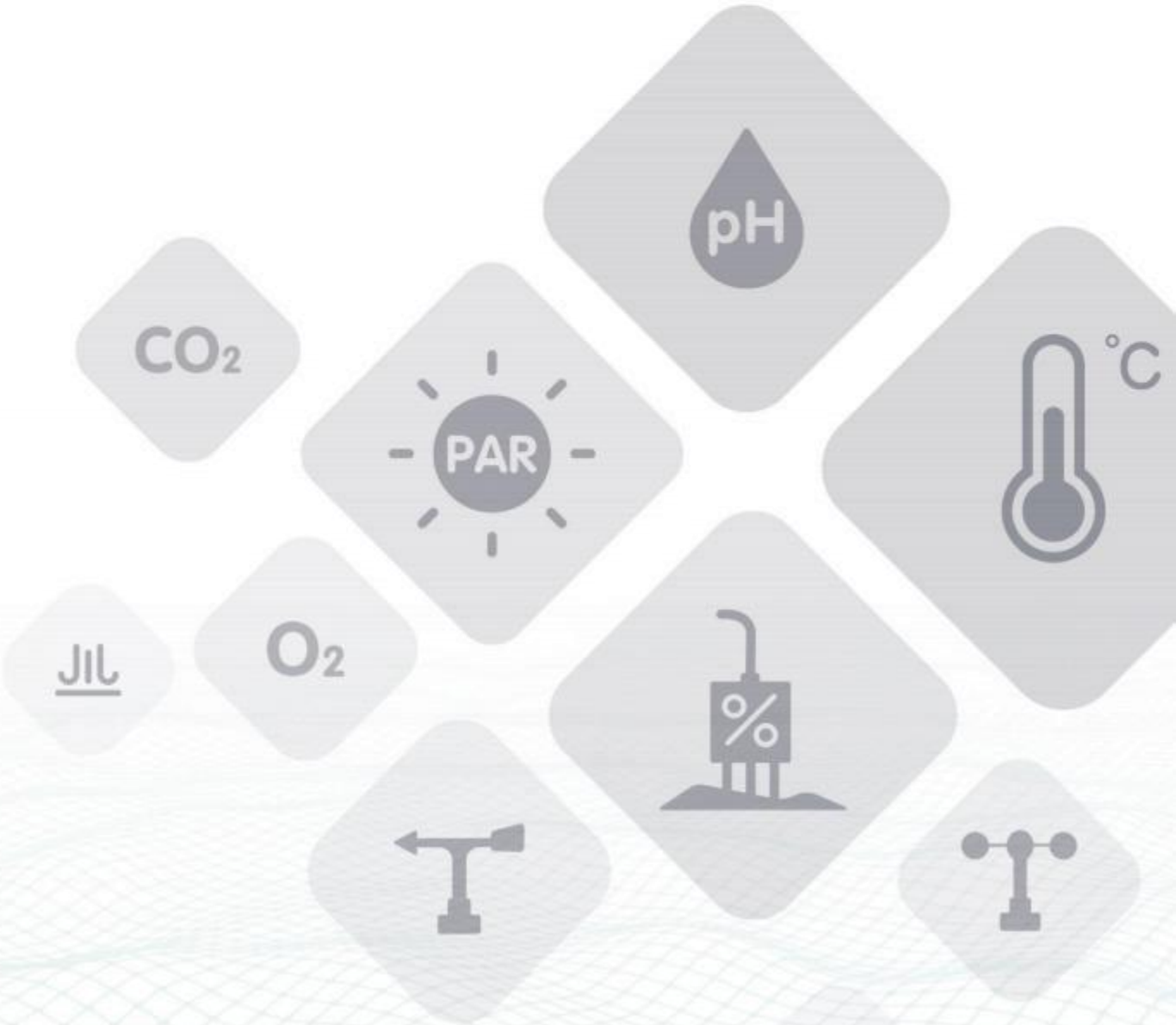
SENSECAP

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

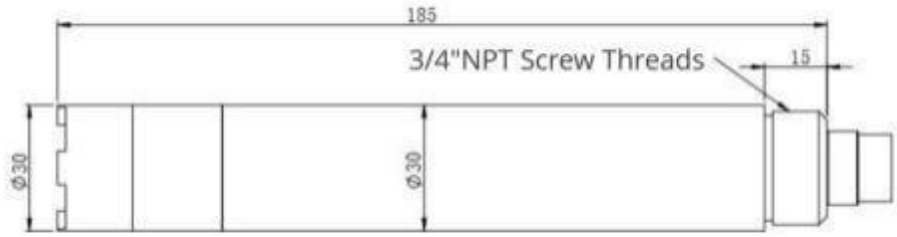
S-RJY-01 integrated online fluorescence method dissolved oxygen sensor is designed based on the principle of quenching excitation fluorescence by specific substances in physics. When the excitation light is irradiated on the fluorescent substance on the surface of the fluorescent film head, the fluorescent 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 compensation.

- No electrolyte required, no polarization
- No need to consume oxygen, not affected by flow rate
- Built-in temperature sensor, automatic temperature compensation
- 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
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	10 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 ofthe 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 along 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	xxxx	xxxx	xxxx
address	function code	register address	number of registers	CRC check code (low byte first)

2. Read data response frame:

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

3. Write data instruction frame:

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

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

06	06	xxxx	xxxx	xxxx
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
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
0x0101	ODO Value	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
0x0100	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
0x0102	ODO saturation	The saturation value is multiplied by 10 (e.g., a saturation of 50.5% is displayed as 505, with a default of one decimal place). This register cannot be read in sequence with the previous two registers.	1 (2 bytes)	read
0x1001	ODO Zero calibration	Calibration in anaerobic water, write data is 0; read data is zero offset.	1 (2 bytes)	write /read
0x1003	ODO slope calibration	Calibration in air-saturated water, write data is 0; read data is slope value × 100.	1 (2 bytes)	write /read
0x1000	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
0x2000	sensor address	The default is 55(DEC), and the write data range is 1~127.	1 (2 bytes)	write / read

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
0x2003	Baud Rate	The default value is 9600. Write 0 to 4800; Write 1 to 9600; Write 2 to 19200.	1 (2 bytes)	write / read

5.3 Command example

Default Registers:
Change Slave Address:
Address: 0x2000 (42001)
Number of Registers: 1
Function Code: 0x06
Default Sensor Address: 01
To change the Modbus device address of the sensor from 01 to 06, use the following command:

Send Command: 01 06 20 00 00 06 02 08
Response: 01 06 20 00 00 06 02 08
Note: The address is changed to 06 and saved after power off.

Baud Rate:

Address: 0x2003 (42004)
Number of Registers: 1
Function Code: 0x06
Default Value: 1 (9600bps)
Supported Values: 0-2 (4800-19200bps)
The baud rate can be set via the upper computer and works immediately without needing a restart. The baud rate is saved after power off. Supported baud rates are 4800, 9600, and 19200. The integer values map to baud rates as follows:

Integer value	Baud Rate
0	4800bps
1	9600bps
2	19200bps

Send Command: 01 06 20 03 00 02 F3 CB
Response: 01 06 20 03 00 02 F3 CB
Note: The baud rate is changed to 19200bps and saved after power off.

Function Registers:

a) Measure Temperature Command:
(1)Address: 0x0100 (40101)
Number of Registers: 1
Function Code: 0x03
Example Value: 19.2°C
Send Command: 01 03 01 00 00 01 85 F6

Response: 01 03 02 00 C0 B8 14

The register returns unsigned hexadecimal integer data. Temperature value = Integer/10, with 1 decimal place.

(2)Address: 0x0002

Number of Registers: 2

Function Code: 0x03

Example Value: Temperature 18.5°C

Request Frame: 01 03 00 02 00 02 65 CB

Response Frame: 01 03 04 00 B9 00 01 EA 16

Example Reading:

temperature value
00 B9 00 01

Temperature Value 00 B9 indicates a hexadecimal reading, with 00 01 indicating the temperature value has 1 decimal place, converted to 18.5°C in decimal.

b) Measure ODO Value Command:

(1)Address: 0x0101 (0x40102)

Number of Registers: 1

Function Code: 0x03

Example Value: 1.05mg/L

Send Command: 01 03 01 01 00 01 D4 36

Response: 01 03 02 00 64 B9 AF

The register returns unsigned hexadecimal integer data. ODO value = Integer/100, with 2 decimal places.

(2)Address: 0x0000

Number of Registers: 2

Function Code: 0x03

Example Value: Dissolved oxygen value 0.98mg/L

Request Frame: 01 03 00 00 00 04 44 09

Response Frame: 01 03 08 00 62 00 02 01 01 00 01 3E 2D

Example Reading:

Dissolved oxygen value
00 B9 00 01

Dissolved Oxygen Value 00 62 indicates a hexadecimal reading, with 00 02 indicating the dissolved oxygen value has 2 decimal places, converted to 0.98 in decimal.

c) Continuous Read Temperature and ODO Value Command:

(1)Address: 0x0100 (40101)

Number of Registers: 2

Function Code: 0x03

Example Value: Temperature 19.2°C and ODO value 1.05mg/L

Send Command: 01 03 01 00 00 02 C5 F7

Response: 01 03 04 00 C0 00 64 FB E4

Registers return unsigned hexadecimal integer data. Temperature value = Integer/10, with 1 decimal place. ODO value = Integer/100, with 2 decimal places.

(2)Address: 0x0000

Number of Registers: 4

Function Code: 0x03

Request Frame: 01 03 00 00 00 04 44 09

Response Frame: 01 03 08 00 62 00 02 01 01 00 01 3E 2D

Example Reading:

ODO value	Temperature value
00 62 00 02	01 01 00 01

Dissolved Oxygen Value: 00 62 indicates a hexadecimal reading, with 00 02 indicating the dissolved oxygen value has 2 decimal places, converted to 0.98 in decimal.

Temperature Value: 01 01 indicates a hexadecimal reading, with 00 01 indicating the temperature value has 1 decimal place, converted to 25.7°C in decimal.

d) Calibration Commands:

Temperature Calibration:

Address: 0x1000 (41001)

Number of Registers: 1

Function Code: 0x06

Calibration Example: Calibrate at 25.8°C

Send Command: 01 06 10 00 01 02 0D 5B

Response: 01 06 10 00 01 02 0D 5B

Calibration should be performed in a constant temperature environment after the temperature reading stabilizes.

ODO Zero Point Calibration:

Address: 0x1001 (41002)

Number of Registers: 1

Function Code: 0x06

Calibration Example: Calibrate in oxygen-free water

Send Command: 01 06 10 01 00 00 DC CA

Response: 01 06 10 01 00 00 DC CA

ODO Slope Calibration:

Address: 0x1003 (41004)

Number of Registers: 1

Function Code: 0x06

Calibration Example: Calibrate in air-saturated water solution

Send Command: 01 06 10 03 00 00 7D 0A

Response: 01 06 10 03 00 00 7D 0A

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 anddisplayed in hexadecimal .

6. Maintenance

6.1 Use and Maintenance

Operation	Recommended maintenance
Cleaning sensor probe	Washit 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 ofthe sensor: Clean the external surface ofthe sensor with tap water. Ifdebris 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 ofthe 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 ofthe 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 ofzero 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 ofthe sensor in the standard solution, the measuring end ofthe sensor should be at least 10cm away from the bottom ofthe beaker, wait for 3 to 5 minutes for the value to stabilize, and perform slope calibration.