Smart NRG User Guide

October 2016

Trademarks and Patents

Smart NRG is a trademark of Blue I Water Technologies Ltd.

Patents issued and pending at the time of this printing

Disclaimer

Blue I Water Technologies Ltd. does not accept any responsibility for any damage caused to its products by unauthorized personnel. Use of non-Blue I Water Technologies' reagents and/or replacement parts will void all warranties.

ASTM CE UL FCC

Contents

Safety Instructions

General Safety Precautions

Use this product only in the manner described in this manual. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Utiliser ce produit uniquement de la manière décrite dans ce manuel. Si l'équipement est utilisé d'une manière non spécifiée par le fabricant, la protection fournie par l'équipement peut être altérée.

Smart NRG control board unit should not be opened except for initial installation and troubleshooting, and should only be opened by a trained and approved technician.

Le tableau de commandes de l'Smart NRG ne doit en aucun cas être ouvert si ce n'est lors de l'installation initiale et en cas de dépannage – auquel cas son ouverture ne doit être effectuée que par un technicien ayant reçu la formation adéquate et dûment habilité.

Only properly trained and licensed electricians should attempt to wire or service the electronic components of the analyzer/controller.

Attention! Seuls des électriciens qualifiés ayant reçu la formation adéquate peuvent entreprendre le branchement, l'entretien ou la réparation des composants électroniques de l'analyseur/du contrôleur.

There is an Electrical Shock Hazard when servicing this system.

Il existe un risque de choc électrique lors de l'entretien de ce système.

Always verify that all electrical power source(s) are off before opening the analyzer/controller unit or attempting to service electronic components or wiring.

Ayez soin de toujours vérifier que la ou les source(s) d'alimentation électrique est ou sont bien déconnectée(s) avant d'ouvrir l'unité ou d'entreprendre toute opération de service technique et tout branchement des composants électroniques.

Extreme caution should be used when installing, operating, and maintaining the Smart NRG controller. Only properly trained technicians are authorized to install and maintain the analyzer/controller.

Il y a lieu d'agir avec une extrême prudence lors de l'installation, de la mise en œuvre et de la maintenance du contrôleur Smart NRG. Seuls des techniciens dûment formés à cet effet sont autorisés à effectuer l'installation et la maintenance de l'analyseur/du contrôleur.

Only properly trained and licensed operators should attempt to make any changes to chemical dosing levels.

Seuls des opérateurs qualifiés ayant reçu la formation adéquate sont habilités à modifier les dosages des produits chimiques utilisés.

Always follow local health and safety regulations when performing any service on the analyzer/controller unit or when changing chemical dosing settings.

Conformez-vous sans exception aux consignes locales de santé et de sécurité lorsque vous effectuez toute opération technique sur l'analyseur/le contrôleur, ou lorsque vous modifiez les paramètres de dosages chimiques.

Proper Handling of Batteries

Do not use sharp objects to remove or insert batteries.

Do not mix Lithium batteries with alkaline batteries.

Replace batteries only with similar batteries or equivalent power.

Verify that the exposed tips of the battery compartment wires do not touch to avoid short circuit.

Lithium batteries are **dangerous goods**, and can pose a safety risk if not prepared and shipped in compliance with international transport regulations.

Mishandling of the batteries may cause explosion.

Do not expose the batteries or the pack to direct sunlight, heat, or fire.

Do not use damaged batteries.

Do not get the batteries wet. Water can cause the batteries to overheat.

Dispose of the batteries only in battery recycling facilities.

Proper Handling of the Electrodes

Do not swallow the electrolyte. Avoid electrolyte contact with skin or eyes. In case of accidental contact, wash with a lot of cold water. In case of eye inflammation, contact a doctor immediately.

Wear safety glasses and gloves when working with the electrolyte solution.

N'avalez pas de substance électrolyte. Evitez tout contact de l'électrolyte avec la peau ou les yeux. En cas de contact accidentel avec cette substance, rincez abondamment à l'eau froide! En cas d'inflammation oculaire, consultez immédiatement un médecin.

Portez des lunettes et des gants de protection lors de la manipulation de la solution électrolyte.

Do not touch or damage the electrodes. The electrolyte is sensitive to oxidation: Always keep the electrolyte bottle closed after use.

Do not transfer the electrolyte to other containers.

The electrolyte should not be stored for more than one year and should be clear (not yellow) in appearance (for use by date, see label).

Ne touchez pas ni n'abîmez les électrodes. L'électrolyte est sensible à l'oxydation. Maintenez la bouteille contenant l'électrolyte toujours fermée après utilisation. Ne transvasez pas l'électrolyte dans d'autres récipients. L'électrolyte ne doit pas être conservé plus d'un an et doit garder une apparence claire (pas jaunâtre) (pour la période d'utilisation, voir l'étiquette).

Avoid forming air bubbles when pouring the electrolyte into the measuring chamber.

Evitez la formation de bulles d'air en versant la solution électrolyte dans le compartiment de dosage.

1

Introduction

Smart NRG is a low energy, self-powered water quality analyzer system designed specifically for performing measurements at hard to reach places along the water distribution network often without electricity or communication.

Housed in two IP67 waterproof and UV resistant casings and using a built-in battery pack, the system provides municipals periodic or on-demand, continuous, and reliable measurements of the following parameters simultaneously:

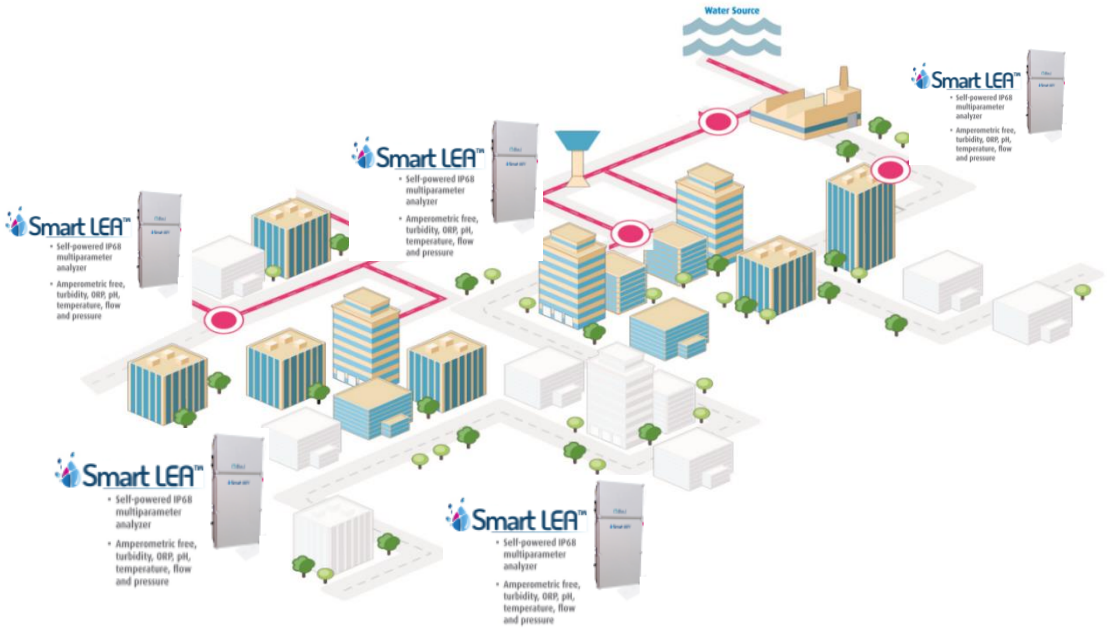
- Free Chlorine
- Turbidity
- pH
- Redox
- Conductivity
- Pressure
- Flow (internal flow meter)
- Temperature

Measurements data is stored locally and also transmitted via cellular communication to a web-based application allowing you to review measurement results, alerts, and modify settings anywhere anytime.

1.1 Overcoming the Urban Challenge

Even in urban places where power supply and communication are at reach, the main barrier of real-time, online water quality monitoring is the high cost of the monitoring station itself.

The Smart NRG system eliminates the cost of the monitoring station.



1.2 Functional Overview

Free Chlorine Measurement	
A passive-operated sensor with gold cathode and silver chloride anode. The system applies a low voltage 20mV to the sensor keeping it in measurement-ready stat at all times and preventing from entering sleep mode when it is not measuring.	• Measurement range: 0 – 2 ppm or 0 – 10 ppm • Resolution: 0.01 ppm • Repeatability: 1% span
Conductivity Measurement	
A k=1 cell constant conductivity sensor. Low current components in the electronic board enable the sensor to measure using low power, and to continue measuring while the battery enters end of life period.	• Measurement range: 20 to 5000 µSim • Accuracy: 2 – 4% Measure Value • Resolution: 1 µs • Repeatability: 0.01

Turbidity Measurement	
A white light nephelometry (90° and 180°). The turbidity sensor is a proprietary design of Blue I. Low current components in the circuit enable the sensor to measure using low power, and to continue measuring while the battery enters end of life period. Bubble removal and cleaning is done automatically by an internal mechanism.	• Measurement range: 0 to 20 NTU • Accuracy: 2 – 4% Measure Value • Resolution: 0.001 • Repeatability: 0.01
pH Measurement	
Provided by a ceramic diaphragm and gel filling electrode.	• Measurement range: 0 to 14 • Resolution: 0.01 pH • Repeatability: 0.01
Redox Measurement	
Provided by a ceramic diaphragm and gel filling sensor.	• Measurement range: 0 to 2000 mV • Resolution: 1 mV • Repeatability: 0.01
Temperature Measurement	
Provided by a PT-100 sensor.	• Measurement range: 0° C to 100° C • Resolution: 0.1° C • Repeatability 0.1
Flow Measurement	
Provided by a pulse sensor (not provided)	• Measurement range: Adaptive • Accuracy: 3-5% Measure Value • Repeatability: 0.01
Pressure Measurement	
Provided by a pressure membrane.	• Measurement range: 0 to 10 bar (0 to 145 psi) • Accuracy: 3% Measure Value • Resolution: 0.05 bar (0.72 psi)

1.3 System Overview

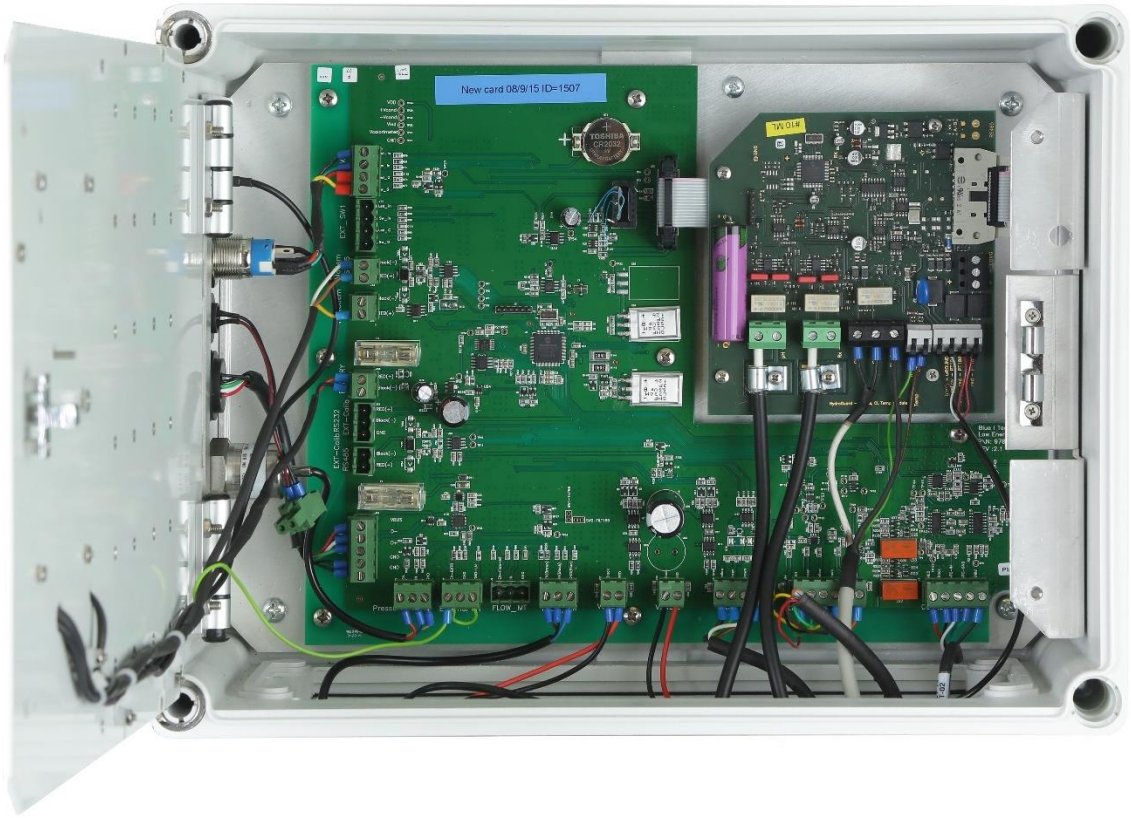
The Smart NRG water quality analyzer is composed of the following modules:

1.3.1 Electronic Board Module

The electronic board controls the activity of the system. The board is designed to manage all measurement with low power consumption and to save water usage by flowing water into the system only when measurement is performed.

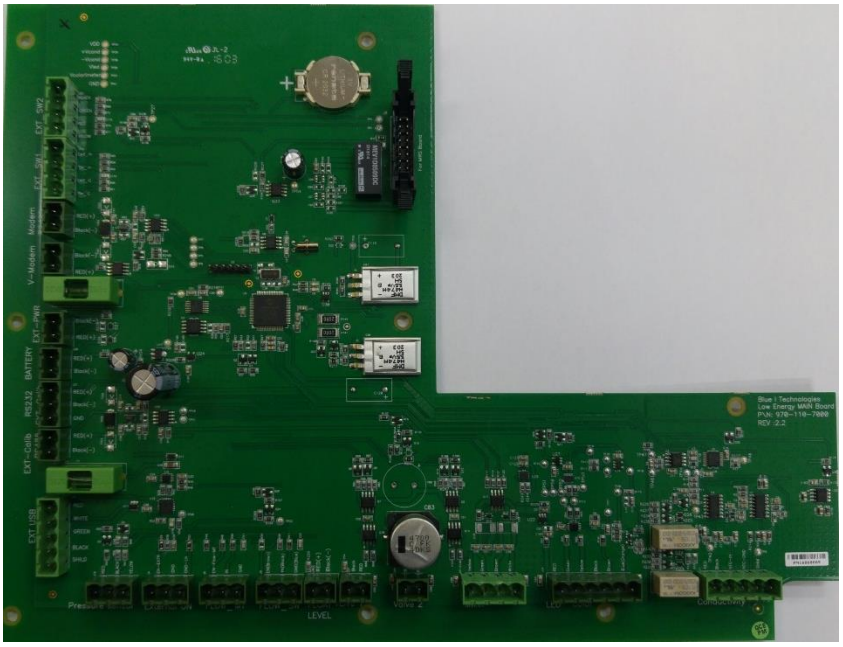
A USB port allows you to connect a PC to the board for setup, calibration, status information, and data download.

The board stores measurements and status information locally and transmits the information via a modem per your configuration.



1.3.2 Sensors Board Module

The sensors board controls the electrical connection to the sensors, value readings, calibration curves, reading conversion. The pH, redox, and temperature sensors consume low power during regular operation and can go into standby mode immediately when not measuring. Low current and low voltage (up to 7 Volt) components in the circuit enable the free chlorine, conductivity, and turbidity sensors (high power consumption) to measure using low power and to extend their operation into the end-of-life period of the battery.

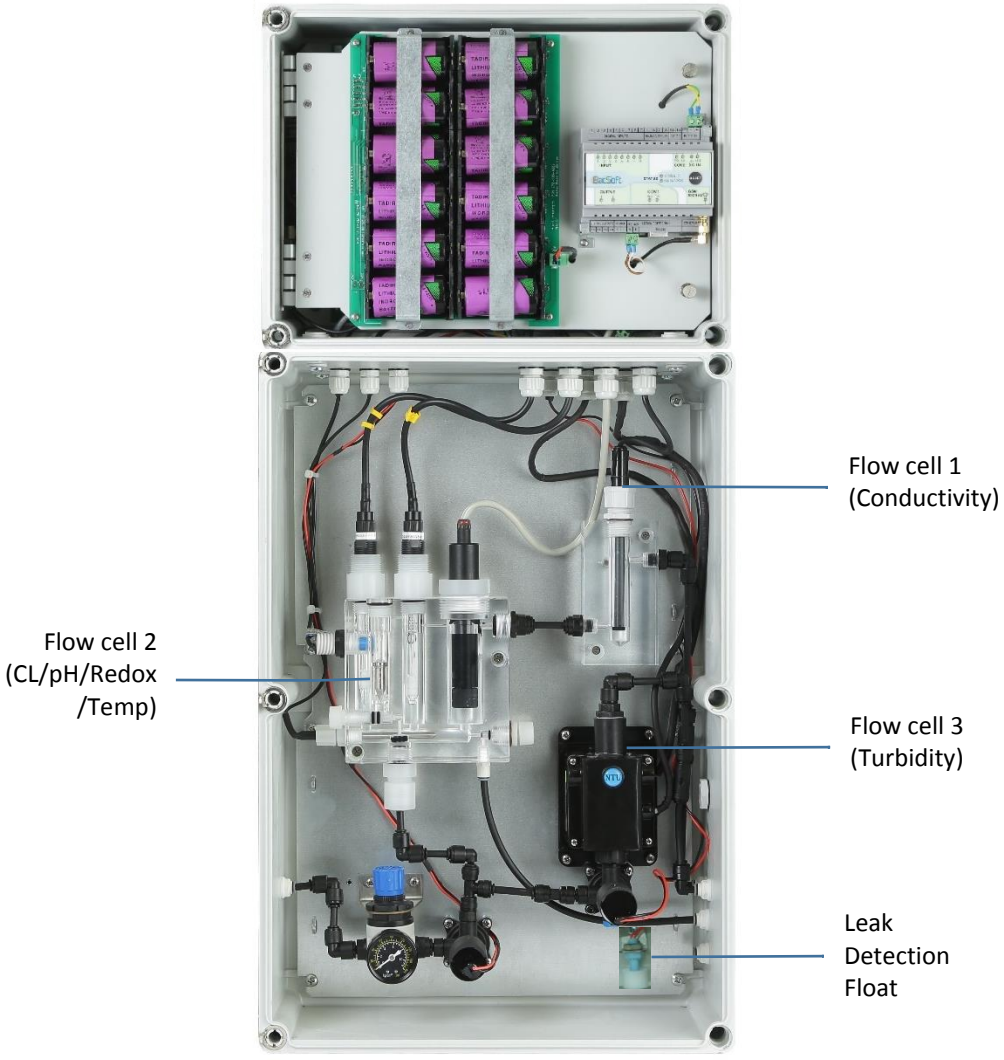


1.3.3 Flow Cells

The system includes three flow cells:

- **Flow cell 1** – holds the conductivity sensor. The cell is designed to enable fast temperature balance between the water temperature and ambient temperature.
- **Flow Cell 2** – holds the free chlorine, pH, redox, temperature, and flow sensors. Water flows into the cell only when measurement is scheduled. The water flow is indicated by the inductive sensor. To save power, the sensors perform measurements only when water flow is indicated.

  The cell's water flow is 35 liters/hour. Water pressure to the cell must be adjusted to 0.5 – 1 bar.
- **Flow cell 3** – specifically designed to hold the turbidity sensor and features automatic cleaning and a water outlet for manual cleaning. The cell's open design enables air bubbles escape from the cell and ensures accurate measuring with minimal maintenance.



1.3.4 Automatic Leak Detection

The Smart NRG system is equipped with a sensor connected to a float. In case water leaks inside the controller casing, the float, which is located at the bottom of the casing, rises and the sensor identifies the leak. The sensor will send an alert to the operator via SMS or email and will close the main valve.

1.3.5 Battery Pack

The battery pack includes 12 X 3.6 V Lithium Thionyl Chloride, size D batteries with prolonged life span (compared with Lithium batteries under the same conditions).

Technical data for one battery in pack:

Nominal capacity at 4 mA, to 2 V	19 Ah
Rated voltage	3.6 V
Rated current	9V DC Voltage (maximum current 1A, Average current 0.2A) AC according to Local Standards
Maximum recommended continuous current	230 mA
Maximum pulse current capability	500 mA
Weight	93 g (3.28 oz.)
Volume	51 cc
Operating temperature range	-55° C to +85° C
Li metal content	approx. 5 g
U.L. Component Recognition	MH 12193

Hazardous Materials.

Lithium batteries are **dangerous goods**, and can pose a safety risk if not prepared and shipped in compliance with international transport regulations.

For more information, refer to the International Air Transport Association's *Dangerous Goods Regulations (DGR)* for Lithium batteries.

1.3.6 Shipping of Lithium Batteries

Worldwide besides the United States – TL-5930 cell and its finishing versions are subject to the Dangerous Goods Regulations, and thus shall be transported as Class 9. The cells must be packed in accordance with Special Provisions / Packing Instructions of the applicable code, e.g., IATA/ICAO (Packing Instructions: PI968, PI969 and PI970), IMO (SP188) and ADR (SP188). It is necessary to refer regularly to regulation changes under UN number 3090 (lithium metal batteries) and UN 3091 (lithium metal batteries packed with or in equipment).

Transportation within, to and from the US - Parts 171, 172, 173 and 175 of US-DOT CFR 49 are governing the transportation of lithium cells and batteries. TL-5930 cell is defined as "Medium lithium cells and batteries" and they detail the required packaging and labels when transported separately or in/with equipment.

1.3.7 Fuse Type (F1, F3)

Fuse Holder – WURTH ELEKTRONIK 696108003002 FUSE HOLDER, 5X20MM, PCB. The 696108003002 is a 10A 250VAC cartridge Fuse Holder with PA6/66 insulator, matt tin over nickel contact plating, copper alloy contact and PCB-mounting and through hole holder terminals.

Fuse Holder CUP – PA6/66 FLAMMABILITY RATING: UL94V0 COLOR: GREEN ENVIRONMENTAL OPERATING TEMPERATURE: -30°C UP TO +120°C COMPLIANCE: LEAD FREE AND ROHS PACKAGING BOX ±0,1 MECHANICAL FUSE-LINK: 5x20 mm

1.3.8 CR2032 Battery

Nominal voltage (V):	3
Nominal capacity (mAh):	225
Continuous standard load (mA):	0.2
Operating temperature (C):	-30 ~ +60

2

Installation

2.1 Site Preparation and Working Environment

The system's IP 67 water-proof and UV resistant housing enables outdoor or indoor installation at areas which are prone to wetness and moisture. In urban areas, we recommend installing the system inside a locked cabinet to prevent unauthorized access and vandalism.

The system working environment is as follows:

Pollution Degree: 2

Installation Category: 2

Altitude: 2,000 m

Humidity: 1 to 90% non-condensing

Temperature: 0.5° C to 55° C (35° F to 131° F)

2.2 Verifying the Smart NRG Controller Parts Received

The Smart NRG controller is shipped in a cardboard carton, secured with foam packing material. A packing list is included in each shipping carton. Check the components in the shipping carton against the items on the packing list. If any part is missing, contact your Smart NRG distributer.

The following table details the Smart NRG components and their quantities.

Component	Quantity	Part Number
Controller	1	Smart NRG
Antenna	1	
Mounting brackets (in a bag)	8	970-110-8006
pH electrode	1	970-210-0104
Redox electrode	1	970-210-0105
Chlorine electrode	1	970-210-8002
Chlorine membrane	1	970-210-8002
Signed Warranty Certificate	1	970-210-8092
QC Check Document	1	
6 mm pipe (10 meters)	1	
3.6 V Lithium Thionyl Chloride, size D battery	12	

2.3 Installing the Controller

2.3.1 Plumbing Requirements

- A 6 mm pipe equipped with a valve for maintenance purposes.

  It is recommended to connect the water inlet pipe at the bottom of the main line to minimize air entering into the system.

- The 6 mm water inlet pipe should not exceed 10 meters.

  If you use a longer line (above 3 meters), make sure to adjust the **Delay before Measurement** parameter accordingly (see “Setting Status Mode Parameters” on page 36).

- A pre-filter is recommended but not mandatory. A fitting is supplied for 6mm (1/4”) tubing.

  Install the filter before the water inlet to the system.

- Installing an air valve is recommended to reduce air bubbles in the system (affect the turbidity measurement). Install the air valve before the water inlet to the system.

- The customer is responsible to install a flow meter on the main line and connect it to the controller external flow meter inlet (see “Wall Mounting” on page 17).

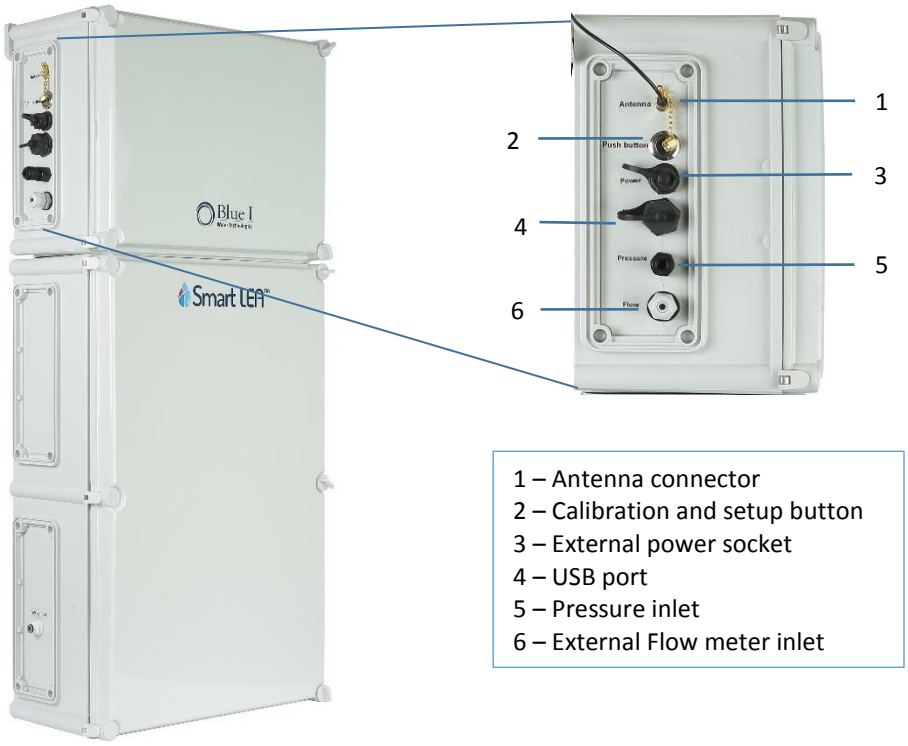
2.3.2 Wall Mounting

1. Use the provided mounting brackets as a drilling template to mark the drilling holes from each side of the system. Drill the holes using an 8 mm drill.

2. Fasten the unit to the wall using the mounting brackets at the back of the unit.
3. Verify that the unit is installed upright at 90° vertical to the ground. Any sideways or back/forward tilt may impair the function of the system.

   The system is equipped with a tilt sensor. If a tilt is detected, the sensor sends an alert. Make sure to address the issue and fix the tilt.

4. Unscrew the antenna connector cap and connect the provided antenna.



1 – Antenna connector
2 – Calibration and setup button
3 – External power socket
4 – USB port
5 – Pressure inlet
6 – External Flow meter inlet

5. Attach the antenna to a metal object or place it on top of the controller.
   Position the antenna away from any signal obstruction in front of the antenna.

6. To connect an external flow meter, feed the cable of the flow meter through the inlet and connect it to the **FLOW_MT** terminal block.

   We recommend using the **fl1400-13 Paddle Wheel** flow sensor from Create Instruments Technologies Co., Ltd.

   A 5-meter cable is provided with the sensor and is connected in the following way:

   - Red wire connects to **EN_Flow_MT**
   - Yellow wire connects to **IN**
   - White wire connects to **GND**

2.3.3 Installing the System in a Cabinet

In urban areas, it is recommended to install the system inside a locked cabinet.

Cabinet requirements:

- The cabinet must be equipped with at least two fitting panels, one for the top mounting ears and one for the middle or bottom mounting ears.
- One water inlet hole on the cabinet left side.
- Three water outlet holes on the cabinet right side.
  The holes should be aligned with the Smart NRG water inlet and outlets.

▶ To install the system in a cabinet

1. Use the provided mounting brackets as a drilling template to mark four drilling holes in the affixing panels (two holes for each panel) and drill the holes using an 8 mm drill.
2. Fasten the unit to the panels using the mounting brackets at the back of the unit.

3. Verify that the unit is installed upright at 90° vertical to the ground. Any sideways or back/forward tilt may impair the function of the system.

The system is equipped with a tilt sensor. If a tilt is detected, the sensor sends an alert. Make sure to address the issue and fix the tilt.

The following figure shows a typical cabinet installation.

4. Unscrew the antenna connector cap and connect the provided antenna.
5. Place the antenna outside the cabinet. If possible, attach the antenna to a metal object and keep it further from any signal obstruction in front of the antenna.
6. To connect a flow meter, see “Wall Mounting” on page 17.

2.4 Setting up the System for First Use

Setting up the system includes the following steps: insert batteries, connect water inlet and outlets, and adjust the water inlet pressure.

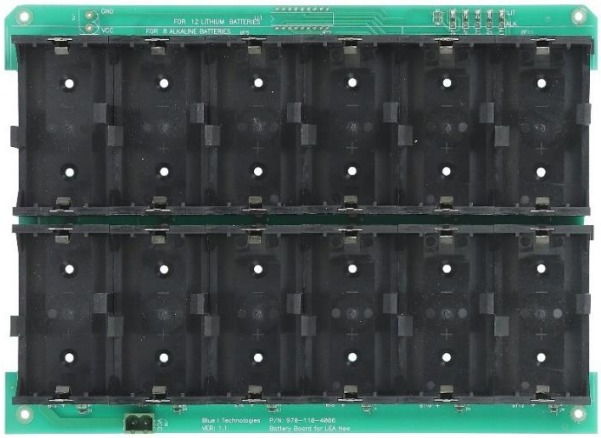
2.4.1 Inserting Batteries

The Smart NRG controller is supplied with a pack of 12 x 3.6 V Lithium Thionyl Chloride, D size batteries. The pack is provided in a separate box for safety reasons. The system supports the following batteries, which have been proved to provide energy and low self-discharge rate required in this application:

- Tadiran TL-5930 – Catalog Number: TL5930/S
- Varta – Catalog Number: 7120.101.511

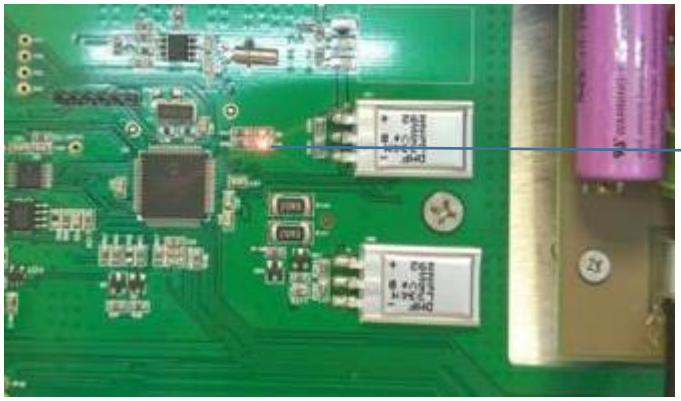
▶ To insert batteries:

1. Unlock and open the top enclosure door.



2. Remove the clamps and insert the provided batteries while making sure they are placed in the right direction.
3. Fasten the batteries clamps as shown in the figure below:

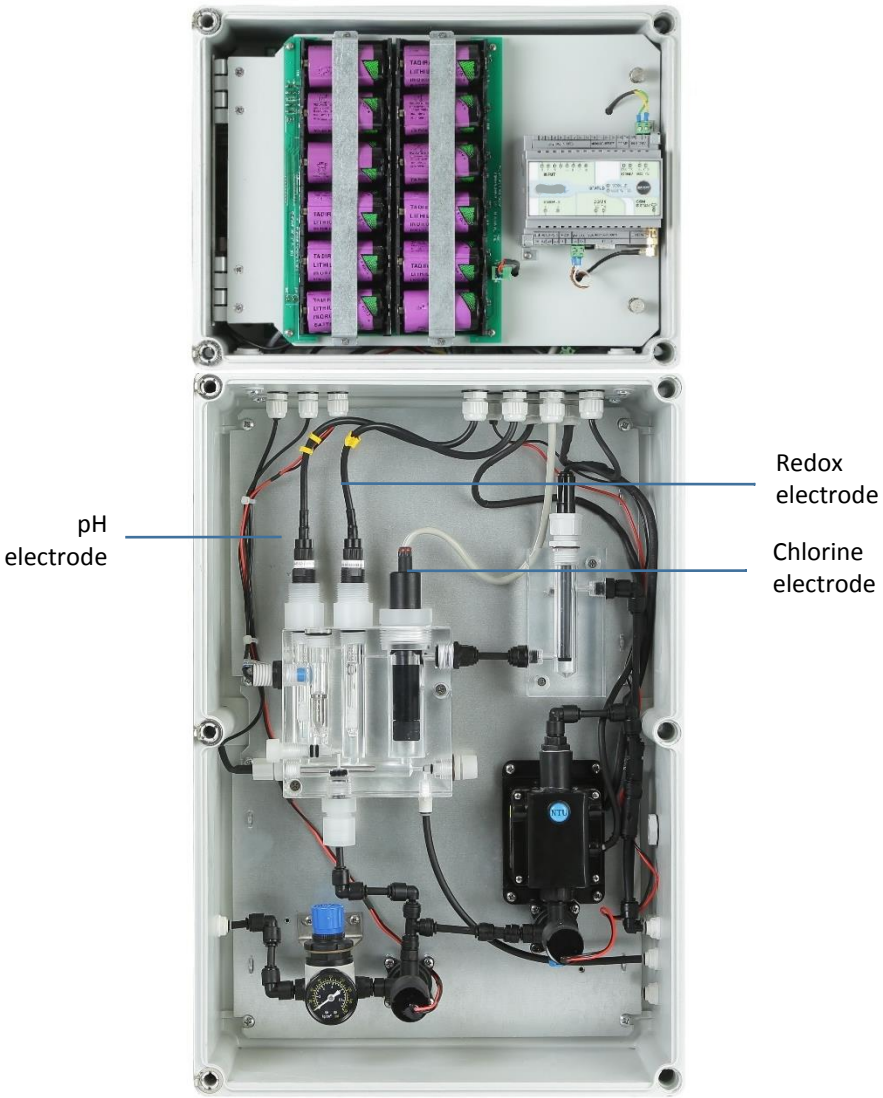
4. Close the top enclosure door.
5. Connect the batteries connector and verify that a red LED is turned on in the electronic board.



2.4.2 Connecting the Electrodes

The Free Chlorine sensor is supplied from the factory pre-filled with electrolyte solution and does not require filling for first time operation.

1. Remove the Chlorine electrode from its packaging, remove the yellow covering, and insert it to the right holder and hand-tighten the cap.
2. Remove the Redox electrode from its packaging, remove the silicon cap and insert into the left holder.
3. Screw the cable labeled RX and hand-tighten.
4. Remove the pH electrode from its packaging, remove the silicon cap and insert into the middle holder.
5. Screw the cable labeled PH and hand-tighten.



2.4.3 Connecting Water Inlets and Outlets

Water pressure before the water inlet to the unit should not exceed 10 Bar. Inside the unit, the system requires a pressurized water supply to the flow cells. The pressure must be adjusted between 0.5 to 1 Bar (14.5psi).

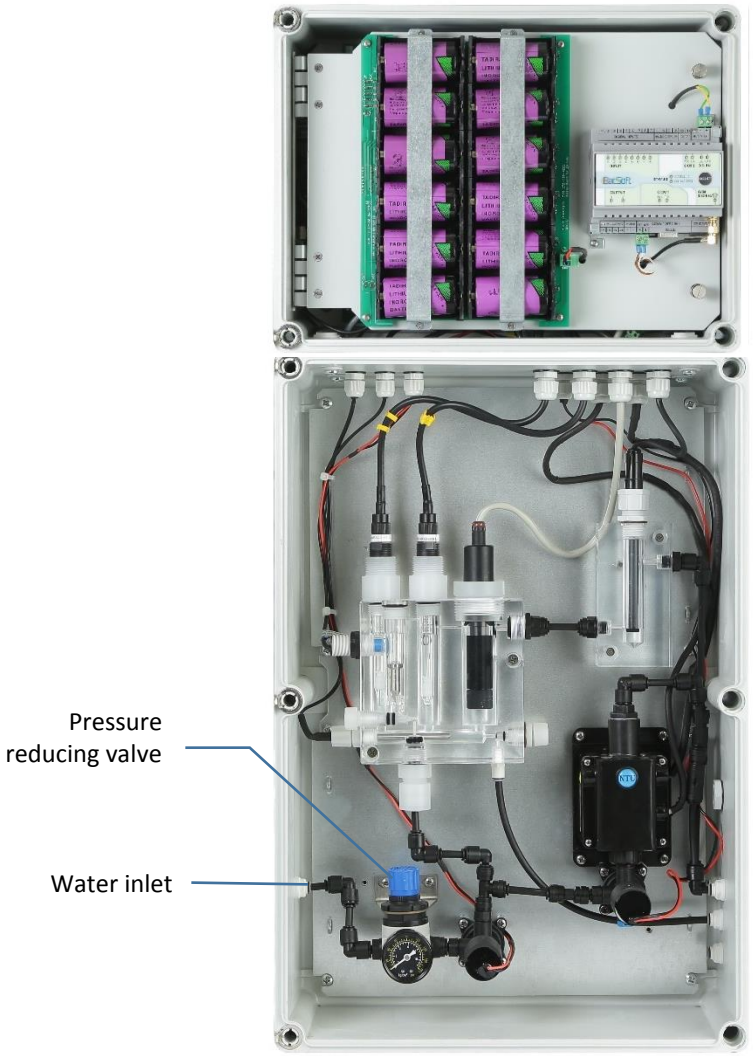
Maximum pressure reaching to the pressure reducing valve should not exceed 1 Bar.

After connecting water to the system, allow the system to operate for **24 hours** before performing calibration for the first time.

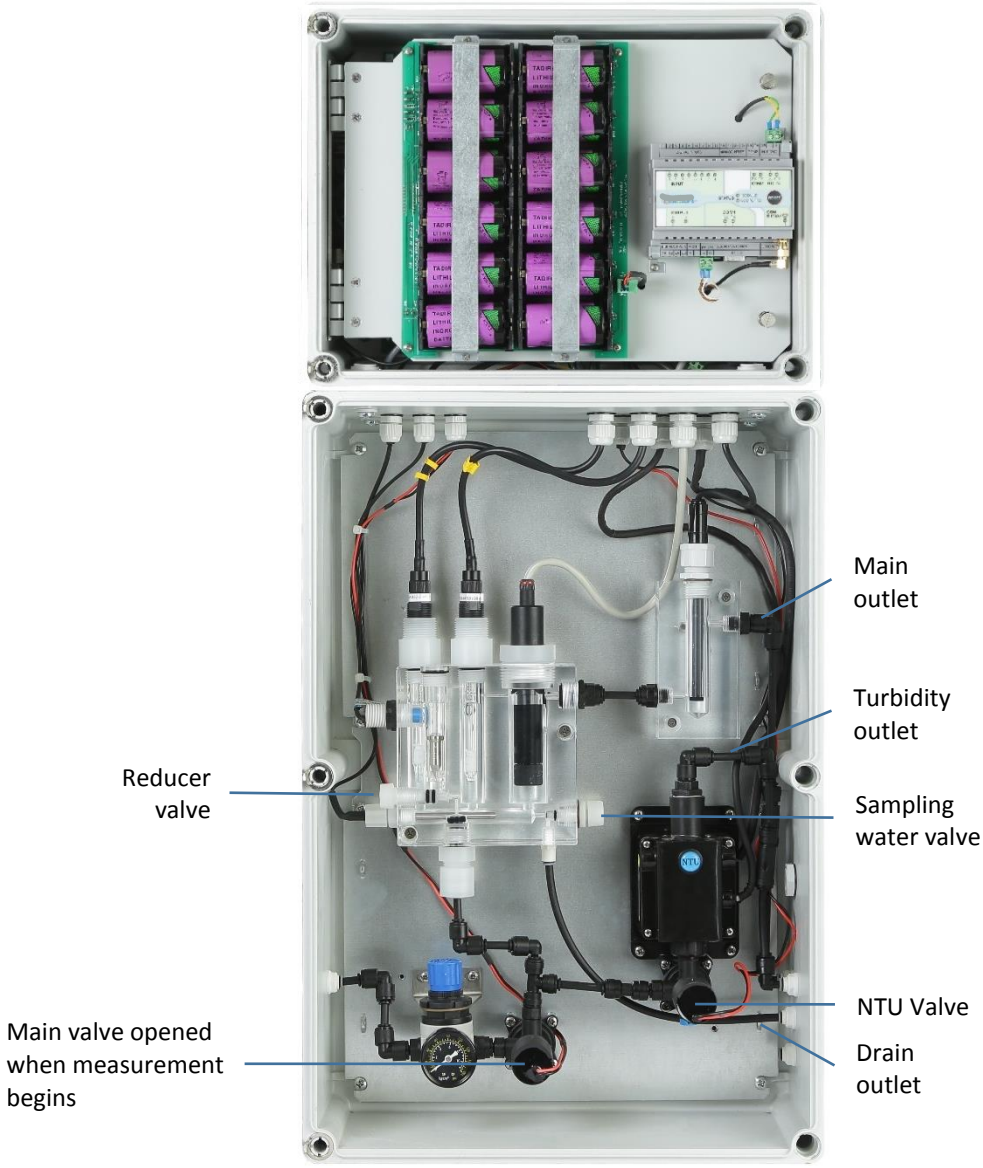
1. Lead the 6 mm water inlet pipe through the hole at the **bottom** left side and connect it to the Main valve.

   Water inlet pipe should not exceed 10 meter and the water pressure should not exceed 10 Bar.

2. Adjust the water pressure (0.5 – 1 bar) inside the unit by opening or closing the pressure reducing valve as required.



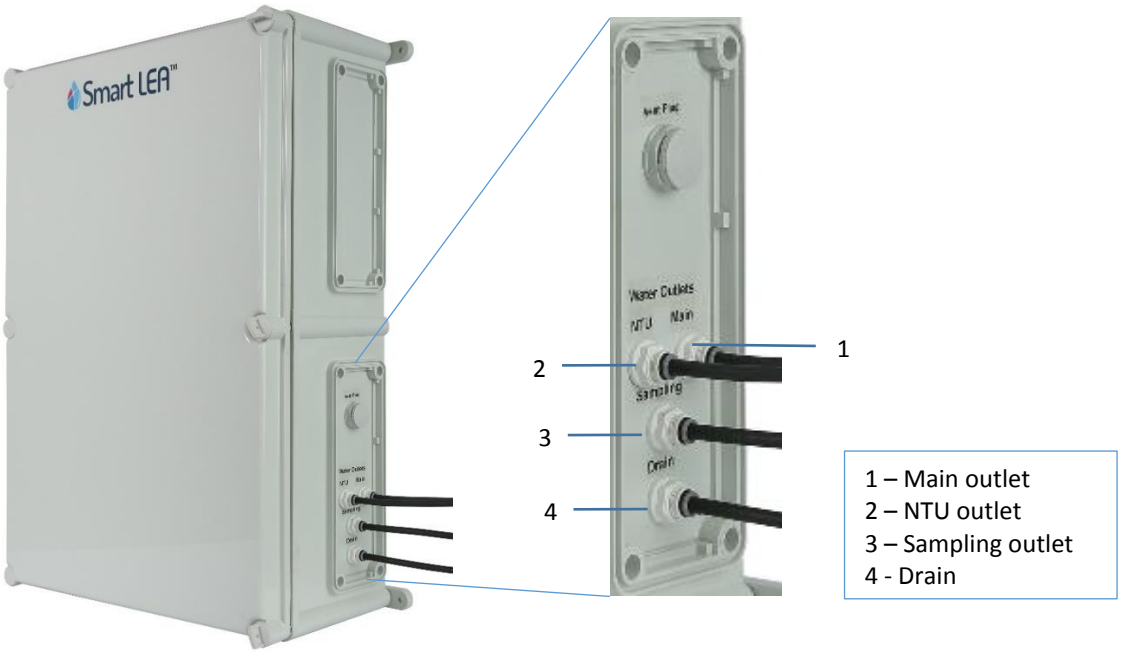
3. Connect 6 mm pipes to the Main, Drain, and Turbidity water outlets:



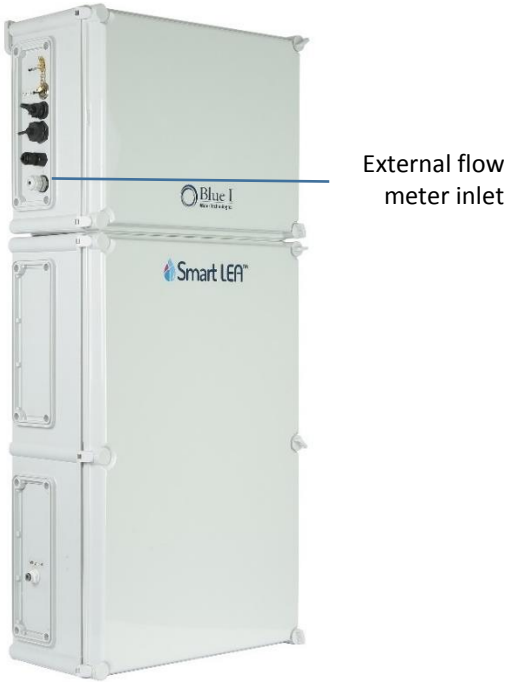
There are mechanical valves for both the Main and NTU solenoids. Make sure that the mechanical valves are always set to Auto.

The Drain outlet can be used to collect a water sample from the flow cell for calibration purposes using external tools.

4. Lead the pipes through the holes on the right side:



5. Adjust the reducer valve to **align** the metal part with the inductive flow sensor.
6. From a water meter installed on the main line, connect a 6 mm pipe to the water meter inlet.
   The customer is responsible to install the water meter on the main line.



3

Operation and Configuration

For first time operation, use the PC software to configure the controller by connecting to it locally through the USB port. Subsequent operation and monitoring can be down via the web application.

If the system is installed with a Backsoft modem, you can configure Alarms and Turbo mode in the Backsoft remote application.

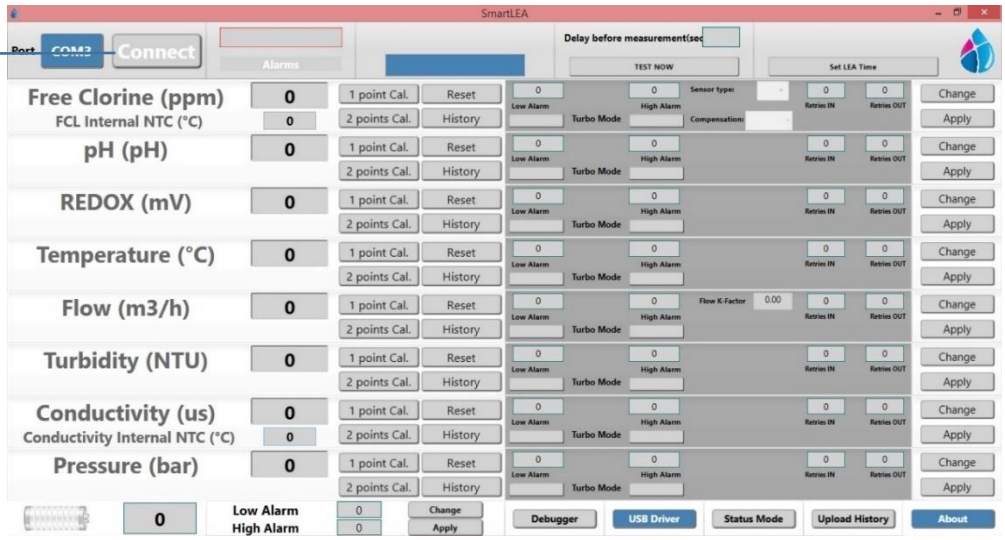
3.1 Installing the PC Software

You can download the PC software from Blue I web site at www.blueitechnologies.com.

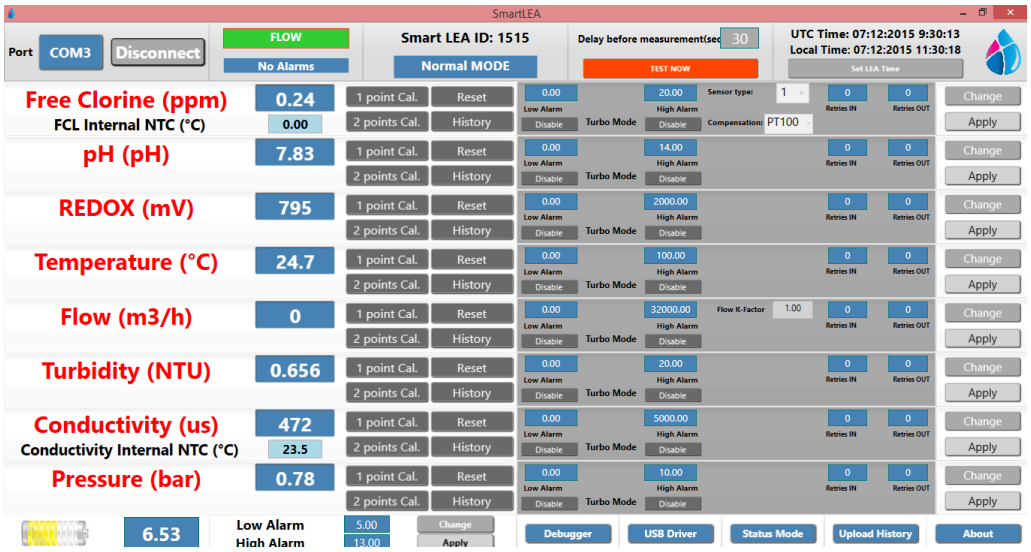
3.2 Connecting to the Controller

1. Connect a USB cable from the laptop on which you have installed the software to the controller USB port. The USB drive automatically detected and installs the required components.
2. Launch the Smart NRG application. The main screen appears.
3. Select the serial COM port number.
4. Press and hold the Push button on the left side of the controller until it flashes.
5. Click **Connect** to connect to the controller and receive the current system status.

Click Connect



Once connection is established, current system status is displayed.



3.3 First Time Operation and Configuration

The controller comes pre-configured with default values. However, before first time operation, it is highly recommended to perform an external measurement of water parameters values and calibrate the system according to the results.

Before performing calibration for the first time, let the system operate for **24 hours** to allow the electrodes to stabilize. Follow local regulations for calibration requirements.

3.3.1 About the Smart NRG PC Software

The PC software allows you to view the system status and alarms, view measurements history, initiate immediate test, calibrate water parameters values, set thresholds, and set thresholds for Turbo mode.

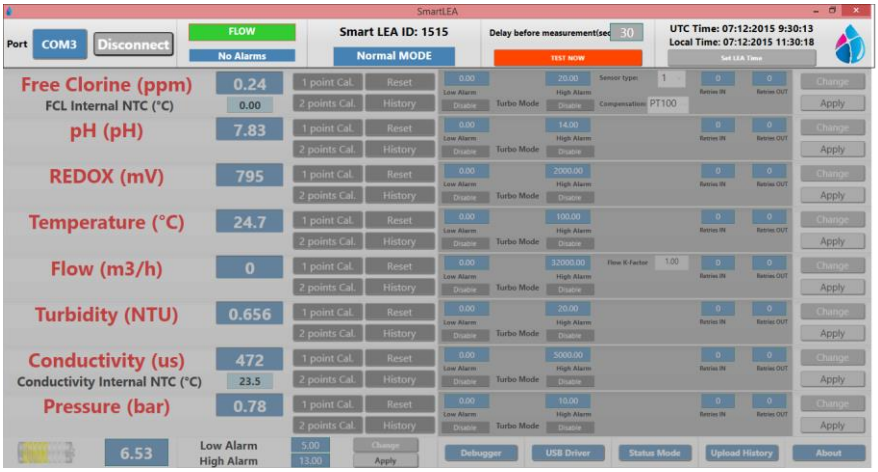
The following sections describe the user interface elements of the PC software.

Top Section

This area displays the following information from left to right:

- **Connect/Disconnect** – starts communication from the controller to the software.
- **Flow** – when green indicates that water flows through the flow cells.
- **Alarms list** – displays the last alerts in the system. Click the button to displays the complete list of alerts.
- **Normal/Turbo MODE** – indicates the current operation mode of the controller.
  - **Normal** – regular operation mode.
  - **Turbo mode** – high frequency measurement mode for increased monitoring (see “Activating Manual Turbo Mode” on page 37).

- **Delay before measurement** – displays the delay in seconds before the measurement begins. This allows water in the inlet pipe to leave the system so the measurement is performed on fresh water from the main line.
- **Test now** – starts a new measurement cycle.
- **UTC Time** and **Local Time** – displays UTC time and the system local time. Click **Set Lea Time** to set the system local time.



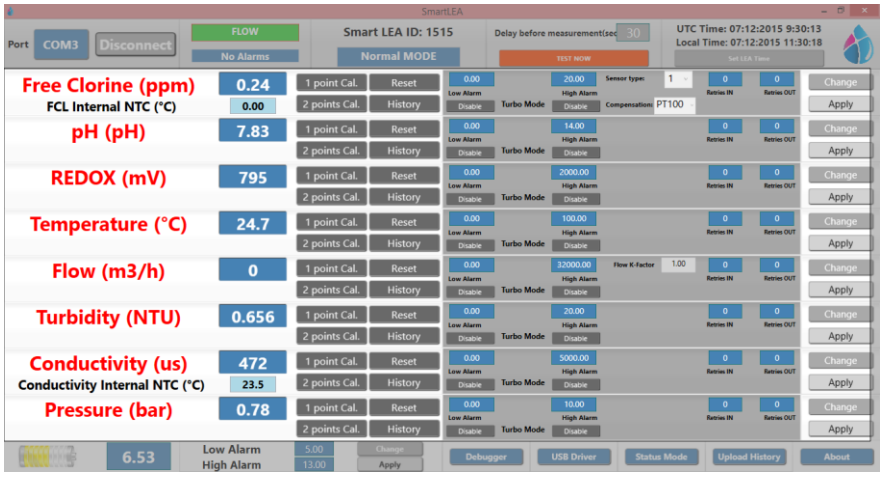
Middle Section

This area displays water parameters values from the last measurement, provides 1 or 2 points calibration for each parameter, and allows you to configure Turbo mode.

See “Calibrating Parameters” on page 32 and “Configuring Automatic Turbo Mode” on page 38.

1 point/2 points calibration, reset, and calibration history

Parameters values

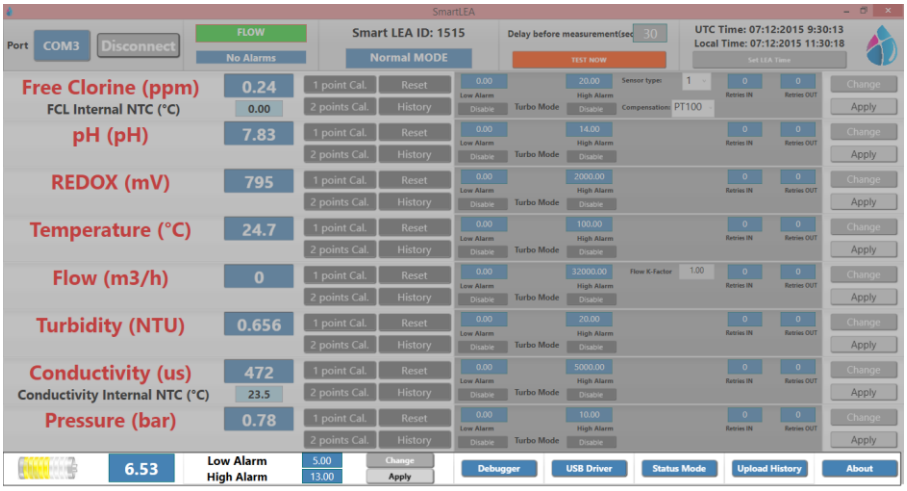


Turbo mode configuration

Bottom Area

This area displays the following information from left to right:

- **Battery** icon – indicates the battery status and its current voltage. Minimum voltage required for the system operation is: 5.5 Volt.
- **Low Alarm/High Alarm** – displays the low and high voltage thresholds. When battery level exceeds these thresholds, alerts are triggered (see, "Setting Battery Level Alarms" on page 37).
- **Debugger** – for use of Blue I technicians only.
- **USB Driver** – installs required USB driver on the PC.
- **Status Mode** – enables you to set **Delay before measurement**, **Measurement interval**, and **Modem interval** parameters for both Normal and Turbo modes (see "Setting Status Mode Parameters" on page 36).
- **Upload History** – loads the controller data log into the PC software.
- **About** – displays the system's protocol, software, hardware, controller versions.



3.3.2 Calibrating Parameters

The system provides one point or two points calibration methods. Before you begin calibrating water parameters, allow the system to work for several hours.

It is mandatory to calibrate the system using an external measurement for accurate results. Always follow local regulations for the required calibration method and frequency.

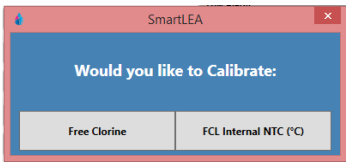
To calibrate water parameters using one-point calibration:

1. Measure the parameter you want to calibrate using an external test by opening the sampling water outlet and measuring the parameter in the sampling water.
2. Click **1 Point Cal** next to the parameter you want to calibrate.

   For Chlorine, the system prompts you to select **Free Chlorine** or **FCL Internal NTC**.

   If you choose FCL Internal NTC then you need to specify NTC instead of PT 100.

   Electrode with internal NTC or electrode with external PT100.



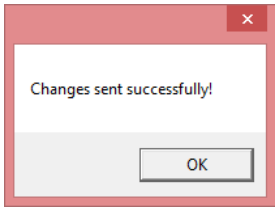
   The One Point Calibration dialog is displayed.

3. Click **Measure**. The system initiates a measurement of the parameter and displays the result in the **Sensor value is** field:

4. In the **Calibrate to** field, type in the value to which you want to calibrate the parameter. This is typically the result of your external measurement.

   Optionally, click **Offset** to calibrate the offset of the electrode.

5. Click **Send** to save the settings to the controller memory.



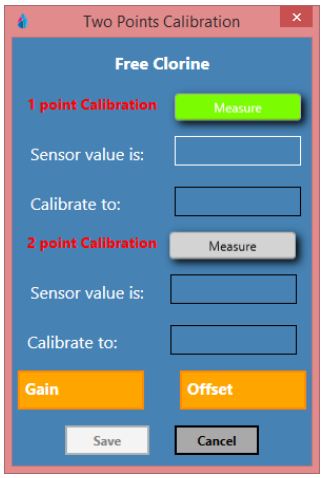
6. Repeat this process for the required parameters.

▶ To calibrate parameters using two points calibration:

For calibration with standard solution only.

1. Measure the parameter you want to calibrate using an external test by opening the sampling water outlet and measuring the parameter in the sampling water.
2. Click **2 Point Cal** next to the parameter you want to calibrate.

   The Two Points Calibration dialog is displayed.



3. Click **Measure** next to **1 point Calibration**. Measurement result is displayed in the **Sensor value** field.
4. In the **Calibrate to** field, type in the value to which you want to calibrate.
5. Click Measure next to **2 point Calibration**. Measurement result is displayed in the **Sensor value** field.
6. In the **Calibrate to** field, type in the value to which you want to calibrate.
7. Click **Save** to save the settings to the controller memory.

3.3.3 Calibrating Free Chlorine

Parameters must be calibrated with measurements taken with external testing devices. Always use digital calibration devices. Alternatively, standard solutions may be used. Make sure the standard solution is not expired or contaminated prior to using.

Always take water for calibration from the sampling valve, **NOT** from the process line directly. The analyzer should always be calibrated with water from exactly the same source.

Perform chlorine calibration every six month according to manufacturer instructions.

▶ To calibrate free chlorine:

1. Before calibrating chlorine, calibrate temperature and pH and verify that both parameters are at normal operating levels.
2. Fill the sampling container from the flow cell.
3. Test the water sample for chlorine using a digital photometer or other external testing device.

3.3.4 Calibrating Other Sensors

Calibration of other sensors requires the use of a reliable external testing device or standard solution. When using an external testing device, follow the chlorine calibration sequence making sure to take the water sample from the same water supply of the sampling cell (sensors).

Perform Redox and pH calibration once a year. We recommend calibrating both Redox and pH whenever you calibrate the chlorine sensor.

Perform turbidity calibration once a year.

1. Remove the sensor, clean with a dry cloth and place in the standard solution.
2. Place the sensor in the standard solution and wait for the reading to stabilize.

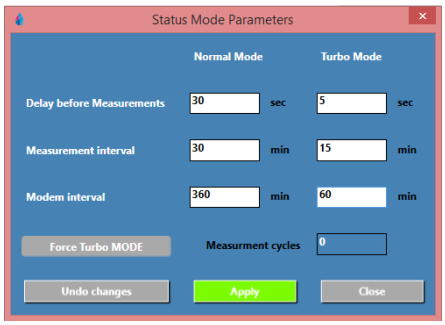
3.3.5 Setting Status Mode Parameters

The Status Mode Parameters enable you to set the controller **Delay before measurement**, **Measurement interval**, and **Modem interval** for both Normal and Turbo modes.

To set the status mode parameters:

1. Click **Status Mode** at the bottom of screen.

The Status Mode Parameters dialog is displayed.



2. Set the parameters Normal and Turbo modes as required:
   - **Delay before measurement** – sets the delay in seconds before the measurement begins. This allows water in the inlet pipe to leave the system so the measurement is performed on fresh water from the main line.

Pipe Length	Recommended Delay
Up to 1 meter	30 seconds
Up to 3 meter	90 seconds

   - **Measurement interval** – sets the measurement frequency in minutes.
   - **Modem interval** – sets the data transmission frequency in minutes.

     The setting for the last two parameters greatly affect battery consumption. Consult the following table for typical settings.

Measurement/Modem Interval	Expected Battery Life
60 minutes / once a day	3 years
60 minutes / every two hours	2 years
15 minutes	9 months

3. Click **Apply** and **Close** to save the settings.

3.3.6 Setting Battery Level Alarms

Battery alarms provide alerts when the battery enters end-of-life period allowing you to replace the battery before it dies out. You can define both low level and high level alarms. A high level voltage may indicate battery malfunction that may harm the system's electronics and needs replacement.

The system is pre-defined with default settings that you can change as follows.

▶ To set battery thresholds:

1. Click **Change** at the bottom of the screen.

2. Type in values for low voltage alarm and high voltage alarm and click **Apply** to save the changes.
   - Recommended setting for low alarm: 5.5.
   - Recommended setting for high alarm: 8.5.

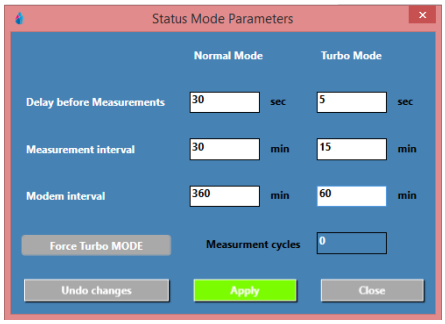
3.4 Activating Manual Turbo Mode

You can manually put the system into Turbo mode, in which the system performs measurements at higher rate than in Normal mode. This is useful when you suspect a water quality event is about to occur; or when an event is already taking place and you want to closely monitor water parameters.

▶ To activate manual Turbo mode:

1. Click **Status Mode** at the bottom of screen.

The Status Mode Parameters dialog is displayed.



2. Click **Force Turbo Mode**, type in the required number of measurement cycles.

3. Click **Apply**.
4. To exit from manual Turbo mode, set **Measurement cycles** to **0** (zero) and click **Apply**.

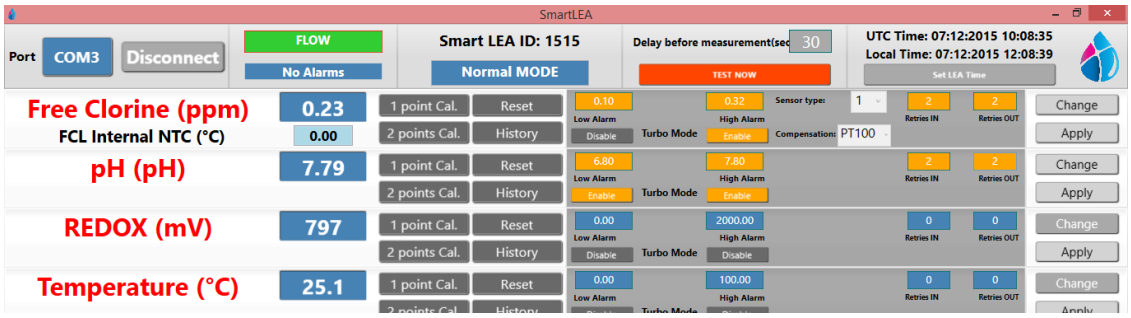
3.5 Configuring Automatic Turbo Mode

Turbo mode enables you to closely monitor water quality events. This is done by configuring a required range (low and high thresholds) for the parameters. When parameter measurements are outside the range, the system begins measuring at a high rate until the measurement results return to normal range. This allows you to follow the event through, perform corrective actions, and verify that water quality returns to normal range.

You can set Turbo mode for a single parameter, several parameters, or all of them. In addition, for each parameter, you can set low or high thresholds, the number of repeated measurements before entering Turbo mode, and the number of repeated measurements before returning to Normal mode.

▶ To configure Turbo mode:

1. Set the **Delay before measurement**, **measurement interval**, and **modem interval** for Turbo mode in Status Mode Parameters (see "Setting Status Mode Parameters" on page 36).
2. In the main area, click **Change** next to a parameter and set the following parameters:



   - **Low Alarm/High Alarm** – specify the thresholds that when exceeded, the system enters Turbo mode.

     For example, for **pH** you may define **Low Alarm** – 6.8 and **High Alarm** – 7.8.

   - **Enable** – activates the low and high thresholds you have specified. You can activate either one of the thresholds or both.
   - **Retries IN** – specify the number of measurements exceeding the thresholds before the system enters into Turbo mode.

     For example, 2 retries mean the system enters Turbo mode only after two exceeding consecutive measurements.

   - **Retries OUT** – specify the number of measurement within the thresholds before the system returns to Normal mode.

     For example, 2 retries mean the system exits Turbo mode only after two consecutive measurements within the thresholds.

3. Repeat this process for each parameter as required.
4. Click **Apply** to save the changes.

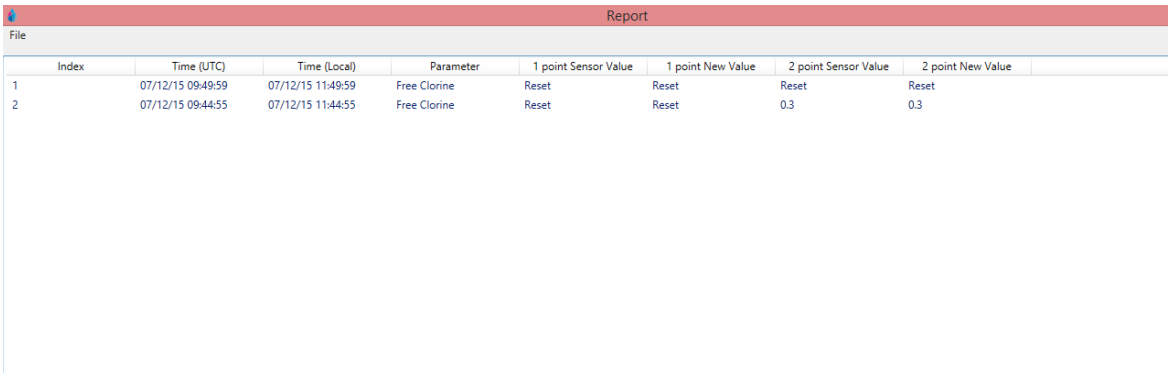
3.6 Viewing the Calibration Log

The PC software records all calibration changes per parameter in a dedicated report.

▶ To view the calibration log:

Click **History** next to the parameter for which you want to see the log.

A log of all calibration actions for the selected parameter is displayed. The log displays the time and date of the change, the one or two points sensor value, and the new one or two points calibrated values.



Index	Time (UTC)	Time (Local)	Parameter	1 point Sensor Value	1 point New Value	2 point Sensor Value	2 point New Value
1	07/12/15 09:49:59	07/12/15 11:49:59	Free Clorine	Reset	Reset	Reset	Reset
2	07/12/15 09:44:55	07/12/15 11:44:55	Free Clorine	Reset	Reset	0.3	0.3

3.7 Viewing the Data Log

The system enables you to view and export the data log to an Excel file.

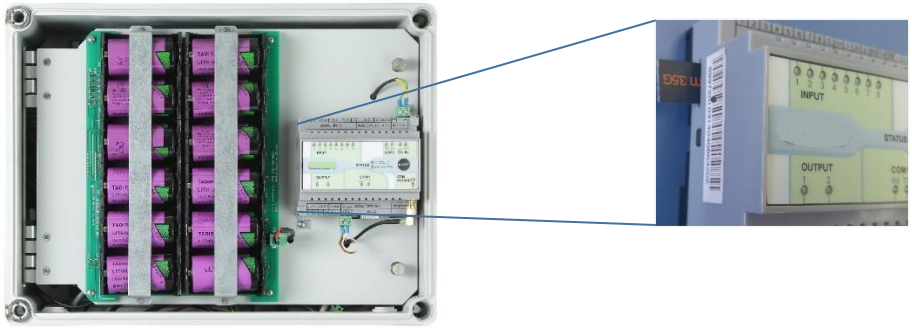
1. Click **Upload History** and type in the number of records you want to view. Each record equals a measuring cycle of the system. The total number of records depends on the system measuring interval.
2. Click **Load**.
3. Click **File > Save** to save file in Excel format.

4

Remote Monitoring and Configuration

The Smart NRG system uses cellular communication to transmit measurements results and system date to a web-based application. By connecting to the web-based application, you can review the measurement results, alerts, and modify system settings anywhere anytime (internet connection is required).

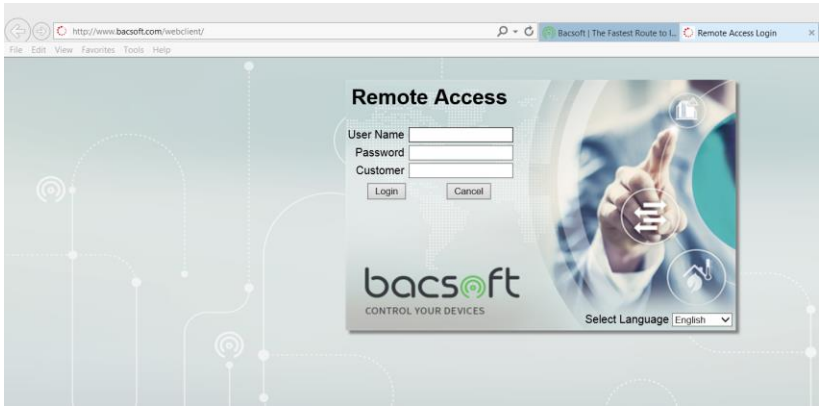
The customer is responsible for purchasing a data SIM card with an unlimited plan and configure it in the Modem. The SIM card is inserted to the slot located on the left side of the modem.



4.1 Logging On

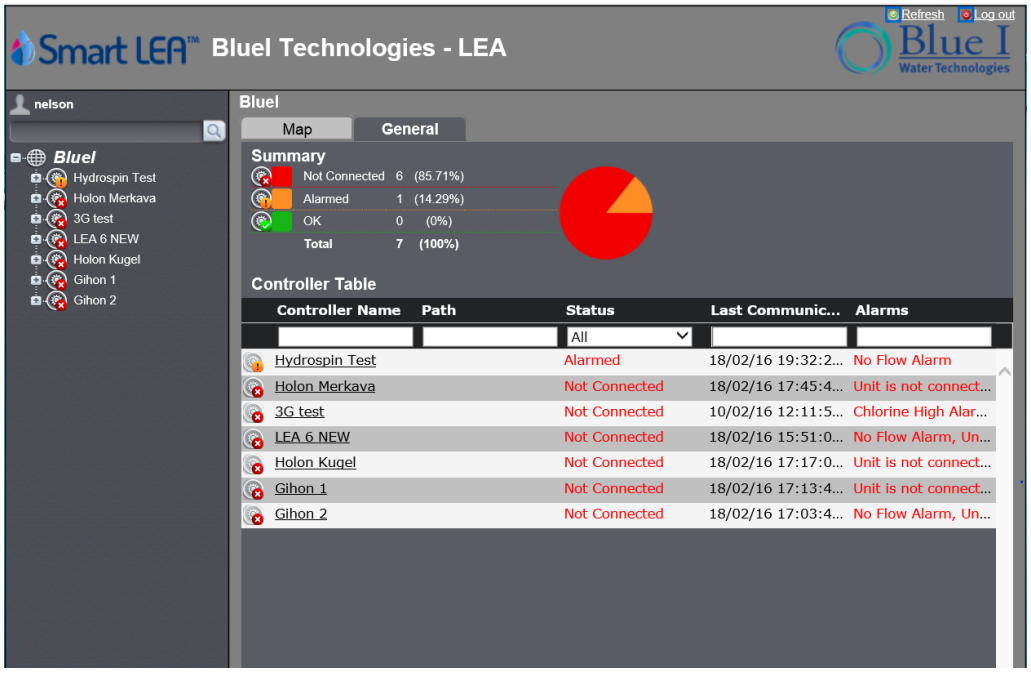
1. In your Internet browser, type in the address: www.backsoft.com.
2. In the main page, click the **Login** tab.

   The Remote Access Login page is displayed.



3. Type in your user name, password, and customer credentials and click **Login**.

   The main screen is displayed.



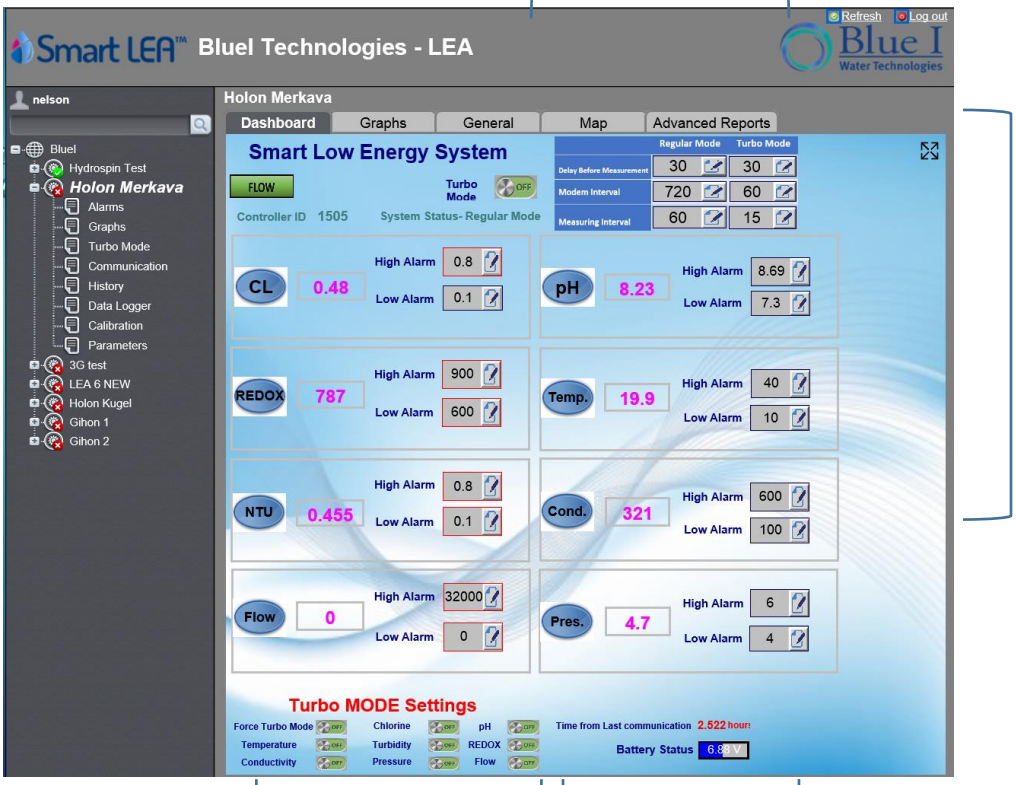
The Left pane displays a list of your Smart NRG installations. Expanding each installation opens a list of direct links to the system alarms, graphs, Turbo mode settings, Communication settings, History data, calibration settings, and parameters data.

The main area displays two tabs:

- **Map** – display the units on a map.
- **General** – a color coded summary of the controllers' status (OK, Alarmed, Not Connected) and the Controllers Table. You can filter this table by typing or selecting in the fields above each column.

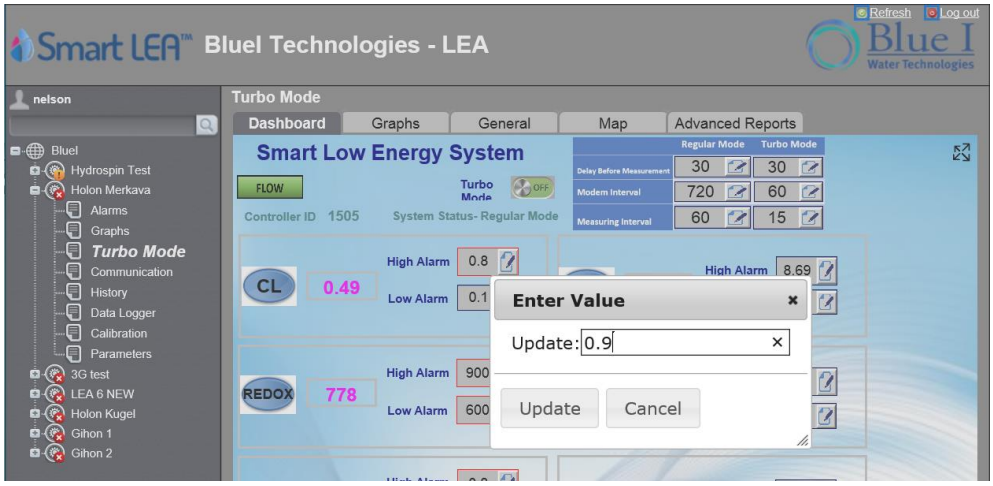
4.2 Configuring the Controllers Parameters

Click a controller name in the Controllers Table or in the left pant to access open the **Dashboard** and display detailed data. The **Dashboard** tab displays current measurement values for each parameter along with measurement frequency settings, flow status, Turbo mode settings, battery status, and time from last communication.



To configure parameters high/low alarm thresholds:

1. Click the edit icon  next to the parameter value you want to modify.
2. In the dialog that opens, type in a new value:



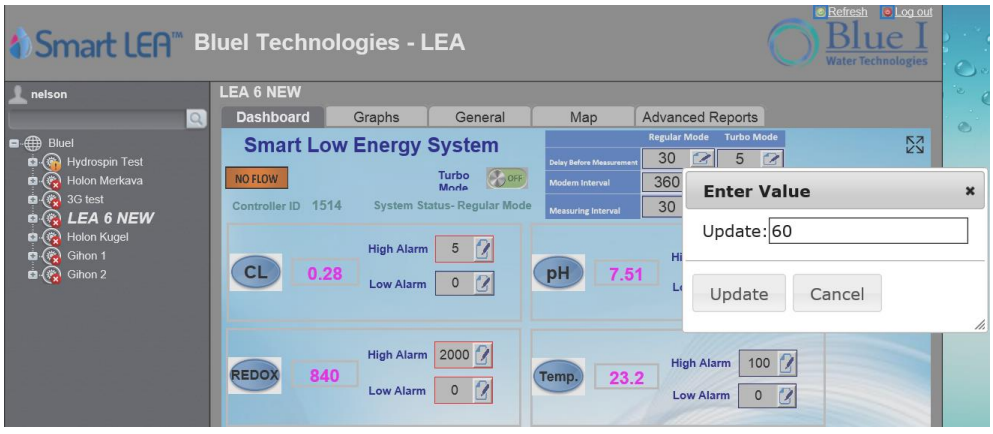
3. Click **Update**.

4.3 Modifying Delay before Measurement, Measuring Interval, and Modem Interval

You can set the controller **Delay before measurement**, **Measurement interval**, and **Modem interval** for both Normal and Turbo modes.

To modify the parameters:

1. Click the edit icon  next to the parameter value you want to modify.
2. In the dialog that opens, type in a new value:

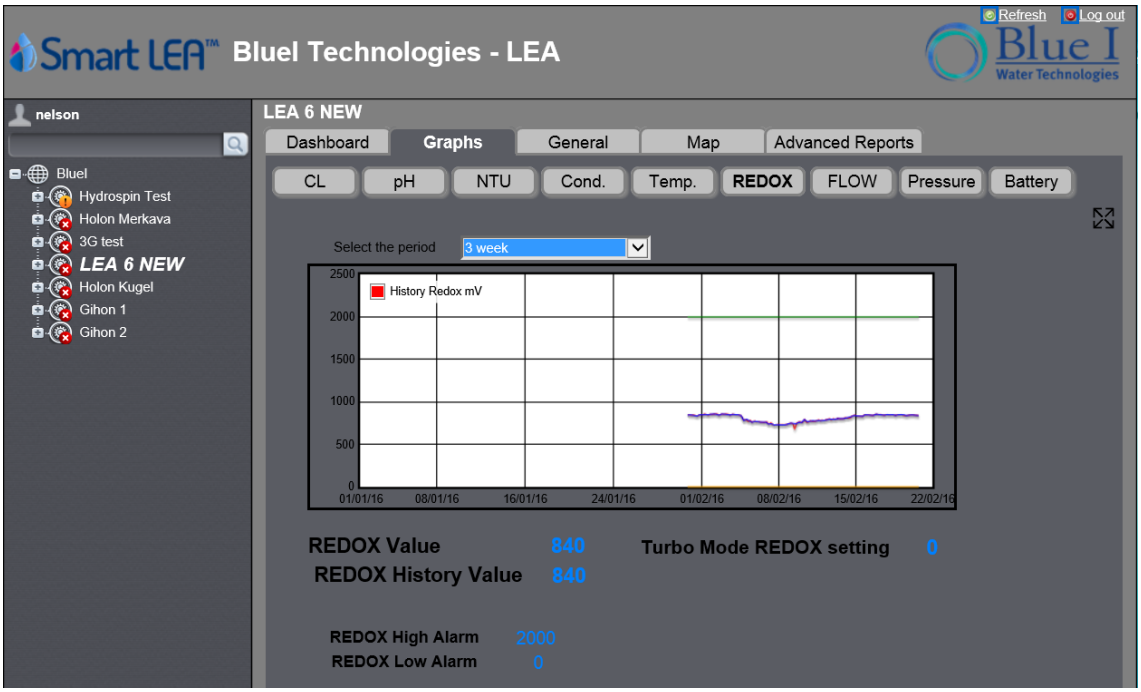


3. Click **Update**.

4.4 Creating Historical Graphs

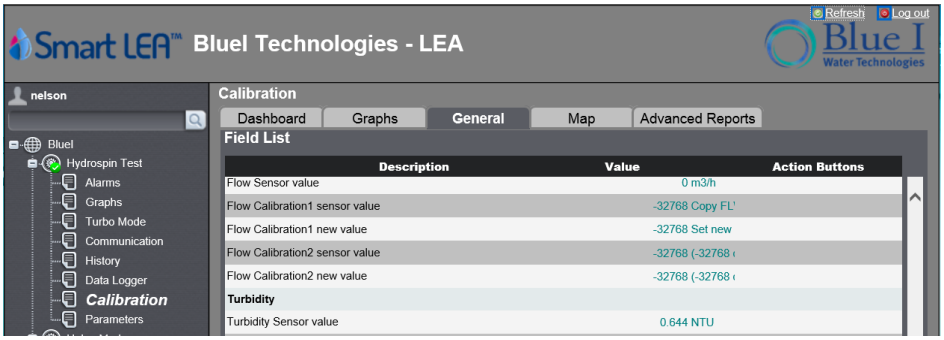
The application enables you to create historical graph for each parameter value. The graphs can be displayed for a period between one to five weeks back.

1. Click the **Graphs** tab.
2. Select the parameter for which you want to create the graph.
3. Select the time period. The graph is displayed.



4.5 Monitoring System Parameters

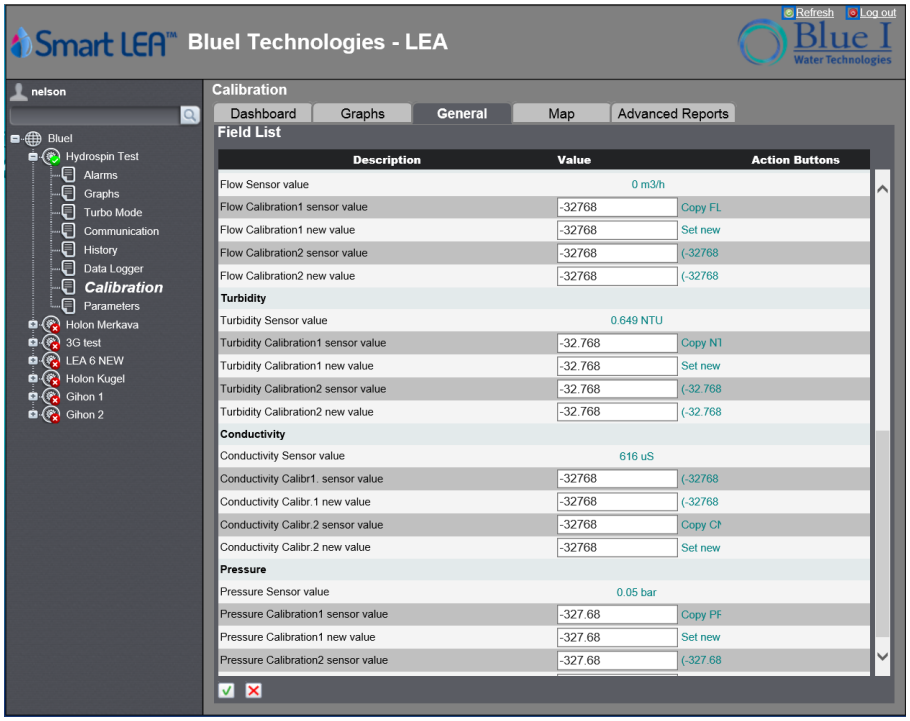
The **General** tab enables you to view all the system parameters in a tabular format. The list of parameters changes according to the selected item on the left. For example, selecting **Turbo Mode** displays all the possible parameters relating to Turbo Mode; while **Calibration** displays all the possible parameters relating to parameters calibration.



To modify values:

1. Click the  icon at the lower left corner and type in new values in the relevant fields.

   Not all parameters can be modified in this tab.



2. Click  to save the changes.

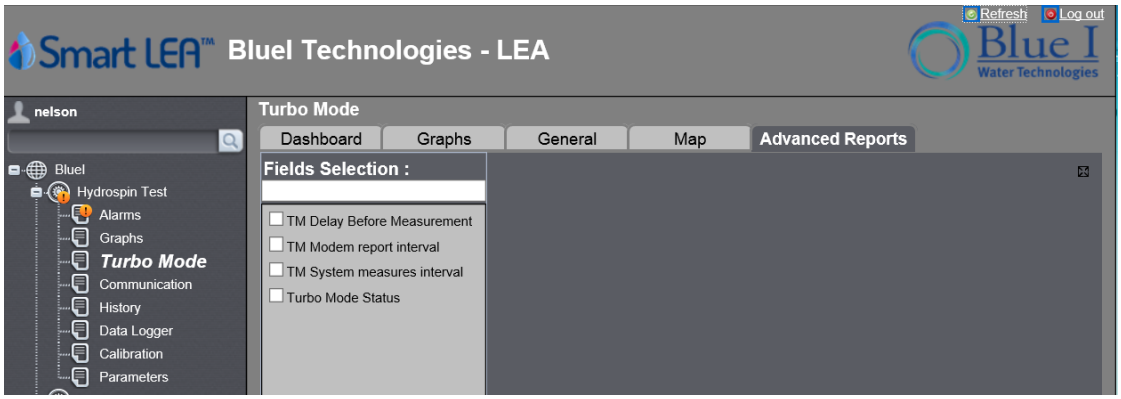
4.6 Creating Advanced Reports

The application enables you to create reports containing up to five different parameters for any time period and export them to several different formats.

To create advanced reports:

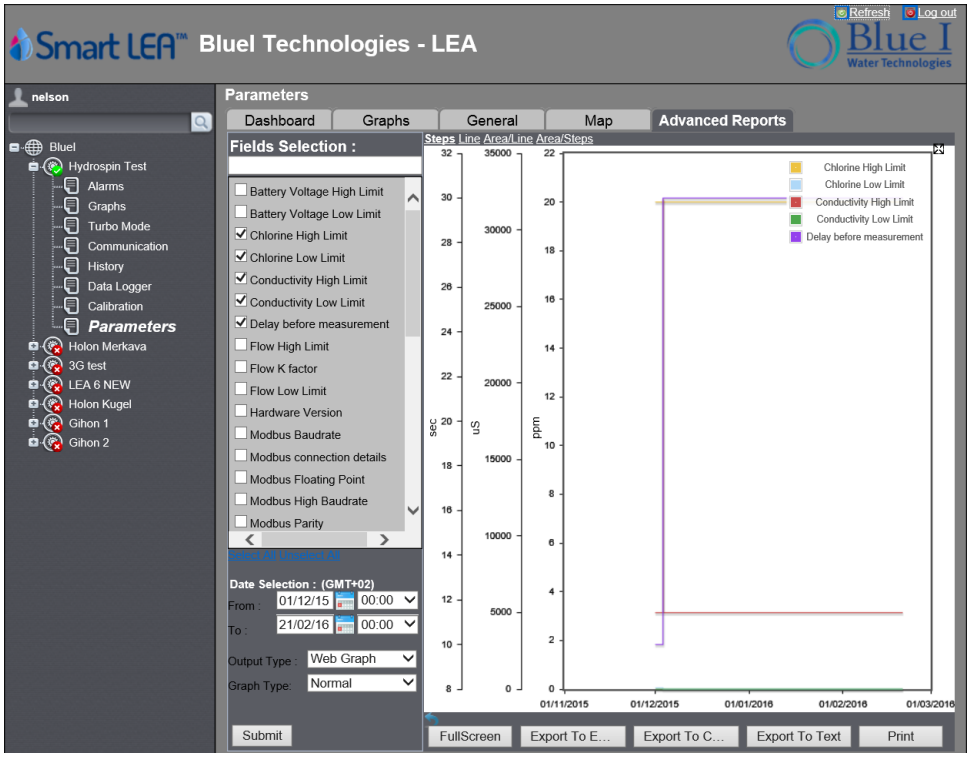
1. Click the **Advanced Reports** tab.
2. In the **Fields Selection** list on the left, select up to **five** parameters.

   Note:
   The parameters in the **Fields Selection** list change according to the selected item on the left. For example, **Turbo Mode** provides four parameters; while **Parameters** provides all the possible parameters in the system.



3. In the **From/To** fields, select the time period.
4. In **Output Type**, select the report type:
   - Web Graph – graphical report
   - Web Report – tabular report
   - Excel File – saves report to an Excel file
   - CSV File – saves report to a CSV file
   - Text File – saves report to .tab file (open with a text editor)
5. In **Report Type**, select the report values: **Normal**, **Empty**, **Maximum**, **Minimum**, or **Last** values.
6. Click **Submit**.

   The report is displayed in the main area. If you selected **Web Graph** or **Web Report**, you can export the report by clicking one of the **Export to Excel**, **Export to CSV**, or **Export to Text** buttons at the bottom.



5

Maintenance

5.1 Replacing Batteries

The life span of the battery pack depends on the number of measurements per day and the number of data transmissions.

Battery alarms enable you to be notified when the battery voltage begins to weaken and allows you to replace the batteries before they run out (see “Setting Battery ” on page 37).

5.2 Chlorine Sensor

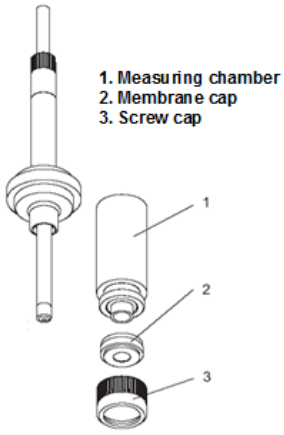
Perform sensor maintenance whenever any of the following conditions are met:

- When the membrane is visibly soiled, clean the sensor.
- Refill the sensor with electrolyte once per season or every 12 months. Depending on the water quality and chlorine level, this period can be reduced or extended.
- Calibrate the sensor when necessary (see “Calibrating Parameters” on page 32).

5.2.1 Cleaning the Sensor

Caution: Do not use chemicals that reduce the surface tension. When using hydrochloric acid, observe all the safety regulations.

1. Remove the sensor from the flow cell.



2. Clean the membrane mechanically with a gentle water jet or swirl in a solution of 2% hydrochloric acid (no other additives).
3. If the membrane is still visibly soiled, replace the membrane.

5.2.2 Replacing the Membrane and Refilling the Electrolyte

1. Unscrew the measuring chamber from the shaft.
2. Unscrew the front screw cap holding the membrane.
3. Remove the membrane and replace with a new membrane.

   After replacing the membrane, you must refill measuring chamber with electrolyte.
4. Screw the cap back.

Do not swallow the electrolyte. Avoid electrolyte contact with skin or eyes. In case of accidental contact, wash with a lot of cold water. In case of eye inflammation, contact a doctor immediately.

Wear safety glasses and gloves when working with the electrolyte solution.

Do not touch or damage the electrodes. The electrolyte is sensitive to oxidation: Always keep the electrolyte bottle closed after use.

Do not transfer the electrolyte to other containers.

The electrolyte should not be stored for more than one year and should be clear (not yellow) in appearance (for use by date, see label).

Avoid forming air bubbles when pouring the electrolyte into the measuring chamber.

5. Unscrew the measuring chamber from the sensor shaft.
6. Hold the measuring chamber at an angle and fill in about 7 to 8 ml (0.24 to 0.27 fl.oz) electrolyte, up to the internal thread of the measuring chamber.
7. Tap the filled measuring chamber several times on a flat surface so that air bubbles can detach and rise.
8. Insert the sensor shaft vertically from above into the measuring chamber.
9. Slowly tighten the measuring chamber to the stop. Excess electrolyte is pressed out of the sensor during the tightening.

5.2.3 Reconditioning the Sensor

Long-term operation (above a week) in chlorine-free medium (very low sensor currents) leads to a deactivation of the sensor. This is a continuous process that reduces the sensor ability to work properly.

After long-term operation in a chlorine-free medium, you must recondition the sensor.

▶ Prerequisites:

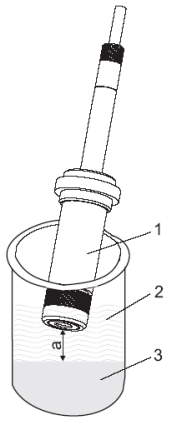
- De-mineralized water (or electrolyte)
- Polishing sheet (Emory Cloth)
- Beaker

- Approximately 100 ml (3.4 fl.oz) of chlorine bleach liquid NaOCl approximately 13%, pharmaceutical quality (available at chemical stores or pharmacies)

To recondition the sensor:

1. Remove the sensor from the assembly.
2. Unscrew the measuring chamber and set it aside.
3. Polish the gold cathode of the sensor using the polishing sheet:
   a. Place a wetted strip of the sheet in your hand.
   b. Polish the gold cathode by moving it circularly on the strip.
   c. Rinse the sensor with de-mineralized water (or electrolyte).
4. Top up the electrolyte if required and screw the measuring chamber back into place.
5. Fill the beaker with chlorine bleach liquid to about 10 mm (0.39") and position it safely.

   Caution The sensor must not touch the liquid.
6. Place the sensor in the gaseous phase about 5 to 10 mm (0.2" to 0.39") above the chlorine bleach liquid.



7. The sensor current increases. The absolute value and the speed of increase depend on the temperature of the chlorine bleach liquid:
   - When the sensor reaches a high chlorine value, leave it under these conditions for 20 more minutes.
   - If the chlorine value is not increasing, cover the beaker to minimize air movement.
8. Re-install the sensor in the assembly.
9. Re-establish flow. The sensor current will normalize.
10. After sufficient settling time (no noticeable drift), calibrate the sensor.

5.3 Conductivity Sensor

Regular cleaning of the conductivity sensor ensures its long-term operation. The cleaning frequency depends on the water source being tested. As general guidelines, clean the sensor whenever there is significant visible dirt, when the measurement accuracy is affected, or before calibration.

▶ To clean the conductivity sensor:

1. Close water flow to the conductivity flow cell and remove the sensor.
2. Wash the sensor under a stream of water to remove dirt.
3. Use a soft cloth to remove any additional dirt and oil.
4. Replace the sensor and resume water flow.

5.4 Cleaning the Flow Cells

Over time, the flow cells can accumulate dirt and stains on their side walls. This may affect the accuracy of measurement. Regular cleaning of the flow cells ensures long-term operation of the system. As general guidelines, clean the flow cells once a year or when the cells are visibly stained.

▶ To clean the flow cells:

1. Close the water flow to the cell and remove the electrodes.
2. Close the system water outlet valves.
3. Fill the cells with the Blue I cleaning solution (Nakita) up to the marked line.
4. Allow the material to rest for 40 minutes in the cells.
5. When the cells are clean, open the water outlet and let the material drain from the system.
6. Close water outlet, reconnect the sensors, and resume water flow.

6 Troubleshooting

6.1 Issues and Workarounds

Issue	Cause	Possible Solution
Water is dripping from the controller	Leakage from pipe connectors.	Check all pipe connectors and hand-tighten as required. If necessary, use Teflon to improve sealing.
No data is received from the controller	• Modem disconnected from power. • Antenna disconnected. • SIM card not installed.	• Verify the modem is connected to power: LEDs blinking. • Verify antenna is connected properly and is placed outside the controller at a high spot (see "Wall Mounting" on page 17). • Insert a SIM card.
Pressing Power button does not activate the controller	Empty batteries or batteries not connected properly. The controller is disconnected from power.	Verify that the batteries are not empty. Verify that all batteries are inserted in the appropriate direction. Connect the controller to power.
One or more parameters do not display data	Electrode fault. Electronic board fault	Check the relevant electrode and replace if necessary. Verify that LEDs on the Electronic board are flashing.

6.2 Unable to Solve an Issue

If you cannot solve the issue, contact your Support representative and make sure you have the following information:

- Detailed description of the issue
- Model Number
- Serial Number

  The serial number can be found on the main label of the box and on the sticker on the right side of the Smart NRG.
- Purchase Date
- Purchased from
- Application (potable water, industrial treatment, pool/spa)

7

Appendix A – Specifications

OPERATING TEMPERATURE	
Ambient temperature	1.5°C to 55°C (35°F to 131°F)
Storage temperature	0°C to 60°C (32°F to 140°F)
CHLORINE MEASUREMENT	
Electrode	Passive-operated sensor with gold cathode & silver/silver chloride anode
pH operation range	4 to 8
Free chlorine measurement range	0-2 ppm or 0-10 ppm
Resolution	0.01 ppm
Repeatability	1% span
Body material	PVC
Membrane material	PTFE
Membrane cap material	PBT (GF30), PVDF
pH MEASUREMENT	
Range	0 to 14
Electrode	Ceramic diaphragm and gel filling
Input impedance	0.5 x 10^{12} Ω
Resolution	0.01 pH
Repeatability	0.01
Body material	Glass
ORP (REDOX) MEASUREMENT	
Measurement range	0 to 2000 mV
Sensor	Ceramic diaphragm and gel filling
Resolution	1 mV
Body material	Glass or plastic
Repeatability	0.01
TEMPERATURE MEASUREMENT	
Sensor	PT-100
Range	1.5°C to 50°C (35°F to 122°F)
Resolution	0.1°C (32°F)
Repeatability	0.1
TURBIDITY MEASUREMENT	
Sensor	White light nephelometry (90° and 180°)
Measuring range	0 to 20 NTU
Accuracy	2-4% FS
Resolution	0.001
Repeatability	0.01
Colorimeter body material	PP
Bubble removal	Automated internal mechanism
Cell cleaning	Automated internal mechanism
CONDUCTIVITY	
Sensor	k=1 cell constant conductivity
Range	20 to 5000 µSim
Accuracy	2-4% FS
Resolution	1 µs
Repeatability	0.01
Measuring surface	Graphite or similar
Body material	Plastic
Temperature compensation	NTC

FLOW SENSOR	
Sensor type	Pulse
Accuracy	3-5% FS
Repeatability	0.01
Measurement range	Adaptive
PRESSURE SENSOR	
Type	Pressure membrane
Measurement range	0 to 10 bar (0 to 145 psi)
Resolution	0.05 bar (0.72 psi)
Accuracy	3% FS
Pressure inlet	6 mm (OD) pipe connector
INTEGRATED FLOW SWITCH	
Sensor	Inductive proximity sensor
Output	Volt free contact
Minimum flow	35 l/h
Minimum pressure	0.5 bar
MECHANICAL DATA	
Dimensions (electronics enclosure) (H x W x D)	280 x 380 x 180 mm (11" x 15" x 7.1")
Dimensions (sensors enclosure) (H x W x D)	560 x 380 x 180 mm (22" x 15" x 7.1")
Dimensions (complete system) (H x W x D)	840 x 380 x 180 mm (33" x 15" x 7.1")
Cable entries	PG 7 and PG 9 cable glands
Ingress protection	IP 67
Weight (approx.)	16 kg (35.2 lbs.)
ELECTRICAL CONNECTION	
Power supply	12 X 3.7 V batteries, Size D
System	24 months autonomy (1 reading/h)
Power button	For technician/field access
LOCAL DATA CONNECTION	
USB	Maintenance & calibration port
INTERNAL COMMUNICATION PROTOCOL	
Modbus	
GSM/GPRS COMMUNICATION	
Low power modem	Default 1 transmission/day (adjustable)
Outdoor antenna (included)	SMA connector
WATER SUPPLY - 6 mm (OD) pipe connectors	
Water inlet	1
Pressure inlet	1
Outputs	2 drainage 1 sampling water
DATA LOGGING	
Memory	Cyclic and block mode
Capacity	65,000 readings
Mode	Count and event
Frequency (water quality parameter)	15 min - 1 day
Event logging	Yes
Alarms	SMS/Email

Declaration of Compliance

We hereby declare that all products are tested and inspected before leaving the factory and are checked to meet our specifications according to accepted procedures.

Daniel Cohen Khallas

Quality Control Manager

Warranty

Please retain proof of purchase.

Please keep a record of the product in the form below to be sent to Blue I Water Technologies in the event of a warranty claim.

Blue I Water Technologies warrants this product and its parts against defects in materials or workmanship for eighteen (18) months from date of installation or twenty-four (24) months from date of shipment from Blue I Water Technologies, whichever is earlier.

- 2-year warranty on electronic cards
- 1-year warranty on all other components
- The warranty does not cover consumable parts, such as electrodes.

Blue I Water Technologies' responsibility includes repair or replacement, **at the sole discretion of Blue I Water Technologies**, of the whole product or part of it, when the defect is due to faulty functioning and/or defective materials.

For your records:

*The serial number can be found on the main label of the box and on the sticker on the right side of the Smart NRG.

Blue I Water Technologies accepts no responsibility for damage caused by:

a. Use/operation not consistent with operating instructions
b. Improper installation
c. Exposure to conditions that are not in accordance with Blue I's specifications, e.g., pressure/flow/temp
d. Damage during shipment (submit claim to the carrier)
e. Disasters such as fire, flood, lightning or improper electric current
f. If the equipment is modified or if non-Blue I Water Technologies' reagents or replacement parts are used

Completion of the RMA procedure and return of defective component(s) to Blue I Water Technologies, Ltd. Is required for all warranty items.

User manuals and datasheets can be downloaded from our website www.blueitechnologies.com and by scanning this QR code:

Warranty Claim

Please fill in the information below and retain with proof of purchase

Model Number: _____

Serial Number: _____

Purchase Date: _____

Purchased from: _____

Application: _____ (e.g., potable water, industrial treatment, pool/spa)

In case of submitting a warranty claim, send this form along with proof of purchase to:

Blue I Water Technologies
18 Hamelacha St.
Afek Industrial Park
Rosh Ha'ayin 4809148
ISRAEL

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