AQUALABO

Smart water solutions

LowTuS

User manual

V1.3 _ August 2023

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1. WARRANTY

The LowTuS equipment sold by the AQUALABO company are guaranteed against all manufacturing defects for a period of 2 years excluding consumables (unless expressly stipulated by AQUALABO) from:

- the date on which the buyer or authorized representative declares technical acceptance of the equipment at the factory,
- or alternatively,
  - for mainland France: from the date of the delivery note,
  - for other destinations: from the date of shipment certified by LTA, waybill, or bill of lading.

AQUALABO's warranty applies exclusively to malfunction resulting from a design flaw or inherent defect. It is strictly limited to the free delivery of replacement parts (except consumables) or the repair of the device in our workshops within 10 working days, transport not included.

The following are, by express agreement, formally excluded from our warranty:

- Any economic damage, such as staff costs, loss of profit, business disruption, etc.
- Any failure due to improper use of the device (unsuitable mains power, fall, attempted conversion, etc.), lack of maintenance by the user or poor storage conditions.
- Any failure due to using parts, not supplied by AQUALABO, on the equipment.
- Any failure due to transporting equipment in non-original packaging.
- Batteries, aerials, and in general, any item listed under "accessories".

Our customers are asked to always request our agreement before sending us a device for repair. No returns will be accepted without the prior written consent from our after-sales service which will stipulate the return procedure. In this case, the items will be returned in their original packaging, carriage paid, to the following address:

AQUALABO - 115 Rue Michel Marion 56850 Caudan - France

We reserve the right to reship any device received without this agreement. Regardless of the type and conditions of transport chosen to ship the equipment for repair under guarantee, in the original packaging, the related expenses as well as insurance costs will be the customer's responsibility.

Any damage resulting from returning the equipment falls within the framework of the guarantee on the express condition that customers have sent their claims to the carrier, by registered letter with acknowledgment of receipt, within forty-eight hours, with a copy of the letter sent to AQUALABO.

For devices with a warranty form, it only applies if the form received with the device is returned to AQUALABO duly completed.

SOFTWARE WARRANTY

The software is guaranteed by the software publisher or distributor under the conditions specified in the documentation related to those software packages.
AQUALABO does not, under any circumstances, guarantee the software packages.
By express agreement, we formally exclude from our warranty all economic damage, in particular for staff costs, loss of profit, business disruption, etc.
Customers are informed that AQUALABO may not, under any circumstances, be held responsible for any failure or bugs the software contain.

PROPERTY RIGHTS AND TRADE SECRETS

2. INFORMATION

AQUALABO equipment has been designed, manufactured, tested and inspected in accordance with ISO 9001 procedures.

If the equipment is not used immediately, it should be stored in a clean, dry place. Abide by the following storage temperatures (10-35°C).

AQUALABO equipment is carefully inspected before packaging. Upon receipt of your device, check the condition of the packaging and if you notice an anomaly, submit the usual reservations with the carrier **within 48 hours**. Then consult the packing list and check that everything is in order. Finally, if you notice that something is missing or the equipment damaged, contact AQUALABO without delay.

LowTuS turbidimeters are entirely designed and manufactured by AQUALABO in France.

AQUALABO

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3. SAFETY

3.1 Safety instructions

3.1.1 Safety instructions in the manual

This manual provides important information on how to operate the product safely. Read it carefully to familiarize yourself with the product before commissioning and using it. This manual should be kept near the product so that the information you need is always easy to find.

Important safety instructions are highlighted in this manual. They are indicated by the warning symbol (yellow triangle) on the left-hand side.

CAUTION

Indicates a potentially hazardous situation that may result in product damage or destruction, serious (irreversible) injury or even death, if the safety instructions are not followed.

3.1.2 Labels on the product

Be aware of all information labels and safety symbols affixed to the product.

3.2 Operating safety

3.2.1 Intended use

Comply with the following points for safe operation:

- Store and use the device under the environmental conditions mentioned in this manual
- Do not disassemble the device.
- Power the device in compliance with the specified DC voltage range.
- Comply with the use restrictions given below.

3.2.2 Unauthorized use

The product must not be operated if:

- it is visibly damaged (e.g. after being transported).
- it has been stored under adverse conditions for a long period of time.

3.2.3 User qualification

We assume that operators know how to manage this equipment by virtue of their professional training and experience. In particular, the operators must be able to understand and correctly implement the safety instructions/labels when using the product. Trained personnel should be familiar with and follow the instructions in this manual.

3.3 Notes on handling

LowTuS turbidimeters are opto-electronic devices. As such, they must be treated with care. Always protect the device from conditions that could adversely affect its components. In particular, adhere to the following

- The ambient temperature and humidity, when using and storing, must be within the limits indicated in the TECHNICAL CHARACTERISTICS section.
- Irrespective of the circumstances, the device must be protected from the following influences:
  - Intensive exposure to sunlight and heat,
  - Corrosive or caustic fluids, organic solvents, or vapor with a high solvent content.
- As this sensor is an optical measurement device, the optical path and more particularly, the two optical windows must be protected. Dirt and scratches may affect measurement performance.
- All work on the inside of the instrument, must be performed by AQUALABO or by AQUALABO-approved technicians.

3.4 Packaging

The LowTuS turbidimeter is shipped in packaging designed to protect it during transport.

It is essential that you keep the original packaging as well as the inner packing in such a way as to ensure optimum protection of the device from impact in the event of transport.

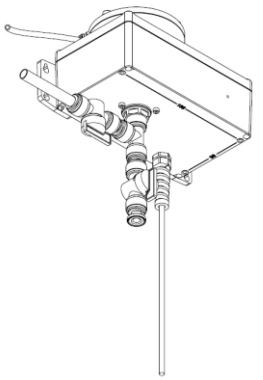
The original packaging is also required for return transport under appropriate conditions if repair is needed. Please remember that we shall decline any warranty claim for damage caused by unsuitable transportation.

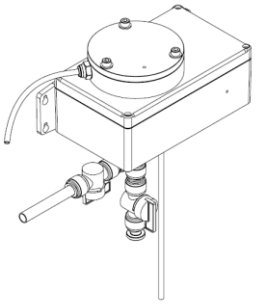
4. OVERVIEW OF THE LOWTUS SENSOR

4.1 Description

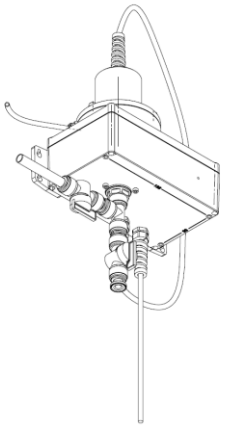
The LowTuS turbidimeter is an in-line water turbidity measurement device including optical system and associated electronics.

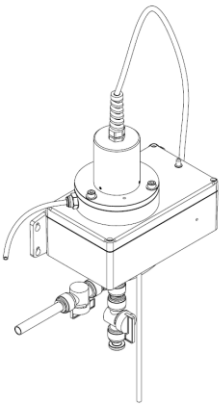
There are two versions: STANDARD, with fully free flat lid and, PREMIUM, with integrated automatic cleaning system in the lid.





STANDARD





PREMIUM

4.2 Package contents

The package consists of a LowTuS sensor with a single power and communication cable.

Cable length varies depending on the model ordered.

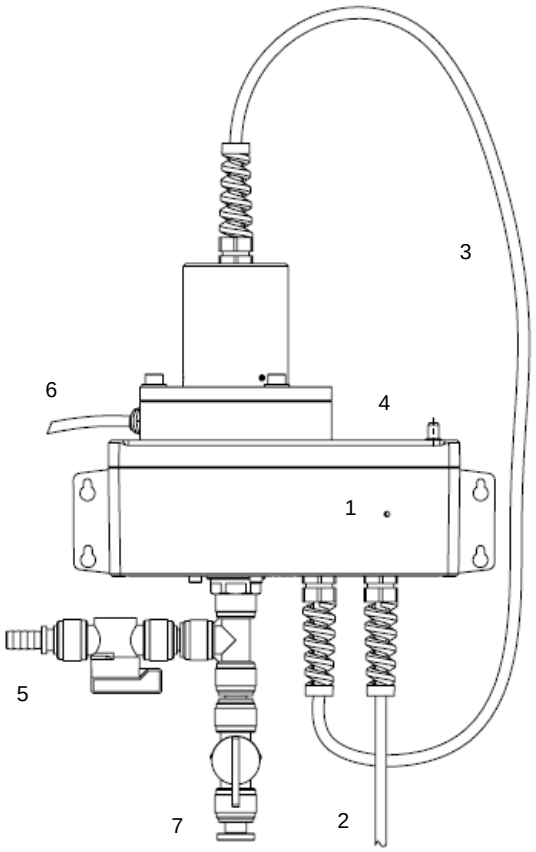
The LowTuS device is delivered with:

a) the pre-configurated valves unplugged,
b) locking clips for fluid circuit,
c) a quick checking solid state tool (PREMIUM version only).

Upon receipt of your device, check the condition of the packaging and if you notice an anomaly, submit the usual reservations with the carrier **within 48 hours**. If you notice that something is missing or the equipment is damaged, contact AQUALABO without delay.

4.3 General view of the LowTuS sensor

The PREMIUM version is described below with its automatic cleaning system built into the removable lid. In this version, a specific cable transfers energy from the main part of the LowTuS device to a motor in the lid to generate a cleaning process using a rotating arm with a rubber blade.



1 – DEVICE ENCLOSURE with status LED
2 - POWER SUPPLY and COMMUNICATION CABLE
3 – DEVICE-TO-MOTOR CABLE
4 - FLOW CELL BODY
5 - FLUID INLET
6 - FLUID OUTLET
7 - DRAIN

CAUTION:
The main cable is used to power the sensor and communicate with a master device. The product's seal is not guaranteed when the sensor is suspended by its cable or when the cable is damaged (cut or partial abrasion of the outer sheath).

The premium version has a Low Turbidity sensor which incorporates a mechanical system to **automatically clean** the measuring cell. This system prevents the build-up of contamination in the measuring field, optical scattering and IR radiation cells. This automatic de-bubbling system prevents bubbles from sticking to the optical windows so as to prevent measurement errors.	

Calibration can be performed using clear water and a turbidity standard, aqueous Formazine solution, in static mode (no flow i.e. flowcell closed by the lid).

Ensure that the standard solution turbidity value is within the range.

A solid Tare reference could be used as a quick check. This tool is then introduced in the open and perfectly dry flow cell. The turbidity equivalent value of the tool is factory defined for the LowTuS device. Consequently, the tool is compatible with a single device. This tool contains two holes which combined with the pin fixed in the upper part of the measuring cell allow for two positions of use. The first position identified as the "**DARK position**" represents complete closure of the source channel window to generate a minimal signal on the receiver. The second position identified as the "T**URBIDITY VALUE position**" equates to low intensity light transfer from the transmitter to the receiver. In this position, a non-zero signal is observed. It is therefore advisable to use this tool to test if the measuring equipment is operating correctly.	 

The quick check tool is an optical system. There is a specific box for safe storage.

Be sure to clean and then dry the measuring chamber with a clean tissue before inserting the tool.

4.3 Description of the measurement chain and measuring principle

The measurement principle is based on measuring InfraRed light diffusion at 90° (ISO 7027) and enables continuous monitoring of turbidity across low measurement ranges.

The LowTuS device is an open protocol RS485 Modbus slave. It delivers temperature and turbidity values to a master. This master could be either a local display-controller-transmitter or a remote monitoring system.

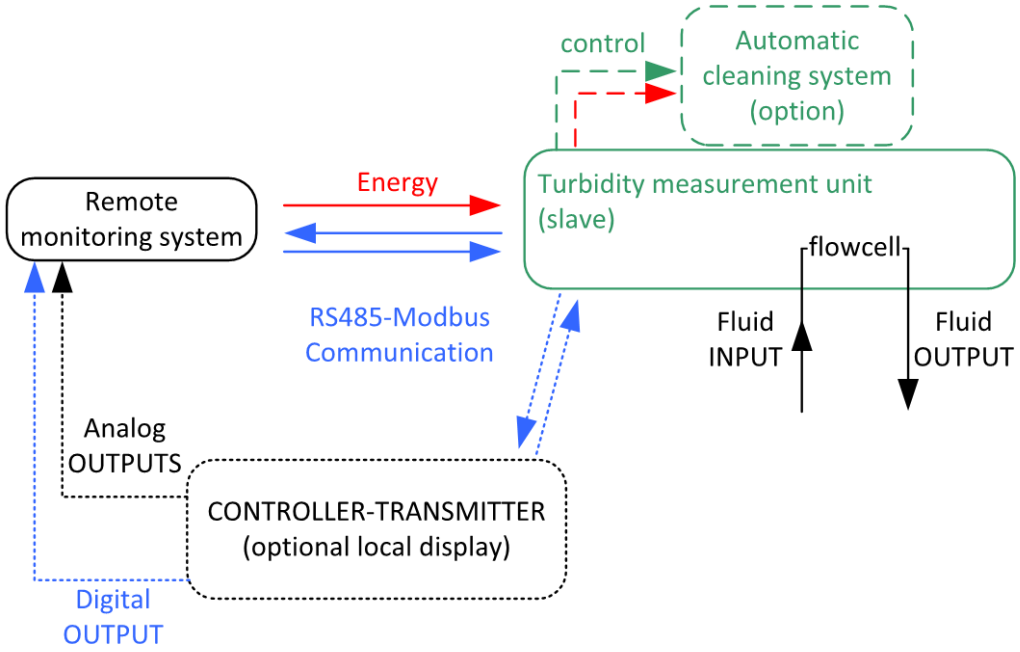


Figure 1: Main diagram in the MASTER/SLAVE configuration including LowTuS.

CAUTION:

The LowTuS sensor has an optical system based on an IR light source. Never look directly into the light source. Risk of irreversible damage to sight.

CAUTION:

Intense, external light may saturate the sensor's optical system receiver and therefore distort the measurement.

4.4 Available parameters

LowTuS device is a digital sensor delivering the following data:

Parameter	Unit	Description
Temperature	° Celsius	Fluid temperature: measurement located in the flow cell body.
Turbidity (Main parameter)	NTU	Two available ranges (see data sheet for details); Factory calibrated with diluted Formazine standard solutions; Additional calibration could be implemented by the user during the product's life.
Turbidity with user defined micro-offset	NTU	Taken from the main parameter given a user-defined offset. This offset could be defined using an externally measured sample (e.g. laboratory turbidimeter). This sample will be easily collected using the drain valve. **$TURBIDITY_{micro\text{-}offset\ adjusted} = TURBIDITY_{main\ parameter} + Micro\text{-}offset\ value$** The micro-offset value could be positive or negative.
Custom TSS value	mg/L	Taken from the main parameter given a user-defined offset and gain. These specific coefficients are user-defined after sample analysis. **$TSS_{custom} = Gain_{TSS} . TURBIDITY_{main\ parameter} + Offset_{TSS}$** Coefficients could be positive or negative.
Wiper cycles	Number of Cycles	Information about wiper aging (useful only for the PREMIUM version).

4.5 On-site installation: Wall-mount configuration

LowTuS device is a wall-mounted flow cell.

Use 4 attachment screws appropriate for the wall bracket and a mass of 3 kg (device and tubes full of water).

Type of screws:

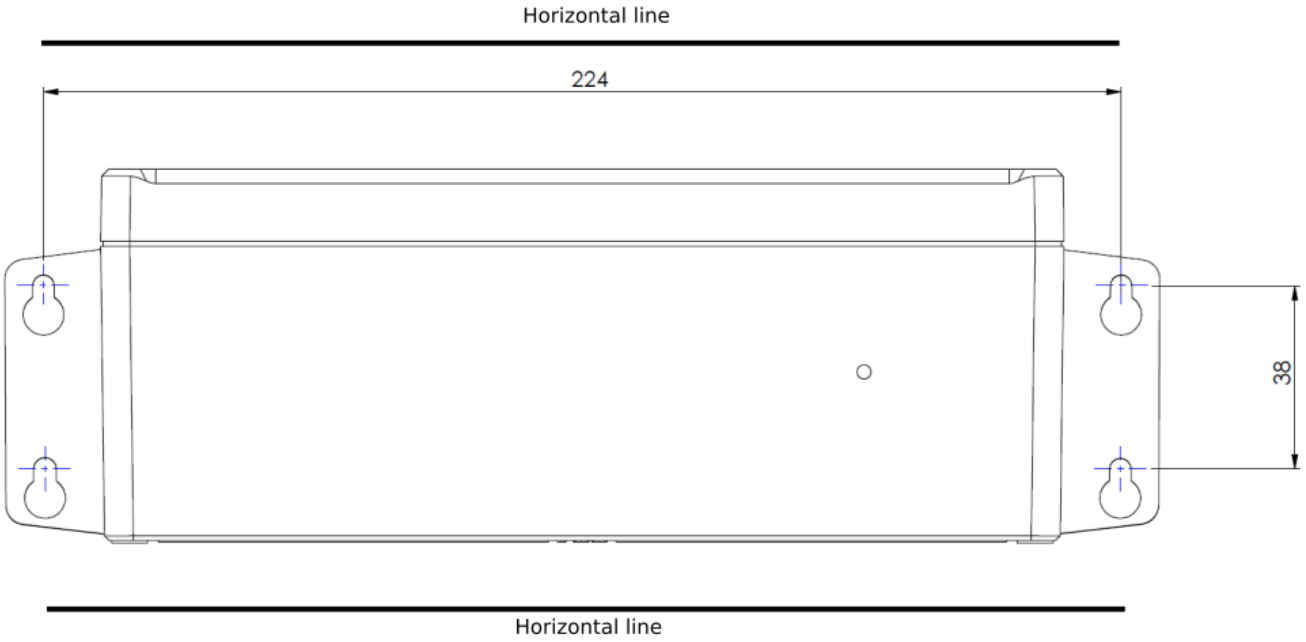
- Ø 4 mm max.
- Ø screw head 8 mm max.

To avoid air bubbles getting trapped in the flow cell, please adjust a perfect horizontal position of the device.

CAUTION:

Wall material must be able to securely hold the device long-term.

Install the LowTuS in a vibration-free environment.


Horizontal line
224
38
Horizontal line

5. CONDITIONS OF USE

5.1 Fluid circuit description

5.1.1 Fluid configuration:

The LowTuS device is compatible with analysing aqueous solutions.
Organic solvents could damage plastic parts.
Flow rates min / max: 100 ml/min – 1500 ml/min

5.1.2 Compatible pipe types:

Fluid inlet and drain:

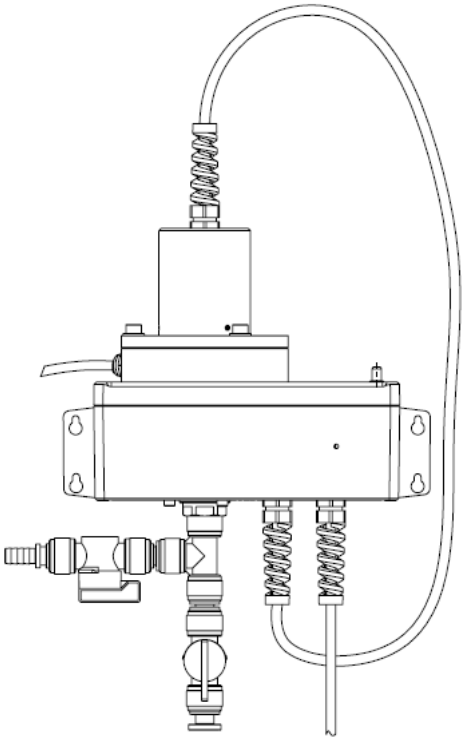
- semi-rigid in PE Ø int 10mm Ø ext 12 mm => opaque black
- flexible Ø int 10mm mounted on fluted tip => opacity recommended to reduce algae growth.

Fluid outlet:

- semi-rigid in PE Ø int 4 mm Ø ext 6 mm => opaque blue
- flexible Ø int 4 mm mounted on fluted tip => opacity recommended

CAUTION:

Fastening the hoses to the wall bracket near the product is mandatory to avoid premature wear and tear of the couplings.



FLUID OUTLET

Semi-rigid PE 4x6 pipe or flexible pipe: internal diameter 4 mm mounted on fluted tip.

FLUID INLET

Semi-rigid PE 10x12 pipe or flexible pipe: internal diameter 10 mm mounted on fluted tip.

CAUTION:

Fluid output must be carefully configurated to release fluid from a higher level than the fluid inlet (120mm vertical gap) at atmospheric.

5.2 Fluid circuit assembly

LowTuS is delivered with the valves unplugged. Please only connect the two pre-configured valves, INLET and DRAIN once the device has been wall-mounted.

5.2.1 Description of the pre-assembled valves:

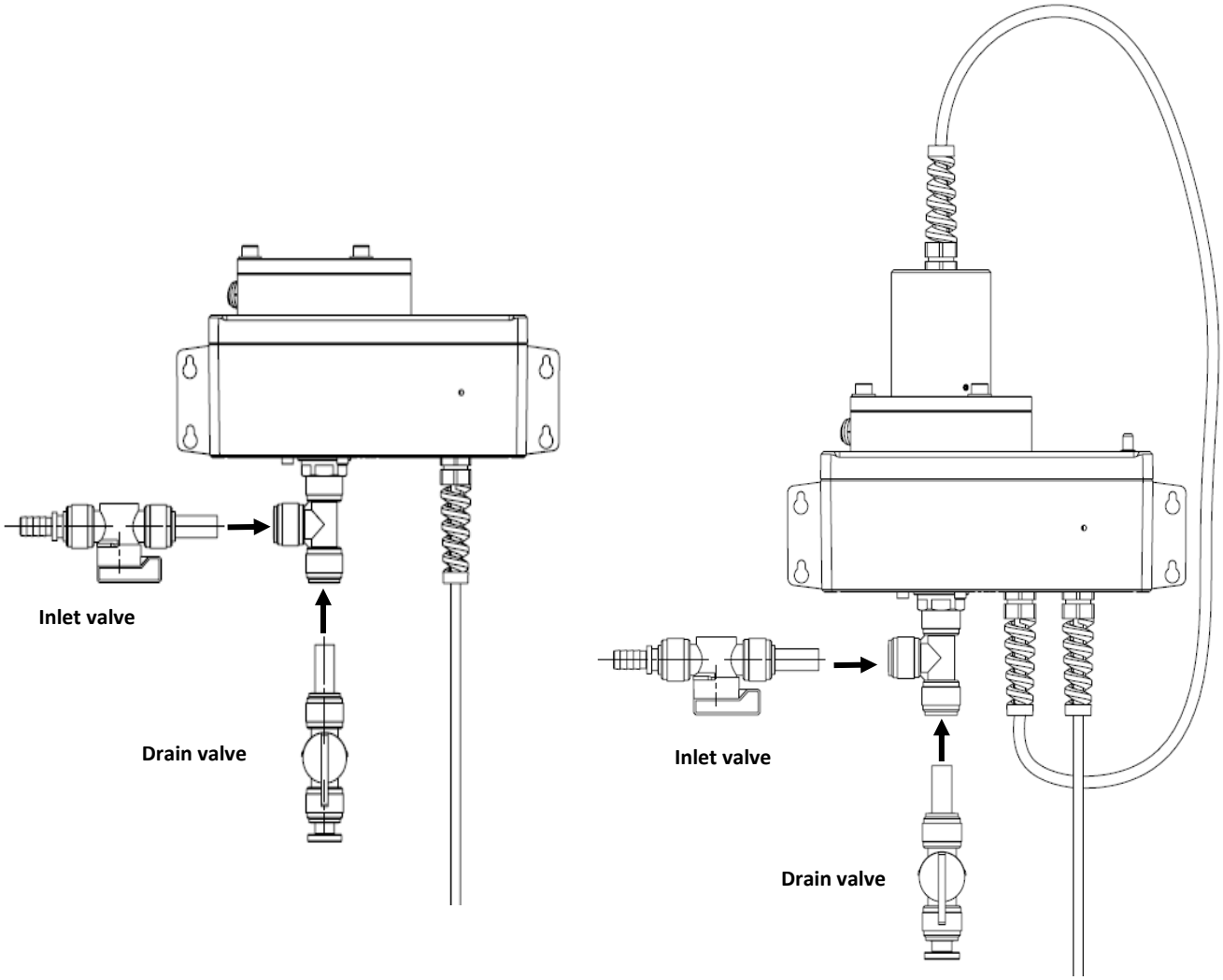
INLET valve: fluted tip inserted in one side of the valve; 50mm semi-rigid 10x12 PE tube in the other side,

DRAIN valve: stopper inserted in one side of the valve; 50mm semi-rigid 10x12 PE tube in the other side.

In both cases, the semi-rigid 10x12 PE tube must be inserted into T-part under the flow cell (see arrows in the picture). Inlet and drain valves are in position when it mechanically stops in the quick coupling. In the right position the remaining space between the valves and the T-part is around 5mm.

CAUTION:

During the assembly (10x12 tube insertion), the operator stands the T-part manually to avoid any mechanical stress on this part.



5.3 INLET or OUTLET tubes

5.3.1 Tube quality control:

Make sure that the tube used is clean and does not present any scratches, cracks or deformity. To avoid leakage, ensure that the tube size and the push-in system size of the fittings are the same. Cut the semi-rigid tube with the dedicated cutter tool to obtain a 90° cut for the part of the tube to be inserted into the fittings. Before inserting the tube, check the inside of the fitting. Remove any possible obstruction inside.

Make sure that the tube is correctly and fully inserted. Please connect the tube by hand. Inserting the tube into the fitting requires a moderate force.

5.3.2 Assembly checking:

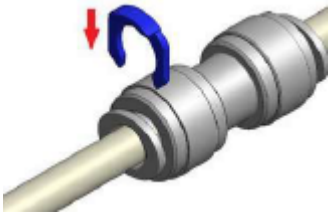
To make sure that the fitting is properly connected to the tube, hold the T-part with one hand, and with the other hand pull the tube once without releasing the collar.

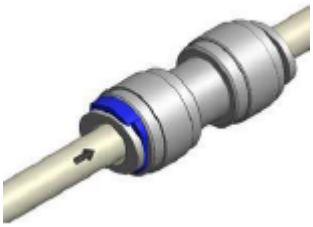
5.3.3 Final locking:

After pulling, slide a locking clip of the right size between the fitting body and the collar.

Push the tube into the fitting once more for a complete insertion.

The use of a locking clip avoids accidental disconnection and eliminates any play between the tube and the fitting.





5.3.4 Disconnection:

Make sure the pressure has been removed from the circuit before disassembling the tube.

Firstly, remove the locking clip.

Push the collar in the direction of the fitting body and pull the tube, keeping collar in the same position, near the fitting body.

6. CONNECTION AND WIRING

The LowTuS turbidimeter comes with a factory-installed cable (of a given length) with bare wires.

CAUTION:

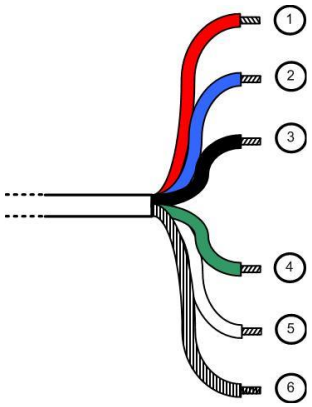
Any modification of the connector installed by the manufacturer, bare wires or 6-contact plug, represents a major transformation of the product and entails a loss of guarantee.

Never exceed a voltage of 10VDC (absolute maximum rating) on communication lines RS485, A or B, otherwise the transceiver component RS 485 could be irreversibly damaged.

SDI-12: Abide by the voltage value described in the related standard (nominal: 5 VDC) **Not used in this version**

Always connect ground + shield first.

CONDUCTOR IDENTIFICATION TABLE :



Cable length up to 15m included.

1 - Red	Power Supply, V+
2 - Blue	SDI-12 Not Used
3 - Black	Weight
4 - Green	B "RS-485"
5 - White	A "RS-485"
6 - Green/Yellow	Cable shielding
Connect wires 3 and 6 together	

Cable length from 15 to 100 m

Red Yellow Orange Purple Pink	Power Supply, V+
2 - Blue	SDI-12 Not Used
3 - Black	Weight
4 - Green	B "RS-485"
5 - White	A "RS-485"
6 - Green/Yellow	Cable shielding
Connect wires 3 and 6 together	

7. COMMUNICATION

7.1 General information

7.1.1 Communication and protocol

The LowTuS sensor has one digital serial communication mode: the Modbus RTU protocol (RS485 physical medium) which enables the exchange of information between the master device and the sensor (slave) such as, the measurement configuration, measurement values and calibration of the available parameters.

7.1.2 Sensor address

The LowTuS sensor's RS485/Modbus communication address is factory set. Its value is constant (80) and different from that attributed to any other model in the DIGISENS range. The broadcast address (0) is aimed at a sensor whose address is unknown to change its Modbus address.

These addresses can be modified by an operator wishing to manage a network of several sensors, thereby avoiding any conflict.

7.2 Device activity

An RGB LED is in the front panel of the LowTuS sensor. It gives information to the user about device activity.

LED color	Description
GREEN slow flash: breathing	Device activated; no specific action
GREEN fast flash	Measurement action
RED-GREEN flash	Measurement error
BLUE flash	Automatic cleaning system running
RED-BLUE flash	Cleaning system error

7.3 Measurements

After full assembly of the fluid circuit, connection to water supply, connection to power supply and RS485-modbus master device, the LowTuS will provide measurements after each measurement request from the master.

The communication sequence description (timing, frames), the list of registers is available in the DIGISENS sensor modbus documentation.

Please note that the measurement period, sliding average, number of measurements before cleaning system cycle, could be defined by the master using the Modbus protocol.

NOTE:

Gathering temperature values is an easy way to validate the RS485-modbus communication, from connection quality, powering, measurement requests until register readings with a slow change to ambient temperature values, reading after reading.

CAUTION:

It may take a few hours, after device set-up, to obtain signal stability for the turbidity measurement due to global system thermic stabilization.

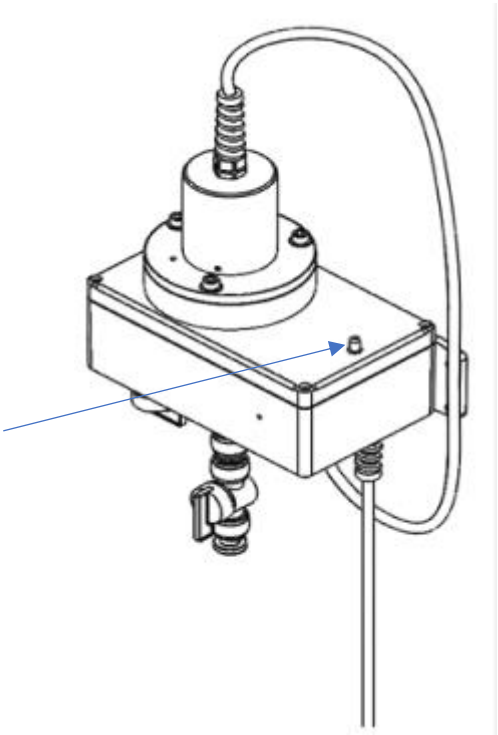
Any bubbles trapped in the upstream circuit of the system's flow cell, during the installation, may also have an impact on measurement stability. If the initial disturbances do not disappear, it may be necessary to add a debubbling device upstream of the measuring cell.

8. MAINTENANCE/CLEANING SEQUENCE

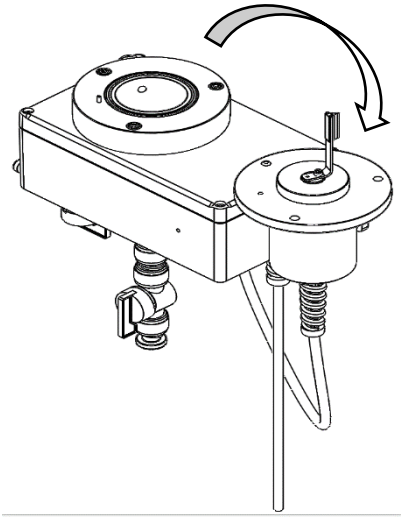
8.1 Maintenance steps

- Stop the wiper cleaning cycle (turn off the LowTuS device).
- Stop the fluid supply to the cell. If the drain valve is not connected to a drainpipe, put a tank under the flow cell.
- Close the inlet valve and open the drain valve.
- To remove the device's lid, unscrew the three M6 screws on the top.

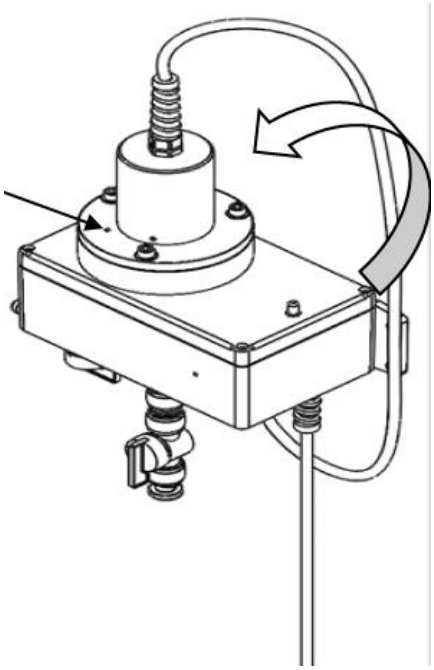
Lid holder pin, on the top right side of the main part of the device



- Extract the lid from the flowcell with a vertical movement then put the lid on the lid holder pin.



- After internal cleaning or calibration process, check the O-ring is in good condition,
- Close the flow cell, place the lid on the top of the flow cell. The right position is obtained when the pin is in the small hole.
- Screw the 3 points using flat washers.



CAUTION:

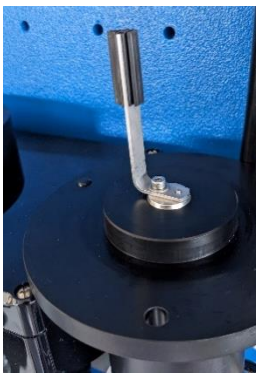
Do not hit the wiper arm when removing the lid or during the maintenance process.

CAUTION:

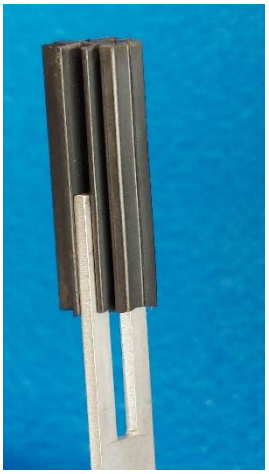
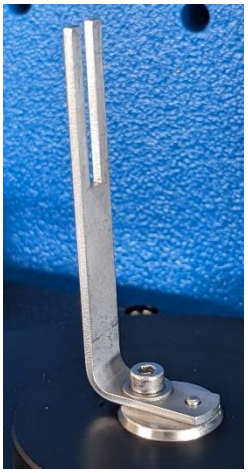
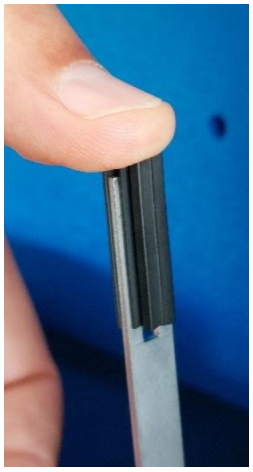
Do not hang the lid by the cable.

8.2 Change of the wiper (PREMIUM version).

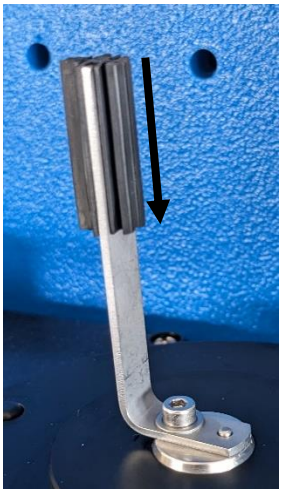
To change the wiper, extract the lid from the flowcell with a vertical movement then put the lid on the lid holder pin as described in the preceding paragraph.



In a classical aging situation, the user needs to change only the flexible rubber blade. In this way, extract it from the stainless-steel arm (fork shape), by sliding it vertically. Insert the new pre-cut rubber blade in fork. Look at the pictures below to place the fork in the right grove of the blade. Manually push the blade into the fork at maximum.


Clean the flexible blade with paper towel and IPA (IsoPropyl Alcohol).

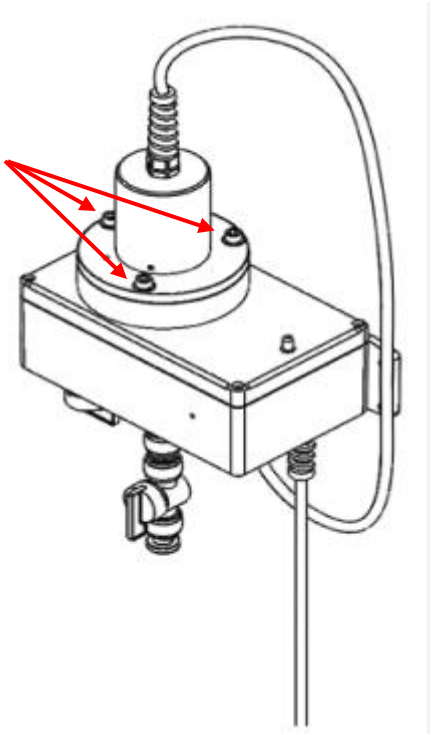


CAUTION:

Make sure it is pushed all the way into the bottom of the fork.

After wiper blade replacement: change the o-ring 60x3 (ME-JOI-S-00072) by the new one in maintenance kit. Slightly grease the o-ring and positioned it in its groove.

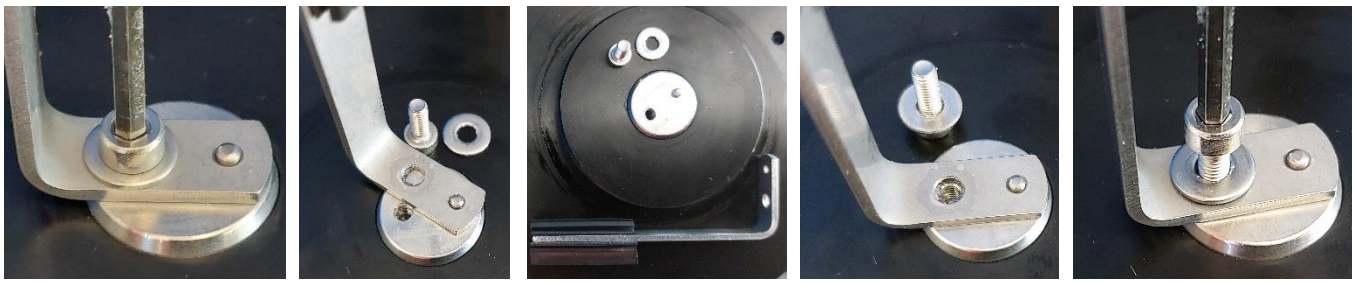
Close the flow cell by placing the lid on the top of the flow cell and screws the three M6 screws and washers with BTR key. The right position is obtained when the pin is in its housing.



8.3 Stainless steel arm replacement (PREMIUM version)

NOTE: In case of the stainless-steel arm has been damage, the operator could change it. Using a 2.5mm hexagonal profil key, unscrew and keep out the unique M3 screw and the washer. Release arm from the pin.

Insert the new assembly -rubber blade+arm- on the pin. Align the drill hole of the arm with the M3 thread. Place the M3 screw and washer. Manually tighted the assembly.

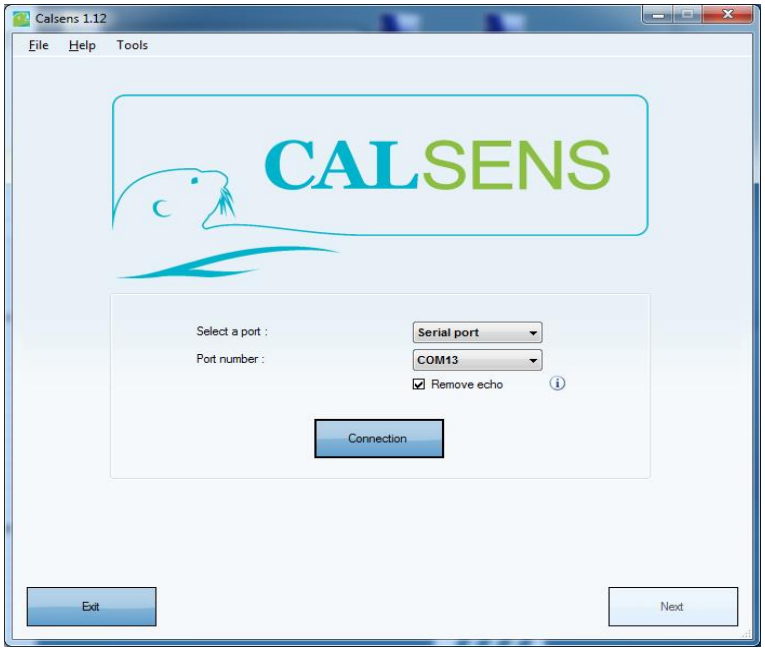


After wiper arm replacement: change the o-ring 60x3 (ME-JOI-S-00072) by the new one in maintenance kit. Slightly grease the o-ring and positioned it in its groove.

9. CALSENS SOFTWARE

9.1 General description

The CALSENS software tool is compatible with all DIGISENS sensors. A USB-RS485 converter gives access to many functionalities of LowTuS device.



NOTE: Aqualabo 4200 DIGITAL MODULE contains the USB-RS485 converter and 12VDC power supply.

9.2 Features

SCAN

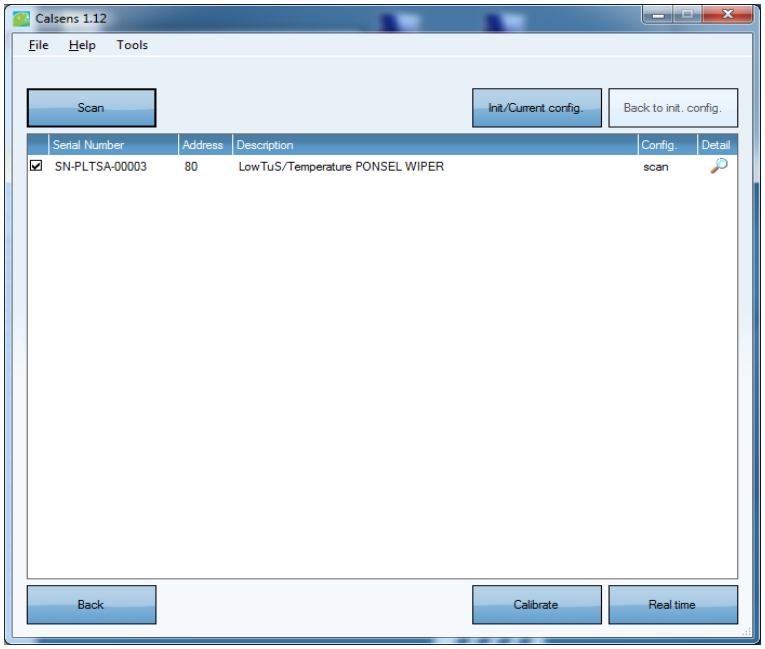
After connection, using a USB or COM port, the first useful function is the Modbus address scan.

This SCAN function goes from address 1 to 243, to detect DIGISENS sensors connected to the local network.

A correctly identified DIGISENS sensor will appear in the window with its main characteristics:

a) Serial number,
b) Current Modbus address,
c) Description.

The user can go directly from this window to:
- SENSOR DETAILS, (magnifier icon)
- CALIBRATION,
- REAL TIME measurement.



NOTE: The LowTuS device description contains "WIPER" if it is a premium version with an autocleaning system.

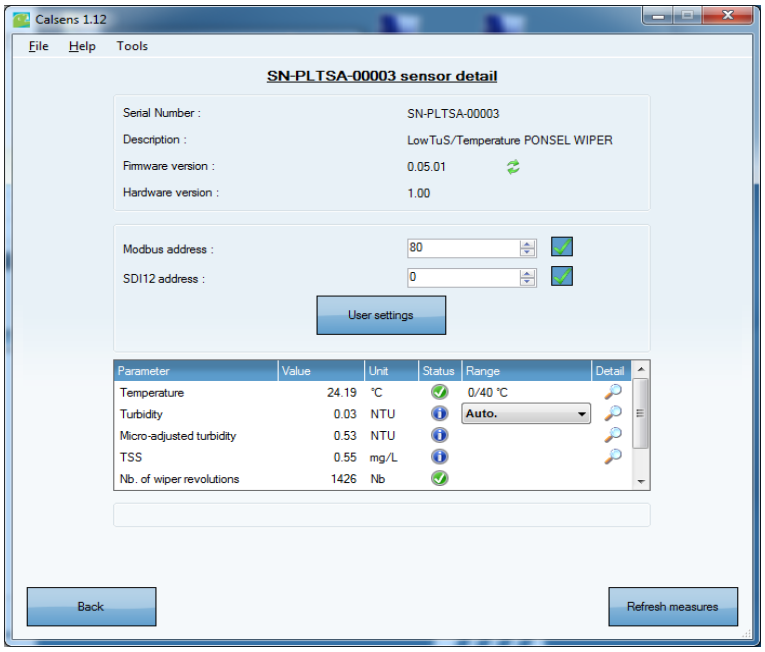
SENSOR DETAIL

This window contains 4 main aspects:

a) Description and versions,
b) Network address selection,
c) User settings button,
d) Manual measurement window with description of parameters, units, instantaneous values, and measurement status.

It enables occasional measurement of all available parameters during the device set-up phase.

For most of the parameters, a magnifier icon gives access to the calibration history and details.



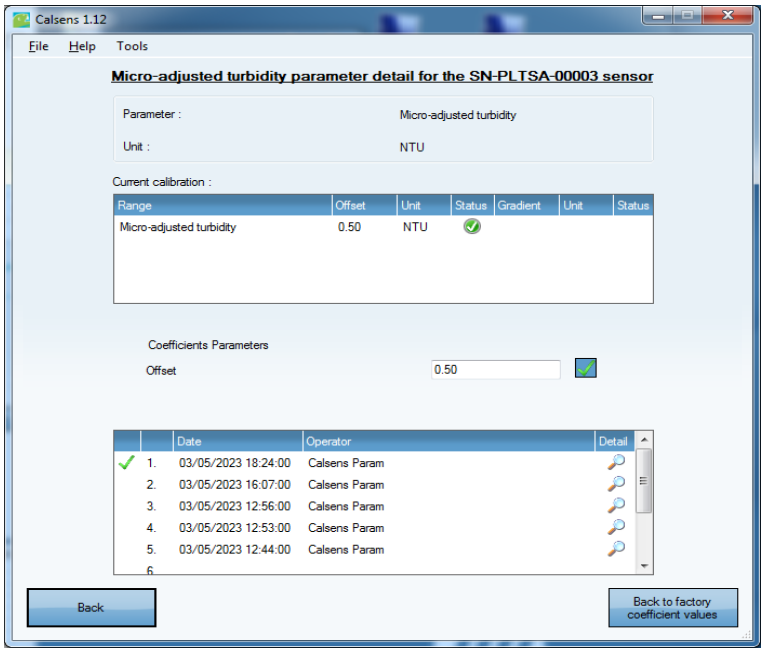
CALIBRATION DETAILS

The example to the right shows the calibration data of the micro-adjusted turbidity parameter.

Firstly, the currently used coefficients are displayed.

If the coefficients (offset; gradient) exist and are directly operator-defined, they can be modified.

If the coefficients are modified, then the current ones are updated and a new log is created.



USER SETTINGS

The LowTuS device user settings button gives access to the autocleaning system and power configuration.

The check mark "full power" allows the device to work in full energy consumption or in low consumption.

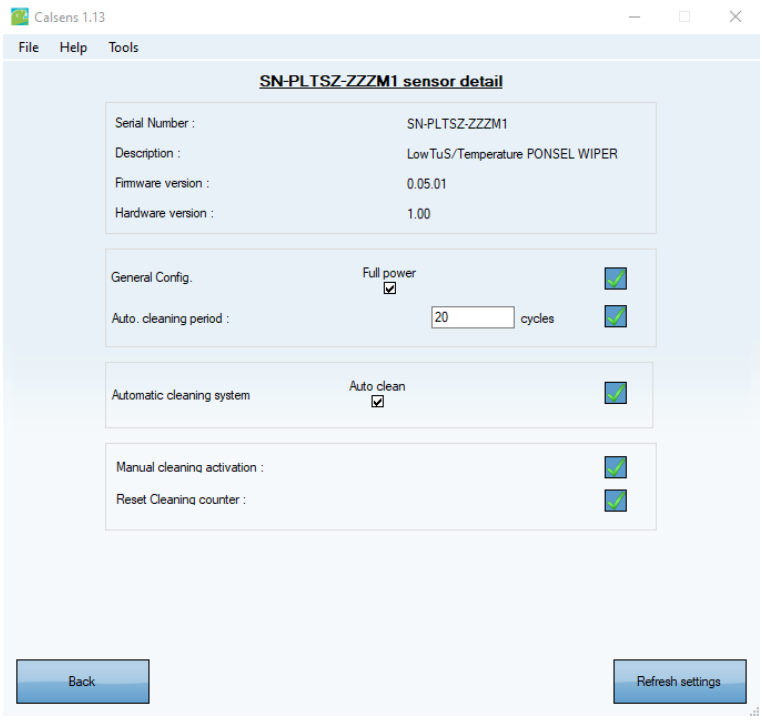
Then, there are 2 steps to define automatic cleaning:

Step 1: Configuration
The auto-cleaning process could be defined in terms of the “number of measurement cycles before the cleaning action”.

Step 2: Activation
The “Auto-clean” checkbox then enables automatic cleaning.

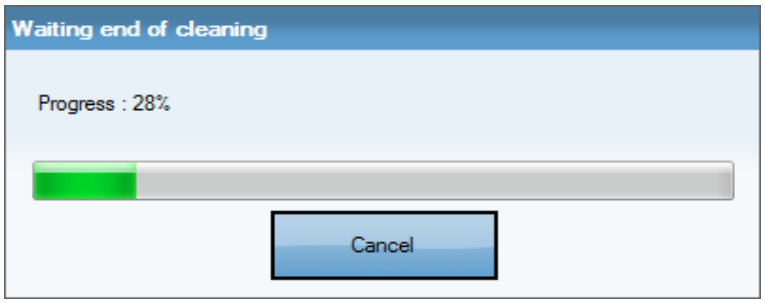
Furthermore, the user can, in maintenance sequence, freeze the cleaning periodicity, or manually generate one cleaning action.

During the life of the LowTuS device (premium version), the cleaning system’s rubber blade must be changed.
Simultaneously, the user must reset the cleaning counter.



AUTO-CLEANING SYSTEM

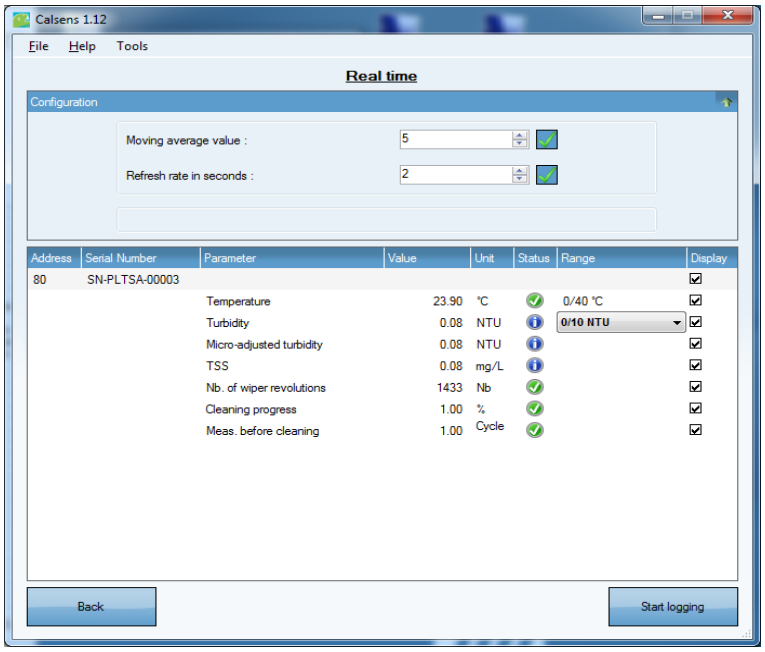
When the auto-cleaning system is activated, manually or following a per-configurated period, a pop-up window with a progress bar is displayed.



REAL TIME MEASUREMENT

For all DIGISENS sensors, the REAL TIME window gives access to a sliding average value and refresh rate for periodic measurement.

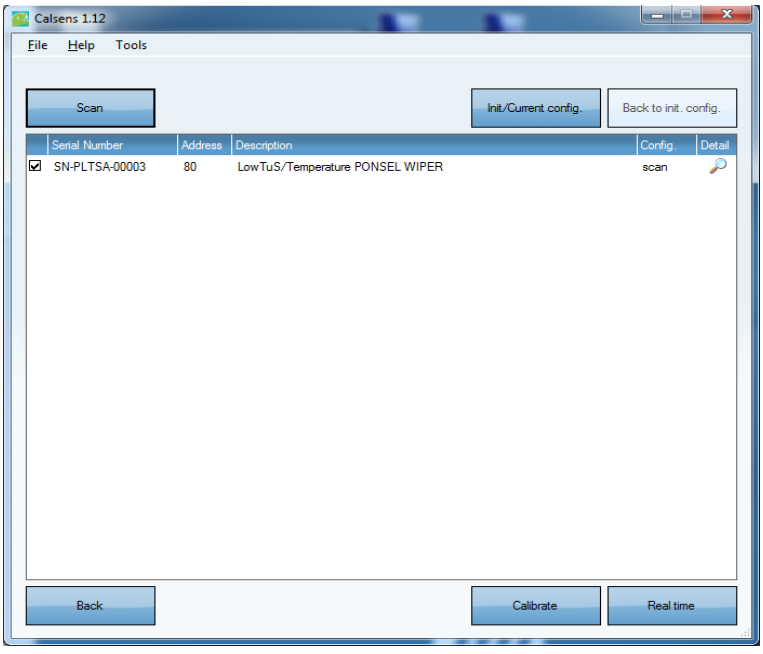
The operator can select parameters between the available list and load this selection in a named CSV file.



9.3 Calibration

9.3.1 General

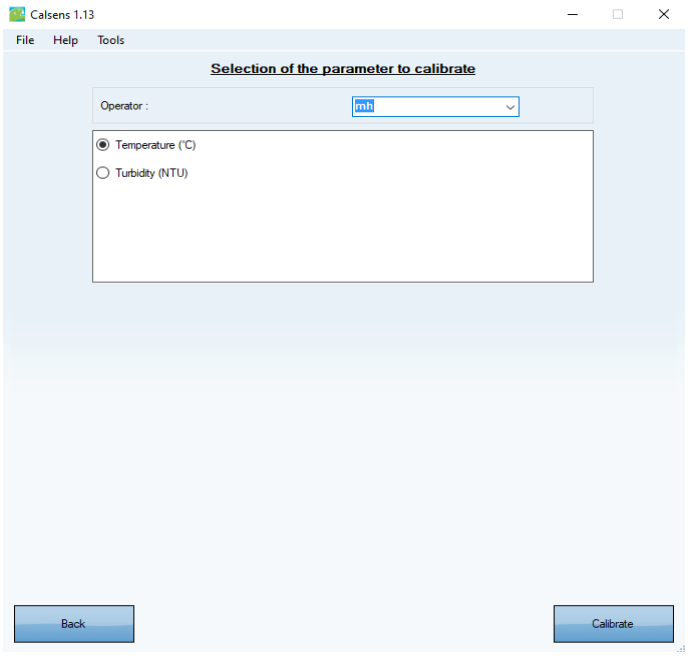
The calibration screen can be accessed from the main screen when one or more sensors are selected. Only selected sensors will be calibrated.



Most of the parameters can be calibrated in two steps: an offset and a gradient. All the calibration steps are made from the same model:
- A reference value has to be filled in. Often, there is a default value advised by Ponsel Mesure.
- The real time measurement for each parameter from each sensor is displayed to verify the stability and the validity.
- When the step is cancelled, the parameter selection screen appears, and the calibration is stopped.
- When the step is validated, the application checks the validity and the stability of the measurement. If the measurement is correct, the application displays the next step. If the measurement is invalid or not stable, the application displays a confirmation message. The user can either ignore the warning and go to the next step or stay in the current step to wait for the measurement to improve.

9.3.2 Parameter selection

The application automatically selects the common parameters from all the sensors. Multiple calibration can only calibrate one parameter at a time. The operator's name has to be filled in before running the calibration.



a. Fluid temperature parameter

Two-step sequence i.e. two distinct stabilized temperature conditions.
The operator must have a reference thermometer.

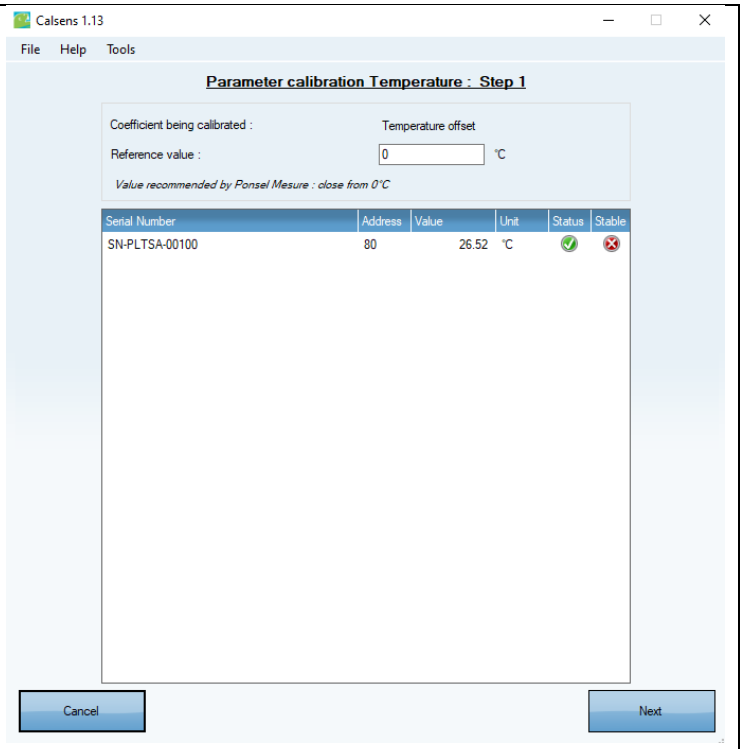
Temperature Calibration					
Etape/ Step	Nom Name	Paramètre / Calibrated Parameter	Description	Conditions opératoires/ Sensor conditions	Valeur étalon /Reference Input Value
1	Coef Offset T	Temperature	Offset (°C) (CTN)	Water T1	T1 °C
2	Coef Slope T	Temperature	Slope (%) (CTN)	Water T2	T2 °C

Step 1: Offset

Subject the unit to water circulation in stabilized low temperature conditions, fluid at T1.
The master sends requests for repeated measurements until a sufficiently stable measurement is obtained,
Write the temperature value T1 (°C), delivered by the reference equipment, in the "Reference value" box, related to the temperature offset.
The temporary offset coefficient generated by the sensor is activated for the next step.

Step 2: Gradient

Subject the unit to water circulation in stabilized upper temperature conditions, fluid at T2, significantly different from T1.
The master sends requests for repeated measurements until a sufficiently stable measurement is obtained,
Write the temperature value T2 (°C), delivered by the reference equipment, in the "Reference value" box, related to the temperature slope.
The slope coefficient is generated by the sensor.



Validation:
The coefficients generated by the sensor are considered to be temporary until final validation. The master does this by writing the operator's name and the date.

b. Turbidity parameter

Complete calibration is performed with a static solution of formazine.
1. Close the taps to isolate the cell from the fluid circuit
2. Open the lid
3. Open drain valve to empty the flow cell and close the drain valve.
4. Four 80ml to 100ml of clear water into the flowcell and open drain valve. Repeat 2 times step 3.and 4.
5. Clean the measuring cell with a clean cloth before calibrating to zero with demineralized water (Turbidity<0.1 NTU for range 0-10NTU)
6. After measurements and user validation of the first step of calibration process, open drain valve to change fluid.
7. Dry internal surfaces of measuring cell before addition of formazine standard.
and or formazine solution into the cell.

Generally, suitable formazine standard solutions are obtained by dilution of a mother formazine solution (known turbidity level near to 4000 NTU).

a) For example, 80 NTU turbidity standard solution, suitable for 0-100NTU range, is obtained from 4000NTU mother solution (known accuracy), using 5.00+/-0.03mL graduated pipette to introduce exactly 4mL of mother solution into a 200.00+/-0.15mL volumetric flask. Clear water (turbidity< 0.1NTU) is then added to obtain exactly 200mL of standard solution.
b) From the 80 NTU standard solution, ten times dilution gives 8 NTU formazine standard solution using 10.00+/-0.02mL volumetric pipette and a 100.0+/-0.1mL volumetric flask.

8. Then rinse the measuring cell with distilled water to remove any traces of Formazine solution and replace the top cover on the measuring cell.

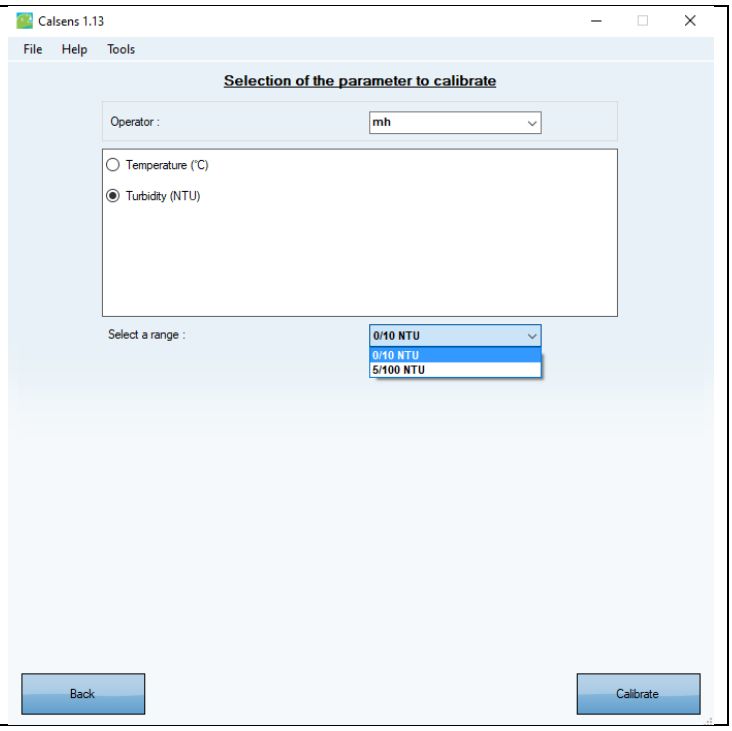
CAUTION:

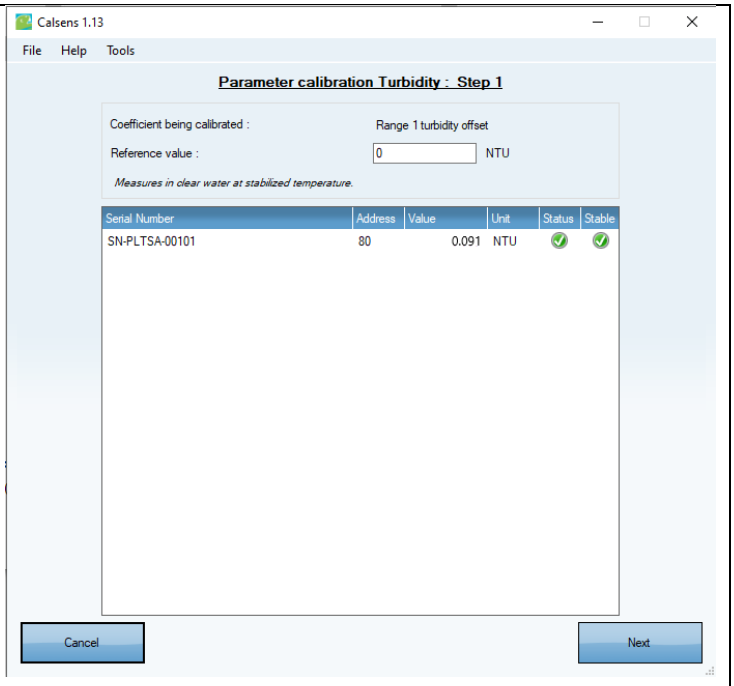
When replacing the module ensure the O-ring remains in the right position.

Turbidity Calibration					
Etape/ Step	Nom Name	Paramètre / Calibrated Parameter	Description	Conditions opératoires/ Sensor conditions	Valeur étalon /Reference Input Value
1	Coef Offset	Turbidity	Offset (NTU)	Demineralized water	< 0,5NTU (range 1 : 0-10 NTU) < 5 NTU (range 2 : 0-100 NTU)
2	Coef Slope	Turbidity	Slope (%)	Formazine solution	8 NTU (range 1) 80 NTU (range 2)

CAUTION:

The formazine solution must be discarded after passing through the cell

Select the Turbidity parameter and the range to be calibrated from the 2 available ranges	

Step 1: Offset Subject the unit to demineralized water. When the measurement is stabilized, write the turbidty value in the “reference value” box Step 2: Gradient Wipe the measuring cell with a clean cloth before adding a formazin solution. Subject the unit to a formazine solution. <u>Recommended concentration</u>: In range 1 (0-10 NTU): 8 NTU In range 2 (5-100 NTU): 80 NTU When the measurement is stabilized, write the turbidty value in the “reference value” box. The slope coefficient is generated by the sensor. Manually activate one revolution of the wiper, for the Premium version, to stir the solution before reading the standard value.	

Parameters with ranges

If a parameter is using ranges, it is important to note that only one range can be calibrated at a time. Consequently, a calibration log input matches the calibration of one range.

Calibration validation

When all the calibration steps have been validated, the full calibration summary will be provided to the user for each calibrated sensor. The summary displays the main information concerning the sensor and its calibration. The reference and coefficient values and their status are displayed as well. Real time monitoring, with the new coefficients applied, is given to validate the measurement.

The summary validation confirms the calibration. The coefficients are saved here or in the calibration log and replace the current coefficient values.

CAUTION:

At least 2 rinses are required before restarting the circulator and considering the measurement as valid.

9.4 Configuration of a micro-adjustment for the Turbidity parameter.

Micro-adjusted turbidity is an easy way to apply a small offset value to turbidity measurement. This positive or negative offset impacts only on the third parameter delivered by the sensor (1-temperature ; 2-calibrated turbidity ; 3-micro-adjusted turbidity).

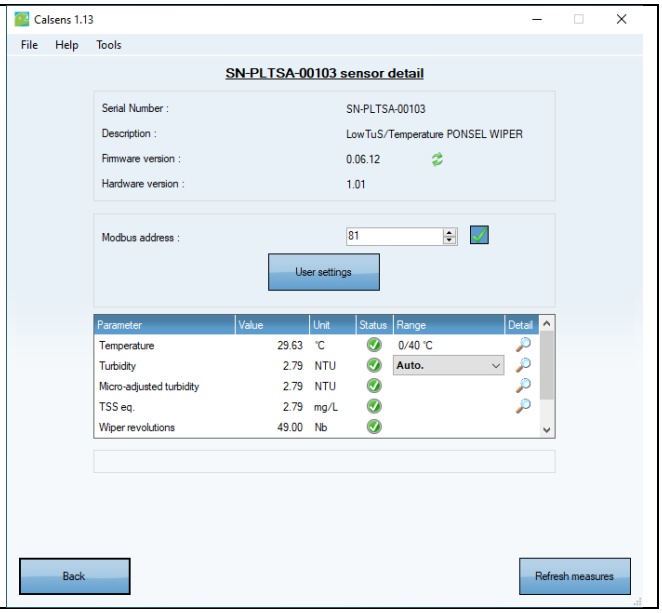
TURBIDITY **micro-offset adjusted**[parameter3] **= TURBIDITY** **main parameter**[parameter2] **+ user defined Micro-offset value**

This offset could be defined using an externally measured sample (laboratory turbidimeter, for example). This sample will be easily collected with the drain valve.

Example:
The current stabilised signal from Lowtus is 2.62 NTU.

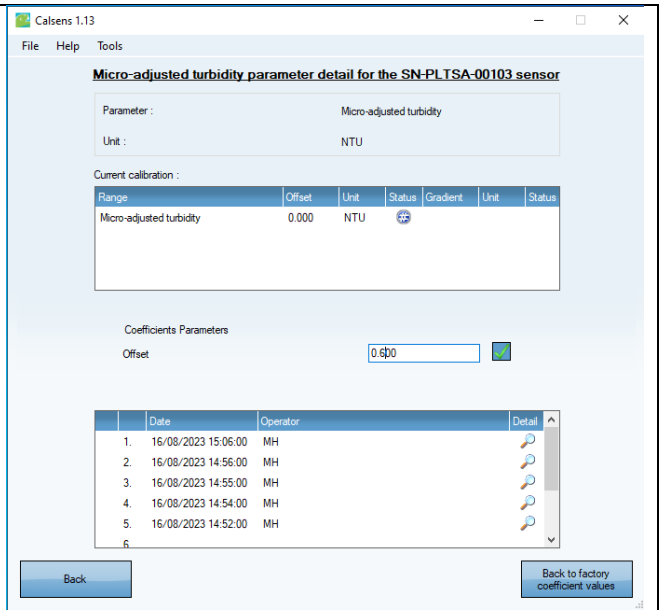
At least one sample (10mL or more), collected at the same time, has been analysed by a laboratory turbidimeter, considered as a reference device. The average laboratory result is 3.22 NTU.

Then, 3.22-2.62 = 0.60 offset could be applied to Lowtus to adjust the measurement to the punctual lab result.

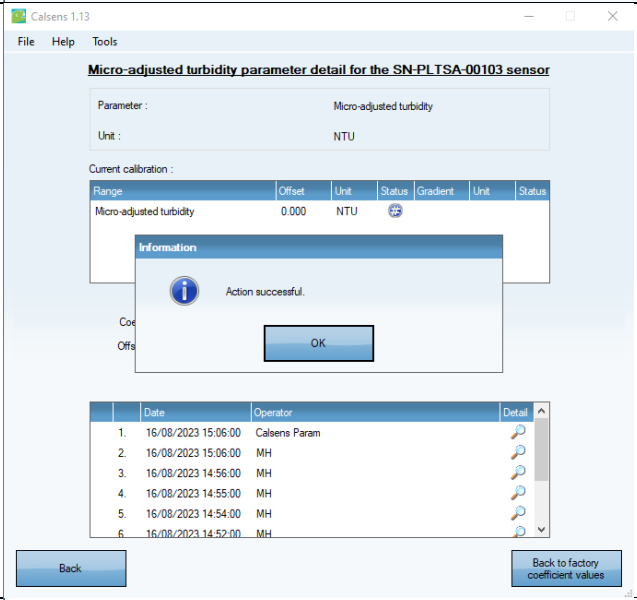
On the sensor details page, click on the magnifying glass on the “Micro-adjusted turbidity” parameter.	

On this page, enter the offset value to apply to the turbidity parameter before validating.

On this example, an offset of 0.600 NTU is applied.



When the parameter is validated, an information window appears with the message:" Action successful".

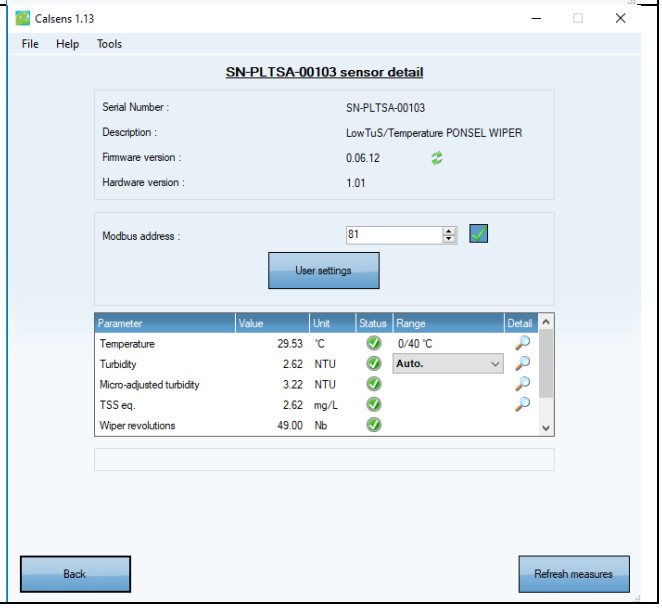


Return to the sensor details page and check the offset is well applied.

The micro-adjusted turbidity parameter (3) is increased by 0.600 NTU more than the parameter (2)Turbidity.

NOTE:
The parameter (2) remains the same. It is the base turbidity measurement. Parameter (3) is then an externally adjusted value linked to operator choice.

Calibration history function gives up to 10 timestamped information about micro-offset applied in the past (Metrologic monitoring of measurement).



9.5 Verification of the Turbidity parameter using the solid tare tool (PREMIUM version).

Each Premium device includes a signal control tool.

Figure 2 : Signal control tool with specific box for safe storage

The tool's principle of operation is to simulate light scattering at 90° as the particles of a known formazine solution. The designed tool operates in two positions, as to easily create two signals levels, minimum signal and one tailored value around 3NTU. Firstly, a quarter turn of the tool blocks the light path and allows "no light" configuration of the device. In a second step, a gain checking could be realized using the other position of solid-state tool. Each tool is factory defined related to formazine solutions in the serialized equipment.

- close fluid input valve,
- unscrew the 3 locking points of the flow cell lid,

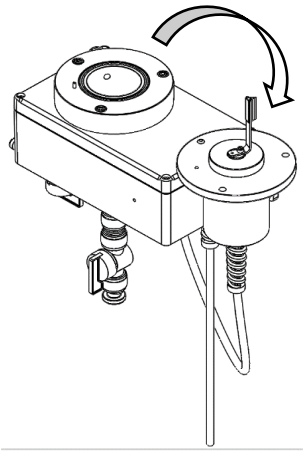
- Extract the lid from the flowcell with a vertical movement then put the lid on the lid holder pin.

- open drain valve,

- extract the tool from its box and check the optical parts. Clean it, if necessary, to remove dust, for example.

- Clean and dry the measuring chamber with clear water and a clean tissue before inserting the tool,

- air dry and check the internal surfaces of the flow cell.



Step 1: Dark position, zero "no light"

Step 2: Turn a quarter turn the tool to check the turbidity position, tailored value around 3 NTU

Signals analysis:

Step 1 turbidity (parameter-2) result is over 0.5 NTU = formazine calibration error (wrong measurement coefficients) or optic or electronic defaults.

Step 2 : signal drift or parameter-2 value is more than 4% of the value assigned on the tool, firstly check the control conditions (perfectly dried flowcell). if there is still a deviation of 4% from the declared value, a complete calibration with static solutions of formazine are required.

The quick check tool is an optical system. There is a specific box for safe storage.

Be sure to clean and then dry the measuring chamber with a clean tissue before inserting the tool. Residual humidity in the flow cell generates signal drift.

9.6 Configuration of the Turbidity parameter in mg/L.

Turbidity refers to the content of a fluid that disturbs its optical properties (reduced transparency). In streams, it is usually caused by suspended matter and colloidal particles that absorb, diffuse, or reflect light.
It is a basic indicator of water quality.
Nephelometric turbidity is based on the amount of 90° light scattered by the particles in a light exposed water column.

Turbidity in mg/L parameter provides the user with information on the concentration of suspended solids dependent on the main parameter.
The conversion law between Nephelometric turbidity and total suspended solid is user free. Based on samplings and TSS laboratory analysis, the user can then find and adjust a custom affine relationship, with offset and gradient coefficients, between nephelometric turbidity in NTU and particles concentration in mg/L for its installation.

$$TSS_{custom} = Gain_{TSS} \cdot TURBIDITY_{main\ parameter} + Offset_{TSS}$$