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Chlorophyll Sensor for Water Quality

User Manual

ATO-RS-CH-N01-2

1. Product Introduction

ATO-RS-CH-N01-2 is a device for measuring chlorophyll concentration in water bodies. It employs a fluorescence principle with a fiber-optic light transmission design. An internal filtering algorithm enhances resistance to external light interference. It incorporates a built-in temperature transmitter for automatic temperature compensation. The device outputs relative fluorescence units, facilitating analysis of the relationship between fluorescence intensity and chlorophyll concentration based on specific conditions. Applications include research, surveys, and monitoring in rivers, lakes, ponds, marine environments, aquaculture, drinking water sources, and studies of algal and phytoplankton conditions.

1.2 Technical Specifications

Measurement Range	0~400μg/L；0~100RFU
Measurement Error	±5%FS（25℃）；±0.5℃
Resolution	0.1μg/L 0.1RFU Temp：0.1℃
Response Time	≤30s
Operating Conditions	0~40℃
Power Supply	DC 7~30V
Power Consumption	0.4W
Communication Interface	RS485; Standard ModBus-RTU protocol; Communication baud rate: Default 4800 (configurable to 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200)
Measurement Principle	Fluorescence method
Waterproof Rating	IP68
Electrode Wire Length	Default 5m
Housing Material	Corrosion-resistant plastic

1.1 Features

- Measurement range: 0 to 4dd μg/L.

- Waterproof rating：IP68.

- ptical filtering algorithm with strong resistance to external light interference and automatic temperature compensation, suitable for longiterm online environmental monitoring applications.

- The RS485 ModBus-RTU communication protocol facilitates connection to a computer for monitoring and communication.

- The ModBus communication address is configurable, and the baud rate is adjustable.

- The sensor operates on a wide voltage range, accepting DC power from 7 to 30 volts.

1.5 Dimension
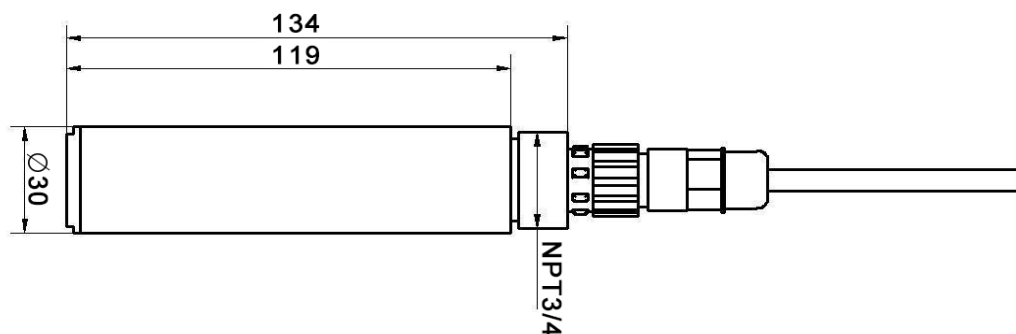
1.6 Installation

Submerged Installation
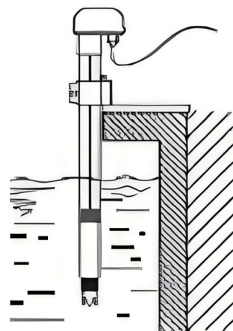
Features NPT 3/4" threads for use with our waterproof tubing. Pass the cable through the tubing and screw the device into the waterproof tube's threads.

Note:

1. When installing the transmitter, account for water level fluctuations to ensure the device remains at least 10 cm below the water surface. It must be positioned in an area with slow-moving water and no bubbles.

2. The transmitter should be installed 5 cm away from surrounding walls, with no obstructions within 7 cm below the device.

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2. Equipment User Manual

2.1 Wiring Instructions

The default output cable is a four-core bare wire.

	Wire Color	Note
power	Brown	Power positive (10–30 V DC)
	Black	Power negative
communication	Yellow	485-A
	Blue	485-B

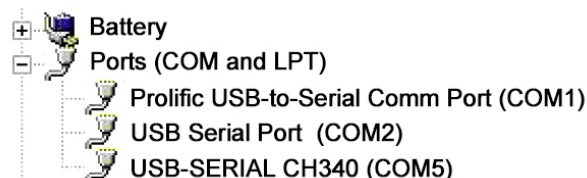### 2.2 Parameter Configuration Guide

Open the data package, select "Debugging Software" → "485 Parameter Configuration Software", and locate   485 Parameter Configuration Tool   Just open it.

V5.0.6.3_20230113

485 Parameter Configuration Tool

Battery
Ports (COM and LPT)
    Prolific USB-to-Serial Comm Port (COM1)
    USB Serial Port (COM2)
    USB-SERIAL CH340 (COM5)

1) Select the correct COM port (located under "My Computer > Properties > Device Manager > Ports"). The image below lists several different 485 converter driver names.

2) Connect only one device and power it on. Click the software's test baud rate function. The software will detect the device's current baud rate and address. The default baud rate is 4800 bit/s, and the default address is 0x01.

3) Modify the address and baud rate as needed, while also checking the device's current functional status.

4) If testing fails, recheck the device wiring and the installation status of the 485 driver.

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2.3 Calibration Instructions

The sensor supports 1-point or 2-point calibration. It is generally recommended to perform two-point calibration using zero and 100μg/L (0.5mg/L Rhodamine B) chlorophyll solutions.
For the calibration standard, use deionized water as the zero point and a 100μg/L (0.5mg/L Rhodamine B) chlorophyll solution as the second calibration point.

Temp, °C	μg/L Chl to Enter
30	72.6
28	74.1
26	75.6
24	77.0
22	79.4
20	82.0
18	86.4
16	90.8
14	93.2
12	95.1
10	98.0
8	100.0

1. First restore the chlorophyll concentration slope K, with the chlorophyll concentration deviation value B set to the default value.

2. Place the sensor in deionized water (avoid direct sunlight on the optical window; submerge the measuring end of the device). Read the chlorophyll value, e.g., chlorophyll value = 0.2 μg/L, and record it as X.

The figure shows the correlation values between 0.5 mg/L Rhodamine B and chlorophyll a at different temperatures.

3. Place the sensor in a 100μg/L (0.5mg/L Rhodamine B) solution and repeat step 2. Record the value as Y.

4. Record the values of K and B according to the following formula: $K = 100/(Y - X)$.

   $B = -X$

5. Write the K and B values to the sensor. Refer to the relevant register documentation for the write procedure.

Note: Calibration using Rhodamine B standard solution provides only approximate values. To ensure accurate readings, field-obtained fluorescence readings must be correlated with results from the extraction analysis of the aforementioned samples. We used Rhodamine B (Item # R104960) purchased from Aladdin.
Warning: Rhodamine B is classified as a substance that may cause cancer/induce mutations in organisms. Gloves must be worn during handling.

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2.4   Modbus Communication and Register Details

2.4.1 Basic Equipment Communication Parameters

Code	8-bit binary
Data bit	8-bit
Parity bit	None
Stop position	1-bit
Error check	CRC (Cyclic Redundancy Check)
Baud rate	The factory default is 4800 bit/s.

2.4.2 Data Frame Format Definition

Using the ModBus-RTU communication protocol, the format is as follows:

Initial structure ≥4 bytes of time

Address code = 1 byte

Function code = 1 byte

Data area = N bytes

Error check = 16-bit CRC code

End structure ≥4 bytes of time

Address code: The transmitter's address, unique within the communication network (factory default 0x01). Function code: Indicates the command function sent by the host.

Data area: Contains the specific communication data. Note: For 16-bit data, the high byte comes first! CRC code: A two-byte check code.

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2.4.3 `Register Address`

Register Address	support function codes	Instruction
0x0000	0x03/0x04	Chlorophyll concentration value (μg/L; 16-bit unsigned integer, actual value multiplied by 10)
0x0001	0x03/0x04	Temp (°C; 16-bit signed integer, actual value scaled by a factor of 10)
0x0002	0x03/0x04	RFU value (16-bit unsigned integer, actual value scaled by a factor of 10)
0x0050	0x03/0x04/0x06/ 0x10	Chlorophyll Concentration Deviation Value (16-bit signed integer, actual value multiplied by 10)
0x0051	0x03/0x04/0x06/ 0x10	Temp deviation value (16-bit signed integer, actual value scaled by a factor of 10)
0x0060	0x03/0x04/0x06/ 0x10	Chlorophyll concentration slope (16-bit signed integer, actual value scaled up by 100)
0x07D0	0x03/0x04/0x06 / 0x10	1–254 (16-bit unsigned integer, factory default 1)
0x07D1	0x03/0x04/0x06 / 0x10	0 represents 2400 1 represents 4800 2 represents 9600 3 represents 19200 4 represents 38400 5 represents 57600 6 represents 115200 7 represents 1200

2.4.4 Communication Protocol Examples and Explanations

Example 1: Read the current chlorophyll concentration and temperature from device address 01

Downlink frame:

Address code	Function code	Register address	Register contents	checksum low bit	check digit high bit
0x01	0x03	0x00 0x00	0x00 0x02	0xc4	0x0b

Response Frame:

Address code	Function code	Number of valid bytes	Register contents		checksum low bit	check digit high bit

0x01	0x03	0x04	0x0d 0x2e 0x00 0xdb	0xd8	0xcd

Hexadecimal 0d2e converts to decimal 3374, resulting in a turbidity value of 3374/10 = 337.4 µg/L.

Hexadecimal 00db converts to decimal 219, yielding a temperature of 219/10 = 21.9°C

Example 2: Chlorophyll Concentration Deviation Value Setting

Downlink Frame: Write a deviation value of -10 µg/L to the device. The written value should be -100, which converts to hexadecimal 0xff9c.

Address code	Function code	Register address	Register contents	checksum low bit	check digit high bit
0x01	0x06	0x00 0x50	0xff 0x9c	0xc8	0x42

A134x0dedgment Frame: (11xrding to the MxdB2s standard, the ac34x0dedgment is a mirrored message oe the sent frame)

Address code	Function code	Register address	Register contents	checksum low bit	check digit high bit
0x01	0x06	0x00 0x50	0xff 0x9c	0xc8	0x42

Example 3: Setting the Chlorophyll Concentration Slope

Output Data Value = (Actual Data - Deviation Value) * Slope

If a standard solution of 100µg/L is measured, and the value obtained after applying the set deviation is 125.0µg/L, then write 100/125=0.80 to register 0x0060. After scaling by 100, the written value becomes 80, which converts to hexadecimal as 0x0050.

Frame transmission:

Address code	Function code	Register address	Register contents	checksum low bit	check digit high bit
0x01	0x06	0x00 0x60	0x00 0x50	0x89	0xE8

Acknowledgment Frame: (According to the ModBus standard, the acknowledgment is a mirrored message of the sent frame)

Address code	Function code	Register address	Register contents	checksum low bit	check digit high bit
0x01	0x06	0x00 0x60	0x00 0x50	0x89	0xE8

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3. Precautions and Maintenance

◆ Warning: Risk of personal injury. This equipment must not be used as a safety device or emergency stop device, nor for any other purpose where equipment failure could result in personal injury. Usage Restrictions: Use only for its intended and authorized purpose. Technical manuals must be consulted before installation, operation, or maintenance. Failure to comply with these instructions may result in death or serious injury.

◆ If the equipment shows obvious malfunctions, please do not attempt to open it for repair. Contact us as soon as possible.

◆ Before measurement, remove the black rubber protective cover.

◆ Regularly clean deposits from the transmitter's measurement probe according to the operating environment, as deposits will cause measurement errors. Avoid scratching the probe's light-guiding section during cleaning. (Recommended cleaning interval: every 30 days)

◆ It is recommended to rinse the outer surface of the transmitter with running water. If any residue remains, wipe it off with a soft, damp cloth.

◆ Calibrate the equipment before each use. For long-term operation, calibration is recommended every 3 months. Calibration frequency should be adjusted appropriately based on specific application conditions (such as the level of contamination in the operating environment and chemical residue buildup).

◆ Do not immerse the plug portion in water before locking the cable plug and device plug together.