Ammonium ISE sensor

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Preface

Thank you for purchasing ammonium ISE sensor. Please read this manual carefully before operating and using it correctly to avoid unnecessary losses caused by false operation.

Note

- Modification of this manual's contents will not be notified as a result of some factors, such as function upgrading.
- We try our best to guarantee that the manual content is accurate, if you find something wrong or incorrect, please contact us.
- This product is forbidden to use in explosion-proof occasions.

Version

U-SUP-ADI3050-EN2

Disclaimer

- The company does not make any guarantees for the terms outside the scope of this product warranty.
- This company is not responsible for damage to the instrument or loss of parts or unpredictable damage caused directly or indirectly by improper operation of the user.

No.	Name	Quantity	Note
1	Ammonium ISE sensor	1	
2	Manual	1	
3	Certificate	1	

After opening the box, please confirm the package contents before starting the operation.If you find that the model and quantity are incorrect or there is physical damage in appearance, please contact us.

Contents

1 Introduction

1.1 Introduction

Online ammonium ISE sensor measures ammonium electron concentration without using any chemicals.No reagent,no pollutants,more economic and environmentally friendly. The sensor uses pH, Ammonium Ion electrodes,and an optional potassium ion electrode to determine the $NH4^+$-N concentration.It is designed for use in all kind of natural water,such as lakes,streams,rivers,as well as waste water plants.

1.2 Features

- Digital sensors,RS-485output,MODBUS support;
- No reagent,no pollutants,more economic and environmentally friendly；
- Automaticcompensationfor$NH4^+$,pH and temperature in water;
- Can be directly connected to our company's controller,hand held meter,more convenient to use.

1.3 Technical parameters

Table 1 Technical parameters

Measure variables	NH4_N、pH		
Measuring range	NH4_N：（0~100）mg/L、（0~1000）mg/L pH：（4~10）pH		
Accuracy	NH4_N：±10% or ±0.5mg/L pH：±0.1pH		
Resolution	NH4_N：0.01mg/L pH：0.01pH		
Compensation	Temperature	pH	K^+（Optional）
	Temperature electrode：NTC Compensation scope：0℃~50℃	Compensation scope：(4~10)pH	Compensation scope：（0~100）mg/L

Response time	≤2min
Reference system	Ag/AgCl reference salt bridge
Output	Support RS-485， Modbus protocol
Connector	Aviation plug
Power	（9~24）VDC，≥1A
Power waste	≤0.5W
pressure	≤2bar
Medium pH value	（4~10）pH
temperature range	（0~50）℃
Protection level	IP68
Cable length	Default 10m, customizable for other lengths
Installation method	Immersion installation

Note:

The above technical parameters are all data under laboratory standard liquid environment. Sensor life and maintenance calibration frequency are related to actual field conditions.

2 Structure and dimensions

Dimensions: Φ 36mm * 265mm (with protective cover)

Process connection: NPT3/4 thread.

Material: POM+316L

Weight: 310g

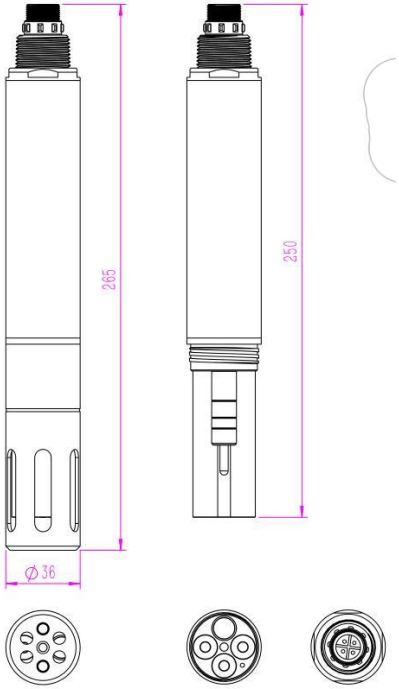


Fig.1 Product dimensions (Unit: mm)

3 Installation

3.1 Installation method

Fixed installation with 6-point thread at the tail end.

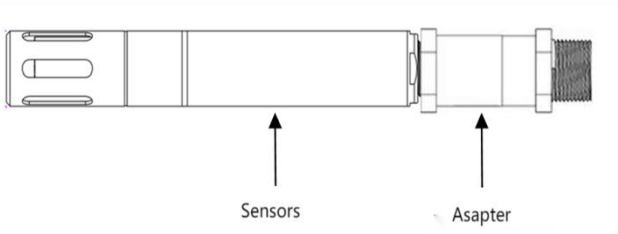


Fig.2 Assembly adapter

3.2 Before use

(1) Take off the protect cap:

Please take off the protect cap of NH4, pH and reference electrode before installation and keep them properly for future use.

(2) Cleaning and activation:

First use DI water to wash the electrodes (DO NOT USE WIPER, IT WILL DAMAGE THE ELECTRODE SENSING FILM).

It needs to be re-activated before use. Activation method: soak the electrode in 10ppm NH4CL solution for more than 24 hours (see standard solution preparation for details).

3.3 Sensor Installation

(1) Wiring and power supply

① The female and male connector of sensor cable should be screwed tightly to avoid moisture incursion.

② Do not use the sensor cable to pull the sensor! It is required to install sensor in a secure and stable

mounting bracket.

③ Make sure power supply voltage is correct before power on.

(2) Sensor installation

① It is recommended to install the sensor vertically with electrodes facing down.

② Considering water level change, the sensor should be installed 30cm below water level.

③ The sensor must be securely installed to avoid damage caused by water flow and other things.

Warning

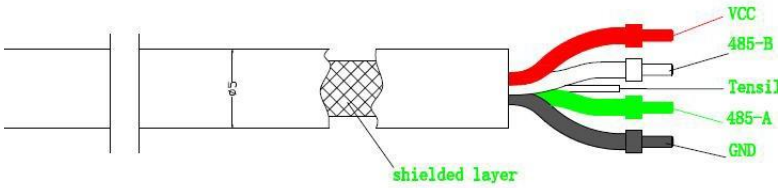
1.Please install the protective mesh cover correctly.

2.Do not use the sensor cable to lift the sensor.

3.Do not cover the measuring surface with lifting accessories.

4 Electrical connection

4 wire AWG-24 OR AWG-26 shielding wire. OD=5.5mm



1, Red—Power (VCC)
2, White—485 Date_B (485_B)
3, Green—485 Date_A (485_A)
4, Black—Ground (GND)
5, Bare wire—shield

Wiring precautions:

(1) Do not use sensor cables to lift sensors. It is recommended to install cable protection covers to ensure good power supply and water tightness of the cables.

(2) Before powering on, make sure the line sequence and supply voltage are accurate.

5 Calibration

5.1 Brief description

(1) Regularly calibrate the electrodes based on the on-site water quality and usage conditions. The electrode supports one or two point calibration, connected through an electrical transmitter, and calibrated according to the operating instructions of the transmitter. OR according to sensor communication protocol.
(2) When a new electrode is not used for a long time, it should be soaked in pure water or ammonia nitrogen standard solution for 5-10 minutes. The electrode should avoid long-term immersion in pure water or ammonia nitrogen standard solution.
(3) To improve the accuracy of the measurement, it is recommended to repeat the calibration after the first sample measurement. Possible interference ions may exist in the sample solution, affecting the measurement of potential and giving incorrect results. Repeated calibration can eliminate interfering ions as background and obtain accurate measurement results.
(4) The calibration sequence is from low concentration solution to high concentration solution. At this time, the electrode does not need to be cleaned. When transferring from high concentration solution to low concentration solution, the electrode should be repeatedly rinsed clean.
Ammonium ISE Sensor supports one-point or two-points calibration. The calibration tool can be used with our Smart PC software or according to sensor communication protocol. For our Smart PC software, please can the QR code on the right to get it. Customers can also develop by themselves according to the communication protocol.

5.2 Calibration standard solution and calibration formula

（1）pH standard solution (when pH calibration is required, customized by the customers)

We recommend to purchase the pH standard solution with the value of 4.00, 6.86 and 9.18, respectively. pH user calibration formula:
pH(standard value)=K*pH(measurement)+B Normal factory default:K=1, B=0

（2）NH_4^+ standard solution

Factory supplied with a bottle of NH_4^+ mother standard solution (NH_4^+ concentration:1000mg/L), customer can use the NH_4^+ mother standard solution to dilute to obtain the corresponding concentration of standard solution;

Notes: before the test, the configured NH_4^+ standard solution needs to add ISA ion activator and stir well to ensure the ionic strength, and the addition ratio is 2% of the standard solution capacity. The amount of solution required can be immersed in three single-electrode heads.

NH_4^+ user calibration formula (LG(X) is calculated logarithmic in base 10):

lg[NH_4^+(standard value)]=K*LG[NH_4^+(measurement)]+B

Normal factory default:K=1, B=0

Notes: one-point calibration, keep K=1, calculate B, and write K and B at the same time;

Two-points calibration, calculate K and B according to quadratic equation with one variable,and write K and B at the same time.

（3）Potassium ion standard solution (when equipped with potassium ion electrode)

①Take 1.9067g of KCl and dissolve in deionized water, fixed capacity to 1L. At this time, the 1000mg/L K^+ mother solution is prepared;

②Take 1mL of the 1000mg/L K^+ mother solution and dissolve in deionized water, fixed capacity to 1L. At this time, the 1mg/L K^+ standard solution is prepared;

③Take 10mL of the 1000mg/L K^+ mother solution and dissolve in deionized water, fixed capacity to 1L. At this time, the 10mg/L K^+ standard solution is prepared;

④Take 100mL of the 1000mg/L K^+ mother solution and dissolve in deionized water, fixed capacity to

1L. At this time, the 100mg/L K^+ standard solution is prepared;

Notes: all the above standard solutions need to standardize the use of deionized water to determine the volume, and Wahaha's pure water can be used instead when the preparation conditions of deionized water are insufficient. K^+ user calibration formula:

K^+(standard value)=K*K^+(measurement)+B Normal factory default:K=1, B=0

6 Maintenance schedule and methods

6.1 Maintenance schedule

Cleanliness is very important for maintaining accurate readings. The frequency is according to the use environment.

Maintenance task	Recommended maintenance frequency
Sensor cleaning	Cleaning every 2 to 3 weeks
Calibration sensor	Every 3 to 4 weeks

6.2 Maintenance methods

(1) Clean the sensor surface： Wash the outer surface of sensor with tap water, if there is still residue,using soft brush, for some stubborn dirt, household detergent can be added in tap water to clean.

(2) Check the cable： inspect the sensor cable if there is damage.

(3) Electrode Cleaning：

① Wash the outer surface of electrode with soft brush. Note that do not touch sensitive membrane of $NH4^+$ electrode.

② Use clean water to wash the pH and reference electrode. Then gently wipe off with a lint free cloth or a soft brush.

③ Do not use anything to wipe sensitive membrane of $NH4^+$ electrode. Only rinse it with clean water (DI water is best).

④ If sensor needs calibration after cleaning, use a lint free cloth to dry the surface sensor case exclude sensitive membrane. It is recommended to dry by blowing or gently wiping with absorbent paper!

⑤ During calibration, electrode cleaning with DI water shall be repeated for each step to avoid polluting the standard solution.

(4) Store the sensor: Regular electrode maintenance requires pH and reference electrode to be stored in protected solutions which equipped with sensor. Please keep $NH4^+$ electrode in 1ppm $NH4^+$ solution. Note: If the membrane is kept in a dirty or dry state for a long time, it will lead to electrode failure and is not within the

warranty scope.

(5) Replace the electrode:

① $NH4^+$, reference and pH electrode are all consumable parts. Please replace them in time according to the actual situation.

② Return to the factory every 18 months to replace the dynamic sealing ring.

7 Troubleshooting

Table 2 lists symptoms, possible causes, and recommended solutions for common problems encountered with the sensor. If your symptom is not listed, or if none of the solutions solves your problem, please contact us.

Table 2

ERROR	POSSIBLE CAUSE	SOLUTION
Abnormal communication	Controller and cable connection error	Reconnect the controller and cables
	Interface and protocol problems	1.Use our SmartPC upper computer software to checkwhether the communication is normal; 2.Check according to the product supporting communication protocol.
No change in value	Software and hardware anomalies	Please contact us
The measured value is too high or too low.Or the value continues to be unstable.	Sensors are seriously contaminated	Clean the sensor body and special light window surface
	Electrode loss failure	Replace the new electrode
	Calibration Required	Carry out user calibration
Other errors	Please contact us	

8 Communication

This instrument provides a standard RS485 serial communication interface, adopts the international common standard Modbus-RTU communication protocol, and supports the 0x03 read holding register command, 0x06 write single register command, and 0x10 write multiple registers.

Data transmission mode: Big-endian mode;

Float：1-0-3-2；

Int32(long)：1-0-3-2

8.1 Protocol specification

8.1.1 Query Device Address (0x00)

If the device address is unknown, you can use the address 0x00 to send the 03 instruction to query the device address.

8.1.2 Broadcast Address (0xFF)

When the host sends the device address as 0xff, it is a broadcast instruction, and the slave does not respond when receiving the broadcast instruction.

8.2 Register list

8.2.1 Communication Parameters

Table 3 Communication Parameters

Register Address	Register Name	Data Type	Number of Registers	Byte Count	Read/Write Permission	Description
0x1100	Device address	uint8_t	1	2	R/W	1-247，default is 1
0x1101	Baud rate	uint8_t	1	2	R/W	2= 9600 (default) , 3= 14400 ,4= 19200 ， 5= 38400，6= 57600， 7= 115200，8= 1200， 9= 4800
0x1102	Serial port format	uint8_t	1	2	R/W	1= N81(default) , 2 = N82

Register Address	Register Name	Data Type	Number of Registers	Byte Count	Read/Write Permission	Description
						3 = E81, 4 = O81 N:None E:Even O:Odd 8：8 data bits 1：1 stop bit 2：2 stop bits

8.2.2 Measurement Parameter Registry

Table 4 Measurement Parameter Registry

Register Address	Register Name	Data Type	Number of Registers	Byte Count	Read/Write Permission	Description
0x1200	Number of measurement parameter	uint8	1	2	R	Range：1-10
0x1201	Measurement parameter 1	uint16	1	2	R	The high byte is the parameter type, 0x0e: COD; The low byte represents the unit, 0x08: mg/L. If the register is 0xFFFF, then this register is meaningless.
0x1202	Lower limit of range 1	float	2	4	R	The lower limit of the range of sensor parameter 1. If the value of the parameter 1 register is 0xFFFF, then this register is assigned 0.

Register Address	Register Name	Data Type	Number of Registers	Byte Count	Read/Write Permission	Description
0x1204	Lower limit of range 1	float	2	4	R	The upper limit of the range of sensor parameter 1. If the value of the parameter 1 register is 0xFFFF, then this register is assigned 0.
0x1206	Optional measurement parameter 2	uint16	1	2	R	The high byte is the parameter type, 0x0e: COD; The low byte represents the unit, 0x08: mg/L. If the register is 0xFFFF, then this register is meaningless.
0x1207	Lower limit of range 2	float	2	4	R	The lower limit of the range of sensor parameter 2. If the value of the parameter 2 register is 0xFFFF, then this register is assigned 0.
0x1209	Upper limit of range 2	float	2	4	R	The upper limit of the range of sensor parameter 2. If the value of the parameter 2 register is 0xFFFF, then this register is assigned

Register Address	Register Name	Data Type	Number of Registers	Byte Count	Read/Write Permission	Description
						0.
0x120B	Optional measurement parameter 3	uint16	1	2	R	Ditto
0x120C	Lower limit of range 3	float	2	4	R	Ditto
0x120E	Upper limit of range 3	float	2	4	R	Ditto
0x1210	Optional measurement parameter 4	uint16	1	2	R	Ditto
0x1211	Lower limit of range 4	float	2	4	R	Ditto
0x1213	Upper limit of range 4	float	2	4	R	Ditto
0x1215	Optional measurement parameter 5	uint16	1	2	R	Ditto
0x1216	Lower limit of range 5	float	2	4	R	Ditto
0x1218	Upper limit of range 5	float	2	4	R	Ditto

8.2.3 Data Register

Table 5 Data Register

Register Address	Register Name	Data Type	Number of Registers	Byte Count	Read/Write Permission	Description
0x2000	Protocol version + device type	uint16	1	2	R	High byte: Data version, low byte: Device type Device type: For example, 0x34 represents

Register Address	Register Name	Data Type	Number of Registers	Byte Count	Read/Write Permission	Description
						conductivity
0x2001	Supplementary protocol type	uint16	1	2	R	Not in use, fill with 0s
0x2002	Parameter 1 value	float	2	4	R	Measurement value of parameter 1 is based on the measurement parameter registry; otherwise, the value of this register is meaningless
0x2004	Temperature value	float	2	4	R	This register is fixed as the temperature measurement value, in degrees Celsius. If there is no temperature, set the value to -999.0
0x2006	Parameter 2 value	float	2	4	R	Ditto
0x2008	Parameter 3 value	float	2	4	R	Ditto
0x200A	Parameter 4 value	float	2	4	R	Ditto
0x200C	Parameter 5 value	float	2	4	R	Ditto
0x240E	Manual wiper	uint8_t	1	2	W	Write 1 to execute probe cleaning once
0x240F	Automatic wiper time	uint16_t	1	2	Write only	Interval time for sending (1, 5, 15, 30, 60 (1h), 240 (4h), 720 (12h), 1440 (1D), 4320 (3D), 10080

Register Address	Register Name	Data Type	Number of Registers	Byte Count	Read/Write Permission	Description
						(7D), unit: min)
0x2410	Restore factory settings	uint8_t	1	2	W	Write 1 to execute the factory settings of the sensor

Measurement value reading method:

Read continuously starting from the address 0x2000, and the reading length refers to the number of measurement parameters in 0x1200. For example, if the number of measurement parameters is 4, then read from 0x2000 to 0x200B.

8.2.4 Calibration Register

Table 6 Calibration Register

Register Address	Register Name	Data Type	Number of Registers	Byte Count	Read/Write Permission	Description
0x3000	Read the number of calibration points	uint8_t	1	2	R	The number of calibration points (m) supported by the sensor parameters to be calibrated, with a maximum of 5 points supported.
0x3001	Current calibration point	uint8_t	1	2	R/W	Current range: 1-m
0x3002	Calibration parameter type	uint8_t	1	2	R/W	Specific types refer to the measurement parameter registration table. 0 - Temperature 1 - Parameters of register 0x1201 in the registration table 2 - Parameters of

Register Address	Register Name	Data Type	Number of Registers	Byte Count	Read/Write Permission	Description
						register 0x1206 in the registration table 3 - Parameters of register 0x120B in the registration table 4 - Parameters of register 0x1210 in the registration table 5 - Parameters of register 0x1215 in the registration table
0x3003	Sensor calibration status	uint8_t	1	2	R	0x0000: Calibration successful 0x0001: Calibration not yet completed 0x0002: No standard liquid information received or no such standard liquid available 0x0003: Signal cannot be stabilized or signal is out of range 0x0004: Slope or offset out of allowed range
0x3004	Exit ‘calibration	uint8_t	1	2	W	Write 1 to exit calibration
0x3005	Reference standard value	float	2	4	W	Standard liquid value, data format is float
0x3007	Measured value	float	2	4	R	Unadjusted original measured value. (If

Register Address	Register Name	Data Type	Number of Registers	Byte Count	Read/Write Permission	Description
						the standard value refers to CalA and the measured value refers to MeasA, refer to section 6.1 of the calibration procedure)

8.3 Communication examples

8.3.1 Example of Reading Measurement Parameters

When obtaining the number of measurement parameters, the sensor responds with 4:

Send Hex：01 03 12 00 00 06 c0 b0

Recv Hex:：01 03 0c 00 04 10 06 00 00 00 00 c0 00 46 5a 22 2e

To obtain the registration table for all 4 measurement parameters, read (1 + 5x4) registers

Send Hex：01 03 12 00 00 15 81 7d

Recv Hex：01 03 2a 00 04 10 06 00 00 00 00 c0 00 46 5a 10
02 00 00 42 c8 00 00 43 fa 10 1a c5 ac 37 27 00
00 3f 80 10 1c 00 00 00 00 00 00 40 a0 13 73

To read the measurement values, read 4 measurement values and temperature:

Send Hex：01 03 20 00 00 0c 4e 0f

Recv Hex：01 03 18 20 14 00 00 00 00 42 d4 66 66 41 ca 13
33 43 95 c2 8f 3b f5 df 3b 40 47 a0 d8

8.3.2 Calibration example

Taking the first point of calibration as an example

Calibration parameter type 0x01

Send Hex：01 06 30 02 00 01 e6 ca

Recv Hex：01 06 30 02 00 01 e6 ca

Write the value of the standard solution:

Send Hex：01 10 30 05 00 02 04 00 00 41 20 56 19

Recv Hex：01 10 30 05 00 02 5e c9

Write the current calibration point and initiate the first calibration point:

Send Hex：01 06 30Recv Hex：01 03 02 00 00 b8 44

01 00 01 16 ca

Recv Hex：01 06 30 01 00 01 16 ca

Query calibration status:

Send Hex：01 03 30 03 00 01 7b 0a