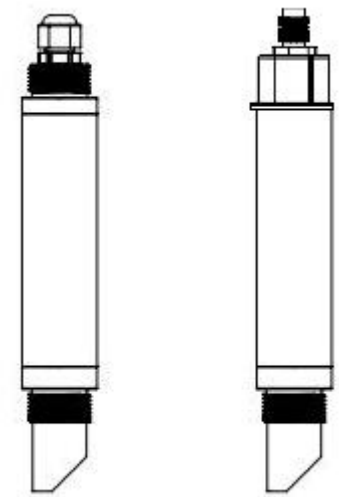
Turbidity Sensor



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Preface

- Thank you for purchasing our product.
- This manual is about the various functions of the product, wiring methods, setting methods, operating methods, troubleshooting methods, etc.
- Please read this manual carefully before operation. Use this product correctly to avoid unnecessary losses due to incorrect operation.
- After you finish reading, please keep it in a place where it can be easily accessed at any time for reference during 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.
- The content of this manual is strictly prohibited from being reprinted or copied.

Version

U-SUP-ADU1310 -EN4

Safety Precautions

For the safe operation of this product, please strictly follow the outlined safety precautions.

About this manual

- Please ensure the instrument operators have a careful reading of this manual.
- Prior to operation, please study this manual in detail to ensure a thorough comprehension of the device's functionality.
- This manual only describes the product's functions. The responsibility for the device's suitability for any special or personalized purpose lies solely with the operator.

Precautions for product protection, safety, and modification

- For your safety and the normal operation of the product and its controlling systems, the guidelines and precautions specified in this manual are supposed to be fully observed. Operating the instrument in ways not specified in this manual may compromise its protective features. Our company shall not be liable for any malfunctions or accidents resulting from non-compliance with the precautions described.
- When equipping the product and its controlling systems with lightning protection or separate safety protection circuits, it needs to be implemented by other devices.
- If you need to replace components or fittings of the product, please use the model specified by the company.
- This product is not designed for use in systems directly related to personal safety, such as nuclear power facilities, radioactive equipment, railway systems, aviation equipment, marine equipment, and medical equipment. If applied, it is the user's responsibility to implement additional equipment or systems to ensure personal safety.
- Do not modify this product.
- The following safety symbols are used in this manual:



Hazard: Failure to take appropriate precautions may result in serious personal injury, product damage, or major property loss.



Warning: Pay special attention to critical information related to the product or specific sections of this user manual.



- Confirm whether the supply voltage is consistent with the rated voltage before operation.
- Do not use the instrument in a flammable and combustible or steam area.
- To prevent electric shock and operation errors, ensure proper grounding protection is in place.
- Thunder prevention engineering facilities must be well managed: the shared grounding network shall be grounded at the correct electric level, shielded, with wires properly routed, and an SPD surge protector applied as needed.
- Some internal components may carry high voltage. To avoid the risk of electric shock, do not open the front square panel unless it is being handled by trained personnel or maintenance staff authorized by our company.
- To avoid electric shock, disconnect the power before performing any checks.
- Check the condition of the terminal screws regularly. If loose, please tighten them before use.
- Unauthorized disassembly, modification, or repair of the product is not allowed, as it may lead to malfunctions, electric shock, or fire hazards.
- Wipe the product with a dry cotton cloth. Do not use alcohol, benzine, or other organic solvents, and avoid exposing the product to any liquids. If the product falls into the water, please cut off the power immediately to prevent leakage, electric shock, or fire hazards.
- Please check the grounding protection regularly. Do not operate the product if you think that the protection, such as grounding protection and

fuses, is inadequate.

- 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; failure to do so may damage the product's protective devices.



- Do not use the instrument if it is found damaged or deformed upon opening the package.
- Prevent dust, wire ends, iron fines, or other objects from entering the instrument during installation, as this may cause abnormal operation or failure.
- During operation, to modify the configuration, signal output, startup, stop, and operation safety shall be fully considered. Improper operation may lead to failure and even destruction of the instrument and control equipment.
- Each part of the instrument has a certain service life, which must be maintained and repaired regularly for long-term use.
- If the product comes to the end of its service life, it should be disposed of as industrial waste as a way of environmental protection.
- Disconnect the instrument when it is not in use.
- If you find smoke from the product, smell an 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 terms beyond the scope of this product warranty.
- This company is not responsible for damage to the instrument, loss of parts, or unpredictable damage caused directly or indirectly by improper operation by the user.

No.	Items	Quantity	Note
1	Turbidity Sensor	1	
2	User manual	1	
3	Certificate of Conformity	1	

After opening the box, please confirm the scope of delivery before starting the operation. If you find that the model and quantity are incorrect or there is physical damage to the product's appearance, please contact us.

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1 Overview

1.1 Introduction

The low-range turbidity sensor is an advanced instrument designed specifically for the precise measurement of low turbidity in high-clarity water. It operates on the optical scattering principle (typically the 90°scattered-light method) and adopts digital signal processing. The instrument provides highly accurate and stable detection of trace suspended particles in water, making it ideal for applications requiring exceptionally high water purity.

1.2 Measuring Principle

The turbidity sensor operates based on the laser 90 ° scattering method, in which a laser beam is emitted from the air into the water surface perpendicularly. As the laser passes through the water, suspended particles scatter the light. The sensor in the water detects the scattered light intensity at a 90 ° angle relative to the incident beam and converts the scattered light intensity into a turbidity value according to its calibration curve.

1.3 Features

- Compact design for easy system integration.
- Simple construction for convenient cleaning and maintenance.
- Beveled optical window to minimize bubble adhesion.
- Sealed structure providing resistance to water ingress and high pressure.
- IP68-rated for submersible installation.

2 Technical Parameters

Table 1 Technical parameters

Measured variables	Turbidity
Measurement methods	Laser 90° scattering method (laser light source)
Light source	860 nm laser
Measurement range	(0~100) NTU
Accuracy	2% or ± 0.05 NTU (whichever is greater) (Based on Formazin primary standard solution at 25 °C)
Resolution	0.00 1 NTU
Repeatability	≤1%
Indication stability	≤1.5%
Zero offset	≤1.5%
Response time	T_{90} ≤ 120 seconds
Analog output	(4~20) mA, configurable to match the measurement range
Communication	RS-485 interface, Modbus-RTU
Power supply	(9~28) VDC
Power consumption	≤ 5 W
Sample flow rate	(100~1000) mL/min (500 mL/min recommended)
Pressure rating	≤ 1 MPa
Operating temperature	(-5~45) ℃ (non-freezing)
Storage temperature	(-20~60) ℃
Calibration method	Factory-calibrated with the default calibration curve; Single-point calibration, Formazin two-point calibration, and customized 2–6-point calibration
Material	Housing: 316LSS or 304SS Seal ring: EPDM
Protection level	IP68 (IP65 for cable)

3 Structure and Dimensions

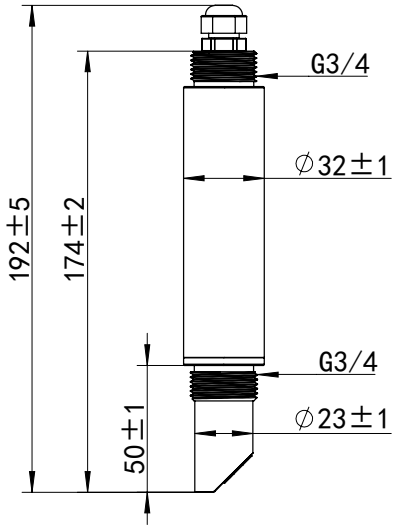


Fig.1 Dimensions (unit: mm, threaded side)

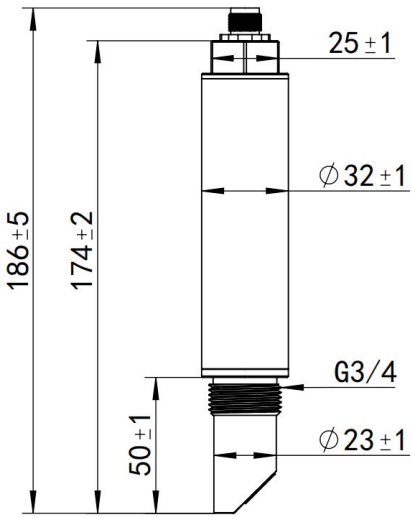


Fig.2

Fig.3 Dimensions (unit: mm, wrench flats)

4 Installation

4.1 Installation Notes

- Do not perform installation while water or power is on.
- The water pressure at the inlet should be kept below 0.6 MPa.
- The flow rate should be within the range of (100~1000) mL/min, with 500 mL/min recommended.
- The water inlet must remain continuously supplied with water; intermittent flow is not allowed.

4.2 Installation Method

(1) Pipeline Installation

Fix the sensor onto the mounting bracket via the G3/4 threads located at the front or rear of the sensor.

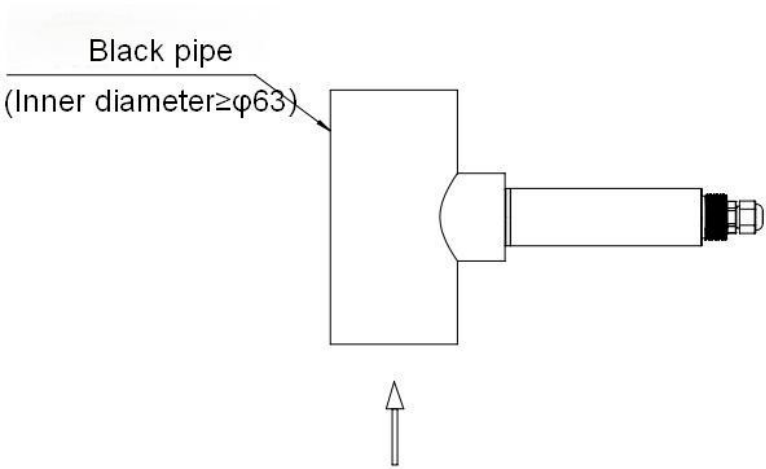
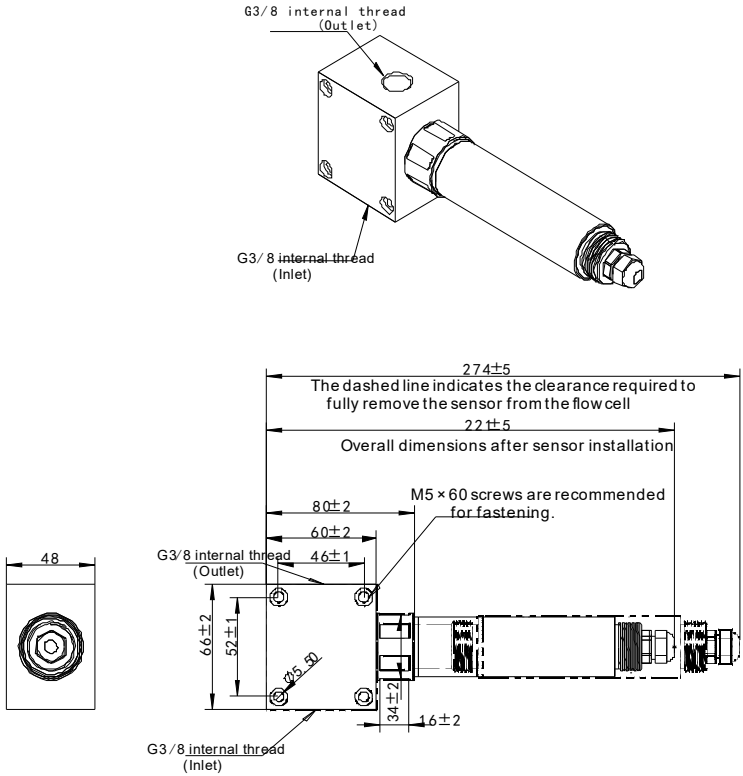


Fig.4 Installation diagram

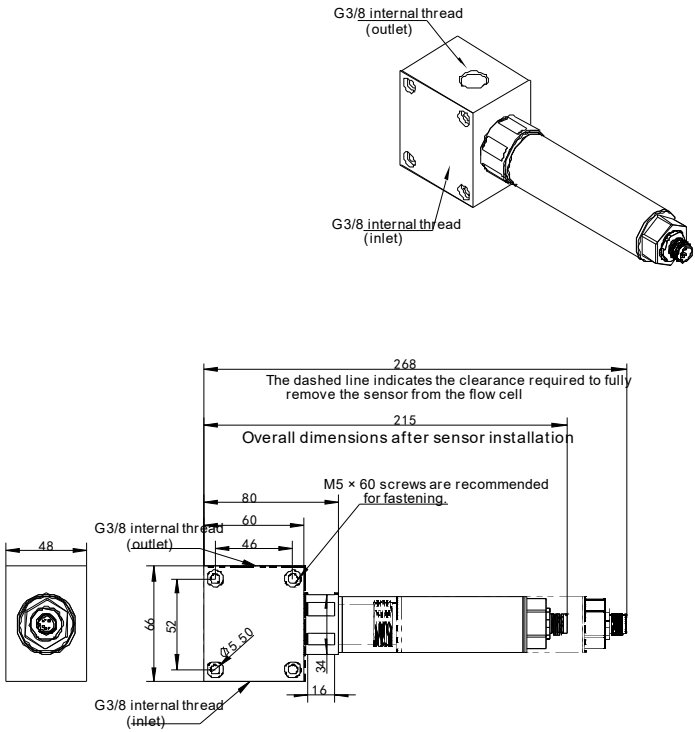
(2) Flow cell installation

The PEEK Flow cell is optional and its installation diagram is shown below:



Note: the installation method is shown above (Sensor is horizontal)

Fig.5 Flow cell installation diagram (thread side)



Note: the installation method is shown above
(Sensor is horizontal)

Fig.6 Flow cell installation diagram (wrench flats)

5 Electrical Connection

Note: Please carefully follow the instructions to finish the electrical connection; otherwise, the sensor may be damaged.

(1) Direct lead type

The sensor adopts a 6-core cable. The sensor cable definition is shown in the figure below:

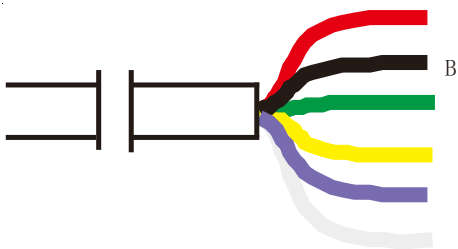


Fig.7 Cable diagram

Table 2 Cable definition

No.	Color	Definition
1	Red	(9~28)V DC+
2	Black	(9~28) V DC-
3	Green	RS485 output A
4	Yellow	RS485 output B
5	Purple	(4~20) mA output +
6	White	(4~20) mA output -

(2) Circular Connector type

The sensor with circular connector type features M12-6 pin connector.

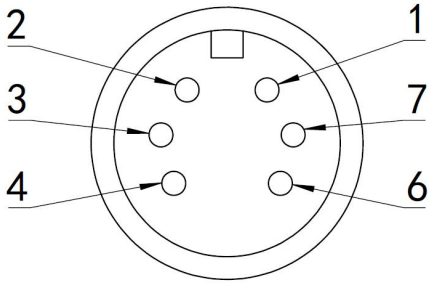


Fig.8 Connector diagram

Table 3

No.	Definition
1	(9~28)V DC+
2	RS485 output A
3	(9~28) V DC-
4	RS485 output B
5	(4~20) mA output +
6	(4~20) mA output -

6 Calibration

The sensor is generally factory-calibrated before shipment and ready for use upon delivery.

To maintain measurement accuracy, regular calibration of the conductivity sensor is recommended.

6.1 Preparation of Calibration Standards

A new turbidity calibration standard is recommended every 1–2 months.

Calculation of stock solution volume:

Where:

$$\mathrm{V}stock = \frac{\mathrm{V}\ total\ \times \mathrm{C}\ required}{4000}$$

4000: Concentration of the stock standard solution (NTU)

Where:

- V_{stock}: Volume of stock standard solution (mL)
- V_{total}: Final volume of the prepared standard (mL)
- $C_{required}$: Required turbidity concentration (NTU)
- 4000: concentration of the stock standard solution (NTU)

The 4000 NTU stock standard solution is diluted with zero-turbidity water to obtain the required concentration.

Example: Measure 100 mL of the 4000 NTU stock standard solution, transfer it to a volumetric container, and dilute with zero-turbidity water (deionized water with turbidity below 0.5 NTU) to a final volume of 1 L. The resulting solution has a turbidity of 400 NTU.

Storage and Handling Requirements

(1) The 4000 NTU stock standard solution should be stored in a refrigerator at (4–8)°C, protected from light. The shelf life is 1 year.

(2) Standard solutions with turbidity levels above 400 NTU should be refrigerated at (4–8)°C and protected from light. Solutions below 400 NTU should be prepared immediately before use.

(3) Throughout the specified period of use, the measured turbidity should remain

within ±3% of the nominal concentration.

(4) All instruments and containers used for testing should be thoroughly cleaned. Care should be taken to prevent deionized water or solid particles (such as dust) from entering the standard solution.

6.2 Calibration Procedure

For detailed calibration steps, refer to the calibration procedure in the appendix or the operating instructions for the connected transmitter.

7 Fault Analysis and Troubleshooting

7.1 Routine Maintenance

(1) Regularly check whether the water inlet and outlet are normal.

(2) Clean the sensor light window and the inside of the flow cell regularly.

(3) Regularly compare the measurement accuracy. If the measurement error exceeds the requirements, the sensor needs to be recalibrated.

7.2 Troubleshooting

For common equipment malfunctions, please refer to the table below for troubleshooting. If the problem persists, please contact our company.

Table 4 Troubleshooting

Troubles	Troubleshooting	Solutions
RS485 communication failed.	The signal cable is not connected properly.	Reconnect the signal cable after a power failure.
	Sensor damage	Contact our company
Abnormally high turbidity (Excluding water source issues)	Internal contamination of equipment	Clean the internal water system and sensors of the cleaning equipment (operators must receove relevant operating training).
Turbidity value too low	Light source damaged	Contact our company
Equipment leak	Excessive water pressure	Control the water pressure within 1 MPa

8 Warranty and After-Sales Service

Our company guarantees that any product quality issues arising during the warranty period will be covered under our unconditional "Three Guarantees" policy, which includes free repair, replacement, or return. All non-customized products are eligible for return or exchange within 7 days (excluding products damaged due to misuse). For customized products, the warranty terms specified in the contract shall apply.

Disclaimer

The following situations are not covered under the "Three Guarantees" policy, even during the warranty period:

(1) Product malfunctions caused by improper use by the customer.

(2) Product malfunctions resulting from unauthorized disassembly, repair, or modification by the customer.

Appendix A Communication Protocol

A.1 Protocol Information

(1) Protocol Specification

Parameter	Description
Communication Interface	RS485
Protocol	Modbus RTU
Serial Port Settings	9600, N, 8, 1 (default)
Slave Address	0x01 (default)

(2) Function Codes

Function Code	Description	Exception Response Function Code
0x03	Read Holding Registers	0x83
0x06	Write Single Register	0x86
0x10	Write Multiple Registers	0x90

(3) Exception Codes

Exception Code	Description
0x01	The requested function is not supported or is not available in the current operating state.
0x02	The specified register cannot be written.
0x03	The specified value is invalid or outside the allowable range.

(4) Querying the Slave Address — Single-Slave Mode

If the slave address is unknown, send a function code 0x03 request using address 0x00 to query the slave address.

(5) Broadcast Commands

A request sent by the master using slave address 0xFF is treated as a broadcast command. Slaves do not return a response to broadcast requests.

A.2 Frame Format

(1) Read Holding Registers — 0x03

- Request

Field	Slave Address	Function Code	Starting Address	Quantity of Registers	CRC
Value	Addr	0x03	M	N	CRC16
Length (bytes)	1	1	2	2	2

- Response

Field	Slave Address	Function Code	Byte Count	Register Data	CRC
Value	Addr	0x03	N × 2	Data	CRC16
Length (bytes)	1	1	1	N × 2	2

(2) Write Single Register — 0x06

- Request

Field	Slave Address	Function Code	Register Address	Register Value	CRC
Value	Addr	0x06	M	Data	CRC16
Length (bytes)	1	1	2	2	2

- Response

Field	Slave Address	Function Code	Register Address	Register Value	CRC
Value	Addr	0x06	M	Data	CRC16
Length (bytes)	1	1	2	2	2

(3) Write Multiple Registers — 0x10

- Request

Field	Slave Address	Function Code	Starting Address	Quantity of Registers	Byte Count	Register Data	CRC
Value	Addr	0x10	M	N	N × 2	Data	CRC16
Length (bytes)	1	1	2	2	1	N × 2	2

- Response

Field	Slave Address	Function Code	Starting Address	Quantity of Registers	CRC
Value	Addr	0x10	M	Data	CRC16
Length (bytes)	1	1	2	2	2

A.3 Communication Examples

(1) Reading Registers

Read 2 registers; starting address 0x0000.

- Request

Slave Address	Function Code	Starting Address	Quantity of Registers	CRC
0x01	0x03	0x0000	0x0002	0xC40B

- Response

The returned register values are 0x0001 and 0x0002.

Slave Address	Function Code	Byte Count	Register Data	CRC
0x01	0x03	0x04	0x0001, 0x0002	0x2A32

- **Exception Response**

If the requested function is not available, the slave returns an exception response.

Slave Address	Exception Function Code	Exception Code	CRC
0x01	0x83	0x01	0x80F0

(2) Writing a Single Register

Write 0x0002 to register address 0x0001.

- **Request**

Slave Address	Function Code	Register Address	Register Value	CRC
0x01	0x06	0x0001	0x0002	0x59CB

- **Response**

Slave Address	Function Code	Register Address	Register Value	CRC
0x01	0x06	0x0001	0x0002	0x59CB

(3) Exception Response

If the specified register is not writable, the slave returns an exception response.

Slave Address	Exception Function Code	Exception Code	CRC
0x01	0x86	0x02	0xC3A1

(4) Writing Multiple Registers

Starting at register address 0x0001, write two register values: 0x0002 and 0x0003.

- **Request**

Slave Address	Function Code	Starting Address	Quantity of Registers	Byte Count	Register Data	CRC
0x01	0x10	0x0001	0x0002	0x04	0x0002, 0x0003	0xD3A2

- **Response**

Slave Address	Function Code	Starting Address	Quantity of Registers	CRC
0x01	0x10	0x0001	0x0002	0x1008

If the data value is invalid, the slave returns an exception response.

- **Exception Response**

Slave Address	Exception Function Code	Exception Code	CRC
0x01	0x90	0x03	0x0C01

(5) Querying the Slave Address — Single-Slave Mode

If the slave address is unknown, send the following 0x03 request using address 0x00.

- **Request**

Slave Address	Function Code	Starting Address	Quantity of Registers	CRC
0x00	0x03	0x0000	0x0002	0xC5DA

If the slave address is 0x01, the response is:

- **Response**

Slave Address	Function Code	Byte Count	Register Data	CRC
0x01	0x03	0x04	0x0001, 0x0002	0x2A32

A.4 Serial Communication Settings

Serial Communication Registers

Parameter	Register	Function Code	Data Type	Acce ss	Description
RS485 Slave Address	0x1100	0x03 / 0x06	short	R/W	1–254
RS485 Baud Rate	0x1101	0x03 / 0x06	short	R/W	1 = 2400; 2 = 9600 (default); 3 = 14400; 4 = 19200; 5 = 38400
Serial Port Configuration	0x1102	0x03 / 0x06	short	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

A.5 Register Map

A.5.1 Measurement and Configuration Registers

Parameter	Register	Function Code	Data Type	Access	Description
Data Version and Sensor Type	0x2000	0x03	short	R	High byte: data version; Low byte: sensor type; Data version: 0x01; Turbidity sensor type: 0x35
Turbidity	0x2001	0x03	short	R	Range: 0–4000
Turbidity Decimal Places and Unit	0x2002	0x03	short	R	Decimal places: 0; Unit: NTU
Temperature	0x2003	0x03	short	W/R	Range: −100 to

Parameter	Register	Function Code	Data Type	Access	Description
		/0x06			1100
Temperature Decimal Places and Unit	0x2004	0x03 /0x06	short	W/R	Decimal places: 1; Unit: °C
Turbidity Factor	0x2005	0x03 /0x06	short	W/R	Range: 1–1000
Turbidity Factor Decimal Places and Unit	0x2006	0x03	short	R	Decimal places: 2; Unit: dimensionless
Sensor Humidity	0x2007	0x03	short	R	Returns 0 if this function is not supported.
Temperature Mode	0x200C	0x03 /0x06	short	W/R	1 = Automatic (default); 2 = Manual
Fault Code	0x200D	0x03	long	R	See the fault code table.
Filter Coefficient	0x2011	0x03 /0x06	short	W/R	Set to 0 when filtering is not used.
Restore Factory Defaults	0x2020	0x06	short	W	0x01

A.5.2 Calibration Registers

Parameter	Register	Function Code	Data Type	Access	Description
Calibration Status	0x3000	0x03	short	R	0x0000 = Calibration successful; 0x0001 = Calibration not completed; 0x0002 = Calibration standard information not received or specified standard not supported; 0x0003 = Signal unstable or outside the allowable range; 0x0004 = Slope or offset outside the

Parameter	Register	Function Code	Data Type	Acce ss	Description
					allowable range
Calibration Standard Turbidity	0x3001	0x06	short	W	Standard Solution Value: Read the upper 8 bits of register 0x2002 as the number of decimal places. For example, if the number of decimal places is 1 and the standard solution value is 10.0 NTU, send the decimal value 100.
Start Calibration	0x3002	0x06	short	W	0x0001 = Start first-point calibration; 0x0002=Start second-point calibration
Exit Calibration	0x3003	0x06	short	W	Write 0x01 to exit calibration mode.
Turbidity Offset	0x3004	0x03 /0x06	short	W/R	±100 NTU
Manual Wiper Activation	0x3005	0x06	short	W	0x55
Automatic Wiping Interval	0x3006	0x03 /0x06	short	W/R	Interval in minutes: 1, 5, 15, 30, 60 (1 h), 240 (4 h), 720 (12 h), 1440 (1 d), 4320 (3 d), or 10080 (7 d)

A.6 Calibration Procedure

A.6.1 Calibration Using Standard Solutions

1. Write the turbidity value of the calibration standard to register 0x3001. Then write 0x0001 to register 0x3002 to place the sensor in calibration mode.
2. Read register 0x3000 to check the calibration status and determine whether the calibration has been completed.
3. If calibration is not completed successfully within 5 minutes after the sensor enters calibration mode, the sensor automatically exits calibration mode. The

sensor also exits calibration mode if an exit-calibration command is written to register 0x3003.

A.6.2 Offset Calibration

Write the required turbidity offset to register 0x3004.

A.7 Units

Table 5 Units reference table

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
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