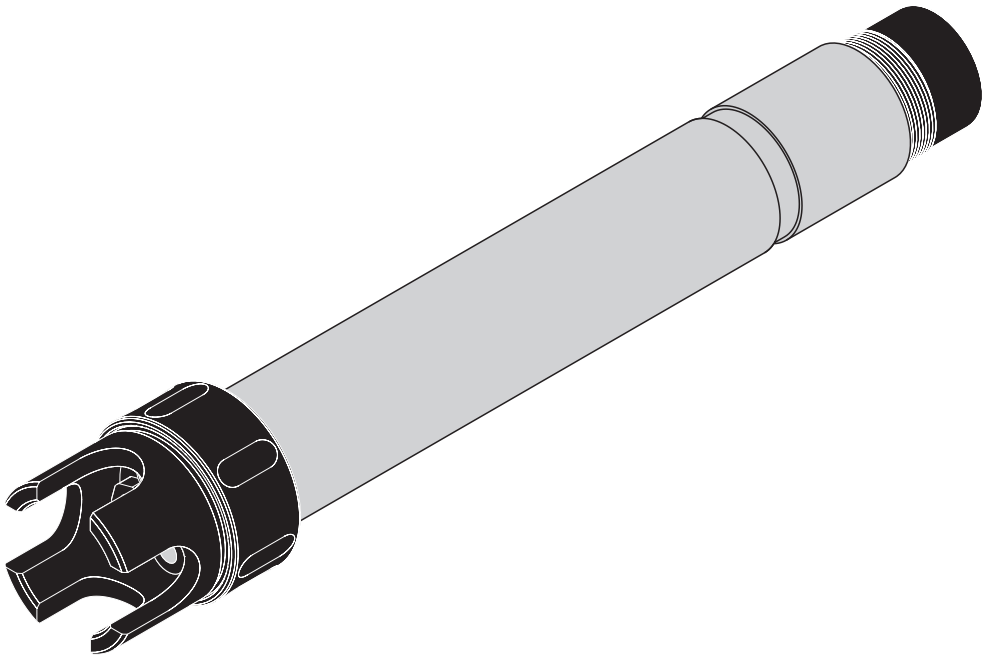
Operating manual

VARiON 700 IQ



IQ SENSOR NET
Modular combination sensor
for ammonium and nitrate

ba75533e03 10/2005

Accuracy when going to press

The use of advanced technology and the high quality standard of our products are the result of continuous development.
This may result in differences between this operating manual and your sensor. Also, we cannot guarantee that there are absolutely no errors in this manual. Therefore, we are sure you will understand that we cannot accept any legal claims resulting from the data, figures or descriptions.

Note
The latest version of the present operating manual can be found on the Internet under www.WTW.com.

1 Overview

1.1 How to use this component operating manual

Structure of the IQ SENSOR NET operating manual

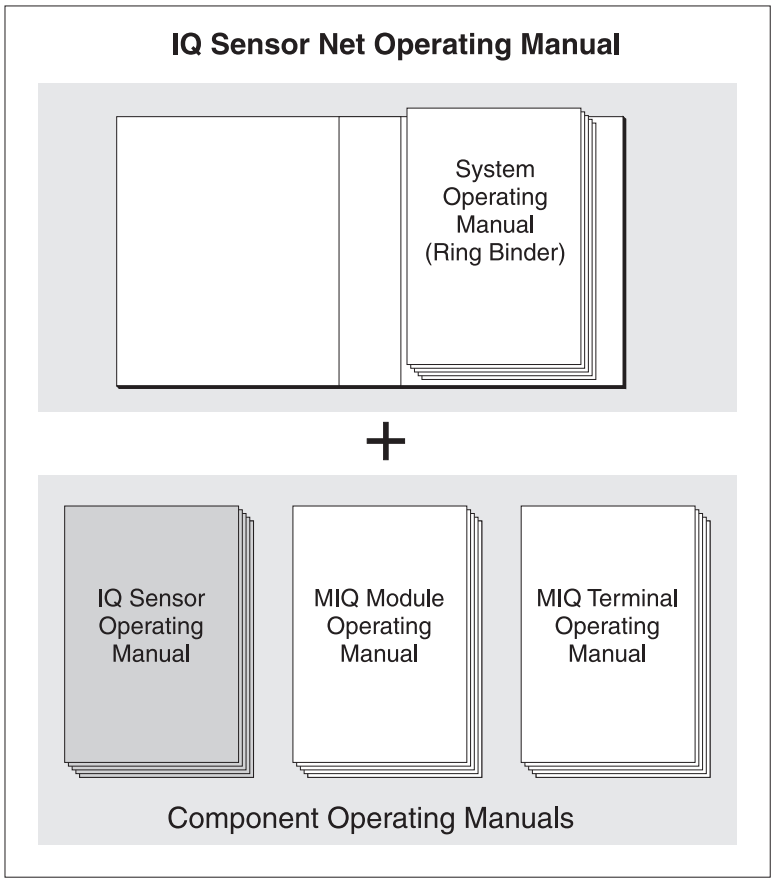


Fig. 1-1 Structure of the IQ SENSOR NET operating manual

The IQ SENSOR NET operating manual has a modular structure like the IQ SENSOR NET itself. It consists of a system operating manual and the operating manuals of all the components used.

Please file this component operating manual in the ring binder of the system operating manual.

1.2 Structure of the combination sensor VARiON 700 IQ

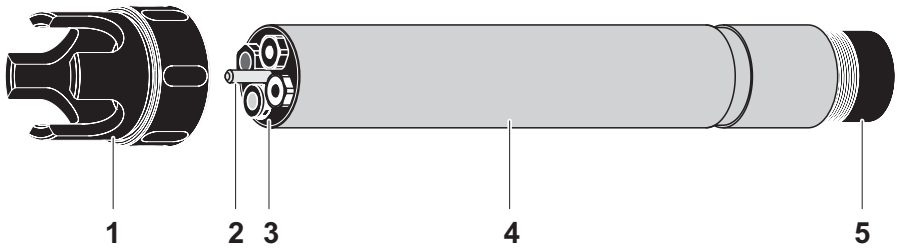


Fig. 1-2 Structure of the combination sensor VARiON 700 IQ

1	Protective hood
2	Temperature probe
3	Electrode support with electrodes (sample equipment)
4	Sensor shaft
5	Plug head connector

Electrodes

For a VARiON 700 IQ combination sensor ready to measure, a jointly used reference electrode and at least one ion sensitive electrode for the main measured parameters (ammonium, nitrate) are required. The electrodes are screwed into the electrode support. The electrode support has four receptacles for this.

Automatic interfering ions compensation

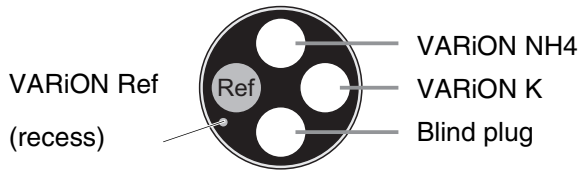
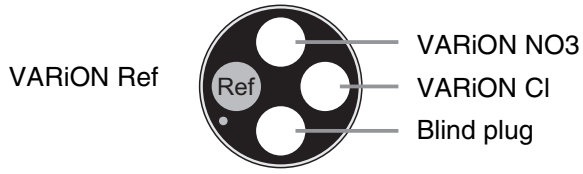
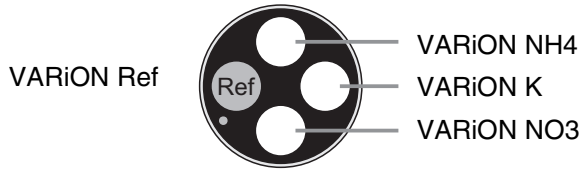
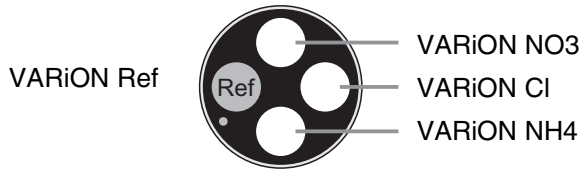
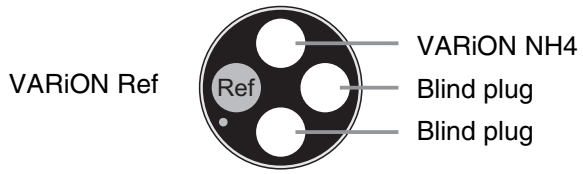
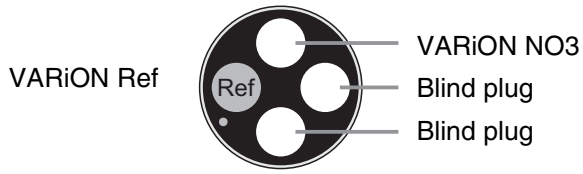
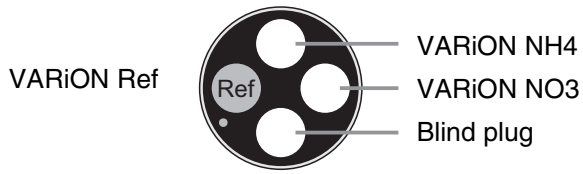
The VARiON 700 IQ enables the automatic interfering ions compensation for one main measured parameter. Thus the influence of certain interfering ions due to measuring technique can be automatically compensated for.
Interfering ions in water / waste water applications are mostly chloride for nitrate measurement and potassium for ammonium measurement. To determine the interfering ions concentration, another electrode (compensation electrode) is mounted into a free receptacle.

Note
Information on the fundamentals of measuring with ion sensitive electrodes are given in the WTW primer, ION SELECTIVE MEASUREMENT IN ONLINE ANALYSIS.

Operating modes and electrode equipment

Due to its modular structure, the VARiON 700 IQ can be adapted to various requirements (see table on the following page).

Notes:
The reference electrode has an extra receptacle marked by a recess. The ion sensitive electrodes can be mounted in the remaining three receptacles in any order. Empty receptacles have to be closed with blind plugs.

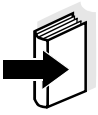
Operating mode	Electrode equipment
Ammonium measurement, compensated	
Nitrate measurement, compensated	
Ammonium measurement, compensated, plus nitrate measurement	
Nitrate measurement, compensated, plus ammonium measurement	
Ammonium measurement	
Nitrate measurement	
Ammonium measurement, nitrate measurement	

Shielding of the VARiON 700 IQ

The VARiON 700 IQ combination sensor and the corresponding electrodes in conjunction with the IQ SENSOR NET system form a measuring system that is protected to a high degree against low and high frequency interference as well as against the indirect effects of lightning strikes.

1.3 Recommended fields of application

The VARiON 700 IQ combination sensor is a sensor for the online determination of ammonium ions and/or nitrate ions in water / waste water applications. It supplements D. O. measurement in the aeration tank of waste water treatment plants and enables an efficient process control of nitrogen removal.



Note
More detailed information on measuring with ion sensitive electrodes is given in the WTW primer, ION SELECTIVE MEASUREMENT IN ONLINE ANALYSIS.

2 Safety

This component operating manual contains special instructions that must be followed in the operation of the VARiON 700 IQ combination sensor. Thus, it is essential to read this component operating manual before carrying out any work using this sensor. In addition to this manual, the SAFETY chapter of the IQ SENSOR NET system operating manual must be followed.

Always keep this component operating manual together with the system operating manual and any other component operating manuals in the vicinity of the IQ SENSOR NET system.

Special user qualifications

The VARiON 700 IQ combination sensor was developed for applications in online measurement - essentially in the field of wastewater treatment. Thus, we assume that the operators are familiar with the necessary precautions to take when dealing with chemicals as a result of their professional training and experience.

General safety instructions

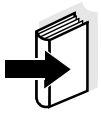
Safety instructions in this operating manual are identified by the warning symbol (triangle) in the left column. The signal word (e. g. "Caution") indicates the level of danger:

Warning
indicates instructions that must be followed precisely in order to prevent serious dangers to persons.

Caution
indicates instructions that must be followed precisely in order to avoid slight injuries or damage to the instrument or the environment.

Other labels

Note
indicates notes that draw your attention to special features.



Note
indicates cross-references to other documents, e.g. operating manuals.

2.1 Authorized use

The authorized use of the VARiON 700 IQ with the electrodes built in consists of its use as a sensor within the IQ SENSOR NET.
The technical specifications according to chapter 8 TECHNICAL DATA must be observed. Only operation according to the instructions given in this operating manual is considered to be authorized.

Any other use is considered to be **unauthorized**. Unauthorized use invalidates any claims with regard to the guarantee.

Caution
Only connect and operate the sensor together with IQ Sensor Net accessories.

2.2 General safety instructions

The sensor left the factory in a safe and secure technical condition.

Function and operational safety

The failure-free function and operational safety of the sensor is only guaranteed if the generally applicable safety measures and the special safety instructions in this operating manual are followed during its use.

The failure-free function and operational safety of the sensor is only guaranteed under the environmental conditions that are specified in chapter 8 TECHNICAL DATA.

The specified temperature (chapter 8 TECHNICAL DATA) must be maintained during the operation and transport of the sensor. Protect the sensor, particularly against frost or overheating.

Caution
The sensor may only be opened by specialists authorized by WTW.

Safe operation

If safe operation is no longer possible, the sensor must be taken out of operation and secured against inadvertent operation.

Safe operation is no longer possible if the sensor:

- has been damaged in transport
- has been stored under adverse conditions for a lengthy period of time
- is visibly damaged
- no longer operates as described in this manual.

If you are in any doubt, contact the supplier of your sensor.

Obligations of the operator

The operator of the sensor must ensure that the following rules and regulations are followed when dealing with hazardous substances:

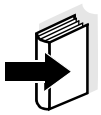
- EEC directives for protective labor legislation
- National protective labor legislation
- Safety regulations
- Safety data sheets of the chemical manufacturer.

3 Commissioning

3.1 Scopes of delivery

WTW supplies the VARiON 700 IQ in sets for different measuring requirements. Each set contains the following components:

- Unequipped sensor VARiON 700 IQ. The electrode receptacles are closed with blind plugs
- Reference electrode VARiON Ref
- Depending on the set, the suitable selection from the following measurement and compensation electrodes:
  - VARiON NH4 (ammonium measurement electrode)
  - VARiON K (potassium compensation electrode)
  - VARiON NO3 (nitrate measurement electrode)
  - VARiON Cl (chloride compensation electrode)
- Protective hood VARiON 700 IQ-SK
- Calibration vessel Sensor-Cal/40
- Potassium chloride solution for storing the reference electrode in
- Operating manual



Note
Information on the available sets is given in the WTW catalog and on the Internet.

3.2 System requirements of the IQ SENSOR NET

Software versions of the controller and terminal components

Depending on the system, the operation of the VARiON 700 IQ requires the following software versions in the IQ SENSOR NET:

● DIQ/S 182	Software:	Version 3.10 or higher
● MIQ/C184 (XT)	Controller software:	Version 2.83 or higher
	Terminal software:	Version 2.66 or higher
● MIQ/MC	Controller software:	Version 2.83 or higher
● MIQ/T 2020 (PLUS)	Terminal software:	Version 2.66 or higher
● IQ Software Pack	Software:	5.00 or higher

3.3 Notes on the handling of the electrodes

The electrodes of the VARiON 700 IQ combination sensor were developed for the rough use in waste water treatment plants. They are, however, precision parts that can be damaged by inappropriate use. Therefore, exactly follow the instructions in the two following chapters.

3.3.1 Reference electrode

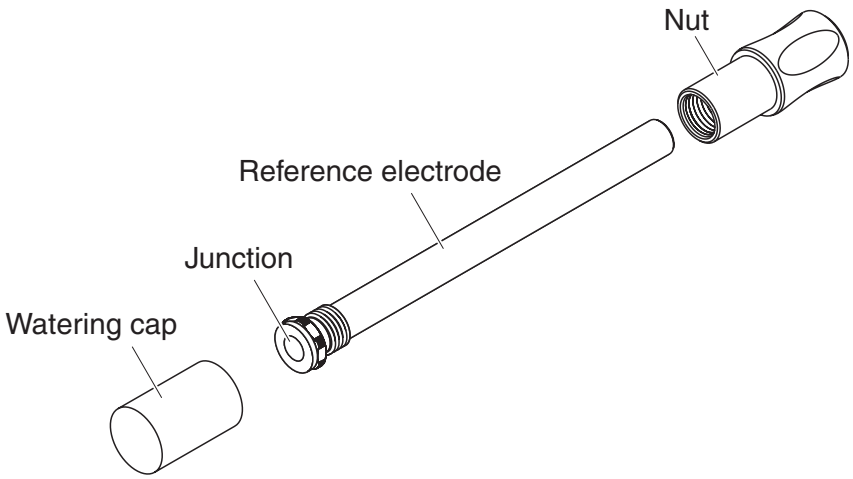


Fig. 3-1 Reference electrode with storing aids

In the delivery condition, the electrodes are equipped with a watering cap and a nut that protects the screw-in thread. The watering cap contains 3 mol/l potassium chloride solution. Before mounting, first remove the watering cap, then the nut. Keep both storing aids in case you might want to store the electrode.

Caution

The junction of the reference electrode must not

- **dry up (follow notes on storage)**
- **be damaged**
- **be brought into contact with grease.**

Notes on storage

If you will not use the electrode for a longer period of time, screw the electrode into the nut as far as it will go. Fill the watering cap to the brim with 3 mol/l potassium chloride solution and screw the watering cap on the electrode.

3.3.2 Measurement and compensation electrodes

Commissioning

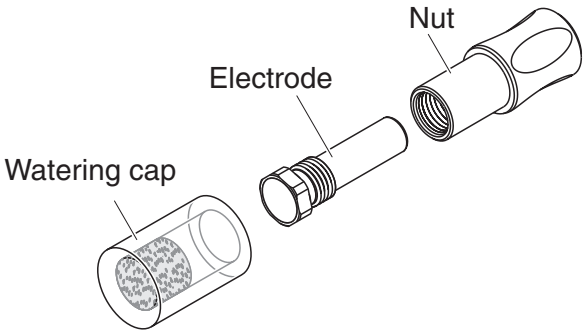


Fig. 3-2 Measurement or compensation electrode with storing aids

In the delivery condition, the electrodes are equipped with a watering cap and a nut that protects the screw-in thread. Before mounting, first remove the watering cap, then the nut. Keep both storing aids for the case you might want to store the electrode.

Caution

The membrane of the electrode must not

- **dry up (follow notes on storage)**
- **be damaged**
- **be brought into contact with grease.**

Notes on storage

If you will not use the electrode for a longer period of time, screw the electrode into the nut as far as it will go. Soak the foam insert in the watering cap with VARiON/ES-1 standard solution (lower concentration) and plug the electrode into the watering cap.

Caution

Make sure to use the correct solution for the watering cap (VARiON/ES-1 standard solution). If you use the watering solution of the reference electrode instead the function of the electrode can be seriously damaged.

3.4 Preparing the sensor for measurement

3.4.1 Equipping the sensor with electrodes

Caution

The sensor can be damaged by dirt and moisture. Before mounting the electrodes make sure the area behind the sealing ring of the electrodes and the receptacle are dry and clean. The VARiON 700 IQ may only be submersed when the electrodes or original blind plugs are mounted.

Note

More detailed information on the electrode equipment for the various operating modes is given in the table on page 1-3.

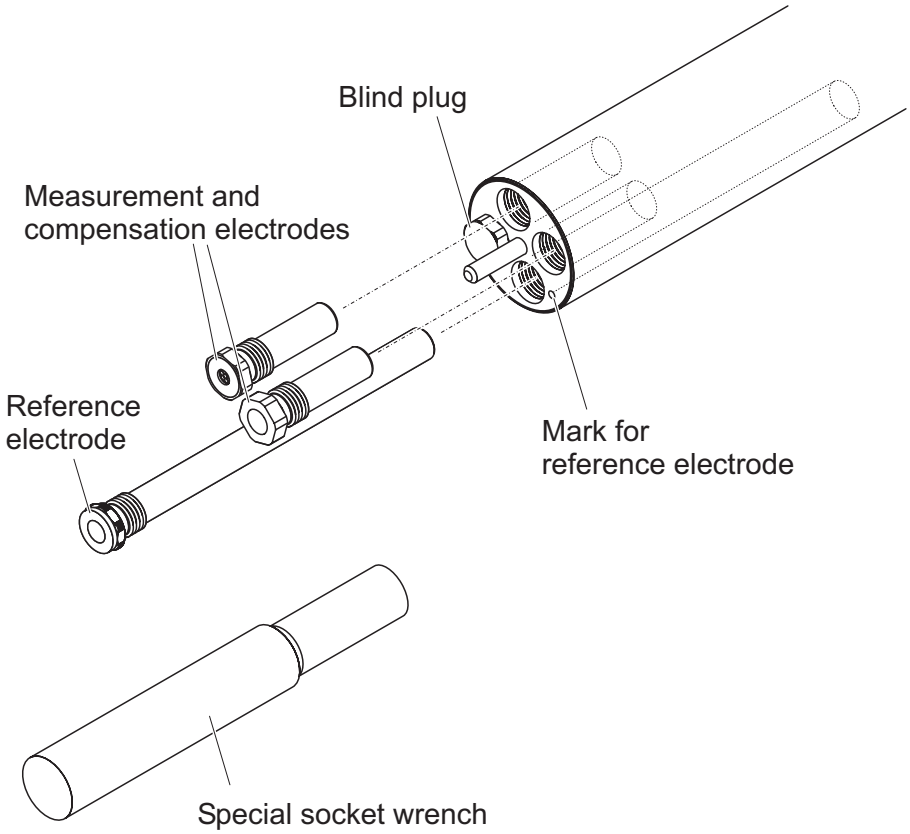


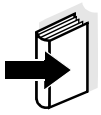
Fig. 3-3 Equipping the sensor with electrodes.

All receptacles are closed with blind plugs in the delivery condition. Screw the electrodes into the receptacles instead of the blind plugs.

When doing so observe the following points:

- The receptacle for the reference electrode is marked by a recess. It extends into the inside of the sensor clearly deeper than the other three receptacles (see Fig. 3-3).

- The measurement and compensation electrodes can be mounted in the remaining three receptacles in any order.
- Before mounting always make sure the electrode and receptacle are clean and completely dry.
- Plug the electrode on the special socket wrench and insert the electrode with the special socket wrench.
- Screw until the electrode seats without any gap on the electrode support. Thus the tightness and electrical contacts are granted.



Note
When mounted, the electrodes can be recognized by the features described in section 5.3.

3.4.2 Mounting the protective hood

CH cleaning head (option)

For permanent operation, we recommend to use the CH cleaning head for compressed-air driven cleaning. It is mounted instead of the standard protective hood. The compressed air cleaning is started time-controlled via the IQ SENSOR NET system. Information on the required components is given in the WTW catalog and on the Internet.

If no CH cleaning head is used the standard protective hood should always be mounted for measuring. It protects the electrodes from rough mechanical impact.

Mounting the standard protective hood

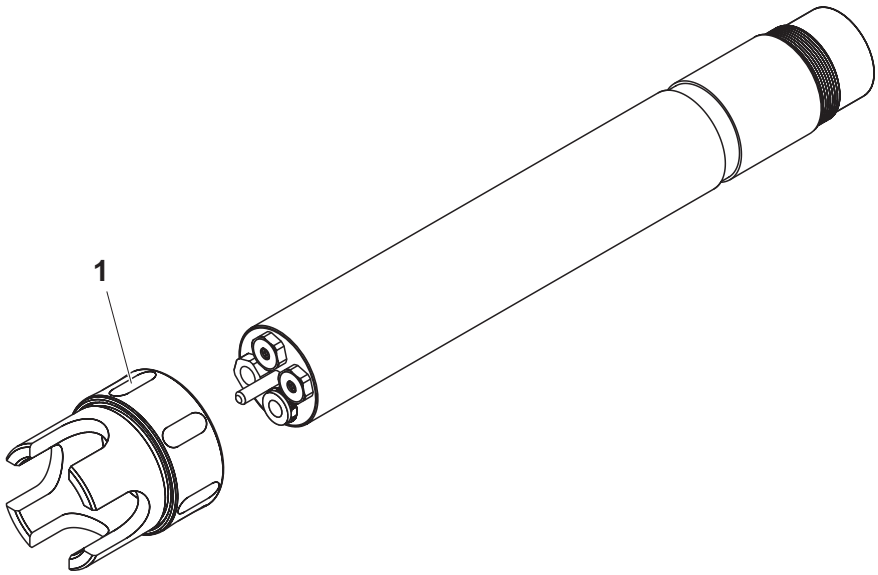


Fig. 3-4 Mounting the standard protective hood.

1	Loosen the coupling ring (1) of the protective hood.
2	Push the protective hood on the sensor as far as it will go.
3	Tighten the coupling ring of the protective hood.

Cleaning the protective hood

The coupling ring of the protective hood can be taken apart for cleaning purposes (see section 5.2 EXTERIOR CLEANING).

3.4.3 Connecting the sensor to the IQ SENSOR NET

Connection cable

The SACIQ sensor connection cable is required to connect the sensor. Information on this and other IQ SENSOR NET accessories is given in the WTW catalog and on the Internet.

Note
Do not suspend the sensor on the sensor connection cable. Use an armature or electrode holder. Information on this and other IQ SENSOR NET accessories is given in the WTW catalog and on the Internet.

Note
how to connect the SACIQ sensor connection cable to the IQ SENSOR NET is described in chapter 3 INSTALLATION of the IQ SENSOR NET system operating manual.

Are the plug connections dry?

Before connecting the sensor and sensor connection cable, make sure that the plug connections are dry. If moisture gets into the plug connections, first dry the plug connections (dab them dry or blow them dry using compressed air).

Connecting the sensor to the sensor connection cable

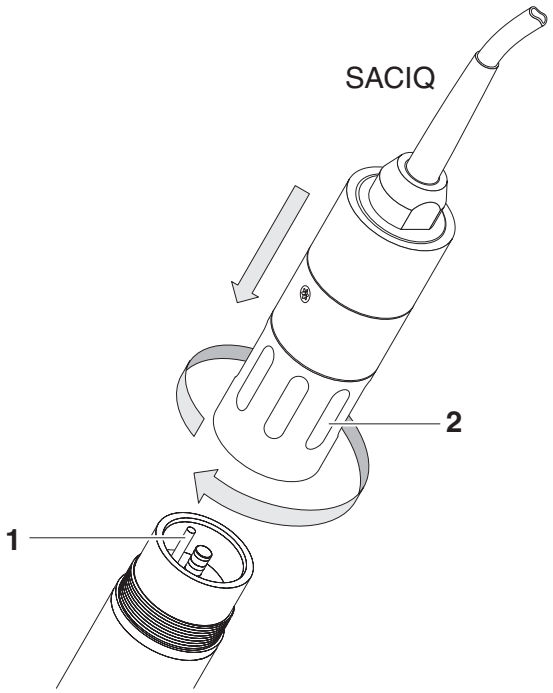


Fig. 3-5 Connect the sensor

1	Take the protective caps off the plug connections of the sensor and the SACIQ sensor connection cable, and keep them safe.
2	Plug the jack of the SACIQ sensor connection cable onto the plug head connector of the sensor. At the same time, rotate the socket so that the pin in the plug head connector (1) clicks into one of the two holes in the jack.
3	Then, screw the coupling ring (2) of the sensor connection cable onto the sensor up to the stop.

3.5 VARiON 700 IQ setting tables

3.5.1 General information

The VARiON 700 IQ software automatically recognizes all built-in ion sensitive electrodes and checks the equipment for validity. Depending on the equipment, the following sensors are displayed in the list of sensors:

Sensor	Designation
VARiON 700 IQ ammonium sensor	*VARiON A*
VARiON 700 IQ nitrate sensor	*VARiON N*

Carrying out settings

Switch to the main settings menu from the measured value display with Ⓢ. Then navigate to the setting menu (setting table) of the sensor. The exact procedure is described in the relevant IQ SENSOR NET system operating manual.

The setting tables of both sensors are described in the following chapters.

Sensor overlapping settings

Certain settings are sensor overlapping and can be changed in both sensors, *VARiON A* and *VARiON N* . A change in the setting menu of one sensor causes at the same time a change for the other sensor.

The sensor overlapping settings are:

- *Cal. procedure*
- *Temperature mode (°C/°F)*
- *Temp. adjustment*

3.5.2 Setting table for the VARiON A (ammonium sensor)

Menu item	Selection/values	Explanations
Measuring mode	● *NH4-N* ● *NH4* ● *mV*	Citation form of the mass concentration or voltage of the electrode.
Measuring range (*NH4-N*)	● *AutoRange* ● *0.1 ... 100.0 mg/l* ● *1 ... 1000 mg/l*	2 measuring ranges can be selected. With *AutoRange*, the instrument automatically switches to the suitable measuring range.
Measuring range (*NH4*)	● *AutoRange* ● *0.1 ... 129.0 mg/l* ● *1 ... 1290 mg/l*	2 measuring ranges can be selected. With *AutoRange*, the instrument automatically switches to the suitable measuring range.
Measuring range (*mV*)	● *-2000 ... 2000 mV*	Fixed range
Potassium compens.	*Automatic* / *Manual* *1 ... 1000 mg/l*	*Automatic* (with a potassium electrode mounted)*:* When the potassium electrode is mounted, the potassium compensation takes places automatically only. The current measured potassium concentration value is displayed in the second line. *Manual* (without any potassium electrode mounted): After determining the potassium content of the test solution enter the determined potassium content manually in the second line. The measured value is corrected corresponding to the entered potassium content (0 = no potassium compensation) Note: Detailed information on the subject of potassium compensation is given in WTW primer ION SELECTIVE MEASUREMENT IN ONLINE ANALYSIS.

Menu item	Selection/values	Explanations
Calib. history K (only with *Potassium compens. Automatic*)	● *Do not download* ● *Transmit to log book*	*Send to log book* generates a log book message with the calibration history of the potassium electrode. When opening the setting table again the setting is reset to *Do not download*.
Initial calib. K (potassium electrode, only with *Potassium compens. Automatic*) *Initial calib. A* (ammonium electrode)	● *On* ● *Off*	An initial calibration is required when the sensor is calibrated for the first time or when an electrode has been replaced. During initial calibration, the basis for the evaluation of the drift voltage is determined. Here you can select whether the next calibration should be an initial calibration. After the initial calibration has been carried out, the setting for initial calibration automatically switches to *Off*.
Cal. procedure (only in the *NH4-N* and *NH4* measuring mode)	● *1 point ref. (1)* ● *2 point stand. (2)*	● 1-point calibration in the test sample with determination of the ammonium and potassium concentration by independent measurements. The results of these measurements ("lab values") are entered manually. ● 2-point calibration with the WTW combination standard solutions, VARiON/ES-1 and VARiON/ES-2. Note: The calibration procedures are described in detail in section 4.1 CALIBRATION.
Temperature mode	● *°C* ● *°F*	Unit of the measured temperature value (Celsius, Fahrenheit).

Menu item	Selection/values	Explanations
Temp. adjustment	*-1.5 °C ... +1.5 °C*	The temperature compensation function enables the temperature sensor to be balanced against a reference temperature measurement (displacement of the zero point by ±1.5 °C). Notes: ● Due to the thermal capacity of the sensor, it is necessary to place it in a container with at least 2 liters of water. ● Leave the sensor in this container for at least 15 minutes while stirring occasionally, then carry out the adjustment. If the temperature difference of the water and sensor is > 10°C, leave the sensor in the container for at least one hour while stirring occasionally.
Save and quit		The system confirms the saving of the settings and the display switches to the next higher level.
Quit		The display switches to the next higher level without saving the new settings.

3.5.3 Setting table of the VARiON N (nitrate sensor)

Menu item	Selection/values	Explanations
Measuring mode	● *NO3-N* ● *NO3* ● *mV*	Citation form of the mass concentration or voltage of the electrode.
Measuring range (*NO3-N*)	● *AutoRange* ● *0.1 ... 100.0 mg/l* ● *1 ... 1000 mg/l*	2 measuring ranges can be selected. With *AutoRange*, the instrument automatically switches to the suitable measuring range.
Measuring range (*NO3*)	● *AutoRange* ● *0.5 ... 450.0 mg/l* ● *5 ... 4500 mg/l*	2 measuring ranges can be selected. With *AutoRange*, the instrument automatically switches to the suitable measuring range.
Measuring range (*mV*)	● *-2000 ... 2000 mV*	Fixed range
Chloride compens.	*Automatic* / *Manual* *1 ... 1000 mg/l*	*Automatic* (with a chloride electrode mounted)*:* When a chloride electrode is mounted, the chloride compensation takes places automatically only. The current measured chloride concentration value is displayed in the second line. *Manual* (without any chloride electrode mounted): After determining the chloride content of the test solution enter the determined chloride content manually in the second line. The measured value is corrected corresponding to the entered chloride content (0 = no chloride compensation) Note: Detailed information on the subject of chloride compensation is given in WTW primer ION SELECTIVE MEASUREMENT IN ONLINE ANALYSIS.
Calib. history Cl (only with *Chloride compens. Automatic*)	● *Do not download* ● *Transmit to log book*	*Send to log book* generates a log book message with the calibration history of the chloride electrode. When opening the setting table again the setting is reset to *Do not download*.

Menu item	Selection/values	Explanations
Initial calib. Cl (chloride electrode, only with *Chloride compens. Automatic*) *Initial calib. N* (nitrate electrode)	● *On* ● *Off*	An initial calibration is required when the sensor is calibrated for the first time or when an electrode has been replaced. During initial calibration, the basis for the evaluation of the drift voltage is determined. Here you can select whether the next calibration should be an initial calibration. After the initial calibration has been carried out, the setting for initial calibration automatically switches to *Off*.
Cal. procedure (only in the *NO3-N* and *NO3* measuring mode)	● *1 point ref. (1)* ● *2 point stand. (2)*	● 1-point calibration in the test sample with determination of the nitrate and chloride concentration by independent measurements. The results of these measurements ("lab values") are entered manually. ● 2-point calibration with the WTW combination standard solutions, VARiON/ES-1 and VARiON/ES-2. Note: The calibration procedures are described in detail in section 4.1 CALIBRATION.
Temperature mode	● *°C* ● *°F*	Unit of the measured temperature value (Celsius, Fahrenheit).

Menu item	Selection/values	Explanations
Temp. adjustment	*-1.5 °C ... +1.5 °C*	The temperature compensation function enables the temperature sensor to be balanced against a reference temperature measurement (displacement of the zero point by ±1.5 °C). Notes: ● Due to the thermal capacity of the sensor, it is necessary to place it in a container with at least 2 liters of water. ● Leave the sensor in this container for at least 15 minutes while stirring occasionally, then carry out the adjustment. If the temperature difference of the water and sensor is > 10°C, leave the sensor in the container for at least one hour while stirring occasionally.
Save and quit		The system confirms the saving of the settings and the display switches to the next higher level.
Quit		The display switches to the next higher level without saving the new settings.

4 Calibration and measurement

4.1 Calibration

4.1.1 General information

Why calibrate?

When an ion sensitive electrode is operated its characteristic curve changes with the course of time. Calibration determines the distinguishing data of the characteristic curve. The characteristic curve is the base for calculating the measured value from the electrode voltage.

When to calibrate?

Calibrate during the initial commissioning, after exchanging an electrode and at regular intervals (depending on the application).

Calibration log and calibration history

The calibration history contains the calibration log of the initial and last of the following calibrations. You can call up the calibration history via the *Calibration history of selected sensor* display option.

4.1.2 Overview of the calibration procedures

You can carry out the calibration of the ammonium and nitrate electrode including the compensation electrode (K or Cl) in a single procedure. You can also calibrate individual electrodes if necessary. The following calibration procedures are available:

2 point stand. (2)

2-point calibration with WTW combination standard solutions.
This calibration procedure determines the electrode voltages at two different known concentrations. The characteristics of the electrode characteristic curve are calculated from them. The result of the *2 point stand. (2)* calibration procedure is the basis for the electrode evaluation. It is the recommended calibration procedure for the initial calibration.

1 point ref. (1)

1-point calibration in the test sample.
This calibration procedure adjusts the value directly measured in the test sample to an independently determined reference value ("lab value"). Reference values have to be determined for each relevant ion type (e.g. ammonium and potassium for ammonium measurement). To do so, a sample is taken from the test solution and, for example, the relevant reference concentration is determined photometrically in the lab.

Determined calibration data

Depending on the calibration procedure (single-point or two-point), the following data are determined during calibrating:

Calibration procedure,	Drift voltage:	Slope
2 point stand. (2)	☒	☒
1 point ref. (1)	☒	

The calibration data is output in the calibration log. It informs you of the condition of the electrode. The meaning of the selected calibration procedure for the evaluation of the electrode aging based on the calibration data is described in section 4.1.3.

In the IQ SENSOR NET systems 184 XT and 2020 XT the calibration data of the last calibrations is summarized in the calibration history. The calibration history is described in the section 4.1.7 CALIBRATION RESULT.

Note
The calibration history of the compensation electrode (potassium or chloride) is not output with the calibration history of the relevant sensor (VARiON A or VARiON N). If necessary, you can generate a log book message with the calibration history via the menu item, *Calib. history K (or Cl)* in the setting table of the relevant sensor. The log book message is available in the log book of the total system (message code IIC521 for potassium, IID521 for chloride).

4.1.3 Calibrating in practice

Note
The following information applies to the ammonium, nitrate and compensation electrode (K or Cl) equally.

Initial calibration

The first calibration (initial calibration) is especially important as it is the reference point for all other calibrations (following calibrations).

An initial calibration is required each time an electrode is commissioned. The initial calibration is switched on and off in the setting menu of the sensor (see section 3.5).

With the initial calibration, the zero point for the drift voltage is determined. It serves as the reference value for the drift voltage, which is determined and recorded in the calibration log with every following calibration. In addition to the slope, the drift voltage informs about the age condition of the electrode (see section 4.1.7).

Note
An optimum initial calibration is achieved with the *2 point stand. (2)* calibration procedure only, which determines the current slope of the electrode. If the initial calibration is carried out with the *1 point ref. (1)* calibration procedure, the default setting (59.16 mV) is taken over.

Following the initial calibration, we recommend to carry out a calibration with the *1 point ref. (1)* procedure in order to compensate for matrix effects of the real test sample. If the interfering ions compensation is done manually, the concentration of interfering ions (potassium or chloride) should be measured and entered at the same time.

Following calibrations

Basically, any calibration procedure can be used for the following calibrations. The slope of the electrode should be determined at regular intervals in any case in order to be able to evaluate the aging of the electrode. If an electrode can no longer be calibrated it is blocked for measurement.

"Emergency operation" after invalid calibration

After a calibration error the sensor can be operated with the last valid calibration data until the error is eliminated (e.g. by exchanging an electrode).

Maintenance and calibration case, VARiON Case

The VARiON Case is available for in-situ calibration. The convenient case provides room for all accessories required for calibration and sampling (details, see section 5.1).

Optimum calibration of an electrode

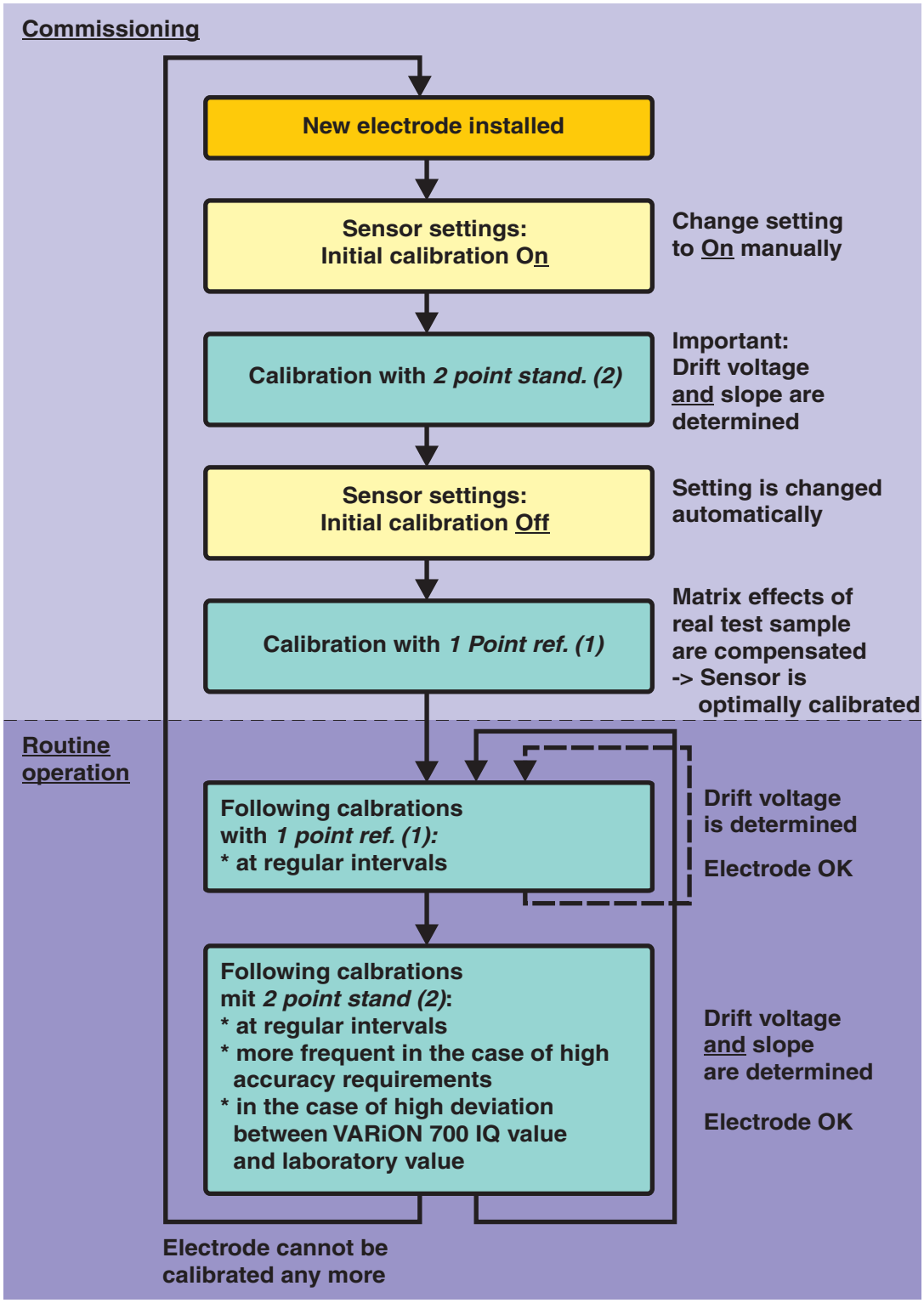


Fig. 4-1 Sequence of calibrations

4.1.4 General sequence of a calibration on the IQ SENSOR NET

Note
After exchanging an electrode always carry out an initial calibration (see section 4.1.3).

Selecting the calibration procedure

The calibration procedure and type (initial or following calibration) are determined in the setting tables (see section 3.5 VARiON 700 IQ SETTING TABLES). Check the settings as necessary.

Carrying out the calibration

Generally, a calibration on the IQ SENSOR NET is carried out as follows. System specific details are given in the respective IQ SENSOR NET system operating manual.

1	Using (M), switch to the measured value display and select a measurement window or the VARiON 700 IQ.
2	Call up the calibration with (C). The next step switches on the maintenance condition for the sensor. A corresponding message appears on the display.
3	Confirm the message with (OK). The maintenance condition is active.
4	The menu-guided calibration routine starts. Follow the instructions on the display. When the calibration routine is completed, the measured value display appears again (the measured value flashes because the sensor is still in the maintenance condition).
5	If the calibration was successful, bring the sensor into the measuring position.
6	Wait for a stable measured value.
7	Switch off the maintenance condition.

4.1.5 Calibration procedure, *2 point stand. (2)*

Note
A chloride electrode should be polished before being calibrated (see section 5.4).

Standard solutions

For the *2 point stand. (2)* calibration procedure, the following WTW standard solutions are required in the following order:

- VARiON/ES-2 (high concentration)
- VARiON/ES-1 (low concentration).

These standard solutions contain all ion types that come into question (ammonium, nitrate, potassium and chloride) and are especially adapted to the VARiON 700 IQ.

Calibration vessels

Calibration in the lab can simply be done in a beaker. For in-situ calibration we recommend to use the calibration vessel provided. It can be attached to the sensor for calibration and thus grants a stable structure and easy handling (e.g. the sensor with the filled calibration vessel can be leaned against a rail).

Cleaning the calibration vessel

The calibration vessel must be absolutely clean for calibration. Observe the following instructions:

- Immediately after calibrating, rinse the calibration vessel with deionized water and wipe it with a clean cloth or leave it in a drying rack to dry for the next calibration.
- Make sure there are no salt residues from the previous calibration or sludge residues from the sensor in the calibration vessel.
- The coupling ring of the Sensor-Cal/40 calibration vessel can be taken apart for cleaning purposes (see section 5.2 EXTERIOR CLEANING).

Caution
Do not use any detergents for cleaning. Detergent residues can seriously affect the function of the electrodes.

Handling of the Sensor-Cal/40 calibration vessel

Always fill the calibration vessel to the inner brim (optimum filling level, see Fig. 4-2).

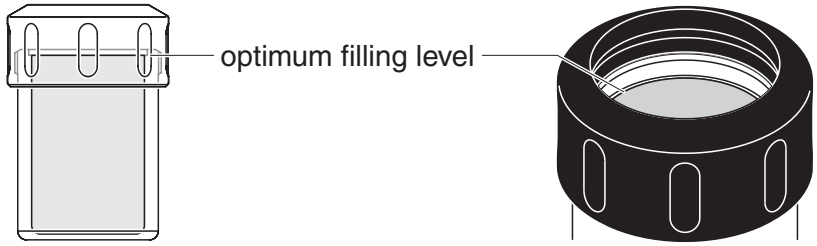


Fig. 4-2 Optimum filling level.

The calibration vessel should always be filled to the optimum filling level so the electrodes are sufficiently immersed in the standard solution.

For calibration push the VARiON 700 IQ into the calibration vessel as far as it will go. Excess standard solution can come out at the coupling ring while doing so (standard solutions are salt solutions and harmless during short contact with the skin). With the aid of the coupling ring you can attach the calibration vessel to the sensor (Fig. 4-3).

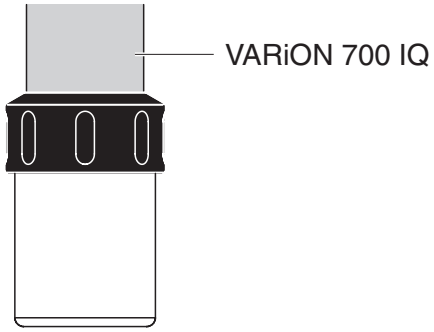


Fig. 4-3 VARiON 700 IQ in the calibration vessel

Note
The displays during calibration are partly dependent on the electrode equipment.

The following steps describe the calibration if the sensor is equipped with the electrodes, VARiON A (NH4), VARiON N (NO3) and VARiON K (K). If the equipment is different calibration is carried out analogously.

Procedure
2 point stand. (2)

Displays	Explanation
Note: After electrode change perform initial calibration in standards.	The display message reminds you of the correct settings for *Initial calibration* and *Cal. procedure*. If necessary, cancel the calibration procedure with ESC and correct the settings. Otherwise, confirm with OK.
Sensors to be calibrated *All (NH4, NO3, K)* (example)	Select the electrodes to be calibrated with ↻. You can select all combinations of electrodes that are possible with the electrode equipment. Subsequently confirm with OK. Note: This dialog is skipped if only one electrode is available.
Cal.: 2 POINT STAND. (2) *Clean and rinse sensor/electrode.* *Have VARiON/ES-2 standard ready for calibration.*	Carry out the steps as described. Subsequently confirm with OK.
Fill calibration vessel with VARiON/ES-2 standard to the edge. Attach to sensor, tighten.	Carry out the steps as described and press OK.
Remaining time: x minutes *Please wait...* 	Waiting time for conditioning.
Discard used standard. Refill calibration vessel with VARiON/ES-2 standard. Mount to sensor.	Carry out the steps as described. **Subsequently confirm with OK immediately.**

Displays	Explanation
U(mV): A:110 N:156 K:90 *Please wait...*  (example)	The electrode voltages are measured. As soon as a stable measured value is recognized, the next display appears.
Cal.: 2 POINT STAND. (2) *Have VARiON/ES-1 standard ready for calibration.*	Carry out the steps as described. Subsequently confirm with (OK).
Fill calibration vessel with VARiON/ES-1 standard to the edge. Attach to sensor, tighten.	Carry out the steps as described. Subsequently confirm with (OK).
Remaining time: x minutes *Please wait...* 	Waiting time for conditioning.
Discard used standard. Refill calibration vessel with VARiON/ ES-1 standard. Mount on sensor.	Carry out the steps as described. **Subsequently confirm with (OK) immediately.**
U(mV): A:56 N:218 K:36 *Please wait...*  (example)	The electrode voltages are measured. As soon as a stable measured value is recognized the calibration result appears.
S(mV) DV(mV) Res *NH4-N 53.7 0 +* *NO3-N -61.5 3 +* *K 54.5 1 +* (example)	Calibration result for each calibrated electrode. *S(mV)* = slope *DV(mV)* = drift voltage *Res* = evaluation result **+** : calibration successful **-** : calibration unsuccessful Confirm with (OK). For commissioning, follow the further instructions on the display.

4.1.6 Calibration procedure, *1 point ref. (1)*

Note
A chloride electrode should be polished before being calibrated (see section 5.4).

Main steps

Step 1: Selection of the electrodes to be calibrated, conditioning, and determination of all electrode voltages ("reference voltages").
The sensor is in the measuring position.
The calibration step is started from the measured value display with Ⓒ. After completion the system returns to the measured value display.

Step 2: Sampling at the same time and location if possible and determination of all relevant concentrations (including interfering ions concentration for the automatic or manual interfering ions compensation).

Step 3: Entry of the results of the concentration determination.
The calibration step is started by pressing Ⓒ again.

Note
The displays during calibration are partly dependent on the electrode equipment.

The following steps describe the calibration if the sensor is equipped with the electrodes, VARiON A (NH4), VARiON N (NO3) and VARiON K (K). If the equipment is different calibration is carried out analogously.

Procedure *1 point ref. (1)*, step 1

Displays	Explanation
Note: After electrode change perform initial calibration in standards. (example)	The display message reminds you of the correct settings for *Initial calibration* and *Cal. procedure*. If necessary, cancel the calibration procedure with ESC and correct the settings. Otherwise, confirm this and other possible messages with OK.

Displays	Explanation
Sensors to be calibrated *All (NH4, NO3, K)* (example)	Select the electrodes to be calibrated with ⟲. You can select all combinations of electrodes that are possible with the electrode equipment. Subsequently confirm with OK. Note: This dialog is skipped if only one electrode is available.
Cal.: 1 POINT REFERENCE (1) *Step 1:* ** Check sensor* ** Clean sensor if necessary* ** Immerse sensor in sample*	Carry out the steps as described. Subsequently confirm with OK.
Cal.: 1 POINT REFERENCE (1) *Step 1:* ** 15 minutes conditioning time* ** Determine reference voltage(s)*	Confirm with OK.
U(mV): A:52 N:223 K:81 *Please wait...*  (example)	The electrode voltages are measured. Continue with sampling and concentration measurement (step 2).

Procedure
***1 point ref. (1)*, step 2**

Displays	Explanation
Step 2:Take a sample and determine the concentration(s) for ammonium, nitrate, potassium, chloride in the lab. Subsequently, start step 3 with 'C'. (example)	Confirm with OK. The display switches to the measured value display. The sensor is in maintenance condition. Now take the sample and determine the concentrations (details see following text).

Note
During the subsequent determination of the reference concentrations in the laboratory you can use the sensor for measuring again by simply abolishing the maintenance condition.

The sensor continues to use the old calibration data. The reference voltages determined in step 1 of the calibration will not be lost. They remain stored until step 3 of the calibration is completed. They do not have to be noted and entered again.

Proceed as follows with sampling and determining the reference concentration:

1	Take a sample, if possible immediately after determining the reference voltage and in the vicinity of the sensor.

Note
Ammonium and nitrate have to be determined immediately after taking the sample as the their content changes very quickly due to the micro organisms that are present. It is best to take the sample using a syringe filter for transport to the laboratory or to stabilize it otherwise. When adding stabilizing solutions, the dilution factor has to be taken into account.

2	Depending on the electrodes to be calibrated, determine the relevant concentrations in the lab. They are: – Ammonium and potassium for the ammonium electrode – Nitrate and chloride for the nitrate electrode
3	Continue calibration with Ⓒ as follows.

Procedure
***1 point ref. (1)*, step 3**

Displays	Explanation
Cal.: 1 POINT REFERENCE (1) *Step 3: Enter reference concentration(s).* *Reference voltage(s) already determined (DD.MM.YYYY)*	For checking purposes, the display shows the date on which the stored reference voltages were determined. Confirm with Ⓞⓚ.
Continue with ... *...Input ref. conc.*	If you want to determine the reference voltages anew, use Ⓒ to select the *...New calibration* option. Otherwise, confirm with Ⓞⓚ.

Displays	Explanation
Input reference concentration *Determined value* *NH4-N (0.1..100.0 mg/l)* (example)	Select the electrodes to be calibrated with ⟳. You can select all combinations of electrodes that are possible with the electrode equipment. Subsequently confirm with OK. Note: This dialog is skipped if only one electrode is available.
Value of ref. concentration *14.5 mg/l NH4-N* (example)	Set the measured reference concentration with ⟳. Subsequently confirm with OK.
	Repeat the last two steps analogously for all other reference concentrations. After the last value has been entered the calibration result appears.
S(mV) DV(mV) Res *NH4-N 53.7* 5 +* *NO3-N -61.5* 6 +* *K 54.5* 2 +* (example)	Calibration result for each calibrated electrode. *S(mV)* = slope (* = taken over from the last valid two-point calibration) *DV(mV)* = drift voltage *Res* = evaluation result **+** : calibration successful **-** : calibration unsuccessful Confirm with OK. For commissioning, follow the further instructions on the display.

4.1.7 Calibration result

Calibration evaluation

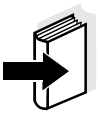
After calibrating the system automatically evaluates the current state of all electrodes based on their calibration data. The drift voltage and slope are evaluated separately. For a valid calibration, the drift voltage and slope have to be within the following ranges:

Value of the slope: 50 ... 70 mV

Drift voltage: -45 ... +45 mV

Possible results of the calibration

Display after the calibration	Log book entries (meaning/actions)
Measured value display	The electrode war successfully calibrated. The slope and drift voltage are within the valid range. Calibration data, see calibration log or calibration history.
"----"	The electrode could not be calibrated. The sensor is blocked for measurement. This can have the following causes: ● The slope and/or drift voltage are outside the valid range ● The measurement signal during calibration was unstable. The measurement was canceled. Note: After a calibration error the sensor can be operated with the last valid calibration data until the error is eliminated (e.g. by exchanging an electrode). A corresponding dialog at the end of the calibration refers to this.



Note
Actions for error elimination are given in chapter 7 WHAT TO DO IF....

Calibration history (available in the IQ SENSOR NET systems 184 XT and 2020 XT only)

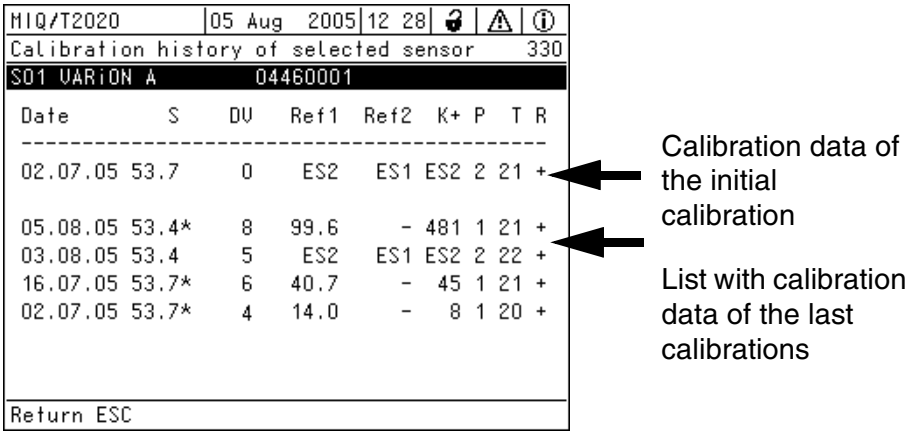


Fig. 4-4 Calibration history of selected sensor(example: VARiON A)

The calibration history contains the following information:

Date	Date of the calibration
S	Slope [mV] of the electrode With the *1 point ref. (1)* calibration procedure, the value is marked by a sign (*). This means the value was taken over from the last 2-point calibration. If no valid slope was determined, the default setting (59.2 mV) is displayed.
DV	Drift voltage [mV] 0 is displayed with the initial calibration.
Ref1*/*Ref2	Depending on the calibration procedure. *1 point ref. (1)*: entered reference concentration [mg/l] *2 point stand. (2)*: used standard solutions
K+ or ***Cl-***	Depending on the calibration procedure. *1 point ref. (1)*: entered interfering ions concentration [mg/l] *2 point stand. (2)*: standard solution, VARiON/ES-2
P	Calibration procedure, number 1 ... 2
T	Temperature [°C]
R	Evaluation of the calibration **+** : calibration successful. The sensor measures with the new calibration data. **-** : calibration unsuccessful. Invalid calibration data cause the measurement to be invalid. **?** : calibration unsuccessful. Invalid calibration data were discarded. Measurement is continued with the calibration data of the last valid calibration.

4.2 Measuring

4.2.1 Measuring operation

Note the data given in section 8.2 APPLICATION CONDITIONS, especially the minimum immersion depth of the sensor (> 30 mm with mounted protective hood).

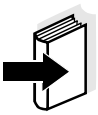
Note
To keep the sensor clean, we recommend to use the CH cleaning head (see chapter 6 REPLACEMENT PARTS AND ACCESSORIES).

4.2.2 Factors affecting the measured values

Caution
Greases, oils, certain tensides and similar substances can shorten the operational lifetime of the electrodes. Therefore, they should not be present in the test sample.

For measurement with the VARiON 700 IQ the following influencing variables can be important, depending on the measured parameter:

Measured parameter	Influencing variable
Ammonium	● pH value ● Potassium ions
Nitrate	● Chloride ions



Note
The effects of influencing variables on measurement and compensating actions are described in detail in the WTW primer ION SELECTIVE MEASUREMENT IN ONLINE ANALYSIS.

5 Maintenance and electrode exchange

5.1 General maintenance notes

Warning
Contact with the sample can be dangerous for the user! Depending on the type of sample, suitable protective measures must be taken (protective clothing, protective goggles, etc.).

Maintenance condition

We recommend to switch on the maintenance condition each time the sensor is taken out of the measuring position. This avoids unwanted reactions of linked outputs. More information on the maintenance condition is given in the relevant IQ SENSOR NET system operating manual.

VARiON/Epack

The VARiON/Epack set with usual replacement parts is available for maintenance (see chapter 6 REPLACEMENT PARTS AND ACCESSORIES).

Maintenance and calibration case, VARiON Case

The VARiON Case is available for in-situ calibration and maintenance. It provides room for replacement electrodes, calibration equipment, maintenance equipment and various accessories. The case is delivered without any equipment. A sample equipment is shown on the following page.

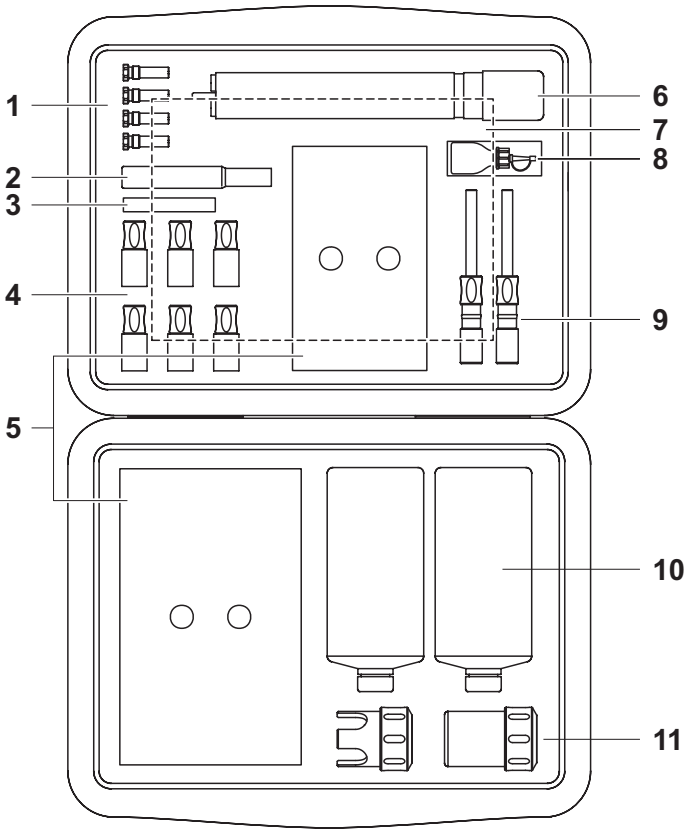


Fig. 5-1 Sample equipment of the VARiON Case calibration and maintenance case

1	Blind plug
2	Special socket wrench
3	Polishing strip
4	Replacement electrodes with watering caps
5	Compartments for various accessories (wiping cloths, sample bottles, personal protective equipment etc.)
6	Recess for sensor
7	Operating manual
8	Storing solution for reference electrode
9	Replacement reference electrodes with watering caps
10	Calibration standards
11	Protective hood / calibration vessel

5.2 Exterior cleaning

Note
To keep the electrodes clean, we recommend to use the CH cleaning head (see chapter 6 REPLACEMENT PARTS AND ACCESSORIES).

With normal operation (e.g. municipal wastewater) we strongly recommend to clean the outside of the sensor:

- when it is strongly contaminated (after visual check)
- if erroneous measured values are suspected
- each time before removing an electrode

Caution
Do not use any detergents for cleaning. Detergent residues can seriously affect the function of the electrodes.

Note
We recommend to clean the sensor shaft and electrodes while the sensor is still connected to the sensor connection cable. Otherwise, moisture and/or dirt can get into the plug connection where it can cause contact problems.

If you need to disconnect the sensor from the sensor connection cable, please note the following points:

- Before disconnecting the sensor from the SACIQ sensor connection cable, remove any larger pieces of contamination from the sensor, particularly in the area of the plug connection (brush it off in a bucket of tap water, wash it off with a hose or wipe it off with a cloth).
- Unscrew the sensor from the SACIQ sensor connection cable.
- Always place a protective cap on the plug head of the sensor and on the SACIQ sensor connection cable so that no moisture or dirt can get into the contacting surfaces.

Cleaning the sensor

Clean the sensor shaft with tap water and a soft sponge or brush. Remove the protective hood. The electrodes are best cleaned under running tap water using a soft toothbrush or brush.

Cleaning the coupling ring of the protective hood and calibration vessel

The coupling ring can be unscrewed and dismantled for cleaning as follows:

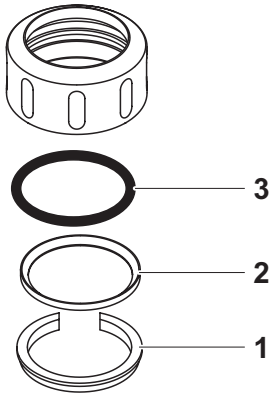


Fig. 5-2 Dismantling the coupling ring

1	Remove the retaining ring (pos. 1 in Fig. 5-2).
2	Remove the intermediate ring (pos. 2) and sealing ring (pos. 3).

After the parts have been cleaned, reassemble the coupling ring in reverse order. When doing so make sure that the tapered side of the intermediate ring (pos. 2) points towards the sealing ring (pos. 3).

5.3 Exchanging the electrodes

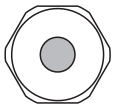
Caution

The sensor can be damaged by dirt and moisture. Each time before dismantling an electrode carefully clean the area around the electrodes (section 5.2). Before mounting an electrode make sure the area behind the sealing ring of the electrode and the receptacle are dry and clean. The VARiON 700 IQ may only be submersed when the electrodes or original blind plugs are mounted.

Use the special socket wrench provided to dismantle an electrode. Electrodes are installed as described in section 3.4.1 EQUIPPING THE SENSOR WITH ELECTRODES.

Recognizing the electrode type from outside

When mounted, the electrodes can be recognized by the following features:

Electrode	Hexagon	Front surface	Other features
VARiON Ref 	black	black	– Thread at the hexagon
VARiON NH4 	black	black	– Hexagon without thread
VARiON K 	black	white	
VARiON NO3 	white	white	
VARiON Cl 	black	black	– Larger membrane – Membrane flush with the front surface

Note

For the correct storage of the electrodes please follow the instructions in section 3.3 NOTES ON THE HANDLING OF THE ELECTRODES.

5.4 Polishing the chloride electrode

Caused by the test medium, a coating can develop on the surface of the chloride electrode, which reduces the electrode slope. To maintain a proper chloride compensation the surface must be renewed by polishing at regular intervals (recommended: routinely once a week and additionally each time before calibrating).

Caution
Danger of damaging the electrode. Exclusively use the SF 300 polishing strip. Never use normal sandpaper or similar.

The polishing can be done while the electrode is mounted (remove the protective hood as necessary). Use the SF 300 polishing strip supplied with the electrode to polish the electrode. Moisten the rough side of the polishing strip with water and polish off the coating with slight pressure.

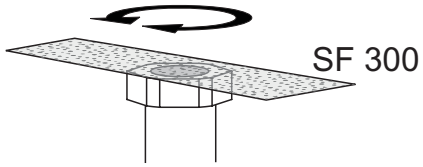


Fig. 5-3 Polishing the chloride electrode

5.5 Disposal

Sensor We recommend disposing of the sensor as electronic refuse.

Electrodes If no official regulations apply to the contrary, used and defective electrodes can be treated as household waste.

6 Replacement parts and accessories

6.1 Electrodes

Exchange electrodes

Description	Model	Order no.
Reference electrode	VARiON Ref	107042
Ammonium electrode	VARiON NH4	107044
Nitrate electrode	VARiON NO3	107045
Potassium electrode	VARiON K	107046
Chloride electrode	VARiON Cl	107047

Storing equipment

Description	Model	Order no.
250 ml potassium chloride solution for the storage of the electrode	KCl-250	109705

6.2 General accessories

Standard solutions for calibration

Description	Model	Order no.
1 liter combination standard 1 (low concentration)	VARiON/ES-1	107050
1 liter combination standard 2 (high concentration)	VARiON/ES-2	107052

Maintenance equipment

Description	Model	Order no.
Polishing strip	SF 300	203680

General replacement parts

Description	Model	Order no.
Protective hood	VARiON 700 IQ-SK	107056
Calibration vessel	Sensor-Cal/40	109420

Description	Model	Order no.
Replacement parts set, comprising – 1 blind plug for receptacle – 1 special socket wrench – 3 replacement sealing rings for electrodes/blind plugs – Storing equipment for electrodes: 1 nut, 1 watering cap with sponge for measurement or compensation electrode, 1 watering cap for reference electrode	VARiON/Epack	107057

Calibration and maintenance case

Description	Model	Order no.
Empty case for the storage of calibration and maintenance equipment for the VARiON 700 IQ	VARiON Case	107058

Components for cleaning system

Description	Model	Order no.
Cleaning head	CH	900107
Passive valve module	MIQ/CHV	900109
Active valve module (does not require a free relay output in the IQ SENSOR NET system)	MIQ/CHV PLUS	480018

Note
Information on other IQ SENSOR NET accessories is given in the WTW catalog and on the Internet.

7 What to do if...

No measured value display

Cause	Remedy
– Sensor not connected	– Connect the sensor
– Incorrect electrode equipment	– Correct electrode equipment
– Electrode(s) not at all or incorrectly recognized by the system	– Check electrode positions (gap-free mounting) – Check electrode receptacle for moisture – If necessary, unscrew the electrode/blind plug and thoroughly dry the electrode/ blind plug and receptacle
– Unknown	– Look for error messages in the log book
– Liquid in the sensor shaft	– Sensor defective, send it back

Measurement provides implausible measured values

Cause	Remedy
– No calibration performed	– Calibrate the electrode
– Calibration error (e.g. incorrect lab values, contaminated standard solutions)	– Check calibration conditions – Recalibrate the electrode
– Manual interfering ions compensation works with an unsuitable value	– Determine and enter the interfering ions compensation once again, then recalibrate
– Electrode(s) not at all or incorrectly recognized by the system	– Check electrode positions (gap-free mounting) – Check electrode receptacle for moisture – If necessary, unscrew the electrode/blind plug and thoroughly dry the electrode/ blind plug and receptacle
– Electrode contaminated	– Clean the electrode (see section 5.2)
– Liquid in the sensor shaft	– Sensor defective, send it back

Measurement provides jumping, unstable or drifting values

Cause	Remedy
– Measurement / compensation electrode: Electrode membrane not moistened by measuring solution, e.g. due to air in front of the membrane	– Moisten membrane with deionized water using a wash bottle. To do so, position the opening of the wash bottle on the membrane and splash against the membrane vigorously
– Measurement / compensation electrode: Air bubble behind the membrane	– Hold the electrode in a vertical position with the membrane down and knock it on the side with the special socket wrench
– Measurement / compensation and reference electrode: Insufficient electrical contact in the electrode receptacle	– Check electrode positions (gap-free mounting) – Check electrode receptacle for moisture – If necessary, unscrew the electrode/blind plug and thoroughly dry the electrode/ blind plug and receptacle
– Reference electrode dried up	– Replace reference electrode
– Measurement / compensation electrode or reference electrode leaky or damaged	– Replace defective electrode
– Liquid in the sensor shaft	– Sensor defective, send it back

Slope outside the valid range after calibrating

Cause	Remedy
– Calibration error (e.g. contaminated standard solutions)	– Check calibration conditions – Recalibrate the electrode
– Electrode not enough adapted to the test sample or calibration solution (conditioned)	– Switch to mV mode and observe measured value – When measured value stable repeat calibration
– Electrode defective due to aging	– Replace defective electrode

Drift voltage outside of the valid range despite valid slope

Cause	Remedy
– Calibration error (e.g. incorrect lab values, contaminated standard solutions)	– Check calibration conditions – Recalibrate the electrode
– Electrode not enough adapted to the test sample or calibration solution (conditioned)	– Switch to mV mode and observe measured value – When measured value stable repeat calibration
– Reference electrode defective due to aging	– Replace defective electrode

8 Technical data

8.1 Measuring characteristics

Measuring principle

Potentiometric measurement by means of ion sensitive electrodes. Modular structure with jointly used reference electrode and ion sensitive electrodes. Integrated microprocessor electronics, screened 2-wire connection for power and data transmission.

Measured parameters

Main measured parameters	Ammonium and/or nitrate (depending on the electrode equipment)
Secondary measured parameter	Temperature

Measuring ranges and resolution, Ammonium measurement

Measuring mode	Measuring range	Resolution
NH4-N	0.1 ... 100.0 mg/l 1 ... 1000 mg/l	0.1 mg/l 1 mg/l
NH4	0.1 ... 129.0 mg/l 1 ... 1290 mg/l	0.1 mg/l 1 mg/l
mV	-2000 ... +2000 mV	1 mV

Measuring ranges and resolution, Nitrate measurement

Measuring mode	Measuring range	Resolution
NO3-N	0.1 ... 100.0 mg/l 1 ... 1000 mg/l	0.1 mg/l 1 mg/l
NO3	0.5 ... 450.0 mg/l 5 ... 4500 mg/l	0.1 mg/l 1 mg/l
mV	-2000 ... +2000 mV	1 mV

Interfering ions compensation

Main measured parameter	Interfering ions that can be compensated for
Ammonium	Potassium (K^+)
Nitrate	Chloride (Cl^-)

Selectable procedures for interfering ions compensation

Compensation procedures	Description
automatic	up to 1000 mg/l interfering ions when equipped with the corresponding compensation electrode (chloride for nitrate measurement or potassium for ammonium measurement)
manual	without compensation electrode by manual entry of the interfering ions concentration (range 0 ... 1000 mg/l).

Temperature measurement

Sensing element type	integrated NTC
Measuring range	- 5 °C ... + 60 °C (23 ... 140 °F)
Accuracy	± 0.5 K
Resolution	0.1 K
Response time t_{95}	< 20 s

Temperature compensation

automatic in the range 0 °C ... 40 °C (32 ... 104 °F)

8.2 Application conditions

Allowed temperature range

Measuring medium	0 °C ... 40 °C (32 ... 104 °F)
Storage/transport	0 °C ... 40 °C (32 ... 104 °F)

Allowed pH range of the measuring medium

4 ... 12

Pressure resistance

Sensor with the electrodes or blind plugs screwed in and the SACIQ sensor connection cable connected:

Max. allowed overpressure	2 x 10^4 Pa (0.2 bar)

Type of protection

Sensor with the electrodes or blind plugs screwed in and the SACIQ sensor connection cable connected:

IP 68, 0.2 bar (2 x 10^4 Pa)

Depth of immersion min. 30 mm; max. 2 m depth

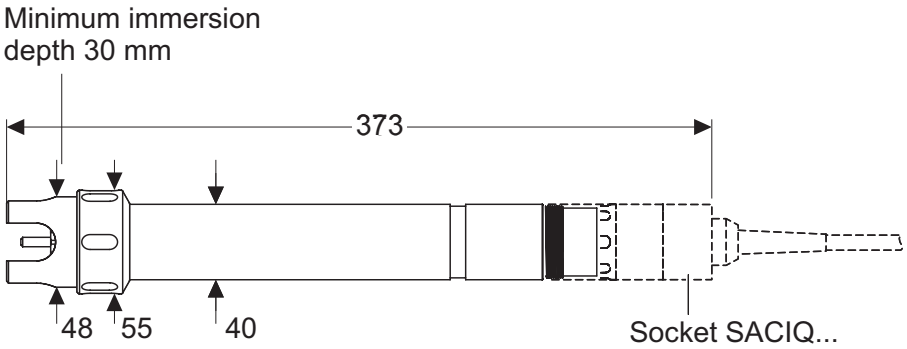
Operating position pendulous to horizontal

Field of application

- Control / monitoring in the aeration tank of a waste water treatment plant
- Water and waste water monitoring

8.3 General data

Dimensions



Weight (without sensor connection cable) approx. 670 g with protective hood

Connection technique Connection via SACIQ sensor connection cable

Material

Shaft	V4A stainless steel 1.4571
Protective hood	POM
Electrode support	POM
Temperature probe	V4A stainless steel 1.4571
Plug head connector housing	POM
Plug, 3-pole	ETFE (blue) Tefzel®
Electrodes	see section 8.5

Instrument safety

Applicable norms	– EN 61010-1 – UL 3111-1 – CAN/CSA C22.2 No. 1010.1

8.4 Electrical data

Nominal voltage	max. 24 VDC via the IQ SENSOR NET (details see chapter TECHNICAL DATA of the IQ SENSOR NET system operating manual)
Power consumption	0.2 W
Protective class	III

8.5 Data of the VARiON electrodes

8.5.1 Materials

	VARiON NH4	VARiON NO3	VARiON K	VARiON Cl	VARiON Ref
Electrodes					
Enclosure	POM	POM	POM	PVC	PVC
Clamping ring	POM	POM	POM	-	-
Membrane	soft PVC with stainless steel protective grating	soft PVC with stainless steel protective grating	soft PVC with stainless steel protective grating	ISE element (solid body) in epoxy	-
Diaphragm	-	-	-	-	Porous PVDF
Sealing ring	FPM (Viton®)	FPM (Viton®)	FPM (Viton®)	FPM (Viton®)	FPM (Viton®)
Contacts	gold-plated	gold-plated	gold-plated	gold-plated	gold-plated
Storing equipment					
Watering cap	Silicone	Silicone	Silicone	Silicone	POM
Nut	POM	POM	POM	POM	POM

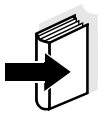
8.5.2 Weights

VARiON NH4	VARiON NO3	VARiON K	VARiON Cl	VARiON Ref
5 g	5 g	5 g	5 g	13 g

9 Indexes

9.1 Explanation of the messages

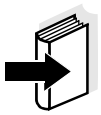
This chapter contains a list of all the message codes and related message texts that can occur in the log book of the IQ SENSOR NET system for the VARiON 700 IQ sensor.



Note
Information on

- the contents and structure of the log book and
- the structure of the message code

is given in the LOG BOOK chapter of the IQ SENSOR NET system operating manual.



Note
The last three digits of the message code identify the source of the message:

- 521 = VARiON 700 IQ Armature (component class, adapters ADA)
- 391 = Sensor VARiON A (ammonium sensor)
- 392 = Sensor VARiON N (nitrate sensor)

9.1.1 Error messages

Message code	Message text
EA1391	*Meas. range exceeded or undercut* ** Check process* ** Select other meas. range*
EA1392	*Meas. range exceeded or undercut* ** Check process* ** Select other meas. range*
EA2521	*Sensor temperature too high!* ** Check process and application*
EA3521	*Sensor temperature too low!* ** Check process and application*
EAN521	*Potassium meas.: Range exceeded or undercut* ** Check process*
EAO521	*Chloride meas.: Range exceeded or undercut* ** Check process*

Message code	Message text
EC1391	*Sensor could not be calibrated,* *Sensor blocked for measurement* ** Check calibration conditions and calibration standard* ** View calibration history* ** Service sensor immediately* *(see operating manual)*
EC1392	*Sensor could not be calibrated,* *Sensor blocked for measurement* ** Check calibration conditions and calibration standard* ** View calibration history* ** Service sensor immediately* *(see operating manual)*
EC7521	*Potassium electrode could not be calibrated,* *Sensor blocked for ammonium and potassium measurement* ** Check calibration conditions and calibration standard* ** View calibration history* ** Service sensor immediately* *(see operating manual)*
EC8521	*Chloride electrode could not be calibrated,* *Sensor blocked for nitrate and chloride measurement* ** Check calibration conditions and calibration standard* ** View calibration history* ** Service sensor immediately* *(see operating manual)*
EIA521	*Invalid electrode equipment* ** allowed equipment s. operating manual*
ES1521	*Component hardware defective* ** Contact WTW*

9.1.2 Info messages

Message code	Message text
IIA521	(This message is generated when the electrode equipment is changed. It informs you of the new assignment of the electrode receptacles)
IC1391	*Sensor has been successfully calibrated* ** For calibration data, see calibration history*
IC1392	*Sensor has been successfully calibrated* ** For calibration data, see calibration history*

Message code	Message text
IC3521	*Potassium electrode has been successfully calibrated* ** For calibration data, see calibration history*
IC4521	*Chloride electrode has been successfully calibrated* ** For calibration data, see calibration history*
IIC521	(this message contains calibration data of the potassium electrode)
IID521	(this message contains calibration data of the chloride electrode)

9.2 Status info

The status info is a piece of coded information about the current state of a sensor. Each sensor sends this status info to the controller. The status info of sensors consists of 32 bits, each of which can have the value 0 or 1.

Status info, general structure

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	(general)
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	(internal)
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	

The bits 0 - 15 are reserved for general information.
The bits 16 - 21 are reserved for internal service information.

You obtain the status info:

- via a manual query in the menu, *Einstellungen/Settings/Service/List of all components* (see system operating manual)
- via an automated query
  - of a superordinate process control (e. g. when connected to the Profibus)
  - of the IQ Data Server (see operating manual of the IQ SENSOR NET software pack)

Note
The evaluation of the status info, e.g. in the case of an automated query, has to be made individually for each bit.

VARiON 700 IQ Status info

Status bit	Explanation
Bit 0	*Component hardware defective*
Bit 1-31	-