

## KWS-650C Online Dissolved Oxygen Sensor



## Catalog

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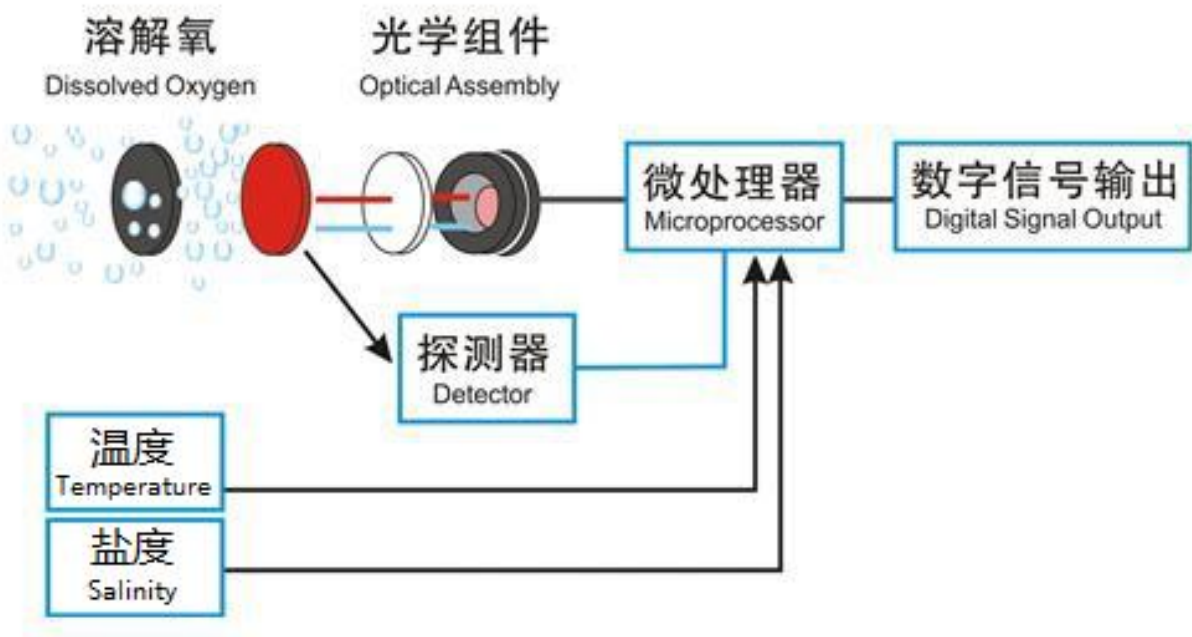


### **Modify the Record**

| <b>Date</b> | <b>Version</b> | <b>Modify the content</b>                       |
|-------------|----------------|-------------------------------------------------|
| 20260402    | V1.0           | The accuracy has been changed to " $\pm 3\%$ ". |
|             |                |                                                 |

## 1. Introduction

KWS-650C integrated online fluorescence dissolved oxygen sensor is designed based on the quenching principle of excited fluorescence by specific substances in physics. When the excitation light shines on the fluorescent substance on the surface of the fluorescent membrane head, the fluorescent substance is excited and emits fluorescence. The extinguishing time of the fluorescence is affected by the concentration of oxygen molecules on the surface of the fluorescent membrane head. The concentration of oxygen molecules can be calculated by detecting the phase difference between the fluorescence and the excitation light and comparing it with the internal calibration curve, and the final value is output after temperature and salinity compensation.



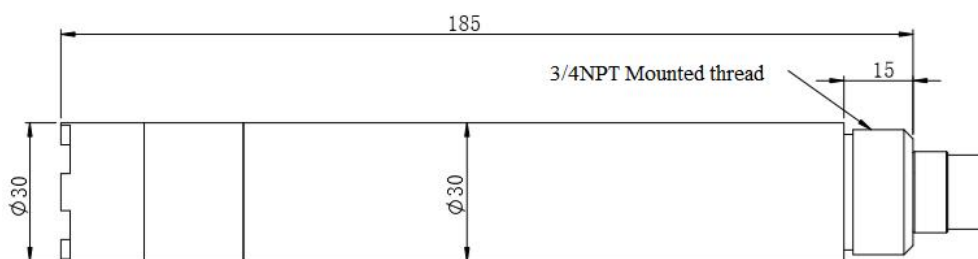
## 2. Feature

- No electrolyte is required and will not be polarized.
- No oxygen consumption, not affected by flow rate.
- Built-in temperature sensor, automatic temperature compensation.
- Built-in salinity compensation, flexible parameter settings.
- Free from interference by chemicals such as sulfides.
- Small drift, rapid reaction, more accurate measurement.
- Long service cycle, lower cost of use.
- Simple replacement of fluorescent cap.
- R-485 interface, Modbus/RTU protocol.
- Low power consumption , anti-interference.

### 3. Technical Specifications

|                                          |                                             |
|------------------------------------------|---------------------------------------------|
| <b>Model</b>                             | KWS-650C                                    |
| <b>Case material</b>                     | POM, ABS/PC alloy, 316L stainless steel     |
| <b>Measurement principle</b>             | Fluorescence method                         |
| <b>Range</b>                             | 0 ~ 20.00 mg/L (0 ~ 200% saturation, 25℃)   |
| <b>Resolution</b>                        | 0.01mg/L, 0.1℃                              |
| <b>Accuracy</b>                          | ±3%, ±0.3℃                                  |
| <b>Response time (T90)</b>               | < 30s                                       |
| <b>Minimum detection limit</b>           | 0.08mg/L                                    |
| <b>Calibration method</b>                | Two-point calibration                       |
| <b>Cleaning method</b>                   | /                                           |
| <b>Temperature compensation</b>          | Automatic temperature compensation (Pt1000) |
| <b>Output method</b>                     | RS-485 (Modbus RTU)                         |
| <b>Storage temperature</b>               | -5~ 65℃                                     |
| <b>Working conditions</b>                | 0 ~ 50℃, ≤0.2MPa                            |
| <b>Installation method</b>               | Submersible installation, 3/4 NPT           |
| <b>Power consumption</b>                 | 0.2W@12V                                    |
| <b>Power supply</b>                      | 12~ 24V DC                                  |
| <b>Protection level</b>                  | IP68                                        |
| <b>Life of fluorescent membrane head</b> | 1 year (under normal use)                   |
| <b>Cable length</b>                      | 5 meters, other lengths can be customized   |

### 4. Dimension



### 5. Installation and Electrical Connection

#### 5.1 Install

The sensor shall be installed fixedly below the liquid level. The installation and use shall avoid collision or scraping against the surface of the fluorescent film head. The fluorescent film head part shall avoid being attached by the bottom sediment. Remove the rubber cover when use.

#### 5.2 Electrical connection

- Red wire-power cord ( 12 ~ 24 V )
- Black wire-ground wire ( GND )

- Blue Line-485 A
- White Line-485 B

Check wiring sequence carefully before power on to avoid unnecessary losses caused by wiring errors.

### 5.3Wiring instructions

Considering that the cables have been immersed in water (including seawater) or exposed to air for a long time, all wiring positions are required to be waterproof, and the cables should have certain corrosion resistance.

## 6.Maintenance

### 6.1 Use and maintenance

#### 6.1.1 Maintenance schedule

Different from the dissolved oxygen probe technology of electrochemical principle, the fluorescence dissolved oxygen probe does not consume oxygen and does not need to be cleaned frequently (except when it is used in viscous liquid).

| Maintenance Task                                   | Recommended Maintenance Frequency                                          |
|----------------------------------------------------|----------------------------------------------------------------------------|
| Cleaning sensor                                    | Wash every 30 days                                                         |
| Check for damage to sensors and caps               | Check every 30 days                                                        |
| Replace the fluorescent cap                        | Replace it once a year                                                     |
| Calibrate (if required by the competent authority) | According to the maintenance schedule required by the competent department |

Note: The maintenance frequency in the above table is only recommended, and the maintenance personnel shall clean the sensor according to the actual use of the sensor; however, the replacement frequency of the fluorescent cap is recommended once a year.

#### 6.1.2 Maintenance method

a) Sensor outer surface: clean the outer surface of the sensor with tap water, if there is still debris residue, wipe with wet soft cloth, for some stubborn dirt, you can add some household washing liquid to tap water to clean.

b) Surface of fluorescent film head: If there is dirt on the surface of fluorescent film head, please rinse with clean water or wipe gently with a soft cloth. Pay attention to the intensity of cleaning to avoid causing scratches in the measuring area and affecting the measurement accuracy.

c) Inside the fluorescent film head: it is generally unnecessary to clean. If water vapor or dust enters into the fluorescent film head, the cleaning steps are as follows:

- Screw down the fluorescent film head;
- Rinse the inner surface of the fluorescent film head and the optical window of the sensor.
- For oily dirt, you can use household cleaning solution;
- Gently dry the water with a clean cloth and let dry;
- Reinstall the fluorescent film head.

d) Check the cables of the sensor: there should be no damage to the skin and root of the cables; Terminals should not be submerged in water; When the sensor is normally installed, the cable should not be tensioned, otherwise the internal wire of the cable will easily break and the sensor cannot work normally.

e) Check whether the casing of the sensor is damaged by corrosion or other causes.

f) Daily storage of fluorescent film head: When not in use, a rubber protective cover with a wet sponge should be covered to keep the surface of the measuring area of fluorescent film head wet. If the surface of the measuring area of the sensor fluorescent film head is chronically dry, measurement error or data instability will occur, and it shall be soaked in water for 48 hours before use.

## 6.2 Frequently asked questions

| Wrong                                                                              | Probable Cause                                                                       | Solution                                                                                           |
|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| The operating interface cannot connect or does not display the measurement results | Error connecting controller to cable                                                 | Reconnect the controller and cable                                                                 |
|                                                                                    | Cable failure                                                                        | Please contact us.                                                                                 |
|                                                                                    | The fluorescent cap is not tightened or damaged                                      | Refit and tighten the fluorescent cap or replace the fluorescent cap.                              |
| The measured value is too high, too low, or the numerical value remains unstable.  | The outer surface of the fluorescent cap is attached to the outer object             | Clean the outer surface of the fluorescent film head and agitate the film head during measurement. |
|                                                                                    | The fluorescent cap was damaged                                                      | Replace the fluorescent cap                                                                        |
|                                                                                    | The fluorescent cap has exceeded its service life                                    |                                                                                                    |
| Temperature measurements change slowly.                                            | The temperature measuring area (stainless steel housing) is attached to the exterior | Gently brush the attachment with a soft brush                                                      |

## 6.3 Calibration of sensors

### a) Zero Calibration

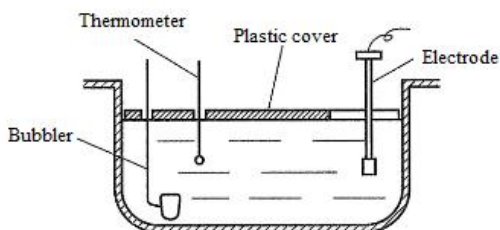
Weighing 5 g of sodium sulfite by a balance, adding 95mL of water into a 250-mL measuring cylinder, pouring the water into a beaker, adding the sodium sulfite which has been weighed, stirring with a glass rod, dissolving, and obtaining a solution of 5% sodium sulfite, putting the sensor in a solution, And the zero-point calibration is carried out after the three-minute numerical stability is stable. Refer to the Appendix to the instructions

### b) Slope Calibration

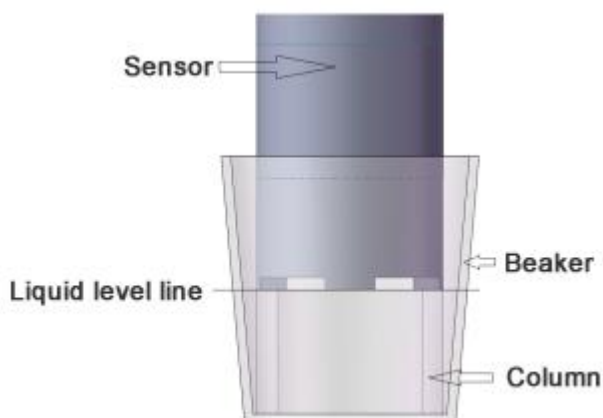
The sensor probe is placed in air saturated water and the slope is calibrated after 3 minutes of numerical stability. The instructions refer to the appendix.

### c) Preparation of Air Saturated Water: add 2/3 volume fresh distilled water to the constant temperature water bath to float the porous plastic sheet on the water surface (see figure below). At the same time, the bubbler (air pump) is used to aerate the water continuously for more than 1

hour, stop aeration, and get air saturated water after 20 minutes or so. Put the sensor into the water and calibrate the slope after the numerical value is stable.



Note: As an alternative, slope calibration can also be performed in water-saturated air. Pour pure water into the calibration cup, with the liquid level slightly lower than the column height by about 1mm. After the sensor's fluorescent membrane head is dipped in water, shake it lightly (to ensure that the surface of the fluorescent membrane is moist and there are no water drops), and place the sensor vertically on the calibration cup column (as shown in the figure below, to ensure that the water surface does not touch the fluorescent membrane). Wait for 3 minutes for the value to stabilize before calibrating the slope.



## 6.4 Precautions

- Avoid exposing the inner surface of the fluorescent film head to sunlight
- Please do not touch the fluorescent film with your hands
- Avoid bubbles adhering to the surface of the fluorescent film during measurement and calibration
- Avoid applying any mechanical stress (pressure, scratches, etc.) directly to the fluorescent film during use

## 7. Quality and service

### 7.1 Quality assurance

- Quality inspection departments have standardized inspection procedures, with advanced detection equipment and instruments, and in strict accordance with the test procedures for products that do 72 hours aging test, stability test, not asubstandard products factory.

- The receiving party directly returns the product batch with a failure rate of 2%, and all the costs incurred are borne by the supplier. The reference standard refers to the product description provided by the supplier.
- Guarantee the quantity of goods and the speed of shipment.

## 7.2 Service commitment

The company provides local after-sales service within one year from the date of sale, but does not include damage caused by improper use. If repair or adjustment is required, please return it, but the shipping cost must be concealed. Damaged on the way, the company will repair the damage of the instrument for free.

## 8. Appendix data communication

### 8.1 Data Format

The default data format for Modbus communication is: 9600, n, 8, 1 (baud rate 9600bps, 1 start bit, 8 data bits, no parity, 1 stop bit).

### 8.2 Modbus Frame Format (xx represents a byte)

#### a) Read data instruction frame

|         |    |                        |                     |                                     |
|---------|----|------------------------|---------------------|-------------------------------------|
| 05      | 03 | xx xx                  | xx xx               | xx xx                               |
| Address | FC | Register start address | Number of registers | CRC check code (low bytes in front) |

#### b) Read data response frame

|         |    |                 |               |                                     |
|---------|----|-----------------|---------------|-------------------------------------|
| 05      | 03 | xx              | xx xx         | xx xx                               |
| Address | FC | Number of bytes | Response data | CRC check code (low bytes in front) |

#### c) Write data instruction frame

|         |    |                  |              |                                     |
|---------|----|------------------|--------------|-------------------------------------|
| 05      | 06 | xx xx            | xx xx        | xx xx                               |
| Address | FC | Register address | Read-in data | CRC check code (low bytes in front) |

#### d) Data response frame

|         |    |                  |              |                                     |
|---------|----|------------------|--------------|-------------------------------------|
| 05      | 06 | xx xx            | xx xx        | xx xx                               |
| Address | FC | Register address | Read-in data | CRC check code (low bytes in front) |

### 8.3 Register Address

| Register Address  | Name                        | Instruction                                                                                                                | Number of Registers | Access Method |
|-------------------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------|---------------------|---------------|
| 40001<br>(0x0000) | Measured value+ temperature | Four double-byte integers, measured, measured decimal, temperature decimal places, respectively, measured, decimal places. | 4 (8 bytes)         | read          |

|                   |                                      |                                                                                                                                                                                                                           |             |              |
|-------------------|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------|
| 40005<br>(0x0004) | Dissolved oxygen saturation (0-200%) | Two double-byte integers, saturation values and decimal places, respectively.                                                                                                                                             | 2 (4 bytes) | read         |
| 44097<br>(0x1000) | Zero calibration                     | Calibrated in anoxic water, writing data 0; readout data zero offset.                                                                                                                                                     | 1 (2 bytes) | Write / read |
| 44101<br>(0x1004) | Slope calibration                    | Calibrate in air-saturated water, write data to 0, read data to slope value $\times 1000$ .                                                                                                                               | 1 (2 bytes) | Write / read |
| 44113<br>(0x1010) | temperature correction               | In the solution, the written data is the actual temperature value $\times 10$ , and the readout data is the temperature calibration offset $\times 10$ .                                                                  | 1(2 bytes)) | Write / read |
| 44129<br>(0x1020) | Salinity compensation                | The read/write data is salinity value (PSU) $\times 10$ , which is used for salinity compensation; the factory default is 0, no salinity compensation. The write value range is 0 to 500, corresponding to 0 to 50.0 PSU. | 1 (2 bytes) | Write / read |
| 48195<br>(0x2002) | Sensor address                       | The default is 5, and the data range is 1-255.                                                                                                                                                                            | 1 (2 bytes) | Write / read |
| 48196<br>(0x2003) | Baud rate                            | Default is 9600.0--9600, 1 - 19200                                                                                                                                                                                        | 1 (2 bytes) | Write / read |
| 48225<br>(0x2020) | Reset sensor                         | The calibration value restores the default value, and the write data is 0. Note that the sensor needs to be calibrated again after resetting.                                                                             | 1 (2 bytes) | write        |

## 8.4 Command example

### a) Measurement command:

Function: Get the dissolved oxygen value and temperature measured by the sensor; the unit of dissolved oxygen is mg/L, and the unit of temperature is  $^{\circ}\text{C}$ .

Request frame: 05 03 00 00 00 04 45 8D

Response frame: 05 03 08 01 02 00 02 00 B0 00 01 DB 0C

Reading example:

|             |                   |
|-------------|-------------------|
| DO value    | temperature scale |
| 01 02 00 02 | 00 B0 00 01       |

For example, the DO value 01 02 indicates the hexadecimal reading DO value, and 0002 indicates the dissolved oxygen value with 2 decimal points, which is converted to a decimal

value of 2.58.

The temperature value 00B0 represents the hexadecimal reading temperature value, 0001 indicates the temperature value with 1 decimal point, converted to a decimal value of 17.6.

**b) Calibration instruction:**

Zero calibration

Function: set the calibration value of dissolved oxygen zero point of electrode;

Request frame: 05 06 10 00 00 00 8C 8E

acknowledgement frame : 05 06 10 00 00 00 8C 8E

Slope calibration

Function: set the slope calibration value of dissolved oxygen for the electrode; here the slope value is calibrated in air saturated water.

Request frame: 05 06 10 04 00 00 CD 4F

Response frame: 05 06 10 04 00 00 CD 4F

**c) Set the device ID address:**

Function: set the MODBUS device address of the electrode;

Change the device address 05 to 01, with the following example

Request frame: 05 06 20 02 00 01 E3 8E

Response frame: 05 06 20 02 00 01 E3 8E

**d) Salinity compensation command:**

Function: Set the salinity compensation of the sensor;

Measure the water body with a salinity of 35.0 PSU and add salinity compensation. The example is as follows:

Request frame: 05 06 10 20 01 5E 0D 2C

Response frame: 05 06 10 20 01 5E 0D 2C

## 8.5 Error response

If the sensor does not execute the upper computer command correctly, the following format information is returned:

| Definition      | Address | FC      | CODE | CRC check |
|-----------------|---------|---------|------|-----------|
| data            | ADDR    | COM+80H | xx   | CRC 16    |
| Number of bytes | 1       | 1       | 1    | 2         |

a) CODE: 01 – Functional code error

03 – Data error

b) COM: Received function code