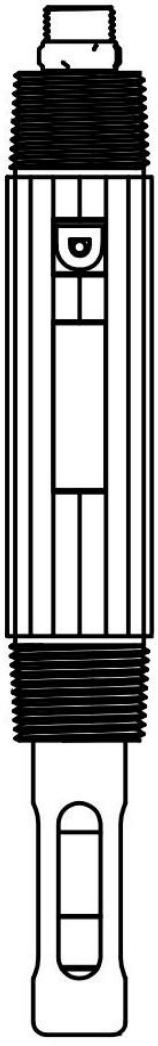
Digital dissolved oxygen sensor

Basic User Manual



Model: OPD790

Version 1.0

Contents

Chapter 1 Specification

Product specifications are subject to change without notice.

Measuring Principle	Fluorescence quenching
DO Measuring Range	Oxygen content: 0,00~20,00 mg/L Saturation: 0 ~ 200% Temperature: 0.0~50.0℃
DO Resolution	Oxygen content: 0,01mg/L Saturation: 1% Temperature: 0.1℃
Accuracy	Oxygen content: ±0.1 mg/L Saturation: ±1% Temperature: ± 0.5 °C
Temp Compensation	Temp Compensation, Salinity Compensation, Barometric Pressure Compensation
Response Time	0-> 100 %； T90< 40s；100 -> 0%；T90< 65s
Calibration Method	Zero calibration and full scale calibration
Working Temp	0°C to 50°C
Storage Temp	-10°C to 60°C
Working Pressure	≤3bar
Sample flow rate / Sample flow	Not depend on
Protection Grade	IP68
Power Requirements	DC 5~12V
Power consumption	0.1W
Measurement frequency	Real-time
Communication interface	RS485 MODBUS
Main Material	Main pole PPS (or ABS), measuring head 316 stainless steel
Shell Dimension	φ35mm, overall length 250mm
Installation size	1" NPT pipe threads on each end
Wire&sensor connection method	M16
Weight	About 260g (without cable)
Cable length	PUR (polyurethane) sheath, standard 5 meters

Chapter 2 Basic Information

2.1 Security Information

Please read this manual completely before unpacking, installing and operating this equipment. Pay special attention to all precautions. Otherwise, it may cause serious personal injury to the operator or damage the equipment.

2.2 Overview

The dissolved oxygen sensor adopts optical measurement technology based on the principle of fluorescence quenching, and the measurement is reliable and accurate without frequent calibration.

The sensor does not require consumables or maintenance during use, which can greatly reduce the cost of use. The only consumption is replacing the membrane cover every two years.

Since the sensor does not consume oxygen, the dissolved oxygen sensor can be used in most measuring environment, even if the flow rate is very low.

Features

- Reduce maintenance work (no need to replace electrolyte) and reduce operating costs
- Low sensor drift and longer calibration interval
- No need to polarize before use
- Fast response time
- No minimum flow rate requirement (no oxygen consumption)

2.3 Dimensions

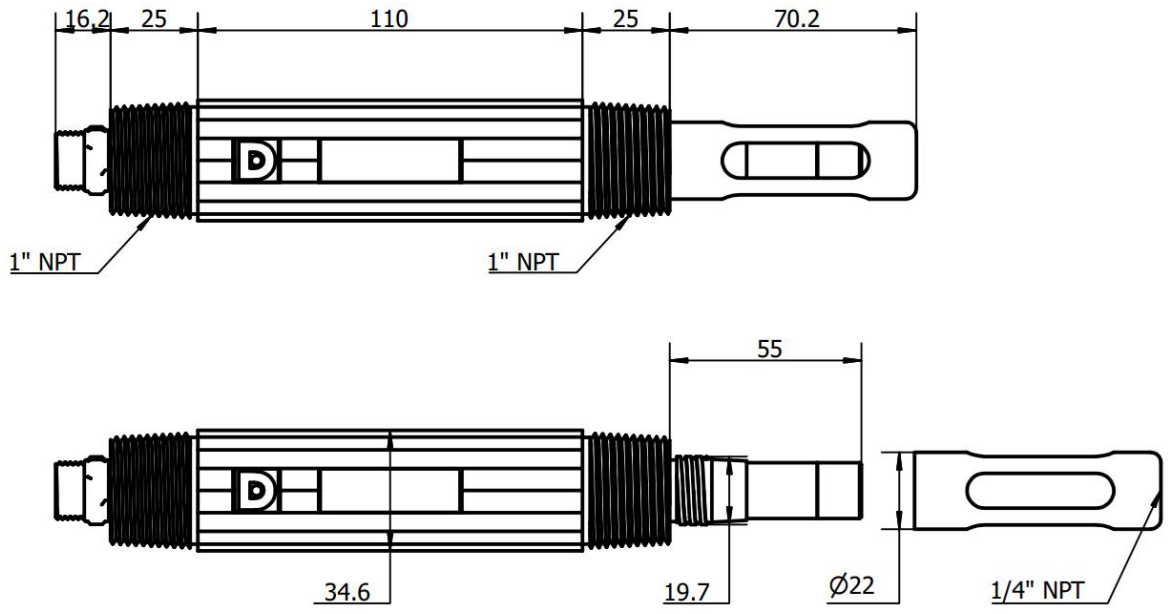


Figure 1 Dimensions of the sensor

Chapter 3 Installation

3.1 Sensor Installation

During immersion installation, the sensor body needs to be fixed to the mounting bracket, and the sensor wire cannot be used to hang it to avoid damage to the sensor.

When installing in an open pool, it is recommended to use a horizontal bracket and hang the sensor bracket to the horizontal bracket by a chain, keeping it a considerable distance from the edge of the pool bank. Refer to the pictures in this section to install and fix the sensor. To ensure that the sensor can measure safely and accurately, please meet the following conditions during installation:

- The bracket must be easily accessible for regular maintenance and cleaning of the sensor or the bracket itself.
- Do not let the stand (and sensor) swing and hit the bank of the pool.
- When the application involves pressure and temperature, ensure that the bracket and sensor meet all the limit parameter requirements.
- Use brackets with elbows when installing in the aeration tank.

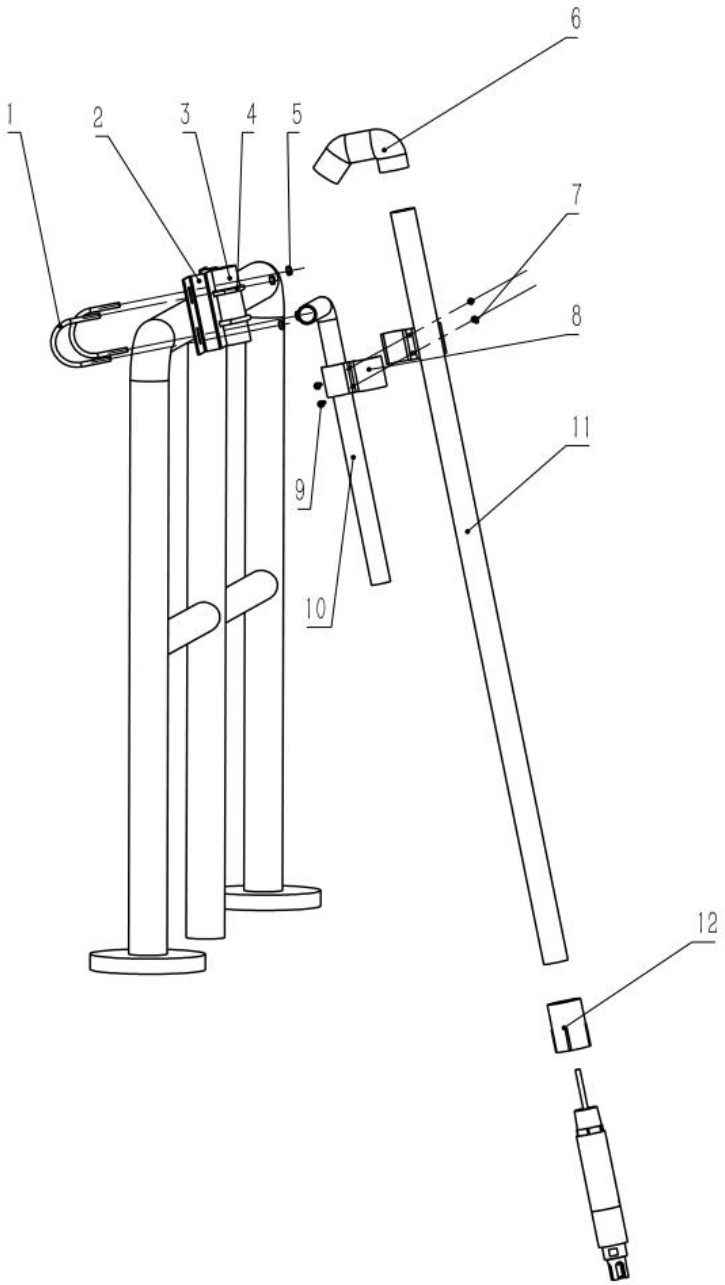


Figure 2 Schematic diagram of railing installation

1- DN60 U-shaped card	7- M4 screw nut*2
2- “⊓”shaped board	8- “8”shaped clip 25&32
3- Handle sleeve	9- M4*25 screw*2
4- DN40 U-shaped card	10- Handle
5- M6 screw nut*8	11- DN32PVC Bracket
6- Rainproof elbow	12-1 inch inner wire straight pipe joint

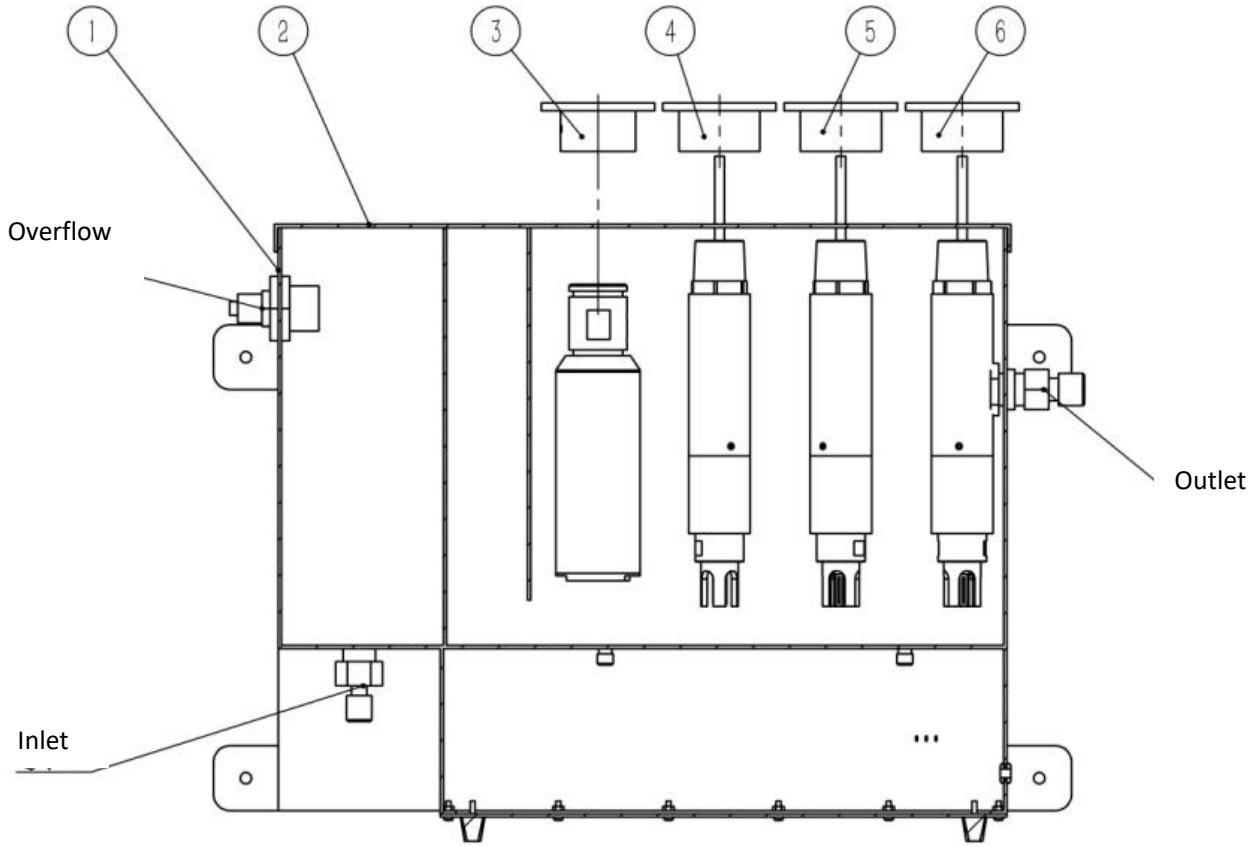


Figure 3 Schematic diagram of flow cell installation

1-Flow cell	4-pH sensor fixed connection cover
2-Flow cell cover	5-DO sensor fixed connection cover
3-Turbidity sensor fixed connection cover	6-Conductivity sensor fixed connection cover

3.2 Sensor Wiring

The sensor is correctly connected as defined in the table below.

Cable Colour	Red	Black	Green	White
Terminal definition	+6~12VDC	Power ground	RS485 A（+）	RS485 B（-）
Terminal symbols	V+	V-	AS	BS

Chapter 4 Use

4.1 Communication Protocol

The sensor communication is RS485 Modbus-RTU. For the specific communication protocol, please refer to the Modbus related protocol description. The default sensor communication address is 1, the baud rate is fixed at 9600, 8 data bits, 1 stop bit, no parity.

4.2 Read Measured Value

The measured value of the sensor can be read by connecting the meter or using other Modbus master devices. Please refer to Appendix A for the Modbus register address. The sensor measurement value data is 4-byte floating point data, and the data sequence is little endian. Pay attention to the conversion sequence.
Example, to read sensor measurements, the host sends
[01 03 26 00 00 06 CE 80]
sensor return
[01 03 0C 00 00 C8 41 00 00 80 3F F6 28 04 41 51 40]
return value
[00 00 C8 41] means the temperature is 25℃
[00 00 80 3F] means dissolved oxygen saturation 100%
[F6 28 04 41] means the dissolved oxygen content is 8.26mg/L

4.3 Sensor Calibration

The sensor provides two measurement calibration methods, one-point calibration and two-point calibration. One-point calibration corrects the sensor slope in a saturated oxygen environment. Usually, one-point calibration can meet the daily calibration maintenance. Two-point calibration, which calibrates sensor zero and slope, this method of calibration provides the greatest possible accuracy, and is especially recommended when measuring low concentrations of oxygen

4.3.1 One Point Calibration

One-point calibration is to calibrate the sensor under the condition that the dissolved oxygen saturation is 100%, which can be done in the following two ways.

a) In air-saturated water (standard method)

- Restore the sensor to factory calibration, set K=1, B=0;
- Prepare air-saturated water (take 500mL as an example) by:

(1) Aeration into distilled water at a flow rate of about 1L/min for about 10 to 20 minutes;
(2) Stir the distilled water with a magnetic stirrer (800rpm) for about 1 hour;

- Put the sensor into air-saturated water, make sure that 1/3 of the sensor is below the water surface, wait for the sensor temperature to balance with the water temperature, and the saturation reading is stable. It usually takes about 1 to 3 minutes, and record the saturation reading X;
- Calculate the factor value K=1/X, and write the calculated K and B=0 into the sensor;
- After the calibration is completed, check the dissolved oxygen saturation reading. If it is not within the range of 100±0.5%, you need to check whether the current environment is stable and calibrate again.

b) In water saturated air (easy method)

When conditions are limited, the sensor can be calibrated by creating a water-saturated air environment in the sensor cover, a method that can introduce up to 2% error if not performed properly.

- Soak the sensor in clean water or tap water for about 2 minutes, restore the factory calibration, set K=1, B=0;
- Take out the sensor, and dry the membrane cover with a soft tissue paper (the black coating on the membrane cover cannot be wiped off) to ensure that there are no visible water droplets in the black area;
- Use clean water to soak the sponge in the protective cover, but there should be no flowing water. Put the sensor into the protective cover, and do not tighten the protective cover. Be careful not to let the black area of the sensor come into contact with water droplets during the whole process;
- Wait for the reading to stabilize (about 2~4 minutes), record the saturation reading X, calculate the factor value K=1/X, and write the calculated K and B=0 into the sensor.

4.3.2 Two Points Calibration

Two-point calibration is based on one-point calibration, and then zero-point calibration is performed to obtain the best measurement accuracy. The calibration method is as follows

- Restore calibration first, set K=1, B=0;
- Perform one point (100%) calibration first, and record the sensor saturation reading as X in 100% environment;
- Prepare oxygen-free water, dissolve about 25g of anhydrous Na2SO3 in 500mL of distilled water, prepare it before use, and do not store it for a long time;
- Put the sensor in oxygen-free water, wait (at least 2 minutes) for the reading to stabilize, and record the saturation reading as Y;
- Calculate the factor K and deviation B according to the formula, and write K and B into the sensor

K=100/(X-Y), B=-KY

Note: After the calibration is completed, the residual sodium sulfite solution on the sensor surface needs to be rinsed with clean water immediately, and then put into use. The sensor should not be immersed in oxygen-free water for a long time, otherwise the sensor membrane will be damaged.

4.3.4 Reset Calibration

Set the sensor factor K to 1 and the bias to 0 to restore calibration.

Chapter 5 Maintenance

The use and maintenance of optical dissolved oxygen is relatively simple, but attention should be paid to the protection, cleaning and replacement of the membrane cover during use.

5.1 Maintenance Cycle

The maintenance plan shows the recommended maintenance intervals. For applications that cause sensor fouling, maintenance tasks should be performed more frequently.

Maintenance Work	**Maintenance Frequency**
Visual inspection	Every month
Cleaning	Every week (According to the environmental of use)
Check calibration	Every month (According to the environmental of use)
Replace the membrane cover	Every 24 months

5.2 Cleaning

Avoid contacting the black coating of the membrane cover with organic solvents, sharp and hard objects, or be severely impacted, otherwise the life of the membrane cover will be greatly reduced. When cleaning the membrane cover, try not to wipe the black coating directly with a paper towel. You can clean the membrane cover with a paper towel after dipping it in water.

5.3 Replace Membrane

If the black coating of the membrane cover is obviously faded, partly peeled off, or the membrane cover is broken, the membrane cover needs to be replaced.
When unscrewing the old membrane cover and replacing it with a new membrane cover, please check the light window of the sensor and the red area on the inner surface of the new membrane cover for debris, fibers and other debris. If so, please clean it before installing the new membrane cover.

5.4 Storage

The dissolved oxygen membrane cover needs to maintain a certain humidity to reduce the rehydration time when it is put into service again. When the sensor is not in use, attach a protective cover with a damp sponge to the sensor. It is also possible to store the sensor in a beaker with clean water for short-term storage.

Appendix A Modbus Register Information

Baud Rate:9600
Data Bits: 8
Parity Bit: NONE
Stop Bit: 1
Slave Address: 1~254, default 1

Item	Register	Data Type	Length	Access Type	Function Code	Description
Salinity	0x1500	Float[Note]	2	R/W	03/16	Salinity compensation value in ppt
ATM	0x2400	Float	2	R/W	03/16	Atmospheric pressure compensation value in kPa
Slave ID	0x3000	Uint16	1	R/W	03/16	Default 1
SN	0x0900	Char	7	RO	03	ASCII format SN string
HW	0x0700	Uint16	1	RO	03	Hardware version
SW	0x0701	Uint16	1	RO	03	Software version
TEMP	0x2600	Float	2	RO	03	Temperature value in ℃
SAT	0x2602	Float	2	RO	03	Saturation value in %
DO	0x2604	Float	2	RO	03	Dissolved oxygen measurement in mg/L
K	0x1100	Float	2	R/W	03/16	Saturation factor value
B	0x1102	Float	2	R/W	03/16	Saturation offset value

Note: The floating-point format is ANSI/IEEE-754 single-precision floating-point numbers, byte order DCBA.