



User Manual

COD Digital Sensor

COD-210



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Content

General Introduction.....	3
Dimensional drawing.....	3
Technical parameters.....	4
Installation Notes and Wire Connection.....	5
Calibration.....	6
Maintenance and precautions	7
Common Issue and Solutions.....	7
Quality and Service.....	8
Accessories and spare parts	8
Data Communication.....	8

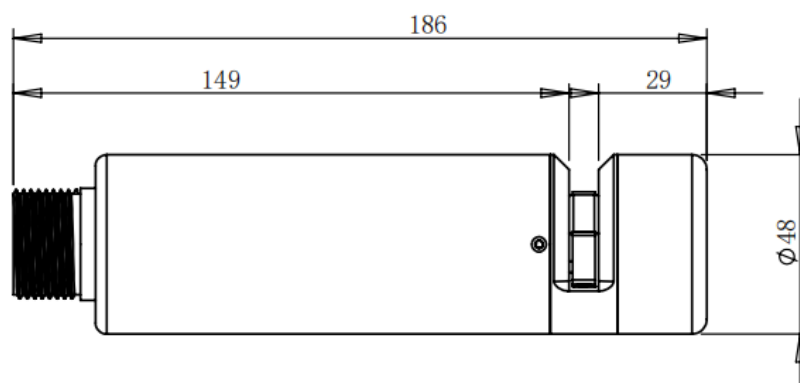
General Introduction

COD-210 is a newly launched UV254 COD sensor by our company. It adopts ultraviolet absorption method and integrates years of application development experience in the industry, with small volume sensors, internal self-cleaning integrated, surface treated for corrosion resistance; fast reaction analysis speed, no need for chemical reagents, using imported deep ultraviolet UV LED cold light source from abroad, long life of light measurement, at the same time adopting compensation light source of 550nm, effectively eliminating turbidity and coloration on the impact of sensor measurements, higher reliability

Features:

- Digital sensors, directly outputting RS-485 digital signals and supporting MODBUS/RTU.
- Dual-path measurement; compensation light sources at 254 nm and 550 nm to eliminate turbidity and coloration effects
- Imported UV254 LED cold light source, long life and small drift; filter design, low interference and stable.
- Measurable parameters include COD, TOC, turbidity and temperature without chemical reagents or sample digestion treatment.
- Small in size, with an integrated automatic cleaning brush inside to effectively prevent biological adhesion;
- Surface corrosion and passivation treatment
- Low power consumption of sensors, and internal circuit design to resist interference

Dimensional drawing



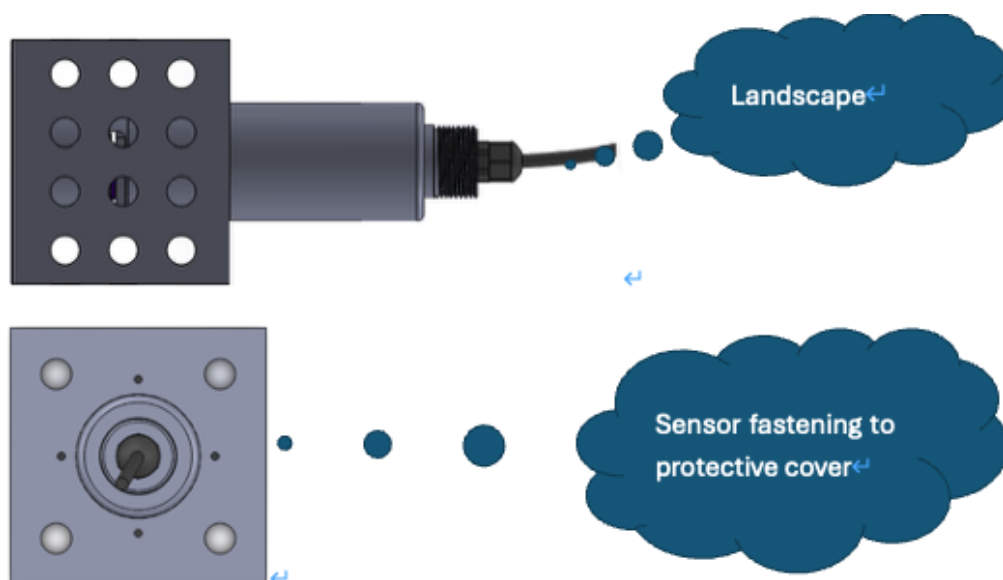
Technical parameters

Name	Parameters
Output Signal	Support RS-485, MODBUS/RTU protocol
Measurement Method	UV 254 double wavelength ultraviolet absorption method
COD Range	0.3 ~ 370 mg/L equivalent to KHP
COD Accuracy	±5% F.S. equivalent to KHP
COD Resolution	0.1 mg/L or 0.01 mg/L equivalent to KHP
Turbidity Range	0 ~ 100 NTU
Reproducibility	±1% F.S. equivalent to KHP
Working Conditions	0.1 ~ 50°C °, <0.1 MPa
Calibration Mode	Two-point calibration
Response Time	10 seconds T90
Power Supply	12 or 24 VDC ±10%, 15 mA; 200 mA brush rotation
Dimensions	Diameter 48 mm; Length 186 mm; Another optional protective cover available
Protection Grade	IP68, water depth of 10 m
Flow Rate	Less than 3 m/s
Service Life	Sensor for more than 3 years, cleaning brush system for more than 18 months
Cable Length	Default is 5 meters, customizable
Sensor Housing Material	Titanium alloy, 316L, quartz glass
Maintenance and Calibration Frequency	Sensor every three months, cleaning brush every six months

Installation Notes and Wire Connection

1. Installation

- Avoid collision when installing sensors; avoid shaking back and forth during measurement, if the monitored area has turbulent water flow, fix the sensor.
- When installing sensors for measurement, it is necessary to choose horizontal installation to avoid foreign matter depositing in the monitoring window of the measuring device and causing inaccurate measurement data;
- If the measurement area is dense with branches and attachments, it's easy to get stuck in the cleaning brush shaft, causing a dead sensor. In this case, you need to consider selecting protective covers for protection installation as shown below.



- Install sensors, with a maximum depth of water surface not exceeding 2 meters; sensor submerged in water level below 30 cm.
- The sensor shall be installed in a slowly flowing water source where no bubble.

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

1. Turbidity calibration

- Zero-point calibration: Use a beaker to measure an appropriate amount of zero turbidity liquid, place the sensor vertically in the solution, and keep it about 2 cm away from the four sides of the beaker. After waiting for approximately one minute until the values stabilize, perform the zero-point calibration. The instructions are referenced in Appendix.
- Slope calibration: Place the sensor in a solution and place it in a 100 NTU standard solution, wait about one minute for the value to stabilize before performing slope calibration. The instructions refer to Appendix.

2. COD calibration

- KHP (potassium hydrogen phthalate, $C_8H_5KO_4$), CAS # 877-24-7 is a commonly used dye in environmental research and can be used for COD calibration.
- Preparation of standard solution :
 - ① Weigh accurately 0.8503 g of KHP and place it in a 1000 mL flask. Fill with distilled water or deionized water until the highest mark is reached. This solution is a concentration of 1000 mg/L for COD.
 - ② Take 100 mL of this solution and inject it into a volumetric flask with a capacity of 1,000 mL. Then fill it up to the highest mark with distilled water or deionized water. After shaking well, the concentration of COD is 100 mg/L.
 - ③ Store this concentrated standard liquid (Step 5.2.1) in a black glass bottle at low temperature to prevent its decomposition. The diluted standard liquid (Step 5.2.2) needs to be used within 24 hours after preparation.
- Calibration (two-point calibration)
 - ① Place the sensor in distilled water or deionized water, with at least 2 cm of the electrode immersed in the water and no bubbles or obstructions blocking the light path. After the reading stabilizes, perform zero-point calibration according to Appendix commands.
 - ② Place the sensor in a solution of 100 mg/L COD and wait for the reading to stabilize before performing slope calibration according to Appendix commands.

Note: When calibrating, first calibrate turbidity and then calibrate COD.

Warning: KHP has a carcinogenic risk, please wear gloves when operating.

Maintenance and precautions

1. Maintenance

- Measurement window: Check if there are any attachments or deposits on the measurement window; use a dust-free, wet cloth to wipe the window. If it is difficult to remove the deposit with just wiping, you can use a dust-free cloth soaked in detergent for cleaning. Or you can use diluted hydrochloric acid for wiping. When using dilute hydrochloric acid, be careful not to directly touch it with your hands.
- Cleaning brush: Prevent foreign objects from blocking the rotation of the cleaning brush, ensuring that there are no obstructions at the rotating axis. If there is a lot of branches and attachments in the monitoring area, it may be necessary to consider selecting protective covers for protection installation. The protective cover can be selected separately by contacting our sales staff.
- Sensor outer surface: Clean the attached substances on the surface regularly, and use detergent for cleaning.
- Automatic cleaning for continuous use of 18 months, need to return to factory and replace dynamic sealing device.

2. Precautions

- Measurement window: Do not use sharp objects to scratch the measurement monitoring window; avoid bubbles adhering during measurements.
- Automatic cleaning brush: Do not forcibly rotate the cleaning brush shaft.
- Installation note: The sensor is best installed horizontally to avoid deposition of foreign objects in the measurement monitoring window; when foreign objects such as branches easily block at the pivot point during monitoring and measuring, it should be protected by a protective cover.

Common Issue and Solutions

Problem	Possible Cause	Solution
The operation interface cannot connect or display measurement results.	Wrong wiring method of cables.	Check the wiring method.
	Incorrect sensor address.	Check if the address is correct.
Measurement values are too high, low, or unstable for a long time.	Foreign objects attached to the probe head of the sensor.	Clean the surface of the sensor probe head.
	Other reasons.	Contact after-sales service.

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
Protective Cover	1(optional)

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 (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

Return from the machine:

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: 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 Code06H: 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 is shown as 256, default 1 decimal)	1 (2 Bytes)	unsigned short
0x0101	COD Value	R	mg/L value x10 (e.g.16.2mg/L COD is shown as 162, default: 1 decimal place)	1 (2 Bytes)	unsigned short
0x0102	TOC Value	R	mg/L value x10 (e.g.22.3mg/L TOC is shown as 223, default: 1 decimal place)	1 (2 Bytes)	unsigned short
0x0103	BOD Value	R	mg/L value x10 (e.g.21.6mg/L BOD is shown as 216, default: 1 decimal place)	1 (2 Bytes)	unsigned short
0x0105	Turbidity Value	R	NTU value x10 (e.g.10NTU is shown as 100, default: 1 decimal place)	1 (2 Bytes)	unsigned short
0x0107	Humidity Value	R	%RH value x10 (e.g.11.3%RH is shown as 113, default: 1 decimal place)	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	COD Zero calibration	R/W	Put the sensor in deionized water. During calibration, the input calibration value is 0; the readout data represents the zero-point offset. (Calibration can also be performed using a COD standard solution in the range of 0–20 mg/L, following the slope calibration method.)	1 (2 Bytes)	unsigned short
0x1002	Turbidity Zero calibration	R/W	Put the sensor in zero-turbidity water. During calibration, the input calibration value is 0; the readout data represents the zero-point offset.	1 (2 Bytes)	unsigned short
0x1003	COD Slope calibration	R/W	Calibrate in a 20-200mg/L standard solution. During calibration, the input calibration value is the concentration of the standard solution multiplied by 10; the output reading is the slope value multiplied by 1000.	1 (2 Bytes)	unsigned short
0x1004	Turbidity Slope calibration	R/W	Calibrate in a 20-200NTU standard solution. During calibration, the input calibration value is the concentration of the standard solution multiplied by 10; the output reading is the slope value multiplied by 1000.	1 (2 Bytes)	unsigned short
0x1100	Sensor switch	W	Enable or disable the sensor measurement feature. Input 0 disables measurement; input 1 enables measurement. The sensor defaults to the enabled (measurement on) state upon	1 (2 Bytes)	unsigned short

Register address	Name	Read/Write	Explanation	Number of registers (byte)	Data type
			power-up.		
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 is 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
0x3000	Automatic Cleaning Interval Setting	W	Default: 30 min; Range: 6 – 6000 min.	1 (2 Bytes)	unsigned short
0x3001	Automatic Cleaning Cycles Setting	W	Default: 3 cycles; Range: 1 – 6 cycles.	1 (2 Bytes)	unsigned short

5. Example command

Default register:

a) Change slave address:

Address: 0x2000 (42001)

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 (42004)

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) Turn-on instruction:**

Address: 0x1100 (41101)

Number of registers: 1

Function Code: 0x06

The sensor defaults to the enabled (measurement on) state upon power-up. Input 0 disables measurement; input 1 enables measurement.

Send instructions: 01 06 11 00 00 01 4D 36

Response: 01 06 11 00 00 01 4D 36

Note: defaults to be enabled with measurement, save when power is out.

b) Temperature instruction:

Address: 0x0100 (40101)

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 value=Integer/10, keep 1 decimal place.

c) Instruction for measuring COD value:

Address: 0x0101 (40102)

Number of registers: 1

Function Code: 0x03

Read sample values: 30.0mg/L

Send instructions: 01 03 01 01 00 01 D4 36

Response: 01 03 02 01 2C B8 09

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

d) Continuously readings of temperature and COD value instructions

Address: 0x0100 (40101)

Number of registers: 2

Function Code: 0x03

Read sample values: 19.2°C or COD value of 30.0mg/L

Send instructions: 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 value=Integer/10, keep 1 decimal place.

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

e) Instruction for measuring humidity:

Address: 0x0107 (40108)

Number of registers: 1

Function Code: 0x03

Calibration sample: 40%RH

Send instructions: 01 03 01 07 00 01 34 37

Response: 01 03 02 01 90 B9 B8

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

f) Calibration instructions:

temperature correction

Address: 0x1000 (41001)

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.

COD Zero calibration

Address: 0x1001 (41002)

Number of registers: 1

Function Code: 0x06

Calibration sample: Calibration in distilled water or deionized water

Send instructions: 01 06 10 01 00 00 DC CA

Response: 01 06 10 01 00 00 DC CA

COD slope calibration

Address: 0x1003 (41004)

Number of registers: 1

Function Code: 0x06

Calibration sample: Calibration in a COD solution of 100mg/L

Send instructions: 01 06 10 03 03 E8 7D B4

Response: 01 06 10 03 03 E8 7D B4

Turbidity Zero calibration

Address: 0x1002 (41003)

Number of registers: 1

Function Code: 0x06

Calibration sample: Calibration in distilled water or deionized water

Send instructions: 01 06 10 02 00 00 2C CA

Response: 01 06 10 01 00 00 DC CA

Turbidity slope calibration

Address: 0x1004 (41005)

Number of registers: 1

Function Code: 0x06

Calibration sample: Calibration in a turbidity solution of 100NTU

Send instructions: 01 06 10 04 03 E8 CC 75

Response: 01 06 10 04 03 E8 CC 75

Automatic cleaning interval setting

Address: 0x3000 (43001)

Number of registers: 1

Function Code: 0x06

Calibration sample: default cleaning interval in 30min, change it to 60min

Send instructions: 01 06 30 00 00 3C 86 DB

Response: 01 06 30 00 00 3C 86 DB

Automatic cleaning cycles setting

Address: 0x3001 (43002)

Number of registers: 1

Function Code: 0x06

Calibration sample: default cycle is 3, change it to 6

Send instructions: 01 06 30 01 00 06 57 08

Response: 01 06 30 01 00 06 57 08



For other question, feel free to contact us.

Thank you for choosing ChiMay!

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