Agrinovo

AGRINOVO-O3-100

Digital Ozone (O_3) Electrode Sensor

1. Overview

The AGRINOVO-O3-100 is a digital ozone electrode sensor with integrated electronics and microprocessor for continuous water quality monitoring. It measures dissolved ozone concentration and temperature via RS485 Modbus-RTU interface with automatic or manual temperature compensation.

Key Features

- Ozone range: 0–20.00 mg/L
- Resolution: 0.01 mg/L
- Accuracy: ±0.02 mg/L
- Built-in temperature sensor (TH10K)
- Auto/manual temp compensation
- RS485 Modbus-RTU, IP68
- Pressure rated: 0–6 bar
- Dual salt-bridge reference system

Applications

- Water treatment and disinfection
- Aquaculture ozone monitoring
- Industrial process control
- Environmental water quality monitoring

2. Specifications

Parameter	Specification
O_3 Range	0.00–20.00 mg/L
O_3 Resolution	0.01 mg/L
O_3 Accuracy	±0.02 mg/L
Temperature Range	0–70°C
Temperature Resolution	0.1°C
Temperature Accuracy	±0.5°C
Temperature Sensor	Thermistor TH10K
Temperature Compensation	Automatic / Manual
Pressure	0–6 bar
Reference System	Dual salt-bridge, eco-friendly liquid junction

3. Electrical Characteristics

Parameter	Specification
Supply Voltage	12–24 VDC
Power Consumption	≤0.5W
Isolation	2500Vrms
Housing Material	Glass + PP + POM
Mounting Thread	PG13.5
Cable Length	5m
Connector	Terminal
Protection Rating	IP68 (submersible)
Companion	A580 gas-tight flow cell
Electrode Lifespan	~12 months (typical, conditions dependent)
Calibration Interval	~3 months (typical, conditions dependent)

4. Wiring

Wire Color	Function	Description
Red	V+	DC Power Supply (12–24V DC)
Black	GND	DC Power Ground
Green	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.

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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	O_3 Value	0–2000	÷100 → mg/L	R
0x0001	O_3 Decimal + Unit	—	See unit table	R
0x0004	Electrode Signal	–1000–4000	÷100 → mV	R
0x0005	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	O_3 Value	0.00–20.00	mg/L	R
0x0004–0x0005	Electrode Signal	–10.00–40.00	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	O_3 Calibration Status	BIT0=zero, BIT1=slope	—	R/D
0x001A	O_3 Electrode Offset	–0.30–0.30 mg/L (int: –30–30)	0.00 mg/L	R/D
0x001B	Offset Decimal + Unit	0x020E	—	R/D
0x001C	O_3 Electrode Slope	30.0–300.0% (int: 300–3000)	100.0%	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
0x002D	Filter Coefficient	1–16	—	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	0x0008 (DOZ)	R
0x0045	Device Model	0x1210	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 O_3, 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 E6 02 0E 03 E6 02 0E 07 CB 02 00 00 00 00 00 00 FA 01 0B F5 80
```

Decoding:

Register	Hex	Decimal	Scaling	Result
0x0000 O_3 Value	0x03E6	998	÷100	**9.98 mg/L**
0x0004 Electrode Signal	0x07CB	1995	÷100	**19.95 mV**
0x0008 Temperature	0x00FA	250	÷10	**25.0°C**

Float Mode — Read O_3, electrode signal, and temperature (Function 0x03)

Read 10 registers from 0x0000:

```
Request:  01 03 00 00 00 0A C5 CD
Response: 01 03 14 E7 2F 41 1F DA 2A 41 1F DA 2A 41 9F 00 00 00 00 75 26 41 C7 5E CC
```

Decoding:

Register	Bytes	Float Value	Result
0x0000–0x0001 O_3	E7 2F 41 1F	9.993941	**9.99 mg/L**
0x0004–0x0005 Electrode	DA 2A 41 9F	19.981525	**19.98 mV**
0x0008–0x0009 Temperature	75 26 41 C7	24.932201	**24.9°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
```

Broadcast Discovery

Use address 0xFF with only one device connected.

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9. Calibration

O_3 calibration supports up to 2 points: **slope** and **zero**. Slope must be calibrated first.

Calibration Flow

1. Place the sensor in standard solution.
2. Write the standard value (slope) or zero-point 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 (slope/offset) out of limits (returned to measurement)

Calibrate Slope Point (e.g. 5.00 mg/L)

Write 500 (0x01F4) to register 0x0043:

```
Request:  01 06 00 43 01 F4 78 09
Response: 01 06 00 43 01 F4 78 09
```

Calibrate Zero Point

Write 0x0001 to register 0x0043:

```
Request:  01 06 00 43 00 01 B9 DE
Response: 01 06 00 43 00 01 B9 DE
```

Query Calibration Status

```
Request:  01 03 00 43 00 01 75 DE
Response: 01 03 02 00 00 B8 44
```

Status is in register 0x0019: BIT0 = zero calibrated, BIT1 = slope calibrated.

- 0x0000 — No calibration
- 0x0002 — Slope calibrated only
- 0x0003 — Both slope and zero calibrated

Clear All Calibration

Write 0x7FFF to register 0x0043:

```
Request:  01 06 00 43 7F FF [CRC]
```

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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.

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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
Calibrate slope 1.00 mg/L	01	06	00 43	00 64	79 F5
Calibrate zero point	01	06	00 43	00 01	B9 DE
Query calibration status	01	03	00 43	00 01	75 DE

14. Unit Lookup Table

The low byte of “Decimal + Unit” registers (0x0001, 0x0005, 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

- Requires A580 gas-tight flow cell
- Immersion or flow-through installation
- Mount using PG13.5 thread
- Ensure probe tip is fully submerged
- Avoid air bubbles on electrode surface

Environment & Maintenance

- Working temperature: 0–70°C
- Pressure: 0–6 bar, IP68 submersible
- Clean electrode periodically
- Re-calibrate every ~3 months
- Electrode lifespan ~12 months (typical)
- Store in clean water when not in use

16. Troubleshooting

Symptom	Possible Cause	Action
No communication response	Wiring fault, parameter mismatch, or CRC error	Check RS485 A/B wiring for shorts or loose connections; verify baud rate, address, and N-8-1 settings match; confirm CRC checksum
Measurement over-range	Actual concentration exceeds range, fouled electrode, or invalid calibration	Verify medium concentration is within 0–20 mg/L; clean electrode probe; re-calibrate sensor
Large data fluctuations	Turbulence/bubbles in medium, low filter coefficient, or temperature compensation drift	Eliminate turbulence and air bubbles; increase filter coefficient (register 0x002D); re-calibrate temperature compensation