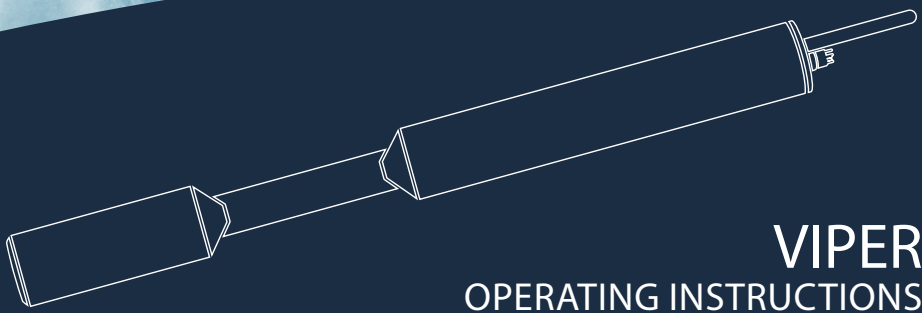
TriOS
Optical Sensors



VIPER

OPERATING INSTRUCTIONS

Table of Contents

1 General Information

1.1 Introduction

Welcome to TriOS.

We are glad that you have chosen to purchase our VIPER photospectrometer.

VIPER is a submersible VIS process spectrophotometer, that is designed for use in industry and science. It may only be used for measuring aqueous solutions, e.g. process wastewater, river water, groundwater and seawater in a temperature range from 2 to 40 °C.

The sensor VIPER and all accessories supplied by TriOS Mess- und Datentechnik GmbH must be installed and operated in accordance with the specifications from TriOS Mess- und Datentechnik GmbH. All parts have been designed and tested according to international rules for electronic instruments. The device complies with applicable international rules on electromagnetic compatibility.

Please use only original accessories and cables from TriOS Mess- und Datentechnik GmbH for a smooth and professional use of the devices.

The safety precautions noted on the following pages are intended to provide a simple and correct operation of the instrument and all its accessories to prevent harm from coming to you, other people or devices.

Please read this manual carefully before using the equipment and save it for future reference.

Make sure that you have read and understood the safety precautions described below before using the sensor. Always make sure that the sensor is operated correctly.

Please note that the user is responsible for compliance with local and state regulations for the installation of electronic equipment. Any damage caused by improper use or unprofessional installation is not covered by the warranty.

NOTICE	**Should translations differ from the original German text, then the German version is binding.**

Software Updates

The figures used in this manual refer to software version 1.0.2 or higher. Updates include bug fixes, new features and options. Devices with older software versions may vary from this manual version.

Copyright notice

1.2 Health and Safety Information

This manual contains important information about health and safety rules. This information is labelled according to the international specifications of ANSI Z535.6 (“Product safety information in product manuals, instructions and other collateral materials”) and must be followed strictly. The distinction is made between the following categories:

⚠ DANGER	Danger warning / will lead to serious injury or death
⚠ WARNING	Warning / may lead to serious injury or death
⚠ CAUTION	Caution / may cause moderate injury
NOTICE	Can result in damage to property

Tip / Useful Information

Electromagnetic waves

Devices that radiate strong electromagnetic waves can influence the measurement data or result in a malfunction of the sensor. Avoid using the following devices in the same room as the TriOS sensor: mobile phones, cordless phones, transmitters/receivers and other electrical devices that produce 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 safety and operating instructions of the manufacturer when using reagents. Observe the valid Hazardous Materials Ordinance for reagents (German GefStoffV).

Biological safety

Liquid waste may be a biohazard. Therefore, you should always wear gloves when working with such materials. Please observe the current biological material ordinance (German BioStoffV).

Waste

When handling liquid waste, observe the regulations on water pollution, drainage and waste disposal.

1.3 Warnings

- This sensor is designed for use in industry and science. It may only be used for the measuring of aqueous solutions, e.g. process wastewater, river water, groundwater 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 substances that cause corrosion (e.g. acids, alkalis, chlorine-based compounds). The material resistance should be tested for each application.
- VIPER has NBR (nitrile butadiene rubber) seals. Sealing rings made from other materials may be used upon individual request. Before operation, please ensure that the measured medium does not damage the seals.
- Do not cut, damage or change the cord. Make sure that no heavy objects are placed on the cord and that the cord is not folded. Make sure that the cord is not run near hot surfaces.
- If the sensor cable is damaged, it must be replaced with an original part by the customer support of TriOS Mess- und Datentechnik GmbH.
- Do not place unsuitable items in the optical path when the measurement process is in operation, because this can cause damage to the sensor or incorrect measurement results.
- Stop operation of the sensor if excessive heat develops (i.e., if it is hot to the touch). Switch off the sensor immediately and unplug the power cord from the power supply. Please contact your dealer or TriOS technical support.
- Never try to disassemble or modify a part of the sensor if such a procedure is not explicitly described in this manual. Inspections, modifications and repairs may only be done by the dealer or by qualified experts authorized by TriOS.
- Devices from TriOS Mess- und Datentechnik GmbH meet the highest safety standards. Repairs to the device (that involve the replacement of the connecting cable) must be carried out by TriOS Mess- und Datentechnik GmbH or a workshop authorized by TriOS. Faulty, improper repairs can result in 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 Users and Operating Requirements

The VIPER photometer has been developed for use in industry and science. The target group for the operation of VIPER probe is technically skilled staff in plants, sewage treatment plants, water plants and institutes. The use of this device often requires the handling of hazardous substances. We assume that the operating personnel are familiar with dealing with dangerous substances based on their professional training and experience. The operating personnel must be able to correctly understand and implement the safety labels and information on the packaging and in the package inserts of the test kits.

1.5 Intended use

The intended use of VIPER consists solely in recording absorbance spectra in the visible range and carrying out photometric measurements at specific wavelengths as described in this manual. In this respect, VIPER is a submersible sensor which can be submerged or used with a flow cell. Observe the technical specifications of the accessories. Any other use is considered improper.

This sensor is designed for use in science and industry. Use this sensor exclusively for measuring the absorbance of aqueous liquids. The use in other media may result in damage to the sensor. Should you wish to use VIPER in media other than the specified, please contact the technical support of TriOS Mess- und Datentechnik GmbH (support@trios.de).

NOTICE	**Avoid any unnecessary contact with the glass parts in the optical path, as they can become scratched or dirty. This means that the functionality of the device is no longer guaranteed.**

According to current scientific knowledge, the device is safe to use if handled properly and according to the instructions in this manual.

NOTICE	**Damage caused by improper use is excluded from the warranty.**

1.6 Disposal Instructions

At the end of the device's life or use, the device and its accessories can be returned to the manufacturer for environmentally friendly disposal for a fee (see address below). The preceding professional decontamination of the device must be proven with a certificate. Please contact us before you send the device back to get more details.

Address of the manufacturer:

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

1.7 Certificates and Approvals

This product meets all of the requirements of the harmonized European standards. It therefore meets the legal requirements of the EU guidelines. TriOS Mess- und Datentechnik GmbH confirms the successful testing of the product by affixing the CE marking. (See annex).

2 Introduction

VIPER is an independent measuring instrument that can be operated with a 12–24 VDC power supply.

It is equipped with a configurable serial interface that supports RS-232 and RS-485 standards as well as the protocol Modbus RTU. This makes the sensor particularly suitable for complex, PLC-controlled industrial systems, as well as for long-term research purposes.

A built-in Ethernet interface also enables sensor configuration via various web browsers. Users may assign offsets and scaling factors to measurements, configure serial interfaces and other sensor related settings. Refer to the corresponding chapter of this manual for further information.

Like all TriOS Mess- und Datentechnik GmbH sensors, VIPER is delivered pre-calibrated so that it is ready for immediate use.

This manual provides information about the specifications, the installation and the operation of the sensor VIPER.

2.1 Calibration Sets

2.1.1 DIN EN ISO 7887:2012-04

The norm DIN EN ISO 7887:2012-04 describes the “Examination and determination of color”.

Method B specifies the determination of the true color of a water sample using an optical instrument. The determination wavelengths are 436, 525 und 620 nm. The method is applicable to raw and potable water and lightly colored industrial wastewater.

Method C describes the determination of true color using optical instruments for the determination of absorbance at a wavelength of 410 nm. The color solution for calibration consists of potassium hexachloroplatinate and cobalt chloride.

VIPER measures color at 410 nm as well as SAC 436, SAC 525 and SAC 620 direct in the medium. A filtration of the water is not necessary because the absorbance at a wavelength of 720 nm is used for turbidity correction.

2.1.2 DIN EN ISO 6271:2016-05_APHA / Hazen_Pt-Co color

DIN EN ISO 6271:2016-05 specifies a spectrophotometric method for estimating the color of clear liquids by the platinum-cobalt color scale. It is applicable to clear liquids having color characteristics similar to those of the reference platinum-cobalt scale.

The term “platinum-cobalt color” used in the norm is preferred over the terms “Hazen color” and “APHA color”.

The Pt-Co scale is defined as a classification of the color of a solution containing platinum, in the form of the hexachloroplatinate(IV) ion, and cobalt(II) chloride hexahydrate in specified concentrations.

The recommended path length is 50 mm. The measuring range is 0 to 500 Pt-Co color.

VIPER measures color at 390 nm or 455 nm direct in the medium. A filtration of the water is not necessary because the absorbance at a wavelength of 720 nm is used for the turbidity correction.

2.1.3 GOST 3351-74_Cr-Co color

The USSR National Standard Method „GOST 3351-74" describes a photometric method to evaluate the presence of color in drinking water. The colorimetric scale is prepared with a mixture of potassium dichromate and cobalt sulfate in diluted sulfuric acid. It is defined form 0 to 70 color degrees. The evaluation of color with a photoelectric colorimeter is done using path lengths of 50 to 100 mm. The optical density of the filtrate of the water sample is measured in the blue part of the spectrum at 413 nm.

VIPER measures color at 413 nm directly in the medium. A filtration of the water is not necessary because the absorbance at a wavelength of 720 nm is used for the turbidity correction.

2.2 Product Identification

All TriOS Mess- und Datentechnik GmbH products have a label, which clearly shows the product designation.

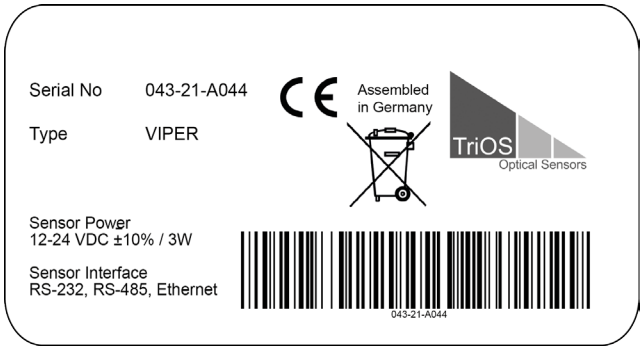
There is also a rating plate on the sensor with the following information that you can use to uniquely identify the product:

Serial number

Product type

Power supply

Interface



In addition to the product bar code, the rating plate includes the TriOS Mess- und Datentechnik GmbH logo and the CE quality label.

Please note that the specifications given here are for illustration purposes only and may be different depending on the version of the product.

2.3 Scope of Delivery

The shipment contains the following components:

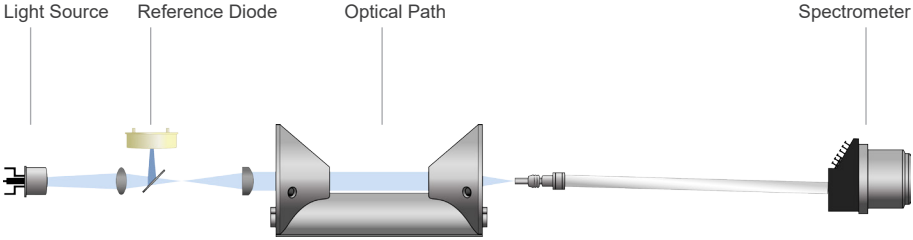
- Sensor
- Manual
- Accessories (if applicable)

Keep the original device packaging in case the device needs to be returned for maintenance or repairs.

2.4 Measurement Principle and Design

For the optimal use of the sensor, it is recommended to become familiar with the idea and theory underlying the device, as well as with its assembly procedure.

VIPER consists of four parts: a defined light source, a lens system, the optical path through the medium, and a spectrometer.



The light source consists of 5 LEDs. The emitted light is focused to a parallel beam passing the measurement medium. A second lens with a small focal length focuses the beam at the inlet slit of the miniature spectrometer.

The emitted light is partially absorbed and scattered by molecules and particles during passage through the medium. The spectrometer picks up the remaining, spectrally resolved light and determines its intensity **I** at different wavelengths over a defined wavelength range. A measurement in ultrapure water provides the so-called base-intensity $\mathbf{I_0}$. This is the light intensity that reaches the spectometer after passage through the pure measuring medium which contains only solvent molecules and no other components like determinants and particles.

The remaining light intensity **I** is divided by the base-intensity $\mathbf{I_0}$ to calculate transmission **T** (see Equation 1). According to Equation 2 the absorbance **A** is calculated for each wavelength over the defined wavelength range.

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

Equation 1: Calculation of transmission

$$A = -log_{10} T \qquad T = -log_{10} \frac{I}{I_0}$$

Equation 2: Calculation of absorption

Each sensor is delivered with a water basis as zero line. It is measured in ultra pure water following our internal calibration standards.

2.4.1 Spectra Calculation

Every measurement of VIPER consists of a light and a dark measurement. During the light measurement the LEDs emit their light, which is detected with the spectrometer as a light spectrum (= raw light). During the dark measurement the LEDs are off. The detected spectrum (= raw dark) is caused only by electronic noise. The dark values are approximately constant over the whole wavelength range and depend slightly on the measuring temperature and the integration time (IT).

The time during which the spectrometer collects the light photons is called the integration time (IT). The maximum value of a single spectrometer photodiode is approx. 65000 counts. If the light intensity at a certain wavelength is too high, the IT is lowered.

The raw dark spectrum is subtracted from the raw light spectrum. The remaining values are calculated with the IT and a temperature correction factor. The result is a calibrated spectrum.

The reference for the calculation of absorbance is usually a measurement in ultra pure water. The calibrated spectrum of the ultra pure water measurement is called the zero line or waterbase. The intensity of each wavelength is the so-called base-intensity $\mathbf{I_0}$. According to Equation 2 absorbance for each wavelength is caculated. The received spectrum is the absorbance spectrum. The unit of the absorbance value is AU which stands for absorbance unit.

NOTICE	**The absorbance values should not exceed 2.5 AU. If this is the case, the concentration of the determinants or the particle fraction in the measurement medium is too high for the selected path length. The path length must be shortened to obtain qualitative measurements and measured values.**

2.4.2 Calculation of the Parameters

Every VIPER is equipped with a pre-defined parameter set (see table in chapter 5.1)

Under consideration of the pathlength, absorbance values [AU] at specific wavelengths are calculated to absorbance values with the unit [1/m].

The calculation of the spectral absorption coefficient (SAC) is described below:

VIPER uses absorbance at a wavelength of 720 nm (A720) for turbidity correction of absorbance (A_{WL}, measured at a specific wavelength). The SAC at the specific wavelength ($\mathbf{SAC_{WL}}$) is calculated as shown in Equation 3. In this equation **d** is the optical path length in millimeter [mm]. For VIPER, optical path lengths of 50 mm, 100 mm, 150 mm and 250 mm are available.

$$SAC_{WL} = \frac{(A_{WL} - A_{720}) \cdot 1000}{d} \; [1/m]$$

Equation 3: Spectral absorption coefficient at a specific wavelength (WL).

2.4.3 Temperature Correction

The light intensity of LEDs often varies with temperature. Therefore, a temperature correction factor is determined for each wavelength of the VIPER spectrum and used for the spectrum calculation.

2.5 Parameter and Measuring Ranges

The following table provides an overview of the measurement ranges of the detectable parameters in dependence on the path length. Some applications are working with a factor to scale the SAC (spectral absorption coefficient) at a certain wavelength into a special parameter.

NOTICE

The transmission at 720 nm may not fall below 33 %, otherwise the content of suspended solids in the medium is too high and the measuring range for the parameters could be exceeded. 33 % transmission corresponds to an absorbance value of 0.5 AU.

VIPER measuring ranges in dependence on the path length*.

Parameter	according to	Unit	Factor	Path Length (mm)				
				10	50	100	150	250
SAC_{436}	DIN EN ISO 7887: 2012-04	1/m	-	1...250	0.2...50	0.1...25	0.06...17	0.04...10
SAC_{525}	DIN EN ISO 7887: 2012-04	1/m	-	1...250	0.2...50	0.1...25	0.06...17	0.04...10
SAC_{620}	DIN EN ISO 7887: 2012-04	1/m	-	1...250	0.2...50	0.1...25	0.06...17	0.04...10
True Colour 410	DIN EN ISO 7887: 2012-04	mg/L Pt	18.52	20...3750	4...750	2...375	1.2...250	0.8...150
Pt-Co colour 390	DIN EN ISO 6271:2016-05	mg/L Pt	7.4	8...1500	1.6...300	0.8...150	0.4...100	0.2...60
Pt-Co colour 455	DIN EN ISO 6271:2016-05	mg/L Pt	36.4	40...7500	8...1500	4...750	2.4...500	1.4...300
Cr-Co colour 380	-	° (degree of colour)	9.7	10.0...2000	2...400	1...200	0.6...130	0.4...80
Cr-Co colour 413	Gost 3351-74	° (degree of colour)	34.1	40...7000	8...1400	4...700	2.6...450	1.6...275

* under laboratory conditions

2.6 Browser

VIPER is equipped with a web interface for sensor configuration and calibration. To access the web interface, you need a G2 InterfaceBox, an Ethernet cable and an Ethernet-enabled device with a web browser, e.g. a notebook / laptop.

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

http://VIPER/

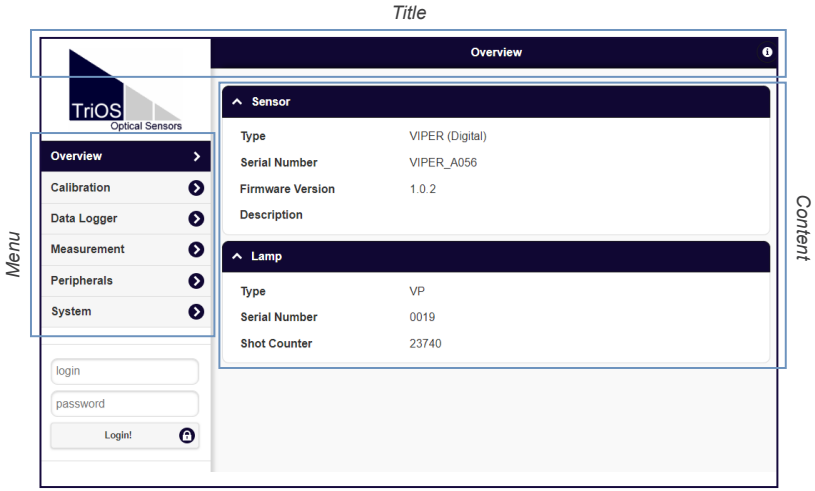
http:// VIPER _AXXX / (AXXX represents the serial number)

http://192.168.77.1/

When an Ethernet-enabled device is connected, the automatic measurements are suspended. As soon as the sensor is disconnected from your device again, the measurements will continue at the set interval if the timer for automatic measurements is activated.

The web interface is divided into three areas:

Title (above), menu (to the left under the TriOS logo) and content (right).



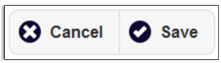
Under the menu, there is a login section only accessible to certified TriOS Mess- und Datentechnik GmbH service technicians.

In the menu on the left, the subpoints are listed. There is a “Help” link on the right side that will take you to the TriOS Mess- und Datentechnik GmbH website. An active internet connection is required to access the website.

The following figures are examples for VIPER True color according to DIN EN ISO 7887:2012-04. The other calibration sets vary in details.

The menu is used to navigate the web interface. Each line is a link to another page with different setting options. The link that refers to the page that is currently displayed is always highlighted in the menu. Some of the contents and functions are reserved for the employees of TriOS Mess- und Datentechnik GmbH Customer Service. Authentication is needed to access this content. This content is not accessible to every user.

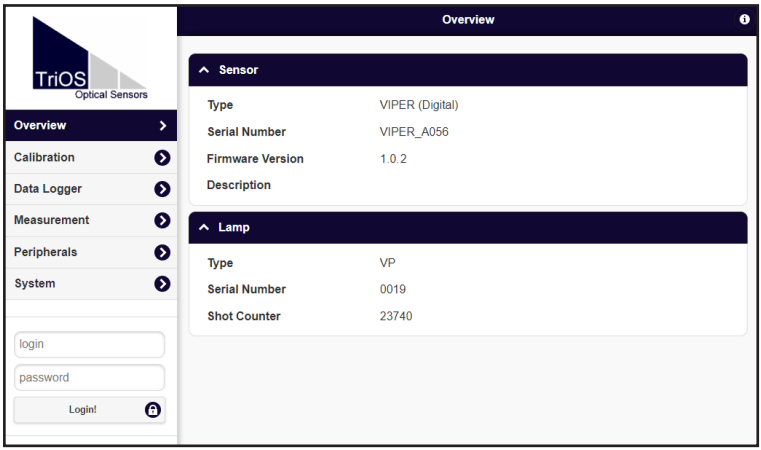
The contents area displays the relevant information and setting options. Content that requires authentication is disabled (“grayed out”) if authentication fails or is not possible due to lack of appropriate information.



If settings have been made, they must be saved with the “Save” button. Otherwise the settings will be lost again.

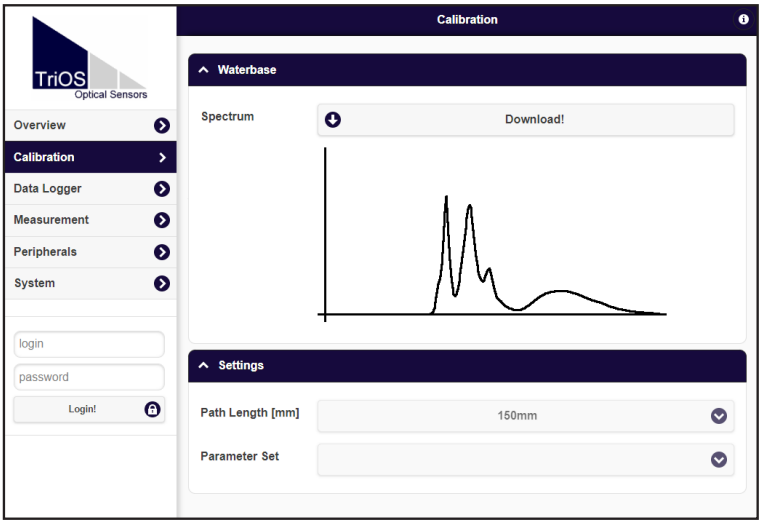
Overview

The “Overview” page summarises basic information about VIPER. This includes device type, serial number and firmware of the sensor at the top, and lamp type, lamp serial number and shot counter (number of light flashes) at the bottom.



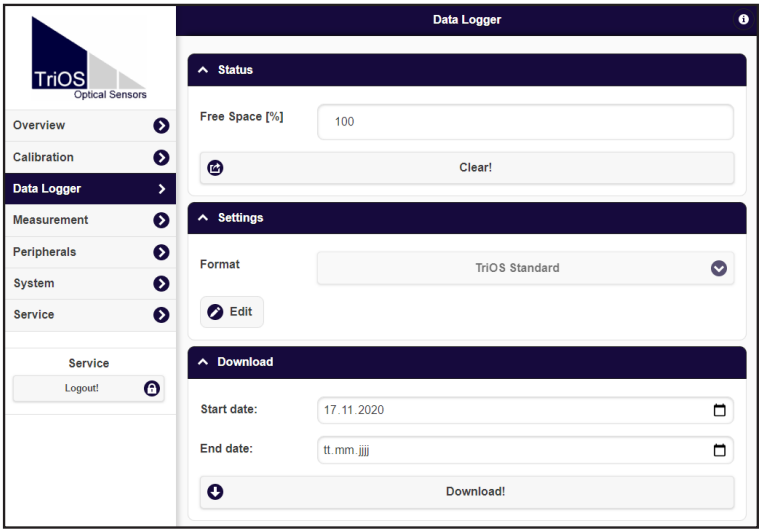
Calibration

Lamp spectrum (I_0) is displayed on the “Calibration” page under “Waterbase”. The setting of the optical path in millimetres is displayed in “Settings”.



Data logger

VIPER is equipped with an internal data logger with a data memory of 2 GB. This allows an almost completely self-sufficient operation over a very long period. The only accessory required is an appropriately dimensioned power supply. The following figure shows the layout of the page “Data Logger”



Status

The status indicates the memory percentage which is still available.

The “Clear” button formats the memory and deletes all data - for safety only after confirming the security prompt.

After confirming the security prompt, the memory on the VIPER and thus all data is irrevocably deleted.

Settings

VIPER stores and outputs data in the file formats CSV (Comma Separated Values) and the dat. format. CSV files can be opened in the most common spreadsheet programs. The default configuration is “TriOS Standard”. In this case, numerical values are saved in CSV format and spectra are saved in .dat format. However, you can change this setting and save both in CSV format.

Download

Previously stored data can be retrieved with the “Download” button. It is possible to set a start and an end date for the data download. We recommend choosing a window of time for the download / export, because the download of approximately 2 GB can take a long time.

Measurement

The “Measurement” page shows the results of the last performed measurement and allows configuring the settings for automatic measurements.

Parameter

A new measurement can be triggered at any time. To do this, click on the “Measure Now!” button. A new measurement will then be performed with the saved settings.

The results calculated at the last measurement are listed. “Edit” allows to scale the measured values with “Offset” and “Scaling”.

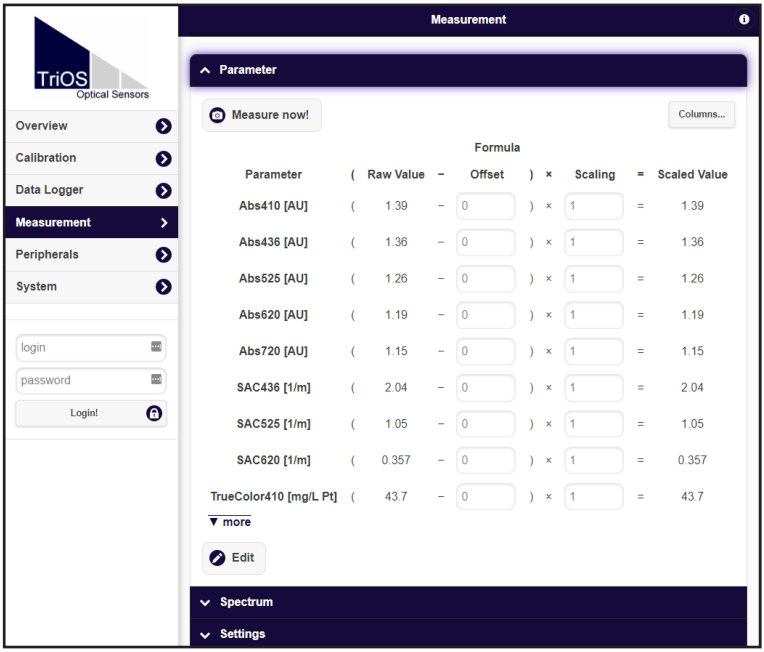
The formula used to calculate the scaled measured value with scaling factor and offset is shown in the top row.

(Raw Value - Offset) x Scaling = Scaled Value

(Measured value - axis shift) x scaling factor = scaled measured value

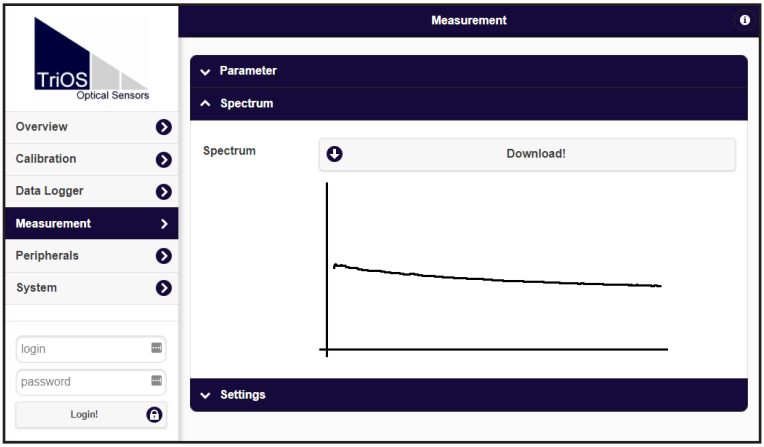
NOTICE

The possibility to scale parameters is given for every parameter that is calculated by a TriOS Mess- und Datentechnik GmbH probe. Parameters should only be scaled, if a reference measurement of the medium concerning the parameter is available.



Spectrum

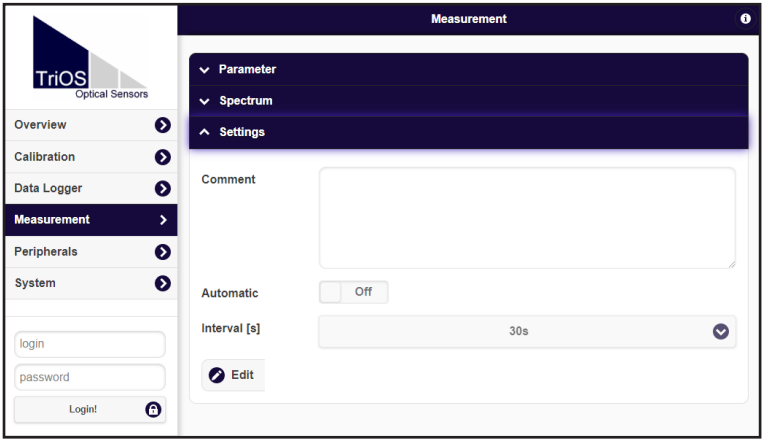
The “Spectrum” item shows the measured absorption spectrum. Press the “Download” button to download/copy this spectrum to the computer as a CSV file.



Settings

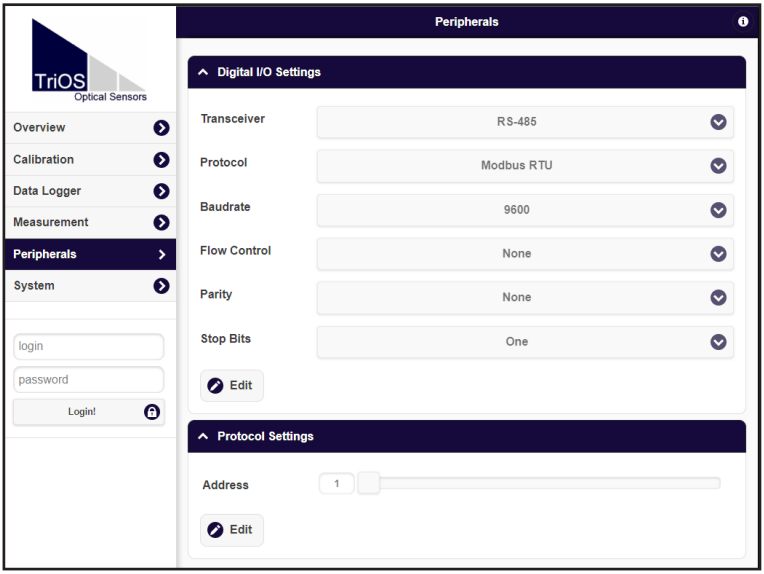
In the subitem “Settings”, settings for the automatic measurement can be made after pressing the “Edit” button:

- Comments entered in the “Comment” field can be linked to measured values and spectra.
- Automatic measurements can be activated.
- An interval for the automatic measurements can be specified.



Peripherals

The “Peripherals” page is used to configure the interface, select a protocol, and change the Modbus address. To do so, just click on the “Edit” button at the page bottom.



The factory settings are:

Hardware mode: RS-485

Protocol: Modbus RTU

Baud rate: 9600

Flow control: None

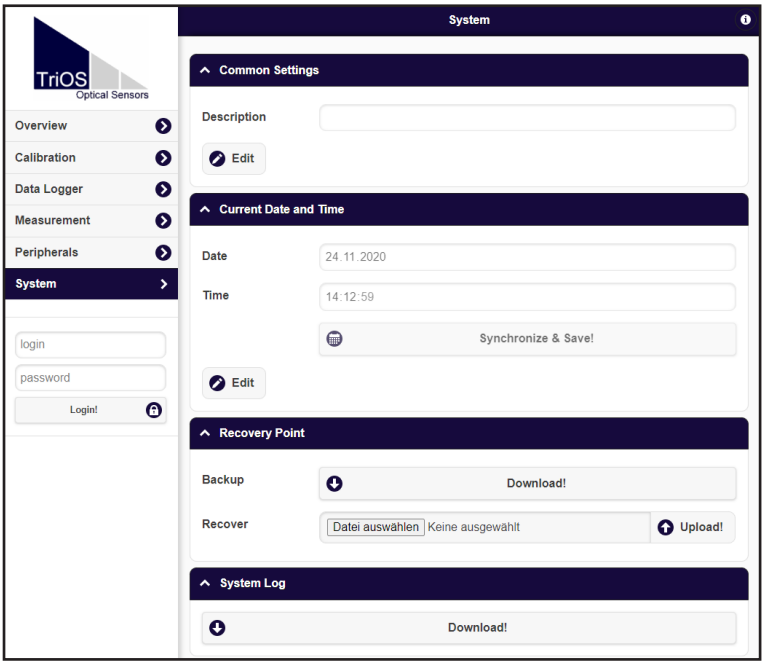
Parity: None

Data bits: 8

Stop bits: 1

System

The “System” page is used for general VIPER configurations. Users can load a calibration file and download the current calibration as a recovery point.



Common Settings

After pressing the “Edit” button, a comment such as a name or the location of the sensor can be entered here. This then appears in the “Overview” menu.

Current Date and Time

Here the date and time of the sensor can be set manually or synchronized with the PC.

Recovery Point

Click on the “Download” button to download the latest sensor calibration to a PC or other support. This calibration file (config.ini) must be stored and kept safe. For the normal user this file is encrypted and unreadable to avoid unauthorized changes.

Use the “Upload” function to restore a previously downloaded calibration file or to upload a calibration file generated by the technical support of TriOS Mess- und Datentechnik GmbH. If the operation is successful, this will be indicated by a green box that reads “Success”. Otherwise, you should see a box with an error message at

the top of the screen.

The following error messages and warnings are possible:

- “File not OK”: The calibration file could not be read correctly. Check the path and select the correct file. If the error persists, contact TriOS Mess- und Datentechnik GmbH technical support.
- “Device type or serial number does not match”: The calibration file is not suitable for the currently connected sensor.

System Log

If the device is being serviced, system information can be downloaded here.

Service

To use the Service function, you need a login and a password. You will receive a login and password when you participate in a TriOS training session.

3 Commissioning

This chapter covers the correct installation and mounting of VIPER. Read this chapter with particular attention and follow the safety instructions in order to protect the sensor from any damage and yourself against injuries.

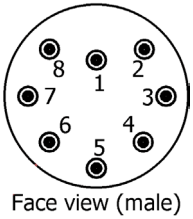
Before VIPER is put into operation, ensure that it is securely fastened and that all connections are properly wired.

3.1 Electrical Installation

VIPER is designed for 12–24 VDC. With the G2 InterfaceBox a standard 12 or 24 VDC power supply can be used with a minimum output current of 200 mA.

If the G2 InterfaceBox is not used, please pay special attention to the pin-setting, as shown in chapters 3.1.1 and 3.1.2.

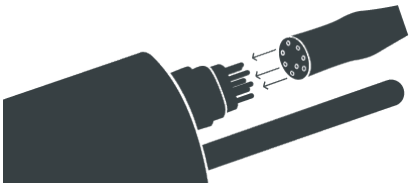
3.1.1 SubConn-8pin Stecker



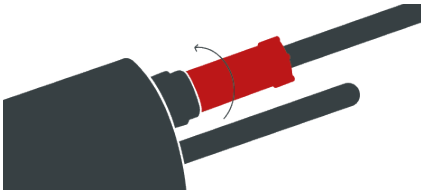
Face view (male)

1. Ground (Power + Ser. 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+

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

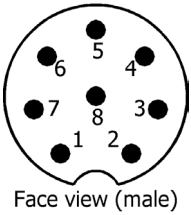


The next step is to rotate the locking sleeve in a clockwise direction to lock the end of the connector into the bulkhead connection.



NOTICE **Do not bend the connector 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



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 + Ser. Interface)
8. Power (12...24 VDC)

NOTICE **Make sure that the polarity of the operating voltage is correct, otherwise the sensor may be damaged.**

There is an 8-pin M12 connector at the cable end of VIPER.

To get an open end M12 plug to connect to SCADA or PLC never cut the cable. A suitable socket with open cable ends can be purchased. Always use the 8-pin M12- sensor connector. Please contact TriOS Mess- und Datentechnik GmbH technical support for further information!

3.2 Interfaces

VIPER can be operated as follows:

1. Operation of the sensor with a TriOS Mess- und Datentechnik GmbH controller via the serial interface.
2. Operation in a custom installation to get measured values via the serial interface (RS-485 or RS-232).
3. Configuration of the sensor and recording single measurements using the web interface.
4. Operation with a suitable power supply (eg. B. G2 InterfaceBox purchased by TriOS Mess- und Datentechnik GmbH): Data are collected on the internal memory (up to 2 GB) and analyzed subsequently after the download.

3.2.1 Digital Interfaces

VIPER provides two lines for digital, serial communication with a control device. It will thereby support the RS-232 and RS-485 standards. Via the web interface it is possible to switch these standards.

Both RS-232 and RS-485 are voltage interfaces. RS-232 voltages are in the range from -15 V to +15 V, RS-485 from -5 V to +5 V, towards GND.

Upon delivery VIPER is configured to RS-485 with the following settings:

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

VIPER supports the data protocol Modbus RTU. A detailed description of the Modbus RTU protocol can be found in the annex of this manual.

The following “Peripheral” options are available under “Digital I/O”:

- **Transceiver:** Choose the standard for data transmission
  Selectable are:
  - RS-232 (and EIA-232)
  - RS-485 (and EIA-485)
- **Protocol:** Suitable data communication protocol:
  - Modbus RTU
- **Baud rate:** Specifies the selectable baud rate, i.e. transmission speed.

NOTICE	**Lower the baud rate if communication problems occur.**

- **Flow Control:** Enables flow control on the software level (XON / XOFF).

NOTICE	**This is only supported with the internal “TriOS data protocol” and must be deactivated when using Modbus RTU.**

- **Parity:** Activates the parity check for data transmission. Possible options are:
  - None (= deactivated)
  - Even
  - Odd
- **Stop Bits:** Specifies the number of stop bits.

NOTICE **For various Modbus devices it may be necessary to set it to “Two” if parity check is to be avoided.**

The section “Protocol Settings” shows additional properties available for configuration.

With the Modbus RTU protocol the following additional properties are available:

- **Address:** This is the device slave address for Modbus communication. It identifies the sensor in the bus system and must be unique.

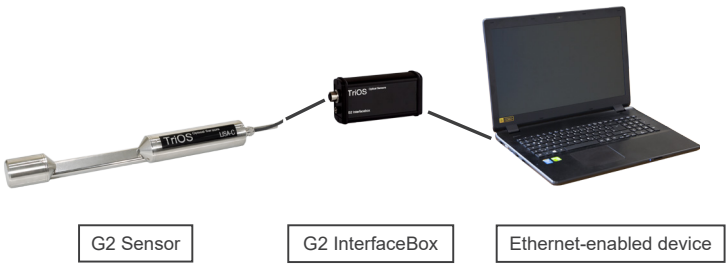
3.2.2 Network

For the new TriOS G2 sensors, the IEEE 802.3 10BASE-T-compliant Ethernet interface is used as a universal interface. Thus, it is possible to connect a single sensor or to build a complex sensor network.

Network with a single G2 Sensor

To configure VIPER via various webbrowsers, the TriOS G2 InterfaceBox can be used. The G2 InterfaceBox is both the connection and the power supply for the sensor and can be used with all of the TriOS G2 sensors.

The following figure shows a connection to a single sensor:



The TriOS G2 InterfaceBox translates the 8-pin M12 sensor plug to the conventional power supply connections (2.1 mm barrel connector) and to the network access (RJ45 socket).

G2 InterfaceBox

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

1. Power supply 12 VDC / 24 VDC 2.1 mm barrel connector
2. Sensor connector 8 pin M12
3. Ethernet connector RJ45 socket

The G2 InterfaceBox WiFi differs slightly from the illustration shown here. Further information regarding the G2 InterfaceBox WiFi can be found in the corresponding Quick Start Guide.

Proceed as follows to connect VIPER to an Ethernet-capable device via the G2 InterfaceBox:

Step 1) Make sure that the Ethernet adapter of your device is configured to automatically obtain network settings (IP address and DNS server).

Step 2) Plug the M12 connector at the cable end of VIPER into the M12 socket (2) of the G2 InterfaceBox and tighten the screw cap.

Step 3) Connect the 12 or 24 VDC power supply to the G2 InterfaceBox to supply power to the sensor.

Step 4) Wait at least three seconds before finally connecting the Ethernet LAN cable to your Ethernet-enabled device and the G2 InterfaceBox.

The web interface can now be accessed with any browser using the following URLs:

http://viper/

http://viper_AXXX/ (AXXX is the serial number)

http://192.168.77.1/

If the web interface is not accessible, make sure that the LAN cable is connected after the sensor has been powered on and try all three URL options.

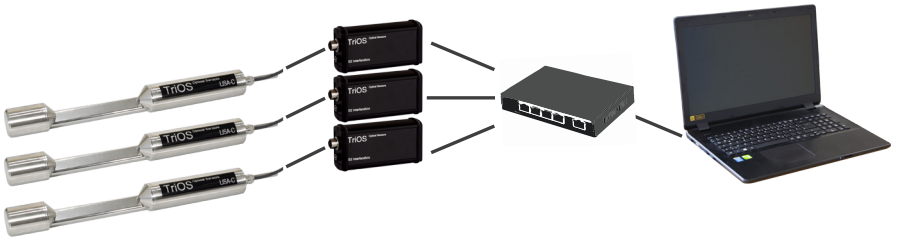
Automatic measurement by VIPER is stopped when an Ethernet-capable device is connected. When the LAN connection between the sensor and the internet-capable device is disconnected, the measurements will continue at the set interval if the timer is activated.

Network with multiple G2 sensors

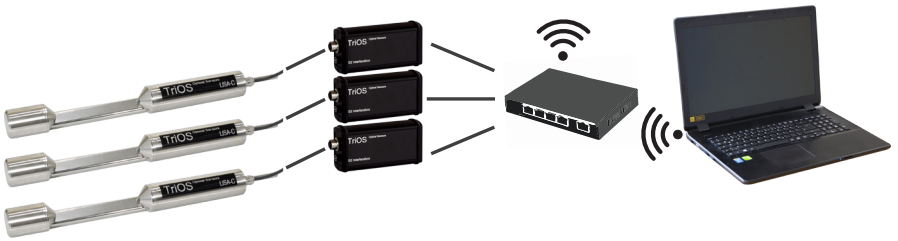
By using an Ethernet switch/hub or a conventional router, it is possible to connect multiple sensors into a complex network and use them simultaneously. In the sensor network, each sensor requires its own G2 InterfaceBox for the power supply.

Like any G2 sensor, VIPER delivers a simple DHCP server as well as a simple DNS server, which is configured exclusively for a direct connection, as described in the previous section. For a complex sensor network, the servers must be supplied by the user. VIPER recognizes these servers automatically and then turns off the internal servers. Ask your network administrator how a sensor network is best implemented in your case.

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



G2 Sensors	G2 InterfaceBox	a) Ethernet-Switch / Hub b) Router with DHCPServer	a) Ethernet-enabled device with DHCP-Server b) Ethernet-enabled device



G2 Sensors	G2 InterfaceBox	a) Access Point b) WLAN-Router with DHCP-Server	a) WLAN-enabled device with DHCP-Server b) WLAN-enabled device

VIPER 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 reached via the host name http://viper_AXXX/ (AXXX 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 Use

VIPER can be operated with any of the TriOS controllers. Instructions for correct installation can be found in the controller manual.

NOTICE **Never transport the sensor only hanging on the cable.**

4.1 Normal Operation

4.1.1 Immersion Operation

For immersion operation, VIPER can be completely or partially immersed in the water / measuring medium. To obtain correct readings, the measuring windows must be fully immersed and free from air bubbles. Use the mounting rod with a shackle and a stainless steel chain or a steel wire to hang the device in the medium. Do not add weight to or pull on the sensor cable. VIPER can also be attached 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 pipe against excess spot pressure, install the brackets close to the device covers. Suitable brackets can be obtained from TriOS.

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

4.1.2 Cleaning System

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

Nano Coating

All optical windows from TriOS Mess- und Datentechnik GmbH are treated with a nano-coating.

window with nano coating window without nano coating

The wettability of the surface of the coated glass is significantly lower. This effect is caused by the nano-coated surface of the glass, to which dirt cannot adhere. In combination with the compressed-air cleaning, the windows are kept clean for long periods of time so the amount of cleaning necessity is reduced.

Compressed air cleaning

VIPER can be modified with an optional compressed air purge for all path lengths between 50 and 250 mm. The optical path has an air outlet directly at the measuring windows and a hose fitting for the connection of compressed air. TriOS controllers have valves that are controlled by software, which allows fixed cleaning intervals to be set. Compressed air of between 3 and 6 bars must be provided.

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).**

With compressed air cleaning for long paths, the elbow fittings must be screwed into the holes provided in the center piece.

The hoses suitable for the path can then be connected to the Y-piece and the free ends of the hoses to the elbow fittings, as shown in the following figure.

The compressed air supply hose is attached to the last free opening of the Y-piece.

Be careful not to set the air pressure above 6 bar.

Suitable materials for compressed air cleaning for long paths are available from TriOS.

To connect the hose, push the hose into the matching connection port. To remove the hose, press the blue locking ring in the direction of the connection and pull the hose out. Secure the hose to the device and the cable with cable ties if necessary to avoid uncontrolled hits and movement of the compressed-air hose.

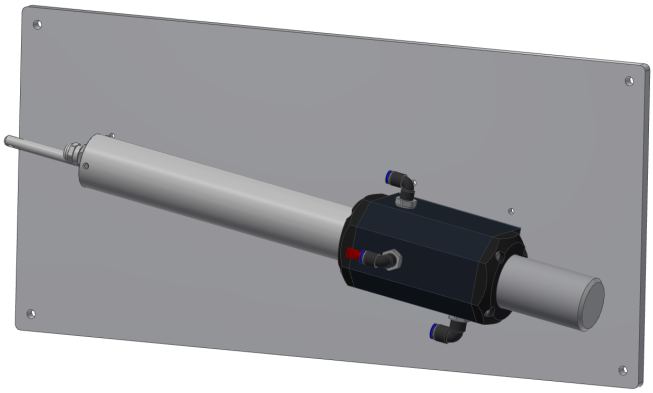
NOTICE	**The pressure must not exceed 7 bar! Valve damage could occur!**

4.1.3 Float

The float is the ideal solution for fluctuating water levels.

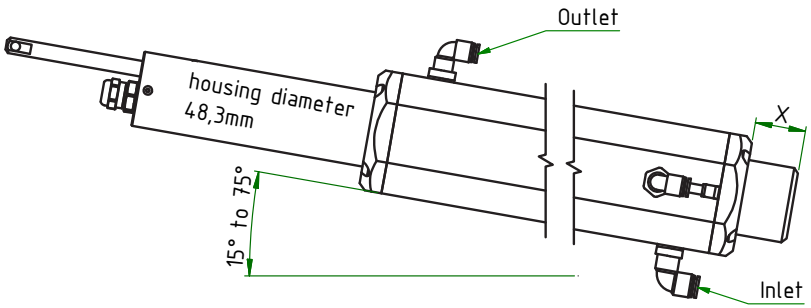
4.2 Bypass

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



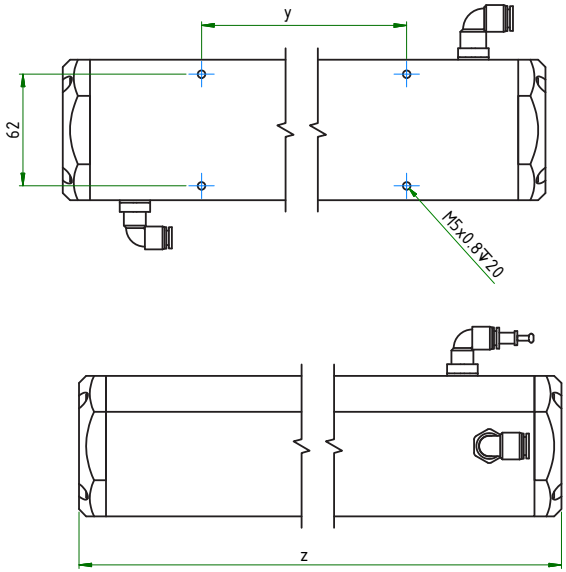
NOTICE **The maximum pressure in the flow cell must not exceed 1 bar. Make sure that the sensor is installed in the correct position to ensure the free flow of water.**

The flow cell for VIPER has three hose connections. The inlet has an 8 mm hose connection and is located on the right 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 on top of the cell that can be used for cleaning with liquids. When not in use, this inlet should be closed with a plug.



Since VIPER can be obtained in different path lengths, the dimensions of the associated flow cell vary accordingly as described in the following table:

Path Length [mm]	x [mm]	y [mm]	z [mm]
50	82,5	96	150
100	82,5	96	200
150	82,5	96	250
250	82,5	96	300



The hoses are installed by applying slight 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 the compressed air cleaning.**

4.3 Use with a Cuvette

For laboratory use and very small water volumes VIPER can be equipped with a cuvette holder for standard 5 mm cuvettes (see picture below).

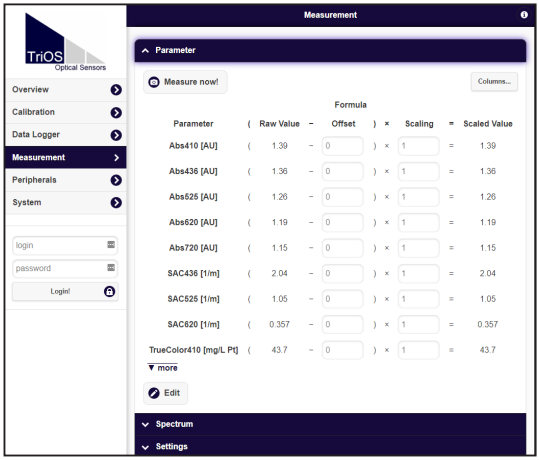
Measurements with 50 mm and 100 mm cuvettes can also be performed by simply positioning the cuvettes in the optical path. It should be noted that due to the design, a 50 mm cuvette cannot be used in a 50 mm path, but the next larger path length must be selected. The same applies to the 100 mm cuvette.

For measurements with cuvettes it is inevitable to set a new zero line. This requires professional training and experience. The recording of a new waterbase requires authentication and is reserved to TriOS Mess- und Datentechnik GmbH authorized and qualified professionals. Please contact TriOS Mess- und Datentechnik GmbH technical support for further information.

5 Calibration

5.1 Factory Calibration

All sensors are factory calibrated based on your order. The calibration factors of VIPER are stored in the sensor, i.e. all output values are calibrated values.



The following parameters are predefined at the factory:

Calibration set	Parameter	Unit	Factor
VIPER cal true color	True Colour410	mg/L Pt	18.52
	SAC436	1/m	-
	SAC525	1/m	-
	SAC620	1/m	-
VIPER cal Hazen	Pt-Co-Colour390	mg/L Pt	7.4
	Pt-Co-Colour455	mg/L Pt	36.4
VIPER cal Russisch Grad	Cr-Co-Colour380	°(degree of colour)	9.7
	Cr-Co-Colour413	°(degree of colour)	34.1

5.2 Water Base

The recording of a new water base, e.g. when using cuvettes, requires authentication and is reserved to TriOS Mess- und Datentechnik GmbH authorized and qualified professionals. Please contact TriOS Mess- und Datentechnik GmbH technical support for further information.

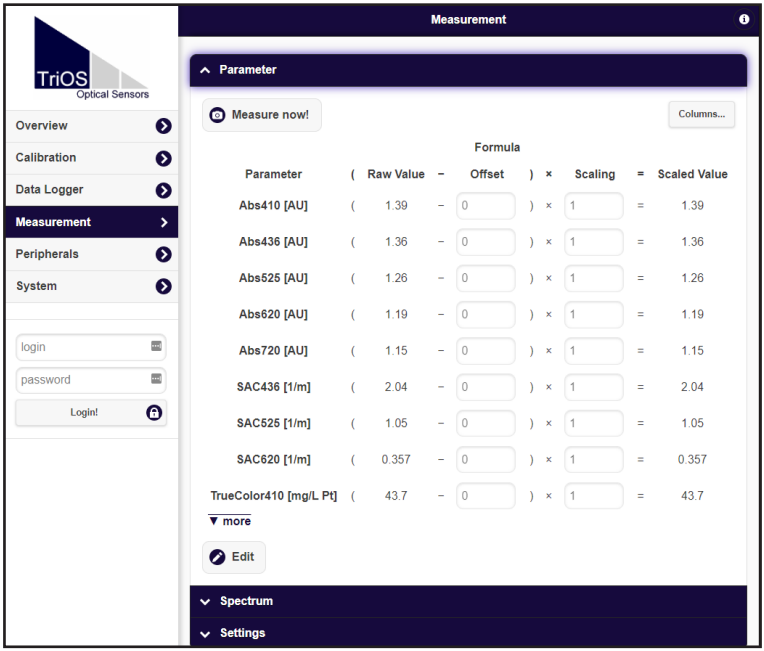
1. If the login was successful, VIPER can be calibrated. That means a new water base (zero line) can be recorded.
2. Before calibration, the actual water base should be downloaded and saved as a „Recovery Point“.
3. The path length of the sensor to be calibrated is entered into the field “Path Length [mm]”.

Important: Once the path length is entered, the new settings must be saved to be accepted for the following measurements with “Save”. Please also observe the notes from chapter 6.1.3.

4. A new calibration is performed with “Calibrate” after the prompt is confirmed. The sensor should already be immersed in ultrapure water for this purpose.

5.3 Customer Calibration

The sensor can be adapted to laboratory analyses and local conditions with calibration factors. This adapted scaling is set using the “Custom calibration” function of the controller or directly in the browser for the sensor (“Measurement” → “Parameter” → “Edit” → insert “Offset” and / or “Scaling” → “Save”). The customer calibration or local calibration supplements the manufacturer calibration. The manufacturer calibration values are not changed by the customer calibration.



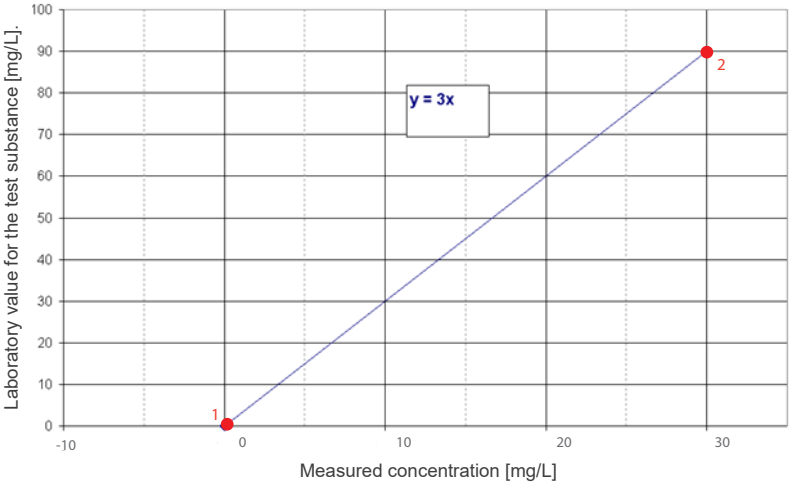
The formula used to calculate the scaled measured value with scaling factor and offset is shown in the top row.

(Raw Value – Offset) x Scaling = Scaled Value
(Measured value – Axis Offset) x Scaling factor = Scaled measured value

Customer calibration serves as a fine adjustment of the sensor to special media and supplements the manufacturer calibration.

The local calibration is adjusted using a linear equation. Normally, only the scaling factor is needed to adjust the local calibration.
For local calibration, at least one data point consisting of a laboratory value and a sensor value is required.

1. Offset = 0 is given
2. Make a diagram like the one shown below and connect the two data points with a straight line. The slope of the straight line is the scaling factor.



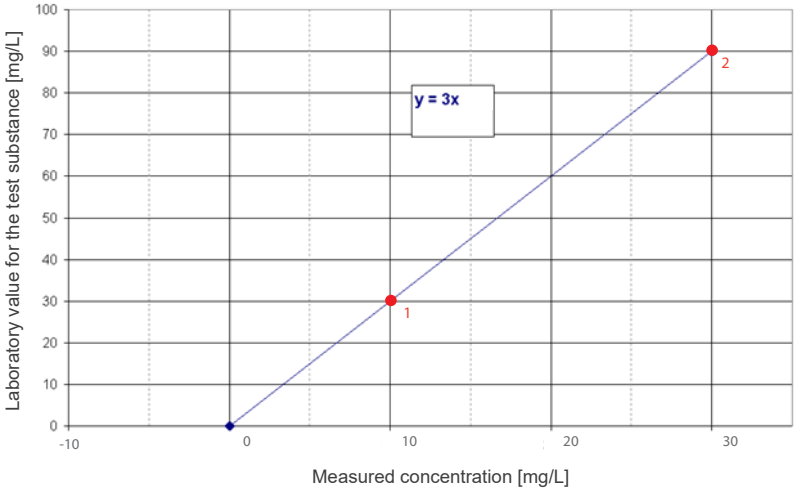
3. The scaling factor can be calculated using the following equation:

   Scaling factor = Laboratory value / Measured value

   For the previous example in the figure, this means:

   Scaling factor = 90 mg/L / 30 mg/L = 3

4. If there are several laboratory values available, all of the laboratory values should be entered in the graph. Offset = 0 should still be given. As shown in the diagram, the slope of the line is equal to the scaling factor.



TriOS controllers can be used to set scaling factors and offset values for the measurement parameters of the sensor. Please refer to the corresponding manual. Make sure not to double scale with the sensor: once in the G2 sensor menu directly and once more with the TriOS controller!

Customer calibration can be used as a fine adjustment of the sensor for special media and is not intended to replace the manufacturer calibration.

NOTICE **Measuring ranges and detection limits of the scaled parameters depend on the scaling factor!**

5.4 Measurement Properties

Ideally, the optical path of VIPER is chosen so that the absorption at the different wavelengths is between 0.01–2.5 AU.

Abs 360 – 720 [AU]	0.01…2,5	2.5…3	≥3

Absorption in 1/m is dependent on the optical path. Ideally, the range is between:

50 mm path	0.2…50
100 mm path	0.1…25
150 mm path	0.06…17
250 mm path	0.04…10

NOTICE **The transmission at 720 nm may not fall below 33 %, otherwise the content of suspended solids in the medium is too high and the measuring range for the parameters could be exceeded. 33 % transmission corresponds to an absorbance value of 0.5 AU.**

6 Malfunction and Maintenance

To ensure an error-free and reliable measurement, the device should be periodically inspected and maintained. For this, the sensor must be cleaned first.

6.1 Cleaning and Upkeep

Deposits (fouling) and dirt depend on the medium and the duration of exposure to the medium. Therefore, the degree of contamination depends on how the sensor is used. For this reason, it is not possible to give a general answer regarding how often the sensor should be cleaned.

Normally, the system is kept clean by the nano-coated window and also by the air cleaning system. If the contamination is too severe, the following instructions should be followed.

6.1.1 Cleaning the housing

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

To loosen dirt, we recommend soaking the sensor for several hours in a rinsing solution. During cleaning, do not let the exposed connectors come in contact with water. To prevent contact with water, make sure that the locking cap of the connector is properly locked. Please learn about the risks and the safe handling of the cleaning solution used.

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

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

Brownish dirt or spots can be contamination due to iron manganese oxides. For this type of contamination, 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 briefly come in contact with the acid, and then it should be thoroughly rinsed.

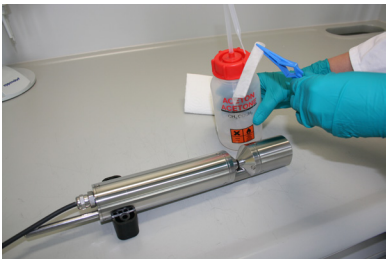
NOTICE	**Under no circumstances should the sensor be cleaned with hydrochloric acid. Even very low concentrations of hydrochloric acid can damage stainless steel components. In addition, TriOS Mess- und Datentechnik GmbH warns against the use of strong acids, even if the sensor should have a titanium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

6.1.2 Cleaning the Measuring Window

You can clean the window 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 facilitate the cleaning of optical windows, TriOS Mess- und Datentechnik GmbH offers a cleaning kit with an empty vial for 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.**



6.1.3 Preparing the Sensor for the Function Test and Zero Value Determination

Clean the probe as described in chapter 6.1.1 “Cleaning the Housing”. At the end of the cleaning process, rinse the probe carefully with deionized water. Dry the sensor with a paper towel. Wipe the sensor off with a small amount of acetone on a kitchen towel to remove any greasy residues.

⚠ CAUTION **For your own protection, be sure to wear suitable gloves and safety goggles!**

Clean the sensor window with special optical paper or a soft, lint-free cloth and a few drops of acetone according to the previous instructions on cleaning the measuring window.

Important: Next, polish the window with a soft, dry cloth or special optical paper to remove the thin film that may have appeared while cleaning the window.

Have a suitable measurement container filled with ultra-pure water ready nearby. The measuring vessel should be carefully cleaned with rinsing agent solution before use and then rinsed with ultrapure water.

Immerse the sensor in the container of ultra-pure water. Make sure that the measuring windows are completely covered by water. Wait 10 to 15 minutes. During this time, hidden dirt can come loose from the sensor.

Remove the probe from the water and rinse it with ultra-pure water. Empty and then refill the container with fresh ultra-pure water and immerse the sensor again. Lift the probe and move it around in the water to remove any air bubbles. Complete the function test or the calibration of the sensor.

The sensors should be positioned diagonally in the measurement container if possible, to prevent very small, almost invisible air bubbles from collecting at the top of the measuring window. When using an upright measuring cylinder, which requires the sensor to be positioned vertically, make sure to check for air bubbles in the optical path.

Please check the stability of the container, when the sensor is immersed!

6.2 Maintenance and Inspection

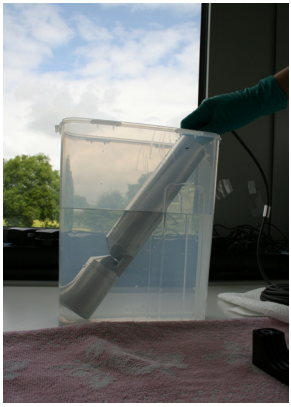
NOTICE	**Avoid any contact with the glass parts in the optical path, as they can become scratched or dirty. This means that the functionality of the device is no longer guaranteed.**

6.2.1 Checking the Zero Value

Prepare the sensor for the zero-value check as described in the previous chapter.

We recommend using the TriOS VALtub to check and determine the zero value, as this seals the optical path optimally and enables a fast zero-value measurement. Make sure that the O-rings of the VALtub are positioned exactly over the seals of the sensor.

Alternatively, another container suitable for immersion can be used. When taking a measurement, the optical path must always be completely immersed in the water.



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

Before the zero-value check, the sensor is prepared as described in the previous chapter. Rinse the cleaned sensor carefully with ultra-pure water and immerse it in a container of ultra-pure water. The optical path must be completely in the water. Look for air bubbles!

Do the zero-value determination at an ambient temperature of 20°C, if possible. The temperature of the ultra-pure water should also be 20°C.

General Information:

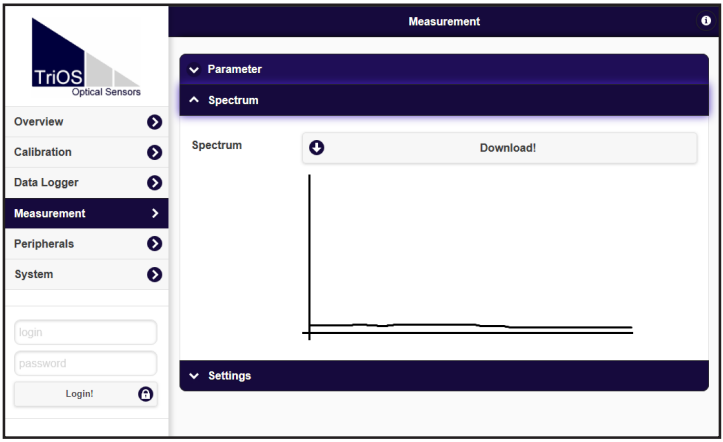
- Do not touch the part of the sensor which has been submerged in the ultra-pure water with your hands during the sensor check unless you are wearing gloves.
- Be sure to use highly pure water (ultra pure, resistance of 18.2 MΩcm) or distilled water.
- If impurities in the water show up during the check, the process must be started again!
- Make sure there are no air bubbles in front of the measuring windows. Even very small air bubbles in front of the measuring windows can cause a transmission of 97% or less.

We recommend doing at least five individual measurements in “Measurement” prior to the check to bring the sensor up to operating temperature.

Limit values to decide whether a new zero line must be drawn:

- 0.1 AU for 720nm
- 0.2 AU for other absorptions in nm

Below these values, you do not need to draw a new zero line, unless there are structures that are clearly interfering with the measurement.



6.3 Troubleshooting

6.3.1 Uploading recovery Point

The “Upload” function on the “System” page allows a previously downloaded calibration to be restored or a calibration file created by TriOS Mess- und Datentechnik GmbH service to be installed on the sensor.

Enter the storage path for the appropriate calibration file in the “File” field or select it by clicking on the “Browse...” button. Next, click on the “Upload” button to begin the transfer. When the process has been successfully completed, a green “Success” box will be displayed. If the process is not successful, a red box will be displayed with an error message.

The following error messages and warnings are possible:

- **„File not OK“**: The calibration file could not be read correctly. Check the path and select the correct file. If the error persists, contact TriOS Mess- und Datentechnik GmbH technical support.
- **„Device type or serial number does not match“**: The calibration file is not suitable for the currently connected sensor.

6.3.2 Firmware Update

For a firmware upgrade, an authentication is needed. This authentication will be provided after successfully attending a TriOS training.

6.4 Return

Please be sure to follow the procedure for your return. In case of a return of the sensor, please contact the technical support first. In order to ensure a smooth process of the return and to avoid misdeliveries, each return must first be reported to the technical support. You will then receive a numbered RMA form, which you must fill out completely and return to us. Please write the number clearly visible from the outside on the return package. Only in this way can your return be correctly assigned and accepted.

Returns without RMA number can not be accepted and processed!

Please note that the sensor must be cleaned and disinfected before shipping. In order to send the goods undamaged, it is best to use the original packaging. If this is not available, ensure that safe transport is guaranteed and that the sensors are secured by sufficient packing material.

7 Technical Data

7.1 Technical Specifications

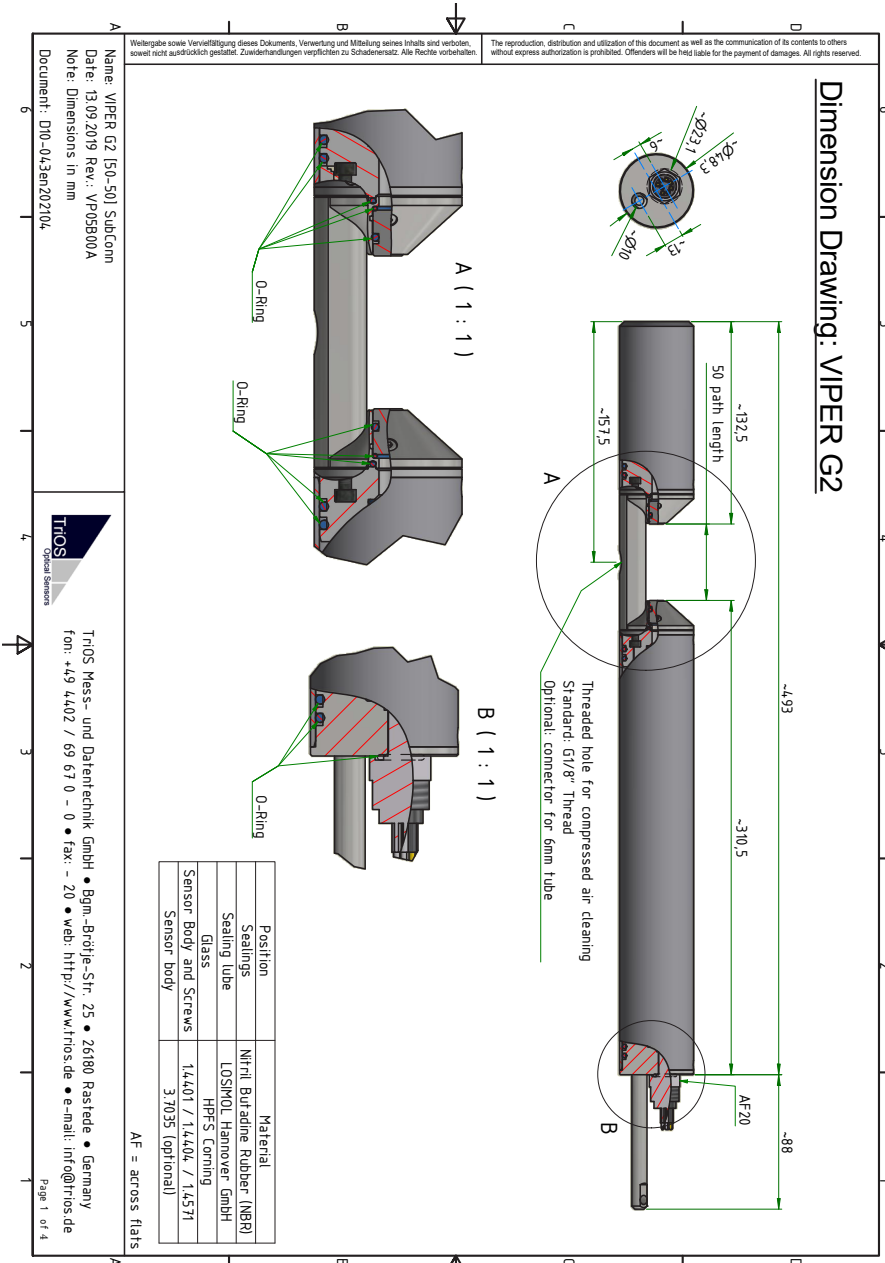
Measurement technology	light source	5 LED	
	detector	High-end miniature spectrometer, 256 channels	
		360 to 750 nm, 2.2 nm/pixel	
Measurement principle		Attenuation	
Optical path		10 mm, 50 mm, 100 mm, 150 mm, 250 mm	
Parameter		SAC_{436}	
		Pt-Co color scale (APHA/Hazen) (390 nm, 455 nm)	
		Colouring based on DIN EN ISO 7887-C (410 nm, 436 nm, 525 nm, 620 nm)	
		Cr-Co color scale (380 nm, 413 nm)	
Measuring range		0.01...2.5 AU (absorption units)	
Measurement accuracy		< 0.2 %	
Turbidity compensation		Yes	
Data logger		~ 2 GB	
T100 response time		2 min	
Measurement interval		≥ 1 min	
Housing material		Stainless steel (1.4571/1.4404) or titanium (3.7035)	
Dimensions (L x Ø)		495 mm x 48 mm (with 50 mm path)	~ 19.5˝ x 1.9˝ (with 50 mm path)
Weight	stainless steel	~ 2.4 kg (with 50 mm path)	~ 5.3 lbs (with 50 mm path)
	titanium	~ 1.3 kg (with 50 mm path)	~ 2.9 lbs (with 50 mm path)
Interface	digital	Ethernet (TCP/IP)	
		RS-232 or RS-485 (Modbus RTU)	
Power consumption		≤ 3 W	
Power supply		12...24 VDC (± 10 %)	
Maintenance effort		≤ 0.5 h/month (typical)	
Calibration/maintenance interval		24 months	
System compatibility		Modbus RTU	
Warranty		1 year (EU: 2 years)	US: 2 years

INSTALLATION

Max. pressure	with SubConn	30 bar	~ 435 psig
	with fixed cable	3 bar	~ 43.5 psig
	in FlowCell	1 bar, 2...4 L/min	~ 14.5 psig, 0.5 to 1.0 gpm
Protection type		IP68	NEMA 6P

Sample temperature	+2...+40 °C	~ +36 °F to +104 °F
Ambient temperature	+2...+40 °C	~ +36 °F to +104 °F
Storage temperature	-20...+80 °C	~ -4 °F to +176 °F
Inflow velocity	0.1...10 m/s	~ 0.33 fps to 33 fps

7.2 External Dimensions



8 Accessories

8.1 Controller

8.1.1 TriBox3

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

TriBox3 is a measurement and control system for all TriOS sensors. The device offers 4 sensor channels with selectable RS232 or RS485 function. Besides Modbus-RTU several other protocols are available. A built-in valve allows the use of a compressed air cleaning system for the sensors. In addition, the TriBox3 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, waste water treatment plants and many other fields.

8.1.2 TriBox mini

Digital 2-channel controller

Mini controller with two digital sensor inputs and two 4...20mA outputs. All stored measured values and diagnostic data can be read out via an integrated web browser.

8.2 Compressed air fittings for 100 – 250 mm paths

The compressed air cleaning for long paths has two compressed air flushing heads to be able to clean both measuring windows simultaneously. Hoses in different lengths are available to equip various path lengths with a compressed air cleaning system.

8.3 VALtub

The VALtub is used to check and recalculate the zero values. Due to the adapted shape, only small amounts of water are needed here to make a measurement.

9 Warranty

The warranty period of our devices is 2 years from the date of invoice within the EU and the United States. Outside it is 1 year. Excluded from the warranty are all normal consumables, such as light sources.

The warranty is subject to the following conditions:

- The device and all accessories must be installed as described in the corresponding manual and operated according to the specifications.
- Damage due to contact with aggressive and material-damaging substances, liquids or gases, as well as transport damage, is 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 sensor will void the warranty!**

10 Customer Service

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

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

Contact technical support:

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

To enable fast assistance, please send us the sensor ID number (4 last digits of the serial number, consisting of letters and digits, e.g. 28B2) by e-mail.

11 Contact

We are constantly working to improve our equipment. Please visit our website for news.

If you have found a bug in any of our devices or programs, or would like additional features, please contact us:

Technical Support: support@trios.de

General questions/sales: sales@trios.de

Website: www.trios.de

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26180 Rastede

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12 Keyword Index

13 FAQ - Frequently Asked Questions

For more FAQs, please visit our website: www.trios.de.

1. Why do I need the G2 InterfaceBox?

   VIPER is an independent measuring instrument, which can be operated without additional hardware.

   VIPER setting can be changed 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.

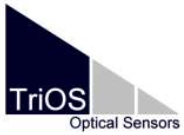
2. Why must the optical window be carefully cleaned?

   The optical window must always be treated with extreme caution. A scratched or damaged optical window can significantly affect the measurement. This leads to false measurements results as the light is lost due to the damage.

   For more information, please refer to chapter 3.2.3 of this manual.

Annex

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 Designation	**VIPER**
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 61326-1:2013 EN 61010-1:2010 +A1:2019 +A1:2019/AC:2019 EN IEC 63000:2018
Datum / Date / Date	Unterschrift / Signature / Signatur
26.10.2021	R. Heuermann

D05-043yy202110

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Modbus RTU

Software Version

This Modbus protocol refers to software version 1.0.1 and higher.

Serial Interface

Upon delivery, VIPER is configured to RS-485 with the following settings:

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

Data types

Name	Register Count	Format
Bool	1	false: 0x0000, true: 0xFF00
Uint8	1	unsigned 8 bit integer. Value range: 0x0000 - 0x00FF
Uint16	1	unsigned 16 bit integer. Value range: 0x0000 - 0xFFFF
Uint32	2	unsigned 32 bit integer. Value range: 0x00000000 - 0xFFFFFFFF
Float	2	IEEE 754 32 bit floating point value.
Char[n]	$\lceil \frac{n}{2} \rceil$	ASCII string of n characters.
Uint16[n]	n	Array of n Uint16 values.
Float[n]	n	Array of n Float values.

Functions

These Modbus function codes are supported by VIPER:

Name	Code	Description / Application
Read multiple registers	0x03	Read the serial number and firmware version, configuration and calibration data, and of course measurement data.
Write multiple registers	0x10	Write configuration data.
Write single register	0x06	Trigger a measurement process.
Report slave ID	0x11	Read serial number and firmware version.

Standard Modbus Server Address

Upon delivery, VIPER is set to address 1 (0x01).

Not all parameters from register 1000 (0x03E8) are enabled. Whether registers remain empty depends on the optional calibration set.

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

The following table describes the Modbus register mapping:

Name	R/W	Address	Data type	Description
Measurement timeout	R	1	Uint16	The Timeout in [10^{-1} s] of a running measurement process (see “Trigger measurement”).
Device serial number	R	10	Char[10]	The serial number of the sensor.
Firmware version	R	15	Char[10]	The installed firmware version.
Lamp serial number	R	20	Char[8]	The serial number of the lamp module.
Self-trigger activated	RW	102	Bool	Enables or disables the self-trigger. For external trigger: deactivate the self-trigger.
Self-trigger interval	RW	103	Uin32	The interval in [s] for self-triggered measurements. Value range: 1s – 86400s.
Path length	R	106	Uint16	The length in [mm] of the optical path. The value must match the optical path defined by the window set of the sensor. Values: 50mm, 100mm, 150mm, 250mm.
Data comment #1	RW	109	Char[64]	1st custom comment row for measured data.
Data comment #2	RW	141	Char[64]	2nd custom comment row for measured data.
Data comment #3	RW	173	Char[64]	3rd custom comment row for measured data.
Data comment #4	RW	205	Char[64]	4th custom comment row for measured data.
System date and time	RW	237	Uint32	The date and time in seconds since 1970/01/01.
Device description	RW	239	Char[64]	A custom device description. E.g. “Drain pipe south”
Abs380 absorbance / scaled absorbance	R	1000 / 1500	Float	Raw / Scaled value for absorbance at 380 nm in AU
Abs390 absorbance / scaled absorbance	R	1002 / 1502	Float	Raw / Scaled value for absorbance at 390 nm in AU
Abs410 absorbance / scaled absorbance	R	1004 / 1504	Float	Raw / Scaled value for absorbance at 410 nm in AU
Abs413 absorbance / scaled absorbance	R	1006 / 1506	Float	Raw / Scaled value for absorbance at 413 nm in AU
Abs436 absorbance / scaled absorbance	R	1008 / 1508	Float	Raw / Scaled value for absorbance at 436 nm in AU
Abs455 absorbance / scaled absorbance	R	1010 / 1510	Float	Raw / Scaled value for absorbance at 455 nm in AU
Abs525 absorbance / scaled absorbance	R	1012 / 1512	Float	Raw / Scaled value for absorbance at 525 nm in AU
Abs620 absorbance / scaled absorbance	R	1014 / 1514	Float	Raw / Scaled value for absorbance at 620 nm in AU
Abs720 absorbance / scaled absorbance	R	1016 / 1516	Float	Raw / Scaled value for absorbance at 720 nm in AU (turbidity correction)

PtCo390 concentration / scaled concentration	R	1018 / 1518	Float	Raw / Scaled concentration for PtCo at 390 nm in mg/L Pt
PtCo455 concentration / scaled concentration	R	1020 / 1520	Float	Raw / Scaled concentration for PtCo at 455 nm in mg/L Pt
CrCo380 concentration / scaled concentration	R	1022 / 1522	Float	Raw / Scaled concentration for CrCo at 380 nm in °
CrCo413 concentration / scaled concentration	R	1024 / 1524	Float	Raw / Scaled concentration for CrCo at 413 nm in °
SAC436 concentration / scaled concentration	R	1026 / 1526	Float	Raw / Scaled concentration for SAC at 436 nm in 1/m
SAC525 concentration / scaled concentration	R	1028 / 1528	Float	Raw / Scaled concentration for SAC at 525 nm in 1/m
SAC620 concentration / scaled concentration	R	1030 / 1530	Float	Raw / Scaled concentration for SAC at 620 nm in 1/m
TrueColor410 concentration / scaled concentration	R	1032 / 1532	Float	Raw / Scaled concentration for true color at 410 nm in mg/L Pt
SQI	R	1034	Float	SQI value
Spectrum type	R	2000	Uint16	The type of the last measured spectrum. Values: 0x0001: Absorption spectrum
Averaging	R	2001	Uint16	The number of samples the last measured spectrum is a mean of.
CalFactor	R	2002	Float	The normalization factor of the last measured spectrum.
Flash count	R	2004	Uint16	The number of lamp-flashes of the last measured spectrum.
Path length	R	2006	Uint16	The length in [mm] of the optical path of the last measured spectrum.
Temperature	R	2007	Float	The temperature in [°C] of the last measured spectrum. The value is taken from the spectrometer temperature.
Length	R	2009	Uint16	The count of values in the last measured spectrum. The length varies, since absorption spectra are limited to the range of [350nm ; 720nm].
Abscissa	R	2100	Float[Length]	The values of the abscissa of the graph of the last measured spectrum. In general these are the wavelengths.
Ordinate	R	2612	Float[Length]	The values of the ordinate of the graph of the last measured spectrum. In general these are the absorption values.
Waterbase path length	R	4006	Uint16	The length in [mm] of the optical path of the waterbase spectrum.

Write single register (0x06)

A special case of the “write single register” function is writing to the following register. Instead of changing configuration values, special actions are performed.

Name	Address	Description
Trigger measurement	1	A single measurement is triggered. Depending on the value written, a different type of measurement is performed: 0x0101: Absorption spectrum + Substance analysis Other values are reserved for future purpose.

Report slave ID (0x11)

The sensor name, serial number and firmware version is replied each as null-terminated ASCII string.

Beispiel:

V	I	P	E	R	0x00	A	0	5	C	0x00	1	.	0	0x00