

## KWS-270 Online Nitrate Nitrogen Sensor

### Introduction

The KWS-270 integrated online nitrate nitrogen sensor is made of a PVC membrane-based nitrate ion selective electrode. It is used to test the nitrate ion content in the water with temperature compensation to ensure that the test is fast, simple, accurate and economical. This user manual introduces the technical parameters, maintenance and communication protocol of the nitrate nitrogen sensor in detail.



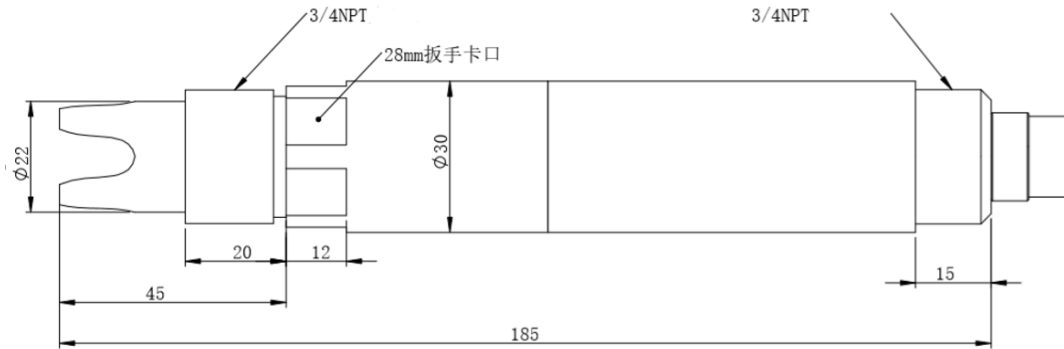
### Feature

- Signal output: RS-485 bus, Modbus/RTU protocol, easy to connect to third-party equipment such as PLC, DCS, industrial control computer, general controller, paperless recording instrument or touch screen.
- The patented nitrate ion electrode, the internal reference liquid seeps out from the microporous salt bridge very slowly under a pressure of at least 100KPa (1Bar). Such a reference system is very stable, and the electrode life is longer than that of ordinary industrial electrodes.
- The membrane cap can be replaced, reducing costs
- Easy to install: 3/4" NPT pipe thread is convenient for sinking installation or installation in pipelines and tanks.

### Technical Specifications

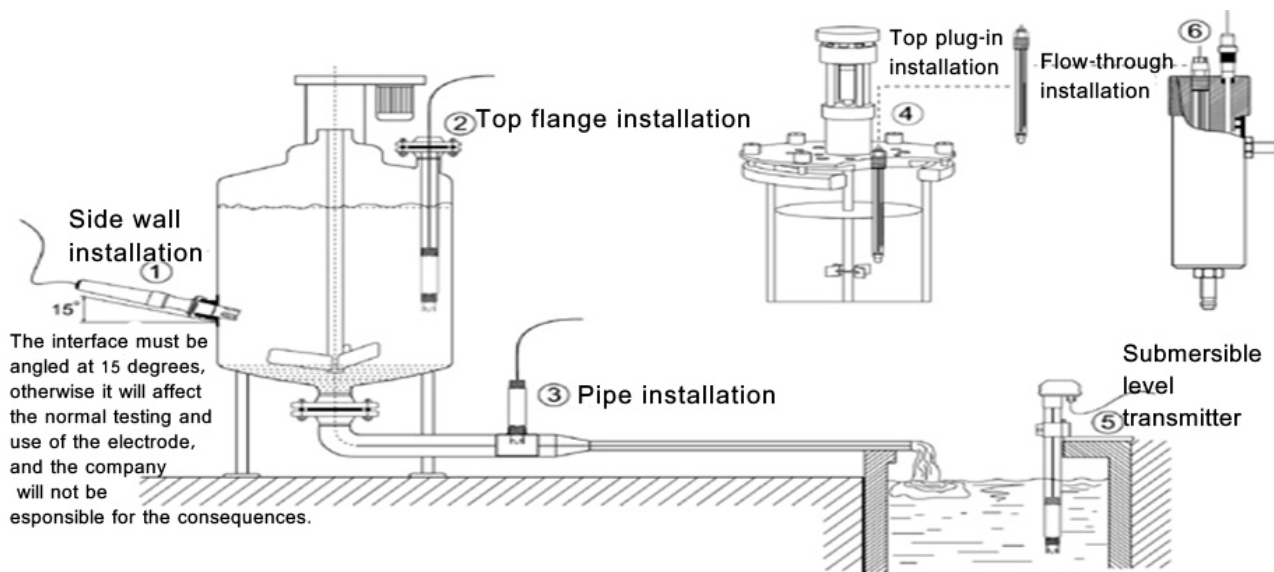
|                          |                                      |              |
|--------------------------|--------------------------------------|--------------|
| Model                    | KWS-270-P                            | KWS-270-S    |
| Casing Material          | POM and ABS                          | POM and 316L |
| Range                    | 0~1000.0mg/L                         |              |
| Resolution               | 0.1mg/L                              |              |
| Accuracy                 | ±5% or ±2mg/L, ±0.5℃                 |              |
| Response Time (T90)      | <60s                                 |              |
| Temperature Range        | 0 ~ 40℃                              |              |
| Work Pressure            | ≤0.2MPa                              |              |
| Temperature Compensation | automatic temperature compensation   |              |
| Output                   | RS-485 (MODBUS RTU), 4-20mA optional |              |
| Power Supply             | 12~24VDC                             |              |
| Wetted Part Material     | POM and PVC                          |              |
| Installation             | Immersion mounting, 3/4 NPT thread   |              |
| Cable Length             | 5 m, customizable                    |              |
| Calibration Method       | Two-point calibration                |              |
| Power Consumption        | <0.2W @12V                           |              |
| Ip Grade                 | IP68                                 |              |

## Dimension



## Installation and Electrical Connection

### Installation



Note: The sensor should not be installed upside down or horizontally when installed, at least at an angle of 15 degrees or more.

### Wiring

- Red - power cord (12 ~ 24V)
- Black - ground (GND)
- Blue - 485A
- White - 485B

After wiring is completed, it should be carefully checked to avoid incorrect connections before powering up.

Cable specification: Considering that the cable is immersed in water (including sea water) for a long time or exposed to the air, the cable has certain corrosion resistance. The outer diameter of the cable is  $\Phi 6$  mm and all interfaces are waterproof.

## Maintenance

### Use and maintenance

Clean the electrode in distilled water (or deionized water), blot it dry, don't wipe it dry. Place the electrode on the electrode holder. Before use, immerse the tip of the electrode in tap water for 24 hours.

The electrode should be kept dry before use, and the sensing element of the electrode should be put in a protective bottle. Before the test, the electrode should be soaked in tap water for 24 hours. The effect of soaking is better if it is energized. If stored overnight or longer, clean the electrode head with deionized water, wipe it dry, and put it in the original packaging.

Check whether the terminal is dry, if it is stained, wipe it with absolute alcohol and blow it dry before use. Avoid long-term immersion in distilled water or protein solution, and prevent contact with silicone grease. For the electrode that has been used for a long time, its PVC film may become translucent or attached with deposits. In this case, it can be rinsed with distilled water (or deionized water). The electrode has been used for a long time, and when there is a measurement error, it must be calibrated.

When the electrode is still unable to be calibrated and measured when the electrode is maintained and maintained by the above method, it means that the electrode has failed. Please replace the electrode.

### The main interference ions are shown in the following table:

Interference ion concentration that can produce 10% error under different nitrate ion concentration

| Interferences (moles/liter) | $10^{-4}$ M Nitrate | $10^{-3}$ M Nitrate | $10^{-2}$ M Nitrate |
|-----------------------------|---------------------|---------------------|---------------------|
| $\text{ClO}_4^-$            | $10^{-8}$           | $10^{-7}$           | $10^{-6}$           |
| $\text{I}^-$                | $5 \times 10^{-7}$  | $5 \times 10^{-6}$  | $5 \times 10^{-5}$  |
| $\text{ClO}_3^-$            | $5 \times 10^{-6}$  | $5 \times 10^{-5}$  | $5 \times 10^{-4}$  |
| $\text{CN}^-$               | $10^{-5}$           | $10^{-4}$           | $10^{-3}$           |
| $\text{Br}^-$               | $7 \times 10^{-5}$  | $7 \times 10^{-4}$  | $7 \times 10^{-3}$  |
| $\text{NO}_2^-$             | $7 \times 10^{-5}$  | $7 \times 10^{-4}$  | $7 \times 10^{-3}$  |
| $\text{HS}^-$               | $10^{-4}$           | $10^{-3}$           | $10^{-2}$           |
| $\text{HCO}_3^-$            | $10^{-3}$           | $10^{-2}$           | 0.1                 |
| $\text{CO}_3^{2-}$          | $2 \times 10^{-3}$  | $2 \times 10^{-2}$  | 0.2                 |
| $\text{Cl}^-$               | $3 \times 10^{-3}$  | $3 \times 10^{-2}$  | 0.3                 |
| $\text{H}_2\text{PO}_4^-$   | $5 \times 10^{-3}$  | $5 \times 10^{-2}$  | 0.5                 |
| $\text{HPO}_4^{2-}$         | $5 \times 10^{-3}$  | $5 \times 10^{-2}$  | 0.5                 |
| $\text{PO}_4^{3-}$          | $5 \times 10^{-3}$  | $5 \times 10^{-2}$  | 0.5                 |
| $\text{OAc}^-$              | 0.02                | 0.2                 | 2                   |
| $\text{F}^-$                | 0.06                | 0.6                 | 6                   |
| $\text{SO}_4^{2-}$          | 0.1                 | 1.0                 | 10                  |

## Calibration

Note: the sensor has been calibrated at the factory, if not exceeding the measurement error, the calibration should not be random.

### a) Zero calibration

Put the sensor into the vial containing the zero-point standard solution and wait for 5 minutes. After the value is stable, check whether the displayed value is within the error range. If not, perform a zero-point calibration. Refer to the appendix for calibration instructions.

### b) Slope calibration

Put the sensor into the vial containing the slope standard solution and wait for 5 minutes. After the value is stable, check whether the displayed value is within the error range. If not, perform a slope calibration. Refer to the appendix for calibration instructions.

## Quality and service

### Quality assurance

- Quality inspection departments have standardized inspection procedures, with advanced detection equipment and instruments, and in strict accordance with the test procedures for products that do 72 hours aging test, stability test, not let one sub

standard products factory.

- The receiving party directly returns the product batch with a failure rate of 2% , and all the costs incurred are borne by the supplier. The reference standard refers to the product description provided by the supplier.

- Guarantee the quantity of goods and the speed of shipment.

### Service commitment

The company provides local after-sales service within one year from the date of sale, but does not include damage caused by improper use. If repair or adjustment is required, please return it, but the shipping cost must be conceited. Damaged on the way, the company will repair the damage of the instrument for free.

## Appendix data communication

### 1. Data Format

The default data format for Modbus communication is: 9600, n, 8, 1 (baud rate 9600bps, 1 start bit, 8 data bits, no parity, 1 stop bit).

Parameters such as baud rate can be customized.

### 2. Information Frame Format

#### a) Read data instruction frame

42                      03                      xx xx                      xx    xx                      xx    xx

Address    Function code    Register address    Number of registers    CRC check code (low byte first)

#### b) Read data response frame

42                      03                      xx                      xx..... xx                      xx    xx

Address    Function code                      Bytes                      Answer data                      CRC check code (low byte first)

#### c) Write data instruction frame

42                      06                      xx xx                      xx xx                      xx xx

Address    Function code                      Register address    Write data                      CRC check code (low byte first)

#### d) Write data response frame (same data command frame)

42                      06                      xx xx                      xx xx                      xx xx

Address    Function code                      Register address    Write data                      CRC check code (low byte first)

### 3. Register Address

| Register Address  | Name                           | Description                                                                                                                                                                                               | Number Of Registers | Interview Method |
|-------------------|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------------|
| 40001<br>(0x0000) | Measured value<br>+temperature | 4 double-byte integers, which are the measured value of nitrate ion, the number of decimal places of the measured value, the temperature value, and the number of decimal places of the temperature value | 4 ( 8 bytes)        | read             |
| 44097<br>(0x1000) | Zero calibration               | When the range is 0~100mg/L, it needs to be calibrated in 10mg/L standard solution. When the range is 0~1000mg/L, it needs to be calibrated in 100mg/L standard solution. The                             | 1 ( 2 bytes)        | Write/read       |

|                   |                         |                                                                                                                                                                                                                                                                                                                                                                                                                                |              |             |
|-------------------|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|
|                   |                         | written data is the value of the concentration of the standard solution used x10. The data read out is the mV value x100 corresponding to the zero point calibration value.                                                                                                                                                                                                                                                    |              |             |
| 44101<br>(0x1004) | Slope calibration       | When the range is 0~100mg/L, it needs to be calibrated in the 100mg/L standard solution, and the data written is the value of the concentration of the standard solution used x10.<br><br>When the range is 0 ~ 1000mg/L, it needs to be calibrated in 1000mg/L standard solution, and the written data is the value of the concentration of the standard solution used x10. The read data is the actual slope value (mV) x100 | 1 ( 2 bytes) | Write/read  |
| 44113<br>(0x1010) | Temperature calibration | Calibrated in solution, the data written is the actual temperature value x10; the read data is the temperature calibration offset x10.                                                                                                                                                                                                                                                                                         | 1 ( 2 bytes) | Write /read |
| 48195<br>(0x2002) | Sensor address          | The default is 66 and the data range is 1-255.                                                                                                                                                                                                                                                                                                                                                                                 | 1 ( 2 bytes) | Write /read |
| 48196<br>(0x2003) | Baud rate               | The default value is 9600. 0--9600, 1--19200.                                                                                                                                                                                                                                                                                                                                                                                  | 1 ( 2 bytes) | Write /read |

## 4. Command example

### a) Read data instruction

Function: Obtain the nitrate ion concentration and temperature measured by the sensor; the unit of nitrate ion concentration is mg/L; the unit of temperature is °C.

Request frame: 42 03 00 00 00 04 4A FA

Response frame: 42 03 08 00 55 00 01 01 18 00 01 B7 AC

Example of reading:

| Nitrate nitrogen value | Temperature value |
|------------------------|-------------------|
| 00 55 00 01            | 01 18 00 01       |

Nitrate nitrogen value: 00 55 means hexadecimal reading nitrate nitrogen value, 00 01 means nitrate nitrogen value with one decimal place, converted to decimal value is 8.5

Temperature value: 01 18 represents the hexadecimal reading temperature value, 00 01 represents the temperature value with a decimal, converted to a decimal value of 28.0.

#### b) Calibration instructions:

Zero calibration

Function: Set the nitrate-nitrogen zero point calibration value of the sensor. Calibrate in 10mg/L standard solution, examples are as follows:

Request frame: 42 06 10 00 00 64 82 12

Response frame: 42 06 10 00 00 64 82 12

Slope calibration

Function: Set the nitrate nitrogen slope calibration value of the sensor. Calibrate in 100mg/L standard solution, examples are as follows:

Request frame: 42 06 10 04 03 E8 C2 86

Response frame: 42 06 10 04 03 E8 C2 862

#### c) Set the device ID address:

Function: set the MODBUS device address of the electrode;

Change the device address 06 to 01. The example is as follows

Request frame: 42 06 20 02 00 01 EC F9

Response frame: 42 06 20 02 00 01 EC F9

## 5. Error response

If the sensor does not execute the host command correctly, it will return the following format information:

| Definition      | address | function code | CODE | CRC check |
|-----------------|---------|---------------|------|-----------|
| data            | ADDR    | COM+80H       | xx   | CRC 16    |
| Number of bytes | 1       | 1             | 1    | 2         |

a) CODE: 01 – function code error

03 – data is wrong

b) COM: Received function code