TriOS
Optical Sensors

Conductivity
OPERATING INSTRUCTIONS

Table of Contents

General
Information

Introduction

Comm-
issioning

Use

Calibration

Malfunction and
Maintenance

Technical
Data

Accessories

Warranty

Customer
Service

Contact

Keyword
Index

FAQ

1 General Information

1.1 Introduction

Welcome to TriOS.

We are glad that you have chosen to purchase our conductivity sensor.

Conductivity sensors are measuring devices that measure the ability of a measuring medium to conduct electric current between two electrodes. The current flows by ion transport. This means that measuring media with a higher number of ions conduct the current better.

In this manual, you will find all the information you need to commission the conductivity sensor. Technical specifications, detection limits and dimensions can be found in chapter 7.

Please note that the user is responsible for complying with local and national regulations on the installation of electronic devices. Any damage caused by incorrect use or unprofessional installation will not be 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 to ensure reliable and correct operation of the devices.

Before using the device, read the manual carefully, and keep this manual on hand for future reference. Before commissioning the sensor, please make sure that you have read and understood the following safety precautions. Always make sure that the sensor is operated correctly. The safety precautions described on the following pages should ensure the reliable and correct operation of this device and any additional associated devices and should prevent injuries to yourself or other persons and damage to other equipment.

| **NOTICE** | If the translation is at all different from the original German text, the German version is binding. |

Copyright Notice

All of the content in this manual, including texts, photographs and graphics, are protected by copyright. Unless expressly stated otherwise, TriOS Mess- und Datentechnik GmbH is the owner of the copyright. Persons who violate the copyright shall be liable pursuant to § 106 et seq of the copyright law, they will be warned at their own expense and must pay compensation.

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 strictly followed. The following are distinct 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 at 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 a biohazard. Therefore, you should always wear gloves when working with such materials. Please observe the currently valid biological agents regulation! (German BioStoffV)

Waste

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

General Information // Conductivity

General Information

Introduction

Comm-issioning

Use

Calibration

Malfunction and Maintenance

Technical Data

Accessories

Warranty

Customer Service

Contact

Keyword Index

FAQ

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 sea water.

> **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 coming into contact with salt water or other corrosive substances (e.g. acids, alkalis, chlorinated compounds).

- The material resistance should be checked after every use.

- The sensor has seals made from NBR (nitrile 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 cord. Make sure that no heavy objects are placed on the cord and that the cord is not folded. Make sure that the cable is not anywhere near hot surfaces.

- If the sensor cable is damaged, it must be replaced with an original part by the customer service of TriOS Mess- und Datentechnik GmbH.

- Stop operation of the sensor if excessive heat develops (i.e. if it is hot to the touch). Switch off the sensor immediately and remove the cable from the power supply. Please contact your dealer or the TriOS customer service.

- 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 dealer or by qualified experts authorized 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. Faulty, improper repairs can result in accidents and injuries.

> **⚠ DANGER** 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 conductivity sensor has been developed for use in industry and science. The target group for the operation of the sensor is technically skilled staff in plants, sewage treatment plants, water plants and institutes. Operating 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 purpose of the conductivity sensor is exclusively the implementation of conductivity measurements as described in this manual. For this purpose, the sensor is an immersion sensor, which is used underwater or with flow cells. Please note the technical data of the accessory parts. Other uses do not comply with the intended use.

The sensor may only be used to measure the conductivity 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 sensor in other media than those specified in this manual, please contact the customer service of TriOS Mess- und Datentechnik GmbH (support@trios.de).

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 Disposal Information

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 for more details before you send the device back.

Address of manufacturer:

TriOS Mess- und Datentechnik GmbH
Bürgermeister-Brötje-Str. 25
D-26180 Rastede
Germany

Telephone: +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 harmonised European standards. It therefore meets the legal requirements of the EC guidelines. TriOS Mess- und Datentechnik GmbH confirms the successful testing of the product by affixing the CE marking. (See Annex.)

General
Information

Introduction

Comm-
issioning

Use

Calibration

Malfunction and
Maintenance

Technical
Data

Accessories

Warranty

Customer
Service

Contact

Keyword
Index

FAQ

2.2 Scope of Delivery

The shipment contains the following components:

- Sensor
- Operating Instructions

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

2.3 Measurement Principle and Design

Graphite electrodes

1 inch GAS thread

The conductive measuring sensor has two graphite electrodes facing each other. A voltage is applied to the electrodes so that a current is generated in the measuring medium.

The intensity of the current depends on the number of ions (anions and cations) in the measuring medium, which move back and forth between the electrodes. A high number of ions in the medium thus causes a higher electrical conductivity and thus a higher current flow. The conductivity of the sensor is given in μS/cm.

3 Commissioning

This chapter deals with the commissioning of the conductivity 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 of the connections are connected correctly.

3.1 Electrical installation

The conductivity sensor is supplied with a fixed cable (2 m or 10 m) with M12 8pin industrial plug.

3.1.1 Fixed Cable with M12 Industrial Plug
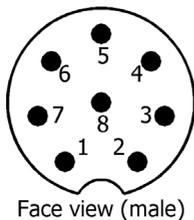
1. RS-485 A

2. RS-485 B

7. Ground (Power + Ser. Interface)

8. Power (12...24 VDC)

Face view (male)

NOTICE	Ensure correct polarity of the operating voltage or otherwise the sensor may be damaged.

3.2 Interfaces

3.2.1 Serial Interface

The conductivity sensor provides two lines for digital, serial communication with a control device. It is equipped with a configurable digital serial interface RS-485 (also EIA 485). The interface cannot be switched and is already defined when delivered.

The serial interface is configured by default to Modbus protocol with the following settings:

-      Baud rate: 9600 bps

-      Data bits: 8

-      Stop bits: 1

-      Parity: none

-      Flow control: none

For the RS-232, voltages of −5 V to +5 V with respect to the ground are possible. RS-485 uses a differential signal where the sign-negative potential of the A line is put on the B line. The A-B difference is decisive where the transmission is most resistant to interactive interference signals.

A detailed description of the Modbus protocol commands can be found in the Annex.

4 Use

The conductivity sensor can be operated with all TriOS controllers. Instructions for correct installation can be found in the relevant controller manual.

For operation, the graphite electrodes of the conductivity sensor must be immersed at least 5 cm in the measuring medium and the lateral openings must be aligned in the flow direction of the measuring medium.

Flow direction

When installing the sensor, it must be ensured that the sensor remains under water at all times and is not moved by any current, as otherwise implausible measured values could result.

5 Calibration

For sensor calibration we recommend the HamiltonTM conductivity standard with 1413 µS/cm. The controller helps you to perform a one-point calibration step by step.

1. Prepare the calibration solution
2. Press the sensor symbol (top right)
3. Select the sensor (CON_XXXXX)
4. Press "Calibrate!"
5. Select a measuring range that suits your application and the standard used (standard 0 – 20000 µS/cm)
6. Enter the setpoint of the calibration solution.
7. Now immerse the sensor in the solution and wait until the measured value has stabilized.
8. Then press "Calibrate!"

5.1 Temperature Compensation

Temperature compensation is performed automatically by the integrated temperature sensor.

6 Malfunction and Maintenance

To ensure an error-free and reliable measurement, the conductivity sensor should be periodically checked and maintained.

6.1 Cleaning and Upkeep

Vegetation deposits and dirt depend on the medium and the duration of exposure in the medium. Therefore, the degree of pollution depends on how the sensor is used. For this reason, it is not possible to give a general answer regarding the intervals at which the sensor must be cleaned.

6.1.1 Cleaning the Enclosure

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

To ensure a long service life of the conductivity sensor, it should be checked regularly for contamination.

Remove dirt from the sensor head with a soft clean cloth. Carefully rinse off heavier soiling on the outside with warm, clean water.

If necessary, you can also use a detergent with non-abrasive properties and let the sensor soak in it for 2-3 minutes.

After cleaning you should rinse the sensor with warm water.

Calibrate the sensor after each cleaning.

6.2 Troubleshooting

6.2.1 Sensor is not displayed

If your TriBox mini did not recognize the sensor, you should check which firmware is installed on your TriBox mini, because the conductivity sensor only works with TriBox mini firmware 1.2.4. Proceed as follows:

• Contact customer service (support@trios.de) which will send you a link to the firmware:

• Connect a laptop with the TriBox mini WiFi to the SSID TB-mini-WLAN-Exxx

• Open a browser window and enter http://192.168.0.1/ in the address line – you will be directed to the web interface of the TriBox mini

• Log in as "Service", the access data (if not yet available) will be provided by TriOS customer service

• Make sure that no sensors are connected to the COM ports

• Go to the menu "Service" → "Firmware Upgrade" → "Select tar file" → "Upload"

• When the upload is complete, you will receive a confirmation in the upper window of the web interface.

6.2.2 Fault during Measurement

If the measured values vary greatly, a visual inspection of the sensor is recommended to ensure that

• the sensor is immersed deeply enough in the measuring medium

• there are no air bubbles between the electrodes

• there is no contamination on the measuring electrodes.

6.2.3 Replacing the Sensor

NOTICE	If the sensor is replaced, the controller settings must be reconfigured for the new sensor.

1. If you have to replace your sensor with a new one, you should set your TriBox 3 to maintenance mode: "Options" → "Maintenance mode".

2. Remove the sensor from the FlowCell / from the pipe. At this point you should also check whether the O-rings are still in perfect condition. Replace the O-rings if necessary.

3. Configuration of the new sensor:

   Connect the new sensor to the TriBox3. Press "Seek sensors". After a short time the TriBox3 should have recognized the sensor.

   Display:

   "Display" → Selection of window → select the windows to be changed for the conductivity sensor → "Current value" → selection of the measured value to be displayed.

   Automatic measurements:

   Select the conductivity sensor in the "Sensor" menu (blue field).

   Select "Automatic measurements" → "Automatic measurement" or "Fastest possible" (as required).

   To set the automatic measurements (if the "Fastest possible" mode has not been selected), go to "Options" → "Automatic measurement" → "Measurement grid" → Select the measurement interval from the drop-down menu as required.

   Set the Modbus address:

   "Sensor" menu → press on the field of the conductivity sensor → "Modbus server settings" → "Slave address" → set the address required for your system.

   Analog outputs:

   "Options" → "Analog outputs" → select the analog output on which the previous conductivity sensor was set → "used measured value" → select the new sensor from the drop-down menu → set the scaling.

   Postprocessing:

   If you want to keep the previous postprocessing settings, you can do this via "Sensor" → "Conductivity". Here you can change the sensor settings if required.

6.3 Returns

Please observe the following instructions when returning items.

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

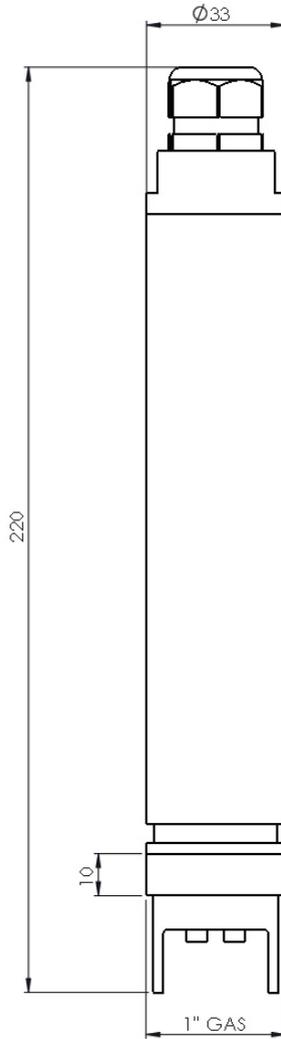**Caution! Return shipments without an RMA number cannot be accepted and processed!**

Please make sure that the sensor is cleaned and disinfected before shipping. In order to prevent damage to the goods during shipping, 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	Conductivity
Measurement principle	Conductivity with two graphite electrodes
Parameters	Conductivity
Measurement range	0.00 µS… 20000 µS
Measurement accuracy	±0.5 µS at 20 µS ± 5 µS at 200 µS ± 50 µS at 2000 µS ± 500 µS at 20000 µS
Response time	T90 < 60s
Temperature compensation	Via NTC
Housing material	PVC housing, graphite electrodes
Dimensions (L x Ø)	220 mm x 33 mm	~ 8.7" x 1.3"
Interface	RS-485 Modbus RTU
Power supply	12…24 VDC
Connection	8-pin M12 connector, cable length 2 m or 10 m
Maintenance interval	2 years
System compatibility	Modbus RTU
Warranty	1 year (EU & US: 2 years) on electronics; wear parts are excluded from the warranty
Process pressure	10 bar	~ 145 psig
Calibration method	One-point calibration with standard measuring solution
Process temperature	0…50°C	~ +32 °F to +122 °F

7.2 External Dimensions

General Information

Introduction

Comm-issioning

Use

Calibration

Malfunction and Maintenance

Technical Data

Accessories

Warranty

Customer Service

Contact

Keyword Index

FAQ

Ø33

220

10

1" GAS

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 TriOS sensors. The device provides 4 sensor channels with selectable RS-232 or RS-485 function. In addition to the Modbus RTU, various other protocols are available. A built-in valve allows the use of compressed-air cleaning for the sensors. The TriBox3 also offers TCP/IP and WLAN networks, USB connection and 6 analog outputs (4...20 mA). An integrated relay can trigger alarms or control external devices. Features such as low power consumption, a robust aluminium housing and a range of interfaces make it suitable for all applications that have to do with environmental monitoring, drinking water, wastewater treatment plants and many other areas.

Firmware 1.4.11 or higher.

8.2 TriBox mini

Digital 2-channel controller

Mini controller with two digital sensor inputs and two 4...20mA outputs. All of the measured values and diagnostics data that are saved can be selected using an integrated web browser.

Firmware 1.2.4 or higher

9 Warranty

The warranty period of our devices within the EU and the United States is 2 years from the date of the invoice. Outside of the EU, the warranty is valid for one year. 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 must be operated according to the specifications.

- Damage due to contact with corrosive and damaging substances, liquids or gases and damage during transport are not covered by the warranty.

- Damage due to improper handling and use of the device is not covered by the warranty.

- Damage resulting from 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 help us provide you faster service, please send us the sensor ID number by email (the last four 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 and information.

If you have found an error or bug in one of the 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

D-26180 Rastede

Germany

Telephone	**+49 (0) 4402 69670 - 0**
Fax	**+49 (0) 4402 69670 - 20**

12 Keyword Index

General Information

Introduction

Comm-issioning

Use

Calibration

Malfunction and Maintenance

Technical Data

Accessories

Warranty

Customer Service

Contact

Keyword Index
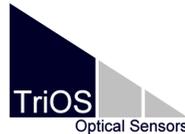
FAQ

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	**eCHEM Leitfähigkeit** **eCHEM Conductivity**
Typ / Type / Type:	**Art. Nr. 90S430100** **Art. Nr. 90S430130**
Mit den folgenden Bestimmungen With applicable regulations Avec les directives suivantes	2014/30/EU EMV-Richtlinie 2011/65/EU RoHS
Angewendete harmonisierte Normen Harmonized standards applied Normes harmonisées utilisées	EN 61326-1:2013

Datum / Date / Date

Unterschrift / Signature / Signatur

06.11.2018

R. Heuermann

D05-900yy201811

Modbus RTU

Serial Interface

Upon delivery, the serial interface is configured with the following settings:

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

Data types

Name	Register	Format
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

All data types that occupy more than one register are stored in the big-endian format, i.e. the word with the most significant bits is in the register with the lowest register number.

Functions

The following Modbus function codes are supported by the sensor:

Name	Code	Description / Use
Read holding registers	0x03	Reading of register values, e.g. the serial number, the firmware version and of course also the measured values.
Write multiple registers	0x10	Writing values into a sequence of successive registers.

Default Modbus slave address

In the factory setting, the sensor has the slave address 30 (0x1E).

Read multiple registers (0x03)

The following table contains the register assignment for this command:

Name	R/W	Register	Data type	Description
Firmware version	R	0	UInt16	Version number of the installed firmware
Serial number of the sensor	R	2	UInt32	Serial number of the sensor.
Serial baud rate	R/W	25	UInt16	The baud rate for serial communication. Default: 9600 baud. 0 := 9600 bps 1 := 19200 bps
Modbus slave address	R/W	24	UInt16	The Modbus slave address of the sensor. Default: 30.
Conductivity	R	4	Float	The measured conductivity. Unit µS/cm.
Temperature	R	12	Float	The measured temperature. Unit °C.

Write multiple registers (0x10)

Name	R/W	Register	Data type	Description
Setpoint for calibration	W	4+5	float	The setpoint of the conductivity during calibration is written into this register.
Measurement range	RW	6	UInt16	In this register the measuring range of the sensor can be set: 1 = 20µS / 2 = 200µS / 3 = 2000µS / 4 = 20000µS
Restoring previous calibration	W	31	UInt16	By writing a 1 in this register, the previous calibration is restored.

Calibration of the sensor

To calibrate the sensor via Modbus, the following steps must be performed:

1. Check the value range for which the calibration is to be performed and, if necessary, enter the corresponding value range in register 6. The sensor stores separate calibration data for each value range.
2. Immerse the sensor in the calibration solution and wait until the measured values have stabilized. The current conductivity values can be read out from registers 4 and 5 during the process.
3. Enter the setpoint of the calibration solution in the registers 4 and 5 if the measuring results are satisfactory. The sensor will then calculate the calibration values using the current measurement and the setpoint.
4. Check the new calibration. If necessary, the previously used calibration can be restored by writing the value 1 into register 31.