TriOS
Optical Sensors

microFlu V2

OPERATING INSTRUCTIONS

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1 General Information

1.1 Introduction

Welcome to TriOS.

We are pleased that you have chosen our microFlu V2 dive sensor.

microFlu V2 fluorometers are online instruments for the determination of dyes and pigments, such as in cyanobacteria, chlorophyll a, tryptophan or cdom (coloured dissolved organic matter) by measuring fluorescence emission. The parameters emit light at a certain wavelength when excited by a defined external light source.

In this manual you will find all the information about microFlu V2 that you need for commissioning. Technical specifications as well as detection limits and the dimensions can be found in chapter 7.

Please note that the user is responsible to comply 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. All sensors and accessories supplied by TriOS Mess- und Datentechnik GmbH must be installed and operated in accordance with the specifications provided by TriOS Mess- und Datentechnik GmbH. All parts were designed and tested in accordance with international standards on electronic instruments. The device meets the requirements of the international standards on electromagnetic compatibility. Please use only original TriOS accessories and cables for a smooth and professional use of the devices.

Read this manual thoroughly before using the device and retain 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. 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.

NOTICE	**In case of inconsistence, the German original version shall prevail.**

Software updates

This manual refers to software version 1.0.11 Updates include bug fixes and new features and options. Devices with older software versions may not have all functions described here.

Copyright notice

1.2 Health and safety information

This manual contains important information on health and safety rules. This information is labelled according to the international specifications of ANSI Z5356 ("Product safety information in product manuals, instructions and other collateral materials") and must be strictly followed. 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. The radiation emitted (UV light) can cause serious damage to the 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 biologically dangerous. Therefore, you should always wear gloves when working with such materials. Please observe the currently valid biological material ordinance!

Waste

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

1.3 Warnings

- This sensor has been developed for use in industry and science. It should only be used for the measurement of aqueous solutions, e.g. process waste water, river water or seawater.

NOTICE	**Stainless steel sensors are not intended for use in sea water or in high chloride concentrations (corrosion). Only sensors made of titanium can be used in these cases.**

- Sensors made from stainless steel must be cleaned immediately after contact with salt water or other substances that cause corrosion (e.g.acids, alkalis, chlorine-based connections).
- The material resistance should be tested for each application.
- The sensor has seals made of NBR (acrylonitrile butadiene rubber). 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 cable. Make sure that there are no heavy objects on the cable and that the cable does not buckle. Make sure that the cable is not run near hot surfaces.
- If the sensor cable is damaged, it must be replaced with an original part by TriOS Mess- und Datentechnik GmbH or an authorized TriOS technician.
- Do not place any unsuitable objects in front of the measuring window 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. if it is hot to the touch). Switch off the sensor immediately and disconnect the cable 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 carried out by the equipment dealer or by specialists authorised and qualified by TriOS.
- Devices from TriOS Mess- und Datentechnik GmbH meet the highest safety standards. Repairs to the device (which involve the replacement of the connecting cable) must be carried out by TriOS Mess- und Datentechnik GmbH or by a workshop authorized by TriOS. Defective, improper repairs can lead to accidents and injuries.

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

1.4 User and operating requirements

The fluorometer microFlu V2 was developed for use in industry and science. The target group for the operation of the fluorometer microFlu V2 is technically experienced personnel in plants, wastewater treatment plants, waterworks and institutes. The use of this device often requires the handling of hazardous substances. We assume that operators are familiar with dealing with hazardous substances due to their professional training and experience. In particular, operators must be able to understand and apply the safety signs and safety instructions on the packaging and the package inserts of the test sets.

1.5 Intended use

The intended use of the microFlu V2 is exclusively to perform fluorescence measurements as described in this manual. For this purpose, the fluorometer is an immersion sensor, which is used underwater or with flow cells. Please note the technical data of the accessory parts. Any other use is not considered to be in compliance with the intended use.

The sensor may only be used to measure the fluorescence of aqueous fluids, such as process wastewater, municipal wastewater, and the surface/groundwater. The use of other media can damage the sensor. For the use of the microFlu V2 in media other than those specified here, please contact the technical support of TriOS Mess- und Datentechnik GmbH (support@trios.de).

NOTICE	**Avoid touching the measuring window, since it can become scratched or dirty. This means the functionality of the device can no longer be guaranteed.**

According to current scientific knowledge, the device is safe to use when it is handled according to the instructions in this user manual.

1.6 Proper disposal

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 addressbelow). The preceding professional decontamination must be proven with a certificate. Please contact us for more details before you send the device back.

Shipping address:

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

1.7 Certificates and approvals

This product meets all 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

microFlu V2 fluorometers are low-cost, submersible miniature fluorometers for highly accurate and selective measurement of cdom (colored dissolved organic matter), chlorophyll a and phycocyanin in cyanobacteria. Long-term stability of measurements is ensured by the combination of low power consumption and innovative coating of the optical window, as an energy efficient and environmentally friendly antifouling solution.

The devices can be used in diverse applications for the monitoring of sea and river waters, as well as in drinking and wastewater treatment systems. Internal reference signals of the high performance LEDs used for fluorescence excitation compensate ageing effects and temperature influences.

2.1 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:

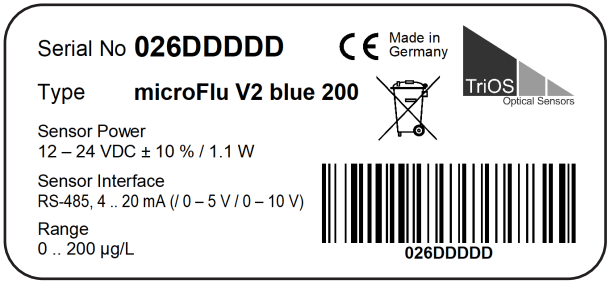
Serial number

Product type

Power supply

Electric

Measuring range



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 illustration purposes only and may deviate depending on the version of the product.

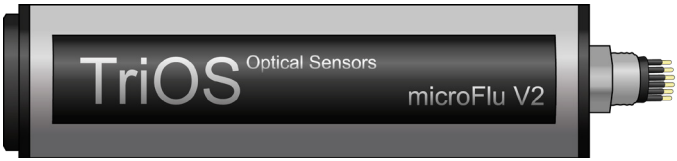
2.2 Purchased parts package

The delivery contains the following components:

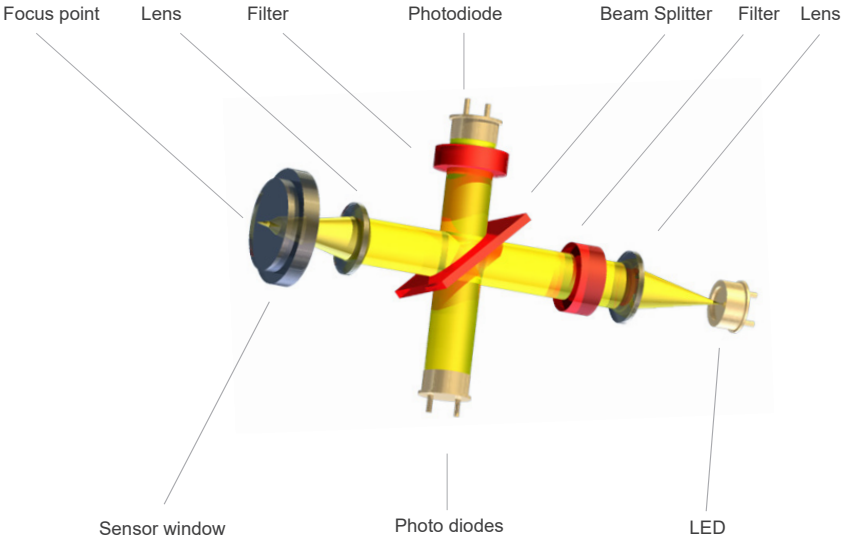
1. Sensor
2. Operating instructions
3. Accessories (if applicable)

Keep the original packaging of thedevice in case it needs to be returned for maintenance or repairs.

2.3 Measurement principle and design



For optimal use of the sensor, you must know and understand the idea and theory that the sensor is based on. The following is an overview of the measurement principle, the optical arrangement and the subsequent calculation.



Essentially, the microFlu V2 consists of four parts: a defined light source, a lens system, the optical path, and a detector with equal-light suppression. The arrangement of these parts is represented schematically in the above illustration.

The light source consists of an LED with a defined wavelength depending on the version or parameter.

The excitation light beam is parallelized and a small part is reflected by a beam splitter (short pass) onto a reference diode to compensate fluctuations in the light source. A large part of the light is focused with a lens about 10 mm in front of the optical window. Fluorescent light is collected with the same lens and is reflected again by the beam splitter due to the higher wavelength. An interference filter in front of the photodiode for measuring fluorescence intensity prevents extraneous and scattered light from penetrating.

A special electronic circuit is used to eliminate ambient light.

2.3.1 Fluorescence

Fluorescence is the spontaneous emission of light directly after a material has been excited. The emitted light is generally lower in energy (larger wavelength) than the previously absorbed light (shorter wavelength).

Photons are absorbed and electrons of the molecule are lifted into an energetically higher orbital, i.e. excited. If they fall back to their original level, the released energy produces heat and photons (fluorescent light).

Double-bond electrons are excited more easily, because the p-electrons of the double bond are distributed over both atoms and are therefore not so strongly bound. Molecules with a conjugated double bond are particularly suitable for fluorescence; the electrons are distributed over several atoms and are therefore very easy to excite.

2.3.2 Parameter

microFlu V2 uses different LEDs depending on the parameter for long-term stable measurements of fluorescence values. The following parameters (see table) can be measured or derived with microFlu V2.

Parameter	Excitation wavelength	Detection wavelength
chl	470	685
blue	620	655
cdom	375	460
rho	470	590
fluo	470	590
TRP	275	360
BT	255	305

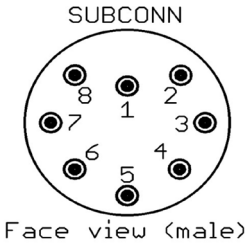
3 Commissioning

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

Before the sensor is put into operation, it is important to ensure that it is securely attached and all connections are connected correctly.

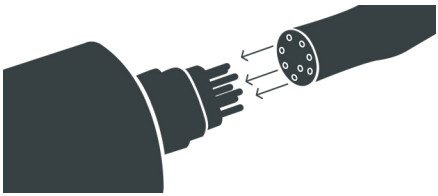
3.1 Electrical installation

3.1.1 SubConn 8-pin connector

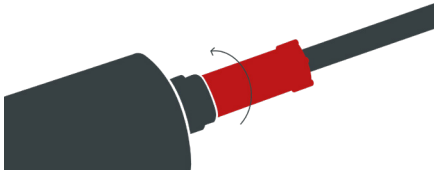


1. Ground
2. RS-485 A
3. RS-485 B
4. Supply voltage +12-24 VDC
5. Voltage output +5 V (optionally +10 V)
6. Current output 4-20 mA
7. Analog ground
8. Not connected

Connect the male end of the connecting cable into the connector by making the pins align with the slots of the cable.

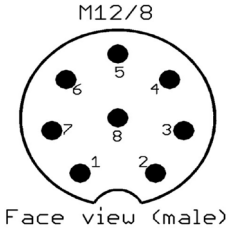


The next step is to hand-tighten the locking sleeve to secure the end of the connector into the bulkhead connection.



NOTICE **Do not twist or bend the connector when plugging or unplugging it. Insert the connector straight in and use the locking sleeve to attach the male contact pin.**

3.1.2. Fixed cable with M12 industrial plug



1. RS-485 A
2. RS-485 B
3. Voltage output +5 V (optionally +10 V)
4. Analog ground
5. Current output 4-20 mA
6. Not connected
7. Ground
8. Supply voltage +12-24 VDC

NOTICE **Ensure correct polarity of the operating voltage, because otherwise the sensor may be damaged.**

3.2 Interfaces

3.2.1 Serial interface

The microFlu V2 provides a line for digital serial communication with a control unit. It is equipped with a configurable digital serial interface as RS-485 (also EIA 485). The interface cannot be switched and is already defined when delivered.

With RS-485, voltages from -5 V to +5 V to ground are possible.

In delivery state microFlu V2 is configured with RS-485 with the following settings:

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

Detailed description of the Modbus protocol commands can be found in the annex.

RS-485 uses a differential signal with the sign-negative potential of the A line is put on the B line. The differential value between lines A and B is the decisive factor for the transmission robustness against conducted noise signals.

3.2.2 Analogue interface

The microFlu has two analog interfaces. The voltage output (0...5 V / 0...10 V) and the current output (4...20 mA) behave linear to the measuring range. Between the outputs can be selected, so that only one option is available at any time.

To convert the values of the mA analog output accordingly, the following formula must be used:

$$Parameter[\mu g/\,L] = \frac{analog\ value\ [mA] - 4\ [mA]}{16\ [mA]} \cdot upper\ limit\ of\ the\ measured\ value$$

To calculate the values of the 0...5 V output, the following formula must be used.

$$Parameter[\mu g/\,L] = \frac{analog\ value}{5} \cdot upper\ limit\ of\ the\ measured\ value$$

4 Use

microFlu V2 can be operated with all TriOS controllers. For instructions on correct installation, refer to the controller manual.

4.1 Normal operation

4.1.1 Immersion operation

For immersion operation, the microFlu V2 can be completely or partially immersed in the water / measurement medium. To make a correct measurement, the measuring window must be completely immersed and free of air bubbles. microFlu V2 can also be fixed with suitable hydraulic clamps. Make sure to use suitable clamps with an inner diameter of 48 mm. To protect the housing pipe against excess punctual pressure, install the brackets close to the device covers. Fitting brackets can be obtained from TriOS.

When immersing the sensor, make sure there are no air bubbles in front of the sensor discs. If there are air bubbles in front of the window, shake the sensor carefully until the bubbles have been removed.

4.1.2 Float

It is also possible to use the microFlu V2 in a float, which is particularly useful for fluctuating water levels.

4.1.3 FlowCell / Bypass

With the optional flow cell, the microFlu V2 can be installed as a bypass. Together with the flow cell, a panel is available on which the microFlu V2 and the flow cell can be easily mounted.

Follow the instructions below to install the microFlu V2 in the flow cell:

1. Preparation of the flow cell:
   - Mount the flow cell to the panel using the mounting kit
   - Fitting the fittings to the flow cell
   - Mount drain
2. Remove the pressure ring from the FlowCell. It can easily be loosened by hand. Make sure that the 36x2.5 NBR O-ring is not lost. Then plug this onto the front of the microFlu V2.
3. Now bring the pressure ring from the cable/connector side onto the microFlu V2.
4. Insert the microFlu V2 into the flow cell, making sure that the O-ring does not slip into the FlowCell.
5. Tighten the screw connection (without tools).
6. Start the flow.

NOTICE	**Tubes with a diameter of 8 mm (6 mm inner diameter) are required.**

4.1.4 Cleaning system

microFlu V2 is equipped with an innovative antifouling technology to avoid dirt and deposits on the optical window: nano-coated windows combined with compressed air cleaning.

Nano coating

All TriOS optical windows are treated with a nano-coating.

Window with nano-coating Window without nano-coating

Wetting of the surface on the coated glass is significantly lower. The nanocoating greatly helps reduce the contamination of the optical windows. In combination with the compressed-air cleaning, the windows are kept clean for long periods of time and thus reduce the amount of cleaning necessary.

5 Calibration

5.1 Manufacturer calibration

All TriOS sensors are delivered calibrated. The calibration factors of the microFlu V2 are stored in the sensor,meaning all output values are calibrated values.

The conversion from the original measurement parameter to the scaled measurement parameter is carried out by means of the following equations.

The offset and scaling factor are stored in a sensor for the measurement parameter.

The manufacturer calibration of the sensor is carried out as follows:

- The offset is determined by measuring in ultra-pure water (free of humic and fulvic acid, 18.2 MΩcm water)

$$A = raw - offset$$

- The scaling factor for each measuring range is determined by using the respective calibration standard.

$$B = A \cdot lin$$

with

A	offset corrected value
Raw	raw data
Offset	offset value
B	concentration of the substance in physical units
lin	scaling factor

The manufacturer calibration should not be changed!

5.2 Customer calibration

The sensor can be adapted to laboratory analyses and local conditions with other calibration factors. This is set with the scaling function of the controllers. The customer calibration or local calibration works in addition to the manufacturer calibration, whose values are not changed by the customer calibration.

The customer calibration can be used as a fine adjustment of the sensor for special media and supplements the manufacturer calibration.

Before recording measurement values, check the zero value of the sensor with their reference solutions. If necessary, determine a new zero value (see chapters 6.2.1 and 6.3.1).

Local calibration is adjusted by means of a linear equation. Two constants will be needed for this, the scaling factor and the offset, which can be used according to the following equation:

$$A = parameter - offset$$

$$B = A \cdot Scaling$$

With *A* as the parameter output that is output by microFlu V2.

A offset corrected value

Offset offset value

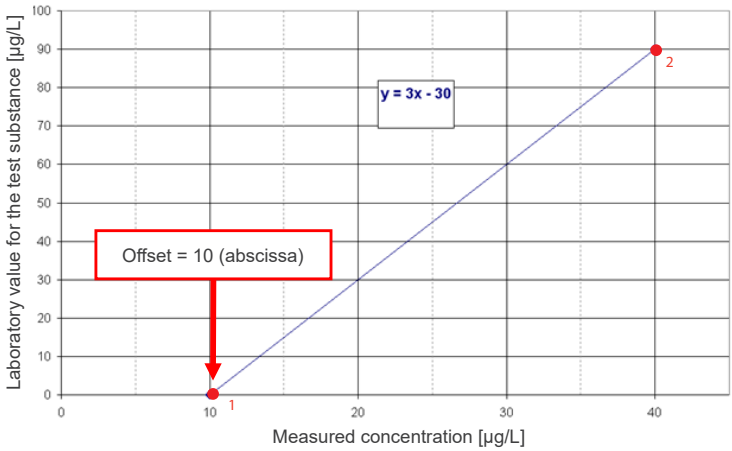
B customer calibrated parameters

For local calibration, at least two data points, i.e. a laboratory value and a sensor value, are required. The easiest way to do this is to use a non-contaminated sample and a contaminated sample.

1. The non-contaminated sample is used to determine the offset. To do this, immerse the fluorometer in the non-contaminated liquid. In this particular case, the signal directly specifies the value of the offset for the local calibration.

   $$offset = measuredvalue1$$

   If a non-contaminated sample is not available, the equation listed in 5. above provides another option.
2. Now immerse the sensor in the contaminated medium and note the reading2 that the fluorometer outputs and make a laboratory analysis of the sample.
3. Create a graph as shown below and connect the two data points with a straight line. The slope of the straight line is the scaling factor.



4. The scaling factor can be calculated using the following equation

$$scaling\ factor = \frac{lab}{measuredvalue2 - offset}$$

With *lab* standing for the laboratory values and *measuredvalue* for the values output by the sensor.

For the previous example in the figure, this means:

$$scaling\ factor = \frac{90\ \text{mg/L}}{(40 - 10)\ \text{mg/L}} = 3$$

5. If no non-contaminated sample is available, at least two samples with as different contamination as possible are required. In this case, you will first calculate the scaling factor

$$scaling\ factor = \frac{(lab2 - lab1)}{(measuredvalue2 - measuredvalue1)}$$

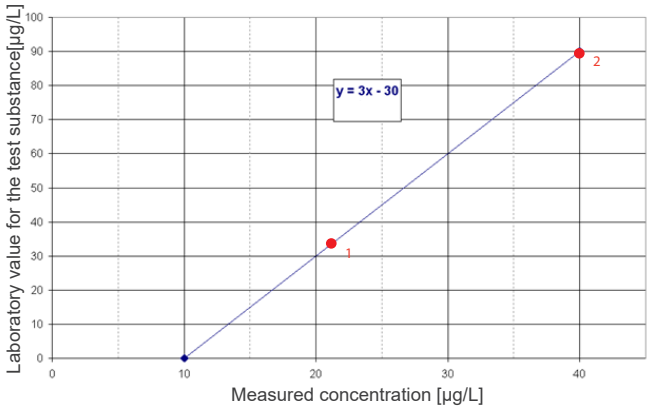
Calculation of the offset without zero-point measurement (1.):

$$offset = measuredvalue2 - \frac{lab2}{Scaling\ factor}$$

measuredvalue2 should be significantly larger than *measuredvalue1*. The offset is also given by the abscissa of the straight line (X-axis intersection). For the above example, this means:

$$scaling\ factor = \frac{90 - 30}{40 - 20} = 3$$

$$offset = 40 - \frac{90}{3} = 40 - 30 = 10$$



All TriOS controllers have the ability to set scaling factors and offset values for the measurement parameters. Please refer to the appropriate manual.

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	**Measurement ranges and detection limits of the scaled parameters are dependent on the scaling factor!**

6 Malfunction and maintenance

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

6.1 Cleaning and upkeep

Deposits (vegetation) and dirt depend on the medium and the duration of exposure of the medium. Therefore, the degree of pollution depends on the use. For this reason, it is not possible to give a general answer to 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 bad, the following instructions should be followed.

6.1.1 Cleaning the enclosure

⚠ CAUTION	**Please use protective goggles and gloves when cleaning the sensor, especially when using acids, etc.**

To loosen solid dirt, we recommend soaking the sensor in a rinsing solution for a few hours. During any cleaning, exposed connectors should be avoided so that these do not come in contact with water. To ensure this, make sure that the locking cap of the connector is properly locked. Please inform yourself thoroughly about the risks and safety 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. 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 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 components made of stainless steel. In addition, TriOS Mess- und Datentechnik GmbH cautions against using 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!

TriOS Mess- und Datentechnik GmbH offers a cleaning set with a bottle of acetone and special optical cleaning paper to simplify cleaning the optical window.

NOTICE	**Do not use any aggressive cleaning solutions, putty, sandpaper or cleaning solutions that contain abrasive substances to remove caked-on dirt.**

6.2 Return

Please observe the following procedure for your returns.

If returning a sensor, please contact customer service first. To ensure a smooth return and to avoid incorrect deliveries, each return package must first be reported to the customer service. You will then receive an RMA form, which you need to fill out completely, check and send back to us. Customer service will check your form and then give you an RMA number. Please attach the document with the number so it is clearly visible on the outside of the return package or write it in large numbers on the packaging. This is the only way your return package can be correctly allocated and accepted.

Caution! Return shipments without an RMA number can not be accepted and processed!

Please make sure that the sensor is cleaned and disinfected before shipping. In order to ship the goods undamaged, use the original packaging. If this is not on hand, make sure that safe transport is guaranteed and the sensor is safely packed using enough packing material.

7 Technical data

7.1 Technical specifications

Measurement technology	Light source	LED + filter	
	Detector	Photo diode + filter	
Measurement principle		Fluorescence	
Parameter		Chlorophyll a [µg/L] Phycocyanin [µg/L] CDOM [µg/L] Tryptophan [µg/L]	
Measuring range		See parameter list 7.2	
Detection limit		See parameter list 7.2	
Measurement accuracy		+/- (5 % + detection limit) Variation BT: ± (10 % + Detection limit)	
Turbidity compensation		No	
Data logger		No	
Response time T90		6 s (default)	
Smallest measuring interval		3 s (default)	
Interface	digital	RS-485, Modbus RTU	
	analogue	4–20 mA (default), max. load 500 Ohm	
		0–5 V, min. load 1 kOhm	
		0–10 V, min. load 1 kOhm	
Power consumption	typical	max. 0.6 W	
	with activated analog interface	max. 1.1 W	
	Power down	max. 70 mW	
Power supply		12–24 VDC (± 10 %)	
Required supervision		Typically ≤0.5 h/month	
Calibration/maintenance interval		24 months	
Warranty		1 year (EU & USA 2 years)	
Housing material		Stainless steel (1.4571/1.4404) or titanium (3.7035)	
Dimensions (L x Ø)		~ 162 mm x 48 mm	~ 6.4” x 1.9”

Weight	VA	~ 650 g	~ 1.4 lbs
	TI	~ 510 g	~ 1.1 lbs
Max. pressure	With SubConn	30 bar	~ 435 psig
	with fixed cable	3 bar	~ 43.5 psig
	in flow unit	1 bar, 2...4 L/min	~ 14.5 psig at 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 to 33 fps

7.2 Measuring ranges and detection limits*

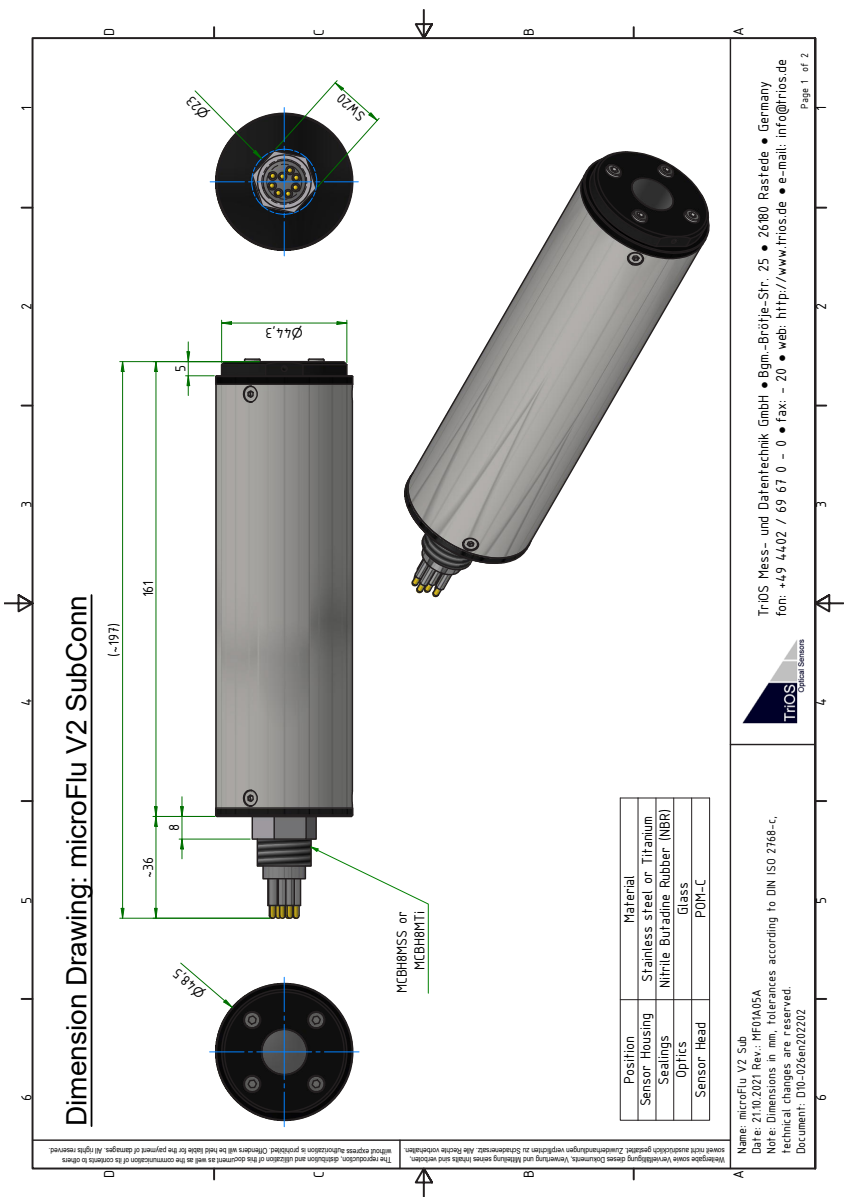
The following table provides an overview of the measurement ranges of various parameters and their limits of detection:

Sensor version	Parameter	Ex / Em	Measuring range	Detection limit
chl	Chlorophyll a	470 nm / 685 nm	0---200 µg/L	0.05 µg/L
blue	Cyanobacteria	620 nm / 655 nm	0...200 µg/L	0.5 µg/L
cdom	CDOM (colored dissolved organic mater)	375 nm / 460 nm	0...500 µg/L	0.25 µg/L
rho	Rhodamine	470 nm / 590 nm	0...200 µg/L	0,2 µg/L
fluo	Fluoresceine	470 nm / 590 nm	0...200 µg/L	0,05 µg/L
TRP	Tryptophan	275 nm / 360 nm	0...500 µg/L	3 µg/L
BT	BT	255 nm / 305 nm	0...1000 µg/L	20 µg/L

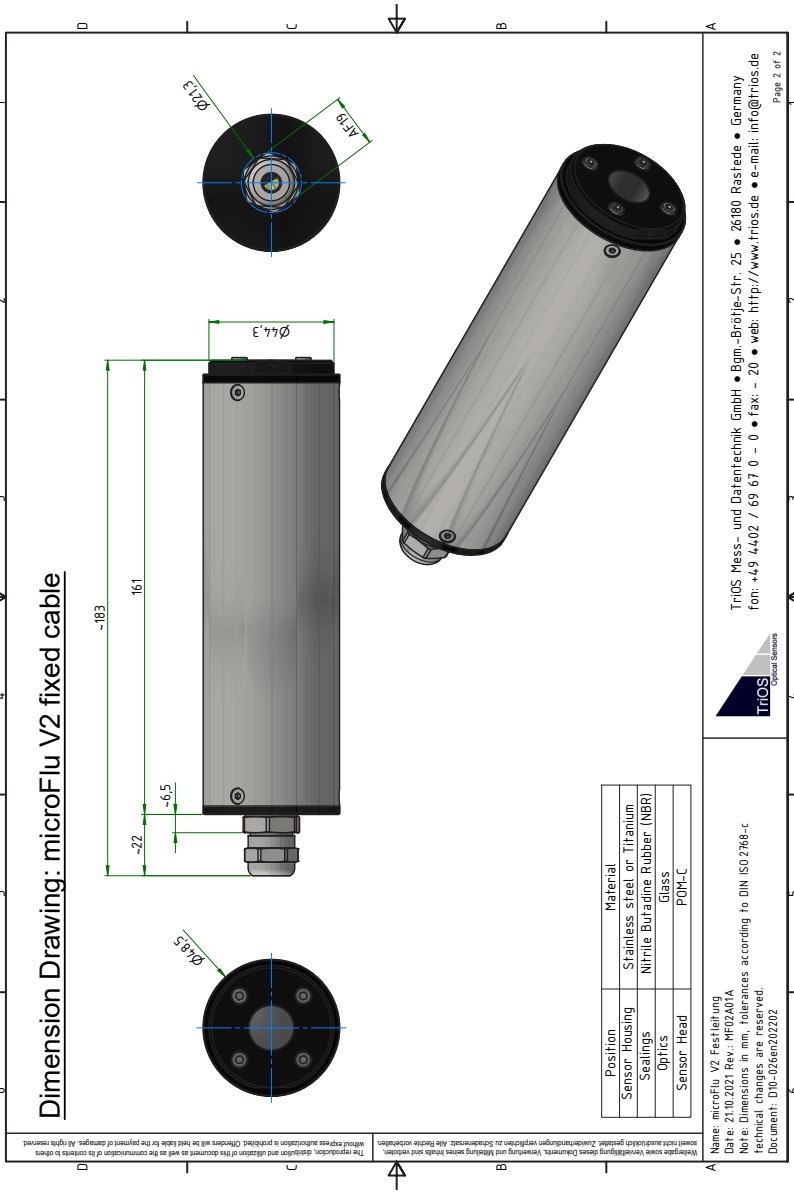
*under laboratory conditions

7.3 External dimensions

Version with SubConn see chapter 3.1.1



Version with fixed cable see chapter 3.1.2



8 Accessories

8.1 TriBox3

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

TriBox3 is a measurement and control system for all Tri-OS 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 Besides the TriBox3 offers various interfaces, includingan IEEE 802.3 Ethernet interface, a 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 to control external devices. Low power consumption, a robust aluminium housing and multiple interfaces makes it suitable for all applications in the areas of environmental monitoring, drinking water and waste water treatment plants, and many other areas.

8.2 TriBox Mini

Digital 2-channel controller

Mini controller with two digital sensor inputs and two 4...20mA outputs. All measurement data and diagnostic data can be read out via a built-in web browser.

9 Warranty

The warranty period of our devices within the EU is 2 years from the date of the invoice. Outside of the EU, the warranty period is one year. All normal consumables, such as light sources, are not included in the warranty.

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 caused by contact with aggressive and material damaging substances, liquids or gases as well as transport damage, are not covered by the warranty.
- Damage due to 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 voids the warranty!**

10 Customer service

If you are having a problem with the sensor, please contact TriOS customer service.

We recommend sending the sensor in for maintenance and calibration every 2 years. To do this, please request an RMA number from customer service.

Technical support contact:

support@trios.de

Telephone: +49 (0) 4402 69670 - 0

Fax: +49 (0) 4402 69670 – 20

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

11 Contact

We are constantly working to improve our devices. Visit our website for news.

If you have found an error or bug in one of our devices or programs, please let us know:

Customer service:	support@trios.de
General questions / sales:	sales@trios.de
Website:	www.trios.de

TriOS Mess- und Datentechnik GmbH

Bürgermeister-Brötje-Str. 25

26180 Rastede

Germany

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Fax:	+49 (0) 4402 69670 - 20

12 Keyword Index

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	**microFlu V2**
Typ / Type / Type	chl 200, blue 200, cdom 500, rho 200, fluo 200, TRP 500, BT 10000
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 13.06.2024	Unterschrift / Signature / Signature R. Heuermann

D05-026yy202406

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Modbus RTU

Software version

This Modbus protocol refers to software version 1.0.7 and higher.

Serial interface

In the delivery state, microFlu V2 has the following settings for the serial interface (RS485):

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

Data types

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 - 0xFFFFFFFF
Float	2	IEEE 754 32 Floating point number, big endian
Char[n]	$\left[\frac{n}{2}\right]$	Null-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

microFlu V2 supports the following Modbus functions:

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

Standard slave address

The factory default setting of the slave address is:

Address	Parameter
3 (0x03)	chl
4 (0x04)	blue, TRP
5 (0x05)	cdom

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

Access permissions

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

The following table describes the Modbus register assignment *:

Designation	R/W	Address	Data type	Description
Modbus slave address	R/W	0	Uint8	Identifier used for the Modbus protocol. Valid IDs: 1...247
Measurement	R/W	1	Uint16	When you are in Burst mode, writing to this register has no effect. When not in Burst mode, writing any value to this register will trigger a new measurement. When a measurement is in progress, an attempt to write to this register will be met with a "Device busy" exception. When read (with or without Burst mode), it returns the estimated time remaining for the currently running measurement, in tenths of a second (1/10 of a second); if no measurement is running, 0 is returned.
Device Serial Number	R	10	Char[10]	The serial number of the microFlu.
Firmware Version	R	15	Char[10]	The version of the installed firmware
Continuous Mode	R/W	101	Bool	If this is set to true, the sensor will measure continuously every 3 seconds.
Temporary Continuous Mode Override	R/W	102	Bool	Is not stored over power cycles. Can be used to temporarily enable or disable Continuous Mode (see register #101); this allows tests to be performed without changing the operation of the instrument at the next power-up. Note that writing to the Continuous Mode Register (#101) also changes the value of this register (although the opposite is not true), so this register always contains the current operating mode, while the Continuous Mode Register (#101) always contains the stored operating mode.
Analog Output Mode	R/W	103	Uint8	Determines the state of the analog current and voltage output pins. Values: 0: Off 1: 4-20 mA 2: 0-10 V 3: 0-5 V

Analog Output Source	R/W	104	Uint8	Which parameter should be used for the analog output. 4: variant parameter 5: custom parameter #1 6: custom parameter #2 7: custom parameter #3
Analog Output Minimum Value	R/W	105	Float	The calculated minimum value at which the analog output produces the smallest possible output signal. For example, if the analog output is configured to 4-20 mA and this value is set to 20, then a measurement result of 10, 15, or 20 will output 4 mA each.
Analog Output Maximum Value	R/W	107	Float	The maximum calculated value at which the analog output produces the highest possible output signal. For example, if the analog output is configured to 4-20 mA and this value is set to 500, a measurement result of 500, 700, or 1033 will output 20 mA each.
Power Saving Timeout	R/W	111	Uint16	How many seconds to wait after a measurement before activating the energy saving mode. Values above 60 seconds (i.e. from 61) deactivate this function.
Description	R/W	112	Char[64]	Any description. Can be used for identification.
Modbus Baud Rate	R/W	144	Uint32	The baud rate used for Modbus interactions. Note: This setting is NOT saved permanently; it will be reset to 9600 at the next boot-up. This is to prevent someone from forgetting both their baud rate and their Modbus address and then having no way of finding them out again. Warning: After answering this request, the sender will most likely have to change its Modbus settings or the communication will fail from this point on.
Modbus Bit Settings	R/W	146	Uint16	How many data bits, stop bits and parity bits should be used for Modbus interactions. Attention: After answering this request, the sender will most likely have to change his Modbus settings or the communication will fail from this point on.

Measure Count	R	200	Uint32	How many total measurements have been taken since the last shutdown. Can be used to determine if a new measurement has been completed when the instrument is running in Continuous Mode.
Upload Status	R	202	Uint16	Provides information about a running or a failed Modbus file upload. This includes a firmware upload or a config.ini upload. Possible values: 0: No upload took place 1: An upload was started, but the file is not (yet) completely uploaded 2: The internal flash had an error; the upload must be repeated from the beginning. 3: The uploaded file seems to be formed incorrectly. Will only be used when uploading the config.ini. 4: A firmware was uploaded, but the specified CRC was wrong; the upload must be repeated from the beginning. 5: A file was uploaded, but it was longer than it should be; the upload must be repeated from the beginning. 6: A file has been uploaded. In case of firmware, the sensor waits for a restart.
Updater Result	R	203	Uint16	The result of the updater running before each boot and possibly installing firmware updates that were previously uploaded. Possible values: 0: No file was uploaded, so there was nothing to do 1: The internal flash chip where the update file is stored had a malfunction during the update. 2: The uploaded file was not a valid update file 3: The uploaded file was a valid update file, but is not compatible with this hardware version 4: An internal error occurred during the update 5: The installation process was successful 6: The updater itself seems to be defective
Parameter Offset	R/W	400	Float	Configurable value. Used together with the "Parameter scaling" and "Moving average" tabs to calculate the processed parameters.

Parameter Scaling	R/W	402	Float	Configurable value. Used together with the Parameter Offset and Parameter Moving Average registers to calculate the processed parameters
Parameter Moving Average	R/W	404	Uint16	Configurable value. Used together with the Parameter Offset and the Parameter Scaling Register to calculate the processed parameter.
Custom#1 c0	R/W	405	Float	Configurable value. Used together with the Custom#1 c1 to calculate the user-defined output parameter in Custom#1 according to the formula (variant · c1) + c0
Custom#1 c1	R/W	407	Float	Configurable value. Used together with the Custom#1 c0 parameter to calculate the custom output parameter in Custom#1 according to the formula (variant · c1) + c0
Custom#1 Moving Average	R/W	409	Uint16	Configurable value. Used to calculate Custom#1 Processed
Custom#1 Name	R/W	410	Char[64]	Freely selectable name that can be used to identify this parameter. Not used by the sensor itself, but displayed when connected to a TriBox3 or similar controller.
Custom#1 Unit	R/W	442	Char[32]	Freely selectable unit for this parameter, in case it does not have the same unit as the normal parameter of this sensor. Not used by the sensor itself, but displayed when connected to a TriBox3 or similar controller.
Custom#2 c0	R/W	458	Float	Configurable value. Used together with the Custom#2 c1 to calculate the user-defined output parameter in Custom#2 according to the formula (variant · c1) + c0
Custom#2 c1	R/W	460	Float	Configurable value. Used together with the Custom#2 c0 to calculate the user-defined output parameter in Custom#2 according to the formula (variant · c1) + c0
Custom#2 Moving Average	R/W	462	Uint16	Configurable value. Used to calculate Custom#2 Processed
Custom#2 Name	R/W	463	Char[64]	Freely selectable name that can be used to identify this parameter. Not used by the sensor itself, but displayed when connected to a TriBox3 or similar controller.

Custom#2 Unit	R/W	495	Char[32]	Freely selectable unit for this parameter, in case it does not have the same unit as the normal parameter of this sensor. Not used by the sensor itself, but displayed when connected to a TriBox3 or similar controller.
Custom#3 c0	R/W	511	Float	Configurable value. Used together with the Custom#3 c1 to calculate the user-defined output parameter in Custom#3 according to the formula (Variant · c1) + c0
Custom#3 c1	R/W	513	Float	Configurable value. Used together with the Custom#3 c0 to calculate the custom output parameter in Custom#3 according to the formula (variant * c1) + c0
Custom#3 Moving Average	R/W	515	Uint16	Configurable value. Used to calculate Custom#3 Processed
Custom#1 Name	R/W	516	Char[64]	Freely selectable name that can be used to identify this parameter. Not used by the sensor itself, but displayed when connected to a TriBox3 or similar controller.
Custom#1 Unit	R/W	548	Char[32]	Freely selectable unit for this parameter, in case it does not have the same unit as the normal parameter of this sensor. Not used by the sensor itself, but displayed when connected to a TriBox3 or similar controller.
Sensor Variant	R	600	Char[10]	A short name indicating the parameter that this sensor measures. There are the following variants: chl - chlorophyll a blue - phycocyanin cdom - colored dissolved organic matter TRP - tryptophan
Minimum Possible Value	R	605	Float	Smallest value that the sensor displays to the customer.
Maximum Possible Value	R	607	Float	Largest value that the sensor displays to the customer.
Parameter	R/W	1000	Float	The measured value. What this value represents depends on what exactly this sensor can measure (see #600). This tab contains the raw result of the last measurement, without modification by the moving average filter or any offset/scaling settings.

Custom#1	R	1002	Float	Value of the first configurable parameter before applying Scaling, Offset and Moving Average.
Custom#2	R	1004	Float	Value of the second configurable parameter before applying Scaling, Offset and Moving Average.
Custom#3	R	1006	Float	Value of the third configurable parameter before applying Scaling, Offset and Moving Average.
SQI	R	1008	Float	A value that can be used to determine if the last measurement was appropriate. Currently always 1.0.
Parameter Processed	R	1500	Float	The measured value after applying the user-defined Scaling, Offset and Moving Average. What this value represents depends on what exactly this sensor can measure (see #600).
Custom#1 Processed	R	1502	Float	Value of the first configurable parameter, after applying Scaling and Offset.
Custom#2 Processed	R	1504	Float	Value of the second configurable parameter, after applying Scaling and Offset.
Custom#3 Processed	R	1506	Float	Value of the third configurable parameter, after applying Scaling and Offset.

NOTICE **The configuration registers should be written to as seldom as possible and especially not in every measuring cycle, otherwise the flash memory may be damaged.**

Write single register (0x06)

Unlike many other TriOS sensors, this command has no special meaning for microFlu.

Report slave ID (0x11)

The sensor name, serial number and firmware version are each answered as a null-terminated ASCII string.

Example:

T	R	I	O	S	0x00	m	i	c	r	o	F	l	u	0x00	0	2	6	0	0	0	0	A	0x00	1	.	0	.	7

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