TriOS
Optical Sensors

NICO

Operating instructions

Table of contents

1 General information

1.1 Introduction

Welcome to TriOS. We are delighted that you have chosen the NICO UV photometer.

NICO is an optical immersion sensor for the continuous online measurement of nitrate. The measurement principle is based on the principle of photometry. By measuring the absorption at three wavelength points, a precise optical nitrate determination is made, taking turbidity and organic substances into account. An internal temperature correction additionally increases the stability of the measured values.

The photometer is equipped with the TriOS G2 interface, which allows quick and easy sensor configuration using a web browser. Integration into existing process control systems and external data loggers is easy to implement. A laptop, tablet or smartphone can be used for control via WLAN without the need to install special application software or an app.

In this manual you will find all the information about NICO that you need for commissioning. Technical specifications as well as detection limits and dimensions can be found in chapter 7.

Please note that the user is responsible for complying with regional and national regulations for the installation of electronic devices. Any damage caused by incorrect use or unprofessional installation is not covered by the warranty.

All sensors and accessories supplied by TriOS Mess- und Datentechnik GmbH must be installed and operated in accordance with TriOS Mess- und Datentechnik GmbH specifications. All parts have been designed and tested according to international standards for electronic instruments. The device complies with international standards for electromagnetic compatibility. Please use only original TriOS accessories and cables to ensure smooth and professional use of the devices.

Read this manual carefully before using the device and keep it for future reference. Before using the sensor, make sure that you have read and understood the safety precautions described below. Always ensure that the sensor is operated correctly. The safety precautions described on the following pages are intended to ensure problem-free and correct operation of the device and the associated accessories and to prevent you, other persons or devices from being harmed.

NOTICE

If translations differ from the original German text, the German version is binding.

Firmware updates

This manual refers to firmware version 1.2.14 and higher. Updates include troubleshooting and new functions and options. Devices with older firmware versions may not have all the functions described here.

Copyright notice

1.2 Health and safety instructions

This manual contains important information on health and safety regulations. This information is marked in accordance with the international specifications of ANSI Z535.6 (“Product safety information in product manuals, instructions and other collateral materials”) and must be followed. The following categories are distinguished:

⚠ DANGER

Danger / Will cause serious injury or death

⚠ WARNING

Warnings / May cause serious injury or death

⚠ CAUTION

Caution / May cause moderate injury

NOTICE

May lead to material damage

Tip / Useful information

Electromagnetic waves

Devices that emit strong electromagnetic waves can influence the measurement data or cause the sensor to malfunction. Avoid operating the following devices in the same room as the TriOS sensor: cell phones, cordless phones, transceivers or other electrical devices that generate electromagnetic waves.

⚠ CAUTION

Never look directly into the light source without suitable UV protection! The UV light can irreversibly damage your eyes.

Reagents

Follow the manufacturer's safety and operating instructions when using reagents. Observe the applicable Ordinance on Hazardous Substances for Reagents (GefStoffV)!

Biological safety

Liquid waste may be biologically hazardous. You should therefore always wear gloves when handling such materials. Observe the currently valid Biological Substances Ordinance (BioStoffV)!

Waste

When handling liquid waste, the regulations for water pollution, drainage and waste disposal must be observed.

1.3 Warning notices

This sensor has been developed for use in industry and science. It should only be used to measure aqueous solutions such as drinking water, process waste water, river water or seawater.

NOTICE

Sensors made of stainless steel are not made for use in seawater or high chloride concentrations (corrosion). Only sensors made of titanium can be used here.

- Sensors made of stainless steel must be cleaned immediately after contact with salt water or other corrosion-causing substances (e.g. acids, alkalis, chlorine-based compounds). The material resistance should be tested for each application.
- The sensor has seals made of NBR (acrylonitrile butadiene rubber). Sealing rings made of other materials may be used on individual request. Before operation, make sure that the measuring medium does not damage the seals.
- Do not cut, damage or modify the cable. Make sure that there are no heavy objects on the cable and that the cable does not kink. Ensure that the cable does not run close to hot surfaces.
- If the sensor cable is damaged, it must be replaced with an original part by TriOS Mess- und Datentechnik GmbH technical support.
- Do not place any unsuitable objects within the optical path while the measurement process is running, as this may cause damage to the sensor or falsified measurement results.
- Stop operation of the sensor if excessive heat is generated (i.e. more than lukewarm). Switch off the sensor immediately and disconnect the cable from the power supply. Please contact your dealer or TriOS technical support.
- Never attempt to disassemble or modify any part of the sensor unless specifically described in this manual. Inspections, modifications and repairs may only be carried out by the device dealer or by TriOS authorized and qualified specialists.
- Devices from TriOS Mess- und Datentechnik GmbH comply with the highest safety standards. Repairs to the devices (which include the replacement of the connecting cable) must be carried out by TriOS Mess- und Datentechnik GmbH or an authorized TriOS workshop. Incorrect, improper repairs can lead to accidents and injuries.

NOTICE

TriOS does not guarantee the plausibility of the measured values. The user is always responsible for monitoring and interpreting the measured values.

1.4 User and operating requirements

The NICO photometer was developed for use in industry and science. The target group for operating the immersion sensors is technically experienced specialist personnel in companies, sewage treatment plants, waterworks and institutes.

The application often requires the handling of hazardous substances. We assume that the operating personnel are familiar with the handling of hazardous substances due to their professional training and experience. In particular, the operating personnel must be able to correctly understand and implement the safety markings and safety instructions on the packaging and in the package inserts of the test kits.

1.5 Intended use

The intended use of NICO is exclusively to carry out photometric measurements as described in this manual. In this respect, the photometer is an immersion sensor that is used under water or with flow cells. Please observe the technical data of the accessories. Any other use is considered improper.

The sensor may only be used for measuring the absorption or transmission of aqueous liquids, such as process waste water, municipal waste water, surface water and groundwater. The use of other media can

damage the sensor. To use the NICO in media other than those specified here, please contact the technical support team at TriOS Mess- und Datentechnik GmbH (support@trios.de).

NOTICE

Avoid any contact with the glass parts in the optical path, as these can become scratched or dirty. As a result, the functionality of the device is no longer guaranteed.

According to current scientific knowledge, the device is safe to use if it is handled in accordance with the instructions in this operating manual.

NOTICE

Damage caused by improper use is excluded from the warranty.

1.6 Disposal instructions

At the end of its service life or useful life, the device and its accessories can be returned to the manufacturer (see address below) for disposal in an environmentally friendly manner. Proof of prior professional decontamination must be provided in the form of a certificate. Please contact us before returning the device for further details.

Address of the manufacturer:

TriOS Mess- und Datentechnik GmbH
Bürgermeister-Brötje-Str. 25
26180 Rastede
Rastede, Germany
Phone: +49 (0) 4402 69670 - 0
Fax: +49 (0) 4402 69670 - 20

1.7 Certificates and approvals

The product meets all requirements of the harmonized European standards. It therefore fulfills the legal requirements of the EU directives. TriOS Mess- und Datentechnik GmbH confirms the successful testing of the product by affixing the CE mark (see appendix).

2 Introduction

NICO is an intelligent measuring instrument that can be operated without additional hardware. The following chapters explain the correct operation of NICO with all its functions and setting options.

2.1 Product identification

All TriOS Mess- und Datentechnik GmbH products are provided with a product label that clearly shows the product designation.

There is also a type plate on the device with the following information, which you can use to clearly identify the product:

The nameplate also contains the product barcode, the TriOS Optical Sensors logo and the CE quality mark.

Please note that the specifications given here are for illustrative purposes only and may vary depending on the product version.

2.2 Scope of delivery

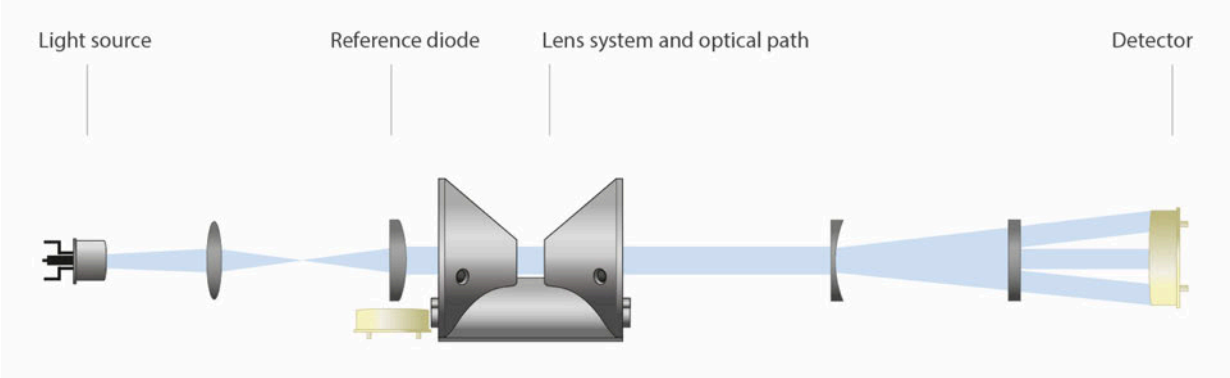
The delivery includes the following components:

- Sensor
- Connection cable
- Operating instructions/short instructions
- Accessories (if applicable)

Keep the original packaging of the device for possible return shipment for maintenance or repair purposes.

2.3 Measurement principle and setup

For optimal use of the sensor, it is inevitable to know and understand the idea and theory on which the sensor is based. The following is a thorough overview of the measuring principle, the optical arrangement and the subsequent calculation.



Essentially, the photometer consists of four parts: a defined light source, a lens system, the optical path through the medium and a spectrometer. The arrangement of these parts is shown schematically in the figure above.

A xenon flash lamp is used as a broadband light source.

The light passes through the medium in the optical path and is partially absorbed by it. The spectrometer records the remaining light with spectral resolution and determines its intensity I at different wavelengths over a defined wavelength range.

The light attenuation when passing through a measurement medium is compared with the light attenuation caused by ultrapure water. The measurement in ultrapure water provides the so-called base intensity $_{I0}$.

According to equation 1 and equation 2, the sensor determines the transmission T and the absorption coefficient A for individual wavelengths over the defined wavelength range.

Equation 1: Calculation of transmission

$$T = \frac{I}{I_0}$$

Equation 2: Calculation of the absorption coefficient

$$A = -log_{10} T$$

with

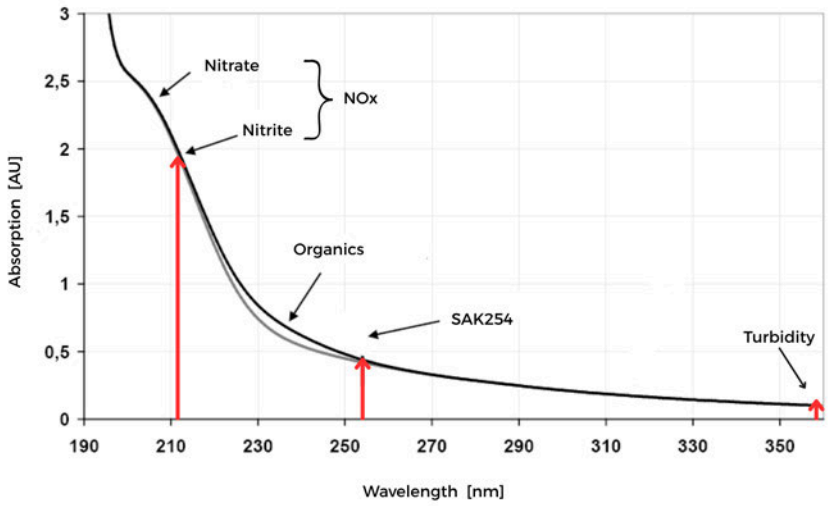
T	Transmission in %
I	current light intensity
I_0	Basic light intensity for ultrapure water A
A	Absorption in AU (AU = absorbance unit)

The integrated analysis software can be used to calculate the corresponding concentrations from the absorption. The unit of the absorbance value is the absorbance unit [AU]. The manufacturer calibration is based on an assignment of the absorbance units to a defined nitrate concentration based on standard nitrate solutions at a wavelength of 212 nm. Due to an integrated compensation of turbidity and organics, the measurement principle of the NICO can be described as attenuation.

2.3.1 Analysis

See figure: Detection at wavelengths 212, 254 and 360 nm (red arrows).

NICO



Absorption spectra substances NICO

2.3.2 Parameters

NICO measures the absorption at 212 nm. The derived parameters NO_3-N, NO_3, NO_X-N and NO_X are output.

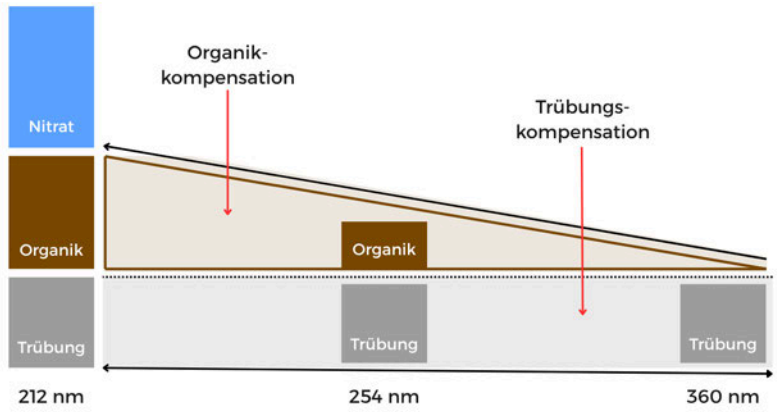
The absorbance values [AU] with the unit [1/m] at 212, 254 and 360 nm are calculated taking the path length into account. NICO uses the absorption at 212 nm for the detection of NO_3-N. The absorption at 254 (SAC_{254}) and 360 nm is used for the correction of organic compounds and turbidity. Optical path lengths of 0.3, 1, 2, 5 or 10 mm are available for NICO. A longer version of NICO allows for longer path lengths of 20 and 50 mm.

It is possible to adapt the sensor to laboratory analyses and local conditions using scaling factors. Please note that the manufacturer calibration is not affected by the customized calibration.

All available parameters can be scaled. For details, see chapter 5 Customer calibration.

2.3.3 Compensation of turbidity and organics

The optical nitrate measurement can be influenced by the presence of particles (turbidity) and organic substances (organics). For this reason, the manufacturer calibration includes compensation for turbidity and organics, as shown schematically in the figure below.



For the organics compensation, it is possible to choose from three fixed compensations for different applications or a customer-specific compensation:

Default:	Standard manufacturer calibration.
HIGH:	Manufacturer calibration with increased compensation for high concentrations of organic substances.
LOW:	Manufacturer calibration with reduced compensation for low concentrations of organic substances.
Custom:	Individual compensation of organics.

Details can be found in chapter 5.2 Customer calibration.

2.3.4 Reference values

In addition to the derived parameters NO_3-N, NO_3, NO_X-N- and NO_X, the following reference values are output.

The SQI value is the sensor quality index, which indicates the quality of the measurement.

RefA indicates the light intensity on the 212 nm channel.

RefB indicates the light intensity on the 254 nm channel.

RefC indicates the light intensity on the 360 nm channel.

RefD indicates the light intensity of the reference diode.

Details and limit values of the reference parameters can be found in chapter 5.3 Measurement properties and chapter 6 Malfunction and maintenance.

2.4 Browser

The photometer is equipped with a web interface that can be used to configure and calibrate the sensor. To access the web interface, you need the G2 InterfaceBox and an Ethernet-capable device with a web browser, such as a notebook.

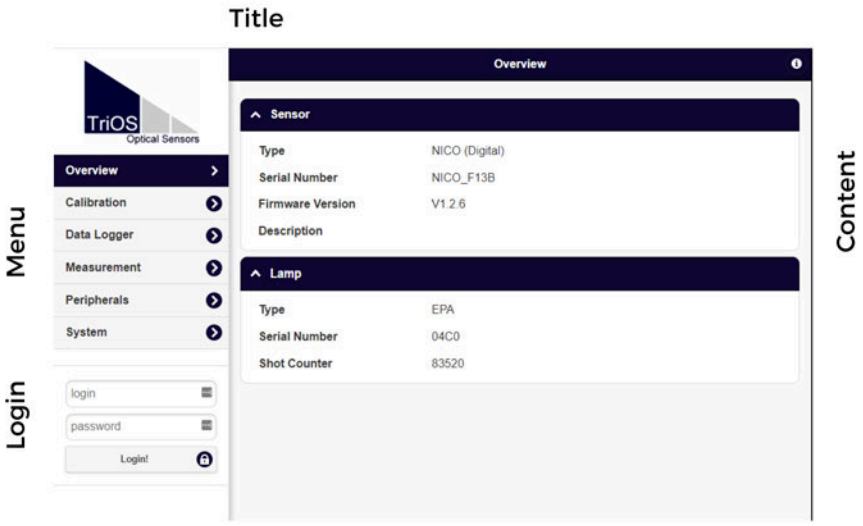
Open one of the following URLs in your web browser (depending on the structure of the network):

http://xxxx/ or

http://xxxx_FXXX/ (FXXX is the serial number) or

http://192.168.77.1/

The web interface is divided into three areas (see figure): Title. Menu and Content.



The name of the current page is displayed in the title. To the right is the info button. This shows the contact details of the relevant TriOS authorized dealer and TriOS Mess- und Datentechnik GmbH.

The individual pages are listed in the menu on the left. The name of the current page is highlighted in blue.

Below the menu is the login area, which certified TriOS service technicians can use to authenticate themselves. In most cases, problems can be solved here on site.

The menu is used to navigate the web interface. Each line is a link to a different page with correspondingly different setting options. The link that refers to the page currently displayed is always highlighted in the menu. Special, selected content and functions are reserved exclusively for TriOS Mess- und Datentechnik GmbH Technical support staff. Authentication is required for this content, so it is not accessible to everyone.

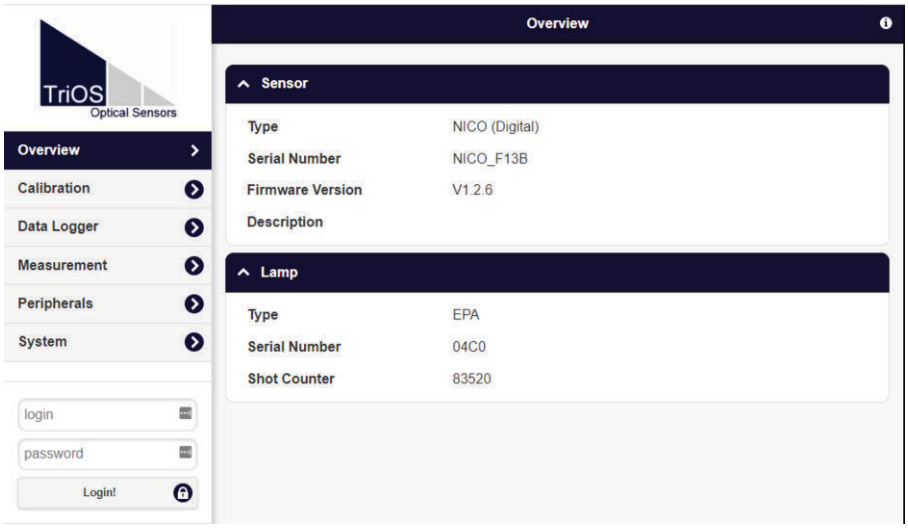
The “Content” area displays the relevant information and setting options. Content that requires authentication is deactivated (“grayed out”) if authentication fails or is not possible due to a lack of corresponding information.

Once settings have been made, they must be saved using the " **Save**" button. Otherwise the settings will be lost.

Overview

Basic information about the sensor is summarized on the overview page (“Overview”, see above). This includes the device type and serial number of the sensor as well as the version number of the installed

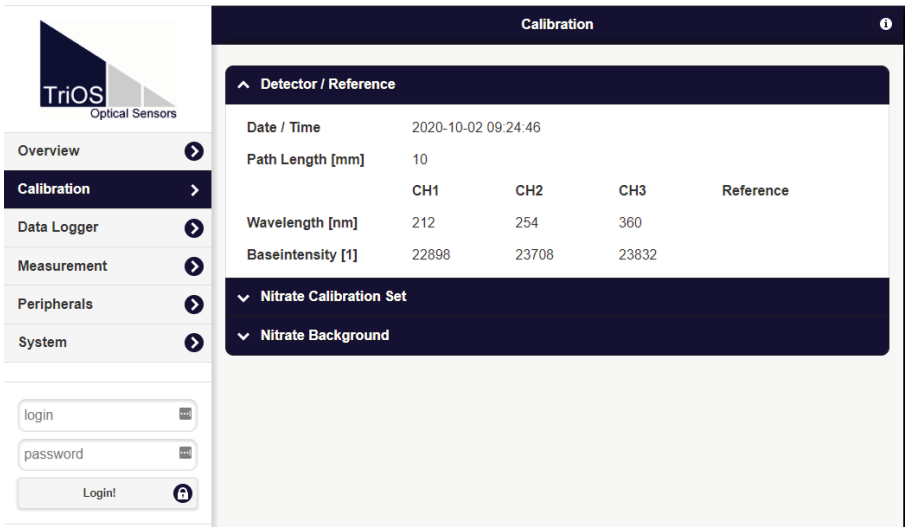
firmware. The type of lamp module with serial number is also listed, as well as the number of measurements that have been carried out by this lamp module.



Calibration

Please note that adding a new water base requires legitimization and only qualified personnel are authorized to do so. For further information, please contact the technical support of TriOS Mess- und Datentechnik GmbH.

Further details are described in chapter 5 Calibration.

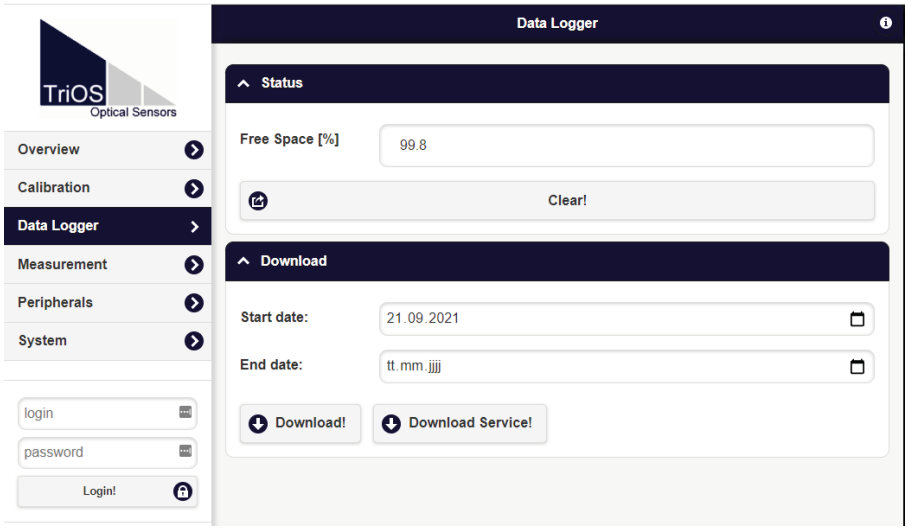


Data logger

NICO is equipped with a simple data logger function. This enables NICO to operate almost completely autonomously over a long period of time. However, a sufficient power supply must be ensured.

The data logger function is controlled via the “Data Logger” page, which is shown in the following illustration.

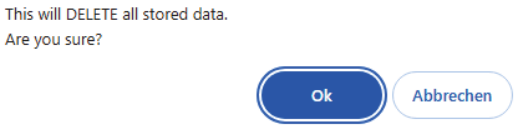
The measurement interval is set to 30 seconds at the factory. If the memory is full, only the last recorded measurement data is saved and old data is overwritten.



Status

The “Status” area shows what percentage of the memory is still free.

The “Clear” button is used to format the memory and delete all data. For security reasons, only confirm the security prompt.



After confirming the security prompt, the memory on the measuring device, and therefore all data, is irrevocably deleted.

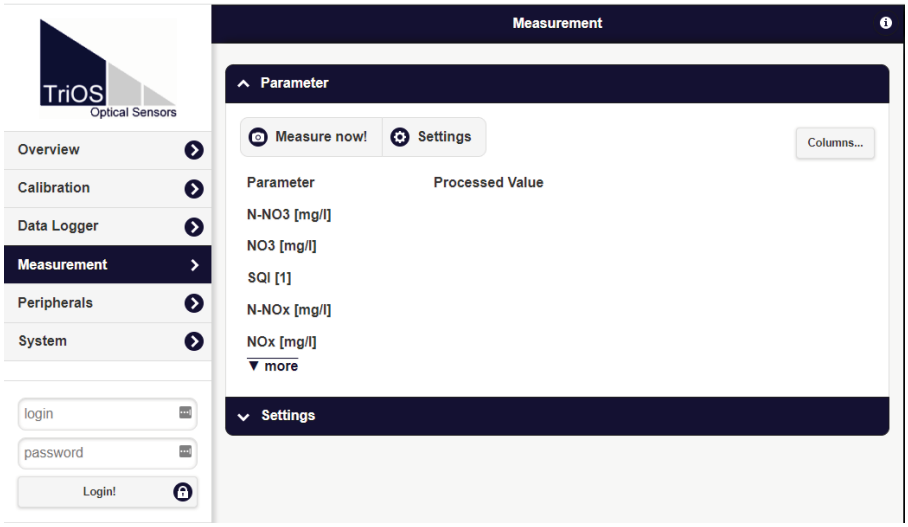
Download

The previously saved data can be retrieved using the “Download” button.

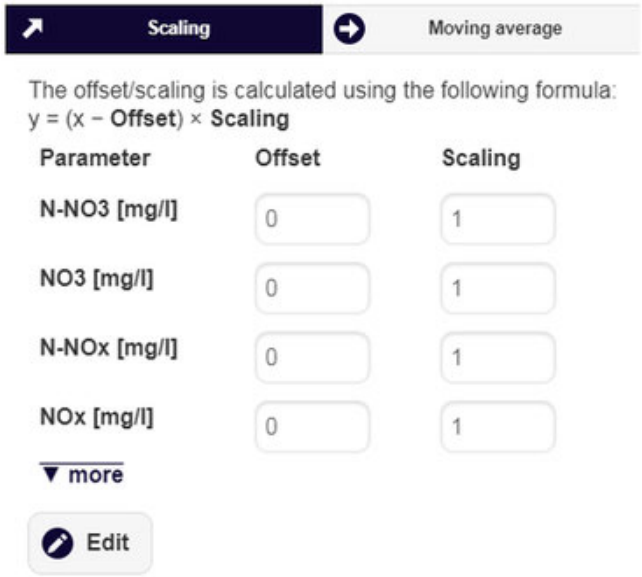
As the memory may contain a lot of data, the download may take a long time. It is therefore always advisable to specify a time range for the download and to download the data in several packages.

Measurement

The “Measurement” page shows the results of the last measurement carried out, as well as the settings for the interval for automatic measurements. A new measurement can be triggered at any time. To do this, press the “Measure now!” button. A new measurement is then carried out with the saved settings.

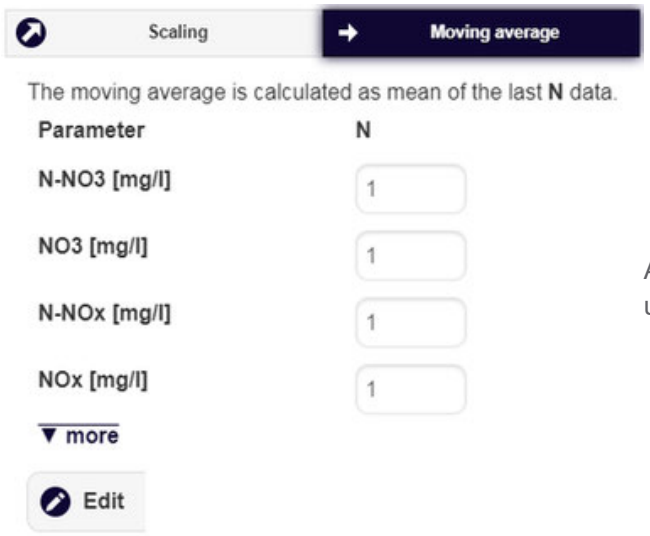


Scaling factors



Under the “Settings” button in the “Scaling” sub-item, scaling factors can be entered for all parameters; details can be found in chapter 5, Customer calibration.

Average value correction



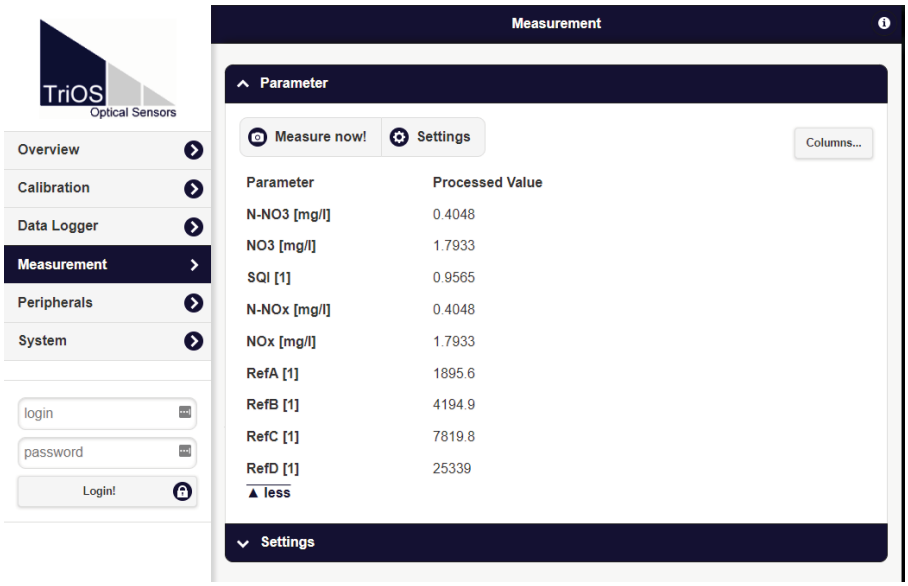
An average correction for N (number) measured values can be defined in the “Moving average” sub-item.

Parameters

The results calculated during the last measurement are displayed under “Parameters”. The example view shows the values of the parameters:

NO3-N	calculated with spectral analysis in mg/L
NO3	calculated with spectral analysis in mg/L
NOX-N	calculated with spectral analysis in mg/L
NOX	calculated with spectral analysis in mg/L

If you press the “more” button, reference parameters appear, which are explained below.



Limit values for absorption at 210 nm and 360 nm

SQI	OK	Attention!	See chap. 6
	1...0,8	0,8...0,5	<0,5

RefA indicates the light intensity on the 212 nm channel and should always be above 150, otherwise not enough light will reach the detector.

RefB specifies the light intensity on the 254 nm channel and should always be above 150, otherwise not enough light will reach the detector.

RefC indicates the light intensity on the 360 nm channel and should always be above 150, otherwise not enough light will reach the detector.

RefD indicates the light intensity of the reference diode and should always be above 13,000.

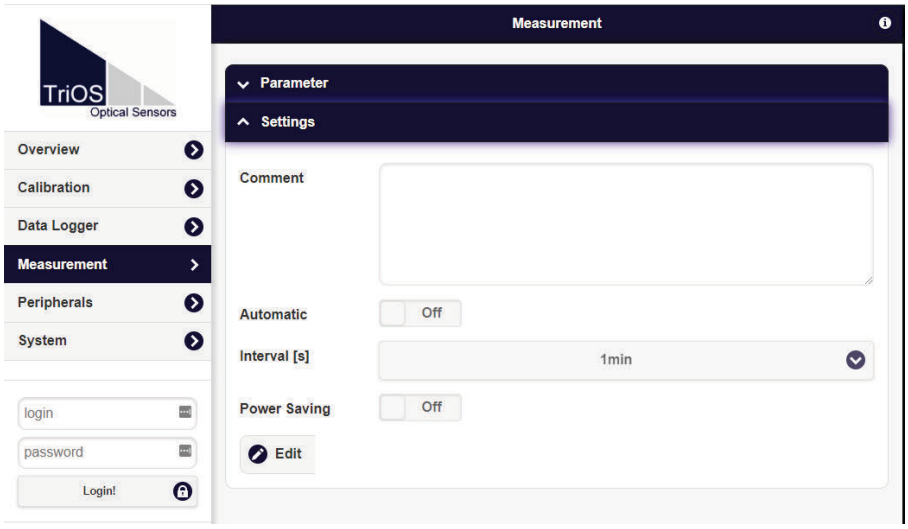
Further details on assessing the reference values are described in Chapter 5. Customer calibration and Chapter 6. Malfunction and maintenance.

We are constantly striving to improve our products. The values given here are provisional and may change in the course of development.

Settings

Settings for the automatic measurement can be made in the “Settings” sub-item after pressing the “Edit” button.

- Comments can be added in the “Comment” field, which are then linked to the measured values and spectra in order to simplify subsequent data assignment.
- Automatic measurements can be activated.
- An interval for the automatic measurements can be defined.



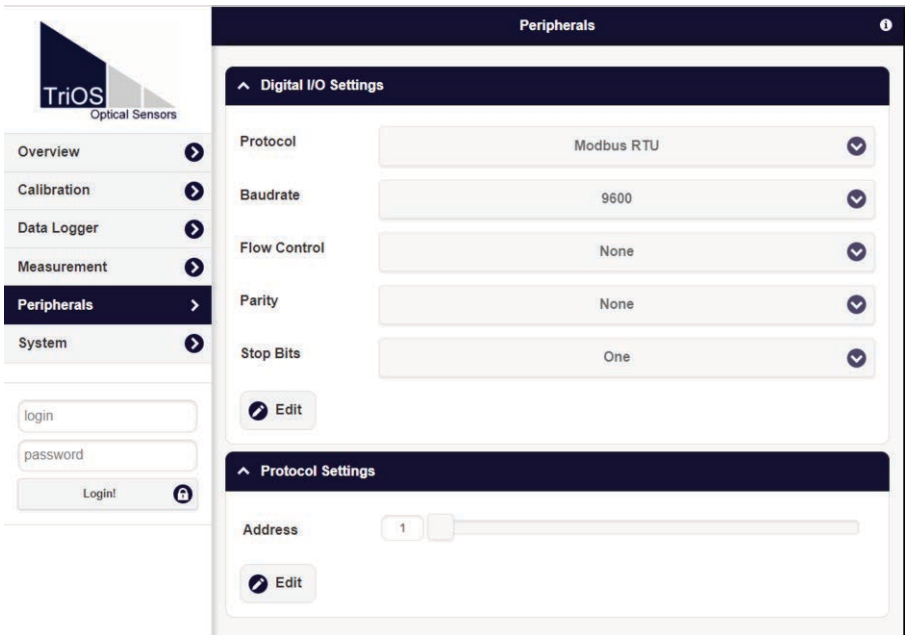
Please note that the factory setting for automatic measurement is set to “off”.

NOTICE

To record data sets, please only activate automatic measurement under a permanent power supply!

Peripherals

After pressing the “Edit” button in the “Peripherals” submenu, the interface can be configured, a protocol selected and the Modbus address changed.



The factory settings are

Protocol: Modbus RTU

Baud rate: 9600

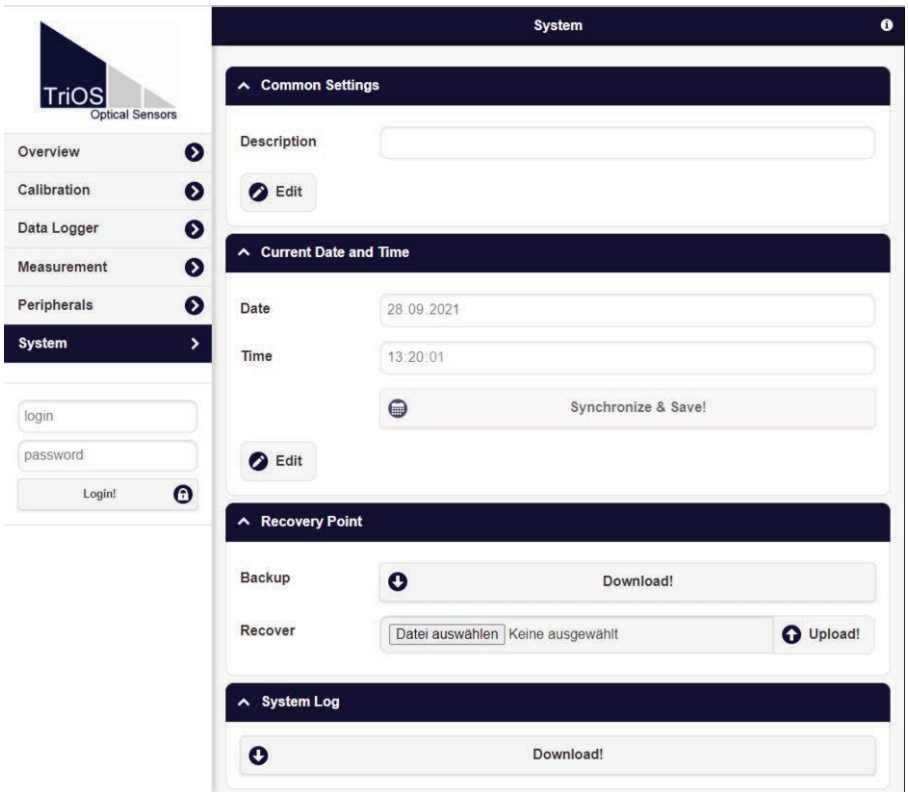
Flow control: None

Parity: None

Stop bits: 1

System

The “System” page is used to manage the sensor. Tasks on this page are time settings, downloading the current calibration as a restore point and providing a LOG file.



Common settings

Under “Common Settings”, a comment such as a name or the location of the sensor can be entered after pressing the “Edit” button.

Date and time

Under “Current Date and Time”, the date and time of the sensor can be set or the date and time can be synchronized with the PC.

Restore point

To download the current calibration from the sensor and save it on a PC or other medium, click the “Download” button under “Recovery Point”. This calibration file (config.ini) must be saved and stored in a safe place.

If a previously downloaded calibration or a calibration file created by the TriOS Mess- und Datentechnik GmbH service department is to be uploaded to the NICO, this can be achieved using the “Upload” function.

Please note that this function requires authentication. See also chapter 5 Calibration.

System log

This is freely accessible and shows events such as measurements carried out, changed settings and error messages. System information can be downloaded here in the event of servicing. This information may be important in the event of troubleshooting by technical support and must be included with the request.

2.5 Login

To use the service function, you need a login and a password. You will receive this when you attend a TriOS training course.

3 Commissioning

This chapter deals with the Commissioning of the sensor. Pay particular attention to this section and follow the safety precautions to protect the sensor from damage and yourself from injury.

Before putting the sensor into operation, make sure that it is securely fastened and that all connections are made correctly.

3.1 Electrical installation

NICO is supplied with either a SubConn 8pin underwater connector or a fixed cable with an 8-pin M12 industrial plug.

NICO is designed for a supply voltage range of 12 - 24 VDC (±10%). In conjunction with a G2 InterfaceBox, a standard power source with 24 VDC and an output of 8 W can be connected.

NOTICE

The sensor can be operated with 12 - 24 VDC (±10%).

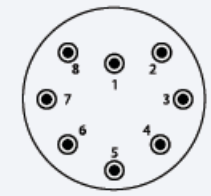
If no G2 InterfaceBox is used, please pay attention to the pin assignment. Connect the operating voltage to pin 8 in the middle of the cable and the reference voltage (ground potential) to pin 7.

NOTICE

Ensure that the polarity of the supply voltage is correct, otherwise the sensor may be damaged.

3.1.1 SubConn connector 8pin

Pin assignment

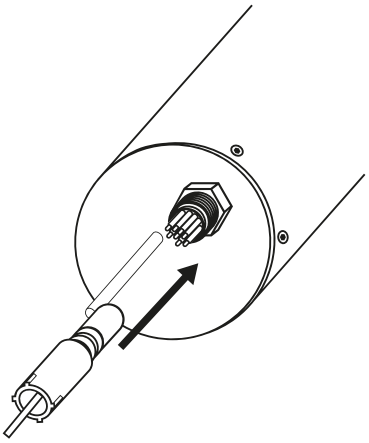


1. ground (power + serial interface)
2. RS-232 RX / RS-485 A (commands)
3. RS-232 TX / RS-485 B (data)
4. power (12 - 24 VDC)
5. ETH_RX-
6. ETH_TX-
7. ETH_RX+
8. ETH_TX+

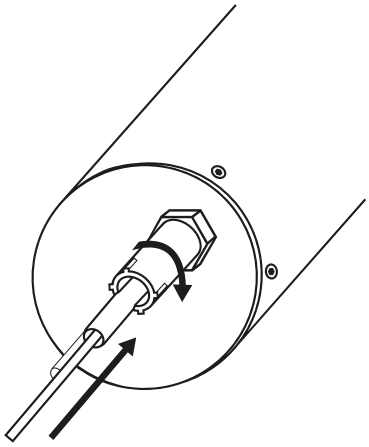
Connection

Step 1

Step 2



Plug the connector end of the connection cable onto the connector plug by aligning the pins with the slots on the cable.



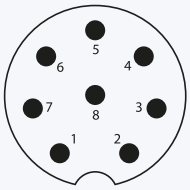
In the next step, turn the locking sleeve clockwise to secure the plug end to the bulkhead connector.

NOTICE

Do not bend the connection back and forth when inserting or removing it. Insert the connector straight and use the locking sleeve to tighten the pin contact.

3.1.2 Fixed cable with M12 industrial plug

Pin assignment



Face view (male)

1. RS-232 RX / RS-485 A (commands)
2. RS-232 TX / RS-485 B (data)
3. ETH_RX-
4. ETH_RX+
5. ETH_TX-
6. ETH_TX+
7. ground (power + serial interface)
8. power (12 - 24 VDC)

3.2 Interfaces

3.2.1 Serial interface

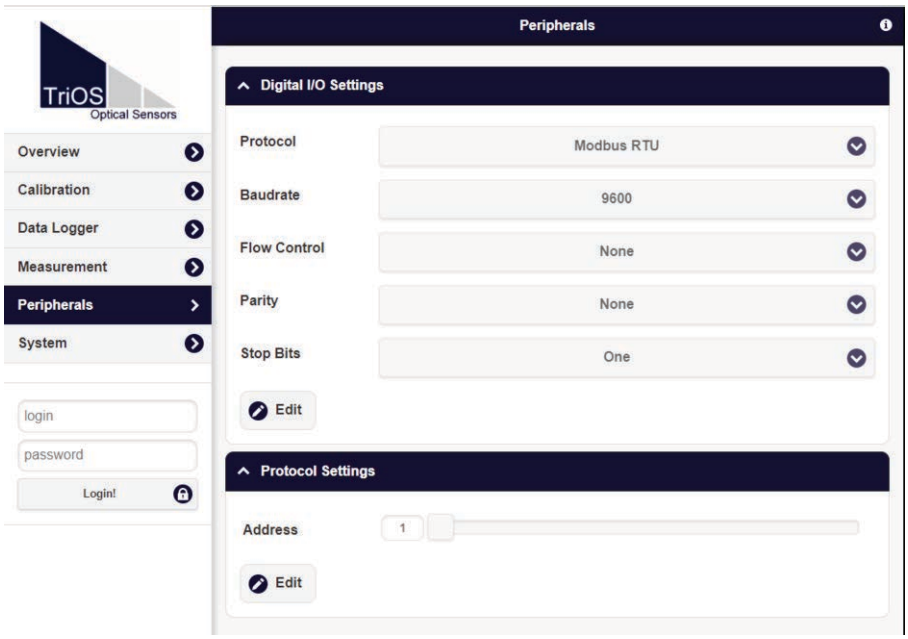
There are the following options for operating the NICO:

1. Operating the NICO with a TriOS controller via the serial interface.
2. Operation of the NICO in a customer-specific installation via the RS-485 serial interface.
3. Configuring the NICO and recording individual measurements via the web interface.
4. Operation of the NICO with an external power supply (e.g. G2 InterfaceBox). The data is collected on an internal memory (up to 2 GB) and analyzed after downloading.

NICO provides two lines for digital, serial communication with a control device. These are equipped with a digital serial interface. The RS-485 standard (also EIA-485) is supported.

The RS-485 digital interface is a voltage interface. With RS-485, voltages from -5 V to +5 V to ground are possible.

RS-485 uses a differential signal, whereby the sign-negated potential of the A line is applied to the B line. The decisive factor is the difference A-B, which makes the transmission as robust as possible against interference signals.



Transceiver

- EIA-485 (also RS-485)

Protocol

Specifies the data protocol to be used. Currently supported:

- Modbus RTU
- ASCII Output

A detailed description of the Modbus RTU protocol for NICO can be found in the appendix.

Baud rate

The baud rate specifies the transmission speed. The following options are available:

- 1200
- 2400
- 4800
- 9600 **Standard setting for all TriOS controllers**
- 19200
- 38400
- 57600

> ***NOTICE***
>
> **If there are difficulties with communication, you should try to reduce the baud rate.**

Flow control

Activates flow control at software level (XON/XOFF).

> ***NOTICE***
>
> **If the Modbus RTU protocol is used, “None” must be selected here.**

Parity

Activates the parity check during data transmission. Possible options are:

- None (deactivated)
- Even
- Odd

Stop bits

Defines the number of stop bits. Possible options are:

- One
- Two

> ***NOTICE***
>
> **For various Modbus devices, it may be necessary to set “Two” here if no parity check is to take place.**

Settings for the active protocol can be made in the “Protocol Settings” section.

- The following properties are also available in the Modbus RTU protocol:
  - Address: This is the slave address for Modbus communication. It identifies the sensor in the bus system and must be unique.

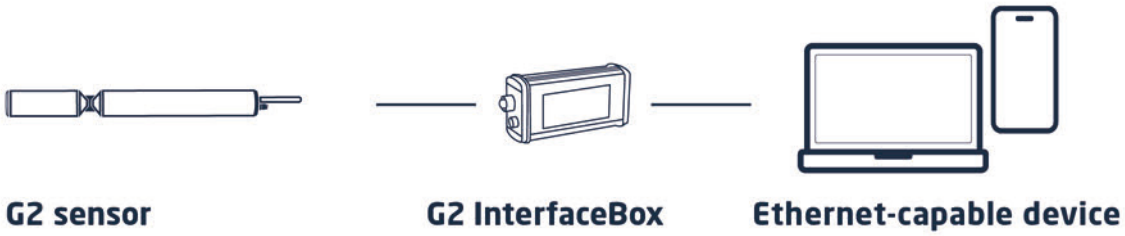
3.2.2 Network

The IEEE 802.3 10BASE-T compliant Ethernet interface is used as the universal interface for TriOS G2 sensors. This makes it possible to establish a connection to a single sensor or even to set up a complex sensor network.

Network with a single G2 sensor

The simplest way to establish a connection with NICO is to use the G2 InterfaceBox. It is used both to establish the connection and to supply power to the sensor and can be used universally for all TriOS G2 sensors.

The following figure shows a connection setup to a single sensor:



The TriOS G2 InterfaceBox translates the 8pin M12 sensor plug to the commercially available connections for the power supply (2.1 mm hollow plug) and for network access (RJ-45 socket).

There are three connections on the housing of the G2 InterfaceBox:

1. Power supply 12 or 24 VDC; 2.1 mm hollow plug
2. Sensor connection 8pin M12
3. Ethernet connection RJ-45 socket

Proceed as follows to connect the sensor to an Ethernet-enabled device using the G2 InterfaceBox:

1. Ensure that your device's Ethernet extension is configured to automatically obtain the network settings (IP address and DNS server).
2. Insert the M12 plug at the cable end of the sensor into the M12 socket (2) of the G2 InterfaceBox and close the screw cap.
3. Connect the 12 or 24 VDC power supply unit to the G2 InterfaceBox to supply the sensor with power.
4. Wait at least 3 seconds before finally connecting the LAN cable to your Ethernet-enabled device and the G2 InterfaceBox.

The web interface can now be accessed with any browser via the URL

http://nico (or nicoplus)

http://nico_FXXX/ (FXXX is the serial number) or

http://192.168.77.1/.

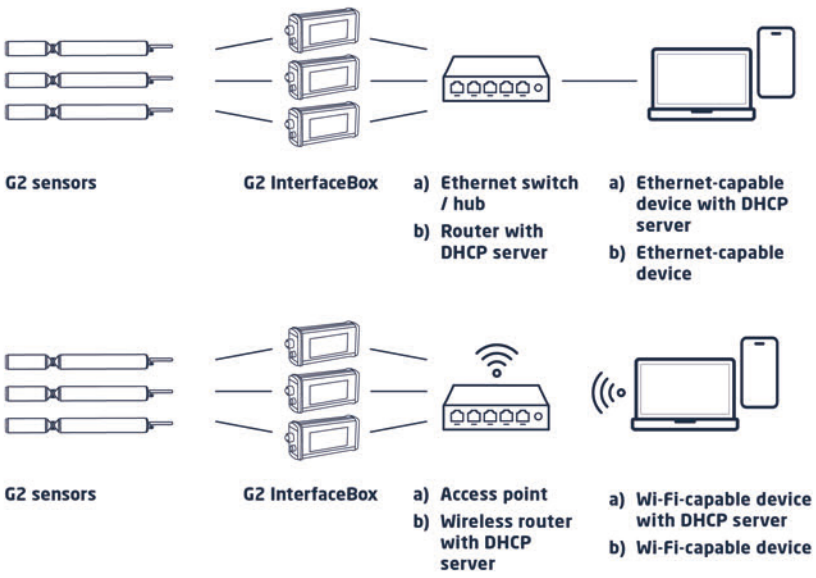
If the web interface cannot be called up, make sure that the LAN cable is connected after you have supplied the sensor with power and try all three URL options.

Network with several G2 sensors

Using an Ethernet switch or hub or a commercially available router, it is possible to connect several sensors in a complex network and use them simultaneously. In the sensor network, each sensor requires its own G2 InterfaceBox for the power supply.

Like every G2 sensor, NICO supplies a simple DHCP server and a simple DNS server, which are configured exclusively for the direct individual connection - as described in the previous section. For a complex sensor network, it is necessary for these servers to be provided by the user. NICO recognizes them automatically and then switches off the internal servers. Ask your network administrator for advice on how this can best be implemented in your case.

The following illustrations show examples of different ways of setting up a sensor network.



NICO can only be used from one Ethernet-enabled device at a time.

If several sensors are used in a network, the web interface can be accessed via the host name http://nico_FXXX/ (FXXX is the serial number) or via the IP. Ask your network administrator for advice.

NOTICE

Damage caused by improper use is excluded from the warranty!

4 Application

NICO can be operated with all TriOS controllers. You will find notices for correct installation in the respective controller manual.

NOTICE

Never transport the sensor just hanging on the cable.

4.1 Normal operation

4.1.1 Diving operation

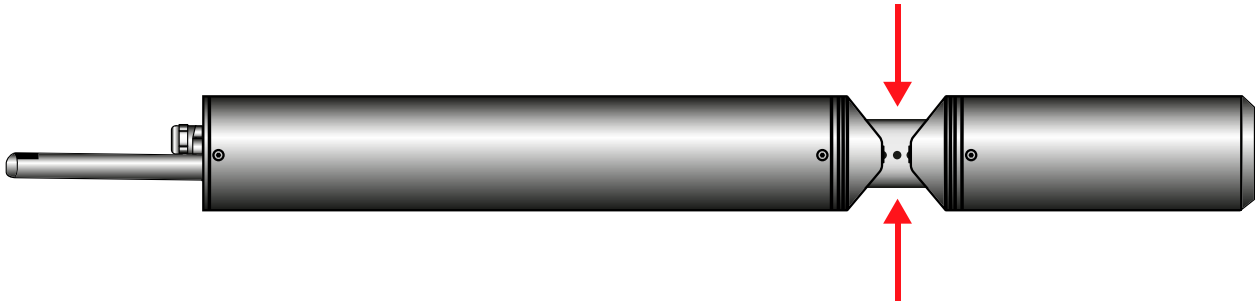
For diving operation, NICO can be completely or partially immersed in the water/measuring medium. For correct measurement, the optical windows must be completely submerged and free of air bubbles. Use the mounting rod with a shackle and a stainless steel chain or steel wire to suspend the device in the medium. Do not carry or pull on the sensor cable.

NICO can also be fastened with suitable hydraulic clamps as shown in the following illustration. Make sure to use suitable brackets with an inner diameter of 48 mm. To protect the housing tube from excessive punctual pressure, mount the clamps close to the device covers. Suitable brackets can be obtained from TriOS.

NICO mounting in clamps or on the shackle

The sensor should be installed at right angles to the direction of flow. This minimizes deposits on the windows and optimally supports the function of the nano coating.

The sensor must not touch the floor, otherwise damage may occur.



When immersing the sensor, make sure that there are no air bubbles in front of the sensor windows. If there are air bubbles in front of the window, shake the sensor cautiously until the bubbles are removed.

4.1.2 Cleaning system

NICO and all other sensors from TriOS Mess- und Datentechnik GmbH are equipped with an innovative anti-fouling technology to prevent soiling and dirt on the optical window: Nano-coated windows in combination with compressed air cleaning.

Nano-coating

All TriOS optical windows are treated with a nano coating.

Windows without nano coating

Windows with nano coating

The wettability of the surface of the coated glass is significantly lower. This effect is achieved by the nano-coated surface of the glass, to which no dirt adheres. In combination with compressed air cleaning, the windows remain clean for long periods of time, reducing the amount of cleaning required.

Compressed air cleaning

NICO can be modified with the optional compressed air cleaning head. The head has an air outlet directly on the pane of the device and a hose fitting for connecting compressed air.
TriOS controllers have valves on which software-controlled fixed flushing intervals can be set. Compressed air between 3 and 6 bar must be provided for this.

NOTICE

The optimum pressure for compressed air cleaning is between 3 and 6 bar. The total length of the hose should not exceed 25 meters. Suitable hoses are available from TriOS (polyurethane, 6 mm outer diameter, 4 mm inner diameter)

To connect the hose, simply push the hose into the appropriate connection. To disconnect it again, push the blue locking ring towards the connection and pull the hose out. If necessary, secure the hose to the device and cable with cable ties to prevent uncontrolled flailing of the compressed air hose.

NOTICE

The pressure must not exceed 7 bar! Valve damage could occur!

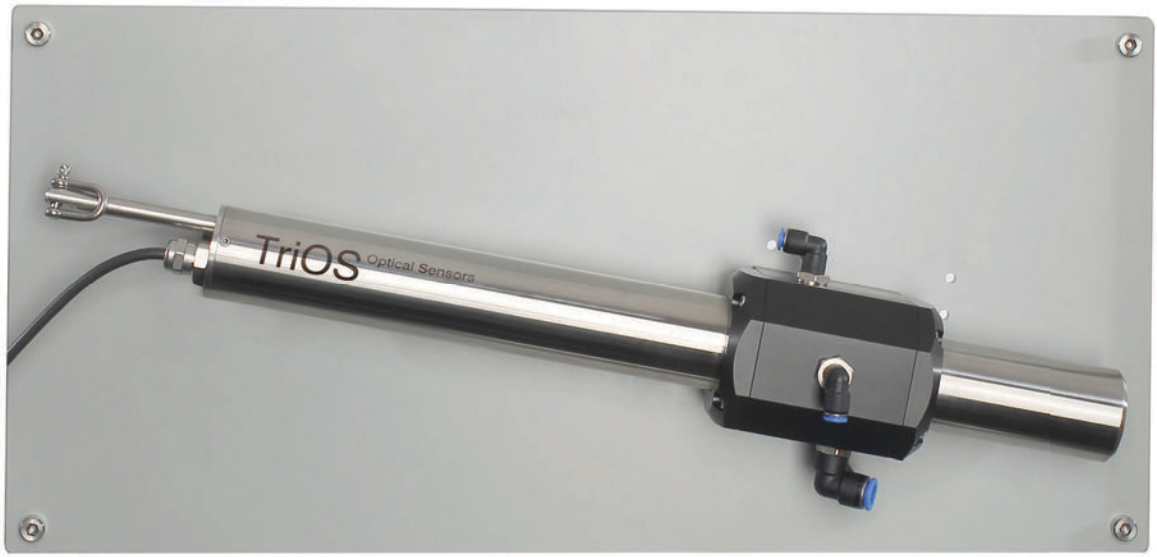
Compressed air flushing can affect the measurement results. Therefore, the flushing intervals should be sensibly controlled.

4.1.3 Float

The float is the ideal solution for applications with fluctuating water levels.

4.2 Bypass installation

With the optional flow cell, NICO can be installed as a bypass. Together with the flow cell, a panel is available on which NICO and the flow cell can be easily mounted.



NOTICE

The maximum pressure in the flow cell must not exceed 1 bar. Make sure that the sensor is installed in the correct position to ensure a free flow of water.

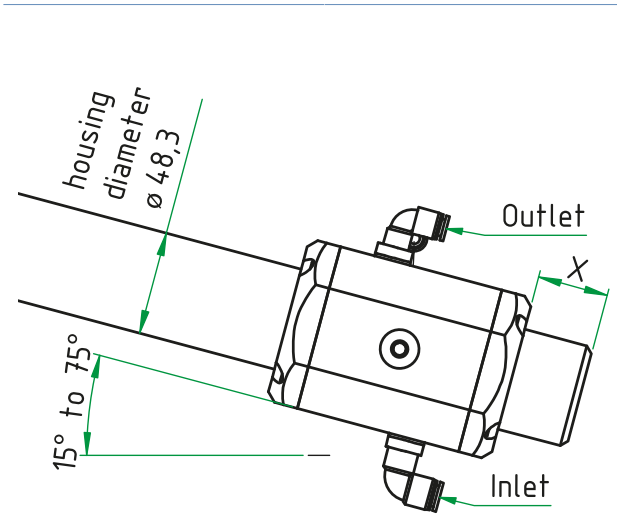
The FlowCell has three hose connections. The inlet has an 8 mm hose connection and is located on the right-hand side of the flow cell. On the left side of the cell is a 6 mm drain hose connection.

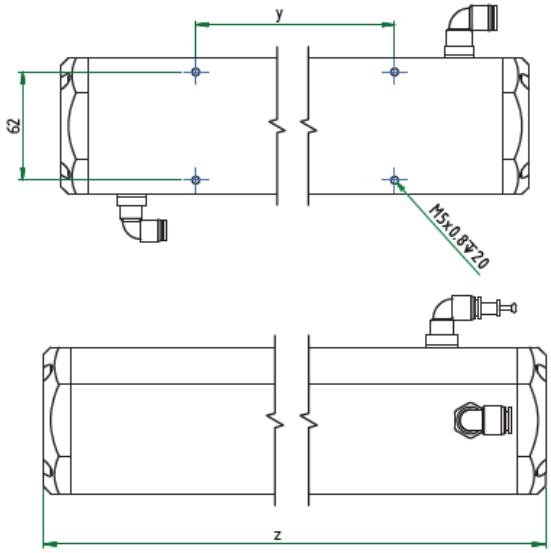
Finally, there is a third hose connection at the top of the cell that can be used for cleaning with liquids. If this inlet is not used, it should be closed with a plug.

As NICO can be purchased in different path lengths, the dimensions of the associated flow cell vary accordingly as described in the following table:

FlowCell dimensions by path length

Path length [mm]	x [mm]	y [mm]	z [mm]
up to 10	99,5	62	108
50	98,5	96	150





The hoses are installed by applying light pressure to the hose connectors. To remove the hoses again, press on the locking ring on the hose connector and pull gently on the hose.

NOTICE

The flow cell cannot be combined with compressed air cleaning.

Installation of the sensor in the FlowCell

To install the NICO in the flow cell, please proceed as follows:

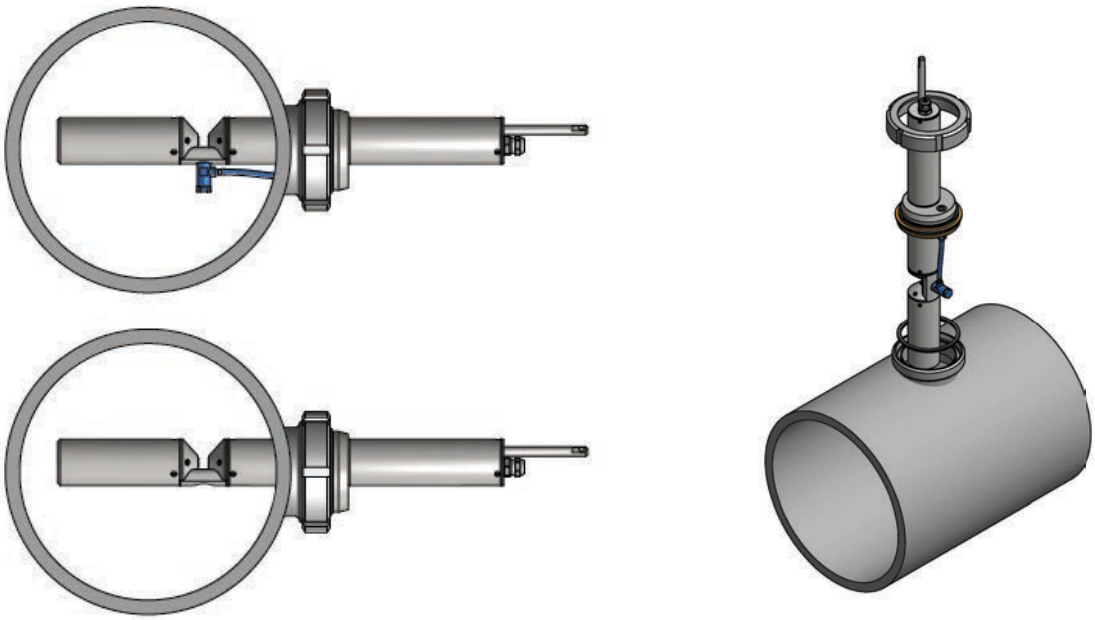
1. Remove the two end caps and the two sealing rings by loosening the eight screws.
2. Slide the sensor into the flow cell and fix it in the correct position. All openings must be free so that the liquid flowing through can flow directly through the optical path. The back of the NICO should point towards the underside of the flow cell. The screw heads on the tube ends should disappear completely into the flow cell so that the NICO is centered in the flow cell.

3. Slide a sealing ring over each sensor into the grooves provided in the flow cell. Before final assembly, check the sealing rings for damage and insert new ones if necessary. The sealing rings (48 x 5 mm NBR) are available as spare parts from TriOS Mess- und Datentechnik GmbH.
4. When the position of the sensor is correct, install the two end caps and secure them again with the eight screws.

The flow cell and NICO should be installed at an angle between 15° and 75° to the horizontal so that neither air bubbles nor sinking dirt particles interfere with the measurement. After installation, check for leaks and a free flow of water.

4.3 Pipe installation

NICO can be mounted directly in the pipe (either with the special flange version of the sensor or on-site installations by the customer). In case of a grounded pipe, no additional grounding of the sensor housing is required (as long as no insulation is mounted between the pipe and the sensor). One of the available flange solutions from TriOS is shown in the illustrations below (possible with and without compressed air purge).



Pipe installation with (above) and without compressed air purge

5 Calibration

5.1 Manufacturer calibration

All TriOS sensors are supplied calibrated. The calibration of the NICO is stored in the sensor, i.e. all output values are calibrated values. See also chapter 2.1 Measurement principle.

5.2 Customer calibration

The sensor can be adapted to laboratory analyses and local conditions using scaling factors. This is set either in the controller or directly in the sensor's browser. To do this, open the “Measurement” submenu in the browser. The customer calibration or local calibration works in addition to the manufacturer calibration, the values of which are not changed by the customer calibration.

If you are successfully logged in, the NICO sensor can be calibrated and a new water base can be recorded.

NOTICE

Incorrect calibration can lead to undefined behavior of the sensor!

Before calibration, it is essential to download the current water base and save it as a “recovery point” (see also chapter 5. Customer calibration 6.3.1. Download recovery point).

Please save the current water base (zero line) before calibration!

5.2.1 Organic compensation

Before scaling the values, the organic compensation should be checked and adjusted if necessary. For the organic compensation, you can choose from three fixed compensations for different applications or an application-specific compensation:

Default:	Standard manufacturer calibration.
High:	Manufacturer calibration with increased compensation for high concentrations of organic substances.
LOW:	Manufacturer calibration with reduced compensation for low concentrations of organic substances.
Custom:	Individual compensation of organics.

If the measured nitrate value deviates from the laboratory value, the higher or lower specified compensation should be tried first.

Before carrying out an application-specific organic compensation, it must be ensured that the requirements for this are met.

You can check this as follows. Time series of the reference values RefB and RefC can be plotted (at least 20 values). If the values of RefC are higher than the values of RefB, an individual compensation of the organics may be useful.

If the organic compensation does not improve your measured values, please contact technical support.

5.2.2 Scaling

In the “Measurement” menu item in the “Parameters” sub-item, the “Measure now!” button can be used to trigger individual measurements. button and all available parameters can be scaled after pressing the “Settings” button. The formula on which the calculation of the scaled measured value with scaling factor and offset is based is as follows:

Raw Value - Offset) x Scaling = Scaled Value

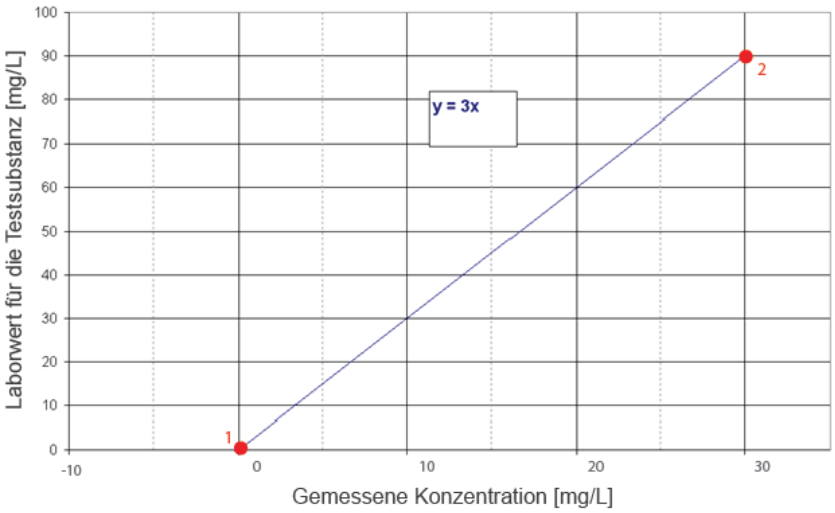
(measured value - axis offset) x scaling factor = scaled measured value

The local calibration is adjusted using a linear equation. Normally, only the scaling factor is required for this. An offset calibration is not recommended in every case.

Customer calibration with laboratory values should only be carried out if the offset=0 and the scaling is between 0.8-1.2. Larger deviations should be checked. We do not recommend an offset calibration. Please contact TriOS technical support if necessary.

At least one data point consisting of laboratory value and sensor value is required for local calibration.

1. Offset = 0 is assumed
2. Create a diagram as shown below and connect the two data points with a straight line. The slope of the straight line is the scaling factor.



3. The scaling factor can be calculated using the following equation:
   Scaling factor = laboratory value/measured value
   For the example in the image above, this means
   Scaling factor = 90 (mg/L)/ 30 (mg/L) = 3
4. If several laboratory values are available, all laboratory values should be entered in the graph. In this case, offset = 0 should still be assumed, as shown in the diagram, the slope of the straight line is equal to the scaling factor.

The scaling factors must be set in the controller. All TriOS controllers have the option of setting scaling factors and offset values for measurement parameters. Please refer to the relevant controller manual. If you are not using a TriOS controller, it is possible to set the scaling factors in the web interface. However, make sure that you do not double scale the sensor.

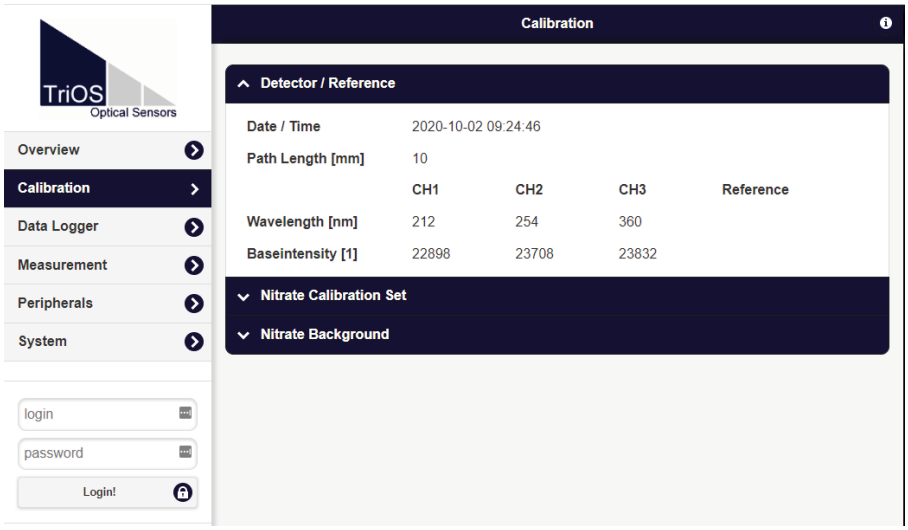
The customer calibration serves as a fine adjustment of the sensor to special media and is not intended to replace the manufacturer calibration.

NOTICE

Measurement ranges and detection limits of the scaled parameters depend on the scaling factor!

If you carry out a calibration, please ensure that the sensor is calibrated in the environment in which it is to be measured.

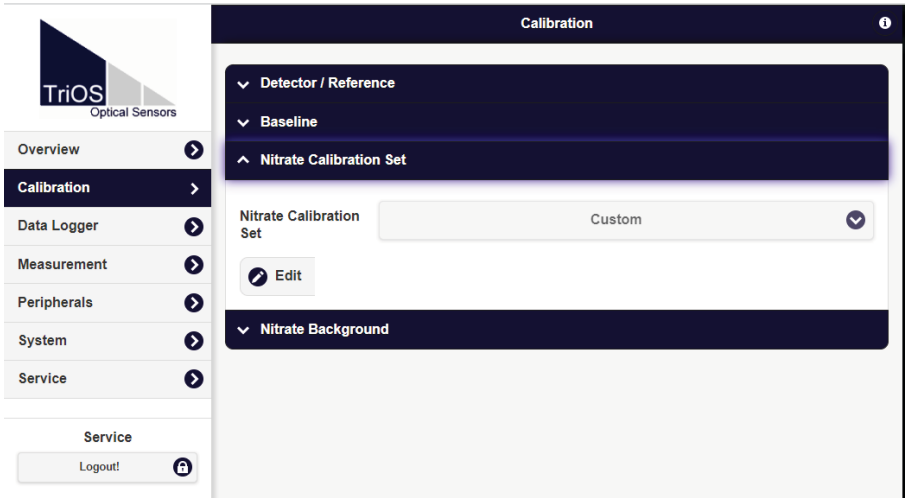
On the “Calibration” page under the “Detector/Reference” menu item, the set optical path is displayed in millimeters as well as the base intensity at the wavelengths 212, 254 and 360 nm and the reference diode.



The path length of the sensor can be entered via the “Path length [mm]” text field. Possible path lengths are 0.3, 1, 2, 5 and 10 mm.

Please note that the entry of the path length must be saved using the “Save” button so that it is set correctly for the next measurements.

Under the menu item “Nitrate Calibration Set” you have the option of specifying your calibration more precisely.

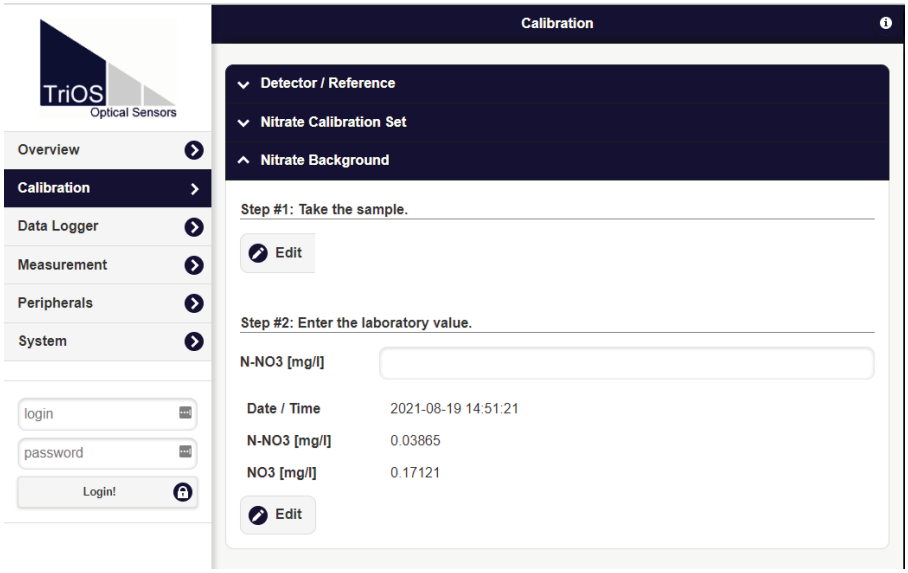


Default: Standard manufacturer calibration.
HIGH: Manufacturer calibration with increased compensation for high concentrations of organic substances.
LOW: Manufacturer calibration with reduced compensation for low concentrations of organic substances.
Custom: Individual compensation of organics. Under certain conditions, the compensation for high concentrations of organic substances generated in the customer calibration is taken into account.

You can check the organics compensation as follows. Time series of the reference values RefB and RefC can be plotted (at least 20 values). If the values of RefC are higher than the values of RefB, an individual compensation of organics may be useful.

It may be necessary to calibrate the NICO sensor for organic substances on an application-specific basis. In this case, it is necessary to enter a NO3-N [mg/L] reference value (laboratory analysis) suitable for the sample from Step #1 under Step #2.

This is done under the menu item “Nitrate Background”.



5.2.3 Measurement properties

The path length must be selected according to the absorption level of the medium.

Turbidity and organics compensation

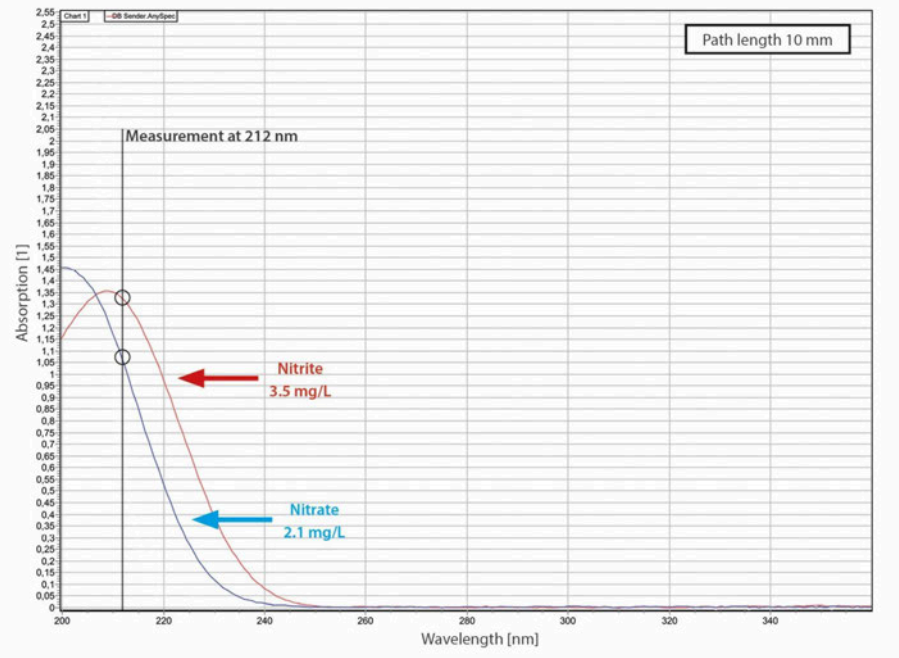
There is a correlation between turbidity/organics and absorption, but this is highly dependent on the size and type of particles and the concentration of organic substances. Normally, the organics will sufficiently compensate the existing calibration settings (default, high, low). If you have any doubts about the accuracy of the output data, please contact TriOS technical support.

Nitrite

Increased concentrations of nitrite can interfere sensitively with the optical nitrate determination, as nitrite and nitrate absorb in the same wavelength range. The figure below shows the absorption curves of nitrate (2.1 mg/L) and nitrite (3.5 mg/L).

Please note that in the specific spectral analysis at 212 nm, nitrate and nitrite may overlap. As the sensor has been calibrated for nitrate, the measured value is only valid for nitrate. If nitrite is present, it is no longer possible to determine how high the respective concentration actually is, resulting in an incorrect determination.

A differentiated measurement of nitrite and nitrate can be carried out with the TriOS OPUS.

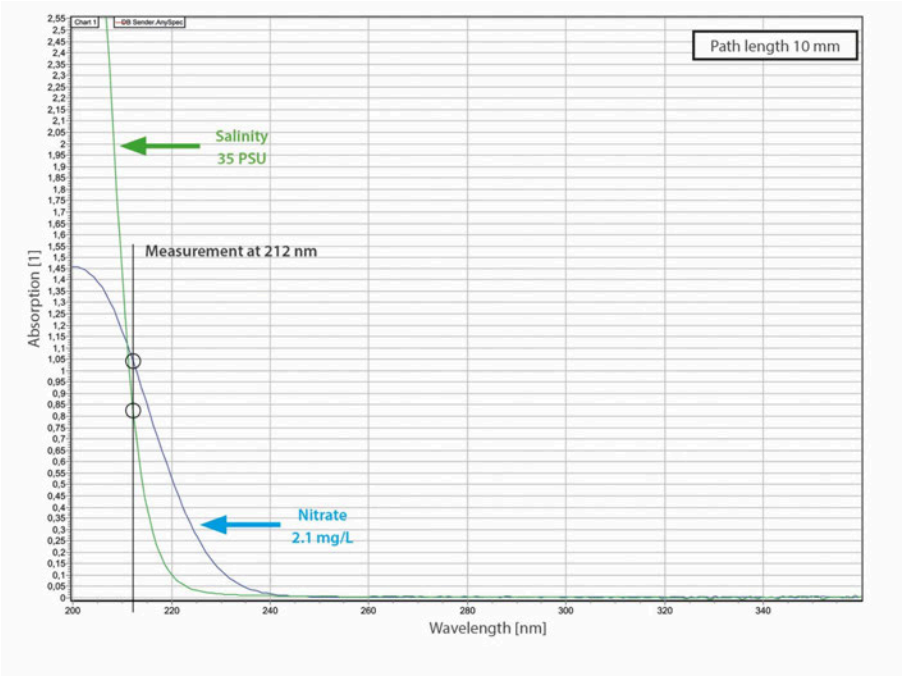


Salinity

Please note that the optical determination of nitrate in conjunction with high salt concentrations (≥ 1 PSU) can lead to interference. Salinity absorbs light of the same wavelength range.

The figure below shows the absorption curves of nitrate (2.1 mg/L) and the salinity of seawater (35 PSU). In the specific spectral analysis at 212 nm, the absorption of nitrate and salinity may overlap.

A differentiated detection of salinity and nitrate can be carried out with the OPUS sensor.



Path lengths and limit values

The reference values RefA, RefB, RefC and SQI should first be checked in the application. The following table lists the limit values of the reference values RefA, RefB, RefC and SQI for checking the sensor in the application.

Reference value	Explanation	Lower limit value	Recommendation
RefA	Light intensity on the 212 nm channel	150	Check the sensor and shorten the path length if necessary
RefB	Light intensity on the 254 nm channel	150	Check the sensor and shorten the path length if necessary
RefC	Light intensity on the 360 nm channel	150	Check the sensor and shorten the path length if necessary
SQI	Spectral quality index	0,5	Check the sensor and shorten the path length if necessary

If the limit values RefA, RefB, RefC and SQI fall below the limit values listed in the table above, make sure that NICO is working properly before changing the path length! Further details can be found in chapter 6 Malfunction and maintenance.

Unknown substances

Substances that absorb UV light but are not included in the calibration can significantly interfere with the measurement result. Under certain circumstances, measured values can no longer be calculated (NAN or permanently zero). If this is the case, please contact TriOS technical support (see also chapter 10).

6 Malfunction and maintenance

To ensure error-free and reliable measurement, the device should be checked and maintained at regular intervals. To do this, the sensor must first be cleaned.

6.1 Cleaning and care

Deposits (fouling) and dirt depend on the medium and the duration of exposure to the medium. Therefore, the degree of soiling depends on the application. For this reason, it is not possible to give a general answer as to how often cleaning of the sensor is necessary.

Normally the system is kept clean by the nano-coated window and additionally by the air purification system. If the soiling is too severe, the following instructions should be followed.

NOTICE

Damage caused by improper cleaning is not covered by the warranty!

6.1.1 Cleaning the housing

⚠ CAUTION

Please use protective goggles and gloves when cleaning the sensor, CAUTION especially if acids or similar are used for cleaning.

To loosen solid dirt, we recommend soaking the sensor in a rinsing solution for a few hours. Exposed plug connections should be avoided during any cleaning so that they do not come into contact with water. For this purpose, please always ensure that the locking cap of the connector is firmly closed during cleaning. Please inform yourself thoroughly about the risks and safety of the cleaning solution used.

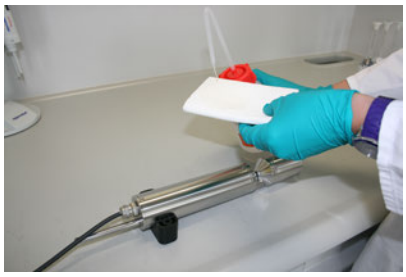
If the sensor is very dirty, additional cleaning with a float may be necessary. You should exercise extreme caution to avoid scratching the optical windows.

In case of calcification, a 10% citric acid solution or acetic acid solution can be used for cleaning.

Brownish dirt or dots may be contamination from iron or manganese oxides. In this case, a 5% oxalic acid solution or a 10% ascorbic acid solution can be used to clean the sensor. Please note that the sensor should only come into contact with the acids briefly and then be rinsed thoroughly with water.

NOTICE

Under no circumstances should the sensor be cleaned with hydrochloric acid. Even very low concentrations can damage stainless steel components. In addition, TriOS Mess- und Datentechnik GmbH warns against the use of other strong acids, even if the sensor has a titanium housing.


6.1.2 Cleaning the measuring window

You can clean the windows with a lint-free cloth, a clean paper towel or a special optical paper from TriOS Mess- und Datentechnik GmbH with a few drops of acetone. Make sure that you do not touch the window surface with your fingers!

To make cleaning the optical windows easier, TriOS Mess- und Datentechnik GmbH offers a cleaning set with acetone and special optical cleaning paper.

NOTICE

Do not use harsh cleaning solutions, spatulas, sandpaper or cleaning agents containing abrasive substances to remove stubborn dirt.


NOTICE

Avoid any additional contact with the glass parts in the optical path, as they may become scratched or dirty. As a result, the functionality of the device is no longer guaranteed.

If the windows are scratched or damaged despite all caution, they can be replaced.

6.2 Maintenance and testing

To assess the reference values and to avoid unnecessary maintenance and failure of the measuring operation, please carry out the following steps:

1. The reference value RefD indicates the light intensity of the xenon flash lamp. If this value is below 13,000, the sensor must be sent in for inspection. The lamp is probably worn out. Please note that consumable parts of the sensor, such as the lamp and the reference diodes, are subject to normal ageing processes and must be replaced depending on the frequency of use. Please contact technical support.
2. If the reference value RefD is above 13,000, but the values of RefA, RefB and RefC are below 150, remove the sensor from the medium and carry out a measurement in air. If the values of RefA, RefB and RefC do not increase, please carry out a thorough cleaning of the sensor and especially the optical windows (as described in detail in the chapter “Cleaning and care”) and repeat the air measurement.
3. If cleaning does not cause the values of the reference values RefA, RefB and RefC to increase when measuring in air, we recommend checking the zero value in ultrapure water, as described in detail in the chapter “Checking the zero value”.
4. The reference values RefA, RefB and RefC should be of the same order of magnitude as the reference value RefD: RefA, RefB and RefC ≈ RefD ± 5000 is acceptable.
5. If the reference values RefA, RefB and RefC do not reach the order of magnitude of the RefD even after careful cleaning and measurement in ultrapure water, the sensor must be sent in. Please contact TriOS technical support.
6. If reference values RefA, RefB and RefC reach the order of magnitude of RefD, but are still below 150 in the medium, the optical path should be shortened.

6.2.1 Checking the zero value

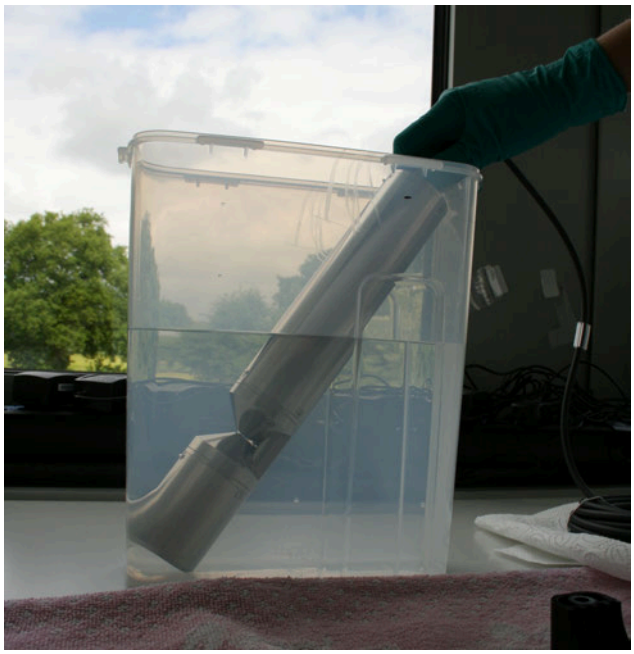
To decide whether a new zero line needs to be drawn, the following limit values apply (in ultrapure water with clean optical windows):

- 4 mg/L $_{N\text{-}NO3}$ at 1 mm path
- 0.4 mg/L $_{N\text{-}NO3}$ at 10 mm path

No new zero line needs to be drawn below these values.

Prepare the sensor for the zero value test as described in the previous chapter. We recommend using the TriOS VALtub to check the zero value, as this optimally seals the optical path and enables a quick zero value check. Make sure that the VALtub's o-rings are positioned exactly on the sensor's seals.

Alternatively, another vessel suitable for immersion can be used. The optical path must always be completely immersed in the water during the measurement.



The zero value of the NICO is checked via the web interface. To access the web interface, you need the G2 InterfaceBox and an Ethernet-enabled device with a web browser, such as a notebook.

Before the zero value test, the sensor is prepared as follows:

Clean the sensor as described in chapter 6.1.1 Cleaning the housing. At the end of cleaning, rinse the sensor carefully with deionized water and dry it with a paper towel. Wipe the sensor with a little acetone on a kitchen towel to remove grease residues.

⚠ CAUTION

Always wear suitable gloves and safety goggles for your own protection!

Clean the windows of the sensor with special optical paper or a soft, lint-free cloth and a little acetone according to the instructions for cleaning the measuring window.

Important: Then polish the windows with a dry, soft tissue or special optical paper to remove any thin film that may have formed.

Provide a suitable measuring vessel filled with ultrapure water. The measuring vessel should be carefully cleaned with detergent solution before use and then rinsed with ultrapure water.

Immerse the sensor in the vessel sufficiently filled with ultrapure water so that the optical windows are completely covered with water. Wait 10 - 15 minutes. During this time, hidden dirt can be removed from the sensor.

Remove the device from the water and rinse it with ultrapure water. Fill the container with fresh ultrapure water and immerse the sensor again. Lift the sensor and move it slightly in the water to remove any air bubbles and air pockets. You can now check the zero value via the web interface.

If possible, the sensor should be in an inclined position in the measuring vessel or in a horizontal position in the VALtub in order to avoid an accumulation of very fine, barely visible air bubbles at the upper optical window. When using a stationary measuring cylinder in which the sensor is positioned vertically, particular attention should be paid to air bubbles in the optical path.

Ensure sufficient stability!

If possible, carry out the zero value test at an ambient temperature of 20 °C. The temperature of the ultra-pure water should also be 20 °C.

General notices:

- Do not touch the part of the sensor that is immersed in the ultrapure water with your hands unless you are wearing gloves during the sensor test.
- Be sure to use ultrapure water (ultra pure, resistance of 18.2 MΩcm) or distilled water.
- If impurities appear in the water during the test, it must be replaced!
- Make sure that there are no air bubbles in front of the optical windows.

It is recommended to carry out at least 5 individual measurements under “Measurement” before the test in order to bring the sensor up to operating temperature.

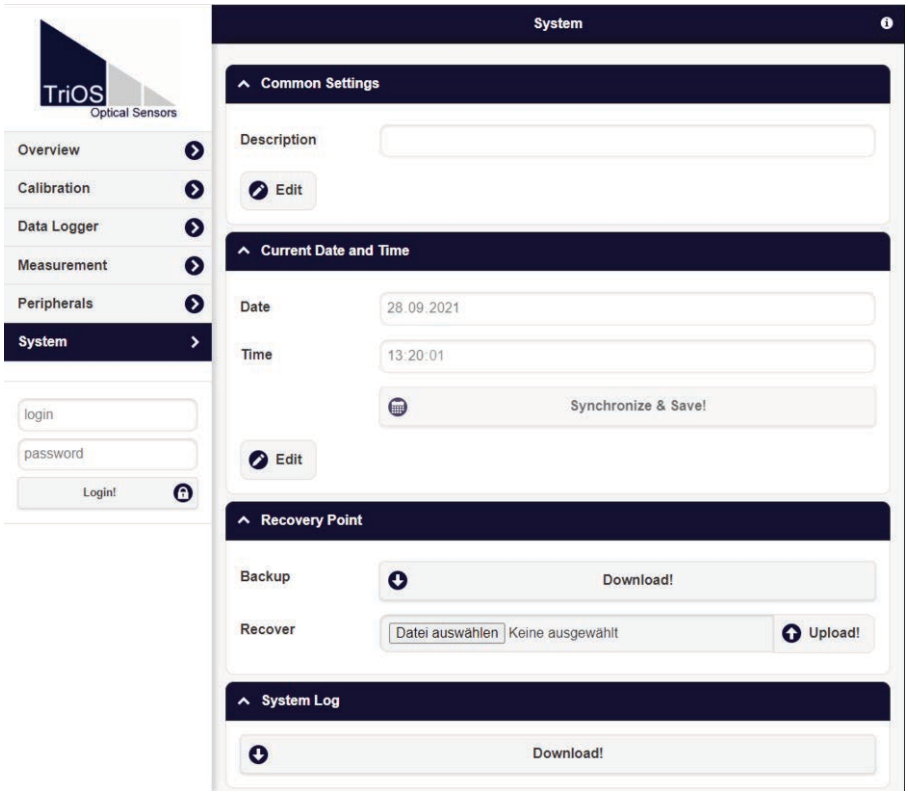
NOTICE

Damage caused by improper cleaning is not covered by the warranty!

6.3 Troubleshooting

6.3.1 Upload recovery point

A previously downloaded Recovery Point can be uploaded via the menu item “System” > “Recovery Point”. This is possible via the “Upload” function.



Select the path to your calibration file by pressing the “Browse” button and upload the file by pressing the “Upload” button. Successful uploading of the file is indicated by a green “Success” box, otherwise an error message is displayed.

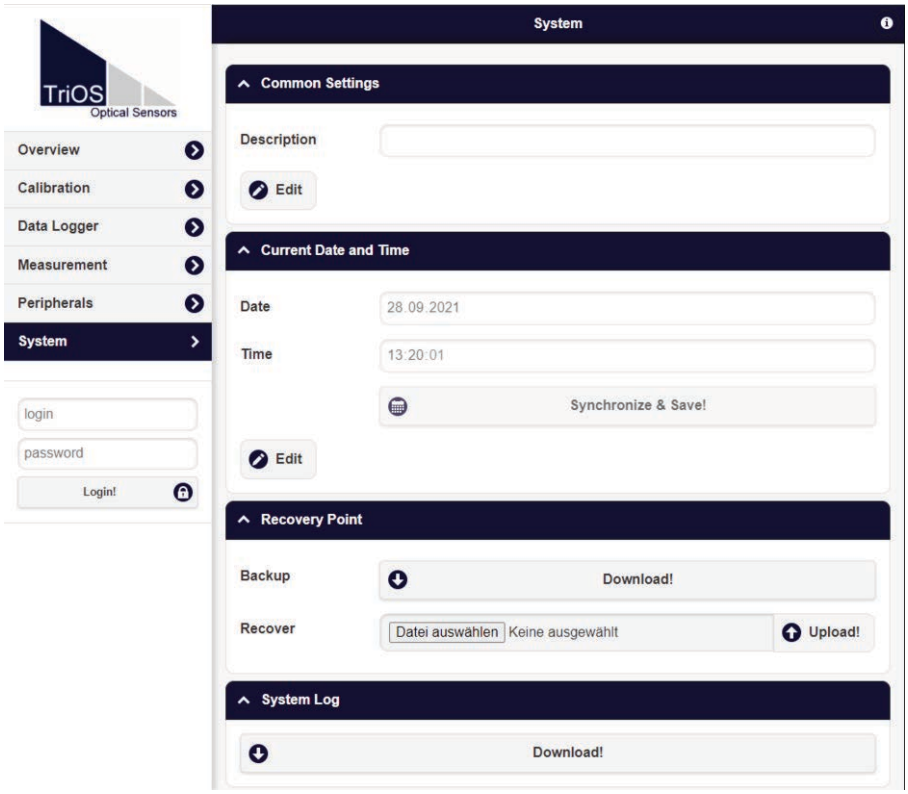
The following error messages are possible:

- **“File not OK”:** The calibration file could not be read out correctly. Please check the path to your calibration file and if the error cannot be corrected, please contact the technical support of TriOS Mess- und Datentechnik GmbH.
- **"Device type or serial number does not match":** The calibration file does not match the connected sensor.

6.3.2 Uploading a new calibration

If service is required, the “Download Service” file (see chapter 2.5.3 Data logger) should first be sent to TriOS technical support (see also chapter 2.5.3 Data logger and chapter 5 Calibration).

If a calibration file created by TriOS Mess- und Datentechnik GmbH support is then to be uploaded to the NICO, this is possible using the “Upload” function.



6.4 Return shipment

Please note the procedure for your return.

If you wish to return the sensor or the device, please contact technical support first. To ensure a smooth return process and to avoid incorrect shipments, every return shipment must first be reported to technical support. You will then receive a numbered RMA form, which you must complete in full, check and return to us.

Please stick this form with the number clearly visible on the outside of the return package or write it in large letters on the packaging. This is the only way your return can be correctly assigned and accepted.

Please note! Returns without an RMA number cannot be accepted and processed!

Please note that the sensor or the device must be cleaned and disinfected before shipping.

Use the original packaging to ensure that the goods are sent undamaged. If this is not available, ensure that safe transportation is guaranteed and that the sensors are secured with sufficient packing material.

7 Technical data

7.1 Technical specifications

Measurement technology	**Light source**	Xenon flash lamp
	Detector	4 photodiodes + filter
Measurement principle		Absorption (Attenuation)
Optical path		0.3 mm, 1 mm, 2 mm, 5 mm, 10 mm, 20 mm, 50 mm
Parameters		NO_3 / NO_3-N, NO_x / NO_x-N (calibrated with NO_3 standard solution)

Response time		20 s
Temperature compensation		No
Turbidity compensation		Yes
Data logger		~ 2 GB
Reaction time T100		20 s
Measurement interval		≥ 10 s

Interface	**digital**	Ethernet (TCP/IP) RS-485 (Modbus RTU)
Power supply		12 - 24 VDC (± 10 %)
Power consumption		≤ 7 W

Connection		Fixed cable with 8-pin M12 connection	
Housing material		Stainless steel (1.4571/1.4404) or titanium (3.7035)	
Dimensions (L x Ø)		~ 470 mm x 48 mm*	~ 18.5“ x 1.9“ *
Weight	**VA**	~ 3 kg	~ 6.6 lbs
	Ti	~ 2 kg	~ 4.4 lbs

* With 10 mm path

Sample temperature	0...+55 °C* +2...+40 °C for specified measurement accuracy	~ +32 to +131 °F* ~ +36 to +104 °F
Ambient temperature	0...+55 °C* +2...+40 °C for specified measurement accuracy	~ +32 to +131 °F* ~ +36 to +104 °F

* No ice crystals in the sample water

Relative humidity		0 ... 95 % non-condensing	
Storage temperature		-20...+80 °C	~ -4 to +176 °F

* No ice crystals in the sample water

Max. pressure	**with SubConn**	30 bar	~ 435 psi
	with fixed cable	3 bar	~ 43.5 psi
	in FlowCell	1 bar, 2...4 L/min	~ 14.5 psi at 0.5 to 1.0 gpm
Inflow velocity		0.1...10 m/s	
Degree of protection	**Sensor side**	IP68	
	Controller side	IP65/ IP67	
Operating altitude		max. altitude 2000 m (6562 ft)	

Maintenance effort	≤ 0.5 h/month typical
Calibration/ maintenance interval	24 months
System compatibility	TriBox3, TriBox mini, Modbus RTU
Warranty	1 year (EU & US: 2 years)

Measurement ranges and detection limits

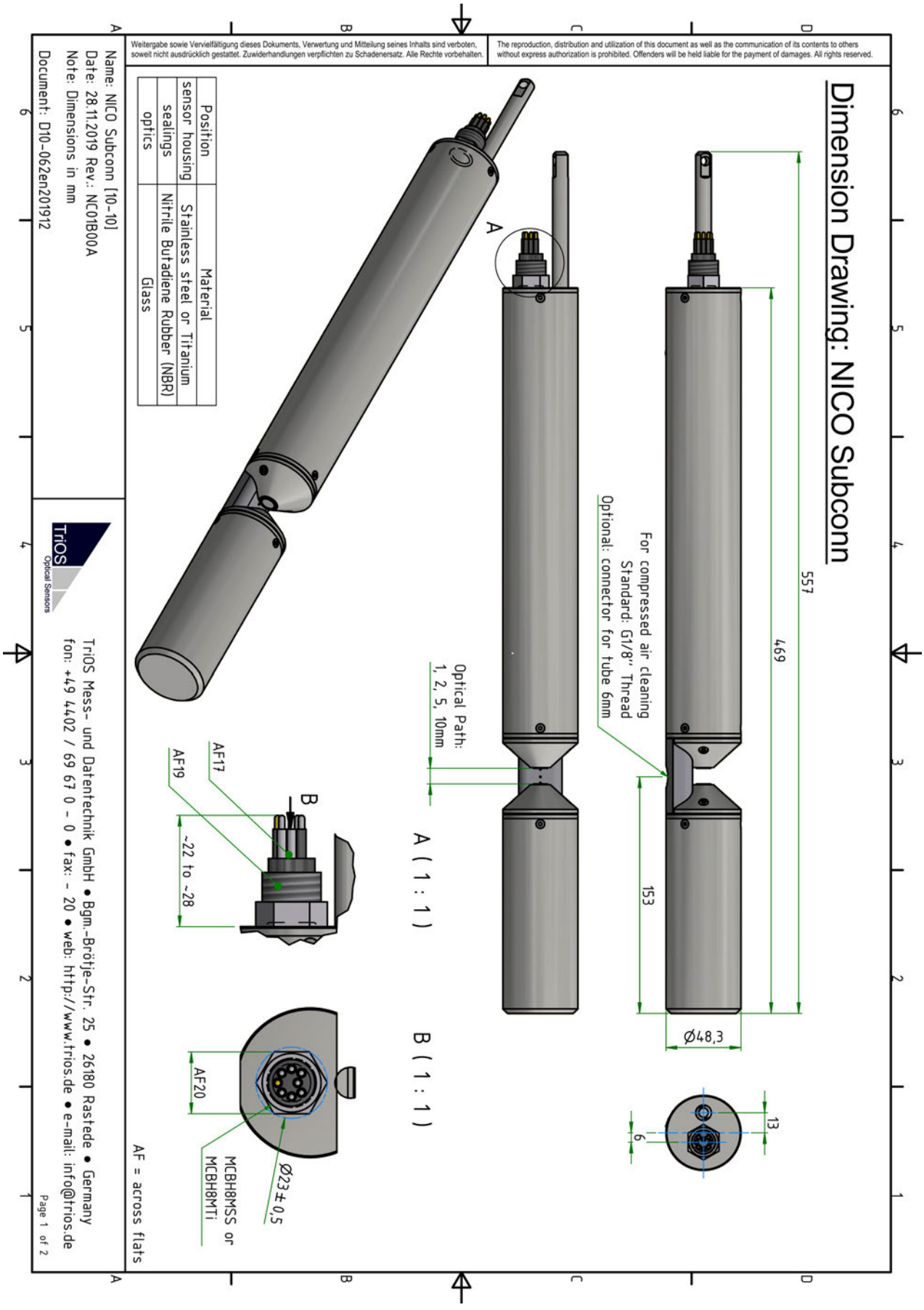
Path length	Parameter	Measurement range [mg/L]	Accuracy[1, 2,3]	Precision[1] [mg/L]	Detection limit[1] [mg/L]	Limit of quantification[1] [mg/L]
0.3 mm	Nitrate NO_3-N	0...165	± (5 % + 3.3)	0.50	1.65	5.0
	Nitrate NO_3	0...730	± (5 % + 14.5)	2.22	7.26	22.2
1 mm	Nitrate NO_3-N	0...50	± (5 % + 1)	0.15	0.5	1.5
	Nitrate NO_3	0...222	± (5 % + 4.4)	0.66	2.2	6.65
2 mm	Nitrate NO_3-N	0...25	± (5 % + 0.5)	0.075	0.25	0.75
	Nitrate NO_3	0...111	± (5 % + 2.2)	0.33	1.1	3.32
5 mm	Nitrate NO_3-N	0...10	± (5 % + 0.2)	0.03	0.1	0.3
	Nitrate NO_3	0...44	± (5 % + 0.88)	0.133	0.44	1.33
10 mm	Nitrate NO_3-N	0...5	± (5 % + 0.1)	0.015	0.05	0.15
	Nitrate NO_3	0...22	± (5 % + 0.44)	0.067	0.22	0.67
20 mm	Nitrate NO_3-N	0...2.5	± (5 % + 0.05)	0.008	0.025	0.075
	Nitrate NO_3	0...11	± (5 % + 0.22)	0.033	0.11	0.33
50 mm	Nitrate NO_3-N	0...1	± (5 % + 0.02)	0.003	0.01	0.03
	Nitrate NO_3	0...4.43	± (5 % + 0.09)	0.014	0.044	0.133

Note: 1 mg/L NO3-N corresponds to 4.43 mg/L NO3.

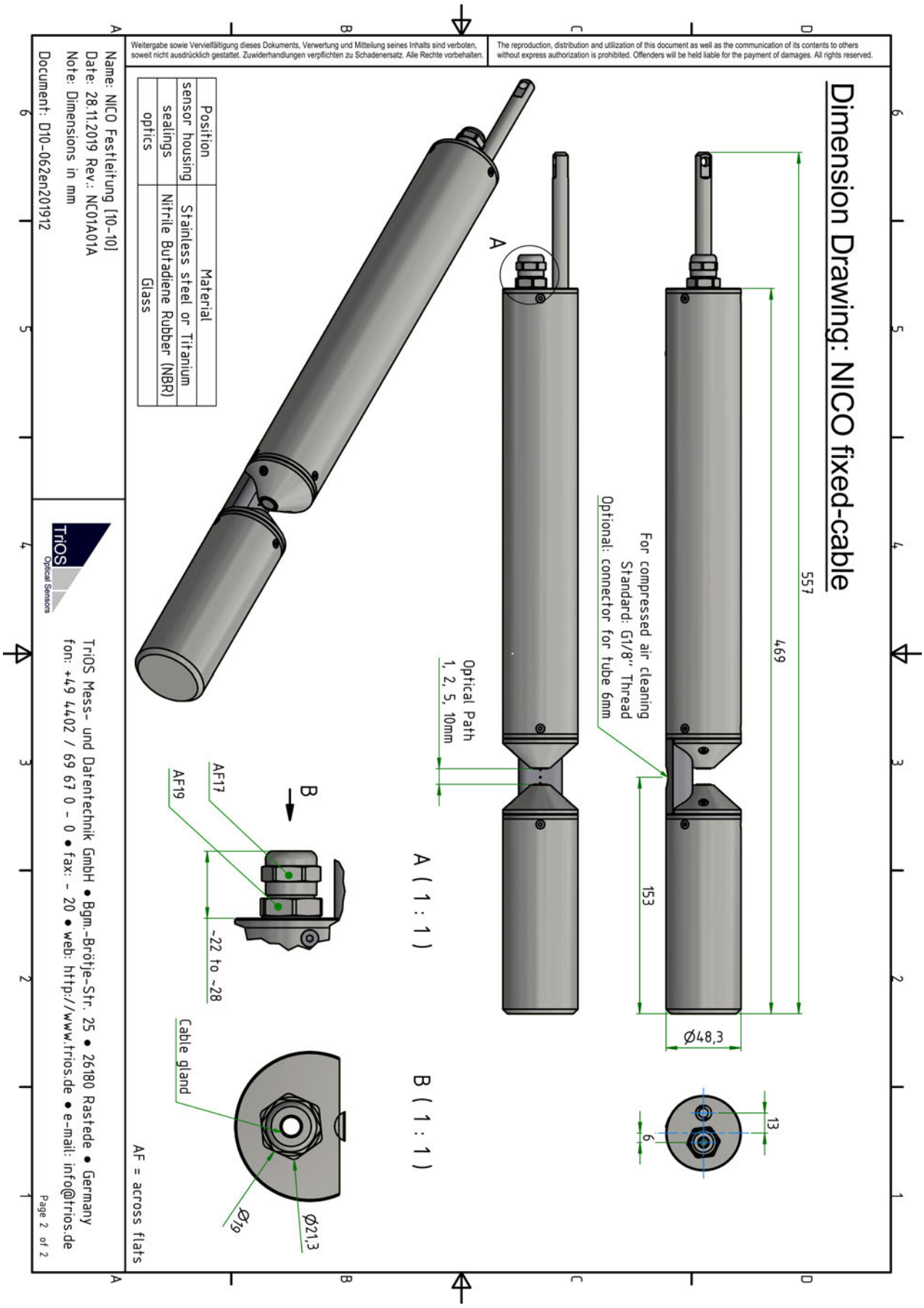
[1] Under laboratory conditions
[2] Related to a nitrate standard solution
[3] General: +/- (5 % + 2-fold detection limit)

7.2 Outer dimensions

SubConn plug



Fixed cable


Dimension Drawing: NICO fixed-cable
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The reproduction, distribution and utilization of this document as well as the communication of its contents to others without express authorization is prohibited. Offenders will be held liable for the payment of damages. All rights reserved.
Position | Material
sensor housing | Stainless steel or Titanium
sealings | Nitrile Butadiene Rubber (NBR)
optics | Glass
For compressed air cleaning
Standard: G1/8'' Thread
Optional: connector for tube 6mm
557
469
153
Ø48,3
13
6
Optical Path
1, 2, 5, 10mm
A (1 : 1)
B (1 : 1)
AF17
AF19
~22 to ~28
Cable gland
Ø16
Ø21,3
AF = across flats
Name: NICO Festleitung [10-10]
Date: 28.11.2019 Rev.: NC01A01A
Note: Dimensions in mm
Document: D10-062en201912
TriOS Optical Sensors
TriOS Mess- und Datentechnik GmbH • Bgm.-Brötje-Str. 25 • 26180 Rastede • Germany
fon: +49 4402 / 69 67 0 - 0 • fax: - 20 • web: http://www.trios.de • e-mail: info@trios.de
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8 Accessories

8.1 VALtub

VALtub is used for the validation of TriOS photometers. The sample can be filled conveniently and leak-proof and analyzed without immersing the sensor.
The VALtub is also used to check and recalculate the zero values. Due to the adapted shape, only small amounts of water are required to carry out a measurement.
It is suitable for all TriOS photometers.

8.2 Controller

8.2.1 TriBox3

Digital 4-channel display and control unit with integrated solenoid valve for compressed air control

TriBox3 is a measuring and control system for all TriOS sensors. The device offers 4 sensor channels with selectable RS-232 or RS-485 function. In addition to Modbus RTU, various other protocols are available.
A built-in valve allows the use of compressed-air cleaning for the sensors. The TriBox3 also offers various interfaces, including an IEEE 802.3 Ethernet interface, an IEEE 802.11 b/g/n interface, a USB port and 6 analog outputs (4...20 mA).
An integrated relay can be used to trigger alarms or control external devices. Low power consumption, a robust aluminum housing and a range of interfaces makes it suitable for all applications in environmental monitoring, drinking water, wastewater treatment plants and many other areas.

8.2.2 TriBox mini

Digital 2-channel controller

Die TriBox mini is an controller with two digital sensor inputs and two 4...20 mA outputs and represent a cost-effective alternative to analog measuring points.
The TriBox mini is compatible with all TriOS sensors.
All stored measured values and diagnostic data can be read out via an integrated web browser.

9 Warranty

The warranty period for our devices within the EU and the USA is 2 years from the date of invoice. Outside the EU it is 1 year. Excluded from the warranty are all normal consumables
(depending on the product, e.g. light sources or windows).

The warranty is subject to the following conditions:

- The device and all accessories must be installed as described in the relevant manual and operated in accordance with the specifications.
- Damage caused by contact with aggressive and material-damaging substances, liquids or gases, as well as transport damage, are not covered by the warranty.
- Damage caused by improper handling and use of the device is not covered by the warranty.
- Damage caused by modification or unprofessional attachment of accessories by the customer is not covered by the warranty.

NOTICE

Opening the device will void the warranty!

10 Technical support

If you have a problem with a TriOS sensor / a TriOS device, please contact TriOS technical support.

We recommend sending in sensors every 2 years for maintenance and calibration. To do this, please request an RMA number from technical support.

Contact technical support:

E-mail: support@trios.de
Phone: +49 (0) 4402 69670 - 0
Fax: +49 (0) 4402 69670 - 20

To enable us to help you quickly, please send us the sensor ID number (serial number with 8 digits, consisting of letters and numbers, e.g. 6700003F) by e-mail.

11 Contact us

We are constantly working on improving our devices. Please visit our website for the latest news.

If you have found a fault in one of our devices or programs or would like additional functions, please contact us:

Technical Support:	support@trios.de
General questions/sales:	sales@trios.de
Website:	www.trios.de

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Rastede, Germany

Telephone	+49 (0) 4402 69670 - 0
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12 Keyword index

R

S

T

U

W

13 Appendix

CE declaration of conformity

Hersteller/Manufacturer/Fabricant: TriOS Mess- und Datentechnik GmbH
Bürgermeister-Brötje-Str. 25
D- 26180 Rastede

Konformitätserklärung
Declaration of Conformity
Déclaration de Conformité

Die TriOS GmbH bescheinigt die Konformität für das Produkt
The TriOS GmbH herewith declares conformity of the product
TriOS GmbH déclare la conformité du produit

Bezeichnung Product name Désignation	**NICO**
Typ / Type / Type	-
Mit den folgenden Bestimmungen With applicable regulations Avec les directives suivantes	2014/30/EU EMV-Richtlinie 2011/65/EU RoHS-Richtlinie + (EU) 2015/863 + (EU) 2017/2102
Angewendete harmonisierte Normen Harmonized standards applied Normes harmonisées utilisées	EN IEC 61326-1:2021 EN 61010-1:2010 +A1:2019 +A1:2019/AC:2019 EN IEC 63000:2018
Datum / Date / Date 23.05.2024	Unterschrift / Signature / Signature R. Heuermann

D05-062yy202405

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Modbus RTU

Firmware version

This Modbus protocol refers to firmware version 1.2.14 and higher.

Serial interface

On delivery, the NICO sensor is configured to RS-485 with the following settings:

- Baud rate: 9600 bps
- Data bits: 8
- Stop bits: 1
- Parity: none

Data types

Data type name	register	format
Bool	1	false: 0x0000, true: 0xFF00
Uint8	1	8-bit positive integer. Values: 0x0000 - 0x00FF
Uint16	1	16-bit positive integer. Values: 0x0000 - 0xFFFF
Uint32	2	32-bit positive integer. Values: 0x00000000 - 0xFFFFFFFFFF
Float	2	IEEE 754 32-bit floating point number
Char[n]	$[\frac{n}{2}]$	Zero terminated ASCII character string
Uint16[n]	n	Field of n 16-bit integers (cf. Uint16)
Float[n]	2n	Field of n floating point numbers (cf. Float)

Functions

NICO supports the following Modbus functions:

Name	Code	Description / Use
Read multiple registers	0x03	Reads out the serial number, firmware version, configuration, calibration and measurement data
Write multiple registers	0x10	Write configuration
Write single register	0x06	Triggering (calibration) measurements
Report slave ID	0x11	Read serial number and firmware version

Standard Modbus server address

On delivery, NICO is set to address 1 (0x01).

Read / Write multiple registers (0x03 / 0x10)

Exceptions for device assignment

Please note that most registers are not available during a measurement. Attempting to read or write them will result in a device assignment exception instead. The only registers that are available during a measurement are

Read: Register below 100, self-triggering

Write: Self-triggering

The registers contain the following values: Notice: Before the registers from address 1000 can be read, a measurement must have been triggered beforehand.

Access restrictions

The “R/W” column describes the access restrictions for registers. An “R” means that it can be read (0x03), a “W” means that it can be written to (0x10).

Designation	R/W	Address	Data type	Data type Description
Modbus slave address	R/W	0	Uint16	The Modbus slave address of the sensor. Permitted addresses: 1...247
Action Result	R	3	Uint16	After issuing a command (see “Writing individual registers”, no. 3), the status of this command is written to this register. 0: The command was executed successfully. 1: Access denied. 0x4000: The command has failed. 0x8000: The command is still being executed.
Device serial number	R	10	Char[10]	The device name, followed by the serial number of the sensor, separated by an underscore. E.G. “NICO_F020”
Firmware version	R	15	Char[10]	The version number of the installed firmware
Lamp serial number	R	20	Char[8]	Type and serial number of the xenon flash lamp (XFL)
Lamp shot counter	R	24	Uint32	Number of flashes emitted
Self-trigger activated	RW	102	Bool	Activates or deactivates the self-timer. With external trigger: Deactivate the self-timer. Notice: When used with a control unit, it is recommended to deactivate the self-timer.
Self-trigger interval	R/W	103	Uint32	The interval in [s] for self-triggered measurements. Value range: 1 s - 86400 s. Notice: When used with a control unit, it is recommended to deactivate self-triggering.
Path length	R	106	Uint16	The length of the optical path in [mm]. Notice: 0 has a special meaning of 0.3 mm.
Data comment #1	R/W	109	Char[64]	First comment line for the measurement data
Data comment #2	R/W	141	Char[64]	Second comment line for the measurement data
Data comment #3	R/W	173	Char[64]	Third comment line for the measurement data

Designation	R/W	Address	Data type	Data type Description
Data comment #4	R/W	205	Char[64]	Fourth comment line for the measurement data
System date and time	R/W	237	Uint32	Date and time in seconds since 01.01.1970
Device description	R/W	239	Char[64]	A free description of the sensor. E.g.: “southern supply line”
Parameter index for offset / scaling	R/W	400	Uint16	The zero-based index of the parameter for the following offset and scaling settings. The parameter list is displayed in this document starting with the Modbus address 1000. (e.g. 0x0000 for N-NO3, 0x0001 for NO3 etc.)
Offset	R/W	402	Float	Parameter offset. Formula: scaled = (raw value - offset) * scaling
Scaling	R/W	404	Float	Parameter scaling. Formula: scaled = (raw value - offset) * scaling
N-NO3 /scaled	R	1000 / 1500	Float	
NO3 /scaled	R	1002 / 1502	Float	
SQI /scaled	R	1004 / 1504	Float	
RefA /scaled	R	1006 / 1506	Float	
RefB /scaled	R	1008 / 1508	Float	
RefC /scaled	R	1010 / 1510	Float	
RefD /scaled	R	1012 / 1512	Float	
N-NOx /scaled	R	1014 / 1514	Float	
NOx /scaled	R	1016 / 1516	Float	

Write single register (0x06)

Writing a value that is not 0x0000 to the following coils/registers executes the associated action.

Designation	Address	Address Description
Trigger measurement	1	A single measurement is recorded. The type of measurement depends on the value written:

Designation	Address	Address Description
		0x0101: Standard measurement All other values are reserved for future extensions and may cause indeterminate behavior of the sensor. Notice: Up to and including firmware version 1.2.14, Modbus requests may not be answered during the measurement. From all subsequent firmware versions, the sensor outputs the measured value of the previous measurement until the current measurement has been completed.
Command	3	Executes certain actions on the internal configuration status, depending on which value is written. The following values are possible: 6: Restart 7: Delete data protocol

Report slave ID (0x11)

Returns the sensor designation, followed by the serial number, followed by the firmware version, each as a zero-terminated ASCII character string.

Example:

T	R	I	O	S	0x00	N	I	C	O	0X00	F	0	2	0	0X00	1	.	2	.	14	0X00

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