s::can
A Badger Meter® Brand

Water Quality Sensor

ammo::lyser V2

Badger Meter

SCA-UM-04765-EN-03 (July 2026)

User Manual

S-23-M-EN

TABLE OF CONTENTS

1 GENERAL

This manual contains, firstly, general information (chapter 1) and safety instructions (chapter 2). The next chapter (chapter 3) provides a technical description of the product itself as well as information regarding transportation, scope of delivery and correct storage and disposal. The following chapters explain the installation (chapter 4) and the initial startup (chapter 5). This manual also contains information on calibration of the measuring device (chapter 6), data management (chapter 7), how to perform a function check (chapter 8) and maintenance (chapter 9). Information on troubleshooting (chapter 10), the available accessories (chapter 11) and the technical specifications (chapter 12) complete the document.

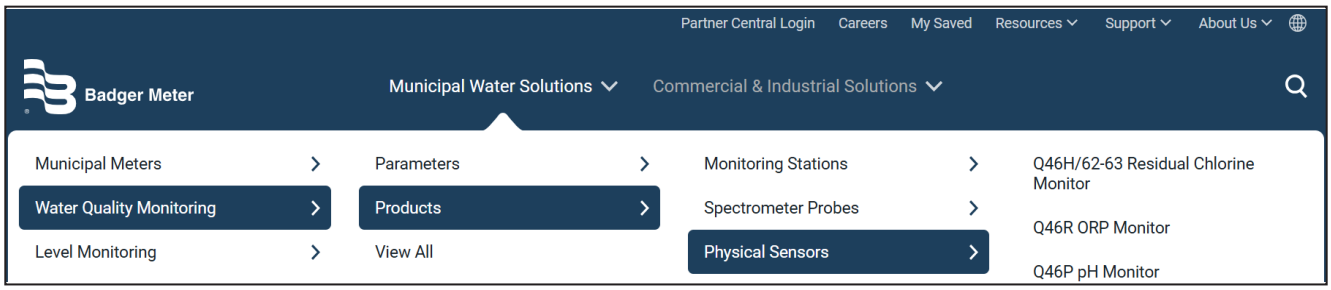
Each term in this document that is marked *italic and underlined*, can be found on the display of your controller for operation or as lettering on your Badger Meter product.

In spite of careful elaboration this manual may contain errors or incompletion. Badger Meter Austria does not assume liability for errors or loss of data due to such faults in the manual. The original manual is published in English and German by Badger Meter Austria. This original manual serves as the reference in case discrepancies occur in versions of the manual after translation into other languages.

This manual refers to the Badger Meter products listed in chapter 3 at the time of publication (see version date in the footer). This manual is therefore also valid for the fluor::lyser V2 probe type, even though only the ammo::lyser probe type is mentioned in the manual. Information and technical specifications from Badger Meter manuals of earlier publication dates are replaced by this manual.

The electronic version (PDF-document) of this manual is available on the Badger Meter Website at:

- *Resources > Product Documentation* (https://www.badgermeter.com/en-gb/product-documentation)
  Documents filtered by: Brand = s::can and Product / Model = ammo::lyser
- *ammo::lyser Physical Sensor* (https://www.badgermeter.com/en-gb/products/water-quality-monitoring/physical-sensors/ammolyser-pro or https://www.badgermeter.com/en-gb/products/water-quality-monitoring/physical-sensors/ammolyser-eco).
- Direct Link: https://badgermeter.widen.net/content/zubth6ol6o/original?download=false&x.app=api



2 SAFETY GUIDELINES

Installation, electrical connection, initial startup, operation and maintenance of any Badger Meter product as well as complete Badger Meter measuring systems may only be performed by qualified personnel. This specialist personnel must be trained and authorised for these activities by the plant operator or by Badger Meter Austria. The specialist personnel must have read and understood this user manual and follow the instructions contained therein.

For the proper initial startup of complete Badger Meter measuring systems, the user manuals for the controller and software used for operation (con::lyte, con::cube, con::line, moni::tool, Io::Tool), the connected probes and sensors as well as the used additional devices (e.g. compressor) must be observed.

The operator has to obtain the local operating permits and has to comply with the joint constraints associated with these. Additionally, the local legal requirements have to be observed (e.g. regarding safety of personnel and means of labour, disposal of products and materials, cleaning, environmental constraints). Before putting the measuring device into operation, the operator has to ensure that during mounting and initial startup - in case they are executed by the operator himself - the local legislation and requirements (e.g. regarding electrical connection) are observed.

All Badger Meter products are leaving our factory in immaculate technical and safety conditions. Inappropriate or not intended use of the product, however, can cause danger! The manufacturer is not responsible for damage caused by incorrect or unauthorised use. Any kind of manipulation of the device is strictly prohibited - except for the activities described in this document. Conversions and changes to the device must not be made, otherwise all certifications and guarantee / warranty become invalid. For details regarding guarantee and warranty please refer to our general conditions of business (GTC).

2.1 Declaration of Conformity

This Badger Meter product has been developed, tested and manufactured for electromagnetic compatibility (EMC) and according to applicable European standards, as defined in the declaration of conformity. A CE-mark is applied on the device.

The full text of the EU declaration of conformity related to this product can be requested from Badger Meter Austria or your local Badger Meter sales partner or can be downloaded from the Badger Meter Website (ttps://www.badgermeter.com/en-gb/products/water-quality-monitoring/physical-sensors/ammolyser-pro)

For further details about certifications related to this product please refer to the technical specifications located at the end of this manual.

2.2 Special Hazard Warning

Because the Badger Meter measuring systems are frequently installed in industrial and municipal waste water applications, one has to take care during mounting and demounting of the system, as parts of the device can be contaminated with dangerous chemicals or pathogenic germs. All necessary precautions should be taken to prevent endangering of one's health during work with the measuring device.

3 TECHNICAL DESCRIPTION

3.1 Intended Use

The ammo::lyser is an ion selective sensor designed for the continuous monitoring of dissolved Ammonium Nitrogen (NH4-N) in waste water, surface water or drinking water. Depending on the sensor type different electrodes will be used. The measured value is displayed in mg/l.

Optional the sensor can be equipped with additional ion selective electrodes that measure the concentration of Nitrate Nitrogen (NO3-N), Chloride (Cl), Fluoride (F), Potassium (K) or the pH-value. The last two parameters (K, pH) can be used to compensate cross sensitivities of the ammonium measurement. In that way a higher measuring accuracy can be reached compared to traditional ion selective sensors without such compensations for cross sensitivities.

The temperature of the medium will be measured continuously and is available as an additional parameter. Temperature will be used for correction of measured readings during the local calibration process.

In all types of applications, the respective acceptable limits, which are provided in the technical specifications in the respective user manuals, have to be observed. All applications falling outside of these limits, and which are not authorised by Badger Meter Austria GmbH in written form, do not fall under the manufacturer's liability.

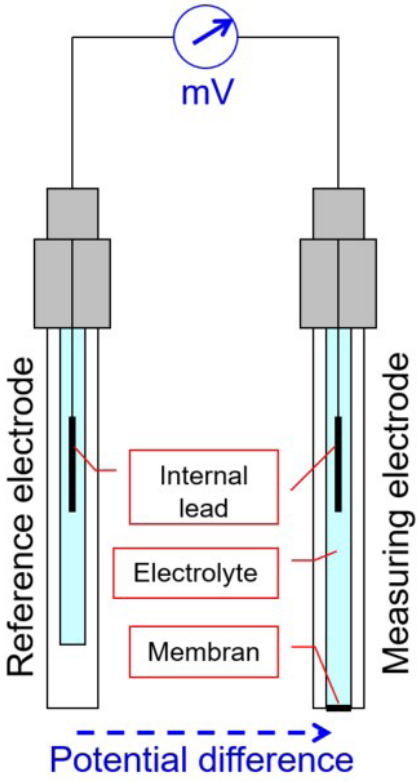
The device must only be used for the purpose described in this user manual. Use in applications not described in this manual, or modification of the device without written agreement from Badger Meter, is not allowed. Badger Meter is not liable for claims following from such unauthorised use. In such a case, the risks are the sole responsibility of the operator.

3.2 Functional Principle

The ammo::lyser measures the potential difference between the ion selective measuring electrode (ISE) and the reference electrode (see figure on the right). The voltage circuit is closed via the measuring medium.

The measuring electrode is equipped with a selective membrane (polymer, single crystal or glass) which measures changes of specific ion activity. The difference in specific ion activities generates a potential at the membrane interface. This potential is then measured against the stable potential of the reference electrode.

According to the Nernst equation the measured potential [mV] is proportional to the concentration of the specific ion.

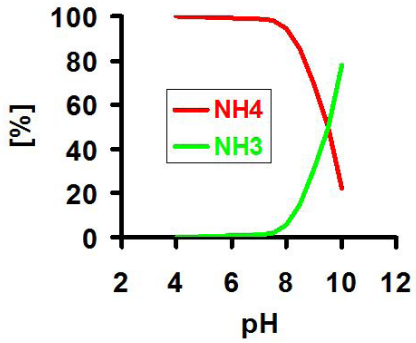


In addition, the ammo::lyser can be equipped with functionalities to compensate the Ammonium measurement for pH and Potassium.

- pH compensation:

$$NH_4^+ + OH^- \leftrightarrow NH_3 + H_2O$$

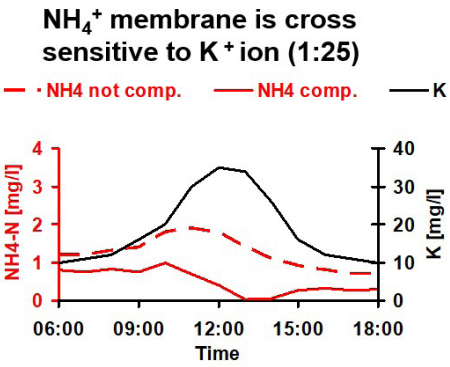
Increasing concentrations of NH3-N (Ammonia) at pH > 7.5 (see figure on the right) cannot be detected by the ion selective electrode. Therefore the NH4-N reading is below the real concentration. In order to eliminate this effect, the ammo::lyser can be equipped with a pH electrode.



- Potassium compensation:

The ion selective electrodes are specific for only one type of ion. Potassium ion has the same charge and similar size as Ammonium, therefore it will be detected by the measuring electrode and give less accurate, increased readings (see figure on the right).

In case of high and / or fluctuating Potassium concentration, the usage of a seperate Potassium electrode for compensation of Ammonium reading can be used.



3.3 Product

The following device variants of the ammo::lyser are available. Regarding detailed information of the device variants please refer to the technical specifications located at the end of this manual. Regarding detailed information of the accessories parts please refer to section 10 (accessories).

Type	Specification	NH4-N	NO3-N	K	Cl	F	pH	Temp.
E-532-PRO-075	ammo::lyser with 7.5m fixed cable and Potassium compensation	X		X				X
E-532-PRO-000	ammo::lyser with plug connection and Potassium compensation	X		X				X
E-532-PRO-pH-075	ammo::lyser with 7.5m fixed cable, Potassium- and pH-compensation	X		X			X	X
E-532-PRO-pH-000	ammo::lyser with plug connection, Potassium- and pH-compensation	X		X			X	X
E-532-PRO-NO3-075	ammo::lyser with 7.5m fixed cable, Potassium compensation and Nitrate electrode	X	X	X				X
E-532-PRO-NO3-000	ammo::lyser with plug connection, Potassium compensation and Nitrate electrode	X	X	X				X
E-532-ECO-075	ammo::lyser with 7.5m fixed cable	X						X
E-532-ECO-000	ammo::lyser with plug connection	X						X
E-532-ECO-pH-075	ammo::lyser with 7.5m fixed cable and pH-compensation	X					X	X
E-532-ECO-pH-000	ammo::lyser with plug connection and pH-compensation	X					X	X

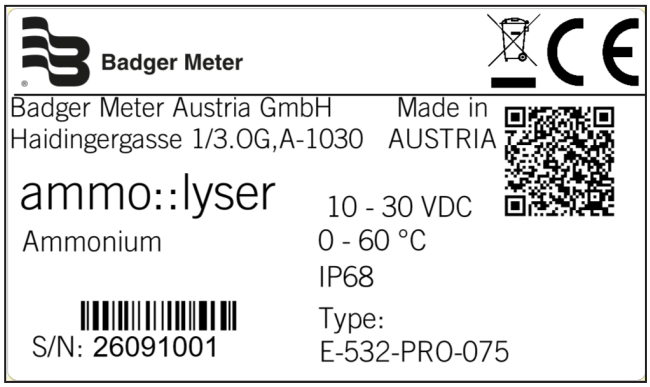
Type	Specification	NH4-N	NO3-N	K	Cl	F	pH	Temp.
E-532-ECO-NO3-075	ammo::lyser with 7.5m fixed cable and Nitrate electrode	X	X					X
E-532-ECO-NO3-000	ammo::lyser with plug connection and Nitrate electrode	X	X					X
E-532-ECO-CL-075	ammo::lyser with 7.5m fixed cable and Chloride electrode	X			X			X
E-532-ECO-CL-000	ammo::lyser with plug connection and Chloride electrode	X			X			X
E-532-ECO-NO3-pH-075	ammo::lyser with 7.5m fixed cable, pH- and Nitrate electrode	X	X				X	X
E-532-ECO-NO3-pH-000	ammo::lyser with plug connection, pH- and Nitrate electrode	X	X				X	X
E-532-ECO-CL-pH-075	ammo::lyser with 7.5m fixed cable, pH- and Chloride electrode	X			X		X	X
E-532-ECO-CL-pH-000	ammo::lyser with plug connection, pH- and Chloride electrode	X			X		X	X
E-542-075	fluor::lyser with 7.5m fixed cable					X		X
E-542-000	fluor::lyser with plug connection					X		X

Single electrodes (spare part)	New Version V2	Refurbished Version V2	New Version V1[1)]	Refurbished Version V1[1)]
Ammonium NH4-N	E-533-ISE-NH4	E-633-ISE-NH4	E-532-ISE-NH4	E-632-ISE-NH4
Ammonium NH4-N [2)]	E-535-ISE-NH4	E-635-ISE-NH4	E-534-ISE-NH4	E-634-ISE-NH4
Nitrate NO3	E-533-ISE-NO3	E-633-ISE-NO3	E-532-ISE-NO3	E-632-ISE-NO3
Potassium K	E-533-ISE-K	E-633-ISE-K	E-532-ISE-K	E-632-ISE-K
Chloride CL	E-533-ISE-CL		E-532-ISE-CL	
Fluoride F	E-543-ISE-F		E-542-ISE-F	
pH	E-533-ISE-pH		E-532-ISE-pH	
Reference	E-533-ISE-ref		E-532-ISE-ref	

1) Previous version V1 of ammo::lyser (was delivered until 2006)
2) Current membrane version (delivered since 2018)

The device is typified by a type label, as shown on the right, that contains the following information:

- Manufacturer's name and country of origin
- Several certification marks
- Device name
- Bar code
- Device serial number (S/N)
- Information on power supply
- Acceptable temperature limits
- Environment rating (IP)
- Item number (Type)
- QR code to user manual



1 Reference electode (always slot position 1)

2 Ammonium or Fluoride electrode (in most cases slot position 2)

3 pH electrode, ISE-electrode or empty (depending on type)

4 Potassium or another ISE-electrode or empty (depending on type)

5 Temperature sensor

6 Cleaning nozzle

7 Sensor cable

8 Connection for automatic cleaning

9 Connection thread for sensor mounting ($1^1/_2$ inch outside)

10 Sensor housing

Dimensions of ammo::lyser in mm

3.4 Storage, Transport and Disposal

The permissible limit values for operation, storage and transportation of the device are specified in the last chapter of this manual (Technical Specifications) and must be observed. In addition, the device should not be exposed to strong impacts and vibrations. The device must be stored away from solvent vapors, radioactive and strong electromagnetic radiation.

The reference- and pH-electrode have to be protected from drying out. Drying out of both electrode types will result in reduced measuring quality at the beginning and reduced life span up to complete loss of function (> 48 hours). For wetted storage of the reference and pH-electroden the delivered protective cap can be used. Moreover both electrode types should be stored vertically with the membrane downwards and the plug upwards, to ensure complete wetting of the inside.

For long term storage without reducing the life time of the electrode, a 3 M Potassiumchloride solution (KCl) has to be used. For short term the electrode storage can be done in drinking or tap water (never use distilled or demineralised water!). In this case an aging of the electrode occurs similar to the normal operation.

The Ammonium-, Fluoride-, Potassium-, Chloride- and Nitrate electrode will be stored on air dry. Before initial startup a conditioning is needed.

For information about maximal storage duration please refer to the technical specifications located at the end of this manual.

Damage to the sensor and the electrodes caused by wrong storage will not be covered by warranty.

Transport should be done in a packaging that protects the device (original packaging if possible).

This product is marked with the WEEE symbol to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2012/19/EC. The symbol indicates that this product should not be treated as household waste. It must be disposed and recycled as electronic waste. Please assist to keep our environment clean.

3.5 Scope of Delivery

Immediately upon receipt, please check the received consignment for completeness on the basis of the delivery note and check for any possible damage incurred during shipping. Please inform the delivering dispatcher and Badger Meter Austria immediately in case of any damages in transit.

The following parts should be included in the delivery:

- ammo::lyser (part-no. E-532-x-xxx)
- Connection cable (part-no. C-1-010-SENSOR) in case of plug version (-000)
- Tool for electrode replacement (part-no. E-532-TOOL)
- User manual ammo::lyser (part-no. S-23-M-EN)

The following parts could be included in the delivery if ordered as an option:

- Set for cleaning connection (part-no. B-41-SENSOR)
- Extension cable (part-no. C-210-SENSOR or C-220-SENSOR)
- Probe carrier (part no. F-11-OXI-AMMO for submersed installation)
- Fixing adapter for railing (part-no. F-15)
- Flow cell setup clean water for ammo::lyser (part-no. F-45-AMMO)
- Flow cell setup waste water for ammo::lyser (part-no. F-48-AMMO)
- Cleaning valve (part-no. B-44 or B-44-2)
- Compressor (item-no. B-32-230, B-32-110 or B-32-012)

In case of incompleteness please contact your Badger Meter sales partner immediately!

4 INSTALLATION

4.1 Environment

The correct installation of measuring instruments is an important prerequisite for satisfactory operation. Therefore the following checklist for the installation can be used to ensure that all sources for potential operational problems can be ruled out to the greatest possible extent during the installation, allowing the monitoring system to operate properly.

For information on environmental limitations (e.g. temperature), also refer to the Technical Specifications at the end of the manual.

- Favourable flow conditions (little turbulence, acceptable flow rate, pressure, etc.)
- Unadulterated, representative measuring medium
- Measuring medium is in equilibrium state (no gas release, no precipitation, etc.)
- No external interferences (no electric and electro-magnetic interferences by leakage current, earth fault of pumps, electric motors, electric power lines, etc.)
- Easy accessibility (mounting, sampling, functional check, demounting)
- Availability of sufficient space (probe / sensor, installation fitting, controller, etc.)

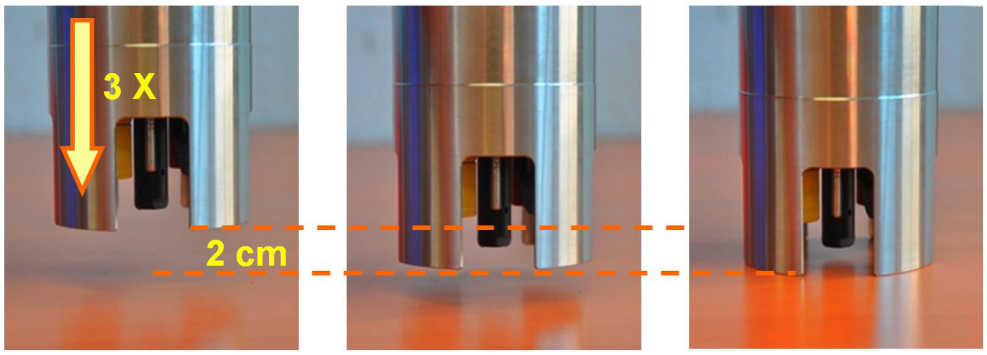
- Power supply for controller (operational reliability, voltage, power, peak free)
- Process medium to be measured connected to protective earth conductor (correct system earthing)
- GPRS connection for data transfer and remote control
- Oil- and particle free compressed-air supply (optional for automatic probe / sensor cleaning)
- Best possible weather and splash water proof conditions
- Shortest possible distances between system components (probe / sensor – controller – compressed-air supply – energy supply)
- Correct dimensioning, mounting and protection of all cables and lines (non-buckling, no risk of stumbling, no damage etc.)

4.2 Installation Notes for ammo::lyser

For correct and low-maintenance operation of the sensor please keep the following notes in mind.

- Never hang the sensor into the water on the sensor cable only or pull it out on the cable only.
- Protective caps have to be removed from the reference- and pH-electrode before installation and shall be stored for later storage or shipment.
- Because each measured medium has a different ion composition and ion concentration, the electrodes need time to adapt to the particular medium (conditioning). Therefore storage of the sensorhead (or of the replacement electrodes) in the measured medium is recommended already several hours before initial startup. Too short conditioning time of the electrodes can result in drifting readings.
- The sensor head has to point downwards when installed. This ensures that no air bubbles inside the electrode will falsify the measured readings. Air bubbles that accumulate on the membrane (both inside and outside) will lead to false, sometimes unstable or jumping readings.

To remove air bubbles inside the electrodes caused by transport or handling, the sensor has to be knocked onto a flat and hard surface several times carefully straight before installation or any reinstallation (see figures on the right).



4.3 Connection of automatic Cleaning

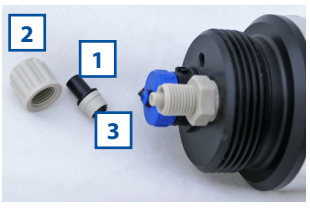
The compressed air cleaning can be used for ammo::lyser when installed submersed or in the flow cell for waste water (F-48-AMMO). Information on the configuration of the cleaning settings (frequency, duration, waiting time) is given in the Technical Specifications at the end of the manual.

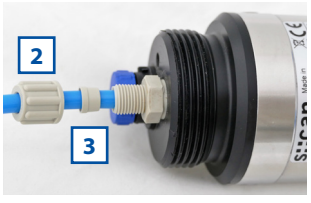
The correct configuration of the automatic cleaning is an important prerequisite for satisfactory operation. Therefore the following checklist can be used to ensure that all sources for potential cleaning problems can be ruled out to the greatest possible extent, allowing the monitoring system to operate properly.

- The cleaning valve should never be connected to the compressed air coupling of your compressor directly, i.e. without a pressure hose in between.
- The total length of the pressure hoses should be kept as short as possible to avoid unnecessary pressure losses (especially the distance between cleaning valve and the sensor).
- Any foreign matter in the compressed air supply may impair the hydraulic-pneumatic cleaning process. If you have any doubts about the purity of the air used (contamination by particles, oil, etc.), please install an appropriate filter upstream from the solenoid valve.
- In regions with extremely low outside temperature, frost-free installation of the compressed air hose is recommended in order to prevent any condensation in the compressed air hose from freezing.
- Please note that different probe and sensors may have different maximum permissible pressures specified for automatic cleaning. Therefore, when using a central pressurised air supply, the lowest pressure specification is used in such a case, the lowest pressure specification is decisive. Alternatively, a corresponding pressure reducer can be installed to supply the measuring devices with the correct cleaning pressure.
- The use of the Badger Meter compressor, which is optimized for supplying compressed air to all probes and sensors, is recommended for proper operation of the automatic cleaning system.

The compressed air connection set (B-41) contains components necessary to connect the sensor cleaning located on top of the ammo::lyser to the cleaning valve. The compressed air connection is performed by the following steps (see figures below also):

- Remove dummy insert [1] from pressure connection on top of the sensor by unscrewing the union nut [2] and removing the conical part [3].
- Put the union nut [2] and the conical part [3] over the cleaning hose.
- Push the cleaning hose over the pressure connection (warm up with hot water if necessary).
- Fasten union nut [2] by hand.



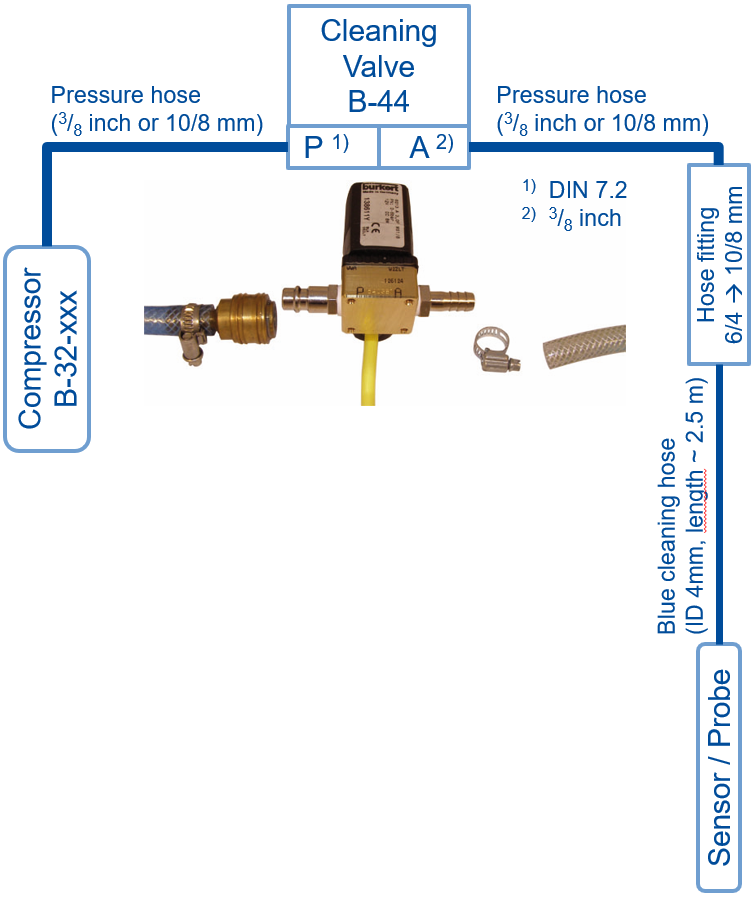


The connection of the compressed air hose to the cleaning valve depends on the used type of the valve (B-44 or B-44-2).

- Cleaning valve B-44

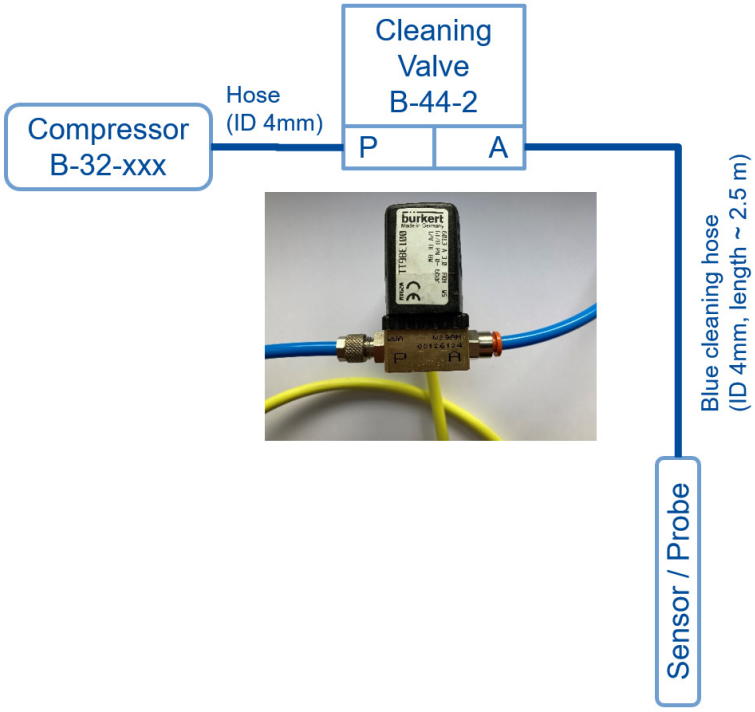
A compressed air hose (to be provided by customer, ID 8 to 9 mm) must be used to connect the adapter fitting of the pressure connection set (B-41) to the output side of the cleaning valve (marked with A). Fasten the air hose with hose clamps.

Another compressed air hose with DIN 7.2 compressed air coupling (to be provided by customer) are required to hook up the compressed air supply to the input side of the cleaning valve (marked with P).



- Cleaning valve B-44-2

The adapter fitting of the pressure connection set (B-41) can be removed to connect the blue tube directly to the push-pull fitting of the cleaning valve. The same type of tube can be used to connect the cleaning valve to the compressor.



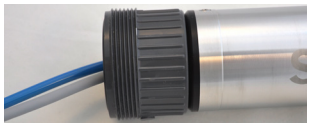
4.4 Mounting with Sensor Carrier (F-11-OXI-AMMO)

This section explains how the ammo::lyser can be installed in the sensor carrier (part-no. F-11-OXI-AMMO). Regarding the dimensions of this installation accessories please refer to section 11.1.3.

The installation of the sensor with this carrier is performed by the following steps:

- Separate the sensor carrier into different parts by unscrewing the union nut [2].
- The insert part of the sensor carrier without thread [1] will be fixed to the extension pipe [4] firmly (e.g. using a PVC adhesive). This extension pipe (OD 50 mm or $1^1/_2$ inch) must be provided on site.

- Lead the sensor cable and the air hose for automatic sensor cleaning through the sensor carrier.



- The part of the sensor carrier with double thread [3] will be screwed on top of the sensor (cable side).

- Lead the sensor cable and the air hose for automatic sensor cleaning through the prepared extension pipe.

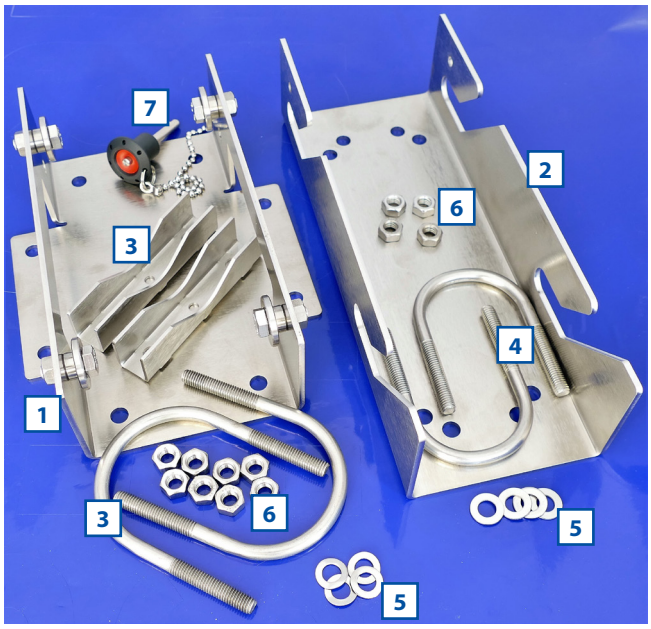
- Mount the ammo::lyser onto the sensor carrier with the extension pipe using the union nut [2].

4.5 Monting of Railing Bracket / Fixing Adapter (F-15)

This section explains the mounting of the railing bracket (fixing adapter) with the extension pipe on the railing in case of a submersed installation.

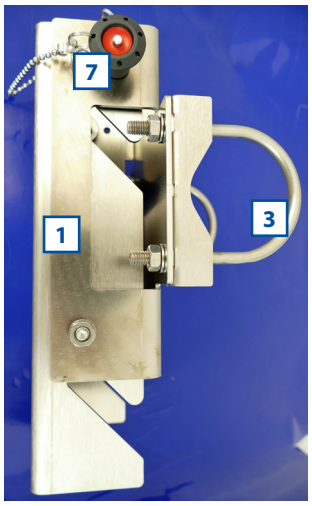
The following parts are included in the delivery of the railing bracket F-15:

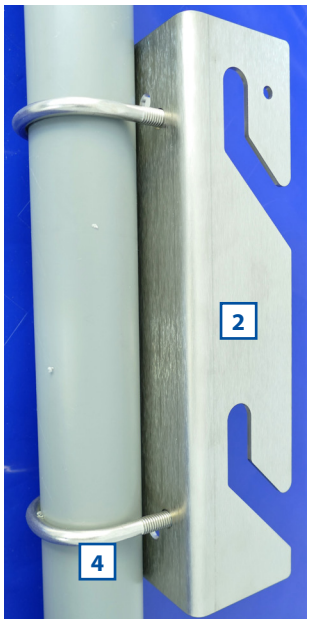
1. Fixing adapter for railing
2. Fixing adapter for extension pipe of sensor carrier
3. Fixing clamp for railing ($2^1/_2$ inch / 63.5 mm)
4. Fixing clamp for extension pipe of sensor carrier (50 mm)
5. Washers for fixing clamp
6. Screw nuts for fixing clamp
7. Safety pin for railing bracket



Once the sensor is installed in the sensor carrier with the extension pipe (see section 4.4) the mounting of the railing bracket is performed by the following steps:

- Fasten the fixing adapter for the railing [1] with the fixing clamp [3], the screw nuts and the washers, included in delivery, onto the railing.
- Fasten the other part of the fixing adapter [2] with the fixing clamp [4], the screw nuts and the washers, included in delivery, onto the extension pipe of the sensor carrier.
- Now insert the sensor with the extension pipe into the railing bracket from top.
- Secure the railing bracket with the locking pin [7] to prevent it from being pulled out unintenionally.
- If necessary, adjust the inclination of the extension pipe and the immersion depth of the sensor. To do this, loosen the corresponding screw nuts of the fixing clamps.





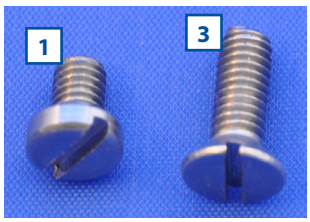
4.6 Installation in Flow Cell

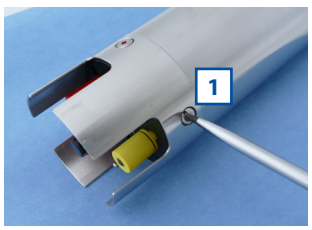
The following sections explain how the ammo::lyser can be installed in a flow cell. There are two types of flow cell available, one for clean water (part-no. F-45-AMMO) and one for waste water (part-no. F-48-AMMO). For both flow cells a specific adapter has to be mounted onto the ammo::lyser (see section 4.6.1). Regarding the dimensions of these flow cells please refer to section 11.1.5 and 11.1.6.

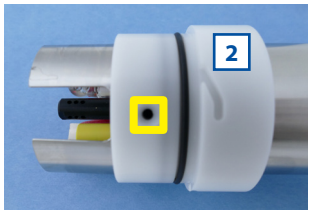
4.6.1 Mounting Adapter of Flow Cell

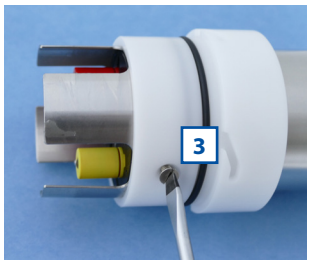
The mounting of the flow cell adapter on the sensor is performed by the following steps:

- Unscrew both slotted screws [1] from the measuring head. Do not screw out the red, sealed, hex socked screws.
- Remove the adapter [2] from the flow cell (with help of a strap wrench if necessary) and place it over the measuring head. Align the holes for the fixing screws with the holes in the sensor (see yellow mark in the figure below). Also ensure the correct fit of the o-ring sealing.
- Fix the sensor with two flat head slotted screws [3] which are included in the delivery of the flow cell setup.









4.6.2 Installation in Flow Cell for Clean Water (F-45-AMMO)

The following parts are included in the delivery of the flow cell F-45-AMMO:

1 Flow cell for clean water

2 Adapter for flow cell

3 2 screws for adapter mounting

4 2 fixing holders for panel mounting

5 Metal bracket for flow cell fixation on panel

Once the flow cell adapter is fixed on the sensor (see section 4.6.1) the installation of the flow cell is performed by the following steps:

- Place the sensor in the opening of the flow cell in that way, the grooves of the flow cell adapter are aligned with the four metal pins of the flow cell (see yellow mark in the figure on the right).
- Now push the sensor down and turn it clock-wise to fix it into the bayonet lock.
- If needed the flow cell can be mounted onto a panel or a flat wall using the 2 fixing holders and the metal bracket.

4.6.3 Installation in Flow Cell for Waste Water (F-48-AMMO)

The following parts are included in the delivery of the flow cell F-48-AMMO:

Once the flow cell adapter is fixed onto the sensor (see section 4.6.1) the installation of the flow cell is performed by the following steps:

1 Flow cell for waste water

2 Adapter for flow cell

3 2 screws for adapter mounting

- Place the sensor in the opening of the flow cell in that way, the grooves of the flow cell adapter are aligned with the four metal pins of the flow cell (see yellow mark on the right).
- Now push the sensor down and turn it clock-wise to fix it into the bayonet lock.

5 INITIAL STARTUP

Once the mounting and installation of the sensor have been completed and checked (see chapter 4) the initial startup of the Badger Meter monitoring system will require the following actions, in the order presented below:

- Connect the sensor to the controller used for operation (see section 5.1 and 5.2).
- Connect the cleaning devices to the proper terminal connections in the cable terminal compartment of the used controller (please refer to the manual of the controller used for operation).
- Establish main power supply to the controller (please refer to the manual of the controller) and wait until the operation software has started up.
- Perform initialisation of the sensor. Refer to section 5.3.1 in case of using a con::lyte D-320, refer to section 5.3.2 in case of using con::cube with moni::tool and refer to section 5.3.3 in case of using con::line with Io::Tool.
- Perform parameterisation of the sensor. Refer to section 5.4.1 in case of using a con::lyte D-320, refer to section 5.4.2 in case of using con::cube with moni::too and refer to section 5.4.3 in case of of using con::line with Io::Tool.
- Configure the measurement and automatic cleaning settings (please refer to the manual of the controller and section 12 regarding cleaning settings).
- Check the proper function of the cleaning system.
- Connection and parameterisation of data transfer when desired (please refer to the manual of the controller).
- Check the plausibility of the readings obtained after sufficient running-in time (see section 12 regarding running-in time).
- If necessary, calibrate the readings of the sensor to the local water marix when the readings are stable (see chapter 6).

5.1 Controller for Operation

For proper operation of the sensor you will need one of the following controller and operating software respectively.

Controller	Type	Software
con::lyte	D-320	V7.12B3 or higher
con::cube	D-315	moni::tool V2 or V3
con::cube	D-330	moni::tool V4 or V5
con::line	D-500-012	Io::Tool V3 or V4

Badger Meter Austria recommends to use the most current version of the operating software on the controller. For service operation with ana::pro please refer to section 10.4.2.

5.2 Connection to the Controller for Operation

The sensor will be delivered either with fixed cable or with a plug connection on the sensor itself. In case of plug connection the connection cable C-1-010 has to be used to connect the sensor to a compatible socket provided on the controller. Ensure that the sensor plug and the connector are dry and clean. Otherwise communication errors and / or device damage might occur.

In case the controller does not supply enough sockets, the distribution box for sensors C-41-HUB can be used.

5.3 Probe Initialisation

To enable the operator terminal to operate several probes / sensors simultaneously, it is necessary to assign each probe / sensor its own address. This is done automatically during probe initialization. The connected measuring device is first recognized by the operator terminal via the preset address. If this address is already in use, the operator terminal assigns a new, still free, address for the measuring device and stores this address on the measuring device.

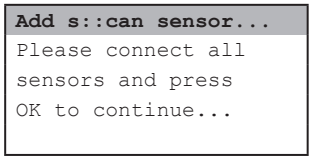
The exact procedure of the probe initialization for the different operator terminals is described in the following sections.

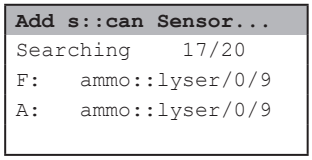
Sensors of the same type should always be initialized individually and one after the other.

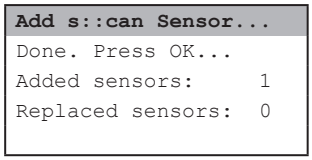
5.3.1 Probe Initialisation using con::lyte

At the initial start-up the con::lyte D-320 provides an automatic probe and sensor initialisation procedure (see upper figure on the right).

- Connect the sensor to the 6-pin connector socket of the con::lyte (see section 5.2).
- Push the *OK* button to start the probe search (see middle figure right).
- After successfully completing the probe search (*Done*), push the *OK* button to initiall the probe (see lower figure right).

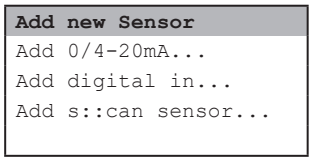


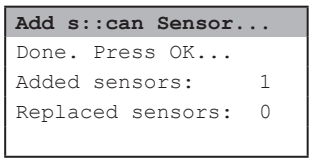




If sensor will be initialized at a later date, the following steps are needed:

- Connect the sensor to the 6-pin connector socket of the con::lyte (see section 5.2).
- Switch to Status display by using the *Left-* or *Right* button.
- Push *Function* button.
- Select menu *Manage sensors...* and confirm with *OK*.
- Select menu *Add sensor ...* and confirm with *OK*.
- Select menu *Add s::can sensor ...* and confirm with *OK* to start the probe search (see upper figure right).
- After successfully completing the probe search (*Done*), push the *OK* button to initiall the probe (see lower figure right).





After a new sensor has been added, the parameters can be added in the parameter screen manually (see section 5.4.1 and menu *Add parameters...*).

In case the installation failed, the message *Error adding!* will be displayed.

5.3.2 Probe Initialisation using con::cube (moni::tool)

1 Click the *Service* tab on the moni::tool screen.

2 Login as *Administrator* with Password *admin1* or your individual username.

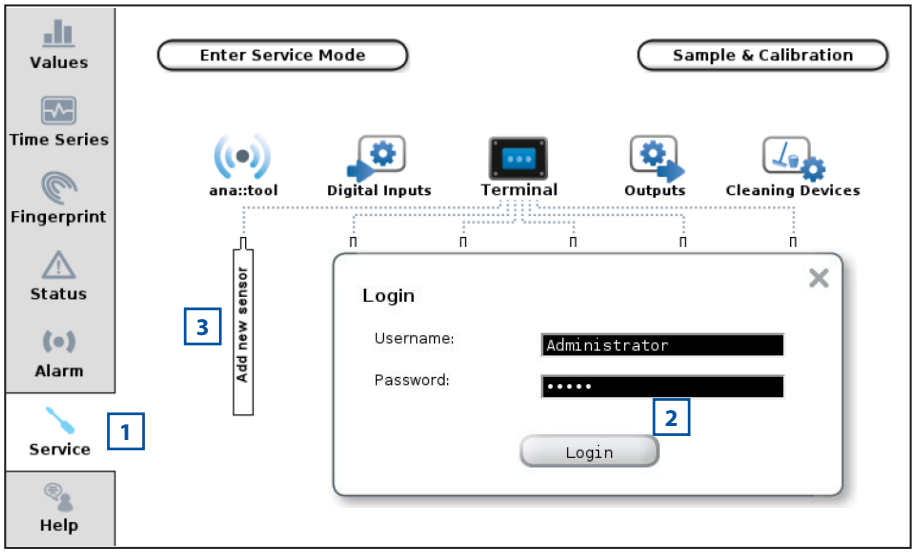
3 Click on an empty sensor icon (*Add new Sensor*) to initiate the initialisation process.

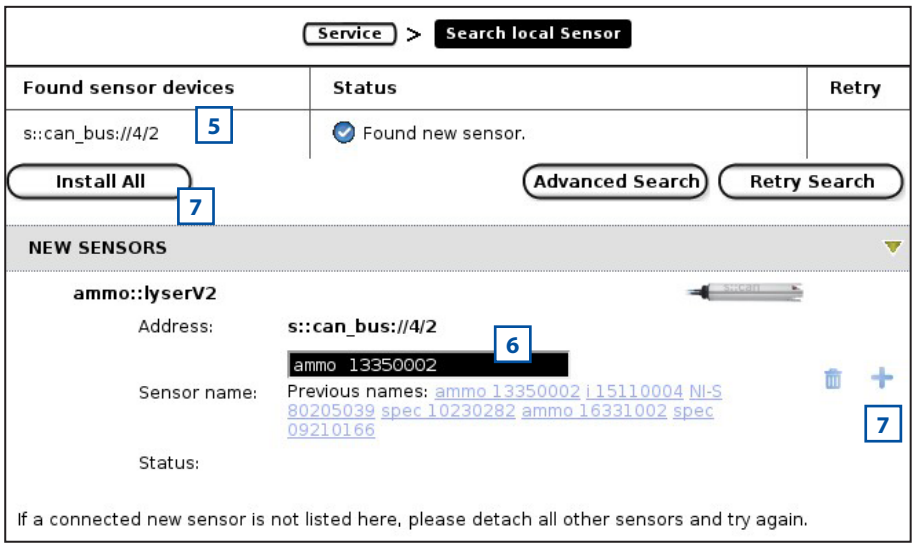
4 An automatic search procedure will start, searching for the connected sensor.

5 When the automatic search prodedure is finished, all connected probes and sensors will be displayed. Those sensors that are connected for the first time and not installed will have the Status *Found new sensor*. These sensors are listed as *New Sensors* below also.

6 If needed the suggested *Sensor name* can be modified. This name will be used in the system overview of the *Status* and *Service* display also.

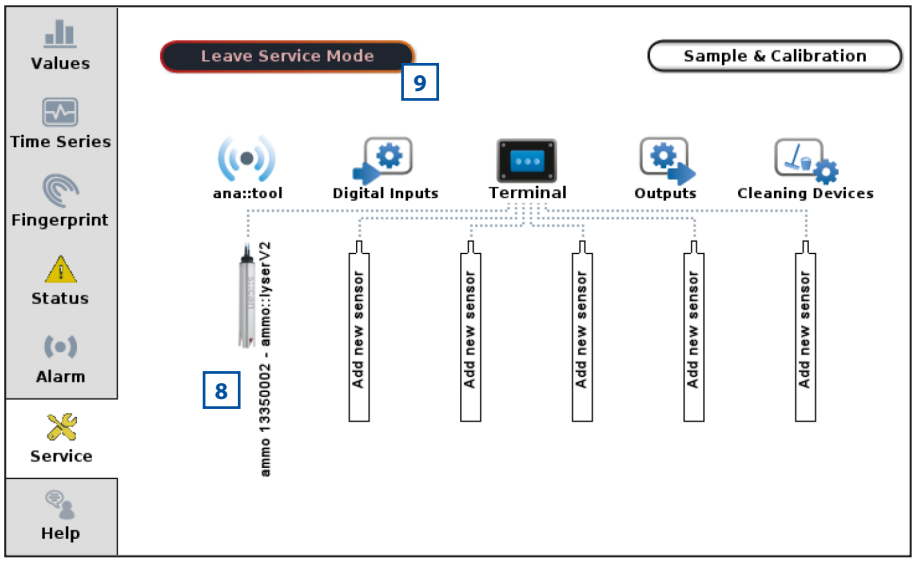
7 To install the new sensor click either on the blue + sign on the right side of the sensor or push the button *Install All*.



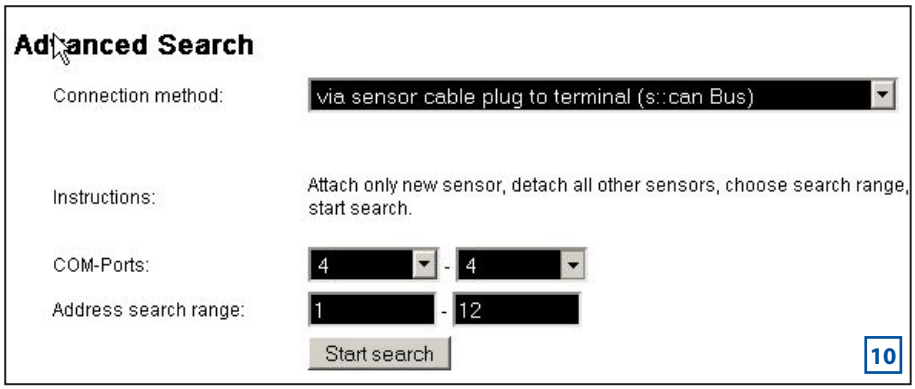


8 moni::tool will install the sensor and switch to the *Service* display. The new sensor is displayed in the system overview.

9 Push the button *Leave Service Mode* located on the upper left side to start the measuring process.

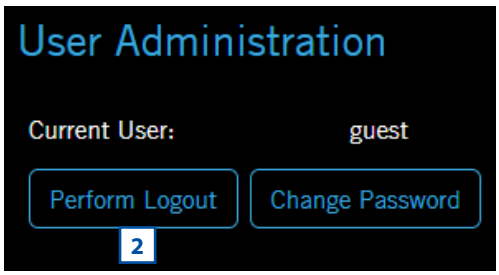


10 When pushing the button *Advanced Search* the method how the sensor is connected (*Connection methode)*, the used *COM-Port* and the *Address* can be defined exactly. This option shall be used by advanced users only.

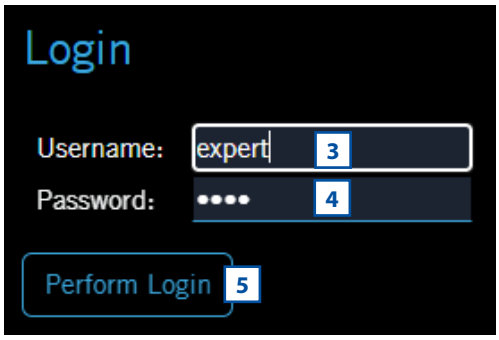


5.3.3 Probe Initialisation using con::line (Io::Tool)

For operation of Io::Tool there are three users levels available. Per default the user is logged in as *guest* automatically (no password required). For probe initialisation the user level *user* or *expert* (both with password *scan*) is needed. A change of the user level is performed by the following steps:

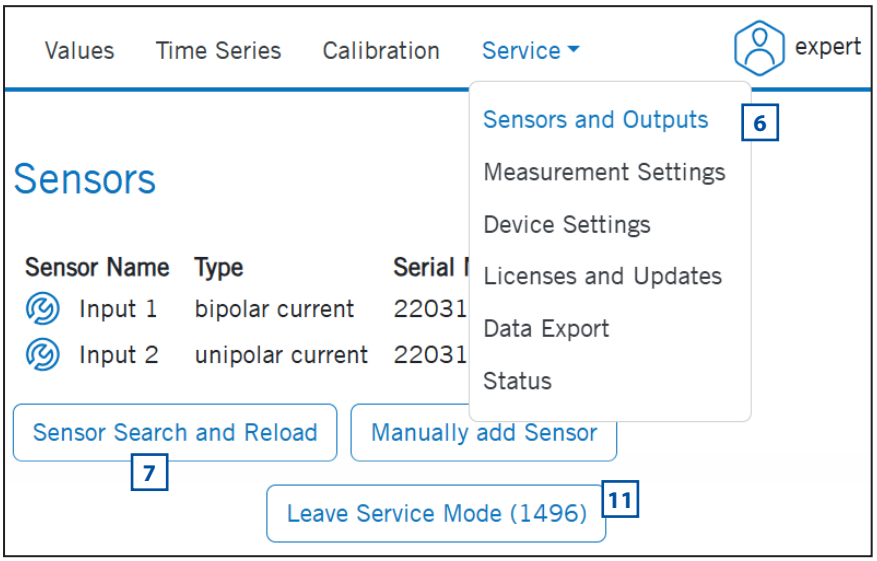


1. Click on the user icon in the upper right corner of Io::Tool.
2. Click on the button *Perform Logout* to logout the current user.
3. Enter the new *Username* (user or expert).
4. Enter the *Password* (*scan* for user and expert).
5. Click on the button *Perform Login* to login as new user.

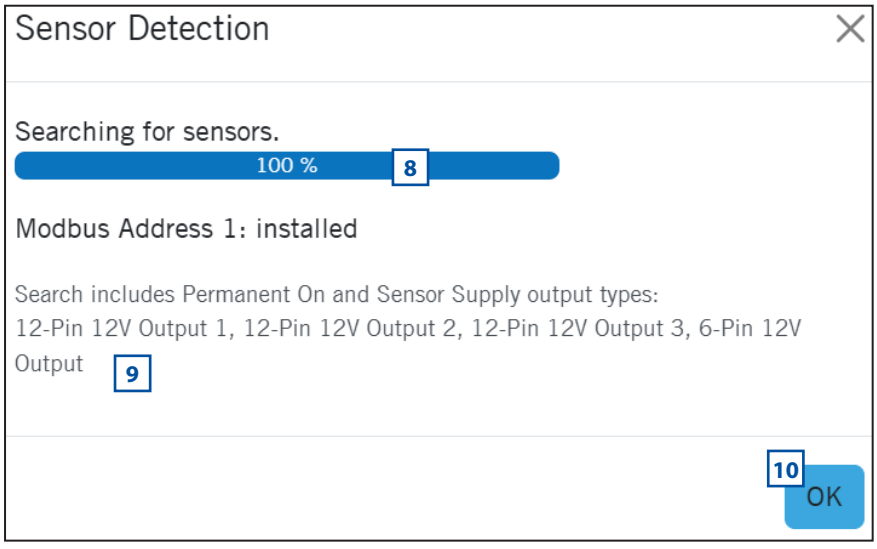


The con::line can be configured to operate energy-saving. Per default all con::line plugs used to connect the sensors, are powered permanently.

Once all sensors are connected to the con::line (see section 5.2) the search for a new sensor and the initialisation is performed by the following steps:



6. Open the menu *Service \ Sensors and Outputs* and push the button *Enter Service Mode*.
7. Push the button *Sensor Search and Reload* to search for any connected sensors.
8. An automatic procedure starts searching for all sensors which are connected directly to the con::line via sensor plug.
9. During the *Searching for Sensors* Io::Tool will inform which outputs are included in the search procedure. Outputs must be configured to *Permanent On* or *Sensor Supply* in order to be included in this search.
10. Click on the button *OK* to install the new sensors.
11. Click on the button *Leave Service Mode* to stop the service mode.



5.4 Probe Parameterisation

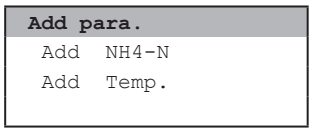
An overview of the parameters that can be measured with the different types of ammo:lyser can be found in section 3.3. Within the technical specifications, located at the end of this manual, the meauring ranges and information about accuracy for the parameters are specified.

5.4.1 Probe Parameterisation using con::lyte

After successful sensor initialisation (see section 5.3.1) the needed measuring parameters of the ammo::lyser must be added to the parameter display. This is performed by the following steps:

The maximum number of parameters depends on the con::lyte type used or the license installed (see con::lyte menu *Status / Settings / License ...*).

- Switch to status display with *Left-* or *Right* button.
- Push *Function* button.
- Select menu *Manage sensors...* and confirm with *OK*.
- Select *ammo::lyser/0/x* and confirm with *OK*.
- Select menu *Add parameters...* and confirm with *OK*.
- Select needed parameter and confirm with *OK*.

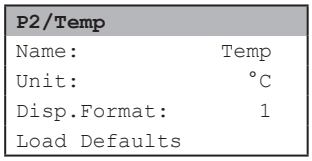


The selected parameter will be displayed now on the next free position of the parameter display. The default display configuration is used. Changing the display format is performed by the following steps:

- Select the parameter in the parameter display using *Up-* or *Down* button.
- Push *Function* button.
- Select menu *Display settings...* and confirm with *OK*.

In the displayed parameter configuration the following settings can be modified.

- *Name* Displays the actual name of the parameter.
- *Unit* Displays the actual unit of the parameter.



A change of the name or unit of the parameter is performed by the following steps:

- Select the entry with *Up-* and *Down* buttons and confirm by pushing the *OK* button.
- Change the name with *Up-*, *Down-*, *Left-* and *Right* buttons.
- Push the *OK* button to confirms the new name.

Please note that change of the parameter name or unit will not change the parameter configuration itself (e.g. if you change the parameter name NO_3-N to NO_3 the reading will still be NO_3-N).

- *Disp.Format* Within this line the number of displayed decimal places (between 0 and 5) can be set. Please note that in case of too many digits high values can not be displayed and the parameter reading will switch to plus signs (++.+++++).
- *Load Defaults* Confirming this entry by pushing the *Ok* button will restore the default display settings from the sensor.

All modifications performed by the operator within these settings menu will be documented in the config file of the con::lyte (see manual con::lyte D-320).

5.4.2 Probe Parameterisation using con::cube (moni::tool)

After successful probe initialisation (see section 5.3.2) all parameters available on the sensor will be installed and displayed on the *Values* screen of moni::tool.

⚠ If not all new parameters are displayed, please check the maximum number of parameters of your monit::tool license.

1 If required, the measurement parameters can be configured individually via the menu item *Service / Terminal / Parameters*.

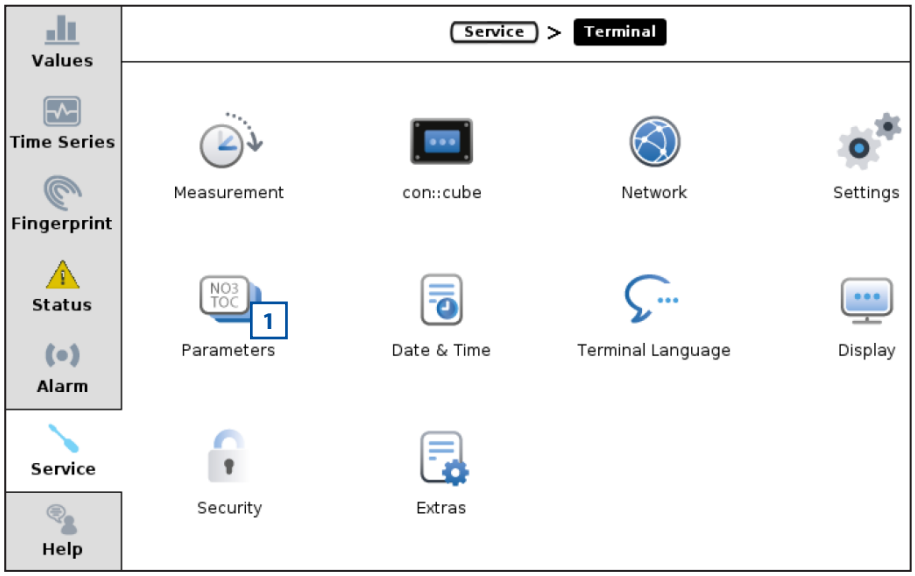
2 After selecting the menu item, a list of all installed parameters is displayed.

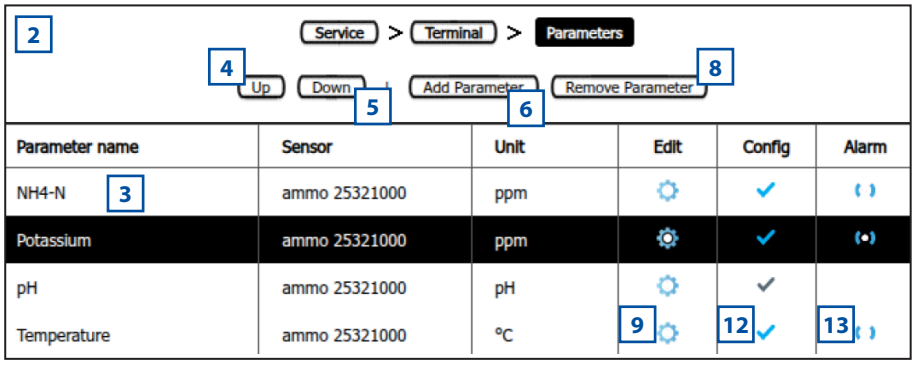
3 To select one or more parameters, simply click on the parameter name (the lines of the selected parameters will be highlighted).

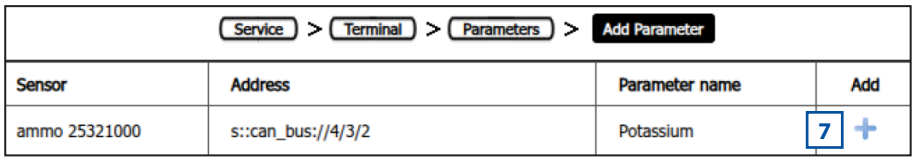
4 A click on the button *Up* moves the selected parameter one position up the the *Value* screen.

5 A click on the button *Down* moves the selected parameter one position down the the *Value* screen.

6 A click on the button *Add Parameter* adds a new parameter to the *Value* screen. A table of all parameters that are available will be displayed.

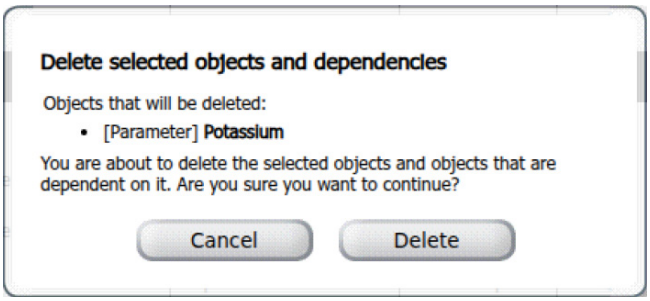






7 Click on the blue plus sign (+) on the right of the parameter you want to add to the *Values* screen.

8 A click on the button *Remove Parameter* removes the selected parameters from the *Value* screen. This action has to be confirmed in a new screen by pushing the button *Delete all* (see figure on the right).



9 A click on the blue gear wheel (*Edit*) on the right of the parameter in the parameter overview displays the actual parameter settings.

10 Depending on the used *Service Level* different settings are displayed. The *Parametername*, the *Unit* and the *Resolution* can be modified in the *Basic* level.

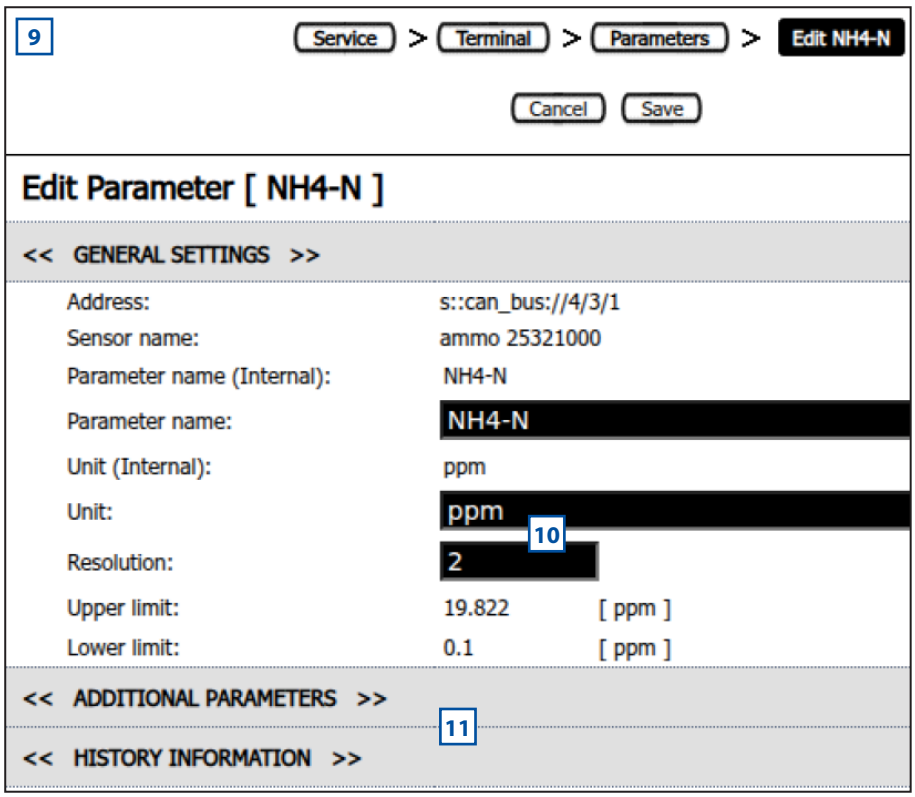
11 At a higher *Service Level* (*Advanced*, *Expert*) the andvanced settings are displayed (*Address*, *Parameter name (Internal)*, *Unit (Intern)*). The electrodes are configured in the *Additional Parameters* (see section 10.4.1) and the *History Information* shows the installation date.

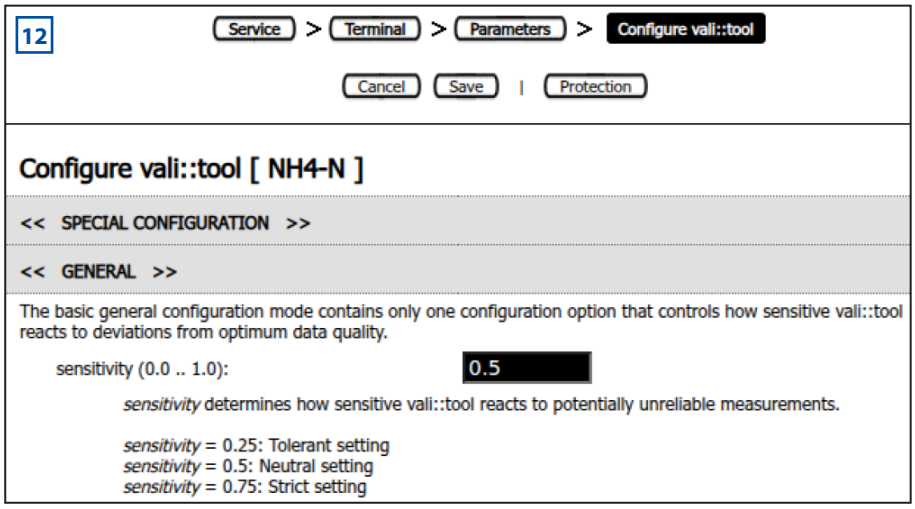
12 A click on the blue check mark (*Config*) on the right of the parameter in the parameter overview displays the actual settings of vali::tool for this parameter. The *Basic* screen is displayed on the right. Please refer to the manual moni::tool for further information.

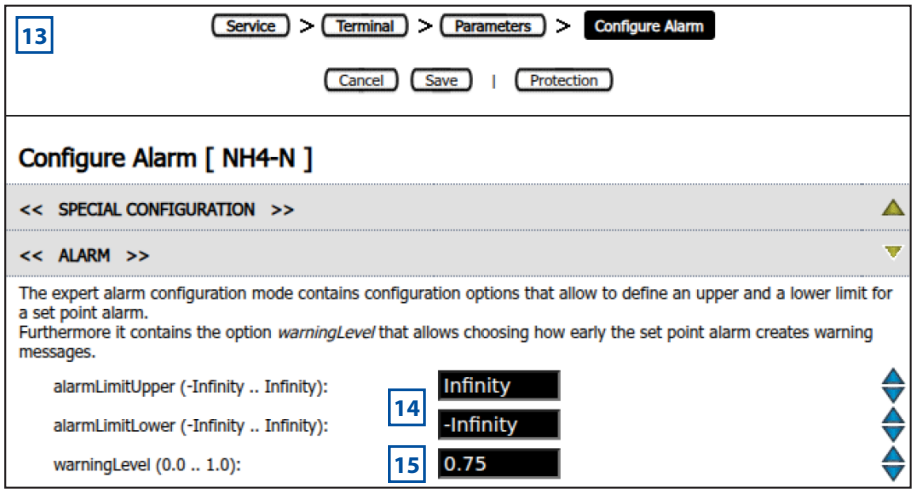
13 A click on the blue icon (*Alarm*) on the right of the parameter in the parameter overview displays the alarm settings for this parameter.

14 The upper (*alarmLimit Upper*) and the lower (*alarmLimitLower*) alarm threshold can be entered here.

15 In addition, a percentage value (*Warning Level*) can be defined, above which a warning is triggered.







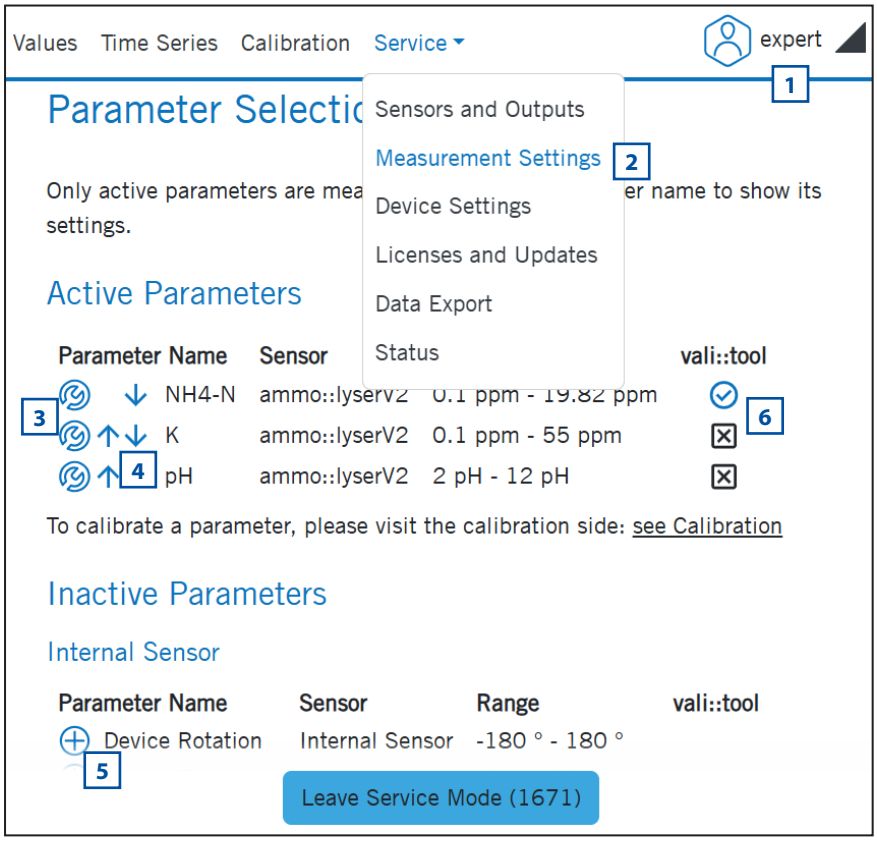
5.4.3 Probe Parameterisation using con::line (Io::Tool)

After successful probe initialisation (see section 5.3.3) all parameters available on the sensor will be installed and displayed on the *Values* screen of Io::Tool.

If not all new parameters are displayed, please check the maximum number of parameters of your Io::Tool license.

The settings of the parameters can be configured in the section *Parameter Selection* of the *Service \ Measurement Settings* menu. Furthermore other available parameters (*Inactive Parameters*) can be activated to be measued, displayed and stored. The changes are performed by the following steps:

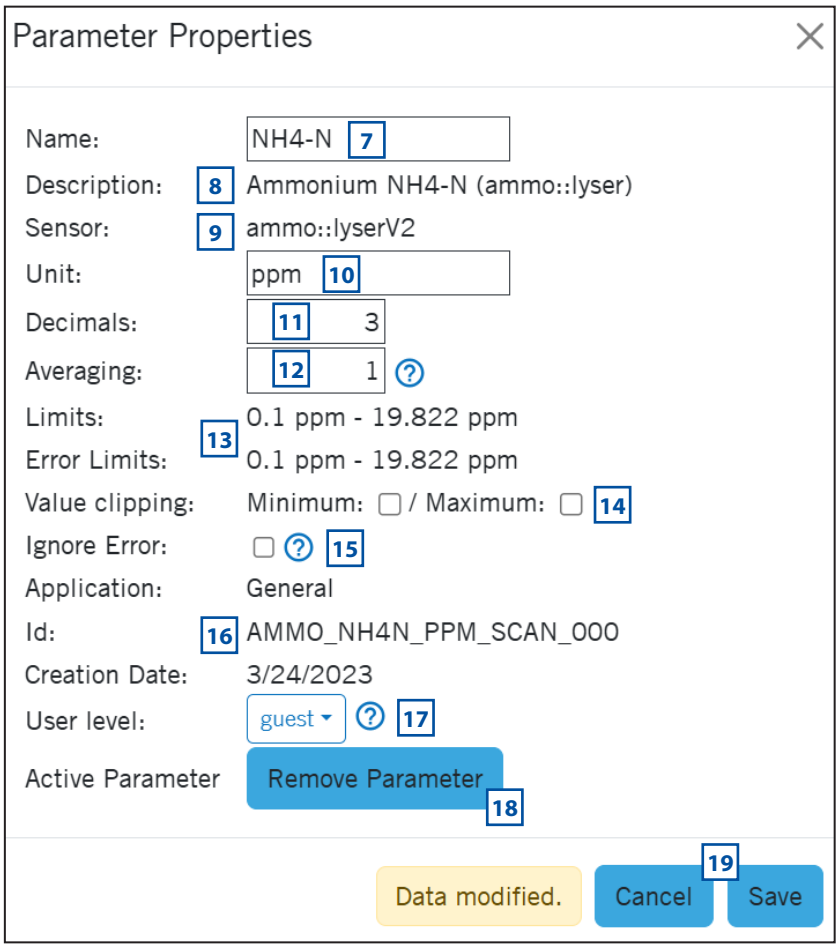
1. Ensure you are logged in as user *expert* (see section 5.3.3).
2. Open the menu *Service \ Measurement Settings* and push the button *Enter Service Mode*.
3. Below the entry *Active Parameters* all parameters are listed which are measured and displayed. Pushing on the blue tool icon on the left side of the parameter name will display further parameter details (*Parameter Properties* - see next page).
4. The sequence of the parameter on the *Value* display can be changed by pushing the blue arrow icons on the left side of the parameter. This will also change the sequence in the Modbus data transmission.



5. Below the entry *Inactive Parameters* all parameters are listed which can be measured but are not used. Pushing on the blue plus icon on the left side of the parameter name will move the parameter to the active parameters.
6. This checkbox indicates, if any vali::tool settings are activated for this parameter (blue tick icon) or not (black cross icon). Push the check box to open the *Data Validation* register sheet. For more details see figures on next pages and user manual for vali::tool software.

Depending on whether a vali::tool licence is installed on con::line or not, the parameter properties *Averaging* calculation and *Value clipping* must be set in the *Data Validation* register sheet (with vali::tool) or in the *Parameter* register sheet (without vali::tool). For more details, see the figures on the following pages.

The *Parameter Properties* are displayed after clicking the blue plus-icon on the left side of the parameter name.



7 *Name* displays the used parameter name. This can be changed if needed.

8 *Description* is the exact description of the parameter.

9 *Sensor* is the name of the device that measures this parameter.

10 *Unit* shows the used parameter unit. This can be changed if necessary.

11 *Decimals* is the number of displayed decimal places of the parameter. This can be changed if necessary.

12 *Averaging* displays the number of previous readings used to calculate the moving average. The value 1 (factory setting) deactivates averaging.

13 *Limits* shows the defined measuring range for the parameter used. *Error Limits* shows the range outside of which an error message is displayed for this parameter.

14 These check boxes define, if the reading display will be limited to the measuring range (*Value clipping*).

15 When activating the checkbox *Ignore Error* a parameter error will not cause an error message of the device (e.g. no red background of the reading or red device LED).

16 *Application* defines the typical water type for this parameter. The *Id* and the *Creation Date* are the identification of the default parameter configuration.

17 The selection field *User level* defines, if the parameter is always visible (*guest*) or only visible after a specific user is logged in (e.g. *user* or *expert*).

18 Pushing the button *Remove Parameter* will not display and store the readings of this parameter anymore and move the parameter to the inactive parameters.

19 As soon as any setting has been changed, the text *Data modified* is visible on the display. Push the button *Save* to store the new settings permanently or the button *Cancel* to avoid any changes.

20 When using vali::tool, the clipping of the displayed measurement value to the measuring range (see [14] above) is set in the section *Value Clipping* of the *Data Validation* register sheet.

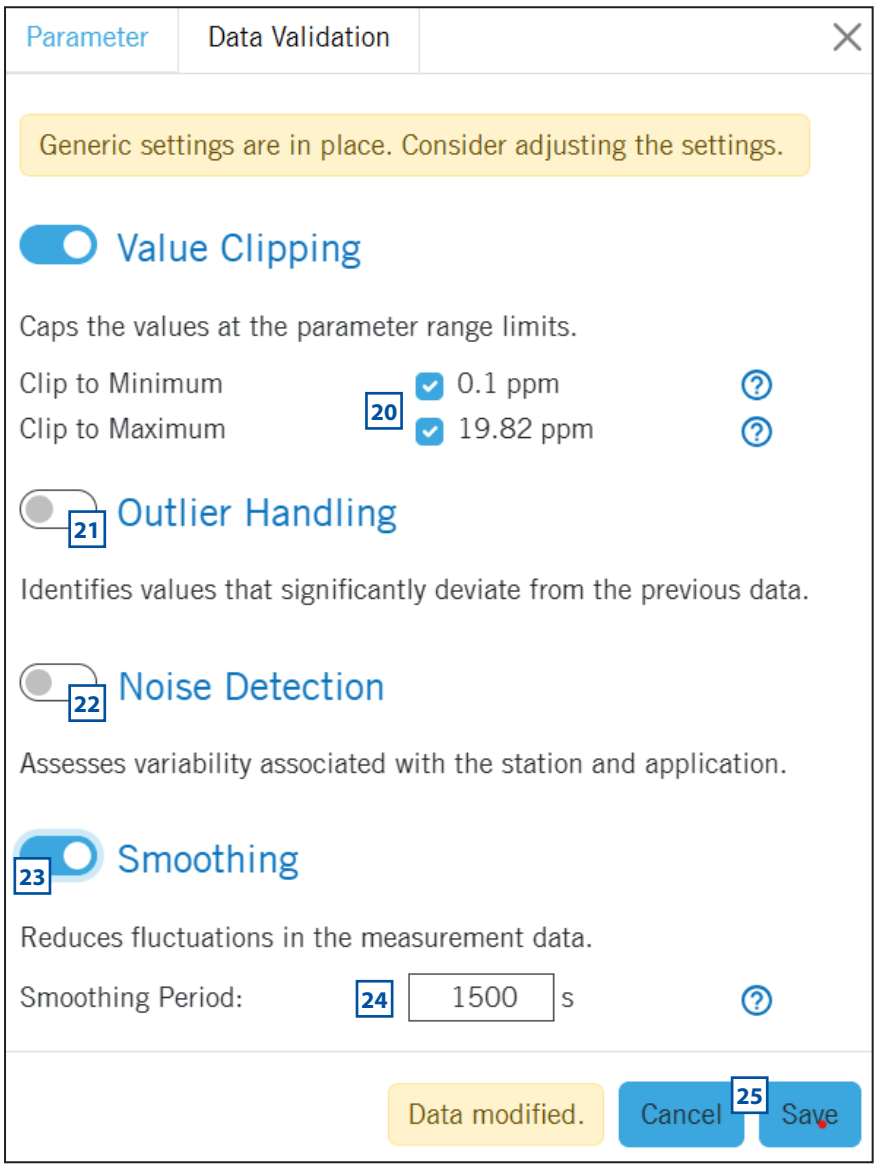
21 Activation and configuration of the verification of measurement outliers (*Outlier Handling*). Details can be found in the help text (*?*) and in the vali::tool user manual.

22 Activation and configuration of the check for high scattering of readings (*Noise Detection*). Details can be found in the help text (*?*) and in the vali::tool user manual.

23 Activation and configuration of the averaging of measurement readings (see [12] above) is set in the section *Smoothing* in the *Data Validation* register sheet.

24 The time range (*Smoothing Period*) used for averaging is defined here in seconds (*s*) and not in the number of measurements.

25 Click on the button *Cancel* to keep the settings of vali::tool *Data Validation* unchanged. Click on the button *Save* to store the modified settings.



6 CALIBRATION

The ammo::lyser is equipped with quality certified measuring electrodes and ready for use. Because the electrodes have to adapt to the composition of the measured medium (background matrix), a certain time for conditioning is needed (see technical specifications). As soon as the measurement is stable, a matrix adaption (local calibration) can be performed if needed.

6.1 Types of Calibration

The ammo::lyser is equipped with a global calibration (factory setting) for each installed electrode. A reset to this global calibration is possible at any time. The table below can be used as assistance, to decide which calibration type shall be used:

Global Calibration	Local Calibration	
	Offset Calibration with 1 Sample	Linear Calibration with 2 Samples
▪ At initial startup ▪ During conditioning ▪ After electrode replacement ▪ In case of failed (not accepted) linear calibration	▪ At initial startup, in case reading does not correlate with reference value after completed conditioning (matrix adaption). ▪ If sensor displays zero, although concentration in measured medium is > 0.3 mg/l ▪ If sensor displays stable reading > 0.3, although concentration in measured medium = 0. ▪ During routine functional check to adapt the reading to the reference value. ▪ If readings are drifting to higher concentrations. ▪ After electrode replacement, in case reading does not correlate with reference value after completed conditioning and activated global calibration.	▪ If reading correlates with reference value at lower concentrations, but differs at higher concentration. ▪ If higher accuracy of measurements is required. ▪ If measurement range shall be changed. ▪ When the electrode is aged, but shall not be replaced yet (adaption of electrode slope).

6.2 General Notes for Calibration

- The local calibration can be performed either directly in the measured medium without removing the sensor from the installation place (recommended) or outside in a beaker (min. 250 ml) with calibration solution.
- First the temperature, then pH and Potassium and finally the other ISE electrodes shall be calibrated.
- Before performing any kind of calibration ensure appropriate conditioning time of the sensor (see technical specifications).
- Before performing a local calibration ensure the correct function of the sensor (see section 8).
- During calibration ensure that the complete measuring head (i.e. all electrodes) are submersed into the measuring medium and protective caps are removed.
- The temperature sensor can be calibrated on air or in the measuring medium towards a reference thermometer.
- If a linear calibration was performed outside the measuring medium successfully and there is still a difference between the real concentration in the measuring medium and the sensor reading after installation, an offset calibration shall be performed directly in the measuring medium additionally.

A local calibration is performed by the following steps:

1 Check sensor readings:

- Check on the controller for operation, if the sensor readings are stable (no jumps, no scattering, no drift) for at least 5 consecutive measurements.
- Open calibration menu and wait until displayed quality number is > 0.9.

2 Take sample & store actual reading:

- Push button *Sample* to store the actual reading on the sensor. The previous sample value will be overwritten.
- Take a sample for reference measurement at the same time close-by the measuring electrode.
- Now you can switch the controller for operation back to normal measuring mode.

3 Analyze reference sample:

- If required, filtrate and stabilise the reference sample.
- Analyse the reference sample as soon as possible.

4 Performing local calibration:

- Open calibration menu on controller for operation.
- Enter the reference value of the appropriate sample.
- Check if the desired calibration type (offset, linear) is selected.
- Perform the calibration by pushing the calibrate button.

5 Check sensor readings:

- Wait if any error message is displayed.
- Wait for next measurement.
- Check if reading is plausible and no status error is displayed.

6.3 Special Notes for Calibration of ISE Electrodes

Ion type, ionic strength and other characteristics of the measuring medium will significantly affect the results obtained with the ion selective electrodes. For highest accuracy the same environment conditions (temperature, flow velocity, pH) shall be ensured during the calibration procedure like during the normal operation. Therefore it is recommended to perform calibration directly in the measured medium with sensor installed. Ideally, two samples are used which were taken at different times, and represent the high and low values of the measuring range that is expected in the application.

If standard solutions are needed for calibration, never use normal standards ready for use, because these are made with distilled water and will never represent a natural ion background matrix. Standard solutions can be made quickly and easily with the real measured medium or drinking water by adding high concentrated standards (spiking).

The table on the right shows a selection of possible standards that can be used for spiking the samples.

Name	Concentration [1)]
Ammonium Standard Solution	1000 mg/l NH4-N
Potassium Standard Solution	1000 mg/l K
Nitrate Standard Solution	1000 mg/l NO3-N
Chloride Standard Solution	1000 mg/l Cl
Fluoride Standard Solution	1000 mg/l F

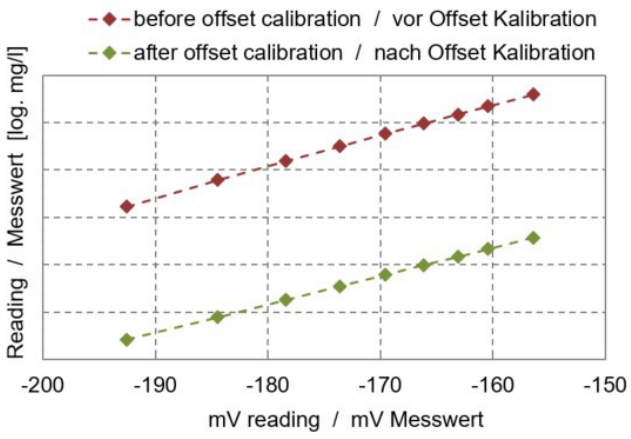
1) The Ammonium concentration of 1 liter sample can be increase by 10 mg/l by adding 10 ml of standard.

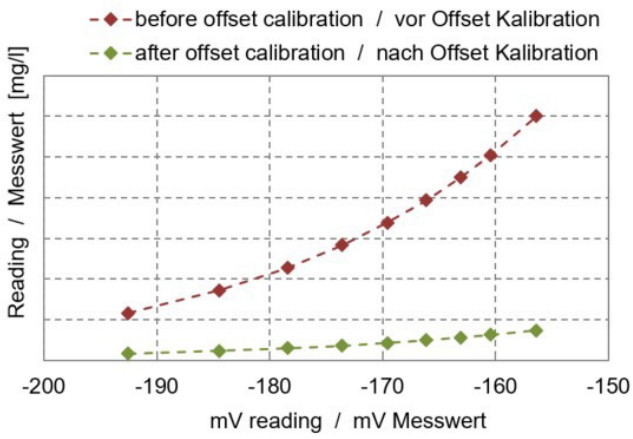
- The samples used for a two point calibration should represent the total measuring range, but the concentration difference must not be more than a factor 100.
- As a general rule sample 1 should be approx. 2.5 % and sample 2 should be approx. 90 % of the max. measured concentration.
- The upper measuring range will be redefined by a linear calibration (higher lab value + 10%). Higher values will be displayed but System Status will be set to Warning. That means, if high sample with NH4-N = 18 mg/l is used, the upper measuring range will be 18 + 10% = 19.8 mg/l.

Within the table below you will find two further examples for sample spiking with 1000 mg/l standard:

Sample 1	Concentration	Standard added	Concentration of Sample 2	New Measuring Range
1.0 liter	0.3 mg/l	5 ml	5.3 mg/l	0 - 5.83 mg/l
0.5 liter	2.8 mg/l	10 ml	22.8 mg/l	0 - 25.08 mg/l

The local calibration is applied to the raw value (mV readings) and not to the calculated concentration (mg/l value). The correlation between mV and mg/l value is not linear but logarithmic. That means performing an offset calibration will not change the mg/l readings by a constant factor. The two figures below are showing the effect of an offset calibration.

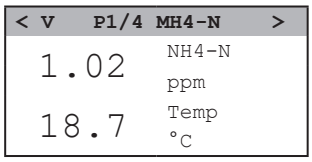


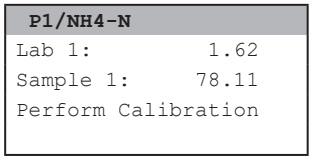


6.4 Performing a Calibration using con::lyte

This controller for operation provides, in addition to the normal calibration procedure (see further down), the possibility for a quick calibration call directly from the parameter view. This is performed by following steps:

- Select the parameter in the parameter display with *Up-* or *Down* button.
- Push *OK* button, which directly displays the calibration screen.
- Select *Sample 1* and confirm with *OK* to store the raw signal of the actual reading.
- Take a water sample to analyse real parameter concentration.
- Enter the result from laboratory analyse into the field *Lab 1*.
- Select entry *Perform Calibration* and confirm with *OK*.
- Leave the calibration screen with *Back* button.

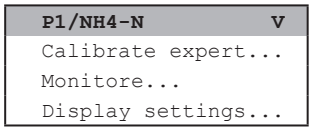




Now the selected parameter is local calibrated.

The advanced local calibration provides extensive possibilities for the calibration of the selected parameter. This is performed by the following steps:

- Select the parameter in the parameter display with *Up-* or *Down* button.
- Push the *Function* button.
- Selecting the menu *Calibrate expert...* and push the *OK* button.



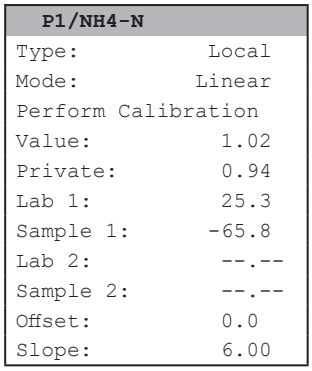
Now the complete calibration screen is displayed and provides the following options:

- *Type* — Two different types of calibration are available: *Local* (customer calibration) or *Global* (factory calibration). By default *Local* is selected. This is the normal calibration performed by the operator. As soon as *Global* is selected and confirmed with *OK*, a reset to the factory calibration (global) is performed.
- *Mode* — As available local calibration variants either *Offset* or *Linear* can be selected.

⚠ A local calibration can be performed either starting from type *Global* or *Local*. Depending on this either the global slope or the local slope will be used when perfoming an offset calibration.

- *Perform Calibration* — Confirming this entry by pushing the *Ok* button will execute the local calibration, using the *Lab* and *Sample* values displayed on the calibration screen.
- *Value* — Displays the measured value of the sensor like on the parameter screen (i.e. using the actual calibration). The value will be updated permanently.
- *Private* — Displays the quality number of this reading. The quality can vary between 0 (bad) and 1 (perfect). It should be > 0.9 when storing the displayed value as a sample.The value will be updated permanently.
- *Lab 1* — Within this line the correct value for the measured *Sample 1* must be entered. The unit of the *Lab* must be in accordance with the measuring parameter.

  An entered *Lab* value can be deleted by selecting it and pushing the *Function* button so that it will not be used in the calibration.



- *Sample 1* When confirming this entry by pushing the *Ok* button, a measurement will be performed and stored as first sample 1 for the local calibration. The sample for the laboratory should be taken at the same time. The displayed and stored value, which will be used for the calibration is the raw value (mV value) and therefore might be negative also.
  Existing readings (*Sample 1* or *Sample 2*) are overwritten whenever a new measurement is performed by pushing *OK*. If no sample measurement was performed or if the measurement was invalid, the message *Measure!* or dashes (--.--) will be displayed instead of a numerical value.
- *Offset* Displays the used offet of the actual calibration. It is not possible to edit this value.
- *Slope* Displays the used slope of the actual calibration. It is not possible to edit this value.

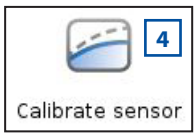
6.5 Performing a Calibration using con::cube (moni::tool)

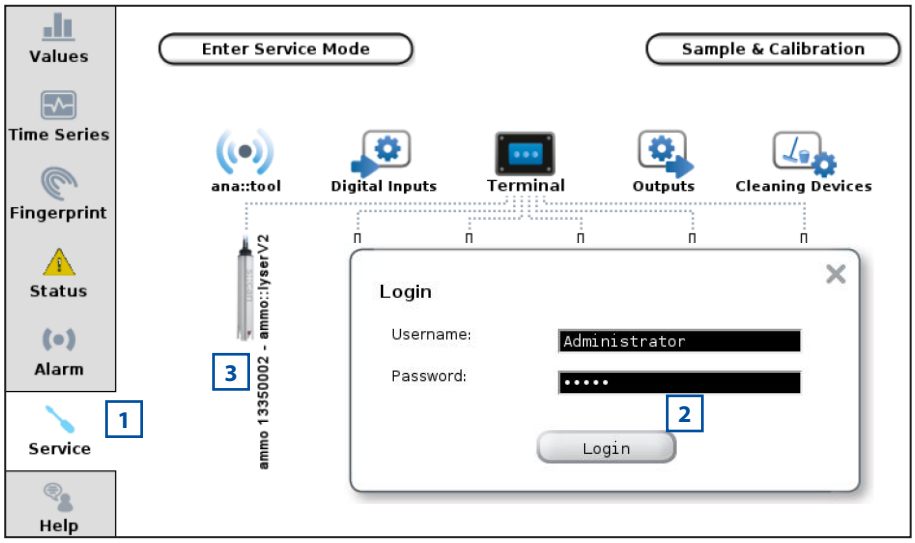
1 Click the *Service* tab of the moni::tool screen.

2 Logon as *Administrator* with password *admin1* or your individual username.

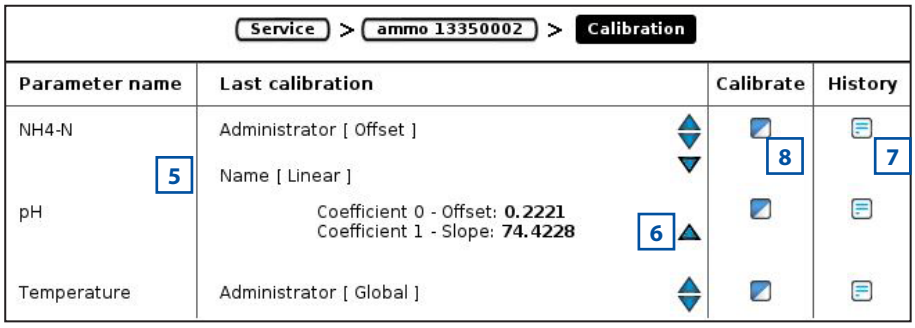
3 Click the icon of the sensor you want to calibrate in the displayed system overview.

4 Click the icon *Calibrate sensor* in the next screen.





5 Now the screen shows a list of all parameters being measured by this sensor (*Parameter name*).



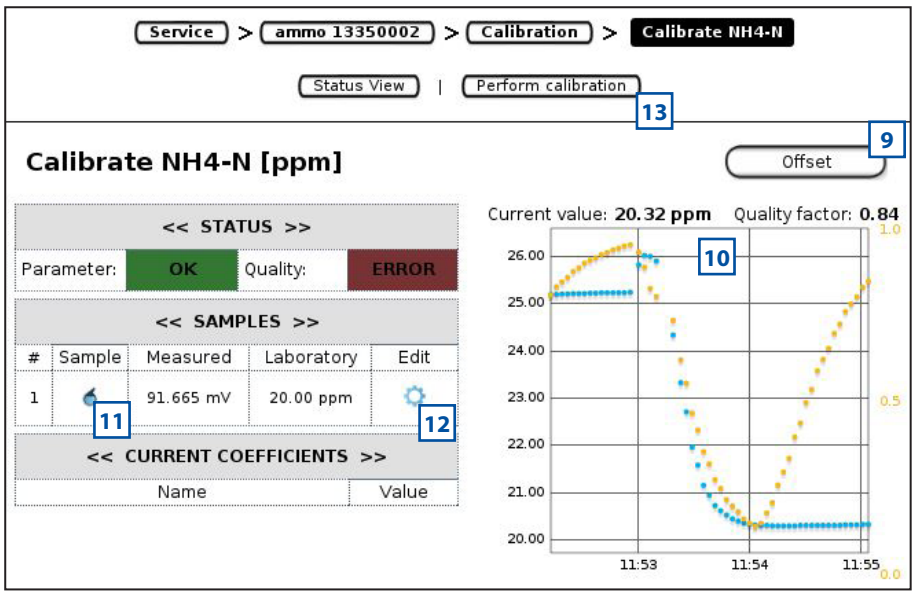
6 Clicking on the blue triangles will display more information about actual used calibration for this parameter.

7 Furthermore a click on the *History* icon rightmost opens a logbook showing all calibration procedures performed with this con::cube up to now.

8 Open the calibration screen by clicking on the *Calibrate* icon on the right side of the parameter you want to calibrate.

9 This button displays the actual used calibration (*Global*, *Offset* or *Linear*). Push this button to select the type of calibration you want to perform.

10 The current reading and the quality factor of the parameter will be displayed numerically and graphically. Wait until readings are stable (*Quality OK*).



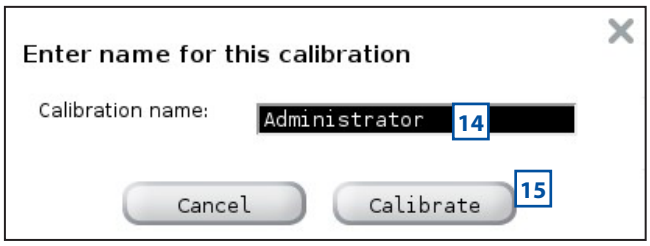
11 Push the *Sample* icon to perform a new measurement and store the reading on the probe. Please note that the value displayed below *Measured* is the raw value (mV reading). The *Sample #1* will be used for offset and linear calibration.

12 Push the *Edit* icon to enter the result of the laboratory analysis and store it on the probe.

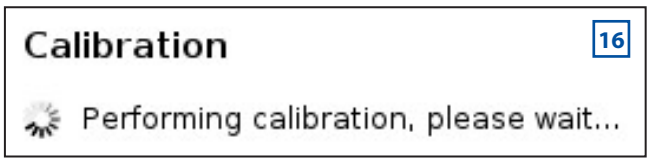
13 Push the button *Perform Calibration* to start the calibration procedure.

14 In the next window an individual name can be entered to describe the calibration (*Calibration name*).

15 Push the button *Calibrate* to continue the calibration procedure.



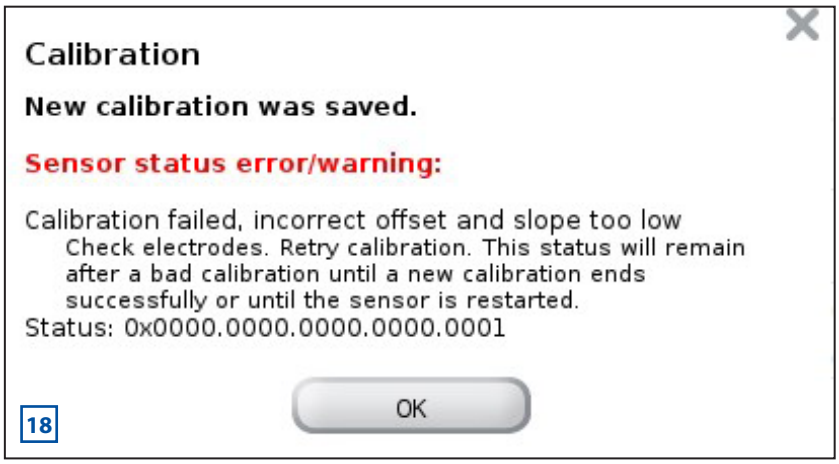
16 During the calibration procedure a message is displayed on the screen.



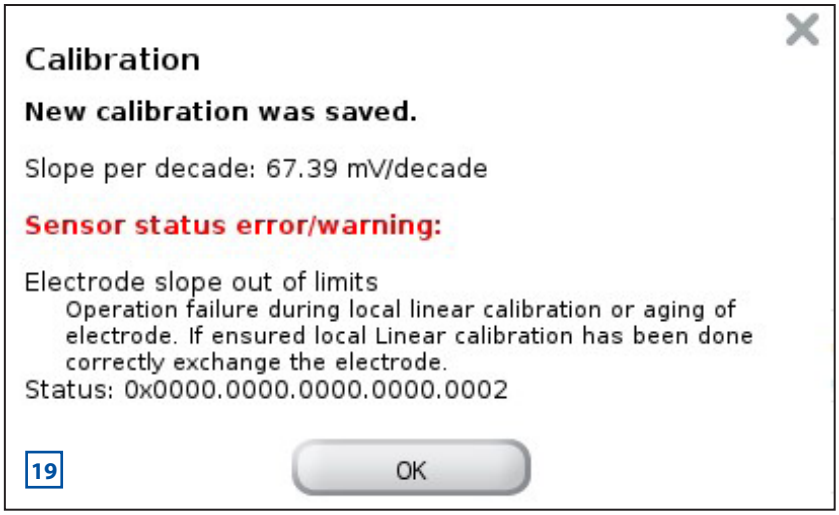
17 After the calibration procedure is finished a user message will inform the operator, if the local calibration was successful (see figure on the right) or not (see figures on the next side).

The calculated *Slope per decade* will be displayed in case of a linear calibration. This might help to judge the electrode quality (see section 8.5).

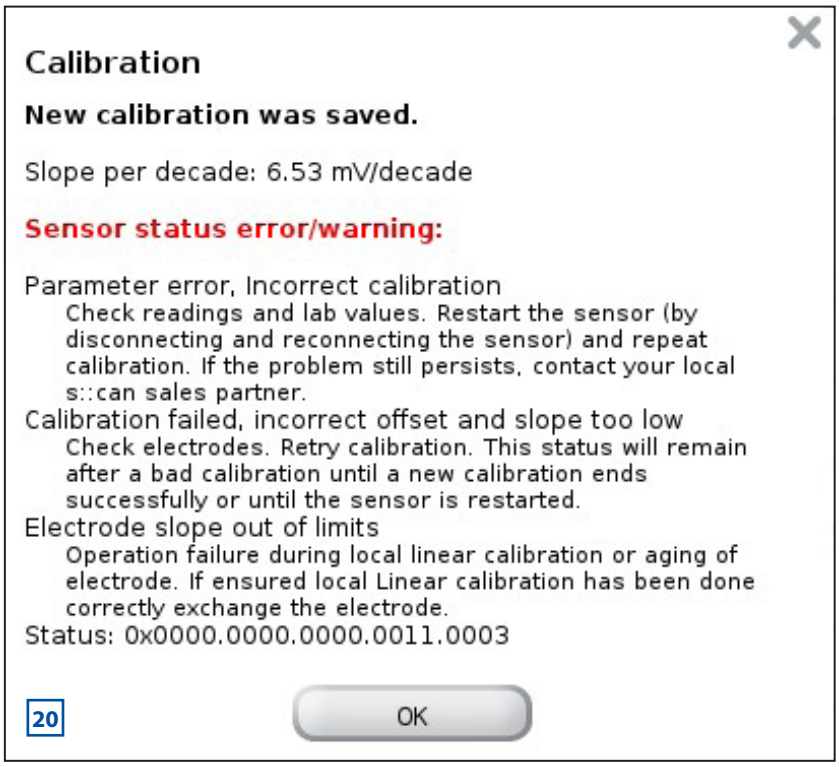
18 If the offset of the local calibration is incorrect or the slope is too low, the displayed user message will look as shown in figure 18 on the right.



19 If the slope of the local calibration is too high, the user message will look as shown in figure 19 on the right.

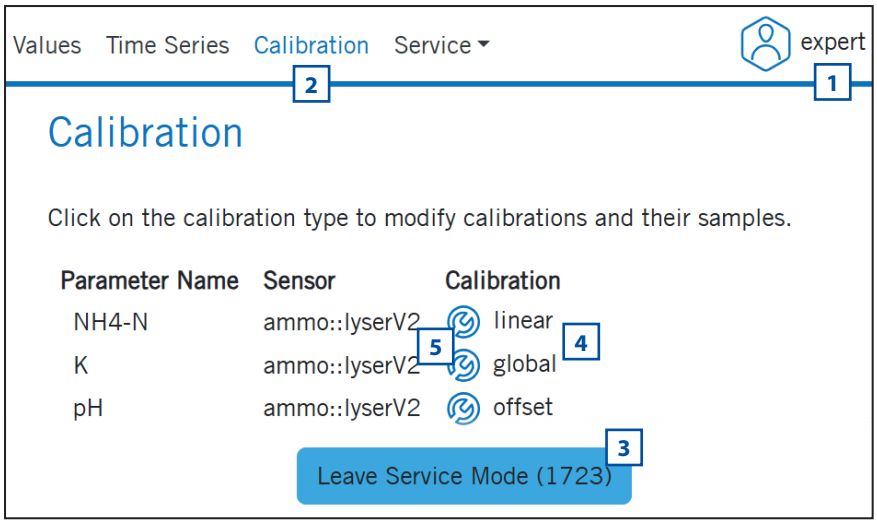


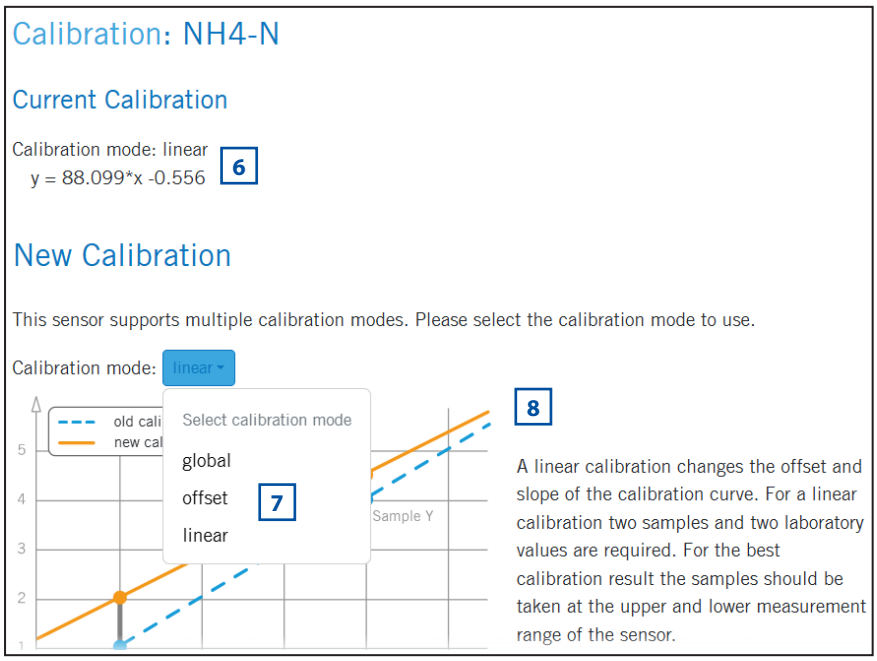
20 If several calibration failures have occured, all of them will be displayed in the user message as shown in figure 20 on the right.



! In case a *Sensor status error / warning* is displayed, the performed local calibration will be refused and the ammo::lyser will stay unchanged.

6.6 Performing a Calibration using con::line (Io::Tool)





1 Ensure you are logged in as user *expert* (see section 5.3.3).

2 Push the main menu item *Calibration*.

3 Push the button *Enter Service Mode*, to stop the measuring process. The button name will be changed to *Leave Service Mode*.

4 Within the listed parameters the actual used type of *Calibration* is displayed (e.g. *global*, *offset* or *linear*).

5 Pushing on the blue tool icon on the left side of the calibration type (*Calibration*) will open the calibration window for this parameter.

6 The actual used *calibration mode* with the used offset and slope is displayed.

7 Push the drop-down menu button on the right side of *Calibration mode* to select the calibration to be performed.

8 The effect of the selected *Calibration mode* is explained here as a diagram and as plain text.

9 Push the button *Trigger Measurement* to start a single measurement. Once the measurement process is complete, the *Measurement date* and the displayed parameter values are updated.

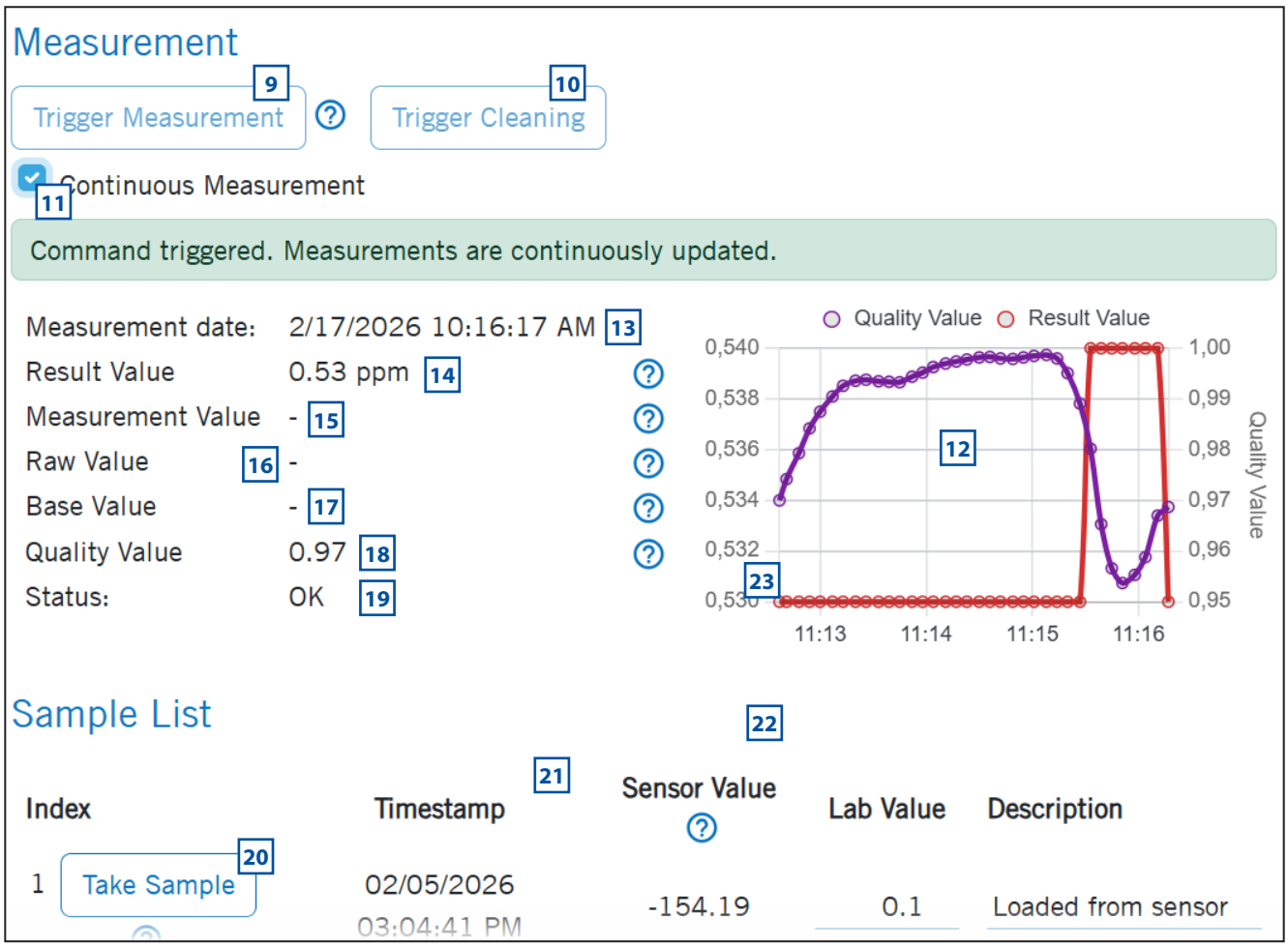
Please note that these measurements are not stored in the database (i.e. not visible in time series or transfered via data export).

10 Push the button *Trigger Cleaning* to start a single automatic cleaning cycle.

11 Activate the checkbox *Continuous Measurement* to start a fast automatic measurement mode. The *Measurement date* and the measured parameter values will be updated automatically.

12 If the *Continuous Measurement* is activated, all sensor values are displayed graphically as a time series. Individual time series can be deactivated by clicking on the name in the legend (legend label will be crossed out).

13 The date and time stamp of the last measurement is displayed here (*Measurement date*).



14 The *Result Value* is the same value that is displayed in the *Value* screen of the con::line (i.e. after clipping to measuring range and quality check).

15 The *Measurement Value* is the local calibrated value without limitation to the measuring range and without quality check. It is only displayed, if it differs from the *Result value*.

16 The *Raw Value* is the sensor reading, with the same unit as the *Measurement Value*, before performing any local calibration. It is identical to the global sensor reading. It is only displayed, if it differs from the *Measurement Value*.

17 The *Base Value* is the original physical signal of the sensor. It has a different unit than the final reading (e.g. mV) and is only displayed, if it differs from the *Raw Value*.

18 The *Quality Value* is an indicator for the stability of the sensor signal (*Base Value*). If the value is > 0.9, the sensor signal is stable (*Ok*) and can be used as a sample measurement for a local calibration.

19 The *Status* of the sensor is displayed here as plain text.

20 Push the button *Take Sample* to perform a measurement and store it on the sensor as sample reading for a local calibration.

21 The *Timestamp* of the stored sample used for local calibration is displayed.

22 The *Sensor Value*, which will be either the *Raw Value* or the *Base Value* of the stored sample is displayed.

23 The value of the used standard or the reading of the handheld can be entered here (*Lab Value*).

24 Push the button *Save Sample List* to store all modified data on the sensor itself.

25 A user message confirms that the sample list has been saved successfully.

26 Push the button *Perform Calibration* to execute the local calibration.

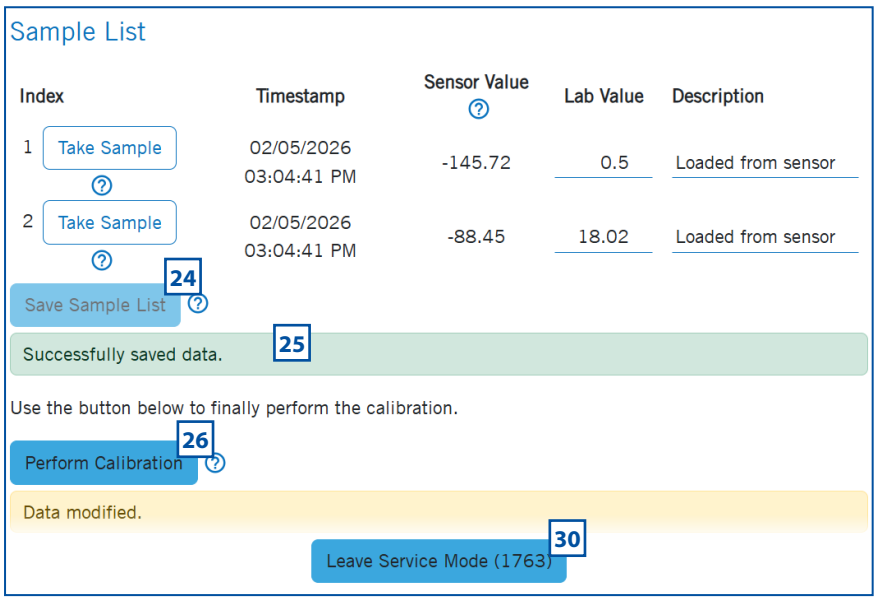
27 In case an error occured while saving the sample list or performing a calibration, the user will be informed.

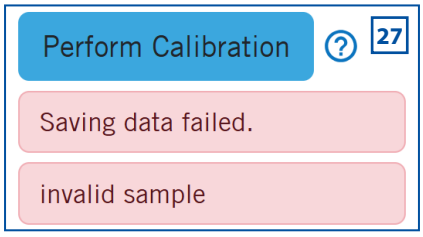
28 Push the button *Trigger Measurement* to start one manual measurement and check if the Status is *OK* after the local calibration.

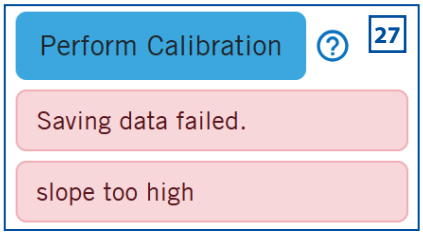
29 If the local calibration is not *OK*, the warning or error reasons are explained in plain text in yellow or red (*Status*).

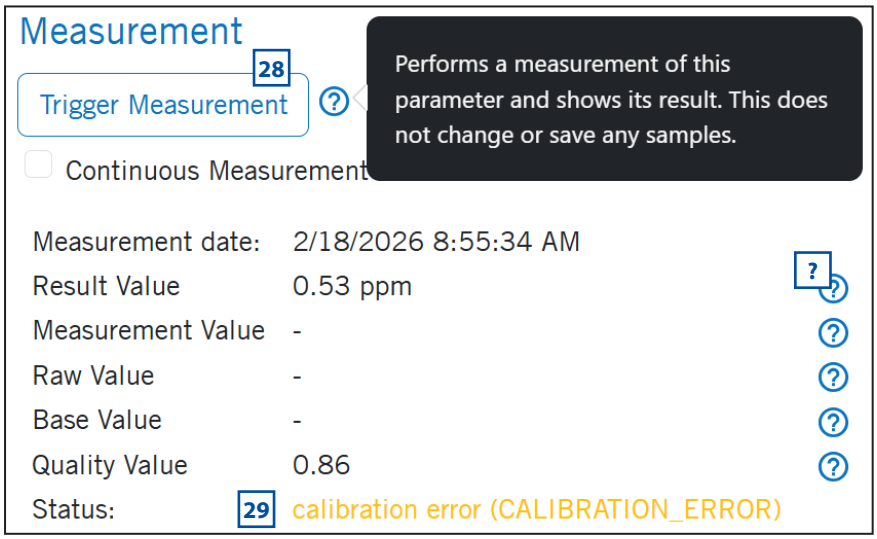
30 Finally push the button *Leave Service Mode* to end the calibration and start normal measurement again.

? In case any displayed number or button is not clear within the calibration menu, simply click the blue question mark icon (*?*) to open a window with help text.









7 DATA MANAGEMENT

7.1 Data Storage

The following information is stored directly on the sensor:

- Global calibration (default settings) for all parameters
- Actual used local calibration for all parameters
- Reading of two sample measurements for each parameter
- Laboratory result (comparison value) of two samples for each parameter
- Information for compensation of parameter readings
- Device information (e.g. electrode type for each slot, serialnumber, address, please refer to section 10.3)

The sensor readings can be stored on the controller used for operation. There is no possibility to store readings on the sensor itself.

7.2 Data Transfer

The measurements are performed on the sensor and the readings are transfered to the controller used for operation via the sensor cable using Modbus RS 485.

The reading can be transfered from the sensor either as parameter concentration [e.g. mg/l] or as raw value [mV]. Transfer and storage of mg/l and mV at the same time is not possible.

7.3 Data Visualisation

For visualisation of the sensor readings one of the following Badger Meter controller for operation or tools can be used:

- con::lyte (parameter readings)
- con::cube (parameter readings and time series)
- con::line in combination with Io::Tool (parameter readings and time series)
- visu::tool for offline visualisation of parameter readings and status messages

8 FUNCTION CHECK

A function check might be required for one of the following reasons:

- Initial startup
- Routine function check
- Suspicion of monitoring system malfunction
- Modification of monitoring system (e.g. integration of additional sensor or device)
- Change of measuring point / location

Depending on the application (water composition), the probes and sensors used and the environmental conditions a regular function check (weekly to monthly) is recommended. The following sections provide an overview of all the actions that must be performed to check the monitoring system quickly (see section 8.1), to check the plausibility of the collected readings (see section 8.2) and to check the integrity of a single probe or sensor (see section 8.3).

8.1 Check of System / Monitoring Station

Check if the monitoring system is powered and operational			
con::lyte	con::cube / moni::tool	con::line / Io::Tool	Remark
▪ Green LED is on? ▪ Readings are visible on the display after touching one key? ▪ Displayed system time is current and is updated every second?	▪ 4 LEDs on housing cover are light up or at least flashing? ▪ moni::tool screen is displayed after touching the screen? ▪ Click on system clock at the bottom of the screen will shows current time and last measurement. Both are current?	▪ 4 LEDs on housing cover are light up or at least flashing (at least during measurement)? ▪ Io::Tool can be started on mobile device? ▪ Displayed date and time on the bottom of the screen is current?	▪ Check power supply of controller. ▪ Check battery and solar panel in case of battery usage. ▪ Power off controller for 2 minutes and power on again.

Check if the monitoring system is measuring automatically and readings are updated continuously			
con::lyte	con::cube / moni::tool	con::line / Io::Tool	Remark
▪ Push button *Left* to enter *Status* view. ▪ Check if counter of *Waiting* time is active. ▪ Check if Service mode is not active. ▪ Check if measurement is not paused	▪ Check counter in the lower right corner of the moni::tool screen, which displays the remaining time until next measurement. ▪ Check time series. ▪ Check if Service mode is not active.	▪ Check counter at the bottom of the Io::Tool screen, which displays the remaining time until next measurement. ▪ Check time series. ▪ Check if Service mode is not active.	▪ Check measuring interval. ▪ Leave Service mode.

Check if the Status of the monitoring system is OK

con::lyte	con::cube / moni::tool	con::line / Io::Tool	Remark
▪ No error messages or error symbols are displayed in the header line? ▪ Check whether an alarm is pending.	▪ LED of con::cube is blue and *Status* icon of moni::tool is not blinking yellow? ▪ Open *Status* tab and select symbol of affected sensor for more information.	▪ LED of con::line is blue (at least during measurement)? ▪ Readings are displayed within a blue circle? ▪ Check device status in *Service / Status*	▪ Note all displayed error messages. ▪ Download logbook. ▪ See section 8.2 for check of parameter readings. ▪ See section 8.3 for check of sensor integrity.

Check of installation and automatic cleaning

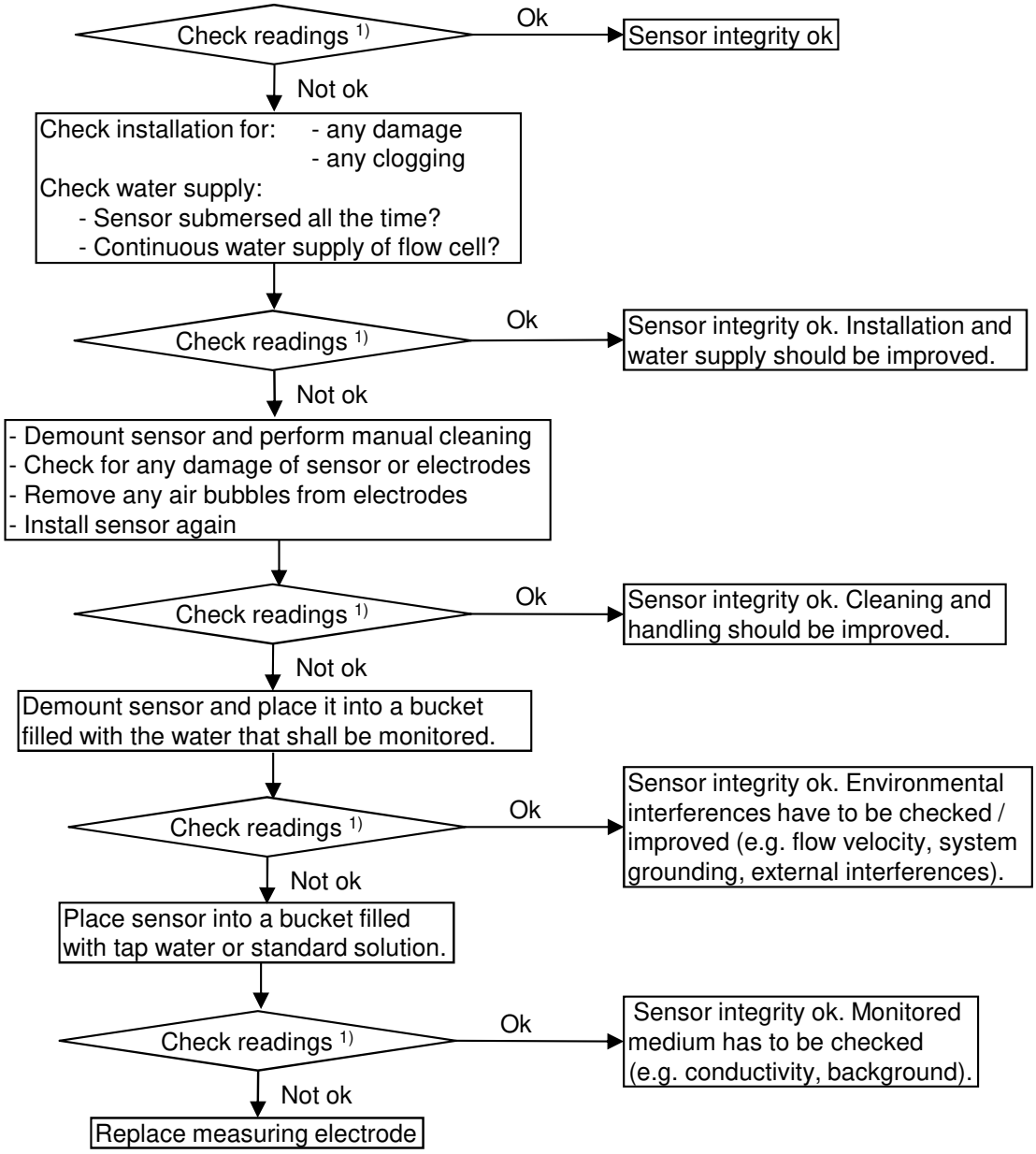
Monitoring system	Remark
▪ Monitoring station (by-pass)	▪ All tubes and fittings are tight and all probes and sensors are supplied with medium? ▪ No air bubbles within the tubes?
▪ Submersed Installation (in-situ)	▪ Mounting equipment of all devices is ok and all probes and sensors are submersed? ▪ Flow conditions are stable (little turbulences, etc.)?
▪ Automatic cleaning is operational	▪ Use function *Clean now* or wait for next cleaning cycle. ▪ Watch for air bubbles when cleaning is activated.
▪ Compressed air supply for automatic cleaning	▪ All tubes and fittings are tight?
▪ Function of compressor and storage tank	▪ Drain condensed water from storage tank of compressor (not necessary for compressor B-32). ▪ Check function of the compressor (see manual of compressor).

8.2 Check of Readings

Check	Reason	Remark
▪ Current readings: Completely displayed. No NaN and no dashes (- - - -,- -) or plus signs (++++,++) are displayed.	▪ No communication to sensor ▪ Parameter error ▪ Reading is too long to be displayed ▪ vali::tool error	▪ Use arrow buttons / scroll bar to scroll through all displayed parameters. ▪ Check status and configuration of the parameter.
▪ Status of displayed readings:	▪ Red background or frame for parameter indicates an error or alarm. ▪ Grey background or frame indicates reading is not current. ▪ Flashing background indicates an error.	▪ Check parameter status ▪ Check sensor integrity
▪ Up-to-date: Readings are updated on regulary base?	▪ Measuring interval is too long ▪ Automatic measurement has been stopped manually	▪ Consider measuring interval and smoothing.
▪ Continuity: Check historical readings (timeseries) for interruptions or discontinuities	▪ Change of medium ▪ Local calibration ▪ Maintenance of probe / sensor (cleaning, etc.) ▪ Readings out of range ▪ System failure (loss of power, communication error, etc.) ▪ Unsteady flow through flow cell installation	▪ Check only possible if timeseries are availbale. ▪ Use visu::tool to display the time series.
▪ Plausibility of timeseries: Timeseries reflect daily / seasonal fluctuation or known process changes	▪ Drift of readings (can be caused by fouling or aging of electrode) ▪ Increasing noise (can be caused by flow conditions or fouling) ▪ Fixed readings / no fluctuation	▪ Check logbook of plant operator if possible.
▪ Measuring range: Readings are within the specified and calibrated measuring range?		▪ Quality of results might be reduced outside the specified range.
▪ Accuracy: Difference between laboratory (comparison) values and readings of the sensor	▪ In case of significant difference during initial operation, a local calibration must performed (please refer to section 6). ▪ In case of significant difference during normal operation, a function check must be performed.	▪ To verify the accuracy of the displayed readings, only a reliable and validated comparison method has to be used.
▪ Data transfer		▪ Check if displayed readings on local controller are equal with displayed readings on customer display system.

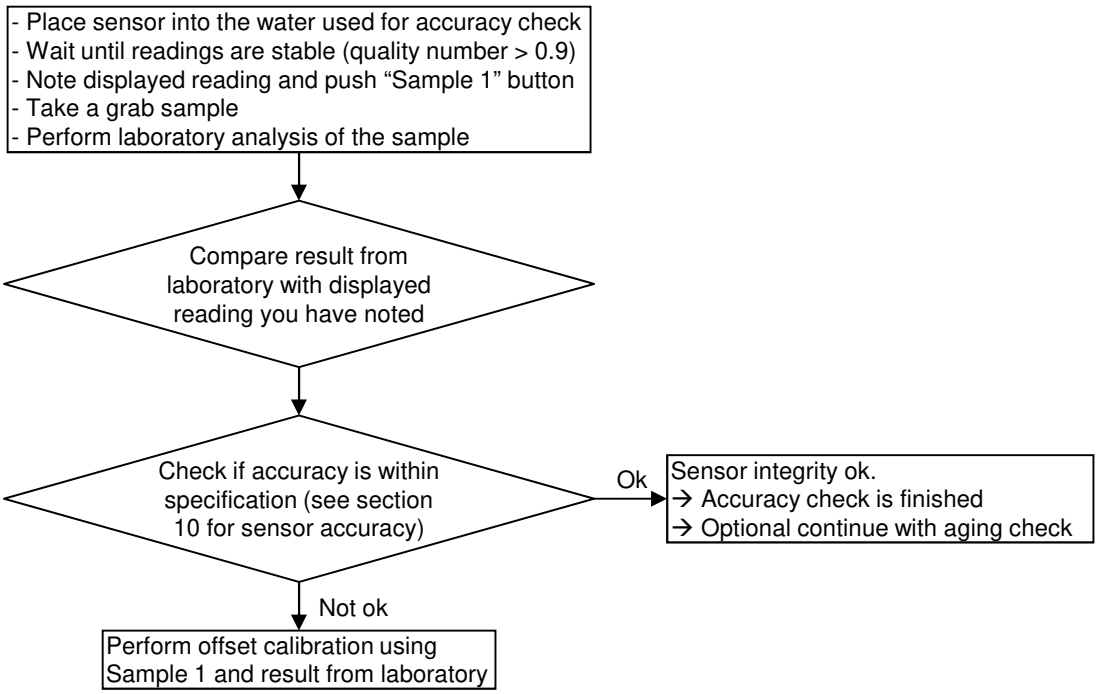
8.3 Check of Sensor Integrity

When there is any doubt regarding the integrity of the sensor, please use the following flowchart to check sensor and installation:



[1] Check if the sensor readings are plausible and stable (no jumps, no scattering, no drift) for at least 5 consecutive measurements.

8.4 Check of Accuracy



8.5 Check of Electrode Aging

Aging of an ISE electrode means the sensitivity decreases. This can be quantified by checking the electrode slope. The electrode slope of a new electrode is 56 mV per decade at 20°C (54 mV at 10°C and 58 mV at 30 °C). Once the electrode slope has reached the lower limit (i.e. 20% of original slope, see table below also), the electrode needs to be replaced.

Slope per decade	% of original slope	Electrode Status	Comment
25 - 59 mV	45 - 105 %	fully operational	electrode ok [1)]
12 - 25 mV	20 - 45 %	already aged	reduced accuracy, electrode can be replaced
< 12 mV	< 20 %	dead	electrode has to be replaced

[1)] The electrode slope of a new or refurbished electrode depends on the background matrix of the measured water. High amount of interfering ions and / or high conductivity will reduce the slope.

The actual electrode slope (i.e. the actual electrode status) can be checked by using one of the following possibilities:

- Performing a linear calibration. Whenever a linear calibration is performed, the electrode slope is checked internally. The linear calibration will be rejected in case the electrode slope is too low.
- When the con::cube (moni::tool) is used to perform the linear calibration, the electrode slope (slope per decade) will be displayed as additional information. Using the table above the operator can judge the actual electrode status.
- The electrode slope can be calculated by the operator himself based on the two sample readings in different standards with known concentrations (see formula for calculation below). If the difference of the used standards is a factor of 10 (e.g. 2 mg/l and 20 mg/l) the slope per decade is simply the difference of the mV readings.

  Slope per decade [mV] = (mV Sample1 - mV Sample 2) / (LOG (mg/l Sample 1 / mg/l Sample 2))

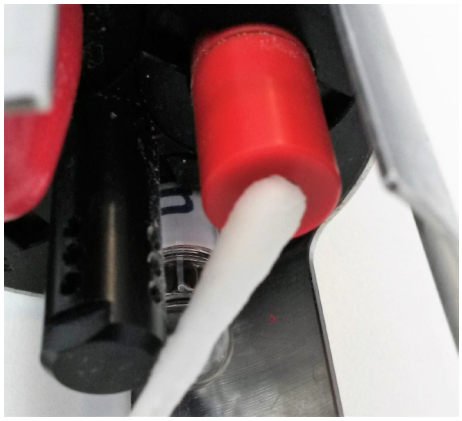
9 MAINTENANCE

9.1 Cleaning

During routine operation the cleaning of the ammo::lyser, i.e. the measuring electrodes of the sensor, is performed automatically via compressed air. To clean the sensor manually the following is recommended:

⚠ Before demounting the sensor be sure that automatic air cleaning is deactivated via operating software and air supply line is depressurised to avoid dirt and / or injury by suddenly escaping pressurized air.

- Rinse sensor with hand-hot (lukewarm) drinking water to remove course deposits from the sensor housing. To clean the sensor housing (not the electrodes themselves) a soft cleaning agent (e.g. dishwashing detergent) can be used.
- Put the sensor in a bucket of hand-hot drinking water for several minutes. A laboratory brush can be used to remove deposits on and in between the measuring electrodes (see figure on the right hand side).
- The cleaning of the measuring electrodes is performed by using a soft cloth (one that does not leave behind fibres), cotton swabs (see figure on the right hand side) or paper tissues that are moistened with tap water before they are applied.



⚠ When cleaning the measuring electrodes, care has to be taken that the membranes are not damaged (do not use abrasive materials such as scouring sponges or stiff brushes).

⚠ Never use tenside or surfactant containing cleaning agents (washing liquid) to clean the electrodes or the membranes.

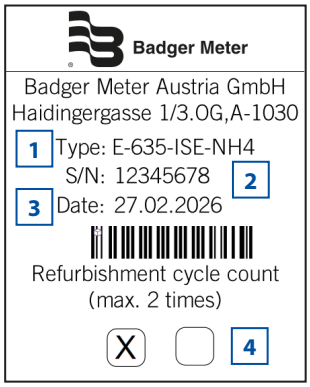
9.2 Refurbishment of Electrodes

The ISE electrode is a typical spare part and has to be replaced regularly. Some types of electrodes (NH4-N, K, NO3-N) can be refurbished at Badger Meter Austria. That means that all aged components (membrane cap, electrolyte) will be replaced and the refurbished electrode will be tested for it's quality.

This refurbishment can be ordered directly by email from Beadger Meter Austria (austriasales@badgermeter.com). Please specify the type and number of electrodes. You will receive a quote with a return number for the used electrodes..

On all electrodes is a label attached that provides the following information:

1. Type der electrode
2. Serial number (S/N)
3. Production date
4. Number of refurbishment (2 refurbishments are possible)



9.3 Replacement of Electrodes

The electrodes need to be replaced regularly (see technical specifications regarding life time). The replacement is performed by the following steps:

1 For replacement of the electrodes you need the ammo::lyser itself, replacement electrode, tool for electrode replacement (E-532-TOOL) and paper tissue for cleaning.

2 Clean the sensor as explained in section 9.1.Finally dry the electrodes and electrode head with an absorbant paper tissue.

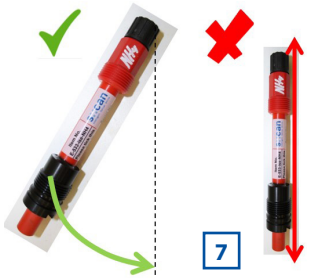
3 Screw out the electrode that needs to be replaced using the tool for electrode replacement (E-532-TOOL). Doing this, hold the sensor slightly inclined to ensure no moisture can enter the electrode slot.

4 Remove the old electrode from the slot and check if there is any dirt or moisure within the electrode slot. Whipe it clean and dry with a paper tissue if needed.

5 Unpack the new electrode carefully.

6 The pH- and reference electrodes are protected with a cap. Before removing the cap cut the cable strap that fixes the cap.

7 Take the new or refurbished ISE electrode and shake it like a mercury thermometer to remove air bubbles from the internal side of the membran.



8 Make sure that the threads, all sealing O-rings and the electrode plug are clean and undamaged before putting the electrode carefully into the slot.

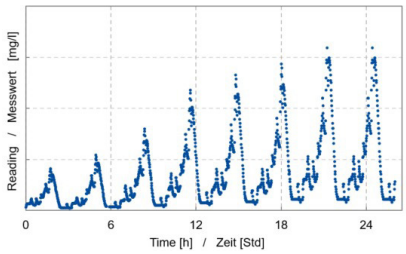
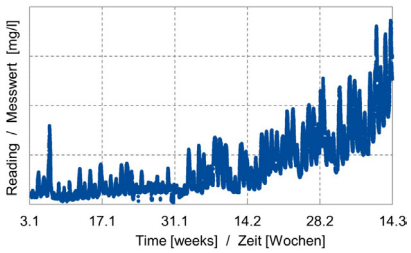
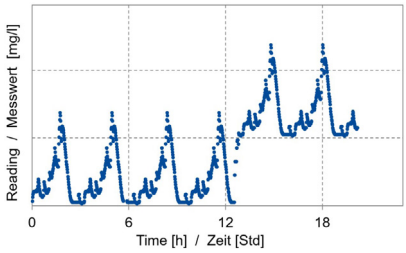
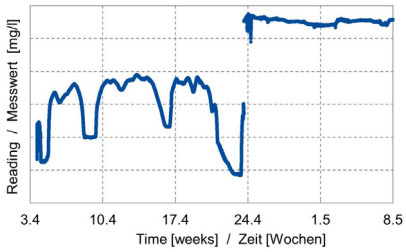
9 Putting a thin film of vasiline onto the O-ring makes it easier to screw in the electrode.

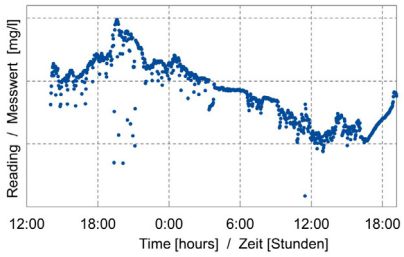
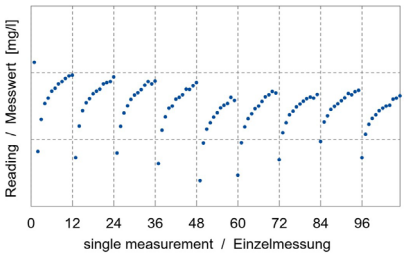
10 Carefully screw the electrode into the sensor using the electrode key (E-532-TOOL) until hand tight.

! Finally install of the ammo::lyser according to the procedure described in section [5] and switch back to the global calibration. If needed, perform a local calibration of the new electrode according to the procedure described in section [6].

10 TROUBLESHOOTING

10.1 Typical Error Pattern

Error	Reason	Removal
Drift of readings (after startup or electrode replacement) 	▪ New electrodes need time to adapt to the measuring medium (conditioning time)	▪ Conditioning of electrode before the installation ▪ Perform local calibration after the electrodes are completely conditioned
Drift of readings (during operation) 	▪ Change in the measuring medium (e.g. interference of ions) ▪ Air bubbles ▪ ISE electrode aged ▪ Electrode used for NH4-N compensation aged ▪ Reference electrode aged	▪ Check measuring medium ▪ Remove air bubbles ▪ Clean the sensor / electrodes ▪ Perform linear calibration ▪ Replace electrode
Shift / jump of readings (offset) but still changes in concentration visible 	▪ Small air bubbles sticking to the membrane ▪ Dirt / deposition on the electrode ▪ Sudden change in measuring medium composition	▪ Remove air bubbles ▪ Clean the sensor / electrodes ▪ Check mV reading of sensor in tap water or standard ▪ Perform check of accuracy (see section 8.4)
Shift / jump of readings (offset) and no changes in concentration visible 	▪ Large air bubbles sticking near the membrane surface ▪ Fouling of the electrode caused by organics present in the measuring medium (chemical / mechanical damage) ▪ Membrane mechanical damaged / destroyed	▪ Remove air bubbles ▪ Clean the sensor / electrode ▪ Check mV reading of sensor in tap water ▪ Perform linear calibration ▪ Replace electrode

Error	Reason	Removal
Noisy readings (sudden periodical jumps) on single or all parameters 	▪ Electromagnetic interference caused by other equipment installed nearby ▪ Moisture or water ingress	▪ Ensure that measuring medium is grounded correctly ▪ Check if electrode slots are clean and dry ▪ Check sensor integrity
Regular jumps of readings synchronized with automatic cleaning 	▪ Too intensive air pressure cleaning ▪ Wrong automatic cleaning settings (waiting time between end of cleaning and measurement too short)	▪ Reduce intensity / frequency of automatic cleaning ▪ Check if cleaning pressure is max. 4 bar ▪ Increase waiting time before measurement
Low accuracy of readings (readings too low or too high compared to laboratory values)		▪ Check sensor integrity ▪ Check reading accuracy (see section 8.4)
One reading is NaN	▪ Reading out of measuring range ▪ Parameter not calibrated correctly ▪ Electrode defective	▪ Check sensor integrity ▪ Check reading accuracy (see section 8.4)
All displayed readings are NaN	▪ Communication problem between sensor and operation terminal ▪ Sensor not installed correctly	▪ Check connection plug and sensor cable ▪ Reinstall sensor
Quality factor < 0.90 permanently	▪ Unstable measuring medium conditions (e.g. concentration, flow, temperature) ▪ Damaged ISE or reference electrode	▪ Check electrode readings in stable flow and temperature (use bucket filled with measuring medium if needed). ▪ Visual inspection of electrodes for mechanical damage

10.2 Error Messages and Status Messages

During execution of a measurement the monitoring system (system status), the measuring device itself (device status) and the result (parameter status) will be checked for possible errors and for plausibility. In case of an error (status bit will be set from 0 to 1) a user message will be displayed to the operator.

Depending on the controller used for operation these messages are shown on the display (function *Monitor...* in case of con::lyte, *Status* tab in case of moni::tool and *Value details* in case of Io::Tool) and also stored in the result or log files. In addition to the general error message with recommendations for troubleshooting, an error code will be displayed. These error codes are displayed in binary form (0000, 0001, 0010, 0011, 0100, etc.) or as a hex number (0x0001, 0x0002, 0x0004, 0x0008, 0x0010, etc) in case of con::lyte and moni::tool. Io::Tool uses short names (e.g. VAL_OUT_OF_RANGE) as error codes.

Up to 16 status bits are used for different errors. If several errors occur at the same time, the con::lyte and moni::tool will add up all the status bits. This detailed information might be important if you request Badger Meter Customer Service. Below you will find examples how to translate these combined hex codes:

Hex	Bin	Bits
0x8000	1000 0000 0000 0000	b15
0x8001	1000 0000 0000 0001	b0, b15
0x4011	0100 0000 0001 0001	b0, b4, b14

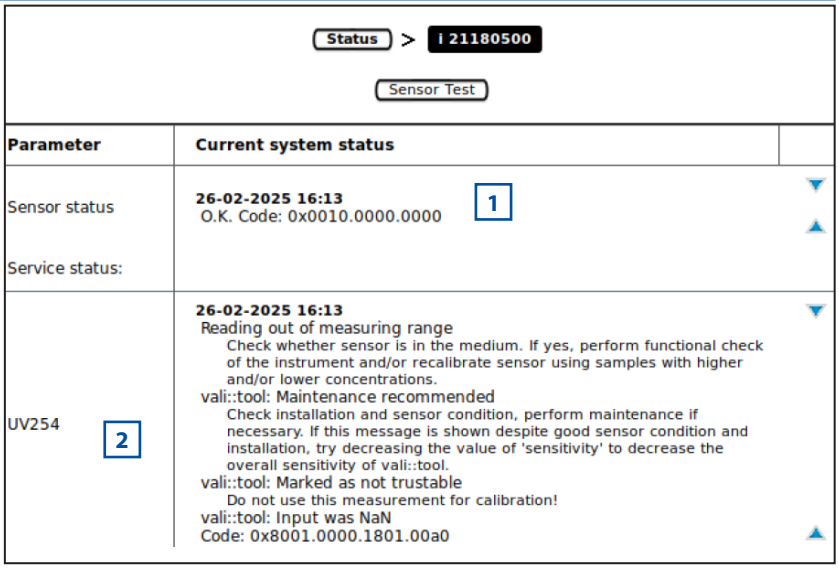
Within moni::tool the complete status code of a simple parameter has the following format:

0xTTTT.SSSS.PPPP.pppp.VVVV.vvvv.

Code	Status Type	Remark
0xTTTT	System status sensor	visible in the second column of all moni::tool parameter result files (e.g. Error 0x0010 or Ok 0x0000)
0xSSSS	Sensor status general	valid for all sensors
0xssss	Sensor status private	valid for respective sensor
0xPPPP	Parameter status general	valid for all parameters
0xpppp	Parameter status private	valid for respective parameter
0xVVVV	vali::tool status general	valid for all clean values of vali::tool software
0xvvvv	vali::tool status private	valid for respective clean values of vali::tool software

1 Within the moni::tool *Status* tab of the sensor you will see the system status and the sensor status as clear text and as status code (0xTTTT.SSSS.ssss).

2 Within the moni::tool *Status* tab of the parameter you will see the parameter status and in case of activated vali::tool the vali::tool status also (0xPPPP.pppp.VVVV.vvvv).



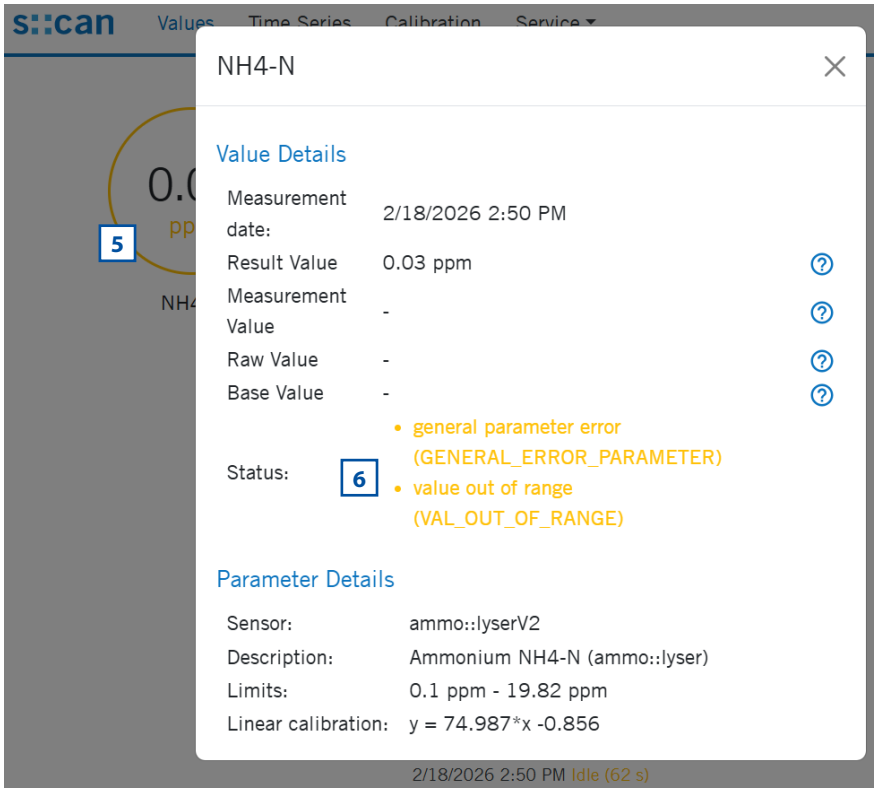
Timestamp	Station 1	ammo::lyser	3 ammo::lyser	ammo::lyser	4 ammo::lyser
Measurement interval	Status	NH4-N - Measured value [ppm]	Status [NH4-N - Measured value]	NH4-N - Clean value [ppm]	Status [NH4-N - Clean value]
31.05.2019 12:32	Ok 0x0000	4.25	Ok 0x0000.0000.0000.0000	3.33	Ok 0x0000.0000
31.05.2019 12:34	Ok 0x0000	4.78	Ok 0x0000.0000.0000.0000	3.43	Ok 0x0000.0000
31.05.2019 12:36	Ok 0x0000	6.05	Ok 0x0000.0000.0000.0000	3.61	Ok 0x0000.0000
31.05.2019 12:38	Ok 0x0000	58.24	Ok 0x0000.0000.0000.0000	3.84	Ok 0x1001.0010
31.05.2019 12:40	Ok 0x0000	123.67	Ok 0x0000.0000.0000.0000	8.64	Ok 0x0000.0000
31.05.2019 12:42	Ok 0x0000	139.51	Ok 0x0000.0000.0000.0000	18.57	Ok 0x0000.0000
31.05.2019 12:44	Ok 0x0000	136.43	Ok 0x0000.0000.0000.0000	28.85	Ok 0x0000.0000

3 Im moni::tool Ergebnisfile der Sensorparameter wird der Status (0xTTTT.SSSS.PPPP. pppp) in der Spalte neben den Messwerten gespeichert.

4 Wenn vali::tool aktiviert ist enthält das Ergebnisfile auch den vali::tool *Status* (0xVVVV. vvvv) in der Spalte neben den bereinigten Werten.

5 Ein Klick auf den Parameter-messwert in der *Werte*-Ansicht von Io::Tool zeigt alle Parame-terdetails (*Werteigenschaften*).

6 Wenn der *Status* nicht *OK* ist, werden eine oder mehrere Fehler- oder Statusneldungen in roter Schrift angezeigt.



10.2.1 System Status

Within this section all error bits / error messages are listed, which are used to describe the status of the monitoring system (TTTT). Besides the error message displayed on the controller used for operation (con::line, con::cube or con::lyte) in the left column, the reason of the error (middle column) and notes for trouble shooting (right column) are displayed. If the error can't be removed although the suggested procedure for removal was executed several times, please contact your Badger Meter sales partner.

TTTT-Error 0x0001 - b0	Reason	Removal

communication error (COMMUNICATION_ERROR)
 	
No communication between sensor and terminal.
 	
`ES007 / COMM!`
`Probe not detected.`
`Check power supply and connection cable.`
	▪ No communication between sensor and operation terminal.
	▪ Replacement sensor was not installed correctly.
		▪ Check sensor cable and connector.
		▪ Disconnect and reconnect sensor.

TTTT-Error 0x0002 - b1	Reason	Removal
Invalid sensor 0002	▪ Sensor serial number has changed.	▪ Connect the previously installed sensor. ▪ Perform sensor replacement (moni::tool) or new sensor installation (con::lyte).

10.2.2 Sensor Status

Within this section all error bits / error messages are listed, which are used to describe the status of a sensor in general (SSSS). Besides the error message displayed on the controller used for operation (con::line, con::cube or con::lyte) (see left column), the reason of the error (middle column) and notes for trouble shooting (right column) are displayed. If the error can't be removed although the suggested procedure for removal was executed several times, please contact your Badger Meter sales partner.

SSSS-Error 0x0001 - b0	Reason	Removal
general device error (GENERAL_ERROR_DEVICE) *General sensor error* ES100 / 0001 Probe reports an error. Call service! Param.Status error. Status Code:..	▪ Sensor reports error during internal check. ▪ At least one internal sensor check failed.	▪ For details see additional status message below. ▪ In case no further messages are shown, note the error code and contact your s::can sales partner.

SSSS-Error 0x0002 - b1	Reason	Removal
sensor misuse (SENSOR_MISUSE) *SENSOR MISUSE* ES101 / 0002 MISUSE Medium temperature. Take probe out of medium, immediately!	▪ Operation outside the specification (e.g. temperature too high). This can damage the device permanently.	▪ Take the sensor out of the medium immediately and check environmental conditions.

SSSS-Error 0x8000 - b15	Reason	Removal
maintenance needed (MAINT_NEEDED) *Sensor mainentance required* ES115 / 8000 Device maintenance required Code 8000 0000	▪ At least one internal sensor check reports a warning.	▪ Perform function check of the sensor according the manual (see section 8 and 8.3).

10.2.3 Parameter Status

Within this section all error bits / error messages are listed, which are used to describe the status of a parameter in general (PPPP) and the individual status of the ammo::lyser (pppp). Besides the error message displayed on the controller used for operation (con::line, con::cube or con::lyte) (see left column), the reason of the error (middle column) and notes for trouble shooting (right column) are displayed. If the error can't be removed although the suggested procedure for removal was executed several times, please contact your Badger Meter sales partner.

PPPP-Error 0x0001 - b0	Reason	Removal

general parameter error (GENERAL_ERROR_PARAMETER)
 	
General parameter error
 	
`EP 100 / 0001`
`Status error.`
`Code: 0001.0000`
`Details in following log messages.`
	▪ At least one internal parameter check failed.	▪ For details see additional status message below.
		▪ In case no further messages are shown, note the error code and contact your s::can sales partner.

PPPP-Error 0x0002 - b1	Reason	Removal

hardware error (HW_DEFECT)
 	
Parameter error, Hardware error
 	
`EP 100 / 0002`
`Parameter failure, hardware failure`
	▪ Electrode signal not ok.
	▪ An electrode is missing, too old or defective.
		▪ Check the electrode (see section 8.3).
		▪ Replace the electrode (see section 9.2).

PPPP-Error 0x0004 - b2	Reason	Removal
configuration error (CONFIG_ERROR) *Parameter error, configuration error*	▪ Parameter error ▪ Configuration error	▪ Change the local calibration. ▪ Switch back to global calibration.

PPPP-Error 0x0008 - b3	Reason	Removal
no medium detected (NO_MEDIUM) *Parameter error, Wrong medium*	▪ Sensor outside of the medium. ▪ Sensor in incorrect medium.	▪ Check supply of medium. ▪ Check medium itself.

PPPP-Error 0x0010 - b4	Reason	Removal

Calibration error (CALIBRATION_ERROR)
 	
Parameter error, Incorrect calibration
 	
`EP 100 / 0010`
`Parameter failure, calibration failure`
	▪ Invalid sensor configuration.
	▪ At least one calibration coefficient is invalid.
		▪ Check readings and lab values.
		▪ Restart sensor by un- and replugging.
		▪ Set back to factory settings.
		▪ Repeat local calibration.

PPPP-Error 0x0020 - b5	Reason	Removal
sensor busy (SENSOR_BUSY) *Parameter not ready* `EP 100 / 0020`	▪ Parameter not activated on the sensor. ▪ Sensor still warming up.	▪ Activate parameter. ▪ Wait until sensor is fully operational.

PPPP-Error 0x8000 - b15	Reason	Removal

value out of range (VAL_OUT_OF_RANGE)
 	
Reading out of measuring range
 	
`EP 115 / 8000`
`Out of range`
`Code 8000 0000`
`The parameter is out of measurement range`
	▪ Measured parameter is outside the defined measuring range.	▪ Check if sensor is in the medium.
		▪ Perform function check (see section 8 and 8.3).

pppp-Error 0x0001 - b0	Reason	Removal

hardware error (HW_DEFECT)
 	
Electronics fail
 	
`EP 100 / 0001`
`Status error.`
`Code: 0001.0000`
`Details in following log messages.`
	▪ Electronic failure	▪ Check sensor head and electrode.
		▪ Perform Function check (see section 8 and 8.3).

pppp-Error 0x0002 - b1	Reason	Removal

maintenance needed (MAINT_NEEDED)
 	
Electrode slope out of limits
 	
`EP 100 / 0002`
`Parameter failure,`
`hardware failure`
	▪ Electrode slope after linear calibration is too high (> 120 %) or too low (< 80 %).	▪ Repeat linear calibration.
		▪ Replace electrode if slope is too low (see section 9.2).

pppp-Error 0x0004 - b2	Reason	Removal
maintenance needed (MAINT_NEEDED) *Electrode cleaning necessary*	▪ Electrode polluted or defective.	▪ Perform manual cleaning. ▪ Perform Function check (see section 8 and 8.3).

pppp-Error 0x0008 - b3	Reason	Removal
service needed (SERV_NEEDED) *Missing electrode*	▪ No electrode installed. ▪ Electrode defective.	▪ Install electrode. ▪ Perform function check (see section 8 and 8.3).

10.2.4 Status Messages vali::tool

The table below shows all errors regarding clean parameters of the vali::tool software incl. the user message, the reason of the error and notes for trouble shooting. If the error can't be removed although the suggested procedure was executed several times, please contact your s::can sales partner.

Parameter Status Error 0xVVVV	Message moni::tool	Reason	Removal
0x0001 - b0	vali::tool reports an error	At least one internal check reports a warning.	Check further status messages.
0x0800 - b11	Maintenance recommended	Parameter check reports a warning.	Check system and sensor, perform functional check.
0x1000 - b12	Marked as not trustable	Parameter check reports a warning.	Do not use this value for calibration.

10.3 Device Settings

In case detailed sensor information or configuration settings need to be checked, the following sections describe how to find this information when operating the sensor with a Badger Meter operator terminal.

10.3.1 Check of Device Settings using con::lyte

Select the entry *Manage sensors...* in the main menu of the status screen. Select the name *ammo::lyserV2/0/1* in the list of installed sensors and confirm with *OK*, whereby the second number (*1*) indicates the address assigned to the sensor. After confirming the entry *Configure...* as well as the *Probesettings* entry in the next view, the following information of the sensor will be displayed:

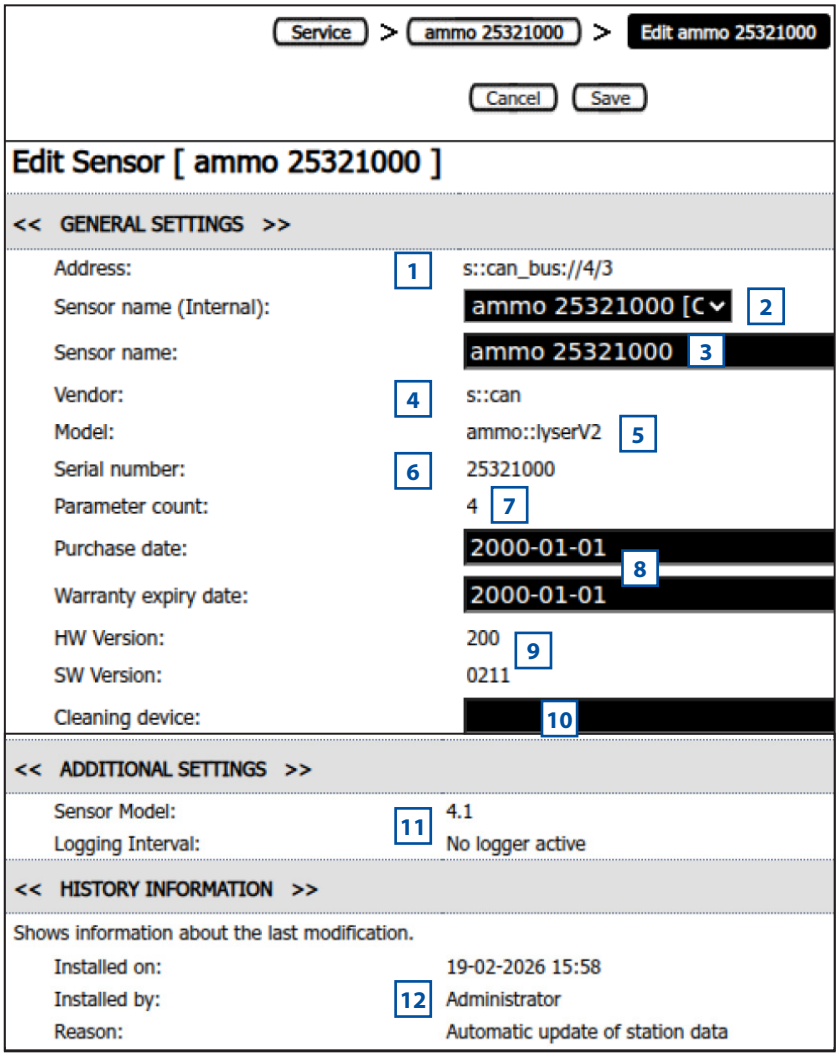
- Internal sensor identifier (*M-Version* and *Model*)
- Sensor name (*ammo::lyserV2*)
- Serialnumber of the sensor (*S/N*)
- Hardware version of the sensor (*H/W-Version*)
- Software version of the sensor (*S/W-Version*)

Information of the single measuring parameter can be retrieved via the entry *Parameter info...* from the main menu of the parameter display. In addition to the parameter name (*Name*), the unit of measurement (*Unit*) the number of decimal places (*Disp. Format*), also the lower and upper limit of the parameter range (*P. lower* / *P. upper*) and the adjusted alarm range (*Al. lower* / *Al. upper*) are displayed.

```
P1/NH4-N
Sen.:  ammo::lyserV2
Name:          NH4-N
Unit:            ppm
Disp. Format:      1
P. lower:        0,1
P. upper:       19,8
Al. lower:  ----,---
Al. upper:  ----,---
```

10.3.2 Check of Device Settings using con::cube (moni::tool)

For checking the sensor settings click on the ammo::lyser icon within the system overview of the *Service* tab and select *Sensor Settings*. Depending on the *Service Level* (figure below is *Service Level Expert*) some or all of the following information will be displayed:



1 Interface of the sensor (COM-port, *Address*).

2 Sensor name used internal (*Sensor name (internal)*). Should not be changed by the operator.

3 *Sensor Name* for the display, allocated to the device by the operator.

4 Manufacturer name of the sensor (*Vendor*).

5 Type of the sensor (*Model*).

6 Serial number of the sensor (*Serial Number*).

7 Number of available parameters (*Parameter count*).

8 Information regarding the purchase (*Purchase date*, *Warranty expiry date*). Can be entered by the operator at initial startup.

9 Actual hardware and software version of the sensor (*HW Version*, *SW Version*).

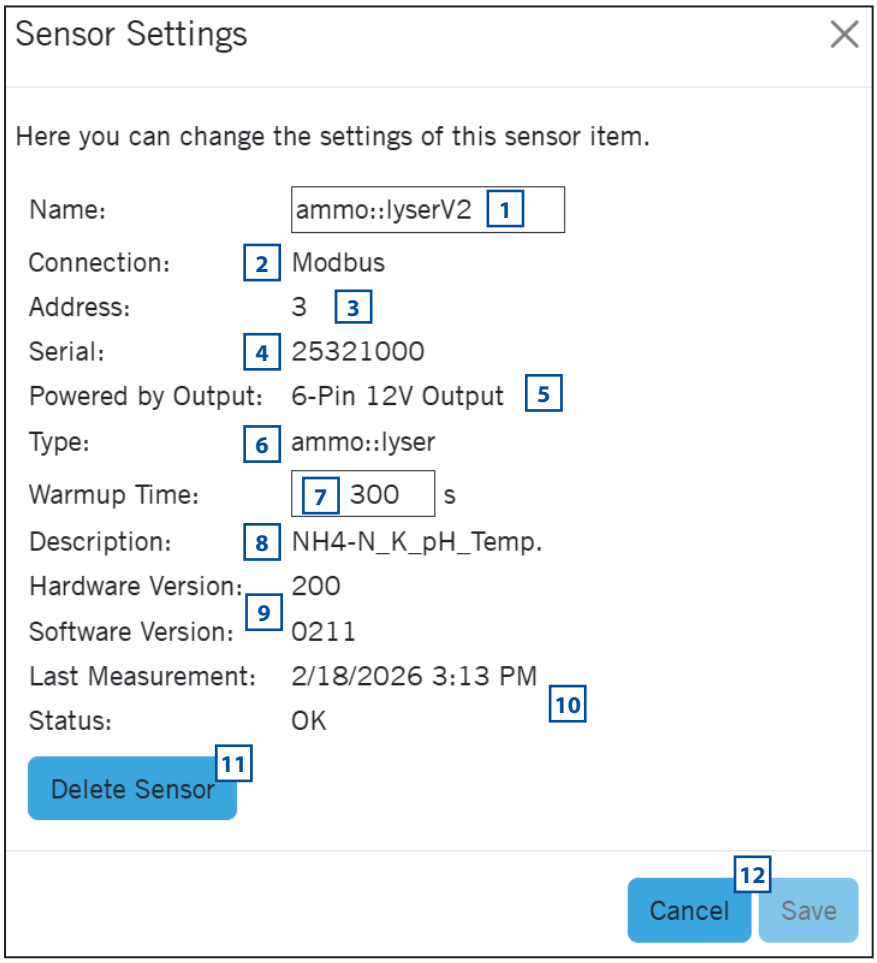
10 Cleaning device allocated to the sensor (*Cleaning device*). Not used for this type of sensor.

11 Internal type number of the connected sensor (*Sensor Model*) and information regarding logging (not available for this type of sensor).

12 History information about installation and last modification of the sensor (*Installed on*, *Installed by* and *Reason*).

10.3.3 Check of Device Settings using con::line (Io::Tool)

For checking the sensor settings select the menu *Service / Sensors & Outputs*. Push the button *Enter Service Mode* and click on the blue tool icon located on the left side of the *ammo::lyser*. Within the window that pops up (*Sensor Settings*) the following information will be displayed:



1. The sensor name (*Name*) which can be edited by the operator.
2. The type of *connection* to the sensor (e.g. *Modbus*).
3. The used *address* for this sensor.
4. The *serial number* of the sensor.
5. The used output of the con::line for power supply of this sensor (*Powered by Output*).
6. The *type* of the sensor.
7. The required period of time that the sensor has to be energised before measuring (*Warmup Time*). This information is important for sleep mode.
8. Parameters that can be measured (*Description*).
9. Actual hardware and software version of the sensor (*Hardware Version*, *Software Version*).
10. Time stamp (*Last Measurement*) and *Status* of the last measurement.
11. The sensor can be removed by pushing the button *Delete Sensor*.
12. Push the button *Save* to store the modifications permanently or the button *Cancel* to avoid any changes.

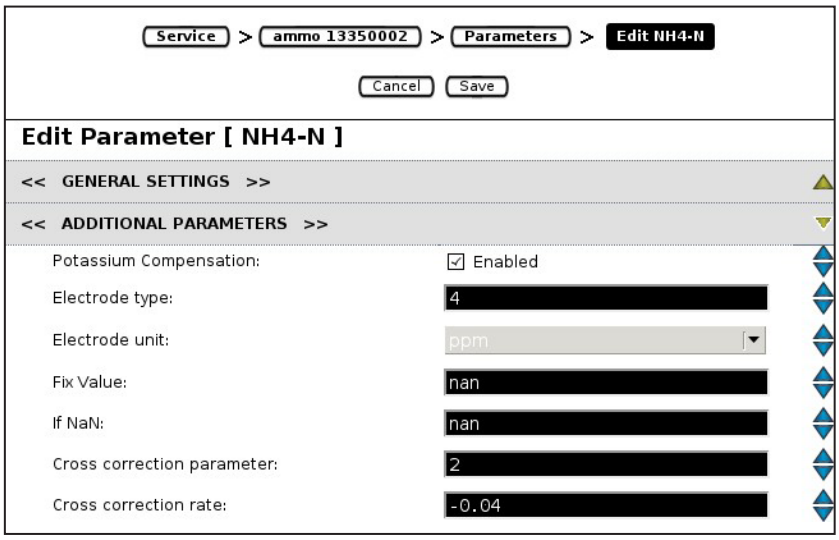
10.4 Modification of Device Settings

Any modification of the device settings must be performed by trained service staff or after confirmation of your local Badger Meter Sales Partner. In general the following device settings can be modified with moni::tool or ana::pro software:

- Activation or deactivation of potassium compensation
- Modification of fixed values for parameter
- Modification of device address
- Modification of electrode type

10.4.1 Modification of Device Settings using moni::tool

Selecting *Service / ammo / Parameter / Edit Parameter* will list the parameter settings. The *Service Level Expert* has to be used to see all information as displayed below:



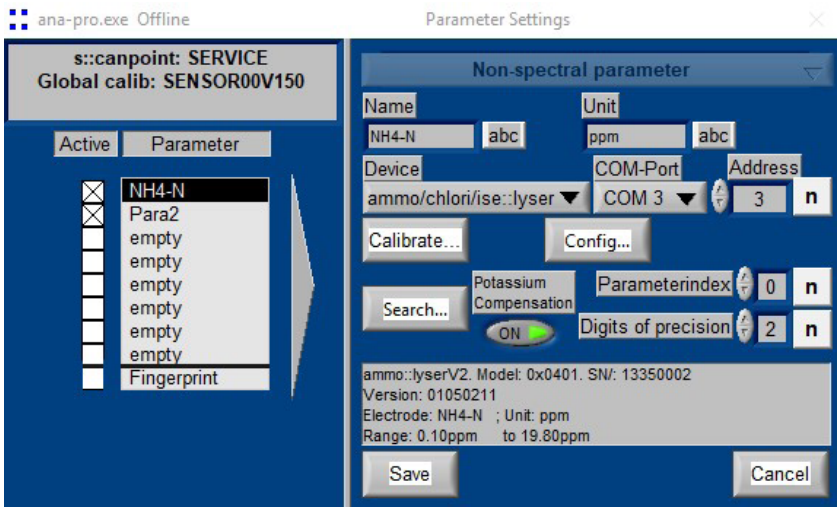
- *Potassium Compensation* is active when the checkbox is marked. A click on the checkbox will disable the compensation.
- The entry *Electrode type* defines, which ISE electrode is used in this slot. The following types are supported:

  0 ..... Temperature
  2 ..... pH
  4 ..... Ammonium (NH4-N)
  5 ..... Nitrate (NO3-N)
  6 ..... Potassium (K)
  10 ... Chloride (Cl)
  11 ... Fluoride (F)

- The *Electrode unit* is selected in accordance to the parameter and can be changed to the raw signal (mV).
- The parameter output can be set permanently to a *Fix value*, which will be displayed and used instead of the real reading. This feature can be used, if an electrode, which is used for compensation, is defective until it is replaced.
- Any value that will be entered in the field *If NaN* will be displayed if the electrode will not delivery a reading.
- The entry *Cross correction parameter* defines the slot of the electrode that will be used for compensation of the actual selected parameter.
- The entry *Cross correction rate* defines the coefficient used for the compensation of cross sensitivity.

10.4.2 Modification of Device Settings using ana::pro

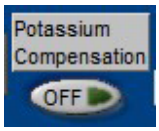
In the operating - and service software ana::pro the sensor can be initialised over the menu item *Parameter / Settings*. In case the parameter of interest is not yet displayed by default in the Parameter Settings window, they can be selected as explained below:



- Double click on the parameter field that you want to correspond with the parameter to be displayed.
- After double clicking, the window will enlarge and show detailed information belonging to this parameter.
- Select *Non-spectral parameter* in the upper selection bar.
- Select *ammo/chlori/ise::lyser* under *Device*.
- The *COM-Port* is the interface to which the sensor is connected (e.g. COM-Port of the con::nect).
- Enter the address allocated to the sensor in the RS 485 network in the entry *Address.*
- Push the button *Search…* (when an incorrect COM-Port and / or sensor address are selected, the *Search…* function will still find the sensor if only one instrument is connected).

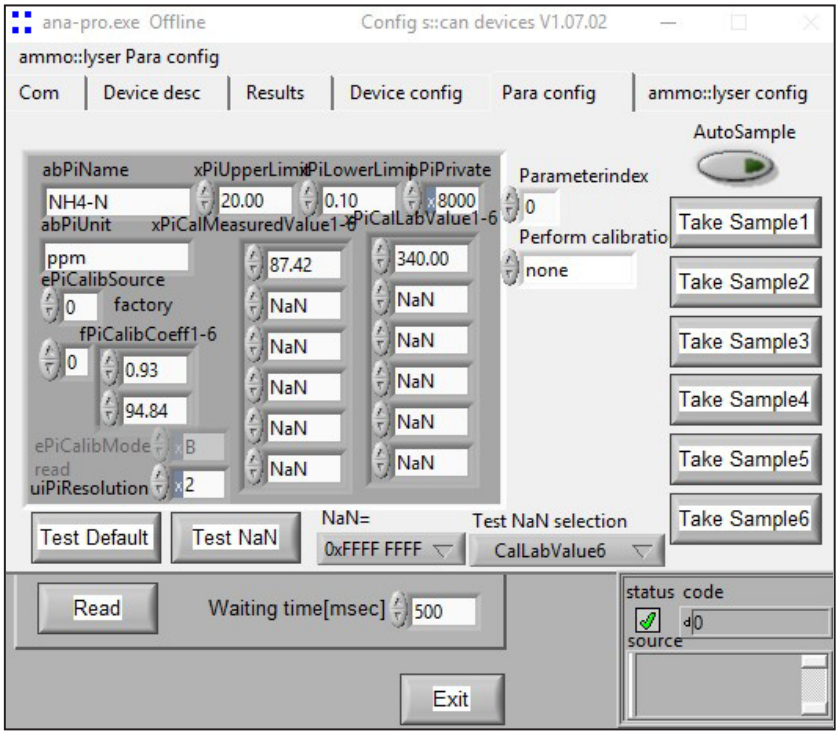
As soon as the sensor has been detected, information will be shown in the grey text field in the lower part of the dialogue window (model and serial number, version, electrodes and measuring range).

Furthermore information that *Potassium Compensation* is activated will be displayed by the green *ON* button. To deactivate the compensation simply push this buton which will switch to *OFF* (see figure on the right hand side).



- Push button *Config...* in menu *Parameter / Settings*.
- Push button *Search...* in register card *Com*. As soon as the sensor will be detected, the checkbox (*status source*) in the lower right corner switches to ok (green check mark) and further register cards become visible.
- In register card *Device desc* the sensor type (*abModel*), the serial number of the sensor (*abSerialNumber*), the actual hardware (*abHWRelease*) and software (*abSWRelease*) are displayed.

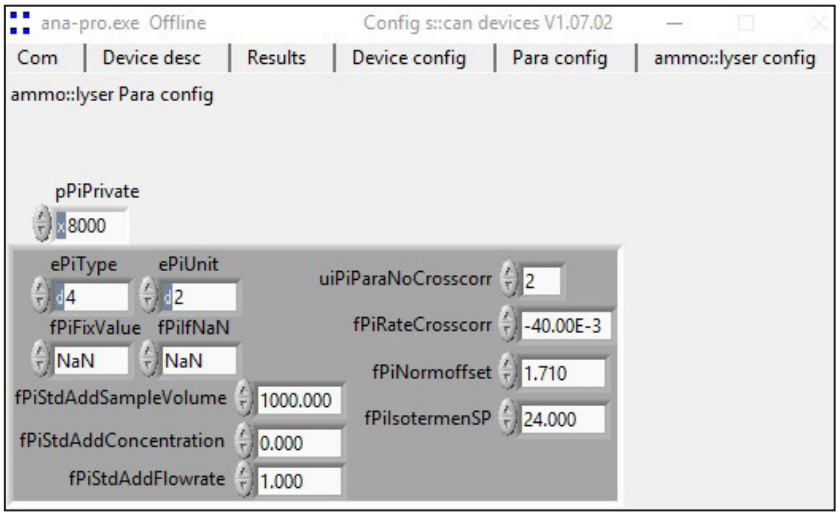
In register card *Para config* the complete configuration of each measured parameter is displayed (see figure below).



- Within the entry *Parameterindex* the internal number of the electrode position can be entered. According to the figure in section 3.3 and the numbers on the electrode head index 0 = position 2, index 1 = position 3 and index 2 = posittion 4. To ensure you have the correct index, always check if the parameter name, which is displayed in field *abPiName* is correct.
- Besides the parameter name the actual used measuring range (*xxx-LimitPi*) and the unit (*abPiUnit*) is displayed. Also actual used offset and slope (*fPiCalibCoeff*) and number of digits (*uiPiResolution*) are displayed.
- In the right part of the configuration screen the stored sample readings (mV) and laboratory values (ppm) are displayed. Only the first two samples can be used for local calibration. A new sample measurement can be triggered by pushing the *Take Sample* button. Furthermore both sample and laboratory values can be entered into the display field directly.

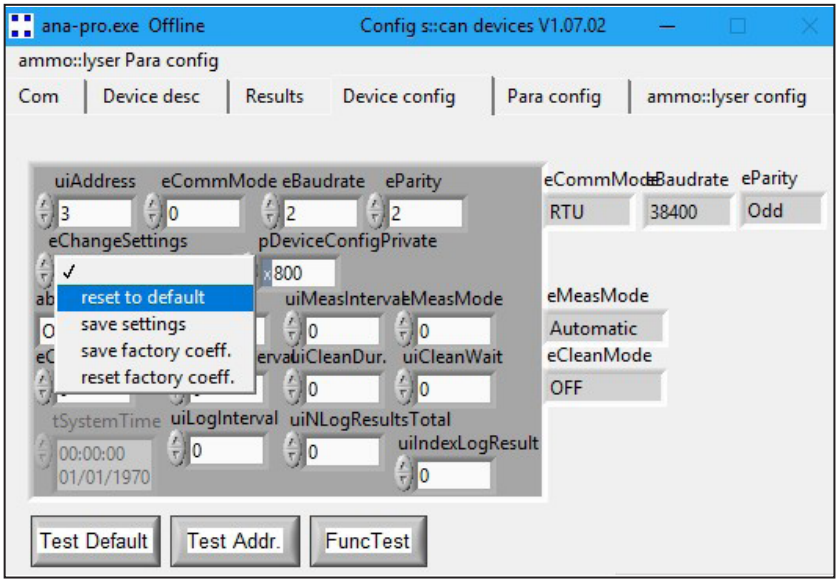
You can finish the configuration menu by pushing the button *Exit* or you can switch to the register card *ammo::lyser Para config*, which will display further configuration settings (see following figure).

- Within the field *ePiType* the electrode type used on this position is defined. Refer to section 10.4.1 to see which electrode types are supported. Besides the actual unit is displayed (2 = ppm and 3 = mV).
- Within the fields *fPiFixValue* and *fPiifNaN* the output can be set to a fixed value and also display of NaN readings can be changed (see section 10.4.1)
- In the right part of the configuration window the information needed to compensate and calculate the parameter readings are displayed.



All changes in any register card shall be done directly in the display field using the mouse and the keyboard. The scrollbar labelled with two small triangles beside the display field shall not be used.

After any change of the configuration, switch to register card *Device config* and select entry *save settings* in the selection field *eChangeSettings*. Then close configuration menu by pushing *Exit* and reboot ammo::lyser by powering off and on again. Finally check within the configuration menu if modifications have been stored correctly in the register card.



10.5 Return Consignment (RMA - Return Material Authorization)

Return consignments of the Badger Meter monitoring system, or parts of the system, shall be done in a packaging that protects the device (original packaging or protective covering if possible). Before returning a consignment, please contact your local Badgner Meter sales partner or Badger Meter Austria customer services (austriasupport@badgermeter.com). A RMA number will be assigned for each device, independent if the reason of the return consignment is service, repair, exchange or demo equipment.

The online RMA form to request your RMA number is available on the Badger Meter Website (https://badgermeter. my.site.com/partnercentral/s/submit-rma). Return consignments without an RMA number will not be accepted. The customer always has to bear the costs for return consignment.

Further details on return can be found in the RMA confirmation!

11 ACCESSORIES

11.1 Installation

11.1.1 Connection Cable

For operation of ammo::lyser with plug a connection cable is necessary. This is included in the standard order.

Name	Specification	Remark
Part-no.	C-1-010-SENSOR	
Cable lenght	1 m	
Assembling	ex works	
Dimensions plug	20 mm (0.79 inch)	outer diameter
Material	PU	Cable sheathing
Environment rating (IP)	IP 68	
Interface connection	IP 67, RS 485, 12 VDC	to sensors

11.1.2 Extension Cable

The cable of the ammo::lyser can be elongated when necessary with an extension cable (10 m or 20 m length). The extension cable is attached using the sensor cable connector plug.

⚠ A direct connetion of the extension cable to ammo::lyser with sensor plug (E-532-X-000) is not possible. A connection cable (see section 11.1.1) is needed also.

Name	Specification	Remark
Part-no.	C-210-SENSOR C-220-SENSOR	
Cable lenght	10 m 20 m	C-210-SENSOR C-220-SENSOR
Assembling	ex works	
Dimensions plug	20 mm (0.79 inch)	outer diameter
Material	PU	Cable sheathing
Environment rating (IP)	IP 68	
Interface connection	IP 67, RS 485, 12 VDC	to sensors

11.1.3 Probe Mounting

For proper and easy submersed installation of the ammo::lyser a seperate sensor carrier is available. This part can be fixed on the sensor directly and extended by a pipe (to be provided by the customer) if necessary. For tube length > 1 m stainless steel pipes or plastic pipes with higher wall thickness are recommended.

Name	Specification	Remark
Part-no.	F-11-OXI-AMMO	
Material	PVC	
Dimensions	83 / 80 mm (3.27/3.15 inch)	Diameter / height
Weight	approx. 0.3 kg	
Process connection	DN 50 inside G 1 1/2 inch thread	extension pipe OD 50 mm to sensor
Installation / mounting	submersed	see section 4.4

11.1.4 Railing Bracket / Fixing Adapter

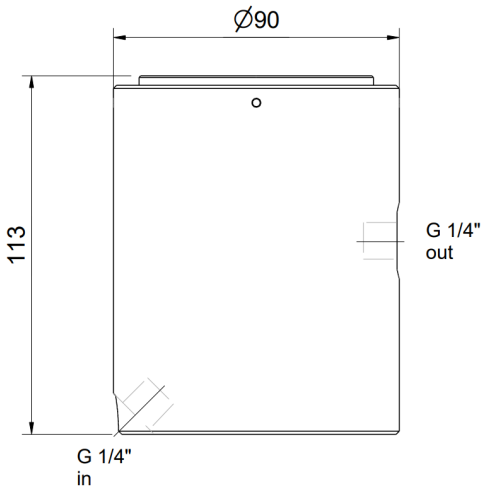
For proper and easy mounting of installation pipes onto the railing a seperate fixing adapter carrier is available.

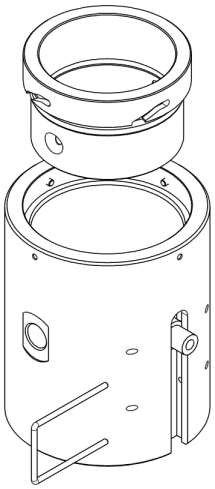
Name	Specification	Remark
Part-no.	F-15	
Material	Stainless steel	
Dimensions	158 / 267 / 73 mm 6.22 / 10.51 / 2.87 inch	W / H / D
Weight	approx. 2.8 kg	
Process connection	50 mm (1.97 inch)	OD extension pipe
Installation / mounting	up to 64 mm (2.5 inch)	OD of railing

11.1.5 Flow Cell Setup Clean Water

For not submersed measurement of drinking / tap water sample stream in a bypass installation (e.g. monitoring station) with ammo::lyser, a separate flow cell is available.

Name	Specification	Remark
Part-no.	F-45-AMMO	
Housing material	POM-C white	
Dimensions	90 / 113 mm 3.54 / 4.45 inch	Diameter / height
Weight	approx. 0.5 kg	
Process connection	$^1/_4$ inch inside	for inlet and outlet
Installation	flow-through (by-pass)	
Flow rate	min. 0.4 l/min (24 l/h)	
Mounting	2 mounting holders	incl. 2 M4x10 screws
Operating temperature	0 to 50 °C (32 to 122 °F)	
Operating pressure	0 to 6 bar (0 to 87 psi)	
Accessories - F46-PROCESS	Connection fitting $^1/_4$ inch to hose ID 6 mm	2 pcs. fitting straight 2 pcs. fitting 90°



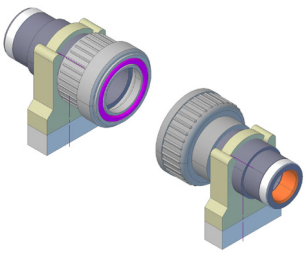


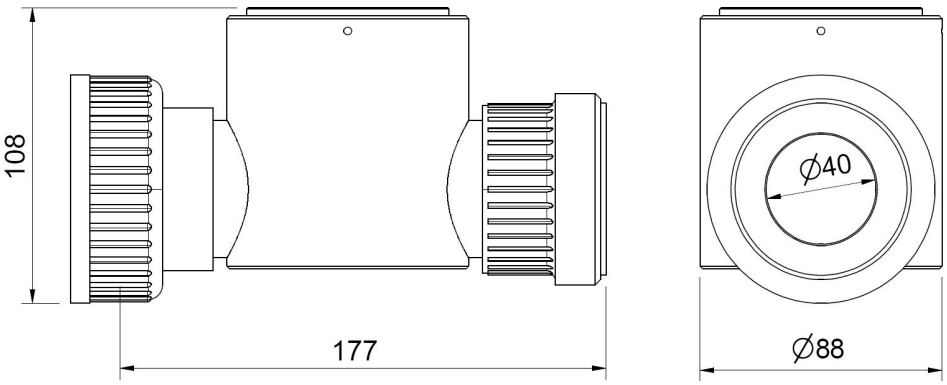
Dimensions of flow cell for clean water (F-45-AMMO) in mm and F-46-PROCESS

11.1.6 Flow Cell Setup Waste Water

For not submersed measurement of a waste / raw water sample stream in a bypass installation (e.g. monitoring station) with ammo::lyser, a separate flow cell is available.

Name	Specification	Remark
Part-no.	F-48-AMMO	
Housing material	PVC	
Dimensions	177 / 108 / 83 mm 6.97 / 4.25 / 3.27 inch	W / H / D
Weight	approx. 0.5 kg	
Process connection	1 inch inside (G 1“) 40 mm ID	via F-48-PROCESS direct connection to G 1“
Installation	flow-through (by-pass)	
Flow rate	min. 4 l/min max. 40 l/min	recommended
Operating temperature	0 to 50 °C (32 to 122 °F)	
Operating pressure	0 to 3 bar (0 to 43.5 psi)	2 bar differential pressure for automatic cleaning
Accessories	2 pcs. fittings to G 1“	F-48-PROCESS





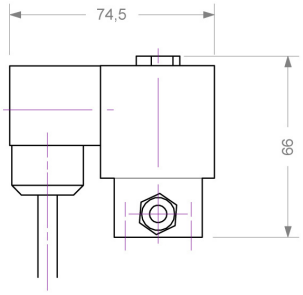
Dimension of flow cell for waste water (F-48-AMMO) in mm

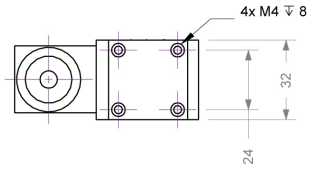
11.2 Automatic Cleaning

11.2.1 Cleaning Valve

For operation of the automatic compressed air cleaning, a cleaning valve is available.

Name	Specification	Remark
Part-no.	B-44 B-44-2	
Cable length	2.5 m 1.0 m	B-44 B-44-2
Assembling	ex works, with cable end sleeves	+ blue - brown
Dimensions	85 / 75 / 70 mm 3.35 / 2.95 / 2.76 inch	W / H / D
Material	Brass,stainless steel 1.4305 FPM	Housing Sealing material
Environment rating (IP)	IP 65	
Media that can be handled	neutral gases and liquids	
Temperature limits	-10 to 90 °C 14 to 194 °F -30 to 60 °C -22 to 140 °F	of medium of environment
Operation voltage	12 VDC	by terminal for operation
Power consumption	8 W (during cleaning)	
Connection fitting compressed air side *P*	Standard DIN 7.2 coupler coupler screw connection 6/4 mm, nickel-plated brass	B-44 B-44-2
Connection fitting probe side *A*	Hose ID $^{3}/_{8}$ inch plug-in fitting (6 mm OD)	B-44 B-44-2
Direct connection valve	$^{1}/_{8}$ inch	if fittings supplied ex works are removed





11.2.2 Pressure Connection Set

For connection of the compressed air cleaning of the sensor a specific pressure connection set is available.

Name	Specification	Remark
Part-no.	B-41-SENSOR	
Pressure hose	3 m	ID 4 mm / OD 6 mm
Assembling	ex works	
Material	PU Nickel-plated brass	tube connection fitting
Process connection	$^{3}/_{8}$ inch	connection fitting
Operating pressure	0 to 6 bar (0 to 87 psi)	

11.3 Spare Parts

11.3.1 Reference Electrode

The reference electrode needs to be replaced by a new one regulary. Please refer to the technical specification (section 12) regarding life time of electrode.

Name	Specification	Remark
Part-no.	E-533-ISE-REF	
Scope of delivery	Electrode with protective cap	
Storage duration	max. 2 years	with protective cap
Storage temperature	2 to 40 °C (35 to 104 °F)	Storage in fridge recommended

11.3.2 pH Electrode

The pH electrode needs to be replaced by a new one regulary. Please refer to the technical specification (section 12) regarding life time of electrode.

Name	Specification	Remark
Part-no.	E-533-ISE-PH	
Scope of delivery	Electrode with protective cap	
Storage duration	max. 2 years	with protective cap
Storage temperature	2 to 40 °C (35 to 104 °F)	Storage in fridge recommended

11.3.3 Ammonium Electrode (NH4-N)

The Ammonium electrode needs to be replaced either by a new or a refurbished one regulary. Please refer to the technical specification (section 12) regarding life time of electrode.

Name	Specification	Remark
Part-no.	E-535-ISE-NH4 E-635-ISE-NH4	new electrode refurbished electrode
Storage duration	max. 1 year	see production date
Storage temperature	2 to 40 °C (35 to 104 °F)	Storage in fridge recommended

11.3.4 Potassium Electrode (K)

The Potassium electrode needs to be replaced either by a new or a refurbished one regulary. Please refer to the technical specification (section 12) regarding life time of electrode.

Name	Specification	Remark
Part-no.	E-533-ISE-K E-633-ISE-K	new electrode refurbished electrode
Storage duration	max. 1 year	see production date
Storage temperature	2 to 40 °C (35 to 104 °F)	Storage in fridge recommended

11.3.5 Nitrate Electrode (NO3-N)

The Nitrate electrode needs to be replaced either by a new or a refurbished one regulary. Please refer to the technical specification (section 12) regarding life time of electrode.

Name	Specification	Remark
Part-no.	E-533-ISE-NO3 E-633-ISE-NO3	new electrode refurbished electrode
Storage duration	max. 1 year	see production date
Storage temperature	2 to 40 °C (35 to 104 °F)	Storage in fridge recommended

11.3.6 Chloride Electrode (Cl)

The Chloride electrode needs to be replaced by a new one regulary. Please refer to the technical specification (section 12) regarding life time of electrode.

Name	Specification	Remark
Part-no.	E-533-ISE-CL	
Storage duration	max. 1 year	see production date
Storage temperature	2 to 40 °C (35 to 104 °F)	Storage in fridge recommended

11.3.7 Fluoride Electrode (F)

The Fluoride electrode needs to be replaced by a new one regulary. Please refer to the technical specification (section 12) regarding life time of electrode.

Name	Specification	Remark
Part-no.	E-533-ISE-F	
Storage duration	max. 1 year	see production date
Storage temperature	2 to 40 °C (35 to 104 °F)	Storage in fridge recommended

12 TECHNICAL SPECIFICATIONS

Name	Specification	Remark
Part-no.	E-532-PRO-nnn E-532-PRO-xxx-nnn E-532-ECO-nnn E-532-ECO-xxx-nnn	PRO ... with Potassium compensation ECO ... without Potassium compensation xxx ... additional measuring parameter nnn ... plug (000) or cable (075) see section 3.3 for details
Measuring parameter	Ammoniumnitrogen - NH_4-N Potassium - K Nitratenitrogen - NO_3-N Chloride - Cl Fluoride - F pH Temperature	on all E-532 on E-532-PRO only optional optional on E-542 optional on all versions
Measuring principle	Ion selective electrode (ISE)	
Compensation	Temperature pH Potassium	for all electrodes during calibration for NH4-N measurement for NH4-N measurement with PRO version
Measuring range	NH_4-N: 0.1 - 1000 mg/l K: 1 - 1000 mg/l NO_3-N: 0.3 - 1000 mg/l Cl: 1 - 1000 mg/l F: 0.1 - 1000 mg/l pH: 2 - 12 pH Temp: 0 - 60 °C	readings displayed up to 1500 readings displayed up to 3900
Resolution	0.02 - 19.99: 0.01 mg/l 20.0 - 99.9: 0.10 mg/l 100 - 1000: 1.0 mg/l pH: 0.01 pH Temp: 0.1 °C	after linear calibration after linear calibration after linear calibration
Accuracy	ISE: < 5 % of measurement or +/- 0.2 mg/l pH: < 0.3 pH	the greater of the two values is valid
Warmup time	300 s	Minimum power supply time before measurement begins
Response time	< 2 min	T_{90} between 10^{-3} and 10^{-2} mol/l
Running in time (start up)	4 - 24 h	can be reduced by conditioning (e.g. in tap water)
Installation	submersed or in flow cell	
Environment rating	IP 67 (plug version -000) IP 68 (cable version -075)	due to connection plug on sensor
Operating temperature	0 to 60 °C / (32 to 140 °F)	
Operating pressure	0 to 1 bar / (0 to 14.5 psi)	
Operating limits others	min, 0.01 m/s max. 3 m/s max. 30 Nm	flow rate (measurement possible in standing water) mechanical stability, centric load, adequate for most known application conditions and all Badger Meter installation / mounting parts

Name	Specification	Remark
Operating pH range	NH4-N: < 8 NO3-N: 2 - 12 K: 2 - 12 F: 5 - 8	without pH compensation without pH compensation
Cross sensitivity NH4-N	K: 1 : 25 Na: 1 : 100 Li: 1 : 2000	
Cross sensitivity NO3-N	Cl: 1 : 200 Br: 1 : 1 I: 10 : 1	
Cross sensitivity K	NH4-N: 1 : 200	
Cross sensitivity F	OH: 10 : 1	
Power supply	9 to 30 VDC	
Power consumption	0.72 W (typical)	
Dimension	60 / 350 mm 23.62 / 137.8 inch	Diameter / length (see section 3.3)
Weight	approx. 2.7 kg	
Housing material	POM-C, stainless steel 1.4571	Medium contacted
Interface connection	sys plug (IP 67), RS 485	to Badger Meter operator terminal, plug fits through 20 mm hole
Sensor cable lenght	7.5 m fixed cable (-075) or 1.0 m connection cable with plug connection on top of sensor (-000)	
Sensor cable specification	PUR (polyurethane jacket), 22 AWG, 6.3 mm (outside diameter); -30 to 80 °C (-22 to 176 °F)	older versions with grey sensor cable
Sensor cable assignment	Pin 1: Data - (green cable strand) Pin 2: Data + (pink cable strand) Pin 3: +12 VDC (red cable strand) Pin 4: Ground (black cable strand) Pin 5: not used Pin 6: Shielding (blank cable strand)	green (grey cable version) yellow (grey cable version) white (grey cable version) brown (grey cable version) black (grey cable version)
Storage temperature	Sensor incl. electrodes: 2 to 40 °C (35.6 to 104 °F)	for longterm storage of replacement electrodes 4 °C (39.2 °F) recommended.
Storage of sensor	dry, reference- and pH-electrode with protective cap filled with 3M potassium chloride solution	
Typical lifespan (application)	ISE electrode: $^1/_2$ - 1 year pH-electrode: 1 year Reference electrode: 1 year	depending on application
Typical lifespan (storage)	ISE electrode: max. 1 year pH-electrode: max. 2 years Reference electrode: max. 2 years	at 4 °C (39.2 °F) with protective cap filled with KCl with protective cap filled with KCl
Refurbishment electrodes	for NH4-N, K, NO3-N only	max. 2 times per electrode possible
Automatic compressed air cleaning - sensor connection	G $^1/_8$ inch for air hose OD 6 mm	
Automatic compressed air cleaning - specification	compressed air, free of oil and particles min. 2 bar (29 psi) max. 4 bar (58 psi)	 permissable pressure at cleaning connection of sensor
Automatic compressed air cleaning - flow cell	min. 2 bar (29.0 psi) differential pressure to the existing water pressure	

Name	Specification	Remark
Automatic cleaning - settings	Duration: 2 - 6 s Interval: 10 min. - 6 hours Delay: 10 s (typical)	valve open depending on application delay until start of next measurement (consider that flow cell has to be filled up with new medium)
Warranty	2 years	
Guarantee	1.5 years	https://badgermeter.widen.net/s/fgkmlct2gr
Conformity - EMC	EN 61326-1: 2013 S.I. 2016/1091	EU UK
Conformity - RoHS2	EN IEC 63000: 2018 S.I. 2012/3032	EU UK
EAC certificate	available on the Badger Meter Website	https://badgermeter.widen.net/content/rcy7k3d8lz/original?download=false&x.app=api

www.badgermeter.com

Translations: SCA-UM-04815-DE; SCA-UM-05549-FR