

## Optical Dissolved Oxygen Online Analyzer

# Operation Manual







ZX-V2.1

## Introduction

- Thank you for purchasing the Optical Dissolved Oxygen Online Analyzer. The operation manual gives a detailed description about various realizable functions, wiring methods, setup methods, operation methods and fault handling methods. Please read carefully the operation manual and understand the correct application methods before putting into operation, to avoid unnecessary losses due to operation mistakes. If the instrument is operated in other ways not described in the manual, the protections that the instrument give may be destroyed, and the failures and accidents incurred due to violation of precautions shall not be borne by our company.
- Please read the operation manual carefully before applying the instrument. On the precondition of full understanding, the instrument shall be installed, operated and maintained by professional electrical personnel at site. Wrong installation or operation may lead to destruction of instrument or personal injury.
- The company promises to the user that, the hardware and accessories provided with the instrument during delivery shall not have any defects in materials and manufacturing process. Calculated from the day of purchase of the instrument, if the user informs of any defect on the product in the guaranty period, the company provides free maintenance or replacement unconditionally for the defect product. The company guarantees to provide lifelong maintenance for all the products.
- Following the principle of sustainable development, the company shall reserve the rights of modifying the performance parameters in the operation manual and also the rights of amending or abolishing the operation manual, without prior notification. The company shall notify the user in advance if modification of some parameters of the instrument may lead to serious accident. For improved instrument, the company shall publish updated operation manual or improvement instruction. If the descriptions in the operation manual deviate from the material object, the latter shall prevail.

- Any modification on the instrument is forbidden. Any accidents incurred due to unauthorized modification shall not be borne by the company.

## Indication of Signs in the Operation Manual

| Sign   | Name      | Meaning  |
|--|-----------|--|
|   | DANGER    | Serious personal injury, instrument destruction, great property losses or other accidents will be the consequence if no appropriate preventive measures have been adopted. |
|   | ALERT     | Pay special attention to the important information linked to product or particular part in the operation manual.   |
|   | WARNING   | Operate with cautious. Any operation mistake may lead to big problems.   |
|  | ATTENTION | Read carefully the annotation, which will provide substantial help to correct operation of the instrument.   |



### DANGER

- Do not use the instrument in a flammable and combustible or steam area.
- The instrument can work in general cases. If the failure of the instrument may result in major accident or destroy other equipment, emergency stop electric circuit and protection loop should be set up.
- Confirm if the supply voltage is in consistent with the rated voltage before operation.
- To prevent from electric shock, operation mistake, abnormal display or big deviation in measurement, a good grounding protection must be made.
- Thunder prevention engineering facilities must be well managed: the shared grounding network shall be grounded at iso-electric level, shielded, wires shall be located rationally, SPD surge protector shall be applied properly.
- Some inner parts may carry high voltage. Do not open the square panel in the front except our company personnel or maintenance personnel acknowledged by our company, to avoid electric shock.
- Cut off electric powers before making any checks, to avoid electric shock.

- Check terminal screws and installation conditions on a regular basis. If it's loose, tighten it and then apply it.
- Unauthorized dismantling, processing, modification or repair of instrument can never be allowed. Otherwise, the instrument may move abnormally, or electric shock or fire accidents may be caused.
- Use dry cotton to wipe the instrument, instead of alcohol, gasoline or other organic solvent. Prevent any liquid from splashing onto the instrument. If the instrument falls into water, cut off power immediately, to avoid electric leakage, electric shock and fire accidents.
- Check grounding protection and fuse conditions on a regular basis. Do not run the equipment if grounding protection and fuse are not well equipped.
- The ventilation hole on the instrument casing must be kept unclogged, to avoid failure, abnormal movement, short lifetime and fire accident due to high temperature.
- Operate in strict accordance with the operation manual, otherwise, it's possible to damage the protection device of the instrument.



## ALERT

- Do not use the instrument if it is found damaged or deformed at opening of package.
- Prevent dust, wire end, iron fines or other objects from entering the instrument during installation, otherwise, it will cause abnormal movement or failure.
- During operation, to modify configuration, signal output, startup, stop, operation safety shall be fully considered. Operation mistakes may lead to failure and even destruction of the instrument and controlled equipment.
- Each part of the instrument has a certain lifetime, which must be maintained and repaired on a regular basis for long-time use.
- The product shall be scrapped as industrial wastes, to prevent environment pollution.

## User instruction

Please respect the operation procedures and precautions in the operation manual to use the product.

The instrument can work in general cases. If the failure of the instrument may result in major accident or destroy other equipment, emergency stop electric circuit and protection loop should be set up.

- The quality guaranty period of electrode of conductivity is one year, for the sake of more accurate measurement. After one year upon ex-work, the performance

will be influenced whether to be further used. Then it should be replaced in time.

- Power on the instrument before calibration to preheat for over half an hour.
- During measurement, clean the instrument in distilled water (or deionized water) and dry with filter paper, to avoid inclusions in the test liquid.
- Contact the manufacturer in case of anomaly or damage of the instrument. Do not repair it at your own.

## Contents

|  |    |
|--|----|
| Introduction .....                                   | 1  |
| User Instruction .....                               | 3  |
| Section I Product Introduction.....                  | 6  |
| Characteristics .....                                | 6  |
| Technical Indicators .....                           | 7  |
| Application Scope .....                              | 8  |
| Section II Fixation & Installation.....              | 9  |
| Installation of Instrument .....                     | 9  |
| Installation of Electrode .....                      | 10 |
| Wiring of Instrument .....                           | 11 |
| Section III Push-button Operation.....               | 13 |
| Section IV HMI and Operation .....                   | 14 |
| Section V Configuration.....                         | 16 |
| System Configuration.....                            | 16 |
| Signal Configuration .....                           | 16 |
| Online Calibration .....                             | 17 |
| Remote Transmission Configuration.....               | 17 |
| Alarm Configuration .....                            | 18 |
| Version Inquiry.....                                 | 18 |
| Section VI Communication .....                       | 19 |
| Section VII Failure Analysis & Trouble-shooting..... | 21 |
| Appendix .....                                       | 22 |

## Section I Production Introduction

Optical Dissolved Oxygen Online Analyzer, an intelligent online chemical analyzer, is widely applied for continuous monitoring and measurement of dissolved oxygen, saturation, oxygen partial pressure and temperature in the solution in the industry of thermal power, chemical fertilizer, environmental protection, metallurgy, pharmacy, biochemistry, food and water, etc.

Continuous monitoring measurement data is connected with the recorder via transmitting output to realize remote monitoring and recording. It can also be connected with RS485 portal via MODBUS-RTU protocol to access computer for monitoring and recording.

### Characteristics

- 2.8 inches 12864 lattice screen.
- Isolating transmitting output, with little interference.
- Isolating RS485 communication.
- DO/SAT measurement, temperature measurement, upper/lower limit control, transmitting output, RS485 communication.
- Configurable upper/lower limit alarm and delay.
- Configurable hummer and LCD backlight switch.
- Optional language, Chinese and English.
- Air calibration.

## Technical indicators

- Measurement variables: dissolved oxygen, saturation  
Measuring range: 0 - 20mg/L, 0 - 200%  
Resolution: 0.01mg/L, 1%  
Accuracy:  $\pm 3\%$ FS  
Repetition:  $\pm 0.5\%$ FS
- Measurement variables: temperature  
Measuring range: 0 - 45°C  
Resolution: 0.1°C  
Correction accuracy:  $\pm 0.5^\circ\text{C}$
- Output type: 4 - 20mA current transmission output  
Max. loop resistance: 750Ω  
Accuracy: 0.1%FS
- Output type: RS485 digital signal output  
Communication protocol: standard MODBUS-RTU  
(customizable)
- Power: AC220V $\pm 10\%$ , 50Hz/60Hz
- Alarm relay: AC250V、3A



## **Application Scope**

- Sewage treatment
- Waste water treatment
- Water treatment
- Drinking water
- Surface water: river, lake and sea
- Fishery
- Boiler feed water (trace oxygen measurement)

## **Section II Fixation & Installation**

### **Installation of instrument**

Please read the instruction of installation location and method of instrument as described during installation.

### **Installation precautions**

The instrument serves mainly for detection and transmission, not dedicated for control. It is equipped with a relay switch output, for warning and reminding use generally. If the user involves the function in participating loop control, the failure of the instrument may lead to major accident or destruction of other equipment, emergency stop electric circuit and protection loop should be set up. Otherwise, the company will not be liable for any consequences incurred.

The instrument is panel-mounted and should be installed indoor, sheltered from wind, rain and direct sunlight. To avoid rise of temperature inside the instrument, it should be installed at a well-ventilated place. Do not tilt it during installation and try to locate it horizontally (tilting back <math><30^\circ</math>).

### **Installation should be kept away from the following site**

In direct exposure to sunlight and near thermal equipment.

With ambient temperature over 60 degrees in operation.

With humidity over 85% in operation.

Nearby electromagnetic source.

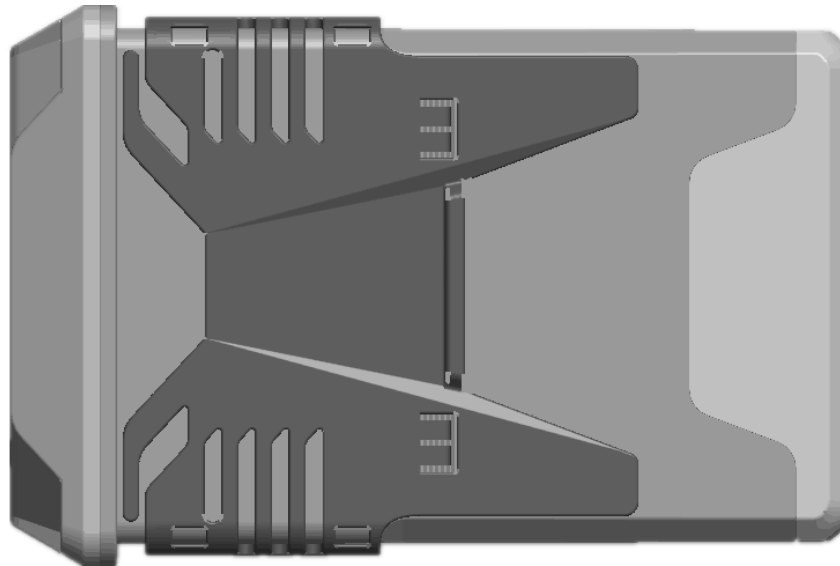
In strong mechanical vibration.

With varying temperature and dew condensation.

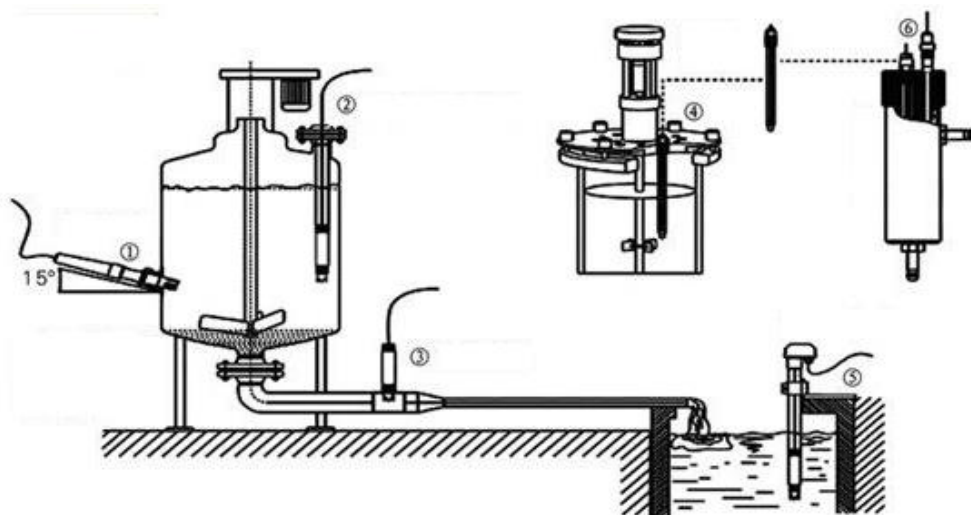
With oil smoke, steam, humidity, dust and corrosive gases.

## Installation methods

Open a 92.5 \* 92.5(mm) installation hole on the instrument cabinet or installation panel (the dimension is 100\*100\*150mm). Insert the instrument into the installation hole and latch on the butterfly clasp, as shown below.



## Installation of electrode

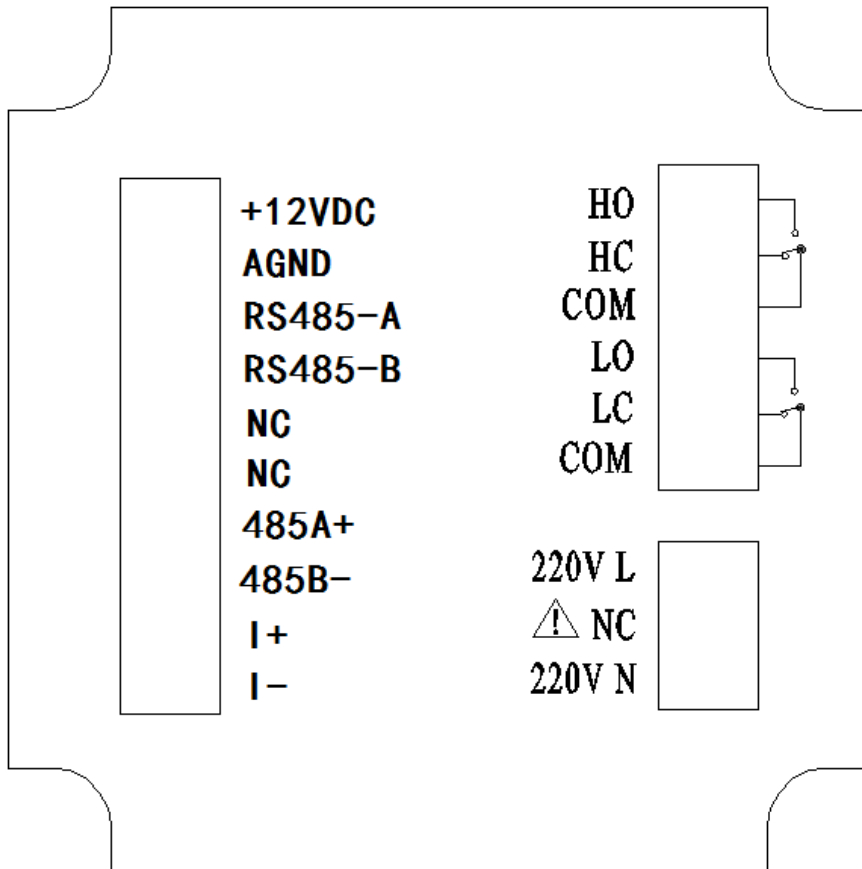


Schematic diagram of common installation method

1. Side wall installation.2. Top flange type installation.3. Pipe installation.4. Top type installation.5. Immersed type installation.6. Flow-through type installation.

The connector must be an oblique angle at 15°, otherwise, the normal test and use will be impacted, and the consequences will not be borne by our company.

## Wiring of instrument



Wiring diagram

### Identification of terminal

- +12VDC: Power supply of dissolved oxygen electrode
- AGND: Power negative of dissolved oxygen electrode
- RS485-A: Dissolved oxygen electrode communication-A
- RS485-B: Dissolved oxygen electrode communication-B
- NC: Null
- NC: Null
- RS485(A+): RS485 communication interface A+

- RS485(B-): RS485 communication interface B-
- I(+): 4-20mA output port +
- I(-): 4-20mA output port -
- HO: High alarm of normal open relay
- HC: High alarm of normal close relay
- COM: Common port
- LO: Low alarm of normal open relay
- LC: Low alarm of normal close relay
- COM: Common port
- 220V L: AC220V fire wire
- NC: Null
- 220V N: AC220V zero wire

### **Attention**

Confirm that the instrument is not power on before connected with signal wire, to avoid electric shock.

Use double insulation wire to prevent fire accident.






Do not put electric product close to signal terminal, which may cause failure.

## Section III Push-button Operation

### Button display



### Definition of buttons

| Sign  | Button Name | Function description  |
|---|-------------|---|
|  | EXIT        | Check the related alarm status on the “monitoring page”<br>Return to previous level page in the up& down level page linked to “menu page” |
|  | MOVE RIGHT  | Make a recurrent selection of digit of parameters<br>Check the display values of other unit on the “monitoring page”                      |
|  | MENU        | Enter the MENU on the “monitoring page”<br>Exit the MENU on the “menu page”   |
|  | MOVE DOWN   | Select the related menu on the “menu page”<br>Modify the values in the configuration state  |
|  | ENTER       | Enter the submenu or confirm modification on the “menu page”  |

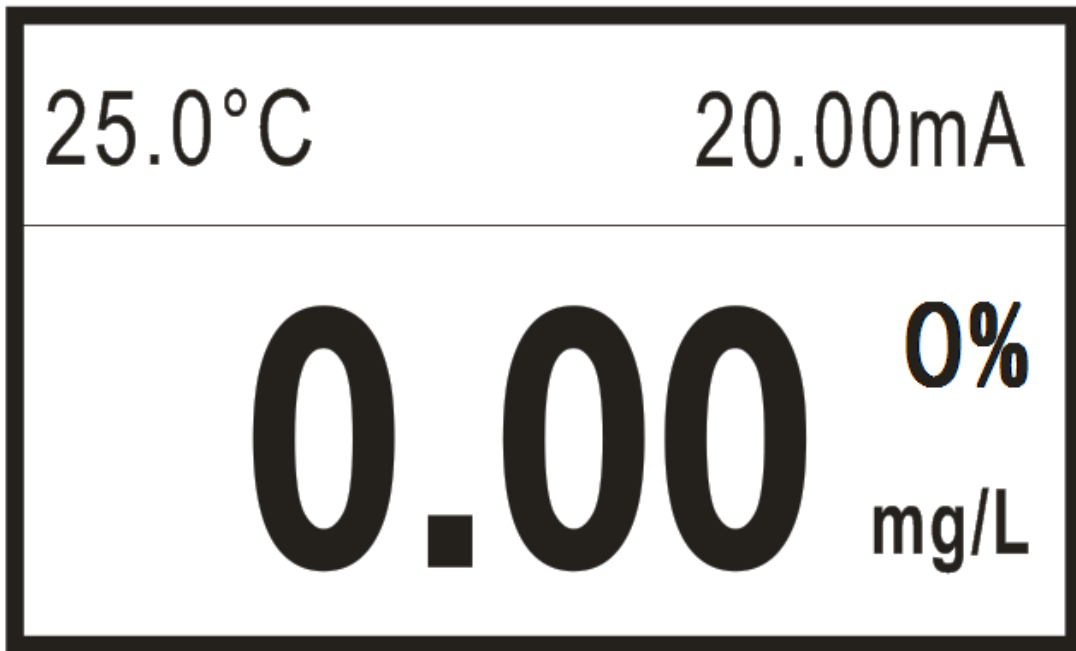
## Section IV HMI and Operation

### Monitoring page

The instrument is equipped with monochrome lattice LCD, 128\*64 resolution.

Push [MENU] to enter password verification page; input password to enter the home page.

Push [EXIT] to enter alarm inquiry page, to inquire the current alarm configuration information.



main monitoring page

## Password verification page

Input password and push [ENTER] to enter home page.

Initial password is 0000, which can be modified via password modification function.

Please contact us if you forget your password.

----- User Password -----

Password: 0000

## Main menu

----- Main Menu -----

- ➡ 1. System Setting
- 2. Signal Setting
- 3. Online Calibration
- 4. Remote Setting
- 5. Alarm Setting
- 6. Version Query

System Setting: settings of language, buzzer and backlight, modification of password and factory settings

Signal Setting: settings of signal correction, slope, air pressure offset, salinity and response time.

Online Calibration: Electric pole's air Calibration

Remote Setting: settings of RS485 parameters and current transmission output.

Alarm Setting: settings of parameters of high and low alarm.

Version Query: current version number



## Section V Configuration

### System configuration

#### ----- System Setting -----

- ➡ 1. Language
- 2. Buzzer
- 3. Backlight Setting
- 4. Change Password
- 5. Factory Setting

Language: switch of language, Chinese and English.

Buzzer: setting of switch of buzzer during alarm.

Backlight Setting: setting of LCD backlight.

Change Password: password modification and log-in with new password.

Factory Setting: back to factory settings

### Signal configuration

#### ----- Signal Setting -----

- ➡ 1. DO Correction
- 2. Slope Setting
- 3. Air Pressure Setting
- 4. Salt content setting
- 5. Response Time

DO Correction: The measured value of dissolved oxygen can be corrected, and the correction range is -9.99 to 9.99mg/L.

Slope Setting: Manually set the linearity of the electrode signal, please do not modify

it by yourself. It is necessary to modify it under the guidance of professional technicians.

**Air Pressure Setting:** set the air pressure value of the current altitude. The default value is the standard atmospheric pressure, 760mmHg.

**Salt Content Setting:** set the salinity of the current solution. The default is 0.00g/Kg.

**Response Time:** Setting the response time of the electrode, the default is 60s.

## **Online calibration**

----- Online Calibration -----  
➡ 1.Air Calibration

**Air Correction:** In case of air and Saturated oxygen solution to calibrate, push [ENTER] to calibrate.

## **Remote Transmission Configuration**

----- Remote Setting -----  
➡ 1.RS485 Setting  
2.Current Transmission

**RS485 Setting:** set 485 communication address and baud rate.

**Current Transmission:** set 4mA corresponding value and 20mA corresponding value of 4-20mA output.

## Alarm configuration

----- Alarm Setting -----  
➡ 1.DO High Alarm  
2.DO Low Alarm

DO High Alarm: when the measured value is higher than high alarm pull-on value, high alarm relay pulls on; when the measured value is lower than high alarm cut-off value, high alarm relay cuts off.

DO Low Alarm: when the measured value is lower than low alarm pull-on value, low alarm relay pulls on; when the measured value is higher than lower alarm cut-off value, low alarm relay cuts off.

## Version inquiry

----- Version Query -----

Version Query: inquire the current hard software version, which is high traceable.

## Section VI Communication

The instrument is provided with standard RS485 series communication interface, in accordance with international universal standard MODBUS-RTU communication protocol, supporting No.03 register reading and holding command.

### MODBUS standard format (read and hold command from Register 03)

#### Command format:

| Definition | Address | Function code | Register address | Data number | CRC check |
|------------|---------|---------------|------------------|-------------|-----------|
| Data       | ADDR    | 0x03          | M                | N           | CRC 16    |
| Bytes      | 1       | 1             | 2                | 2           | 2         |

#### Return format:

| Definition | Address | Function code | Register address | Data number | CRC check |
|------------|---------|---------------|------------------|-------------|-----------|
| Data       | ADDR    | 0x03          | 2*N              | Data        | CRC 16    |
| Bytes      | 1       | 1             | 1                | 2*N         | 2         |

#### Descriptions of register address:

| Address | Data type | Data size | Function code | Description                                       | Access authority |
|---------|-----------|-----------|---------------|---|------------------|
| 0x0000  | short     | 2 bytes   | 0x03          | DO value (unit:mg/L, to be divided by 100)        | Read only        |
| 0x0001  | short     | 2 bytes   | 0x03          | Temperature value (unit: °C, to be divided by 10) | Read only        |
| 0x0002  | short     | 2 bytes   | 0x03          | Saturation value (unit: %, to be divided by 10)   | Read only        |

**Example of DO reading:**

Computer sends: 00 03 00 00 00 01 85 DB

DO meter returns: 00 03 02 00 00 85 84

Return command annotation:

00 is the address of slave device, which can be set in the instrument;  
03 is the function code, reading and holding register;  
02 is the length of data of returned DO value, 2 bytes;  
02 is the returned PH value 686 (hexadecimal high byte);  
00 00 is the returned DO value 0.00mg/L, to be divided by 100 to get the current DO value. Range: 0.00-20.00mg/L;  
85 84 is the CRC16 check code, which changes along with the previous data;

**Example of temperature reading:**

Computer sends: 00 03 00 01 00 01 D4 1B

DO meter returns:00 03 02 00 FA 05 C7

Return command annotation:

00 is the address of slave device, which can be set in the instrument;  
03 is the function code, reading and holding register;  
02 is the length of data of returned temperature value, 2 bytes;  
02 is the returned PH value 686 (hexadecimal high byte);  
00 FA is the returned temperature value 25.0°C (unit: °C), to be divided by 10 to get the current DO value. Range: -10.0 - 60.0°C;  
05 C7 is the CRC16 check code, which changes along with the previous data;

## **Section VII Failure Analysis & Trouble-shooting**

1. No display on controller?

A: Check if the power cable is correctly connected, power is on.

2. Number in display is jumping up and down?

A: Check if there is any interference equipment such as frequency converter is nearby. The instrument should be kept away from such interference equipment or protected with good shielding measures.

3. The response of number is slow?

A: If the electrode is covered by dirt, the response would be slow. Clean the pollutant in a corresponding method. A slow response is normal in winter.

## Appendix

The data source is HJ506—2009 national environment protection standard.

| Temperature / °C | Solubility (mg/L) of oxygen under standard atmospheric pressure (101.325kPa) | Correction value [(mg/L)/(g/Kg)] of DO when the salt content in water is increased by 1g/Kg. | Temperature / °C | Solubility (mg/L) of oxygen under standard atmospheric pressure (101.325kPa) | Correction value [(mg/L)/(g/Kg)] of DO when the salt content in water is increased by 1g/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   | 0.0364   |
| 11               | 11.03  | 0.0614   | 32               | 7.30   | 0.0354   |
| 12               | 10.78  | 0.0593   | 33               | 7.18   | 0.0348   |
| 13               | 10.54  | 0.0582   | 34               | 7.07   | 0.0338   |
| 14               | 10.31  | 0.0561   | 35               | 6.95   | 0.0332   |
| 15               | 10.08  | 0.0545   | 36               | 6.84   | 0.0322   |
| 16               | 9.87   | 0.0532   | 37               | 6.73   | 0.0316   |
| 17               | 9.66   | 0.0514   | 38               | 6.63   | 0.0306   |
| 18               | 9.47   | 0.0500   | 39               | 6.53   | 0.0300   |
| 19               | 9.28   | 0.0489   | 40               | 6.43   | 0.0291   |
| 20               | 9.09   | 0.0475   |                  |  |  |

Table 1 The function among oxygen solubility, water temperature and water salt content

| Electric conductivity/<br>(mS/cm) | Salt content in water/<br>(g/Kg) | Electric conductivity/<br>(mS/cm) | Salt content in water/<br>(g/Kg) | Electric conductivity/<br>(mS/cm) | Salt content in water/<br>(g/Kg) |
|-----------------------------------|----------------------------------|-----------------------------------|----------------------------------|-----------------------------------|----------------------------------|
| 5                                 | 3                                | 20                                | 13                               | 35                                | 25                               |
| 6                                 | 4                                | 21                                | 14                               | 36                                | 25                               |
| 7                                 | 4                                | 22                                | 15                               | 37                                | 26                               |
| 8                                 | 5                                | 23                                | 15                               | 38                                | 27                               |
| 9                                 | 6                                | 24                                | 16                               | 39                                | 28                               |
| 10                                | 6                                | 25                                | 17                               | 40                                | 29                               |
| 11                                | 7                                | 26                                | 18                               | 42                                | 30                               |
| 12                                | 8                                | 27                                | 18                               | 44                                | 32                               |
| 13                                | 8                                | 28                                | 19                               | 46                                | 33                               |
| 14                                | 9                                | 29                                | 20                               | 48                                | 35                               |
| 15                                | 10                               | 30                                | 21                               | 50                                | 37                               |
| 16                                | 10                               | 31                                | 22                               | 52                                | 38                               |
| 17                                | 11                               | 32                                | 22                               | 54                                | 40                               |
| 18                                | 12                               | 33                                | 23                               |                                   |                                  |
| 19                                | 13                               | 34                                | 24                               |                                   |                                  |

Table 2 The function between electric conductivity and salt content

| Temperature/<br>°C | Pressure of saturated water steam/<br>hPa | Temperature/<br>°C | Pressure of saturated water steam/<br>hPa | Temperature/<br>°C | Pressure of saturated water steam/<br>hPa |
|--------------------|---|--------------------|---|--------------------|---|
| 0                  | 6.1                                       | 15                 | 17.1                                      | 30                 | 50.2                                      |
| 1                  | 6.6                                       | 16                 | 18.1                                      | 31                 | 53.2                                      |
| 2                  | 7.1                                       | 17                 | 19.3                                      | 32                 | 56.2                                      |
| 3                  | 7.6                                       | 18                 | 20.7                                      | 33                 | 59.4                                      |
| 4                  | 8.1                                       | 19                 | 22.0                                      | 34                 | 62.8                                      |
| 5                  | 8.7                                       | 20                 | 28.1                                      | 35                 | 66.2                                      |
| 6                  | 9.3                                       | 21                 | 29.9                                      | 36                 | 69.8                                      |
| 7                  | 10.0                                      | 22                 | 31.7                                      | 37                 | 73.4                                      |
| 8                  | 10.7                                      | 23                 | 33.6                                      | 38                 | 77.2                                      |
| 9                  | 11.5                                      | 24                 | 35.6                                      | 39                 | 81.0                                      |
| 10                 | 12.3                                      | 25                 | 37.7                                      | 40                 | 85.0                                      |
| 11                 | 13.1                                      | 26                 | 40.0                                      |                    |   |
| 12                 | 14.0                                      | 27                 | 42.4                                      |                    |   |
| 13                 | 14.9                                      | 28                 | 44.9                                      |                    |   |
| 14                 | 16.0                                      | 29                 | 47.6                                      |                    |   |

Table 3 The function between pressure of saturated water steam and temperature



| Altitude h<br>/<br>m | Average<br>atmospheric<br>pressure p/<br>hPa | Altitude h<br>/<br>m | Average<br>atmospheric<br>pressure p/<br>hPa | Altitude h<br>/<br>m | Average<br>atmospheric<br>pressure p/<br>hPa |
|----------------------|--|----------------------|--|----------------------|--|
| 0                    | 1013   | 1900                 | 799  | 3800                 | 630  |
| 100                  | 1001   | 2000                 | 789  | 3900                 | 622  |
| 200                  | 988  | 2100                 | 779  | 4000                 | 614  |
| 300                  | 976  | 2200                 | 769  | 4100                 | 607  |
| 400                  | 964  | 2300                 | 760  | 4200                 | 599  |
| 500                  | 952  | 2400                 | 750  | 4300                 | 592  |
| 600                  | 940  | 2500                 | 741  | 4400                 | 584  |
| 700                  | 928  | 2600                 | 732  | 4500                 | 577  |
| 800                  | 917  | 2700                 | 723  | 4600                 | 570  |
| 900                  | 905  | 2800                 | 714  | 4700                 | 563  |
| 1000                 | 894  | 2900                 | 705  | 4800                 | 556  |
| 1100                 | 883  | 3000                 | 696  | 4900                 | 549  |
| 1200                 | 872  | 3100                 | 687  | 5000                 | 542  |
| 1300                 | 861  | 3200                 | 679  | 5100                 | 535  |
| 1400                 | 850  | 3300                 | 670  | 5200                 | 529  |
| 1500                 | 840  | 3400                 | 662  | 5300                 | 522  |
| 1600                 | 829  | 3500                 | 654  | 5400                 | 516  |
| 1700                 | 819  | 3600                 | 646  | 5500                 | 509  |
| 1800                 | 809  | 3700                 | 638  |                      |  |

Table 4 The corresponding value of average atmospheric pressure and altitude