# FDO-99E Fluorescence Method Dissolved Oxygen Analyzer

# PRODUCT MANUAL


DONGRUN SHANDONG DONGRUN INSTRUMENT SCIENCE & TECHNOLOGY CO., LTD.

# CATALOG

# 1、Security Notice

**Welcome to use FDO-99E Fluorescence Method Dissolved Oxygen Analyzer, manufactured by Shandong Dongrun Instrument Science and Technology Co., Ltd!**

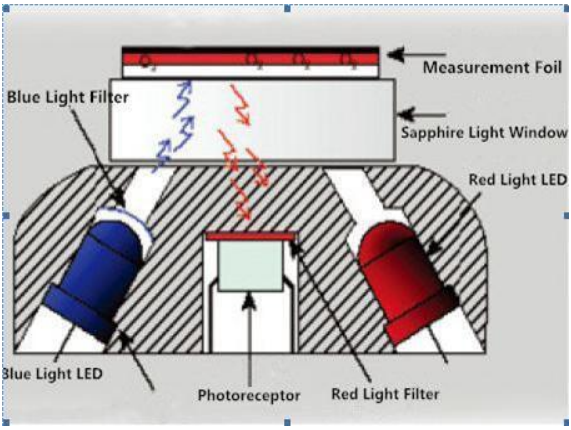
Before instrument installation, please make sure to read this manual carefully, which not only guides you to the correct use of instrument, more important is to avoid unsafe issues caused by improper use of instrument. Our company will not bear any responsibility due to any instrument damage or failure caused by improper use.

To ensure safety, the electrical connection should be done by the professionals. This instrument adopts AC 220V or DC 24V power supply, please do not open the instrument shell or junction box under the condition of power connection, in order to avoid electric shock or instrument damage. Before turning on the instrument and connecting to power, please be sure to confirm the power supply is properly connected to the specified location on the meter socket. Incorrect connection may result in permanent damage of instrument.

The degree of instrument lightning protection mainly depends on the situation of implementation of the related instrument system lightning protection project. The instrument itself is NOT anti-lightning.

# 2、Product Outline

Fluorescence Method Dissolved Oxygen Analyzer is based on the “quenching” principle of certain substances to reactive fluorescent in the physics, which detects the concentration of dissolved oxygen or partial pressure of oxygen in the water. Figure on the right is the sensor measuring principle diagram: The front-end measuring sensor consists of two LEDs (emitting red-ray and blue-ray separately), photoelectric detector and the fluorescent cap.




The fluorescent material that in the front-end of fluorescent cap is a special kind of ruthenium metal compounds. Fluorescent substances are coated below the polyester foil that allows gas molecules to pass. The surface of polyester foil is coated with a layer of black ray insulation materials, in order to avoid interference from ray of the sun or other rays in the water. When sensor works, the fluorescent material was stimulated to produce red-ray when the modulated blue-ray is reaching. Due to the "quenching" effect of oxygen molecules, the intensity of excitated fluorescence is related to time and oxygen concentration. The higher oxygen concentration, the lower the intensity of excited fluorescence, and the shorter the time. The stimulate red ray is detected by the photoelectric sensor, that compares with the reference light signal, then it calculates the phase difference, and compares with internal calibration value, then oxygen concentration is calculated, through the linearization and temperature compensation, outputs of the oxygen density in the end.

Widely used in industrial and municipal sewage treatment plant: regulating reservoir, aeration tank, aerobic/anaerobic digestion pool water monitoring, and water environment detection, such as river, lake, sea, fishery, etc.

# 3、Product Features

1) No need to replace solid electrode or film / electrolyte
2) No flow speed/ agitation requirement
3) Higher resolution and measurement accuracy
4) Stable measurement, no drift
5) It will not be poisoning by sulfide.
6) The service life of sensor fluorescence cap is above 1 year.
7) It is not affected by the thermal disturbance.
8) It is not affected by cross interference of the following substances: H2S, pH, CO2, NH3, SO42-, CL-, CL2 etc.
9) Basic maintenance-free
10) 128 * 64 dot matrix LCD screen can display measurement value, signal output, time, temperature etc. Yellow backlighting design, is beautiful and practical.
11) Protection degree IP65, suitable for outdoor use
12) 4~20mA isolation current output, optional field bus interface
13) Can provide a cleaning relay and two programmable control relays
14) Ensure internal memory chips set parameters after power-off, and recording data is not lost in ten years.

# 4、Technical Parameters

## 4.1 Sensor Performance

1. Measurement range: DO: 0-20 mg / l or 0-20ppm, Air saturation: 0-120%

2. Resolution: 0.01mg / l

3. Measurement Accuracy: ±0.2mg/l or 1% F.S

4. Response time: T90<60s

5. Temperature sensor: Operating range: 0 – 50℃;

Resolution: 0.1℃, Accuracy: ±0.5℃, Response time:<10s

6. Operating temperature: 0 - 50℃

7. Storage temperature: -40 - 80℃

8. Installation depth: 0 - 10 m

9. Calibration: no need to calibrate, as factory has made three-point calibration.

10. Chemical adaptability: safe for using methanol and ethanol, avoid other organic solvents.

11. Measurement foil: Polyester embedded ruthenium metal fluorescence powder

12. Light insulation coating: Teflon

13. Foil service life: 5 years (10 seconds measured interval)

14. Sensor shell: 316L stainless steel

15. Size: Φ41×140mm

16. Weight: 600g

17. Power supply:DC5V or DC9V, power supplied by transmitter

18. Sensor cable: standard 10 meters

## 4.2 Transmitter Performance

1) Power supply: 85V AC ~ 265V AC or 24V DC±10%;

2) Power consumption: 6W (starting current 220VAC: 300mA (10 ms))

3) Operating temperature range: - 20℃ ~ 60℃

4) Two lines of analog signal output: 4 ~ 20 mA. DC

5) Output load resistance: 0 ~ 500 Ω

6) Data record capacity: 15000

7) Event record capacity: 4800

8) Output relay: 2, clean relay: 1, contact capacity: 5A/30VDC or 5A/250VAC

9) Mechanical size:

Dimension: 98 * 98 * 130 mm

Panel installation: insert part width * height is 92 * 92 mm, length: 115 mm

Panel opening: 93 * 93 mm

# 5、Packing List

Packing list refers to Table 1.

**Table 1 Packing List**

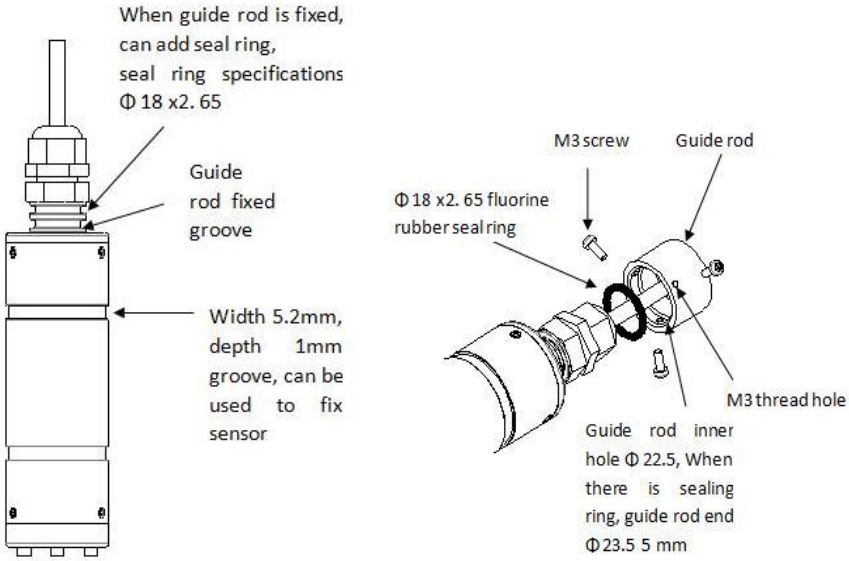
| Name | Quality |
|---|---|
| Transmitter | 1 |
| Install card buckle | 2 |
| Sensor | 1 |
| Product manual | 1 |
| Product Certificate | 1 |

# 6、Installation & Wiring

## 6.1 Sensor Installation

The distance between fluorescence dissolved oxygen sensors installed and the surface of water, is 0.2-1m according to the actual situation. The fluorescent cap cannot contact with the sludge or hard objects. There should be no light shining on the lower part of the fluorescent cap directly.

There are a lot of floating material, or flowing hard particles in the water, which may contact to the sensor, so actions should be taken in order to avoid damage of sensors or inaccurate measurements.



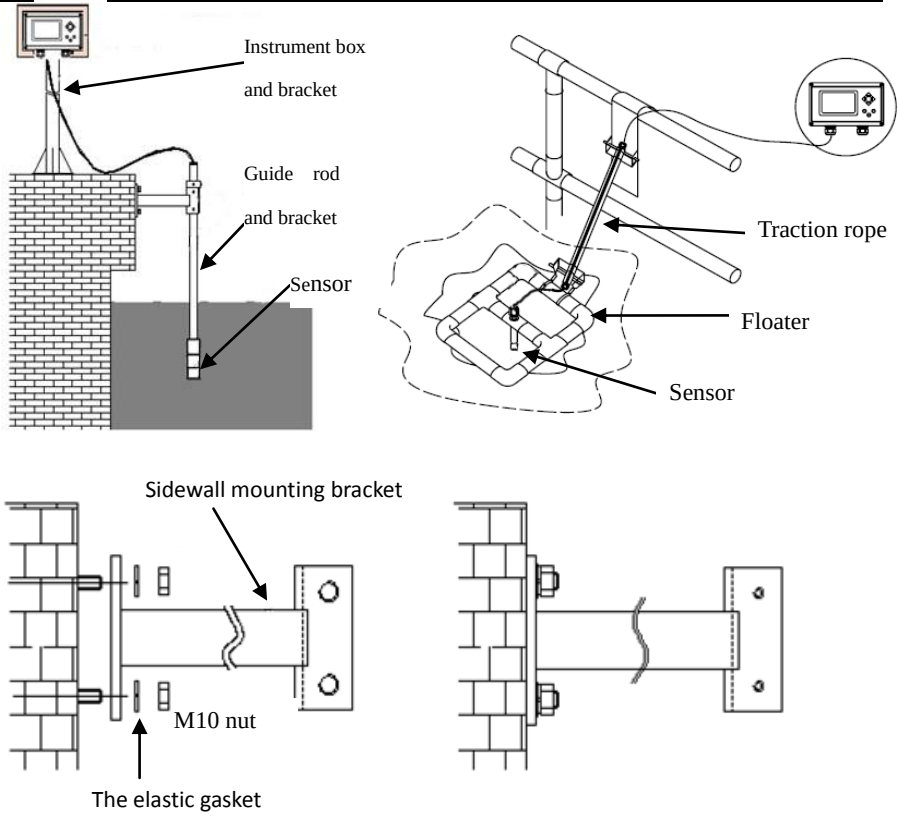



FIG. 1 Sensor Installation Diagram

## 6.2 Transmitter Installation

### 6.2.1 Panel-mounted Type

Need to open a 93 mm x 93 mm square hole on the installation panel, then fix the transmitter on the panel by install card buckle.

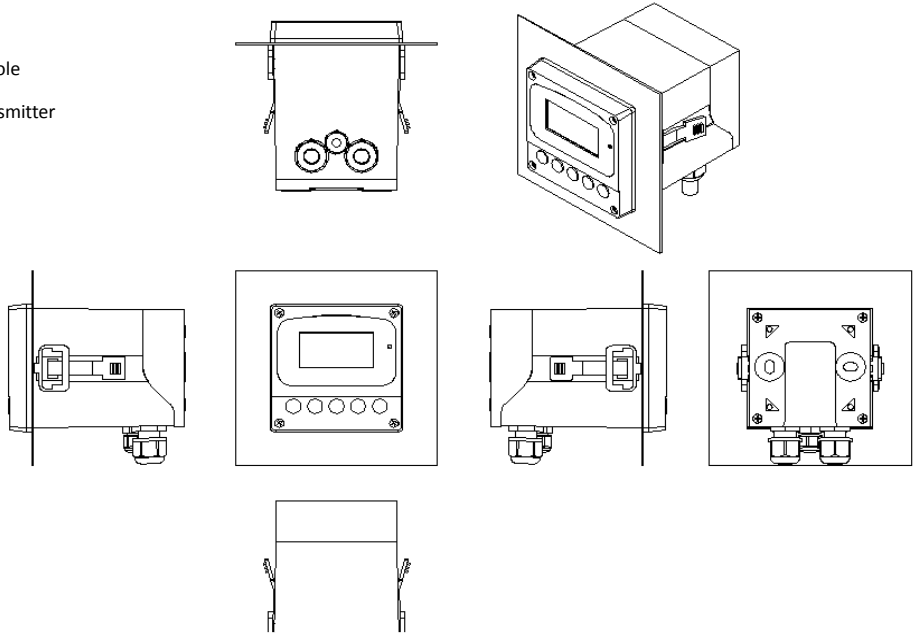


FIG. 2 Panel Mounted Diagram

### 6.2.2 Piping Mounted Type

Transmitter is installed by location A on the back of the transmitter.

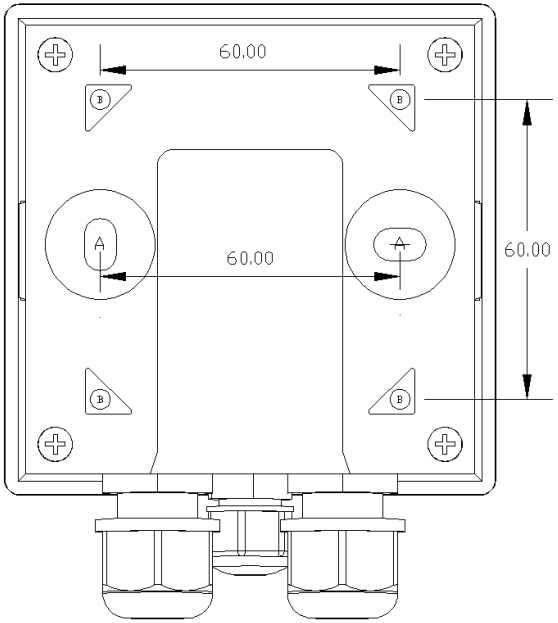



FIG.3 Back Diagram of Transmitter

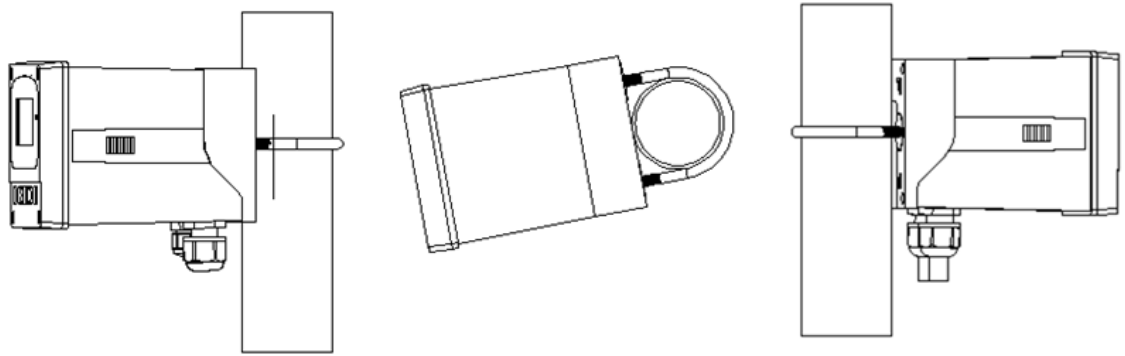


FIG. 4 Piping Mounted Diagram

### 6.2.3 Plate Mounted Type

Turn the four M4 screws through the mounting plate into

Hole location B, and then install the mounting plate.

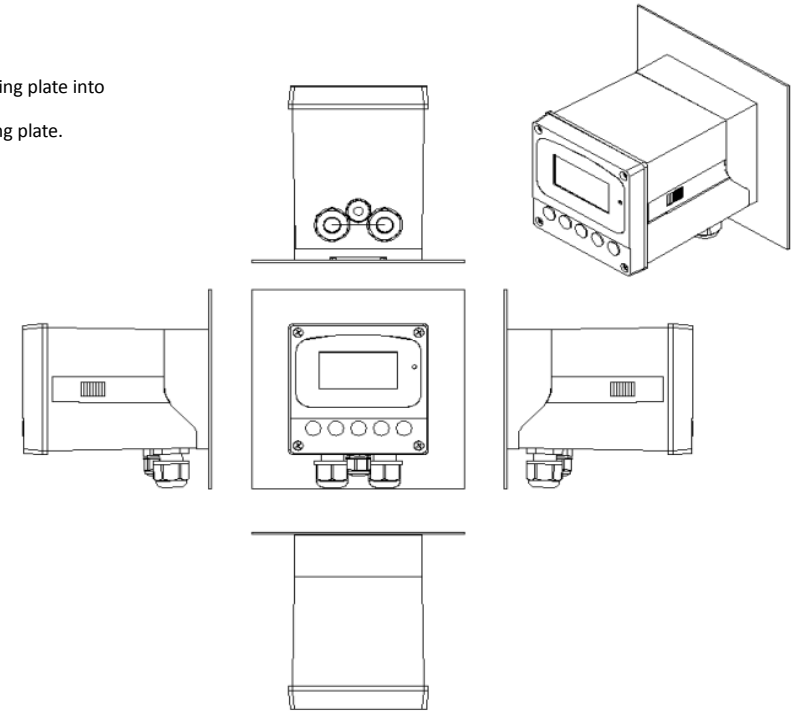


FIG.5 Backplate Mounting Diagram

## 6.3 Wiring

There is a PG9 thread hole below the instrument, you can access electrode lead(outer diameter ϕ4～ϕ6) to the meter; two M20X1.5 thread holes, you can access signal line(outer diameter ϕ6～ϕ10) and power cord to the meter. To ensure the instrument has good protection grade, please tighten the lock nut of the thread hole after through the lead wire. For the unused thread holes, please insert the waterproof rubber plug provided with the goods through the thread holes, then tighten the lock nut. To do so can prevent external water vapor into the instrument, and ensure the instrument can be used reliably.

## Electrical Connection Attention

**In order to ensure safety, the electrical connection should be done by the professionals. The power supply should be kept between 220±20VAC (±2.4V.DC when power supply is 24V.DC). To ensure the safety of the instrument and the accuracy of the measurement, the ground wire must be connected to the earth reliably.**

Static may damage the internal electronic components, resulting in performance degradation or damage of the instrument. The following measures are recommended to prevent the damage of sensor caused by static:

Release static from your body first before you touch any electronic components (e.g. printed circuit board & the components on it). You can touch the grounded metal surface of the instrument shell or a metal conduit or pipe:

1) In order to reduce the buildup of the static, excessive movement need to avoid. Please put the static-sensitive parts into an antistatic container or package when transports.
2) In order to release static from user's body and keep releasing , please wear a toggle-joint electrostatic catcher connected with ground wire.
3) If possible, please use antistatic ground pad or workbench pad.

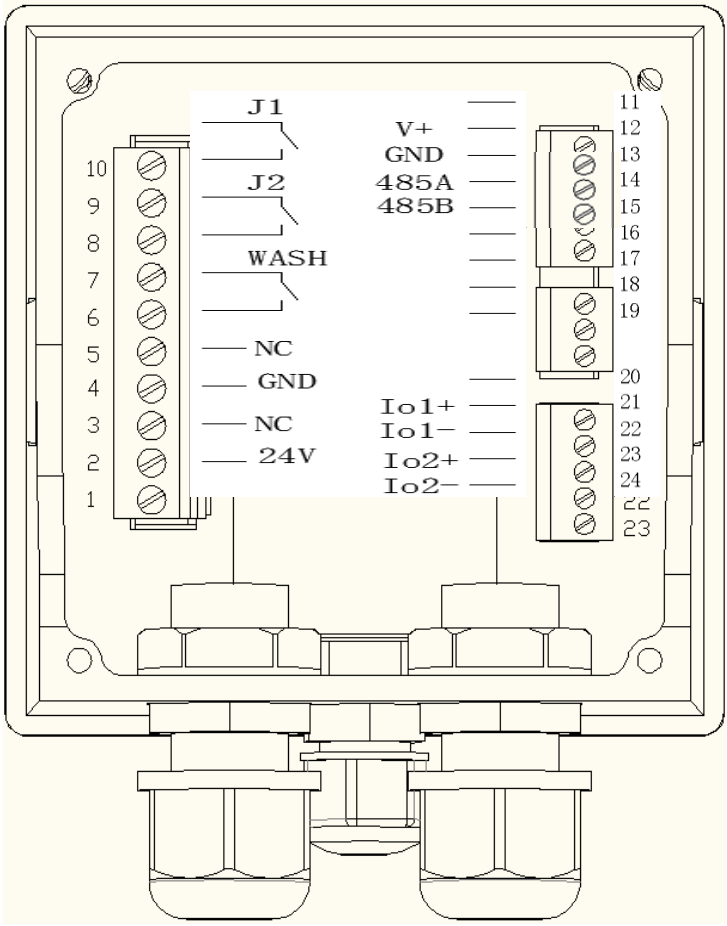

J1
J2
WASH
NC
GND
NC
24V
V+
GND
485A
485B
Io1+
Io1−
Io2+
Io2−
1
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**Table 2 Intelligent Transmitter Terminal Definition (Power Supply DC24V)**

| No. | Name | Instruction |
|---|---|---|
| 1 | 24V | DC24V Power supply + |
| 2 | NC | Not connected |
| 3 | GND | DC24V Power supply- |
| 4 | NC | Not connected |
| 5-6 | WASH | Wash relay normally open contact |
| 7-8 | RELAY2 | Relay 2 normally open contact |
| 9-10 | RELAY1 | Relay 1 normally open contact |
| 11 | NC | Not connected |
| 12 | V+ | Sensor power supply+ |
| 13 | GND | Sensor power supply- |
| 14 | 485A | Sensor 485 communication A |
| 15 | 485B | Sensor 485 communication B |
| 16 | NC | Not connected |
| 17 | NC | Not connected |
| 18 | NC | Not connected |
| 19 | NC | Not connected |
| 20 | NC | Not connected |
| 21 | Io1+ | 4-20mA Current output 1+ |
| 22 | Io1- | 4-20mA Current output 1- |
| 23 | Io2+ | 4-20mA Current output 2+ |
| 24 | Io2- | 4-20mA Current output 2- |

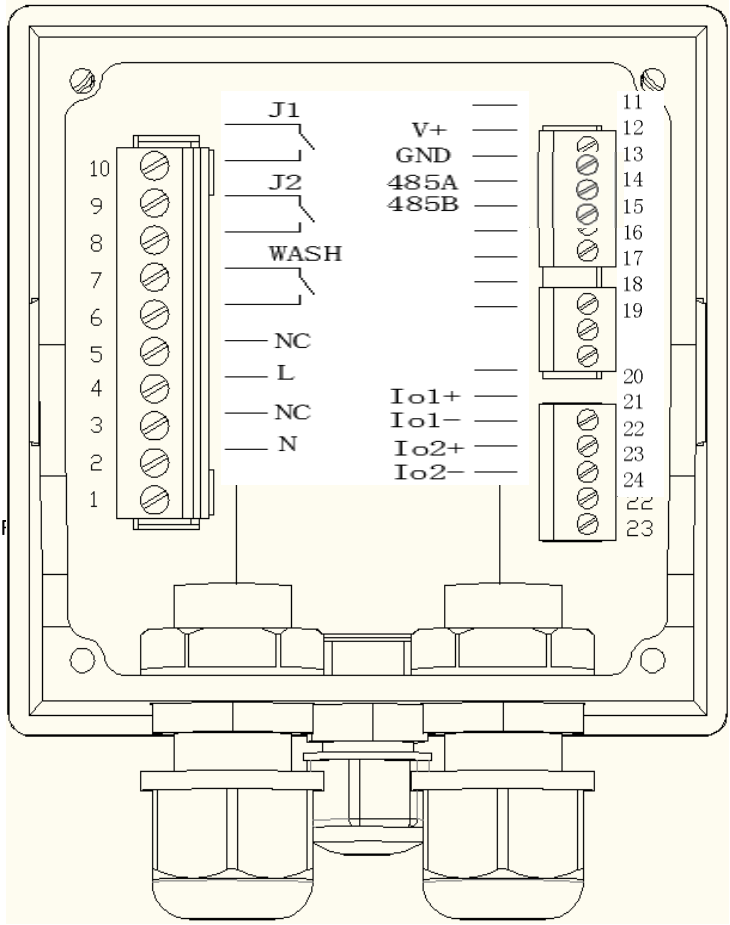
J1
J2
WASH
NC
L
NC
N
V+
GND
485A
485B
Io1+
Io1−
Io2+
Io2−
10
9
8
7
6
5
4
3
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**Table 3 Intelligent Transmitter Terminal Definition (Power Supply AC85-265V)**

| No. | Name | Instruction |
|---|---|---|
| 1 | N | AC85-265V Power supply null line |
| 2 | NC | Not connected |
| 3 | L | AC85-265V Power supply fire wire |
| 4 | NC | Not connected |
| 5-6 | WASH | Wash relay normally open contact |
| 7-8 | RELAY2 | Relay 2 normally open contact |
| 9-10 | RELAY1 | Relay 1 normally open contact |
| 11 | NC | Not connected |
| 12 | V+ | Sensor power supply+ |
| 13 | GND | Sensor power supply- |
| 14 | 485A | Sensor 485 communication A |
| 15 | 485B | Sensor 485 communication B |
| 16 | NC | Not connected |
| 17 | NC | Not connected |
| 18 | NC | Not connected |
| 19 | NC | Not connected |
| 20 | NC | Not connected |
| 21 | Io1+ | 4-20mA Current output 1+ |
| 22 | Io1- | 4-20mA Current output 1- |
| 23 | Io2+ | 4-20mA Current output 2+ |
| 24 | Io2- | 4-20mA Current output 2- |

# 7、Panel Introduction

Instrument front panel is shown in Figure 8,the upper half is the display area, including 128*64 lattice LCD display interface and one LED light; and the lower part is the key area, including five keys. Specific functions are shown in Table 4.


FIG 8. Transmitter Front Panel Schematic Diagram

**Table 4. Transmitter Front Panel Function Description Table**

| No. | Name | Mark | Instruction |
|---|---|---|---|
| 1 | LED Light | ACT | System running status indicator light |
| 2 | Menu Key |  | Press this key for 2s under measurement state, then enter the settings interface；press this key back to the previous menu under setting state. |
| 3 | Up key |  | Press this key under setting state to make number plus 1 or switch the up display content. |
| 4 | Down key |  | Press this key under setting state to make number minus 1 or switch the down display content. |
| 5 | Right key |  | Press this key under setting state to move to the right to switch display content or page flip. |

| | | | |
|---|---|---|---|
| 6 | OK Key | 确认 | Press this key under setting state to confirm operation content, then enter the next step of the operating procedures. |

# 8、Menu Operation Introductions

## 8.1 Display Interface Instructions

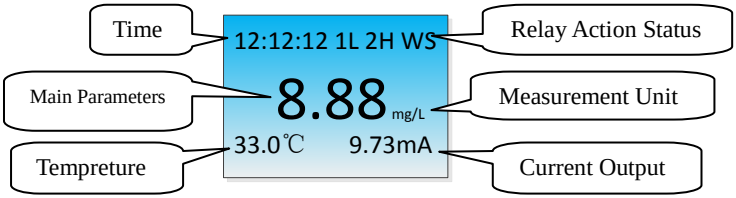
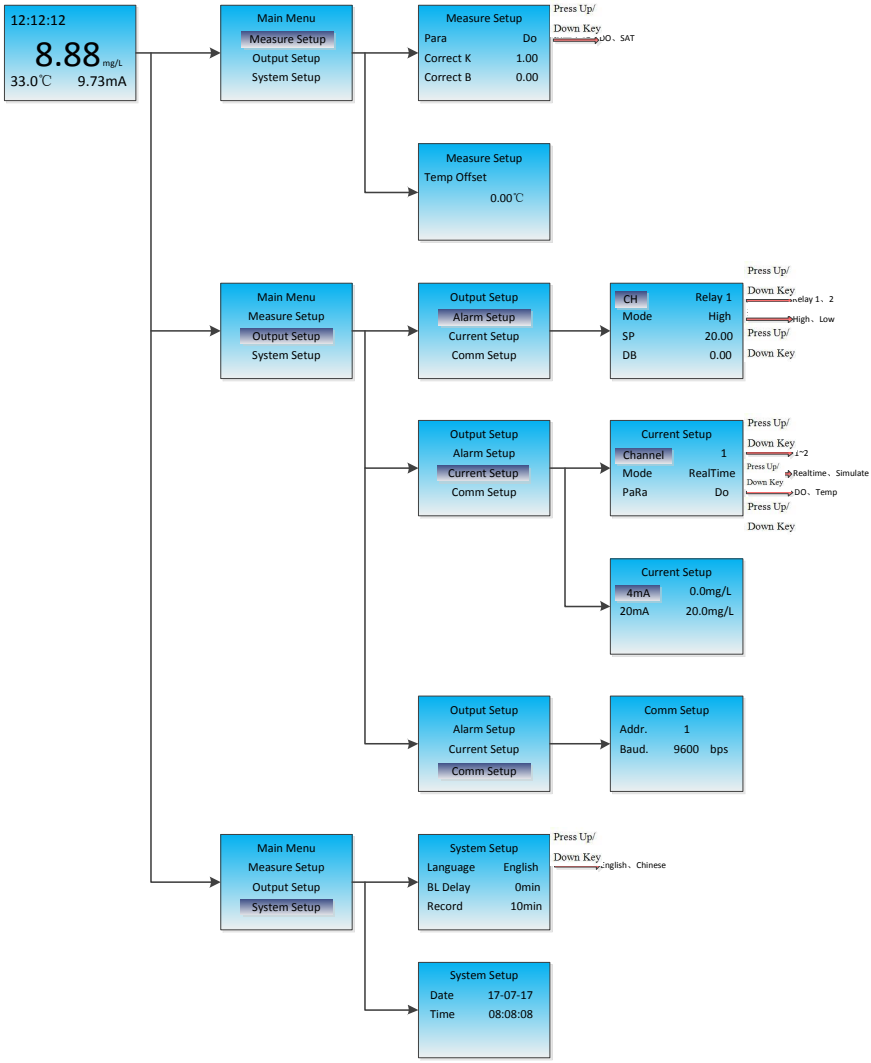


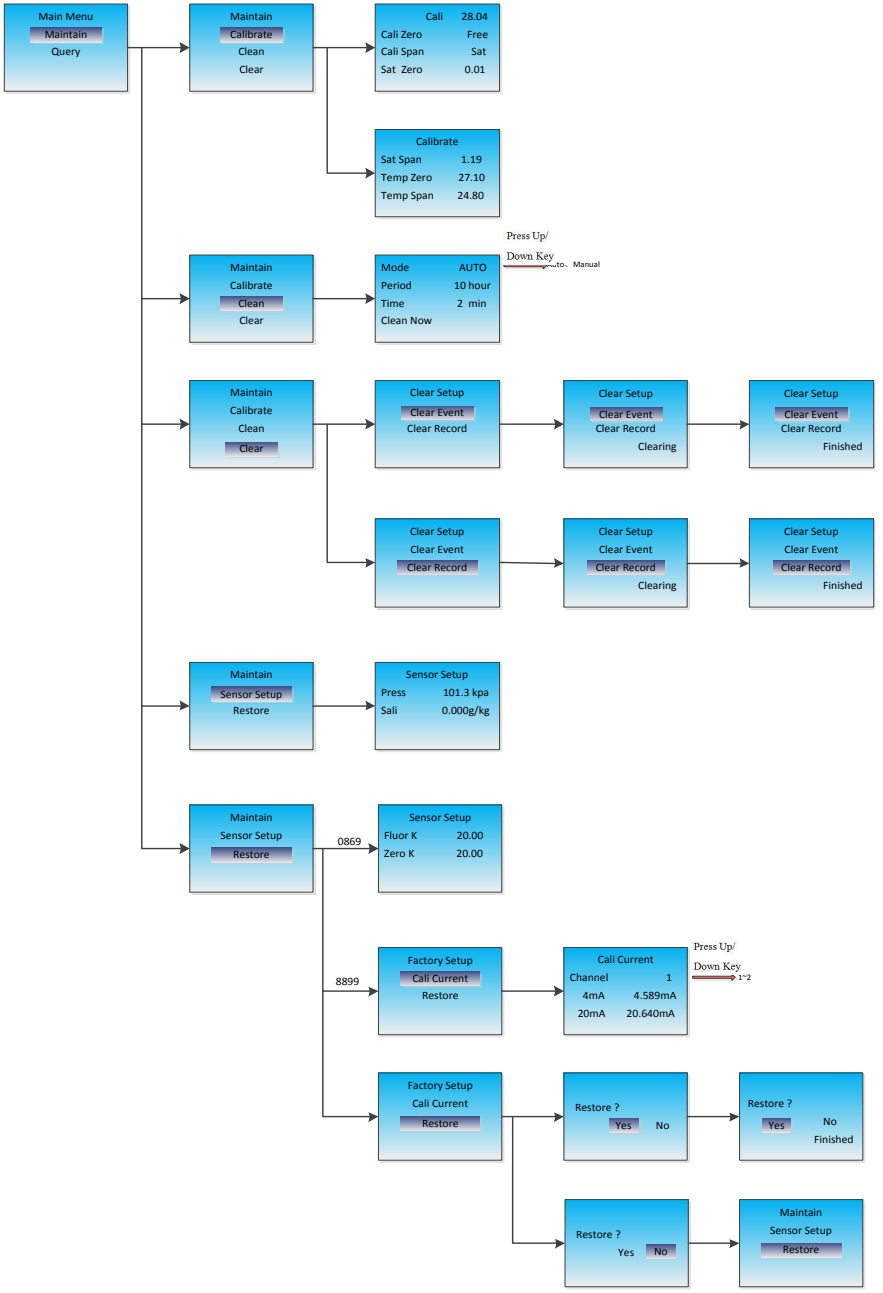

FIG 9 Display Interface Schematic Diagram

**Table 5 Display Interface Function Table**

| No. | Name | Function |
|---|---|---|
| 1 | Time | Display current time. |
| 2 | Main Parameters | Display measured values. |
| 3 | Tempreture | Display measured tempreture. |
| 4 | Relay Action Status | The number represents the corresponding relay. H represents high limit alarm. L represents low limit alarm. WS indicates the action of the cleaning relay. |
| 5 | Measurement Unit | Display mg/L |
| 6 | Output Current | Display output current value. |

## 8.2 Parameter Setting Operation




Main Menu
Maintain
Query
Maintain
Calibrate
Clean
Clear
Cali 28.04
Cali Zero Free
Cali Span Sat
Sat Zero 0.01
Calibrate
Sat Span 1.19
Temp Zero 27.10
Temp Span 24.80
Press Up/
Down Key
Maintain
Calibrate
Clean
Clear
Mode AUTO
Period 10 hour
Time 2 min
Clean Now
Maintain
Calibrate
Clean
Clear
Clear Setup
Clear Event
Clear Record
Clear Setup
Clear Event
Clear Record
Clearing
Clear Setup
Clear Event
Clear Record
Finished
Clear Setup
Clear Event
Clear Record
Clear Setup
Clear Event
Clear Record
Clearing
Clear Setup
Clear Event
Clear Record
Finished
Maintain
Sensor Setup
Restore
Sensor Setup
Press 101.3 kpa
Sali 0.000g/kg
Maintain
Sensor Setup
Restore
0869
Sensor Setup
Fluor K 20.00
Zero K 20.00
8899
Factory Setup
Cali Current
Restore
Cali Current
Channel 1
4mA 4.589mA
20mA 20.640mA
Press Up/
Down Key
Factory Setup
Cali Current
Restore
Restore ?
Yes No
Restore ?
Yes No
Finished
Restore ?
Yes No
Maintain
Sensor Setup
Restore

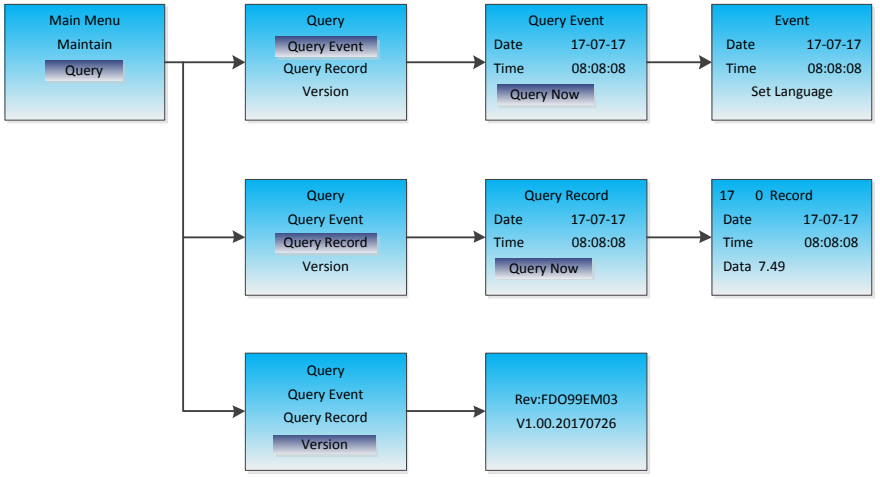
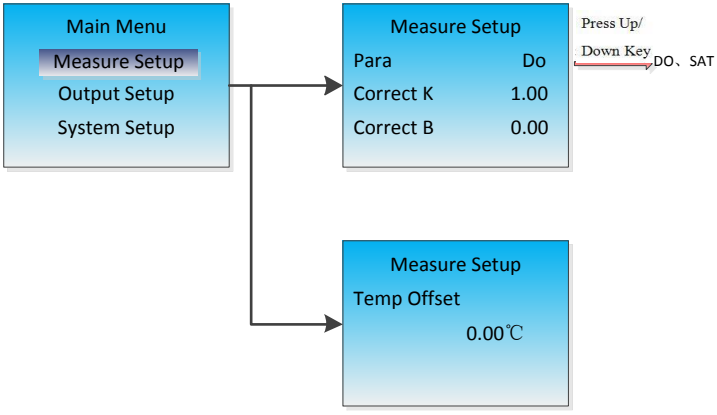



FIG 10. Parameter Setting Flow Chart

### 8.2.1 Measurement Setup

In the main menu interface, move the cursor to "**Measure Setup** " option, press the "OK key" and then enter Settings interface:



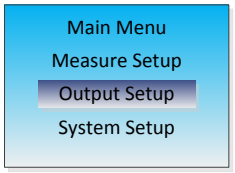

**Measure Setup：** Display and select the current measurement parameters (oxygen concentration, saturation).

**Dissolved oxygen slope, dissolved oxygen offset:** This option can make value adjustment based on calibration, the default slope is 1.00, and the default offset is 0.00.

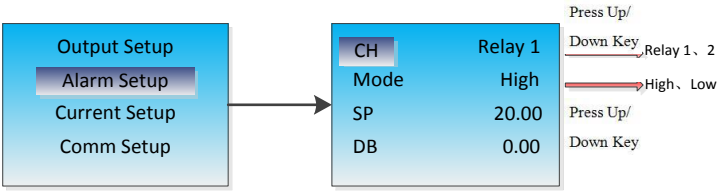
**Tempreture offset:** To adjust tempreture indicating value, and the default value is 0.00.

## 8.2.2 Output setup

In the main menu interface, move the cursor to "**Output setup**" option, press the "OK key" and then enter Settings interface:



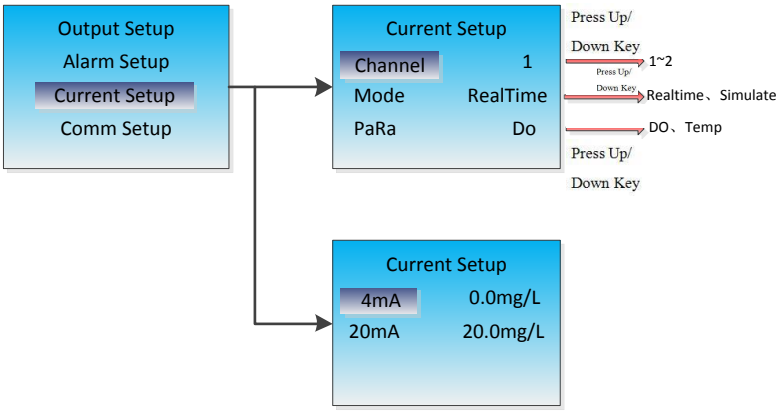

### 8.2.2.1 Alarm Setup




The transmitter has two channel relay can be used to set the alarm. Alarm Mode can select the “high” limit alarm or “low ” limit alarm. "Threshold" is the alarm set point. "Delay" is to avoid frequent relay action and set the alarm action return difference.

In above case, when measured value is greater than 20.00 mg/L, the first channel alarm relay actions (terminal 7, 8 closed), and it won’t restore normal until the measured value is lower than 20.00 (high limit alarm value- high limit hysteresis). If measured value is volatile, the hysteresis value need to set greater correspondingly , in order to avoid frequent relay action.

### 8.2.2.2 Current Setup



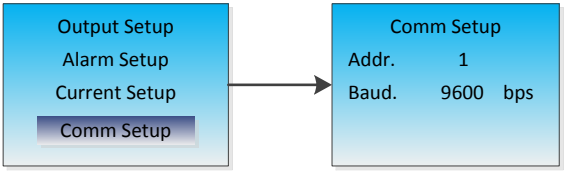

Setup high and low limit of 4-20 mA corresponding measurement range.

There are two modes of the transmitter output currents:

Real-time: reflect the real measurement parameters according to measurement range;

Simulation: in order to test the accuracy of output current, the 4-20 mA current output can be adjusted.

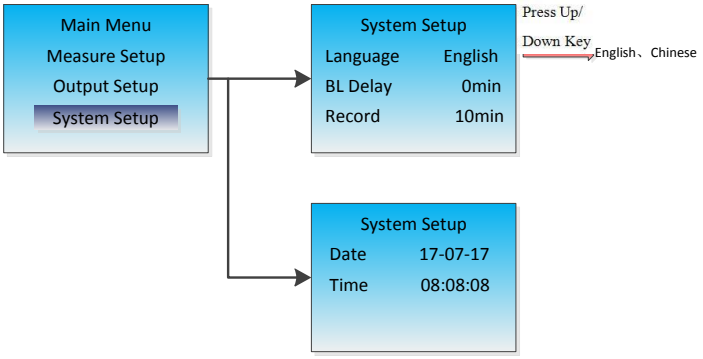
### 8.2.2.3 Communication Setup




The transmitter default communication address is 1.

The transmitter can be set the baud rate for: 9600、19200、38400、57600、115200

### 8.2.3 System Setup



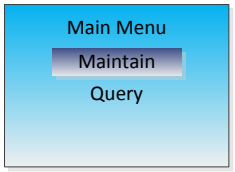

In order to save energy and prolong the life of LCD backlight, you can set the delay time. When the delay time is 0 min, backlight keeps on. The range of delay time is 0-255 min.

Instrument can be set to record data according to the cycle set by user, in case of later queries. The range of setting record cycle is 0-999 min.

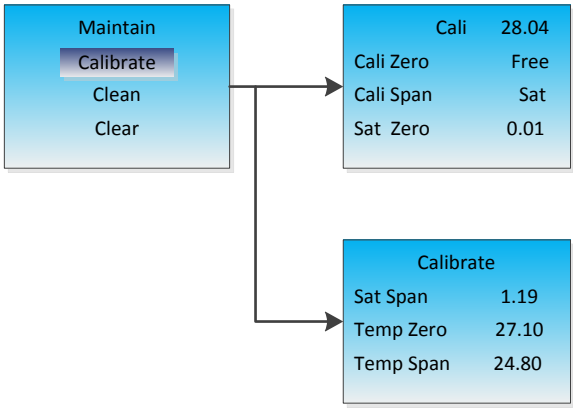
Date and time display is auxiliary functions of transmitter, which can be revised if the value is not correct.

### 8.2.4 System Maintaining

In the main menu interface, move the cursor to "**Maintain**" option, press the "OK key" and then enter Settings interface:

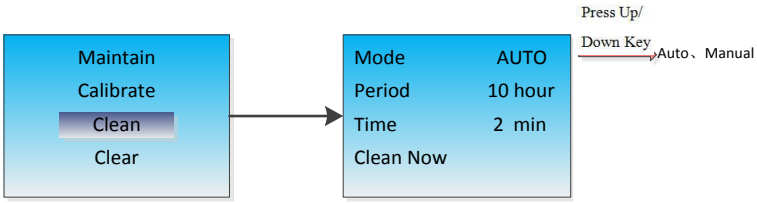


### 8.2.4.1 Calibration




Our product is calibrated strictly before leaving the factory. Please contact with manufacturer for advice before setting calibration on your own.

### 8.2.4.2 Cleaning Setup

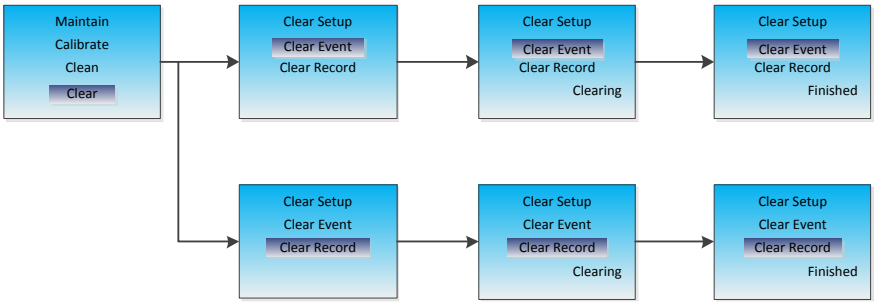



**Cleaning period:** used to implement the automatic cleaning function. The time interval between two automatic cleaning is cleaning period. The cleaning cycle setting range is 0-255 hours.

**Cleaning time:** used to control the closing time of cleaning relay.

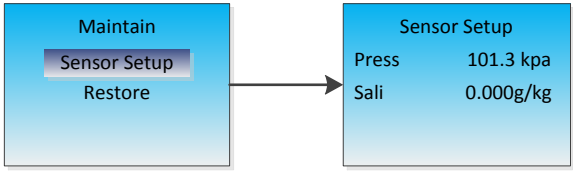
**Clean now:** used to implement the manual cleaning function. Select " Clean now" and press the "ok" key, then can close cleaning relay and start cleaning. Cleaning duration is equal to setting value of cleaning time.

### 8.2.4.3 Clear Setup



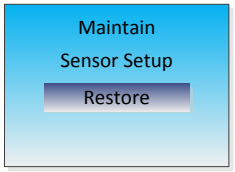

In order to clear the invalid data or events in the process of debugging, set this function specially. “Clear” function will clear out all of the data or events, so please pay attention during operation.

### 8.2.4.4 Condition Setup



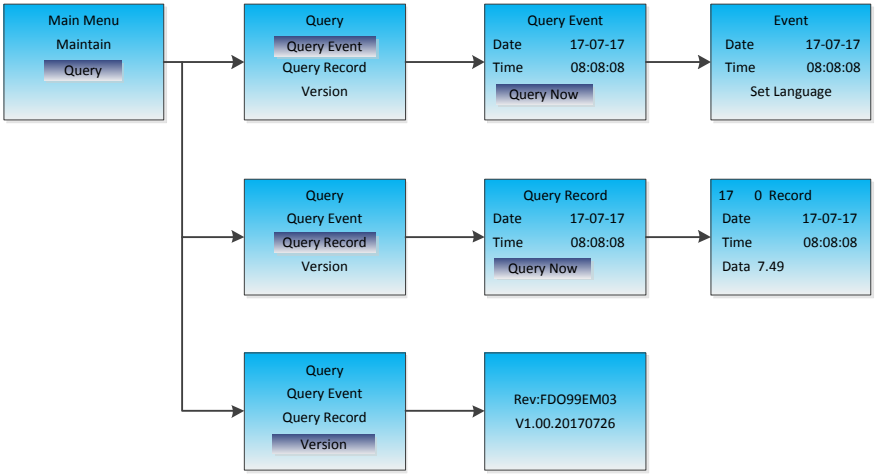

Due to dissolved oxygen are greatly influenced by atmospheric pressure and salinity value, so it is necessary to correct the atmospheric pressure and salinity. During using process user measured the current air pressure and salinity values by other tools or instruments and enter the values into the transmitter, then the transmitter can figure out the current actual density value based on HJ506-2009 national standards.

### 8.2.4.5 Parameter Restore




“Parameter Restore” is controlled by the password, the user do not need to operate temporarily for now.

### 8.2.5 Query




# 9、Instrument Maintenance

The instrument generally does not need daily maintenance. If it has obvious failure, in principle, do not open to repair by yourself, please contact us asap.

## 9.1 Maintenance Schedule

| Maintenance Task | Every 90 days | Every 2 years |
|---|---|---|
| Clean sensor（Note 1） | 0 | |
| Check whether the sensor or fluorescent film are damaged. | 0 | |
| Change senor fluorescent film | | 0 |
| Calibrate sensor | Maintenance schedule can be carried out under requirement of relevant department in charge. | |

Note 1: The cleaning frequency is set according to specific applications, too high or too low cleaning frequency is not appropriate in some occasions.

## 9.2 Sensor Cleaning

Clean the surface of sensor with water flow. If there is residual debris left, please wipe it with a wet soft cloth or scrub gently with soft brush (soft toothbrush is optional).Don't put the sensor in the sun or in places where is reflected by sunlight.

In the whole service life of sensor, if the sensor exposure time in the sun is longer than 1hour, it will lead to the ageing of the fluorescent cap, thereby can cause fluorescent cap error and the wrong readings shown by display screen.

## 9.3 Transmitter Cleaning

In the case of shell tightly shut, wipe the outer surface with wet cloth.

## 9.4 Fluorescent Film Replacement

Replacement of fluorescent film refers to figure 11. Please place the Φ 14.5 X1.8 fluorine rubber sealing ring, organic glass isolation window covered by fluorescent film, fluorescent gland in turn, and tighten M3X10 screw and spring pad, to ensure spring pad is flattened and no screw loose (It will affect the sealing performance here. There're 3 screws in total. Please pay attention to the coordination of 3 screws, don't tighten one screw at one time and make the other two screws can not be tightened).

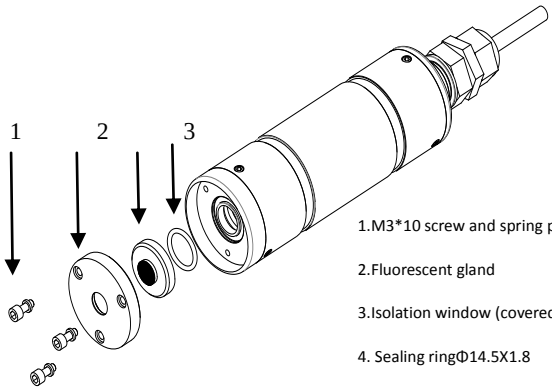



FIG.11 Replacement Schematic Diagram of Fluorescent Film

# 10、Common Troubleshooting

| No. | Phenomenon | Possible Causes | Handling Method |
|---|---|---|---|
| 1 | No display in the transmitter | Power supply is not connected or fuse is blown. | Check the power supply, or replacing the fuse, the fuse specification is 0.2 A. |
| 2 | Transmitter display values keep unchanged, and the keys works normally. | 1.The connecting line of transmitter and sensor connects wrong or has a fault;<br>2. Transmitter power has no output or sensor is damaged. | Check the connecting line of transmitter and sensor whether connect correct, and confirm the connection is in good condition.<br>Check the red and blue light of sensor whether flash once every 2 seconds, if not, test 5V power supply of transmitter whether has output. |
| 3 | Displayed Measured value jumps disorderly, or is extremely large. | The sensor leaks. | Take out the sensor from the water immediately, unscrew the fluorescent cap, check to see if the electric circuit has water inside and suck up the water with a soft gauze. |
| 4 | The readings shown on transmitter are stable, but in large difference from actual values. | Fluorescent cap is dirty and interferes measurement. | Clean the sensor. |
| 5 | Transmitter has no signal or abnormal output. | Related parameters have setup error, or electric current load resistance is too large. | Check the software settings, electric current load resistance should be < 500 Ω. |

## 11、Relational Table of Oxygen Dissolved Value and Water Temperature

| Temperature ℃ | Oxygen Dissolved Value under normal atmospheric pressure of 101.325 kpa mg/L | Temperature ℃ | Oxygen Dissolved Value under normal atmospheric pressure of 101.325 kpa mg/L |
|---|---|---|---|
| 0 | 14.62 | 21 | 8.91 |
| 1 | 14.22 | 22 | 8.74 |
| 2 | 13.83 | 23 | 8.58 |
| 3 | 13.46 | 24 | 8.42 |
| 4 | 13.11 | 25 | 8.26 |
| 5 | 12.77 | 26 | 8.11 |
| 6 | 12.45 | 27 | 7.97 |
| 7 | 12.14 | 28 | 7.83 |
| 8 | 11.84 | 29 | 7.69 |
| 9 | 11.56 | 30 | 7.56 |
| 10 | 11.29 | 31 | 7.43 |
| 11 | 11.03 | 32 | 7.30 |
| 12 | 10.78 | 33 | 7.18 |
| 13 | 10.54 | 34 | 7.07 |
| 14 | 10.31 | 35 | 6.95 |
| 15 | 10.08 | 36 | 6.84 |
| 16 | 9.87 | 37 | 6.73 |
| 17 | 9.66 | 38 | 6.63 |
| 18 | 9.47 | 39 | 6.53 |
| 19 | 9.28 | 40 | 6.43 |
| 20 | 9.09 | | |

# 12、Quality Insurance

Shandong Dongrun Instrument Science and Technology Co., Ltd, guarantees the important components and technology of instrument body one-year warranty period from purchase date. During the warranty period if the product has problem, please package instrument properly and freight prepaid shipped back to us. Our customer service department will check the damage cause of the instrument. If it is a product quality problem, we will repair it for free. If it is human factors result in malfunction or damage ,our company will repair wholeheartedly, but appropriate material cost fees will be charged (Some parts such as electrode or standard solution are consumables, which are not included into the warranty scope).

Please inform our sales staff before product repair. If possible, please use the instrument former delivery pack, otherwise please wrap instrument by bubble pack and then package by corrugated carton. Please enclose the brief description of instrument fault into package, in order to help customer service department repair the product asap.

Our company will not take responsibility for the damage caused by poor package during repair delivery.

DONGRUN

**Shandong Dongrun Instrument Science and Technology Co., Ltd**

ADD: NO.1 Xiulin Road, Laishan District, Yantai City, Shandong, China

TEL: 0086-535-3971626

FAX: 0086-535-6919362

WEB: www.cndongrun.com

E-MAIL: bobby@cndongrun.com