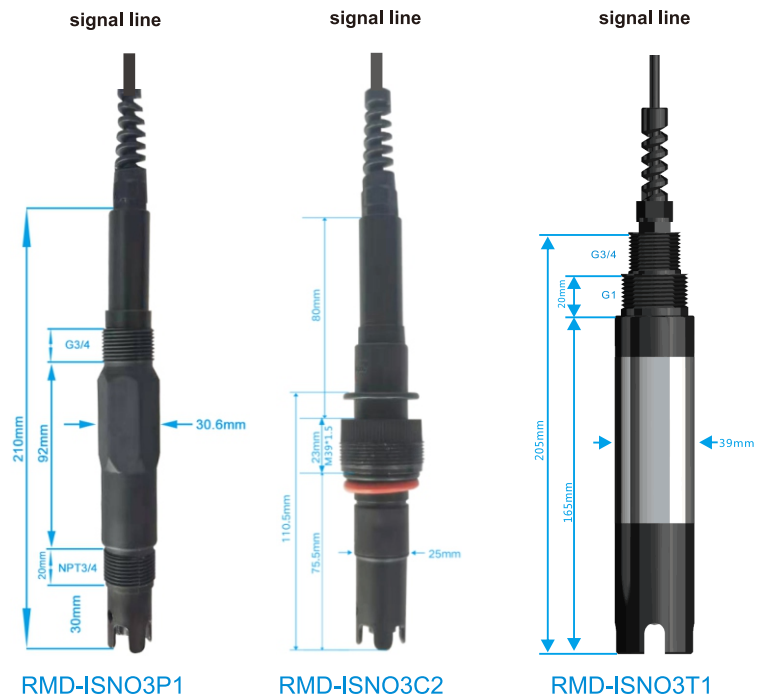


1. Technical data

| | |
|--------------------------|---|
| Concentration range | 1M to 7×10^{-6} M (14000ppm...0.1ppm) |
| pH range | 2.5...11pH |
| Temperature range | 0.0...50°C |
| Temperature compensation | Automatic |
| Electrode Resistance | 1...4 MΩ |
| Slope | $56 \pm 4 \text{mV}(25^\circ\text{C})$ |
| Sensor type | PVC membrane |
| Reproducibility | $\pm 2\%$ |
| Power supply | DC9-30V(Recommend 12V) |
| Output | RS485;4...20mA |
| Accuracy | $\pm 5\% \text{FS}$ |
| Pressure range | 0...3bar |
| Shell material | PPS,ABS,PC,316L |
| Pipe thread | 3/4,M39*1.5,G1 |
| Cable length | 5m or customized |
| Protection grade | Ip68 |
| Interferences | ClO_4^- , I^- , ClO_3^- , F^- |

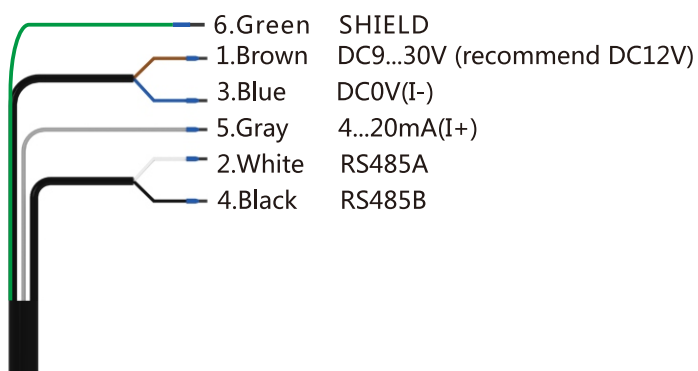


2. Before use

- 2.1 Please read this instruction carefully before use.
- 2.2 The membrane head is a fragile, it cannot be repaired if it is damaged.
- 2.3 In the measurement process, if there is dirt, adhesive or scale on the electrode bulb, the measured value will be inaccurate or fluctuate. It should be cleaned and calibrated in time.
- 2.4 If there are bubbles in the membrane head, the measured value will be inaccurate or fluctuate.

3. Electrode wiring

- 3.1 Please follow the instructions carefully, the wrong wiring will damage the product completely.
- 3.2 Please carefully check all the wiring in the system and confirm that the wiring is complete right before switch on the power.
- 3.3 Note: RS485A line and RS485B line are strictly forbidden to contact with the power supply line, otherwise the communication of the electrode will be permanently damaged.



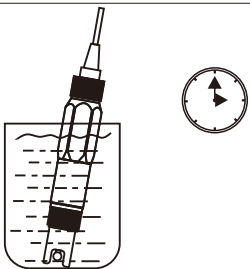

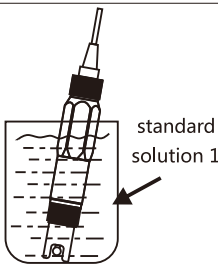
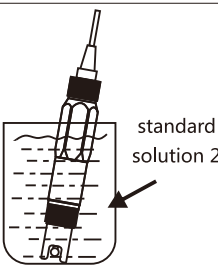
Electrode outlet

4.Electrode activation

- 4.1 The electrode should be activated in deionized solution for more than 24 hours.
- 4.2 Dry electrode must be activated before use.

5.Electrode calibration

- 5.1 The electrode has been calibrated before shipment, and the user can directly use it.
- 5.2 It is recommended to use the two-point method for calibration, usually with 10.00ppm solution calibrate the zero point, then the slope is determined with the solution of 100.00ppm.
- 5.3 The electrode should be calibrated in fresh solution. The standard solution can be set, and the second standard solution should be larger than the solution to be tested.
- 5.4 Users are recommended to calibrate the electrode every 1 to 2 months.
- 5.5 The calibrating steps are as follows.

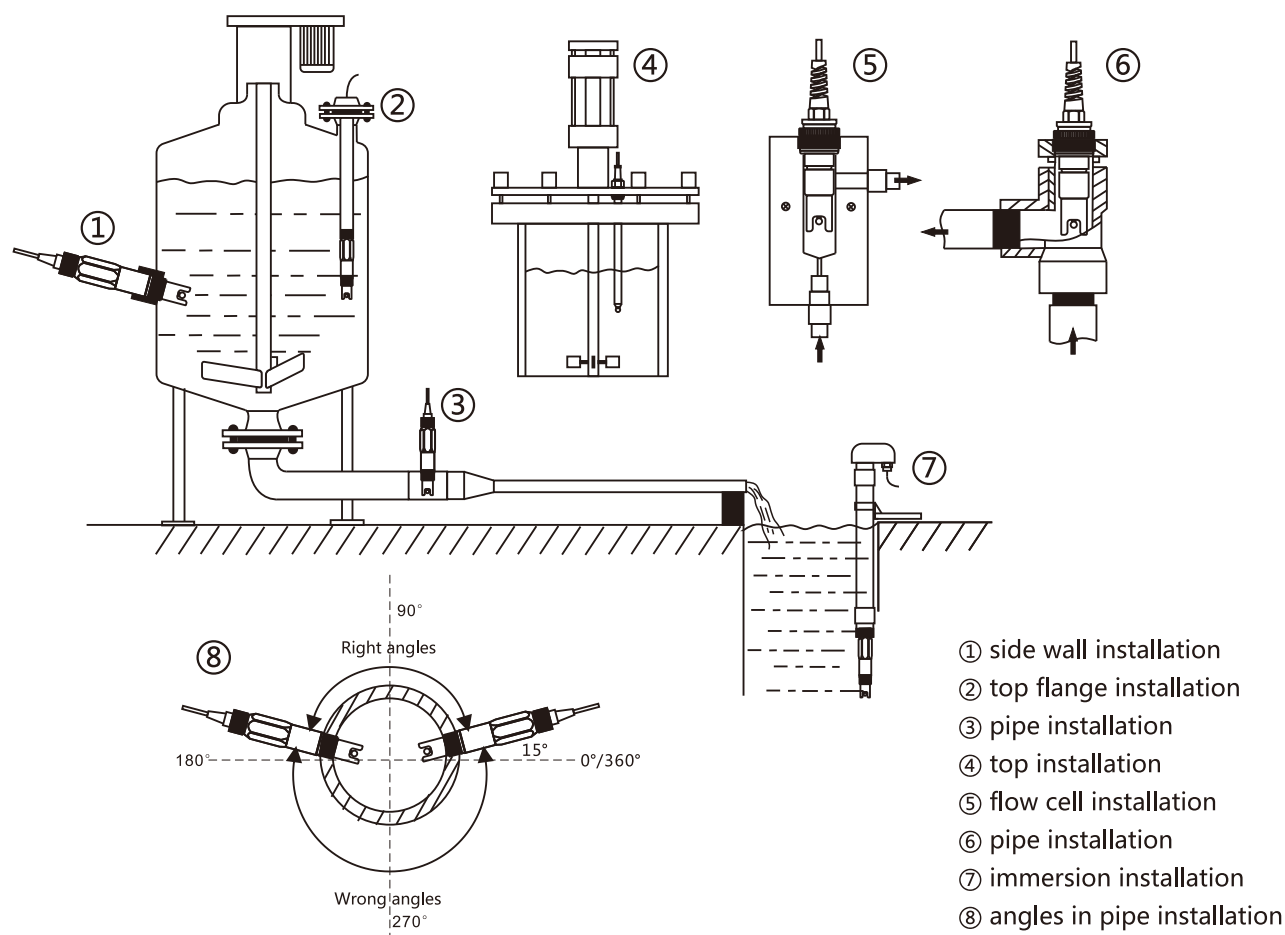
| | | | |
|---|--|--|---|
|  <p>1. The electrode should be activated in deionized solution for more than 24 hours.</p> |  <p>2. Rinse the electrode with distilled water or deionized water and dry it with a paper towel.</p> |  <p>3. Put the electrode in first point standard solution and wait until the value is stable, calibrate the first point .Then take the electrode out of the solution, rinse and dry it with a paper towel.</p> |  <p>4. Put the electrode in second point standard solution and wait until the value is stable, calibrate the second point .Then take the electrode out of the solution, rinse and dry it with a paper towel.</p> |
|---|--|--|---|

6. Electrode installation

6.1 The electrode is recommended to be installed in the flow cell for more stable and accurate measurement.

6.2 If installing electrode in the pipe, the right angle should be $15^{\circ} \sim 165^{\circ}$.

6.3 Installation method.



Pay attention to the immersion installation:

1. In this installation, there will be dirt on the electrode frequently, it needs to be cleaned regularly.
2. Measuring value is not stable.
3. Different insertion depths will affect the measured value.
4. The position of the electrode must be above the sediment.

7. Electrode communication

7.0 Default communication instructions:

Note: 1. Data starting at 0x represents hexadecimal;

2. The check code is 16CRC, the low byte is in the front and the high byte is in the back;

3. Floating point number occupy four bytes;

7.1 Communication description (factory default):

| Factory default | |
|-----------------|-----------------|
| baud rate | 9600(default) |
| data bit | 8 |
| stop bit | 1 |
| check bit | no |
| address | 1 (default) |

7.2 Host computer transmission format:

| | Data type | Description | Remarks |
|-----------------------|----------------|--|--|
| Integer | 16 bit integer | The high and low bytes of the word component are not reversed | Example: 0x 0032 to decimal number is 50 |
| Floating point number | (CDAB) 3412 | The high-low word of the double-byte component is reversed, but the high-low byte of the word is not reversed. | Example: 72 37 41 DB transfer to floating point number, CDAB change order is ABCD, ie 41 DB 72 37 transfer to floating point is 27.4 |

7.3 Function code description

7.3.1 This product supports 03,06,16 and other common function codes

7.3.2 The output register uses 16 function codes when writing double word data or writing multiple data in batches

| | |
|----|-----------------------------------|
| 03 | Read single or multiple registers |
| 06 | Write single register |
| 16 | Write multiple registers |

7.4 Read floating point number

7.4.1 Host computer transmission format:

| | ID address | Function code | Register start address | | Qty of registers | | CRC16 | |
|----------------------------------|------------|---------------|------------------------|----------|------------------|----------|----------|-----------|
| | | | High byte | Low byte | High byte | Low byte | Low byte | High byte |
| Example 1 Read measured value | 0x 01 | 0x 03 | 0x 00 | 0x 01 | 0x 00 | 0x 02 | 0x 95 | 0x CB |
| Example 2 Read Temp value | 0x 01 | 0x 03 | 0x 00 | 0x 03 | 0x 00 | 0x 02 | 0x 34 | 0x 0B |

7.4.2 Slave computer response format:

| | ID address | Function code | Qty of registers | Read register data in hexadecimal floating point number | | | | CRC16 | |
|------------------------------------|------------|---------------|------------------|---|-------|-------|-------|----------|-----------|
| | | | | C | D | A | B | Low byte | High byte |
| Example 1 Measured value return | 0x 01 | 0x 03 | 0x 04 | 0x 2C | 0x 81 | 0x 40 | 0x 91 | 0x 52 | 0x E7 |
| Example 2 Temp value return | 0x 01 | 0x 03 | 0x 04 | 0x 72 | 0x 37 | 0x 41 | 0x DB | 0x 20 | 0x 8E |

Note: 72 37 41 DB transfer to floating point number, CDAB change order is ABCD, ie 41 DB 72 37 transfer to floating point is 27.4

7.5 Read integer

7.5.1 Host computer transmission format:

| | ID address | Function code | Register start address | | Qty of registers | | CRC16 | |
|----------------------------------|------------|---------------|------------------------|----------|------------------|----------|----------|-----------|
| | | | High byte | Low byte | High byte | Low byte | Low byte | High byte |
| Example 1 Read warning status | 0x 01 | 0x 03 | 0x 00 | 0x 07 | 0x 00 | 0x 01 | 0x 35 | 0x CB |

7.5.2 Slave computer response format:

| | ID address | Function code | Qty of registers | Read register data in hexadecimal integer | | CRC16 | |
|------------------------------------|------------|---------------|------------------|---|-------|----------|-----------|
| | | | | A | B | Low byte | High byte |
| Example 1 Warning status return | 0x 01 | 0x 03 | 0x 02 | 0x 00 | 0x 00 | 0x B8 | 0x 44 |

7.6 Write floating point number

7.6.1 Host computer transmission format:

| | ID address | Function code | Register start address | | Qty of registers | | Qty of bytes | Write register data in hexadecimal floating point number | | | | CRC16 | |
|--|------------|---------------|------------------------|----------|------------------|----------|--------------|--|-------|-------|-------|----------|-----------|
| | | | High byte | Low byte | High byte | Low byte | | C | D | A | B | Low byte | High byte |
| Example 1 Write Measured value offset | 0x 01 | 0x 10 | 0x 00 | 0x 12 | 0x 00 | 0x 02 | 0x 04 | 0x 00 | 0x 00 | 0x 3F | 0x 80 | 0x 63 | 0x 2A |

7.6.2 Slave computer response format:

| | ID address | Function code | Register start address | | Qty of registers | | CRC16 | |
|---|------------|---------------|------------------------|----------|------------------|----------|----------|-----------|
| | | | High byte | Low byte | High byte | Low byte | Low byte | High byte |
| Example 1 Measured value offset return | 0x 01 | 0x 10 | 0x 00 | 0x 12 | 0x 00 | 0x 02 | 0x E1 | 0x CD |

Note: the measured value is offset by 1.00, floating point number 1.00 converts to hexadecimal 0X3F800000, transpose the high and low positions 0X00003F80 and write 0X0012.

7.7 Write integer

7.7.1 Host computer transmission format:

| | ID address | Function code | Register start address | | Write register data in hexadecimal integer | | CRC16 | |
|-----------------------------------|------------|---------------|------------------------|----------|--|-------|----------|-----------|
| | | | High byte | Low byte | A | B | Low byte | High byte |
| Example 1 Write device address | 0x 01 | 0x 06 | 0x 00 | 0x 19 | 0x 00 | 0x 02 | 0x D9 | 0x CC |

7.7.2 Slave computer response format:

| | ID address | Function code | Register start address | | Write register data in hexadecimal integer | | CRC16 | |
|------------------------------------|------------|---------------|------------------------|----------|--|-------|----------|-----------|
| | | | High byte | Low byte | A | B | Low byte | High byte |
| Example 1 Device address return | 0x 01 | 0x 06 | 0x 00 | 0x 19 | 0x 00 | 0x 02 | 0x D9 | 0x CC |

Note: change the local computer address 1 to address 2 and write the hexadecimal number 0x 00 02 into register 0x 00 19.

7.8 Calibrating instructions

7.8.1 Before calibration

Write the value of zero calibration (that is, the value of the first point) and the value of slope calibration (that is, the value of the second point) to the electrode before calibration;

If the zero calibration value is 10.00ppm, write the data 0x41 20 00 00 to register 0x36;

Send command: 01 10 00 36 00 02 04 00 00 41 20 41 19;

If the slope calibration value is 100.00ppm, write the data 0x42 C8 00 00 to register 0x38;

Send command: 01 10 00 38 00 02 04 00 00 42 C8 91 96.

7.8.2 Start calibration

First step :

Clean and dry the electrode ,put the electrode in the solution 10.0ppm of zero point calibration;

Send command: 01 03 00 66 00 01 64 15;

After the measured ADC value is stable, read the ADC value in the 0x66 register;

Write the instruction to confirm the calibration to the 0x 3E register;

Send command: 01 06 00 3E 00FF A8 46.

Second step :

Clean and dry the electrode ,put the electrode in the solution 100.00ppm of slope calibration;

Send command: 01 03 00 66 00 01 64 15;

After the measured ADC value is stable, read the ADC value in the 0x66 register;

Write the instruction to confirm the calibration to the 0x 3F register;

Send command: 01 06 00 3F 00 FF F9 86.

7.9 Address description

| Name | Hosting number | Data type | Length | Read/write | Description |
|---------------------------------|----------------|----------------|--------|------------|---|
| Measurements | 0X 00 01 | floating point | 2 | read | Storage location for measured value(ppm or mg/L) |
| Temperature measurement | 0X 00 03 | floating point | 2 | read | Storage location for measured temperature |
| Current output value | 0X 00 05 | floating point | 2 | read | Output current based ION / mV measurements |
| Warning | 0X 00 07 | Integer | 1 | read | 00: Normal 01: Measurement exceeds the upper limit; 02: Measurement exceeds the lower limit; 03: Temperature exceeds the upper limit; 04: Temperature exceeds the lower limit |
| Measure mode | 0X 00 08 | Integer | 1 | read/write | 00: ION ; 01: mV |
| Upper limit of measurement | 0X 00 0A | floating point | 2 | read/write | Upper limit of measured value (20mA corresponding value) |
| Lower limit of measurement | 0X 00 0C | floating point | 2 | read/write | Lower limit of measurement value (4mA corresponding value) |
| Upper temperature limit | 0X 00 0E | floating point | 2 | read/write | Upper temperature limit |
| Lower temperature limit | 0X 00 10 | floating point | 2 | read/write | Lower temperature limit |
| Measured value offset | 0X 00 12 | floating point | 2 | read/write | Adjust measurement |
| Temperature offset | 0X 00 14 | floating point | 2 | read/write | Adjust temperature value |
| Damping coefficient | 0X 00 16 | Integer | 1 | read/write | 0-10 |
| Device address | 0X 00 19 | Integer | 1 | read/write | 1-255 |
| Baud rate | 0X 00 1A | Integer | 1 | read/write | 0=2400 , 1=4800 , 2=9600 3=19200 , 4=38400 |
| Restore factory | 0X 00 1B | Integer | 1 | write | |
| mV calibration value | 0X 00 30 | floating point | 2 | read/write | |
| Calibrating slope | 0X 00 34 | Integer | 2 | read | -0.1984 |
| Zero point calibration solution | 0X 00 36 | Integer | 1 | read/write | 10.000 |
| Slope calibration solution | 0X 00 38 | Integer | 1 | read/write | 100.00 |
| Manual temperature | 0X 00 3A | floating point | 2 | read/write | 25°C |
| Zero confirmation | 0X 00 3E | Integer | 1 | write | |
| Slope confirmation | 0X 00 3F | Integer | 1 | write | |
| Measured ADC | 0X 00 66 | Integer | 1 | read | |

7.10 Common instruction examples

| | Function | Send command | Return command | Remarks |
|----|---------------------------------------|---|----------------------------|---|
| 1 | Read measured value | 01 03 00 01 00 02 95 CB | 01 03 04 2C 81 40 91 52 E7 | The 2C814091 change order to 40912C81 and its floating point is 4.53 |
| 2 | Read temperature measurement | 01 03 00 03 00 02 34 0B | 01 03 04 72 37 41 DB 20 8E | The 723741DB change order to 41DB7237 and its floating point is 27.4 |
| 3 | Read current output value | 01 03 00 05 00 02 D4 0A | 01 03 04 00 00 41 40 CB 93 | The 00004140 change order to 41400000 and its floating point is 12.00 |
| 4 | Read warning | 01 03 00 07 00 01 35 CB | 01 03 02 00 00 B8 44 | 0000 is the current state |
| 5 | Write measurement mode | 01 06 00 08 00 01 C9 C8 | 01 06 00 08 00 01 C9 C8 | Set to mV mode |
| 6 | Write upper limit of measurement | 01 10 00 0A 00 02 04 00 00 41 20 42 58 | 01 10 00 0A 00 02 61 CA | The upper measurement limit is set to 10.00 |
| 7 | Write lower limit of measurement | 01 10 00 0C 00 02 04 00 00 3F 80 E3 AA | 01 10 00 0C 00 02 81 CB | The lower measurement limit is set to 1.00 |
| 8 | Write upper temperature limit | 01 10 00 0E 00 02 04 00 00 42 C8 43 15 | 01 10 00 0E 00 02 20 0B | The upper temperature limit is set to 100.00 |
| 9 | Write lower temperature limit | 01 10 00 10 00 02 04 00 00 40 A0 C3 1B | 01 10 00 10 00 02 40 0D | The lower temperature limit is set to 5.00 |
| 10 | Write measured value offset | 01 10 00 12 00 02 04 00 00 3F 80 63 2A | 01 10 00 12 00 02 E1 CD | Set to 1.00 |
| 11 | Write temperature offset | 01 10 00 14 00 02 04 00 00 3F 80 E3 00 | 01 10 00 14 00 02 01 CC | Set to 1.00 |
| 12 | Write damping coefficient | 01 06 00 16 00 01 A9 CE | 01 06 00 16 00 01 A9 CE | Set to 1 |
| 13 | Write device address | 01 06 00 19 00 02 D9 CC | 01 06 00 19 00 02 D9 CC | Set to 2 |
| 14 | Write baud rate | 01 06 00 1A 00 00 A8 0D | 01 06 00 1A 00 00 A8 0D | Set to 2400 |
| 15 | Write restore factory | 01 06 00 1B 00 FF B9 8D | 01 06 00 1B 00 FF B9 8D | Factory default values are restored once sent |
| 16 | Write mV calibration value | 01 10 00 30 00 02 04 00 00 42 AC C0 66 | 01 10 00 30 00 02 41 C7 | Write mV standard liquid value 86mV |
| 17 | Read calibration slope | 01 03 00 34 00 02 85 C5 | 01 03 04 CC CD 3E 4C 45 09 | The CCCD3E4C change order to 3E4CCCD and its floating point is 0.2 |
| 18 | Write zero point calibration solution | 0110003600020400003F8060C1 | 01 10 00 36 00 02 A1 C6 | Set to 1.000 |
| 19 | Write slope calibration solution | 0110003800020400004120C095 | 01 10 00 38 00 02 C0 05 | Set to 10.000 |
| 20 | Write manual temperature | 01 10 00 3A 00 02 04 00 00 41 A0 40 EC | 01 10 00 3A 00 02 61 C5 | Set to 20.0 |
| 21 | Write zero calibration | 01 06 00 3E 00 FF A8 46 | 01 06 00 3E 00 FF A8 46 | Confirm to calibration zero |
| 22 | Write slope calibration | 01 06 00 3F 00 FF F9 86 | 01 06 00 3F 00 FF F9 86 | Confirm to calibration slope |
| 23 | Read measured ADC | 01 03 00 66 00 01 64 15 | 01 03 02 2E E0 A4 6C | 2EE0 turns to integer 12000 |

8.Maintenance and storage

8.1 After washing the electrode, only use soft paper towel to absorb the water. Do not rub the membrane.

8.2 when the electrode is stored, the protective cover must be put on, The protective solution must contain diluted ion standard solution (0.001M or 10ppm) to soak.

8.3 If there is white potassium chloride crystal on the electrode, this salty substance will not affect the use.
It is only necessary to rinse the electrode with distilled water to remove the crystal and then dry it.

8.4 Cable connector must be kept clean and free of moisture or water.

8.5 The electrode should not be placed in the air for long periods of time. Put on the protective cover when it is not in use.

8.6 Maintenance rate:

| Maintenance task | Recommended maintenance rate |
|--------------------------------|------------------------------|
| Clean sensor | Clean every 30 days |
| Check if the sensor is damaged | Check every 30 days |

9.Troubleshooting

9.1 If the measurement is not accurate, mostly because the condition of electrode has changed, so it is necessary to check whether the electrode is in good condition. And the electrode is not easy to damage, generally the membrane head may has dirt , polluted etc, it should be timely maintenance.

9.2 If the value of the instrument is too large, too small or no change ; Check whether the electrode is in good connection with the instrument.

9.3 Modbus troubleshooting:

| Problem | Possible reason | Solution |
|--------------------------|---|---|
| Modbus no response | The baud rate, or stop bit does not match the Modbus master settings | Verify that the Settings match the Modbus master device Settings, and verify that the Modbus master device parity check is set to None |
| | Rs232 or RS485 cable is faulty | Replace/repair cables |
| | No network offsets and terminations, or network offsets and terminations are not suitable. | Check the termination or offset Settings for all network devices. Only the endpoints of the network should be turned on and terminated, and there should be only a point on the network to provide an offset. |
| | The slave address is incorrect, or the slave address is the same as the address of another bus device | Verify that all addresses are unique and are between 1 and 255. |
| Modbus abnormal response | Register not supported | Verify that the register is supported |
| | Incorrect data type | Verify that the requested register data type matches the Modbus master device request; for example, you cannot access a floating point data using 2-byte integer data. When a floating point data (2 registers / 4 bytes) is requested, two registers must be requested at the same time. |