SZ504-A

Online Dissolved Oxygen Sensor

User Manual

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Catalog

Preface

Dear customer

Thank you for using our product . Reading the entire manual before use is highly recommended for operation and maintenance the instrument and out of unnecessary trouble.

Please observe the operating procedures and precautions in this manual.

To make sure the effective after-sales protection provided by the instrument, please do not use any operation or maintenance other than which mentioned in the manual.

Due to non-compliance with the precautions specified in this manual, any fault and loss caused shall not be covered by the warranty, and the manufacturer shall not bear any relevant responsibility. If you have any questions, please contact our after-sales service department or representative.

Carefully unpack the instrument and accessories from the shipping container, and inspect for possible damage during shipping. Check received parts with items on the packing list. If any parts or materials are damaged or missing, please contact our customer service or the authorized distributor immediately. Save all packing materials until you are sure that the instrument functions properly. Any damaged or defective items must be returned in their original packaging materials.

1 Overview

Our Optical dissolved oxygen sensor measures dissolved oxygen using the principle of oxygen dynamic luminescence quenching technique. When blue light excites sensor film, the sensing film emits red light. The phase difference between the blue excitation and returned red emission is measured, and the result is used to calculate DO concentration.

Features:

Membraneless, no electrodes design,

No oxygen consumption, No H2S Interference,

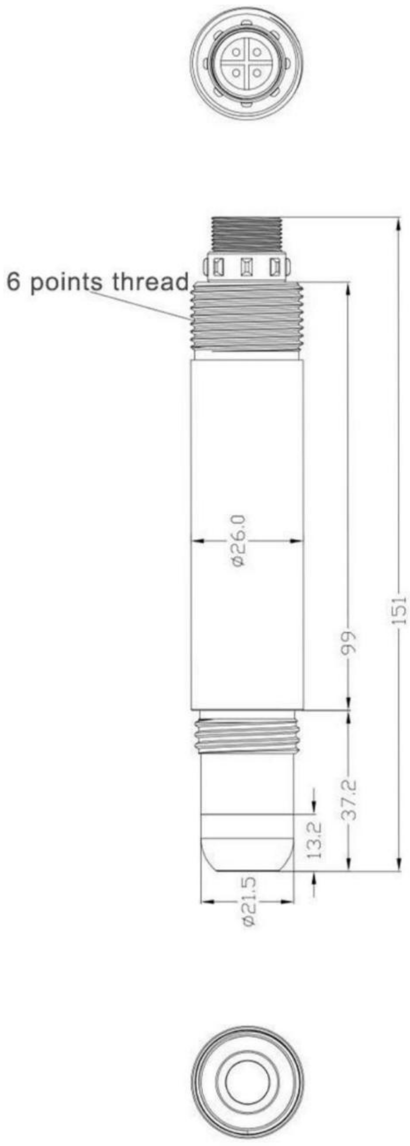
Automatic temperature compensation,

Low Drift, fast response, and more accurate,

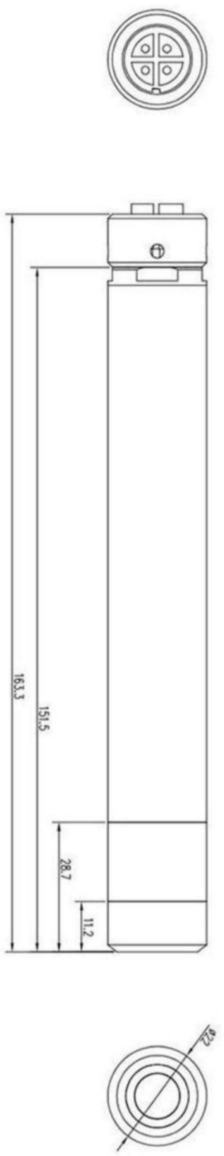
RS-485; MODBUS protocol compatible.

1.1 Introduction

▲ Dissolved Oxygen Sensor ▲ Dissolved Oxygen Sensor (Multi-parameter)



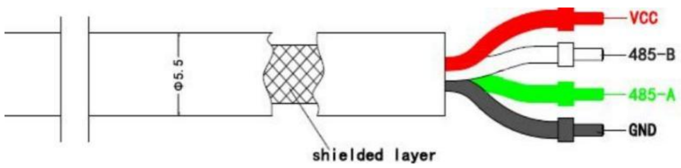
▲ Dissolved Oxygen Sensor Size



▲ Dissolved Oxygen Sensor Size (Multi-parameter)

1.2 Definition of cable

Wire AWG-24 or AWG-26 shielding wire. OD=5.5mm



1, Red—Power (VCC)
2, White—485 Date_B (485_B)
3, Green—485 Date_A (485_A)
4, Black—Ground (GND)

1.3 Technical parameters

Name	Dissolved oxygen sensor	
Principle	Fluorescence	
Range	0-20mg/ L or 0-200% saturation	
Accuracy	±1%	
Housing IP Rating	IP68	
Maximum water depth	60m	20m
Response Time	20sec	
Drift	<1% per year	
Temperature range	0- 50℃	
Temperature accuracy	±0.2℃	
Sensor Interface	Supports RS-485, MODBUS protocol	
Power	0.1W(Power supply： DC 9-24V， >50mA)	
Construction	G3/4 thread	Multi-parameter Matrix Interpolation
Temperature Sensor	NTC	
Sensor size	Φ26mm*187mm (with protective cover)	Φ22mm*163.3mm
Probe cable length	10m (default), customizable	No
Calibration	one-point or two-points calibration	
Fluorescent cap life	1 Year （at normal use）	
Sensor housing material	Titanium alloy	Titanium alloy+POM

Note:

The above technical parameters are all data under laboratory standard liquid environment.

Sensor life and maintenance calibration frequency are related to actual field conditions.

2 Installation

2.1 Configuration table

Standard configuration	Number	Remarks
DO Sensor	1	
Wires and Cables	1	10m
Protective Cover	1	DO Sensor standard (except multi-parameter)
Rubber protection cap	1	

2.2 Before use

Take off the protect cap:

Please take off the protect cap of Optical dissolved oxygen sensor , before installation and keep them properly for future use.Meanwhile, tighten the protective cover.

2.3 Sensor Installation

(1) Wiring and power supply

① The female and male connector of sensor cable should be screwed tightly to avoid moisture incursio.

② Do not use the sensor cable to pull the sensor! It is required to install sensor in a secure and stable mounting bracket.

③ Make sure power supply voltage is correct before power on.

(2) Sensor installation

① It is recommended to install the sensor vertically with electrodes facing down.

② Considering water level change, the sensor should be installed 30cm below water level. The sensor should not be installed no more than 2m below water surface for maintenance purpose.

③ The sensor must be securely installed to avoid damage caused by water flow and other things.

3 Calibration

3.1 Brief description

The dissolved oxygen sensor supports 1-point (normal selection of 100% saturation point) or 2-points calibration in percent/%(in units of 1, e.g. 0.96 for 96% calculation)as a parameter.The 1-point calibration mainly changes the K value, while the 2-points calibration changes the K and B values.

The calibration tool can be used with our Smart PC software or according to the dissolved oxygen sensor communication protocol.

3.2 Calibration Solution Preparation

Preparation for zero oxygen environment: take 200mL distilled water and pour it into the prepared beaker, then add anhydrous sodium sulfite, add and stir at the same time, until anhydrous sodium sulfite is insoluble and solid crystallization occurs, then the standard solution can be regarded as close to 0 oxygen.

Preparation for 100% oxygen environment: Prepare 1 beaker, take 200mL purified water (or distilled water) and pour it into the cup, add to the air pump, and fully aerate the solution (at least 30 minutes).

Note: If the field conditions really do not allow, the sensor can be directly put into the air (calibration accuracy will be slightly deviated).

3.3 Calibration (take 2-points calibration as an example)

First restore the user calibration data to the default, K=1, B=0 (see modbus documentation).

Clean the sensor, place it in a 100 oxygen environment (in air), read the dissolved oxygen value, wait until the data stabilizes and the value approaches 1 (i.e. saturation 100), e.g. 0.96, and record the value as Y.Wash the sensor again into the zero calibration solution, let the front end of the sensor be completely submerged in the solution, read the dissolved oxygen value, wait for the data to stabilize and approach 0, e.g. 0.015, and record as X.

Calculate K and B values according to the following formula: K=(1-0)/(Y-X), B=-KX.

Write K, B values to the sensor. (see modbus documentation for details).

3.4 Appliances and raw materials required

Anhydrous sodium sulfite powder.

Distilled water or deionized water (Watsons distilled Water).

Beakers, gloves, stirring rod, air pump.

4 Maintenance schedule and methods

4.1 Maintenance Schedule

Unlike traditional electrical chemical sensors, optical DO sensors require low maintenance. There are no need for frequent solution filling and calibrations.

Maintenance task	Maintenance intervals (cleaning, calibration)
Cleaning sensors	Cleaning every 30 days
Sensor and sensor cap inspection	Check every 30 days
Sensor cap replacement	Replace once a year
Calibration	Frequent use is recommended every 30 days; occasional use is recommended before each use; or adjust yourself according to the actual working conditions on site.

Note: The maintenance frequency in the above table is only a suggestion, please clean the sensor according to the actual use of the sensor by the maintenance personnel; however, the fluorescent cap replacement, Sensing recommends to replace it once a year.

4.2 Maintenance methods

(1) Sensor maintenance

① **Clean the sensor surface：** Wash the outer surface of sensor with tap water, if there is still residue, using soft brush, for some stubborn dirt, household detergent can be added in tap water to clean.

② **Fluorescent cap external surface cleaning：** Remove the protective cover , flush the dirt on the light window of the sensor with clean water, and finally put the cover on;If you need to wipe it, please wipe it gently with a soft cloth and do not scratch it forcefully. Otherwise, once the fluorescent film is scratched or scratched, the sensor will not work properly.

③ **Clean the cap inner surface:** If water vapor or dust gets inside the fluorescent cap, the cleaning steps are as follows:

Remove the fluorescent cap.

Rinse the inner surface of the fluorescent cap with tap water.

For dirt containing fat and oil, wash it in warm water with household detergent.

Rinse the inner surface of the fluorescent cap with deionized water.

Gently dry all surfaces with a clean flannelless cloth and place in a dry place to allow water to completely evaporate.

④ **Check the cable：** inspect the sensor cable if there is damage.

⑤ **Store the cap：** Regular electrode maintenance requires cap to be stored ina protective cover with a damp sponge and checked and watered regularly, so as to keep the fluorescent film in a moist state for a long time.If the sensor fluorescent cap head is dry for a long time, the measurement results will drift, and it needs to be soaked in water for 48 hours before continuing to work.

(2) Notes

Protect the inner surface of the fluorescent cap from sun exposure.

Do not touch the fluorescent film with your hands.

Avoid applying any mechanical stress (pressure, scratch, etc.) directly to the fluorescent film during use.

5 Frequently Asked Questions

Table 5-1 lists possible problems with sensors and solutions. If your problem is not listed or the solution does not handle your problem, please contact us.

Failure phenomenon	Possible causes	Solution
Probe cannot communicate or does not display measurement results	Controller and cable connection error	Reconnect the controller and cables
	Cable Failure	Please contact us
Unstable DO reading	The outer surface of the fluorescent cap is attached by foreign objects	Clean sensor cap
	Fluorescent cap is damaged	Replace sensor cap
	Fluorescent caps have exceeded their useful life	
	Probe internal hardware failure	Please contact us
Temperature measurement values are out of the measurable range or the readings are garbled	Temperature sensor or probe failure	Please contact us

Table 5-1 List of frequently asked questions

6 Warranty Description

(1) The warranty period is 1 year.

(2) This quality assurance does not cover the following cases.

① Due to force majeure, natural disasters, social unrest, war (declared or undeclared), terrorism, the War or damage caused by any governmental compulsion.

② damage caused by misuse, negligence, accident or improper application and installation.

③ Freight charges for shipping the goods back to our company.

④ Freight charges for expedited or express shipping of parts or products covered by the warranty.

⑤ Travel to perform warranty repairs locally.

(3) This warranty includes the entire contents of the warranty provided by our company with respect to its products.

① This warranty constitutes a final, complete and exclusive statement of the terms of the warranty, and no person or The agent is authorized to establish other warranties in the name of our company.

② The remedies of repair, replacement, or return of payment as described above are exceptional cases that do not violate this warranty, and the remedies of replacement or return of payment are for our products themselves. Based on strict liability or other legal theory, our company shall not be liable for any other damage caused by a defective product or by negligent operation, including any subsequent damage that is causally related to these conditions.

7 Communication protocols

The RS485 communication protocol uses MODBUS communication protocol, and the sensors are used as slaves.

Data byte format.

Baud rate	9600
Starting position	1
Data bits	8
Stop bit	1
Check digit	N

Read and write data (standard MODBUS protocol)

The default address is 0x01, the address can be modified by register

7.1 Reading data

Host call (hexadecimal)

01 03 00 00 00 01 84 0A

Code	Function Definition	Remarks
01	Device Address	
03	Function Code	
00 00	Start Address	See register table for details
00 01	Number of registers	Length of registers (2 bytes for 1 register)
84 0A	CRC checksum, front low and back high	

Slave answer (hexadecimal)

01 03 02 00 xx xx xx xx

Code	Function Definition	Remarks
01	Device Address	
03	Function Code	
02	Number of bytes read	
XX XX	Data (front low and back high DCBA)	See register table for details
XX XX	CRC checksum, front low and back high	

7.2 Writing data

Host call (hexadecimal)

01 10 1B 00 00 01 02 01 00 0C C1

Code	Function Definition	Remarks
01	Device Address	
10	Function Code	
1B 00	Register Address	See register table for details
00 01	Number of registers	Number of read registers
02	Number of bytes	Number of read registers x2
01 00	Data (front low and back high DCBA)	
0C C1	CRC checksum, front low and back high	

Slave answer (hexadecimal)

01 10 1B 00 00 01 07 2D

Code	Function Definition	Remarks
01	Device Address	
10	Function Code	
1B 00	Register Address	See register table for details
00 01	Returns the number of registers written	
7D 2D	CRC checksum (front low and back high)	

7.3 Calculating CRC Checksum

(1) Preset one 16-bit register as hexadecimal FFFF (i.e., all 1s) and call this register the CRC register.

(2) Iso-oring the first 8-bit binary data (both the first byte of the communication information frame) with the lower 8 bits of the 16-bit CRC register and placing the result in the CRC register, leaving the upper 8 bits of data unchanged.

(3) Shift the contents of the CRC register one bit to the right (toward the low side) to fill the highest bit with a 0, and check the shifted-out bit after the right shift.

(4) If the shifted out bit is 0: repeat step 3 (shift right one bit again); if the shifted out bit is 1, CRC register and polynomial A001 (1010 0000 0000 0001) for the iso-or.

(5) Repeat steps 3 and 4 until the right shift is made 8 times so that the entire 8-bit data is processed in its entirety.

(6) Repeat steps 2 through 5 for the next byte of the communication information frame.

(7) Exchange the high and low bytes of the 16-bit CRC register obtained after all bytes of this communication information frame have been calculated according to the above steps.

(8) The final CRC register content is obtained as follows: CRC code.

7.4 Register Table

Start address	Command Description	Number of registers	Data format (hexadecimal)
0x0700H	Get Software and Hardware Rev	2	4 bytes in total 00 ~ 01: hardware version 02 ~ 03: software version For example, reading 0101 represents 1.1
0x0900H	Get SN	7	14 bytes in total 00: reserved 01 ~ 12: serial number 13: Reserved The 12 bytes of the serial number are translated according to ASCII code, i.e. the factory serial number
0x1100H	User calibration K/B (read/write)	4	Total 8 bytes 00~03: K 04~07: B To read K for example, read out as 4 bytes of data (low bit in front, DCBA format, need to convert this data to floating point, see below for conversion method) To write k, for example, we need to convert k to 32-bit floating point and write it in (DCBA format)
0x2700H	Fluorescent cap parameters Settings	16	32 bytes in total 00~03： L0 04~07： L1 08~11： L2 12~15： L3 16~19： TanZero 20~23： T0 24~27： T1 28~31： T2 DCBA format, this data needs to be converted to floating point numbers, see below for conversion method
0x2600H	Dissolved oxygen value acquisition	6	12 bytes in total 00~03: Temperature values 04~07: Dissolved oxygen percentage 08~011: Dissolved oxygen mg/L Reads the temperature value / dissolved oxygen value as 4 bytes of data each (low bit first, DCBA format, this data needs to be converted to floating point numbers, see below for conversion method)

0x2000	Temperature calibration TK/TB (read/write)	4	Total 8 bytes 00~03: TK 04~07: TB To read TK for example, read out as 4 bytes of data (low bit in front, DCBA format, need to convert this data to floating point, see below for conversion method) To write Tk, for example, we need to convert Tk to 32-bit floating point and write it in (DCBA format) **Note: TK and TB should be read and written together**
0x3000H	Device address (read/write)	1	Total 2 bytes 00~01: Device address Settable in the range 1 to 254 e.g. get data as 02 00 (low bit first means address is 2) To write to address 15, for example, write 0F 00 (lower bit first) to the corresponding address When the current device address is unknown, FF can be used as a generic device address to interrogate the current device address
0x1500H	Setting salinity values (reading and writing)	2	4 bytes in total 00~03: Salinity values (Default 0, units ppt, DCBA format, this data needs to be converted to floating point numbers, see below for conversion)
0x2400H	Set the air pressure value(reading and writing)	2	4 bytes in total 00~03: Air pressure values Default standard atmospheric pressure 101.325 in kpa, DCBA format, this data needs to be converted to floating point numbers, see below for conversion

7.5 Conversion algorithms for floating point numbers

7.5.1 Converting floating point numbers to hexadecimal numbers

Step 1: Convert the floating point representation of 17.625 to binary floating point

First find the binary representation of the integer part

$17 = 16 + 1 = 1 \times 2^4 + 0 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$

So the binary representation of the integer part 17 is 10001B

Then find the binary representation of the fractional part

$0.625 = 0.5 + 0.125 = 1 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3}$

So the binary representation of the decimal part 0.625 is 0.101B

So the floating point number in binary form for 17.625 expressed in floating point form is

10001.101B

Step 2: Shift to find the exponent.

Shift 10001.101B to the left until there is only one place left before the decimal point to get 1.0001101B, and

10001.101B = 1.0001101 B x 2^4 . So the exponential part is 4, which, when added to 127, becomes 131, whose binary representation is 10000011B

Step 3: Calculate the end number

Removing the 1 before the decimal point of 1.0001101B gives the trailing number 0001101B

(because the 1 before the decimal point must be 1, the IEEE specifies that only the one after the decimal point should be recorded). An important note for 23-bit trailing numbers: the first bit (i.e. the hidden bit) is not compiled. The hidden bit is the bit to the left of the separator, which is usually set to 1 and suppressed.

Step 4: Symbol bit definition

A positive number has a sign digit of 0 and a negative number has a sign digit of 1, so 17.625 has a sign digit of 0.

Step 5: Convert to floating point

1 digit sign + 8 digits exponent + 23 digits mantissa

0 10000011 00011010000000000000000B (corresponding to 0x418D0000 in hexadecimal)

7.5.2 Converting hexadecimal numbers to floating point numbers

Step 1: Convert hexadecimal number 0x427B6666 to binary floating point number 0100 0010 0111 1011 0110 0110 0110 0110 0110B into sign, exponent and mantissa bits

0 10000100 11110110110110011001100110b

1 digit sign + 8 digits exponent + 23 digits mantissa

Sign bit S: 0 表示正数

Index bit E: 10000100B = 1× 2^7 +0× 2^6 +0× 2^5 +0× 2^4 +0 × 2^3 +1× 2^2 +0× 2^1 +0× 2^0

=128+0+0+0+0+0+4+0+0=132

Last digit M: 11110110110011001100110B = 8087142

Step 2: Calculating floating point numbers

$$D = (-1)^S \times (1.0 + M/2^{23}) \times 2^{E-127}$$

$$= (-1)^0 \times (1.0 + 8087142/2^{23}) \times 2^{132-127}$$

= 1 x 1.964062452316284 x 32

= 62.85