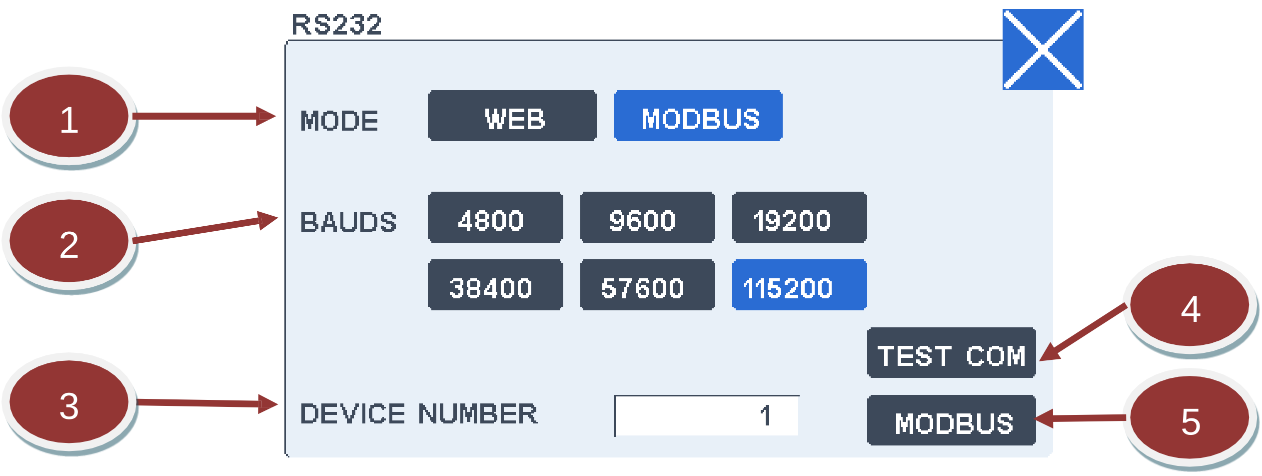
This screen allows declaring the position of the probe. In this example, the pH electrode is declared in position 1. There is also an option to declare the pH parameter in any of the two multifunction modules, M1 or M2. In this case, an additional pH module is needed.

Communication Settings

This screen shows different communication possibilities, RS485 and RS232 ports, RS485 communication for some probes and USB functions.



RS232 Port



This screen allows setting or changing the communication settings for the serial ports RS232.

Communication mode

Two protocols are available: MODBUS protocol and HTTP/HTML5 protocol.

1) MODBUS

The MODBUS communication mode allows reading the last measurements or the error codes as well as starting a new measuring or a cleaning cycle. The MODBUS protocol is a standard and simple protocol implemented on most of the SCADA systems. If necessary, the full protocol can be downloaded at www.modbus.org.

Basic frames using the function no 3 as shown below allows to read the measurements:

Request from the master unit:

Slave number	3	Address of first byte	NB of bytes	CRC16

Answer from the analyser:

Slave number	3	NB of read bytes	1st byte	2nd byte	……	CRC16

A CRC16 is used to check the integrity of the frame.
The frames must be in binary mode (also named RTU mode), not in ASCII mode.

Addresses of the last measurements:

Decimal address	Hexadecimal address	Value for
132	84H	Channel 1
136	88H	Channel 2
140	8CH	Channel 3
…………	…………	…………
196	C4H	Channel 16

Addresses of the error code:

Decimal address	Hexadecimal address	Value for
100	64H	Channel 1
102	66H	Channel 2
104	68H	Channel 3
…………	…………	…………
132	84H	Channel 16

The measurement values follow the floating point standard IEEE754, format single 32 bit (4 bytes), higher first, lower last. Invalid codes are 1 byte long.

Address for starting of a measurement cycle:

Decimal address	Hexadecimal address	Value to write
98	62H	1

A reading at this address returns 0 only when the measurement is finished.

Address for starting of a cleaning cycle:

Decimal address	Hexadecimal address	Value to write
99	63H	1

A reading at this address returns 0 only when the measurement is finished.

2 Port A Baud rate

The baud rate must be set strictly in accordance with the system connected on the RS232 port and generally at the higher speed compatible with the media capacity.

3 MODBUS device number

Each device on a MODBUS network has a specific number. This number can be entered in this field. The default value is 1.

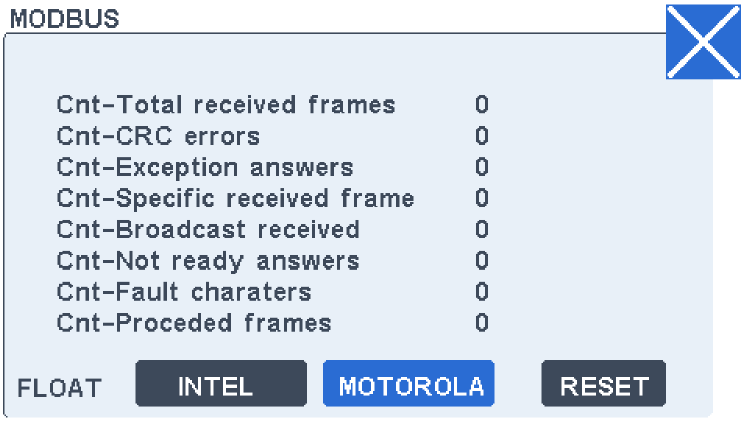
4 RS232 test

This screen allows testing the RS232 port. Each time this screen is called, it sends the sequence "QWERTY0123456789".
Any character received during the time this screen is displayed is written after the label "Received".
It is recommended to use a terminal emulator communication software to test the RS232 port.

5 RS232 /MODBUS test

This screen displays the diagnostic MODBUS counters defined by the MODBUS protocol.

The counters can all be reset to zero by pressing the key RESET.



Counter 1 displays the total number of valid frames received, whatever they are intended or not for the analyser.

Counter 2 displays the number of frames received with a CRC error, whatever they are intended or not for the analyser.

Counter 3 displays the number exception answers preceded. Exception answer is produced in case of unrecognized command or wrong parameter on a received frame.

Counter 4 displays the number of valid frames received specifically intended for the analyser.

Counter 5 displays the number of valid broadcast frames received. Broadcast frame are not usual.

Counter 6 is not in use (for compatibility only).

Counter 8 displays the number of characters received with a format error, whatever they are intended or not for the analyser.

Counter 9 displays the number of frames proceeds for which an answer has been sent to the host.

RS485 Port (MODBUS)

THE MODBUS PROTOCOL

The MODBUS communication mode allows reading the last measurements or the error codes as well as starting a new measuring or cleaning cycle. The MODBUS protocol is a standard and a simple protocol implemented on most of the SCADA systems. If necessary, the full protocol can be downloaded at www.modbus.org.

Basic frames using the function no 3 as shown below allows to read the measurements:

Request from the master unit:

Slave number	3	Address of first byte	NB of bytes	CRC16

Answer from the analyser:

Slave number	3	NB of read bytes	1st byte	2nd byte	……	CRC16

A CRC16 is used to check the integrity of the frame.
The frames must be in binary mode (also named RTU mode), not in ASCII mode.

Addresses of the last measurements:

Decimal address	Hexadecimal address	Value for
132	84H	Channel 1
136	88H	Channel 2
140	8CH	Channel 3
…………	…………	…………
196	C4H	Channel 16

Addresses of the error code:

Decimal address	Hexadecimal address	Value for
100	64H	Channel 1
102	66H	Channel 2
104	68H	Channel 3
…………	…………	…………
132	84H	Channel 16

The measurement values follow the floating point standard IEEE754, format single 32 bit (4 bytes), higher first, lower last. Invalid codes are 1 byte long.

Address for starting of a measurement cycle:

Decimal address	Hexadecimal address	Value to write
98	62H	1

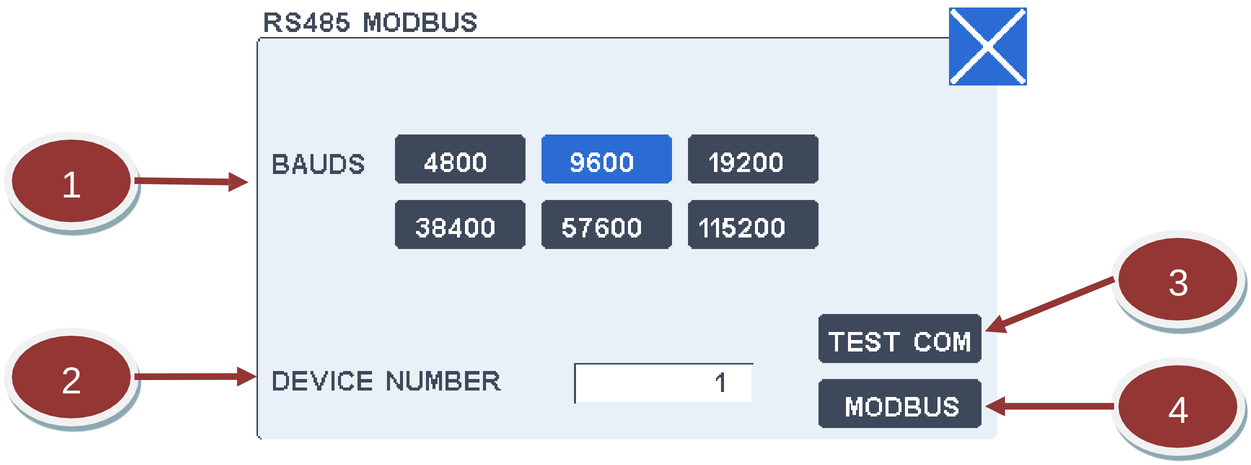
A reading at this address returns 0 only when the measurement is finished.

Address for starting of a cleaning cycle:

Decimal address	Hexadecimal address	Value to write
99	63H	1

A reading at this address returns 0 only when the measurement is finished.

This screen allows setting or changing the communication settings for the serial ports RS485.



1 **Baud rate**

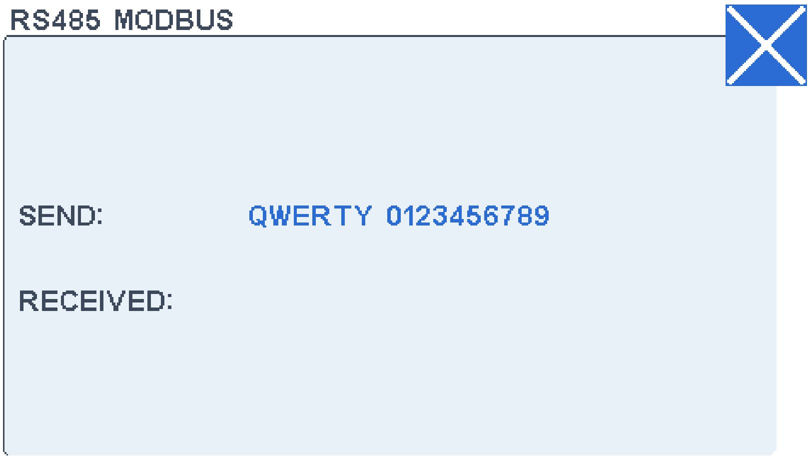
The baud rate must be set strictly in accordance with the system connected on the RS232 port and generally at the higher speed compatible with the media capacity.

2 **Device number**

Each device on a MODBUS network has a specific number. This number can be entered in this field. The default value is 1.

3 **RS485 test**

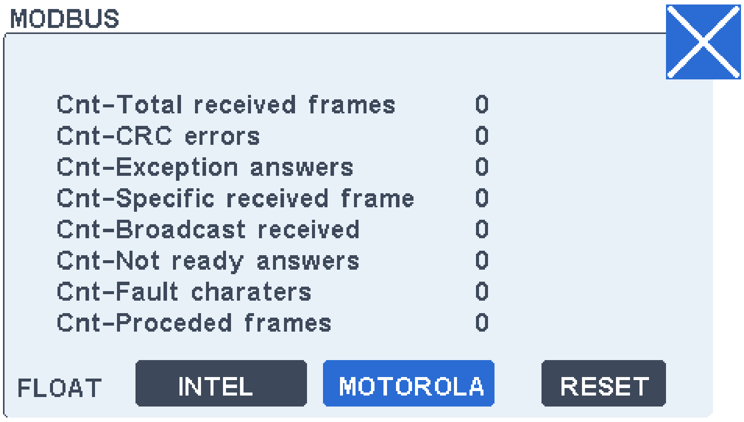
This screen allows to test the RS485 port. Each time this screen is called, it sends the sequence "QWERTY0123456789".
Any character received during the time this screen is displayed is written after the label "Received:".
It recommended to use a terminal emulator communication software to test the RS485 port.



4 MODBUS test

This screen displays the diagnostic MODBUS counters defined by the MODBUS protocol.

The counters can be all reset to zero by pressing the key RESET.



Counter 1 displays the total number of valid frames received, whatever they are intended or not for the analyser.

Counter 2 displays the number of frames received with a CRC error, whatever they are intended or not for the analyser.

Counter 3 displays the number exception answers preceded. Exception answer is produced in case of unrecognized command or wrong parameter on a received frame.

Counter 4 displays the number of valid frames received specifically intended for the analyser.

Counter 5 displays the number of valid broadcast frames received. Broadcast frame are not usual.

Counter 6 is not in use (for compatibility only).

Counter 8 displays the number of characters received with a format error, whatever they are intended or not for the analyser.

Counter 9 displays the number of frames proceeds for which an answer has been sent to the host.

RS485 MODBUS Probes

This screen allows to configure the RS485 probes the first time they are used. **Only one probe must be connected during this configuration phase.**

Press the key "RESET" to initialise the RS485 probe.

If the operation failed, disconnect the probe, reconnect it and press again on "RESET" key. The probe takes into account the new baud rate only on power on.

This screen also allows to list all the RS485 probes declared on measuring channels.
The probe model is displayed and followed by "ok" if recognised, otherwise a red message "No probe" is displayed if the probe is not connected or not recognised.

1 **Reset**

Press the key "RESET" to initialise the RS485 probe.

If the operation failed, disconnect the probe, reconnect it and press again on "RESET" key. The probe takes into account the new baud rate only on power on.

2 **Scan**

To determine the address and configuration of any probe connected on the RS485 port, press on

"SCAN". All the 254 possible addresses are tested to check all the connected probes. The status of the probe is displayed: linked to a measuring channel or unlinked.

If unlinked, the address can be entered in channel parameter screen (position).

3 RS485 probes test

To test the port itself, press on "TEST COM": each time this screen is called, it sends the sequence "QWERTY0123456789".
Any character received is written after the label "Received:"
It is recommended to use a terminal emulator communication software to test the RS485 port.

USB Functions

The USB key can be used for 4 different functions:

a. Recorded measurements and diagnostic file download (default function)

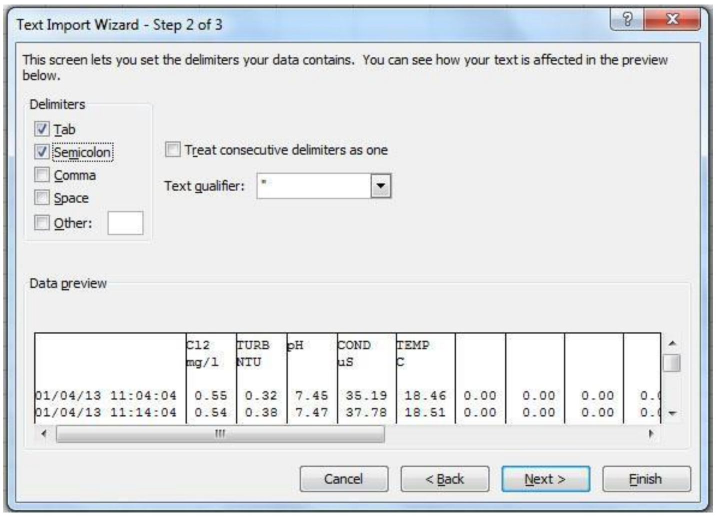
The last 288 lines of measurements with time are recorded in the cyclic internal memory and are transferred to the USB key as a text file when plugged on the USB port. The file name is MXXXXYYYY.txt with XXXX being the board serial number and YYYY an incremental number starting at 0001.

Each line of measurement starts by the date and time as shown in the example below:

```
;Cl2;TURB;pH;COND;TEMP;;;;;;;;;;
;ove;NTU; ;uS;C;;;;;;;;;

01/04/13 11:04:04; 0.55; 0.32; 7.45; 35.19; 18.46; 0.00;  0.00;  0.00;  0.00;  0.00;  0.00;  0.00;  0.00;  0.00;  0.00;  0.00
01/04/13 11:14:04; 0.54; 0.38; 7.47; 37.78; 18.51; 0.00;  0.00;  0.00;  0.00;  0.00;  0.00;  0.00;  0.00;  0.00;  0.00;  0.00
01/04/13 11:24:04; 0.53; 0.36; 7.46; 36.54; 18.66; 0.00;  0.00;  0.00;  0.00;  0.00;  0.00;  0.00;  0.00;  0.00;  0.00;  0.00
```

The channel measurements are separated by a semicolon and can be imported to Excel® as shown below:

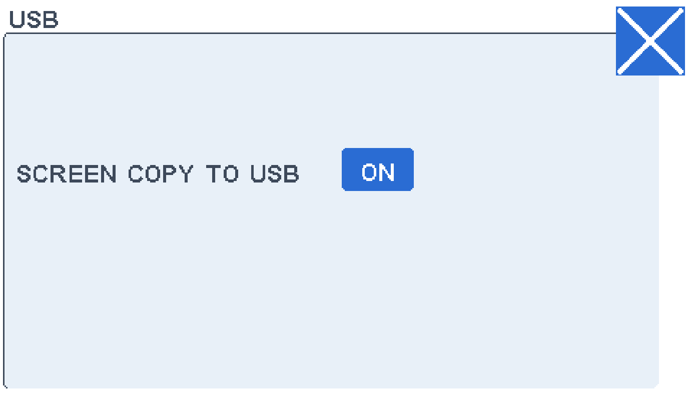


A diagnostic file is also transferred at the same time to the USB key as a text file.
It contains the main configuration parameters and the most important signals that may be useful for troubleshooting.

The file name is DXXXXYYYY.txt with XXXX being the board serial number and YYYY an incremental number starting at 0001.

b. Screen copy

The current screen is copied on the USB key as a bmp format file (Windows® compatible) if the screen copy function has been activated before, as shown on the screen below.
This function is automatically deactivated or in case of power off.



c. Configuration backup and restore

The complete configuration can be backup and restored as explained on section 3.2.3.11.

d. Software update

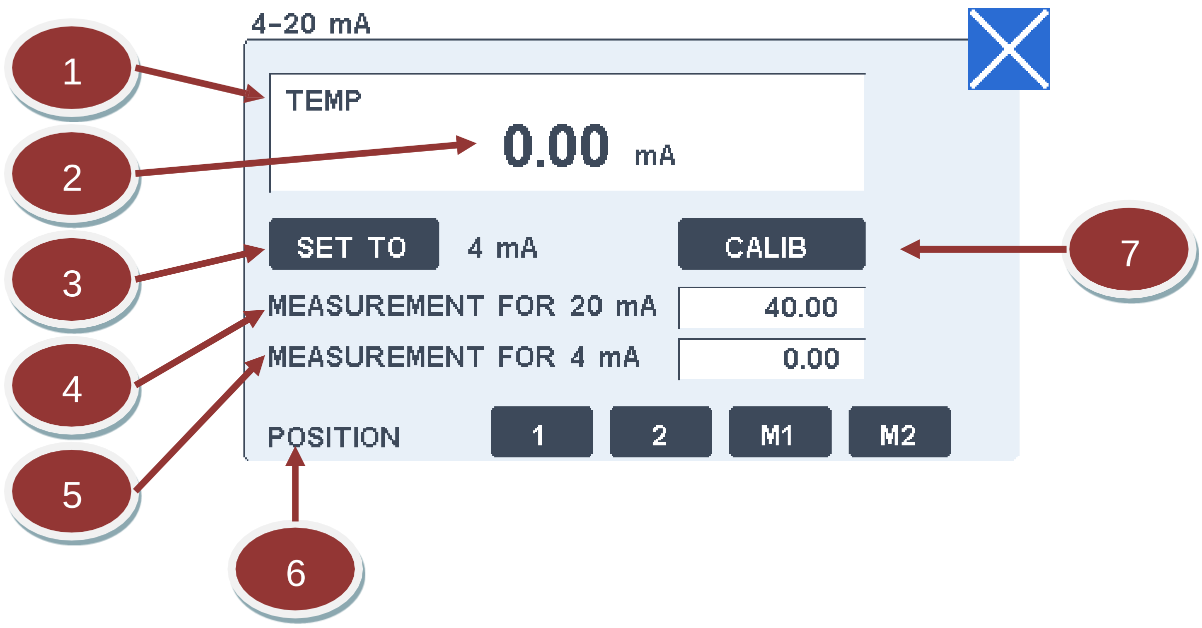
The internal software of the controller can be updated from a USB key by following this procedure:

- Backup the current configuration on an USB key (refer to section 3.2.3.11).
- Copy the new software send by e-mail as an attachment one a USB key.
- Switch off the controller.
- Plug the USB key.
- Select the right file with the arrow keys in case different software releases are on the USB key.
- Press on START.

Once the software update is finished (about one minute), you must reload the configuration from the USB key (refer to section 3.2.3.11).

4-20 mA Output

This screen displays the position of the 4-20 mA output of the selected channel. This screen is used also for 4-20 mA output calibration.



1 **Label of the channel in test**

2 **Current value on the 4-20 mA output**

This value can be checked with an ammeter connected directly on the 4-20 mA output (previously disconnect any cable on the output).

3 **Scan the 4-20 mA output**

This button allows to scan the 4-20 mA output mA by mA to check the output or the connected system.

4 **Value for 20 mA output**

This field allows entering the measured value corresponding to the full scale of 20 mA.

5 **Value for 4 mA output**

This field allows entering the measured value corresponding to the bottom of the scale at 4 mA. Generally, this value stays at 0.

6 **Position**

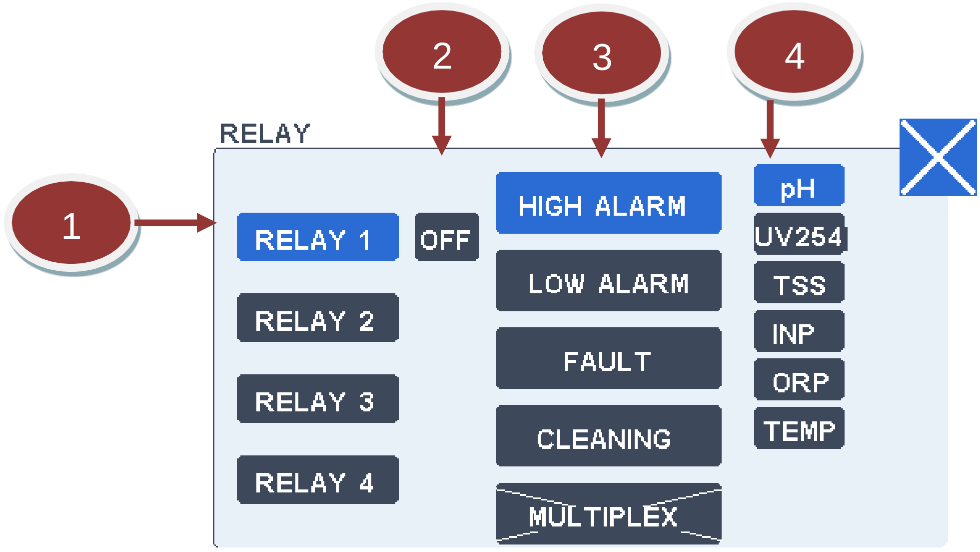
The position of the 4-20 mA output must be chosen. Either 1 or 2 for 4-20 mA outputs on the EL200 board (J6 or J7). Otherwise, if needed, multifunctional modules M1 or M2 can be added for 4-20 mA outputs.

7 **Calibration**

This button enables to calibrate the 4-20 mA output if the value slightly differs from the theoretical ones.
First enter the value read on an ammeter for 4-20 mA (example 3.96 mA), then enter the value read for 20 mA (example 19.95 mA).
Then the 4-20 mA output is recalibrated.

Relays

This screen allows specifying the parameters of the relays. EL200 board contains 4 relays.



1 **Label of the relay**

2 **ON/OFF**

With this key the relay can be activated (ON) or deactivated (OFF) for testing purpose only.

3 **Relays function selection**

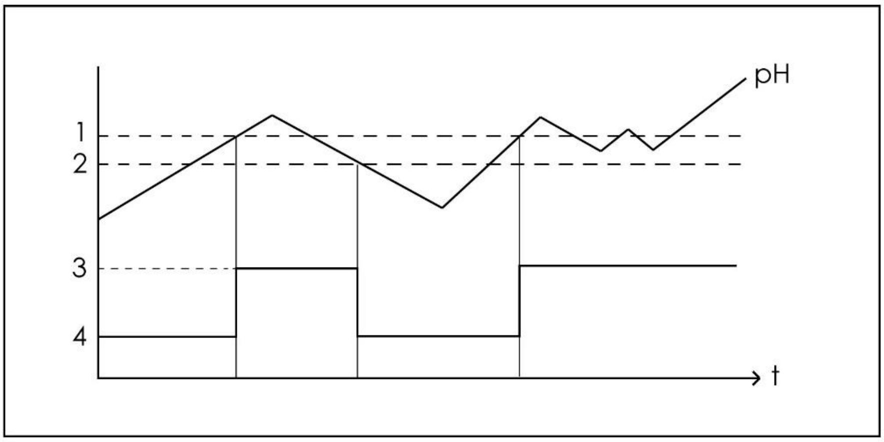
The relay functions are:

- **High alarm**

Activated when the measuring channel overpasses the high alarm threshold.
Boundaries apply for measurements according to the schematic below.

- **Low alarm**

Activated when the measuring channel is under the low alarm threshold. Boundaries apply for measurements according to the schematic below.



1	High alarm value
2	High alarm value - boundary
3	Alarm relay activated
4	Alarm relay deactivated

- **Fault**

Any error detected during a measuring cycle activates this relay until cleared by a new measurement. Fault alarm stays on until the problem is resolved.

- **Cleaning**

Relay activated to drive compressed air or water that are available for probes' cleaning. Period and duration are adjusted on the CLEANING screen.

- **Multiplex external solenoid valve command**

When the multiplexing mode has been selected, the concerned relays are automatically selected for this function.

4 **Selected parameter**

Each relay has to be assigned to one channel declared on the controller, for high and low alarm only.

Cleaning

This screen allows checking or changing cleaning settings.

1 **Cleaning**

If activated, the cleaning of the probe (with compressed air or water) will be activated automatically according to the defined period.

2 **Cleaning period**

This field contains the time between two cleaning cycles. The default period is 6 hours.

3 **Purging time**

This field constains the time during which compressed air or water flushes through the probe to clean it. The default value is 15 seconds.

4 **Recovery time**

This field contains the recovery time before starting again the measurements on the sample after a cleaning operation. The default value is 10 seconds.

5 **Next clean**

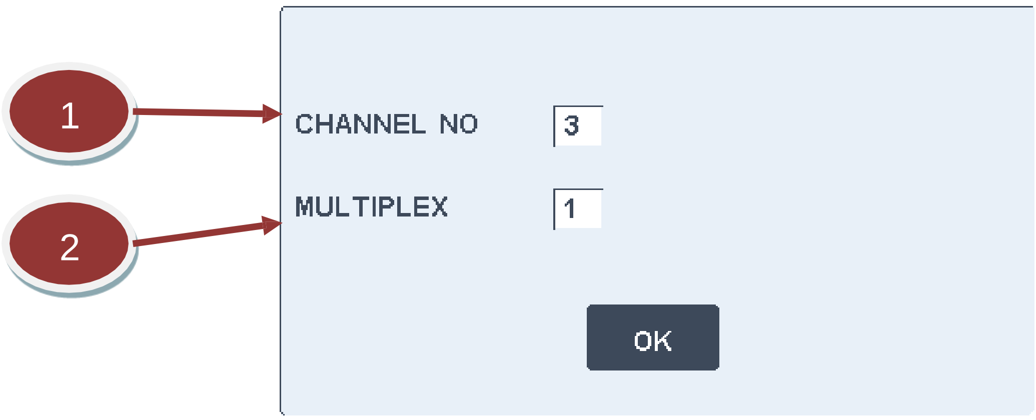
This field displays the information about the cleaning schedule.

Password

The following screen enables to enter a password to get access to any screen of the controller. The initial password is 0 (no password entering). The code 3333 can be used in case of password loss.

Multiplexing

This screen allows configuring the multiplexing mode when and only when a parameter is declared. It is a duplicated channel multiplexing system; each measured channel/parameter is shown in the process screen.

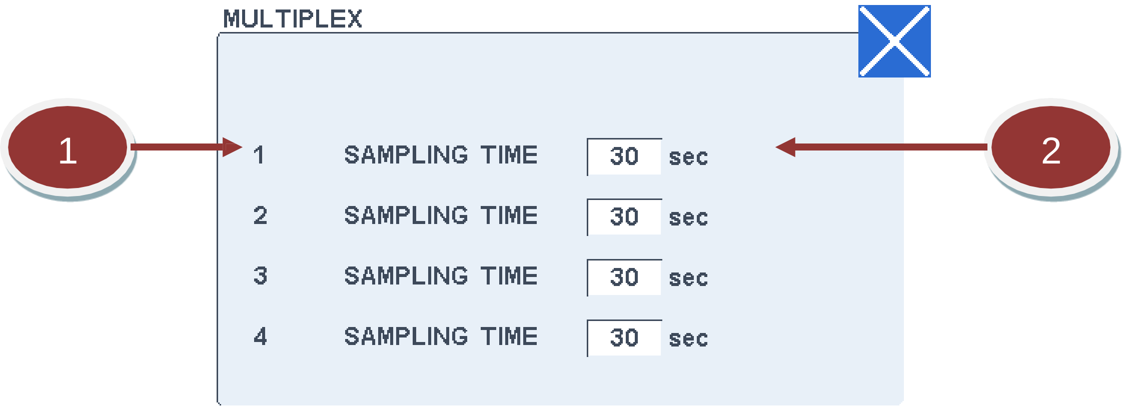


Channel

Specifies the channel number of the declared parameter in the EL200 controller. It is normally automatically given as the parameter is declared.

2 Multiplex

The “MULTIPLEX” window allows fixing the sampling time for each stream. The aim is to well renew the sample before the next measurement is done.



1 Stream

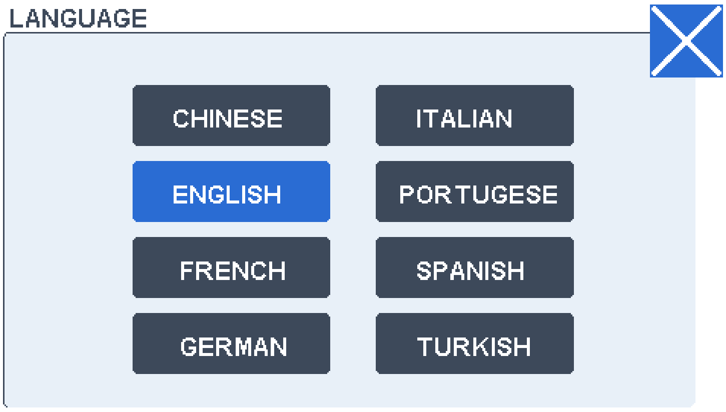
Once the measurement of one stream is finished, the next stream will automatically start its measuring cycle (including the sampling time).

2 Circulation time

This field allows fixing the sampling time of each stream for a good renew of the sample before the measurement takes place.

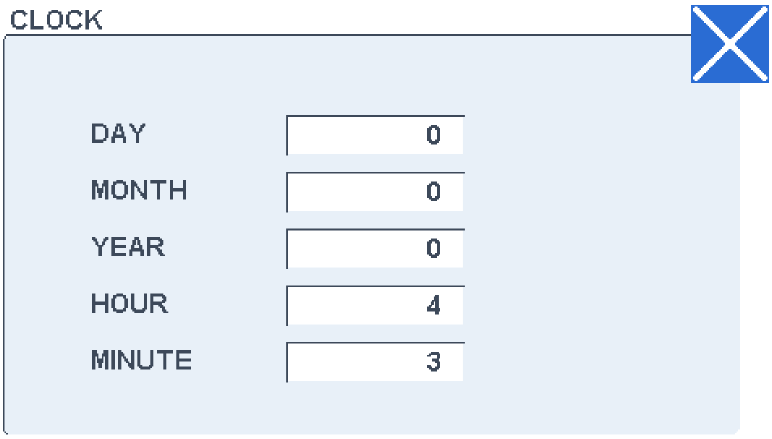
Language

The following screen enables to settle the language. Note that some technical terms may not be translated.



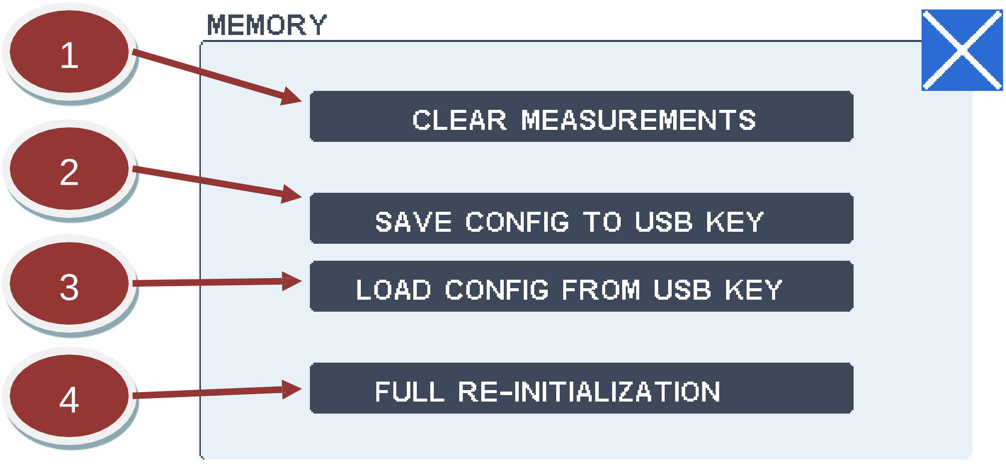
Clock

The following screen is used to set date and time.
Note: date and time data will be lost each time the controller is powered off. Date and time are not displayed in any of the controller screens. It is useful only in the table of recorded measurements that can be download on a USB key.



Memory Settings

This screen allows to manage the memory content.



1 Clear measurement

This button clears all the recorded measurements.

2 Save the configuration on the USB key

This button saves in a .cfg file the analyser configuration on the USB key. This function is recommended before doing a software update as the configuration is erased.

3 Load the configuration on the USB key

This button load from the USB key all the analyser configuration previously saved by the function above. The operator must choose the right configuration file in case of several configuration files stored in the USB key.

4 Full re-initialisation

This button erases all the configuration (channel, parameters, general settings...).
It may be exceptionally used in case of change of board.
The configuration must be re-introduced manually or from a configuration file saved on the USB key.

4. Parameters

The next section describes parameter by parameter the measuring principle, settings, testing, calibration, troubleshooting and specifications.

4.1. Chlorine Measurement by Electrode

4.1.1. Principle

Free chlorine is the amount of chlorine in water which has not reacted with substances other than water, plus its hydrolyzed forms hypochlorous acid ($HClO^-$) and hypochlorite ions (ClO^-). It is the chlorine which is available to disinfect drinking water and oxidize organic substances. Hypochlorous acid is 60 to 100 times more effective than hypochlorite ion in disinfection.
Chlorine hydrolyzes in water in accordance with the following equation:

$$Cl_2 + H_2O \leftrightarrows HOCl + Cl^- + H^+$$

The equilibrium constant for the above hydrolysis reaction:

$$K = \frac{[HOCl][H^+][Cl^-]}{[Cl_2]}$$

The concentration of hypochlorous acid is pH dependent and a curve can be used to describe pH dependence for the following equilibrium:

$$HOCl \leftrightarrows ClO^- + H^+$$

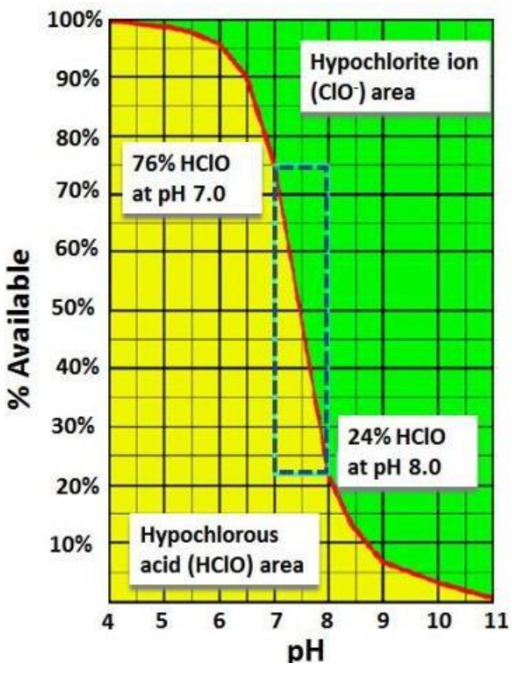


Figure 5. pH effect on dissociation of $HClO^-$

The chlorine electrode is a three-cell, membrane-covered chlorine electrode. One half-cell (RE) is composed of silver/silver iodide electrode, one half-cell stainless steel (CE) and the third half-cell gold disk (WE).

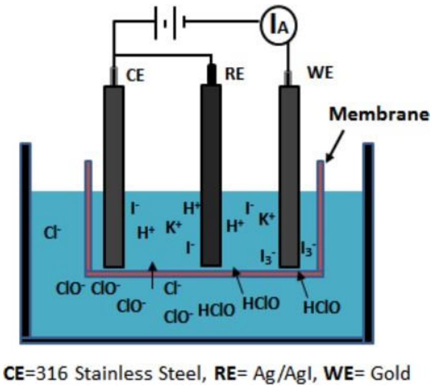
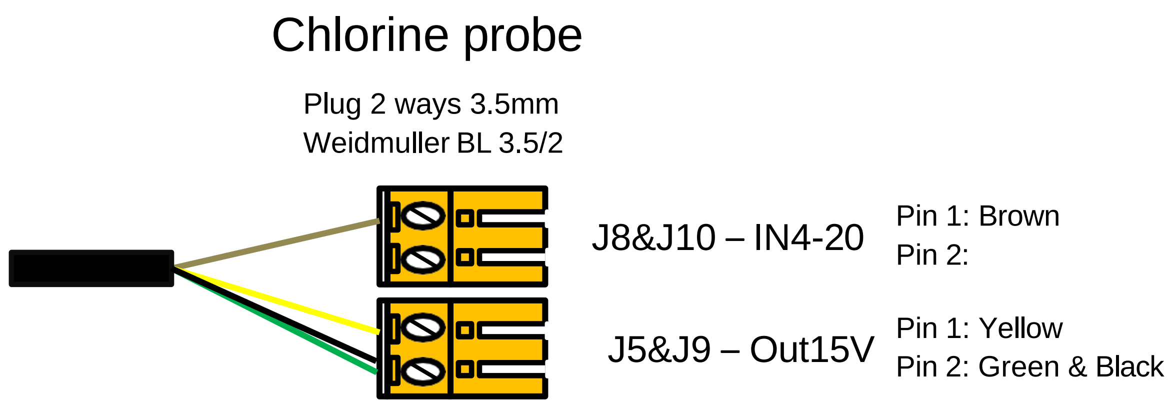


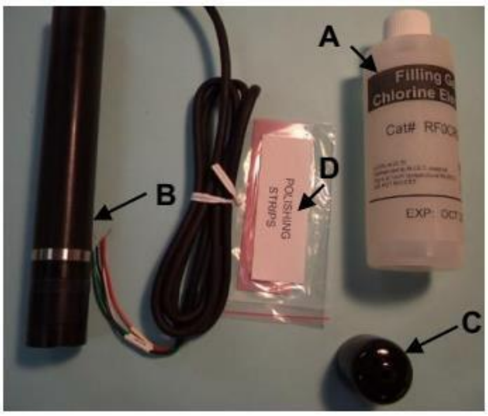
Figure 6. Schematics of membrane covered three-electrode chlorine probe

The residual chlorine sensor is based on the oxidation of iodide to triiodide ions, and further reduction of triiodide ions on the Au working electrode. Therefore, the electrode shows reduced pH dependence, meaning the pH change is buffered by the gel. The signal loss of chlorine sensor is about -5% per increasing pH unit in the range of pH 4 to pH 12.

4.1.2. Connections and Settings



For a safe installation of this probe, follow the instructions as described below.



1. Check that you have the required components:
A: Internal Fill Gel (IFG)
B: Electrode with membrane cap
C: Protection boot
D: Electrode polishing strips

2. Take off the protection boot from the membrane cap.
Safety gloves and glasses are strongly recommended during the preparation of the electrode.

3. Lift the silicone band that covers the vent hole. Make sure the vent hole is open to air (see arrow).

4. Unscrew the membrane cap.

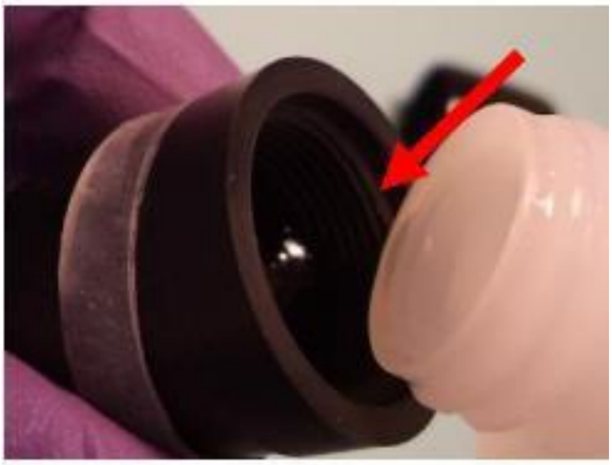
• Avoid using sharp tools.

5. Polish the working electrode (WE) surface (see arrow) with the polishing strip until the appearance is shiny.

• Polish the gold tip in one direction. The polishing only needs a few strokes on the polishing strip.

• Avoid touching the silver halide coating.

• Rinse the electrode with demineralized water after polishing.



6. Fill the membrane cap with the Internal Fill Gel to the upper threads (see arrow).
• Avoid introducing any air bubbles that will interfere in the measurement.

7. Screw the membrane cap on the electrode until it is finger tight. Make sure the event hole is open to air to allow the excess of IFG to escape.
• Do this step over a sink with running water to rinse away excess IFG.

8. Push the silicone vent hole band back into the recess and rinse the electrode thoroughly before using.

9. Wipe water off the electrode gently. Avoid touching the membrane after assembly.

If the electrode is not used after assembly, put it in demineralized (DI) water to keep the membrane wet.

4.1.3. Calibration

Because chlorine standards are not easy to make or maintain (highly unstable), especially in a flow cell or similar application, a standard method rather than a standard solution is recommended to calibrate the electrode. This method compares the electrode measurement to another reliable chlorine measurement method – such as colorimetric DPD method. Using samples from the same environment, the DPD or other colorimetric methods will be used to calibrate the Chlorine Electrode.

4.1.4. Maintenance and Troubleshooting

Maintenance includes electrode cleaning, membrane cap replacement and refreshing the Internal Fill Gel (IFG). The IFG should last about 3 months whereas the membrane cap life expectancy is about 12 months in clean water.

Conditioning is required at first time use after membrane cap change and IFG replacement. Thereafter, a restarted probe needs about 4 hours to get an accurate reading.

Calibration	Monthly. If experience shows the electrode readings follow calibration data in between calibration intervals, the calibration interval can be extended.
Change Internal Fill Gel	Every 3-6 months, more frequent in wastewater or other dirty waters.
Replace Membrane Cap	Every 12 months, more frequent in wastewater water or other dirty waters.
Electrode Storage	Not in use < 2 weeks, store in DI water or drinking water; not in use > 2 weeks, store dry (dump internal fill gel and rinse probe thoroughly).
Working Electrode	Clean with DI water and polishing strip before refilling with IFG.
Temperature / Pressure	Sudden changes in temperature or pressure may induce transient current changes. Wait for normal diffusion conditions to be re-established.

Membrane Cap Cleaning	Rinse with DI water, check regularly based on application circumstances.
Gold Electrode Cleaning	Use the polishing strip to lightly polish the electrode surface

<u>Troubleshooting</u>

Symptoms	Origin
Value is too low	- Membrane cap fouled - Sample pH increased - Bubbles on membrane cap - No IFG - Flow rate too low - Insufficient conditioning
Value is too high	- Membrane cap dirty or damaged - Sample pH decreased - Not enough warm-up time - High pressure - Interference sources - Insufficient conditioning
Slow response time	- Membrane cap fouling - Bubbles on membrane
Reading drift immediately after calibration	- Membrane cap fouled or damaged - Bubbles on membrane - Bubbles inside membrane cap

4.1.5. Specifications

Measuring range: 0 – 20 mg/L

Measuring time: 90 seconds to 90% (T-90), 25 °C

Accuracy: ± 0.1 mg/L

4.2. Conductivity

4.2.1. Principle of Contacting Conductivity Probe

The conductivity is the reciprocal of resistance and is determined by the ratio current/voltage according to Ohm's law.

$$C = \frac{1}{R} = \frac{l_{amps}}{l_{volt}}$$

The conductivity is measured in Siemens by two immersed electrodes of an area A separated by a distance d. Since the measured conductivity depends on the electrode geometry, the measured conductivity must be multiplied by the cell constant to obtain the specific conductivity expressed in Siemens per centimeter (S/cm).

The cell constant is defined by: $k = \frac{d}{A}$

The conductivity of a solution is proportional to its ion concentration, as long as there is no ionic interaction.
Typical specific conductivity and cell constant:

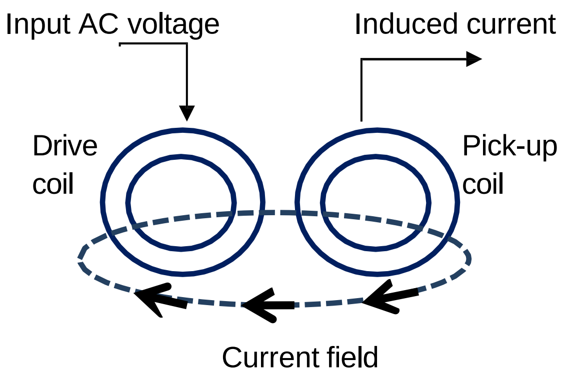
Solution	**Specific conductivity (µS/cm)**
Absolute pure water	0.055
Boiler water	1
Tap water	50
Ocean water	50,000

Application	**Typical range (µS/cm)**	**Recommended Cell constant K**
Ultra-pure water	0 to 2	0.01
Pure water, boiler	1 to 200	0.1
River, tap water	10 to 2,000	1
Sea water, effluents	1,000 to 200,000	10

As conductivity depends on the temperature, a temperature sensor is generally included in the electrode (100 ohm Platinum resistor) and must be connected to the instrument for automatic temperature compensation (ATC). The default coefficient is 2% per ºC but may be modified according to the solution typical coefficient obtain experimentally.

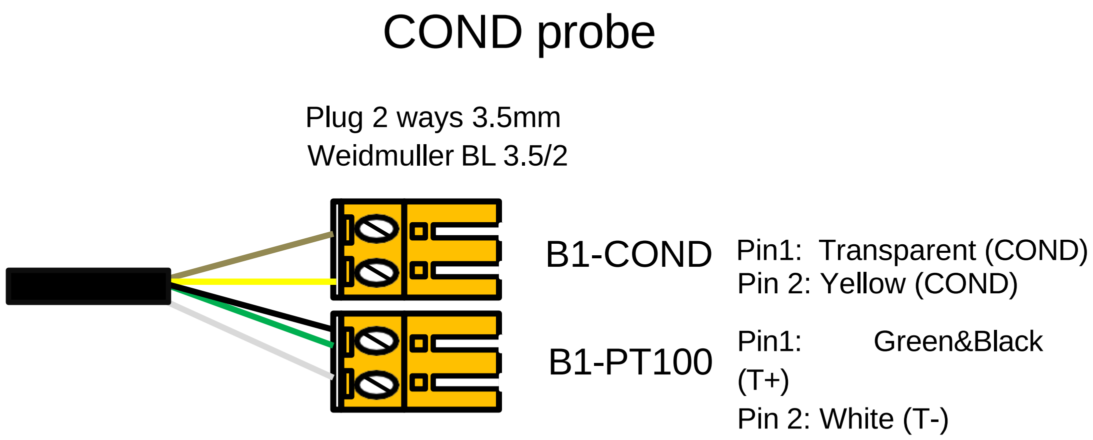
4.2.2. Principle of Inductive Conductivity Probe (Toroidal Conductivity)

Unlike contacting conductivity sensors, an inductive conductivity sensor (Toroidal Conductivity Sensor) is resistant to fouling, coating, and corrosion, and it is designed for minimal maintenance and long service life. It is recommended to use for harsh applications.
An inductive sensor consists of two wire-wound metal toroids encased in a corrosion-resistant plastic body. A toroidal conductivity measurement is made by passing an AC current through a toroidal drive coil, which induces a current in the electrolyte solution. This induced solution current, in turn, induces a current in a second toroidal coil, called the pick-up toroid. The amount of current induced in the pick-up toroid is proportional to the solution conductivity.
For accurate results, the user must calibrate the sensor in-situ; in the process piping due to wall effects.



4.2.3. Connections and Settings

Conducting conductivity probe's wiring is as follows. This sensor needs an external COND module.



Settings for conductivity probes are displayed on the two following screens:

First screen:

1 **Label**

This field allows changing the channel label displayed with the measurement. The label size is limited to 6 characters.

2 **Unit**

This field allows changing the channel unit displayed with the measurement. The unit size is limited to 6 characters.

3 **High alarm value**

The high alarm level can be changed by pressing on this field. A default value is preset when the channel is created. The high alarm level is primary used to fix the high limit represented by a red line on the recorded measurement graph. The limit is used as the minimum graph scale.
The secondary use is to drive a high alarm relay if the relay has been selected for this function. In this case, the relay will be activated as soon as the measurement overpasses the high alarm value and will stay activated until the measurement goes down below this value after subtracting the boundary value.

Refer to installation section for the relay wiring. Both functions NO (Normally Open) and NC (Normally Closed) are available.

4 **Low alarm value**

The low alarm level can be changed by pressing on this field. A default value is preset when the channel is created. The low alarm level is primary used to fix the low limit represented by a green line on the recorded measurement graph.

The secondary use is to drive a high alarm relay if the relay has been selected for this function. In this case, the relay will be activated as soon as the measurement underpasses the low alarm value and will stay activated until the measurement goes down below this value after adding the boundary value.

Refer to installation section for the relay wiring. Both functions NO (Normally Open) and NC (Normally Closed) are available.

5 **Number of decimals**

This field allows changing the number of decimals displayed for the measurement value to adjust the display to significant decimals only.

Note: this choice does not affect the measurements stored in the internal memory or the MODBUS registers.

6 **Boundaries**

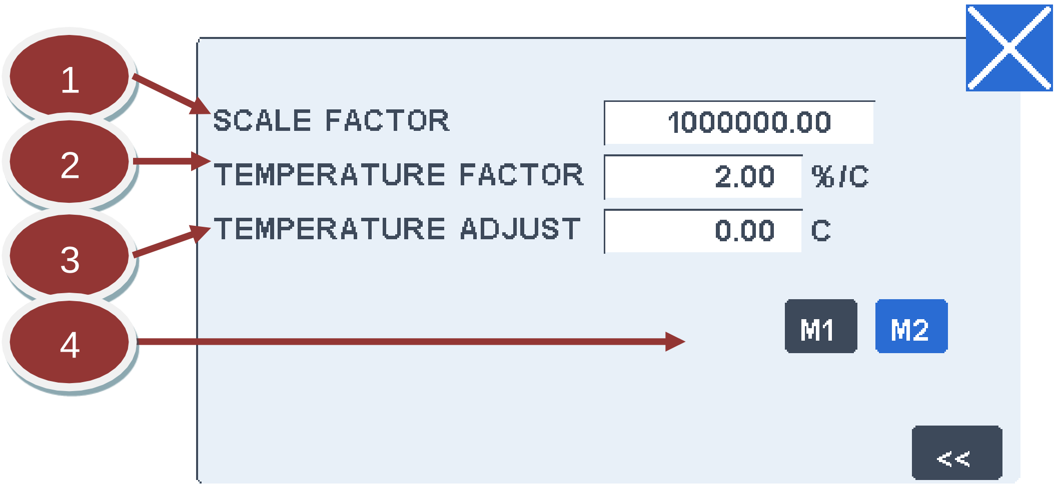
The purpose of boundary is avoiding too frequent changes of state of the alarm relays that can harm process devices like pumps or electric-valves. The boundary value is subtracted from the high level value before leaving the high alarm state and reciprocally added to the low alarm level before leaving the low alarm state. More details including a schematic are provided in the relay section.

7 **Negative values displayed**

Negatives values are normal for most of the measurements as they result from normal fluctuations if the measurement is close to zero.
By default, the display of negative values is allowed as negative values may also result from a wrong zeroing. Consequently, it may be useful to be aware of such problem when observing strongly negative values.
But as negative values have no theoretical meaning, it is possible to replace them by zero by selecting "NO" for this function.

Note that this function does not apply to the recorded measurements or to the MODBUS registers.

Second screen:



1 **Scale factor**

This field allows changing the scale factor of the channel.
Precautions must be taken before changing this value.

This factor is normally determined in factory to transform the basic measurement to a scaled value in the final unit. There is no reason to change it except if elements are replaced.

2 **Temperature coefficient**

The conductivity of a solution is affected by the temperature. This coefficient is used for the temperature compensation. The default value is 2% per °C. It may be adjusted depending on the solution.

3 **Temperature adjustment**

The temperature of the sample given by the internal temperature probe can be adjusted by this field if it differs from the real temperature read on an accurately calibrated thermometer.

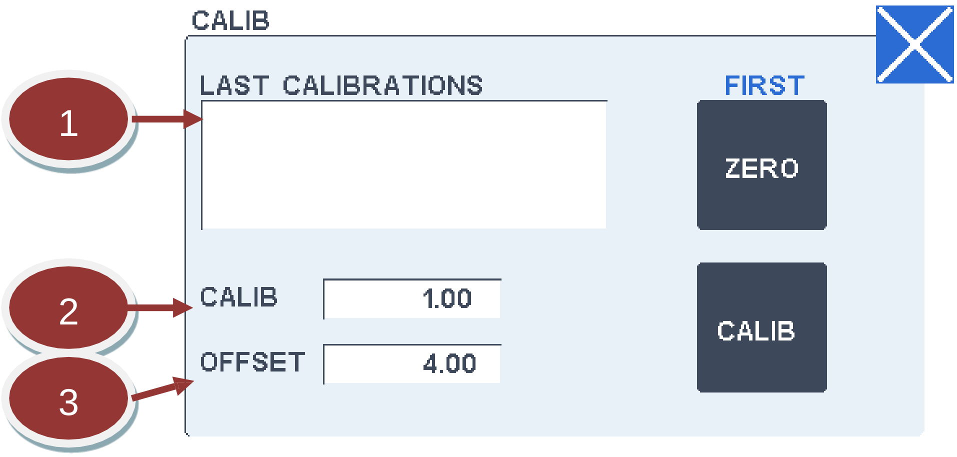
This adjustment is not really important as a difference of temperature is taken into account during the calibration. The adjustment is supposed to stay within ± 4 °C.

4 **Module position**

The position of the conductivity module is shown (M1 or M2).

4.2.4. Calibration

The calibration screen below enables to recalibrate the measurement channel.
See after this screen description the recommendations for recalibration.



1 **Last calibration window**

This window displays the 5 last calibrations done with the date, time and the new calibration factor.

2 **Calibration factor**

This field allows changing manually the calibration factor of the channel.

3 **Offset**

This field shows the internal offset applied for zeroing.
It is updated at each zeroing and has normally not to be changed.

Recommendations for the calibration

The conductivity electrode must be checked on a regular base depending on the condition of use, and recalibrated if necessary.

To recalibrate the conductivity electrode, proceed as follows:

- Put the electrode in pure water.
- Wait for the stabilisation of the conductivity value (a few minutes if the electrode is new or dry), then press on the ZERO key.
- Then put the electrode in a standard solution for conductivity (example 210 µS for 100 mg/L NaCl at 25°C).
- Wait for the conductivity to stabilize.
- Go on the calibration screen and adjust the calibration factor value until you get the expected value.

The calibration is finished. New offset and calibration factors have been calculated and recorded on the calibration history displayed on the calibration screen.
These new offset and factors will be taken into account for all further measurements.

4.2.5. Maintenance and Troubleshooting

Maintenance

The conductivity probe must be cleaned on a regular base depending on the application (daily, weekly or monthly). Do not touch the probe cell surface with any hard object. If the probe cell surface is contaminated, soak the probe cell portion in light detergent and mild acid for about 15 min, respectively.

Troubleshooting

Symptoms	Origin
Negative value	- Bad zero.
Value is too low	- No water in contact with the electrodes. - Dirt on the electrodes. - Bad calibration: check or redo a calibration.
Value is too high	- Bad calibration: check or redo a calibration.
Unstable value	- Electrical interference on the probe cable, put the probe cable away from power cables.

Measuring errors

Error no	Signification	Origin / Remediation
1	Over range	- Check on pure water. - Failure on the conductivity board (replace).

4.2.6. Specifications

Contacting Conductivity Probe Specifications

Measuring range:	with K=0.01	0 - 200 µS
	with K=0.1	0 – 2000 µS
	with K=1	0 - 20 mS
	with K=10	0 - 200 mS

Measuring time: 2 seconds

Accuracy: ± 5%

Inductive Conductivity Probe Specifications

Measuring range: 0 – 100 mS

Measuring time: 2 seconds

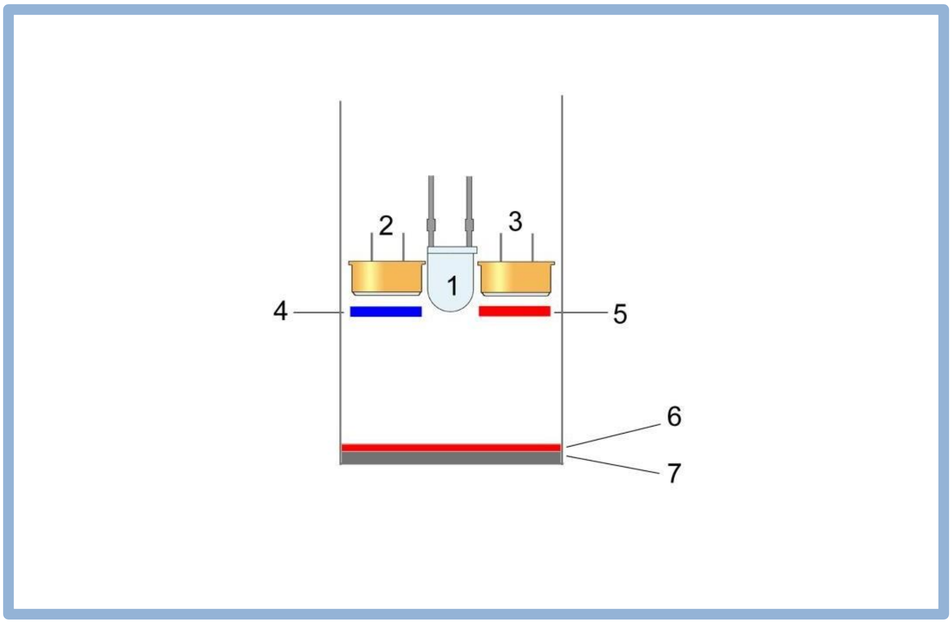
Accuracy: ± 5%

4.3. Dissolved Oxygen

4.3.1. Principle

The measuring principle is based on the fluorescence quenching by oxygen of a special polymer membrane in contact with the sample. The light is emitted by a LED while two detectors with red and blue filters are measuring the fluorescent light (red) and the reference light (blue).

In presence of oxygen, the fluorescence decreases which decreases the signal on the red detector.



1	LED light source	5	Red filter
2	Fluorescence photo detector	6	Luminophore
3	Reference photo detector	7	Insulation membrane
4	Blue filter		

4.3.2. Dissolved Oxygen (DO) Probe by Fluorescence

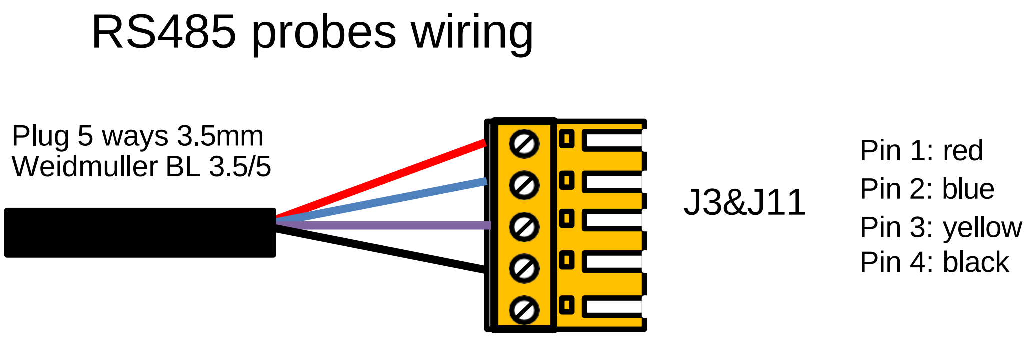
The DO probe offers a 4-20 mA output for continuous measurement applications. The old version of the probe is connected to the two independent analogue input pins J8 and J10 on the EL200 board and the new version is connected through RS485 port. For a safe installation of this probe, it is recommended to follow this Operating Manual.

4.3.3. Dissolved Oxygen Probe by Fluorescence with Autocleaning

This probe has a RS485 interface under Modbus protocol and must be connected to the one of the dedicated RS485 port (J3 or J11) on the EL200 board.

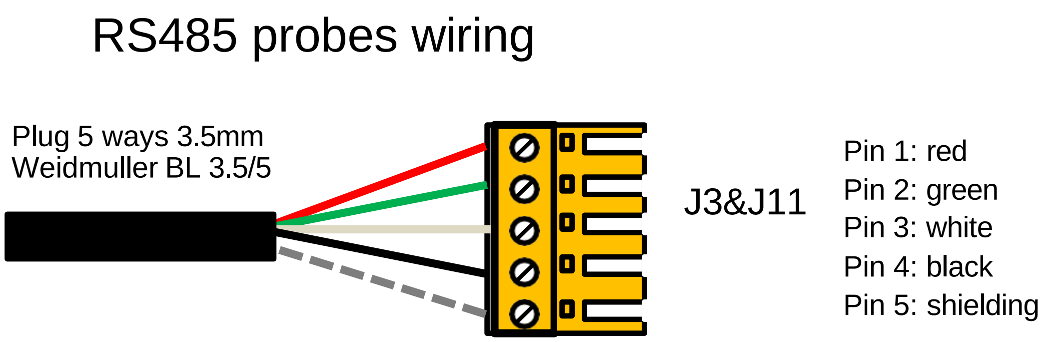
4.3.4. Connections and Settings

Standard DO probe is connected to the RS485 port (RS485 PROBES):



Note: several probes can be connected in parallel, except for the first time the probe is configured. It must be done one by one. Once configured, the probes can be connected in parallel.

DO probe with autocleaning is connected to the RS485 port (RS485 PROBES):

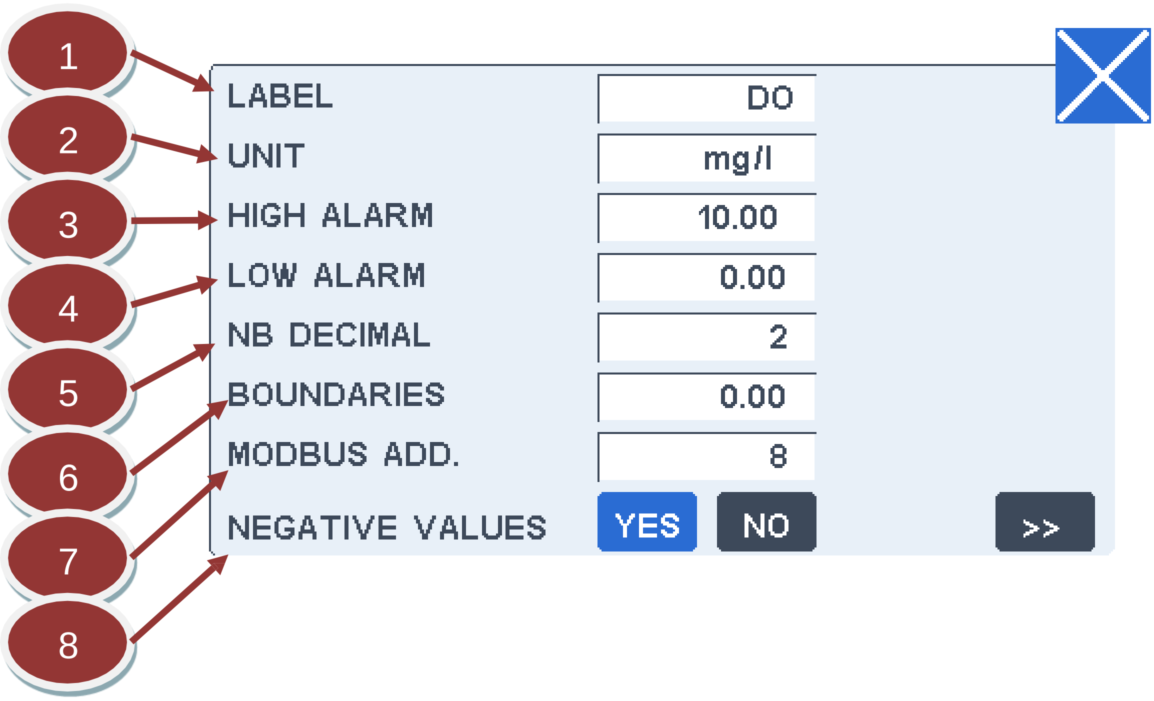


Note: several probes can be connected in parallel, except for the first time the probe is configured. It must be done one by one. Once configured, the probes can be connected in parallel.

The settings are displayed on the two following screens.

First screen:

Note*: This first screen is standard for both type of probes.



1 **Label**

This field allows changing the channel label displayed with the measurement. The label size is limited to 6 characters.

2 **Unit**

This field allows changing the channel unit displayed with the measurement. The unit size is limited to 6 characters.

3 **High alarm value**

The high alarm level can be changed by pressing on this field. A default value is preset when the channel is created. The high alarm level is primary used to fix the high limit represented by a red line on the recorded measurement graph. The limit is used as the minimum graph scale.
The secondary use is to drive a high alarm relay if the relay has been selected for this function. In this case, the relay will be activated as soon as the measurement overpasses the high alarm value and will stay activated until the measurement goes down below this value after subtracting the boundary value.

Refer to installation section for the relay wiring. Both functions NO (Normally Open) and NC (Normally Closed) are available.

4 **Low alarm value**

The low alarm level can be changed by pressing on this field. A default value is preset when the channel is created. The low alarm level is primary used to fix the low limit represented by a green line on the recorded measurement graph.

The secondary use is to drive a high alarm relay if the relay has been selected for this function. In this case, the relay will be activated as soon as the measurement underpasses the low alarm value and will stay activated until the measurement goes down below this value after adding the boundary value.

Refer to installation section for the relay wiring. Both functions NO (Normally Open) and NC (Normally Closed) are available.

5 **Number of decimals**

This field allows changing the number of decimals displayed for the measurement value to adjust the display to significant decimals only.

Note: this choice does not affect the measurements stored in the internal memory or the MODBUS registers.

6 **Boundaries**

The purpose of boundary is avoiding too frequent changes of state of the alarm relays that can harm process devices like pumps or electric-valves. The boundary value is subtracted from the high level value before leaving the high alarm state and reciprocally added to the low alarm level before leaving the low alarm state. More details including a schematic are provided in the relay section.

7 **Modbus address / Only for DO with auto-cleaning**

This field is the Modbus address of the probe that has been set inside the probe during the initialisation sequence.
This value must not be changed, unless the RS485 scan screen indicates that the probe has not the proper address.

8 **Negative values displayed**

Negatives values are normal for most of the measurements as they result from normal fluctuations if the measurement is close to zero.

By default, the display of negative values is allowed as negative values may also result from a wrong zeroing. Consequently, it may be useful to be aware of such problem when observing strongly negative values.

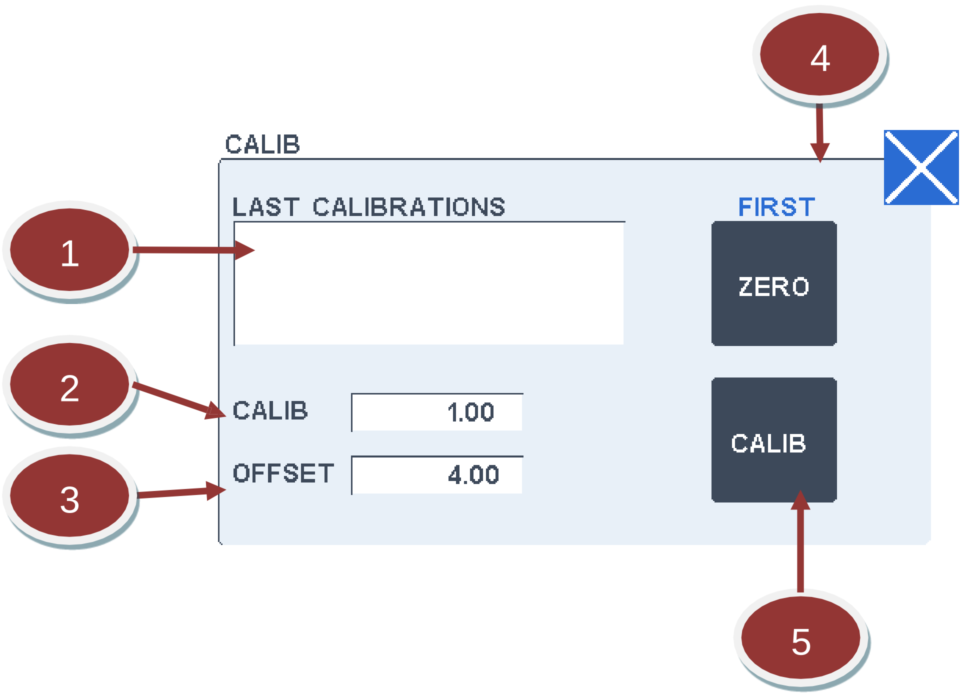
But as negative values have no theoretical meaning, it is possible to replace them by zero by selecting "NO" for this function.

Note that this function does not apply to the recorded measurements or to the MODBUS registers.

4.3.5. Calibration

The calibration screen enables to recalibrate the measurement channel.
Recommendations for recalibration are described after the following screen.

Calibration Screen of the DO Probe



1 Calibration window

This window displays the 5 last calibrations done with the date, time and the new calibration factor.

2 Calibration factor

This field allows changing manually the calibration factor of the channel.
This factor is normally changed automatically while doing calibration procedure by pressing “CALIB” button.

3 Offset

This field shows the internal offset applied for zeroing. It is updated at each zeroing and has normally not to be changed.

4 Zero

This field allows to recalibrate the probe on zero oxygen solution.
Zero calibration

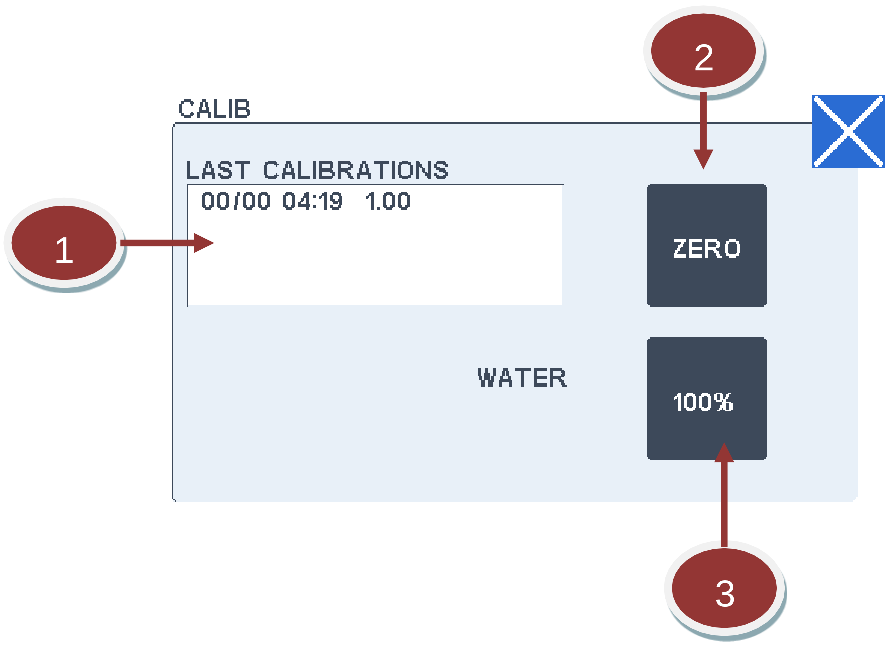
- Put the probe on zero-oxygen solution.

A zero-oxygen solution can be prepared by dissolving 10 g of sodium sulfite into 300 mL of pure water and eventually adding a shake of cobalt chloride that accelerates the reaction. Allow a few minutes of reaction time before using this solution.
Do not keep this solution more than a few hours.

5 Calibration on air saturated water (100%)

The DO probe requires a one-point calibration for 100% saturation. We recommend doing an air-saturated water procedure. Continuously purge with air using an air bubbler or some kind of aeration until the water becomes saturated with air (about 5 min). Immerse the sensor cap and temperature sensor in the air-saturate water and wait until the reading becomes stable. Wait for the stabilization of both the value and the temperature (it may take a few minutes) and press on the 100% key.

Calibration Screen of the DO Probe with Autocleaning



1 **Last calibration window**

This window displays the 5 last calibrations done with the date, time and the new calibration factor.

2 **Zero**

This field allows to recalibrate the probe on zero oxygen solution.

Zero calibration

- Put the probe on zero-oxygen solution.

A zero-oxygen solution can be prepared by dissolving 10 g of sodium sulfite into 300 mL of pure water and eventually adding a shake of cobalt chloride that accelerates the reaction. Allow a few minutes of reaction time before using this solution.
Do not keep this solution more than a few hours.

3 **Calibration on air (100%)**

The DO probe is factory calibrated but the full scale may be recalibrated if necessary (for example once a year).

Before doing the calibration, allow the probe values to stabilize on air, both for the oxygen concentration and the temperature by checking the values on the check screen.

Put the electrode on ambient air, wait for the stabilization of both the value and the temperature (it may take a few minutes) and press on the 100% key.

4.3.6. Maintenance and Troubleshooting

Maintenance

The DO probe must be cleaned on a regular base depending on the application (daily, weekly or monthly). Replacement of the head is recommended to be done each 12 months. However, it depends on the use. For more specific information on maintenance procedure, the user is referred to the “User Guide” document.

For the auto-cleaning probe option, it can be automatically cleaned by sending pressurised air.

Troubleshooting

Symptoms	Origin
Negative value	- Bad zero.
Value is too low	- Dirt on the probe.

	- Bad calibration: check or redo a calibration. Careful with **salinity switch,** check it is in the normal position. - The probe tip (sensor cap) touches a container bottom or other surface area.
Value is too high	- No water in contact with the probe. - Bad calibration: check or redo a calibration.
Unstable value	- Badly immerged probe or high quantity of bubbles. - Fluctuating value on temperature.
Now Output (ZERO DO)	- Check connection to converter and M9/M16 connectors.

Measuring errors

Error no	Signification	Origin / Remediation
1	No connection	- The probe is not or badly connected. - The probe is not properly configured (refer to the RS485 section for probe configuration). **A special initialisation must be done when the probe is used for the first time.**

4.3.7. Specifications

DO Probe

Calibrated range: 0 – 20 mg/L O_2

Measuring time: 40 seconds

Accuracy: ± 0.1 mg/L O_2 (0 to 20 mg/L)

DO Probe with Autocleaning

Calibrated range: 0 – 25 mg/L O_2

Measuring time: 60 seconds

Accuracy: ± 0.02 mg/L O_2 or ± 5%, whichever is greater

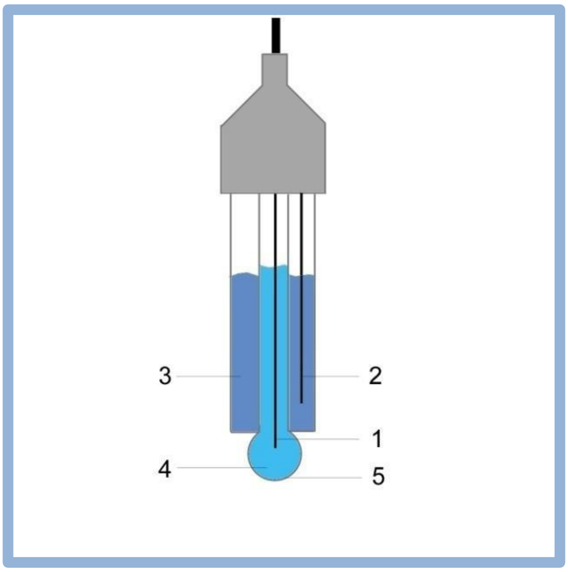
4.4. Oxidation-Reduction Potential (ORP)

4.4.1. Principle

The reduction potential is a measure of the tendency of the solution to either gain or lose electrons when it is subjected to change by introduction of a new species.

A solution with a higher (more positive) reduction potential than the new species will tend to gain electrons from the new species (i.e. to be reduced by oxidizing the new species). A solution with a lower (more negative) reduction potential will tend to lose electrons to the new species (i.e. to be oxidized by reducing the new species).

The method of measurement is based on the potential between two half-cells (reference and sensing) containing a conductor immersed in an appropriate electrolyte solution and ended by a conductive glass membrane. These two half-cells are generally combined in a single body electrode.

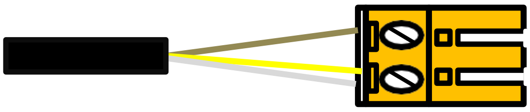


1	Internal electrode	4	Internal electrolyte solution
2	Reference electrode	5	Glass bulb
3	Reference electrolyte solution		

4.4.2. Connection and Settings

ORP electrodes

Plug 2 ways 3.5mm
Weidmuller BL 3.5/2

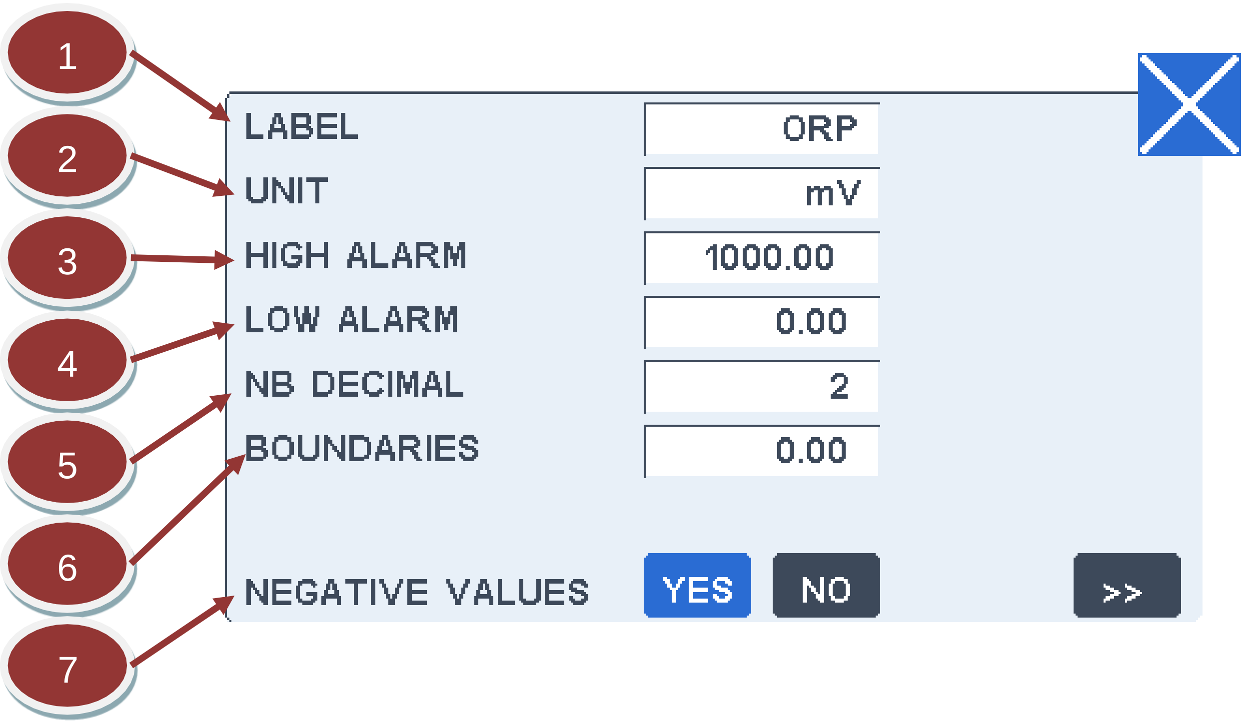


J12-pH

Pin1: Transparent (M)
Pin 2: White & Yellow (R+E)

The settings are displayed on the two following screens.

First screen:



1 **Label**

This field allows changing the channel label displayed with the measurement. The label size is limited to 6 characters.

2 Unit

This field allows changing the channel unit displayed with the measurement. The unit size is limited to 6 characters.

3 High alarm value

The high alarm level can be changed by pressing on this field. A default value is preset when the channel is created. The high alarm level is primary used to fix the high limit represented by a red line on the recorded measurement graph. The limit is used as the minimum graph scale.

The secondary use is to drive a high alarm relay if the relay has been selected for this function. In this case, the relay will be activated as soon as the measurement overpasses the high alarm value and will stay activated until the measurement goes down below this value after subtracting the boundary value.

Refer to installation section for the relay wiring. Both functions NO (Normally Open) and NC (Normally Closed) are available.

4 Low alarm value

The low alarm level can be changed by pressing on this field. A default value is preset when the channel is created. The low alarm level is primary used to fix the low limit represented by a green line on the recorded measurement graph.

The secondary use is to drive a high alarm relay if the relay has been selected for this function. In this case, the relay will be activated as soon as the measurement underpasses the low alarm value and will stay activated until the measurement goes down below this value after adding the boundary value.

Refer to installation section for the relay wiring. Both functions NO (Normally Open) and NC (Normally Closed) are available.

5 Number of decimals

This field allows changing the number of decimals displayed for the measurement value to adjust the display to significant decimals only.

Note: this choice does not affect the measurements stored in the internal memory or the MODBUS registers.

6 Boundaries

The purpose of boundary is avoiding too frequent changes of state of the alarm relays that can harm process devices like pumps or electric-valves. The boundary value is subtracted from the high level value before leaving the high alarm state and reciprocally added to the low alarm level before leaving the low alarm state. More details including a schematic are provided in the relay section.

7 Negative values displayed

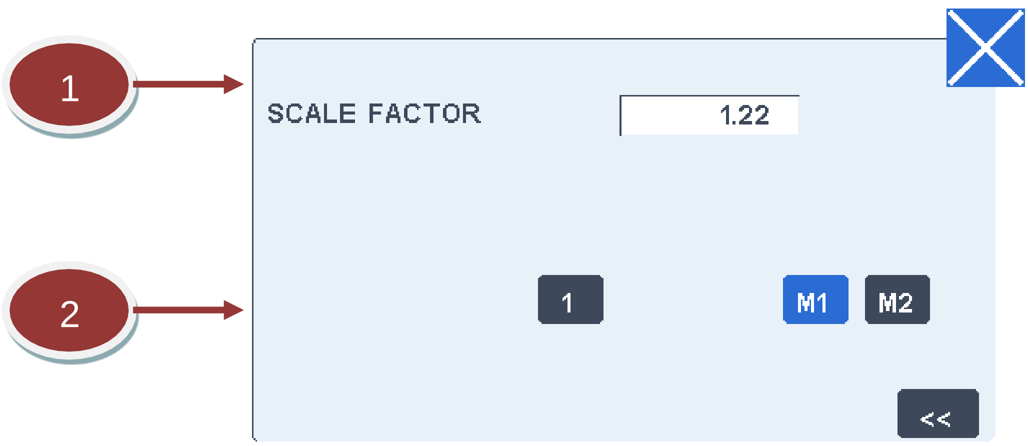
Negatives values are normal for most of the measurements as they result from normal fluctuations if the measurement is close to zero.

By default, the display of negative values is allowed as negative values may also result from a wrong zeroing. Consequently, it may be useful to be aware of such problem when observing strongly negative values.

But as negative values have no theoretical meaning, it is possible to replace them by zero by selecting "NO" for this function.

Note that this function does not apply to the recorded measurements or to the MODBUS registers.

Second screen:



1 Scale factor

This field allows changing the scale factor of the channel.
Precautions must be taken before changing this value.
This factor is normally determined in factory to transform the basic measurement to a scaled value in

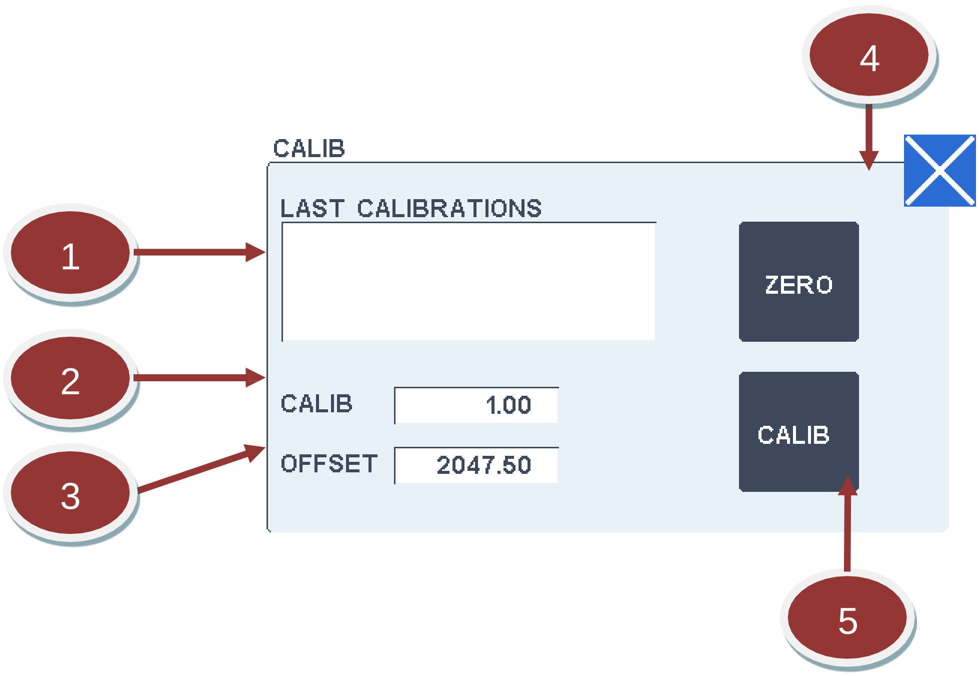
the final unit. There is no reason to change it except if elements are replaced.

2 Position

ORP electrode can be declared in position 1. Pin J12 accepts a direct connection of the electrode. Modules 1&2 can also be used to install the sensor. A pH module is needed.

4.4.3. Calibration

The calibration screen below enables to recalibrate the measurement channel. Recommendations for recalibration are given after the following screen description.



1 Last calibration window

This window displays the 5 last calibrations done with the date, time and the new calibration factor.

2 Calibration factor

This field allows changing manually the calibration factor of the channel.
This factor is normally changed automatically while doing calibration procedure by pressing “CALIB” button.

3 **Offset**

This field shows the internal offset applied for zeroing. It is updated at each zeroing and has normally not to be changed.

4 **ZERO**

This field allows to recalibrate the probe on zero solution. See after on the recommendations how to prepare a zero solution.

5 **Calibration procedure**

The ORP electrode must be checked on a regular base depending on the condition of use, and recalibrated if necessary.

To recalibrate the electrode, proceed as follows:

- Put the electrode in a zero buffer solution (or alternatively replace the electrode by a strap).
- Wait for the stabilisation of the ORP value (check on the process screen), then press on the ZERO key.
- Put the electrode in a standard buffer solution, pH7.
- Wait for the stabilisation of the ORP value.
- Then go to the calibration screen and press on the “CALIB” button. Validate the last measured value and then enter the standard value on the keypad.

The calibration is finished. New offset and calibration factor have been calculated and recorded in the calibration history. These new offset and calibration factors will be taken into account for all further measurements.

4.4.4. Maintenance and Troubleshooting

<u>Maintenance</u>

The ORP probe must be cleaned on a regular base (generally weekly) depending on the application. It must be replaced about every 6 months (depending on the application).
Contamination of the sensing element often results in slow response and inaccurate readings. Clean the electrode by one of the following procedures:

- Inorganic deposits. Immerse the electrode tip in 0.1 N HCl for 10 minutes. Wash the tip with DI water.
- Organic oil and grease films: wash electrode tip and a liquid detergent and water.

- After above treatment, soak the electrode tip in alcohol for 5 minutes, then in quinhydrone saturated pH4.01 for 15 minutes. Rinse with DI water afterwards.

Troubleshooting

Symptoms	Origin
Negative value	- Bad calibration. - ORP probe disconnected.
Value is too low	- Bad calibration: check or redo a calibration.
Value is too high	- Bad calibration: check or redo a calibration.
Unstable value	- Electrical interference on the probe cable, put the probe cable away from power cables. - Dirt on the electrode. - Aging electrode (replace).

4.4.5. Specifications

Measuring range: - 2000 mV to +2000 mV

Measuring time: 2 seconds

Accuracy: ± 1 mV or ± 5% whichever is greater

4.5. pH

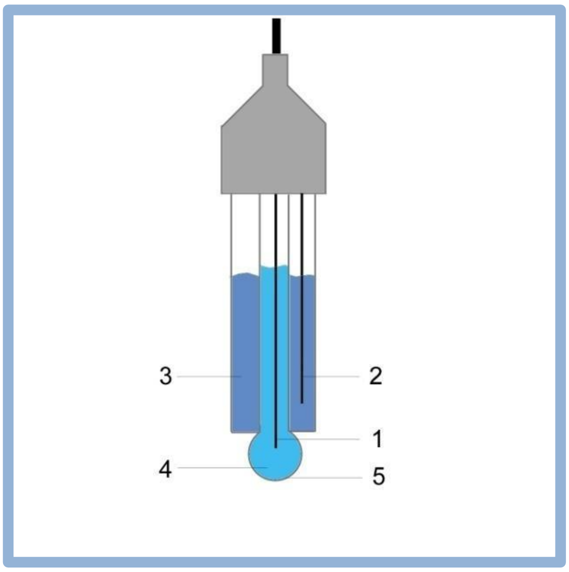
4.5.1. Principle

The pH of a solution is the negative logarithm of the molar concentration of dissolved hydronium ions (H_3O^+).
The method of measurement is based on the potential between two half-cells (reference and sensing) containing a conductor immersed in an appropriate electrolyte solution and ended by a conductive glass membrane. These two half-cells are generally combined in a single body electrode.
The voltage between the half-cell follows the Nernst equation:

$$V = V_0 + 2{,}3\,\frac{RT}{nF}\cdot\log\frac{\left[H^+{}_m\right]}{\left[H^+{}_{ref}\right]}$$

With V_0: voltage of the reference half-cell
R: ideal gas constant
T: absolute temperature,
n: valence
F: Faraday constant
H^+_m: concentration of H^+ in the measured solution
H^+_{ref}: reference concentration of H^+.

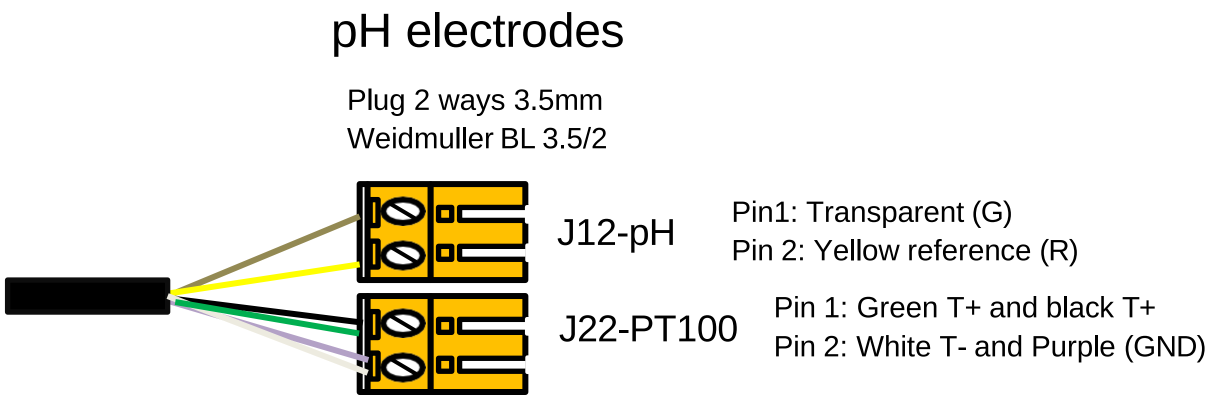
At 25 ºC, one pH unit corresponds to 59.16 mV. At pH 7, the output is 0 V (for all temperatures).
As pH depends on temperature, a temperature sensor is generally included in the electrode (100 Ohm or 1000 Ohm Platinum resistor) and connected to the instrument for automatic temperature compensation (ATC).



1	Internal electrode	4	Internal electrolyte solution
2	Reference electrode	5	Glass bulb
3	Reference electrolyte solution		

4.5.2. Connection and Settings

pH electrodes are connected as follows:



Settings for pH electrodes are displayed on the two following screens.

First screen:

1 **Label**

This field allows changing the channel label displayed with the measurement. The label size is limited to 6 characters.

2 Unit

This field allows changing the channel unit displayed with the measurement. The unit size is limited to 6 characters.

3 High alarm value

The high alarm level can be changed by pressing on this field. A default value is preset when the channel is created. The high alarm level is primary used to fix the high limit represented by a red line on the recorded measurement graph. The limit is used as the minimum graph scale.

The secondary use is to drive a high alarm relay if the relay has been selected for this function. In this case, the relay will be activated as soon as the measurement overpasses the high alarm value and will stay activated until the measurement goes down below this value after subtracting the boundary value.

Refer to installation section for the relay wiring. Both functions NO (Normally Open) and NC (Normally Closed) are available.

4 Low alarm value

The low alarm level can be changed by pressing on this field. A default value is preset when the channel is created. The low alarm level is primary used to fix the low limit represented by a green line on the recorded measurement graph.

The secondary use is to drive a high alarm relay if the relay has been selected for this function. In this case, the relay will be activated as soon as the measurement underpasses the low alarm value and will stay activated until the measurement goes down below this value after adding the boundary value.

Refer to installation section for the relay wiring. Both functions NO (Normally Open) and NC (Normally Closed) are available.

5 Number of decimals

This field allows changing the number of decimals displayed for the measurement value to adjust the display to significant decimals only.

Note: this choice does not affect the measurements stored in the internal memory or the MODBUS registers.

6 Boundaries

The purpose of boundary is avoiding too frequent changes of state of the alarm relays that can harm process devices like pumps or electric-valves. The boundary value is subtracted from the high level value before leaving the high alarm state and reciprocally added to the low alarm level before leaving the low alarm state. More details including a schematic are provided in the relay section.

7 Negative values displayed

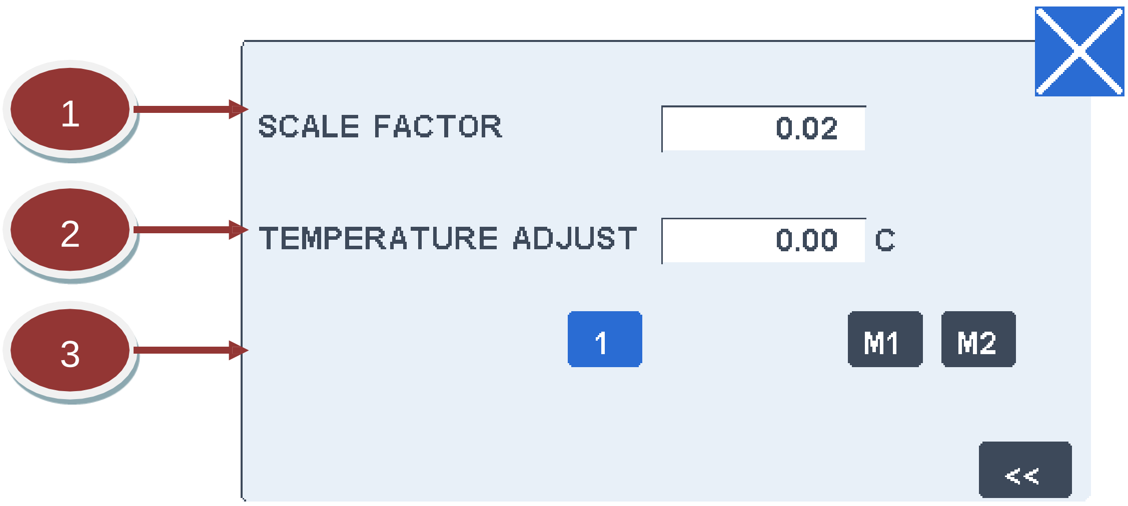
Negatives values are normal for most of the measurements as they result from normal fluctuations if the measurement is close to zero.

By default, the display of negative values is allowed as negative values may also result from a wrong zeroing. Consequently, it may be useful to be aware of such problem when observing strongly negative values.

But as negative values have no theoretical meaning, it is possible to replace them by zero by selecting "NO" for this function.

Note that this function does not apply to the recorded measurements or to the MODBUS registers.

Second screen:



1 Scale factor

This field allows changing the scale factor of the channel.
Precautions must be taken before changing this value.

This factor is normally determined in factory to transform the basic measurement to a scaled value in the final unit. There is no reason to change it except if elements are replaced.

2 Temperature adjustment

The temperature of the sample given by the internal temperature probe can be adjusted by this field if it differs from the real temperature read on an accurately calibrated thermometer.

This adjustment is not really important as a difference of temperature is taken into account during the calibration. The adjustment is supposed to stay within ± 4 °C.

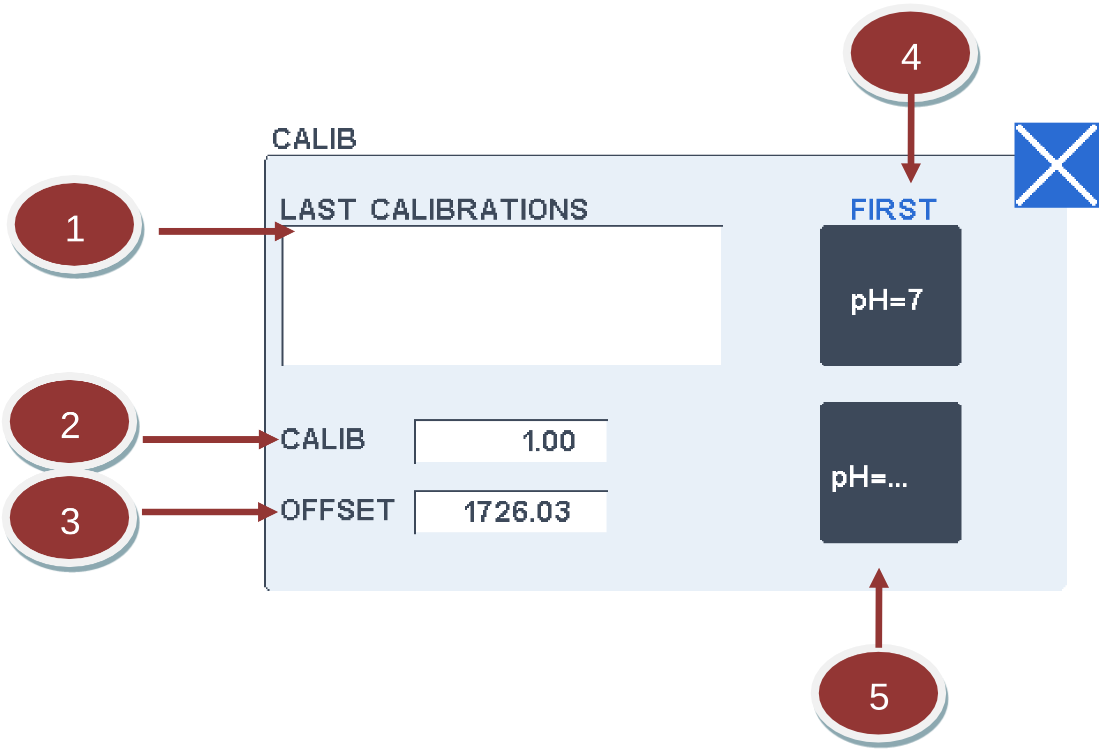
3 **Channel Position**

pH electrode can be declared in position 1. Pin J12 accepts a direct connection of the electrode. Modules 1&2 can also be used to install the sensor. A pH module is needed.

There is an option also to declare the pH parameter in any of the two multifunction modules, M1 or M2.

4.5.3. Calibration

The calibration screen below enables to recalibrate the measurement channel.
Recommendations for recalibration are given after the following screen description.



1 **Last calibration window**

This window displays the 5 last calibrations done with the date, time and the new calibration factor.

2 Calibration factor

This field allows changing manually the calibration factor of the channel.
This factor is normally changed automatically while doing the second point calibration.

3 Offset

This field shows the internal offset applied.
It is updated while doing the pH 7 calibration point and has normally not to be changed.

4 pH 7 calibration point

This button enables to calibrate the pH electrode with a pH 7 buffer.

The current pH value is displayed. After stabilisation, press on the key "SET TO 7.0".
After this, the displayed value must be 7.0.

The offset is adjusted by this first calibration point.

6 pH ... calibration point

This button enables to calibrate the pH electrode with a pH buffer.

The current pH value is displayed. After stabilisation, press on the key "SET TO 4".
After this, the displayed value must be 4.0.

The calibration factor is adjusted by this second calibration point.

Recommendations for recalibration

The pH electrode must be checked on a regular base depending on the condition of use, and recalibrated if necessary.

To recalibrate the electrode, proceed as follows:

- Put the electrode in a pH 7.0 buffer solution.
- Press on the "pH=7" key of the calibration screen. Wait for the stabilisation of the pH value, then press on the "SET TO 7.0" key.
- Put the electrode in a pH 4.0 buffer solution.
- Press on the "pH=..." key of the calibration screen. Enter the value of 4.00. Wait for the stabilisation of the pH value, then press on the "SET TO 4.0" key.

The calibration is finished. New offset and calibration factors have been calculated and recorded in the calibration history. These new offset and calibration factors will be taken into account for all further measurements.

4.5.4. Maintenance and Troubleshooting

Maintenance

The pH probe must be cleaned on a regular base (generally weekly) depending on the application. It must be replaced about every 6 months (depending on the application).
For electrode cleaning, do not use strong solvents (e.g. acetone, carbon tetrachloride, etc) to clean the pH electrode. Be sure to recalibrate the electrode after cleaning. Clean the electrode under warm tap water using dish-washing detergent if the electrode has become dirty with oil or grease. If the electrode has been exposed to protein or similar materials, soak it in acidic pepsin.
If previous cleaning procedures failed to restore response, soak the electrode on 0.1N HCl for 30 minutes. Rinse with DI water and recalibrate.
If electrode response is not restored yet, replace the electrode.

Troubleshooting

Symptoms	**Origin**
Negative value	- Bad calibration. - pH probe disconnected.
Value is too low	- Bad calibration: check or redo a calibration.
Value is too high	- Bad calibration: check or redo a calibration.
Unstable value	- Electrical interference on the probe cable, put the probe cable away from power cables. - Dirt on the electrode. - Aging electrode (replace).

Measuring errors

Error no	**Signification**	**Origin / Remediation**
1	Over range	- Probe disconnected. - Failure on the pH board (replace).

4.5.5. Specifications

Measuring range: 0 to 14

Measuring time: 30 seconds

Accuracy: ± 0.01 pH or ± 5% whichever is greater

4.6. Temperature

4.6.1. Principle

The temperature measurement is based on the resistance measurement of a standard platinum element of 100 ohm or 1000 ohm at 0°C (Pt100). This element is included inside the pH or conductivity electrode.

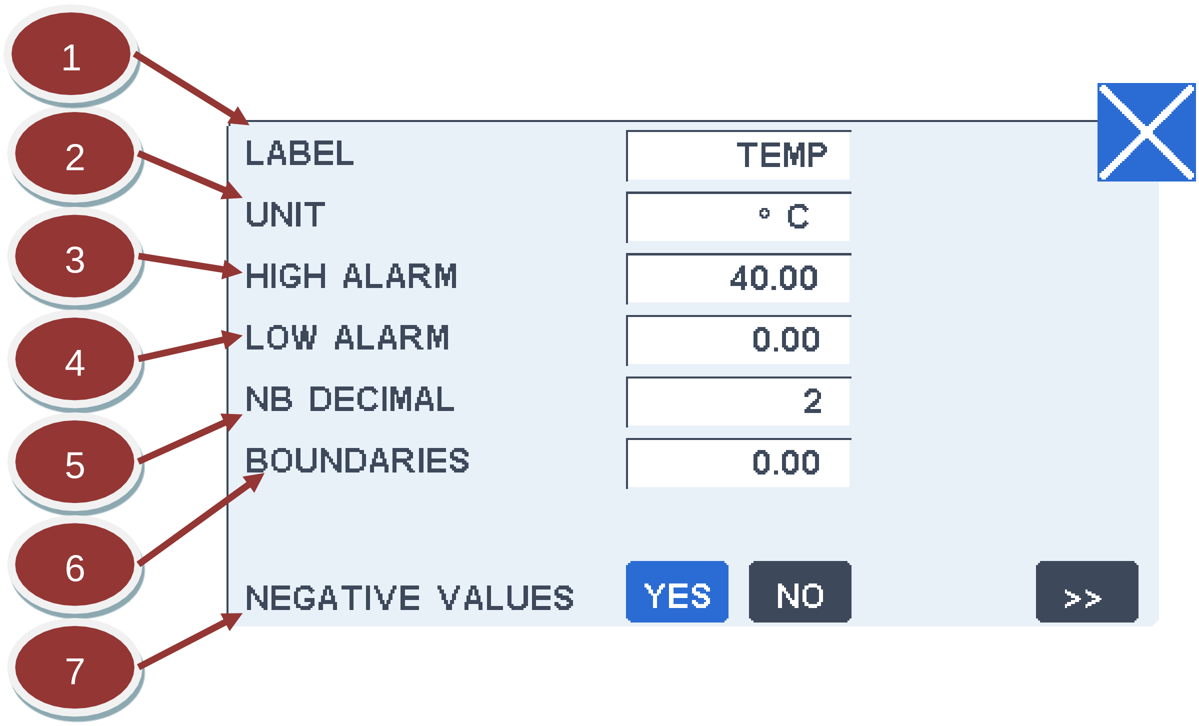
The table below shows the Pt 100 resistance in ohm for temperature between 0°C and 100°C.

°C	0	1	2	3	4	5	6	7	8	9
0	100.00	100.39	100.78	101.17	101.56	101.95	102.34	102.73	103.12	103.51
10	103.90	104.29	104.68	105.07	105.46	105.85	106.24	106.63	107.02	107.40
20	107.79	108.18	108.57	108.96	109.35	109.73	110.12	110.51	110.90	111.28
30	111.67	112.06	112.45	112.83	113.22	113.61	113.99	114.38	114.77	115.15
40	115.54	115.93	116.31	116.70	117.08	117.47	117.85	118.24	118.62	119.01
50	119.40	119.78	120.16	120.55	120.93	121.32	121.70	122.09	122.47	122.86
60	123.24	123.62	124.01	124.39	124.77	125.16	125.54	125.92	126.31	126.69
70	127.07	127.45	127.84	128.22	128.60	128.98	129.37	129.75	130.13	130.51
80	130.89	131.27	131.66	132.04	132.42	132.80	133.18	133.56	133.94	134.32
90	134.70	135.08	135.46	135.84	136.22	136.60	136.98	137.36	137.74	138.12

4.6.2. Settings

The settings are displayed on the two following screens.

First screen:



1 Label

This field allows changing the channel label displayed with the measurement. The label size is limited to 6 characters.

2 Unit

This field allows changing the channel unit displayed with the measurement. The unit size is limited to 6 characters.

3 High alarm value

The high alarm level can be changed by pressing on this field. A default value is preset when the channel is created. The high alarm level is primary used to fix the high limit represented by a red line on the recorded measurement graph. The limit is used as the minimum graph scale.
The secondary use is to drive a high alarm relay if the relay has been selected for this function. socket.

In this case, the relay will be activated as soon as the measurement overpasses the high alarm value and will stay activated until the measurement goes down below this value after subtracting the boundary value.

Refer to installation section for the relay wiring. Both functions NO (Normally Open) and NC (Normally Closed) are available.

4 Low alarm value

The low alarm level can be changed by pressing on this field. A default value is preset when the channel is created. The low alarm level is primary used to fix the low limit represented by a green line on the recorded measurement graph.

The secondary use is to drive a high alarm relay if the relay has been selected for this function. In this case, the relay will be activated as soon as the measurement underpasses the low alarm value and will stay activated until the measurement goes down below this value after adding the boundary value.

Refer to installation section for the relay wiring. Both functions NO (Normally Open) and NC (Normally Closed) are available.

5 Number of decimals

This field allows changing the number of decimals displayed for the measurement value to adjust the display to significant decimals only.

Note: this choice does not affect the measurements stored in the internal memory or the MODBUS registers.

6 Boundaries

The purpose of boundary is avoiding too frequent changes of state of the alarm relays that can harm process devices like pumps or electric-valves. The boundary value is subtracted from the high level value before leaving the high alarm state and reciprocally added to the low alarm level before leaving the low alarm state. More details including a schematic are provided in the relay section.

7 Negative values displayed

Negatives values are normal for most of the measurements as they result from normal fluctuations if the measurement is close to zero.

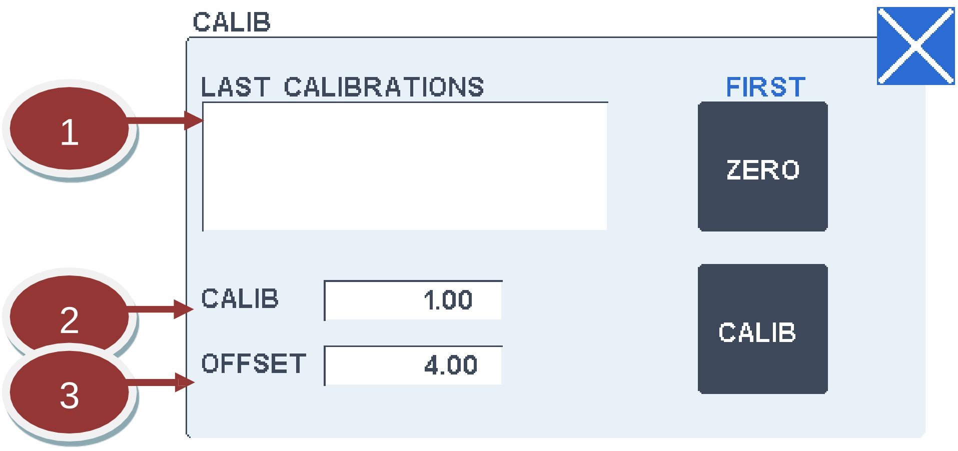
By default, the display of negative values is allowed as negative values may also result from a wrong zeroing. Consequently, it may be useful to be aware of such problem when observing strongly negative values.

But as negative values have no theoretical meaning, it is possible to replace them by zero by selecting "NO" for this function.

Note that this function does not apply to the recorded measurements or to the MODBUS registers.

4.6.3. Calibration

The calibration screen below enables to recalibrate the measurement channel.
Recommendations for recalibration are given after the following screen description.



1 **Last calibration window**

This window displays the 5 last calibrations done with the date, time and the new calibration factor.

2 **Calibration factor**

This field allows changing manually the calibration factor of the channel.

3 **Offset**

This field shows the internal offset applied for zeroing.
It is updated at each zeroing and has normally not to be changed.

Recommendations for recalibration

The temperature probe is factory calibrated with an accuracy of ± 1 °C. It can be recalibrated if a higher accuracy is requested.

To recalibrate the electrode, proceed as follows:

- Put the temperature probe in a Dewar filled of water with a reference thermometer inside.
- Wait for the stabilisation of the temperature value, and then adjust the calibration factor to read the right temperature.

The calibration is finished. The new calibration factor will be taken into account for all further measurements.

4.6.4. Maintenance and Troubleshooting

Maintenance

No maintenance is required.

Troubleshooting

Symptoms	Origin
Value is too low	- Bad calibration: check or redo a calibration.
Value is too high	- Bad calibration: check or redo a calibration.

Measuring errors

Error no	Signification	Origin / Remediation
1	Probe disconnected	- Check the connection of the temperature probe. - Failure on the temperature module (replace).
2	Probe short-circuited	- Check the probe with an ohmmeter, the value must be in a 100 to 120 ohm range, if not replace the probe. - Failure on the temperature module (replace).

4.6.5. Specifications

Calibrated range: 0 - 50 °C

Measuring range: 0 - 100 °C

Measuring time: 2 seconds

Accuracy: ± 1 °C

4.7. TSS Measurement

4.7.1. Principle

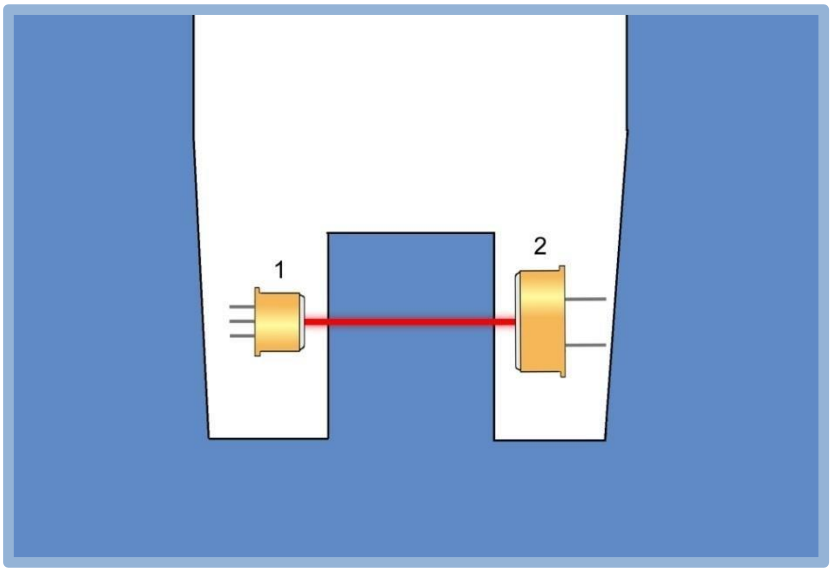
The measuring principle is based on the infra-red light absorbance at 880 nm over a defined optical path.

Two models are available, both are designed for waste water:

- High range with an optical path of 6.4 mm (example biological reactor)
- Low range with an optical path of 25.4 mm (example clarifier or final effluent)

The detection system is placed at the end of an immersed probe in a robust PVC case.

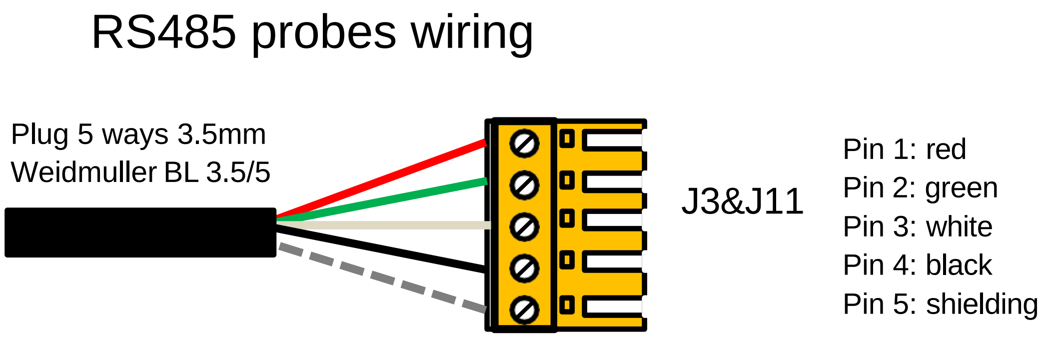
An automatic cleaning of the windows can be done by sending compressed air on a regular base.



1	LED source
2	Photo detector

4.7.2. Connection and Settings

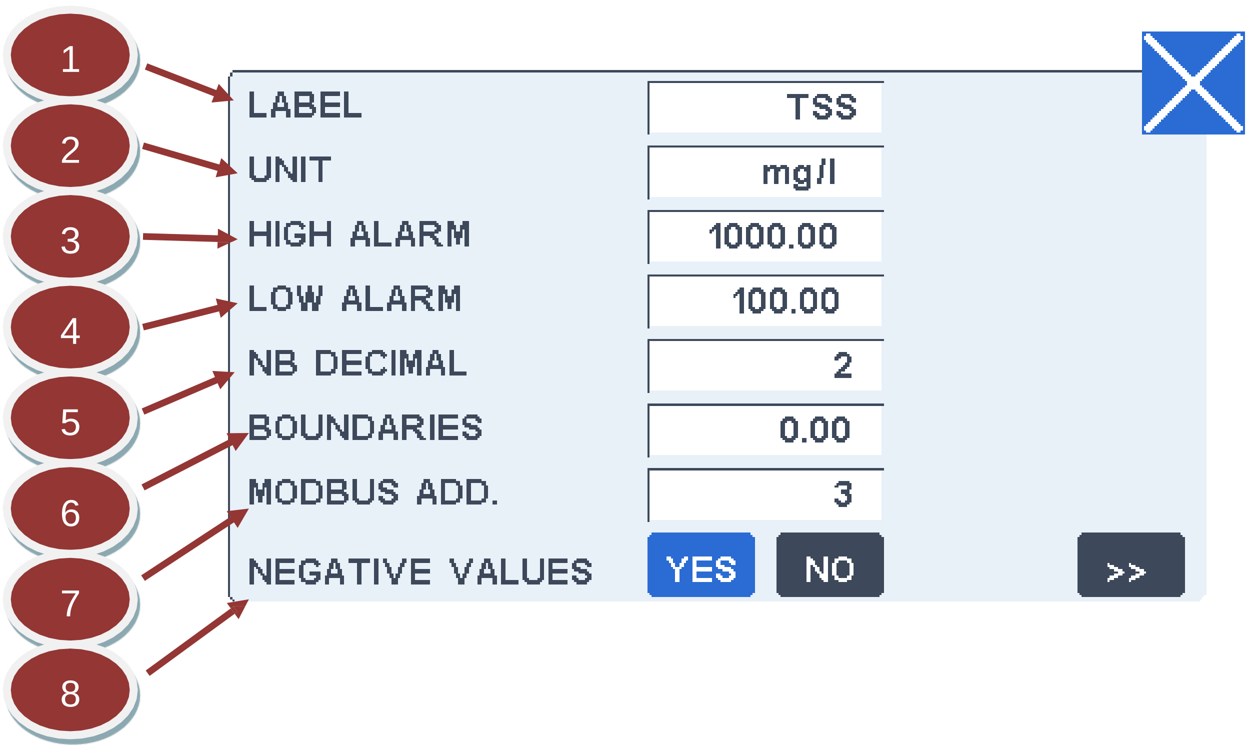
TSS probe is connected as follows via RS485 port



Note: several probes can be connected in parallel, except for the first time the probe is configured. It must be done one by one. Once configured, the probes can be connected in parallel.

The settings are displayed on the two following screens.

First screen:



1 Label

This field allows changing the channel label displayed with the measurement. The label size is limited to 6 characters.

2 Unit

This field allows changing the channel unit displayed with the measurement. The unit size is limited to 6 characters.

3 High alarm value

The high alarm level can be changed by pressing on this field. A default value is preset when the channel is created. The high alarm level is primary used to fix the high limit represented by a red line on the recorded measurement graph. The limit is used as the minimum graph scale.

The secondary use is to drive a high alarm relay if the relay has been selected for this function. In this case, the relay will be activated as soon as the measurement overpasses the high alarm value and will stay activated until the measurement goes down below this value after subtracting the boundary value.

Refer to installation section for the relay wiring. Both functions NO (Normally Open) and NC (Normally Closed) are available.

4 Low alarm value

The low alarm level can be changed by pressing on this field. A default value is preset when the channel is created. The low alarm level is primary used to fix the low limit represented by a green line on the recorded measurement graph.

The secondary use is to drive a high alarm relay if the relay has been selected for this function. In this case, the relay will be activated as soon as the measurement underpasses the low alarm value and will stay activated until the measurement goes down below this value after adding the boundary value.

Refer to installation section for the relay wiring. Both functions NO (Normally Open) and NC (Normally Closed) are available.

5 Number of decimals

This field allows changing the number of decimals displayed for the measurement value to adjust the display to significant decimals only.

Note: this choice does not affect the measurements stored in the internal memory or the MODBUS registers.

6 Boundaries

The purpose of boundary is avoiding too frequent changes of state of the alarm relays that can harm process devices like pumps or electric-valves. The boundary value is subtracted from the high level value before leaving the high alarm state and reciprocally added to the low alarm level before leaving the low alarm state. More details including a schematic are provided in the relay section.

7 Modbus address

This field is the Modbus address of the probe that has been set inside the probe during the initialisation sequence.
This value must not be changed, unless the RS485 scan screen indicates that the probe has not the proper address.

8 Negative values displayed

Negatives values are normal for most of the measurements as they result from normal fluctuations if the measurement is close to zero.

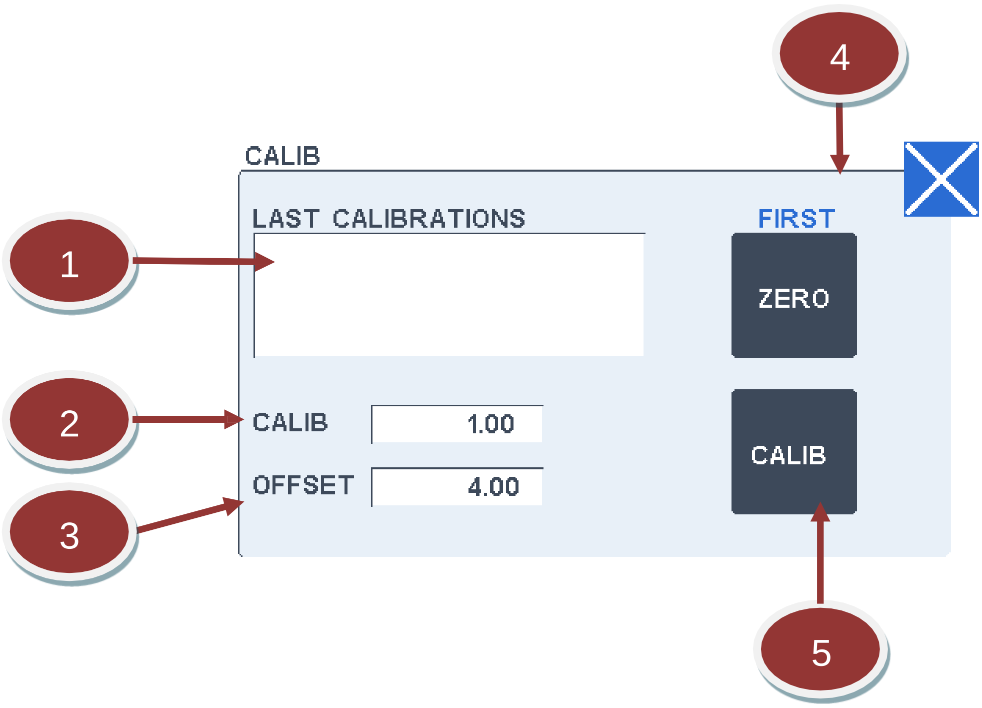
By default, the display of negative values is allowed as negative values may also result from a wrong zeroing. Consequently, it may be useful to be aware of such problem when observing strongly negative values.

But as negative values have no theoretical meaning, it is possible to replace them by zero by selecting "NO" for this function.

Note that this function does not apply to the recorded measurements or to the MODBUS registers.

4.7.3. Calibration

The calibration screen below enables to recalibrate the measurement channel.
Recommendations for recalibration are given after the following screen description.



1 Last calibration window

This window displays the 5 last calibrations done with the date, time and the new calibration factor.

2 Scan last calibrations

These two buttons allow to scroll up and down the 10 last calibration records.

3 Calibration factor

This field allows changing manually the calibration factor of the channel.
This factor is normally changed automatically while doing a calibration procedure by pressing on the "CALIB" button.

4 Zero

This button enables to do the zero. Be sure that the probe is immersed on pure water before pressing on this button.

5 **Calibration procedure**

This button starts a calibration procedure.
The last measured value is displayed and must be validated.
Then the standard value must be entered.
When finished, a new calibration factor is determined and recorded on the calibration history.

Recommendations for recalibration

The analyser is factory calibrated. However, periodical checking is recommended, and a recalibration might be necessary after several months depending on the conditions of use.

To recalibrate the analyser, proceed as follows:

- Do a TSS laboratory measurement on a sample representative of the measuring range.
- Do a manual measurement on the same sample using the check screen (as described above).
- Go on the calibration screen and press on the “ADJUST” button of the check screen. Validate or enter the measurement and then enter the laboratory value on the keypad.

The calibration is finished. A new calibration factor has been calculated and recorded inside the calibration history displayed on the check screen. This new calibration factor will be taken into account for all further measurements.

4.7.4. Maintenance and Troubleshooting

Maintenance

There is no special maintenance on this probe unless checking that the windows are clean.

Troubleshooting

Symptoms	Origin
Value is too low	- Probe not immersed. - Wrong zero. - Bad calibration: check or redo a calibration.
Value is too high	- Bad calibration: check or redo a calibration.
Unstable value	- Deposit or dirt on the windows. - Bad calibration, check with a standard.

Measuring errors

Error no	Signification	Origin / Remediation
1	No connection	- The probe is not or badly connected. - The probe is not properly configured (refer to the RS485 section for probe configuration). **A special initialisation must be done when the probe is used for the first time.**

4.7.5. Specifications

Low Range Specifications

Calibrated range: 0 - 1500 TSS

Initial Response time: Less than 10 seconds

Measuring time: < 60 seconds for 90% of response

Accuracy: ± 2 mg/L TSS or ± 5% whichever is greater

High Range Specifications

Calibrated range: 0 - 30 000 TSS

Initial Response time: Less than 10 seconds

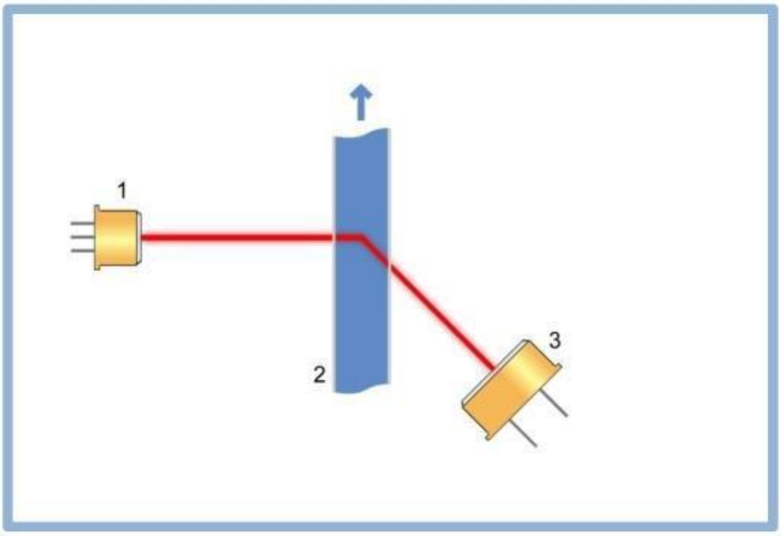
Measuring time: < 60 seconds for 90% of response

Accuracy: ± 100 mg/L TSS or ± 5% whichever is greater

4.8. Turbidity Measurement

4.8.1. Principle

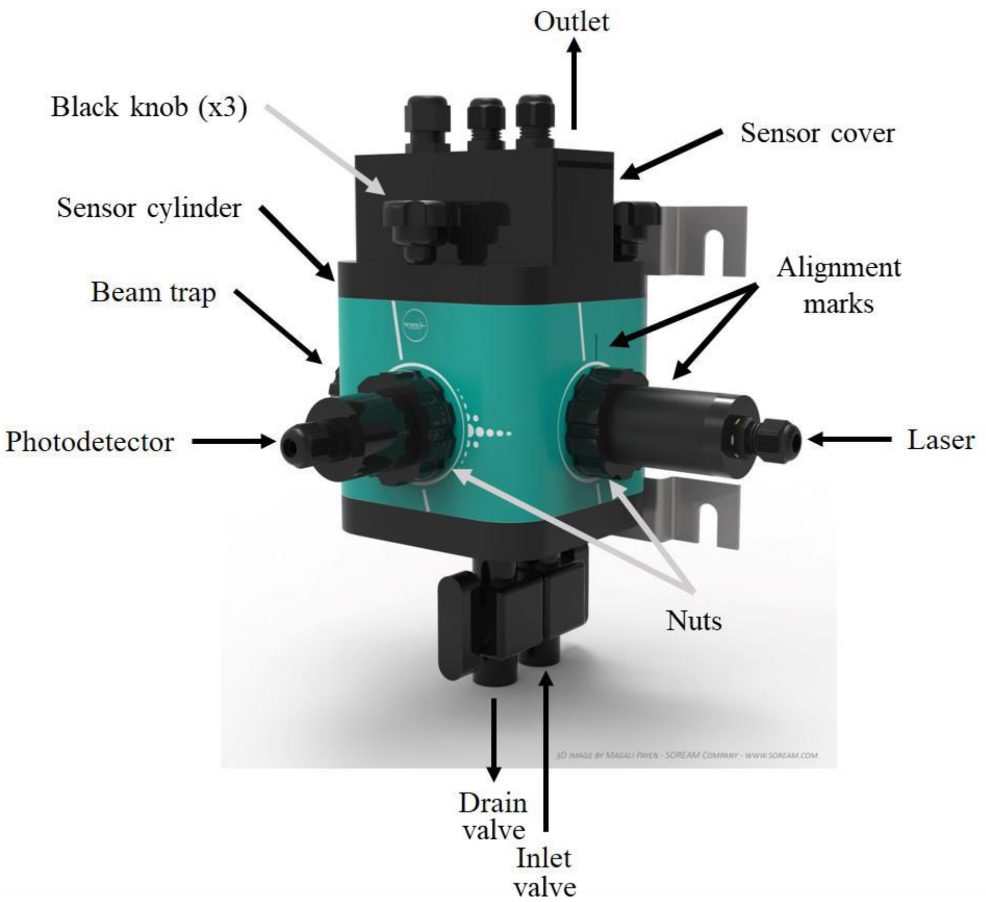
The measuring principle is based on IR @ 890 nm nephelometric method.
The light beam is generated by a LED while the light detection is performed at 90° from the light beam path. The following figure represents a schema of the measuring principle.



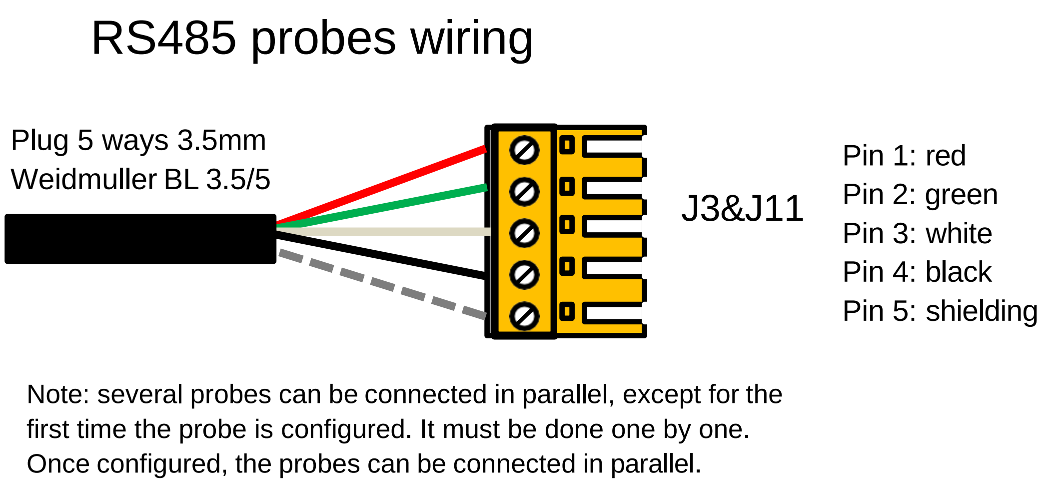
1	LED @ 890 nm or 650 nm for TURB200
2	Water sample
3	Photodetector

4.8.2. Connections and Settings

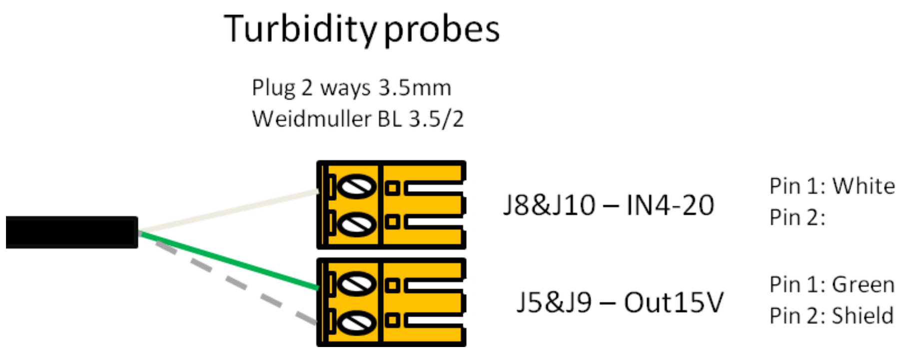
TURB200 Overview:



Connection of the TURB200 sensor:

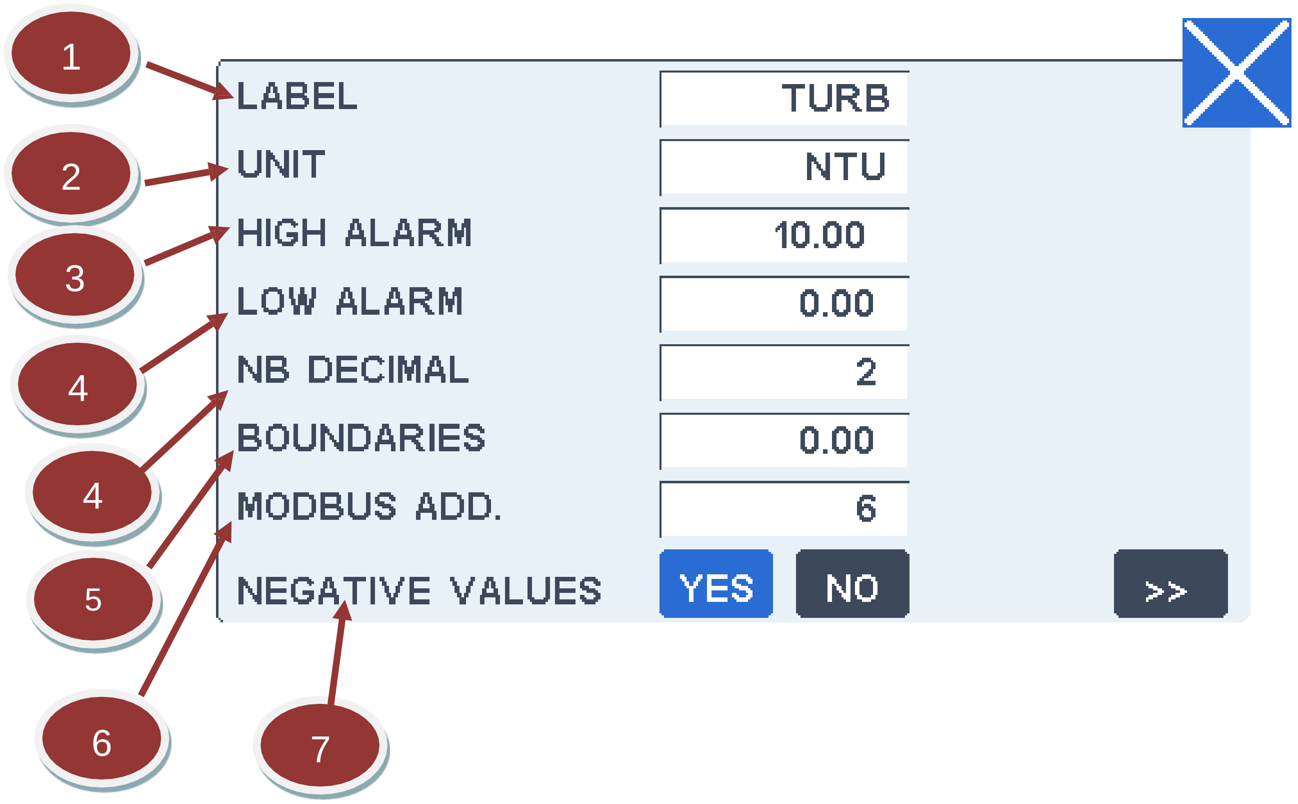


Connections of the turbidity probe:



The settings are displayed on the two following screens.

First screen:



1 Label

This field allows changing the channel label displayed with the measurement. The label size is limited to 6 characters.

2 Unit

This field allows changing the channel unit displayed with the measurement. The unit size is limited to 6 characters.

3 High alarm value

The high alarm level can be changed by pressing on this field. A default value is preset when the channel is created. The high alarm level is primary used to fix the high limit represented by a red line on the recorded measurement graph. The limit is used as the minimum graph scale.

The secondary use is to drive a high alarm relay if the relay has been selected for this function. In this case, the relay will be activated as soon as the measurement overpasses the high alarm value and will stay activated until the measurement goes down below this value after subtracting the boundary value.

Refer to installation section for the relay wiring. Both functions NO (Normally Open) and NC (Normally Closed) are available.

4 Low alarm value

The low alarm level can be changed by pressing on this field. A default value is preset when the channel is created. The low alarm level is primary used to fix the low limit represented by a green line on the recorded measurement graph.

The secondary use is to drive a high alarm relay if the relay has been selected for this function. In this case, the relay will be activated as soon as the measurement underpasses the low alarm value and will stay activated until the measurement goes down below this value after adding the boundary value.

Refer to installation section for the relay wiring. Both functions NO (Normally Open) and NC (Normally Closed) are available.

5 Number of decimals

This field allows changing the number of decimals displayed for the measurement value to adjust the display to significant decimals only.

Note: this choice does not affect the measurements stored in the internal memory or the MODBUS registers.

6

Boundaries

The purpose of boundary is avoiding too frequent changes of state of the alarm relays that can harm process devices like pumps or electric-valves. The boundary value is subtracted from the high level value before leaving the high alarm state and reciprocally added to the low alarm level before leaving the low alarm state. More details including a schematic are provided in the relay section.

7

Negative values displayed

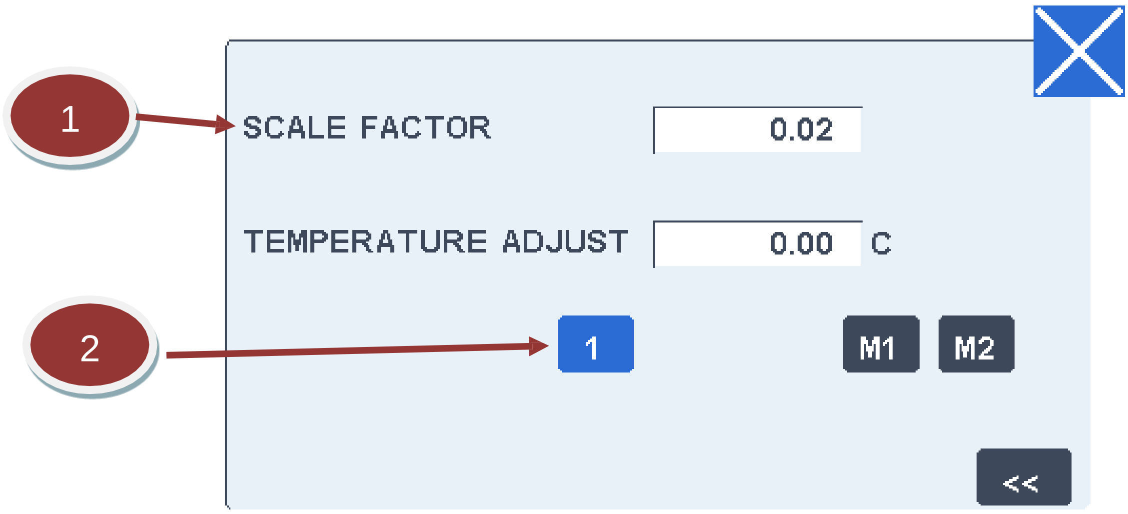
Negatives values are normal for most of the measurements as they result from normal fluctuations if the measurement is close to zero.

By default, the display of negative values is allowed as negative values may also result from a wrong zeroing. Consequently, it may be useful to be aware of such problem when observing strongly negative values.

But as negative values have no theoretical meaning, it is possible to replace them by zero by selecting "NO" for this function.

Note that this function does not apply to the recorded measurements or to the MODBUS registers.

Second screen:



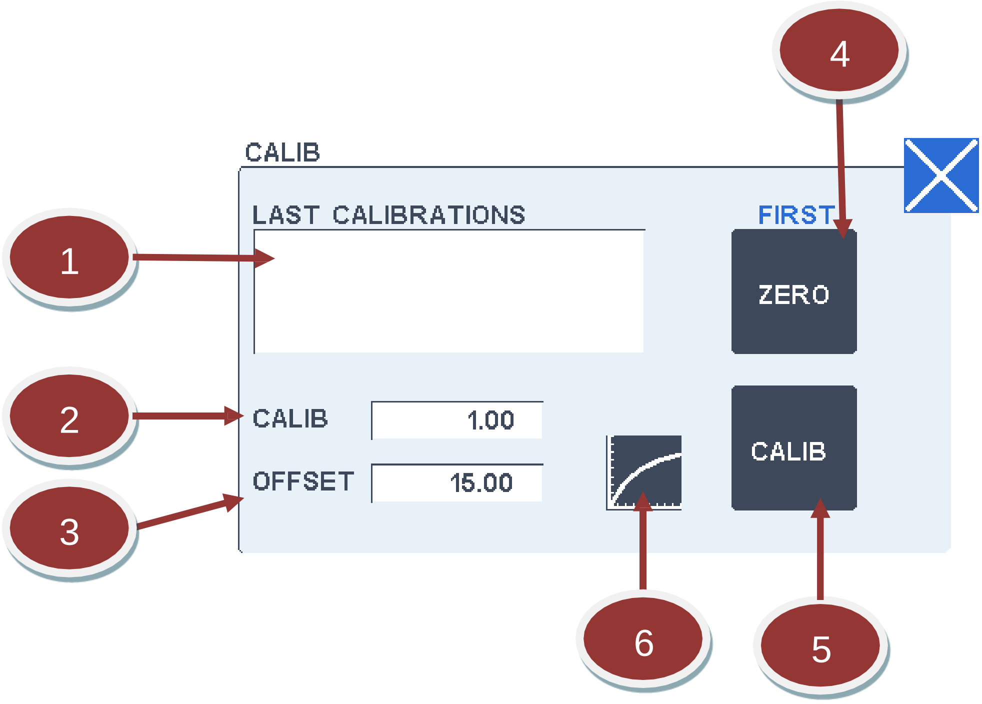
1 Scale factor

This field allows changing the scale factor of the channel. Precautions must be taken before changing this value. This factor is normally determined in factory to transform the basic measurement to a scaled value in the final unit. There is no reason to change it except if elements are replaced or measuring range changed.

2 Position

Position of the 4-20 mA output. Position 1 & 2 refers to pins J10 and J21 for 4-20 mA outputs probes. These probes can also be connected using a 4-20 mA input module. The position must also be specified M1&M2.

4.8.3. Calibration



1 Last calibration window

This window displays the 5 last calibrations done with the date, time and the new calibration factor.

2 Calibration factor

This field allows changing manually the calibration factor of the channel.
This factor is normally changed automatically while doing a calibration procedure by pressing on the "CALIB" button.

3 Offset

This field shows the internal offset applied for zeroing. It is updated at each zeroing and has normally not to be changed.

4 Zero

This button enables to dot the zero. Be sure that the probe is immersed on pure water before pressing on this button.

Zero calibration:

- Put the probe on pure water.

- Wait until values get stable. Then press the ZERO button.

For TURB200:

- Empty the sensor cylinder by opening the drain valve. Once the cylinder is empty, close the two valves of the inlet and the drain at the bottom of the sensor (refer to the picture in section 4.7.2).

- Unscrew the three black knobs on the sensor cover.

- Fill the sensor cylinder with DI water.

- Put back the cover and screw back the three knobs until finger tight.

- Wait until values get stable.

- Then press the ZERO button.

5 Calibration procedure

This button starts a calibration procedure. The last measured value is displayed and must be validated. Then the standard value must be entered. When finished, a new calibration factor is determined and recorded on the calibration history.

Recommendations for recalibration

Make a standard solution of the required concentration (10 NTU, 100 NTU...) depending on the application range. Use a turbidity standard stock solution (eg. Formazine) to make laboratory standards for calibration purposes.

- Introduce the probe on the standard solution.

- Wait until the measured value gets stable.
- Go on the calibration screen and press on the “CALIB” button. Enter the measurement and the enter the standard value on the keypad.

The calibration is finished. A new calibration factor has been calculated and recorded inside the calibration history displayed on the check screen. This new calibration factor will be considered for all further measurements.

For TURB200:

- Empty the sensor cylinder by opening the drain valve. Once the cylinder is empty, close the two valves of the inlet and the drain at the bottom of the sensor (refer to the picture in section 4.7.2).
- Unscrew the three black knobs on the sensor cover.
- Fill the sensor cylinder with the standard solution.
- Put back the cover and screw back the three knobs until finger tight.
- Wait until values get stable.
- Go on the calibration screen and press on the “CALIB” button. Enter the measurement and then enter the standard value on the keypad.

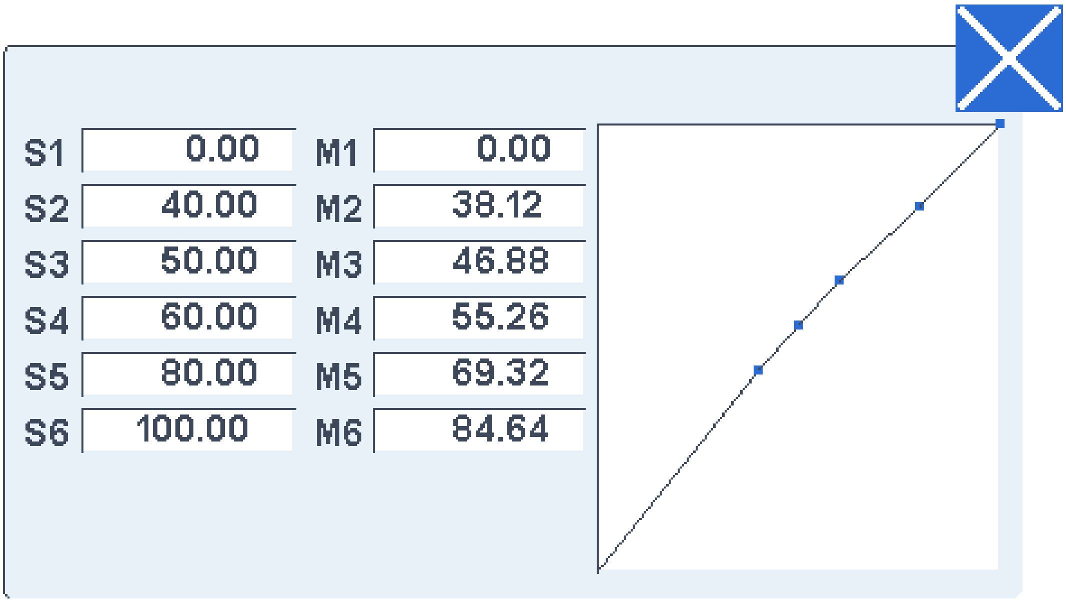
The calibration is finished. A new calibration factor has been calculated and recorded inside the calibration history displayed on the check screen. This new calibration factor will be taken into account for all further measurements.

6 Linearization curve

A linearization curve is entered to automatically compensate the non-linearity effect of turbidity measurement. This button displays the linearization curve and enables to enter or check the linearization values.

The Y-axis corresponds to the rough measurements entered on the M1 to M6 fields while the X-axis corresponds to the standard or final measurement, entered on the S1 to S6 fields.

The M1-M6 and S1-S6 values must be strictly increasing. It is recommended to put 0.0 and 0.0 as starting values for S1 and M1. The final value is linearly extrapolated between these points. Unused points at the end of the table must strictly remain at 0.0 both for S and M.



4.8.4. Maintenance and Troubleshooting

<u>Maintenance</u>

Both the turbidity probe and TURB200 must be cleaned on a regular base depending on the application (daily, weekly or monthly). Do not touch the probe cell surface with any hard object. If the probe cell surface is contaminated, soak the probe cell portion in light detergent and mild acid for about 15 min, respectively. Regarding TURB200, be careful when cleaning the windows not to scratch them.

For TURB200: the laser module must be aligned with the sensor cylinder (black marks shown on p.96). In case of misalignment, make sure to unscrew the black nut before turning the module to correct the alignment. Otherwise, the parts composing the laser module will get unscrewed, and this might result in a water leakage.

Troubleshooting

Symptoms	**Origin**	
	Turbidity probe	**TURB200**
Negative value	- Bad zero.	- Bad zero
Value is too low	- No water in contact with the surface of the probe. - Bad calibration: check or redo a calibration. - Dirt on the surface of the probe.	- Not enough water to cover the windows of the laser and photodetector modules. - Bad calibration: check or redo a calibration. - The laser module is not aligned with the cylinder (check the marks). - Dirt on the windows of the laser and/or photodetector modules.
Value is too high	- The surface of the probe is too close from the bottom of the container. - The colour of the container can impact the measured values. Choose containers with dark colour (black if possible). - Air bubbles on the surface of the probe.	- The laser module is not aligned with the cylinder (check the marks). - Air bubbles on the windows of the laser and/or photodetector modules.
Unstable value	- Air bubbles or dirt on the surface of the probe.	- Screw the three black knobs until finger tight. - Air bubbles on the windows of the laser and/or photodetector modules.

Turbidity probe measuring errors

Error no	**Signification**	**Origin / Remediation**
1	Probe disconnected	- Check connections.

TURB200 measuring errors.

Error no	**Signification**	**Origin / Remediation**
1	No connection	- The probe is not connected or badly connected. - The probe is not properly configured. - **A special initialisation must be done when the probe is used for the first time.**
2	Detector default	- Check wiring. - Failure on photodetector board (repair or replace).
3	The light level is too high	- Too much parasite light. Check that the cover is properly closed. - Test on demineralized water.

		- Check that no air bubble is present in the flow cell. If yes, check the fittings.
4	The light level is too low	- Check red light from the laser by removing the three black knobs of the probe. - The sample is highly turbid. Check the probe on tap water and/or standard solution (100 NTU maximum) - Failure on the photodetector board (repair or replace).

4.8.5. Specifications

Turbidity probe Specifications

Calibrated range: 0 – 40.00 NTU; 0 – 400.0 NTU

Measuring time: < 60 seconds for 90% of response

Accuracy: ± 2 NTU or ± 5% whichever is greater

TURB200 Specifications

Calibrated range: 0 - 100 NTU (other ranges on request)

Measuring time: < 10 seconds for 90% of response

Accuracy: ± 0.015 NTU or ± 2% whichever is greater up to 20 NTU,
± 5% above 20 NTU

4.9. UV254 Measurement

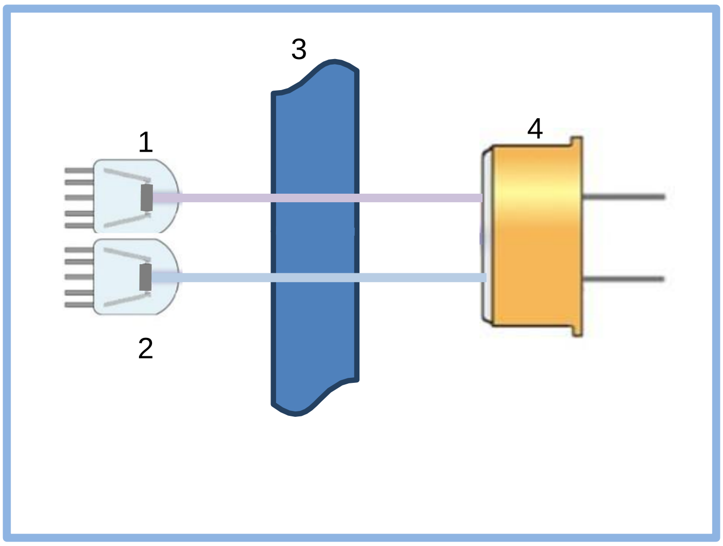
4.9.1. Principle

The measuring principle is based on the UV light absorption from organic matter at 254 nm according to the Beer-Lambert law:

$$[C] = k \cdot \log\left(\frac{I_0}{I_1}\right)$$

With
$[C]$: Sample concentration
k : Absorption coefficient (molecule specific)
I_0 : Light intensity before the sample
I_1 : Light intensity after of the sample

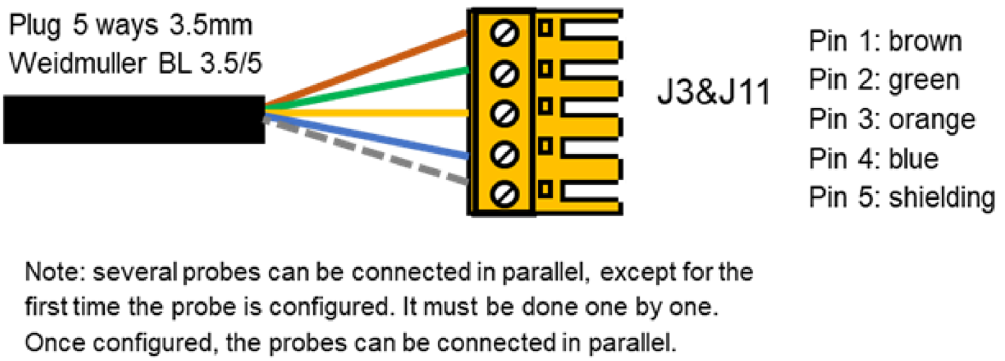
A UV light is measuring the absorption at 254 nm. A reference signal is used to compensate turbidity and other possible absorbing species (eg, deposit on the windows or organic matter) and hence avoid bias on the measurement. Light detection is performed by a photodiode.



1	UV light (LED 254 nm)
2	Reference light (LED 400 nm)
3	Optical path (Sample)
4	Photodetector

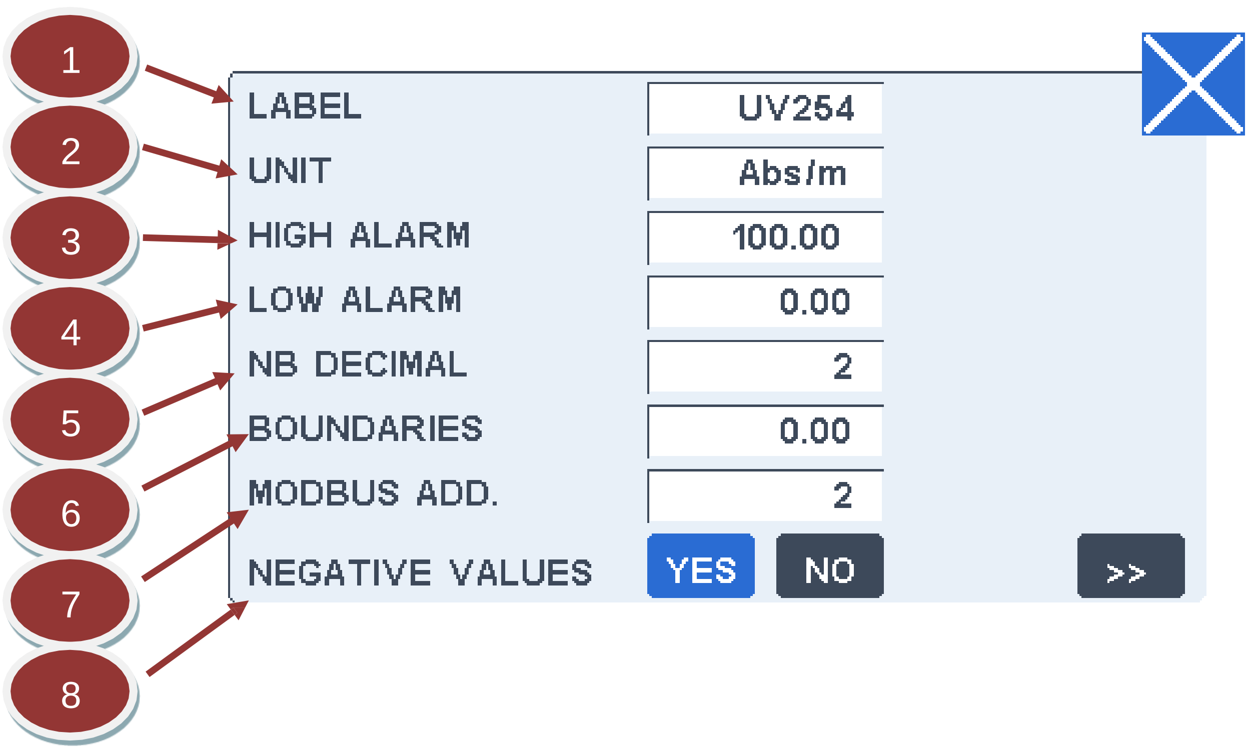
4.9.2. Connections and Settings

UV200 probe is connected as follows via RS485 port:



The settings are displayed on the two following screens.

First screen:



1 **Label**

This field allows changing the channel label displayed with the measurement. The label size is limited to 6 characters.

2 Unit

This field allows changing the channel unit displayed with the measurement. The unit size is limited to 6 characters.

3 High alarm value

The high alarm level can be changed by pressing on this field. A default value is preset when the channel is created. The high alarm level is primary used to fix the high limit represented by a red line on the recorded measurement graph. The limit is used as the minimum graph scale.

The secondary use is to drive a high alarm relay if the relay has been selected for this function. In this case, the relay will be activated as soon as the measurement overpasses the high alarm value and will stay activated until the measurement goes down below this value after subtracting the boundary value.

Refer to installation section for the relay wiring. Both functions NO (Normally Open) and NC (Normally Closed) are available.

4 Low alarm value

The low alarm level can be changed by pressing on this field. A default value is preset when the channel is created. The low alarm level is primary used to fix the low limit represented by a green line on the recorded measurement graph.

The secondary use is to drive a high alarm relay if the relay has been selected for this function. In this case, the relay will be activated as soon as the measurement underpasses the low alarm value and will stay activated until the measurement goes down below this value after adding the boundary value.

Refer to installation section for the relay wiring. Both functions NO (Normally Open) and NC (Normally Closed) are available.

5 Number of decimals

This field allows changing the number of decimals displayed for the measurement value to adjust the display to significant decimals only.

Note: this choice does not affect the measurements stored in the internal memory or the MODBUS registers.

6 Boundaries

The purpose of boundary is avoiding too frequent changes of state of the alarm relays that can harm process devices like pumps or electric-valves. The boundary value is subtracted from the high level value before leaving the high alarm state and reciprocally added to the low alarm level before leaving the low alarm state. More details including a schematic are provided in the relay section.

7 Modbus address

This field is the Modbus address of the probe that has been set inside the probe during the initialisation sequence.
This value must not be changed, unless the RS485 scan screen indicates that the probe has not the proper address.

8 Negative values displayed

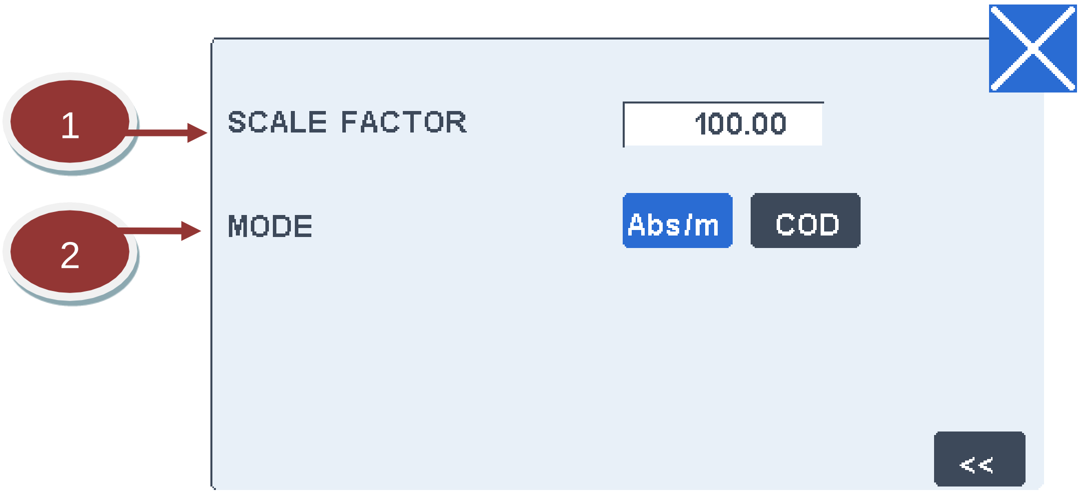
Negatives values are normal for most of the measurements as they result from normal fluctuations if the measurement is close to zero.

By default, the display of negative values is allowed as negative values may also result from a wrong zeroing. Consequently, it may be useful to be aware of such problem when observing strongly negative values.

But as negative values have no theoretical meaning, it is possible to replace them by zero by selecting "NO" for this function.

Note that this function does not apply to the recorded measurements or to the MODBUS registers.

<u>Second screen:</u>



1 Scale factor

This field allows changing the scale factor of the channel.
Precautions must be taken before changing this value.

The default scale factor is set according to the flow cell optical path to transform the absorbance to absorbance by meter:

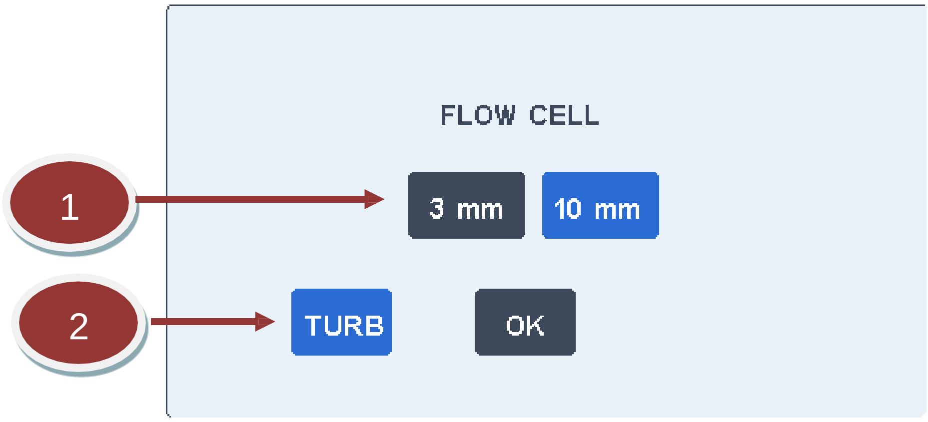
- Flow cell of 10 mm: 100
- Flow cell of 3 mm: 333.3

2 Display mode

This button allows selecting the concentration display mode as Abs/m (default mode) or as COD if the correlation between UV absorbance and COD has been settled.

If COD is selected, the calibration factor is preset to 0.5 (typical value for river water), the linearization curve is taken into account and the label is automatically updated to “COD”. The measurements previously stored in the internal memory will keep their values in Abs/m.

Flow cell size



1 Optical path

This button must be selected depending on the flow cell optical path that represents the distance between the two quartz cylinders visible inside the flow cell.

No change must be done unless the flow cell is changed. The scale factor is automatically set according to the flow cell size.

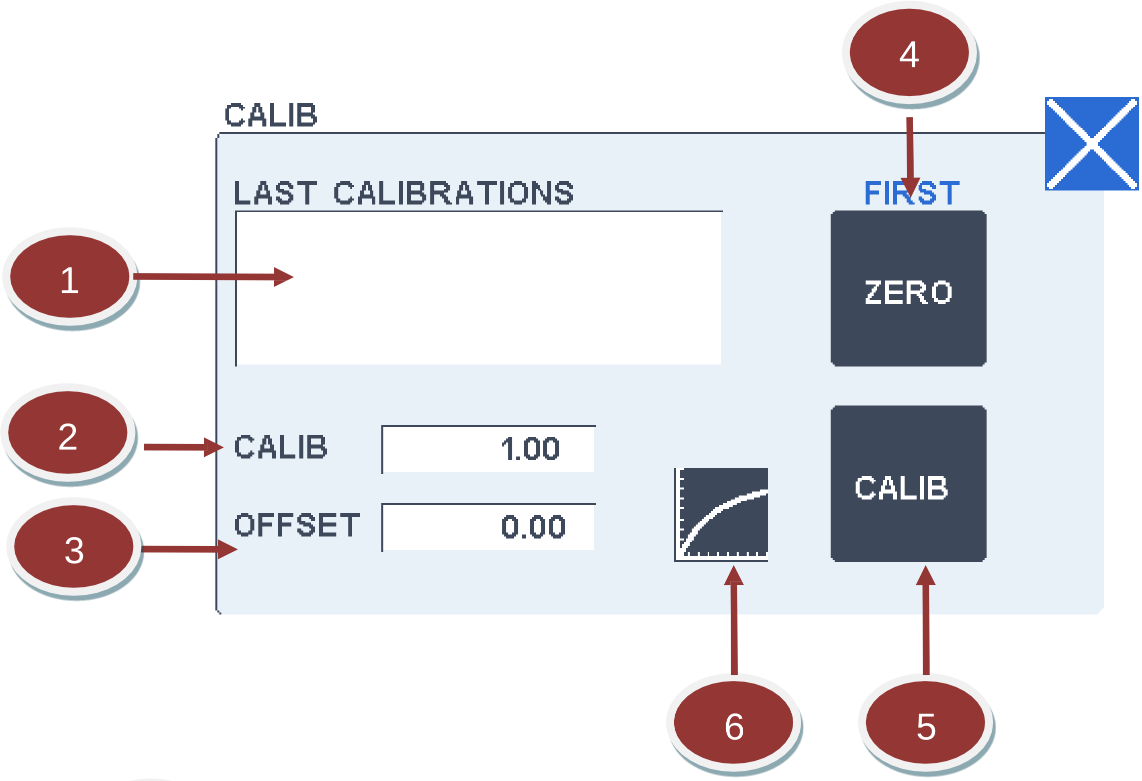
The size of the flow cell is factory selected depending on the application:
- 10 mm: drinking water, low turbidity river water and low turbidity effluents
- 3 mm: turbid river water and turbid effluents

2 Turbidity by UV absorbance

This button activated the display of a turbidity channel on the main screen. In this case, the turbidity is measured by UV absorbance using the reference signal (LED 400 nm) of the UV254. This channel can be calibrated through its parameter screen as TSS.

4.9.3. Calibration

The calibration screen below enables to recalibrate the measurement channel.
Recommendations for recalibration are given after the following screen description.



1 Last calibration window

This window displays the 5 last calibrations done with the date, time and the new calibration factor.

2 Calibration factor

This field allows changing manually the calibration factor of the channel.

This factor is normally changed automatically while doing a calibration procedure by pressing on the "CALIB" button.

3 Offset

This field shows the internal offset applied for zeroing. It is updated at each zeroing and has normally not to be changed.

4 Zero

This button enables to do the zero. Be sure that the probe is immersed on pure water before pressing on this button. When pressing this button optical signals are accessible.

5 Calibration procedure

This button recalibrates the analyser according to a COD laboratory measurement.
The analyser must be in COD mode.

Enter the measured value obtained on the sample given to the laboratory.
Then enter the laboratory COD value.

A new calibration factor is determined and recorded on the calibration history.

Recommendations for recalibration

The probe gives the result in absorbance by meter by default. No calibration is required in this measuring mode regarding the accuracy of flow cell optical path (± 0.1 mm).

If the measuring mode is in COD a UV254-COD relation has to be established. For that, the probe must be calibrated according to a COD laboratory measurement as each kind of effluent has a specific UV254/COD ratio.

The default calibration in COD mode corresponds to river water with a calibration factor of 0.5.
The calibration factor for municipal wastewater is around 10.
Note that many saturated organic compounds like glucose or alcohol do not have UV absorption.

To recalibrate the probe in COD mode, proceed as follows:

- Take a representative sample and bring it to a laboratory for a COD measurement.
- Do a manual measurement on this sample using the check screen (It is recommended to check first the zero).
- When the laboratory measurement is known, go on the calibration screen and press on the "ADJUST" button of the check screen. Enter the measurement given by the analyser and then enter the laboratory value on the keypad.

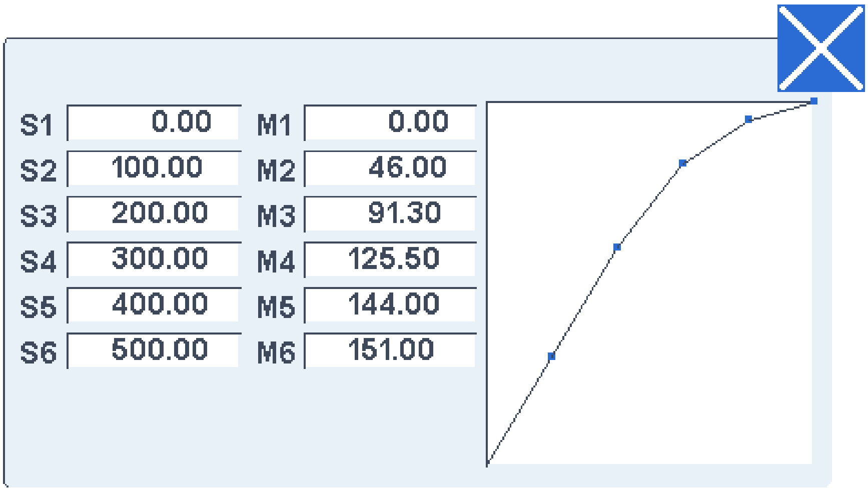
The calibration is finished. A new calibration factor has been calculated and recorded inside the calibration history displayed on the check screen. This new calibration factor will be taken into account for all further measurements.

6 **Linearization curve**

As the Beer-Lambert law is not linear for high absorbance values, a linearization curve is entered to automatically compensate this non-linearity. This button displays the linearization curve and enables to enter or check the linearization values.

The Y-axis corresponds to the rough measurements entered on the M1 to M6 fields while the X-axis corresponds to the standard or final measurement, entered on the S1 to S6 fields.

The M1-M6 and S1-S6 values must be strictly increasing. It is recommended to put 0.0 and 0.0 as starting values for S1 and M1. The final value is linearly extrapolated between these points. Unused points at the end of the table must strictly remain at 0.0 both for S and M.



4.9.4. Maintenance and Troubleshooting

A flow of compress air is recommended to clean the deposits that might stick to the windows. 3 or 4 bar air jet for 10-20 seconds every 60-120 minutes is recommended. However, these are optional settings, and they can be adjusted as for the application.

Troubleshooting

Symptoms	**Origin**
Negative value	- Bad zero. DI water used for zeroing is contaminated. Change the DI water.
Value is too low	- Probe not immersed. - Wrong zero. - Bad calibration: check or redo a calibration.
Value is too high	- Bad calibration: check or redo a calibration.
Unstable value	- Deposit or dirt on the windows. - Light signal too low unstable.

Measuring errors

Error no	**Signification**	**Origin / Remediation**
1	No connection	- The probe is not or badly connected. - The probe is not properly configured (refer to the RS485 section for probe configuration). **A special initialisation must be done when the probe is used for the first time.**
2	Light too low	- LED is not working. Cable is damage. - There is a deposit on the optical path.
3	Light too high	- Electronic card has to be changed.

4.9.5. Specifications

Measuring range:	With 3 mm path: 0 - 600 Abs/m (equivalent to 0-5000 mg/L COD/TOC/BOD/BOD5/TSS on rough municipal wastewater) With 10 mm path: 0 - 200 Abs/m (equivalent to 0-100 mg/L COD/TOC/BOD/BOD5/TSS on surface water)
Optical path:	3 mm or 10 mm
Measurement method:	UV light absorbance
Accuracy:	± 2% on standard solution
Response time:	10 sec
Turbidity compensation:	Integrated by dual-beam method
Light source life time:	> 5 years
Mounting:	Immersion
Probe cleaning system:	Air cleaning option available
Cable length:	10 meters
Sensor protection:	IP68
Temperature range:	-20 °C to 70 °C
Body material:	Stainless steel 316L
Wet materials:	Stainless steel 316L, quartz, FKM (Viton), PE

5. General Maintenance and Troubleshooting

The maintenance is limited to the replacement of the probes depending on the customer use.
A weekly checking is recommended. For probes calibration frequency, please, refer to the specifications of each probe.

General troubleshooting:

Disconnect the power cord before servicing!

Symptoms	Checking / Origin
The screen remains totally black after connecting the power cord. **AND** The red LED D8 on the EL200 board is OFF.	- Check the power socket. - Check J19 connector (mains input, high voltage!). - Check J2 connector (24V DC output from the power supply). - Failure on the power supply of the EL200 board.
The screen remains totally black after connecting the power cord. **AND** The red LED D8 on the EL200 board is ON.	- Failure off the EL200 board.
If Bip when powered on but unstable display.	- Check the screen connector J1 on the bottom of the EL200 board. - Failure off the EL200 board.

6. General Specifications

Dimensions (HxWxD):	140 x 140 x 91 mm
Weight:	2 kg
Mounting:	Wall mounted
Rating:	IP65 / Nema 4X
Display:	Colour LCD, 480 x 272 pixels, 4.3", LED backlight
Operating temperature:	- 20 °C to + 55 °C
Maximal altitude:	2000 m
Power supply**:**	90 VAC to 265 VAC (50/60 Hz), 24V DC, 20 VA
Connected on power systems:	TT
Analog 4-20 mA outputs:	2 (expendable to 4 if no other modules), galvanic isolation
Analog 4-20 mA inputs:	2 for inductive conductivity, low range turbidity, DO, Cl_2. Galvanic isolation
RS485 connector for probes:	2 (up to 4x RS485 probes) for DO, TSS
pH/ORP input:	1 (expendable to 2), galvanic isolation
Conductivity input:	0 (expendable to 2), galvanic isolation
Security:	Two level password
Relay:	4x electromechanical SPDT (form C) contact, 5 A
Relay function:	High & low alarm, default (power safe mode selectable)
Communication:	MODBUS RS232 and RS485
USB:	For configuration backup/restore, download and software update, screencopy
Safety standard:	EN 61010-1:2010
EMC standards :	EN 61326-1:2013, IEC61000-3-2, IEC61000-3-3, IEC61000-4-2, IEC61000-4-3, IEC61000-4-4, IEC61000-4-5, IEC61000-4-6, IEC61000-4-11
