



User Manual

Optical Dissolved Oxygen Sensor

ODO-110



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General Introduction

The ODO-110 fluorescent dissolved oxygen sensor uses the "dynamic fluorescence quenching" principle to measure dissolved oxygen in water. The membrane at the tip of the sensor is coated with a fluorescent material. When blue light emitted by a light-emitting diode (LED) irradiates the fluorescent material, the fluorescent material emits fluorescence when returning from the excited state to the ground state, and this fluorescence is the measurement signal. The higher the dissolved oxygen concentration, the shorter the fluorescence lifetime. By measuring the fluorescence lifetime, the dissolved oxygen concentration can be calculated. Built-in temperature and pressure sensors automatically compensate the dissolved oxygen value.

Features:

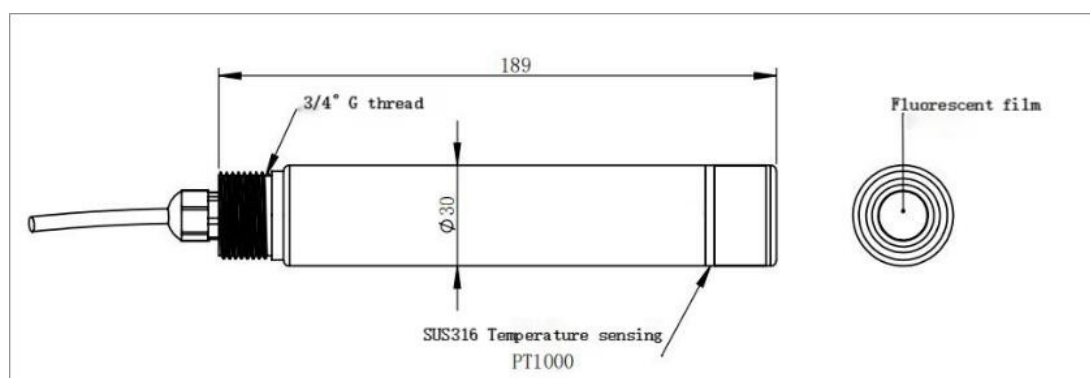
- Digital sensor, directly outputs RS-485 digital signal, supports MODBUS/RTU.
- Built-in temperature and pressure sensors for automatic compensation; built-in salinity compensation.
- Optical design, no electrolyte consumption, no oxygen consumption during measurement.
- Added optical filtering design, resistant to light source interference, good stability.
- No warm-up required, no electrode polarization required, fast response, fastest response 40 seconds (T90).
- Fluorescent cap is easy to replace, lower maintenance cost, long service life.
- Surface undergoes anti-corrosion treatment.
- Low sensor power consumption, internal circuit anti-interference design.

Application:

Online monitoring of river water quality, industrial wastewater, environmental protection water treatment, Fish/shrimp farm, fermentation, BOD testing, toxicology, physiology, etc.;

Note: Different application fields, according to high temperature and pressure, strong acid-base, corrosive media, etc., different characteristics of electrode probes should be selected.

Dimensional drawing

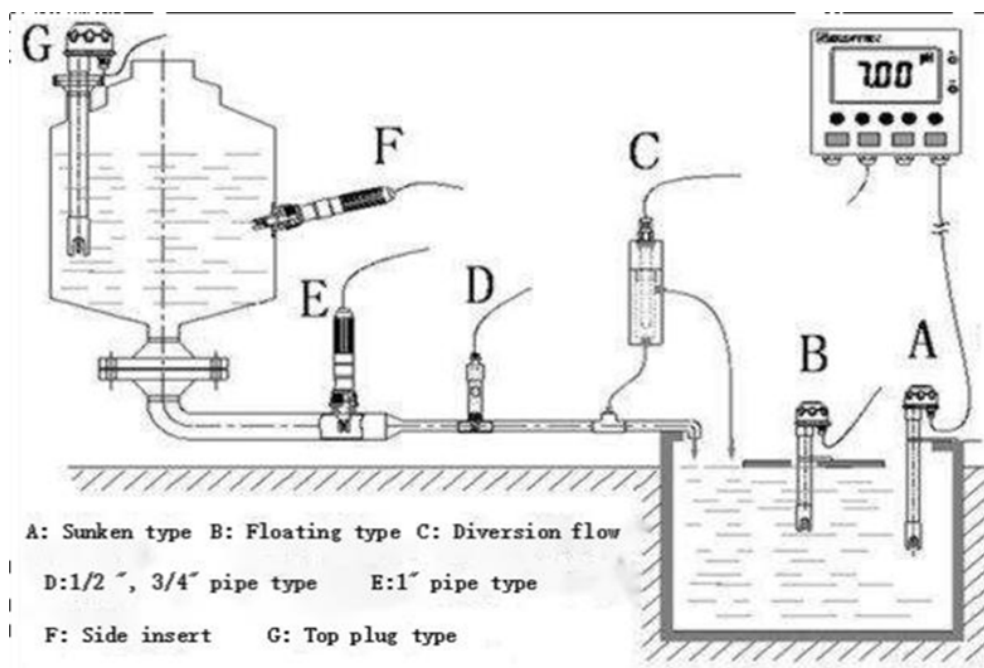


Technical parameters

Name	Parameters
Output Signal	Support RS-485, MODBUS/RTU protocol
Measurement Method	fluorescence quenching
Range	0~20 mg / L (0-200% saturation)
Accuracy	±3%F.S., ±0.5°C
Resolution	0.01mg/L, 0.1°C
Working Conditions	0 ~ 45°C; <0.2 MPa
Calibration Mode	Two-point calibration
Response Time	60 seconds, T90
Temperature Compensation	Automatic temperature compensation (PT1000)
Power Supply	12 or 24 VDC +/- 10%, 20 mA;
Dimensions	Diameter 30 mm; Length 189 mm;
Protection Grade	IP68; Water depth up to 20 depth
Lifespan	Sensor 1year; membrane head 6months
Cable Length	10 m (default), customizable
Sensor Housing Material	POM; customizable

Installation Notes and Wire Connection

1. Installation



Note: Install the sensor in an area with slow water flow and no bubbles.

2. Electrical connection

- Brown wire - power supply (12 or 24 VDC)
- Black wire - Ground
- Blue wire - 485A.
- White wire - 485B.
- Bare wire - shielding layer

Sensor cable: 4-wire AWG-24 or AWG-26 shielded wire.

Outer diameter: 6.0-6.2mm.

Flexible twisted pair shielded cable.

Calibration

1. Zero calibration

Weigh 2 g of sodium sulfite and add it to 98 mL of distilled water. Stir evenly with a glass rod to obtain an excess 2% sodium sulfite solution, preparing oxygen-free water. Insert the sensor into the oxygen-free water. After the value stabilizes, send the zero-point calibration command. The value stabilizes in about 3 minutes. Note: After removing the sensor from the sodium sulfite solution, rinse the sensor surface with distilled water or deionized water, and blot dry with a soft cloth.

2. Slope calibration

Place the sensor in water-saturated air to calibrate the slope. Insert the sensor into a container filled with distilled water (Note: the sensor probe should be 2 cm above the water surface), keep the sensor probe moist without water droplets. After the value stabilizes, send the slope calibration command. The value stabilizes in about 3 minutes.

Note: Air-saturated water can also be prepared for slope calibration: Add distilled water to thermostatted water, use a bubbler to continuously aerate the water for more than 1 hour, stop aeration, and let stand for 20 minutes to prepare air-saturated water. Insert the sensor for slope calibration.

Attached Table:

Table A.1 gives the theoretical mass concentration of oxygen in pure water, $\rho(\text{O})$, in mg per liter of pure water, under standard atmospheric pressure (101.325 kPa), in the presence of water-vapor-saturated air with an oxygen volume fraction of 20.94%.

Table A.1 Functional relationship of oxygen solubility with water temperature and salinity

Temperature (degree C)	Theoretical mass concentration of dissolved oxygen [$\rho(O)_s$] (mg/L) under standard atmospheric pressure (101.325 kPa)	Correction value for theoretical mass concentration of dissolved oxygen when salinity in water increases by 1 g/kg [$\Delta\rho(O)_s$] (mg/L) / (g/kg)	Temperature (degree C)	Theoretical mass concentration of dissolved oxygen [$\rho(O)_s$] (mg/L) under standard atmospheric pressure (101.325 kPa)	Correction value for theoretical mass concentration of dissolved oxygen when salinity in water increases by 1 g/kg [$\Delta\rho(O)_s$] (mg/L) / (g/kg)
0	14.62	0.0875	21	8.91	0.0464
1	14.22	0.0843	22	8.74	0.0453
2	13.83	0.0818	23	8.58	0.0443
3	13.46	0.0789	24	8.42	0.0432
4	13.11	0.0760	25	8.26	0.0421
5	12.77	0.0739	26	8.11	0.0407
6	12.45	0.0714	27	7.97	0.0400
7	12.14	0.0693	28	7.83	0.0389
8	11.84	0.0671	29	7.69	0.0382
9	11.56	0.0650	30	7.56	0.0371
10	11.29	0.0632	31	7.43	
11	11.03	0.0614	32	7.30	
12	10.78	0.0593	33	7.18	
13	10.54	0.0582	34	7.07	
14	10.31	0.0561	35	6.95	
15	10.08	0.0545	36	6.84	
16	9.87	0.0532	37	6.73	
17	9.66	0.0514	38	6.63	
18	9.47	0.0500	39	6.53	
19	9.28	0.0489	40	6.43	
20	9.09	0.0475			

Maintenance and precautions

1. Maintenance

- It is recommended to clean attached substances on the sensor membrane cap every 30 days; avoid using hard objects that may scratch the fluorescent membrane cap during cleaning; please wipe with a soft damp cloth.
- It is recommended to rinse the sensor surface with a water stream. If debris remains, please wipe with a wet soft cloth.

2. Precautions

- Fluorescent membrane cap: Do not scratch the fluorescent membrane cap with sharp objects; once the fluorescent material is scraped off, dissolved oxygen cannot be measured accurately, and the fluorescent membrane cap needs to be replaced.
- Replacing the fluorescent cap: The fluorescent cap is connected to the sensor body by threaded fastening, with a waterproof sealing ring in between; do not omit the sealing ring when replacing.
- Installation and measurement: Avoid installation and measurement in locations with turbulent water flow to reduce the impact of water flow bubbles on measurement.
- Daily storage: When not in use for a long time, store with a protective cover containing a moist protective cotton. After long-term dry storage, soak for 48 hours before use.
- Recommendation: Optionally purchase our company's protective cover to prevent microbial attachment from affecting measurement results.

Trouble shooting tips

Issue	Cause	Tips
Operation interface cannot connect or does not display the measurement	Incorrect cable wiring	Check the wiring method
	Incorrect sensor address	Check / find the address via our tool
The measurement results high/low, or continuously unstable	Sensor probe attached by foreign matter	Clean the sensor window surface
	Bubbles at the measurement location	Remove bubbles

Quality and Service

Thank you for choosing our product.

Shanghai ChiMay provides after-sales service of the machine within one year from the date of sale but does not include the damage caused by improper use. If you need repair or adjustment, please send it back, but the freight must be paid for by yourself.

Accessories and spare parts

Item	QTY (pcs)
Sensor	1
User Manual	1
Certificate of Conformity	1
Boot	1 (optional)

Data Communication

1. Introduction to Modbus protocol

Modbus protocol is a general communication protocol which has been widely used in the field of industrial control. Through this protocol, controllers can communicate with each other or with other devices over a network, such as Ethernet. Modbus protocol uses the master-slave communication technology, that is, the master device actively queries and operates the slave device.

- The master device sends requests to the slave device
- The slave device analyzes and processes the request of the master device, and then sends the result to the master device
- If anything goes wrong, an exception function code will be returned from the device Modbus RTU

Communication mode Frame format

Device Address	Function code	Data	CRC is eight digits lower	CRC is eight places higher
8bit	8bit	n * 8bit	8bit	8bit

- In RTU mode, the transmission of a message must commence with a pause interval of at least 3.5 character times. The first field to be transmitted is the device address. Network devices continuously monitor the network bus, including during the pause intervals. Upon receiving the first field (the address field), each device decodes it to determine if the message is intended for itself. Following the last transmitted character, a pause of at least 3.5 character times signifies the end of

the message. A new message may then begin after this pause.

- The entire message frame must be transmitted as a continuous stream. If there is a pause of more than 1.5 character times before the frame is completed, the receiving device will flush the incomplete message and assume that the next byte is the address field of a new message.

2. Information frame format

The default data format for Modbus communication of the sensor is:

MODBUS-RTU	
Baud rate	9600 (by default)
Device address	1 (by default)
Data bit	8-bit
Parity check	N/A
Stop bit	1-bit

a. Function code 03H: read the register value

Host sending

1	2	3	4	5	6	7	8
ADR	03H	Start register high byte	Start register low bytes	Start register high byte	Start register low bytes	CRC lower byte	CRC high byte

Byte 1: ADR: Slave address code (=001~254)

Byte 2 03H: read register value function code

Bytes 3 and 4: Start address of the register to be read

To read FCC downlink meter,

Bytes 5 and 6: The number of registers to read

Bytes 7 and 8: The CRC16 checksum from bytes 1 to 6

Host sending:

1	2	3	4、5	6、7		M-1、M	M+1	M+2
ADR	03H	Total bytes	data register 1	data register 2	...	data register M	CRC low byte	CRC high byte

Byte 1 ADR: Address code of the slave machine (=001~254)

Byte 2 03H: Read register value function code

Byte 3: The total number of bytes from 4 to M(including 4 and M)

Bytes 4 to M: data registers

Bytes M+1、M+2 : CRC 16 checksum from byte 1 to M

When an error is received from the slave, send it back from the slave:

1	2	3	4	5
ADR	83H	information code	CRC low byte	CRC high byte

Byte 1 ADR: Address code of the slave machine (=001~254)

Byte 2 83H: Error reading register value

Byte 3 information code: 01 – Function code wrong

03 – DATA ERR

Bytes 4、5 : CRC 16 checksums from bytes 1 to 3

b) Function Code 06H: Write a single register value

Host sending:

1	2	3	4	5	6	7	8
ADR	06	Register high byte address	Register low byte address	High byte of data	Low byte of data	CRC code the low byte	CRC code the high byte

When the slave receives correctly, the slave sends back:

1	2	3	4	5	6	7	8
ADR	06	Register high byte address	Register low byte address	High byte of data	Low byte of data	CRC code the low byte	CRC code the high byte

When the slave receives an error, the slave sends back:

1	2	3	4	5
ADR	86H	Error code information code	CRC Code the low byte	CRC Code the high byte

Byte 1 ADR: Address code of the slave machine (=001~254)

Byte 2 86H: Write register value error function code

Byte 3 Error code information code: 01 – Function code wrong

03 – DATA ERR

Bytes 4、5 : CRC checksums from bytes 1 to 3

3. Data structure types

Integer

unsigned short

The data consists of two integers

XXXX XXXX	XXXX XXXX
Byte1	Byte0

Float

Floating-point type, conform to IEEE 754 (single precision);

The data consists of 1 symbol bit, 8-bit exponent, and a 23-bit mantissa

XXXX XXXX	XXXX XXXX	XXXX XXXX	XXXX XXXX
Byte3	Byte2	Byte1	Byte0
sign bit	Exp Index place	F decimal place	

4. Register address

Register address	Name	Read/Write	Explanation	Number of registers (byte)	Data type
0x0100	Temperature value	R	°C value x10 (e.g :25.6 temperature displays as 256, default 1 decimal)	1 (2 Bytes)	unsigned short
0x0101	ODO value	R	mg/L valuex100 (e.g.: 1.02mg/L ODO displays as 102, default 2 decimal places)	1 (2 Bytes)	unsigned short
0x0102	ODO saturation value	R	saturation valuex10 (e.g.: 50.5% saturation is 505, default 1 decimal place)	1 (2 Bytes)	unsigned short
0x0107	humidity measurement	R	%RH value x10 (e.g.: 11.3% relative humidity displays as 113, default 1 decimal)	1 (2 Bytes)	unsigned short
0x1000	temperature correction	R/W	Temperature calibration: write the data as the actual temperature value x10; The readout data is the temperature calibration offset x10	1 (2 Bytes)	unsigned short
0x1001	ODO zero calibration	R/W	The calibration in anaerobic water, write data is 0; readout data is zero offset.	1 (2 Bytes)	unsigned short
0x1003	ODO slope calibration	R/W	The calibration in air saturated water, write data is 0; readout data slope is 1000.	1 (2 Bytes)	unsigned short
0x1100	Sensing switch	W	Turn the sensor measurement function on or off. Turn off measurement when write data is 0 and when write data is 1. The sensor is powered on by default.	1 (2 Bytes)	unsigned short
0x2000	address sensor	R/W	The default is 1, and the data range is 1-127	1 (2 Byte)	unsigned short
0x2003	Baud rate setting	R/W	Default is 9600 write 0 is 4800; Write 1 as 9600; Write 2 as 19200	1 (2 Bytes)	unsigned short
0x2020	Factory Reset	W	The calibration value is restored to the default value and the written data is 0. Note that the sensor needs to be calibrated again before it can be used after reset	1 (2 Bytes)	unsigned short

5. Example command

Default register:

a) Change slave address:

Address: 0x2000 (48193)

Number of registers: 1

Function Code: 0x06

Default sensor address: 01

Change the Modbus device address of the sensor and change the device address 01 to 06, as show below:

Send instruction: 01 06 20 00 00 06 02 08

Response: 01 06 20 00 00 06 02 08;

Note: Change the address to 06 to save, then power off.

b) Baud:

Address: 0x2003 (48196)

Number of registers: 1

Function Code: 0x06

Default: 1 (9600bps)

Support value: 0-2 (4800-19200bps)

The port rate can be changed on the computer setting, after the port rate change, power off and power on save setting. Porter rate supports 4800,9600,19200. The port rate assigned to the integer values is as follows

Integer	Baud
0	4800 bps
1	9600 bps
2	19200 bps

Send instructions: 01 06 20 03 00 02 F3 CB

Response: 01 06 20 03 00 02 F3 CB

Note: Change the rate to 19200bps to save, then power off.

FR Function Register:

a) Boot-up instruction:

Address: 0x1100 (44353)

Number of registers: 1

Function Code: 0x06

The default power-on is the measurement state. Write 0 turns off the sensor measurement function and write 1 turn on the sensor measurement.

Send instructions: 01 06 11 00 00 01 4D 36

Response: 01 06 11 00 00 01 4D 36

Note: Start the measurement and save.

b) Temperature instructions

Address: 0x0100 (40257)

Number of registers: 1

Function Code: 0x03

Read sample values: 19.2°C

Send instructions: 01 03 01 00 00 01 85 F6

Response: 01 03 02 00 C0 B8 14

Register returns hexadecimal unsigned integer data, Temperature value=Integer/10, keep 1 decimal place.

c) ODO instruction:

Address: 0x0101 (40258)

Number of registers: 1

Function Code: 0x03

Read sample values: 1.05 mg/L

Send instructions: 01 03 01 01 00 01 D4 36

Response: 01 03 02 00 64 B9 AF

The register returns hexadecimal unsigned integer data, with an ODO value =Integer / 100, and retains 2 decimal places.

d) Continuous reading of temperature and ODO value instruction:

Address: 0x0100 (40257)

Number of registers: 2

Function Code: 0x03

Read sample values: 19.2°C and ODO value 1.05 mg/L

Send instructions: 01 03 01 00 00 02 C5 F7

Response: 01 03 04 00 C0 00 64 FB E4

The register returns hex unsigned integer data with temperature value =Integer / 10 and retains 1 decimal place.

The register returns hexadecimal unsigned integer data, with an ODO value =Integer / 100, and retains 2 decimal places.

e) Humidity measurement instruction:

Address: 0x0107 (40264)

Number of registers: 1

Function Code: 0x03

Read sample values: relative humidity 40%

Send instructions: 01 03 01 07 00 01 34 37

Response: 01 03 02 01 90 B9 B8

Register returns hexadecimal unsigned integer data, Humidity=Integer/10, keep 1 decimal place.

f) Calibration instructions:

temperature correction

Address: 0x1000 (44097)

Number of registers: 1

Function Code: 0x06

Calibration sample: Calibration at 25.8°C

Send instructions: 01 06 10 00 01 02 0D 5B

Response: 01 06 10 00 01 02 0D 5B

The sensor needs to be calibrated in a constant temperature environment without temperature fluctuation.

ODO zero calibration

Address: 0x1001 (44098)

Number of registers: 1

Function Code: 0x06

Calibration sample: Calibration in anaerobic water

Send instructions: 01 06 10 01 00 00 DC CA

Response: 01 06 10 01 00 00 DC CA

ODO slope calibration

Address: 0x1003 (44100)

Number of registers: 1

Function Code: 0x06

Calibration sample: Calibration in an air-saturated aqueous solution

Send instructions: 01 06 10 03 00 00 7D 0A

Response: 01 06 10 03 00 00 7D 0A



For other question, feel free to contact us.
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