Sludge Concentration Sensor

Preface

Thank you for purchasing self-cleaning sludge concentration 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-ADT3300-EN2

Safety Precautions

In order to use this product safely, be sure to follow the safety precautions described.

About this manual

- Please submit this manual to the operator for reading.
- Please read the operation manual carefully before applying the instrument. On the precondition of full understanding.
- This manual only describes the functions of the product. The company does not guarantee that the product will be suitable for a particular use by the user.

Precautions for protection, safety and modification of this product

- To ensure safe use of this product and the systems it controls, Please read carefully the operation manual and understand the correct application methods before putting into operation, to avoid unnecessary losses due to operation mistakes. If the instrument is operated in other ways not described in the manual, the protections that the instrument give may be destroyed, and the failures and accidents incurred due to violation of precautions shall not be borne by our company.
- When installing lightning protection devices for this product and its control system, or designing and installing separate safety protection circuits for this product and its control system, it needs to be implemented by other devices.
- If you need to replace parts of the product, please use the model specifications specified by the company.
- This product is not intended for use in systems that are directly related to personal safety.Such as nuclear power equipment, equipment using radioactivity, railway systems, aviation equipment, marine equipment, aviation equipment and medical equipment.If applied, it is the responsibility

of the user to use additional equipment or systems to ensure personal safety.

- Do not modify this product.
- The following safety signs are used in this manual:

Hazard, if not taken with appropriate precautions, will result in serious personal injury, product damage or major property damage.

Warning:Pay special attention to the important information linked to product or particular part in the operation manual.

- Confirm if the supply voltage is in consistent with the rated voltage before operation.
- Don’t use the instrument in a flammable and combustible or steam area.
- To prevent from electric shock, operation mistake, a good grounding protection must be made.
- Thunder prevention engineering facilities must be well managed: the shared grounding network shall be grounded at is-electric level, shielded, wires shall be located rationally, SPD surge protector shall be applied properly.
- Some inner parts may carry high voltage. Do not open the square panel in the front except our company personnel or maintenance personnel acknowledged by our company, to avoid electric shock.
- Cut off electric powers before making any checks, to avoid electric shock.
- Check the condition of the terminal screws regularly. If it is loose, please tighten it before use.
- It is not allowed to disassemble, process, modify or repair the product without authorization, otherwise it may cause abnormal operation, electric shock or fire accident.
- Wipe the product with a dry cotton cloth. Do not use alcohol, benzine or

other organic solvents. Prevent all kinds of liquid from splashing on the product. If the product falls into the water, please cut off the power immediately, otherwise there will be leakage, electric shock or even a fire accident.

- Please check the grounding protection status regularly. Do not operate if you think that the protection measures such as grounding protection and fuses are not perfect.
- Ventilation holes on the product housing must be kept clear to avoid malfunctions due to high temperatures, abnormal operation, shortened life and fire.
- Please strictly follow the instructions in this manual, otherwise the product's protective device may be damaged.

- Don’t use the instrument if it is found damaged or deformed at opening of package.
- Prevent dust, wire end, iron fines or other objects from entering the instrument during installation, otherwise, it will cause abnormal movement or failure.
- During operation, to modify configuration, signal output, startup, stop, operation safety shall be fully considered. Operation mistakes may lead to failure and even destruction of the instrument and controlled equipment.
- Each part of the instrument has a certain lifetime, which must be maintained and repaired on a regular basis for long-time use.
- The product shall be scrapped as industrial wastes, to prevent environment pollution.
- When not using this product, be sure to turn off the power switch.
- If you find smoke from the product, smell odor, abnormal noise, etc., please turn off the power switch immediately and contact the company in time.

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 Sludge Concentration 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. Product Overview

Self-cleaning sludge consistency sensor is based on the principle of combined infrared scattering method, and according to ISO7027 infrared scattering light technology, the sludge concentration is determined without the influence of chroma. Sensor without reagent, no pollution; More economical and environmentally friendly. The product is equipped with a self-cleaning brush to eliminate air bubbles and reduce the impact of contamination on measurements for longer maintenance cycles.

Features：

- Digital sensor, RS485 output, MOBUS protocol.
- Infrared scattered light detection technology with reliable repeatability and stability.
- Sapphire custom optical windows and filters are resistant to ambient light and chromaticity.
- With self-cleaning brush to prevent the attachment of microorganisms and extend the maintenance cycle.
- Built-in calibration parameters for easy on-site use and secondary calibration.

2. Structure Chart

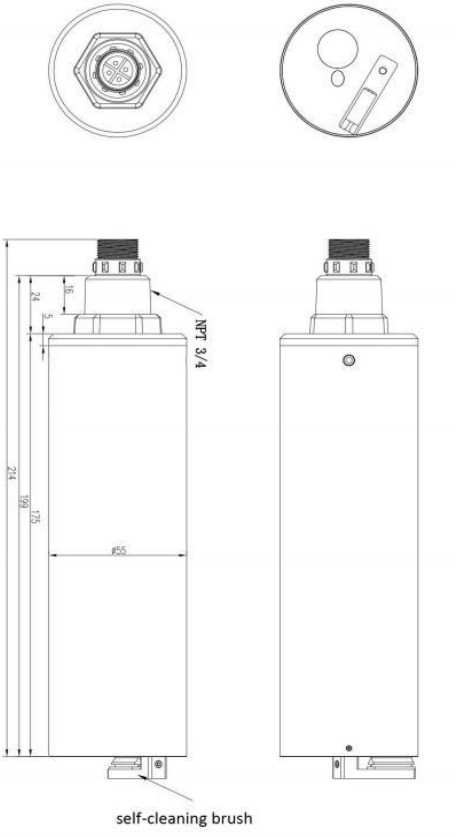

Fig. 1

3. Cable Definition

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

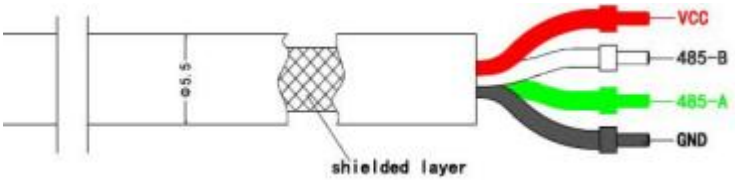

Fig. 2

Table 1

1, Red—Power (VCC)
2, White—485 Date_B (485_B)
3, Green—485 Date_A (485_A)
4, Black—Ground (GND)

4. Technical Specifications

Table 2

Name	Sludge concentration sensor
Measurement Principle	Scattering method
Range	（0~15000）mg/L
Accuracy	±5% or ±20mg/L (whichever is greater)
Resolution	0.1mg/ L
Power	0.2W(non wiping) 0.8W(wiping) Suggested Power Supply： DC 9-24V, >500mA
Temperature Range	0-50℃
IP Range	IP68
Maximum Pressure	3bar
Self-cleaning System	One-piece self-cleaning brush
Sensor Interface	RS-485, MODBUS Protocol
Assemble	Input Installation
Cable Length	10m (default), customized
Calibration	One-point or Two-points Calibration
Body Material	316L

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.

5. Installation

5.1. Configuration Table

Table 3

Standard Configuration	Number	Unit	Remarks
Sludge Concentration Sensor	1	Support	
Wires and Cable	1	Root	10m

5.2. Sensor Installation

(1) Wiring and power supply

① Do not use the sensor cable to pull the sensor! It is required to install sensor in a secure and stable mounting bracket.

② The female and male connector of sensor cable should be screwed tightly to avoid moisture incursio.

Fig. 3

③ Make sure power supply voltage is correct before power on.

(2) Sensor installation

① It is recommended to install the sensor vertically with electrodes facing down.

② In consideration of the fluctuation of water level, install the sensor below water level of 30cm, and try to install it in the position where there are no bubbles in the water;

③ Considering the basic principles of optics, Please keep the sensor. The end of the light window is not less than 10cm from the bottom of the container/related device!

5.3. Fixed Installation on Site

Fixed mounting with NPT3/4 thread at the end.

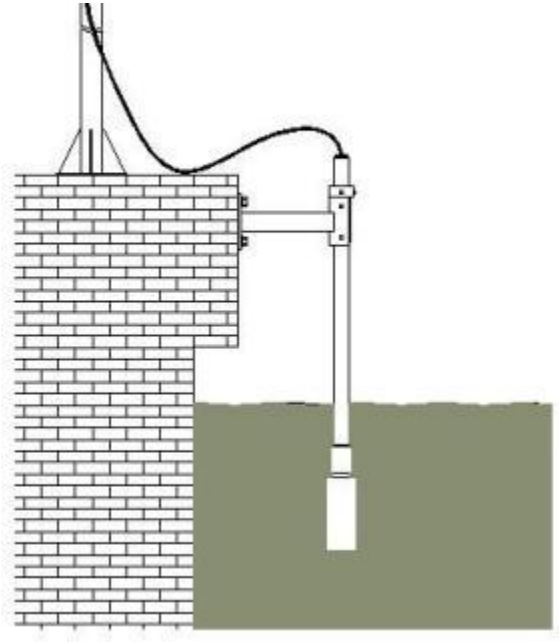

Fig. 4

Warning

Table 4

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.

6. Calibration

6.1. Brief Description

Self-cleaning sludge concentration sensor supports one-point or two-points calibration. The calibration tool can be used with our Smart PC software or according to sensor communication protocol. For our Smart PC software, please can the QR code on the right to get it. Customers can also develop by themselves according to the communication protocol.

Smart PC User Manual:

(1) Open the SmartPC and select "Language" in the title bar: English.

(2) Select the correct port and click "Connect".

(3) Check calibration to perform calibration operation. Press F1 to get the help document. Find the calibration instructions for the Sludge concentration sensor.

(4) You can also use the tool to measure and record data, referring to the help documentation.

6.2. Materials Required

① Drug name：Diatomite, median particle size 32 μm (CAS:68855-54-9) .

② Take 20g of diatomite and dissolve in deionized water, fixed capacity to 1L. At this time, the 20000mg/ L sludge standard solution is prepared.

③ Dilute the solution in step 1 according to the required concentration. For example, take 500mL of 20000mg/ L sludge standard solution and dissolve in deionized water, fixed capacity to 1L. At this time, the 10000mg/ L sludge standard solution is prepared.

6.3. Notes for Calibration

① Because diatomite is insoluble in water, so it is necessary to use a magnetic stirrer to stir to maintain a uniform while standard solution is used.

② When using, all test instruments must be wiped clean to avoid pollution.

③ The test should be carried out in a brown light-proof bottle (with the probe immersed and the detection window >10 cm from the bottom of the bottle), avoiding air bubbles in the window.

④The standard solution should be configured at the time of use.

7. Maintenance Schedule and Methods

7.1. Maintenance Cycle

Although the sensor is equipped with a self-cleaning brush as standard, poor working conditions can still cause the sensor to become contaminated. To ensure accurate measurements, cleaning is important and regular sensor cleaning contributes to data stability.

Table 5

Maintenance Task	Recommended Maintenance Frequency
Sensor Cleaning	Cleaning every 3 to 4 weeks
Calibration Sensor	Every 3 to 4 weeks
Maintenance and Inspection of Self-cleaning Brush	It is recommended to replace the brush skin every three months (depending on the specific working conditions).

Note: The maintenance frequency in the above table is only a recommendation, please ask the maintenance personnel to maintain the sensor according to the actual use of the sensor.

7.2. Maintenance Methods

① Clean the sensor surface：Wash the outer surface of sensor with tap water, if there is still residue, using soft brush, for some stubborn dirt, household detergent can be added in tap water to clean.
② Window surface: clean the outer surface of the sensor with tap water. For some stubborn dirt, traditional detergent and soft cloth can be used to clean it. It is forbidden to scrape the window surface with hard objects.
③ Check the cable：Inspect the sensor cable if there is damage.
④ Check clean brush: check whether the sensor shell is damaged due to corrosion or other reasons. Check whether the sensor's cleaning brush is damaged, excessive wear leads to less than the light window and other abnormalities.

7.3. Attention

① Probe contains sensitive optical components and electronic components. Ensure that the probe far away from severe mechanical impact.

② Self-cleaning turbidity sensor cleaning brush is internally provided with a reduction motor. Under no circumstances shall external force be used to rotate the cleaning brush or hinder the rotation of the cleaning brush (except for replacing the cleaning brush). Large external force factors can cause damage to the deceleration motor.

③ If there is a lot of debris in the water, it is recommended to install a protective net or a protective sleeve on the periphery of the sensor to prevent debris in the water from getting stuck in the cleaning brush;

④ Sensor installation should avoid the positive flow of water and the position of more bubbles.

8. Trouble Shooting

Table 6 lists the symptoms, possible causes, and recommended solutions for common problems encountered with the TSS sensor. If your symptom is not listed, or if none of the solutions solves your problem, please contact us.

Table 6

Error	Possible Cause	Solution
Communication Abnormal	Power Supply or Wiring Issues	Check whether the power supply and wiring are correct according to the instruction.
	Interface or Protocol Issues	1. Use our SmartPC upper computer software to check whether the communication is normal. 2. Check according to the supporting communication protocol of the product.
No Change in Reading	Cleaning Brush Failure	1. Check whether the brush is entangled by foreign matter, if so, please remove the foreign matter; 2. 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 meets the requirements, to avoid the low power supply can not drive the brush rotation.
	Hardware or Software Issues	Contact Customer Service
Measured value is too high, too low or instability.	Sensor's window is dirty and worn.	Clean sensor body, special light window table
	Sensor's brush is worn.	Change Brush
	Calibration is required.	Perform User Calibration
Other Errors	Contact Customer Service	

9. Quality Assurance

(1) The warranty period is 1 year.

(2) This quality assurance does not cover the following cases.

① Due to force majeure, natural disasters, social unrest, war (declared or undeclared), terrorism, the War or damage caused by any governmental compulsion.

② Damage caused by misuse, negligence, accident or improper application and installation.

③ Freight charges for shipping the goods back to our company.

④ Freight charges for expedited or express shipping of parts or products covered by the warranty.

⑤ Travel to perform warranty repairs locally.

(3) This warranty includes the entire contents of the warranty provided by our company with respect to its products.

① This warranty constitutes a final, complete and exclusive statement of the terms of the warranty, and no person or the agent is authorized to establish other warranties in the name of our company.

② The remedies of repair, replacement, or return of payment as described above are exceptional cases that do not violate this warranty, and the remedies of replacement or return of payment are for our products themselves. Based on strict liability or other legal theory, our company shall not be liable for any other damage caused by a defective product or by negligent operation, including any subsequent damage that is causally related to these conditions.

10. Communication Protocols

10.1. ModBus protocol information

●Protocol specifications

Name	Description
Communication Interface	RS485
Transport Mode	ModBus RTU
Port Settings	9600,N,8,1 (Default)
Device Address	0x01 (Default)

●Function code

Function Code	Description
0x03	Read register data, error return code 0x83
0x06	Write a single register, error return code 0x86
0x10	Write multiple registers, error return code 0x90

●Error code

Error Code	Description
0x01	Invalid instruction or current instruction unavailable, this feature is not supported.
0x02	The content of this address cannot be written with data.
0x03	The current input data is invalid and exceeds the input range.

●Query device address (standalone mode)

The device address is unknown. You can use address 0x00 to send the 03 command to query the device address.

●Broadcast instruction

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

●Frame format

Read register data (0x03)

Inquiries：

Name	Device Address	Function Code	Start Address	Number of Registers	CRC
Data	Addr	0x03	M	N	CRC16
Byte Length	1	1	2	2	2

Reply frame:

Name	Device Address	Function Code	Return Bytes	Return Data	CRC
Data	Addr	0x03	N*2	Data	CRC16
ByteLength	1	1	1	N*2	2

Write a single register (0x06)

Inquiries：

Name	Device Address	Function Code	Start Address	Data Value	CRC
Data	Addr	0x06	M	Data	CRC16
Byte Length	1	1	2	2	2

Reply frame:

Name	Device Address	Function Code	Start Address	Data Value	CRC
Data	Addr	0x06	M	Data	CRC16
Byte Length	1	1	2	2	2

Write multiple registers (0x10)

Inquiries：

Name	Device Address	Function Code	Start Address	Data Quantity	Byte Count	Data Value	CRC
Data	Addr	0x10	M	N	N*2	Data	CRC16
Byte Length	1	1	2	2	1	N*2	2

Reply frame:

Name	Device Address	Function Code	Start Address	Byte Count	CRC
Data	Addr	0x10	M	Data	CRC16
Byte Length	1	1	2	2	2

10.2. Examples

●Read data

The starting register address is 0x0000, and the number of read registers is 2:

Device Address	Function Code	Start Address	Number of Registers	CRC
0x01	0x03	0x0000	0x0002	0xC40B

Data response: Read register data as 0x0001,0x0002:

Device Address	Function Code	Return Bytes	Return Data	CRC
0x01	0x03	0x04	0x0001,0x0002	0x2A32

If the current command is unavailable, return an error response:

Device Address	Function Code	Error Code	CRC
0x01	0x83	0x01	0x80F0

●Write data

Register address 0x0001, write data 0x0002:

Device Address	Function Code	Start Address	Data Value	CRC
0x01	0x06	0x0001	0x0002	0x59CB

Data response:

Device Address	Function Code	Start Address	Data Value	CRC
0x01	0x06	0x0001	0x0002	0x59CB

If the current register is not writable, return an error response:

Device Address	Function Code	Error Code	CRC
0x01	0x86	0x02	0xC3A1

●Continuously writing data

Write 2 consecutive register values from register address 0x0001, 0x0002, 0x0003:

Device Address	Function Code	Start Address	Data Quantity	Byte Count	Data Value	CRC
0x01	0x10	0x0001	0x0002	0x04	0x0002, 0x0003	0xD3 A2

Data response:

Device Address	Function Code	Start Address	Data Quantity	CRC
0x01	0x10	0x0001	0x0002	0x100 8

If the written data is invalid, return an error response:

Device Address	Function Code	Error Code	Check Code
0x01	0x90	0x03	0x0C01

●Address inquiry (single machine mode)

The device address is unknown. You can use the address 0x00 to send the 03 command:

Device Address	Function Code	Start Address	Number of Registers	CRC
0x00	0x03	0x0000	0x0002	0xC5DA

10.3. ModBus register information

●Register data

The following register data adopts big endian mode, with high byte first and floating-point number sequence 1234.

The public part including registers marked with * must be supported, while other registers cannot be filled with 0.

Table 7

Name	Register	Function Code	Data Type	Access Type	Description
RS485 Slave Address	0x1100	0x03/0x06	short	W/R	1-254，default 1
RS485 Baud Rate	0x1101	0x03/0x06	short	W/R	1= 2400, 2= 9600 (default) , 3= 14400 4= 19200 5= 38400
Serial Port Configuration	0x1102	0x03/0x06	short	W/R	1= N81(default) 2 = N82 3 = E81, 4 = O81 N:No parity E:even parity check O:Odd Parity 8：Data bit 8 1：Stop position 1 2：Stop position 2

●Digital sensor

The continuous read operation of digital sensor registers 0x2000 to 0x2011 contains unsupported register functions in between, and writing 0 returns.

Register functions that are not supported except for the digital sensor registers 0x2000 to 0x2011 are returned in error code 0x01 format.

The decimal and unit occupy 2 bytes, with the high byte representing the decimal digits and the low byte representing the unit value. Please refer to the unit information.

Table 8

Name	Register Address	Function Code	Data Type	Access Type	Description
Data Version and Device Type	0x2000	0x03	short	R	High byte: data version, Low byte: device type Data version: 0x01 Device Type: 0x36
Sludge Concentration value	0x2001	0x03	short	R	Range：0-9999
Decimals and Units	0x2002	0x03	short	R	Decimal Places：0 Unit：Refer to Table 9
Temperature	0x2003	0x03/ 0x06	short	W/R	Range：-100~1100
Decimals and Units	0x2004	0x03/ 0x06	short	W/R	Decimal Places：1 Unit：℃
Suspended solids sludge concentration factor	0x2005	0x03 /0x06	short	W/R	Range：1-1000
Decimals and Units	0x2006	0x03	short	R	Decimal Places：2 Unit：none
Temperature Mode	0x200C	0x03/ 0x06	short	W/R	1: Automatic (default) 2: Manual

Name	Register Address	Function Code	Data Type	Access Type	Description
Error code	0x200D	0x03	long	R	Reference 10.5 Error code
Calibration Status	0x200F	0x03	short	R	0: Not calibrated 1: Calibrated
Filter Coefficient	0x2011	0x03/ 0x06	short	W/R	0 ~ 9:
Restore Factory Settings	0x2020	0x06	short	W	0x01
Electrode calibration status	0x3000	0x03	short	R	0x0000: Successfully calibrated 0x0001: Calibration not yet completed 0x0002: Standard solution information not received or not available 0x0003: Signal instability or signal out of range 0x0004: Slope or bias exceeds allowable range
Standard solution sludge concentration value	0x3001	0x03	short	R	If the standard solution is 100mg/L, send decimal 100
Electrode Calibration	0x3002	0x06	short	W	0x0001: First point electrode calibration 0x0002: Second point electrode calibration
Exit calibration	0x3003	0x06	short	W	0x01 exits calibration

Name	Register Address	Function Code	Data Type	Access Type	Description
					state
Manual scraping brush	0x3004	0x06	short	W	0x55
Automatic scraping time	0x3005	0x03/ 0x06	short	W/R	Time interval for sending （1、5、15、30、60（1h）、240（4h）、720（12h）、1440（1D）、4320（3D）、10080（7D）Unit：min)

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10.4. Calibration process

Electrode register 0x3001 writes calibration solution information.

Write 0x0001 to electrode register 0x3002 to enter the first point calibration state of the sensor.

Write 0x0002 to the electrode register 0x3002, causing the sensor to enter the second point calibration state.

Read the calibration status of electrode register 0x3000 and check if the current calibration is completed.

Entering the calibration state for more than 5 minutes without successful calibration, or register 0x3003 receiving an exit calibration instruction, the electrode exits the calibration state.

7.5 Unit information

Table 9

Unit	Data	Unit	Data
℃	0x00	℉	0x01
mV	0x02	pH	0x03
uS/cm	0x04	mS/cm	0x05
ppm	0x06	ppt	0x07
mg/L	0x08	g/L	0x09
ug/L	0x0A	%	0x0B

Unit	Data	Unit	Data
hpa	0x0C	g/kg	0x0D
MΩ*cm	0x0E	mmHg	0x0F
NTU	0x10	uA	0x11
mA	0x12	A	0x13
mbar	0x14	Ω	0x15
KΩ	0x16	MΩ	0x17

10.5. Error code

The Error code consists of 32 bits of data, each representing a type of fault.

Error code	Description
Bit0	Storage unit exception, write data failed
Bit1	Temperature sensor abnormal, out of range
Bit2	Abnormal sensor probe, out of range
Bti3	Not calibrated, check if the sensor has completed the calibration operation
Bit4-Bit31	reserve