



User Manual

ORP-220



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General Introduction

The ORP-220 is a basic conventional water quality monitoring digital ORP sensor, equipped with an industrial online electrode. The electrode features a spherical design, which increases the measurement contact area compared to a flat structure, resulting in faster response times and more accurate measurements. It is suitable for long-term online monitoring environments.

Features:

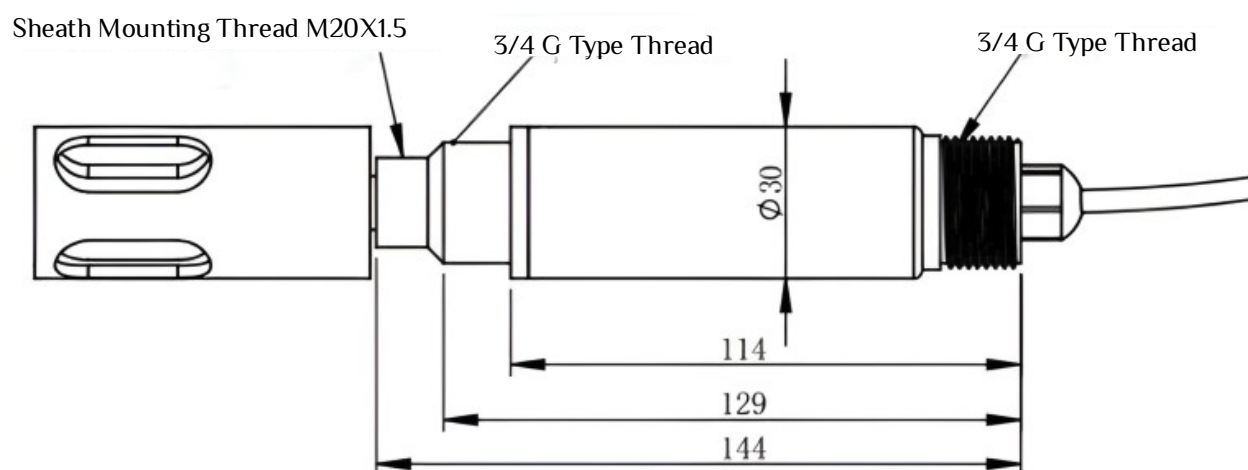
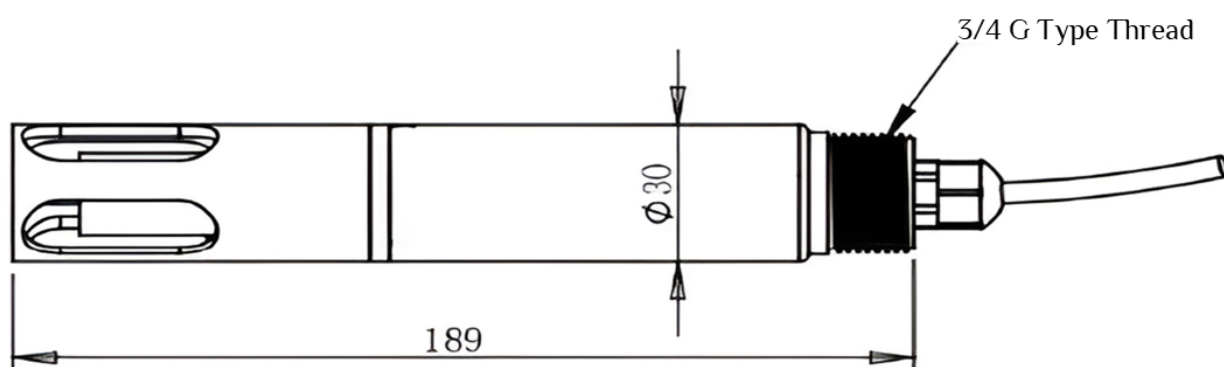
1. Digital sensor, directly outputs RS-485 digital signal, supports MODBUS/RTU.
2. Built-in temperature sensor for automatic temperature compensation.
3. Dual salt bridge and dual high-impedance design, offering strong anti-interference capabilities and stable data.
4. 3/4" G-type upper and lower mounting thread design for easy installation.
5. Low power consumption with anti-interference internal circuit design.
6. Replaceable electrode, suitable for complex water environments, and supports custom electrode configurations.

Application Scope:

River water quality monitoring, industrial wastewater, environmental water treatment, food and beverage, fermentation, and other online process monitoring.

Note: For different application fields, electrode probes with specific characteristics should be selected based on factors such as high temperature and pressure, strong acids and alkalis, and corrosive media.

Product Drawing

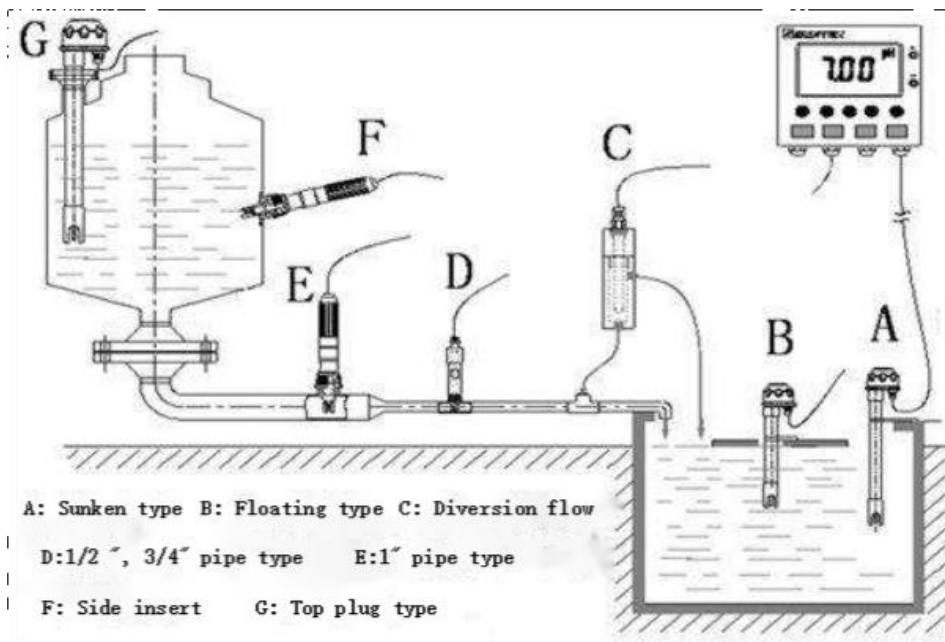


Technical Parameter

Name	Specifications
Output Signal	Supports RS-485, MODBUS/RTU protocol
Measurement Method	Platinum electrode
Range	-1500 to +1500 mV
Accuracy	±6mV
Resolution	1mV
Operating Conditions	Default 0 to 65°C; <0.2 MPa; customizable
Calibration Method	One-point calibration
Response Time	10 seconds (T90)
Power Supply	12 or 24 VDC ±10%, 10 mA
Temperature	NTC
Dimensions	Diameter 30 mm; Length 189 mm
Protection Rating	IP68; Submersible up to 20 meters; customizable for other requirements
Lifespan	1 year or more for the sensor
Cable Length	10 meters (default), customizable
Sensor Housing Material	POM; customizable

Installation Instruction with Cable Definition

1. Installation



Note: During sensor installation, ensure it is tilted at an angle of at least 30° or more; it must not be installed upside down.

Ensure the sensor probe is positioned 2 cm or more away from surrounding walls.

2. Electrical Connection

- Brown wire: Power line (12 or 24 VDC)
- Black wire: Ground line (GND)
- Blue wire: 485A
- White wire: 485B
- Exposed wire: Shield layer

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

Outer diameter: 6.0-6.2 mm;

flexible twisted-pair shielded cable.

Calibration

1. ORP Standard Solution Preparation Methods

a) Preparation of ORP Standard Solution (256 mV)

Weigh 2.1 g of quinhydrone and add it to 200 mL of standard pH buffer solution with a pH value of 4.00. Mix thoroughly.

b) Preparation of ORP Standard Solution (86 mV)

Weigh 2.1 g of quinhydrone and add it to 200 mL of standard pH buffer solution with a pH value of 6.86. Mix thoroughly.

c) Preparation of ORP Standard Solution (-40 mV)

Weigh 2.1 g of quinhydrone and add it to 200 mL of standard pH buffer solution with a pH value of 9.18. Mix thoroughly.

Note: When preparing the pH buffer solution, prepare a total volume of 250 mL, and then measure out 200 mL for use.

2. pH preparation of the corresponding standard solution method:

Measure 250mL of pure water, pour it into a container, add a package of calibration powder with pH=6.86/4.00/9.18 (25°C), stir the glass rod evenly until completely dissolved, and prepare a solution with pH=6.86/4.00/9.18 (25°C).

Calibrate:

Insert the sensor into 86mV (256mV or -40mV) solution and send calibration instructions when the value is stable, and the value is stable for about 3 minutes.

Please refer to the MODBUS RTU Communication Protocol Operation Manual for calibration instructions.

Note: The sensor has been calibrated before delivery, unless it exceeds the measurement error, it should not be calibrated at will.

Maintenance and Precautions

1. Maintenance

- Before measurement, the bubbles in the glass bulb should be thrown away, otherwise the measurement error will be caused.
- After long-term dry discharge, please soak the electrode in the protective bottle for 1 hour or more before use.
- There is an appropriate amount of 3.5mol/L potassium chloride solution in the protective bottle at the front of the electrode, and the electrode head is soaked in it to maintain the activation of the glass bulb and the liquid junction. When measuring, loosen the bottle cap, pull out the electrode, and wash it with pure water. Wash the sensor without using time pure water and insert it into a protective sleeve with 3.5mol/L potassium chloride solution or into a container with 3.5mol/L potassium chloride solution.
- ORP electrode will be passivation after long-term use, the phenomenon is reduced sensitivity, slow response, reading is not accurate, at this time, the lower end of the electrode bulb can be soaked in 0.1mol/L diluted hydrochloric acid for 24 hours, and then soaked in 3.5mol/L potassium chloride solution for 24 hours.
- ORP electrodes are continuously tested in solution for a long time and should be cleaned and activated regularly. You can choose our self-cleaning jacket to clean the sensor regularly.

2. Common Issue and solutions

Problem	Possible cause	Solution
The operation interface cannot be connected or does not display measurement results	The cable connection is incorrect	Check the wiring mode
	Incorrect sensor address	Check whether the address is incorrect
The measurement value is too high, too low, or the value is continuously unstable	The sensor window is attached to a foreign object	Clean the sensor window surface
	Other	Contact after sales

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	Quantity (pcs)
Sensor	1
Standards	1
Specification	1
Certification	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.

- The master device sends requests to the slave device
 - The slave device analyzes and processes the request of the master device, and then sends the result to the master device
 - 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 (acquiesce)
Device address	1 (acquiesce)
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	Register number of high bytes	Register number is low bytes	CRC lower byte	CTC high byte

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

Byte 2: Function code for reading register values

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

(For reading instruments connected under the FCC)

Bytes 5 and 6: Number of registers to be read

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

Slave return:

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: Slave address code (=001~127)

Byte 2 03H: returns the read function code

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

Bytes 4 to M: Register data

Bytes M+1, M+2: The CRC16 checksum from byte 1 to M

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

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

First byte ADR: Slave address code (=001~127)

Second byte 83H: Error reading register value

Third byte information code: 01 - The function code is incorrect

03 - Data error

Bytes 4 and 5: The CRC16 checksum from bytes 1 to 3

b. Function code 06H: 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	Data height byte	Data low byte	CRC code low byte	CRC code 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	Data height byte	Data low byte	CRC code low byte	CRC code 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 low byte	CRC code high byte

First byte ADR: Slave address code (=001~127)

Second byte 86H: Function code for writing register value error

The third byte error code information code: 01 - The function code is incorrect

03 - Data error

Bytes 4 and 5: CRC checksum from bytes 1 to 3

3. Data structure type

Integer

An unsigned integer (unsigned short) The data consists of two-digit integers.

XXXX XXXX	XXXX XXXX
Byte1	Byte0

Floating point type (float)

Floating point type, compliant with IEEE 754 (single precision);

The data includes 1 symbolic bit, 8-bit exponent, and a 23-bit mantissa.

XXXX XXXX	XXXX XXXX	XXXX XXXX	XXXX XXXX
Byte3	Byte2	Byte1	Byte0
Sign bit	Exp exponent	f decimal place	

4. Register address

Register address

Register address	Name	Read/Write	Explanation	Number of registers (byte)	Data type
0x0100	Temperature value	R	°C value x10 (e.g :25.6 temperature display as 256 °C, default 1 decimal)	1 (2 Bytes)	unsigned short
0x0101	ORP value	R	mV value x1(for example, ORP value 86mV is displayed as 86 without decimal places.	1 (2 Bytes)	unsigned short
0x1000	temperature calibration	R/W	Temperature calibration: write the data as the actual temperature value x 10; The read data is the temperature calibration offset x 10	1 (2 Bytes)	unsigned short
0x1001	ORP calibration	R/W	Calibration value written in standard solution with ORP=86mV Actual data 86.	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 data 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.	1 (2 Bytes)	unsigned short

Note: Only one of the standard fluids with positive or negative ORP needs to be selected for calibration.

5. Command example

Default register::

a. Change the slave address:

Address:0x2000

Register count: 1

Function code: 0x06

Default sensor address: 01

Change the Modbus device address of the sensor, changing device address 01 to 06, as follows:

Send instruction: 01 06 20 00 00 06 02 08

Respond: 01 06 20 00 00 06 02 08; Note: Change the address to 06, save power failure.

b. Baud rate:

Address: 0x2003

Register count: 1

Function code: 0x06

Default value: 1 (9600bps)

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

The baud rate can be changed on the host computer. After the baud rate is changed, power off and save the Settings.

The baud rate supports 4800,9600,19200. The baud rate assigned by the integer value is as follows:

Integer	Baud
0	4800 bps
1	9600 bps
2	19200 bps

Send instruction: 01 06 20 03 00 02 F3 CB

Respond: 01 06 20 03 00 02 F3 CB

Note: Baud rate changed to 19200bps, power off save.

Function register:**a. Measuring temperature instruction:**

Address: 0x0100

Register count: 1

Function code: 0x03

Read sample values: 19.2°C

Send instruction: 01 03 01 00 00 01 85 F6

Respond: 01 03 02 00 C0 B8 14

Return hexadecimal unsigned Integer data, temperature = Integer/10, with 1 decimal place reserved.

b. Measure ORP value instruction:

Address: 0x0101

Register count: 1

Function code: 0x03

Read sample value: 86mV

Send instruction: 01 03 01 01 00 01 D4 36

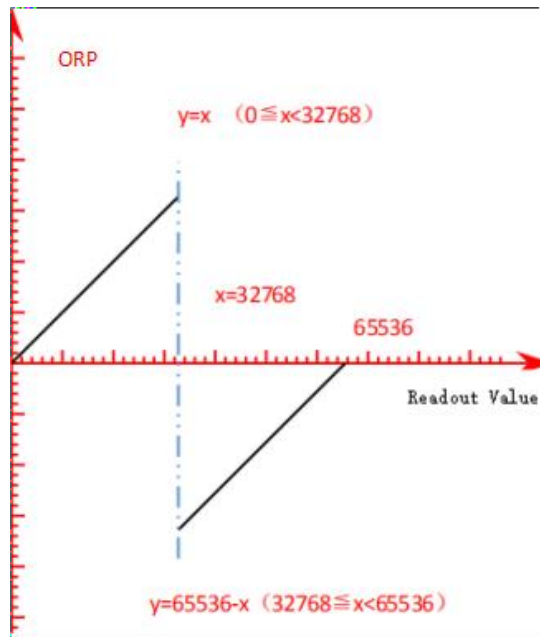
Respond: 01 03 02 00 56 38 7A

The register returns hexadecimal signed Integer data, ORP = Integer.

Note: ORP has a negative value, if the register return value is greater than 7FFF, it needs to be calculated $[-(FFFF-XXXX+1)]$.

For example, if ORP is -40mV, the response command is 01 03 02 FFD8 F9 EE,

$ORP = [-(FFFF-FFD8+1)] = -28$ (this data is hexadecimal), and then converted to decimal to -40.



c. Read temperature and residual chlorine values continuously:

Address: 0x0100

Register count: 2

Function code: 0x03

Read sample value: Temperature 19.2°C and ORP 86mV

Send instruction: 01 03 01 00 00 02 C5 F7

Respond: 01 03 04 00 C0 00 56 7A 31

The register returns hexadecimal unsigned Integer data with a temperature value of=Integer/10, retaining 1 decimal place

The register returns hexadecimal signed Integer data, ORP =Integer.

d. Humidity measurement instruction:

Address: 0x0107

Register count: 1 F

unction code: 0x03

Read sample value: Relative humidity 40%

Send instruction: 01 03 01 07 00 01 34 37

Respond: 01 03 02 01 90 B9 B8

The register returns hexadecimal unsigned Integer data, humidity value = Integer/10, reserving 1 decimal place.

e. Calibration instruction:

Temperature calibration

Address: 0x1000

Register count: 1

Function code: 0x06

Calibration example: Calibration at 25.8 ° C

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

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

The sensor needs to be calibrated in a constant temperature environment where the temperature indicator no longer fluctuates.

ORP zero calibration

Address: 0x1001

Register count: 1 Function code: 0x06

Calibration example: Calibration in a standard solution with an ORP of 86mV

Send instruction: 01 06 10 01 00 56 5C F4

Respond: 01 06 10 01 00 56 5C F4



For other question, feel free to contact us.

Thank you for choosing ChiMay!

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