



# DITBS-3001-OD

## Dissolved Oxygen Sensor User Manual

**RS485 Modubus**

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Status: Released

# Chapter1 Product Introduction

## 1.1 Product Description

Dissolved oxygen online analyzer is one of the intelligent online chemical analysis instruments. It is widely used in dissolved oxygen, saturation, oxygen partial pressure in solutions such as thermal power, chemical fertilizers, metallurgy, environmental protection, pharmaceuticals, biochemistry, food and tap water. And continuous monitoring of temperature.

This product uses a fluorescent dissolved oxygen probe. The sensor has a long life, no maintenance, and excellent performance. The continuous monitoring data can be remotely monitored and recorded through the transmission output and the recorder. It can also be connected to the RS485 interface through the MODBUS-RTU protocol for easy connection Enter the computer to realize monitoring and recording.

This product is equipped with a waterproof housing to convert the signal of the aqueous solution into a standard 485/4-20mA/0-10V signal through digital setting and analysis. The product does not need to be calibrated in one molding process and can be used immediately.

## 1.2 Features

The probe of this product is a fluorescence probe, which uses the principle of fluorescence quenching for measurement. The fluorescence method is relatively active in recent years and can overcome the shortcomings of traditional classical measurement methods that cannot be continuously measured online. The fluorescence method does not consume oxygen, is not subject to magnetic interference, and does not consume Electrode, high sensitivity, low detection limit, long life, has been widely used in sustainable online monitoring and other advantages.

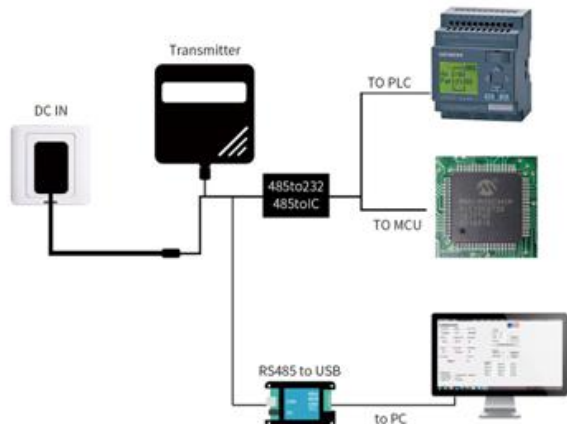
## 1.3 Main parameters

Parameters name	Parameters content
DC power supply	9-24V DC
Power consumption	≤0.15W (@12V DC , 25°C)
measurement accuracy	3%F.s
Detect range	0-20mg/L
Ion resolution	0.01mg/L
Lower detection limit	0.02mg/L
output signal	485/4-20mA/0-10V
temperature range	-10 - 60°C
Repeatability	±2%
Product Size	110×85×44mm3
Probe size	155mm*12mm (Length*diameter)
Maintenance cycle	1 year

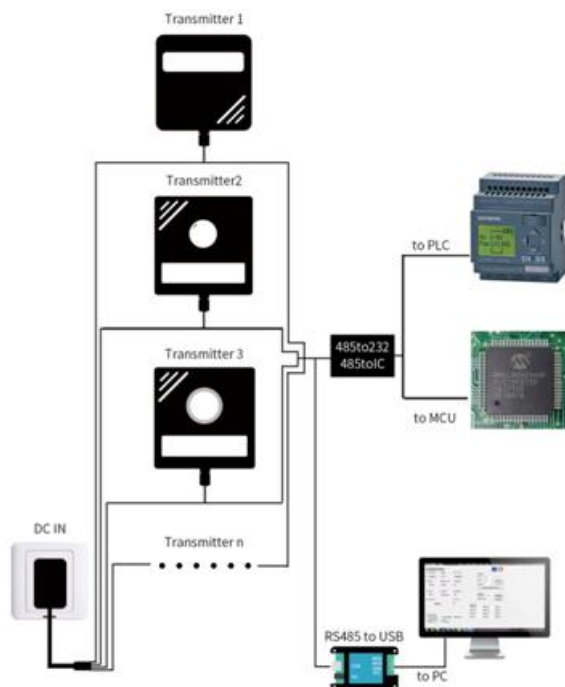
## 1.4 System framework diagram

### 1.4.1 485 interface frame diagram

This sensor can be connected and used alone. First, use 12V DC power supply. The device can be directly connected to a PLC with a 485 interface, and it can be connected to a single-chip microcomputer through a 485 interface chip. The single-chip microcomputer and PLC can be programmed through the modbus protocol specified later to cooperate with the sensor. At the same time, use USB to 485 to connect to the computer, and use the sensor configuration tool provided by our company for configuration and testing.



This product can also be used by combining multiple sensors on a single 485 bus. Please follow the "485 bus field wiring rules" (see appendix) when performing 485 bus combination. In theory, one bus can be connected to more than 16 485 sensors. If you need to connect more 485 sensors, you can use a 485 repeater to expand more 485 devices, and the other end is connected to a PLC with a 485 interface through a 485 interface chip. Connect the single-chip microcomputer, or use USB to 485 to connect to the computer, and use the sensor configuration tool provided by our company to configure and test.



### 1.4.2 Frame diagram of analog interface

The analog interface can be directly connected to the PLC data module, or handed over to the single-chip microcomputer to process the signal, as shown in the figure below:

## Chapter 2 Hardware connection

### 2.1 Inspection before equipment installation

Please check the equipment list before installing the equipment:

Name	Qty
Dissolved oxygen transmitter equipment	1 set
12V Waterproof power supply	1set (Optional)
Warranty card/certificate	1 piece

### 2.2 Interface Description

The power interface is a wide voltage power input of 12-24V. The product pays attention to the positive and negative signal lines, and do not reverse the positive and negative signal lines.



485 interface sensor wiring mode:

Function	Cable Color	Specs
Power	Brown	Power supply +
	Black	Power supply -
Communication	Yellow (grey)	485-A
	Blue	485-B

Analog interface sensor wiring mode:

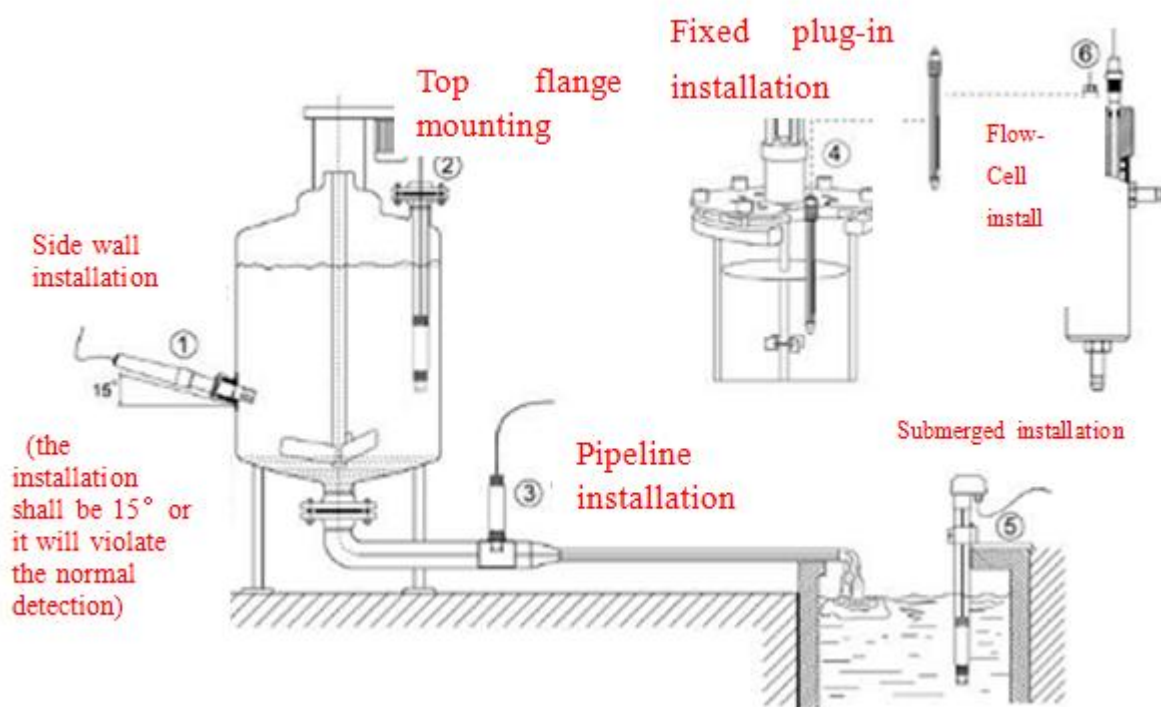
Function	Cable Color	Specs
<b>Power</b>	Brown	Power supply +
	Black	Power supply -
<b>Communication</b>	Yellow (grey)	Voltage/Current Output Positive
	Blue	Voltage/Current Output Positive

The factory default provides 0.6 meters long wire, customers can extend the wire as needed or wire in order.

### 2.3 Installation Notes

This instrument is wall-mounted. Please install it on the wall and try to avoid wind, rain and direct sunlight. To prevent the internal temperature of the instrument from rising, please install it in a well-ventilated place. When installing the instrument, please do not tilt it left or right, try to install it horizontally.

The electrode is a very precise component, and the correct installation method must be used. The wrong installation method will cause damage to the electrode or irreversible damage. The electrode adopts pipeline installation. Immersion type. Flange installation is all possible.



Please do not put the electrode directly into the water, choose the electrode mounting bracket or the flow cup to fix it. Before installation, be sure to use the raw material tape (3/4 thread) to do a waterproof seal to prevent water from entering the electrode and causing short circuit of the electrode cable.

During the water cut, make sure that the electrode is immersed in the test liquid or wear a protective cap with a built-in protective liquid. In winter, the temperature is low and the water needs to be shut down for a long time. Otherwise, the service life will be shortened.

## Chapter 3 RS485 Communication Protocol

### 3.1 Basic communication parameters

parameter	content
<b>coding</b>	8-bit binary
<b>Data bit</b>	8-bit
<b>Parity bit</b>	No
<b>Stop bit</b>	1-bit
<b>Wrong calibration</b>	CRC Lengthy loop code
<b>Baud rate</b>	2400bps/4800bps/9600 bps can be set, the factory default is 9600bps
<b>coding</b>	8-bit binary

### 2.2 Data frame format definition

Adopt Modbus-RTU communication protocol, the format is as follows:

Initial structure  $\geq 4$  byte time

Address code = 1 byte

Function code = 1 byte

Data area = N bytes

Error check = 16-bit CRC code

End structure  $\geq 4$  bytes time

Address code: the address of the transmitter, which is unique in the communication network (factory default 0x01).

Function code: The command function prompt sent by the host, this transmitter only uses function code 0x03 (read memory data).

Data area: The data area is the specific query data area, pay attention to the 16bits data high byte first

CRC code: two-byte check code.

### Inquiry Frame

Address code	function code	Register start address	Register length	Check code low bit	Check code high bit
1byte	1byte	2bytes	2bytes	1byte	1byte

### Reply frame

address code	function code	Effective bytes	First data area	Second data area	Nth data area
1byte	1byte	1byte	2bytes	2bytes	2bytes

## 2.3 Register address

Register address	PLC configuration address	Content	Operating
0001H	40002	Temperature (unit: 0.1 °C)	Read only
0002H	40003	Dissolved oxygen (unit: 0.01mg/L)	Read only
0100H	40101	Device address(0-252)	Read and write
0101H	40102	Baud rate(2400/4800/9600)	Read and write

## 3.4 Communication protocol example and explanation

### 3.4.1 Read the dissolved oxygen value of the device address 0x01

#### Enquiry Frame

address code	function code	starting address	Data length	Check code low bit	Check code high bit
0x01	0x03	0x00,0x02	0x00,0x01	0x25	0xCA

#### Response frame (e.g. read dissolved oxygen value 1.89mg/L)

address code	function code	Effective bytes	Dissolved oxygen value	Check code low bit	Check code high bit
0x01	0x03	0x02	0x00 0xBD	0x78	0x35

Dissolved oxygen: 00BDH(Hexadecimal)=189=>dissolved oxygen=1.89mg/L

### 3.4.2 Read the temperature value of the device address 0x01

#### Enquiry frame

address code	function code	starting address	Data length	Check code low bit	Check code high bit
0x01	0x03	0x00,0x01	0x00,0x01	0xd5	0xca

**Response frame**

address code	function code	starting address	Temperature value	Check code low bit	Check code high bit
0x01	0x03	0x02	0x00 0xAF	0xDB	0xBF

Temperature:00AF H(Hexadecimal)=175=>Temperature=17.5 °C

**3.4.3 Read device address 0x01 temperature, dissolved oxygen concentration value**

**Enquiry frame**

address code	function code	starting address	Data length	Check code low bit	Check code high bit
0x01	0x03	0x00,0x01	0x00,0x02	0x95	0xCB

**Reply frame**

address code	function code	Effective bytes	Temperature value	Dissolved oxygen value	Check code low bit	Check code high bit
0x01	0x03	0x04	0x01 0x1b	0x00 0x28	0xDB	0xBF

Temperature:

011B H(Hexadecimal)=283=>Temperature=28.3 °C

Dissolved oxygen:

0028 H(Hexadecimal)=40=>Dissolved oxygen=0.40mg/L

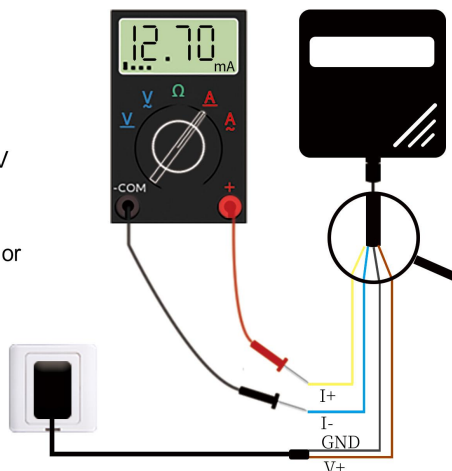
# Chapter 4 Analog wiring instructions

The analog sensor wiring is simple, just connect the wire to the designated port of the device. The equipment supports 3/4 wire connection.

## 4.1 Typical four-wire wiring method

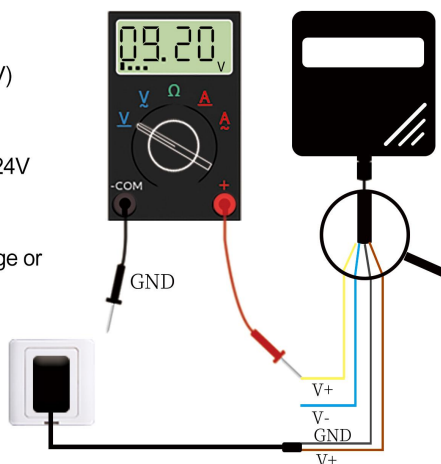
The following figure shows the wiring method of the current sensor. Connect the power cord (brown wire and black wire) of the sensor to the power supply; the yellow (gray) wire of the sensor is the signal positive when the signal is connected to the acquisition device, and the current flow is the sensor To the acquisition device; the blue line of the sensor is the negative signal when the signal is connected to the current acquisition device, and the current flow is from the acquisition device to the sensor;

- Current output type(4-20mA)
- Four-wire connection
- first step
- Connect the sensor with 12V~24V power adapter
- Second step
- Correctly select multimeter range or connect analog signal collector
- third step
- Calculate the formula



The following figure shows the wiring method of voltage type sensor. Connect the power cord of the sensor (brown wire and black wire) to the power supply; the yellow (gray) wire of the sensor is the signal positive when the signal is connected to the acquisition device, and yellow (gray) The voltage of the line is the output voltage; the blue line of the sensor is the negative signal when the signal is connected to the voltage acquisition device, and the voltage of the blue line is the reference voltage, which is 0V consistent with the voltage of the black line.

- Voltage output type(0-5V/0-10V)
- Three-wire connection
- first step
- Connect the sensor with 12V~24V power adapter
- Second step
- Correctly select multimeter range or connect analog signal collector
- third step
- Calculate the formula

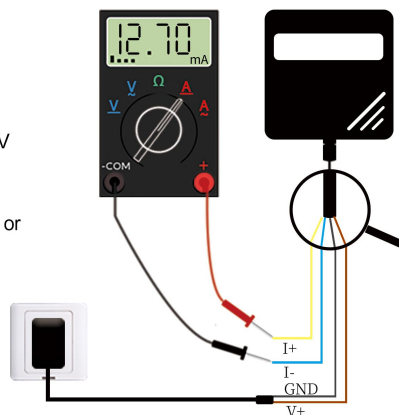


## 4.2 Typical three-wire wiring method

For typical three-wire wiring, compared to four-wire wiring, the blue wire can be omitted. In the sensor, the blue wire and the black wire are short-circuited in the sensor, so the blue wire can be omitted.

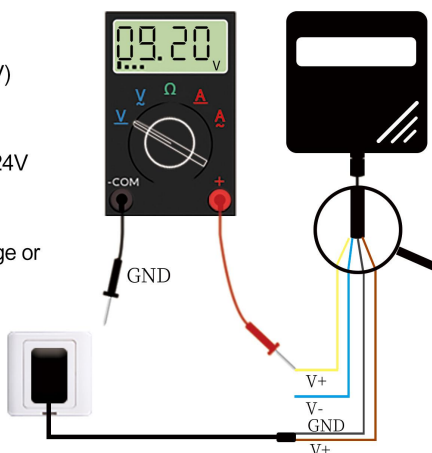
For the three-wire current connection method, after connecting the power cord (brown wire and black wire) of the sensor to the power supply, only the yellow (gray) wire of the sensor is connected to the signal positive of the current acquisition device.

- Current output type(4-20mA)
- Four-wire connection
- first step
- Connect the sensor with 12V~24V power adapter
- Second step
- Correctly select multimeter range or connect analog signal collector
- third step
- Calculate the formula



For the three-wire voltage connection mode, after connecting the power cord (brown wire and black wire) of the sensor to the power supply, only the yellow (gray) wire of the sensor is connected to the signal positive of the voltage acquisition device.

- Voltage output type(0-5V/0-10V)
- Three-wire connection
- first step
- Connect the sensor with 12V~24V power adapter
- Second step
- Correctly select multimeter range or connect analog signal collector
- third step
- Calculate the formula



## Chapter 5 Meaning and conversion of analog parameters

### 5.1 Analog 4-20mA current output

Current value	Dissolved oxygen
4mA	0
20mA	full range

The calculation formula is  $P_{(Dissolved\ oxygen)} = (I_{(current)} - 4mA) * full\ range / 16mA$

The unit of I is mA. 4mA represents 0 point, 20mA represents the maximum range linear conversion

### 5.2 Analog 0-10V voltage output

Voltage value	Dissolved oxygen
0V	0
10V	full range

The calculation formula is  $P_{(Dissolved\ oxygen)} = V_{(voltage)} * full\ range / 5000mV$

The unit of V is mV. Please use 0V to represent 0 points and 10V to represent the maximum range

linear conversion.

### 5.3 Analog 0-5V voltage output

Voltage value	Dissolved oxygen
0V	0
5V	full range

The calculation formula is  $P(\text{Dissolved oxygen}) = V_{(\text{voltage})} * \text{full range} / 10000\text{mV}$

The unit of V is mV. Please use 0V to represent 0 points and 10V to represent the maximum range linear conversion.

## Chapter 6 appendix

### 6.1 Warranty and after-sales

The warranty clauses follow the sensor after-sales clauses of Weihai Jingxun Changtong Electronic Technology Co., Ltd., the sensor host circuit part is guaranteed for two years, the gas-sensitive probe is guaranteed for one year, and the accessories (shell/plug/cable, etc.) are guaranteed for three months.

### 6.2 Dissolved oxygen related national standard parameters

The attached table data comes from HJ506-2009 National Environmental Protection Standard

Temperature/ °C	At standard atmospheric pressure (101.325kPa) Oxygen solubility (mg/L)	Salt content in water For every increase of 1g/Kg Corrected value for dissolved oxygen [(mg/L)/(g/Kg)]	Temperature/ °C	At standard atmospheric pressure (101.325kPa) Oxygen solubility (mg/L)	Salt content in water For every increase of 1g/Kg Corrected value for dissolved oxygen [(mg/L)/(g/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			

Oxygen solubility as a function of salt content

Conductivity/ (mS/cm)	Salt content in water/ (g/Kg)	Conductivity/ (mS/cm)	Salt content in water/ (g/Kg)	Conductivity/ (mS/cm)	Salt content in water/ (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 3 The relationship between saturated water vapor pressure and temperature

Temperature/ °C	Pressure of saturated water vapor/hPa	Temperature/ °C	Pressure of saturated water vapor/hPa	Temperature/ °C	Pressure of saturated water vapor/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	23.1	35	66.2
6	9.3	21	24.9	36	69.8
7	10.0	22	26.7	37	73.4
8	10.7	23	28.6	38	77.2
9	11.5	24	30.6	39	81.0
10	12.3	25	32.7	40	85.0
11	13.1	26	34.9		
12	14.0	27	37.3		
13	14.9	28	39.8		
14	16.0	29	42.4		

Altitude h/M	Average atmospheric pressure p/hPa	Altitude h/m	Average atmospheric pressure p/hPa	Altitude h/m	Average atmospheric pressure p/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		