Agrinovo

AGRINOVO-NH4-100

Digital Ammonium Nitrogen (NH_4^+-N) Ion Electrode Sensor

1. Overview

The AGRINOVO-NH4-100 is a digital ion-selective electrode (ISE) sensor for measuring ammonium nitrogen concentration in water. It integrates electronics and a microprocessor for real-time ion concentration and temperature measurement via RS485 Modbus-RTU, with up to 5-point calibration and automatic or manual temperature compensation.

Key Features

- Ion range: 0.2–1000 ppm
- Resolution: 0.01 ppm
- Accuracy: ±5% F.S.
- Built-in temperature sensor (NTC10K)
- Up to 5-point calibration
- Auto/manual temp compensation
- RS485 Modbus-RTU
- Low power: ≤0.5W

Applications

- Aquaculture ammonia monitoring
- Wastewater treatment
- Environmental water quality monitoring
- Industrial process control

2. Specifications

Parameter	Specification
Ion Range	0.2–1000 ppm
Ion Resolution	0.01 ppm
Ion Accuracy	±5% F.S.
Temperature Range	–10.0–110.0°C
Temperature Resolution	0.1°C
Temperature Accuracy	±0.5°C
Temperature Sensor	Thermistor NTC10K
Temperature Compensation	Automatic / Manual

3. Electrical Characteristics

Parameter	Specification
Supply Voltage	9–27 VDC
Power Consumption	≤0.5W
Isolation	2500Vrms
Housing Material	PPS
Mounting Thread	3/4 inch front thread

4. Wiring

Wire Color	Function	Description
Red	V+	DC Power Supply (9–27V DC)
Black	GND	DC Power Ground
Yellow	RS485-A	Data T/R+
White	RS485-B	Data T/R–

5. Communication Settings

Parameter	Value
Protocol	Modbus-RTU
Baud Rate	9600 bps (configurable: 1200/2400/4800/9600/19200)
Data Bits	8
Parity	None
Stop Bits	1
Default Address	0x01 (range 1–247)

Notes:

- All registers are dual-byte (16-bit). Transmitted high byte first, low byte second.
- Negative integers use two's complement (–1 = 0xFFFF, –2 = 0xFFFE).
- CRC16: Standard Modbus, high byte first, low byte second. CRC bypass code: 0x2A2A.
- Command frame length is fixed at 8 bytes. Frames shorter than 8 bytes after a 0.1s gap are ignored.

6. Register Map

The sensor has three register groups: **Measurement** (real-time data), **Parameter** (configuration), and **Information** (device status/identity).

6.1 Measurement Registers — Integer Mode (Function 0x04)

Address	Description	Range	Scaling	R/W
0x0000	Ion Concentration	0–20000	See decimal register	R
0x0001	Ion Decimal + Unit	—	See unit table	R
0x0002	Electrode Signal	–7500–7500	÷10 → mV	R
0x0003	Signal Decimal + Unit	—	See unit table	R
0x0008	Temperature	–100–1100	÷10 → °C	R
0x0009	Temp Decimal + Unit	—	See unit table	R

Over-range indicators: 0x7FFF = above upper limit, 0x8000 = below lower limit.

6.2 Measurement Registers — Float Mode (Function 0x03)

Each value occupies 2 registers (float32):

Address	Description	Range	Unit	R/W
0x0000–0x0001	Ion Concentration	0.000–20000	ppm	R
0x0002–0x0003	Electrode Signal	–750.0–750.0	mV	R
0x0008–0x0009	Temperature	–10.0–110.0	°C	R

6.3 Parameter Registers (Function 0x03 read / 0x06 write)

Address	Description	Range	Default	R/W
0x0019	Calibration Status	BIT2–BIT6 (see calibration)	—	R/D
0x001C	Electrode Efficiency	70.0–130.0% (int: 700–1300)	100.0%	R/D
0x001D	Calibrated Point Count	0–5	0	R/D
0x001E	Slave Address	1–247 (0xFF = broadcast)	1	R/W
0x001F	Baud Rate	0:1200 · 1:2400 · 2:4800 · 3:9600 · 4:19200	3 (9600)	R/W
0x0020	Temp Compensation Type	0: Manual · 1: Automatic	1 (Auto)	R/W/D
0x0021	Temp Setpoint / Offset	Manual: –10.0–110.0°C · Auto: –10.0–10.0°C (×10)	25.0 / 0.0°C	R/W/D
0x0023	Ion Valence	0: Not set · 1: Monovalent · 2: Divalent	—	R/W

R/W/D: D = reset to default by factory restore. Registers without D are unaffected by factory restore.

6.4 Information Registers (Function 0x03 read / 0x06 write)

Address	Description	Values	R/W
0x0040	Working Mode	0x0010: Measurement · 0x0050: Settings · 0x0060: Calibration	R/W
0x0041	Mode Parameter	See settings/ calibration sections	R/W
0x0042	Work Event	—	R
0x0043	Calibration Status & Operation	See calibration section	R/W
0x0044	Device Type	0x0010 (ION)	R
0x0045	Device Model	0x1210 (ION1210)	R
0x0046	Software Version	BCD coded	R
0x0047	Hardware Version	BCD coded	R
0x0048	Serial Number High	BCD coded	R
0x0049	Serial Number Low	BCD coded	R

7. Reading Data

Integer Mode — Read ion concentration, electrode signal, and temperature (Function 0x04)

Read 10 registers from 0x0000:

```
Request:  01 04 00 00 00 0A 70 0D
Response: 01 04 14 03 EB 02 11 03 EC 01 00 00 00 00 00 00 00 00 00 00 FA 01 0B C7 51
```

Decoding:

Register	Hex	Decimal	Scaling	Result
0x0000 Ion Value	0x03EB	1000	÷100 (from 0x0001)	**10.00 ppm**
0x0002 Electrode Signal	0x03EC	1001	÷10 (from 0x0003)	**100.1 mV**
0x0008 Temperature	0x00FA	250	÷10 (from 0x0009)	**25.0°C**

Float Mode — Read ion concentration, electrode signal, and temperature (Function 0x03)

Read 10 registers from 0x0000:

```
Request:  01 03 00 00 00 0A C5 CD
Response: 01 03 14 00 00 41 20 33 33 42 C8 00 00 00 00 00 00 00 00 00 E3 E8 41 C7 43 0C
```

Decoding:

Register	Float Value	Result
0x0000–0x0001 Ion	10.00	**10.00 ppm**
0x0002–0x0003 Electrode	100.1	**100.1 mV**
0x0008–0x0009 Temperature	24.986282	**25.0°C**

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8. Address Configuration

Change Address (0x01 → 0x02)

```
Request:  01 06 00 1E 00 02 68 0D
Response: 01 06 00 1E 00 02 68 0D
```

Change Baud Rate (9600 → 2400)

```
Request:  01 06 00 1F 00 01 79 CC
Response: 01 06 00 1F 00 01 79 CC
```

Change Ion Valence (→ Divalent)

```
Request:  01 06 00 23 00 02 F9 C1
Response: 01 06 00 23 00 02 F9 C1
```

Broadcast Discovery

Use address 0xFF with only one device connected.

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9. Calibration

The ion electrode requires calibration with 2 or more standard solutions before it can calculate ion concentration. Up to 5 calibration points are supported.

Standard Solution Codes

Concentration	Code	Bit Position
0.1 ppm	0x0002	BIT1
1 ppm	0x0004	BIT2
10 ppm	0x0008	BIT3
100 ppm	0x0010	BIT4
1000 ppm	0x0020	BIT5

Calibration Flow

1. Place the electrode in standard solution.
2. Write the standard solution code to calibration register (0x0043).
3. Wait for completion. Read 0x0043 status:
    - **0:** Calibration successful (returned to measurement mode)
    - **1:** Calibrating — read again shortly
    - **2:** No valid standard value received within 180s (returned to measurement)
    - **3:** Signal unstable or out of range within 180s (returned to measurement)
    - **4:** Sensor performance (efficiency/offset) out of limits (returned to measurement)

Calibration Notes

- Each successful calibration calculates electrode efficiency. If out of range, error 4 is returned.
- Writing 0x7FFF to 0x0043 clears all calibration data.
- Calibration status can be read from register 0x0019 and electrode efficiency from 0x001C.
- Ion valence must be configured (0x0023) before calibration if applicable.

Calibration Commands

Command	Addr	Func	Register	Value	CRC
Clear all calibration	01	06	00 43	7F FF	1B 6E
Calibrate 0.1 ppm	01	06	00 43	00 04	F9 DF
Calibrate 1 ppm	01	06	00 43	00 08	79 D0
Calibrate 10 ppm	01	06	00 43	00 10	79 D8
Calibrate 100 ppm	01	06	00 43	00 20	79 D2
Calibrate 1000 ppm	01	06	00 43	00 40	79 C6
Query calibration status	01	03	00 43	00 01	75 DE

10. Temperature Compensation

Set to Manual Compensation

```
Request:  01 06 00 20 00 00 88 00
Response: 01 06 00 20 00 00 88 00
```

When manual: register 0x0021 is the manual temperature setpoint (×10).

Set to Automatic Compensation

```
Request:  01 06 00 20 00 01 49 C0
Response: 01 06 00 20 00 01 49 C0
```

When automatic: register 0x0021 is the temperature offset (×10). Default 0.0°C.

Set Temperature Offset to –5.0°C

```
Request:  01 06 00 21 FF CE 19 A4
Response: 01 06 00 21 FF CE 19 A4
```

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11. Factory Reset

Factory reset requires two sequential commands:

Step 1 — Enter Settings Mode (write 0x0050 to 0x0040):

```
Request:  01 06 00 40 00 50 88 22
Response: 01 06 00 40 00 50 88 22
```

Step 2 — Execute Factory Reset (write 0x7FFF to 0x0041):

```
Request:  01 06 00 41 7F FF B9 AE
Response: 01 06 00 41 7F FF B9 AE
```

This clears all calibration data, resets temperature mode to automatic, offset to 0.0°C, and restores default parameter values. The device will restart.

12. Error Handling

When an invalid command is received, the device responds with the function code + 0x80:

Error Code	Description
01	Invalid function code (only 0x03, 0x04, 0x06 supported)
02	Invalid register address
03	Invalid register count (exceeds register group boundary)
04	Invalid modification value (out of range)
05	CRC error
06	Write to read-only register

13. Common Commands Reference

Read Registers

Command	Addr	Func	Start	Count	CRC
Read measurement (integer)	01	04	00 00	00 0A	70 0D
Read measurement (float)	01	03	00 00	00 0A	C5 CD
Read all parameters	01	03	00 19	00 0C	94 08
Read all info registers	01	03	00 40	00 0A	C4 19

Write Registers

Command	Addr	Func	Register	Value	CRC
Set address to 0x02	01	06	00 1E	00 02	68 0D
Set baud to 2400	01	06	00 1F	00 01	79 CC
Temp comp → manual	01	06	00 20	00 00	88 00
Temp comp → auto	01	06	00 20	00 01	49 C0
Temp offset –5.0°C	01	06	00 21	FF CE	19 A4
Ion valence → monovalent	01	06	00 23	00 01	B9 C0
Ion valence → divalent	01	06	00 23	00 02	F9 C1

14. Unit Lookup Table

The low byte of “Decimal + Unit” registers (0x0001, 0x0003, 0x0009) contains the unit code:

Code	Unit	Code	Unit	Code	Unit
0x00	mV	0x01	nA	0x02	uA
0x03	mA	0x04	Ω	0x05	KΩ
0x06	MΩ	0x07	uS	0x08	mS
0x09	S	0x0A	pH	0x0B	°C
0x0C	°F	0x0D	ug/L	0x0E	mg/L
0x0F	g/L	0x10	ppb	0x11	ppm
0x12	ppt	0x13	%	0x14	mbar
0x15	bar	0x16	mmHg		

The high byte contains the number of decimal places for the value register.

15. Installation Notes

Placement

- Mount using 3/4 inch thread fitting
- Ensure sensing tip is fully submerged
- Avoid air bubbles on electrode surface

Maintenance

- Clean electrode periodically
- Re-calibrate after extended use or cleaning
- Store in clean water when not in use
- PPS housing is corrosion-resistant