COD sensor

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Preface

Thank you for purchasing self-cleaning COD sensor. Please read this manual carefully before operating and using it correctly to avoid unnecessary losses caused by false operation.

Note

- Modification of this manual's contents will not be notified as a result of some factors, such as function upgrading.
- We try our best to guarantee that the manual content is accurate, if you find something wrong or incorrect, please contact us.
- This product is forbidden to use in explosion-proof occasions.

Version

U-SUP-ADS2000-EN2

Disclaimer

- The company does not make any guarantees for the terms outside the scope of this product warranty.
- This company is not responsible for damage to the instrument or loss of parts or unpredictable damage caused directly or indirectly by improper operation of the user.

No.	Name	Quantity	Note
1	Self-cleaning COD sensor	1	
2	Manual	1	
3	Certificate	1	

After opening the box, please confirm the package contents before starting the operation.If you find that the model and quantity are incorrect or there is physical damage in appearance, please contact us.

Contents

1 Introduction

1.1 Introduction

Self-cleaning COD sensor is based on the UV absorption principle, does not need reagents, will not cause pollution, more environmental protection; Integrated self-cleaning brush, easy to install and use, even long-term online monitoring still has excellent stability.

1.2 Features

- Digital sensors, digital RS-485 output, Modbus protocol;
- Proven UVC LED technology, long lifetime, stable and instant measurement.
- With self-cleaning brushes to prevent biological adhesion and longer maintenance intervals.
- Can simultaneously output COD, BOD, TOC.

1.3 Technical parameters

Table 1 Technical parameters

Type	Regular small range	Regular large range	Economical
Light source	Imported UV254nm LED，550nm turbidity compensation	Imported UV254nm LED，550nm turbidity compensation	UV275nm LED，550nm turbidity compensation
Measured variables	COD, BOD, TOC, TSS, turbidity, temperature		
COD Range	(0.5~500)mg/L equiv.KHP	(0~1500) mg/L equiv.KHP	(0~500) mg/L equiv.KHP
COD Accuracy	±5%		
BOD Range	(0~400) mg/L	(0~1200) mg/L	(0~400) mg/L
BOD Accuracy	±5%		
TOC Range	(0~200) mg/L equiv.KHP	(0~600) mg/L equiv.KHP	(0~200) mg/L equiv.KHP
TOC Accuracy	±5%		

Type	Regular small range	Regular large range	Economical
Temperature Range	(0~50) ℃		
Output	RS485, Modbus protocol		
Power supply	(12~24)VDC, ≥1 A		
Power consumption	Cleaning brush not activated: Power consumption ≤ 0.25W		
	Activating cleaning brush: Power consumption ≤ 1 W (standard small range, economical model) Power consumption ≤ 1.8W (normal large range)		
Process pressure	≤0.3MPa		
Size	Φ50mm*179mm	Φ50mm*179mm	Φ46mm*176mm
Cable Length	10m (default), customizable		

Note:

The above technical parameters are all data under laboratory standard liquid environment. Sensor life and maintenance calibration frequency are related to actual field conditions.

2 Structure and dimensions

2.1 Regular small range type

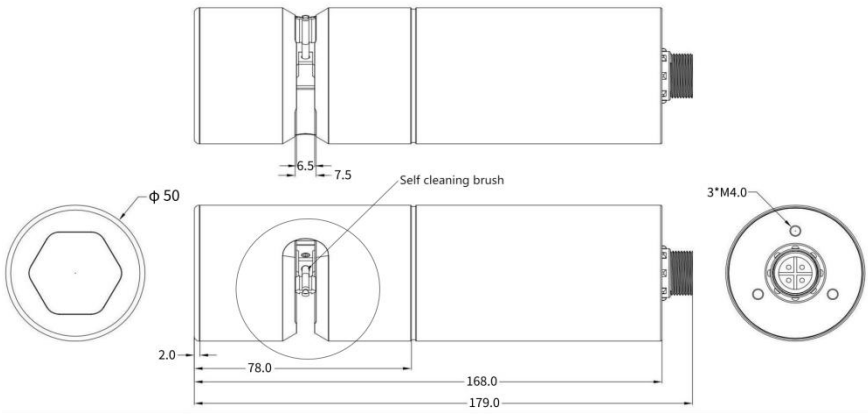


Fig.1 Regular small range COD sensor (Unit: mm)

2.2 Regular large range type

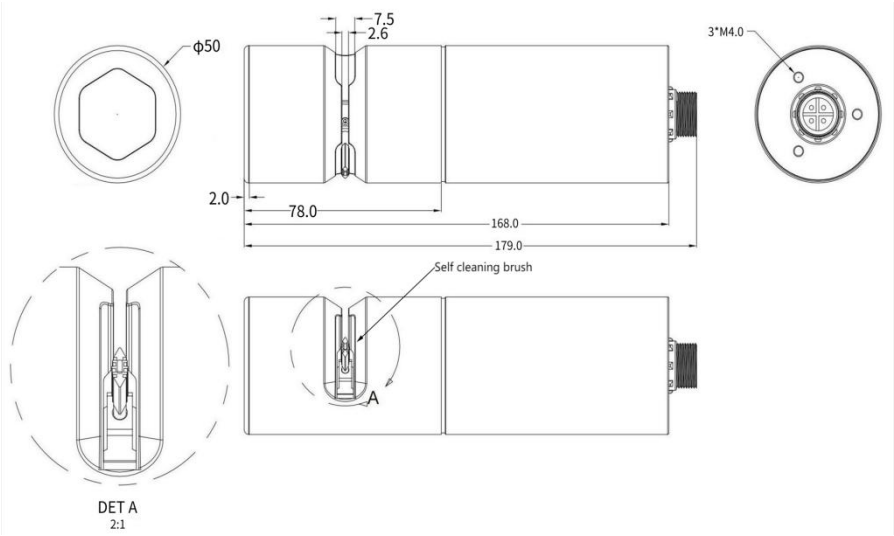


Fig.2 Regular large range COD sensor (Unit: mm)

2.3 Economical type

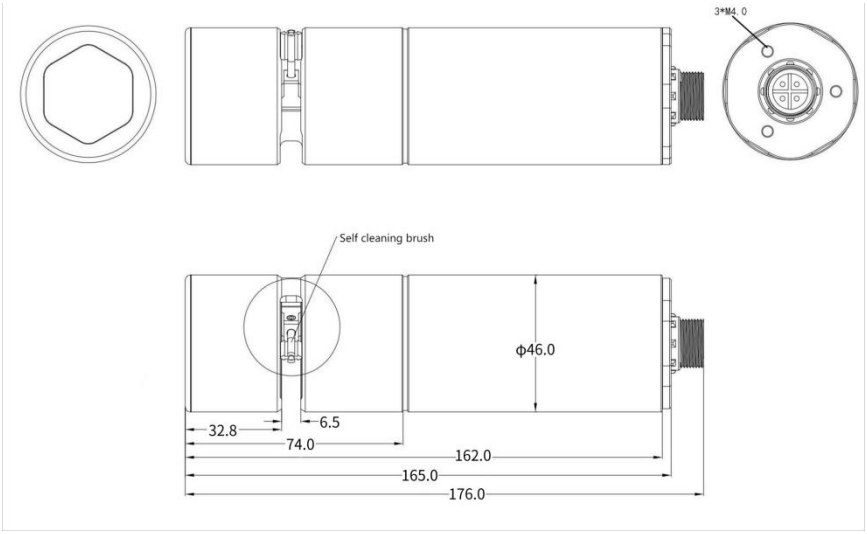


Fig.3 Economical type COD sensor (Unit: mm)

3 Installation

3.1 Configuration

Item	Number	Unit	Note
COD Sensor	1	pcs	Including lifting sheet metal and holding hoop
Metal protective cover	1	pcs	
Cables	1	pcs	
Brush component	1	group	

3.2 Installation precautions

①The sensor shall be installed vertically with the sensor facing down, avoid horizontally installation or with sensor face upward.

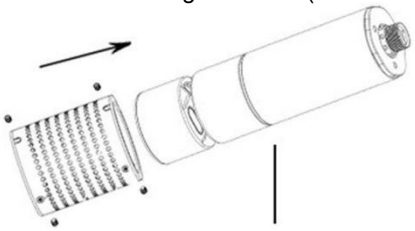
② Considering the influence of water level, the sensor is recommended to be installed under water surface level of 30cm. Probe shall be fully submerged into water.

③ The sensor must be securely mounted to avoid any damage caused by water flow and other unknown factors.

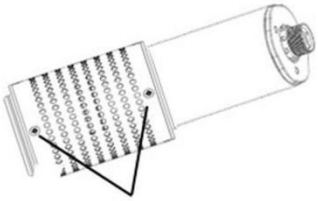
3.3 Installation steps

(1) Protective cover installation:

After unpacking of the sensor, install a protective probe cover onto the sensor, as shown in the figure below (4 screws on the cover shall be tightened).



Loose 4 screws on the protection cover, and then slid the cover on the sensor gap.



Tighten the screws to complete installation

(2) Fixed installation on site：

It is suggested to carry out a fixed installation in the following two ways as shown in Fig.4 and Fig.5.

Elbow installation in Fig.4 is good for environment with no rapid water flow and less debris.

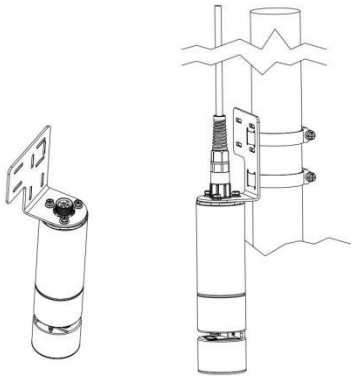


Fig.4

Fig.5 is an illustration for plate installation, which provide a stable installation in rapid water

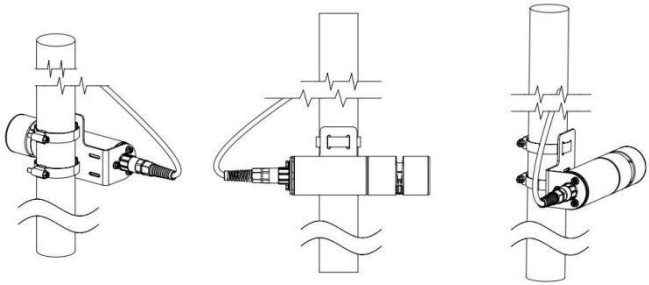


Fig.5

Warning

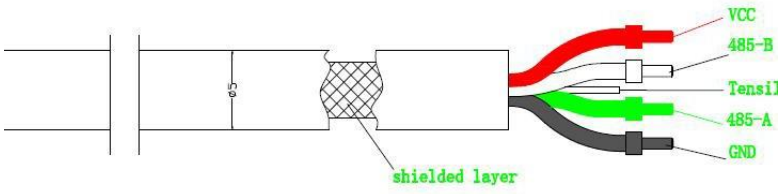
1.Please install the protective mesh cover correctly.

2.Do not use the sensor cable to lift the sensor.

3.Do not cover the measuring surface with lifting accessories.

4 Electrical connection

4 wire AWG-24 OR AWG-26 shielding wire. OD=5.5mm



1, Red—Power (VCC)

2, White—485 Date_B (485_B)

3, Green—485 Date_A (485_A)

4, Black—Ground (GND)

5, Bare wire—shield

5 Calibration

5.1 Brief description

COD sensor supports zero point, one point or two-points calibration with Our company's Smart PC App. You can scan the QR code on the right to get the details of the App, as well as "help" document in the compressed package. For more detailed information, please contact Our company Customer Service directly.

5.2 Calibration Solution Preparation

(1) Required appliances and raw materials

① Required appliances: analytical balance, medicine spoon, 5mL beaker, 1mL measuring cylinder, glass rod, pipette gun, 1L volumetric flask;

② Raw materials: KHP (potassium hydrogen phthalate, C8H5KO4, CAS:877-24-7, as a commonly used stain in environmental research, which can be used for COD calibration, deionized water.

(2) Configuration method

① Take 1.2754g of KHP and dissolve in deionized water, fixed capacity to 1L. At this time, the 15mg/L COD mother solution is prepared;

② Dilute the solution in step 1 according to the required concentration. For example, take 1mL of 15mg/L COD mother solution and dissolve in deionized water, fixed capacity to 1L. At

this time, the 15mg/L COD standard solution is prepared.

③ Other concentrations can be calculated and configured according to the dilution method.

Notes:

The standard solution should be configured at the time of use to ensure accuracy; Highly concentrated mother solution (e.g:1500mg/L) can be sealed in cans and refrigerated for subsequent dilution;The retention period is recommended to be within one month

6 Maintenance schedule and methods

6.1 Maintenance schedule

Although the UV COD comes with a self-cleaning brush as standard, harsh operating conditions can still cause the sensor to become contaminated. To ensure accurate measurements, cleaning is important and regular cleaning of the sensor will contribute to the stability of the data.

Maintenance task	Recommended maintenance frequency
Sensor cleaning	Cleaning every 3 to 4 weeks
Calibration sensor	Depending on the working conditions and user needs, but not later than once 3 months.
Maintenance and inspection of self-cleaning brush	Replace a new brush every 3 to 6 months (depending on water condition)

6.2 Maintenance methods

(1) Inspect probe body： Wash the probe body with tap water, if there is still a clastic residues,using wet soft cloth to wipe, for some stubborn dirt, can add household detergents in tap water to clean.

(2) Check the cable： The cable should not be in any force, tension, or twist. It cause the internal wire broken.

(3) Check the sensor measurement window: carefully inspect probe optical window for potential stains, scratches, or dirty spots. Clean the window gently using cotton swabs. DO NOT USE ANY SOLVENT.

(4) Check the sensor wiper: replace the wiper as necessary if see any tear and wear of the blade.

(5) Recommend to return the probe to factory for wiper O-ring seal replacement after continuous use for 18 months.

Attention:

(1) Sensor has optical components and electronic components which have more than ten years expected lifetime. Ensure to keep that the sensor away from mechanical impact or vibration.

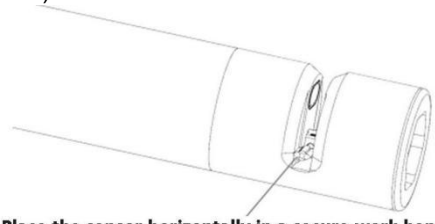
(2) Force to rotate or obstruct the cleaning brush. The large external force will lead to the damage of the motor gear.

(3) If there are many debris in the water body at the installation point, it is recommended to install a protective net around the sensor or a protective sleeve to prevent debris from enter into sensor optical gap.

(4) Sensors should not be installed directly opposite the water flow and where there are many bubbles.

6.3 Wiper replacement

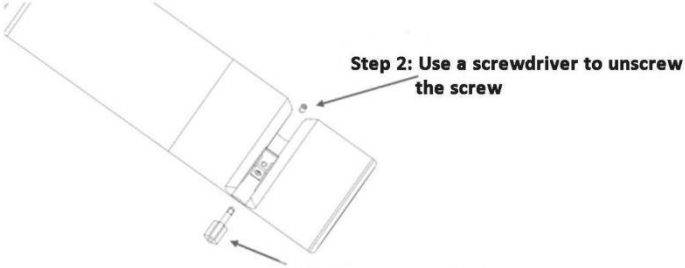
(1) Place the sensor horizontally in a secure work bench and rotate the brush to side (see the picture below).



Step 1: Place the sensor horizontally in a secure work bench and rotate the brush to side

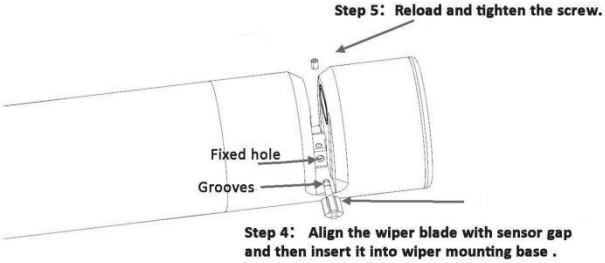
(2) Use a screwdriver to unscrew the screw.

(3) Gently pull the wiper out, use tweezer if necessary.



(4) Align the wiper blade with sensor gap and then insert it into wiper mounting base .

(5) Tighten the screw, DO NOT OVER TIGHTEN.



7 Troubleshooting

Table 2 lists symptoms, possible causes, and recommended solutions for common problems encountered with COD sensor. If your symptom is not listed, or if none of the solutions solves your problem, please contact us.

Table 2

ERROR	POSSIBLE CAUSE	SOLUTION
Communication anomalies	Controller and cable connection error	Check whether the power supply and wiring are correct according to the instruction.
	Interface or communication issues	Use our SmartPC upper computer software to check whether the communication is normal; Check according to the product supporting communication protocol.
No change in reading	Cleaning brush failure	Check whether the brush is entangled by debris, if so, please remove them gently; Turn on the power again and observe whether the brush rotates. If it cannot rotate or rotates abnormally, please contact customer service;
		Check whether the power supply power meets the requirements.
	Software and hardware anomalies	Please contact us
Reading is too high, too Low or unstable	Sensors are seriously contaminated	Wash the surface
	Sensor self - cleaning damage	Replace the cleaning brush
	Calibration is required	Perform user calibration
Other errors	Please contact us	

8 Communication

This instrument provides a standard RS485 serial communication interface, adopts the international common standard Modbus-RTU communication protocol, and supports the 0x03 read holding register command, 0x06 write single register command, and 0x10 write multiple registers.

Data transmission mode: Big-endian mode;

Float：1-0-3-2；

Int32(long)：1-0-3-2

8.1 Protocol specification

8.1.1 Query Device Address (0x00)

If the device address is unknown, you can use the address 0x00 to send the 03 instruction to query the device address.

8.1.2 Broadcast Address (0xFF)

When the host sends the device address as 0xff, it is a broadcast instruction, and the slave does not respond when receiving the broadcast instruction.

8.1.3 Broadcast Address (0xFF)

- **Frame Format**

(1) Read Register Data (0x03)

Inquiry:

Name	Device address	Function code	Starting Address	Number of registers	CRC
Data	Addr	0x03	M	N	CRC16
Length bytes	1	1	2	2	2

Response:

Name	Device address	Function code	Return bytes	Return data	CRC
Data	Addr	0x03	N * 2	Data	CRC16
Length bytes	1	1	1	N * 2	2

(2) Write A Single Register (0x06)

Inquiry:

Name	Device address	Function code	Starting Address	Data values	CRC
Data	Addr	0x06	M	Data	CRC16
Length bytes	1	1	2	2	2

Response:

Name	Device address	Function code	Starting Address	Data values	CRC
Data	Addr	0x06	M	Data	CRC16
Length bytes	1	1	2	2	2

Write multiple registers (0x10)

Inquiry:

Name	Device address	Function code	Starting Address	Number of data	Byte count	Data values	CRC
Data	Addr	0x10	M	N	N * 2	Data	CRC16
Length bytes	1	1	2	2	1	N * 2	2

Response:

Name	Device address	Function code	Starting address	Number of data	CRC
Data	Addr	0x10	M	Data	CRC16
Length bytes	1	1	2	2	2

8.2 Register list

8.2.1 Communication Parameters

Table 3 Communication Parameters

Register Address	Register Name	Data Type	Number of Registers	Byte Count	Read/Write Permission	Description
0x1100	Device address	uint8_t	1	2	R/W	1-247，default is 1

Register Address	Register Name	Data Type	Number of Registers	Byte Count	Read/Write Permission	Description
0x1101	Baud rate	uint8_t	1	2	R/W	1= 2400, 2= 9600 (default) , 3= 14400 ,4= 19200 ， 5= 38400，6= 57600， 7= 115200，8= 1200， 9= 4800
0x1102	Serial port format	uint8_t	1	2	R/W	1= N81(default) , 2 = N82 3 = E81, 4 = O81 N:None E:Even O:Odd 8：8 data bits 1：1 stop bit 2：2 stop bits

8.2.2 Measurement Parameter Registry

Table 4 Measurement Parameter Registry

Register Address	Register Name	Data Type	Number of Registers	Byte Count	Read/Write Permission	Description
0x1200	Number of measurement parameter	uint8	1	2	R	Range：1-10
0x1201	Measurement parameter 1	uint16	1	2	R	0x0E08， The high byte 0x0e is the parameter type, COD; The low byte 0x08 represents the unit, : mg/L.
0x1202	Lower limit of range 1	float	2	4	R	0mg/L

Register Address	Register Name	Data Type	Number of Registers	Byte Count	Read/Write Permission	Description
0x1204	Lower limit of range 1	float	2	4	R	2500mg/L
0x1206	Optional measurement parameter 2	uint16	1	2	R	0x2B08， The high byte 0x2B is the parameter type, BOD; The low byte 0x08 represents the unit, mg/L。
0x1207	Lower limit of range 2	float	2	4	R	0 mg/L
0x1209	Upper limit of range 2	float	2	4	R	2000 mg/L
0x120B	Optional measurement parameter 3	uint16	1	2	R	0x0D08， The high byte 0x0D is the parameter type, TOC; The low byte 0x08 represents the unit, mg/L
0x120C	Lower limit of range 3	float	2	4	R	0 mg/L
0x120E	Upper limit of range 3	float	2	4	R	1000 mg/L
0x1210	Optional measurement parameter 4	uint16	1	2	R	0x2C08， The high byte 0x2C is the parameter type, TSS The low byte 0x08 represents the unit, mg/L
0x1211	Lower limit of range 4	float	2	4	R	0 mg/L
0x1213	Upper limit of	float	2	4	R	12000mg/L

Register Address	Register Name	Data Type	Number of Registers	Byte Count	Read/Write Permission	Description
	range 4					
0x1215	Optional measurement parameter 5	uint16	1	2	R	0x0A10， The high byte is the parameter type turbidity; The low byte 0x10 represents the unit, NTU。
0x1216	Lower limit of range 5	float	2	4	R	0 NTU
0x1218	Upper limit of range 5	float	2	4	R	1200 NTU

8.2.3 Data Register

Table 5 Data Register

Register Address	Register Name	Data Type	Number of Registers	Byte Count	Read/Write Permission	Description
0x2000	Protocol version + device type	uint16	1	2	R	0x2012， Compatible with older versions of protocols High byte 0x20: data version; Low type: 0x12, representing COD electrode
0x2001	Supplementary protocol type	uint16	1	2	R	Not in use, fill with 0s
0x2002	Parameter 1 value	float	2	4	R	Measurement value of COD, unit mg/L
0x2004	Temperature value	float	2	4	R	Measurement value pf temperature ,range

Register Address	Register Name	Data Type	Number of Registers	Byte Count	Read/Write Permission	Description
						0℃~50℃
0x2006	Parameter 2 value	float	2	4	R	Measurement value of BOD, unit mg/L
0x2008	Parameter 3 value	float	2	4	R	Measurement value of TOC, unit mg/L
0x200A	Parameter 4 value	float	2	4	R	Measurement value of TCC, unit mg/L
0x200C	Parameter 5 value	float	2	4	R	Measurement value of turbidity, unit NTU
0x2100	Original value of parameter 1	float	2	4	R	The COD value before calibration, unit mg/L
0x2102	Original temperature value	float	2	4	R	Original temperature value，unit ℃
0x2104	Original value of parameter 2	float	2	4	R	The BOD value before calibration, unit mg/L。
0x2106	Original value of parameter 3	float	2	4	R	The TOC value before calibration, unit mg/L。
0x2108	Original value of parameter 4	float	2	4	R	The TSS value before calibration, unit
0x210A	Original value of parameter 5	float	2	4	R	The COD value before calibration, unit turbidity,。
0x2200	Error code	long	2	4	R	Refer to Table 6 Error code
0x2300	Factor of measurement parameter 1	float	2	4	R/W	Factor of measuring COD

Register Address	Register Name	Data Type	Number of Registers	Byte Count	Read/Write Permission	Description
0x2302	Deviation value of measurement parameter 1	float	2	4	R/W	Deviation value of measuring COD
0x2304	Factor of measurement parameter 2	float	2	4	R/W	Factor of measuring BOD
0x2306	Deviation value of measurement parameter 2	float	2	4	R/W	Deviation value of of BOD
0x2308	Factor of measurement parameter 3	float	2	4	R/W	Factor of measuring TOC
0x230A	Deviation value of measurement parameter 3	float	2	4	R/W	Deviation value of TOC
0x230C	Factor of measurement parameter 4	float	2	4	R/W	Factor of measuring TSS
0x230E	Deviation value of measurement parameter 4	float	2	4	R/W	Deviation value of TSS
0x2310	Factor of measurement parameter 5	float	2	4	R/W	Factor of measuring turbidity
0x2312	Deviation value of measurement parameter 5	float	2	4	R/W	Deviation value of turbidity
0x240E	Manual wiper	uint8_t	1	2	W	Write 1 to execute

Register Address	Register Name	Data Type	Number of Registers	Byte Count	Read/Write Permission	Description
						probe cleaning once
0x240F	Automatic wiper time	uint16_t	1	2	W	Interval time for sending (1, 5, 15, 30, 60 (1h), 240 (4h), 720 (12h), 1440 (1D), 4320 (3D), 10080 (7D), unit: min)
0x2410	Restore factory settings	uint8_t	1	2	W	Write 1 to execute the factory settings of the sensor

Measurement value reading method:

Read continuously starting from the address 0x2000, and the reading length refers to the number of measurement parameters in 0x1200.

8.2.4 Error code

Table 6 Error code

Error code	Description
Bit0	Storage unit exception, write data failed
Bit1	Temperature sensor abnormal, out of range
Bit2	Abnormal sensor , out of range
Bti3	Not calibrated, check if the sensor has completed the calibration operation
Bit4-7	Reserve
Bit8	Not calibrated, check if sensor parameter 1 has completed calibration operation
Bit9	Not calibrated, check if sensor parameter 1 has completed calibration operation
Bit10	Not calibrated, check if sensor parameter 1 has completed

Error code	Description
	calibration operation
Bit11	Not calibrated, check if sensor parameter 1 has completed calibration operation
Bit12	Not calibrated, check if sensor parameter 1 has completed calibration operation
Bit13-Bit31	Reserve

8.2.5 Calibration Register

Table 7 Calibration Register

Register Address	Register Name	Data Type	Number of Registers	Byte Count	Read/Write Permission	Description
0x3000	Read the number of calibration points	uint8_t	1	2	R	The number of calibration points (m) supported by the sensor parameters to be calibrated, with a maximum of 5 points supported.
0x3001	Current calibration point	uint8_t	1	2	R/W	Current range: 1-m
0x3002	Calibration parameter type	uint8_t	1	2	R/W	Specific types refer to the measurement parameter registration table. 0 - Temperature 1 - Parameters of register 0x1201 in the registration table 2 - Parameters of register 0x1206 in the registration table 3 - Parameters of

Register Address	Register Name	Data Type	Number of Registers	Byte Count	Read/Write Permission	Description
						register 0x120B in the registration table 4 - Parameters of register 0x1210 in the registration table 5 - Parameters of register 0x1215 in the registration table
0x3003	Sensor calibration status	uint8_t	1	2	R	0x0000: Calibration successful 0x0001: Calibration not yet completed 0x0002: No standard liquid information received or no such standard liquid available 0x0003: Signal cannot be stabilized or signal is out of range 0x0004: Slope or offset out of allowed range
0x3004	Exit ‘calibration	uint8_t	1	2	W	Write 1 to exit calibration
0x3005	Reference standard value	float	2	4	W	Standard liquid value, data format is float
0x3007	Measured value	float	2	4	R	Unadjusted original measured value. (If the standard value refers to CalA and the measured value

Register Address	Register Name	Data Type	Number of Registers	Byte Count	Read/Write Permission	Description
						refers to MeasA, refer to section 6.1 of the calibration procedure)

8.3 Communication examples

8.3.1 Example of Reading Measurement Parameters

When obtaining the number of measurement parameters, the sensor responds with 4:

Send Hex：01 03 12 00 00 06 c0 b0

Recv Hex:：01 03 0c 00 04 10 06 00 00 00 00 c0 00 46 5a 22 2e

To obtain the registration table for all 4 measurement parameters, read (1 + 5x4) registers

Send Hex：01 03 12 00 00 15 81 7d

Recv Hex：01 03 2a 00 04 10 06 00 00 00 00 c0 00 46 5a 10
02 00 00 42 c8 00 00 43 fa 10 1a c5 ac 37 27 00
00 3f 80 10 1c 00 00 00 00 00 00 40 a0 13 73

To read the measurement values, read 4 measurement values and temperature:

Send Hex：01 03 20 00 00 0c 4e 0f

Recv Hex：01 03 18 20 14 00 00 00 00 42 d4 66 66 41 ca 13
33 43 95 c2 8f 3b f5 df 3b 40 47 a0 d8

8.3.2 Calibration example

Taking the first point of calibration as an example

Calibration parameter type 0x01

Send Hex：01 06 30 02 00 01 e6 ca

Recv Hex：01 06 30 02 00 01 e6 ca

Write the value of the standard solution:

Send Hex：01 10 30 05 00 02 04 00 00 41 20 56 19

Recv Hex：01 10 30 05 00 02 5e c9

Write the current calibration point and initiate the first calibration point:

Send Hex：01 06 30Recv Hex：01 03 02 00 00 b8 44

01 00 01 16 ca

Recv Hex：01 06 30 01 00 01 16 ca

Query calibration status:

Send Hex：01 03 30 03 00 01 7b 0a