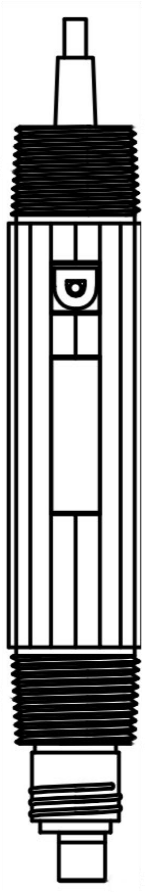
Daruifuno

# Dissolved Oxygen Sensor

## Basic User Manual



Model: OPD79

Version 1.0

# Contents

## Guarantee

Our company seriously warrants each of the instrument for one year (12 months) from the specific date of delivery. Consumables and consumable parts in the equipment are not covered by the warranty. The terms of this warranty shall not apply if damage to the instrument occurs beyond the warranty period, or in the opinion of the company, the breakage or destruction of the instrument is due to improper use, lack of maintenance, improper installation, improper modification, abnormal environmental conditions, etc. The company's obligation under this warranty is limited to providing replacement or repair of this product, as the case may be. The product must be thoroughly cleaned to remove any contaminated chemicals before it is accepted for replacement or repair. Our obligations shall not exceed the price of the product itself. In no event shall the company be liable for damage caused by incidental or consequential damages, whether to persons or objects. The company shall not be liable for any other loss, damage or expense of any kind, including economic loss resulting from the installation, use or improper use of the product.

- For details, please refer to the product's quality promise with the product, and keep this manual and the quality promise properly.

# Chapter 1 Specification

Product specifications are subject to change without notice.

| | |
|---|---|
| Measuring Principle | Fluorescence quenching |
| DO Measuring Range | Saturation 0-200%<br>Dissolved oxygen concentration 0-20mg/L |
| DO Measuring Accuracy | 0-100%<±1%<br>100-200%<±2% |
| DO Resolution | 0.001mg/L, when the measuring range is less than 1mg/L<br>0.008mg/L, when the measuring range is less than 10mg/L<br>0.01mg/L, when the measuring range is 10-20mg/L |
| Temp Accuracy | ±0.2°C |
| Temp Compensation | Full range automatic compensation |
| Response Time | $T_{90}$ less than 60s |
| Calibration Method | One or two points |
| Working Temp | 0 to 50°C |
| Storage Temp | -20 to 70°C |
| Working Pressure | ≤3bar |
| Protection Grade | IP68 |
| Power | 12VDC 60mA |
| Main Material | ABS |
| Shell Dimension | φ35mm　L 198mm |
| Cable Length | Standard 10 meters，length can be customized |

# 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

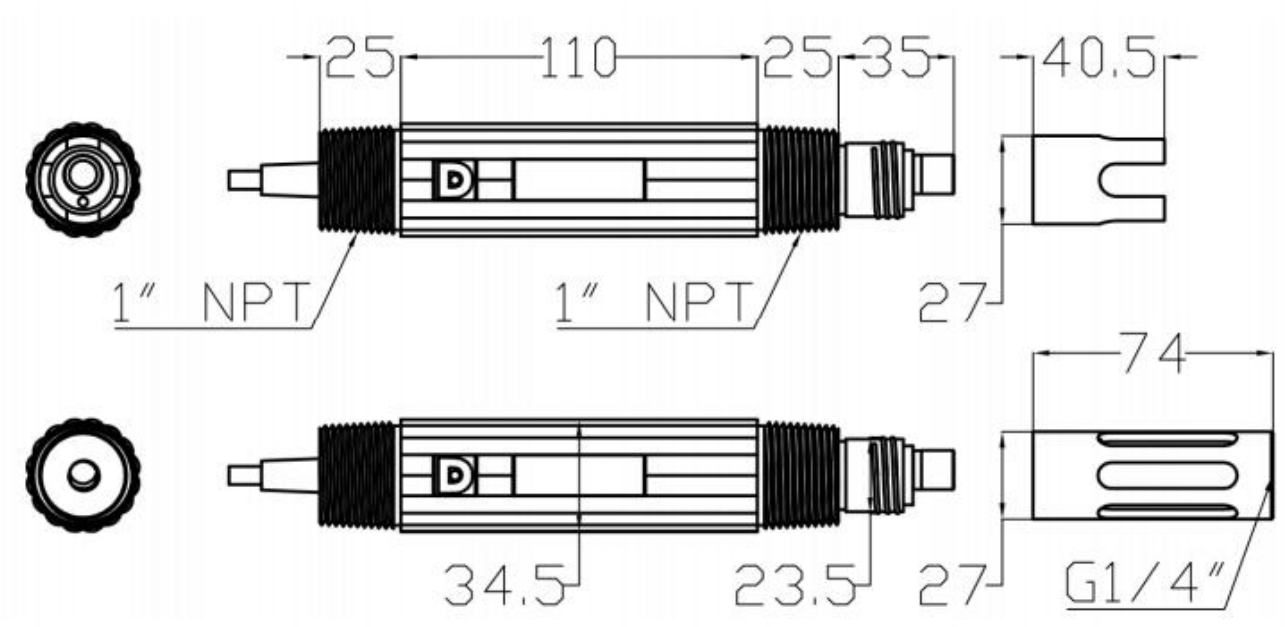



Figure 1 Dimensions of the sensor

# Chapter 3 Installation

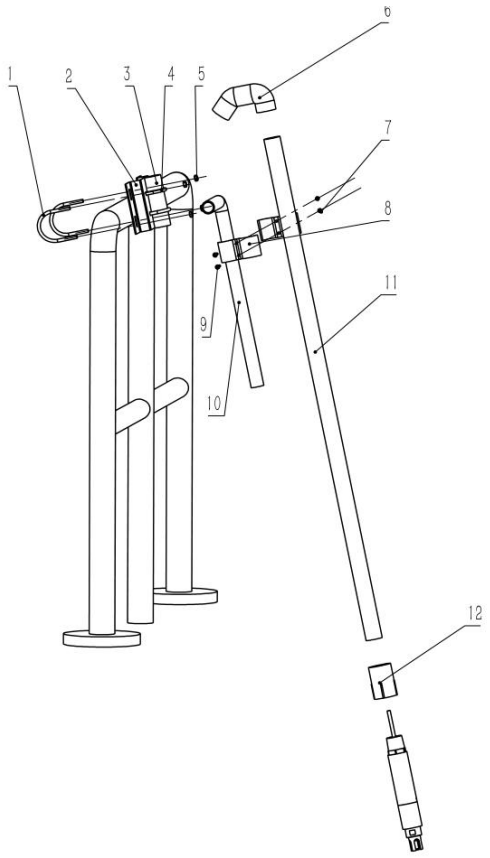
## 3.1 Sensor Installation

The sensor body needs to be fixed to the mounting bracket during immersion installation, and the sensor wire cannot be used to hang it.

Avoid damaging the sensor. When installing in an open pool, it is recommended to use a horizontal bracket and pass the sensor bracket through

The chain is suspended to the horizontal support to maintain 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, the following conditions must be met 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.




| | |
|---|---|
| 1-DN60U card | 7-M48 Nut*4 |
| 2-“几”shaped board | 8-“八”shaped clip 25&32 |
| 3-Handle sleeve | 9-M4*25 screw*2 |
| 4-DN40U card | 10-handle |
| 5-M6 Nut*8 | 11-DN32PVC Bracket |
| 6-Rainproof elbow | 12-1 inch inner wire straight pipe joint |

Figure 2 Schematic diagram of railing installation

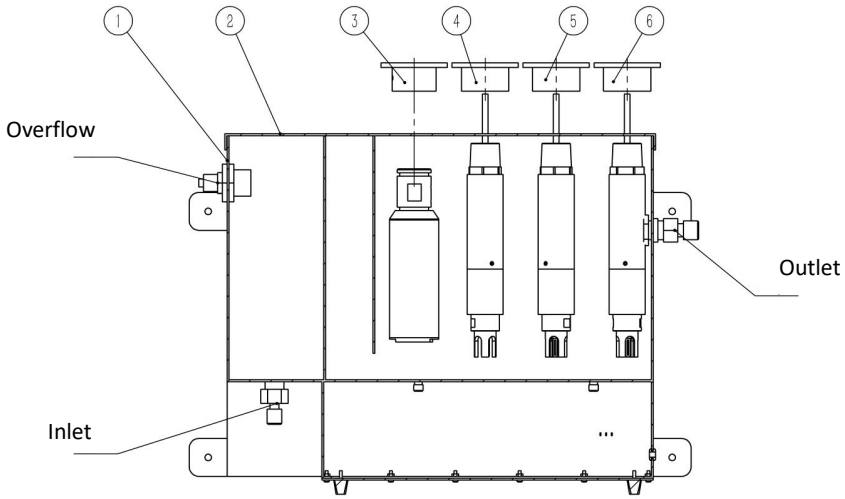



Figure 3 Schematic diagram of flow cell installation

| | |
|---|---|
| 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 | White | Green |
|---|---|---|---|---|
| **Terminal definition** | +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, please refer to Modbus related protocol description for specific communication protocol.
The default communication parameters of the sensor are: communication address=1, baud rate=9600, parity bit=none, stop bit=2 bit, the information parameters can be modified by referring to the register description in Appendix A

## 4.2 Read Measured Value

Sensor measurements can be read by connecting the meter or using other Modbus master devices.Please refer to Appendix A for the Modbus register address of the device.
The sensor measurement data is 4-byte floating point data, and data order is big endian, pay attention to the conversion order.

Example, to read sensor measurements, the host sends
[01 03 01 04 00 08 04 31]
sensor return
[01 03 10 41 04 28 F6 42 C8 00 00 42 CA 00 70 41 C8 00 00 64 52]
return value
[41 04 28 F6] means dissolved oxygen content 8.26mg/L
[42 C8 00 00] means dissolved oxygen saturation 100%
[41 C8 00 00] means the temperature is 25℃

## 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)

- Prepare air-saturated water (500mL as an example) by:

(1) Aeration into distilled water at a flow rate of about 1L/min for about 10~20 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, usually about 1~3 minutes;
- Send one point calibration command [01 06 02 20 00 01 48 78];
- 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;
- Take out the sensor, use a soft paper towel to dry the membrane cover with water (the black coating of the membrane cover cannot be wiped), and 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 touch the water droplets during the whole process;
- Wait for the reading to stabilize (about 2~4 minutes), and send the one-point calibration command [01 06 02 20 00 01 48 78].

### 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. Calibration method as follows.

- Perform one-point (100%) calibration first;
- Prepare oxygen-free water, dissolve about 25g of anhydrous $Na_2SO_3$ in 500mL of distilled water, prepare before use, do not store for a long time;
- Put the sensor in oxygen-free water, wait (at least 2 minutes) for the reading to stabilize, and send the two-point calibration command [01 06 02 20 00 02 08 79];
- After the calibration is completed, check whether the dissolved oxygen saturation reading is 0. If it is not 0, you need to check whether the command is sent correctly and re-calibrate.

***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.*

***Note:*** *It is not possible to do zero calibration alone, you need to perform 100% calibration first, and then perform zero calibration.*

### 4.3.3 Temperature Calibration

The sensor temperature can be calibrated to the input temperature value by writing the integer "temperature value*100" to register 0x000A. For example, to calibrate the temperature to 25°C, the host sends the command [01 06 00 0A 09 C4 AE 0B]

### 4.3.4 Reset Calibration

Reset one point calibration send command [01 06 02 20 00 08 88 7E]
Reset two-point calibration send command [01 06 02 20 00 10 88 74]
Reset temperature calibration send command [01 06 02 20 00 20 88 60]

# 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:** 300, 2400, 4800, 9600 (default), 119200, 38400, 115200
**Data Bits:** 8
**Parity Bit:** NONE
**Stop Bit:** 2
**Slave Address:** 1~254, default 1

| Item | Register | Data Type | Length | Access Type | Function Code | Description |
|---|---|---|---|---|---|---|
| Salinity value×100 | 8 | Unsigned integer | 1 | Read/write | 03/06/16 | Salinity unit ppt |
| Pressure value×100 | 9 | Unsigned integer | 1 | Read/write | 03/06/16 | Pressure unit kPa |
| Temp calibration×100 | 10 | Unsigned integer | 1 | Write only | 03/06/16 | Write temp value×100℃, calibrate temp |
| Read Baud rate | 15 | Unsigned integer | 1 | Read only | 03 | 0=300, 1=2400, 2=2400, 3=4800, 4=9600, 5=11920, 6=38400, 7=115200 |
| Read Slave address | 16 | Unsigned integer | 1 | Read only | 03 | Default 1 |
| Modify Baud rate | 99 | Unsigned integer | 1 | Write only | 06/16 | 0=300, 1=2400, 2=2400, 3=4800, 4=9600, 5=11920, 6=38400, 7=115200 |
| Modify Slave address | 100 | Unsigned integer | 1 | Write only | 06/16 | Address range 1~254 |
| Do value | 260 | Floating point[1] | 2 | Read only | 03 | Do unit mg/L |
| Do Saturation value | 262 | Floating point | 2 | Read only | 03 | Do Saturation unit % |
| Temp value | 266 | Floating point | 2 | Read only | 03 | Temp unit ℃ |
| State value[2] | 271 | Unsigned integer | 1 | Read only | 03 | |
| Calibration bit[3] | 544 | Unsigned integer | 1 | Read/write | 03/06/16 | |

***1: The floating-point format is ANSI/IEEE-754 single-precision floating-point number, and the byte order is ABCD.***
***2: State value bit1 means calibration error; bit3 means temperature over range; bit4 means dissolved oxygen over range.***
***3: For the calibration bit,***
***Write 1 to execute full-scale calibration (100%) in bit0; Write 1 to execute zero-point calibration (0%) in bit1;***
***Write 1 to restore full-scale calibration in bit3; Write 1 to restore zero calibration in bit4;***
***Write 1 to restore temperature calibration in bit5.***

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