



User Manual

Calcium Ion (Hardness) Sensor

DCA-210



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Content

General Introduction	3
Features:.....	3
Dimension Drawing:	4
Technical Parameters:	4
Installation Notes and Wire Connection	5
Calibration	5
Maintenance and precautions.....	6
Quality and Service	7
Accessories and spare parts.....	7
Data Communication	7
1. Introduction to Modbus protocol.....	7
2. Information frame format.....	8
3. Data structure types.....	10
4. Register address	11
5. Example command	12

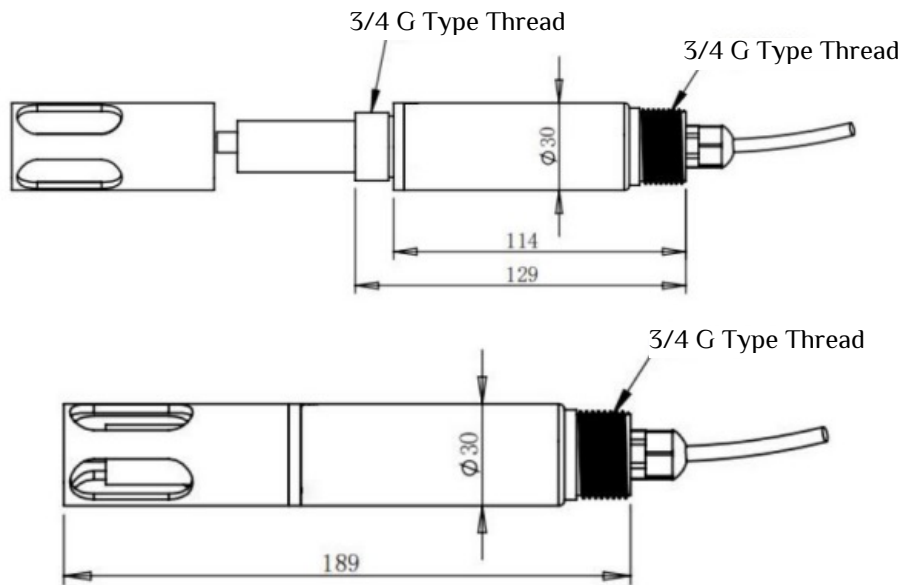
General Introduction

Calcium Ion (Hardness) is a basic digital sensor for routine water quality monitoring. It employs an industrial-grade online electrode and PVC membrane calcium ion selective electrode, enabling selective detection of calcium ion levels in water with rapid response and precise measurement. The sensor features an integrated temperature sensor for automatic temperature compensation, making it ideal for long-term environmental monitoring applications.

Features :

- Digital sensors provide direct Rs-485 digital signals and support MODBUS/RTU protocols.
- Built-in temperature sensor for automatic temperature compensation
- The innovative calcium ion membrane head is replaceable, and the maintenance cost is low
- 3/4" G-type threaded design for easy installation
- The sensor has low power consumption, and the internal circuit is designed to resist interference

Dimension Drawing:

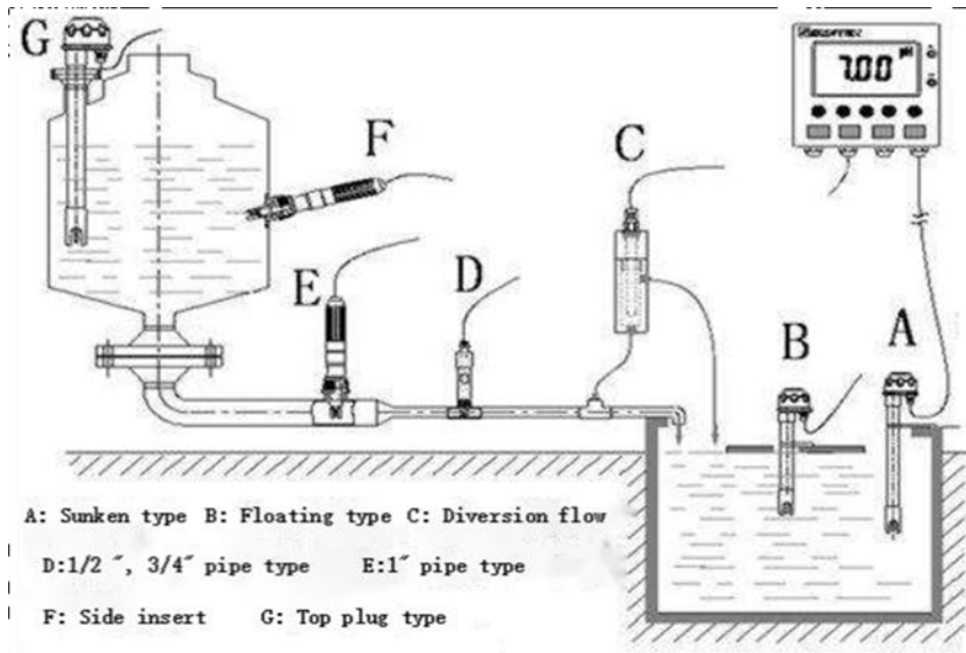


Technical Parameters:

Measuring Method	Film ion selection method
Measurement Range	0~10.0mg/L or 0~100.0mg/L
Accuracy	±5%F.S. or ±3mg/L, whichever is greater
Resolution Ratio	0.01mg/L(0~10.00mg/L) or 0.1mg/L (0~100.0mg/L)
Working Conditions	Temp: 0~40°C; Pressure:<0.2MPa;
Calibration Method	Two-point calibration
Response Time	30 seconds T90
Temperature Compensation	Automatic temperature compensation (Pt100)
Power supply	DC24V or 12V ±10%, 10mA
Water Proofing	IP68; 20 m water depth
Temperature Compensation	0~100°C, Manual/Automatic
Signal Output	RS485 (MODBUS/RTU protocols)
Cable Length	10 meters by default, customizable
Sensor Housing Material	POM, customizable

Installation Notes and Wire Connection

1. Installation



Note: The sensor should be tilt-installed with an angel of at least 30°.

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

For a measurement range of 0-10 ppm, perform zero-point calibration at 1 ppm. After the data stabilizes (typically 15-30 minutes), proceed to slope calibration at 10 ppm. Once the data stabilizes (typically 15-30 minutes), complete the slope calibration.

For a measurement range of 0-100 ppm, perform zero-point calibration at 10 ppm. After the data stabilizes (typically 15-30 minutes), proceed to slope calibration at 100 ppm. Once

the data stabilizes (typically 15-30 minutes), complete the slope calibration.
If the value is unstable during the above process, soak for another 24 hours.

For calibration instructions, refer to the MODBUS RTU communication protocol manual.

Note: The sensor is calibrated before delivery. Do not calibrate it again unless the measurement error exceeds normal range.

Maintenance and precautions

1. Maintenance

- New or unused electrodes must be soaked in distilled water for half an hour before use and then soaked in 1ppm standard buffer for 24 hours to fully activate the membrane head.
- The electrode membrane tip should be cleaned with distilled water. Avoid touching the membrane tip with hard objects to prevent scratches. Keep the membrane tip at least 2cm away from the bottom during measurement.
- If the electrode is not in use for a short period, soak it in a 1ppm calcium ion solution for storage.
- If the electrode is not used for several days, store it in a case with built-in protective liquid. Soak it in 1ppm solution for 24 hours before the next use.
- Avoid long-term immersion in distilled water or protein solution and avoid contact with silicone grease. For electrodes that have been used for a long time, the membrane head will become translucent or attached with sediment, which can be rinsed with distilled water (or deionized water).
- The electrode has been in use for a long time and the measurement data is drifting. Calibrate it.
- The membrane head should be kept dry when the electrode is not used for a long time.

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	Register number of high bytes	Register number is low bytes	CRC lower byte	CRC 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

Return from the machine:

1	2	3	4、5	6、7		M-1、M	M+1	M+2
ADR	03H	Total byte s	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 : CRC16 checksums from bytes 1 through 3

b) Function Code 06H: Write a single register value

The host sends:

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
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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	°C value x10 (e.g.:25.6 temperature display as 256,default 1 decimal)	1 (2 Bytes)	unsigned short
0x0101	Concentration	R	The measurement range is 0 to 10 mg/L. The value is displayed as 162 (e.g., 1.62 mg/L) with two decimal places by multiplying the value by 100. The measurement range is 0 to 100 mg/L. The value is multiplied by 10 (e.g., if the measured value of 16.2mg/L is 162, it is displayed with one decimal place by default).	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 correction	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	zero calibration	R/W	The measurement range is 0-10 mg/L, with data recorded as the standard solution value multiplied by 100 (zero point: 1 ppm). The measurement range is 0-100 mg/L, with data recorded as the standard solution value multiplied by 10 (zero point: 10 ppm).	1 (2 Bytes)	unsigned short
0x1003	The slope of calibration	R/W	The measurement range is 0-10 mg/L, with data recorded as the standard solution value multiplied by 100 (slope point at 10 ppm). The measurement range is 0-100 mg/L, with data recorded as the standard solution value multiplied by 10 (slope point at 100 ppm).	1 (2 Bytes)	unsigned short
0x2000	Sensor address	R/W	The default is 1, and the data range is 1-127	1 (2 Bytes)	unsigned short
0x2003	Baud rate setting	R/W	Default is 9600 write 0 for 4800; Write 1 for 9600; Write 2 for 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, save after 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=Integer/10, keep 1 decimal place.

b) Instruction for measuring concentration value:

Address: 0x0101 (40258)

Number of registers: 1

Function code: 0x03

The measurement range is 0 to 10 mg/L. Sample value: 2.56ppm

Command: 01 03 01 01 00 01 D4 36

Response: 01 03 02 01 00 B9 D4

Returns hexadecimal unsigned integer data. Concentration=Integer/100, keep 2 decimal places.

The range is 0 to 100 mg/L. Read the sample value: 30.0ppm

Command: 01 03 01 01 00 01 D4 36

Response: 01 03 02 01 2C B8 09

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

c) Continuously readings of Temperature and Concentration values instructions

Address: 0x0100 (40257)

Number of registers: 2

Function Code: 0x03

The measurement range is 0 to 10 mg/L. Sample values include temperature 19.2°C and NH value 2.56 ppm

Send instructions: 01 03 01 00 00 02 C5 F7

Response: 01 03 04 00 C0 01 00 FB 9F

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

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

The measurement range is 0 to 100 mg/L. Sample values include temperature 19.2°C and NH value 30.0ppm.

Command: 01 03 01 00 00 02 C5 F7

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

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

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

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.

Zero salinity calibration

Address: 0x1001 (44098)

Number of registers: 1

Function Code: 0x06

Calibration sample:

For the 0-10 range, the written data is the concentration of the standard solution used multiplied by 100. The readout is the mV value corresponding to the zero-point calibration multiplied by 100.

For example, with a range of 0 to 10 ppm: Calibrate the zero point in a 1 ppm/L standard solution.

Command: 01 06 10 01 00 64 DD 21

Response: 01 06 10 01 00 64 DD 21

For the 0-100 range, the written data is the concentration of the standard solution (in 10x units). The readout is the mV value corresponding to the zero-point calibration (in 100x units).

For example, with a range of 0 to 100 ppm: Calibrate the zero point in a 10 ppm/L standard solution.

Command: 01 06 10 01 00 64 DD 21

Response: 01 06 10 01 00 64 DD 21

Slope calibration

Address: 0x1003 (44100)

Number of registers: 1

Function Code: 0x06

Calibration sample:

For the 0-10 range, the written data is the concentration of the standard solution used multiplied by 100. The readout data is the mV value corresponding to the slope calibration value multiplied by 100.

For example, with a range of 0 to 10 ppm: The calibration slope for a 10 ppm/L standard solution:

Command: 01 06 10 03 03 E8 7D B4

Response: 01 06 10 03 03 E8 7D B4

For the 0-100 range, the written data is the concentration of the standard solution used multiplied by 10. The readout data is the mV value corresponding to the slope calibration value multiplied by 100.

For example, with a range of 0 to 100 ppm: The calibration slope for the 100 ppm/L standard solution:

Command: 01 06 10 03 03 E8 7D B4

Response: 01 06 10 03 03 E8 7D B4



For other question, feel free to contact us.
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