BactoSense User Manual

English

Software 3.2.0

Document ID: UM-0006

Compiled on 16 November 2026

https://manual.bnovate.net/bactosense/

Contents

BactoSense

1. Glossary

2. General User Information

3. Instrument Overview

4. Safety

5. Installation

6. I/O-Box

7. Field Bus Interface

8. General Operations and Configurations

9. Upgrade Packages

10. Measurements

11. Results and Data Analysis

12. Data Access and Export

13. Web User Interface

14. BactoCloud

15. Maintenance

16. Warnings, Errors and Troubleshooting

17. Storage, Transport and Disposal

18. Supply Scope, Accessories and Consumables

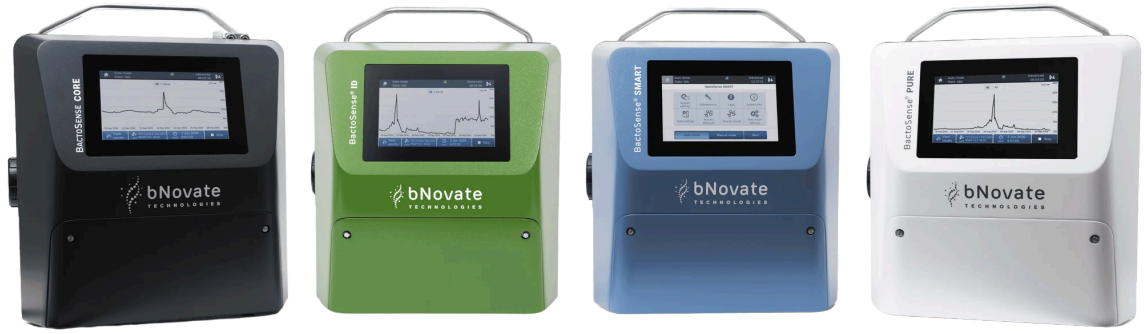
19. Contact

20. Index

BactoSense

Software version **3.2.0**

Rapid Bacterial Monitoring Systems



Getting started

- General user information
- Instrument overview and technical data
- Safety
- Installation

Operating the instrument

- General operations and configurations
- Measurements
- Results and data analysis
- Maintenance
- Warnings, errors and troubleshooting

Interfaces and data

- I/O-Box
- Field bus interface
- Data access and export
- Web user interface
- BactoCloud

Publisher

bNovate TECHNOLOGIES

bNovate Technologies SA
Ch. Dent d'Oche 1A
CH-1024 Ecublens
Switzerland

Tel. +41 21 552 14 21
info@bnovate.com
www.bnovate.com

© bNovate Technologies SA, subject to technical changes without notice.

This document has been written by bNovate Technologies SA. Copying or modifying the content or giving this document to third parties is permitted only with the express consent of bNovate Technologies SA.

1. Glossary

Term	Explanation
ACC	Active Cell Count. The ACC cartridge measures metabolically active cells using an enzymatic assay. ACC is the number of cells inside the ACC gate, per milliliter.
CBC	Coliform Bacteria Count. The CBC cartridge measures intact and metabolically active coliforms using an enzymatic assay. CBC is the number of cells inside the CBC gate, per milliliter.
Cartridge	Refillable container of reagents needed for BactoSense operation
EBC	E. coli Bacteria Count. The EBC cartridge measures intact and metabolically active E. coli using an enzymatic assay. EBC is the number of cells inside the EBC gate, per milliliter.
FCS	Flow Cytometry Standard (FCS) is a data file standard for the reading and writing of data from flow cytometry experiments. The FCS specification has traditionally been developed and maintained by the International Society for Advancement of Cytometry (ISAC). FCS used to be the only widely adopted file format in flow cytometry.
FL1	Fluorescence signal 1 (530 nm)
FL2	Fluorescence signal 2 (715 nm)
FSC	Forward scatter, also known as Small Angle Light Scattering. A detector measures the light scattered from microorganisms and other particles at small angles.
Gate	Gates are tools for data analysis of a subset of data points in flow cytometry.
HNA	High Nucleic Acid. Bacteria with a large amount of DNA which produce a strong fluorescence emission.
HNAC	High Nucleic Acid Count. The number of HNA bacteria inside the TCC or ICC gate, and above the HNA / LNA limit.
HNAP [%]	High Nucleic Acid Percentage. The percentage of HNA bacteria relative to the cell count.
ICC	Intact Cell Count. Total number of intact bacteria inside of the ICC gate, per milliliter.
LNA	Low Nucleic Acid. Bacteria with a lower amount of DNA which produce a weaker fluorescence emission than HNA bacteria.
LNAC	Low Nucleic Acid Count. The number of LNA bacteria inside the TCC or ICC gate below the HNA / LNA limit.

Term	Explanation
Manual Sampling Device	Connection module, allowing manual sampling with the BactoSense Online.
NBC	Enterococcus Bacteria Count. The NBC cartridge measures intact and metabolically active enterococci using an enzymatic assay. NBC is the number of cells inside the NBC gate, per milliliter.
Online Sampling Device	Connection module to a water line, allowing online sampling with the BactoSense Online.
SSC	Side scatter, also known as Large Angle Light Scattering. A detector measures the light scattered from microorganisms and other particles at 90 degrees.
TCC	Total Cell Count. Total number of bacteria detected inside the TCC gate, per milliliter.

2. General User Information

2.1 About this user manual

This user manual provides the user with helpful information about the entire life cycle of the BactoSense and its peripheral devices. Before commissioning and using the instrument, you should be completely familiar with the user manual.

The user manual is intended for all persons who are responsible for the operation and maintenance of the instrument. This document is part of the product. It should be stored in a safe place and always be available to the user.

The most recent version of this document can be ordered from the bNovate representative in your country. A list with all bNovate representatives can be found on our website: www.bnovate.com/distribution-partners.

Additional associated product documentation can be found in the table below.

Table 2-1 Additional documentation

SUPPORTING DOCUMENTATION

40101	Quick Guide	Basic information needed to operate the BactoSense.
40108	Cleaning Kit User Manual	Usage of the reagent kit to decontaminate the BactoSense.
UM_0003	Validation Kit User Manual	Usage of the reagent kit used to validate proper functioning of the BactoSense.
UM_0004	SST Kit BactoSense PURE User Manual	Usage of the reagent kit to perform the system suitability test.
50115	CE declaration of conformity	Compliance with the underlying directives and standards.
50116	UKCA declaration of conformity	Compliance with the underlying directives and standards.
50117	CB test report	UL/CSA/FCC compliance report, also under CH-12116 on https://certificates.iecee.org

2.2 Compliance and applied standards

The BactoSense has been designed and manufactured to meet or exceed industry-recognized standards to ensure the safety, performance, and reliability of the product.

CE

The device meets all applicable requirements for carrying the CE mark. For more details, please refer to the separate declaration of conformity.

UK CA

The device meets all applicable requirements for carrying the UKCA mark. For more details, please refer to the separate declaration of conformity.

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations (CAN ICES-001 (B) / NMB-001 (B)).

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This device is protected from total dust ingress and from low pressure water jets from any direction (IP65).

This device complies with FCC, UL/CAN/CSA-C22.2/IEC 61010-1 and JIS C 1010-1. For more details refer to the CB test report. (https://certificates.iecee.org: CH-12116).

The following standards have been applied to guarantee compliance with regulatory requirements:

APPLIED STANDARDS

Safety (General) (Heating Element) (Laser)

- IEC 61010-1:2010
- IEC 61010-1:2010/A1:2016
- CAN/CSA-C22.2 No. 61010-1 + A1
- UL 61010-1, 3rd Edition A1
- JIS C 1010-1:2019
- IEC 61010-2-010:2019
- CSA C22.2 No. 61010-2-010:19
- EN 60825-1:2014 + A11:2021
- CAN/CSA-E60825-1:15

EMC

- EN IEC 61326-1:2021
- EN 61326-1:2013, Class B, Group 1
- CISPR 11:2015/A1:2016/A2:2019
- EN 61000-3-2:2018
- EN 61000-3-3:2013/A1:2017
- EN 61000-3-11:2017
- EN 61000-3-12:2011
- EN 61000-4-2:2008
- EN 61000-4-3:2006/A1:2007/A2:2017
- EN 61000-4-4:2012
- EN 61000-4-5:2014/A1:2017
- EN 61000-4-6:2016

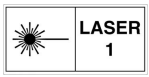
- EN 61000-4-8:2009
- EN 61000-4-11:2020
- EN 55011:2016/A1:2017/A2:2021/A11:2020

Ingress Protection

- IEC 60529:1989
- IEC 60529:1989/A1:1999
- IEC 60529:1989/A2:2013
- IEC 60529:1989/A2:2013/C1:2019
- EN 60529:1991/A1:2000/A2:2013

RoHS

- EN IEC 63000:2018



The BactoSense is classified as a Class 1 Laser product according to the standard IEC 60825-1:2014/A11:2021.

2.3 Safety symbols

The symbols below identify hazards and required protective equipment. Warning and Caution use the same exclamation symbol; read the title and instructions in every box.

DANGER: ELECTRIC SHOCK

Electric shock that may result in serious injury or death

Ignoring this notice may lead to electrical shocks and death.

DANGER: EXPLOSION HAZARD

Explosion that may result in serious injury or death

Ignoring this notice may cause explosions resulting in serious property damage and death.

WARNING: RISK OF INJURY

Injury or hazards to health with long-term effects

Ignoring this warning may lead to injuries with possible long-term effects.

CAUTION: MATERIAL DAMAGE

Ignoring this notice may cause material damage to the instrument and its peripherals.



WEAR PROTECTIVE GLOVES

Mandatory protective equipment

Wear the specified protective gloves when handling samples, sampling devices, cartridges or components that come into contact with samples.

2.4 Pictograms

All pictograms used in this document are explained below:



ADDITIONAL INFORMATION

Additional information about the current topic.

2.5 Intended use of the BactoSense



INTENDED USE

The intended use of the BactoSense is to measure the concentration of microorganisms in water. In particular, the instrument has been developed to count and characterise bacterial populations.

The instrument must be operated by trained technical personnel who have read and understood the content of the user manual.

2.6 Usage restrictions



EXPLOSIVE ENVIRONMENTS

Operation in explosive areas can cause explosions, which can lead to the injury or death of persons in the vicinity.

- It is not permitted to operate the instrument in explosion hazardous areas or rooms.
- It is not permitted to use the instrument with explosive sample substances.

2.7 Improper use

IMPROPER USE

Improper use of the instrument can cause injuries to persons, process-related consequential damage and damage to the instrument and its peripherals. In the following cases the manufacturer cannot guarantee the protection of persons, the instrument and surrounding equipment, and therefore assumes no legal responsibility:

- The instrument is not used in the described area of application and intended use.
- The instrument is not installed, mounted, set up or transported in accordance with the user manual.
- The instrument is not operated in accordance with the user manual.
- The instrument is operated with accessory parts or consumables which bNovate Technologies SA has not specifically provided, approved or recommended.
- The instrument underwent improper changes or modifications.
- The instrument is operated outside of the specifications, in particular pressure, temperature and power.
- The instrument is operated with a different power supply unit.
- The instrument is exposed to vibrations, shocks, or other mechanical forces.

3. Instrument Overview

3.1 BactoSense overview

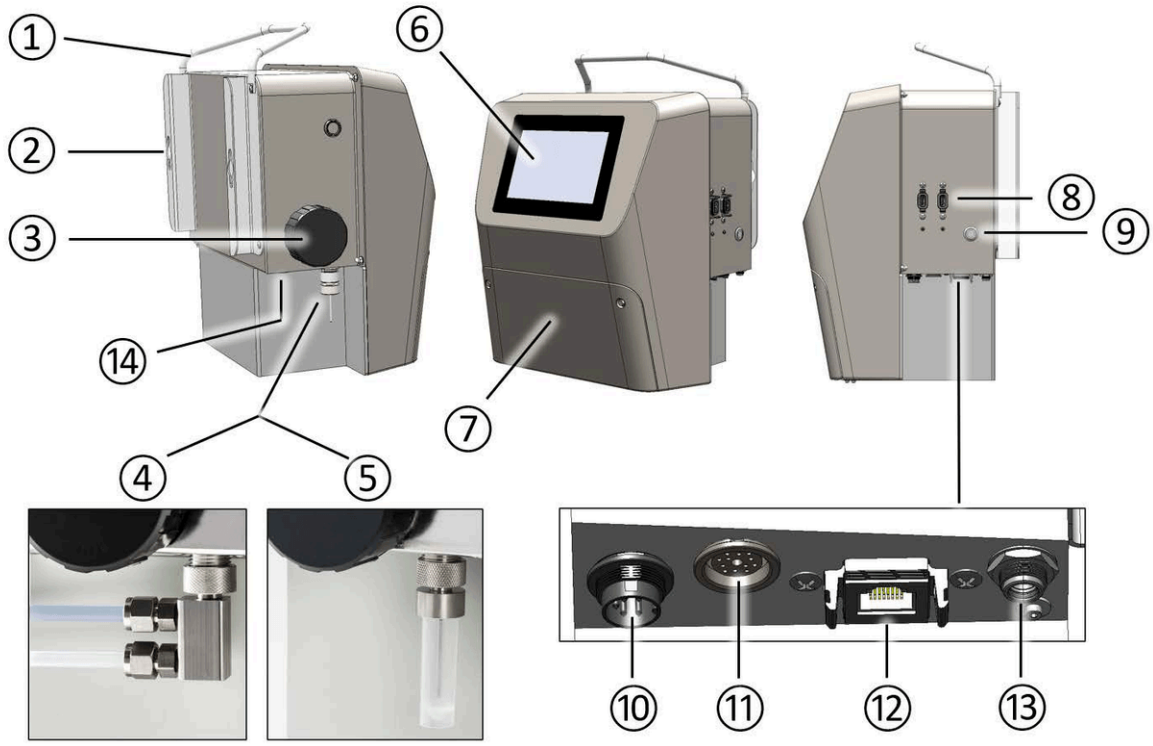


Figure 3-1 BactoSense overview

1	Handle	2	Wall mount
3	Desiccant bag compartment cap	4	Online sampling device
5	Manual sampling device	6	Touchscreen graphical user interface
7	Cartridge compartment door	8	USB sockets
9	Power button	10	Input connector
11	Output connector	12	Ethernet/Modbus TCP interface
13	Power connector	14	USB-C socket

An overview of the cartridge can be found in Cartridge overview.

3.1.1 Type plate of the BactoSense

The type plate of the BactoSense can be found on the right-hand side of the instrument.

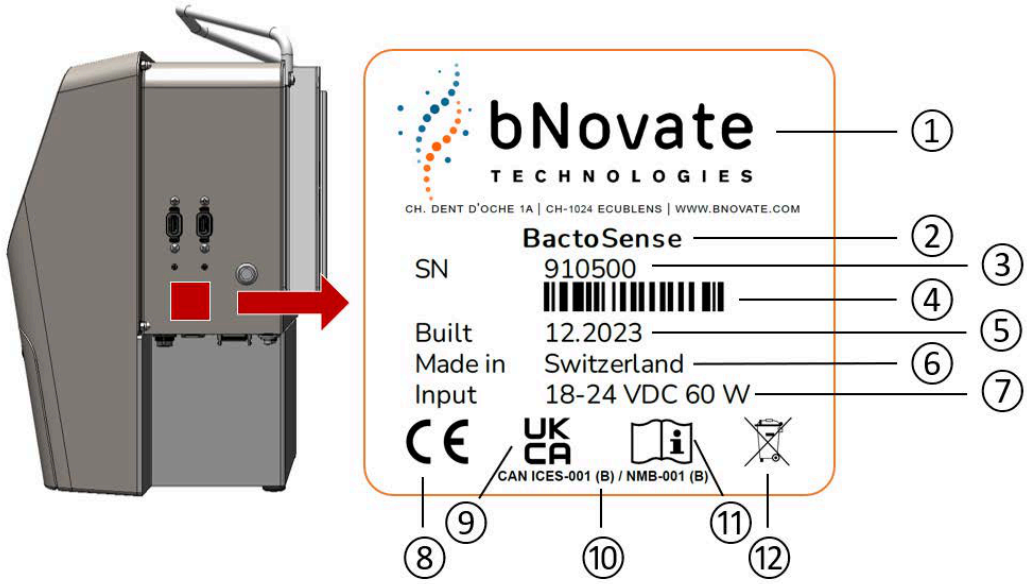


Figure 3-2 Type plate of the BactoSense.

1	Manufacturer	2	Product name
3	Serial number	4	Barcode
5	Manufacturing date	6	Country of origin
7	Voltage and power requirements (see Connecting the BactoSense to power)	8	CE mark
9	UKCA mark	10	Compliance with Canadian EMC and interference standards
11	Read the instructions and operate with caution	12	Disposal information

3.1.2 Type plate of the BactoSense power supply

The type plate of the BactoSense power supply can be found on the power supply and has the following elements:

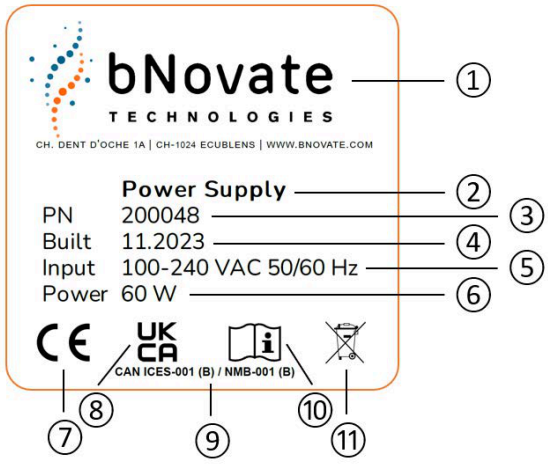


Figure 3-3 Type plate of the BactoSense power supply.

1. Manufacturer
2. Product name
3. Part number
4. Manufacturing date
5. Service voltage and frequency
6. Power consumption
7. CE mark
8. UKCA mark
9. Compliance with Canadian EMC and interference standards
10. Read the instructions and operate with caution.
11. Disposal information

3.2 Technical data

Table 3-1 Technical data and specifications

Property	Specification
GENERAL	
Operating environment	Indoor and protected outdoor use
Operating altitude	Max. 2000 m (6600 ft) above sea level
Operating temperature	5 °C – 30 °C (41 °F – 86 °F)
Operating humidity	10 % – 90 % RH
Storage temperature	15 °C – 25 °C (59 °F – 77 °F)
Storage humidity	10 % – 70 % RH
Ventilation requirements	None
Sound pressure level	< 64 dBA
Protection classes	BactoSense: IP65 Power supply: IP67
PHYSICAL	
Dimension (W x D x H)	361 × 270 × 424 mm (14.2 × 10.6 × 16.7“)
Weight	With cartridge 14.3 kg (31.5 lbs) Without cartridge 11.1 kg (24.5 lbs)
Power supply dimension (W x D x H)	230 × 80 × 65 mm (9.0 x 3.1 × 2.6“)
Power supply weight	0.9 kg (2.0 lbs)
ELECTRICAL	
Installation category	II
Pollution degree	2

Property	Specification
Power supply	Power supply unit: 100 – 240 VAC +/-10 %, 50 / 60 Hz, 1.4 A BactoSense: 18 – 24 VDC, 60 W (see Connecting the BactoSense to power)
Power consumption	Avg. 20 W, max. 60 W
Recovery after power interruption	Configurable auto-restart
INTERFACES, CONNECTIVITY AND REMOTE ACCESS	
USB	2 x USB 3.1, 5 V 1 A per port 1 x USB-C
Ethernet	1 x RJ45 Gigabit Ethernet
Ethernet protocols and options	Web interface Remote desktop (VNC) Modbus TCP HTTP / HTTPS FTP
Digital inputs	4 x digital inputs, optocoupler input: forward voltage 1.2 VDC with 3 kΩ in series, cathode connected to COMMON, max. 30 mA, max. 50 mW
Analogue and digital outputs	Analogue outputs: 2 × 0/4 – 20 mA, recommended 250 Ω load Digital outputs: 4 x digital outputs, freely configurable, SSR output: max. 48 VDC, max. 300 mW, ON-resistance 2 Ω
Display	WVGA, 7.0'' capacitive touchscreen
Mobile connectivity	BactoLink connectivity module (optional)
Advanced data analysis	FCS 3.1 file export
Data storage capacity	128 GB
MEASUREMENT	
Measuring principle	Flow cytometry
Detection range	0 – 5´000´000 cells/mL
Quantification range	1000 – 2'000'000 cells/mL for TCC 100 – 2'000'000 cells/mL for ICC, ACC, CBC, NBC, EBC
Laser type and wavelength	Laser diode 488 nm
Fluorescence	530/50 nm FL1 715 LP nm FL2
Forward scatter (FSC)	488 nm, instrument dependent

Property	Specification
Side scatter (SSC)	488 nm, instrument dependent
Result parameters	Primary result parameters: TCC, ICC, ACC, CBC, NBC, EBC Secondary result parameters, cartridge and configuration-dependent: HNAP, HNAC, LNAC, HACC, Gate+
Automatic measuring interval	Min.: 30 min for TCC, ICC, 45 min for ACC, 60 min for CBC, NBC, EBC Max.: 6 hours
SAMPLING	
Sampling type	Online or manual
Online sampling device	Flow through device: 200 – 400 mL/min (0.05 – 0.10 gal/min) Pressure in device: Max. 0.5 bar (7.3 psi) Aspirated volume: 260 µL Measured volume: 90 µL Inlet tubing • Material: PFA (transparent) • Outer diameter: 6.35 mm (1/4″) • Inner diameter: 4.35 mm • Max. length: 2 m (6.5 ft) Outlet tubing • Material: FEP (blue) • Outer diameter: 6.35 mm (1/4″) • Inner diameter: 4.83 mm • Max. length: 2 m (6.5 ft)
Manual sampling device	Sample container: 5 mL screw-cap tube Sample volume: 2 – 5 mL Aspirated volume: 260 µL Measured volume: 90 µL
Sample conditions	Temperature: 5 °C – 40 °C (41 °F – 104 °F) Turbidity: 0 – 10 NTU, FNU Conductivity: 0 – 100'000 µS/cm at 20 °C for TCC, ICC, ACC 50 – 100'000 µS/cm at 20 °C for CBC, NBC, EBC pH-value: 5 – 12 for TCC, ICC, ACC 6 – 12 for CBC, NBC, EBC Chlorine: max. 3 mg/L Iron: max. 200 µg/L Manganese: max. 50 µg/L
CARTRIDGE	
Types	TCC, Total Cell Count ICC, Intact Cell Count ACC, Active Cell Count CBC, Coliform Bacteria Count NBC, Enterococcus Bacteria Count EBC, E. coli Bacteria Count Compatibility BactoSense model dependent

Property	Specification
Capacity	Up to 1000 measurements for TCC, ICC Up to 700 measurements for ACC, CBC, NBC, EBC
Validity	9 months for TCC, ICC 6 months for ACC, CBC, NBC, EBC
Storage temperature	15 °C – 25 °C (59 °F – 77 °F) ideally at 15 °C (59 °F)
Storage humidity	20 % – 60 % RH
MAINTENANCE	
Preventive maintenance	After 3 cartridges, at least yearly.
Calibration	Factory calibration only
COMPLIANCE	
Applied standards and certifications	Please refer to Compliance and applied standards.

4. Safety

4.1 Dangers

DAMAGED CABLES

Damaged instrument or cabling

Touching damaged cables may lead to electrical shocks or death.

- The instrument may be operated only when the cables are intact.
- The instrument may be operated only if it has been properly installed or repaired.

MAINS VOLTAGE

Dangerous voltage inside the supplied mains device

Touching a wet or damaged mains device may lead to electrical shocks or death.

- Do not position the mains device in moist locations.
- Do not operate the mains device if its housing is damaged.

CORRECT SUPPLY VOLTAGE

Damage due to incorrect service voltage

If the instrument is connected to an incorrect service voltage, the instrument can be damaged.

- The instrument must only be connected to voltage sources as specified on the type plate.
- The instrument must only be operated with the supplied power supply unit, as described in Connecting the BactoSense to power.

KEEP THE MANUAL AVAILABLE

Missing user manual

Operating the instrument without following the procedures indicated in the user manual may lead to injuries to persons and damage to the instrument.

- If the instrument changes hands, always include the user manual.
- If the user manual is lost, you can contact bNovate to request a replacement at

www.bnovate.com/contact.

⚠ PREVENT CONDENSATION

Moisture or condensation on the electrical components

If moisture enters the instrument, the BactoSense can be damaged.

- The covers and lids must always be attached during operation.
- Service inside the instrument must only be performed by trained personnel in a dry room and at room temperature. The instrument should be at operating or room temperature (avoid condensation on optical and electrical surfaces).

⚠ AVOID AGGRESSIVE CHEMICALS

Use of aggressive chemicals

Use of aggressive chemicals can cause damage to instrument components.

- Do not use aggressive chemicals or cleaning agents.
- Should the instrument come in contact with aggressive chemicals, clean it thoroughly with a neutral cleaning agent.
- Use a damp cloth (water only) to clean the exterior of the device.

4.2 Safe handling of chemicals

⚠ HANDLE CHEMICALS SAFELY

Improper handling of chemicals

Please observe the following instructions for safe handling of chemicals:

- Wear the recommended personal protection (safety goggles, protective gloves, protective clothing).
- Wash your hands thoroughly after working with chemicals.
- Study the MSDS (Material Safety Data Sheet) before working with chemicals. If an accidental release happens, please follow the instructions of the MSDS.
- Never smoke or store food or beverages in the working environment.

4.3 Residual risk

⚠ MEASUREMENT ACCURACY

Residual risk

According to the risk assessment of the applied safety directive DIN EN 61010-1, there remains the risk of the displayed measurement values being incorrect. This risk can be reduced with the following measures:

- Use an access code to prevent unauthorized persons from changing parameters.
- Perform the specified servicing duties.

4.4 Warning and danger symbols on the instrument

⚠ FOLLOW THE SAFETY INSTRUCTIONS

No warning or danger symbols on the instrument

Users must ensure that they observe the safety measures as specified in the user manual at all times when working with the instrument and its peripheral equipment, even if no warning or danger symbols are attached to the instrument.

- Observe safety points when performing the described procedures.
- Observe local safety regulations.

4.5 Preventing unauthorized online access



⚠ PROTECT NETWORK ACCESS

BactoSense is equipped with an integrated web user interface. If directly connected to the internet without appropriate protection, unauthorized internet users can access your instrument. Please follow these recommendations:

- Never expose the instrument's network ports unprotected to the internet.
- Operate it behind a firewall and block access to the instrument.
- Connect to branch offices only via VPN.
- Change the standard password on commissioning.
- Always keep up-to-date with the latest changes regarding internet security.
- Immediately install the latest updates (also for the router and firewall).

5. Installation

BEFORE INSTALLATION

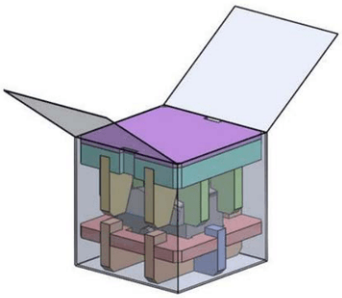
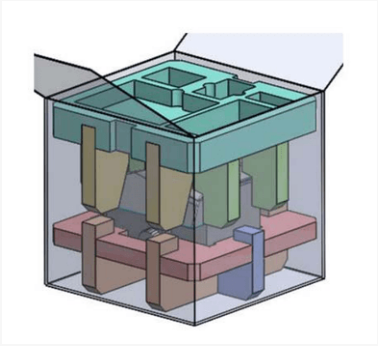
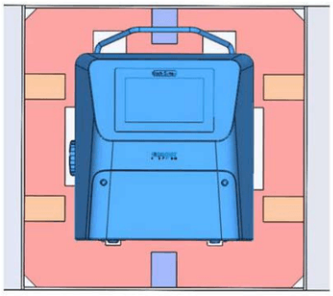
Attention

Before working on the instrument, carefully read the safety points.

- It is forbidden to modify or repair the BactoSense.
- Perform the work steps in the exact order instructed.
- When replacing parts, use only genuine original parts supplied or recommended by bNovate.

5.1 Unpacking the BactoSense

Carefully follow the procedure below to unpack the BactoSense instrument from its packaging.

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	Open the box and remove the lid.	
2.	Remove the compartments with accessories.	
3.	Carefully remove the BactoSense from the box.	
4.	Keep the packaging and foams for future use.	

5.2 Placement of the BactoSense

The BactoSense can be operated as a benchtop instrument on a flat surface, or mounted to a wall or panel.

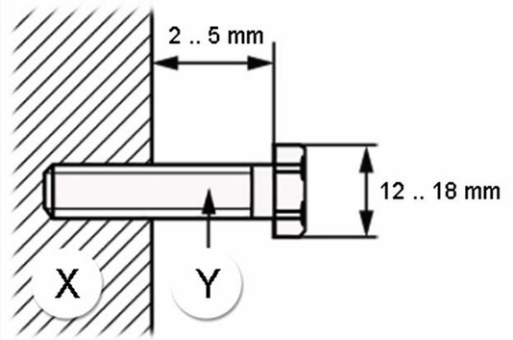
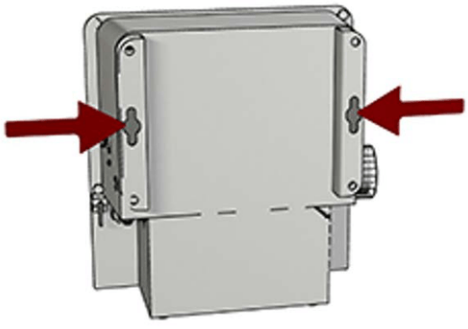
CHOOSE A SUITABLE LOCATION

Note the following points for selecting an appropriate operating location:

- The BactoSense shall be installed in a vibration-free environment.
- The power supply must be stable, without spikes or interruptions.
- The BactoSense should not be exposed to direct sunlight during operation.
- In case of electromagnetic interference from a nearby object affecting the touchscreen (not responsive or flickering), relocate the BactoSense.

5.2.1 Mounting the BactoSense on a wall

The following procedure describes the mounting of the BactoSense to a vertical wall or panel:

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	Install two M8 screws at the same height, separated horizontally by 265 mm (10.4″) on a wall. The screw head diameter needs to be between 12 mm and 18 mm (0.47″ – 0.71″)	**SECURE WALL MOUNTING** The fixation must carry at least 60 kg (132 lbs).
2.	Adjust the distance between the screw heads and the wall according to the picture on the right. X: Wall Y: Screw	
3.	Mount the BactoSense on the wall using its wall mounting system (red arrows). Tighten the two screws such that the BactoSense is firmly attached to the wall.	

5.3 Connecting the BactoSense to power

USE THE ORIGINAL POWER SUPPLY

The BactoSense must be operated using the supplied original power supply unit to ensure:

- Compliance with the applicable standards for safety, EMC, ingress protection and RoHS, as listed in Compliance and applied standards.
- Instrument performance according to bNovate instrument validation protocols.
- Warranty coverage. Operation with alternative power supply units requires specific evaluation and permission by bNovate.

STABLE POWER SUPPLY

An uninterrupted and stable power supply as specified in Technical data must be guaranteed.

The power supply comes in an IP67 enclosure with a cable fitted with a country-specific plug. To connect the BactoSense to power using one of these plugs supplied by bNovate, follow the instructions in Connecting using the standard plug of the power supply unit. To connect using a different plug or power connector, use the procedure described in Modifying the standard power supply unit with a different connector.

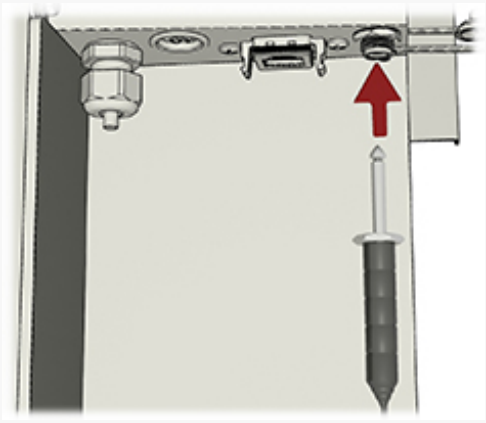
KEEP THE POWER DISCONNECT ACCESSIBLE

- The electrical plug or an additional circuit breaker should always be accessible to disconnect the main supply.
- The circuit breaker should respect the standards IEC60947-1 and IEC60947-3 and should protect a current of 10 A to 16 A.

5.3.1 Connecting using the standard plug of the power supply unit

The following procedure describes how to connect the BactoSense to power using the standard power supply unit and power plug of type J, E, G or B.

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	Make sure the power supply unit is dry and does not show any signs of damage.	
2.	Plug the J, E, G or B-type plug of the power supply unit into a power source supplying the indicated voltage.	
3.	Remove the cover of the power connector socket on the BactoSense.	

	WORK STEP	ADDITIONAL INFO / IMAGES
4.	Insert the power connector plug into the power connector socket.	
5.	Fasten the power connector plug lock ring (X). If the power connector is connected correctly and the instrument is powered, the instrument power button starts blinking.	

DISCONNECT POWER SAFELY

To disconnect the BactoSense from power, first switch the instrument off. Then unplug the power supply unit from the mains power source, before unplugging the power supply plug from the BactoSense.

5.3.2 Modifying the standard power supply unit with a different connector

USING A DIFFERENT POWER CONNECTOR

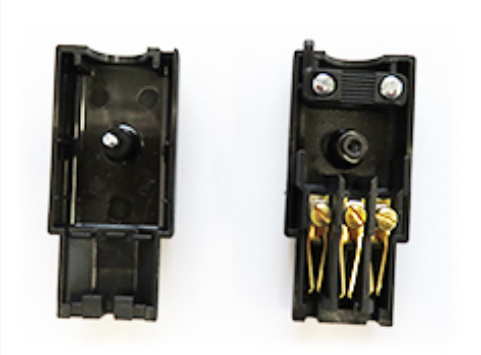
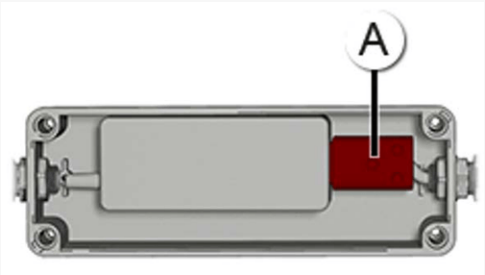
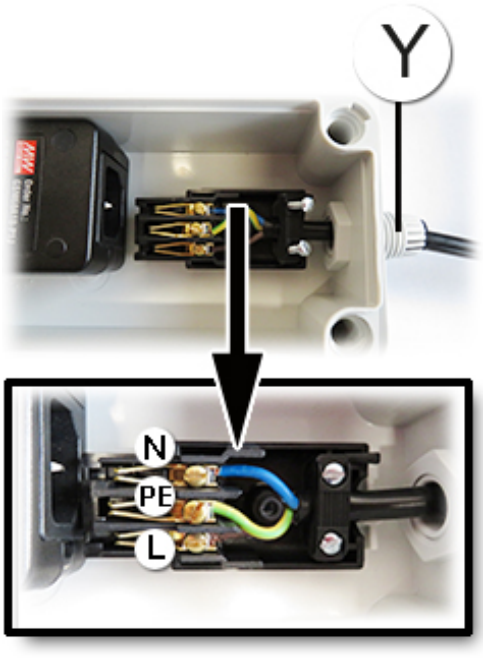
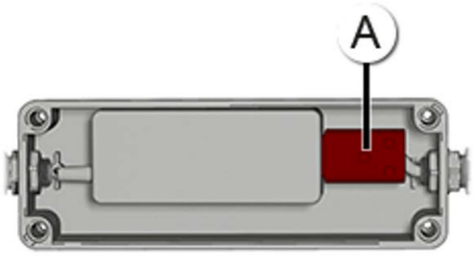
The following procedure only applies, if the BactoSense shall be connected to a power source with a different plug than what has been delivered together with the standard power supply unit (J, E, G or B). In that case, the power supply unit is opened and the new connector installed manually.

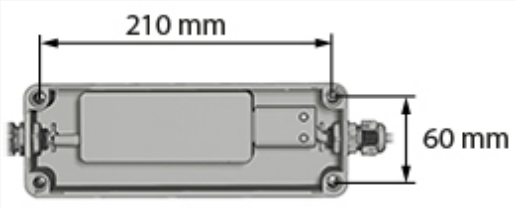
QUALIFIED ELECTRICIANS ONLY

- Only professional electricians are authorized to modify the power supply unit.
- It is forbidden to modify or repair the BactoSense instrument.
- Perform the work steps in the exact order instructed.
- Always use a plug with Protective Earth (PE).

POWER CABLE REQUIREMENTS

- If the power supply cable is longer than 2 m, label it near the plug with the name of the device.
- If the power supply cable is longer than 20 m, the impedance of PE needs to be smaller than 0.2 Ω.

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	**DISCONNECT THE POWER SUPPLY** Ensure that the power supply is not connected to power. Remove the cover of the enclosure by unscrewing the four screws (circles).	
2.	Remove the C13 connector (A) and unscrew it to open. 	
3.	Open the cable connector (Y) and insert the new cable. Cable lengths and wire cross sections: • 0 – 9 m (0 – 30 ft), 1 mm^2 • 9 – 21 m (30 – 69 ft), 1.5 mm^2 (maximum). The cable connector is dimensioned for a cable diameter of 3 – 10 mm (0.12″ – 0.39″).	
4.	**CONNECT PROTECTIVE EARTH** Tighten the 3 wires (N, PE, L) in the electrical terminal and secure the cable insulation. Ensure that a plug with Protective Earth (PE) is used and the device is correctly connected to it.	
5.	Close the C13 connector (A) using the screw and plug it into the power supply. Tighten the cable connector. Try to pull the cable to assess whether the cable connector is tight enough.	

	WORK STEP	ADDITIONAL INFO / IMAGES
6.	Optional: the power supply can be mounted on a wall. M4 screws should be used with a minimum length of 20 mm. With the cover still removed, place the 4 screws and fix the enclosure to the wall.	
7.	Put the cover of the enclosure back and tighten the four screws to seal it.	
8.	Connect the power supply unit to power and the instrument as described in Connecting using the standard plug of the power supply unit.	

5.4 Installation of the manual sampling device

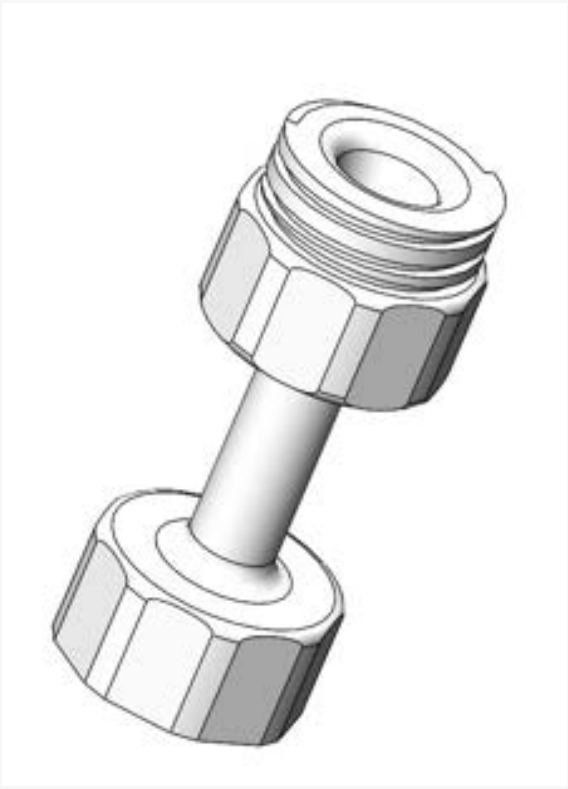
The manual sampling device is intended for measuring individual grab samples, collected in 5 mL screw-cap tubes. The following procedure describes how to install the manual sampling device.



Figure 5-1 Manual sampling device 1: Positioning pins, 2: Plug, 3: Fixation ring, 4: 5 mL screw-cap tube.

WEAR PROTECTIVE GLOVES

Avoid contamination of the equipment. Wear nitrile gloves when handling samples, sampling devices and any components which come in contact with them.

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	Inspect the manual sampling device • Make sure it is free of dust and fibers. If not, clean it with a lint-free tissue wetted with sterile water or ethanol • Make sure the white sealing plug is sitting tightly in the connector	
2.	Attach an empty 5 mL screw-cap tube or the Washstation at the sampling device.	

	WORK STEP	ADDITIONAL INFO / IMAGES
3.	Carefully insert the connector of the sampling device into the sampling device port on the left-hand side of the BactoSense by inserting the metallic positioning pins located inside of the sampling device connector into the openings on the BactoSense sampling device port.	
4.	⚠ **TIGHTEN BY HAND ONLY** Then tighten the knurled fixation ring until the sampling device is installed tightly. Finger-tightening only. Do not use any tools.	
5.	It is recommended to clean the sampling device after installation. If a Washstation is available, follow the procedure in Clean manual sampling device with Washstation, otherwise the procedure in Clean manual sampling device with basic cleaning.	
6.	After the cleaning, it is recommended to perform a Prime prior to measuring the first sample. Follow the procedure in Performing a Prime.	

5.5 Installation of the online sampling device

The online sampling device is intended to measure samples continuously at predefined measurement intervals, and it is therefore directly connected to a water source and drain using an inlet and outlet tubing. The following procedure describes how to install the online sampling device.

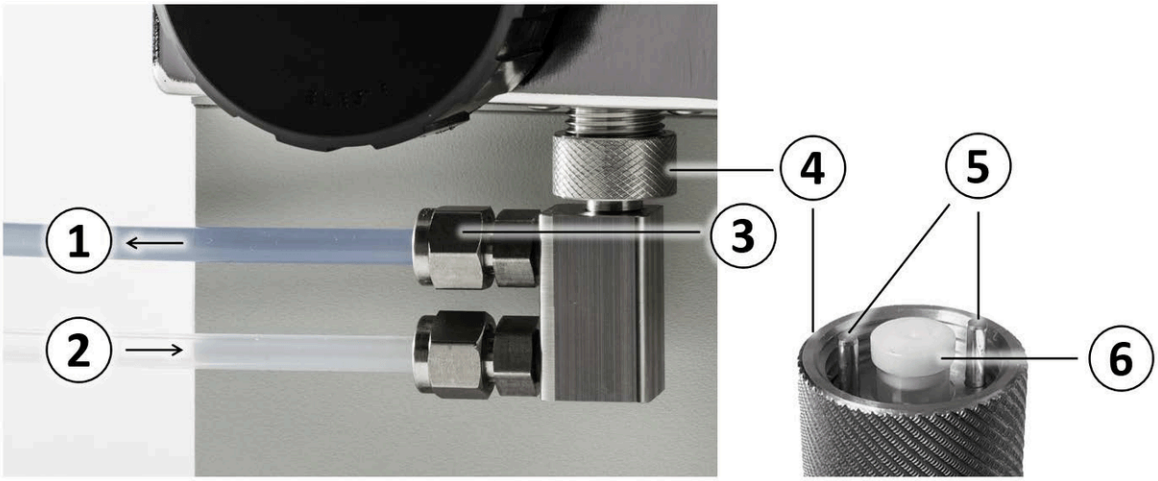


Figure 5-2 Online sampling device 1: Outlet tubing connected to a drain, 2: Inlet tubing connected to a water source, 3: Connector nut, 4: Fixation ring, 5: Positioning pins, 6: Plug.

WEAR PROTECTIVE GLOVES

Avoid contamination of the equipment. Wear nitrile gloves when handling samples, sampling devices and any components which come in contact with them.

SECURE TUBING CONNECTIONS

Firmly attach tubings and sampling device

If the plumbing, tubings or sampling device are not tightly assembled or mounted, liquid can flood surrounding areas and cause material damage to nearby objects or infrastructure. All tube junctions must be carefully secured and tightened. The connections should be checked periodically after installation.

CONNECT THE OUTLET TO A DRAIN

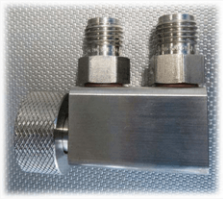
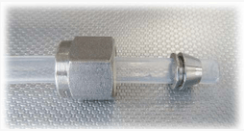
Connect outlet tubing to a drain

In drinking water installations, connect the outlet tubing to a drain to make sure that water which has been diverted from the drinking water pipe system is not returned after flowing through the additional fittings, tubings and BactoSense sampling device.

5.5.1 Attaching the tubings to the online sampling device

The following instructions describe how to attach the inlet and outlet tubings to the body of the online sampling device. Specifications of the tubings can be found in Technical data. The exchange of tubings in case they are contaminated or damaged is described in Replacing online sampling device tubings.

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	Make sure the sampling device is not installed at the BactoSense.	

	WORK STEP	ADDITIONAL INFO / IMAGES
2.	Unscrew the nuts of the two connectors on the sampling device. If necessary use a spanner. Be careful not to lose the ferrules located inside the nut.	
3.	Inspect the two tubings for contamination and damage. Only use clean and intact tubings with straight cuts.	
4.	For both tubings, insert one end through a nut and a ferrule as illustrated.	
5.	Attach the blue tubing (outlet) to the connector closer to the attachment port of the sampling device. Attach the transparent tubing (inlet) to the more distant connector to the attachment port of the sampling device. Use a clamp to fasten the nuts.	
6.	If you want to attach the sampling device, proceed with Installing the online sampling device at the BactoSense.	

5.5.2 Installing the online sampling device at the BactoSense

In this section, the installation of the online sampling device with attached inlet and outlet tubings is described.

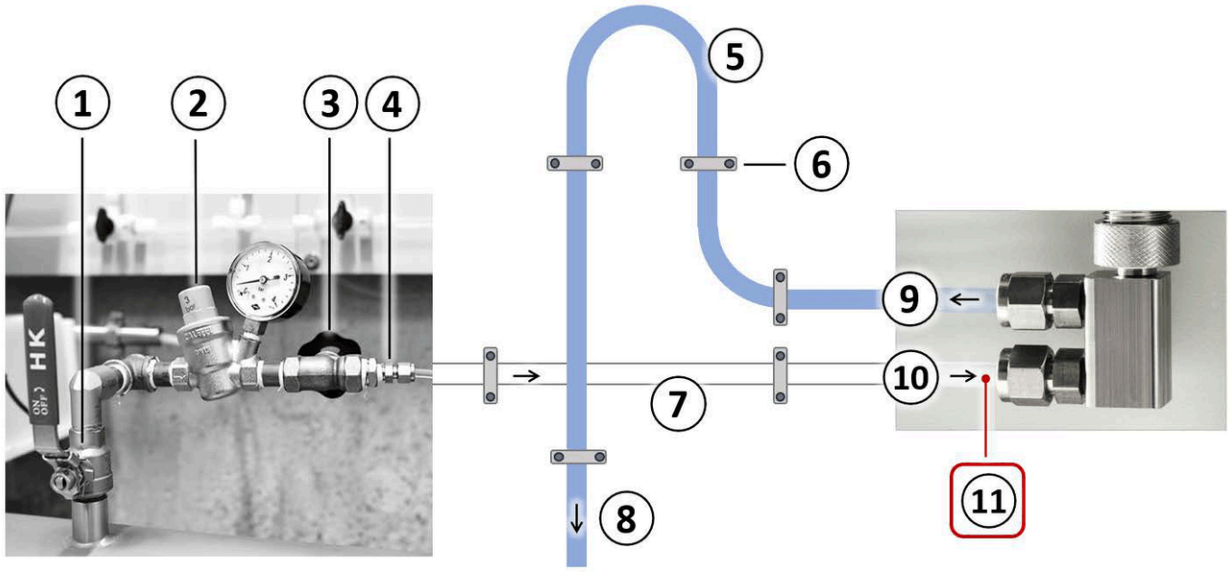


Figure 5-3 Typical installation for the online analysis mode using the online sampling device.

Flow and pressure adjustment

1. On-off valve
2. Pressure valve with gauge

3. Flow valve
4. Reduction fittings

Inlet and outlet tubing

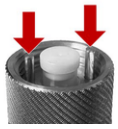
5. Backpressure loop
6. Tubing fixation
7. Horizontal inlet tubing
8. Outlet tubing connected to drain

Online sampling device

9. Outlet tubing
10. Inlet tubing
11. Inlet conditions:
    - Continuous flow
    - 200 – 400 mL/min (0.05 – 0.10 gal/min)
    - Max. 0.5 bar (7.3 psi)

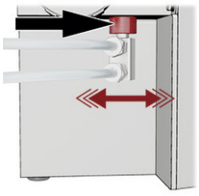
Installation steps

1. Make sure the inlet and outlet tubings are firmly attached to the online sampling device.
2. Carefully insert the connector of the sampling device into the sampling device port on the left-hand side of the BactoSense by inserting the metallic positioning pins located inside of the sampling device connector into the openings on the BactoSense sampling device port.



3. ⚠ **TIGHTEN BY HAND ONLY**

   Then tighten the knurled fixation ring (red) until the sampling device is installed tightly. Finger-tightening only. Do not use any tools.



4. ⚠ **CONNECT THE SAMPLING TUBING SAFELY**

   Carefully connect the free ends of the tubings to the inlet water source and outlet drain. • Level the inlet tubing with the water source to prevent trapping of air bubbles • Shorten the length of the tubings as much as possible • Install the outlet tube with a loop in high position • Minimize the amount of connectors to reduce potential sources of contamination • To prevent any damage to the sampling device and BactoSense, make sure no force is exerted via the tubings. Fixate the tubings to a solid structure in the proximity of the sampling device (30 – 50 cm) if possible. In drinking water installations, connect the outlet tubing to a drain to make sure that the water diverted from the drinking water pipe system is not returned after flowing through the additional fittings, tubings and BactoSense sampling device.

   See figure 5-3.

5. Open the water supply carefully and check the appliance for leaks.

6. ⚠ **CHECK FLOW RATE AND PRESSURE**

   Adjust the flow rate coming from the water supply. Flow rate range: 200 to 400 mL/min (0.05 – 0.10 gal/min) If the flow rate is not within the specified limits, results may be inaccurate or the BactoSense may be damaged. Make sure the pressure in the sampling device does not exceed 0.5 bar (7.3 psi). Install a pressure reducer if needed.

   See figure 5-3.

5.6 Connectivity options

The BactoSense offers several options for integration and online data access.

Table 5-1 BactoSense connectivity options

Connectivity Option	Documentation
I/O Box	I/O-Box
Modbus TCP	Modbus TCP
FTP	Retrieve data via FTP
HTTP and HTTPS	Retrieve files via HTTP or HTTPS
Virtual network computing (VNC) user interface relay (remote control)	GUI relay using VNC
Web user interface	Web User Interface
BactoLink	See separate BactoLink user manual
BactoCloud	BactoCloud

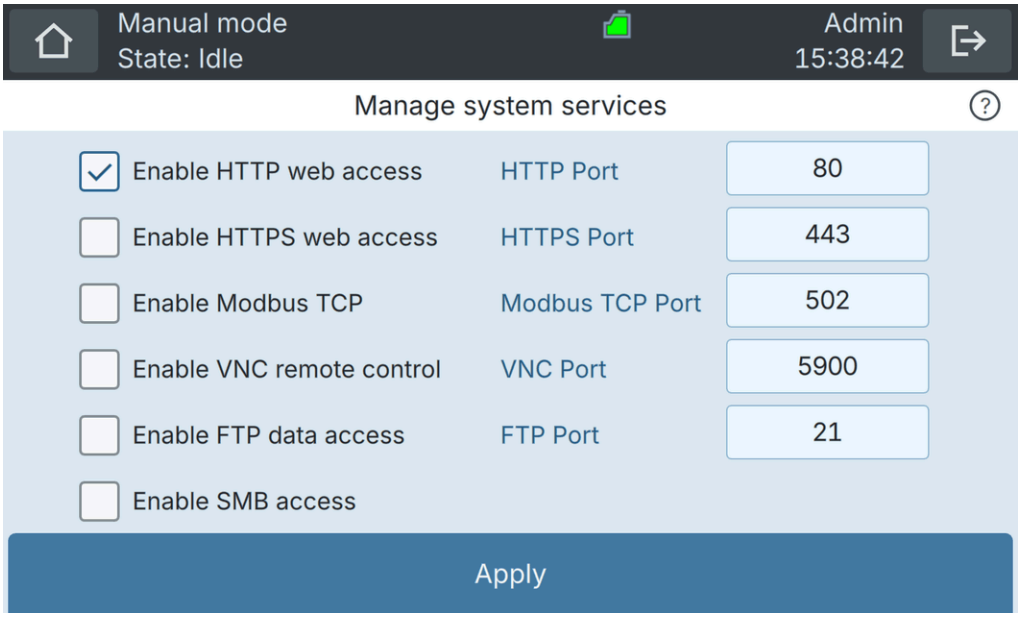


Figure 5-4 BactoSense system services configuration menu. Individual services can be enabled and communication ports configured.

6. I/O-Box

The I/O-Box is an accessory to the BactoSense. It can be used to connect the inputs and outputs of the BactoSense to a PLC/SCADA system.

As an alternative to the I/O-Box, Modbus TCP can be used. Details can be found in Modbus TCP.

6.1 Technical specifications

> **REVIEW THE SPECIFICATIONS**
>
> Carefully read the technical specifications before preparing the integration.

6.1.1 Digital inputs

- Use: 4 digital inputs referenced to Common allow the instrument to be controlled by an external voltage (e.g. voltage coming out of a PLC).
- Specifications: optocoupler input: forward voltage 1.2 VDC with 3 kΩ in series, cathode connected to COMMON, max. 30 mA, max. 50 mW.

Additional notes

> **DIGITAL INPUT REQUIREMENTS**
>
> - The Common (port 18) must be connected to the reference voltage of the input voltage (e.g. 0 V / Ground of the external power source).
> - The digital inputs (ports 14 - 17) voltage range is between 5 - 30 V to produce a logic high level or "1". Otherwise it produces a logic low level or "0".
> - If any of the digital inputs is at a logic high level or "1", the BactoSense enters "PLC- mode".

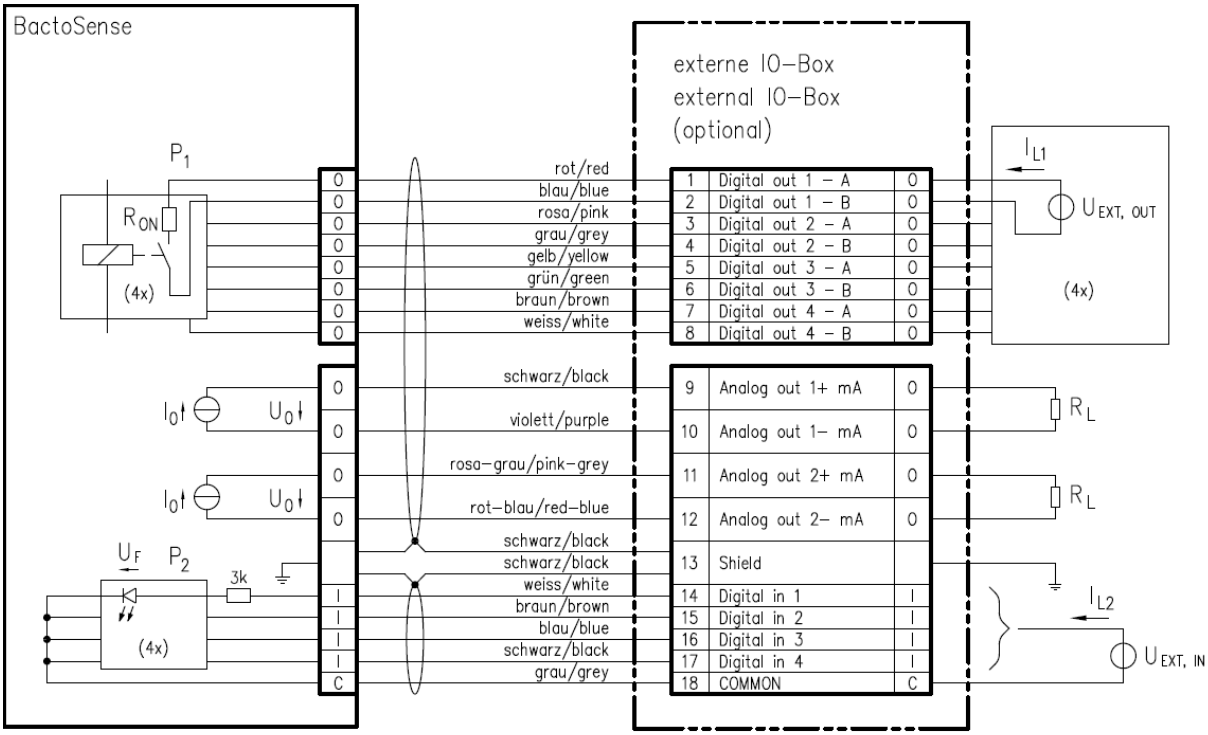
6.1.2 Digital outputs

- Use: 4 digital outputs allow the reporting of 4 different logic states, e.g. errors or alarms. As the output terminals are the output of a MOS-based solid-state relay (LH1540AAB), there is no polarity. Terminals A and B can be used in either direction and can be swapped. Terminals A and B are either in high-impedance (disconnected) or low- impedance (connected) state.
- Specifications: freely configurable, SSR output: max. 48 VDC, max. 300 mW, ON- resistance 2 Ω.

6.1.3 Analogue outputs

- Use: 2 analogue outputs (4 – 20 mA) allow the reporting of two analogue values, e.g. Total Cell Count and HNAP. Note: For the transmission of precise results, the use of Modbus TCP is recommended. See Modbus TCP
- Specifications: 2 × 0/4 – 20 mA, recommended 250 Ω load

6.1.4 IO-box schematics



Parameter	min.	typ.	max.	Unit
I_0	0		21	mA
U_0		15		VDC
R_L		250	500	Ω
$U_{EXT, OUT}$	–48		48	VDC
$U_{EXT, IN}$	0		30	VDC
I_{L1}	–500		500	mA
I_{L2}	0	7.5	30	mA
R_{ON}		1	2	Ω
P_1			300	mW
P_2			50	mW
U_F	1.1	1.27	1.4	VDC

Figure 6-1 BactoSense IO-box schematics.

6.1.5 IO-box overview

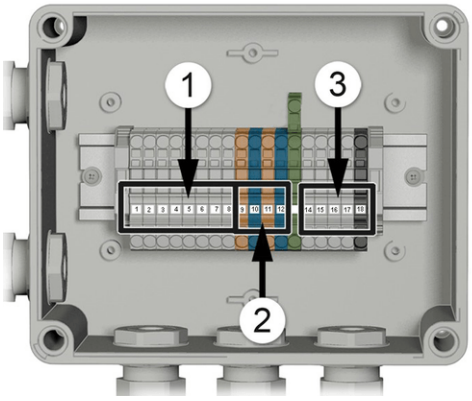


Figure 6-2 Overview of the BactoSense IO-box

①	Position of the digital outputs Terminals 1 – 8 Cable requirements: • AWG 12 – 22 • Cross section: 0.25 – 2.5 mm^2	②	Position of the analogue outputs Terminals 9 – 12 Cable requirements: • AWG 12 – 22 • Cross section: 0.25 – 2.5 mm^2
③	Position of the digital inputs Terminals 14 – 18 Cable requirements: • AWG 12 – 22 • Cross section: 0.25 – 2.5 mm^2		

6.1.6 IO-box reference table

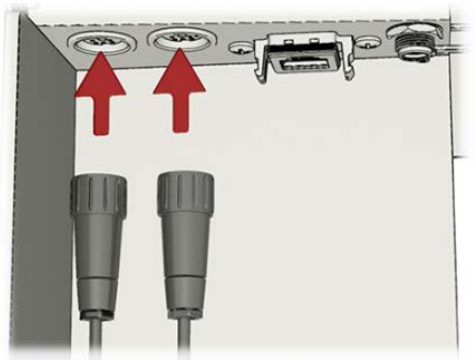
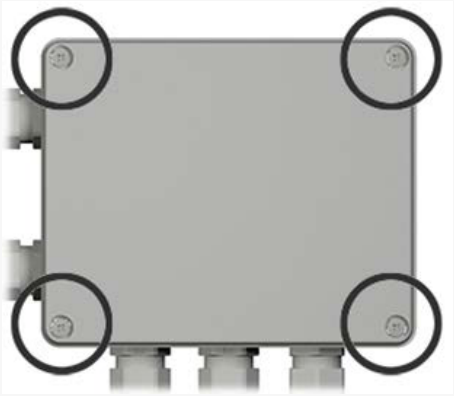
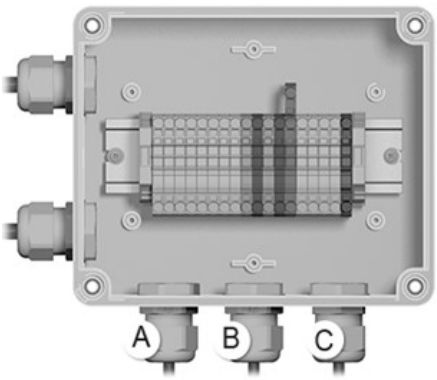
Table 6-1 IO-box reference table

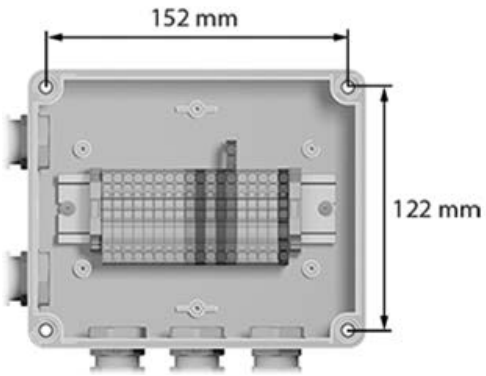
Terminal	Function	Terminal Color	Cable Color
1	Digital output 1 - A	Grey	Red
2	Digital output 1 - B	Grey	Blue
3	Digital output 2 - A	Grey	Pink
4	Digital output 2 - B	Grey	Grey
5	Digital output 3 - A	Grey	Yellow
6	Digital output 3 - B	Grey	Green
7	Digital output 4 - A	Grey	Brown
8	Digital output 4 - B	Grey	White
9	Analogue 1+ mA	Orange	Black
10	Analogue 1- mA	Blue	Purple
11	Analogue 2+ mA	Orange	Pink-Grey
12	Analogue 2- mA	Blue	Red-Blue
13	Shield	Green/Yellow	
14	Digital input 1	Grey	White
15	Digital input 2	Grey	Brown
16	Digital input 3	Grey	Blue
17	Digital input 4	Grey	Black
18	Common	Black	Grey

6.2 Connecting the IO-box

CHECK THE I/O CONNECTIONS

Review the technical specifications in Digital inputs, Digital outputs and Analogue outputs and the schematics in IO-box schematics to ensure correct installation.

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	Insert the two M16 plugs of the IO-box on the right-hand side of the instrument.	
2.	Remove the cover of the enclosure by unscrewing the four screws (circles).	
3.	Insert cable through the cable gland (A, B or C) and connect the wires to the corresponding terminal according to the IO-box reference table.	
4.	Tighten the cable gland. Try to pull the cable to see if the cable gland is tight enough.	

	WORK STEP	ADDITIONAL INFO / IMAGES
5.	Optional: the IO-box can be mounted on a wall. M4 screws should be used with a minimum length of 20 mm. With the cover still removed, place the 4 screws and fix the enclosure to the wall.	
6.	Put the cover of the enclosure back and tighten the four screws to seal it.	

6.3 Connecting the outputs without IO-box

The BactoSense exposes the outputs on a 12-pin M16 female connector. However, the use of an I/O-Box is recommended. The pinout of the connector is given below.

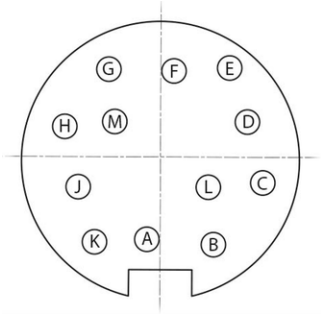


Figure 6-3 Overview of the output connector pinout

A	Digital output 4 - B	G	Digital output 1 - B
B	Digital output 4 - A	H	Digital output 1 - A
C	Digital output 3 - B	J	Analogue 1+
D	Digital output 3 - A	K	Analogue 1-
E	Digital output 2 - B	L	Analogue 2+
F	Digital output 2 - A	M	Analogue 2-

6.4 Connecting the inputs without IO-box

The BactoSense exposes the inputs on a 5-pin M16 female connector. The use of an I/O-Box is recommended. The pinout of the connector is given below.

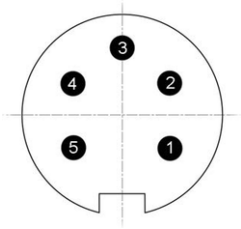


Figure 6-4 Overview of the input connector pinouts

1. Digital input 1
2. Digital input 2
3. Digital input 3
4. Digital input 4
5. Common

6.5 Digital inputs configuration and PLC mode

The instrument can be controlled from an external Programmable Logic Controller (PLC). In order to avoid any conflicts when starting a process, the PLC first locks the instrument into “PLC Mode”, in which the instrument acts as a slave to the PLC. In this mode, all functions of the GUI related to running protocols and other processes are blocked. Once in PLC mode, protocols can be started and aborted from the PLC, using the Instrument’s digital inputs. The digital outputs then provide feedback to the PLC for safe operation.

The PLC mode is a remote-controlled Online mode: the PLC can request a single measurement, or start the scheduler to run protocols at predefined intervals. Measurements started from the PLC also appear in the Online mode results.

When no wires are connected to the digital inputs, their state is 0000.

Table 6-2 Overview of digital inputs states and associated functions.

DESCRIPTION	DIGITAL INPUTS			
	1	2	3	4
Force PLC mode: The instrument is idle but a slave to the PLC.	1	0	0	0
Run configurable protocol / measurement interval	1	0	0	1
Run configurable protocol / measurement interval	1	0	1	0
Run configurable protocol / measurement interval	1	0	1	1

Run configurable protocol / measurement interval	1	1	0	0
Run configurable protocol / measurement interval	1	1	0	1
Run configurable protocol / measurement interval	1	1	1	0
Abort current protocol	1	1	1	1
Slave mode deactivated. End of PLC mode.	0	0	0	0

To run a protocol several times, either use the scheduler option, or trigger a new measurement from the PLC by resetting the inputs state to 1000, then back to the corresponding “Run” state.

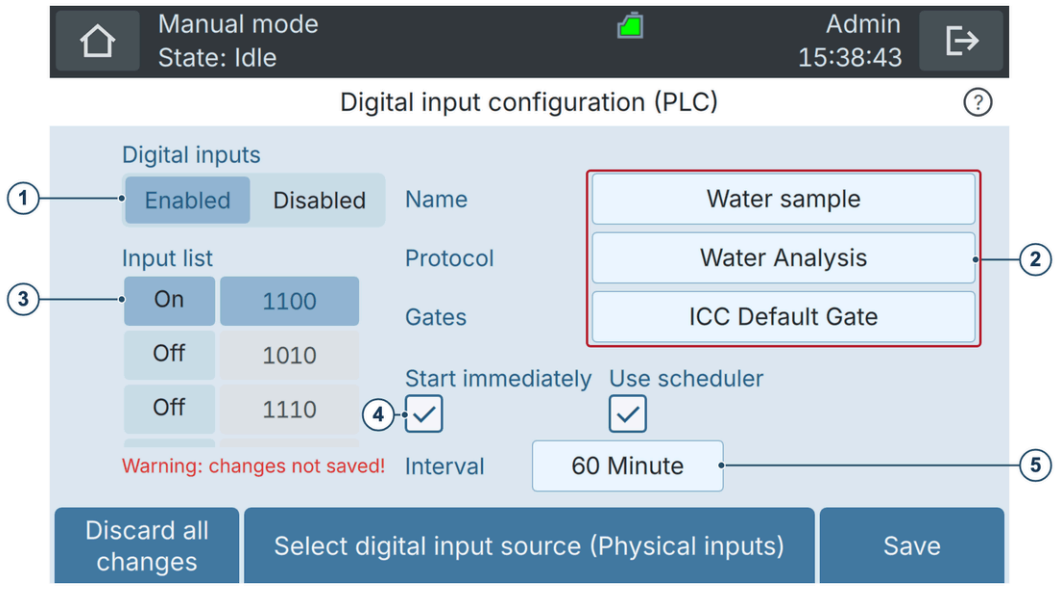


Figure 6-5 Digital inputs configuration

1	Enable or disable digital inputs. If disabled, PLC mode is never active.	2	Protocol parameters: Name, Protocol, and Gates.
3	Select the inputs state you wish to configure. When the state selected in (3) is applied to the DI, the protocol defined in (2), (4) and (5) will be executed	4	If enabled, start the protocol immediately after the inputs state has changed. If not, wait for the duration of the scheduler interval before starting.

5	Scheduler settings: if the scheduler is activated, the protocol will be repeated at the selected interval, until the inputs state is changed. If the scheduler is disabled, the protocol will run only once.	

To configure the configurable digital inputs states, follow these steps:

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	On the Home screen, press Settings.	
2.	Press the Online mode settings button.	
3.	Press the Digital inputs button.	
4.	Make sure the toggle button is set to Enabled.	
5.	Switch on and select the state you wish to configure in the Input list, enter a name for the sample, choose a protocol and choose a gate.	
6.	If you want the protocol to repeat automatically, enable the “Use scheduler” check box, and choose an interval.	
7.	In the above case, choose if you want the protocol to execute immediately or at the end of the first interval with the “Start immediately” check box.	This option is only useful if the scheduler is activated.
8.	Press the Save button.	

6.6 Digital output configuration

The values of digital outputs are modified in the following situations:

- When the instrument is powered off, all outputs are set to 0.
- When the instrument is powered on, the outputs show the current error state: none / critical / non-critical.
- At the end of a measurement in Online mode, the outputs are changed to indicate errors and alarms, according to user-defined settings.
- When Reset is clicked on the output test screen or when Save is pressed on the digital output settings, the outputs are updated to show the error state only (alarms are ignored).
- After manually clearing the errors, the outputs are automatically reset (and therefore show the new error state and no alarms).
- At specific times during the measurement, extra signals can be relayed. By default, none of them is relayed to the outputs. These are:
    - Process running. Active when a protocol is running.

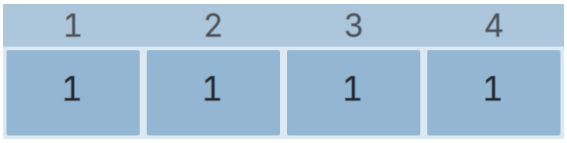
- Sampling device in use. Active when the sampling device is being used. It drops back to inactive after the sample preparation step of measurement protocols.
- Low cartridge. Active when the cartridge level is below 15 %, or if the cartridge is estimated to be empty within a month based on the current measurement frequency.
- Expired cartridge. Active when the cartridge is expired.

The digital output state at the end of a measurement is defined according to these default values, which can be changed in the settings:

- If there are no errors and no alarms, all terminals are set to the user-defined base state. By default, this is 1 everywhere.
- In case of a critical error, the first output is set to 0.
- Non-critical errors set the second output to 0.
- Alarms set the third and fourth output to 0.
- In case of conflict in the output settings, priority is given to:
  i. Critical errors
  ii. Non-critical errors
  iii. Cartridge states
  iv. Alarm

> **ADMIN ACCESS REQUIRED**
> Only Admin users can change the output settings, as these can critically affect external PLC systems.

The following procedure describes how to adjust the digital outputs.

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	On the Home screen, press Settings.	
2.	Press the Online mode settings button.	
3.	Press the Digital outputs button.	
4.	Set **Base state** for outputs 1–4 when no errors or alarms are active.	1: The switch is closed. 0: The switch is open. 

<table>
<tr><td>5.</td><td>Set the response of each output in the Critical error row.</td><td>By default, a critical error opens output 1. 1: The switch is closed. 0: The switch is open. /: The switch is not affected by this error.<table><tr><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>0</td><td>/</td><td>/</td><td>/</td></tr></table></td></tr>
<tr><td>6.</td><td>Set the response of each output in the Non-critical error row.</td><td>By default, a non-critical error opens output 2.<table><tr><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>/</td><td>0</td><td>/</td><td>/</td></tr></table></td></tr>
<tr><td>7.</td><td>Assign each enabled alarm to the required outputs in its alarm row.</td><td>You can only assign alarms that are enabled. You can assign several alarms to the same output.

Example alarm rows: High TCC (top), High HNAP (bottom).<table><tr><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>/</td><td>/</td><td>0</td><td>/</td></tr><tr><td>/</td><td>/</td><td>/</td><td>0</td></tr></table></td></tr>
<tr><td>8.</td><td>Press the Save button.</td><td></td></tr>
</table>

6.7 Analogue output configuration

The analogue current output is changed in the following situations:

- When the instrument is powered off, both outputs are set to 0 mA.
- When the instrument is powered on, both outputs are set to 2 mA.
- When a measurement in Online mode terminates after cell counting, the value is set between 4 and 20 mA, according to range and source definition of the analogue output settings. If the measurement fails due to an error before cell counting begins, the output remains at its previous value.
- When a user manually tests the output, the current is set to whatever value the user has chosen. The reset button sets them to 4 mA.

PRECISE OUTPUT VALUES

For the transmission of precise results, the use of Modbus TCP is recommended. See Modbus TCP

Only **Admin** users can edit the analogue 4 .. 20 mA outputs.

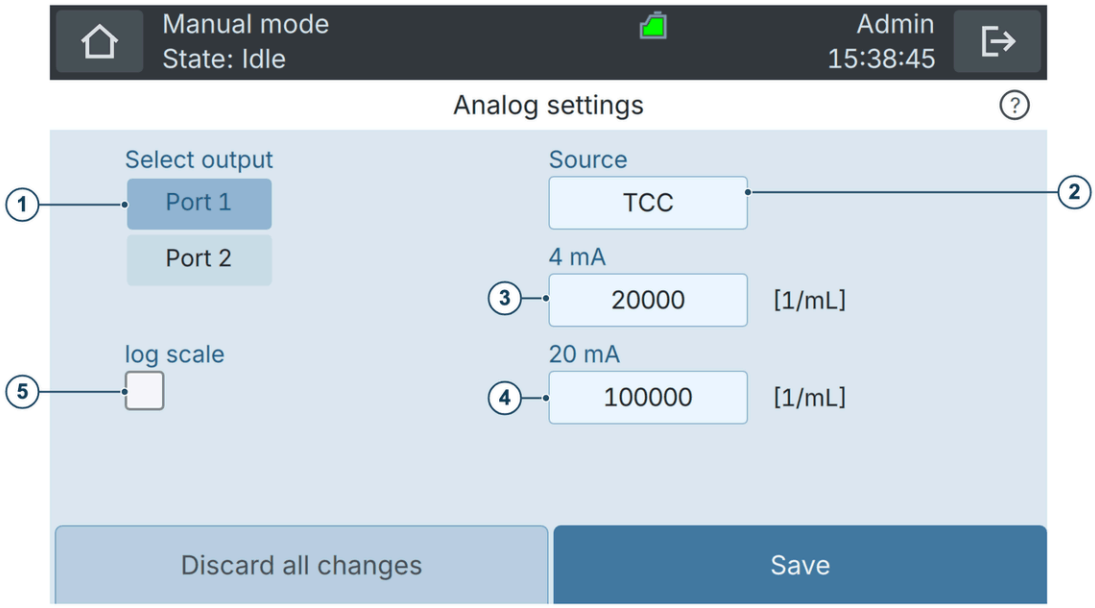


Figure 6-6 Analogue output settings

1	Output port selection	2	Source: Defines which measurement result is transmitted by this output port.
3	Lower limit 4 mA: Which value of the measurement result should correspond to 4 mA.	4	Upper limit 20 mA: Which value of the measurement result should correspond to 20 mA.
5	If selected, interpolates the chosen cell count value range with a logarithmic scale as follows: `ratio = 1 + 9 × (counts − low) / (high − low)` `output = 4 mA + log<sub>10</sub>(ratio) × 16 mA` counts: Measured cell count low: Lower cell count limit high: Higher cell count limit output: Current amplitude in mA		

The following procedure describes how to adjust the analogue outputs.

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	On the Home screen, press Settings.	
2.	Press the Online mode settings button.	
3.	Press the Analog outputs button.	
4.	Choose Port 1 or Port 2 (figure 6-6)	

	WORK STEP	ADDITIONAL INFO / IMAGES
5.	Choose the source (figure 6-6, position 2).	
6.	Define the lower limit of the range (figure 6-6, position 3).	When the source is equal to this value, 4 mA will be output on the selected port.
7.	Define the upper limit of the range (figure 6-6, position 4).	When the source is equal to this value, 20 mA will be output on the selected port.
8.	Press the Save button.	

6.8 Digital and analogue output testing

Log in as Admin and use Test outputs while the instrument is idle, with PLC mode disabled.

> ⚠ **PREVENT UNINTENDED ALARMS**
>
> The Test outputs interface allows you to generate a physical output signal for testing purposes. Make sure that such tests do not generate an alarm on your control system.

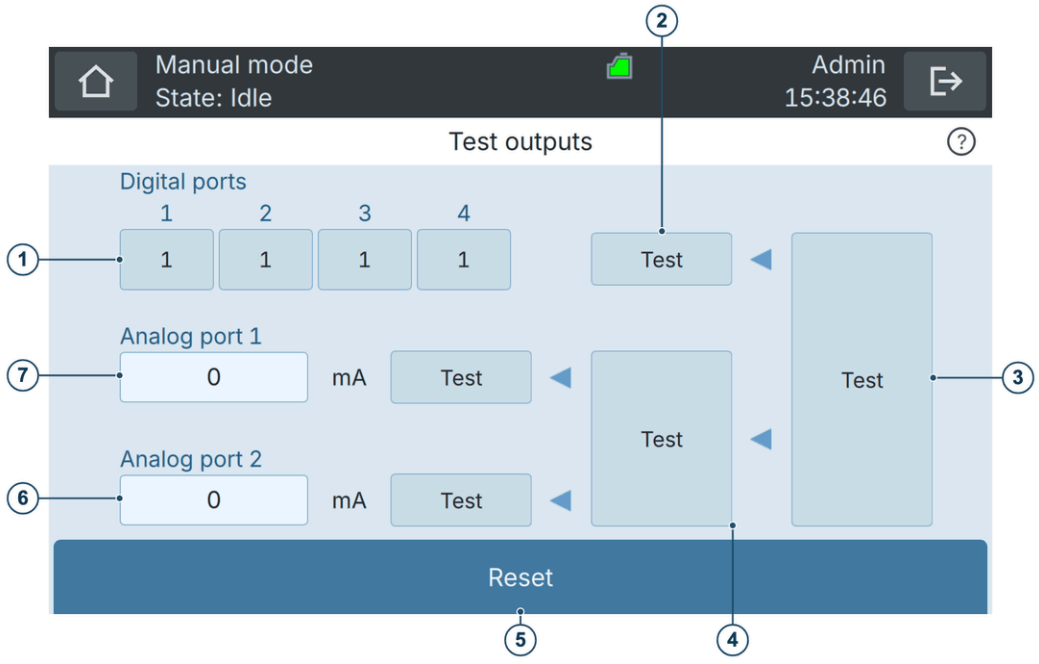


Figure 6-7 Testing analogue and digital outputs

1	Define state of digital outputs for test.	2	Set digital outputs to the state defined in (1).
3	Set all digital and analogue outputs at once.	4	Set current on both analogue outputs.

5	Reset outputs to their state before the tests.	6	Set current on port 2.
7	Set current on port 1.		

The following procedure describes how to test the analogue and digital outputs.

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	On the Home screen, press Settings.	
2.	Press the Online mode settings button.	
3.	Press the Test outputs button.	
4.	Enter the test values that you wish to send to the PLC.	For digital outputs: 1: The switch is closed. 0: The switch is open.
5.	Tests can be triggered individually or together (see figure 6-7): • Testing only the digital outputs on the terminals 1 – 4. • Testing only the analogue outputs on ports 1, 2 or both. • Testing all outputs.	The output signals can be measured on the terminals.
6.	Press the Reset button.	

7. Field Bus Interface

7.1 Modbus TCP

7.1.1 General information for operating with Modbus TCP

The BactoSense can be operated via the Modbus Transmission Control Protocol (TCP). The following requirements must be met:

- The computer and/or the management or control system must be compatible with Modbus TCP.
- The computer and/or the management or control system must have software that can properly process the data provided by the BactoSense.
- The BactoSense must have the Modbus TCP service activated under Home → Settings → System settings → System services.
- The BactoSense must be connected to the bus system.
- To be able to work with the Modbus TCP, the network settings must be set correctly.

Additional information

- The Modbus TCP interface is integrated by default in the BactoSense.
- The Ethernet socket is located at the right-hand side of the instrument.
- The address table necessary for programming can be found in the Modbus TCP address list.
- All registers are encoded big-endian.
- Modbus TCP communication runs on port 502.
- The error code lists can be found in Non-critical errors and Critical errors.
- Modbus TCP can be used for time synchronisation. Follow the instructions in Set NTP Servers and select *Modbus TCP* as a sync source.

7.1.2 Address list on Modbus TCP:

The following values can be read with Modbus function 3 or 4 and written with Modbus function 16.

REGISTER NO	ADDRESS (OFFSET)	DATA TYPE	FUNCTION	VALUES
300201 400201	0x00C8	Unsigned integer bits 0-15	Digital Inputs. Ignored unless "Modbus TCP" is selected as source in Digital Inputs settings screen.	Bit 0: Input 1 Bit 1: Input 2 Bit 2: Input 3 Bit 3: Input 4 For correct bit to input mapping, refer to Digital inputs configuration and PLC mode, in particular table 6-2 and figure 6-5. Input 1111 = 15 means abort.
300202 400202	0x00C9	Unsigned integer bits 0-15	Power control	Bit 0: Power off Bit 1: Reboot

REGISTER NO	ADDRESS (OFFSET)	DATA TYPE	FUNCTION	VALUES
300203 400203	0x00CA	Uint16	Watchdog	Write setpoint in seconds to activate or reset countdown. After the value is written, a countdown decrements it by 1 every second. During countdown, reading the register returns the setpoint. If countdown reaches 0, any ongoing protocol is aborted. Reading the register returns 0 Write 0 to disable countdown.
300204 400204	0x00CB	Uint16	Test register	Write 1 to display a message on DI source page of GUI. Resets to 0 at startup.
300211 400211	0x00D2	UInt16: Year	Get/Set Date and Time. Time is changed as soon as write is finished. Only the fields where registers were written are changed: if only month is written, only the month is updated.	[0, 9999]
300212 400212	0x00D3	UInt16: Month		[1, 12]
300213 400213	0x00D4	UInt16: Day		[0, 31]
300214 400214	0x00D5	UInt16: Hour		[0, 24]
300215 400215	0x00D6	UInt16: Minute		[0, 59]
300216 400216	0x00D7	UInt16: Second		[0, 59]
The following values can be read with Modbus function 3 or 4.				
300001 400001	0x0000	UInt16 (individual bits)	Digital Outputs	Bit 0: Output 1 Bit 1: Output 2 Bit 2: Output 3 Bit 3: Output 4 For correct bit to output mapping, refer to Digital output configuration, or use the output test interface as described in Digital and analogue output testing.
300002 400002	0x0001	UInt16 (individual bits)	Instrument Status 0 = No 1 = Yes	Bit 0: Process running Bit 1: Critical Error Bit 2: Non-critical error Bit 3: PLC mode active Bit 4: Rapid heating (in winter mode) Bit 5: Background heating (winter mode) Bit 6: Sampling device in use
300003 400003	0x0002	UInt16 (individual bits)	Alarm status, i.e., alarms raised during the last measurement.	Bit 0: Alarm 1 Bit 1: Alarm 2 Bit 2: Alarm 3 ...

REGISTER NO	ADDRESS (OFFSET)	DATA TYPE	FUNCTION	VALUES
300004 400004	0x0003	UInt32 MSB (individual bits)	Warning status, i.e., warnings raised during the last measurement.	Bit 0: Warning W01 Bit 1: Warning W02 ... Bit 31: Warning W32
300005 400005	0x0004	UInt32 LSB (individual bits)		
300006 400006	0x0005	UInt16	Error code	See error code list. Note: E00 (unhandled software error) is renamed to 999 to avoid confusion with "no error". Non-critical error codes remain until either cleared automatically by a successful protocol or cleared manually.
300007 400007	0x0006	UInt16	Heartbeat	Seconds of the clock. The value changes every second, use this to monitor responsiveness of the system.
300008 400008	0x0007	UInt16	Measurement stage	IDLE 0 INITIALIZING 1 HEATING 2 FILLING 3 PRIMING 4 MIXING 5 INCUBATING 6 ANALYZING 7 CLEANING 8 FLUSHING 9 PROCESSING 10 VALIDATING 11 MOVING 12 EJECTING 13 EXPORTING 14 RENAMING 15 DELETING 16 SAVING 17 SELFCHECK 18 ABORTED 19 UNKNOWN 98 ERROR 99
300011 400011	0x000A	UInt16	Measurement Progress	[0, 100] 0 .. 100 %
300012 400012	0x000B	Float 32 MSB	Temperature of IO board	Celsius
300013 400013	0x000C	Float 32 LSB		
300014 400014	0x000D	UInt16	Humidity at IO board	[0, 100] 0 .. 100 %

REGISTER NO	ADDRESS (OFFSET)	DATA TYPE	FUNCTION	VALUES
300015 400015	0x000E	UInt16: Year	Date and time of last sampling	
300016 400016	0x000F	UInt16: Month		
300017 400017	0x0010	UInt16: Day		
300018 400018	0x0011	UInt16: Hour		
300019 400019	0x0012	UInt16: Minute		
300020 400020	0x0013	UInt16: Second		
300021 400021	0x0014	UInt16	Cartridge percentage	[0, 100] 0 .. 100 %
300022 400022	0x0015	UInt32 MSB	Cartridge serial no	
300023 400023	0x0016	UInt32 LSB		
300024 400024	0x0017	UInt32 MSB	Fill serial no	
300025 400025	0x0018	UInt32 LSB		
300026 400026	0x0019	Uint16	Cartridge type	1 = TCC 1002 = ICC 1030 = ACC 1003 = ICC-BWT
300027 400027	0x001A	UInt16: Year	Cartridge expiration date	UTC date
300028 400028	0x001B	UInt16: Month		
300029 400029	0x001c	UInt16: Day		
300031 400031	0x001E	UInt32 MSB	Instrument Serial number	
300032 400032	0x001F	UInt32 LSB		

REGISTER NO	ADDRESS (OFFSET)	DATA TYPE	FUNCTION	VALUES
300033 400033	0x0020	String char 1-2	Software version	When shorter than 16 characters, the string is padded with null characters. Example: '1.4.0-BS\0\0\0\0...'
300034 400034	0x0021	String char 3-4		
300035 400035	0x0022	String char 5-6		
300036 400036	0x0023	String char 7-8		
300037 400037	0x0024	String char 9-10		
300038 400038	0x0025	String char 11-12		
300039 400039	0x0026	String char 13- 14		
300040 400040	0x0027	String char 15- 16		
300041 400041	0x0028	UInt16	Memory remaining	Approx measurements remaining before disk is full
300042 400042	0x0029	UInt16	Lifetime of valve remaining	[0, 100], percentage of movements remaining before service.
300043 400043	0x002A	UInt16	Lifetime of plunger remaining	[0, 100], percentage of movements remaining before service.
300044 400044	0x002B	UInt16: Year	Next service due date	UTC date
300045 400045	0x002C	UInt16: Month		
300046 400046	0x002D	UInt16: Day		
300101 400101	0x0064	UInt32 MSB	TCC	Resets to zero after a cleaning protocol or at reboot.
300102 400102	0x0065	UInt32 LSB		
300103 400103	0x0066	UInt32 MSB	ICC	Always 0 if cartridge does not provide ICC.
300104 400104	0x0067	UInt32 LSB		

REGISTER NO	ADDRESS (OFFSET)	DATA TYPE	FUNCTION	VALUES
300105 400105	0x0068	UInt32 MSB	Gate+	Always 0 if cartridge does not provide Gate+
300106 400106	0x0069	UInt32 LSB		
300107 400107	0x006A	UInt32 MSB	HNAC	
300108 400108	0x006B	UInt32 LSB		
300109 400109	0x006C	UInt32 MSB	LNAC	
300110 400110	0x006D	UInt32 LSB		
300111 400111	0x006E	Float 32 MSB	HNAP	
300112 400112	0x006F	Float 32 LSB		
300113 400113	0x0070	UInt32 MSB	ACC	Always 0 if not ACC cartridge.
300114 400114	0x0071	UInt32 LSB		
300115 400115	0x0072	UInt32 MSB	HACC	Always 0 if not ACC cartridge.
300116 400116	0x0073	UInt32 LSB		
300117 400117	0x0074	UInt32 MSB	LACC	Always 0 if not ACC cartridge.
300118 400118	0x0075	UInt32 LSB		
300119 400119	0x0076	Float 32 MSB	HACP	Always 0 if not ACC cartridge.
300120 400120	0x0077	Float 32 LSB		
300121 400121	0x0078	UInt32 MSB	Live TCC	Same as TCC, but the value is updated live during a measurement. Useful for early contamination detection (for example: halting a pump or diverging online water). Returns to zero at the end of the measurement.
300122 400122	0x0079	UInt32 LSB		

REGISTER NO	ADDRESS (OFFSET)	DATA TYPE	FUNCTION	VALUES
300123 400123	0x007A	UInt32 MSB	Live ICC	see above.
300124 400124	0x007B	UInt32 LSB		
300125 400125	0x007C	UInt32 MSB	Live Gate+	see above.
300126 400126	0x007D	UInt32 LSB		
300127 400127	0x007E	UInt32 MSB	Live HNAC	see above.
300128 400128	0x007F	UInt32 LSB		
300129 400129	0x0080	UInt32 MSB	Live LNAC	see above.
300130 400130	0x0081	UInt32 LSB		
300131 400131	0x0082	Float 32 MSB	Live HNAP	see above.
300132 400132	0x0083	Float 32 LSB		
300135 400135	0x0086	UInt32 MSB	Live ACC	see above.
300136 400136	0x0087	UInt32 LSB		
300137 400137	0x0088	UInt32 MSB	Live HACC	see above.
300138 400138	0x0089	UInt32 LSB		
300139 400139	0x008A	UInt32 MSB	Live LACC	see above.
300140 400140	0x008B	UInt32 LSB		
300141 400141	0x008C	Float 32 MSB	Live HACP	see above.
300142 400142	0x008D	Float 32 LSB		

REGISTER NO	ADDRESS (OFFSET)	DATA TYPE	FUNCTION	VALUES
300151 400151	0x0096	UInt16: Year	Date and time of last abrupt shutdown.	
300152 400152	0x0097	UInt16: Month		
300153 400153	0x0098	UInt16: Day		
300154 400154	0x0099	UInt16: Hour		
300155 400155	0x009A	UInt16: Minute		
300156 400156	0x009B	UInt16: Second		
300157 400157	0x009C	UInt16	Power off time	In seconds
300165 400165	0x00A4	UInt16: Year	Date and time of last protocol start.	
300166 400166	0x00A5	UInt16: Month		
300167 400167	0x00A6	UInt16: Day		
300168 400168	0x00A7	UInt16: Hour		
300169 400169	0x00A8	UInt16: Minute		
300170 400170	0x00A9	UInt16: Second		
300171 400171	0x00AA	UInt16	BactoSwitch current measurement stream	From 1 to 4
300172 400172	0x00AB	UInt16	BactoSwitch next measurement stream	From 1 to 4
300173 400173	0x00AC	UInt16	BactoSwitch flow rate	mL/min
300174 400174	0x00AD	UInt16	BactoSwitch status	0 means no error.
300175 400175	0x00AE	UInt16	BactoSwitch connection	0 = not connected 1 = connected successfully

REGISTER NO	ADDRESS (OFFSET)	DATA TYPE	FUNCTION	VALUES
300176 400176	0x00AF	UInt16	BactoSwitch valve state	Bitmask 0x01 = valve of stream 1, etc int 15 = all open
300181 400181	0x00B4	UInt32 MSB	CBC	
300182 400182	0x00B5	UInt32 LSB		
300183 400183	0x00B6	UInt32 MSB	EBC	
300184 400184	0x00B7	UInt32 LSB		
300185 400185	0x00B8	UInt32 MSB	NBC	
300186 400186	0x00B9	UInt32 LSB		
300187 400187	0x00BA	UInt32 MSB	Live CBC	see above.
300188 400188	0x00BB	UInt32 LSB		
300189 400189	0x00BC	UInt32 MSB	Live EBC	see above.
300190 400190	0x00BD	UInt32 LSB		
300191 400191	0x00BE	UInt32 MSB	Live NBC	see above.
300192 400192	0x00BF	UInt32 LSB		

8. General Operations and Configurations

8.1 Switching on and off

The power button of the BactoSense is located on the right-hand side of the instrument.



Figure 8-1 Power button of the BactoSense

> ⚠ **CHECK THE POWER SUPPLY**
>
> Before switching the BactoSense on, make sure that the instrument is connected to a stable power supply meeting the requirements described in Connecting the BactoSense to power.

Switching on To switch the BactoSense on, briefly press the power button. The power button LED remains lit, and after a few seconds, the welcome screen is displayed on the user interface.

Switching off If you are logged in and want to switch the BactoSense off, tap on the logout button on the top right corner of the user interface and select *Power off*. If you want to switch off from the login page itself, press the power button for 10 seconds.

> ⚠ **DISCONNECT POWER SAFELY**
>
> To disconnect the BactoSense from power, first switch the instrument off. Then unplug the power supply unit from the mains power source, before unplugging the power supply plug from the BactoSense.

8.2 Login, user roles and permissions

BactoSense operation requires users to log in. Different user roles with different permissions are available. The user role permissions are listed in User roles and permissions. All logins are password protected.

Login and logout can be performed using the login button displayed in the top right corner of the user interface. The currently active user role is displayed next to that button.

8.2.1 Login

	WORK STEP
1.	Press the login button on the top right corner of the user interface, or the login bar at the bottom in case you switched on the instrument.

	WORK STEP
2.	For BactoSense CORE or BactoSense ID in the standard configuration: Select one of the user profiles Basic, Advanced or Admin. For BactoSense CORE or BactoSense ID upgraded with the Management package (see Management package) and advanced user management mode activated (see Activating advanced user management mode), enter your user ID.
3.	Enter the password and press OK. If you don't know the password, ask your Admin user. In a new instrument no passwords are set. In that case, follow the procedure described in Setting and changing passwords.
4.	After logging in, you see the BactoSense user interface.
5.	To log out, follow the procedure described in Manual logout.

8.2.2 Manual logout

	WORK STEP
1.	Make sure all processes (e.g. measurements or cleaning cycles) have completed. The idle state of the instrument is indicated on the left-hand side of the top bar of the BactoSense user interface.
2.	Press the logout button in the top right corner of the user interface.
3.	Select Log out / Lock screen.
4.	To log in again, follow the procedure described in Login.

8.2.3 Auto-logout

It is possible to configure an automatic logout after a predefined period of inactivity.

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	As an Admin user, press Settings on the Home screen to open the settings menu.	
2.	Press the System settings button.	
3.	Press the Users button.	
4.	Press the Settings button.	
5.	Configure the desired auto-logout time period.	
6.	Press Save.	

8.2.4 Activating advanced user management mode

With the *Advanced User Management* feature, an instrument admin can create users and assign different user roles (Basic, Advanced, Admin). This allows the admin to give different permissions to individual users and log their activity for the audit trail.

Advanced user management mode is available for BactoSense SMART and PURE, and BactoSense CORE or BactoSense ID upgraded with the management package (see Management package).

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	As an Admin user, press Settings on the Home screen to open the settings menu.	
2.	Press the System settings button.	
3.	Press the System configuration button.	
4.	Check the Advanced user management mode checkbox.	
5.	Press Save.	

8.2.5 Setting and changing passwords

Each user role is password protected.

Setting a password at first login Upon initial login with any user role, click *OK* when being prompted for a password. This action will initiate the guided process for configuring your password. The only exception is the service password, where a preset password is provided.

Setting and changing passwords Each user profile can change its own password. Admin users are allowed to change the passwords of other user profiles. The following procedure describes how to change passwords.

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	On the Home screen, press Settings. Basic users press Change password; Advanced and Admin users press System settings, then Users.	
2.	Select the user profile you want to edit, then press Edit.	Basic and Advanced users can change their own PIN. Admin users can also change the PIN of Basic and Advanced users.
3.	Press Change PIN. Enter the new PIN in PIN and Confirm PIN, then press Save.	

8.2.6 Changing password settings

Several password requirements, such as expiration and length, can be configured.

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	As an Admin user, press Settings on the Home screen to open the settings menu.	
2.	Press the System settings button.	
3.	Press the Users button.	
4.	Press the Settings button.	
5.	Configure the password requirements based on your preferences.	

	WORK STEP	ADDITIONAL INFO / IMAGE
6.	Press Save.	

8.2.7 User roles and permissions

Table 8-1 User roles and permissions

RIGHT	BASIC	ADVANCED	ADMIN
View last result	✓	✓	✓
View all results and export	✓	✓	✓
Start, stop, and schedule measurement	✓	✓	✓
Switch between Online and Manual mode	✓	✓	✓
View error and warning log	✓	✓	✓
Rename results	✓	✓	✓
Validate device	✓	✓	✓
Change their own password	✓	✓	✓
View system info	✓	✓	✓
See network settings	✓	✓	✓
View last self-check	✓	✓	✓
Change cartridge	✓	✓	✓
Clear errors	✓	✓	✓
See intervention log	✓	✓	✓
See validation results	✓	✓	✓
Delete results		✓	✓
Re-gate results		✓	✓
Adjust alarms		✓	✓
Adjust gates		✓	✓
Reboot		✓	✓
Run a self check		✓	✓
Delete old measurements		✓	✓
Export all		✓	✓
See intervention info		✓	✓
Export diagnostics		✓	✓

RIGHT	BASIC	ADVANCED	ADMIN
Change analogue and digital outputs			✓
Test analogue and digital outputs			✓
Change the passwords of other users			✓
Create other users			✓
Change authentication settings			✓
Set device name			✓
Set date and time			✓
Change network settings			✓
Change services settings			✓
Activate Modbus with key or deactivate			✓
Change language			✓
Switch to demo mode			✓
Reset settings			✓
Full factory reset (except intervention log)			✓
Import settings			✓
Change automatic power-on settings			✓
Activate upgrade packages with code			✓

8.3 Basic configurations

8.3.1 Language of the user interface

The language can only be changed by admin users.

	WORK STEP
1.	As an Admin user, press Settings on the Home screen to open the settings menu.
2.	Press the System settings button. Press the Language button.
3.	Choose the language and press the OK button.
4.	When prompted to reload the user interface, press Reload interface.

8.3.2 Date and time

Date and time can only be changed by admin users.

AUTOMATIC TIME SYNCHRONIZATION

If time synchronization is enabled, either with NTP servers or through Modbus TCP, your manual date and time settings will be overridden during the next synchronization. Settings can be found under Home > Settings > System settings > Date & time > Time synchronization settings. For setting up NTP server, please refer to Set NTP Servers.

	WORK STEP
1.	As an Admin user, press Settings on the Home screen to open the settings menu.
2.	Press the System settings button.
3.	Press the Date & time button.
4.	Enter the date and time.
5.	Select the time zone.
6.	Press the Set button.

8.3.3 Device name

The device name can only be changed by admin users.

	WORK STEP
1.	As an Admin user, press Settings on the Home screen to open the settings menu.
2.	Press the System settings button.
3.	Press the System configuration button.
4.	Tap the Device name field.
5.	Enter the device name using the keyboard and press OK.
6.	Press the Save button.

8.3.4 Automatic power-on

The BactoSense has a built-in auto-restart functionality to automatically recover from temporary power interruptions. Depending on the configuration, the instrument can simply restart, but also return to operation by performing a self-cleaning process and restarting an Online mode series.

	WORK STEP
1.	As an Admin user, press Settings on the Home screen to open the settings menu.
2.	Press the System settings button.
3.	Press the System configuration button.
4.	Select your automatic power-on preferences. Note: Self-cleaning only occurs if the power has been interrupted during a measurement.
5.	Press the Save button.

8.3.5 Sound notifications

You can turn on audible notifications to indicate the end of a manual measurement or maintenance process, alarm or error. The notification is one or several beeping sounds from the instrument.

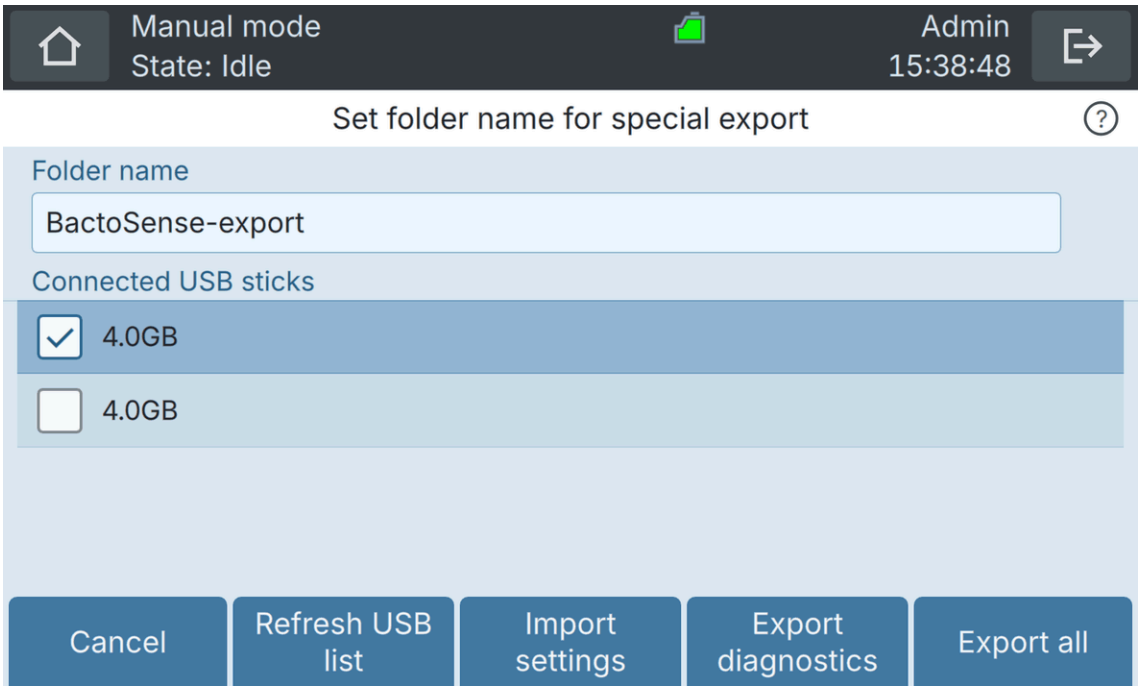
	WORK STEP
1.	As an Admin user, press Settings on the Home screen to open the settings menu.
2.	Press the System settings button.
3.	Press the System configuration button.
4.	Activate Sound notifications.
5.	Press the Save button.

8.4 Import / export settings

Settings are exported to a USB drive as described in Export settings, diagnostics, or all to USB device. The settings are saved in a timestamped file with the `.bnv` extension. To import the settings into a new instrument or restore a backup, copy the `*.bnv` file to the root of the USB drive or to the directory it was exported to. If multiple copies of the settings are located on one USB drive, the system will use the most recent one.

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	As an Admin user, press Settings on the Home screen to open the settings menu.	
2.	Press the Maintenance button.	
3.	Press the Special export import button.	
4.	Connect a USB drive. If needed, press the Refresh USB list button until the drive is detected.	Make sure the *.bnv file is at the root of the USB drive. The USB drive should be formatted in FAT32, which is the common standard.

	WORK STEP	ADDITIONAL INFO / IMAGE
5.	Press the Import settings button.	



6.	Select the settings you want to import. Measurement settings include gate sets, IO settings, alarms, and date and time settings. Network settings include IP, DNS, and NTP addresses	Import measurement settings Import language settings Import network settings
7.	Press Import settings, then Reboot now in the confirmation message, and wait until the device reboots.	

8.5 Alarm configuration

The following rules apply to alarms:

- Only **Advanced** and **Admin** users can change the alarm settings.
- Alarms are only active in the **Online mode**.

BactoSense records alarms in the following ways:

- A popup is displayed in the graphical user interface
- An alarm bell icon appears in the top bar if the last measurement exceeded the alarm threshold. The alarm is shown in the measurement summary when viewing a result.
- A signal can be sent out to a PLC through digital outputs (configurable).

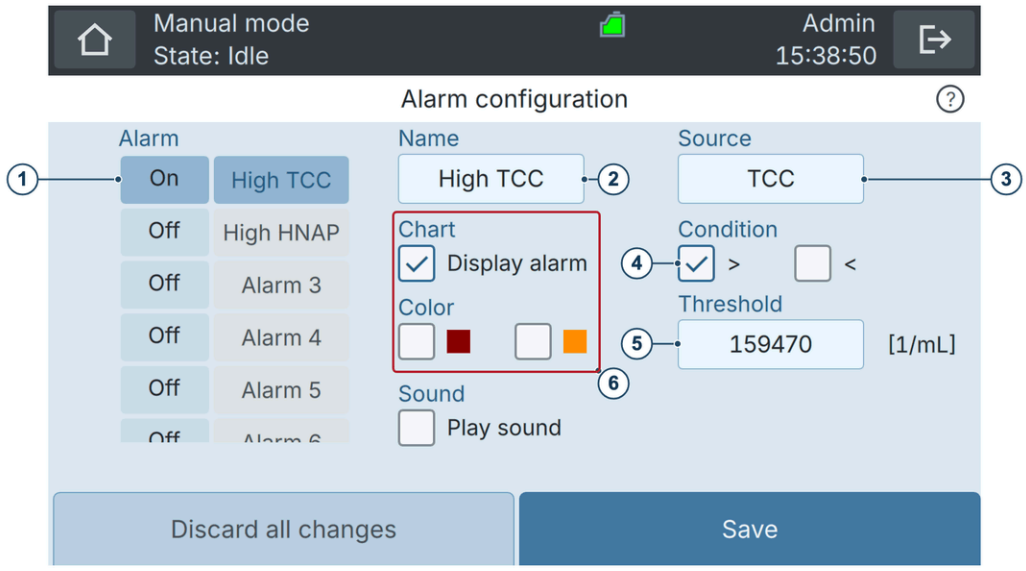


Figure 8-2 Alarm configuration in the BactoSense graphical user interface.

1	Select, enable or disable alarms. Users can configure up to 9 alarms.	2	Name of the currently selected alarm.
3	Source of the alarm: Which measurement result should be evaluated. See figure 8-3.	4	Condition: Trigger the alarm when the measured parameter is larger than (>) or smaller than (<) the threshold.
5	Threshold	6	Display: If checked, a line will be shown on the Online mode plot, in the selected color.

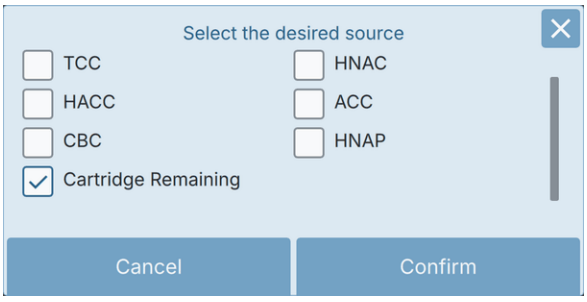


Figure 8-3 BactoSense alarm sources. For a selected source, a condition and a threshold are set. In the example above, an alarm is triggered on a certain cartridge filling level.

The following procedure describes how to configure the alarm:

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	On the Home screen, press Settings to open the settings menu.	
2.	Press the Online mode settings button.	

	WORK STEP	ADDITIONAL INFO / IMAGES
3.	Press the Alarm button.	
4.	Activate, select and configure the alarms (according to figure 8-2 and figure 8-3).	By default, no alarms are active.
5.	Press Save to save the alarm configuration.	

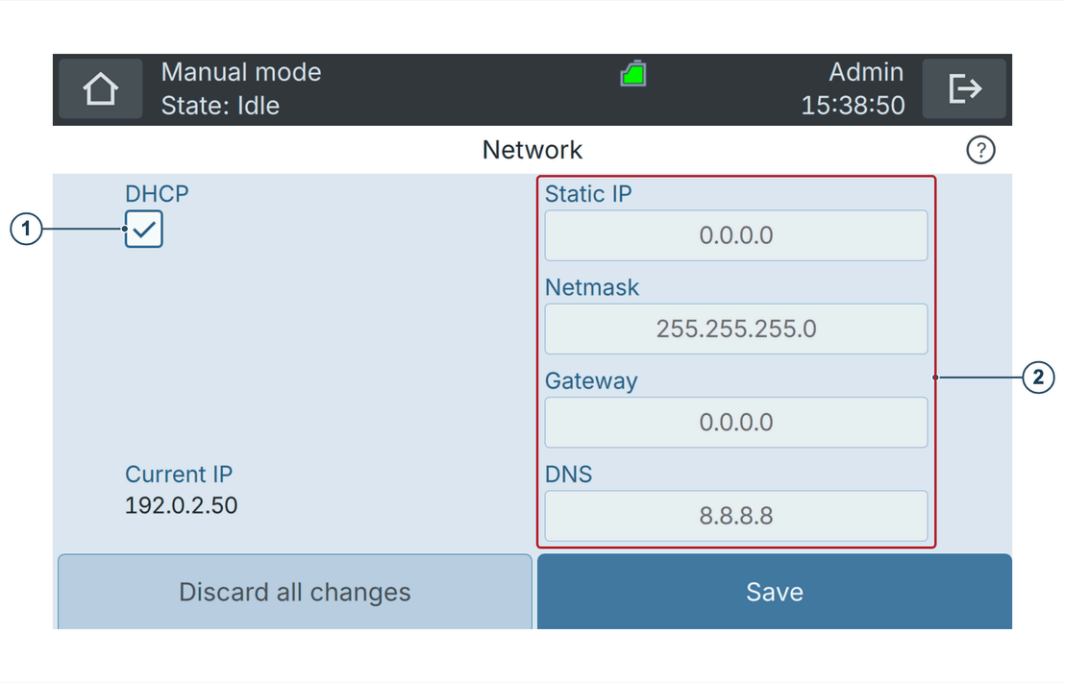
8.6 Network configuration

NETWORK SETTINGS

Ask your network administrator for the correct settings.

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	As an Admin user, press Settings on the Home screen to open the settings menu.	
2.	Press the System settings button.	
3.	Press the Network button.	

	WORK STEP	ADDITIONAL INFO / IMAGE
4.	A: For Dynamic IP check the DHCP check box (1). Note: This is the preferred configuration for most cases when the BactoSense is connected to a router or switch. B: For Static IP uncheck the DHCP check box (1) and enter the desired network configuration (2). Note: This is the preferred configuration when the BactoSense is directly connected to a laptop via Ethernet. Make sure to also adjust the network configuration on the laptop accordingly.	



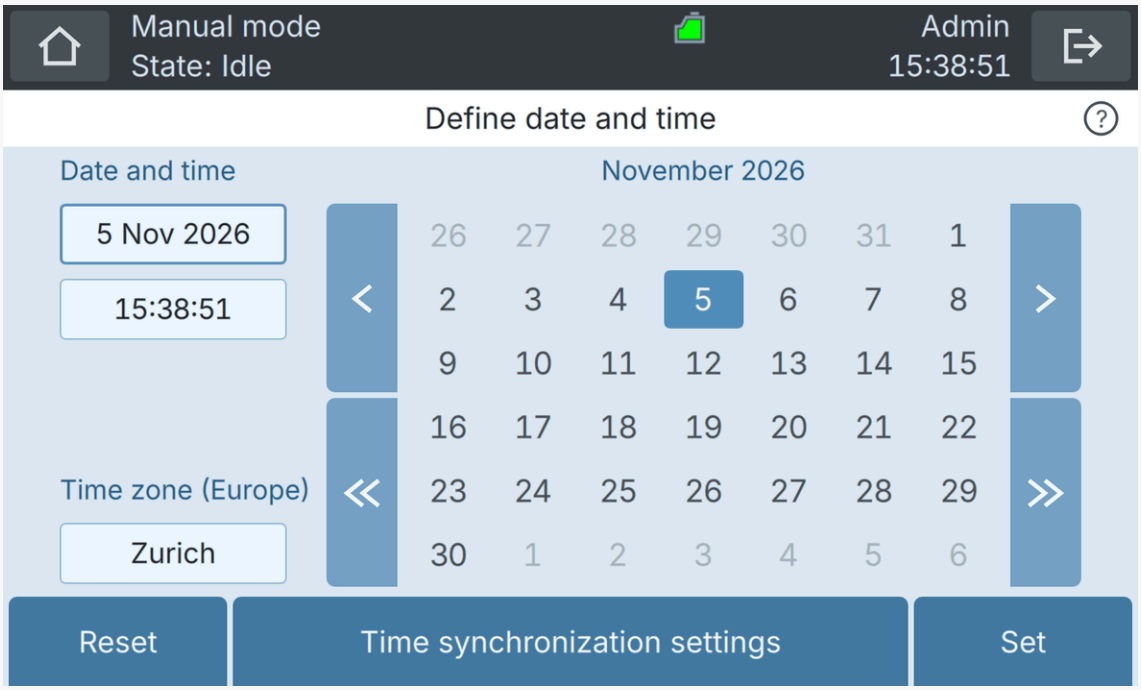
5.	Press the Save button.	
6.	Press the Reboot now button.	

8.7 Set NTP Servers

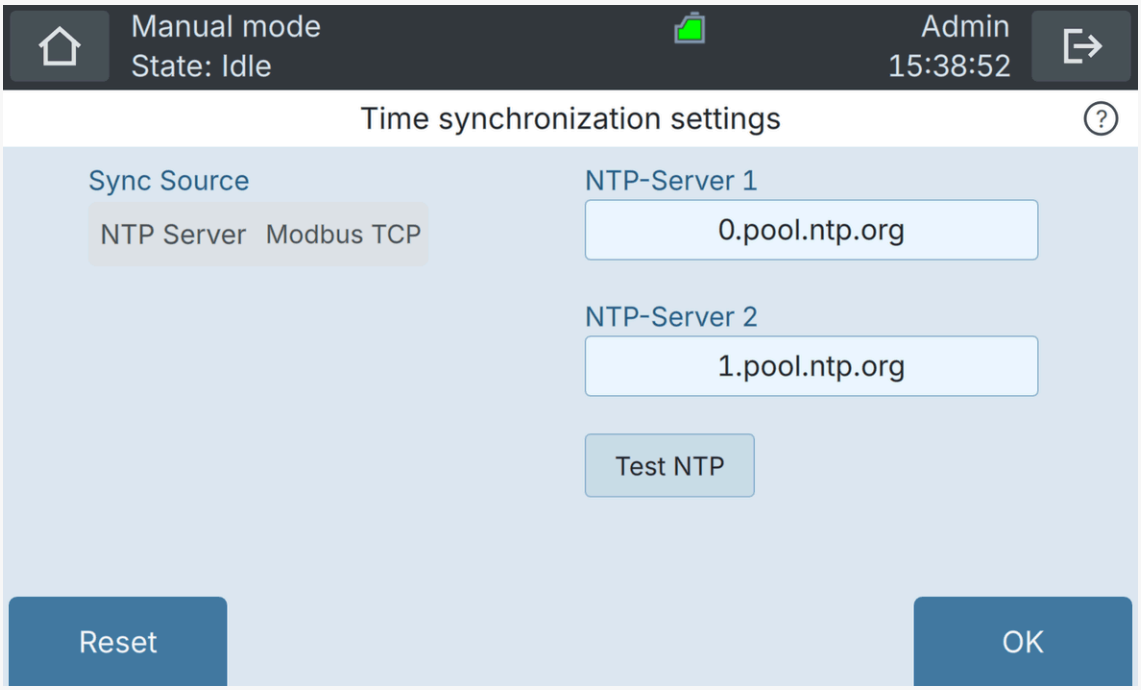
Network Time Protocol (NTP) is a computer network protocol which is used to synchronise time on computers across a network. By default, these are set to synchronise to the Network Time Foundation servers (ntp.org). You have the possibility to set custom NTP servers in the *Date & time* menu.

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	As an Admin user, press Settings on the Home screen to open the settings menu.	
2.	Press the System settings button.	
3.	Press the Date & time button.	

	WORK STEP	ADDITIONAL INFO / IMAGE
4.	Press the Time synchronization settings button.	



5.	Select the desired Sync Source.	**ADDITIONAL INFORMATION** Time synchronisation can be done via NTP server or Modbus TCP. More information about Modbus TCP can be found in Modbus TCP
6.	Update NTP servers.	



	WORK STEP	ADDITIONAL INFO / IMAGE
7	Press the OK button.	**ADDITIONAL INFORMATION** Press Test NTP to check whether the configured servers are reachable. Press OK to save the synchronization settings.

8.8 The BactoSense user interface

8.8.1 General structure, Home screen and Settings menu

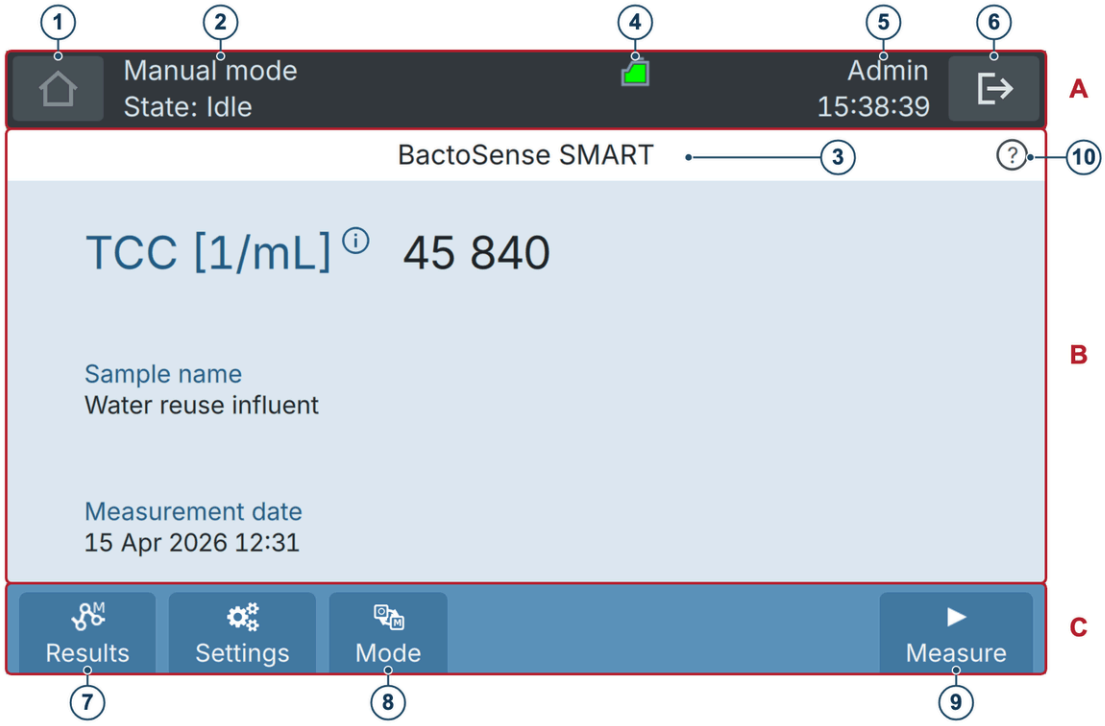


Figure 8-4 The Home screen of the BactoSense user interface.

The Home screen shows the latest measurement result. Press Settings to open the settings menu.

The BactoSense user interface is divided into 3 main sections:

A	Top bar
B	Content view
C	Action bar

The main elements of the user interface are:

1	Home or return button. To navigate through the menu.	2	Operation mode (Manual or Online) Instrument status (currently active process)
3	Current view	4	Top bar status icons, see Top bar status icons.

5	User Role Current time	6	Logout or power off
7	Results: display the measurement results for the selected mode.	8	Mode: choose Online mode for continuous measurements using the online sampling device, or Manual mode for measuring grab samples using the manual sampling device.
9	Measure: open the measurement wizard and choose an analysis protocol (Manual mode).	10	Help: open the user manual at the section for the current screen, see Contextual help.

Depending on the user role, some options may be hidden or disabled.

8.8.2 Top bar status icons

Top bar icons are displayed in the bar in the top of the display. They indicate the status of the instrument.

Table 8-2 Top bar icons

ICON	DESCRIPTION	ICON	DESCRIPTION
	Process running		Demo mode activated
	Cartridge almost empty		Service required (see Maintenance)
	Cartridge almost expired		Cartridge level indication
	Cartridge not correctly initialized or no cartridge		Cartridge empty
	Critical error (Critical errors)		Cartridge expired
	Alarm on last measurement (Online mode only, see Alarm configuration)		Non-critical error (Non-critical errors)

8.9 Cartridge management

The BactoSense cartridges contain the reagents required for measurements and for keeping the instrument clean. Available cartridge types are TCC (Total Cell Count), ICC (Intact Cell Count), EBC (E. coli Cell Count), ACC (Active Cell Count), CBC (Coliform Cell Count), and NBC (Enterococcus Cell Count). The following sections explain cartridge handling. Cartridge storage, transportation and refill are described in Storage, Transport and Disposal.

8.9.1 General instructions for cartridge handling

When handling the cartridge, the following instructions must be followed:

Table 8-3 Cartridge handling instructions

	Follow the procedures described in this manual.		Store and ship between 15 °C – 25 °C (59 °F – 77 °F). The optimal temperature is 15 °C (59 °F).
	Wear nitrile gloves when handling the cartridge.		Store and ship between 20 % and 60 % relative humidity.
	Wear safety glasses when handling the cartridge.		The cartridge is intended for refill.
	Ship, install and store in the indicated orientation		Do not throw the cartridge into the trash.

8.9.2 Checking the filling level and expiration date of a cartridge

The cartridge filling levels and expiration date can be retrieved from several sources.

- The cartridge icon shown in the top bar of the user interface constantly indicates the approximate cartridge filling level. In case the cartridge is about to expire, the cartridge icon displays this too. Explanations of the different icons can be found in Top bar status icons.
- If you need more information, press *Settings* on the *Home screen*, then press *System info*. Under *Cartridge capacity remaining* you see how full the cartridge still is (in percent), and under *Cartridge expiration date* you see when the cartridge expires. The same information can also be retrieved from the web interface (see Web User Interface)

8.9.3 Cartridge overview

The BactoSense cartridge is installed in a dedicated cartridge compartment of the instrument. A door closes the cartridge compartment. The cartridge door must only be opened for removing and installing cartridges.

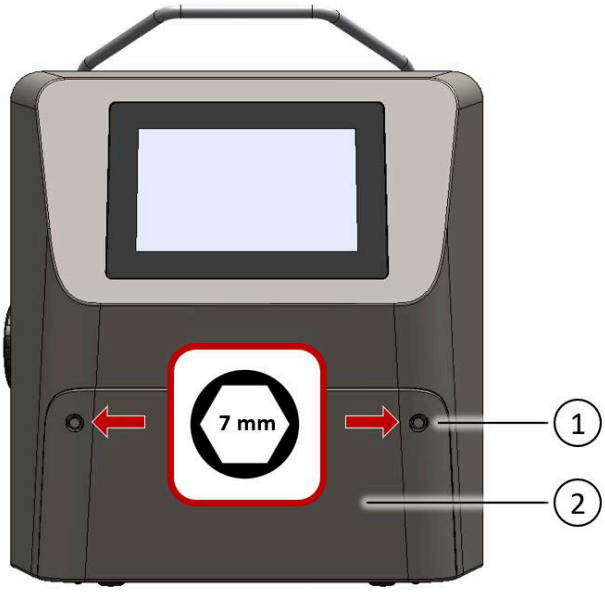


Figure 8-5 The BactoSense cartridge compartment can be opened by removing two 7 mm hex nuts using the supplied hex nut driver.

1	7 mm hex nuts to secure cartridge compartment door	2	Cartridge compartment door

⚠ USE THE CORRECT DOOR TOOL

Open and close the cartridge compartment door only with the dedicated 7 mm hex nut driver.

After opening the cartridge compartment door, the user has access to the cartridge and the connectors which connect the cartridge to the BactoSense.

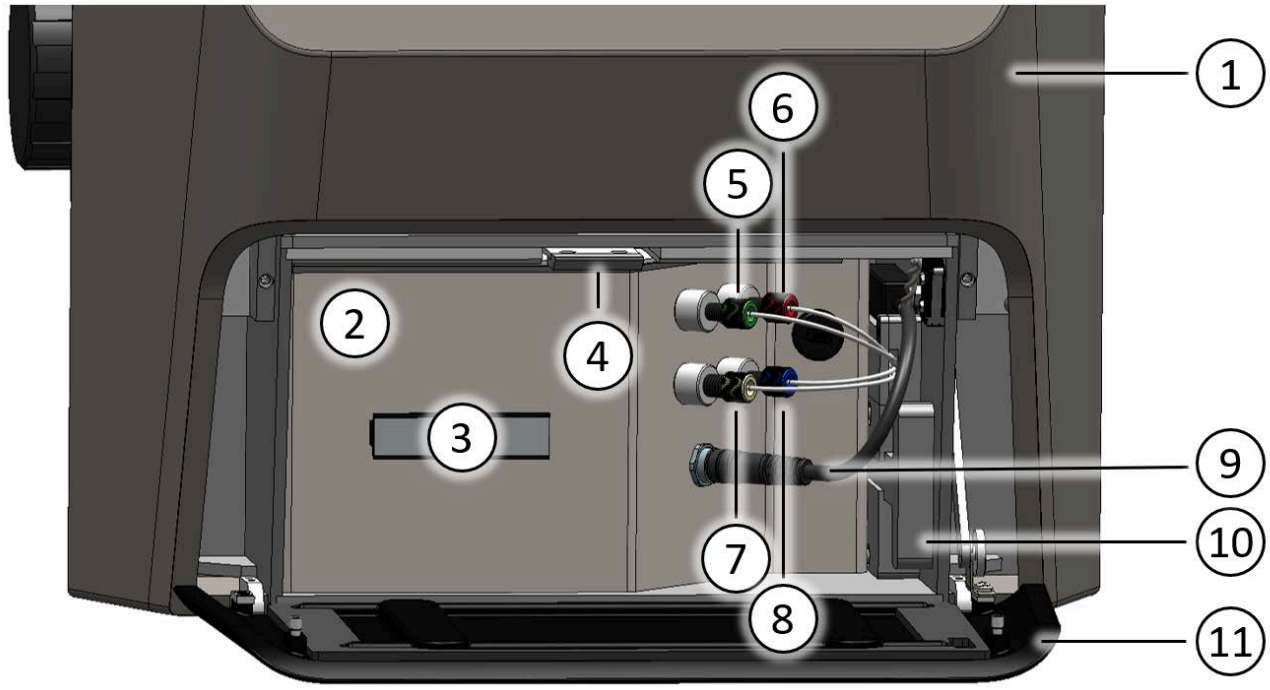


Figure 8-6 Overview of an installed cartridge. The mobility of the cartridge is secured with a fixation latch on top (4), and the cartridge is connected to the instrument with multiple fluidic (5 - 8) and one electronic connector (9). When no cartridge is inserted, the fluidic and electronic connectors can be secured using the removable connector rack (10).

1	BactoSense instrument	2	Cartridge
3	Cartridge handle	4	Cartridge fixation latch
5	Dye connector (green)	6	Bleach connector (red)
7	Waste connector (black or beige)	8	Rinse connector (blue)
9	Electronic connector	10	Removable connector rack
11	Cartridge compartment door		

⚠ PROTECT THE UNUSED CONNECTOR

The BactoSense has five fluidic connectors. Depending on the cartridge type, only four or all five fluidic connectors are needed. In case of TCC or ICC cartridges, make sure the unused fifth connector is always mounted to the connector rack to prevent contamination.

8.9.4 Change cartridges

The following procedure describes the exchange of cartridges. Use this procedure if you want to remove and directly install another cartridge. If you only want to remove a cartridge and not install another one, follow the instruction in Removing a cartridge. The duration of the cartridge exchange is approximately 35 min.

> ⚠ **FOLLOW THE CARTRIDGE WIZARD**
>
> Strictly follow the procedure in the on-screen wizard. **Do not remove or install cartridges without this procedure.**

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	Have the replacement cartridge ready and adjusted to ambient temperature.	
2.	On the Home screen, press Settings to open the settings menu.	
3.	Press the Maintenance button.	Basic users skip this step.
4.	Press the Cartridge change button.	
5.	Select Change cartridge.	
6.	⚠ **FOLLOW THE CARTRIDGE WIZARD** Confirm that you will follow the instructions of the on-screen wizard. Only open the cartridge compartment door when instructed. Adhere to the general cartridge handling instructions in General instructions for cartridge handling. Wear nitrile gloves and safety glasses. Tightly seal the fluidic connectors of the old cartridge with the attached plugs before removing it. Make sure the cartridge compartment door is tightly closed and secured at the end.	⚠ **SKIPPING THE CARTRIDGE WIZARD** Only very experienced users mastering safe cartridge operations are allowed to skip the on-screen instructions. In case of TCC or ICC cartridges, make sure the unused fifth connector is always mounted to the connector rack to prevent contamination.
7.	Handling the removed cartridge • If you wish to store the removed cartridge, refer to the storage instructions in Storage of the cartridge. • If you wish to refill the removed cartridge, refer to the refill instructions in Returning a cartridge for refill.	

8.9.5 Removing a cartridge

This procedure is intended for the removal of a cartridge, without immediate installation of another cartridge. If you want to exchange cartridges, follow the procedure described in Change cartridges. The duration of the cartridge removal is approximately 5 min.

> ⚠ **FOLLOW THE CARTRIDGE WIZARD**
>
> Strictly follow the procedure in the on-screen wizard. **Do not remove or install cartridges without this procedure.**

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	On the Home screen, press Settings to open the settings menu.	
2.	Press the Maintenance button.	Basic users skip this step.
3.	Press the Cartridge change button.	
4.	Select Remove cartridge.	
5.	⚠ **FOLLOW THE CARTRIDGE WIZARD** Confirm that you will follow the instructions of the on-screen wizard. Only open the cartridge compartment door when instructed. Adhere to the general cartridge handling instructions in General instructions for cartridge handling. Wear nitrile gloves and safety glasses. Tightly seal the fluidic connectors of the old cartridge with the attached plugs before removing it. Make sure the cartridge compartment door is tightly closed and secured at the end.	⚠ **SKIPPING THE CARTRIDGE WIZARD** Only very experienced users mastering safe cartridge operations are allowed to skip the on-screen instructions.
6.	Handling of the removed cartridge • If you wish to store the removed cartridge, refer to the storage instructions in Storage of the cartridge. • If you wish to refill the removed cartridge, refer to the refill instructions in Returning a cartridge for refill.	The top bar of the user interface indicates that no cartridge is connected. In the Settings menu, Maintenance is highlighted; Basic users see the highlighted Cartridge change button directly. 

8.9.6 Installing a cartridge

This procedure is intended for the installation of a cartridge, when no other cartridge is installed in the BactoSense. If there is already a cartridge and you want to exchange cartridges, follow the procedure described in Change cartridges. The duration of the cartridge installation is approximately 30 min.

⚠ **FOLLOW THE CARTRIDGE WIZARD**

Strictly follow the procedure of the on-screen wizard. **Do not remove or install cartridges without this procedure.**

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	Have the new cartridge ready and adjusted to ambient temperature.	
2.	On the Home screen, press Settings to open the settings menu.	
3.	Press the Maintenance button.	The Maintenance button is highlighted in orange in case no cartridge is installed. Basic users skip this step.
4.	Press the Cartridge change button.	

	WORK STEP	ADDITIONAL INFO / IMAGE
5.	Select Install cartridge.	
6.	**⚠ FOLLOW THE CARTRIDGE WIZARD** Confirm that you will follow the instructions of the on-screen wizard. Only open the cartridge compartment door when instructed. Adhere to the general cartridge handling instructions in General instructions for cartridge handling. Wear nitrile gloves and safety glasses. Make sure the cartridge compartment door is tightly closed and secured at the end.	**⚠ SKIPPING THE CARTRIDGE WIZARD** Only very experienced users mastering safe cartridge operations are allowed to skip the on-screen instructions. In case of TCC or ICC cartridges, make sure the unused fifth connector is always mounted to the connector rack to prevent contamination.
7.	After completing all steps of the on-screen wizard, the new cartridge is properly initialized.	The cartridge status is indicated with a cartridge symbol in the top bar of the user interface, see Top bar status icons.

8.10 Switching between sampling devices

The BactoSense can be operated with either the manual or the online sampling device. The following procedure describes the exchange of sampling devices. Sampling device storage information can be found in Storage of the sampling devices.

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	Remove the mounted sampling device according to the instructions in Removal of the online sampling device (online sampling device) or Removal of the manual sampling device (manual sampling device)	
2.	Install the new sampling device according to the instructions in Installation of the online sampling device (online sampling device) or Installation of the manual sampling device (manual sampling device).	

8.10.1 Removal of the online sampling device

When switching to the manual sampling device, the online sampling device has to be removed. Follow the procedure below to safely remove the device and prepare it for storage.

WEAR PROTECTIVE GLOVES

Avoid contamination of the equipment. Wear nitrile gloves when handling samples, sampling devices and any components which come in contact with them.

	WORK STEP
1.	Terminate any ongoing measurement series, as described in Terminating automatic online measurements.
2.	Stop the water flow through the sampling device tubings and sampling device.
3.	Carefully unscrew the knurled sampling device fixation ring until the sampling device can be removed.

	WORK STEP
4.	Remove the online sampling device. Make sure the white sealing plug still sits tightly in the connector of the sampling device. If not, it may have remained in the BactoSense sampling device connector. In this case carefully remove it with tweezers and place it back in the sampling device.
5.	Disconnect and drain the inlet and outlet tubings from the water source and the sampling device body.
6.	Inspect the inlet and outlet tubings for contamination and damage. Only reuse clean and intact tubings.
7.	If you want to store the sampling device, place the device and the tubings in separate clean, dry plastic bags and follow the storage instructions in Storage of the sampling devices.
8.	To mount now the manual sampling device, see Installation of the manual sampling device.

8.10.2 Removal of the manual sampling device

When switching to the online sampling device, the manual sampling device has to be removed. Follow the procedure below to safely remove the device and prepare it for storage.

> **WEAR PROTECTIVE GLOVES**
>
> Avoid contamination of the equipment. Wear nitrile gloves when handling samples, sampling devices and any components which come in contact with them.

	WORK STEP
1.	Perform a cleaning of the manual sampling device: If a Washstation is available, follow the procedure in Clean manual sampling device with Washstation, otherwise the procedure in Clean manual sampling device with basic cleaning.
2.	After finishing, attach a clean and empty 5 mL screw-cap tube or the Washstation to the sampling device.
3.	Carefully unscrew the knurled sampling device fixation ring on top of the device until the sampling device can be removed.
4.	Remove the manual sampling device. Make sure the white sealing plug still sits tightly in the connector of the sampling device. If not, it may have remained in the BactoSense sampling device connector. In this case, carefully remove it with tweezers and place it back in the sampling device.
5.	If you want to store the sampling device, place it in a clean and dry plastic bag and follow the storage instructions in Storage of the sampling devices.
6.	To mount now the online sampling device, follow the procedure in Installation of the online sampling device.

8.11 Qualification

Qualification is a process to ensure the BactoSense operates as intended. Different options are available.

To do a fully automated quick check of the instrument status, perform the self-check procedure described in Automatic self-check. This test does not require any reagents or user interaction, is very quick and checks the integrity and communication between the different modules of the BactoSense.

To assess the cleanliness of the BactoSense and rule out a contamination, perform the cleanliness verification procedure in Cleanliness verification.

For operational environments requiring system suitability testing, use the *System Suitability Test Kit (SST Kit)* and follow the procedure in its user manual.

For other environments, an instrument qualification using the *Validation kit* is recommended in the following situations:

- After shipping the instrument or other long-distance transport, exposing the instrument to vibration or shock.
- After storing the instrument for more than one month.
- If there are indications that measurement results could be erroneous.

8.11.1 Cleanliness verification

	WORK STEP
1.	Make sure the manual sampling device is tightly installed as described in Installation of the manual sampling device.
2.	Perform a cleaning of the sampling device with two replications: If a Washstation is available, follow the procedure in Clean manual sampling device with Washstation, otherwise the procedure in Clean manual sampling device with basic cleaning.
3.	Prepare the blank sample in a 5 mL screw-cap tube. There are two options: A) Use cell-free water, e.g. a sterile solution aliquot from the Validation Kit. If you use the sterile solution aliquot from the Validation Kit, remove the cap of the aliquot and place the aliquot in an empty 5 mL screw-cap tube, as described in the user manual of the Validation Kit. B) Take a still mineral water and filter twice using a membrane filter with a pore size of 0.22 µm or smaller.
4.	Navigate to the Home screen of the BactoSense user interface.
5.	On the Home screen, press Mode and select Manual mode. Press Back, then Measure to open the measurement wizard.
6.	Select Prime from the list of available protocols.
7.	Press the Next button.
8.	Remove the tube or Washstation from the manual sampling device and attach the blank sample.
9.	Press the Start button to run the Prime protocol.
10.	After completion of the Prime, press the New button to navigate back to the list of protocols.
11.	Select Water Analysis from the list of available protocols.
12.	Configure two replications.
13.	Enter a sample name by tapping into the Sample name text field, entering the name and pressing OK.
14.	Verify that the ICC or TCC default gate is configured and change it otherwise by pressing into the Gates field.
15.	Press the Next button.
16.	Press the Start button and wait for the two measurements to complete.
17.	After finishing, press the Next button to review the results.

	WORK STEP
18.	Look at the results and compare them to the reference values indicated below. The BactoSense is clean if the following criteria are fulfilled: • For TCC cartridges: TCC [/mL] < 300 • For ICC cartridges: ICC [/mL] < 100
19.	If the cell concentrations are higher than the specified limits, apply the following procedure: • Repeat the procedure with a freshly prepared blank sample. • Repeat the procedure after a decontamination using the Cleaning Kit (see Consumables). • If the test keeps failing, contact bNovate support or your local service representative.
20.	After finishing, attach a clean and empty 5 mL screw-cap tube or the Washstation to the manual sampling device.

8.12 Demo mode

Demo mode can be used when demonstrating the device or when learning how to navigate the menus and use the functions. When it is activated, the instrument reboots into a special mode that displays demonstration data (the owner's measurement results are hidden). All the instrument's functions are replaced by simulations that never move the hardware or modify the results database. This means protocols can be started without needing to load a sample, and users can pretend to delete or re-gate results without ever changing the data. If the demo mode is activated, the message ***Demo*** is displayed in the upper middle of the screen. When the instrument is reverted to normal mode, the owner's data is shown again, and all functions are active again.

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	As an Admin user, press Settings on the Home screen to open the settings menu.	
2.	Press the System settings button. Press the Demo mode button.	 
3.	Select the Activate demo mode checkbox.	
4.	Press the Save and restart button.	
5.	The device reboots automatically.	

To return into normal mode, follow the same procedure, but uncheck the **Activate demo mode** box.

8.13 Factory reset

Factory reset reverts most of the instrument settings to the factory values: Gating limits, measurement interval, default protocol names, users, language and network settings. This option is accessible only by the Admin and Service users.

The following procedure describes how to perform a factory reset:

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	As an Admin user, press Settings on the Home screen to open the settings menu.	
2.	Press the Maintenance button, then the Factory reset button.	 
3.	Use the check boxes to select which parameters you wish to reset: • Instrument settings • Measurements incl. errors and logs • both	**ADDITIONAL INFORMATION** Service logs, validation results and the software update his- tory are not deleted.
4.	Press Reset the device and reboot, then confirm with Yes.	

9. Upgrade Packages

Depending on the BactoSense model, some functionalities are optional and can be activated with a license key.

9.1 Scientific package

The *Scientific Package* is intended for water research professionals to perform advanced data analysis. It contains the following features:

- Additional gate: Apply an additional configurable polygon gate to the FL1 / FL2 data directly in the user interface.
- Light scattering data: Record and display forward and side scatter data for each detected event. Retrieve data in FCS files for post-processing.
- Advanced scheduling: Custom measurement scheduling, see Advanced Scheduling

Additional polygon gate The freely configurable additional polygon gate has the following properties:

- It is available for TCC and ICC cartridges.
- The result parameter is a cell concentration named “Gate+”.
- The gate can be adjusted in the same way as the TCC or ICC default gates. Please refer to Change gates.

Forward and side scatter detector The Forward Scatter (FSC) detector measures light that is scattered by bacteria or other particles. The detector is placed at a small angle to the laser beam’s direction, thus measuring light signals in “forward” direction. In contrast, the Side Scatter (SSC) detector is placed at 90 degrees from the beam’s direction, measuring light scattered towards the side. The combination of fluorescence and scattering information provides high content data, enabling applications like microbiological fingerprinting, profiling or anomaly detection. In particular, the scattering detectors permit accurate fingerprinting (BactoScore) to follow changes in the bacterial population.

Scattering data is available in the following ways:

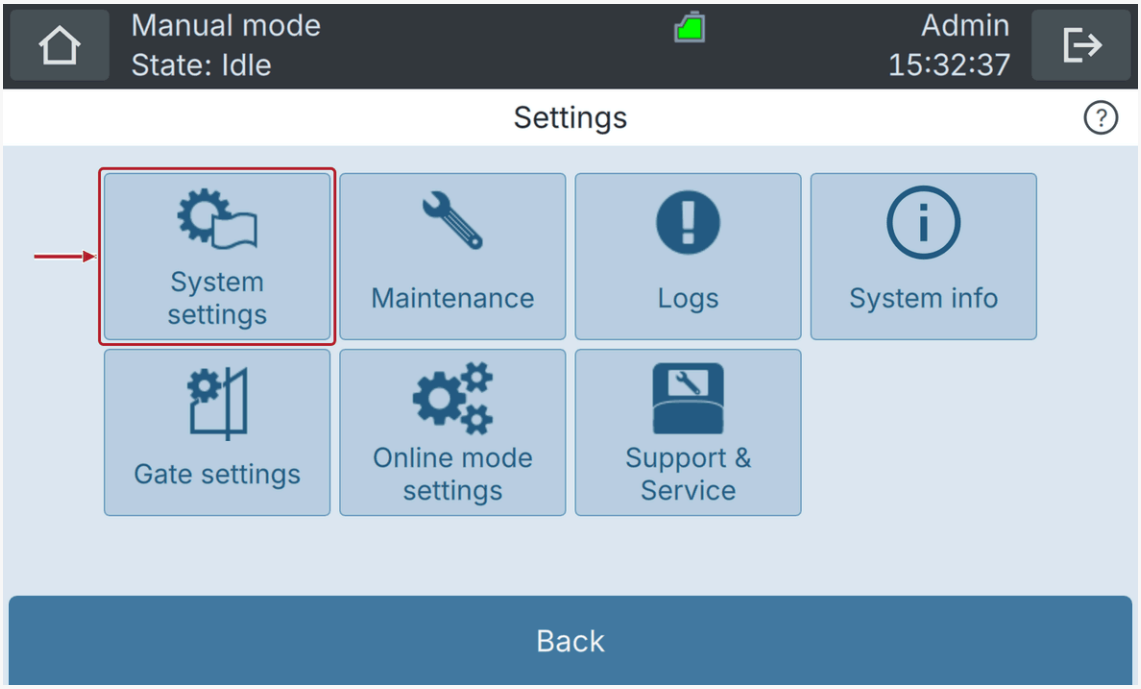
- in the flow cytometry standard (FCS) files. For more information about this file format please refer to Advanced data analysis.
- on the BactoSense user interface as an FSC / SSC dotplot
- on the web interface as an FSC / SSC dotplot
- when downloading the dotplots as images

Activation of the Scientific Package

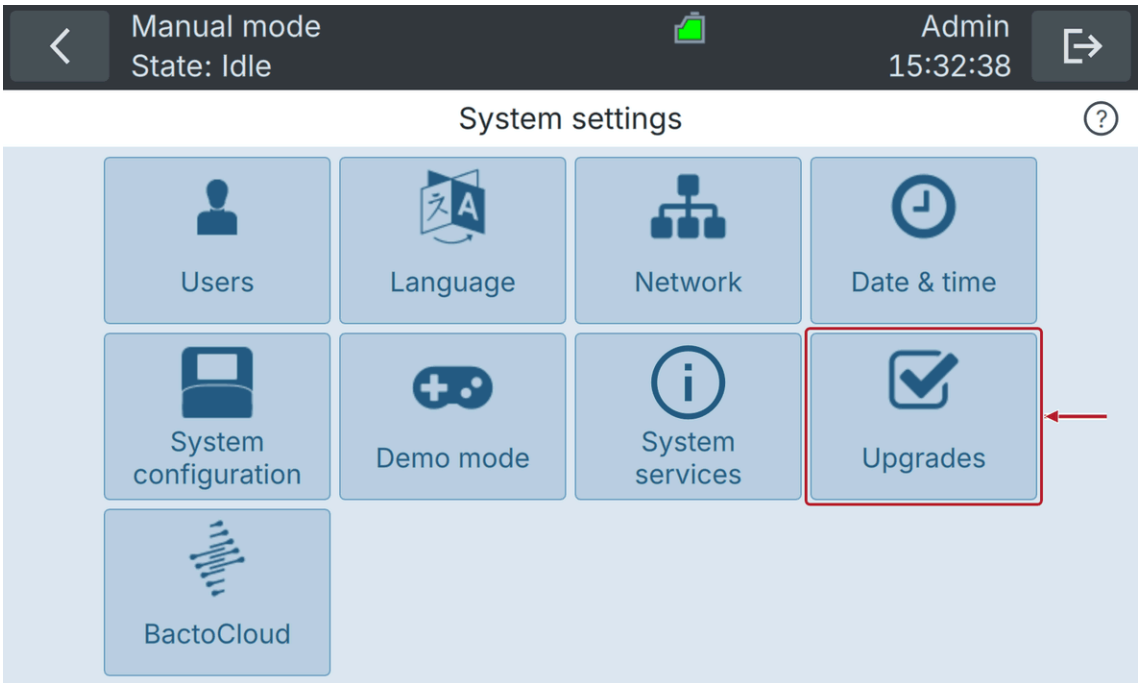
Activate the package while the instrument is idle, with PLC mode and Demo mode disabled.

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	Contact your bNovate Sales representative to purchase an activation key.	
2.	After receiving the activation key, log in as Admin user on the BactoSense.	

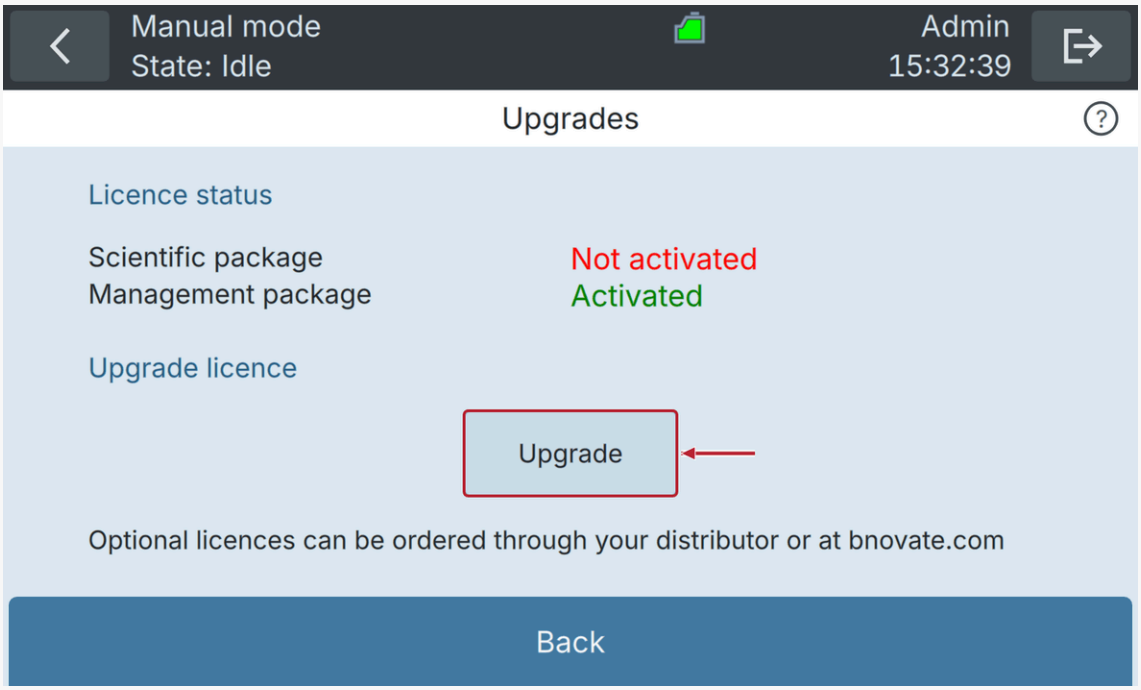
	WORK STEP	ADDITIONAL INFO / IMAGE
3.	On the Home screen, press Settings.	
4.	Press the System settings button.	



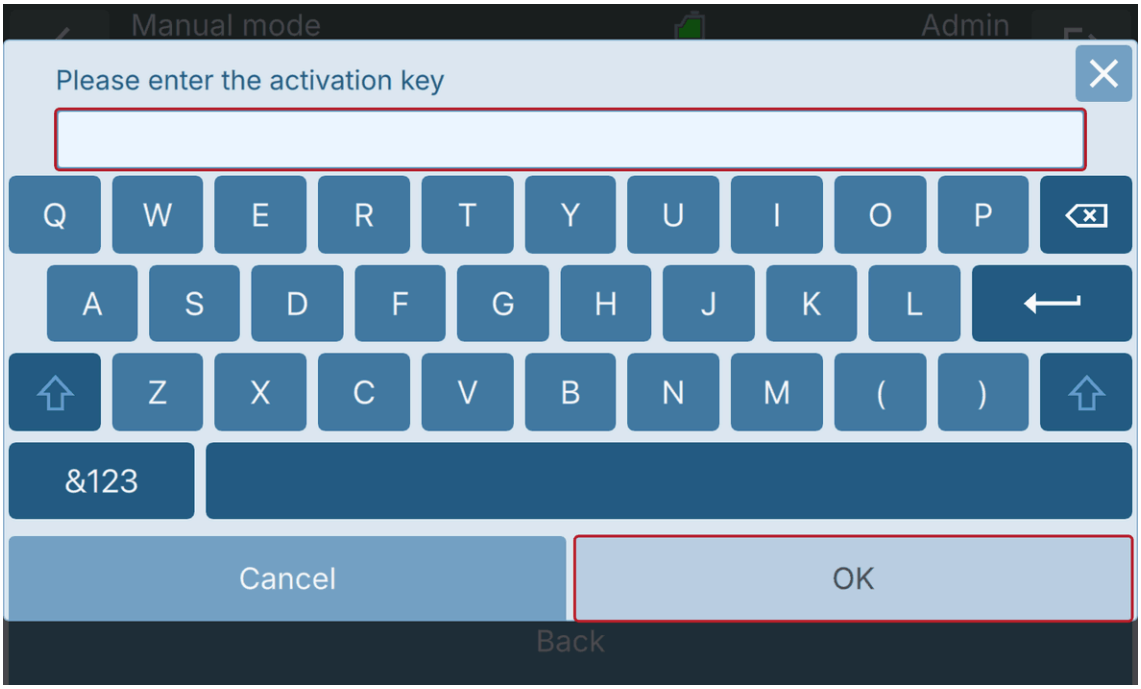
5.	Press the Upgrades button.	



	WORK STEP	ADDITIONAL INFO / IMAGE
6.	Press the Upgrade button.	



7.	Enter the activation key and press OK.	OK becomes available after you enter a key.



After successful activation, press OK in the confirmation message. If the instrument restarts, wait for it to finish, then open Upgrades again. Check that Scientific package shows Activated.

9.2 Management package

The *Management Package* is intended for instrument operation in environments with stronger traceability requirements. It contains the following features:

- Advanced user management (role-based access control)
- Audit trail
- Advanced scheduling: Custom measurement scheduling, see Advanced Scheduling

Advanced User Management With the *Advanced User Management* feature, the instrument owner can create users and assign different user roles (Basic, Advanced, Admin). This allows the owner to give different permissions to individual users and log their activity for the audit trail.

Audit Trail The *Audit Trail* is a record of all relevant operations or changes that have been made with the instrument. It provides a detailed history of actions taken by the user or the instrument itself. The *Audit Trail* can be accessed in the following ways:

- On the instrument user interface, open Home → Settings → Logs → Audit trail (see Access log and audit trail).
- When exporting all data to a USB drive, see Export data to USB device.
- From the web user interface. The access to the web user interface is described in Web User Interface.

Activation of the Management Package

Activate the package while the instrument is idle, with PLC mode and Demo mode disabled.

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	Contact your bNovate Sales representative to purchase an activation key.	
2.	After receiving the activation key, log in as Admin user on the BactoSense.	
3.	On the Home screen, press Settings.	
4.	Press the System settings button.	
5.	Press the Upgrades button.	
6.	Press the Upgrade button.	
7.	Enter the activation key and press OK.	Note: The advanced user management feature is not activated yet. If you wish to activate the advanced user management, follow the next steps.
8.	On the Home screen, press Settings.	
9.	Press the System settings button.	
10.	Press the System configuration button.	
11.	Check the Advanced user management mode check box.	
12.	Press Save, then acknowledge the confirmation with OK.	

10. Measurements

10.1 Samples

The BactoSense can measure manually collected grab samples using the manual sampling device, and also sample automatically from a connected water source using the online sampling device.

Sample types and pretreatments:

- Raw waters and especially surface waters must be filtered with a 20 µm filter. Particles can block the internal filters and damage the instrument. Clear water expected to be potable usually does not need filtering.
- Sparkling water and soft drinks cannot be measured by the instrument.
- Water with a high concentration of chlorine can affect the results of the measurement.
- The sample and operating conditions listed in Technical data must be fulfilled.

10.2 Measuring automatically in Online mode

Measuring in Online mode describes a configuration, in which the BactoSense is connected to a water source using the online sampling device, and automatically draws and measures a sample at predefined intervals.

If you want to measure manually collected grab samples instead, refer to Measuring in manual mode.

For different intervals or selected weekdays, see Advanced scheduling.

10.2.1 Configuring and starting automatic online measurements

The following instructions show how to configure and start automatic online measurements using the online sampling device.

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	Make sure the online sampling device is tightly installed as described in Installation of the online sampling device.	If you have the manual sampling device installed and want to change to the online sampling device, refer to Removal of the manual sampling device to remove the manual sampling device and Installation of the online sampling device to install the online sampling device.
2.	Navigate to the Home screen of the BactoSense user interface.	

	WORK STEP	ADDITIONAL INFO / IMAGES
3.	On the Home screen, press **Mode**. On the **Mode selection** screen, tap **Online mode**, then press **Back** to return to the Home screen.	The current mode is highlighted. Tapping a mode switches to it immediately. If a measurement is running, press **Stop it** to abort it, or press **Wait** and select the mode again after it has finished. If **Instrument validation can't be used with Online mode. Do you want to disable Instrument validation?** appears, press **Yes**. If the Home screen then asks **Do you want to start Online mode?**, press **No** and continue with the next step; **Yes** restarts the series with the previously saved Online mode settings.
4.	Press Start on the Home screen to open the online measurement wizard.	
5.	Under Protocol, make sure the checkbox for “Online Sampling Device (with Backflush)” is checked.	
6.	Enter a sample name by tapping into the Sample name text field.	
7.	Select the desired gate to be applied to the measurements by tapping into the Gates text field.	Generally, default gates are used. Use user-defined gates if your application requires it. Creating and adjusting gates is described in Results and Data Analysis.
8.	Press the Next button.	
9.	If the weekly schedule editor is displayed, press Back to return to the simple interval schedule. Select the measurement interval using the wheel on the right hand side.	The measurement interval describes the time between different measurements. The minimum duration ranges from 30 to 60 minutes, cartridge dependent. The maximum duration is 6 hours.
10.	If needed, delay the starting time by unchecking Start immediately and choosing a specific start time.	The time setting of the BactoSense is described in Date and time.
11.	Press the Start button.	During the measurement, the current estimate of the cell concentration is displayed in the action bar under “Last”.
12.	After each measurement, the time series graph is updated.	For more details press the View results button.
13.	If you want to stop an online measurement series, refer to Terminating automatic online measurements.	

10.2.2 Terminating automatic online measurements

Follow the steps below to terminate a measurement series in Online mode.

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	In Online mode, tap the plot on the Home screen to open the online chart. Press Stop.	

	WORK STEP	ADDITIONAL INFO / IMAGES
2.	Confirm the message to stop the Online mode measurement series.	
3.	If a measurement is running, you can select whether you want to abort it immediately, or wait for completion.	
4.	If you don't continue with another measurement series within the next hours, proceed with removing the online sampling device as described in Removal of the online sampling device and installing the manual sampling device as described in Installation of the manual sampling device.	
5.	If you want to view your data, refer to Reviewing automatic online measurements. If you want to retrieve your data, refer to Data Access and Export.	

10.2.3 Reviewing automatic online measurements

In Online mode, tap the plot on the Home screen to open the line plot of the measurement results over time.

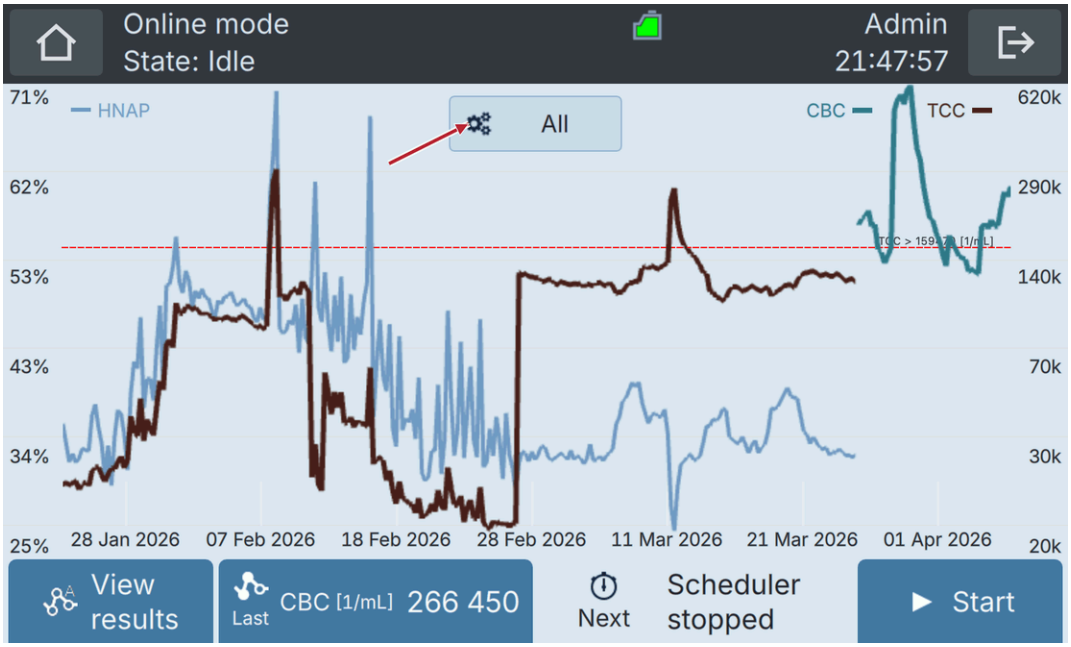


Figure 10-1 Online mode results overview plot

By tapping the button with a gear icon (arrow in figure 10-1), users can change the scales and which metrics are displayed (see figure 10-2). To display alarms on the plot, create an alarm and enable its "Display alarm" setting (see Alarm configuration).

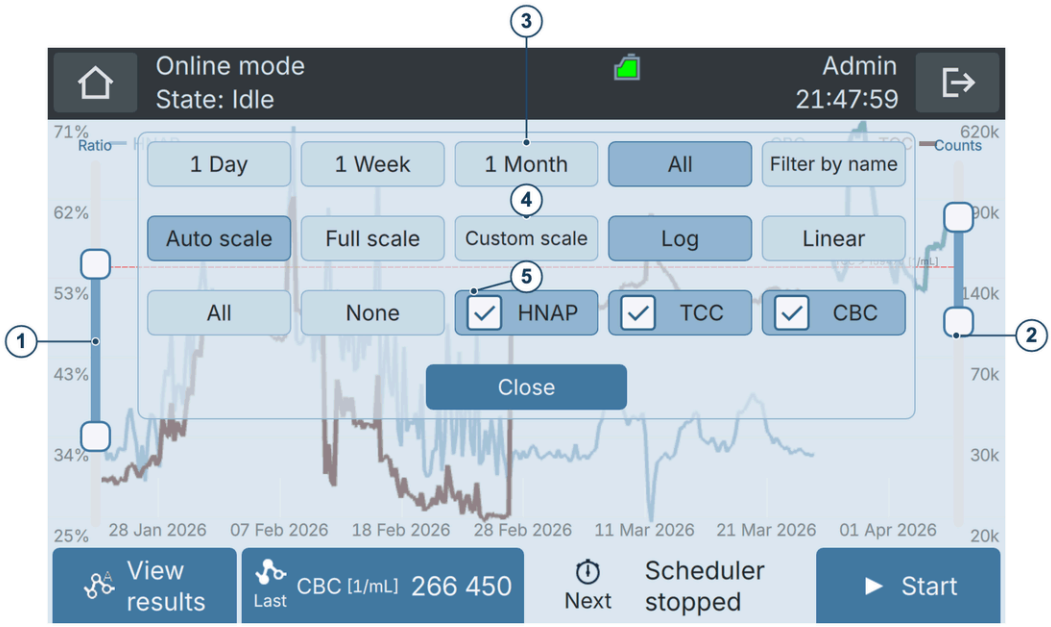


Figure 10-2 Online mode plot settings

1	Adjust the percentage scale. Touch the upper half of the scale bar to move the upper limit. Touch the lower half to move the lower limit.
2	Adjust the counts scale. Touch the upper half of the scale bar to move the upper limit. Touch the lower half to move the lower limit.
3	Choose the display interval or filter by name (see Filtering measurements).
4	Choose the vertical scale: • Auto scale adapts to the current data • Full scale shows the full range of the instrument • Custom scale is adjusted with sliders 1 and 2. Log and Linear control the counts scale (right-hand-side scale).
5	Choose which metrics to display on the graph.

10.2.4 Advanced scheduling

Use advanced scheduling when measurements must run at different intervals or on selected weekdays. A weekly schedule combines one or more rules, each with its own protocol, measurement name, gates and timing. The same weekly plan repeats until you change or stop it.

Advanced scheduling requires an activated Management Package or Scientific Package. If **Advanced** is unavailable, check the package status under **Settings → System settings → Upgrades**; see Upgrade Packages. Before starting, install the online sampling device and check the instrument's date and time.

Create a weekly schedule

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	Follow steps 1–8 of Configuring and starting automatic online measurements to choose Online mode, the protocol, sample name and gates.	Press **Next** to reach the scheduling screen.

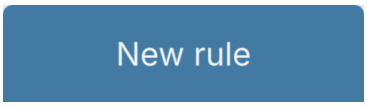
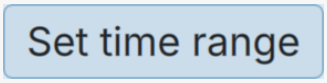
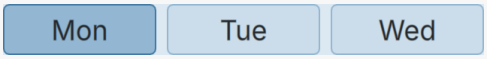
	WORK STEP	ADDITIONAL INFO / IMAGES
2.	Press **Advanced**. If a weekly schedule is already configured, the rule editor may open directly.	Figure 10-3 shows the **Advanced** control on the simple interval screen. 
3.	Select a rule in the left-hand list to edit it, or press **New rule** to add one. Select an unwanted rule and press **Delete** to remove it from the draft.	Review the existing rules before adding another; all rules contribute to the weekly schedule. 
4.	Set **Name**, **Protocol** and **Gate** for the selected rule.	**Name** labels the resulting measurements. Choose gates compatible with the installed cartridge. Maintenance protocols that do not need gates hide this field.
5.	Choose **30 minutes**, **1 hour**, **2 hours**, **Daily** or **Custom**.	The interval presets repeat every day. **Daily** schedules one run per day at the chosen **Start time**. Use **Custom** to select weekdays, another interval or a time window.
6.	For **Custom**, set **Start time**, select the required **Days** and set **Interval** in minutes. Press **Set time range** to choose the daily window, then confirm with **OK**.	Scroll the fields below the frequency buttons to see **Interval**, **Set time range** and **Range**. Figures 10-4 and 10-5 show the same rule before and after scrolling. 
7.	Repeat steps 3–6 for any additional rules. Press **Preview**.	Select a gate if Preview is unavailable because one is missing. If preview reports a conflict, return to the rules and adjust their times or intervals so protocols have time to finish. 
8.	Select each weekday in the preview and check the generated entries. Select an entry to inspect its **Time**, **Name**, **Protocol** and **Gate**.	The preview can include automatically inserted cleaning protocols during long gaps. Review these alongside measurement entries; see Figure 10-6. 
9.	Make any individual changes described below, then press **Save** to apply the weekly schedule.	Changes to rules and preview entries remain a draft until you press **Save**. 
10.	At **Start scheduler now?**, press **Yes** to start the saved plan, or **No** to save it without starting a stopped scheduler.	Check the Home screen to confirm the operating state. To stop an active series, follow Terminating automatic online measurements.



Figure 10-3 Open Advanced scheduling from the simple interval screen

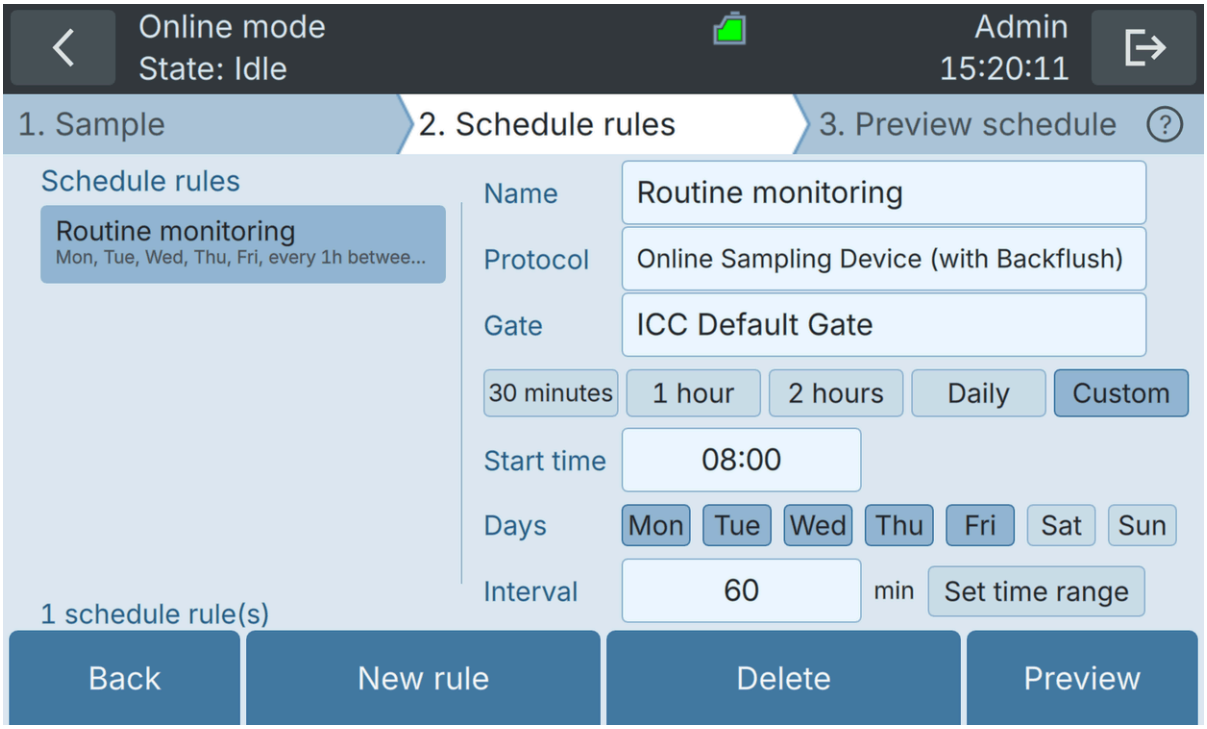


Figure 10-4 Rule editor with measurement settings, frequency and weekdays

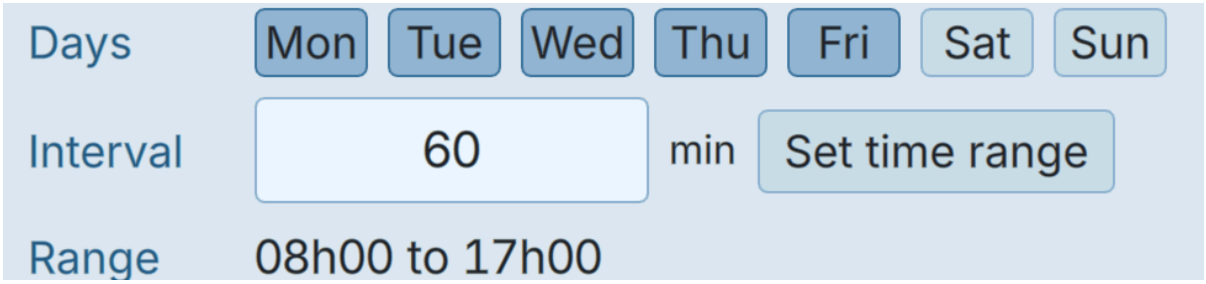


Figure 10-5 Scroll the custom fields to check the interval and time range

Example: hourly monitoring on weekdays. Set **Custom**, **Start time** to **08:00**, **Days** to Monday–Friday, **Interval** to **60 min** and the time range to **08:00–17:00**. The measurement entries start at 08:00, 09:00, ..., 16:00 on those days. The range ends at 17:00; it does not add a 17:00 start. These values illustrate the controls; choose a plan appropriate for your application.

For a window that crosses midnight, use separate rules for the parts before and after midnight and select the corresponding weekdays. Check the generated preview against the intended times.

Adjust individual entries in the preview

Use the preview to make an exception to the generated plan, such as moving one run or changing its measurement name.

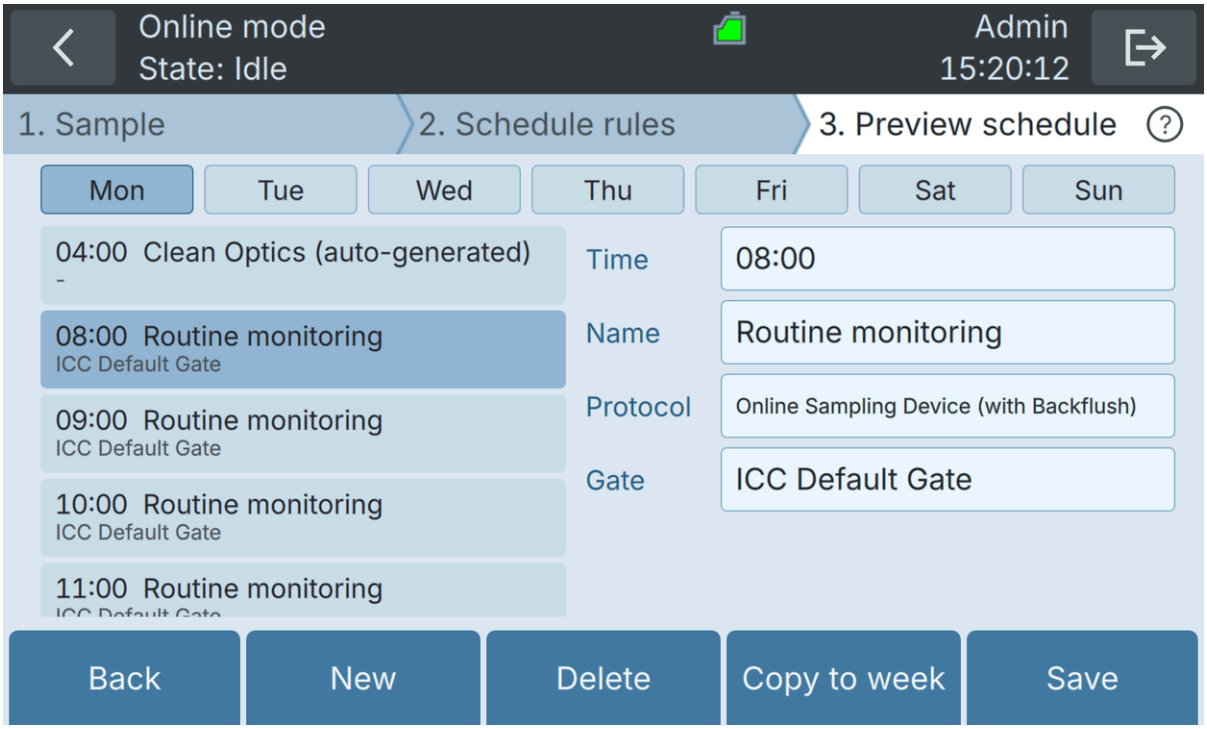


Figure 10-6 Day-by-day preview and settings for the selected entry

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	Select a weekday, then an entry in the left-hand list.	The fields on the right show that entry's settings.
2.	Tap **Time**, **Name**, **Protocol** or **Gate** to change the selected entry.	A change applies to that entry. Check the gate again if you change the protocol. A **Line** field is also available for protocols using BactoSwitch. Time 08:00
3.	Press **New** to add an entry to the selected day, then adjust its fields. To remove an entry, select it and press **Delete**.	Check the new entry's time, protocol and gates before saving. New
4.	Use **Copy to week** only if every day should have the same entries as the selected day. Acknowledge the confirmation with **OK**.	This replaces the other days' entries in the draft, including weekend entries and day-specific exceptions. Review all seven days afterward. Copy to week
5.	Press **Save**, then answer **Start scheduler now?** as described above.	If saving fails, review the message and correct the conflicting times or missing settings before retrying. Save

PRESERVE INDIVIDUAL CHANGES

Back returns from the preview to the rules. Changing a rule and generating a new preview can replace individual entry adjustments. Make those adjustments after the final rule preview and review them before saving.

Change an existing schedule or return to a simple interval

While the scheduler is running, open **Home → Settings → Online mode settings → Schedule interval**. Edit the weekly rules, press **Preview**, review the entries and press **Save**. If the scheduler is stopped, use **Start** on the Online mode Home screen to reopen the measurement wizard.

To use one constant interval again, press **Back** from the preview to the rules, then **Back** to the simple interval screen. Choose the interval and confirm with **OK** in **Schedule interval**, or **Start** in the measurement wizard. Confirming the simple schedule replaces the advanced weekly plan; pressing Back alone does not apply the change.

10.3 Measuring in manual mode

Measuring in manual mode describes a configuration in which the manual sampling device is connected to the BactoSense, and the operator attaches individual grab samples collected in 5 mL screw-cap tubes to the instrument.

10.3.1 Performing a measurement in manual mode

The following instructions show how to configure and start a measurement in manual mode.

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	Make sure the manual sampling device is tightly installed as described in Installation of the manual sampling device.	
2.	If the manual sampling device has been newly installed or the instrument has been switched off or idle for more than 3 days, it is recommended to clean the sampling device. If a Washstation is available, follow the procedure in Clean manual sampling device with Washstation, otherwise the procedure in Clean manual sampling device with basic cleaning.	
3.	If a cleaning of the manual sampling device has been conducted (see previous step), it is recommended to perform a prime prior to measuring the sample. Follow the procedure in Performing a Prime.	
4.	Navigate to the Home screen of the BactoSense user interface.	

	WORK STEP	ADDITIONAL INFO / IMAGES
5.	On the Home screen, press **Mode**. On the **Mode selection** screen, tap **Manual mode**. Press **Back**, then **Measure** to open the measurement wizard.	The current mode is highlighted. Tapping a mode switches to it immediately. If an Online mode series is active, confirm **Do you really want to stop Online mode?** with **Yes**. If a measurement is running, press **Stop it** to abort it, or press **Wait** and select the mode again after it has finished. **Manual mode** cannot be selected while PLC mode is active (see Digital inputs configuration and PLC mode).
6.	Select Water Analysis from the list of available protocols.	If you want technical replicates, select the number of replicates in Replications column. By default, one sample is measured. If more replicates are configured, multiple samples are drawn from the same sample tube.
7.	Enter a sample name by tapping into the Sample name text field, entering the name and pressing OK.	
8.	Check whether your desired gate is configured in the Gates field. If you wish to use another gate, tap into the Gates field and select the desired gate from the available options (depending on the cartridge installed).	Generally, default gates are used. Use user-defined gates if your application requires it. Creating and adjusting gates is described in Results and Data Analysis.
9.	Press the Next button.	
10.	Attach a 5 mL screw-cap tube containing 2 – 5 mL of sample to the manual sampling device.	
11.	Press the Start button.	The estimated protocol duration and expected termination timepoint are displayed. The current state of the measurement is indicated in the top bar (e.g. Initializing, Mixing...)
12.	After finishing the measurement, press Next to view the results. Results are explained in Measurement results.	
13.	If you want to proceed with the next measurement, press the New button.	
14.	If you want to see previous measurement results, press the View results button.	
15.	If you want to rename, regate or export the measurement, refer to the instructions in following sections.	
16.	If you don't want to measure more samples and the instrument will be idle or switched off, perform a cleaning of the manual sampling device. If a Washstation is available, follow the procedure in Clean manual sampling device with Washstation, otherwise the procedure in Clean manual sampling device with basic cleaning.	

10.4 Renaming measurements

Measurements can be renamed from their result details view.

	WORK STEP
1.	On the Home screen, press Settings, then Logs, and select Results (manual mode) or Results (Online mode).
2.	In the results list, select the measurement you want to rename. Exception: If you want to rename a group of replicates (see Working with measurement replicates), long-press on the group of replicates and then press the rename button.
3.	In the result details view, press the Rename button (see Measurement results).
4.	A keyboard and text field with the current sample name will appear. Use the keyboard to change the sample name and press OK.

10.5 Working with measurement replicates

When working in manual mode, analysis protocols can be repeated. This is particularly useful for generating technical replicates of a single sample.

- The number of replicates can be selected when configuring a manual measurement, as described in Performing a measurement in manual mode.
- In the manual mode results list, replicates are grouped into one entry, and the number in brackets next to the sample name indicates the number of replicates. In this view, the results shown for the replicate group consist of average and standard deviation. Individual replicate measurements can be accessed by pressing on the replicate group.
- Replicate groups can easily be renamed, deleted, exported or regated after a long-press on the replicate group in the manual mode results list.

10.6 Regating measurements

Adjusting the gates of individual measurements or a set of measurements is described in Change gates.

10.7 Filtering measurements

Filters limit the results list to the measurements you need. You can filter by date range, by measurement name and, when BactoSwitch is enabled, by BactoSwitch line. When you combine filters, only measurements that match all of them are listed. The filters search all measurements stored on the instrument.

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	On the Home screen, press **Results**.	The list shows the results of the current operating mode: **Online mode results** or **Manual mode results**. To open the list for the other mode, press **Settings**, then **Logs**, and select **Results (Online mode)** or **Results (manual mode)**.
2.	Press **Filter**.	The **Filter results** screen opens. The fields on the left show the current filters.

	WORK STEP	ADDITIONAL INFO / IMAGES
3.	To filter by date, tap the field under **Start date** and select the first day in the calendar. Tap the time field below it and set the hour and minute with the wheels. Set **End date** and its time in the same way.	Both limits are included: measurements up to the end of the selected end minute are listed. The end cannot be earlier than the start. Without a date filter, the range runs from the oldest to the newest measurement.
4.	To filter by name, tap the field under **Filter by name**, enter part of the measurement name and press **OK**.	The list keeps every measurement whose name contains this text, regardless of upper or lower case. For example, *tap* finds "Tap Water Zürich". **None** means that no name filter is set. To remove the name filter, delete the text and press **OK**.
5.	To filter by BactoSwitch line, press **Filter by stream**, select the line and press **Confirm**.	This button is only shown when BactoSwitch is enabled. Each line is listed with its name and stream number; the button then shows **Filtered by stream #n**. Only Online mode measurements sampled through BactoSwitch belong to a line, so all other measurements are hidden while this filter is active. To remove the line filter, select the highlighted line again and press **Confirm**.
6.	Press **OK** to apply the filters and return to the results list.	The action bar shows the date range and any active line and name filters. If no measurement matches, **No measurements to display** appears; press **Change filters** to adjust the filters.

CLEAR THE FILTERS

Press **Reset** on the **Filter results** screen to remove the name and line filters and restore the full date range. Filters in the Manual mode results are cleared when you return to the Home screen. In Online mode, the name and line filters remain active, including on the online chart (see Reviewing automatic online measurements), until you reset them.

10.8 Exporting measurements

There are multiple ways to retrieve measurement data. Retrieval via HTTP, HTTPS, FTP and the web interface are described in Data Access and Export and Web User Interface. In this section, data export to a USB drive is described.

10.8.1 Export to a USB drive

It is possible to export selected or all measurements to a USB flash drive.

Make sure your USB flash drive is formatted in FAT32 format.

	WORK STEP
1.	On the Home screen, press Settings, then Logs, and select Results (manual mode) or Results (Online mode).
2.	In the results list: • Press Export series, choose the date range and optional name filter, then press OK to export a series. • Long-press a replicate group, then press Export to export that group. • Open a single measurement, then press Export to export only that measurement.

	WORK STEP
3.	In the folder name field, the name of the target folder which will be created on the USB drive is shown. Change the name if desired.
4.	Insert a USB stick with enough available memory. Press Refresh list to display the connected USB stick.
5.	Export options • press Export results to export only the basic results (see details in the user interface) • press Export all to export results, raw data and diagnostic information (see details in the user interface)
6.	Wait for the export to complete and then press OK.

10.9 Available analysis and maintenance protocols

10.9.1 Overview of protocols in manual mode

Operators can choose between two analysis protocols in manual mode.

Table 10-1 Analysis protocols for manual mode

PROTOCOL NAME	PROTOCOL DESCRIPTION
Water Analysis	Analyze a water sample and finish with a cleaning cycle. If several replications are executed, the cleaning step is executed only once, at the end. A prime is executed automatically between replicates.
Beads Analysis	This protocol is intended for the analysis of calibration beads and is used with the Validation Kit. The protocol automatically finishes with a cleaning cycle. If several replications are executed, the cleaning step is executed only once, at the end.

Maintenance protocols can be executed before or between analysis protocols, to prepare, flush, or clean the system. In manual mode, the following maintenance protocols are available:

Table 10-2 Maintenance protocols for manual mode

PROTOCOL NAME	PROTOCOL DESCRIPTION
Clean Optics	Launches a cleaning step that washes all components in contact with the sample inside the BactoSense, except the sampling device.

PROTOCOL NAME	PROTOCOL DESCRIPTION
Clean Sampling Device with Washstation	Cleans the manual sampling device such that the outside filter, the needle's interior and exterior can be fully washed between measurements, after a dirty sample or in case of filter blockage. The Washstation device must be mounted on the manual sampling device and a cartridge must be installed for this protocol to appear. This protocol has a higher disinfection power than the Clean Sampling Device protocol and should therefore be preferred. Using the Washstation is the best way to keep the manual sampling device clean and to avoid cross-contamination. Instructions for this protocol can be found in Clean manual sampling device with Washstation.
Clean Sampling Device	Cleans the sampling device so that the external filter and the needle's interior can be washed after an extremely loaded sample or in case of filter blockage. Instructions for this protocol can be found in Clean manual sampling device with basic cleaning.
Fill Tubing	Fills all tubing carrying reagents from the cartridge, to remove bubbles in the tubing. Cleans optics at the end of the process.
Prime and Clean Optics	Fills the tubing with liquid from the sample. Helps to dilute any residues, for example after a Clean Sampling Device protocol. Finishes with a cleaning step.
Prime	Loads sample into the instrument. Instructions can be found in Performing a Prime.

10.9.2 Overview of protocols in Online mode

Operators can choose between two analysis protocols in Online mode.

Table 10-3 Analysis protocols for Online mode

PROTOCOL NAME	PROTOCOL DESCRIPTION
Online Sampling Device (with Backflush)	This is the standard protocol to be used with the online sampling device. This protocol includes automated cleaning procedures between measurements.
Manual Sampling Device	This protocol is used with the manual sampling device installed.

10.9.3 Performing a Prime

Priming preconditions the BactoSense with the sample. Priming can be used to reduce the carryover of cells or unwanted substances, and takes approximately 5 minutes.

Use a Prime under the following circumstances:

- After a Clean Sampling Device protocol (with and without Washstation)
- After measuring a sample with a high chlorine concentration or any other unwanted substance which may affect subsequent measurements

	WORK STEP
1.	Make sure the manual sampling device is tightly installed as described in Installation of the manual sampling device.
2.	Navigate to the Home screen of the BactoSense user interface.
3.	On the Home screen, press Mode and select Manual mode. Press Back, then Measure to open the measurement wizard.
4.	Select Prime from the list of available protocols.
5.	Press the Next button.
6.	Attach the sample you want to measure next to the manual sampling device.
7.	Press the Start button.

11. Results and Data Analysis

11.1 Measurement results

The figure below shows the result of a selected TCC measurement in Online mode. From here, the user can delete or rename the measurement, look up older results (and export them), or export the result. Expert users can repeat the cell counting with new gates. Some user interface elements or actions are only available to specific user roles (Basic, Advanced or Admin).



Figure 11-1 Display of a TCC measurement result in Online mode.

1	Main result parameters, depending on cartridge type used. Find more information in Cartridges, gates and result parameters. Tap the information icon beside the main result to display all result parameters (2).
2	Result information window with all available result parameters and the main dotplot.

3	Main dotplot in the result information window. The FL1 vs FL2 dotplot shows all detected events according to the amplitude of their fluorescence signals FL1 (535 nm, X-axis) and FL2 (715 nm, Y-axis). The red polygon and vertical line show the configured gate. For details refer to Cartridges, gates and result parameters. Tap this dotplot preview to open a pop-up with access to all dotplots (4).
4	Pop-up window with access to all dotplots. The FL1 vs SSC dotplot shows only cells inside the FL1 - FL2 polygon gate, according to their fluorescence signal FL1 (535 nm) and scattered light signal SSC (488 nm). The FL1 histogram shows all cells inside the FL1 - FL2 polygon gate, binned according to their fluorescence in FL1. The available dotplots depend on your instrument model and configuration.
5	The measurement status field indicates alarms or warnings. Tap an alarm or warning indication to view its details.
6	The Delete button removes the measurement permanently (requires confirmation).
7	The Rename button can be used to change the measurement name.
8	The Re-gate result button allows you to apply a different gating set to the measurement data. For details refer to Regate measurements.
9	The Export button allows you to save this result to a USB stick. More information can be found in Export to a USB drive.
10	The navigation buttons on the left and right of the result view allow you to navigate to the previous and next measurements, respectively.
11	Touch the trend plot to open the Online mode plot (the full Online results chart). See Reviewing automatic online measurements.

SELECT MULTIPLE MEASUREMENTS

Multiple selection & batch operations: In the list of measurements, long-press on one measurement to activate the selection of multiple measurements, then select Delete / Re-gate or Export.

To show only some measurements in the results list, filter them by date, name or BactoSwitch line; see Filtering measurements.

11.2 Introduction to gates

Following flow cytometry standards, the BactoSense uses gates to count cells in samples.

We define:

- Gate: A line or polygon applied to a dotplot to quantify populations of measured cells.
- Set of gates, or gating set: The collection of all gates used for a measurement. The types of gates are fixed, but users can change the limits of each gate.
- Gating strategy: Defines how the gates are combined to count cells. For example, HNAC is the number of cells that are inside the TCC polygon and higher than the HNA lower limit.

Gating sets are specific for a type of cartridge. As an example, only gating sets of type TCC can be used with measurements performed using a TCC cartridge.

11.2.1 Default gating sets

The BactoSense has preconfigured gating sets for all available cartridge types. These gating sets are called Default gating sets. They have been carefully designed to be applicable to the vast majority of samples.

- On the Home screen, press Settings, then Gate settings to view the available gating sets.
- Default gating sets can neither be modified nor deleted.
- New gating sets can be created by editing a copy of an existing gating set, as described in Create a new gating set.

11.2.2 List of available gating sets and operations

On the Home screen, press Settings, then Gate settings to view the available gating sets.

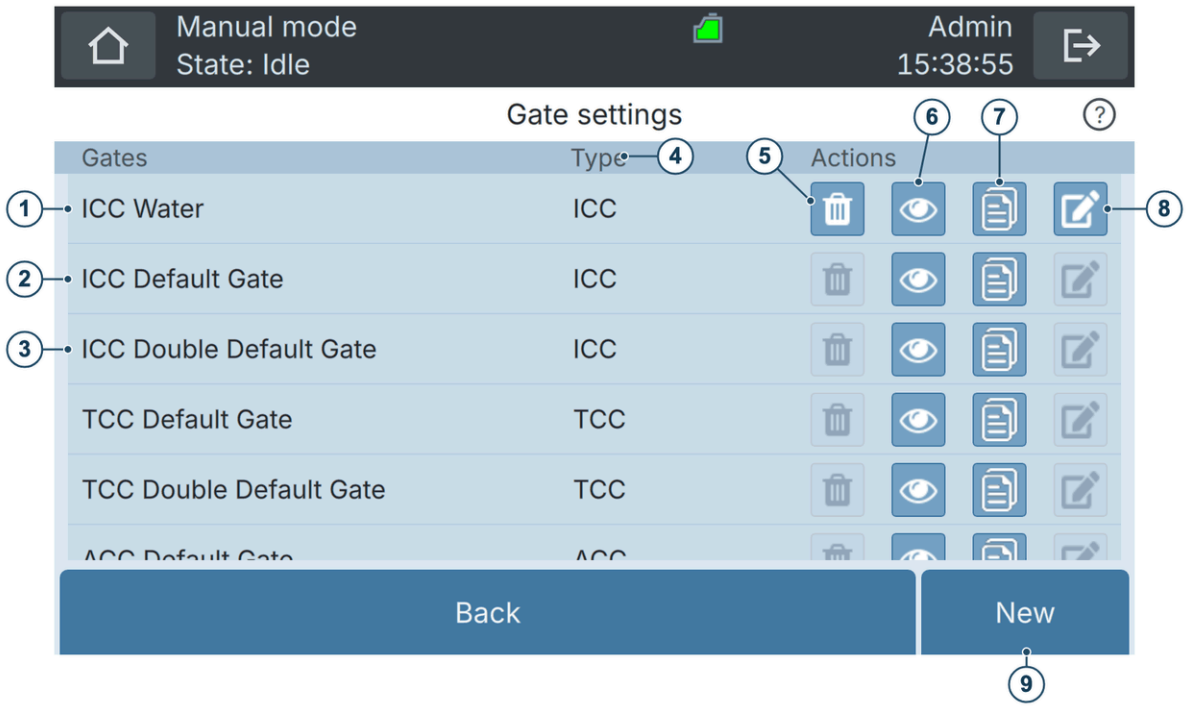


Figure 11-2 List of available gating sets and options to copy and create new sets. Default gates are preconfigured and cannot be deleted or edited.

1	Example of a custom gate for the ICC cartridge.	2	ICC default gate. Default gates are preconfigured.
3	ICC double default gate. This gating set contains an additional configurable polygon gate. Note: For some instrument models, an additional feature is needed for using the additional gate (see Scientific package).	4	Gate types, to be used with the respective cartridge type.
5	Delete an existing gating set. Default gates can not be deleted.	6	Preview the gating set.

7	Create a copy of the gating set.	8	Edit the gating set. Default gates can not be edited.
9	Create a new gating set.		

11.3 Cartridges, gates and result parameters

Depending on the cartridge used for a measurement, different parameters are measured. The subsections below describe gating sets and result parameters for TCC (Total Cell Count), ICC (Intact Cell Count), ACC (Active Cell Count), CBC (Coliform Bacteria Count), EBC (E. coli Bacteria Count), and NBC (Enterococcus Bacteria Count).

CBC, EBC and NBC cartridges are compatible with BactoSense ID and BactoSense SMART. Each uses selective enzymatic labelling and a single polygon gate, and reports one cell concentration. No HNA or activity subpopulations are calculated for these cartridges.

> **INTERPRETING CELL COUNT RESULTS**
>
> BactoSense cell counts are cell concentrations expressed in cells per millilitre (1/mL). Cell counts and culture results expressed in colony-forming units (CFU) measure different properties of a sample and usually give numerically different results.

11.3.1 TCC cartridge

TCC refers to Total Cell Count. The TCC cartridge is therefore used to measure the concentration of all cells.

Table 11-1 Gating set used for the TCC cartridge.

GATE	TYPE	DESCRIPTION
TCC	Polygon	A polygon defined on the FL1-FL2 plane. Points inside this polygon are counted as cells (TCC).
HNA lower limit	Vertical line	A threshold on FL1. Points within TCC but larger than the HNA lower limit in FL1 are counted as HNAC. Points within TCC but smaller than the limit are counted as LNAC.

Table 11-2 Result parameters obtained from the TCC cartridge.

PARAMETER	UNIT	NAME	DESCRIPTION
TCC	1/mL	Total Cell Count	Total number of cells detected inside the TCC gate. It is an addition of HNAC and LNAC: TCC = HNAC + LNAC
HNAP	%	High Nucleic Acid Percentage	The percentage of HNA cells relative to TCC: HNAP = (HNAC / TCC) × 100
LNAC	1/mL	Low Nucleic Acid Count	The number of cells inside the TCC gate, but below the HNA lower limit (vertical line gate).
HNAC	1/mL	High Nucleic Acid Count	The number of cells inside the TCC gate and above the HNA lower limit (vertical line gate).

For further information on how to adjust the gates see Change gates.

11.3.2 ICC cartridge

ICC refers to Intact Cell Count. The ICC cartridge is therefore used to measure the concentration of intact cells.

Table 11-3 Gating set used for the ICC cartridge.

GATE	TYPE	DESCRIPTION
ICC	Polygon	A polygon defined on the FL1-FL2 plane. Points inside this polygon are counted as intact cells (ICC).
HNA lower limit	Vertical line	A threshold on FL1. Points within ICC but larger than the HNA lower limit in FL1 are counted as HNAC. Points within ICC but smaller than the limit are counted as LNAC.

Table 11-4 Result parameters obtained from the ICC cartridge.

PARAMETER	UNIT	NAME	DESCRIPTION
ICC	1/mL	Intact Cell Count	Total number of intact cells inside the ICC gate: ICC = HNAC + LNAC
HNAP	%	High Nucleic Acid Percentage	The percentage of HNA cells relative to ICC: HNAP = (HNAC / ICC) × 100
LNAC	1/mL	Low Nucleic Acid Count	The number of LNA cells inside the ICC gate, but below the HNA lower limit (vertical line gate).
HNAC	1/mL	High Nucleic Acid Count	The number of HNA cells inside the ICC gate and above the HNA lower limit (vertical line gate).

For further information on how to adjust the gates see Change gates.

11.3.3 ACC cartridge

ACC refers to Active Cell Count. The ACC cartridge is therefore used to measure the concentration of metabolically active cells, using an enzymatic assay.

Table 11-5 Gating set used for the ACC cartridge.

GATE	TYPE	DESCRIPTION
ACC	Polygon	A polygon defined on the FL1-FL2 plane. Points inside this polygon are counted as active cells (ACC).
HACC lower limit	Vertical line	A threshold on FL1. Points within ACC but larger than the HACC lower limit in FL1 are counted as HACC. Points within ACC but smaller than the limit are counted as LACC.

Table 11-6 Result parameters obtained from the ACC cartridge.

PARAMETER	UNIT	NAME	DESCRIPTION
ACC	1/mL	Active Cell Count	Total number of active cells inside the ACC gate: ACC = HACC + LACC
HACC	1/mL	Highly Active Cell Count	The number of active cells with FL1 intensity higher than the HACC vertical gate.
LACC	1/mL	Lowly Active Cell Count	The number of active cells with FL1 intensity lower than the HACC vertical gate.
HACP	%	Highly Active Cell Percentage	The percentage of HACC among ACC. HACP = (HACC / ACC) × 100

For further information on how to adjust the gates see Change gates.

11.3.4 CBC cartridge

CBC refers to Coliform Cell Count. The CBC cartridge measures the concentration of coliform bacteria using an enzymatic assay based on β-galactosidase activity. The enzyme converts the cartridge substrate into a fluorescent product, enabling detection of the labelled cells by flow cytometry.

Table 11-7 Gating set used for the CBC cartridge.

GATE	TYPE	DESCRIPTION
CBC	Polygon	A polygon defined on the FL1-FL2 plane. Fluorescently labelled coliform cells inside this polygon contribute to CBC.

Table 11-8 Result parameter obtained from the CBC cartridge.

PARAMETER	UNIT	NAME	DESCRIPTION
CBC	1/mL	Coliform Cell Count	Concentration of labelled coliform cells inside the CBC gate, calculated from the cell count and analysed sample volume.

For further information on how to adjust the gates see Change gates.

11.3.5 EBC cartridge

EBC refers to E. coli Cell Count. The EBC cartridge measures the concentration of *Escherichia coli* bacteria using an enzymatic assay based on β-glucuronidase activity. The enzyme converts the cartridge substrate into a fluorescent product, enabling detection of the labelled cells by flow cytometry.

Table 11-9 Gating set used for the EBC cartridge.

GATE	TYPE	DESCRIPTION
EBC	Polygon	A polygon defined on the FL1-FL2 plane. Fluorescently labelled E. coli cells inside this polygon contribute to EBC.

Table 11-10 Result parameter obtained from the EBC cartridge.

PARAMETER	UNIT	NAME	DESCRIPTION
EBC	1/mL	E. coli Cell Count	Concentration of labelled E. coli cells inside the EBC gate, calculated from the cell count and analysed sample volume.

For further information on how to adjust the gates see Change gates.

11.3.6 NBC cartridge

NBC refers to Enterococcus Cell Count. The NBC cartridge measures the concentration of enterococci using an enzymatic assay based on β-glucosidase activity. The enzyme converts the cartridge substrate into a fluorescent product, enabling detection of the labelled cells by flow cytometry.

Table 11-11 Gating set used for the NBC cartridge.

GATE	TYPE	DESCRIPTION
NBC	Polygon	A polygon defined on the FL1-FL2 plane. Fluorescently labelled enterococci inside this polygon contribute to NBC.

Table 11-12 Result parameter obtained from the NBC cartridge.

PARAMETER	UNIT	NAME	DESCRIPTION
NBC	1/mL	Enterococcus Cell Count	Concentration of labelled enterococci inside the NBC gate, calculated from the cell count and analysed sample volume.

For further information on how to adjust the gates see Change gates.

11.4 Change gates

11.4.1 Regate measurements

Regating is the process of applying a different gating set to existing measurement data.

- A prerequisite for regating is the presence of an alternative gating set. On the Home screen, press Settings, then Gate settings to view the available gating sets.
- The process of modifying an existing gating set is described in Edit existing gating sets.

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	On the Home screen, press Settings to open the settings menu.	
2.	Press Logs, then Results (manual mode) or Results (Online mode), depending on how the measurement was performed.	

	WORK STEP	ADDITIONAL INFO / IMAGES
3.	To regate a single measurement, select the measurement to see the result details page. To regate multiple measurements (batch), long-press on a measurement until it is highlighted and a check box appears on the left. Then tap on additional measurements to select them for regating.	
4.	Press Re-gate result in the single-result view, or Re-gate when several measurements are selected.	
5.	Select the desired gating set by checking its box.	
6.	Press the Confirm button to start the regating process.	**ADDITIONAL INFORMATION** Depending on the number of measurements, regating can take several minutes.
7.	After finishing, press OK.	

11.4.2 Create a new gating set

New gating sets can be created either from a copy of an existing gating set, or from scratch.

Creating a new gating set from a copy

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	As an Advanced or Admin user, press Settings on the Home screen to open the settings menu.	
2.	Press the Gate settings button.	
3.	In the list of available gating sets, identify the gating set from which you want to make a copy to create the new gating set.	Make sure the gating type (e.g. TCC, ICC) matches with your target application.
4.	Press the Copy icon to create a copy of the gating set.	
5.	In the newly generated copy, press the Edit icon and follow the editing instructions in Edit existing gating sets.	

Creating a new gating set from scratch

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	As an Advanced or Admin user, press Settings on the Home screen to open the settings menu.	
2.	Press the Gate settings button.	
3.	In the action bar at the bottom, press New.	

	WORK STEP	ADDITIONAL INFO / IMAGES
4.	Enter a name for the set of gates and select one of the available templates for the installed cartridge.	
5.	Then follow the on-screen gate configuration wizard as described in Edit existing gating sets.	
6.	After finishing, you can select the new gating set when creating new measurements, or regate existing measurements, as described in Regate measurements.	

11.4.3 Edit existing gating sets

Apart from default gating sets, all other gating sets can be modified. Gate editing can comprise renaming, changing the position of the vertical gate, and changing the number and position of the corners of the polygon gate.

In this section, the general process of editing a gating set is described. Strategy to adjust gates for TCC and ICC describes a specific strategy to adjust gating sets for TCC and ICC measurements.

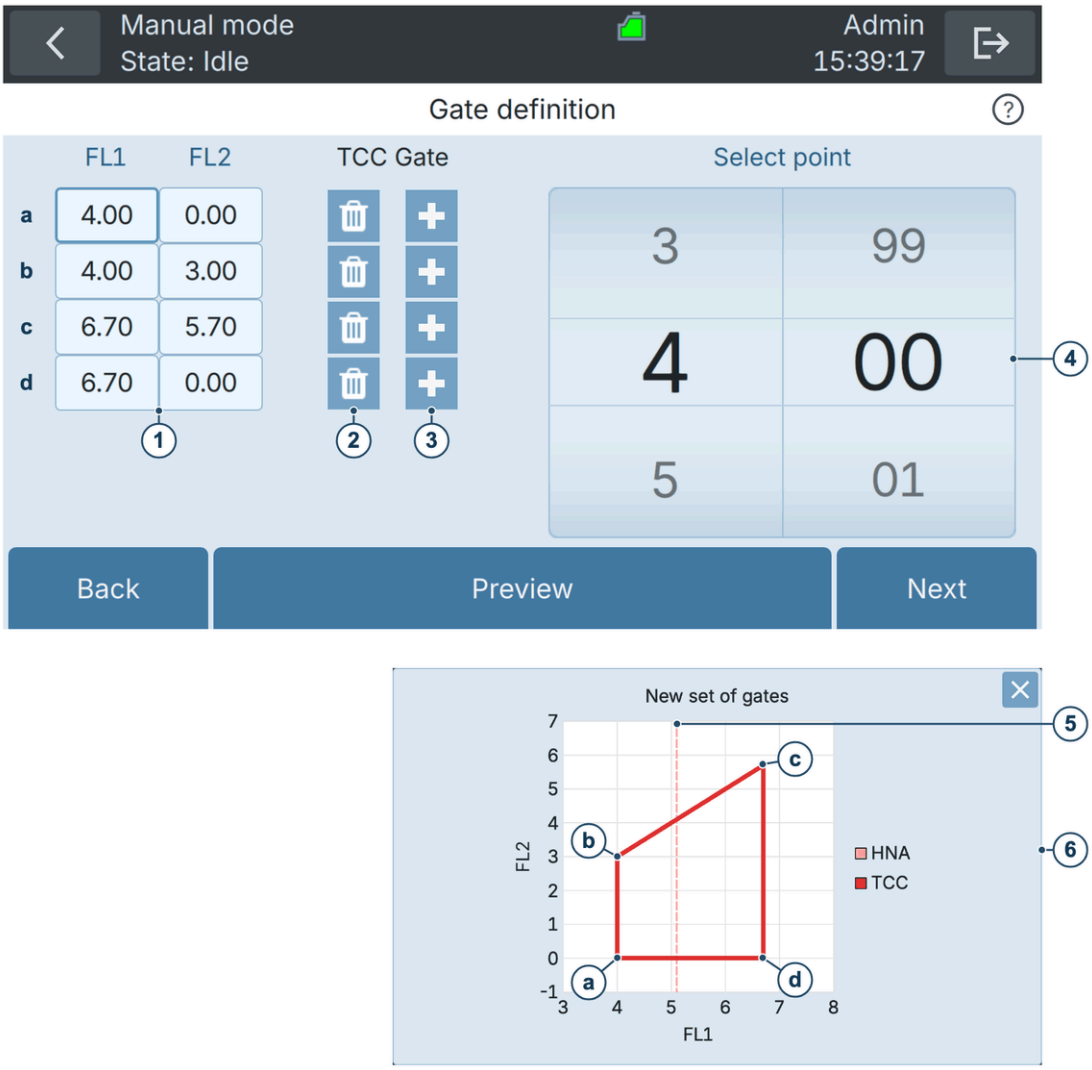
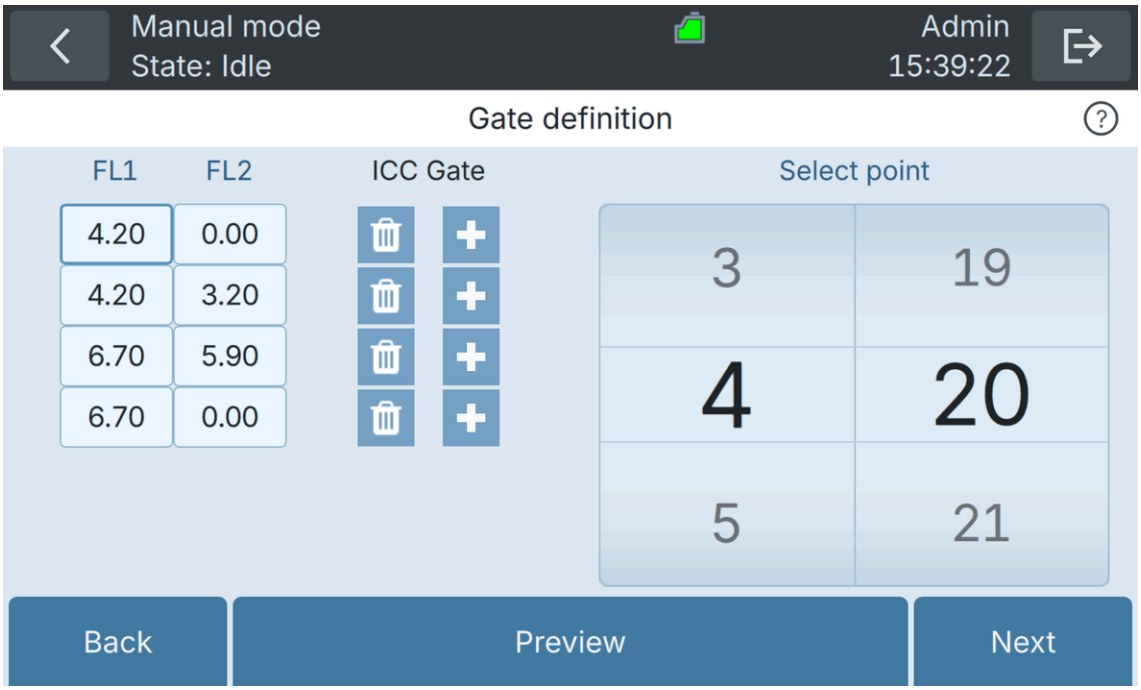


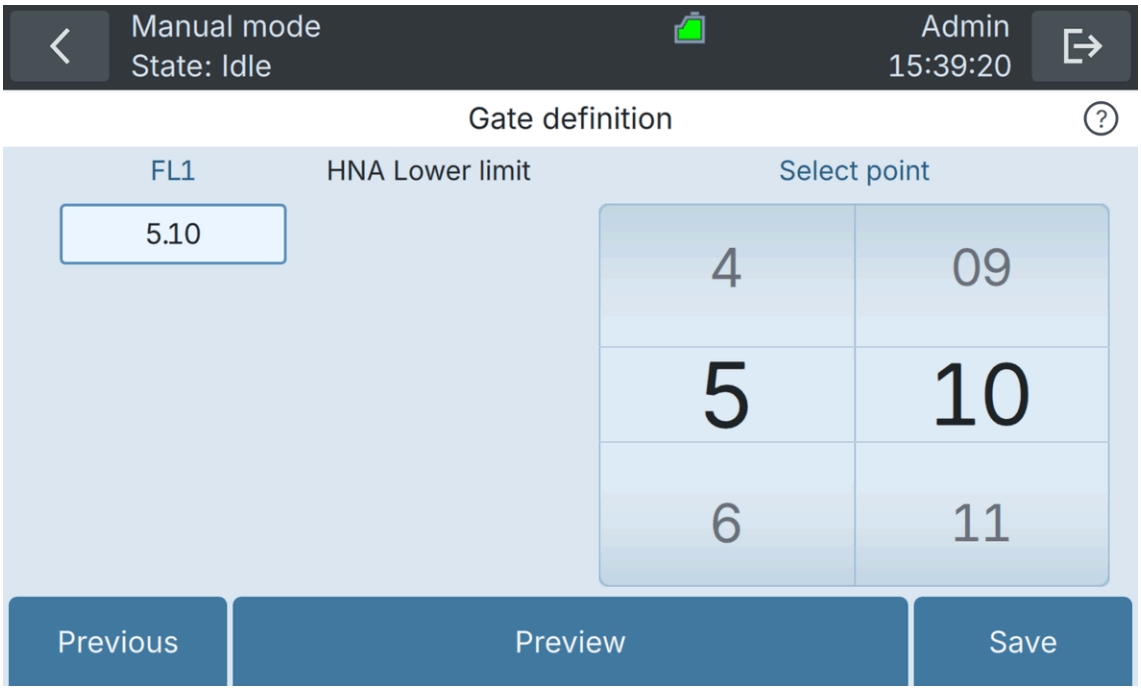
Figure 11-3 Gate settings for TCC

①	Coordinates of the gate's points. a: First point in the gate b: Second point in the gate c: Third point in the gate d: Fourth point in the gate	②	Remove a point from the gate.
③	Add a new point to the gate.	④	Modify the selected coordinate. In this screenshot, the FL1 (a, FL1) coordinate of the first point is selected, so we can move the first point in the gate along the FL1 axis (X-axis).
⑤	HNA lower limit: this gate is defined on the next screen.	⑥	Preview

The following procedure describes how to adjust a gate:

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	As an Advanced or Admin user, press Settings on the Home screen to open the settings menu.	
2.	Press the Gate settings button.	
3.	Press the Edit button of the gate you wish to edit.	
4.	Change the name if desired, then press the Next button.	
5.	Adjust the number and position of polygon corners (for TCC and ICC refer to Strategy to adjust gates for TCC and ICC). A polygon gate can have between 3 and 6 corners.	
6.	Press the Next button.	

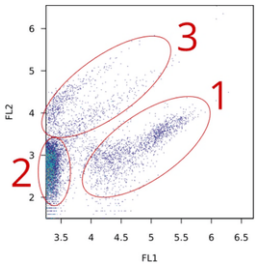
	WORK STEP	ADDITIONAL INFO / IMAGE
7.	Enter the HNA lower limit (for TCC and ICC refer to Strategy to adjust gates for TCC and ICC).	

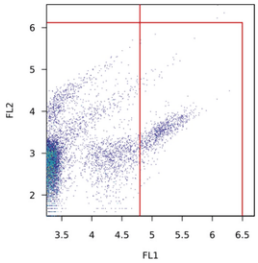
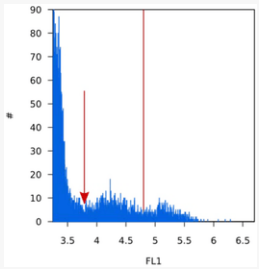
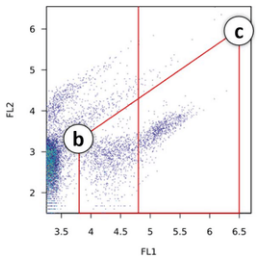


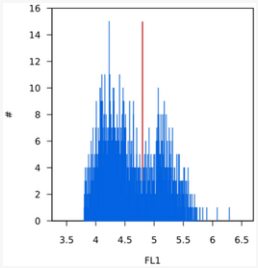
8.	Press Save. In the save dialog, choose Save to update the existing set, or Save as new set to keep the original and create a new set.	
9.	After finishing, you can select the modified gating set when creating new measurements, or regate existing measurements, as described in Regate measurements.	

11.4.4 Strategy to adjust gates for TCC and ICC

The BactoSense is delivered with default gate sets that are suitable for the vast majority of samples. If needed however, advanced users have the possibility to adjust the gate. A general procedure to adjust the gate is explained below and is valid for both TCC and ICC cartridges.

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	Measure a water sample using the standard Water analysis protocol. On the Result details page, the FL1 vs FL2 dotplot shows: 1) LNA and HNA cells in the water 2) Electrical noise from the optical detectors 3) Debris/background noise (This can include damaged cells, aggregates or other particles)	
2.	On the Home screen, press Settings to open the settings menu. Press the Gate settings button.	

	WORK STEP	ADDITIONAL INFO / IMAGE
3.	Depending on your needs, perform one of the following: • Create a new set of gates • Edit an existing set of gates • Copy an existing set of gates and edit the copy	
4.	Give a name to this set of gates and press Next.	
5.	Place the polygon gate at each extremity (left and right). For example, use these four points: (FL1; FL2) = (3.0; 0.0), (3.0; 6.1), (6.5; 6.1), (6.5; 0.0)	
6.	Press Next and Save. For a new template, confirm with Yes. For an edited set, choose Save or Save as new set in the save dialog.	
7.	Navigate to the result view of the water sample you measured previously.	
8.	On the result view, press the Re-gate result button.	
9.	Select the gate you just created, and reprocess the data with the new gate by pressing the Confirm button.	
10.	Open the FL1 histogram and locate the first valley after the noise peak, i.e. the first minimum after the peak at the extreme left (arrow in the picture). Write down the FL1 value of this minimum (e.g. 3.8).	
11.	Return to Gate settings and again edit your gate. Place the left limits of the gate at the previously determined FL1 value. This will exclude the electrical noise of the optical detectors. If needed, for the FL2 axis, place the points “b” and “c” of the gate just below the debris/background area (generally appearing as straight diagonals).	
12.	Save the adjusted gate.	
13.	Navigate again to the result view of the water sample you measured previously.	
14.	On the result view, press the Re-gate result button.	
15.	Select the gate you just created, and reprocess the data with the new gate by pressing the Confirm button.	

	WORK STEP	ADDITIONAL INFO / IMAGE
16.	To place the HNA lower limit, open again the FL1 histogram and locate the minimum between the LNA and HNA peaks (vertical line on the image). Write down its FL1 value (e.g. 4.8).	
17.	Return to Gate settings and again edit your gate.	
18.	Navigate to the HNA lower limit configuration step. Enter the previously identified HNA lower limit to the FL1 field, press Save and select Save in the save dialog.	
19.	Regate the water analysis measurement again and verify that the gate is suitable. Further adjust if needed.	

11.5 Advanced data analysis

BactoSense measurement data can be exported in Flow Cytometry Standard (FCS) 3.1 file format. The FCS file format is standardized by the International Society for Advancement of Cytometry (ISAC) to ensure interoperability between different flow cytometry instruments and analysis software. There are different versions of the FCS format with each version introducing improvements and additional features. FCS data can be used for custom offline postprocessing, such as the application of complex gating strategies, “microbial fingerprinting”, automated anomaly detection and many more.

11.5.1 How to retrieve FCS files

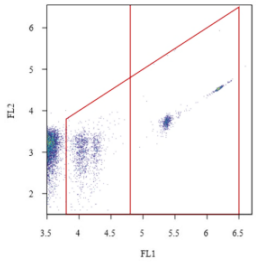
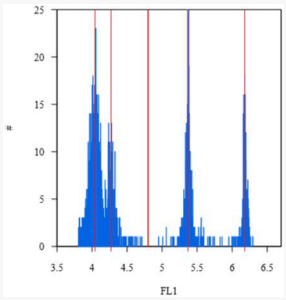
FCS files can be retrieved in the following ways:

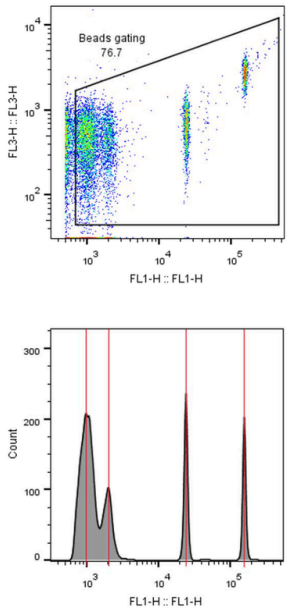
- Download to a USB stick: Using the Export all function (see Export settings, diagnostics, or all to USB device)
- Download from the web interface, either as single files (see Download an FCS-file) or multiple files (see Download a zip file with multiple results)
- Access using FTP (see Retrieve data via FTP)
- Access using HTTPS (see Retrieve files via HTTP or HTTPS)

For help with the setup of an advanced data analysis tool chain, please contact support@bnovate.com.

11.6 Comparison with other flow cytometers

To compare BactoSense results with those from another flow cytometer, a reference solution containing autofluorescent beads can be analyzed. This method allows the user to compare the measurement scales of different devices.

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	It is recommended to use the Validation Kit which contains a ready to use beads solution.	Read the instructions of the Validation Kit for more information.
2.	Install the manual sampling device according to the user manual.	
3.	Take one of the Validation kit's beads solutions and load it into the sampling device.	Read the instructions of the Validation Kit for more information.
4.	**ADDITIONAL INFORMATION** Press the Home button. Press the Back button as many times as needed for the Home button to appear.	 
5.	On the Home screen, press Mode and select Manual mode. Press Back, then Measure to open the measurement wizard.	
6.	Select Prime from the protocol list.	See Performing a Prime.
7.	Press Next, then Start. Let the priming protocol finish.	
8.	Press New, choose Beads Analysis from the list, then press Next and Start.	
9.	Wait for the results and if necessary, precisely adjust the gate of the FL1 vs FL2 dot plot to count only the 4 populations of beads. It is important to ensure that noise, background, and debris are not counted into the gate.	See Edit existing gating sets to adjust the gate. 
10.	On the FL1 vs counts histogram, estimate the log value of each peak's center on the FL1 axis. In this example, we obtain approximately (in log): 1st peak = 4.05; 2nd peak = 4.3; 3rd peak = 5.35; 4th peak = 6.2	

	WORK STEP	ADDITIONAL INFO / IMAGE
11.	Measure the same beads with the other flow cytometer you want to compare. Apply the gating and peak-estimation steps described in steps 9 and 10 to its results. In this example, we obtain approximately (in log): 1st peak = log(10^3) = 3; 2nd peak = log(2*10^3) = 3.3; 3rd peak = log(2.4$10^4$) = 4.4; 4th peak = log(1.6∗10^5) = 5.2	
12.	With the different values obtained for both devices, it is now possible to compare their scales and their measurement windows.	

12. Data Access and Export

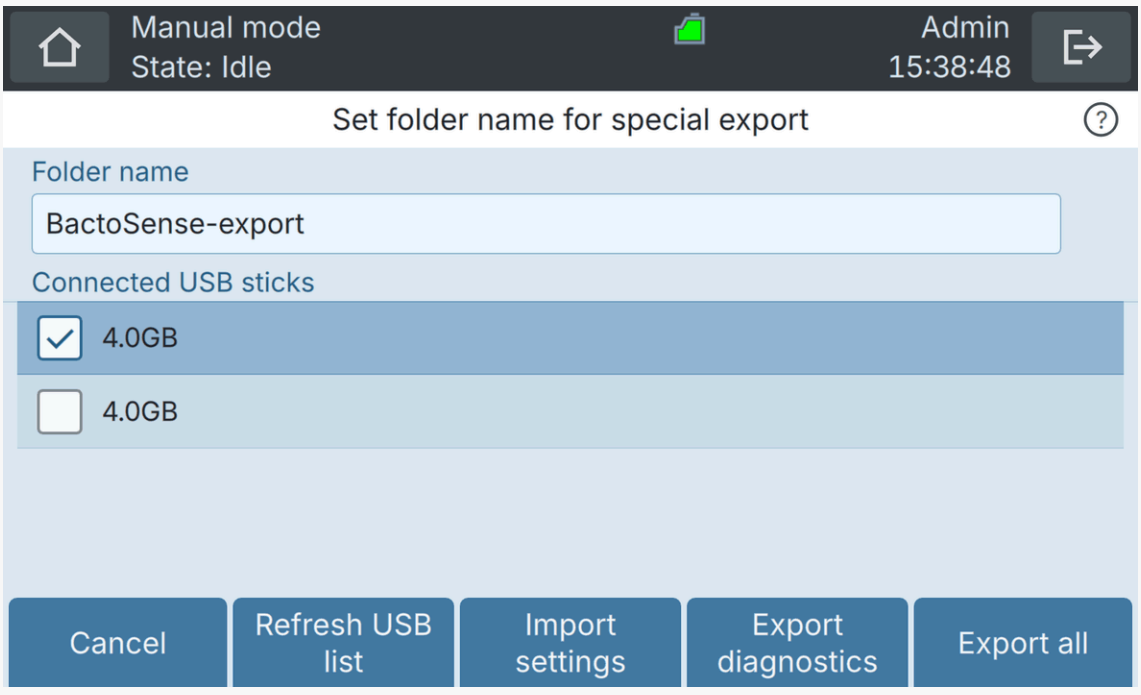
12.1 Export data to USB device

To export measurement data, refer to Export to a USB drive.

12.1.1 Export settings, diagnostics, or all to USB device

The “Special import/export” function allows users to export either all measurement data from the instrument, or to export only diagnostics data which can be interpreted by service technicians.

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	As an Advanced or Admin user, press Settings on the Home screen to open the settings menu.	
2.	Press the Maintenance button. Press the Special export import button.	
3.	Connect a USB mass storage device. The USB flash drive should be formatted in FAT32. If needed, press the Refresh USB list button until the device is displayed.	
4.	The name of the folder which will be created on the USB device is displayed in the Folder name field. Enter a new folder name if desired.	
5.	• To export all data, press the Export all button. • To export diagnostics data, press the Export diagnostics button. • To export settings, press the Export diagnostics button. Do not remove the USB mass storage device during the data transfer.	Exporting all data can take several hours. If the available storage capacity of the USB mass storage device is too small, a notification will be shown.



	WORK STEP	ADDITIONAL INFO / IMAGE
6.	After completion of the export, press the OK button and remove the USB device.	

12.2 Retrieve data via FTP

BactoSense data can be remotely accessed using the FTP protocol (RFC 3659).

- FTP authentication uses the username/password pairs used in the GUI of the instrument. Default account names are: basic, advanced, and admin.
- The CSV and Excel files are generated on-the-fly, and thus always contain the latest measurement data.

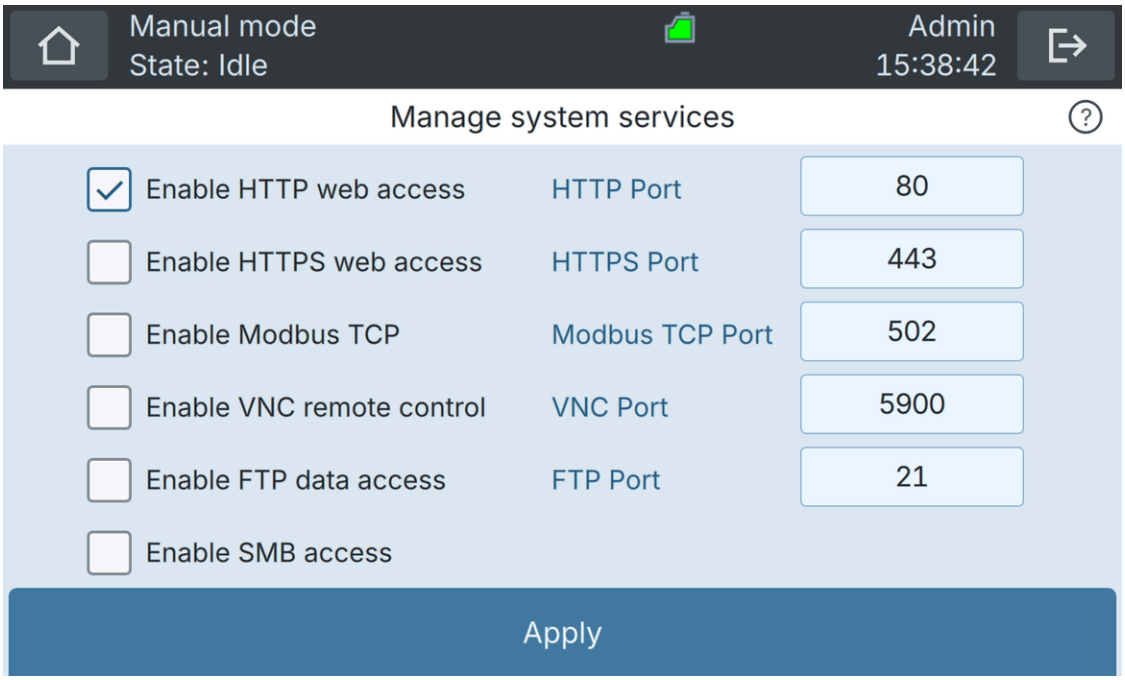


Figure 12-1 The Manage services view of the BactoSense user interface.

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	• Install an FTP client on the device you want to use to retrieve data, e.g. your laptop. • Alternatively, the Windows file explorer can be used.	
2.	Connect the BactoSense via Ethernet to a safe network (e.g. LAN). Connect your device to the same network.	For information about network configurations (i.e. static and dynamic IP settings), refer to Network configuration.
3.	As an Admin user, press Settings on the Home screen to open the settings menu.	
4.	Press the System settings button.	
5.	Press the System services button.	

	WORK STEP	ADDITIONAL INFO / IMAGE
6.	Make sure the Enable FTP data access check box is checked.	
7.	Choose a port for the FTP server.	The default port is port 21.
8.	Press Apply to save the changes. If a reboot is requested, press Reboot now.	Only needed in case you changed the configuration.
9.	On the Home screen, press Settings, then System info to retrieve the IP address of the BactoSense.	For information about network configurations (i.e. static and dynamic IP settings), refer to Network configuration.
10.	For FTP client: Open the client and enter the login details. For the Windows file explorer: Enter the following address in the address bar: ftp://user:password@ip:port	• User/username: Username to log in to the BactoSense • Password: Password to log in to the BactoSense • Host/ip: IP address of the BactoSense • Port: Port configured in System services view (see figure 12-1)

12.3 Retrieve files via HTTP or HTTPS

The HTTP and HTTPS servers are enabled by default and available through a web browser or any HTTP request library. Use the following procedure to retrieve specific files via HTTP or HTTPS. As an alternative, consider the web interface (Web User Interface) or FTP (Retrieve data via FTP).

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	Connect the BactoSense via Ethernet to a safe network (e.g. LAN). Connect your device to the same network.	For information about network configurations (i.e. static and dynamic IP settings), refer to Network configuration.
2.	As an Admin user, press Settings on the Home screen to open the settings menu.	
3.	Press the System settings button.	
4.	Press the System services button.	
5.	For HTTP: Make sure the Enable HTTP web access check box is checked. For HTTPS: Make sure the Enable HTTPS web access check box is checked.	
6.	Choose a port for the HTTP or HTTPS server.	The default port for HTTP is 80. The default port for HTTPS is 443.
7.	Press Apply to save the changes. If a reboot is requested, press Reboot now.	Only needed in case you changed the configuration.
8.	On the Home screen, press Settings, then System info to retrieve the IP address of the BactoSense.	

	WORK STEP	ADDITIONAL INFO / IMAGE
9.	Open a web browser on your device and enter the target file address into the address field. The file address has the following form: For HTTP: `http://ipaddress:port/export/filename.extension?hash=myhash` Example: http://192.168.1.2/export/history_auto.xlsx?hash=QWRtaW46MTExMQ For HTTPS: `https://ipaddress:port/export/filename.extension?hash=myhash` Example: https://192.168.1.2/export/history_auto.xlsx?hash=QWRtaW46MTExMQ	

Name	Description
`ipaddress`	Local IP address of the instrument
`port`	Port of the HTTP or HTTPS server (by default 80 and 443, respectively)
`filename`	Name of the target file. Example: history_auto
`extension`	File extension (csv, xlsx,pdf)
`myhash`	Security key containing user identification. The key is unique to any user-password combination. It is possible to find the key in the web interface (Web User Interface) by copying the link shown when downloading a file. For example: hash=QWRtaW46MTExMQ

12.4 GUI relay using VNC

Virtual Network Computing (VNC) is a graphical desktop-sharing system to remotely control another computer. It transmits the keyboard and mouse input from one computer to another, relaying the graphical-screen updates, over a network. The embedded VNC server in the BactoSense is capable of sharing the user interface over the local area network (LAN) only (exception: remote access using a VPN).

⚠ RESTRICT VNC ACCESS

VNC is an insecure protocol. Use it only on a trusted local network or through a VPN; do not expose it directly to the internet.

CLOSE VNC AFTER USE

A VNC connection can slow down the user interface since it is very taxing in terms of processing power. Be sure to close your VNC connection after use.

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	Install a VNC client on your computer.	
2.	Connect the BactoSense via Ethernet to a safe network (LAN). Connect your computer to the same network.	For information about network configurations (i.e. static and dynamic IP settings), refer to Network configuration.
3.	As an Admin user, press Settings on the Home screen to open the settings menu.	
4.	Press the System settings button.	
5.	Press the System services button.	

	WORK STEP	ADDITIONAL INFO / IMAGE
6.	Make sure the Enable VNC remote control check box is checked.	
7.	Choose a port for the VNC server.	The default port is port 5900.
8.	Press Apply to save the changes. If a reboot is requested, press Reboot now.	Only needed in case you changed the configuration.
9.	On the Home screen, press Settings, then System info to retrieve the IP address of the BactoSense.	
10.	Open the VNC client on your computer and connect to the BactoSense using the IP address and port identified previously.	Your VNC client may allow you to change connection settings to optimize the speed of the connection if needed.
11.	After finishing, return to System services, disable the VNC checkbox and press Apply. If a reboot is requested, press Reboot now.	The VNC connection can slow down the user interface on the BactoSense.

13. Web User Interface

13.1 General information

- The web interface allows users to browse and export results and other data from a remote computer, as well as monitor the state of the instrument (active process, cartridge level, alerts etc.)
- The BactoSense needs to be connected to the same network as the computer that accesses the web interface.
- The web interface can be loaded on any browser on desktop computers or mobile devices.
- Take care about data and network security with all usual measures.

13.2 Connect to the web user interface

An **admin** must first enable HTTP or HTTPS web access under **Settings → System settings → System services**, apply the changes and reboot when prompted. See Retrieve files via HTTP or HTTPS for the service settings and ports.

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	Connect the BactoSense via Ethernet to a safe network (e.g. LAN). Connect your device (e.g. computer or tablet) to the same network.	
2.	On the Home screen of the BactoSense user interface, press **Settings**, then **System info**.	 
3.	Retrieve the IP address of the BactoSense shown on the **System info** page.	
4.	On your device, open a web browser.	
5.	Enter `http://<IP address>` or `https://<IP address>` in the address bar, using the enabled service. Append `:<port>` if its port differs from the default, then press Enter.	
6.	On the login page, use the same username and password as for the BactoSense and press **Login**.	

13.3 Start page in manual mode

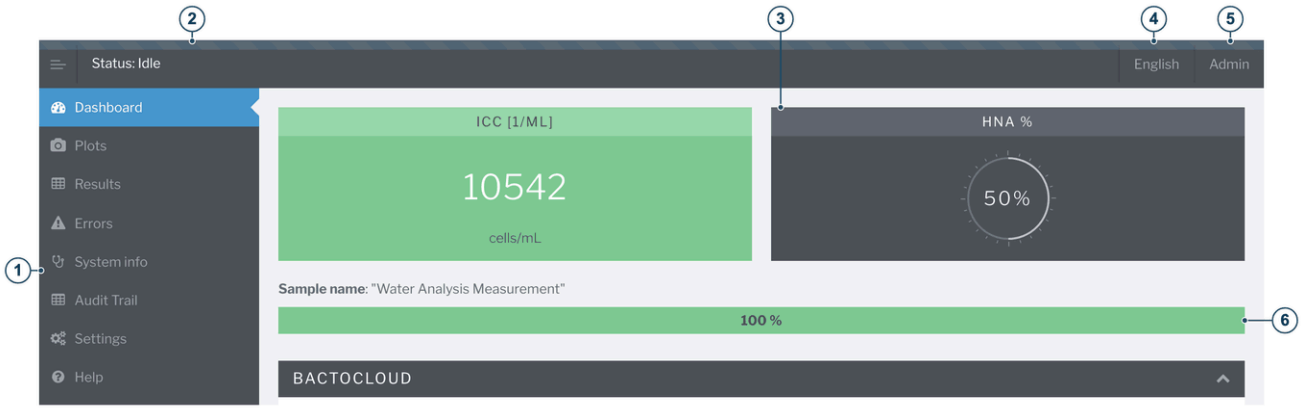
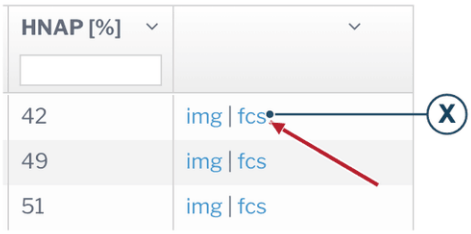


Figure 13-1 Start page on web user interface

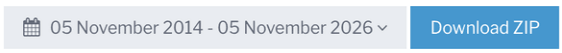
1	Menu	2	State of the instrument
3	Dashboard with latest results	4	Language: Drop-down menu for changing the language.
5	User menu: sign out; admin and service accounts can also reboot the BactoSense	6	Progress of the current measurement

13.4 Download an FCS-file

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	On the web interface, select the Results page on the navigation panel on the left.	
2.	Find the measurement in the appropriate result table below the chart. Scroll horizontally to the links at the right of its row if needed.	
3.	Click the **fcs** link (Position X).	
4.	Wait for the download to complete.	

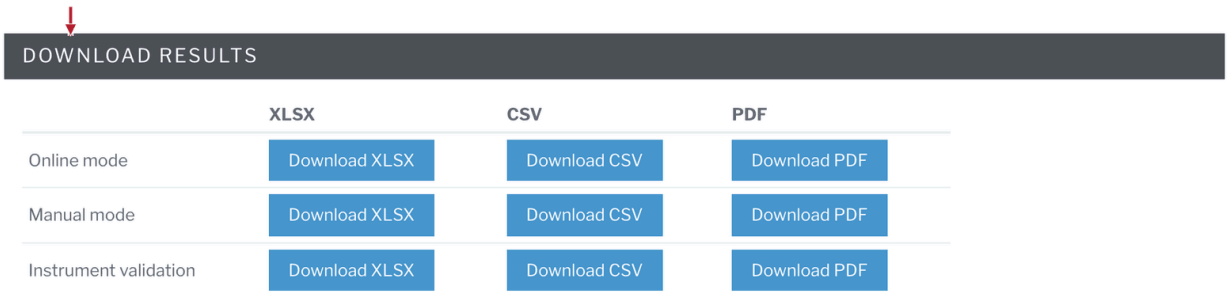
13.5 Download a zip file with multiple results

The results from multiple measurements can be downloaded as a zip file. This zip includes the FCS file and summary plots of each measurement.

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	On the web interface, select the Results page on the navigation panel on the left.	
2.	Find the **Online mode results** or **Manual mode results** table for the measurements you want.	
3.	Select the date range for that table and click **Download ZIP**. A progress bar will appear at the top of the browser until the zip starts downloading.	
4.	Wait for the download to complete.	

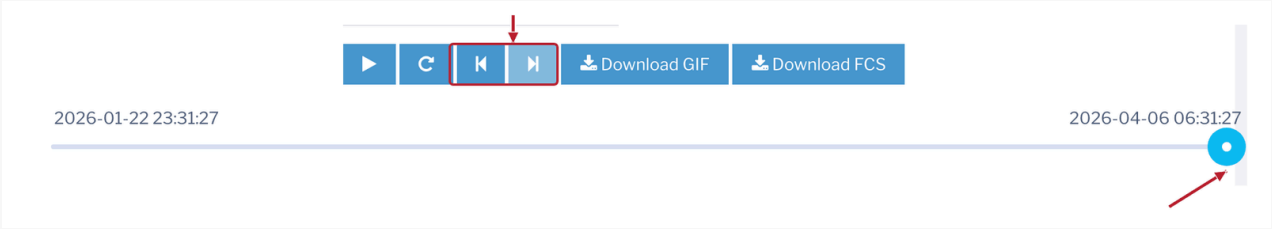
13.6 Download all results as CSV, XLSX or PDF

The list of all results can be downloaded from the web interface in Excel XLSX, CSV or PDF format. Online mode, Manual mode and instrument validation results have separate downloads.

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	On the web interface, select the Results page on the navigation panel on the left.	
2.	Find the **DOWNLOAD RESULTS** section below the results chart and choose the row for the required measurement mode or instrument validation.	
3.	Click **Download XLSX**, **Download CSV** or **Download PDF** in that row to start the download.	
		
4.	Wait for the download to complete.	

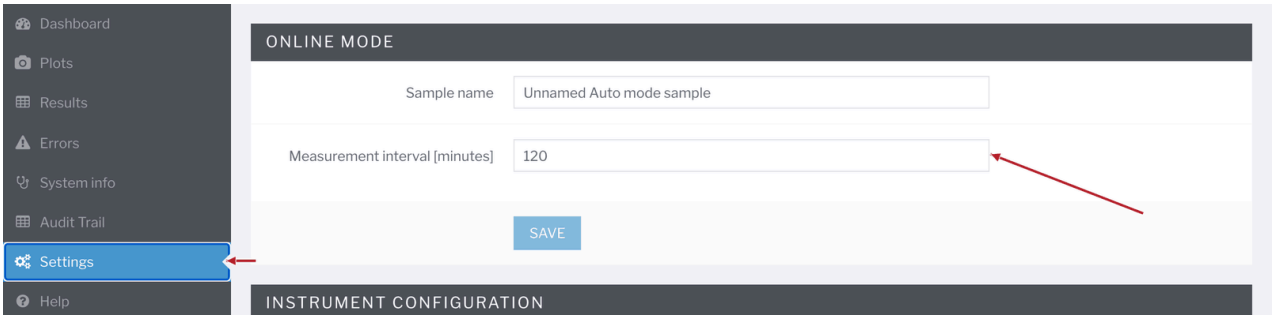
13.7 Animate the evolution of dot plots

The web interface can animate dot plots from Online mode, to help visualize the progression of the measurements. This feature shows static images in rapid succession; the animation can be exported with the Download GIF button.

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	On the web interface, select the Plots page on the navigation panel on the left.	
2.	Use the previous and next arrows or the slider to select a measurement by its timestamp.	
		
3.	Press the triangle Play button to start the animation. Press it again to pause.	
4.	Set **Animation speed** to the desired positive number of plots per second.	
5.	Press **Download GIF** to export up to 60 of the most recent Online mode plots at the selected speed. The export uses the latest plots, regardless of the slider position.	

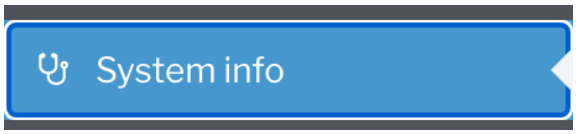
13.8 Change the measurement interval

The interval used for Online mode measurements can be changed from the web interface.

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	On the web interface, select the Settings page on the navigation panel on the left.	
		
2.	Enter an interval from 30 to 360 minutes in **Measurement interval [minutes]**.	
3.	Click **SAVE** to apply the interval.	

13.9 Take screenshots of the GUI

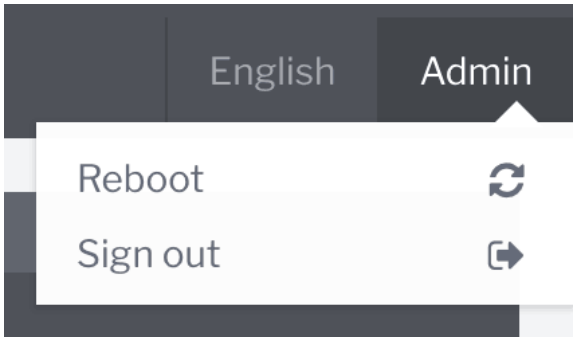
Take screenshots of the BactoSense GUI from the web interface:

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	On the web interface, select the System info page on the navigation panel on the left.	
2.	Press the Get screenshot button at the bottom of the page.	
3.	The screenshot is displayed below.	

13.10 Reboot from web user interface

An **admin** or service account can reboot the BactoSense from the web interface according to the following procedure.

> **REMOTE POWER-ON IS UNAVAILABLE**
>
> The instrument cannot switch on remotely.

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	In the top right corner of the web interface, click the username to open the user menu.	
2.	Select **Reboot**, then click **Reboot** in the confirmation dialog.	
3.	Wait for the instrument to restart, reload the web interface and sign in again if prompted.	

14. BactoCloud

BactoCloud is the secure cloud platform for BactoSense users, enabling real-time visibility, remote access, and intelligent data integration across all water monitoring operations.

14.1 IT requirements

BactoSense initiates an outbound internet connection to BactoCloud. The connection can use BactoLink, a 4G/5G access point or wired internet. Multiple instruments can share an internet connection behind NAT; no VPN or inbound port forwarding is required.

Requirement	Configuration
Network addressing	Provide a working IP address, subnet mask, gateway and DNS resolver. DHCP and static addressing are supported. Confirm static settings with the network administrator.
Outbound access	Allow outbound access to `*.bactocloud.com` and `*.bnovate.net` from the instrument network.
Bandwidth	Plan for more than 1 Mbit/s.
Data usage	Allow roughly 0.5–1 GB per month per instrument measuring hourly. Historical synchronization, diagnostics and software updates add traffic.
Time synchronization	Configure an approved time source where required so event timestamps can be correlated.
Browser proxy	A proxy used by BactoCloud users must support secure WebSocket connections to BactoCloud.

Keep the instrument's local web interface on a controlled plant network and do not expose instrument services to the public internet. Existing PLC, Modbus and I/O connections can remain in use.

For instrument configuration, see Network configuration and Set NTP Servers.

14.2 Registration

Visit www.bactocloud.com/register, enter the requested account details and complete email verification. Registration creates your personal account; organization membership connects it to an instrument fleet.

If you received an invitation, follow its link and sign in or register with the exact email address that was invited. After accepting the invitation, select the organization from the header.

To create an organization for your own fleet, open the organization selector in the header and choose **New Organisation**. Enter its name, choose its time zone and applications, then select **Create Organisation**. Select the intended organization before generating an enrolment code.

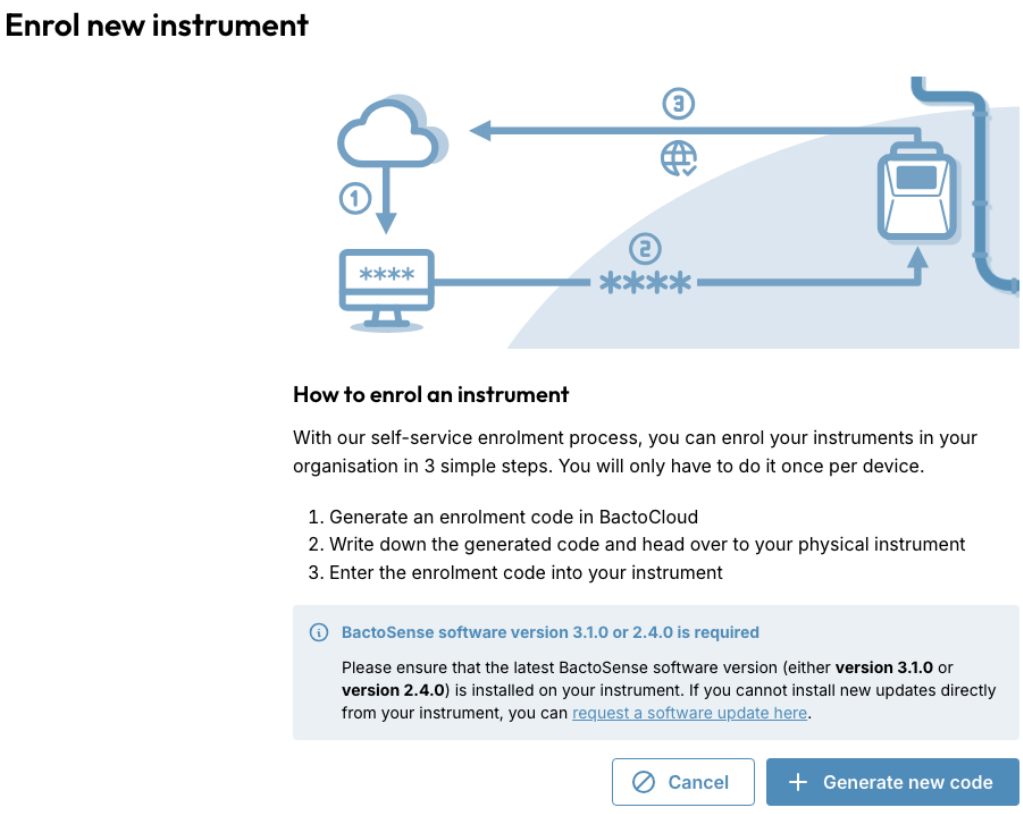
14.3 Instrument enrolment

Enrolment connects an instrument to one BactoCloud organization. You need permission to enrol instruments in that organization and an **admin** account on the instrument. Use the instrument's touchscreen or an approved VNC remote view of that touchscreen. An instrument can belong to only one organization at a time.

Before enrolment, check the installed BactoSense software: Rev3 instruments require **3.1.0 or later**, and Rev2 instruments require **2.4.0 or later**. Individual cloud features can require newer software or instrument options. If you cannot install an update locally, contact your service channel before proceeding.

14.3.1 Generate an enrolment code

1. Sign in to BactoCloud and use the organization selector to choose the organization that should own the instrument.
2. Open the organization selector in the header, choose **Organisation Settings**, then **Instruments** in the sidebar. Select **Enrol instrument**. This action is also available on the empty fleet page when no instruments are enrolled.
3. Review the enrolment explanation and software requirement, then select **Generate new code**.
4. Write down or copy the generated code.



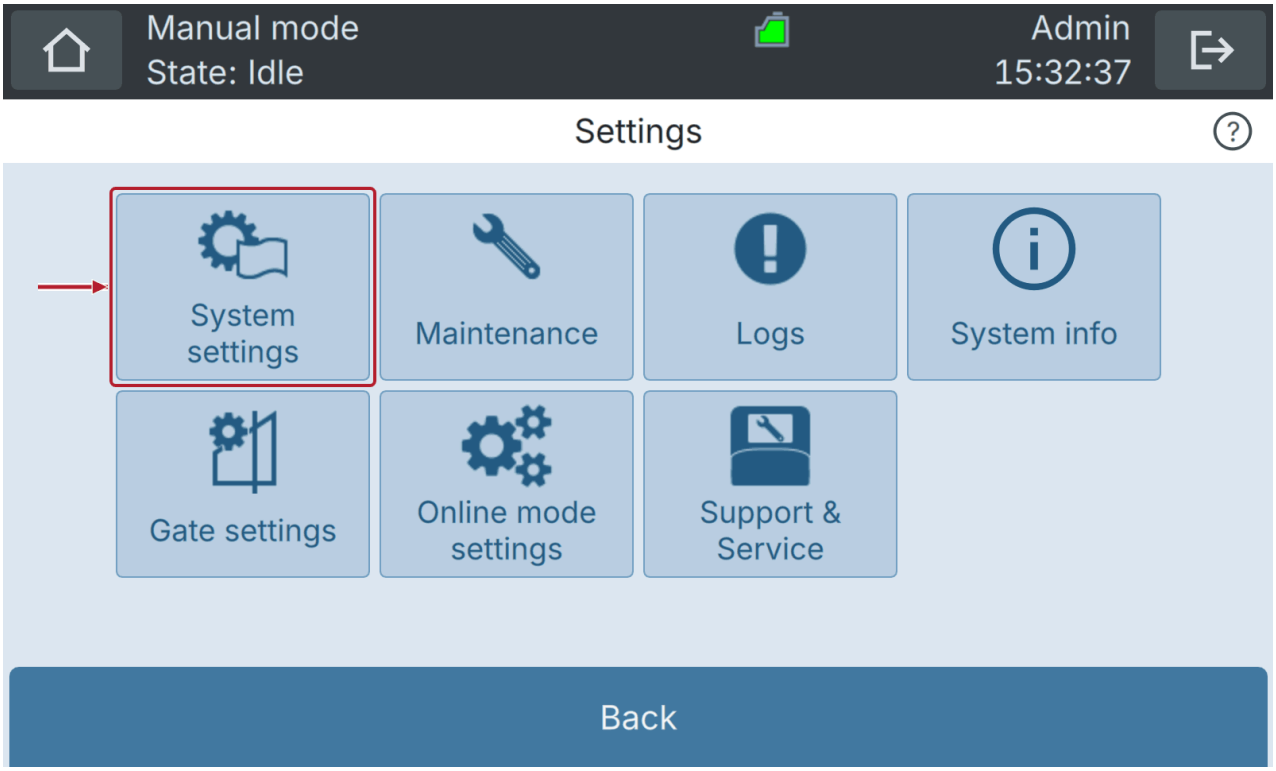
The **Enrolment codes** section lists existing codes and their expiry dates. Use a code before its listed expiry date, or generate a replacement if it has expired. Each code belongs to the organization in which it was generated. If the enrolment action is unavailable, ask an organization administrator to check your access.

14.3.2 Enter the code on the instrument

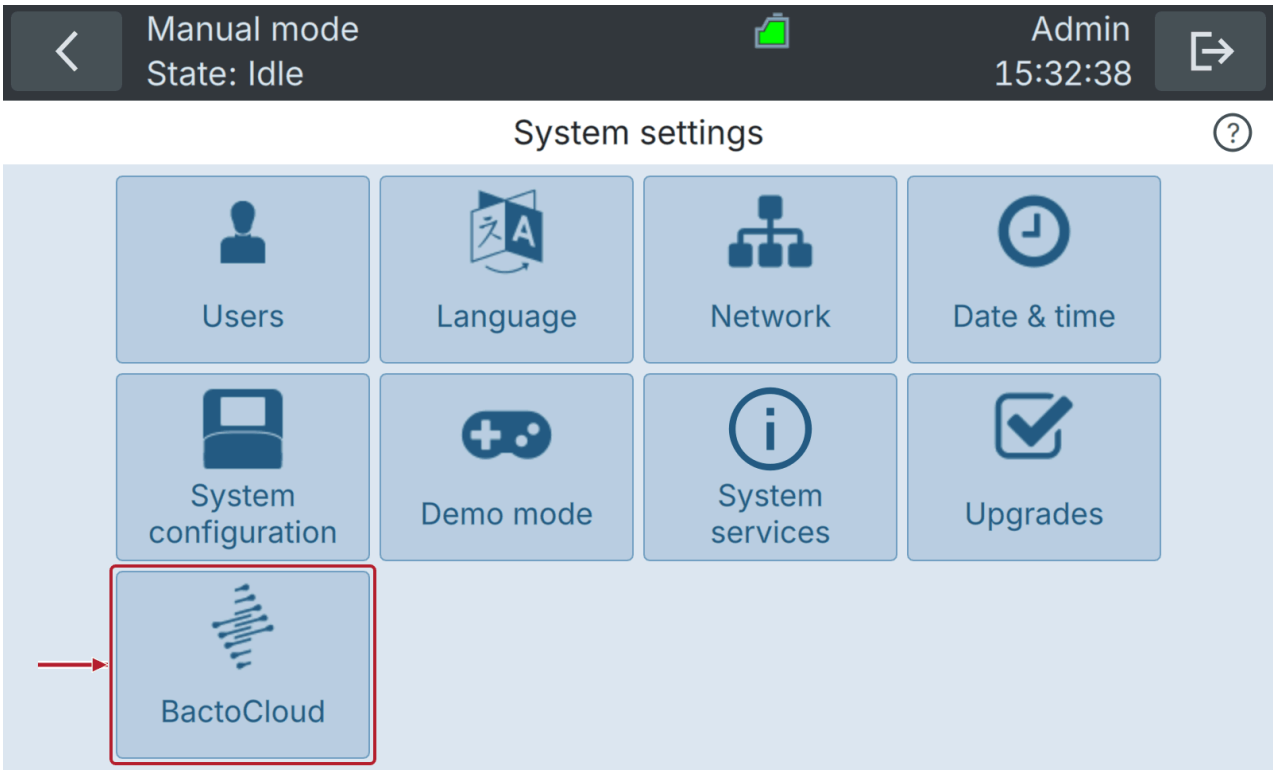
1. On the BactoSense Home screen, select **Settings** in the bottom toolbar.



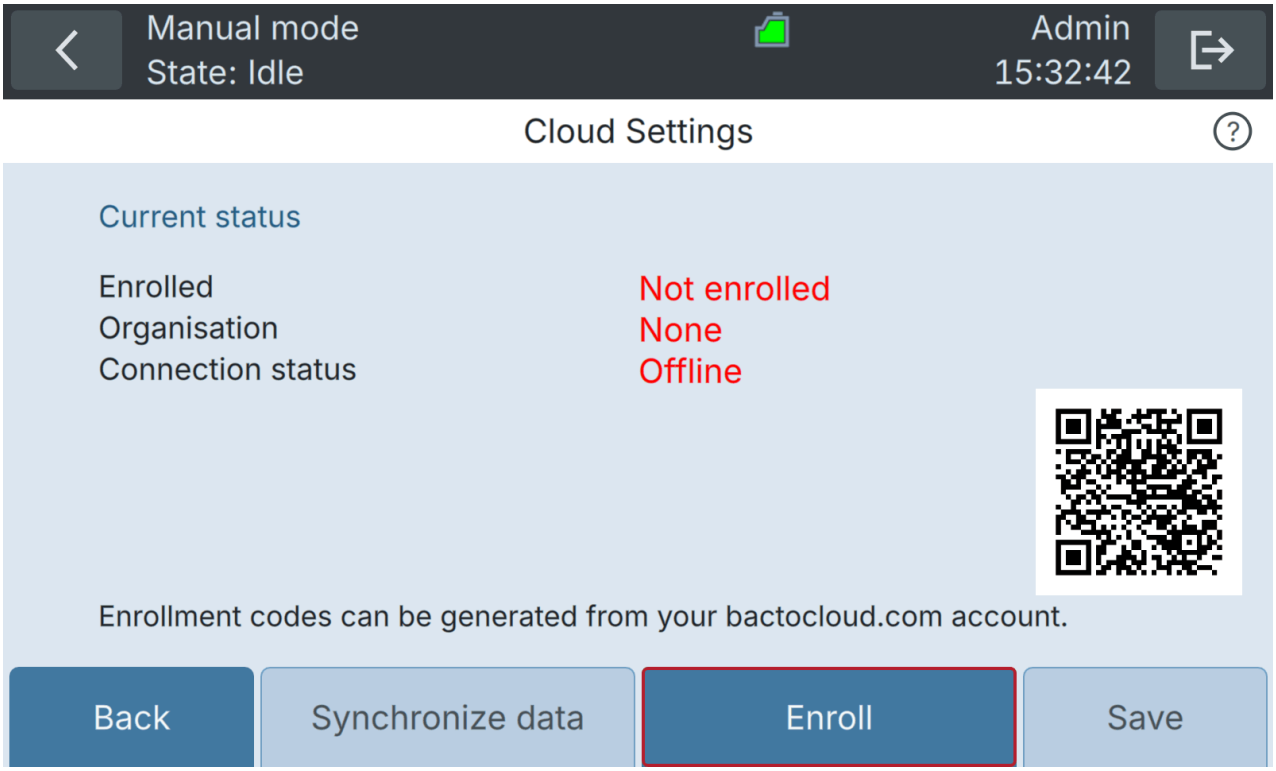
2. Select **System settings** in the Settings menu.



3. Select **BactoCloud** to open **Cloud Settings**.



4. Select **Enroll**, enter the code generated in BactoCloud and confirm the entry. Follow the on-screen messages, then check that **Enrolled** shows **Yes** and **Organisation** names the intended organization.



If **BactoCloud** is unavailable, check your local user role and whether Demo mode or PLC mode is active.

14.3.3 Confirm enrolment

In BactoCloud, use the header's organization selector to open **Organisation Settings → Instruments** and check the instrument's name, serial number and reported connection state. Confirm that its latest status and measurements arrive. **Last seen at** is the time of the latest status received by BactoCloud; it does not test the current network connection.

If the instrument is missing, verify that you generated the code under the intended organization and completed the instrument procedure. If a code is rejected or the instrument already belongs to another organization, ask an organization administrator or support for help.

If status or measurements stop arriving, note the instrument serial number, software version, timestamp and last successful upload. Ask the network administrator to verify DNS and outbound connectivity from the instrument network using the IT requirements.

The organization's instrument inventory also shows **Enrolled since**. Users with instrument deletion permission can select the row action **Unlink Instrument from organisation**. Before unlinking, export any measurements you need to retain. The confirmation warns that unlinking stops uploads and deletes the existing cloud measurements. Verify the target instrument, enter its serial number in the confirmation and select **Unlink instrument**.

15. Maintenance

BactoSense maintenance refers to the activities and procedures performed to ensure the proper functioning, accuracy and reliability of the instrument over its life cycle.

FOLLOW THE MAINTENANCE SCHEDULE

BactoSense service duty

Adhering to the maintenance schedule is important to ensure a long instrument lifetime, safe operation and correct measurement results. Service duties have to be carried out according to the maintenance schedule and original bNovate spare parts have to be used, otherwise this can lead to damage to the instrument or measurement errors. In case of neglected maintenance, bNovate Technologies accepts no warranty claims made by the customer and is not responsible for any resulting costs. Importantly,

- Only service-trained and authorized personnel are allowed to carry out BactoSense service operation
- Carry out servicing duties according to the servicing schedule in Periodic preventive maintenance by service professional and Overview of maintenance by user.
- When carrying out servicing duties, use original bNovate spare parts. The use of third-party spare parts requires the written approval of bNovate Technologies.
- If the instruments are subjected to heavy use or exposed to adverse environmental conditions, service duties must be carried out more frequently.

BEFORE MAINTENANCE

Observe the safety points

Before working on the instrument, ensure that you have carefully read the safety points in this user manual. You should also follow these regulations:

- Only professional electricians are authorized to do the electrical installation of the power plug.
- It is forbidden to modify or repair the BactoSense instrument.
- Perform the work steps in the instructed order.
- When replacing parts, use only genuine original parts listed in the consumables and spare parts list.
- When returning components use the original packaging of the BactoSense
- Be sure to use a plug with Protective Earth (PE) and that the device is correctly connected to it.

15.1 Periodic preventive maintenance by service professional

Preventive maintenance of the BactoSense is a scheduled intervention to replace wear parts, update the software and inspect and validate the instrument. Preventive maintenance is important to prevent failures and optimize the performance and reliability. It can only be conducted by service professionals specifically trained by bNovate.

Preventive maintenance is due after the use of 3 cartridges or after 1 year, whichever comes first.

Contact bNovate support or your local service partner to see available options. Contact details can be found in Contacting customer service.

15.1.1 Retrieve service information

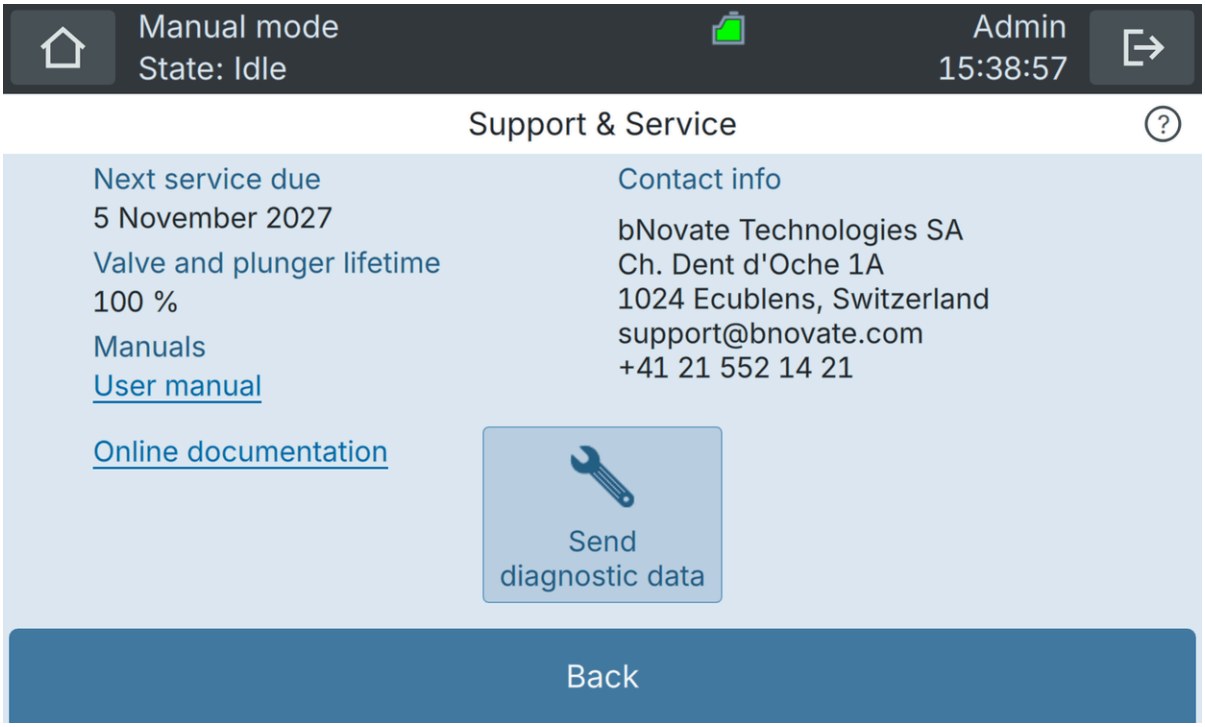


Figure 15-1 Support & Service screen.

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	Log in and navigate to the Home screen.	
2.	Press the Settings button.	Settings
3.	Press the Support & Service button.	
4.	If a service is needed, a warning will be attached to the measurement result. Schedule a preventive maintenance before the service due date.	

15.1.2 Review the service intervention log

The following procedure describes how to view details of past service interventions.

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	As an Advanced or Admin user, press Settings on the Home screen to open the settings menu.	Settings
2.	Press the Maintenance button.	
3.	Press the **Intervention log** button.	

	WORK STEP	ADDITIONAL INFO / IMAGE
4.	Past service interventions are listed in this log screen. Each entry shows: • **Intervention date** and **Operator**: when and by whom the service was performed. • **Changed parts**: the replaced valve, plunger and mixer; a dash (-) marks a part that was not replaced. • **Next service due**: the service due date set during the intervention. • **Valve lifetime** and **Plunger lifetime**: the number of motions after which the valve and the plunger require service, as set during the intervention. • **Comment**: notes from the service professional.	Press **Back** to return to the Maintenance menu.

15.2 Maintenance by the user

Maintenance by user refers to simple and occasional maintenance activities performed by the user. They are important to maximize the instrument's performance, minimize downtime, and extend its operational life.

15.2.1 Overview of maintenance by user

Table 15-1 Overview of the maintenance activities performed by the user

WHEN	WHAT	PROCEDURE
Cartridge expired or empty	Replace cartridge	See cartridge exchange procedure in Change cartridges. See cartridge shipping instructions in Returning a cartridge for refill.
Manual sampling device is newly installed. Instrument has been or will be idle or switched off for more than 3 days.	Cleaning with Washstation or Basic Cleaning	If Washstation is available, see Clean manual sampling device with Washstation. Otherwise see Clean manual sampling device with basic cleaning.
Instrument shows signs of contamination	Decontamination	Requires a Cleaning Kit, see consumables list in Consumables. See Cleaning Kit user manual.
Online sampling device is contaminated.	Cleaning	See cleaning procedure in Clean online sampling device.
Online sampling device tubing is damaged or dirty	Replace tubing	See replacement process in Replacing online sampling device tubings.
Cell concentrations lower than expected or no cells measured	Sampling device inlet filter clogged. Replace the filter.	See Replacement of the sampling device filter. See consumables list in Consumables.

Error E08 appears (internal humidity)	Internal humidity is not within specified limits. Replace the desiccant bag	Replace the desiccant bag. See instructions in Replacement of the desiccant bag. See consumables list in Consumables.
Error E07 appears (disk full)	Disk space is full. Clear disk space	See instructions in Clearing of disk space.

15.2.2 Clean manual sampling device with Washstation

This protocol describes how to clean the manual sampling device using the Washstation. If no Washstation is available, follow the procedure in Clean manual sampling device with basic cleaning.

- This protocol automatically cleans the inner and outer surfaces of the aspiration needle.
- All reagents required come directly from the installed cartridge.
- The protocol takes approximately 15 min.



Figure 15-2 Washstation for cleaning the manual sampling device

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	Make sure the manual sampling device is tightly installed as described in Installation of the manual sampling device.	
2.	Navigate to the Home screen of the BactoSense user interface.	
3.	On the Home screen, press Mode and select Manual mode. Press Back, then Measure to open the measurement wizard.	
4.	Select Clean Sampling Device with Washstation from the list of available protocols.	
5.	Make sure 1 replication is configured in the Replications column.	More replications can be conducted for stronger cleanings.
6.	Press the Next button.	
7.	Mount the Washstation by screwing it on the manual sampling device, similar to a sample tube. Make sure you install it to the end of the thread.	
8.	Press the Start button and wait for 15 min for the protocol to complete.	

	WORK STEP	ADDITIONAL INFO / IMAGES
9.	If the instrument will be idle or decommissioned, leave the Washstation attached to the manual sampling device. If you want to keep on measuring, remove the Washstation and close it with a cap from a 5 mL screw-cap tube.	
10.	If the contamination persists, repeat the procedure with more replications. If it still persists, use the Cleaning Kit to decontaminate the instrument (see Consumables).	

15.2.3 Clean manual sampling device with basic cleaning

This protocol describes how to clean the manual sampling device without the Washstation. If a Washstation is available, follow the procedure in Clean manual sampling device with Washstation instead. This protocol requires sterile water.

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	Make sure the manual sampling device is tightly installed as described in Installation of the manual sampling device.	
2.	Attach a fresh 5 mL screw-cap tube containing 2 – 5 mL sterile water to the manual sampling device.	
3.	Navigate to the Home screen of the BactoSense user interface.	
4.	On the Home screen, press Mode and select Manual mode. Press Back, then Measure to open the measurement wizard.	
5.	Select Clean Optics from the list of available protocols.	
6.	Make sure 1 replication is configured in the Replications column.	Configure more replications for a stronger cleaning.
7.	Press the Next button.	
8.	Press the Start button and wait for 5 min for the protocol to complete.	
9.	Press New to return to the protocol list, then select Clean Sampling Device.	
10.	Make sure 1 replication is configured in the Replications column.	Configure more replications for a stronger cleaning.
11.	Press the Next button.	
12.	Press the Start button and wait for 5 min for the protocol to complete.	

	WORK STEP	ADDITIONAL INFO / IMAGES
13.	Once the protocol is finished, remove the 5 mL screw-cap tube and discard it.	
14.	Press the Home icon at the top left of the user interface to return to the Home screen.	
15.	If you want to continue with measurements, perform a Prime prior to the first measurement. The instructions can be found in Performing a Prime. If the instrument will be idle or shut off, attach a fresh sample tube to the manual sampling device.	
16.	If you face a persisting contamination, first repeat the procedure with more replications. If it still persists, use the Cleaning Kit to decontaminate the instrument (see Consumables).	

15.2.4 Clean online sampling device

The following procedure helps clear biological contamination from the online sampling device. In case of persistent biological contamination or suspected non-biological contamination, change the online sampling device tubing as described in Replacing online sampling device tubings and contact support@bnovate.com for assistance.

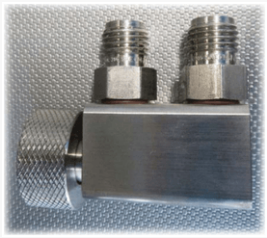
	WORK STEP	ADDITIONAL INFO / IMAGES
1.	Make sure the online sampling device is correctly installed and water flow conditions are fulfilled (see Installing the online sampling device at the BactoSense).	Important: Make sure the outlet tubing is connected to a drain, as cleaning liquid is released into the online sampling device.
2.	On the Home screen, press Mode and select Manual mode. Press Back, then Measure to open the measurement wizard.	
3.	Select the Clean Sampling Device protocol and configure 5 replications.	
4.	Press Next and Start to launch the cleaning.	
5.	After finishing, press New to return to the protocol list.	
6.	Select the Prime protocol and configure 2 replications.	
7.	Press Next and Start to launch the priming.	
8.	After completion, the online sampling device should be clear of minor biological contamination and you can return to regular operation. If contamination persists or non-biological contamination is suspected, contact support@bnovate.com for assistance.	

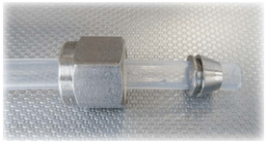
15.2.5 Replacing online sampling device tubings

The inlet and outlet tubing of the online sampling device must be replaced if they show signs of damage or contamination. The required materials are the inlet and outlet tubing and two ferrules. For specifications refer to Technical data, and for the part numbers to Consumables.

> **⚠ DO NOT USE A SPANNER**
>
> Never use a spanner on the sampling device when attached to the BactoSense

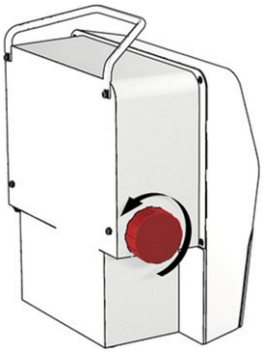
> **WEAR PROTECTIVE GLOVES**
>
> Wear nitrile gloves when manipulating the sampling device or any other components which come in contact with the sample.

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	Make sure all protocols (e.g. measurements) have terminated, or terminate them if needed.	
2.	Stop the water flow through the sampling device.	
3.	Disconnect the tubings to the water supply and drain them.	
4.	Carefully unscrew the knurled sampling device fixation ring until the sampling device can be removed.	
5.	Make sure the white sealing plug still sits tightly in the connector of the sampling device. If not, it may have remained in the BactoSense sampling device connector. In this case carefully remove it with tweezers and place it back in the sampling device.	
6.	Unscrew the nuts of the two connectors on the sampling device using a spanner.	
7.	Pull the nuts off the old tubings.	

	WORK STEP	ADDITIONAL INFO / IMAGES
8.	Discard the old tubings with ferrules.	
9.	Take the new tubings and install the nut and ferrule as illustrated. Screw the nut on the online sampling device using a clamp. Make sure the blue FEP tubing is connected to the top fluidic connector (see figure 5-2 in Installation of the online sampling device).	
10.	Continue with the procedure for installing the online sampling device described in Installing the online sampling device at the BactoSense.	

15.2.6 Replacement of the desiccant bag

The following procedure describes how to replace the desiccant bag. The desiccant bag is a consumable listed in Consumables.

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	Open the desiccant bag container by unscrewing the large cap on the left-hand side of the instrument.	
2.	Replace the used desiccant bag by a new one.	
3.	Close the desiccant bag container by screwing back the large cap.	

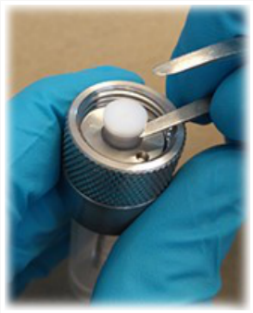
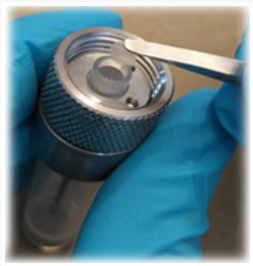
15.2.7 Replacement of the sampling device filter

The sampling device of the BactoSense contains a 25 µm filter which can be replaced by the user. The filter is a consumable listed in Consumables.

USE FRESH PROTECTIVE GLOVES

Wear fresh, non-powdered nitrile gloves when handling the samples, sampling device, or any components which come in contact with them.

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	Unscrew the sampling device from the BactoSense, as described in Removal of the online sampling device for the online sampling device, and Removal of the manual sampling device for the manual sampling device.	

	WORK STEP	ADDITIONAL INFO / IMAGE
2.	Place flat tweezers under the white plug.	
3.	Remove the white plug and mind the transparent filter disc. The filter sometimes stays inside the cavity and sometimes remains attached to the white plug.	
4.	Remove the filter and place a new one. Do not use force, let the filter sink with gravity. Do not push the filter inside with tweezers.	
5.	Re-insert the white plug. Be sure to press it until it reaches the bottom. The force of the white plug will press the filter in the right position.	
6.	Re-install the sampling device as described in Installation of the manual sampling device for the manual sampling device and Installation of the online sampling device for the online sampling device.	

15.2.8 Clearing of disk space

> ⚠ **BACK UP DATA BEFORE DELETING**
>
> When running out of disk space, old data can be deleted.
>
> Make sure you retrieve all data from other users and your data before deleting it from the BactoSense.

	WORK STEP
1.	As an Advanced or Admin user, press Settings on the Home screen to open the settings menu.
2.	Press the Maintenance button.
3.	Press Delete old measurements. This function is available to Advanced and Admin users.
4.	If available, choose one of the following measuring modes: Online / Manual

	WORK STEP
5.	Choose the time interval for the measurements to keep. Measurements older than this will be deleted.
6.	Press Delete measurements, then confirm with Yes, delete to permanently delete the data.

15.3 Software update

Software updates can either be installed from a USB stick, or from an online repository, if an internet connection is available (e.g. through BactoLink). Software updates must be launched manually from the user interface. For updates from the online repository, follow the procedure below. For updates using a USB stick, see Prepare a USB update stick and Install an update from a USB stick.

	WORK STEP
1.	Make sure your instrument has a fast and stable internet connection and you are logged in with Admin permissions.
2.	Recommended: Back up your data, e.g. using export to USB as described in Export data to USB device.
3.	On the Home screen, press Settings to open the settings menu. Press the Maintenance button.
4.	Press System update. Available USB drives and the online repository appear in the list at the top. If no update is shown, press Refresh list. If still no update is shown, no update is available for your instrument or there is an issue with the internet connection.
5.	Select the USB drive or online repository containing the desired update.
6.	Carefully read through the release notes in the Changelog section of the user interface to understand the changes introduced since your current software version.
7.	To update, press Update, confirm with Yes, and follow the instructions. Note: No manual reboot is necessary after the update.
8.	After the update, verify that all instrument configurations are still correct.

15.3.1 Prepare a USB update stick

The following procedures apply to software 3.x. The update image and bNovate Multi Disk Imager can be downloaded from downloads.bnovate.net. The instrument also shows this address as a QR code: when no USB stick or online repository is listed on the System update screen, press Download offline update.

> ⚠ **WRITING THE IMAGE ERASES THE USB STICK**
>
> Writing the update image erases all data on the selected USB stick. Verify the device model and capacity before writing.

	WORK STEP
1.	Use a USB stick with a capacity from 4 GB to 128 GB.
2.	On a computer, download the BactoSense update image (.img file) and bNovate Multi Disk Imager for Windows, macOS or Linux from downloads.bnovate.net. Install bNovate Multi Disk Imager.

	WORK STEP
3.	Insert the USB stick into the computer and launch bNovate Multi Disk Imager.
4.	Under Raw image, select or drop the update .img file.
5.	Under Devices, select the USB stick. Confirm its model and capacity carefully. If the image is reported as larger than the USB stick, cancel and use a larger stick. Do not crop the update image.
6.	Enable Verify data when finished, then click Write image. Confirm the selected device and approve the administrator prompt.
7.	Wait until writing and verification have completed successfully. If the operating system asks to format or repair the USB stick, cancel the prompt.
8.	Safely eject the USB stick before removing it from the computer.

15.3.2 Install an update from a USB stick

	WORK STEP
1.	Make sure you are logged in with Admin permissions.
2.	Recommended: Back up your data, e.g. using export to USB as described in Export data to USB device.
3.	Insert the prepared update stick into a USB socket of the instrument.
4.	On the Home screen, press Settings to open the settings menu. Press the Maintenance button, then press System update.
5.	Wait approximately 30 seconds while the instrument recognizes and decrypts the update, then press Refresh list.
6.	Select the USB stick in the list. If No valid update file in this USB stick. is shown, prepare the stick again as described in Prepare a USB update stick.
7.	Carefully read through the release notes in the Changelog section of the user interface to understand the changes introduced since your current software version.
8.	To update, press Update, confirm with Yes, and follow the instructions. Note: No manual reboot is necessary after the update.
9.	After the update, verify that all instrument configurations are still correct.

15.4 Embedded manual

The embedded manual lets you consult this user manual directly on the BactoSense touchscreen. Its chapters, tables, safety notices and illustrations are stored on the instrument, so no internet connection is needed to read them.

The manual follows the instrument's interface language. English, German, French, Italian and Spanish are supported. If the selected language is unavailable in the installed manual, the English edition is displayed.

15.4.1 Open the manual

The manual is accessible to Basic, Advanced and Admin users.

	WORK STEP
1.	Log in and navigate to the Home screen.
2.	Press **Settings**.
3.	Press **Support & Service**.
4.	Under **Manuals**, press **User manual** to open the chapter contents.

15.4.2 Read and search

Select a chapter in the contents and scroll to read it. Press a cross-reference in the text to open the corresponding section. Use the reader's toolbar to navigate and adjust the text:

CONTROL	FUNCTION
Contents	Return to the chapter list.
Sections	Show the headings in the current chapter. Select a heading to jump to that section, or press **Read** to return to the article.
Search	Enter a word or phrase with the on-screen keyboard and confirm the entry. Select a search result to open its location in the manual.
Back	Return to the previous reading position within the manual, for example after following a cross-reference.
‹ / ›	Open the previous or next chapter.
A− / A+	Decrease or increase the text size.

Press an illustration to enlarge it. Use **+** and **−** to zoom, drag to inspect details, and press **Close** to return to the article. Wide tables can be scrolled horizontally.

To leave the manual and return to the instrument screen, press the device's Back control at the top left. External website links display an address to open on a phone or computer.

15.4.3 Contextual help

On screens with contextual help, a circled question mark appears beside the screen title. Press it to open the manual at the relevant instructions. This is useful, for example, when configuring a measurement schedule, interpreting results or changing a cartridge.

Press the device's Back control at the top left to close help and return to the same screen. Your current selections and unsaved entries are retained.

The embedded copy is supplied with the instrument software. To consult the online edition, press **Online documentation** under **Manuals** on the **Support & Service** screen and scan the QR code with a phone. Reading the online edition requires an internet connection on that device.

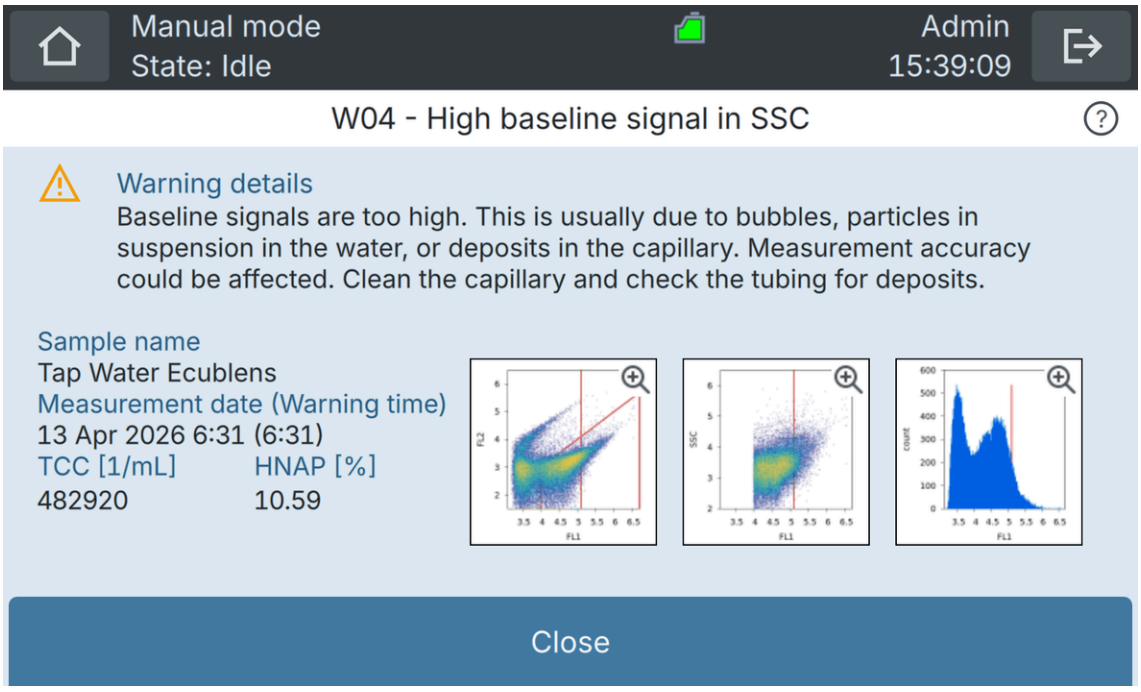
16. Warnings, Errors and Troubleshooting

If the instrument encounters a problem, it enters a different state, depending on the severity of the issue. There are warnings, noncritical errors and critical errors, each having different implications and requiring different actions.

16.1 Warnings

Warnings appear when unusual behaviour is detected during an otherwise successful measurement. They can indicate reduced accuracy of the measurement results or indicate impending errors. Unlike errors, warnings do not prevent the instrument from functioning, but users should pay attention to them as they can indicate sources of inaccuracies.

WARNING	IMAGE
When unusual behavior is detected, a warning is shown next to the measurement results. More information on the warning can be found by clicking on the corresponding warning entry next to the measurement results or directly in the warning log.	



The following warning messages can be displayed:

Table 16-1 Warnings

ERROR CODE	NAME	DESCRIPTION	CAUSES / WHAT TO DO
W01	Cartridge expired	Cartridge reagents have expired. Cell counts may be underestimated. Please replace the cartridge as soon as possible.	• Please replace the cartridge as soon as possible.

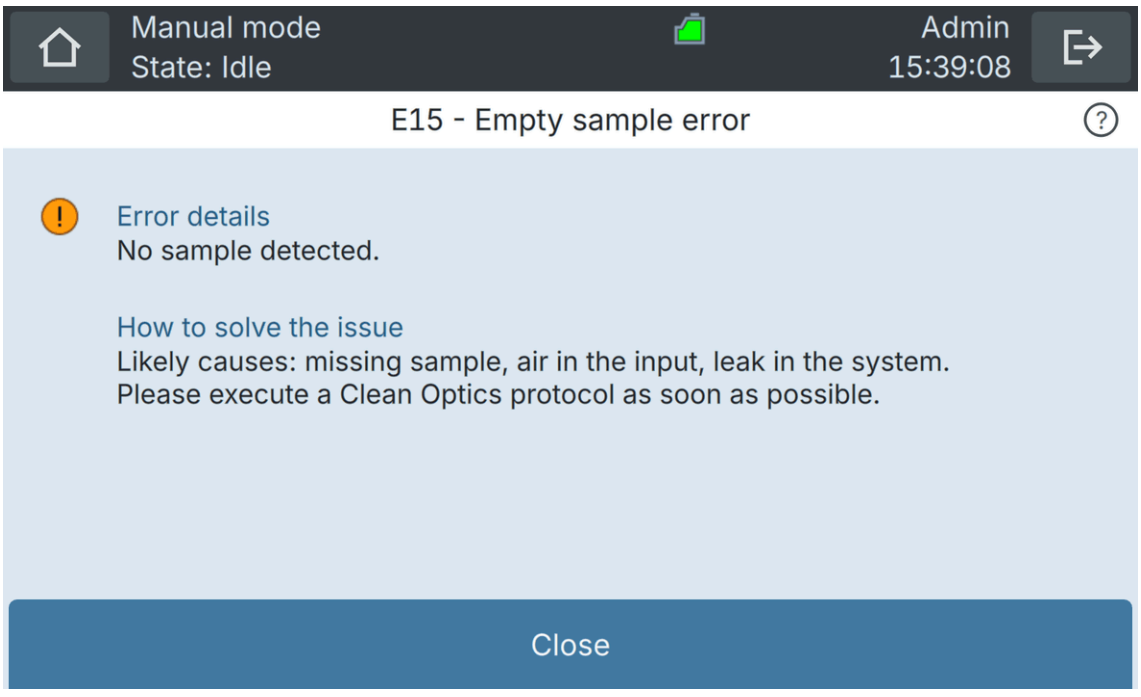
ERROR CODE	NAME	DESCRIPTION	CAUSES / WHAT TO DO
W02-04	High baseline signal in FL1 / FL2 / SSC	Baseline signals are too high. This is usually due to bubbles or particles in suspension in the sample. Measurement accuracy could be affected.	• Check the inlet tubing for any signs of deposits. • Check the water connections, be sure that they are all tight (no air entry). • If the warning persists, please perform cleaning of instrument with the cleaning kit.
W05	Incubator temperature off target	Temperature during incubation was more than 2°C off target. Cell counts may be underestimated. The incubator may be defective. If the problem persists, please call customer service.	• If the problem persists, please contact customer service.
W06	No events detected	No events detected during the measurement. The photodetectors are probably defective. If the problem persists, please call customer service.	• If the problem persists, please contact customer service.
W07	Cell count out of range	Cell count is above 2'000'000 cells/mL, the specification limit of the device. Please dilute the sample to ensure measurement accuracy.	• Please dilute the sample to ensure accuracy of the measurement.
W08	Air bubbles detected	The instrument detected more than 10% volume in bubbles. Measurement precision could suffer.	• Check sampling device is installed properly. • Check the sample for bubbles. • If using online sampling device, check water is supplied at correct pressure.
W10	Enclosure too cold	Enclosure is too cold, rapid heating has been activated before continuing protocol.	• Instrument cannot safely operate if internal temperature is too cold. • Rapid heating attempts to heat the enclosure to ensure safe operations. • Measurements will start once internal temperature is sufficient.

ERROR CODE	NAME	DESCRIPTION	CAUSES / WHAT TO DO
W11	Service required	Service of the instrument is required. Measurement precision can no longer be guaranteed. Continued operation can lead to leaks, which can damage the instrument.	• Next service date is overdue. • Valve and plunger have reached end of life. • Please contact your service representative.
W13	Laser end of life	Laser has reached end of life.	• Please contact your service representative.
W14	Non-critical power cut	The instrument was powered off unexpectedly without a cleaning cycle. Measurement precision could be degraded.	• Ensure the cleanliness of the instrument. • If the issue occurs frequently, install an uninterruptible power supply

16.2 Non-critical errors

Non-critical errors prevent a measurement from terminating successfully, but do not prevent the instrument from running another measurement afterwards. These errors do not require human intervention. Some non-critical errors are promoted to critical errors if they repeat three times.

NON-CRITICAL ERRORS	
The protocol stops. The cause of the error is usually fixed by repeating the analysis or waiting. • Another measurement can immediately be started. If it completes successfully, the error state is cleared. • More information on the error can be found in the error log, by clicking on the corresponding error entry.	



The following non-critical error messages can be displayed:

Table 16-2 List of non-critical errors.

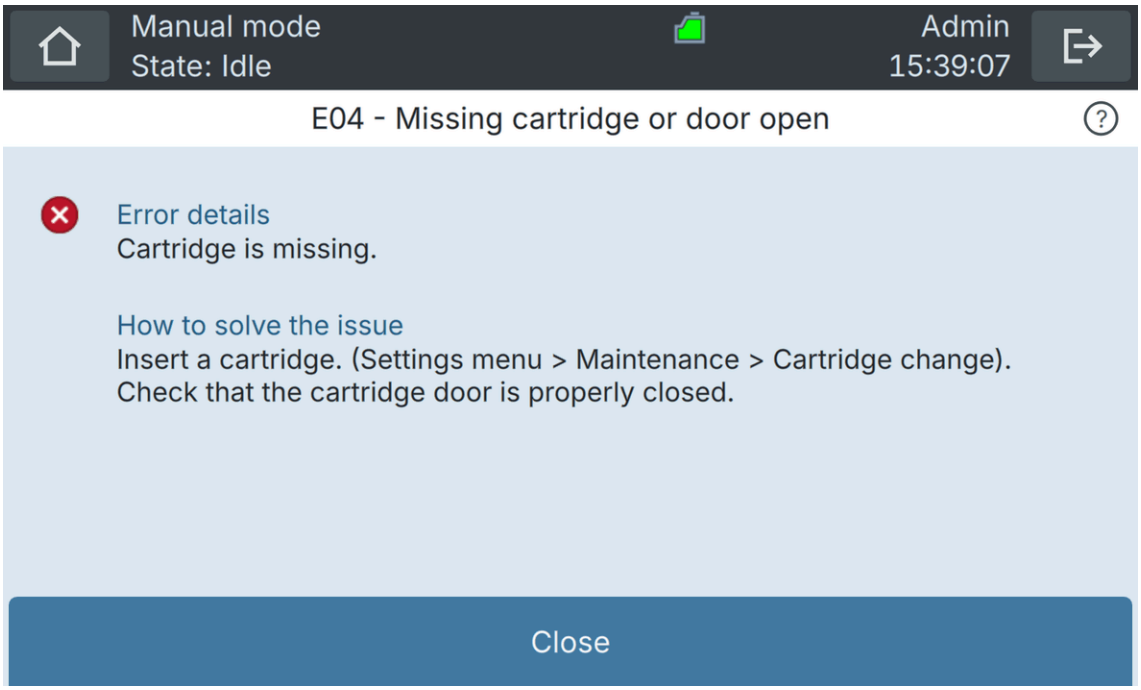
ERROR CODE	NAME	DESCRIPTION	CAUSES / WHAT TO DO
E01	Cartridge door open	Cartridge door is open and prevents measurements from running.	• Close door and retry the measurement.
E08	Enclosure too damp	Enclosure humidity is too high for safe operation.	• Replace desiccant bag, by unscrewing the large cap on the left-hand-side of the instrument (see Replacement of the desiccant bag). • If the problem persists, please contact customer service.
E09	System overheated	Inside temperature is too high for safe operation.	• Reduce ambient temperature or increase measurement interval to allow instrument to cool down.
E14	System overheated	Laser temperature is too high for safe operation.	• Reduce ambient temperature or increase measurement interval to allow instrument to cool down.
E15	Empty sample error	Underpressure detected during mix or dispense.	• Missing sample. • Air in the input. • Leak in the system. • Please execute the Clean Optics protocol (see Overview of protocols in manual mode).
E18	Under-pressure detected	Underpressure detected during dispense.	• Missing sample. • Air in the input. • Leak in the system. • Please execute the Clean Optics protocol (see Overview of protocols in manual mode).
E19	System overheated	The incubator chamber temperature is too high for safe operation.	• Reduce ambient temperature, or increase measurement interval to allow instrument to cool down.

ERROR CODE	NAME	DESCRIPTION	CAUSES / WHAT TO DO
E33	Processing memory overflow	Signal processing circuits memory has overflowed.	• Please execute the Clean Optics protocol (see Overview of protocols in manual mode). • Retry the measurement.
E42	Enclosure too cold despite heating	Enclosure temperature remains too cold after heating procedure.	• Ambient temperature is less than 5 °C (41 °F). • Increase ambient temperature.
E44	Pump module startup error	The pump module failed to power on correctly.	• Simply retry the measurement.
E45	Low valid volume ratio error	The valid volume ratio is too low. This can be caused by an excessively high bacterial concentration in the water or by turbidity/debris.	• The accuracy of the measurement is probably very low. Repeat the measurement while diluting the sample with clear water.
E46	Cartridge is still busy	The cartridge was still initializing when the measurement started.	• Non-critical error. Repeat the measurement. If the problem persists, contact a service technician.
E48	Microfluidic subsystem busy	The microfluidic controller was performing another task when the measurement was taken.	• Non-critical error. Repeat the measurement. If the problem persists, contact a service technician.
E49	GPIO Timeout error	The processing board is waiting for another module to respond.	• Non-critical error. Repeat the measurement. If the problem persists, contact a service technician.
E50	Pump motion blocked	The motion of the pump is blocked.	• Non-critical error. Repeat the measurement. If the problem persists, contact a service technician.
E51	Unable to get temperature reading. The control loop is thus disabled.	Unable to get temperature reading. The control loop is thus disabled.	• Non-critical error. Repeat the measurement. If the problem persists, contact a service technician.
E52	Cartridge valve motion blocked	The motion of the cartridge valve is blocked.	• Non-critical error. Repeat the measurement. If the problem persists, contact customer service.
E55	The acquisition processor cannot be initialized.	The acquisition processor cannot be initialized. This can be caused by an acquisition error or a firmware corruption.	• Reboot the instrument. • If the problem persists, contact customer service.

ERROR CODE	NAME	DESCRIPTION	CAUSES / WHAT TO DO
E56	No events detected during acquisition	No events were detected during the acquisition. This can be caused by a high turbidity of the sample or defective detectors.	• Clean the sampling device using the Washstation, then perform a measurement of clean water. • If the problem persists, contact customer service.
E57	Cartridge busy	Communication with the cartridge failed.	• Non-critical error. Repeat the measurement. • If the problem persists, contact customer service.
E58	Cartridge busy	Communication with the cartridge failed.	• Check the electronic connector between the cartridge and the instrument. • Repeat the measurement. • If the problem persists, contact customer service.
E59	Unable to read valve position	Unable to read valve position. The sensor cable may be disconnected.	• Please contact customer service.

16.3 Critical errors

Critical errors interrupt the workflows of the instrument and require human intervention. The error source needs to be eliminated and the instrument set to running conditions again. Critical errors need to be cleared.

CRITICAL ERRORS	IMAGE
If a critical error occurs during operation, it has the following effects: • The protocol immediately stops. • The instrument goes into a critical error state, and manual intervention is needed before any new protocol can be launched. • The cause of the error must be solved by an operator. The errors can then be manually cleared from the Error log, as described in Error log and Clearing errors.	

The following critical error messages can be displayed:

Table 16-3 List of critical errors.

ERROR CODE	NAME	DESCRIPTION	CAUSES / WHAT TO DO
E00	General error	Unhandled error.	• Please contact customer service
E02	Empty cartridge	Cartridge is empty.	• Replace cartridge (see Change cartridges)
E04	Missing cartridge or door open	Cartridge is missing.	• Insert a cartridge (see Installing a cartridge)
E05	Full waste bag	Cartridge waste bag is full.	• Replace cartridge (see Change cartridges)

ERROR CODE	NAME	DESCRIPTION	CAUSES / WHAT TO DO
E06	Cartridge communication impossible	Cartridge is disconnected, door is open, or cartridge electronics are damaged.	• Make sure the cartridge's electronic cable is connected properly, and that the door is properly closed. • If that doesn't help, replace the cartridge and inform customer service.
E07	Storage disk full	Insufficient storage space to continue operation.	• Delete old measurements and try again (see Clearing of disk space) • This will delete the measurements permanently from the device. • Export measurements as backup solution.
E12	FPGA initialization error	Failed to initialize the signal processing chip.	• Reboot the instrument.
E16	Processing error	An error was discovered while processing the signals.	• The accuracy of the latest result is not guaranteed. Please repeat the analysis.
E17	Over-pressure detected	Overpressure detected during dispense.	• Likely cause: The output filter is probably clogged. • Optical flow cell blocked. • Please call customer service.
E20	Abrupt shutdown	Protocol interrupted for unknown reasons, usually due to a power cut.	• Usually indicates a power cut, or other external interruption to the measurement. • Perform a Clean Optics and Clean Sampling Device protocol before starting a new measurement (see Overview of protocols in manual mode).
E23	Temperature sensor communication error	Communication with temperature sensor on IO board failed.	• Please contact customer service.
E24	Laser communication error	Communication with optical unit failed.	• Please contact customer service.
E25	Pump communication error	Communication with syringe-pump module impossible.	• Please contact customer service.
E26	Power supply communication error	Communication with power supply module impossible.	• Please contact customer service.

ERROR CODE	NAME	DESCRIPTION	CAUSES / WHAT TO DO
E27	Pump communication timeout	Communication with pump module timed out.	• The cartridge door is open. • A cable is disconnected. • A circuit board is damaged, either in the pump or cartridge.
E28	Empty dye supply	Dye tube connected to cartridge is empty.	• The tube is disconnected. • Cartridge is defective. • Repeat the cartridge change procedure, making sure that all tubes are properly connected.
E29	Empty rinse fluid supply	Rinse fluid tube connected to cartridge is empty.	• The tube is disconnected. • Cartridge is defective. • Repeat the cartridge change procedure, making sure that all tubes are properly connected.
E30	Empty bleach supply	Bleach tube connected to cartridge is empty.	• The tube is disconnected. • Cartridge is defective. • Repeat the cartridge change procedure, making sure that all tubes are properly connected.
E31	Cartridge electronics failure	Cartridge level can no longer be determined accurately.	• Replace cartridge and contact customer service.
E32	Incompatible cartridge	Cartridge type is incompatible with this instrument or software.	• Make sure that you have the correct cartridge type for this instrument.
E33	Processing memory overflow	Signal processing circuits memory has overflowed.	• Please execute the Clean Optics protocol (see Overview of protocols in manual mode). • Retry the measurement.
E38	Cartridge not ready error	The new cartridge has not been initialized correctly.	• Execute the “Cartridge Change” procedure (see Change cartridges).
E39	Laser current limit reached	The laser has reached its upper current limit; indicating end of life.	• The laser needs to be replaced. Contact a service technician.
E40	Gate set not found	Reference to the set of gates selected for the measurement cannot be found in the instrument settings.	• The set of gates has been deleted. • Change the set of gates and retry the measurement.

ERROR CODE	NAME	DESCRIPTION	CAUSES / WHAT TO DO
E41	Gate set incompatible	The set of gates selected for the measurement cannot be used with this cartridge.	• Correct cartridge change procedure was not followed. • Incorrect digital input configuration. • Change the set of gates and retry the measurement.
E43	External temperature too low	Ambient temperature is outside of the instrument specifications.	• Increase ambient temperature. • Trying to operate or store the instrument below 5 °C (41 °F) can cause damage to the device.
E47	Unable to find main reference magnet during homing	During initialization, the valve did not home properly.	• Please contact customer service.
E53	Unable to communicate with motor	The communication to the motor controller of the mixer is defective.	• Please contact customer service.
E54	Unable to get the laser temperature	The NTC sensor in the optical module must be defective or disconnected.	• Please contact customer service.

16.4 Logs

The instrument records errors, warnings, alarms and user activity in logs. On the Home screen, press **Settings**, then **Logs**. The **Logs** menu contains the following entries:

ENTRY	CONTENT	AVAILABLE TO
Error log	Critical and non-critical errors, and the events that cleared them. See Error log.	Basic, Advanced and Admin users
Warning log	Warnings raised during measurements. See Warning log.	Basic, Advanced and Admin users
Alarm log	Alarms triggered by measurement results, including BactoCloud alarms. See Alarm log.	Basic, Advanced and Admin users
Access log	Failed login attempts. See Access log and audit trail.	Admin users, with the Management Package
Audit trail	Operations and setting changes by users and the instrument. See Access log and audit trail.	Admin users, with the Management Package
Results (manual mode), **Results (Online mode)**, **Validation results**	Measurement results of each mode. See Filtering measurements and Results and Data Analysis.	Basic, Advanced and Admin users

The newest entries are listed first. The **Error log**, **Warning log**, **Alarm log** and **Audit trail** show the **Displayed time span:** in the action bar. By default, it runs from the oldest to the newest entry; the **Audit trail** shows the last seven days. Press the time span to show another period (see Changing the displayed time span).

16.4.1 Error log

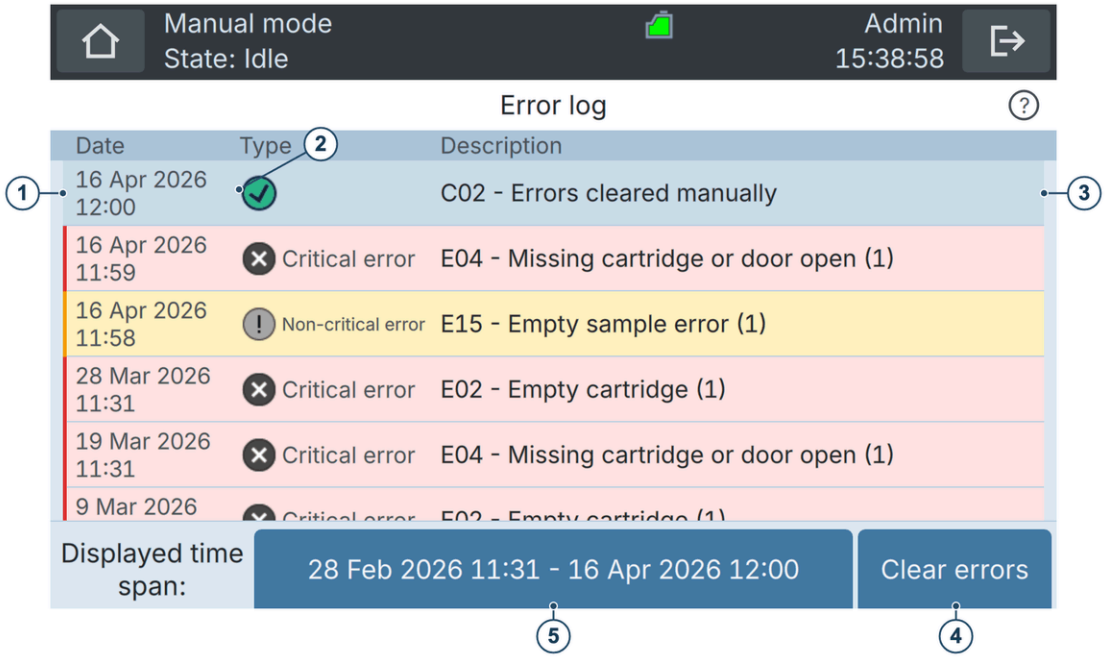


Figure 16-1 : Error log

①	Date and time of the event	②	Type of the event. Only the newest entry shows its symbol in color; older entries show it in grey. Critical error Non-critical error Errors cleared
③	Code and short description of the error or event. The number in brackets shows how often the error has occurred since errors were last cleared.	④	**Clear errors** button (available to Basic, Advanced and Admin users when the instrument is idle). See Clearing errors.
⑤	Displayed time span. Press it to change the period.		

The row color shows the type of each entry: red for critical errors, yellow for non-critical errors and blue for events that cleared errors. Error codes start with E and are listed in Non-critical errors and Critical errors. Two events record that errors were cleared:

- **C01 – Errors cleared automatically**: after a non-critical error, the instrument completed a protocol successfully and considers the earlier errors resolved.
- **C02 – Errors cleared manually**: a user pressed **Clear errors** (see Clearing errors).

If no error was recorded in the displayed time span, **No errors in this date range** is shown.

> **VIEW EVENT DETAILS**
>
> Select an entry to open a page with more information on the cause of the error and recommended resolution steps. Press **Close** to return to the log.

16.4.2 Warning log

The **Warning log** lists the warnings raised during measurements. Each row shows:

- **Date**: date and time of the warning.
- **Description**: warning code and name. The codes are listed in Warnings.
- **Context**: where the warning occurred: **Manual** (manual mode), **Online** (Online mode), **Maintenance** or **Validation**.

Select a warning to view its description. Press **Close** to return to the log. If no warning was recorded in the displayed time span, **No warnings in this date range** is shown.

16.4.3 Alarm log

The **Alarm log** lists the alarms triggered by measurement results. It includes the instrument's own alarms (see Alarm configuration) and, when the instrument is connected to BactoCloud, the alarms raised by BactoCloud alarm rules (see BactoCloud). Each row shows:

- **Date**: date and time of the measurement that triggered the alarm.
- **Name**: a bell symbol and the alarm name. The bell is red for instrument alarms. For BactoCloud alarms, its color shows the severity: red for Critical, orange for Warning and blue for Info.
- **Alarm**: the alarm source, condition and threshold, for example *Cartridge Remaining < 10 %*.

BactoCloud alarms also show a cloud symbol at the end of the row. To acknowledge a BactoCloud alarm after reviewing it, press the check button beside the cloud symbol; acknowledged alarms show a check mark instead. **Acknowledge all** acknowledges every unacknowledged BactoCloud alarm in the list and is only available while at least one remains. Acknowledgement is recorded in BactoCloud. It documents the review but does not resolve the cause of the alarm.

Select an alarm to open the measurement result that triggered it.

16.4.4 Access log and audit trail

The **Access log** and the **Audit trail** are part of the Management Package (see Management package) and are available to Admin users. Without the package, pressing either button shows information about the Management Package instead.

Access log opens the **Failed login attempts** list for the last 30 days. Each row shows the **Date**, the **User ID**, the user's **Role** and the number of failed login attempts by that user on that day. If there were none, **No failed login attempts** is shown.

Audit trail lists relevant operations and setting changes made by users or by the instrument. Each entry shows the **Date**, the **User** and the **Event** and, where they apply, the changed **Parameter** with its **Old value** and **New value**. The audit trail is also included when exporting all data to a USB drive and can be viewed in the web user interface.

16.4.5 Changing the displayed time span

The following procedure applies to the **Error log**, **Warning log**, **Alarm log** and **Audit trail**.

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	Open the log and press the time span button next to **Displayed time span:**.	The **Define time span** screen opens.
2.	Tap the field under **Start date** and select the first day in the calendar. Tap the time field below it and set the hour and minute. Set **End date** and its time in the same way.	The end cannot be earlier than the start.
3.	Press **OK**.	The log lists only the entries within the selected period.

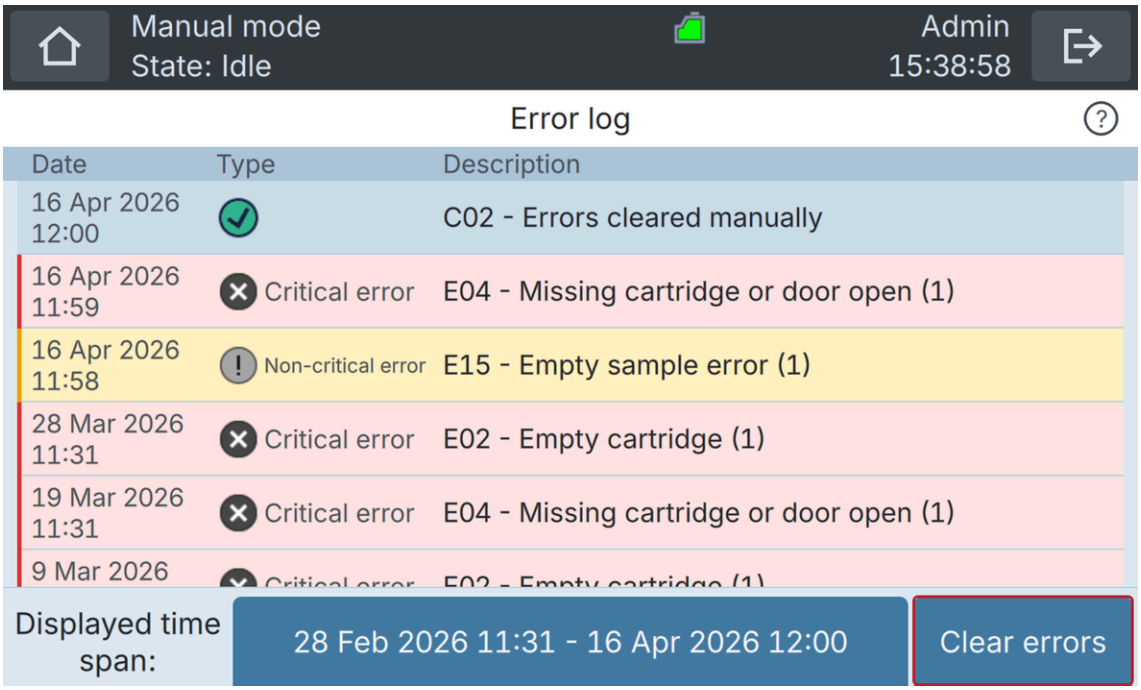
To restore the default time span, press **Reset** on the **Define time span** screen, then press **OK**.

16.5 Clearing errors

Critical errors must be cleared manually. Make sure to first solve the origin of the problem, then manually clear the error with the steps below. Please note that the procedure below does not automatically solve the root cause of the error.

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	On the Home screen, press **Settings** to open the settings menu.	
2.	Press **Logs**, then **Error log**.	

	WORK STEP	ADDITIONAL INFO / IMAGE
3.	Make sure you have resolved the problem leading to the displayed error(s). Then press **Clear errors**.	The button is available to Basic, Advanced and Admin users while no protocol is running.



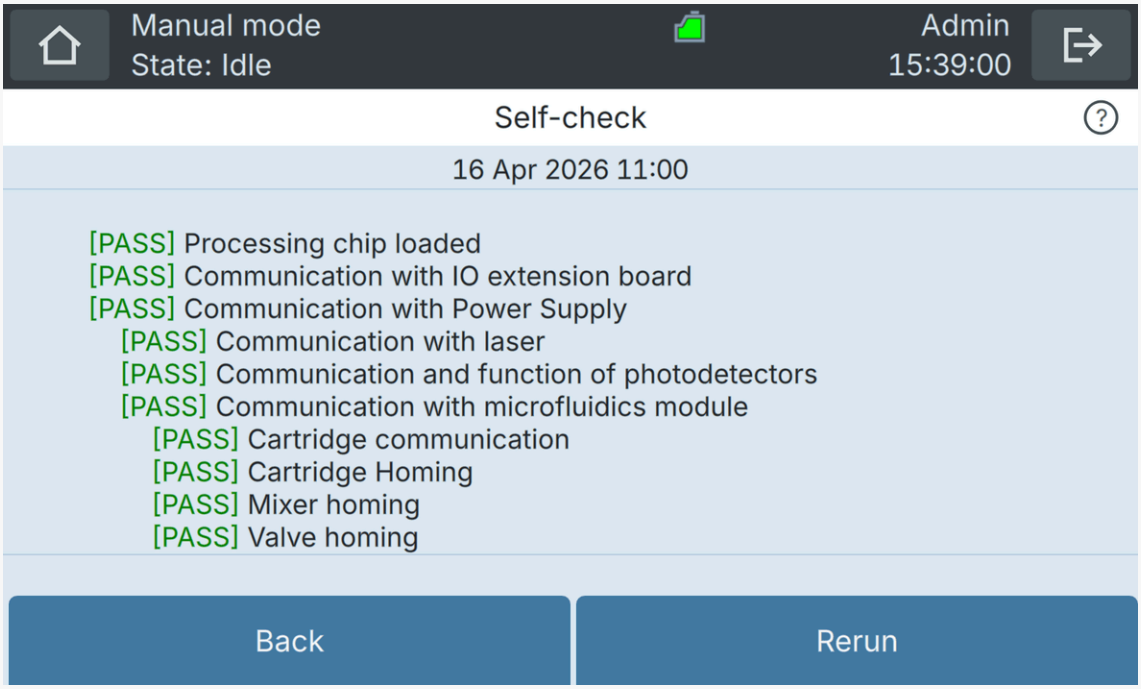
4.	A **C02 – Errors cleared manually** event is added at the top of the log, and the symbols of the earlier errors turn grey. The instrument is ready to analyze again.	

16.6 Automatic self-check

The automatic self-check tool checks that each component of the BactoSense is functioning correctly and identifies those that are not. It can be used to identify problems with the instrument.

	WORK STEP	ADDITIONAL INFO / IMAGE
1.	As an Advanced or Admin user, press Settings on the Home screen to open the settings menu.	
2.	Press the Maintenance button.	
3.	Press the Self-check button.	

	WORK STEP	ADDITIONAL INFO / IMAGE
4.	**ADDITIONAL INFORMATION** Press the Rerun button. Once execution has terminated, the instrument shows a list of all tests, with a green PASS or red FAIL indicator. Some tests may be skipped: if the system cannot communicate with the cartridge, all the tests that require cartridge communication are skipped.	



16.7 Operation at low temperature

The instrument must be operated within a specific temperature range to prevent damage and ensure reliable and reproducible measurement results (see Technical data). At very low and very high ambient temperatures (below 5 °C (41 °F) or above 30 °C (86 °F)), protocols are not executed. At low ambient temperatures, the instrument automatically warms up prior to a measurement to reach the required temperature. During this heating process, the instrument status shows “Heating...”. If the target temperature cannot be reached after several hours, the protocol exits with an error (table 16-2, E42).

ALLOW TIME FOR HEATING

Measurements can be delayed if extensive heating is necessary. To avoid this, keep the instrument temperature above 10 °C (50 °F).

16.8 Troubleshooting

The following table provides an overview of issues and resolutions. If the issue cannot be resolved, please contact your local service representative or bNovate customer service. Contact information for bNovate customer service can be found in Contacting customer service.

Table 16-4 Troubleshooting instructions

OBSERVATION	INSTRUCTION
Nothing on display	• Check whether the BactoSense is connected to power and switched on.
Unresponsive or flickering user interface	• Potential electromagnetic interference from nearby machine (e.g. pump). Relocate BactoSense.
Error message on the display	• Respond to the error message as described in this chapter.
The measurements appear to be wrong	• Ensure that the sample and operating conditions described in Technical data are met. • Check whether the instrument is correctly installed according to Installation. • Ensure that the servicing duties have been performed according to the servicing schedules described in Periodic preventive maintenance by service professional and Maintenance by the user. • Perform an instrument cleaning using the Cleaning Kit. • Perform an instrument validation using the Validation Kit.

17. Storage, Transport and Disposal

17.1 Storage

17.1.1 Storage of the BactoSense

Preparations

	WORK STEP
1.	Make sure the manual sampling device is installed
2.	Perform a Clean sampling device with Washstation process, as described in Clean manual sampling device with Washstation. Alternatively, if no Washstation is available, follow the procedure in Clean manual sampling device with basic cleaning.
3.	Leave an empty tube or empty Washstation attached to the manual sampling device.
4.	Follow the cartridge removal procedure in Removing a cartridge to safely remove the cartridge. Note: Cartridge removal is not required if the storage conditions of the cartridge can also be fulfilled.
5.	Power off the BactoSense.
6.	Unplug the power supply unit from the mains power supply, then unplug the power supply plug from the BactoSense.
7.	Make sure the USB, Ethernet and power sockets are covered with the attached covers.
8.	Pack the BactoSense with attached manual sampling device in its standard cardboard box with foam inserts, or in the transport case.

Storage

Store the BactoSense according to the following storage conditions:

- Temperature between 15 °C and 25 °C (59 °F – 77 °F)
- Relative humidity between 10 % and 70 %
- Non-vibrating, non-corrosive, dark and clean environment

Re-installation

After storage, follow the general installation instructions described in Installation.

> **VALIDATE AFTER STORAGE**
>
> If the BactoSense has been stored for more than one month, perform an instrument validation using the Validation Kit before the first measurement to ensure proper functioning.

17.1.2 Storage of the sampling devices

Note: The BactoSense should always have a sampling device installed. This procedure refers to storage of additional sampling devices if available.

Preparations

	WORK STEP	ADDITIONAL INFO / IMAGES
1.	Remove and clean the sampling device according to the instructions in Removal of the manual sampling device (manual sampling device) or Removal of the online sampling device (online sampling device).	Wear gloves during the process to prevent sampling device contamination. If the tubings of the online sampling device show any signs of contamination or damage, do not reuse and discard.
2.	Cover the cleaned sampling device with the dedicated cap if available.	
3.	Store the clean sampling device in a clean and dry plastic bag.	

Storage

Store the sampling device according to the following storage conditions:

- Temperature between 5 °C and 40 °C (41 °F – 104 °F)
- Relative humidity between 10 % and 70 %
- Non-vibrating, non-corrosive, dark and clean environment

Re-installation

After storage, follow the general installation instructions in Installation of the manual sampling device (manual sampling device) or Installation of the online sampling device (online sampling device).

17.1.3 Storage of the cartridge

⚠ PROTECT AGAINST LEAKING CHEMICALS

Wear protective gloves and goggles. Leaking chemicals can cause skin irritation, eye damage and other health hazards. Make sure the liquid connectors of the cartridge are all tightly sealed with the respective plugs.

CHECK CARTRIDGE EXPIRY

Check the expiration date of the cartridge. The expiration date is printed on the handle of the cartridge in the format Day/Month/Year, or can be found on the instrument user interface under Home → Settings → System info.

Preparations

	WORK STEP
1.	Wear protective gloves and goggles.
2.	Follow the cartridge removal procedure in Removing a cartridge to safely remove the cartridge from the BactoSense.
3.	Make sure the liquid connectors of the cartridge are all tightly sealed with the respective plugs.

	WORK STEP
4.	Pack the cartridge in its original cardboard box with foam inserts.

Storage

Store the cartridge according to the following storage conditions:

- Temperature between 15 °C and 25 °C (59 °F – 77 °F), ideally 15 °C
- Relative humidity between 20 % and 60 %
- Non-vibrating, non-corrosive, dark and clean environment

Re-installation

After storage, follow the general installation instructions in Installing a cartridge.

17.2 Transport

17.2.1 Transport of the BactoSense

Refer to the following transportation instructions to safely transport the BactoSense.

- Follow the general preparation steps in Storage of the BactoSense to prepare the BactoSense for transport.
- Note that the storage conditions for humidity and temperature listed in Technical data and Storage of the BactoSense apply.
- Make sure the manual sampling device is installed for transportation.

Table 17-1 BactoSense transportation instructions

Standard shipping

- Remove the cartridge using the Remove cartridge procedure under Home → Settings → Maintenance → Cartridge change. Basic users open Cartridge change directly from Settings.
- Pack BactoSense and cartridge in their standard cardboard boxes with foam inserts.
- Ship on a pallet or skid.
- Perform an instrument self-check (Automatic self-check) and an instrument validation using the Validation kit when reinstalling the instrument.

Long distance by car or uneven road by car

- Remove the cartridge using the Remove cartridge procedure under Home → Settings → Maintenance → Cartridge change. Basic users open Cartridge change directly from Settings.
- Pack BactoSense and cartridge in their standard cardboard boxes with foam inserts, or alternatively use the transport case (see Accessories).
- Perform a Clean sampling device with Washstation when reinstalling the instrument (see Clean manual sampling device with Washstation).

Short distance by car, even road, instrument lying on its back

- Remove the cartridge using the Remove cartridge procedure under Home → Settings → Maintenance → Cartridge change. Basic users open Cartridge change directly from Settings.

- Transport the BactoSense in the transport case (see Accessories).
- Perform a Clean sampling device with Washstation when reinstalling the instrument (see Clean manual sampling device with Washstation).

Short distance by car, even road, instrument in upright position

- Transport in the transport case (see Accessories), without removing the cartridge.
- Perform a Fill Tubing process after switching on the instrument again, see Overview of protocols in manual mode.

Short distance within facility, instrument in upright position

- Transport in the transport case (see Accessories) or by hand, without removing the cartridge.
- Perform a Fill Tubing process after switching on the instrument again, see Overview of protocols in manual mode.

17.2.2 Transport of the cartridge

Preparations

	WORK STEP
1.	Wear protective gloves and goggles
2.	Follow the procedure in Removing a cartridge to safely remove the cartridge.
3.	Make sure the liquid connectors of the cartridge are all tightly sealed with the respective plugs.
4.	Pack the cartridge in its original cardboard box with foam inserts, or in the transport case if available.

Transportation

Transport the cartridge in normal horizontal position. The cartridge storage conditions listed in Technical data apply.

Re-installation

After transport, follow the general installation instructions in Installing a cartridge.

17.3 Returning the BactoSense or accessories

In case you return the BactoSense or accessories to bNovate or a distribution partner, please follow the instructions in this section.

> ⚠ **DECONTAMINATE BEFORE RETURNING**
>
> Do not return contaminated materials
>
> Instruments that have come into contact with hazardous media must be decontaminated before shipment and must be accompanied by a certificate of decontamination. Contact support@bnovate.com for more information.

⚠ **FOLLOW THE SHIPPING INSTRUCTIONS**

Adhere to shipping instructions

bNovate does not take responsibility for deliveries which do not comply with our shipping regulations and will charge for repairs. Please contact support@bnovate.com if the original packaging is no longer available or you need help with packaging.

17.3.1 Returning the BactoSense

Preparations

	WORK STEP
1.	If the instrument has been exposed to hazardous substances, fully decontaminate it and provide a certificate of decontamination.
2.	Make sure the manual sampling device is installed.
3.	Perform a Clean sampling device with Washstation process, as described in Clean manual sampling device with Washstation. Alternatively, if no Washstation is available, follow the procedure in Clean manual sampling device with basic cleaning.
4.	Leave an empty tube or empty Washstation attached to the manual sampling device
5.	Follow the cartridge removal procedure in Removing a cartridge to safely remove the cartridge.
6.	Power off the BactoSense.
7.	Unplug the power supply unit from the mains power supply, then unplug the power supply plug from the BactoSense.
8.	Make sure the USB, Ethernet and power sockets are covered with the attached covers.
9.	Pack the BactoSense with manual sampling device but without cartridge in its standard cardboard box and fixate the box on a pallet or skid.
10.	If you ship additional items, label them with the serial number of the BactoSense.
11.	Indicate with stickers that the contents of the parcels are fragile, shall be kept dry, and shall only be transported in the indicated orientation.

Return

Ship the BactoSense to bNovate or a distribution partner, adhering to the general storage temperature and humidity requirements listed in Technical data and Storage of the BactoSense.

17.3.2 Returning a cartridge for refill

Preparations

	WORK STEP
1.	If the cartridge has been exposed to hazardous substances, fully decontaminate it and provide a certificate of decontamination.
2.	Follow the cartridge removal procedure in Removing a cartridge to safely remove the cartridge.

	WORK STEP
3.	Pack the cartridge in its standard cardboard box.
4.	Indicate with stickers that the contents of the parcels are fragile, shall be kept dry, and shall only be transported in the indicated orientation.

Return for refill

Ship the cartridge to bNovate, adhering to the general storage temperature and humidity requirements listed in Technical data and Storage of the cartridge.

17.4 Recycling and disposal

The disposal of the BactoSense, accessories and consumables has to be carried out in compliance with regional statutory regulations. The BactoSense contains no environmentally damaging sources of radiation.

Table 17-2 Materials and their recycling or disposal

RECYCLING AND DISPOSAL

CATEGORY	MATERIALS	DISPOSAL POSSIBILITIES
Packaging	Cardboard, wood, paper	Reuse as packaging material or dispose for recycling
	Protective foils, polystyrene shells	Reuse as packaging material or dispose for recycling
Electronics	Printed circuit boards, electro-mechanical components	To be disposed as electronic waste. Follow the local legislation.
Optics	Glass, aluminum	Recycling via centers for recycling glass and waste metal
Housing	Styrene butadiene painted, stainless steel, polystyrene painted, Silica beads (Desiccant bag), filters	Local disposal center
Cartridge	RETURN USED CARTRIDGES Do not disassemble or dispose of the cartridge.	Prepare the cartridge according to Removing a cartridge and return the cartridge with a declaration to bNovate according to Returning a cartridge for refill.

18. Supply Scope, Accessories and Consumables

18.1 BactoSense instruments

Table 18-1 BactoSense instruments and service agreements

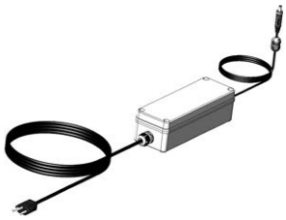
ART. NO.	NAME	IMAGE
200157	BactoSense CORE	
200158	BactoSense SMART	
200159	BactoSense PURE	
200216	BactoSense ID	

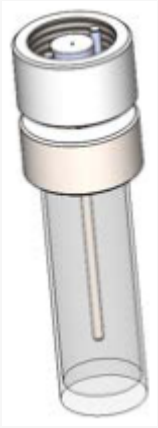
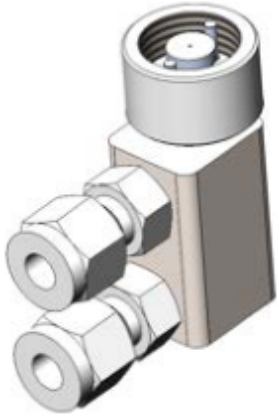
ART. NO.	NAME	IMAGE
200172	BactoCare Essential Annual Service Agreement	
200173	BactoCare Plus Annual Service Agreement	

18.2 Accessories

Accessories can be ordered as needed, for example if you need spare parts. bNovate Technologies recommends ordering a second cartridge with your instrument so that a replacement is available when required.

Table 18-2 Accessories for the BactoSense

ART. NO.	NAME	IMAGE
200048 200049 200050 200152	Power Supply Unit 200048: Type J 200049: Type E 200050: Type G 200152: Type B	
200017	New TCC Cartridge	
200053	New ICC Cartridge	
200174	New ICC Cartridge for BactoSense PURE	
200160	New ACC Cartridge	
200214	New CBC Cartridge	
200219	New EBC Cartridge	
200217	New NBC Cartridge	
200169	Printed User Manual BactoSense English	
200170	Printed User Manual BactoSense French	
200171	Printed User Manual BactoSense German	

ART. NO.	NAME	IMAGE
200006	Manual sampling device	
200007	Online sampling device	
200145	BactoLink for remote instrument access	

ART. NO.	NAME	IMAGE
200008	Transport Box BactoSense	
200009	External IO-Box BactoSense	
200162	Scientific package license key	
200163	Management package license key	

ART. NO.	NAME	IMAGE
100173	Washstation	
200131	Hex nut driver, 7 mm, for cartridge compartment door	

18.3 Consumables

Available consumables are listed below. They can be ordered from your local sales representative.

Table 18-3 Consumables of the BactoSense

ART. NO.	NAME
200003	Screw cap tubes 5 mL, 25 pcs set
200023	Desiccant bag
200025	Set of 5 filters 316L – 25 µm for sampling device
200004	Validation Kit
200186	System suitability test kit for BactoSense PURE
200005	Cleaning Kit
200019	Refill TCC cartridge
200054	Refill ICC cartridge
200176	Refill ICC for BactoSense PURE cartridge
200161	Refill ACC cartridge
200215	Refill CBC cartridge
200220	Refill EBC cartridge
200218	Refill NBC cartridge
200030	Inlet tubing for online sampling device
200029	Outlet tubing for online sampling device
200065	Ferrules for online sampling device

19. Contact

19.1 Contacting customer service

If you have any questions, please contact the bNovate support team under support@bnovate.com, or the service centre responsible in your country or region. An up-to-date list of all bNovate representatives is available online at www.bnovate.com/distribution-partners.

Please have the following information ready when you contact customer service:

- Serial number of the BactoSense.
- Description of instrument behavior and the work steps when the problem occurred.
- Description of what you did when trying to solve the problem yourself.
- Documentation of the third-party products you use in conjunction with the BactoSense.
- Description of operation conditions (place, power supply, measured medium, temperature etc.).
- This user manual.
- Export of the last measurements when the error occurred, see Exporting measurements.

20. Index

Select a section number to open the corresponding topic in this manual.

A

- Accessories 18.2
- Additional Documentation 2.1
- Alarm configuration 8.5
- Analogue Output 6.1.6, 6.3
- Analogue output
  - Configuration 6.7
  - Description 6.7
  - Testing 6.8
- Assembly 5.5
- Audio notifications 8.3.5
- Automatic power-on 8.3.4
- Automatic self-check 16.6
- Auto-restart 8.3.4

B

- BactoLink 18.2
- BactoSense 18.1
  - Maintenance 15.1
  - Overview 3.1

C

- Cartridge 1
  - Change 8.9.4
  - Filling level 8.8.2, 8.9.3
  - Installation 8.9.6
  - Overview 8.9.3
  - Refill 17.3.2, 18.3
  - Removal 8.9.5
  - Storage 17.1.3
  - Transport 17.2.2
- CBC (Coliform Cell Count) 11.3.4
- CE 2.2
- Certification
  - CE 2.2
- Change cartridges 8.9.4

- Chemicals 4.1
- Chlorine 10.9.1
- Cleaning kit 2.1, 15.2, 15.2.2, 18.3
- Clear
  - disk space 15.2.8
- Concentration 2.5
- Configuration
  - Alarm 8.5
  - Network 8.6
- Connection
  - FTP 5.6
  - HTTP 5.6
  - HTTPS 5.6
  - Inputs 6.4
  - Manual sampling device 5.4
  - Modbus TCP 5.6
  - Online sampling device 5.5
  - Outputs 6.1.6, 6.3
  - Power 5.3
  - User interface relay 5.6
  - Web user interface 5.6
- Connectivity 5.6
- Consumables 18.3
- Contact
  - Customer service 19.1
- Critical errors 16.3
  - Clear errors 16.5
- CSV 13.6
- Customer service 19.1

D

- Danger 2.6, 4.1
  - symbols 4.4
- Data
  - FTP 12.2
  - HTTP and HTTPS 12.3
  - USB 12.1
- Data analysis 11.1
- Date 8.7
- Date settings 8.3.2
- Delete 15.2.8
- Demo mode 8.12

- Desiccant bag 15.2.6, 18.3
- Detection limit 3.2
- Device name 8.3.3
- Digital input
  - Configuration 6.5
- Digital Inputs 6.4
- Digital output
  - Configuration 6.6
  - Testing 6.8
- Digital Outputs 6.1.6, 6.3
- Disposal 17.4
- Dotplot 11.1, 13.7

E

- Embedded manual 15.4
- EBC (E. coli Cell Count) 11.3.5
- Electrical installation
  - power 5.3
- Errors
  - Clearing 16.5
  - critical 8.8.2, 16.3, 16.4.1
  - non-critical 8.8.2, 16.4.1
- Evolution
  - Dot plots 13.7
- Export
  - All data 12.1
  - CSV 13.6
  - Diagnostic data 12.1
  - FCS-file 13.4
  - Settings 8.4
  - XLSX 13.6
  - Zip 13.5
- Export to USB 10.8.1

F

- Factory reset 8.13
- FCS 13.4
- Ferrules 18.3
- Field bus interface 7.1
- Filter 18.3
  - Replacement 18.3
- Filter replacement 15.2.7

- Filtering 10.7
- Firewall 4.5
- Forward scatter 1, 3.2
- FSC 1, 3.2
- FTP 5.6, 12.2
- Full disk 15.2.8

G

- Gate 1
- Gating
  - Change 11.4
  - Default gating sets 11.2.1
  - Edit 11.4.3, 11.4.4
  - ICC 11.3.2, 11.4.4
  - Introduction 11.2
  - List 11.2.2
  - Modify 11.4.3
  - New 11.4.2
  - Regate 11.4
  - Regating 11.1
  - Strategy 11.4.4
  - Types 11.3
- Glossary 1
- Graphical user interface
  - Relay 12.4
  - Results 11.1
  - Screenshot 13.9
- Graphical user interface relay 12.4

H

- HNAC 1, 11.3.1, 11.3.2
- HNAP 1, 11.3.1, 11.3.2
- Home screen and Settings menu 8.2.7, 8.3.2, 8.8
- HTTP 5.6, 12.3
- HTTPS 5.6, 12.3
- Humidity 3.2, 3.2

I

- ICC 1, 11.3.2
- Import

    - Settings 8.4
- Improper use 2.7
- Inputs 3.2
    - Connection 6.4
    - Digital 6.5
- Installing a cartridge 8.9.6
- Instrument placement 5.2
- Intended use 2.1, 2.5, 10.1
- I/O-Box 6.1, 18.2
    - Connection 6.2
    - Overview 6.1.4, 6.1.5
    - Reference table 6.1.6

L

- Laser product 2.2
- LNAC 1, 11.3.1, 11.3.2
- Logs 16.4
    - Access log 16.4.4
    - Alarms 16.4.3
    - Audit trail 16.4.4
    - Errors 16.4.1
    - Time span 16.4.5
    - Warnings 16.4.2

M

- Maintenance 15.1
    - Clear disk space 15.2.8
    - Desiccant bag 15.2.6
    - Filter replacement 15.2.7
    - Replacing tubings 15.2.5
    - Service duty 15.1
- Maintenance by user
    - Overview 15.2
- Manual mode 10.3
    - Configuration 10.3
    - Measurement 10.3
    - Results 10.3
- Manual sampling device 18.2

    - Exchange 8.10
    - Filter 15.2.7
    - Installation 5.4
    - Protocols 10.9
    - Removal 8.10.2
    - Storage 17.1.2
- Measurement 2.5, 10.1
    - Comparison of scales 11.6
    - Interval 13.8
    - Rename 10.4
- Measurement parameters
    - ICC 11.3.2
- Measurement result 11.1
- Measurements 11.1
    - Delete 11.1
    - Rename 11.1
- Modbus TCP 5.6, 7.1
    - Address list 7.1.2
- Mounting 5.2, 5.5

N

- NBC (Enterococcus Cell Count) 11.3.6
- Network configuration 8.6
- New gate 11.4.2
- Non-critical errors 16.2
- NTP servers 8.7

O

- Online mode
    - Configuration 10.2.1
    - Measurement 10.2
    - Advanced scheduling 10.2.4
    - Results 10.2.3
    - Termination 10.2.2
    - Protocols 10.9.2
- Online sampling device 18.2
    - Exchange 8.10
    - Ferrules 18.3
    - Filter 15.2.7
    - Installation 5.5, 5.5.2
    - Protocols 10.9.2
    - Removal 8.10.1

    - Replacing tubings 15.2.5
    - Tubing 18.3
    - Tubings 5.5.1
- Optics 10.9
- Outputs 3.2
    - Analogue 6.7
    - Digital 6.6
    - Testing 6.8

P

- Packaging 5.1
- Pictograms 2.4
- Placement 5.2
- PLC 6.5
- Plumbing 5.5.2
- Power 5.3
    - Consumption 3.2
    - Supply 5.3
- Power supply 18.2
- Power-on 8.3.4
- Preventive maintenance 15.1
- Prime 10.9, 10.9.1
- Processes
    - Clean 10.9
- Product documentation 2.1
- Protocol 10.9, 10.9.1
- Protocols
    - Analysis 10.9
    - Online mode 10.9.2
    - Beads Analysis 10.9
    - Clean manual sampling device 15.2.2, 15.2.3
    - Maintenance 10.9
    - Manual mode 10.9
    - Online sampling device 10.9.2
    - Prime 10.9.3
    - Water analysis 10.9

R

- Rating plate
    - BactoSense 3.1.1
    - Power supply 3.1.2

- Recycling 17.4
- Regate 11.1, 11.4
- Regating measurements 10.6
- Remote connection 12.4
- Removing a cartridge 8.9.5
- Rename 11.1
- Renaming measurements 10.4
- Replicates 10.5
- Residual risk 4.3
- Restart 8.3.4
- Results 11.1
  - CBC 11.3.4
  - EBC 11.3.5
  - NBC 11.3.6
  - Online mode 10.2.3
  - HNAC 11.3.1, 11.3.2
  - HNAP 11.3.1, 11.3.2
  - ICC 11.3.2
  - LNAC 11.3.1, 11.3.2
- Retrieve data
  - FTP 12.2
  - HTTP and HTTPS 12.3
  - USB 12.1
- Return 17.3
  - BactoSense 17.3.1
  - Cartridge 17.3.2

S

- Safety 2.3, 4.1
  - Points 5.1, 15.1
  - Symbols 2.3
- Sample 10.1, 10.9.1
  - Types 10.1
  - Volume 3.2
- Sampling device 1
  - Filter 15.2.7
  - Manual 3.2
  - Online 3.2
- Screenshot 13.9
- Servers
  - NTP 8.7
- Service 8.8.2, 15.1, 15.1.2

    - Information 15.1
    - Intervention log 15.1.2
- Settings
    - Export 8.4
    - Import 8.4
- Side Scatter 1
- Sound notifications 8.3.5
- Storage 17.1
    - BactoSense 17.1
    - Cartridge 17.1.3
    - Sampling device 17.1.2
    - Sampling devices 17.1.2
- Supply Voltage 3.2

T

- Target group 2.1
- TCC 1
- Technical data 3.2
- Temperature 3.2, 3.2, 8.9
- Time 8.7
    - Synchronization 8.3.2
- Time settings 8.3.2
- Transport
    - BactoSense 17.2
    - Cartridge 17.2.2
- Transport box 18.2
- Troubleshooting 16.7
- Tubing 10.9.1, 18.3
- Type plate 3.1.2
- BactoSense 3.1.1
    - Power supply 3.1.2

U

- Unpacking 5.1
- Usage restrictions 2.5

- Use
  - Improper 2.5
  - Restrictions 2.5
- User
  - Interface 8.8.2
  - Requirements 2.5
  - Roles 8.2.7
- User interface 8.8
  - Home screen and Settings menu 8.8
- User interface relay 5.6

V

- Validation kit 2.1, 8.11, 10.9, 17.1, 18.3
- VNC 12.4
- VPN 4.5

W

- Warning 4.5, 16.1
  - symbols 4.5
- Washstation 15.2.2, 18.2
- Wavelength 3.2
- Web user interface 4.5, 5.6, 13.1
  - Connection 13.1
  - Dotplot 13.7
  - Download FCS 13.3
  - Download results 13.5
  - GUI 13.3
  - Reboot 13.9

X

- XLSX 13.5

Z

- Zip 13.5