



User Manual

Ammonia Nitrogen Sensor

NHN-220



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General Introduction

NHN-220 is a basic digital ammonia nitrogen sensor for routine water quality monitoring. It uses an industrial online electrode and a PVC membrane ammonium ion-selective electrode to selectively test the content of ammonium ions in water, with fast response speed and accurate measurement. An internal temperature sensor allows automatic temperature compensation, making it suitable for long-term online environmental monitoring use.

Features:

- Digital sensors, directly outputting RS-485 digital signals and supporting MODBUS/RTU.
- Built-in temperature sensor, can automatically compensate for temperature changes
- The innovative ammonium ion membrane head is replaceable, and the cost of maintenance with a replacement membrane head is low.
- 3/4" NPT up and down installation thread design, convenient for installation.
- Low power consumption of sensors, and internal circuit design to resist interference.
- Optional: compensation for pH and potassium ions to reduce interference in testing.

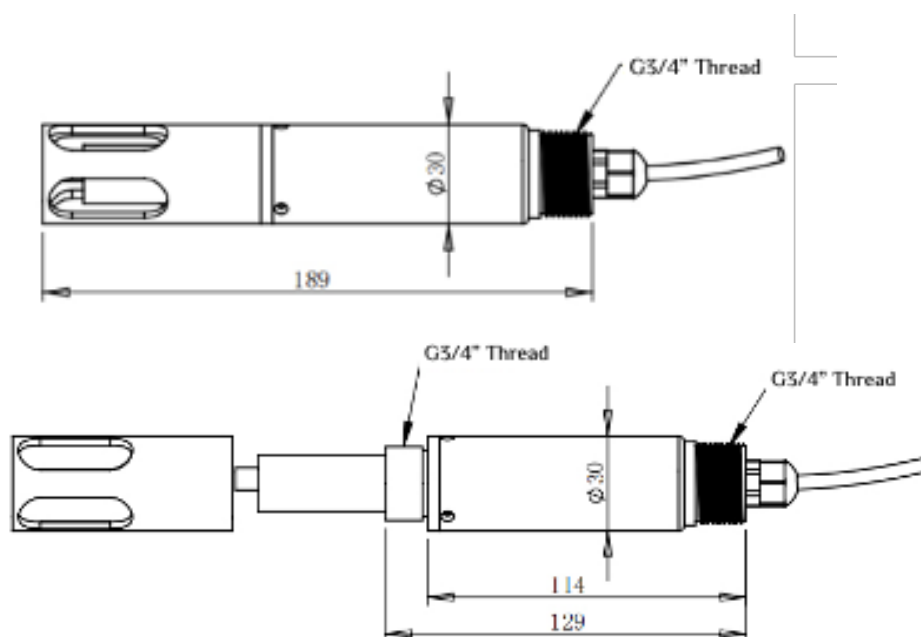
Note: Select pH and potassium ion compensation according to medium PH and ion interference.

Application:

Online monitoring of river water quality, industrial wastewater, environmental protection water treatment, food and beverage, fermentation, etc.;

Note: Different application fields, according to high temperature and pressure, strong acid-base, corrosive media, etc., different characteristics of electrode probes should be selected.

Dimensional drawing

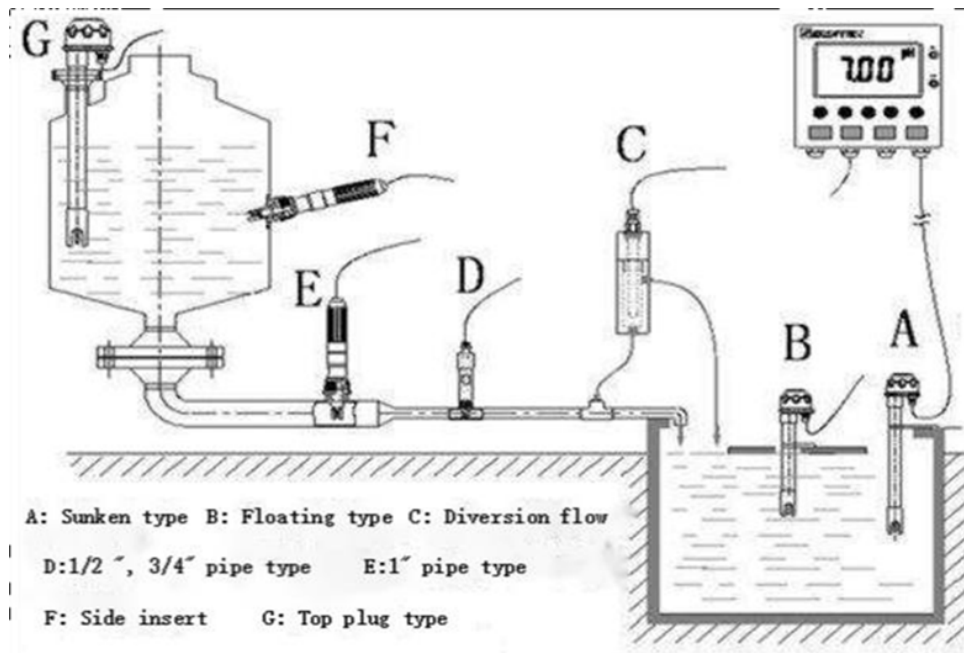


Technical parameters

Name	Parameters
Output Signal	Support RS-485, MODBUS/RTU protocol
Measurement Method	Film ion selective method
Range	0 ~ 10.0 mg/L or 0 ~ 100.0 mg/L (pH range 4 ~ 10)
Accuracy	±5% F.S. or ±3 mg/L whichever is greater
Resolution	0.1 mg/L
Working Conditions	0 ~ 40 C°; <0.2 MPa;
Calibration Mode	Two-point calibration
Response Time	30 seconds T90
Temperature Compensation	Automatic temperature compensation (Pt100)
Power Supply	12 or 24 VDC ±10%, 10 mA;
Protection Grade	IP68; Water depth of 20 meters;
Service Life	Sensor for more than one year; Membrane head for six months
Cable Length	Default length of 5 meters, customizable
Sensor Housing Material	POM; Customizable
Output Signal	Support RS-485, MODBUS/RTU protocol

Installation Notes and Wire Connection

1. Installation



Note: The sensor should be installed at least 2 cm away from the bottom and side wall of the container during installation testing.

2. Electrical connection

- Brown wire - power supply (12 or 24 VDC)
- Black wire - Ground
- Blue wire - 485A.
- White wire - 485B.
- Bare wire - shielding layer

Sensor cable: 4-wire AWG-24 or AWG-26 shielded wire.

Outer diameter: 6.0-6.2 mm;

Flexible twisted pair shielded cable.

Calibration

If the range is 0-10 ppm, zero-point calibration should be performed at 1 ppm. After data stabilization, perform zero-point calibration; it usually takes about 15 to 30 minutes for data stability. Then slope calibration should be done in 10 ppm. After data stabilization, perform slope calibration; it also takes about 15 to 30 minutes for data stability.

If the range is 0-100 ppm, zero-point calibration should be performed at 10 ppm. After data stabilization, perform zero-point calibration; it usually takes about 15 to 30 minutes for data stability. Then slope calibration should be done in 100 ppm. After data stabilization, perform slope calibration; it also takes about 15 to 30 minutes for data stability.

If there is an unstable phenomenon in executing above process, continue to soak for 24 hours.

Please refer to the Modbus RTU communication protocol operation manual for calibration instructions.

Note: The sensor has been calibrated before leaving the factory. It is not advisable to calibrate it arbitrarily unless there are errors beyond measurement error.

Maintenance and precautions

1. Maintenance

- Before using new electrodes or those that have been unused for a long time, they must be soaked in distilled water for half an hour and then immersed in a standard buffer solution of 1 ppm for 24 hours to fully activate the membrane head.
- The electrode membrane head is cleaned with distilled water, and hard objects should not be touched to avoid scratching. When measuring, keep a distance of at least 2 cm between the membrane head and the bottom.
- Please put it in a solution of 1 ppm ammonium ions for short-term storage.
- If you don't use it for a few days, please store it in an inner protective liquid shell. Soak it with 1 ppm solution for 24 hours before next usage to activate it.
- Avoid long-term immersion in distilled water or protein solutions, and prevent contact with silicone oils. Electrodes that have been used for a longer period of time may become semi-transparent or covered with deposits; at this point, they can be rinsed with distilled water (or deionized water).
- The electrode has been used for a long time, and the measured data drifts. Please calibrate it.
- The electrode is dried and preserved when it's not used for a long time.

The main interfering ions are shown in below table

Interferences (moles/liter)	10^{-4} M Ammonium	10^{-3} M Ammonium	10^{-2} M Ammonium
H^+	< 2	< 1	< 1
Li^+	0.2	0.5	0.5
Na^+	0.005	0.08	0.8
K^+	7×10^{-5}	6×10^{-4}	6×10^{-3}
Cs^+	0.003	0.05	0.5
Mg^{3+}	> 0.5	> 1	> 1
Ca^{2+}	> 0.2	> 1	> 1
Sr^{2+}	> 0.2	> 1	> 1
Ba^{2+}	> 0.1	> 0.5	> 0.5
Zn^{2+}	0.001	0.01	0.1
$N_2H_5^+$	> 0.1	> 0.1	> 0.1
Bu_4N^+	1×10^{-5}	1×10^{-4}	1×10^{-3}
Interferences (moles/liter)	10^{-4} M Ammonium	10^{-3} M Ammonium	10^{-2} M Ammonium

Quality and Service

Thank you for choosing our product.

Shanghai ChiMay provides after-sales service of the machine within one year from the date of sale but does not include the damage caused by improper use. If you need repair or adjustment, please send it back, but the freight must be paid for by yourself.

Accessories and spare parts

Item	QTY (pcs)
Sensor	1
User Manual	1
Certificate of Conformity	1

Data Communication

1. Introduction to Modbus protocol

Modbus protocol is a general communication protocol which has been widely used in the field of industrial control. Through this protocol, controllers can communicate with each other or with other devices over a network, such as Ethernet. Modbus protocol uses the master-slave communication technology, that is, the master device actively queries and operates the slave device.

- a. The master device sends requests to the slave device
- b. The slave device analyzes and processes the request of the master device, and then sends the result to the master device
- c. If anything goes wrong, an exception function code will be returned from the device Modbus RTU

Communication mode Frame format

Device Address	Function code	Data	CRC is eight digits lower	CRC is eight places higher
8bit	8bit	n * 8bit	8bit	8bit

- In RTU mode, the transmission of a message must commence with a pause interval of at least 3.5 character times. The first field to be transmitted is the device address. Network devices continuously monitor the network bus, including during the pause intervals. Upon receiving the first field (the address field), each device decodes it to determine if the message is intended for itself. Following the last transmitted character, a pause of at least 3.5 character times signifies the end of the message. A new message may then begin after this pause.
- The entire message frame must be transmitted as a continuous stream. If there is a pause of more than 1.5 character times before the frame is completed, the receiving device will flush the incomplete message and assume that the next byte is the address field of a new message.

2. Information frame format

The default data format for Modbus communication of the sensor is:

MODBUS-RTU	
Baud rate	9600 (by default)
Device address	1 (by default)
Data bit	8-bit
Parity check	no
Stop bit	1-bit

a. Function code 03H: read the register value

Host sending

1	2	3	4	5	6	7	8
ADR	03H	Start register high byte	Start register low bytes	Start register high byte	Start register low bytes	CRC lower byte	CRC high byte

Byte 1: ADR: Slave address code (=001~254)

Byte 2 03H: read register value function code

Bytes 3 and 4: Start address of the register to be read

To read FCC downlink meter,

Bytes 5 and 6: The number of registers to read

Bytes 7 and 8: The CRC16 checksum from bytes 1 to 6

Host sending:

1	2	3	4、5	6、7		M-1、M	M+1	M+2
ADR	03H	Total bytes	data register 1	data register 2	...	data register M	CRC low byte	CRC high byte

Byte 1 ADR: Address code of the slave machine (=001~254)

Byte 2 03H: Read register value function code

Byte 3 : The total number of bytes from 4 to M(including 4 and M)

Bytes 4 to M: data registers

Bytes M+1、M+2 : CRC16 checksum from byte 1 to M

When an error is received from the slave, send it back from the slave:

1	2	3	4	5
ADR	83H	information code	CRC low byte	CRC high byte

Byte 1 ADR: Address code of the slave machine (=001~254)

Byte 2 83H: Error reading register value

Byte 3 information code: 01 – Function code wrong

03 – SET DATA ERR

Bytes 4、 5 : CRC 16 checksums from bytes 1 to 3

b) Function Code06H: Write a single register value

Host sending:

1	2	3	4	5	6	7	8
ADR	06	Register high byte address	Register low byte address	High byte of data	Low byte of data	CRC code the low byte	CRC code the high byte

When the slave receives correctly, the slave sends back:

1	2	3	4	5	6	7	8
ADR	06	Register high byte address	Register low byte address	High byte of data	Low byte of data	CRC code the low byte	CRC code the high byte

When the slave receives an error, the slave sends back:

1	2	3	4	5
ADR	86H	Error code information code	CRC Code the low byte	CRC Code the high byte

Byte 1 ADR: Address code of the slave machine (=001~254)

Byte 2 86H: Write register value error function code

Byte 3 Error code information code: 01 – Function code wrong

03 – SET DATA ERR

Bytes 4、 5 : CRC checksums from bytes 1 to 3

3. Data structure types

Integer

unsigned short

The data consists of two integers

XXXX XXXX	XXXX XXXX
Byte1	Byte0

Float

Float, IEEE 754 (single precision);

The data consists of 1 symbol bit, 8-bit exponent, and a 23-bit mantissa

XXXX XXXX	XXXX XXXX	XXXX XXXX	XXXX XXXX
Byte3	Byte2	Byte1	Byte0
sign bit	Exp Index place	F decimal place	

4. Register address

Register address	Name	Read/Write	Explanation	Number of registers (byte)	Data type
0x0100	Temperature value	R	°Cvalue x10 (e.g :25.6 temperature display as 256, default 1 decimal)	1 (2 Bytes)	unsigned short
0x0101	Ammonium value	R	Range of 0-10mg/L , Ammonium valuelx100 (For example: Ammonium 1.62mg/L is displayed as 162, default 2 decimal places); Range of 0-100mg/L , Ammonium 16.2mg/L is displayed as 162, default 1 decimal place)	1 (2 Bytes)	unsigned short
0x0107	humidity measurement	R	%RH value x10 (For example :11.3% relative humidity display is 113, default 1 decimal)	1 (2 Bytes)	unsigned short
0x1000	temperature calibration	R/W	Temperature calibration: write the data as the actual temperature value x10; The readout data is the temperature calibration offset x10	1 (2 Bytes)	unsigned short
0x1001	Ammonium zero calibration	R/W	Range of 0-10mg/L , the written value is multiplied by 100, zero value is 1ppm; Range of 0-100mg/L , the written value is multiplied by 10, zero value is 10ppm.	1 (2 Bytes)	unsigned short
0x1003	Ammonium slope calibration	R/W	Range of 0-10mg/L , the written value is multiplied by 100, slope point is 10ppm; Range of 0-100mg/L , the written value is multiplied by 10, slope point value is 100ppm.	1 (2 Bytes)	unsigned short
0x2000	address sensor	R/W	The default is 1, and the data range is 1-127	1 (2 Byte)	unsigned short
0x2003	Baud rate setting	R/W	Default is 9600. Write 0 is 4800; Write 1 as 9600; Write 2 as 19200	1 (2 Bytes)	unsigned short
0x2020	Factory Reset	W	The calibration value is restored to the default value and the written data is 0. Note that the sensor needs to be calibrated again before it can be used after reset	1 (2 Bytes)	unsigned short

5. Example command

Default register:

a) Change slave address:

Address: 0x2000 (48193)

Number of registers: 1

Function Code: 0x06

Default sensor address: 01

Change the Modbus device address of the sensor and change the device address 01 to 06, as show below:

Send instructions: 01 06 20 00 00 06 02 08

Response: 01 06 20 00 00 06 02 08;

Note: Change the address to 06 to save, then power off.

b) Baud:

Address: 0x2003 (48196)

Number of registers: 1

Function Code: 0x06

Default: 1 (9600bps)

Support value: 0-2 (4800-19200bps)

The port rate can be changed on the computer setting, after the port rate change, power off and power on save setting. Porter rate supports 4800,9600,19200. The port rate assigned to the integer values is as follows

Integer	Baud
0	4800 bps
1	9600 bps
2	19200 bps

Send instructions: 01 06 20 03 00 02 F3 CB

Response: 01 06 20 03 00 02 F3 CB

Note: Change the rate to 19200bps, save when power is out.

FR Function Register:**a) Temperature instruction:**

Address: 0x0100 (40257)

Number of registers: 1

Function Code: 0x03

Read sample values: 19.2°C

Send instructions: 01 03 01 00 00 01 85 F6

Response: 01 03 02 00 C0 B8 14

Returns hexadecimal unsigned integer data. Temperature value=Integer/10, keep 1 decimal place.

b) Measure Ammonium Instruction:

Address: 0x0101 (40258)

Number of registers: 1

Function Code: 0x03

Read sample values (take an example of measurement range of 0-10mg/L): 2.56ppm

Send instructions: 01 03 01 01 00 01 D4 36

Response: 01 03 02 01 00 B9 D4

Register returns hexadecimal unsigned integer data, NH value=Integer/ 100, keep 2 decimal place.

Read sample values (take an example of measurement range of 0-100mg/L): 30.0ppm

Send instructions: 01 03 01 01 00 01 D4 36

Response: 01 03 02 01 2C B8 09

Register returns hexadecimal unsigned integer data, ammonium value=Integer/ 10, keep 1 decimal place.

c) Continuously read temperature and pH value instructions

Address: 0x0100 (40257)

Number of registers: 2

Function Code: 0x03

Read sample values (take an example of measurement range of 0-10mg/L): 19.2°C and NH value of 2.56ppm

Send instructions: 01 03 01 00 00 02 C5 F7

Response: 01 03 04 00 C0 01 FB 9F

Register returns hexadecimal unsigned integer data, temperature value=Integer/10, keep 1 decimal place.

Register returns hexadecimal unsigned integer data, NH value=Integer/ 100, keep 2 decimal places.

Read sample values (take an example of measurement range of 0-100mg/L): 19.2°C and NH value of 30.0ppm

Send instructions: 01 03 01 00 00 02 C5 F7

Response: 01 03 04 00 C0 01 2C FA 42

d) Humidity measurement instruction:

Address: 0x0107 (40264)

Number of registers: 1

Function Code: 0x03

Read sample values: relative humidity 40%

Send instructions: 01 03 01 07 00 01 34 37

Response: 01 03 02 01 90 B9 B8

Register returns hexadecimal unsigned integer data, Humidity=Integer/10, keep 1 decimal place.

e) Calibration instructions:

temperature correction

Address: 0x1000 (44097)

Number of registers: 1

Function Code: 0x06

Calibration sample: Calibration at 25.8°C

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

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

The sensor needs to be calibrated in a constant temperature environment without temperature fluctuation.

NH zero calibration

Address: 0x1001 (44098)

Number of registers: 1

Function Code: 0x06

Calibration sample (take an example of measurement range of 0-

10mg/L): The written number is multiplied by 100,
and the standard solution is 1ppm/L.

Send instructions: 01 06 10 01 00 64 DD 21

Response: 01 06 10 01 00 64 DD 21

Calibration sample **(take an example of measurement range of 0-100mg/L):** The written number is multiplied by 10,
and the standard solution is 10ppm/L.

Send instructions: 01 06 10 01 00 64 DD 21

Response: 01 06 10 01 00 64 DD 21

NH slope calibration

Address: 0x1003 (44100)

Number of registers: 1

Function Code: 0x06

Calibration sample **(take an example of measurement range of 0-10mg/L):** The written number is multiplied by 100,
and the standard solution is 10ppm/L.

Send instructions: 01 06 10 03 03 E8 7D B4

Response: 01 06 10 03 03 E8 7D B4

Calibration sample **(take an example of measurement range of 0-100mg/L):** The written number is multiplied by 10,
and the standard solution is 100ppm/L.

Send instructions: 01 06 10 03 03 E8 7D B4

Response: 01 06 10 03 03 E8 7D B4



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