Sensorex

YOUR WATER MEASUREMENTS MATTER

Dissolved Oxygen

OPERATING INSTRUCTIONS

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1 General Information

1.1 Introduction

We are glad that you have chosen to purchase the Sensorex Lumin-S, Dissolved Oxygen sensor.

The Dissolved Oxygen sensor is based on luminescent optical technology. This technology eliminates many hassles associated with traditional galvanic and polarographic dissolved oxygen measurement methods. There are no membranes to replace, no electrolyte solutions to replenish, and no anodes to clean. Maintaining the sensor is as easy as replacing the optical sensing cap once every 1-2 years, and since all calibration data is stored on the cap, there's no need to calibrate. This dissolved oxygen sensor outputs a Modbus/RS-485 digital signal for easy PLC integration.

In this manual, you will find all of the information you will need to commission the Dissolved Oxygen 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 Sensorex Corporation must be installed and operated in accordance with the specifications provided by Sensorex Corporation. All parts were designed and tested in accordance with international rules for electronic instruments. The device meets the requirements of the international regulations on electromagnetic compatibility. Please use only original Sensorex 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 so it can be used later. 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.

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 Sensorex 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!

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!

Waste

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

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 (may cause 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 and chlorine-based connections.)
- The material resistance should be checked after every use.
- Do not cut, damage or change the cord. Make sure there are no heavy objects on the cord and that the cord is not folded. Make sure that the cord is not placed near hot surfaces.
- If the sensor cord is damaged, it must be replaced with an original part by the repair service of Sensorex Corporation.
- 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 distributor or Sensorex 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 done by the distributor or by qualified experts authorized by Sensorex.

Devices from Sensorex meet the highest safety standards. Repairs to the device that involve the replacement of the connecting cable must be done by Sensorex or a workshop authorized by Sensorex. Faulty, improper repairs can result in accidents and injuries.

DANGER **Sensorex does not guarantee the plausibility of measurement values. The user is responsible for monitoring and interpreting the values.**

1.4 Users and Operating Requirements

The Dissolved Oxygen sensor was developed for use in industry and science. The target group for the operation of the Dissolved Oxygen 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. 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 Dissolved Oxygen sensor is designed exclusively to take oxygen measurements as described in this manual. For this purpose, the sensor is an immersion sensor, to be 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 compact and robust stainless steel sensor is particularly well suited to the following typical areas of application:

• Industrial and municipal sewage treatment plants

• Wastewater management (nitrification and de-nitrification)*

• Surface water monitoring

• Fish farming, aquaculture

• Drinking water monitoring

The use of other media can damage the sensor. For the use of the Dissolved Oxygen sensor in media other than those specified this manual, please contact Sensorex customer service at www.sensorex.com/support/support-form/

NOTICE	**Avoid touching the membrane, because it can become scratched or dirty. If this happens, the functionality of the device can no longer be guaranteed.**

1.6 Disposal Information

At the end of the device's life or use, dispose of the sensor properly by following local or regional laws and regulations for disposal of electronic waste.

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. Sensorex confirms the successful testing of the product by affixing the CE marking. (See Annex.)

2 Introduction

The Dissolved Oxygen sensor applies luminescence-based optical measurement technology. Maintenance is typically required every 1-2 years, and users need only replace the optical sensing cap. No additional consumables are required.

Unlike galvanic sensor technology, optical technology is suitable for measurements with little to no inflow velocity.

The sensor offers the following advantages:

- Low operating costs due to reduced maintenance work (no electrolyte changes)
- Greater calibration intervals due to low drift behaviour
- No polarization voltage required
- High measuring accuracy, even for low concentrations
- Rapid response times
- No minimum inflow (no oxygen consumption)

The sensor features excellent interference immunity thanks to the integrated preamplifier and digital signal processing. The measured value for dissolved oxygen is automatically compensated with the temperature, air pressure, and salinity (salt content), and transferred without interference to the connected display unit and controller via a digital interface. The optica sensing cap is easy to replace, meaning the sensor is very easy to maintain. The current calibration data is saved directly in the sensor electronics. As a result, the Plug and Play function of the system is enabled without the need for recalibration. The sensor also includes a log book containing the last ten successful calibrations in the form of a ring buffer.

2.1 Product Identification

All Sensorex Lumin-S products have a label, which clearly shows the product designation.

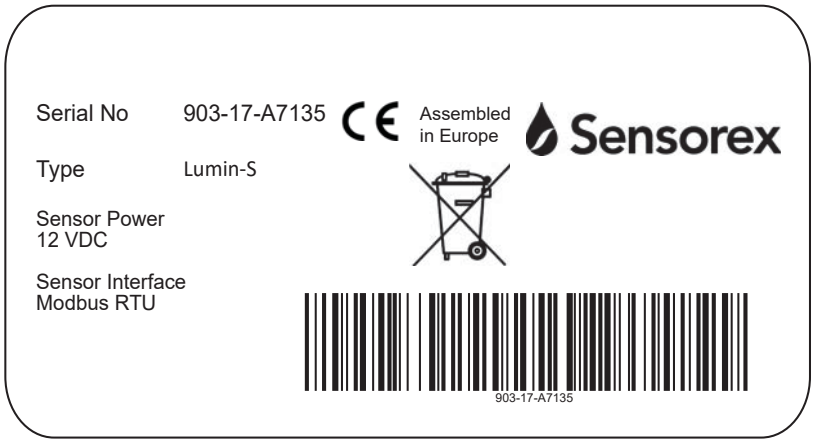
There is also a label on the sensor with the following information that you can use to uniquely identify the product:

Serial number

Product type

Power supply

Interface



In addition to the product bar code, the label includes the Sensorex logo and the quality label. CE

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

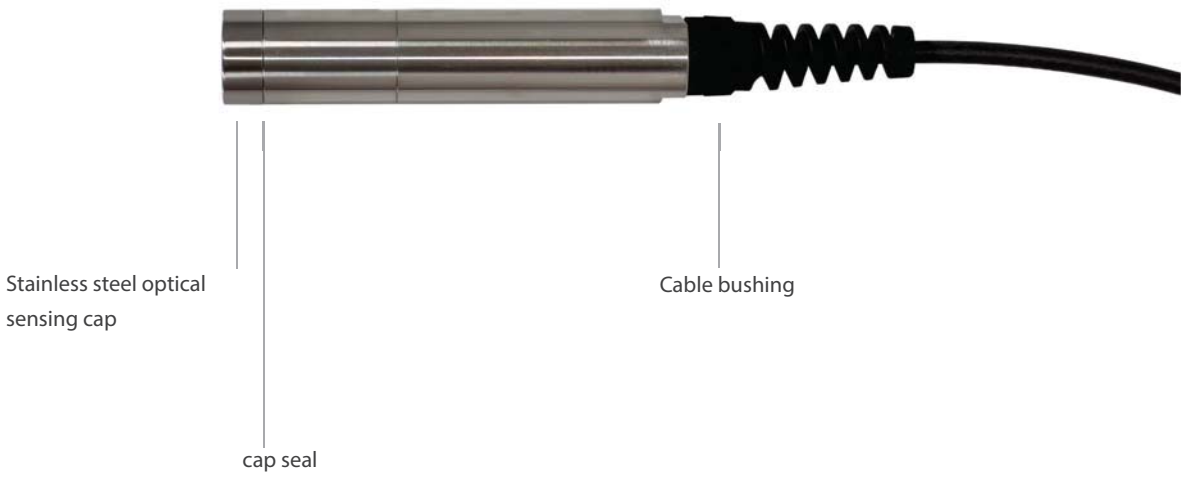
2.2 Scope of Delivery

The shipment contains the following components:

- Sensor
- Operating Instructions
- Accessories (if applicable)

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

2.3 Measurement Principle and Design



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 of the connections are connected correctly.

3.1 Electrical Installation

NOTICE **The sensor must be operated with 12 VDC.**

3.1.1 Fixed Cable with tinned leads

1. White Wire - RS485 A (commands)
2. Brown Wire - RS485 B (data)
3. Pink Wire - Power 12V DC
4. Blue Wire - Ground (Power + Ser. Interface)

NOTICE **Ensure correct polarity of the operating voltage to prevent damage to the sensor.**

The sensor is ready for initial startup once it is connected to your terminal and settled in its mounting hardware.

3.2 Interfaces

3.2.1 Serial Interface

The sensors serial interface is RS485. Key features of RS-485 include:

- Differential interface with high common mode noise rejection making it immune to interference
- Operates from a single supply
- –7V to +12V bus common-mode range
- Up to 32 devices on the bus
- 10-Mbps maximum data rate (at 40 feet)
- 100kbps maximum data rate (at 4000 feet)

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

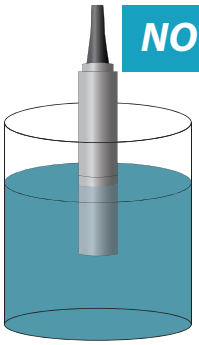
4 Use

The Dissolved Oxygen sensor can be operated with any PLC with MODBUS RS-485 capability.

4.1 Normal Operation

Re-hydration prior to use: Remove the blackprotective cover (by holding the sensor head downward and by unscrewing the hood towards the right). The sensor is delivered dry and the optical sensing cap must be re-hydrated to ensure measurement accuracy. Leave cap attached to sensor (do not remove) when rehydrating. After dry storage, rehydrate the cap attached to the sensor for 12 hours (one night) in clear water.

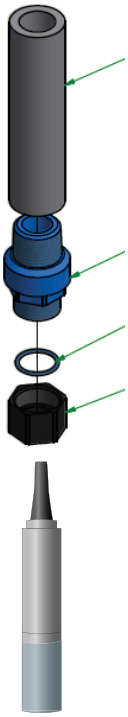
Operation: Standard operation of the sensor is carried out by immersing it into the medium. The sensor can either hang freely or be mounted at 45°. For measurement, you must eliminate bubbles trapped under the membrane. Presence of chlorine may cause overestimation of dissolved oxygen level. During the introduction of the sensor to the measurement environment, wait for the sensor's temperature to stabilize before starting a measurement. To extend the operating life of the optical membrane, the measurement interval should be set to a value greater than 10 seconds.



NOTICE **The membrane is vulnerable to chemicals (organic solvents, acids, peroxide) and mechanical attack (impact, abrasion, tearing).**

4.2 Submersion Installation

Thread adapter onto cable of sensor as shown in figure to right. You will supply your own threaded pipe (1" NPT) to cover the cable of the sensor



5 Calibration

The sensor is calibrated to specification at the factory. The manufacturer does not recommend calibration unless periodically required by regulatory agencies. If calibration is required, let the sensor come to equilibrium with the process before calibration. Do not calibrate the sensor at setup. After the membrane cap is replaced, calibration should be carried out.

It is also advisable to regularly clean the sensor in a water-sulphite solution with a sulphite concentration of <2%, and to subsequently check the zero point (0% saturation). If the zero point has moved, a complete two-point calibration is advised.

5.1 Two-Point Calibration

With two-point calibration, the zero point (0% - offset) and slope (100%) of the sensor are calibrated. This calibration method offers the greatest possible level of accuracy and is recommended for measurements in solutions with a low concentration of dissolved oxygen.

It is carried out as follows:

5.1.1 Offset calibration

The sensor must be cleaned before calibration (see chapter 6). Immerse the sensor in a water-sulphite solution (sulphite concentration <2%) in order to determine the zero point (0% saturation). Mix the solution with the sensor to quickly decrease oxygen saturation (the oxygen fixed to the Membrane Cap must be consumed).

NOTICE	**The sensor can be damaged by chemicals. A damaged membrane can lead to incorrect measurement results. The sensor membrane must not be in contact with the sulphite solution for longer than one hour.**

After calibration, clean the sensor with clear water and carefully dry it.

5.1.2 Slope calibration

Sensor slope is determined by positioning in oxygen-saturated environment (100% saturation). The slope of the sensor is calibrated beyond the defined state of 100% oxygen saturation. This state can in principle be achieved in two ways:

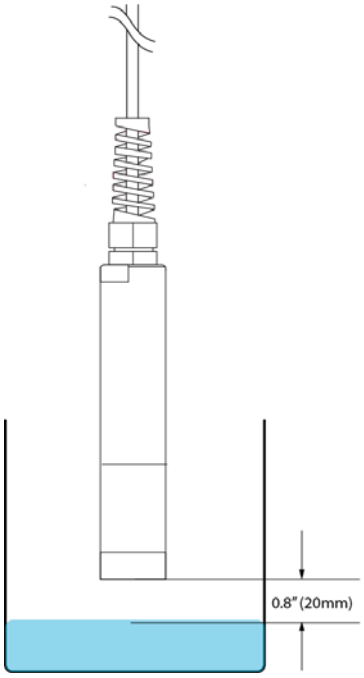
1. By positioning the sensor in water vapor-saturated air (for example, directly over a water surface, see picture on following page).

The sensor must be kept dry during the calibration process. Drops of water adhering to the sensor membrane could distort the measurement.

2. By positioning the sensor in air-saturated water (air is directed through water until the water is saturated with it).

The air pressure and temperature must remain constant during the calibration.

(1) Positioning in water vapor-saturated air



5.2 One-Point Calibration

One-point calibration references only the 100% point: please consult chapter 5.1.2 (slope calibration).

5.3 Measurement Properties

5.3.1 Influences on the measurement

The oxygen measurement is dependent on the following parameters:

- The temperature of the measurement medium
- The air pressure (atmospheric pressure)
- The salinity of the measurement medium

The degree of solubility of oxygen in water is dependent on the temperature, the salinity, and the air pressure. This dependency is stored in the sensor's measurement electronics in the form of functions. The sensor can therefore determine the oxygen concentration of the measurement medium, in order to digitally transmit the influencing factors above, in compensated form, to the transmitter/controller.

5.3.2 Temperature compensation

The temperature compensation is automatically managed by the sensor via the integrated temperature sensor (NTC).

5.3.3 Atmospheric pressure

If using the one-point calibration method of the sensor in water vapor-saturated air, the air pressure must be taken into account. The default value of atmospheric pressure used for the compensation is 1013 hPa.

5.3.4 Salinity

The default value of salinity concentraiton used for the compensation is 0 g/Kg.

6 Malfunction and Maintenance

The maintenance schedule shows minimum intervals for regular maintenance tasks. Perform maintenance tasks more frequently for applications that cause sensor fouling.

NOTICE **Do not disassemble the probe for maintenance or cleaning.**

- The sensor must always be kept clean, particularly in the area around the optical membrane. The presence of a biofilm on the membrane cap can lead to measuring errors.
- A dirty optical sensing cap should be cleaned with warm, soapy water. A soft sponge should be used for cleaning (not an abrasive scouring sponge).
- If the sensor is taken out of operation, it should be rinsed prior to being stored, and the protective cap should be fitted with the protective case and a moist absorbent surface (like cotton).

6.1 Cleaning and Upkeep

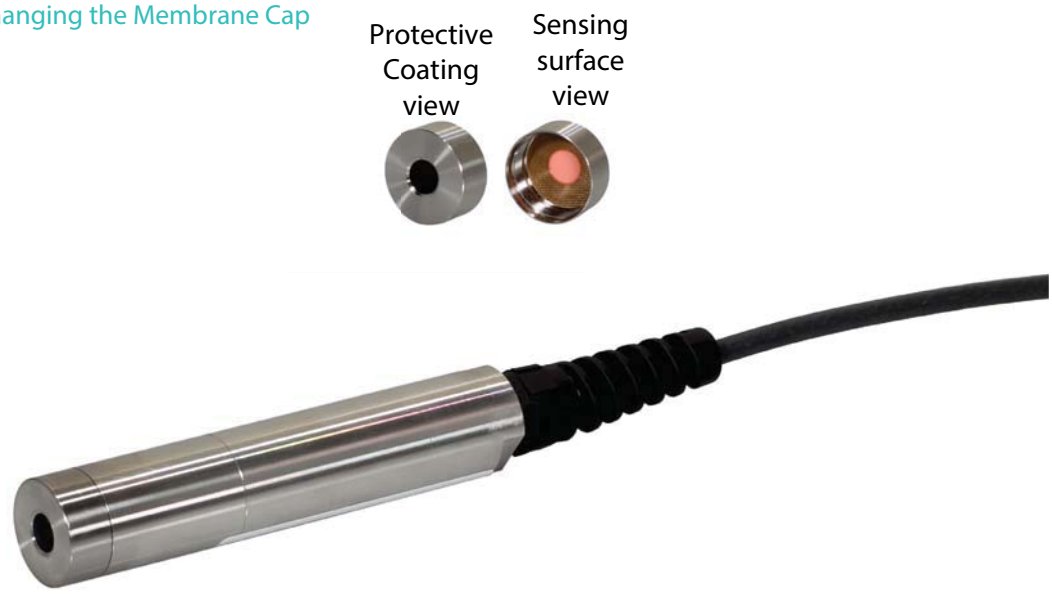
Rinse the sensor and the optical sensing cap meticulously with clear water. If deposits like biofilm or mud persist, wipe the membrane gently with a soft cloth or an absorbent paper.

6.2 Maintenance and Inspection - It is advisable to regularly clean the sensor in a water-sulfite solution with concentration of <2% and use this solution to check zero point calibration (0% saturation). If the zero point has moved, perform a complete 2 point calibration.

NOTICE **Avoid touching the center part of the optical sensing cap, because it can become scratched or dirty. If this happens, the functionality of the device can no longer be guaranteed.**

The average lifetime of the optical sensing cap is 2 years. If the optical sensing cap deteriorates or the sensor is difficult to calibrate, replace the cap with a new cap from the factory.

6.2.1 Changing the Membrane Cap



1. Unscrew the optical sensing cap from the sensor body. ***Do not touch the front of the sensor.***
2. Remove a replacement membrane cap from the black protective bag and screw slowly onto the sensor body. ***Do not touch the* center portion of the cap.**
3. Rehydrate the cap attached to the sensor for 12 hours and perform a 2 point sensor calibration (chapter 5.1).

NOTICE	**Do not unscrew the membrane cap unless changing it.**

6.3 Troubleshooting

6.3.1 - Wrong Values - After every reboot, the sensor will output "9988.0" as a placeholder value for every measurement, as long as no actual measurement values are available.

6.4 Returns

Please observe the following instructions when returning items.

If returning a sensor, please contact customer service first (https://sensorex.com/support/support-form/). You will receive an RMA form, which you need to fill out completely 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 so that your return package can be correctly allocated and accepted.

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 available, make sure that safe transport is guaranteed and the sensor is safely packed using enough packing material.

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

7 Technical Data

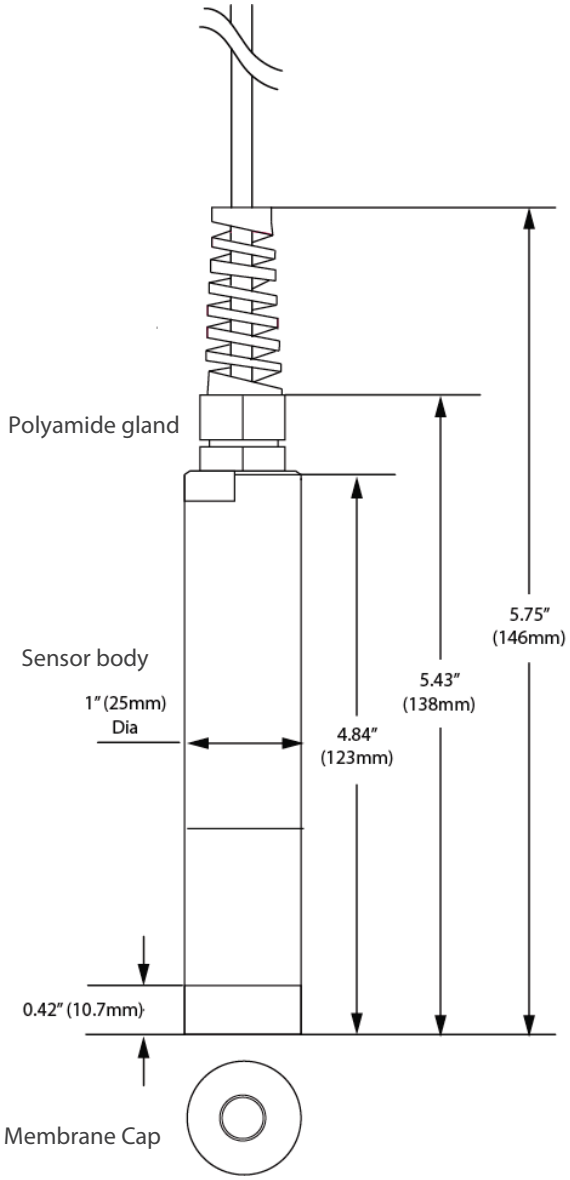
7.1 Technical Specifications

Measurement principle		Luminescence
Parameter		Dissolved Oxygen
Measurement range		0...20 mg/L 0...20 ppm 0...200 %
Measurement accuracy		± 0.1 mg/L ± 0.1 ppm ± 1 %
Resolution		0.01
Response time		90 % of the value in less than 60 seconds
Measurement interval		> 5 s
Inflow Velocity		no movement necessary
Temperature Compensation		Via NTC (compensation active for temperature lower than 0 °C)
Measurement range (temperature)		0...50 °C
Resolution (temperature)		0.01 °C
Accuracy (temperature)		0.5 °C
Membrane Cap		No cross-sensitivity with : pH 1 – 14 ; CO2, H2S, SO2 Cross-sensitivity to Organic solvents, such as acetone, toluene, chloroform or methylene chloride, Chlorine gas
Material		Standard Version in passivated Stainless steel 316L body, strainer and screw, For Seawater application Version in Titanium body, strainer and screw, Cable : polyurethane jacket Steam gland : Polyamide Patch with active material (black) – Membrane : Optical isolation silicon
Dimensions (L x Ø)		146 mm x 25 mm
Weight	stainless steel	~ 450 g
	titanium	~ 300 g
Interface		RS-485 (Modbus RTU)
Power consumption		1 W
Power supply		12 V (± 10 %)
Sensor cable		10 m(33ft)
Calibration/maintenance interval		2 years
Warranty		1 year

INSTALLATION

Max. pressure	5 bar/72.5psig
Protection type	IP68
Sample temperature	0...+50 °C/-32 to 122°F
Ambient temperature	0...+50 °C/-32 to 122°F
Storage temperature	-10...+60 °C/-14 to 140°F

7.2 External Dimensions



9 Limited Warranty

The Sensorex device warranty is valid for 1 year from the date of the invoice. 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 incorrect 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 Sensorex customer service. To send back the sensor, please request an RMA number from customer service.

Customer service:	support@sensorex.com
General questions/sales:	sales@sensorex.com
Website:	www.sensorex.com

Sensorex Corporation

11751 Markon Drive

Garden Grove, CA. 92841 USA

Telephone	+714-895-4344
Fax	+714-894-4839

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@sensorex.com
General questions/sales:	sales@sensorex.com
Website:	www.sensorex.com

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Modbus RTU

Defaults: Address :10
Data: 8 bits, no parity, 2 stop bits
Baud Rate: 9600
Slave ID: 10
32 Bit Float

Parameters

Number	Parameter	Unit
1	Temperature	°C
2	Oxygen saturation	%
3	Oxygen concentration	mg/l
4	Oxygen concentration	ppm

Data types

Name	Register Count	Format
Uint16	1	Unsigned 16 bit integer. Value range: 0x0000 - 0xFFFF
Bits16	1	Register contains a bitmask, where every bit has a special meaning. This is most often used for parameter selection, where Bit 1 corresponds to the temperature and the following bits to parameter 1, 2, 3 and 4
Bits32	2	A bit vector using 32 bits, same as Bits16 but spanning two registers
Uint32	2	Unsigned 32 bit integer. Value range: 0x00000000 - 0xFFFFFFFF
Float	2	IEEE 754 32 bit floating point value
ASCII	1+	A sequence of ascii characters with two 8 bit characters stored in each 16 bit register
Date	8	A date in the form mmhhddMMYYYY, where mm is the minute, hh the hour, dd the day, MM the month and YYYY the year

All multi-register datatypes are stored in big-endian word order. That is the word with the most significant bits is stored at the lesser register address.

Supported Modbus functions

These Modbus function codes are supported by the sensor:

Name	Code	Description / Use
Read multiple registers	0x03	Read the serial number, firmware version and of course measurement data
Write single register	0x06	Write a value in one register
Write multiple registers	0x10	Write data into a sequence of registers
Report slave ID	0x11	Get the sensor identification

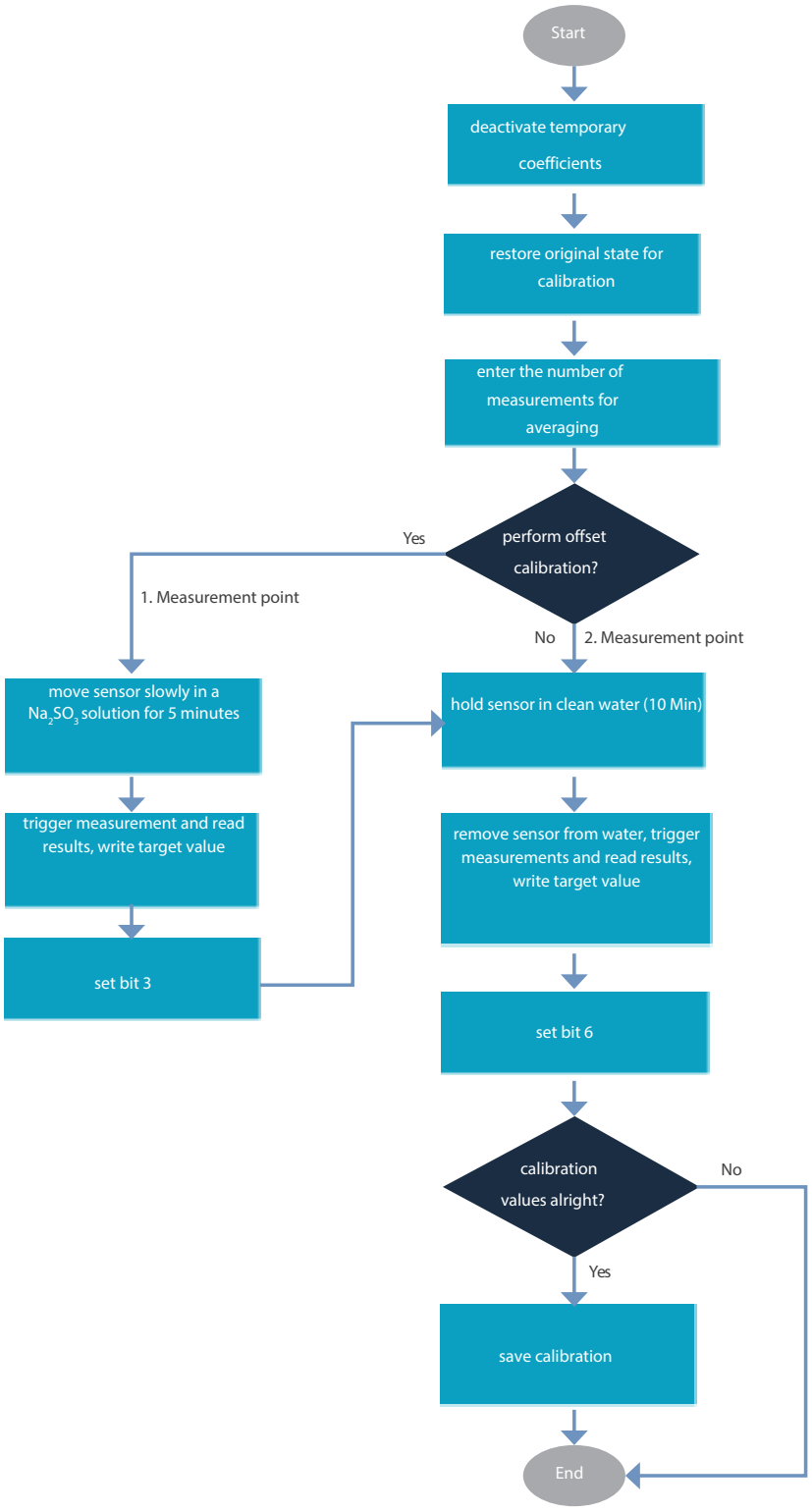
Default Slave Address

The factory default setting of the slave address is 10 (0x0A).

Register description

The following table describes the Modbus register mapping:

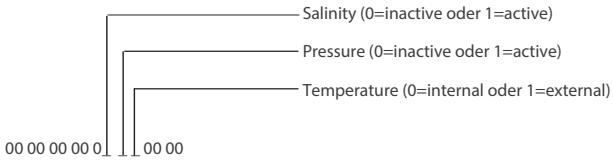
Designation	R/W	Register	Data type	Description
Start measurement	W	1	Bits16	Start a measurement for a set of parameters. Value 31(0x1F)
Restore default calibration	W	2	Bits16	Restore the default calibration coefficients. Value 31(0x1F)
Reset standard of temporary calibration	W	76	Int16	Write 1 into this register to perform the reset
Temperature	R	83	Float	Current temperature measurement in °C
Oxygen saturation	R	85	Float	Measured oxygen saturation in %
Dissolved oxygen	R	87	Float	The concentration of dissolved oxygen in mg/l
Dissolved oxygen	R	89	Float	The concentration of dissolved oxygen in ppm
Modbus slave address	RW	163	Int16	Modbus slave address from 1 to 247
Measurement duration	R	164	Int16	Approximate time to obtain all measurements in ms
Averaging	RW	170	Int16	Averaging for all values except temperature. Values from 1 to 50 are allowed
Parity and Stop Bits	RW	188	Int16	0: Default: 2 stop bits (no parity) 1: Even parity and 1 stop bit 2: Odd parity and 1 stop bit
Temporary coefficients	W	332	Bits32	Each calibration coefficient (Offset, Scaling) has a corresponding bit in this two registers. Bit 1: Offset of temperature sensor Bit 2: Scaling of temperature sensor Bit 3: Offset of oxygen sensor Bit 4: Factory value Bit 5: Factory value Bit 6: Scaling of oxygen sensor
Temperature Offset	RW	512	Float	Write the temperature offset into this register during calibration
Temperature Scaling	RW	514	Float	Write the temperature scaling into this register during calibration
Oxygen Offset	RW	516	Float	Write the oxygen offset into this register during calibration
Oxygen Scaling	RW	522	Float	Write the oxygen scaling into this register during calibration
Operator Name of Temperature	W	638	ASCII[8]	Name of the operator who calibrated the temperature sensor (8 registers for 16 ascii characters)
Date of Temperature Calibration	W	646	Date	Write the current date at the end of the temperature calibration into this registers (see "Data types" section)
Operator of Oxygen Calibration	W	654	ASCII[8]	Name of the operator who calibrated the oxygen sensor (8 registers for 16 ascii characters)
Date of Oxygen Calibration	W	662	Date	Write the current date at the end of the oxygen calibration into this registers (see "Data types" section)
Sensor identifier	R	3344	ASCII[16]	Sensor identifier with serial number (16 registers with 32 characters)


Start
deactivate temporary coefficients
restore original state for calibration
enter the number of measurements for averaging
perform offset calibration?
Yes
1. Measurement point
No
2. Measurement point
move sensor slowly in a Na_2SO_3 solution for 5 minutes
trigger measurement and read results, write target value
set bit 3
hold sensor in clean water (10 Min)
remove sensor from water, trigger measurements and read results, write target value
set bit 6
calibration values alright?
No
Yes
save calibration
End

External compensation of temperature, salinity and atmospheric pressure

The adjustments for each parameter can be activated separately. The value 1 hereby activates the external correction, whereas 0 deactivates it. The temperature is an exception. 0 is used for the internal temperature correction.

Unit	Register
%	166
mg/L	167
ppm	168



NOTICE **These setting are only saved temporarily and are lost after a restart.**

To use an external temperature measurement, it has to be written into the registers 93/94 as a float (unit °C) and activated in the registers 166,167 or 168 with 00 00 00 00 0**0 01** 00 00.

To use a correction for the atmospheric pressure, it has to be written into the registers 95/96 as a float (unit hPa) and activated in the registers 166,167 or 168 with 00 00 00 00 0**0 10** 00 00.

To use a correction value for the salinity, it has to be written into the registers 97/98 as a float (unit ppt) and activated in the registers 166,167 or 168 with 00 00 00 00 0**1 00** 00 00.

To activate more than one correction, it is possible to set all Bits to 1 (active).

Example: Sample for register 166, 0167 and 168.

HEX	DEC	BIN	
0x0070	112	00 00 00 00 0**1 11** 00 00	All three corrections are activated
0x0060	96	00 00 00 00 0**1 10** 00 00	Salinity and pressure activated, temperature internal
0x0040	64	00 00 00 00 0**1 00** 00 00	Salinity activated, pressure deactivated and temperature internal

Calibration of DO sensor via Modbus

To calibrate the sensor using Modbus, measurements have to be triggered and results have to be read continuously. The frames are specified for the factory default slave address 10 (0A). This can be changed if necessary. The CRS is also calculated with the modbus address 10 and has to be recalculated when changed.

Actions before calibration

- Deactivate the use of temporary coefficients. Write a 0 in register 331 and 333. Frame: **0A** 10 01 4C 00 02 04 00 00 00 00 **DF 7E**
- Restore original state of calibration. Write a "1" into register 76. Frame: **0A** 10 00 4C 00 01 02 00 01 **1A AC**
- Enter the number of measurements to average. Set the number is register 170 to 25(or whatever you choose from 1-50) . Frame: **0A** 10 00 AA 00 01 02 00 19 **0C A0**

Measurement point (if required)

- Prepare a sodium sulfite solution (Na2SO3) (17g in 125mL DI water). Move sensor around in the solution. Leave the sensor in the solution. Leave the sensor in solution until the measurement value stabilizes.
- Measurements have to be triggered and results to be read continuously by writing the value 31 into Register 1 and then then waiting for 2 seconds until the measurements. Trigger frame measurement: **0A** 06 00 01 00 1F **98 99** Read frame result: **0A** 03 00 00 53 00 08 **B5 66,** Write the target value 0 as a float into registers 516/517; Frame : **0A** 10 01 4C 00 02 04 00 00 00 00 **DE BD**
- Put bit 3 into register 333(lower half of the long-value into registers 332 and 333), for the offset, that was just calculated, to be used.
- Take the sensor out of the solution and place in clean water for 10 minutes.
- Then take the sensor out of the water and hold in air and continuously preform measurements by writing the value 31 into register 1 and waiting for about 2 seconds before reading the measurements. Trigger frame measurement : **0A** 06 00 01 00 1F **98 99.** Read frame result: **0A** 03 00 53 00 08 **B5 66**