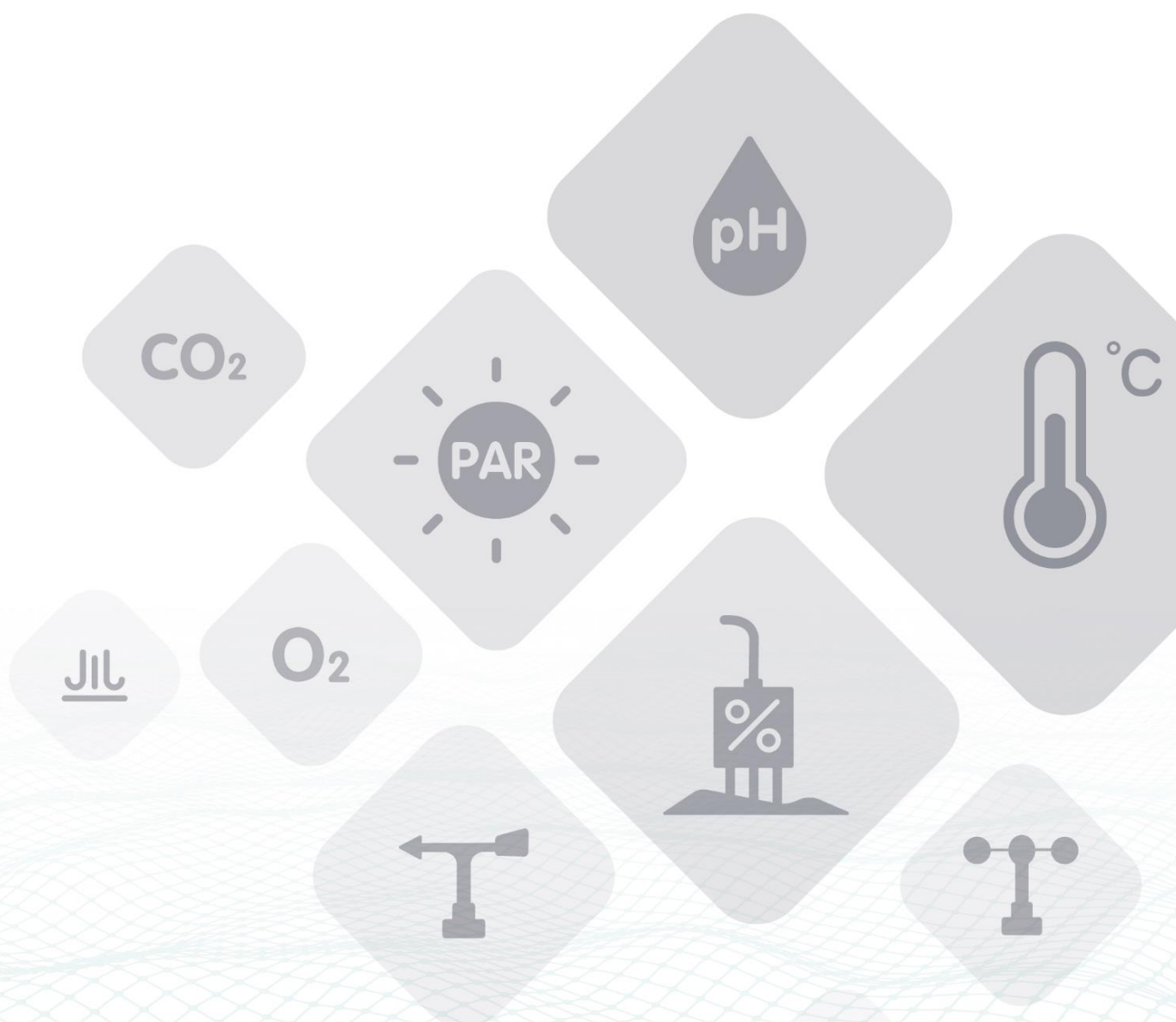# Dissolved Oxygen Sensor - User Manual

Model: S-RJY-01

Version: V1.0

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1. Background meaning and working principle

1.1 Background meaning

Dissolved oxygen (DO) refers to the content of oxygen dissolved in water, which is expressed in milligrams of oxygen per liter of water, and dissolved oxygen exists in water in a molecular state. The amount of dissolved oxygen in water is one of the important indicators of water quality and one of the important factors of water purification.

The content of dissolved oxygen in water is related to factors such as atmospheric pressure, water temperature and salinity. For water bodies not polluted by oxygen-depleting substances (generally organic matter), the dissolved oxygen is saturated, for example, the dissolved oxygen in clean surface water is close to saturation. When there is a lot of organic matter in the water body, the oxygen consumption rate exceeds the oxygen supply rate, and the dissolved oxygen in the water will continue to decrease, even close to zero, so that the organic matter will decompose under the anoxic condition, and the phenomenon of corruption and fermentation will occur, making the water quality serious. deterioration. Therefore, in the quality evaluation of water bodies, dissolved oxygen is used as an indicator of the degree of water pollution.

1.2 Working principle

S-RJY-01 integrated online fluorescence method dissolved oxygen sensor is designed based on the principle of quenching excitation fluorescence by specific substances in physics. When the excitation light is irradiated on the fluorescent substance on the surface of the fluorescent film head, the fluorescent substance is excited and emits fluorescence, and the extinguishing time of the fluorescence is affected by the concentration of oxygen molecules on the surface of the fluorescent film head. The concentration of oxygen molecules can be calculated by detecting the phase difference between the fluorescence and the excitation light and comparing with the internal calibration curve, and the final value is output after temperature and salinity compensation.

- No electrolyte required, no polarization
- No need to consume oxygen, not affected by flow rate
- Built-in temperature sensor, automatic temperature compensation
- Built-in salinity compensation, flexible parameter setting
- Not interfered by chemicals such as sulfides
- Small drift, fast response, more accurate measurement
- Long service life and lower cost
- Fluorescent membrane head is easy to replace and easy to maintain
- RS-485 interface, Modbus/RTU protocol
- Low power consumption and anti-interference design

2. Technical Parameters

Model	S-RJY-01
Measuring principle	Fluorescence
Measuring range	0～20.00mg/L (0～200% saturation, 25℃)
Precision	±2%F.S., ±0.3℃
Resolution	0.01mg/L, 0.1℃
Calibration method	Two-point calibration
Temperature compensation	Automatic temperature compensation (Pt1000)
Output method	RS-485(Modbus/RTU)
Operating conditions	0～50 ℃, <0.2MPa
Storage temperature	-5～65℃
Installation method	Immersion installation, 3/4" NPT pipe thread
Material	PC, stainless steel
Cable length	5 meters
Power consumption	0.3W@12V
Power supply	12~24VDC (typical value 12V)
Degree of protection	IP68

3. Dimensions
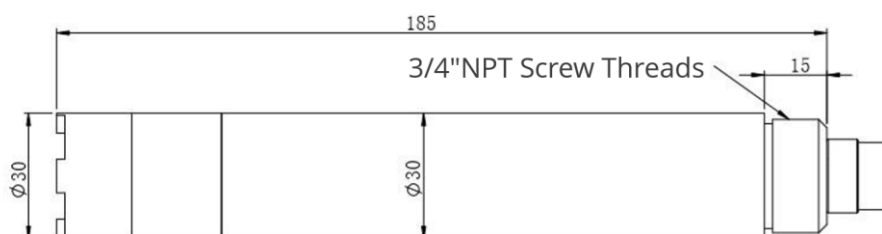
Note: The size sensor connector is a male M16-5 core waterproof connector.

4. Product installation and wiring

The sensor should be submerged below the liquid surface for fixed installation. Avoid bumping or scratching the surface of the fluorescent film head during installation and use. The fluorescent film head part should be prevented from being attached to the bottom sediment. The rubber boot should be removed when in use.

The cable is a 4-core twisted-pair shielded cable, and the line sequence definition is as follows:

- **Red wire—power line (12~24VDC)**
- **Black wire—ground wire (GND)**
- **Blue wire—485A+**
- **White wire—485B-**
- **Green wire—shielded wire**

Check the wiring sequence carefully before powering on to avoid unnecessary losses due to wrong wiring.

Note: Considering that the cables have been soaked in water (including sea water) or exposed to the air for a long time, all wiring points are required to be waterproofed, and the user's cables should have certain corrosion resistance.

5. RS485 communication

The Modbus protocol is a common language used in electronic equipment. Through this protocol, network communication is carried out between devices. It has become a common industry standard and is widely used in data collectors, sensor equipment, etc. Based on this protocol, devices produced by different manufacturers can communicate with each other for system integration.

The Modbus protocol is a master-slave protocol. One node is the master, and other nodes participating in the communication using the Modbus protocol are slaves. Each slave device has a unique address. The sensor has an RS485 interface and supports the Modbus-RTU protocol. Sensing data and communication parameters can be obtained or modified by Modbus commands.

> **Note:**
> Default communication parameters:
> Address 55(DEC), baud rate 9600bps, 1 start bit, 8 data bits, no parity, 1 stop bit.

5.1 **Frame format**

1. Read data instruction frame:

06	03	xx xx	xx xx	xx xx
address	function code	register address	number of registers	CRC check code (low byte first)

2. Read data response frame:

06	03	xx xx	xx xx	xx xx
address	function code	bytes	CRC	Check code (low byte first)

3. Write data instruction frame:

06	06	xx xx	xx xx	xx xx
address	function code	register address	write data	Check code (low byte first)

Write data response frame (same as write data command frame):

06	06	xx xx	xx xx	xx xx
address	function code	register address	write data	Check code (low byte first)

5.2 **Register address**

Register address (DEC/HEX)	Name	Description	Number of registers	Method
44353 (0x1100)	switch machine	Write data 1 when power on, write data 0 when power off. The power-on default is the power-on state.	1 (2 bytes)	Write
40001 (0x0000)	measured value + temperature	4 double-byte integers, which are the measured value, the decimal place of the measured value, the temperature value, and the decimal place of the temperature value.	4 (8 bytes)	read
40001 (0x0000)	measurements	mg/L value x100 (for example: ODO of 1.02mg/L is displayed as 102, with 2 decimal places by default.)	1 (2 bytes)	read
40003 (0x0002)	temperature value	°C value x10 (for example: the temperature of 25.6 °C is displayed as 256, and the default is 1 decimal place.)	1 (2 bytes)	read
40005 (0x0004)	Dissolved oxygen saturation (0~200%)	2 double-byte integers, which are the saturation value and the number of decimal places respectively.	2 (4 bytes)	read
44097 (0x1000)	Zero calibration	Calibration in anaerobic water, write data is 0; read data is zero offset.	1 (2 bytes)	write /read
44101 (0x1004)	slope calibration	Calibration in air-saturated water, write data is 0; read data is slope value × 1000.	1 (2 bytes)	write /read
44113 (0x1010)	temperature calibration	When calibrating in solution, the written data is the actual temperature value × 10; the read data is the temperature calibration offset × 10.	1 (2 bytes)	write /read
44129 (0x1020)	salinity compensation	The read/write data is salinity value (PSU)×10, which is used for salinity compensation; the factory default is 0, no salinity compensation. The written value range is 0~500, corresponding to 0~50.0 PSU.	1 (2 bytes)	write /read
48195 (0x2002)	sensor address	The default is 55(DEC), and the write data range is 1~127.	1 (2 bytes)	write / read

48225 (0x2020)	reset sensor	The calibration value is restored to the default value, and the written data is 0. Note: After the sensor is reset, it needs to be calibrated again before it can be used.	1 (2 bytes)	Write

5.3 Command example

1. Boot command:

Function: Let the sensor emit light continuously and start measuring the dissolved oxygen value.

    Request frame: 06 06 11 00 00 01 4C 81

    Response frame: 06 06 11 00 00 01 4C 81

2. Start measuring command:

Function: Obtain the temperature and dissolved oxygen value measured by the sensor; the unit of temperature is °C, and the unit of dissolved oxygen value is mg/L.

    Request frame: 06 03 00 00 00 04 45 BE

    Response frame: 06 03 08 01 02 00 02 00 B0 00 01 D4 48

    Example readings:

Dissolved oxygen value	temperature value
01 02 00 0 2	00 B0 00 01

    For example: dissolved oxygen value 01 02 indicates the dissolved oxygen value read in hexadecimal , 00 0 2 indicates the dissolved oxygen value with 2 decimal points (the decimal point is related to the range), and the converted decimal value is 2.5 8 .

    The temperature value 00 B0 represents the temperature value of the hexadecimal reading, 00 01 represents the temperature value with 1 decimal point, and the converted decimal value is 17.6.

3. Calibration instructions:

    (1) Zero calibration

Function: Set the dissolved oxygen zero point calibration value of the sensor , the example is as follows:

    Request frame: 06 06 10 00 00 00 8C BD

    Response frame: 06 06 10 00 00 00 8C BD

    (2) Slope calibration

Function: Set the dissolved oxygen slope calibration value of the sensor; here, the slope value calibration is performed in air-saturated water.

    Request frame: 06 06 10 04 00 00 CD 7C

    Response frame: 06 06 10 04 00 00 CD 7C

4. Set device ID address:

Function: set the Modbus device address of the sensor; change the sensor address 06 to 01, the example is as follows

    Request frame: 06 06 20 02 00 01 E3 BD

    Response frame: 06 06 20 02 00 01 E3 BD

5. Salinity compensation command:

Function: Set the salinity compensation of the sensor; measure the water body with a salinity of 35.0 PSU, add salinity compensation, the example is as follows:

    Request frame: 06 06 10 20 01 5E 0D 1F

    Response frame: 06 06 10 20 01 5E 0D 1 F

5.4 **Error response**

If the sensor cannot execute the host computer command correctly, it will return information in the following format:

definition	address	function code	CODE	CRC check
data	ADDR	COM+80H	xx	CRC16
Bytes	1	1	1	2

(1) CODE: 01 - wrong function code
         03 - data error
(2) COM: Received function code

5.5 Use the serial port debugging software to communicate

Users can use any serial port debugging software to communicate with the sensor. Pay attention when communicating, select the correct serial port, baud rate, and other serial port communication parameters, and the data that needs to be sent and received must be transmitted and displayed in hexadecimal .

6. Maintenance

6.1 Use and Maintenance

Operation	Recommended maintenance
Cleaning sensor probe	Wash it every 30 days
Check the sensor and fluorescent film heads for damage	Check it every 30 days
Replace the fluorescent film head	Replace it 1~2 years
Calibrating sensor	3~6 months

- External surface of the sensor: Clean the external surface of the sensor with tap water. If debris remains, wipe it with a damp soft cloth. For some stubborn dirt, you can add some household detergent to the tap water to clean it.
- Check the cable of the sensor: the cable should not be tight during normal operation, otherwise it is easy to break the wire inside the cable and the sensor cannot work normally.
- Check whether the measurement window of the sensor is dirty and whether the cleaning brush is normal.
- Sensors contain sensitive optics and electronics. Make sure the sensor is not subject to severe mechanical impact. There are no user-maintainable parts inside the sensor.

6.2 Calibration

a）Zero calibration

Use a larger beaker to measure an appropriate amount of zero dissolved oxygen liquid, place the sensor vertically in the solution, the sensor measuring end is at least 10cm away from the bottom of the beaker, wait for 3 to 5 minutes for the value to stabilize and perform zero calibration.

b) Slope Calibration

Place the measuring end of the sensor in the standard solution, the measuring end of the sensor should be at least 10cm away from the bottom of the beaker, wait for 3 to 5 minutes for the value to stabilize, and perform slope calibration.