

KWS-190

Water Digital COD Sensor

User Manual



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Attention

- Please follow the operating procedures and precautions of this manual when using.
- If you find that the instrument is working abnormally or damaged during use, please contact the manufacturer and do not repair it by yourself.
- In order to make the measurement more accurate, the sensor should be cleaned frequently and matched with the instrument for calibration; if your sensor has quality problems, please replace it with new one.
- Please powering on the sensor for 30 minutes before calibration .

1. Product configuration

Please confirm the sensor you purchased, the package is complete, if there is any damage to the package or any shortage of accessories, please contact the dealer as soon as possible. The configuration is as follows.

2. Product introduction

The UV Method COD Digital Sensor is a digital sensor developed by our company for real-time online monitoring of water COD (Chemical Oxygen Demand). Organic matter that causes increased COD in water bodies absorbs ultraviolet (UV) light. This product utilizes this characteristic to measure the degree of UV light absorption by organic matter in water, thereby converting it to the water's COD value. To eliminate the influence of suspended solids on UV light, this product is equipped with automatic turbidity compensation functionality.

3. Main features

- ✧ Stainless steel housing, high strength, corrosion-resistant
- ✧ No reagents, no pollution, more economical and environmental protection.
- ✧ Automatic turbidity compensation function.
- ✧ Automatic cleaning function, reducing maintenance costs.
- ✧ Less maintenance, long service life and low cost of use
- ✧ can directly connect to devices with RS485 signal interfaces (e.g., computers, PLCs) for data acquisition. Facilitates integration of the sensor into host computer systems and IoT systems in industrial control environments.
- ✧ Able to configure sensor settings via RS485 communication: slave address, baud rate, online calibration, factory reset, etc.
- ✧ Utilizes multi-point calibration method, support max 5 points calibration.

4. Technical indicators

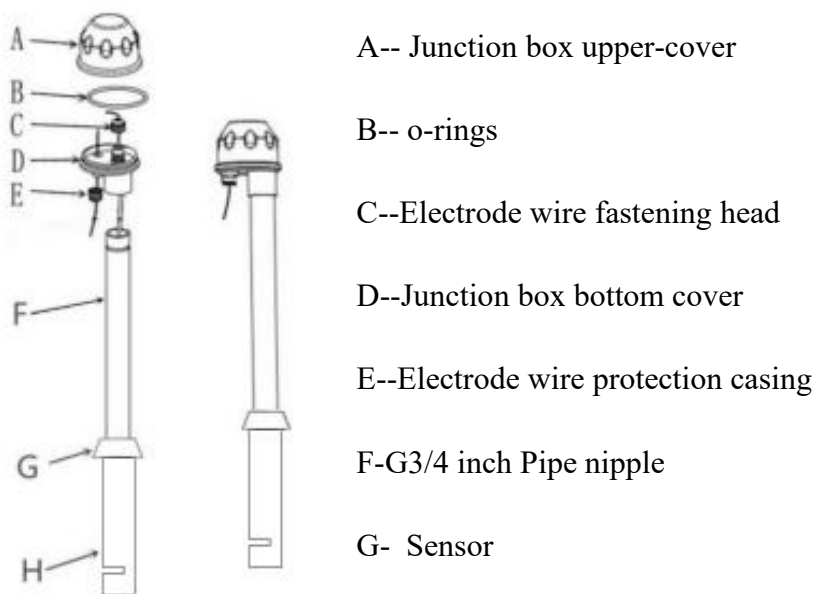
Item	Specification
Measuring Range	COD: 0–500 mg/L or 0–1500 mg/L
Customizable Parameters	COD (0–500 mg/L): TOC 0–200 mg/L; BOD 0–300 mg/L COD (0–1500 mg/L): TOC 0–600 mg/L; BOD 0–900 mg/L
Resolution	0.1 mg/L; 0.1 NTU
Accuracy	±5% FS (0–500 mg/L)±10% FS (500–1500 mg/L)
Turbidity Compensation Range	0–1000 NTU
Communication Interface	RS485, MODBUS protocol (IoT supported)
Working Conditions	Ambient temperature: 0–60 °C Water pressure: < 0.1 MPa
Power Supply	12–24 VDC
Cable Length	5 m (customizable)
Protection Level	IP68
Weight	1 kg (without cable)

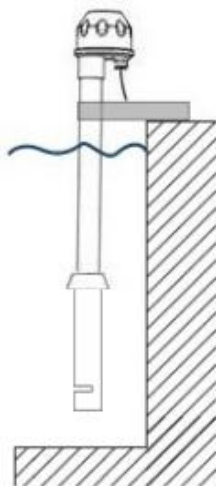
5. Appearance and Dimensions



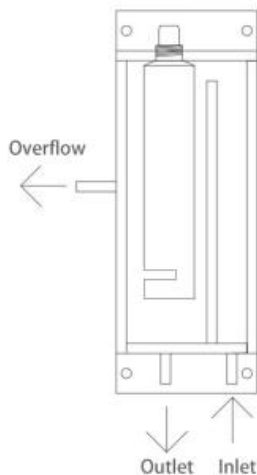
6. Installation and wiring

6.1 Installation method:





Submersible Installation



Flow-Through Installation

Precautions for Submerged Installation:

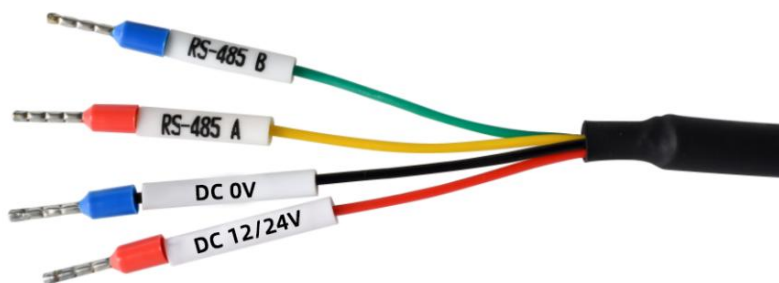
1. When hanging the sensor, avoid hitting the sensor against a wall or other water facility due to water flow. If the water is flowing very fast, please fasten the sensor.
2. Install the sensor in a position where there are no air bubbles in the water.

Precautions for Flowing Installation:

1. The water intake point requires no air bubbles in the water and stable flow rate and water pressure.
2. The location of the drainage can not be higher than the location of the outlet of the flow cell, and the pipeline can not be bent, otherwise it is easy to cause poor drainage.

6.2 Wiring Instructions

Wire Label	DC12/24V	0V	RS-485A	RS-485B
Signal	Power Supply (12~24VDC)	Ground (GND)	485 Comm A	485 Comm B



wiring diagram

The wiring should be checked carefully in connection sequence before powering on to avoid unnecessary damage caused by wiring faults.

NOTE: Considering that the cable is immersed in water (including seawater) or exposed to air for a long period of time, all wiring is required to be waterproof, and users should consider a certain ability to resist corrosion when installing cables.

6.3 Communication Protocol

COD Sensor Register Setting

MODBUS-RTU	
Baud rate	9600 (default)
Device No	1 (default)
Data bit	8 bytes
Parity	NO
Stop bit	1digit

Register setting

Register name	Address	type of data	length	Read/Write	Note
Measure value	R0	unsigned	1	R	(Number of decimal digits determined by R8)
Clean interval	R1	unsigned	1	R	Unit: Minutes
Range Low Point	R4	unsigned	1	R	(Decimal places determined by R8)
Range High Point	R5	unsigned	1	R	(Decimal places determined by R8)
Scale factor	R6	unsigned	1	R	(1 decimal)
Increment	R7	signed	1	R	(Decimal places determined by R8)
Resolution	R8	signed	1	R	Number of decimal digits
Product identification	R9	unsigned	1	R	Default 13

Slave address	R10	unsigned	1	R	Range between 1-247
Baud rate	R11	unsigned	1	R	Default 9600 (Optional: 1200/2400/4800/ 9600/19200/ 38400/57600)
Function calls	R12	unsigned	1	W	See parameter settings for details
Parameter1	R13	unsigned	1	W	See parameter settings for details
Parameter2	R14	unsigned	1	W	See parameter settings for details
Calibration channel	R15	unsigned	1	W	0: COD 1:Turbidity

MODBUS Instruction Format

This sensor is compatible with 0x03, 0x06, 0x10 function codes of MODBUS protocol.

Command format of 0x03

Definition	Address	Function code	Initial address	Number of registers	CRC verify
Data	ADDR	0x03	Rstart	Rnum	CRC 16
Number of bytes	1	1	2	2	2

Return format of 0x03

Definition	Address	Function code	Number of data	Data	CRC verify
Data	ADDR	0x03	Rnum*2	Data	CRC 16
Number of bytes	1	1	1	Rnum* 2	2

Command format of 0x06

Definition	Address	Function code	Initial address	Data	CRC verify
Data	ADDR	0x06	Raddr	Data	CRC 16
Number of bytes	1	1	2	2	2

Return format (same as the command) of 0x06

Definition	Address	Function code	Register address	Data	CRC verify
Data	ADDR	0x06	Raddr	Data	CRC 16
Number of bytes	1	1	2	2	2

Command format of 0x01

Definition	Address	Function code	Initial address	Number of register	Number of data	Data	CRC verify
Data	ADDR	0x10	0x000C	0x0003	0x06	Data	CRC 16
Number of bytes	1	1	2	2	1	6	2

Return format of 0x01

Definition	Address	Function code	Initial address	Number of register	CRC verify
Data	ADDR	0x10	0x000C	0x0003	CRC 16
Number of bytes	1	1	2	2	2

Data reading

This sensor data is read using the 0x03 function code of the MODBUS protocol.

For example, read measure value

Send command: 01 03 00 00 00 01 84 0A

Return: 01 03 02 00 64 B9 AF

Data part is: 00 64

Measure value: 0x0064 convert to decimal is 100, convert to the corresponding value based on the resolution of the sensor. If resolution is 2, then value is 1.00; if resolution is 1, the value is 10.0.

Parameter adjustment

1. The sensor parameter adjustment use the MODBUS protocol 0x06 or 0x10 function code.
2. Use 0x06 function code to adjust parameters into 4 steps
 - 1) write parameter 1 to register R13
 - 2) write parameter 2 to register R14
 - 3) write calibration channel number to R15 register (ignore if non-calibration function)
 - 4) write the function number to register R12
3. write the Function Number, Parameter 1, and Parameter 2 to the 3 registers starting at R12 in one command. Effect is the same as step-by-step writing. Calibration functions require writing 4 registers.
4. Upon successful function call, registers R12, R13, R14, R15 are reset to 0. If the function call fails or parameters are incorrect, R14 will show -1.

Function call parameter list

Function	Function Code	Parameter 1	Parameter 2	Calibration channel
Zero calibration	1	Standard solution value $\times (10^N)$ COD : N is determined by the R8 register. Turb: N=1	1	0: COD, 1:Turb(not support correction calibration)
Slope calibration			2	
Correct calibration			3~5	
Modified coefficient	5	Scale Factor	Display value increment	Arbitrary value
Change configuration of slave	6	The new slave add	New baud rate	Arbitrary value
Restore factory setting	7	Password: 20034	Arbitrary value	Arbitrary value

For example:

Zero calibration: COD standard liquid is 5, sensor's resolution is 1, $5 \times 10^1 = 50$, converted to hexadecimal is 0x0032, therefore, function code is 0x0001, parameter 1 is 0x0032, parameter 2 is 0x0001, Cal Channel is 0.

Data part : 00 01 00 32 00 01 00 00

Send command: 01 10 00 0C 00 04 08 00 01 00 32 00 01 00 00 DE AE

Return: 01 10 00 0C 00 04 01 C9

Slope calibration: COD standard liquid 50, sensor's resolution is 1, $50 \times 10^1 = 500$, converted to hexadecimal 0x01F4, therefore, function code is 0x0001, parameter 1 is 0x01F4, parameter 2 is 0x0002, Cal Channel is 0.

Data part: 00 01 01 F4 00 02 00 00

Send command: 01 10 00 0C 00 04 06 00 01 01 F4 00 02 00 00 EB 0E

Return: 01 10 00 0C 00 04 01 C9

Correction Calibration: COD standard liquid 100, sensor's resolution is 1, $100 \times 10^1 = 1000$, converted to hexadecimal 0x03E8, therefore, function code is 0x0001, parameter 1 is 0x03E8, parameter 2 is 0x0003, Cal Channel is 0. (For additional points, increment Param2: 0x0004 for 2nd point, max Param2=0x0005 for 3 points).

Data part: 00 01 03 E8 00 03 00 00

Send command: 01 10 00 0C 00 04 06 00 01 03 E8 00 03 00 00 6A EE

Return: 01 10 00 0C 00 04 01 C9

Frequently used commands

Read All Data: 01 03 00 00 00 0F 05 CE

Change Slave Addr to 2: 01 10 00 0C 00 03 06 00 06 00 02 25 80 14 4F

Factory Reset: 01 10 00 0C 00 03 06 00 07 4E 43 00 00 75 83

CRC16 Calculation Function (C Language)

/**

Function: Calculate CRC16 checksum

Parameters:

buf: Byte array requiring CRC calculation

len: Array length

Returns: CRC value

*/

```
uint16_t CRC16(uint8_t buf[],int len){
```

```
int i , j;

uint16_t CRCreg = 0xffff;    //modbus CRC16 initial value

uint16_t DXS = 0xA001;      //modbus CRC16 polynomial

for (i=0;i<len;i++){

    CRCreg = CRCreg ^ buf[i];

    for (j=0;j<8;j++) {

        if((CRCreg & 1) == 1)

            CRCreg = (CRCreg >> 1) ^ DXS;

        else

            CRCreg = CRCreg >> 1;

    }

}

return CRCreg;

}
```

7. Sensor maintenance

(1) Rinse the electrode in distilled water (or deionized water), blot

it dry (do not rub). Place the electrode on the electrode holder. Do not use hard objects, organic solvents (e.g., acetone), or strong acids/alkalis for cleaning, as this may damage the optical coating.

- (2) Regularly inspect the working status of the UV lamp (UV light source). If significant decrease in light intensity or flickering is observed, replace it promptly.
- (3) Ensure the sample flow cell is free of sediment blockages. Periodically flush internal channels with a soft brush or high-pressure water gun. If unused for an extended period, drain the flow cell and keep it dry.
- (4) Perform calibration with standard solution (e.g., Potassium Hydrogen Phthalate solution) every 1~3 months to ensure measurement accuracy. If the measurement environment changes significantly (e.g., drastic water quality fluctuations), shorten the calibration interval.
- (5) If possible, periodically compare sensor readings with laboratory COD test results (e.g., Potassium Dichromate method per national standards) to verify sensor accuracy.
- (6) Avoid exposing the sensor to strong light, high temperatures ($>50^{\circ}\text{C}$), or severe vibration, as this may affect the lifespan of optical components.
- (7) Avoid testing samples with high oil concentration, strong corrosivity, or high turbidity. Install pre-treatment devices if necessary.
- (8) When unused for extended periods, turn off the power and disconnect cables to prevent electrode aging. Perform calibration and performance verification before restarting.

(9) Recommended Maintenance Schedule

Maintenance Item	Frequency	Operation Content
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Flow Cell Cleaning	Every 1~2 wks	Flush internal flow cell
UV Lamp Status Check	Every 3 mths	Light intensity check or replacement
Standard Solution Calibration	Every 1~3 mths	Calibrate using standard solution
Overall Sensor Performance Verify	Every 6 mths	Laboratory comparison, circuit check

8. Standard Solution Preparation

KHP (Potassium Hydrogen Phthalate, $C_8H_5KO_4$), CAS# 877-24-7, commonly used in environmental research, can be used for COD calibration.

(1) COD Standard Stock Solution (COD = 1000 mg/L)

- 1) Weigh 0.8502g of Potassium Hydrogen Phthalate and dissolve it in an appropriate amount of distilled water.
- 2) Transfer the dissolved solution to a 1000 mL volumetric flask.
- 3) Continue adding distilled water to the volumetric flask, diluting until the meniscus reaches the calibration mark.
- 4) Cover the cap of the volumetric flask and shake well to mix the solution.
- 5) Store the prepared standard stock solution at 4°C.

(2) COD Standard Solution (COD = 500 mg/L)

- 1) Precisely pipette 25 mL of the 1000 mg/L COD standard stock solution.
 - 2) Transfer the 25 mL aliquot into a 500 mL volumetric flask.
 - 3) Dilute to the mark in the 500 mL volumetric flask with distilled water.
 - 4) Cap the flask securely and mix thoroughly.
- (3) The diluted standard solution (from step (2)) must be used within 24 hours of preparation.
- (4) COD standard solutions should be stored at 4°C to prevent degradation or concentration changes. Sealed containers must be used during storage and handling to prevent evaporation or contamination.
- (5) Users can select standard solution concentrations proportionally based on the UV COD sensor's measurement range. For example, if the range is 0-500 mg/L, standard concentrations could be 0 mg/L, 100 mg/L, 300 mg/L, 500 mg/L.

Note: Wear gloves when preparing standard solutions.