



**BRS**

*BioReactor Simulator*



**Operation and Maintenance Manual**

## **Release History**

Version 4.0, October 2023

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## **1 GENERAL INFORMATION**

The BRS has been developed by BPC for the on-line monitoring and control of anaerobic fermentation tests in a continuous mode with modern instrumentation and IT technologies. The gas flow rate measurements and data logging of the BRS are fully automated during the incubation period. The high precision of gas flow monitoring is based on a patented flow meter array using the principle of liquid displacement and buoyancy. The organic loading rate (OLR), hydraulic retention time (HRT), and specific gas production (SGP) are calculated and displayed in real time.

Before operating the BRS (hereafter referred to as “the instrument”, “the system” or “the equipment” interchangeably) from BPC Instruments AB (hereafter referred to as “BPC Instruments”, “BPC”, “Bioprocess Control” or “BPC Instruments AB” interchangeably), carefully read this operator manual for the instrument, any separate instructions for other equipment used together or in conjunction with the instrument, as well as the safety instructions for any and all chemicals used in the process of utilising the instrument.

### **Safety Information**

When performing experiments with the instrument, always use protective eyewear, gloves, and lab coat. Always make sure there is adequate ventilation and take proper precautions when handling electrical devices near water or explosive gases. Make sure to tie back any hanging objects, such as hair and clothing, when working near rotating or other moving parts.

Do not modify the instrument without the prior consent of the manufacturer. BPC Instruments AB do not assume responsibility for any errors due to equipment modification.

Do not clean or service the instrument while it is running.

Do not expose the instrument to mechanical vibrations or high frequency radio transmissions.

Never operate the instrument in a way it was not intended.

Never operate the instrument or let anyone else operate it without proper training.

Never use the instrument outside or in environments with parameters outside of the instruments recommended range.

Never connect additional electrical equipment not supplied by BPC Instruments AB for the express purpose of using with the instrument. This is true even if the connections can mate.

Always back-up important data to an external device.

Always keep the instrument level and on a flat and stable surface. Failing to do so can, among other things, generate an erroneous gas reading.

Always make sure all safety guards are in place and working before operating the instrument.

Always make sure that all parts are functioning properly immediately after start-up.

Always keep the instrument clean.

Always make sure to have access to relevant chemicals before starting an experiment.

Always dispose of parts and chemicals according to applicable rules in the country of usage.

Periodic maintenance of the instrument and its various accessories is essential. Always make sure they are in working condition. If service or spare parts are required, please visit <https://webshop.bpcinstruments.com> or contact BPC Instruments AB directly or one of its representatives.

Always make sure to connect the power supply so that it is easy to remove from the mains power outlet and so it doesn't risk becoming damaged.

Always make sure that the gas outlet of the Flow Cell Unit (FCU) can release pressure in the event of pressure build-up inside of the instrument. Do not obstruct or block it.

Always wait 60 seconds between powering the system on and off. This will allow for the operating system to shut down properly and for the capacitors to properly cycle.

Always use deionized water to minimize the risk of residue or rust forming on the inside of the FCU.

## **Electrical Safety**

Compliance is required with respect to voltage, frequency and current requirements indicated on relevant parts. Improper operation, damage to the equipment, fire or otherwise undesired effects might be caused by connecting to a different power source. There are no user-serviceable parts in the equipment, unless otherwise agreed upon with BPC Instruments AB.

## **Limited Warranty**

The product warranty provided with the instrument corresponds to the stipulations in Orgalime S 2012, unless otherwise agreed upon with BPC Instruments AB. BPC Instruments AB reserves the right to correct any possible errors, mistakes, changes, updates, technical data or otherwise relevant information in this manual or any other documents, where applicable by law.

**Contact Information**

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Swedish organisation number: 556687-2460

**2 DELIVERY CHECKS**

Upon delivery, unpack and check that the contents match with what is listed below in the Section “Box Content”.

If the packaging or equipment is broken or damaged at delivery, please:

- a) Document and take photos of the parts and packaging
- b) Inform the transport company at the time of delivery
- c) Make sure that the transport company documents the incident
- d) Inform the seller of the incident

## Box Content

BRS III (**Figure 1**) is delivered with the components listed below:



**Figure 1.** BRS III Complete System.

### *Unit A – Incubation Unit*

9 glass reactors (2 L)	1 motor controller signal cable	1 MCU power adapter
9 brushless DC motors 1 motor power splitter	9 axis couplings for brushless DC motors	1 thermostatic water bath 1 base tray
10 brushless DC motor cables 250 mm (6 units) 500 mm (3 units) 1500 mm (1 unit)	10 stirrers GL 45 (2 L) standard	1 thermostatic water bath lid for 9 reactors (2 L)
	1 motor controller unit (MCU)	10 push-in valves 6 mm
9 funnel shaped feeding units	9 bent discharging units	9 silicone stoppers
27 plastic screw caps: With hole (18) Without hole (9)	18 silicon rings	

### ***Unit B – BPC Core BRS Unit***

1 BPC Core BRS	20 check valves	1 main unit power adapter
10 flow cell units (FCUs)	1 plastic syringe	1 ethernet cable

### ***Additional Components***

1 Festo tubing 50 m	20 push-in connectors 6 mm	1 bottle/tube opening tool
1 funnel	3 soft binders 7/180 mm	FCU volume sheet (2 or 9 mL)
10 tubing stoppers	10 multi-coloured marker clamps	

## **3 PRE-COMMISSIONING AND RECOMMENDATIONS**

The following items are not included in the delivered BRS, however they will/may be required to operate the BRS:

- Silicone spray or other similar lubricant
- Silicone tubing, two-way valves and clamps
- Additional wall socket adapters (plugs/contacts) (the ones supplied are according to European, US or UK standards, depending on original purchase order)
- If a customer has a gas chromatograph and is interested in off-line biogas composition analysis, gas sampling units can be ordered separately from BPC
- N<sub>2</sub> or a mixture of N<sub>2</sub>/CO<sub>2</sub> to obtain anaerobic conditions during the startup phase of the experiment (BPC recommends a mixture of N<sub>2</sub> (60%) and CO<sub>2</sub> (40%) to be used)
- Gas sampling units and gas bags for off-line gas composition analysis.

The following recommendations are essential for the safe and efficient operation of BRS instrument:

- The product guarantee provided corresponds to the guarantee stipulated on the confirmed product order form and shipping documentation.
- For a high accuracy analysis, the BRS should not be exposed to mechanical vibrations and/or high frequency radio transmissions and should be placed on a level and stable surface.
- To guarantee the quality and performance of the instrument, only the parts delivered with the instrument should be used.
- BPC reserves the right to correct any possible text and image errors as well as changes to technical data in this manual.





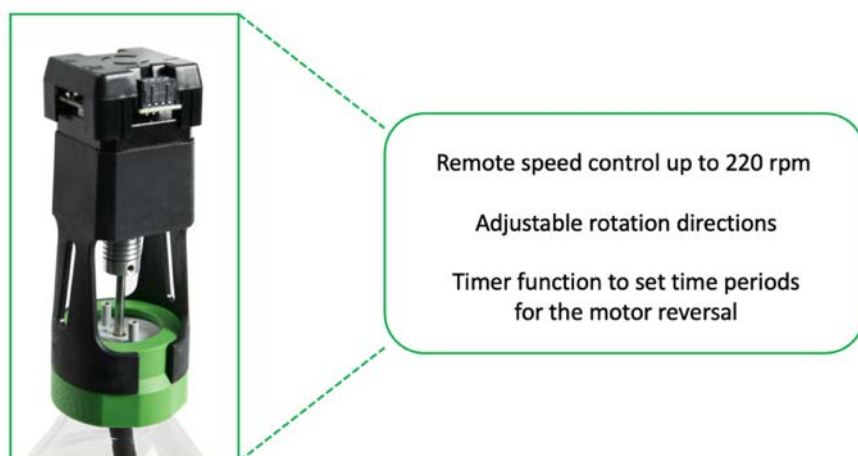
#### 4 EQUIPMENT DESCRIPTION (DESIGN/FUNCTION)

**Incubation Unit (BRS-A Unit):** Here is where the fermentation process takes place (Figure 2). 9 (2 L) reactors are placed inside a thermostatic water bath (68 x 56 x 33 cm), which is used for temperature control (up to 60° C, precision of 0.2° C). The thermostatic water bath is provided with a lid for 9 reactors to minimize water loss and ensure that the temperature set point is rapidly reached. The incubation system provides a well-controlled environment regarding temperature, pH, and relative humidity for biogas/biohydrogen production.



**Figure 2.** Incubation unit

Each reactor is connected to a brushless DC motor that ensures a well-mixed content through a strong, reliable, and multifunctional agitation system (Figure 3). A motor controller provides the power via motor cables, where all the motors receive the same information. **The MCU needs to be turned off and unplugged from the power source when any cables are connected or disconnected from the motors.**



**Figure 3.** Main features of the agitation system in BRS-A Unit.

**Gas Volume Measuring Unit (BRS-B Unit):** Here the gas is recorded and processed. The BPC Core BRS Unit consists of 9 flow cell units for simultaneous gas volume detection from 9 independently operating reactors (Figure 4). Unit C comes with an OLED screen which will display various information, including IP address of the instrument, version of the software, current environmental parameters (temperature and pressure), and alignment indicator. The information can be accessed through two physical buttons located below the screen. The detection unit is equipped with a USB port for software upgrades and possible new applications and a power button.

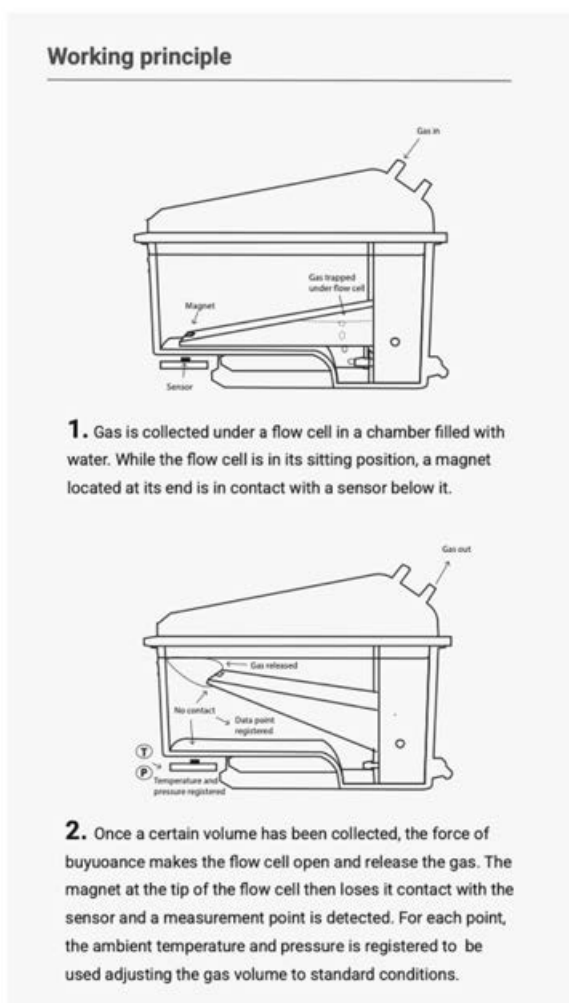


**Figure 4.** Gas volume measuring unit (BRS-B Unit).

The FCU has resolution of 9 ml. **The operational principle is based on liquid displacement and buoyance.** When a certain gas volume enters the flow cell unit, the force of buoyancy leads the flow cell to open and releases the entrapped gas (Figure 5). The system counts each flow cell opening and registers the temperature and pressure for automatic compensation to normalise the flow rate and volume to standard conditions.



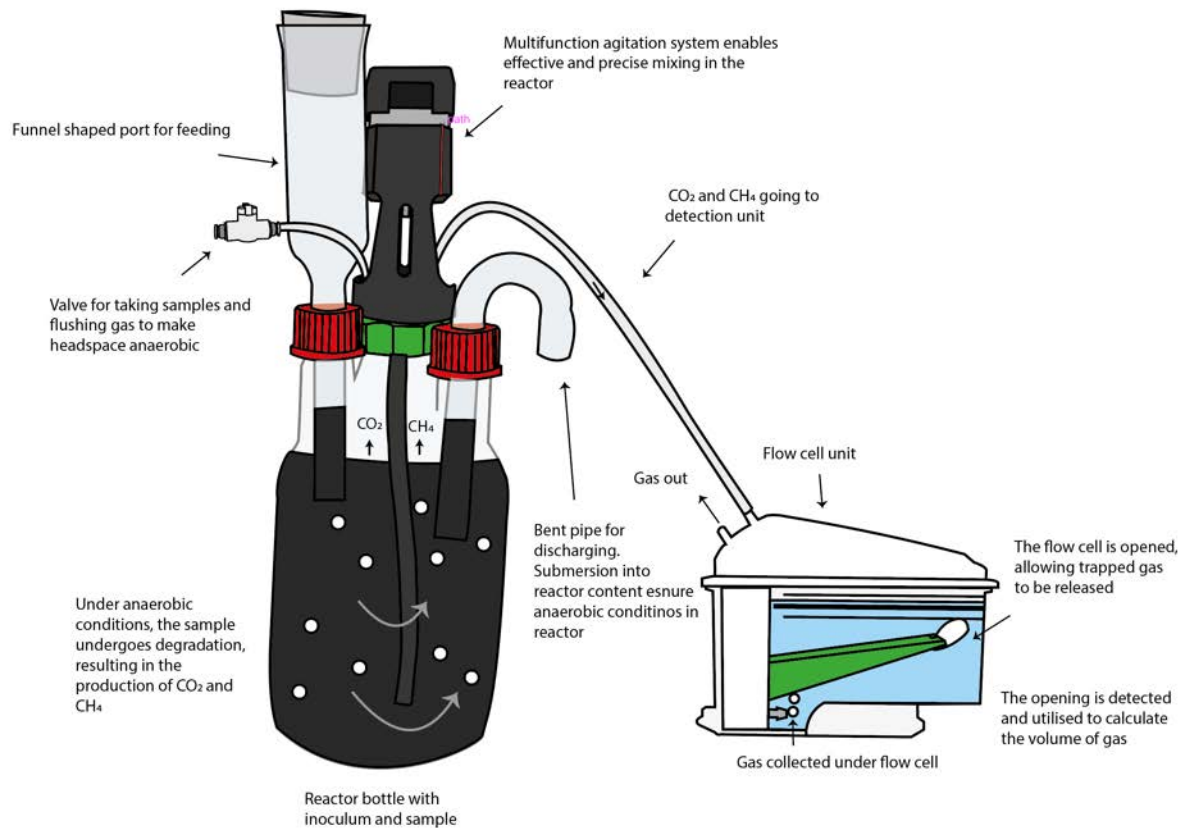
A



B

**Figure 5.** 9 mL FCU (A) and working principle (B).

The entire process involving the different components of the system is summarized in the illustration below (Figure 6):



**Figure 6.** Illustration of the process from biogas production and measurement.

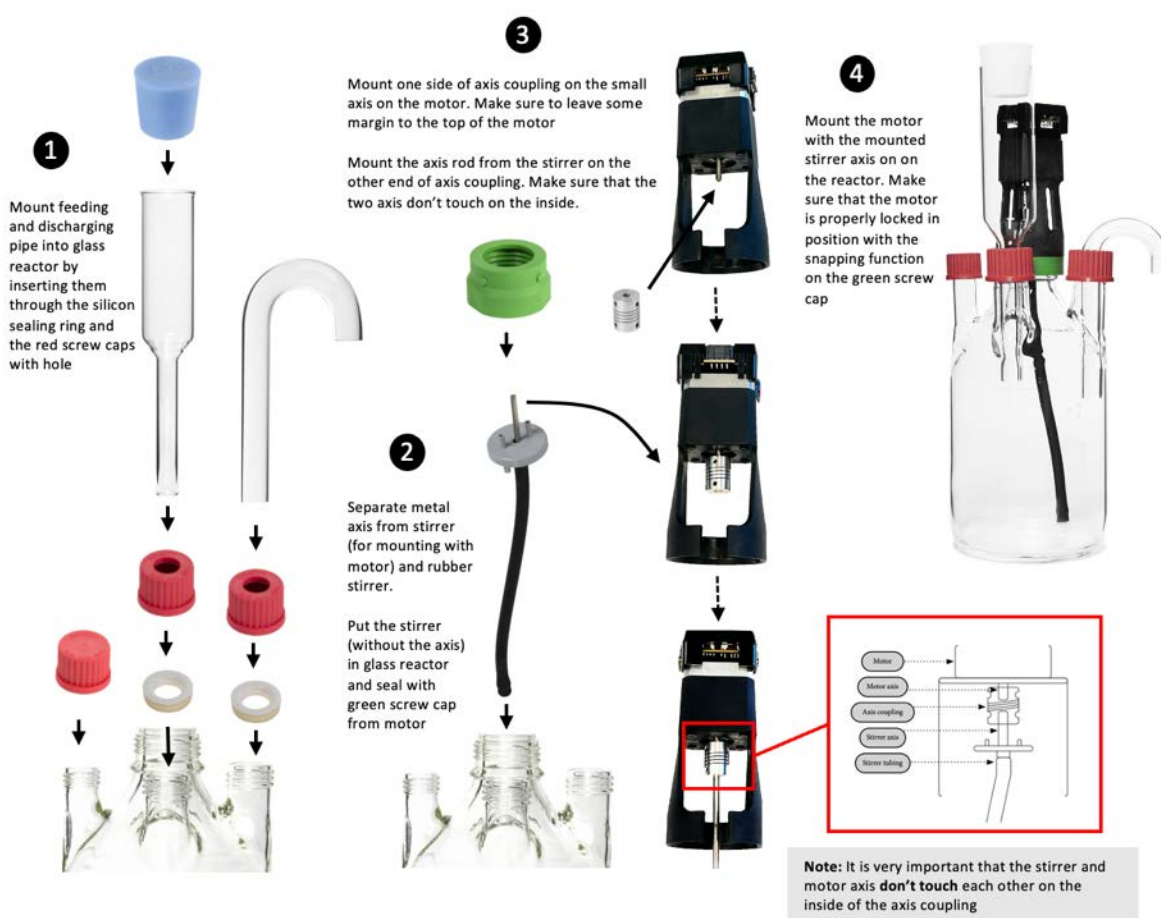
## 5 OPERATION

In order to install and operate the BRS system properly, the steps described below need to be followed:

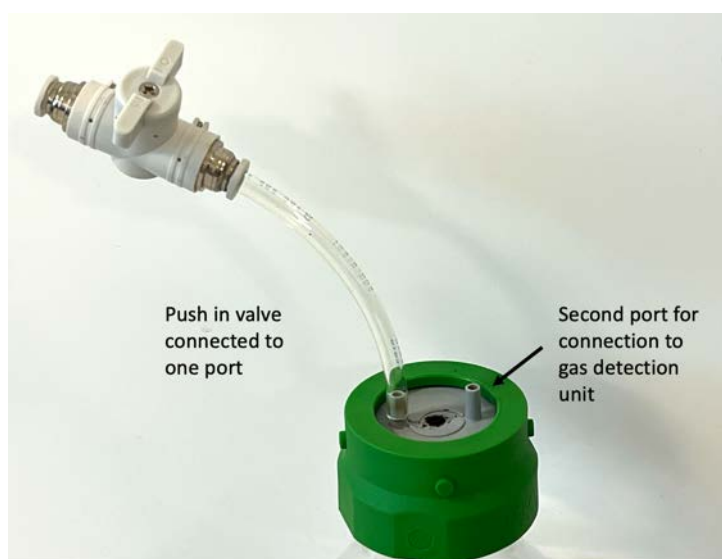
**Step 1:** Unpack the instrument and place the thermostatic water bath on a flat and stable surface.

**Step 2:** Remove the blue plastic protection on the thermostatic water bath lid, mount the legs and handles and place the lid on top of the thermostatic water bath.

**Step 3:** Fix the reactors after adding the samples by following the instructions below:



**Step 4:** Place the reactors inside the thermostatic water bath. Add a piece of tubing to the push-in valve and attach it to one of the 2 ports on the lid (the other one is the gas outlet).



A funnel is provided with the instrument to facilitate the introduction of solid samples inside the reactor. Once all reactors are in place, distilled/deionised water needs to be added into the thermostatic water bath until the recommended level by using the designated hole on the thermostatic water bath lid.

**NOTE:** As the thermostatic water bath uses a conductivity sensor protect it from running dry, some ions need to be added to the water. If not, an alarm will go sound and the water bath will not work. It is therefore recommended to add some table salt or tap water to the water. The exact amount to add will differ from lab to lab, but a good starting point is 20 mg NaCl per litre (of water inside the water bath) or 20 ml of tap water per litre.

In the thermostatic water bath, the temperature is controlled by a simple and intuitive digital interface. The instrument contains 2 LED screens: the first one displaying the current temperature (PV) and the second one showing the desired temperature (SV). Press the button **SET** to determine SV. The desired temperature can be easily selected by using the shift digit, increase and decrease buttons. When the button **SET** is pressed, the last digit of the value displayed in SV blinks, indicating that the respective digit can be changed by pressing the buttons increase (Λ) and decrease (V). If there is a considerable difference between the current and desired temperature in SV, the user can use the shift digit button (R/S) to select the first digit and quickly go from 30 to 60°C, for example. Once the desired temperature is selected, press the button **SET** again to save the value. Once the desired temperature is established, the instrument will heat the water until PV and SV reach the same values. When the light **HEAT** is on, it is an indication that the instrument is on heating mode. When the temperature in PV is close to reach the SV, 2° C from SV, the light **HEAT** will start blinking until the desired temperature is achieved.



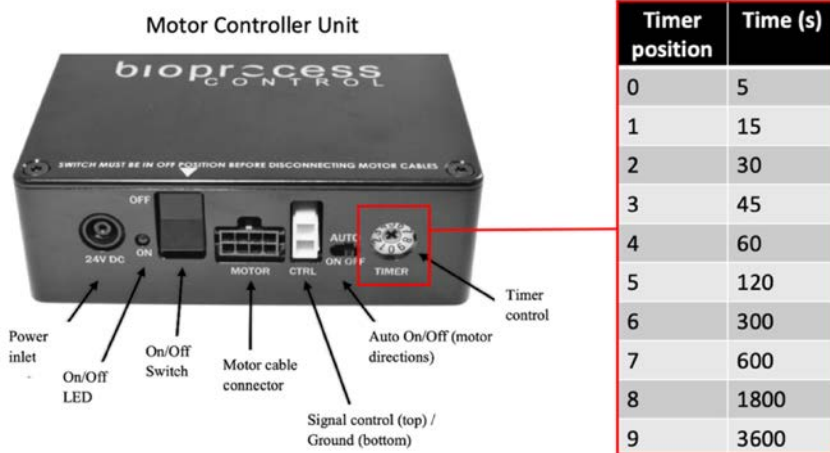
**NOTE:** Check periodically the water level inside the thermostic water bath.

**Step 5:** Fixing the agitation system. Connect the short motor cables (250 mm) in series by attaching one short motor cable to each motor (excluding the last motor in the chain), and then connecting the free end of the cable from motor 1 to the free port on motor 2 and so on until motor 3. Repeat the same operation for the remaining six motors, creating three groups of motors connected to each other through short cables. After that, connect the 500 mm motor cable from the last motor in the chain of each group to the motor power splitter. Finally, use the 1500 mm motor cable to connect the power splitter to the MCU. The last step is to connect the signal cable from the motor controller to the detection unit.

**NOTE:** Make sure that the power adapter for the motor controller is disconnected from the power supply when inserting or removing the motor cables.

From the motor it is only possible to control the direction of the mixing, clockwise (CW), AUTO and counterclockwise (CCW). If users select AUTO, the motor controller will dictate the change of direction at certain intervals using the timer, if the motor controller's AUTO is ON. Since the signal cable connects the motor controller to the BRS-B unit, the phase (single or double) and speed can be controlled using the software (see page 24).





**Step 7:** Add distilled water inside the FCU and place them on the detection unit.

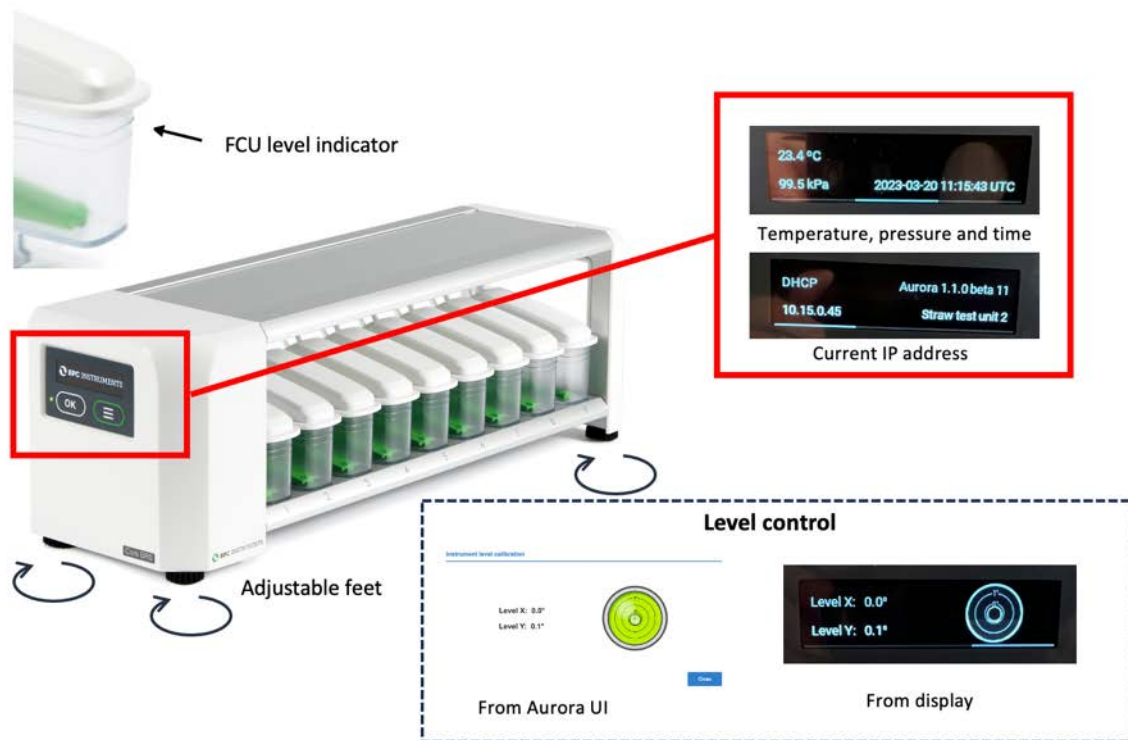


Each FCU has an inlet and outlet for the gas. Use the syringe to introduce water through the inlet of the FCU



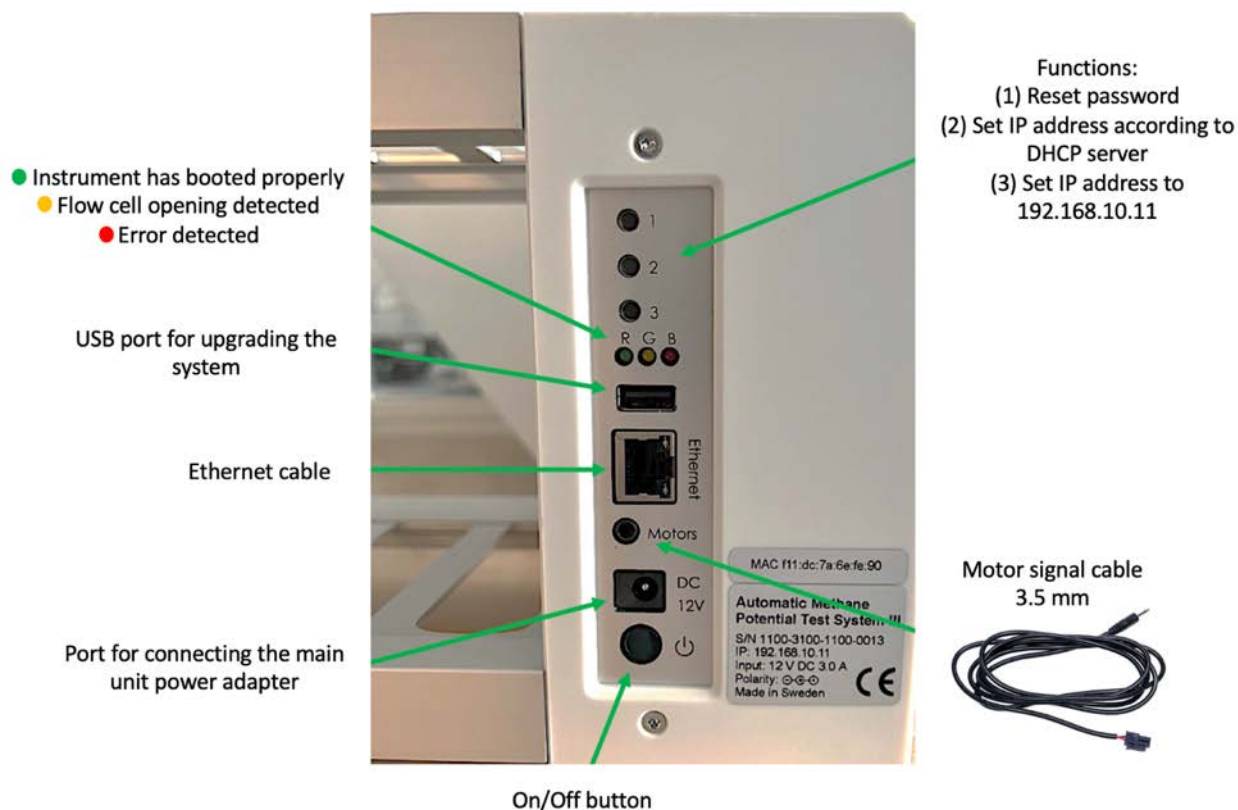
The water should be added until the recommended level

Make sure that each FCU is perfectly seated (horizontally levelled) on the BRS-B Unit. It can be easily observed by checking the **FCU level indicator** and the level control from the software or the OLED screen as shown below. **Adjustable feet** are used to level the instrument.



The BRS-B unit is equipped with an OLED screen that provides information regarding the status of the instrument (environmental conditions, time, current IP address used by the instrument and alignment indicator). This can be accessed through two physical buttons located below the screen.

Backside of the BRS-B unit:



**Step 8:** Cut 9 pieces of Festo tubing sufficient in length to connect the gas outlet of each reactor to the corresponding FCU. In order to simplify this procedure, use push-in connectors (two per channel) provided with the instrument. To avoid water flowing back from FCU, check valves can be inserted close to the inlet of each FCU in order to the target flow in one direction only.



**NOTE:** If the user wants to flush the reactors to create the anaerobic environment, disconnect the tubing from the CO<sub>2</sub>-absorption unit before to eliminate the risk of damaging the external check valves (if used) by the high-pressure gas flow.

**Step 9:** Use the softer binder to group tubing of channels that are related to each other. If the test is conducted in triplicate, it is possible to put together three groups with three channels (tubing) each based on the content of the reactors. In order to easily identify each channel, add the multi-coloured marker clamps (two per channel) provided in different colors. Mark each channel by writing the proper description using a ballpoint pen, water-based pen, marker, etc. After the experiment, users can wipe the label off with a wet tissue and reuse them.



Soft binder 7/180 mm



Multi-coloured marker clamps

**Step 10:** In order to start the test, access the software following the instructions in Chapter 6 of this manual. Add the parameters required for the test and make sure that the status of each channel is classified as **ready** before starting the gas measurements. When using the instrument for the first time, the cell volume of each channel needs to be entered in the control page. A calibration sheet is delivered with the equipment, where the serial number of the flow cell unit is listed together with its calibrated volume. It is important to know where each flow

cell unit will be placed on the system, so that the calibrated values can be entered in the right position.

**NOTE:** Testing the detection unit and software. Before starting the experiment, simulate a flow cell opening by manually removing each FCU and put it back in numerical order from 1 to 9 (repeat this procedure three times). Follow the corresponding result of each opening on the plots in the Graph page of the software to make sure that both the detection system and data acquisition system function properly.

**Step 11:** Once the experiment is finished, generate and download a report in the report menu of the software. Turn off the thermostatic water bath and the motors, including the motor controller. Next, unplug the power adapters (for the Motor Controller and the Gas Volume Measuring Device) from the power source. Disconnect the tubing and remove the lids from the reactors and CO<sub>2</sub> removal bottles after the tests. These components are often difficult to remove after the experiments, since they sit very tightly after usage, specially the tubing to the different connectors. BRS is equipped with a bottle/tube opening tool to easily remove lids and tubing without the risk of damaging them and the connectors.



Bottle/tube opening tool

**Step 12:** The content of glass 2 l reactors after disconnection from gas tubes and agitation motors, is discharged in the proper way, the reactors are disassembled, all parts washed carefully with a proper detergent, and rinsed with water. In case needed, the parts which were in contact with inoculum are sterilized by autoclavation.

## 6 BRS SOFTWARE

### Computer Network Configuration

In order to have access to the web-based software, follow the steps outlined below (this procedure is described considering the most common operating system setups – **Windows 11** and **Mac Os 12.x**):

1

Connect the shielded Ethernet cable to the detection unit  
Connect the shielded Ethernet cable to a computer.


2

Start → Settings → Network & Internet → Ethernet (select the Ethernet network you are connected to) → Edit network IP settings → Manual → IPv4 → Insert IP address and Subnet mask

IP address: 192.168.10.10  
Subnet mask: 255.255.255.0  
Default gateway:



Windows 11

Press  (in the top left corner) → System preferences → Network settings → Ethernet (select the Ethernet network you are connected to) → Configure IPv4: manually → Insert IP address and Subnet mask

Configure IPv4: Manually  
IP address: 192.168.10.10  
Subnet mask: 255.255.255.0  
Router:



Mac OS 12.x

3

Open a web browser (preferably Google Chrome) and insert **192.168.10.11**

	Instrument	Computer
IP address	192.168.10.11	192.168.10.10
Subnet mask	255.255.255.0	255.255.255.0
Default gateway / Router	Leave empty	Leave empty

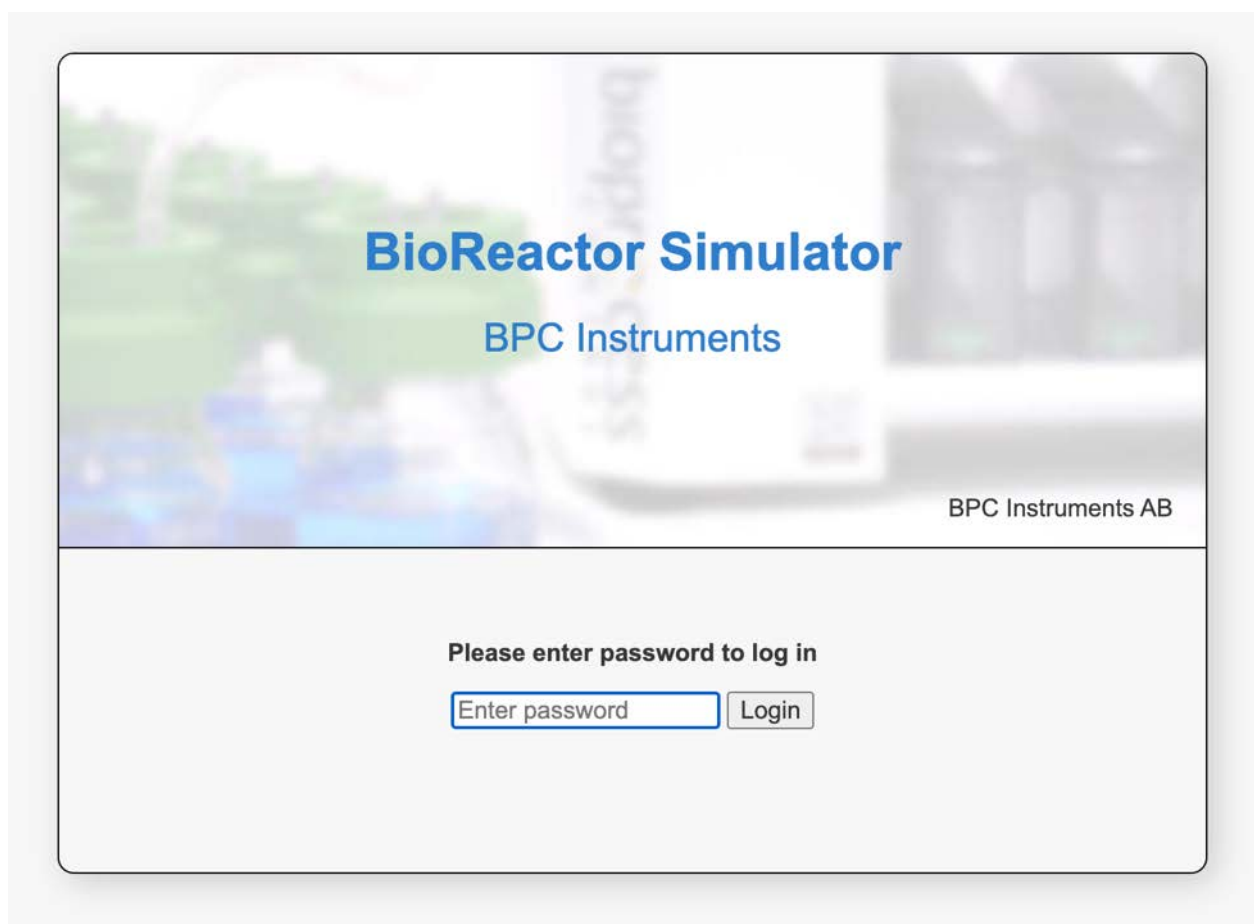
**NOTE:** 192.168.10.10 is the suggested IP to be assigned to the computer connected to the instrument in the network settings of the computer. IP address for the computer and the IP address for the BRS-B Unit are different. This is a design requirement of the IP protocol. Care needs to be taken so that the same address is not used in both locations, as it will render the system inaccessible from the designated computer. When using multiple BPC Core Units, make sure that each unit has its own IP address. This can be achieved by changing the last digit of the IP address.



The OLED screen in the detection unit will display whether the instrument uses a manually assigned IP or an automatic IP assigned by a DHCP server as well as what IP address is currently in use and the version of the instrument's software. In this way, it is simple and easy to connect the instrument to a computer or network.

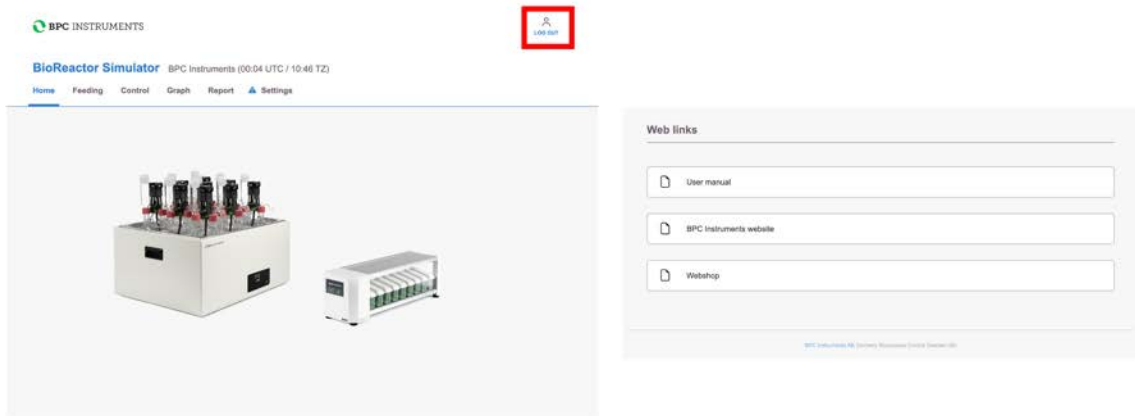
### **Aurora™ Software Description**

After inserting the default IP address of the instrument, users will have access to the **Log in** page (Figure 7). On the Log in page, the default password **bpc** needs to be added.



**Figure 7.** Log in page for BRS.

In the **Home** page, users get an overview of the features of the software, where the topics are ordered according to experimental setup, execution, monitoring and finally documented. In addition, three useful links are provided together with the Log out function (Figure 8).



**Figure 8.** Home page for BRS.

In the **Feeding** page for BRS (Figure 9), 9 lines are related to the 9 reactors where each one of them should be properly labelled based on its content. The page is divided into two sections: the upper one gives an overview of each lines feeding settings and the bottom one is a list of each individual feeding recorded. Please note that the feedings in the software is only for data recording functions so that it is possible in the software to follow the gas production together with the operational data. In other words, the instrument is not able to control any actual feeding. That is up to the user to carry out either manually or with their own automatic setup.



## BioReactor Simulator BPC Instruments (12:44 UTC / 14:47 TZ)

Home **Feeding** Control Graph Report Settings

### Inflow/Outflow

Line	Name	Reactor volume [ml]	Unit of conc. [%] TS VS COD	Automatic	Interval [min]	Next	Count	Status
1	Line 1	2000	<input type="radio"/> TS <input checked="" type="radio"/> VS <input type="radio"/> COD	<input checked="" type="checkbox"/>	1	8s	8	Running
2	Line 2	2000	<input type="radio"/> TS <input checked="" type="radio"/> VS <input type="radio"/> COD	<input checked="" type="checkbox"/>	1	8s	7	Running
3	Line 3	2000	<input type="radio"/> TS <input checked="" type="radio"/> VS <input type="radio"/> COD	<input type="checkbox"/>	1440	23h 53m 8s	1	Running
4	Line 4	2000	<input type="radio"/> TS <input checked="" type="radio"/> VS <input type="radio"/> COD	<input type="checkbox"/>	1440	23h 53m 8s	1	Running
5	Line 5	2000	<input type="radio"/> TS <input checked="" type="radio"/> VS <input type="radio"/> COD	<input checked="" type="checkbox"/>	720	23h 53m 8s	1	Running
6	Line 6	2000	<input type="radio"/> TS <input checked="" type="radio"/> VS <input type="radio"/> COD	<input checked="" type="checkbox"/>	720	23h 53m 8s	1	Running
7	Line 7	2000	<input type="radio"/> TS <input checked="" type="radio"/> VS <input type="radio"/> COD	<input checked="" type="checkbox"/>	1440	23h 53m 8s	1	Running
8	Line 8	2000	<input type="radio"/> TS <input checked="" type="radio"/> VS <input type="radio"/> COD	<input checked="" type="checkbox"/>	1440	23h 53m 8s	1	Running
9	Line 9	2000	<input type="radio"/> TS <input checked="" type="radio"/> VS <input type="radio"/> COD	<input checked="" type="checkbox"/>	1440	23h 53m 8s	1	Detached

1 2 3 4 5 6 7 8 9

◀ 2023-09-18 12:44 ▶ Page 1/1 ▶▶

Add feeding

Time [UTC]	Sample	Sample concentration [%]	Sample amount [g]	Organic amount [g]	Loading rate [g/l/day]	Retention time [days]	
2023-09-18 12:44	Sample A	20	24,0	4.8	3456.0	0.1	✕
2023-09-18 12:43	Sample A	20	24,0	4.8	3456.0	0.1	✕
2023-09-18 12:42	Sample A	20	24,0	4.8	3456.0	0.1	✕
2023-09-18 12:41	Sample A	20	24,0	4.8	3456.0	0.1	✕
2023-09-18 12:40	Sample A	20	24,0	4.8	3456.0	0.1	✕
2023-09-18 12:39	Sample A	20	24,0	4.8	3456.0	0.1	✕
2023-09-18 12:38	Sample A	20	24,0	4.8	3456.0	0.1	✕
2023-09-18 12:37	Sample A	20	24,0	4.8	0.0	0.0	✕

Figure 9. Feeding Page

In Figure 10 the different parameters of the feeding settings are explained.

Description of each channel		The unit used to characterise the organic matter in the sample and the inoculum		At what interval the reactors are fed.		Number of recorded feedings		Status
Line	Name	Reactor volume [ml]	Unit of conc. [%] TS VS COD	Automatic	Interval [min]	Next	Count	
1	Line 1	2000	<input type="radio"/> TS <input checked="" type="radio"/> VS <input type="radio"/> COD	<input checked="" type="checkbox"/>	1	8s	8	Running

Indicates each channel of instrument

Volume of reactor (used for calculation of process parameters)

If feedings should be added automatically or not

Time to next feeding

Status of experiment

**Figure 10.** Description of feeding settings

Each channel has a list of recorded feedings that can be accessed in the table at the bottom of the feeding page. Here it is possible to add, remove and change already recorded feedings (Figure 11).

Select channel to view							Amount of feedstock added
1	2	3	4	5	6	7	
Select time period for feedings in table							Add feeding
Time [UTC]	Sample	Sample concentration [%]	Sample amount [g]	Organic amount [g]	Loading rate [g/l/day]	Retention time [days]	
2023-09-18 12:44	Sample A	20	24,0	4.8	3456.0	0.1	

Time of feeding

Name/description of feedstock

Concentration of feedstock

Amount of feedstock added

Organic amount added (calculated)

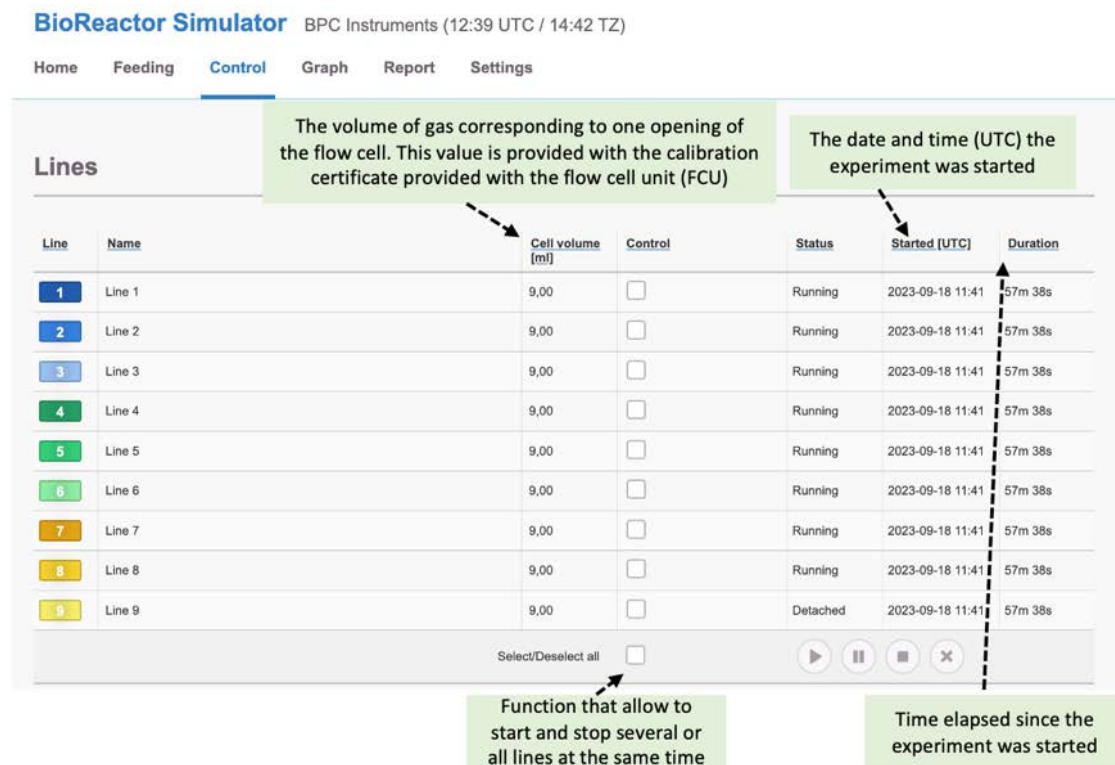
Organic Loading rate of feeding (calculated).

Hydraulic retention time of feeding (calculated)

**Figure 11.** Description of feeding log





The **Control** tab is where direct interaction with the channels and motors are conducted (Figure 12). Using the Aurora<sup>TM</sup> software, it is possible to start and stop all or just selected channels.

On the **Control** page 9 lines are related to the 9 reactors where each one of them should be properly labelled based on its content. This tab is where direct interaction with the channels and motors are conducted, where users can start and stop all or just selected channels (Figure 12). Note that before starting the experiment, it is required to input the FCU volume for each channel. The exact FCU volume is provided in the specification delivered with the FCUs.



**Figure 12.** Description of control page

Located at the bottom right of the lines section is the control panel for the flow cell units. These work as follows:

-  Start data registration. In order to be able to press this button, the status needs to be **ready**
-  Pause data registration. In order to be able to press this button, the status needs to be **running**
-  Stop data registration. In order to be able to press this button, the status needs to be **paused**
-  Clear all data registrations. In order to be able to press this button, the status needs to be **stopped**

Regarding the agitation system, the motors can be controlled in *continuous (single)* or *two-phase (double)* modes. With the two-phase mode, the motors can run intermittently at two different speeds or as ON and OFF. (Figure 13).



	Speed [%]	Time [min]
Phase 1	30	10
Phase 2	10	10

**Figure 13.** Controlling the agitation system through the software.

The **Graph** page (Figure 14) presents two graphs, gas flow rate as a function of time and gas flow loading rate (g/l/day) as well as Retention time (days) as a function of time. The gas volume can be presented in three different ways: without normalization, with normalization without considering the moisture content (dry), and with normalization considering the moisture content (wet). There are three possible units for the gas flow: Nml /min, NmL /h, and Nml/day.

**BioReactor Simulator** BPC Instruments (12:42 UTC / 14:45 TZ)

Home Feeding Control **Graph** Report Settings

**Gas flow**



☒ Select/Deselect all

**Gas normalisation**

Gas normalisation Wet

**Gas flow unit**

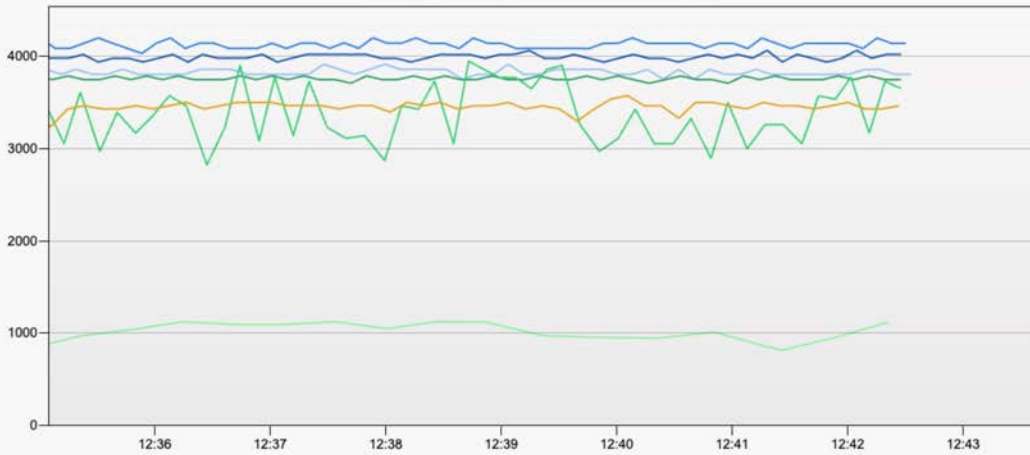
Gas flow unit Nml/h

**Time frame**

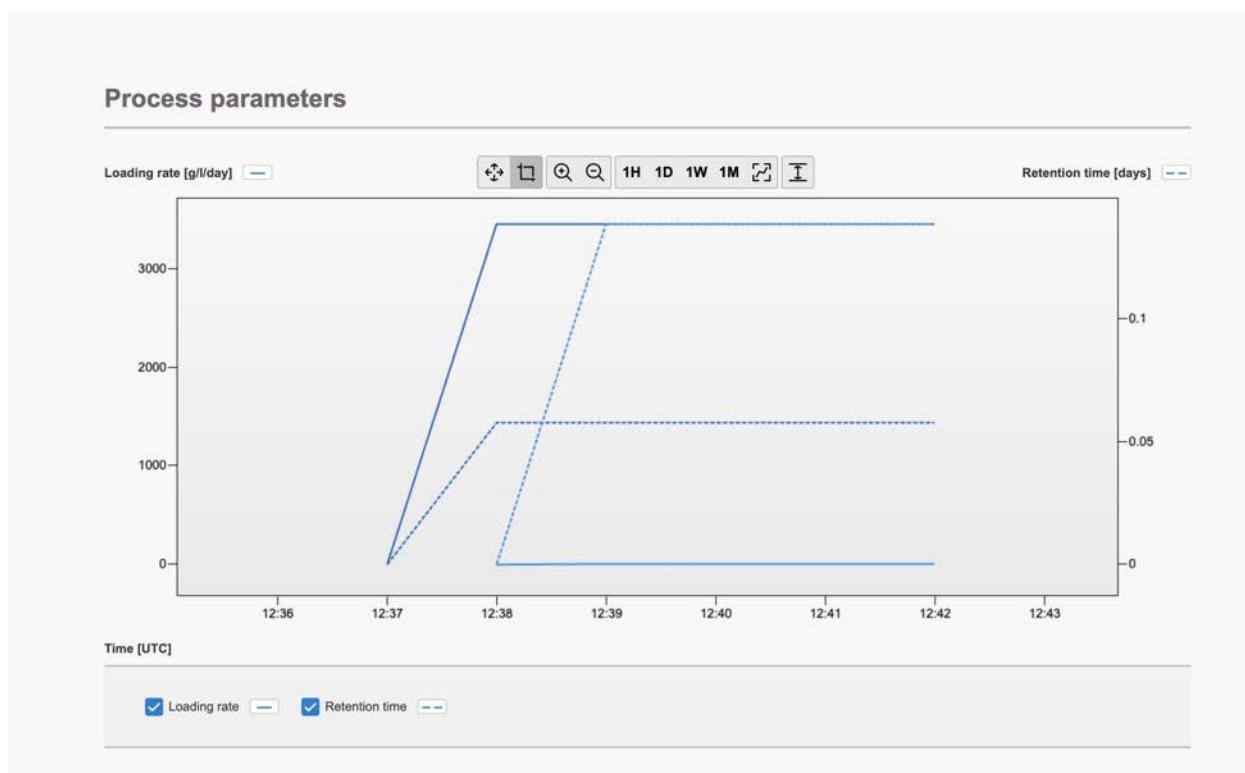
Start date 2023-09-18 12:35

End date 2023-09-18 12:43

Gas flow rate [Nml/h]



Time [UTC]





**Figure 14.** Graph page

Upon initiation of gas registration, the line undergoes a colour transformation from a greyish hue to match the specific colour of the corresponding line. Users have an option to zoom the graphs in order to get a better visualization of the real-time data. Within the graph, users can select individual points along the curve, and for each selected point, details about the corresponding time and gas flow rate will be provided.

**NOTE:** The graph requires at least three data points (i.e., flow cell openings) in order to display information. To simulate an opening during testing, briefly remove the FCU and place it right back; wait a few seconds and then repeat the action one more time. If everything is working properly, a line should appear in each graph. The time axis presents absolute time rather than relative time of the experiment. It is important to set a proper time zone in Settings.

Users have the flexibility to download and generate reports at any time during the experiment from the **Report** tab (Figure 15). This page offers the option to download data from each channel and raw data can be obtained in a CSV format, allowing for individual line downloads or combining them into a single file.

### Report settings

Start date	2023-09-18 00:00 
End date	2023-09-18 12:42 
Gas normalisation	Wet ▼
Gas flow unit	Nml/h ▼
Interpolation interval	Day ▼
Report file format	Microsoft Excel (XLSX) ▼

[Download reports](#)

**Figure 15.** Report settings available

The **Settings** page (Figure 16) serves as a comprehensive hub for instrument configurations, providing various information and functions such as versions, licenses, reset function, experiment type and a logfile. Occasionally, you may notice a blue triangle with a white exclamation mark next to the settings tab in the software. This symbol indicates that there are log entries requiring review or adjustments. If the symbol appears next to a specific setting, it means that this particular setting requires attention. A practical example is illustrated in Figure 16, where a warning pertaining to instrument level calibration is displayed. The warning message not only highlights the specific issue but also offers detailed guidance on resolving the problem. To clear the warning on the logfile, the clear log button needs to be pressed after reviewing and saving the information.

## System information

### System information

Software version: Aurora 1.2.3  
Hardware version: 1083-6.3.1-310-4  
Serial number: 1100-3100-9100-1013

### Software licenses

Copyright BPC Instruments AB

Show open source licenses

## Calibration settings

### Time settings

Instrument: Mo, 2023-10-02 10:59:47 UTC  
Web browser: Mo, 2023-10-02 10:59:47 UTC

Synchronize now

### Instrument level calibration

Instrument level calibration

Warning: The instrument is not level. This may affect measurements. Please use the level function to adjust it.

Reset accelerometer

Show level

### Temperature calibration

Instrument temperature [°C]: 24.1  
Actual temperature:

Save

### Pressure calibration

Instrument pressure [kPa]: 98.8  
Actual pressure:

Save

## System settings

### Instrument name

Instrument name: BPC Instruments

Restore

Save

### Change system password

New password:

Confirm password:

Change password

### System power

Restart the system

Restart

### System reset

Reset to factory default

Reset

### System software update

Choose file: No file chosen

Start update

## Network settings

### Ethernet

Mac address: B8-DC-7A-5D-04-72

Assigned IP: 192.168.10.20

Configuration: ☒ DHCP ☐ Manual

IP: 192.168.10.11

Mask: 255.255.0.0

Gateway: 192.168.10.1

Restore

Save

### Hostname

Hostname: B8-DC-7A-5D-04-72

Restore

Save

## System warning log

2020-01-01 00:00 UTC: POWER RESTORED: Some openings may not have been registered during the power outage.  
2023-10-02 09:35 UTC: POWER OUTAGE: Experiment running. System will automatically shut down to protect experiment data.

Clear log



**Figure 16.** Settings page.

Two settings are generally described below:

1. **Network settings:** Displays IP and Mac address for the instrument. Also allows for configuring the built-in network adapter using either DHCP or manual configuration.
2. **System warning log:** Contains a list of events registered by the instrument which might be useful when trying to resolve an issue. Please have this information ready when contacting support.

## 7 MAINTENANCE

In order to ensure that the instrument and its constituent parts will operate properly for a long period of time, it is crucial to follow the instructions described on this manual. The lifespan of the instrument and its components will depend heavily on how the equipment is used and well maintained. Always make sure to use the instrument according to the following guidelines:

- The instrument must be kept in a dry and clean environment.
- Avoid applying tap water as bath liquid in the thermostatic water bath, since the minerals included in this type of water might negatively impact the material of the bath chamber (calcification or corrosion of stainless steel).
- The flow cell units cannot be opened and are considered consumables.
- Reactors and stirrers are consumables that can be autoclaved.
- To clean the detection unit, wipe it with a damp piece of cloth and, if required, a gentle form of detergent. Water must not get into the machine since it can harm electrical components.

All consumables are easily replaceable in the instrument. The spare parts can be ordered from BPC Instruments. For further information, please visit our webshop (link below):

<https://webshop.bpcinstruments.com>

BPC Instruments also provides a *Maintenance Package* where users can get all consumables that are recommended to be changed at regular intervals