Online Turbidimeter
TB200User ManualVersion: 2.0

Product OverviewThis user manual describes the installation, use, and maintenance of the online turbidimeter and explains the basic measurement principle, the design of the device, and the product features. It serves as a reference for technical personnel with knowledge of the operation and control of water quality analysis instruments.

If the user needs more information, please contact the company's technical service department.

Warranty and MaintenanceIf the warranty period has expired or the following errors occur during the warranty period, no free warranty service will be provided. The errors include, but are not limited to:

- Improper use of the product
- Installation, operation or use not in accordance with this manual
- Failure to perform maintenance of the product as prescribed by the company
- Unauthorized modification or disassembly of the product
- Repairing the product with parts not provided by the company

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Instrument IntroductionThe online turbidimeter consists of a controller and a turbidity sensor. The sensor emits an RS485 signal, which increases immunity to interference in the field. The controller has interfaces for analog, digital, switching and other outputs.

1.1 Measuring principleThe turbidity sensor works according to the international standard ISO 7027.

- The LED light source emits infrared light, which hits the particles floating in the water via the emission fiber and is scattered.
- The scattered light is directed via the receiving fiber to the photoelectric detector.
- After the photoelectric conversion, a series of signal processing and software calculations, the turbidity value of the sample is determined.

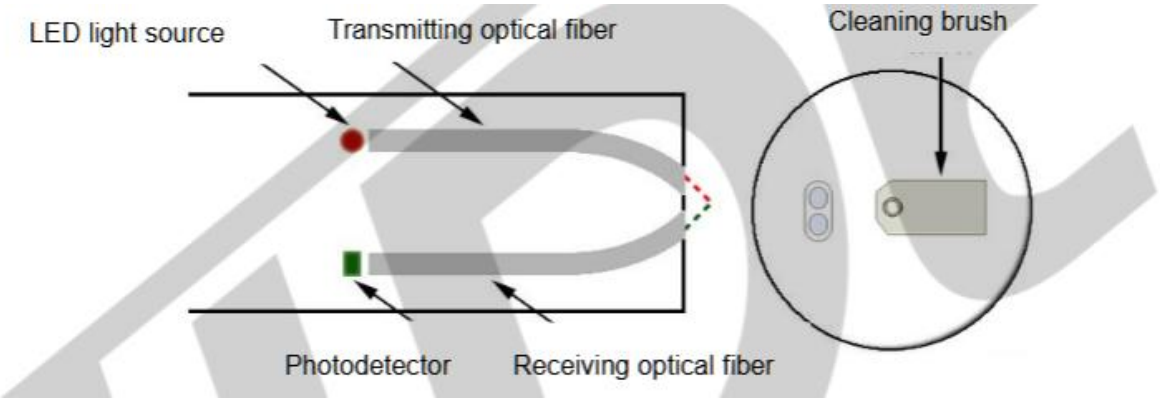

Figure 1-1: Schematic representation of the measuring principle

1.2 Technical data

Table 1-1: Technical specifications of the sensor

Turbidity Sensor Technical Specifications

Measurement parameters	**Turbidity (NTU), Temperature (℃)**
Measuring range	Turbidity: 0~100 / 500 / 2000 / 4000 NTU Temperature: 0~60 ℃
Accuracy	≤ ±2% turbidity
Repeatability	Turbidity: ≤ 1%
Resolution	Turbidity: 0.01 NTU
Zero Point Drift	≤ ±3% F.S.
Span drift	≤ ±3% F.S.
Calibration cycle	3 months
Cleaning system	Mechanical brush, automatic cleaning
Degree of protection	IP68
Supply voltage	12/24 VDC
Power Consumption	<1 W (without cleaning mode)
Communication mode	RS485 (Modbus RTU), max. baud rate 115200 bps
Temperature range	0~60 ℃
Dimensions	160 mm × ϕ40 mm
Weight	0.5 kg
Material	Stainless steel, POM
Structure	LED Light Source, Transmission Fiber, Cleaning Brush, Photodetector, Receiving Fiber

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Technical specifications of the controller

Parameters	**Specification**
Display/Resolution	4.3-inch touchscreen (color) / 480×272
Controller size	188 mm × 160 mm × 126 mm

Parameters	Specification
Power supply	85~260 V AC
Power Consumption	< 4 W
Storage Temperature	-20~70 ℃
Working temperature	-10~60 ℃
Housing material	PC, ABS
Degree of protection	IP55
Analog Output	2 × (0/4–20) mA, max load 500 ohms
Relays	3-way relay (120 V AC, 24 V DC / 1 A)
Digital Output	1 × RS485 output, 1 × RS232 output

1.3 Sensor size

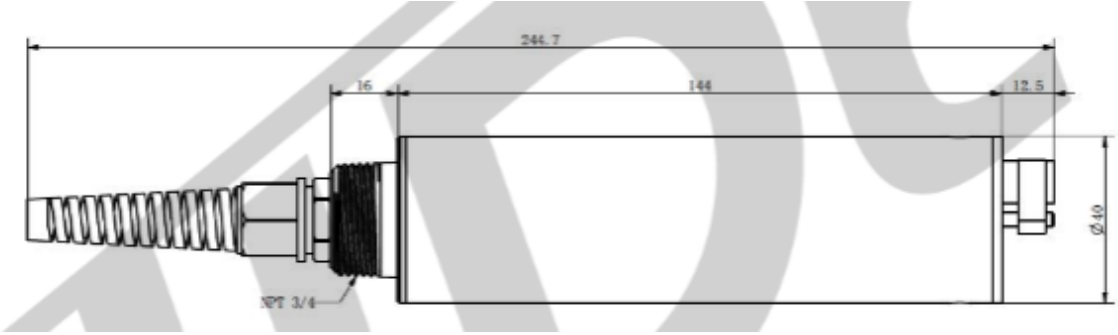

Figure 1-2: Sensor Installation Dimensions

1.4 Features

- Integrated sensor design, electromagnetically insensitive
- High-brightness infrared LED as a light source to eliminate the influence of the sample color
- Unique optical and electronic filter technology to minimize the influence of ambient light on the measurement
- Automatic cleaning by cleaning brush, significantly reduces maintenance
- Stainless steel housing, IP68 rating, suitable for various working conditions
- RS485 signal output, standardized Modbus protocol, easy integration and networking

1.5 Areas of application

- Water quality monitoring of wastewater and industrial wastewater and their outlets

- Monitoring of drinking water intake and process treatment
- Monitoring of surface and groundwater

2 Installation

2.1 Unpacking the equipmentAfter opening the package, carefully check whether the device has been damaged during transport.

- In the event of damage, document it and report the loss to the freight forwarder or company representative as well as to customer service.

2.2 Functional testThe sensor has been extensively tested before leaving the factory; only a short functional check is required before installation.

- Connect the sensor to the controller and turn on the controller.
- After power on, the controller performs a self-test and then automatically switches to the measurement surface.
- During the self-test, the cleaning brush rotates backwards one lap at a time.
- If the display shows that the sensor is operating normally, the functional check is complete.

Note:

- The cleaning brush must not be blocked.
- Be careful not to drop the sensor vertically to prevent damage to the cleaning brush.

2.3 Connecting the Sensor and Controller

2.3.1 Connecting the Turbidity Sensor via Quick Connectors

- The sensor cable has a quick connector for easy connection to the controller.
- The standard cable length is 5 m. If longer cables are required, a special cable must be ordered.

2.3.2 Hardwired Turbidity Sensor

1. With the power on, first disconnect the controller's power supply, loosen the 4 screws of the control panel and open the panel.
2. Pass the cable through the controller's locking connector and connect it to the internal connector. See Table 2-1 and Figure 2-1.
3. Lock the connector, close the panel, and retighten the screws to secure the panel.

Table 2-1: Definition of Turbidity Sensor Wiring

Serial number	Wire color	Connection definition
1	Grey	RS485_A, RS485 Input A
2	Yellow	RS485_B, RS485 Input B
3	Blue	RS485_COM, RS485 input COM
4	Black	GND_EARTH, protective conductor
5	Red	+12V_IN, +12V power supply
6	Brown	GND_IN, Mass of Power Supply

2.3.3 Controller Wiring

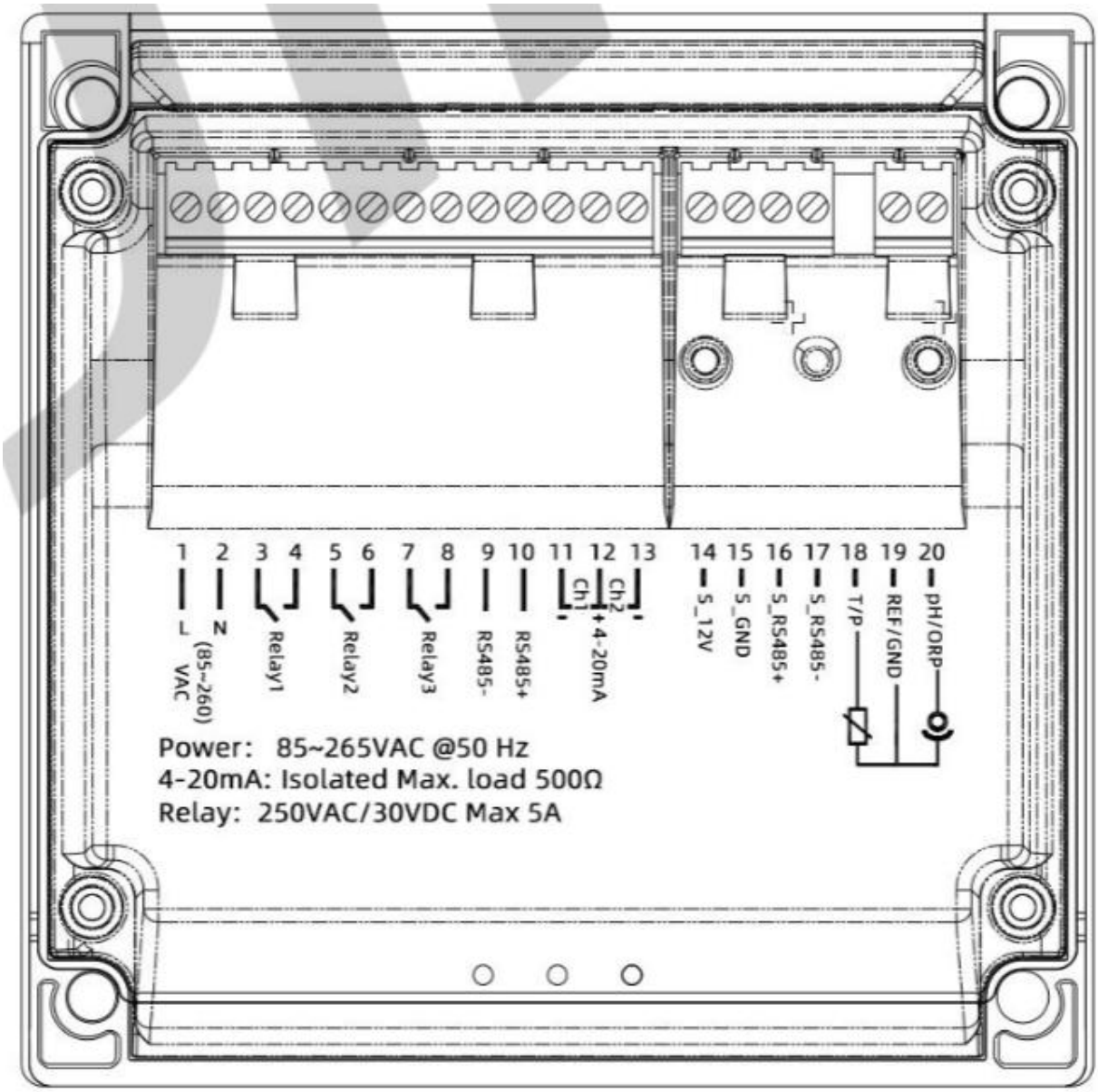

Figure 2-2 - Controller Schematic Wiring Diagram

Table 2-2: Definition of Controller Wiring

Serial number	Description	Definition
1–2	(85–265) VAC L N	AC power input of the controller
3–8	Relay 1,2,3	3-way switch output (250 VAC, 30 V DC / max. 5 A), fornormally open type
9–10	RS485	External RS485 output of the controller

Serial number	Description	Definition
11–13	4–20 mA Ch1.2	Two 4-20 mA analogoutputs, max. load 500 ohms
14–17	Sensor	Digital Sensor Connector Interface
18–20	Analog	Analog Sensor Connector Interface

2.4 Controller Installation

2.4.1 Wall mountingThe wall mounting of the controller is shown in Figure 2-3 .

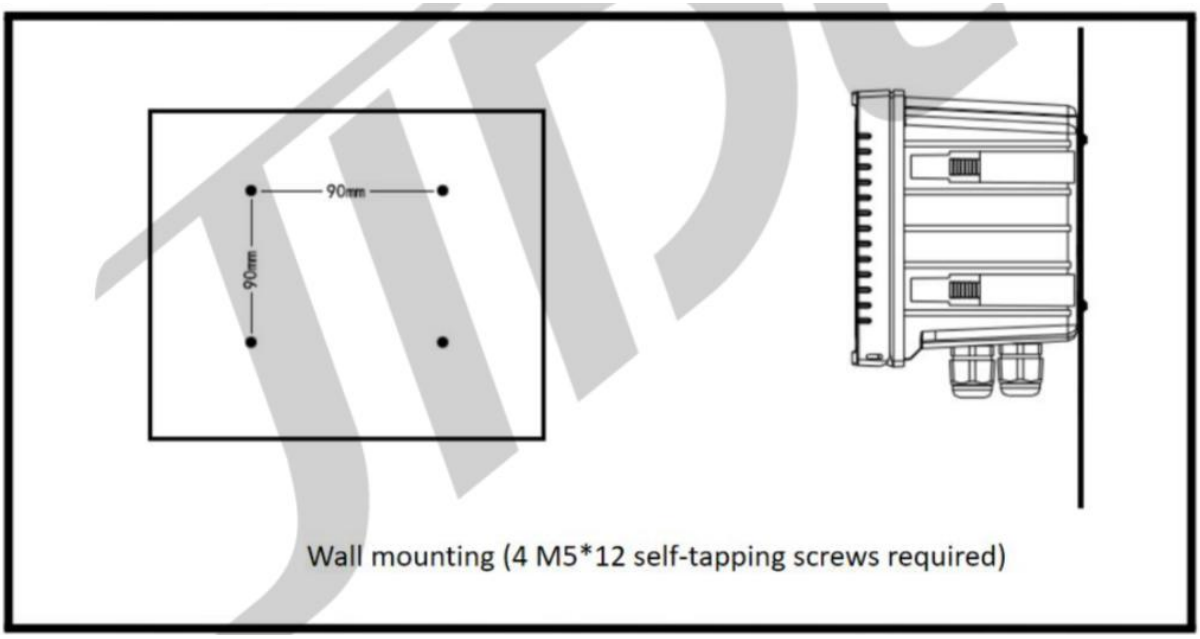

Figure 2-3 - Wall Mounting of the Controller

2.4.2 Installation in a control panelFor installation in a control panel, an appropriate hole must be provided in the panel. In addition, a mounting bracket is required, as shown in Figure 2-4 .

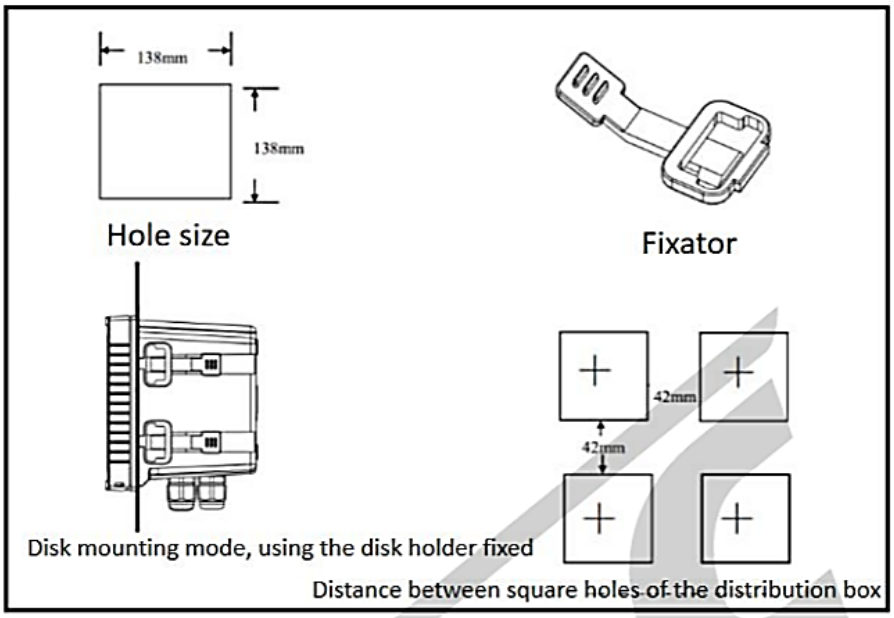

Figure 2-4 - Installation of the Controller Panel

2.5 Sensor Installation

- The sensor end is equipped with an **NPT 3/4 thread** , suitable for various applications such as pipelines, basins, rivers and lakes.
- **Note:** Vertical drop of the sensor during installation may damage the cleaning brush and internal components.

2.5.1 Piping Installation

- There are two options for pipe mounting: **45° installation** and **90° installation**, as shown in **Figure 2-7** and **Figure 2-8** .

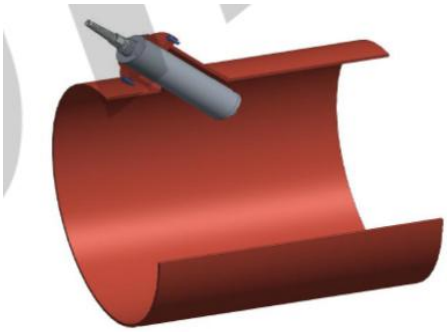

Figure 2-7: Pipe installation at a 45° angle

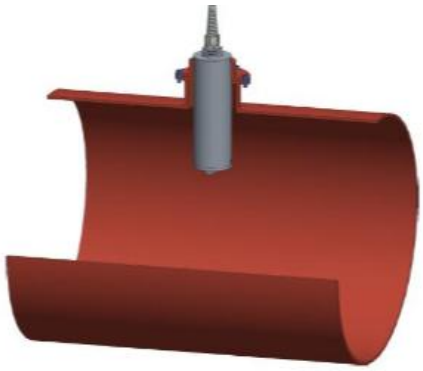

Figure 2-8: Pipe installation at a 90° angle

To ensure a more accurate and stable measurement during pipe installation, the following conditions should be observed:

- The sensor end must be firmly fixed via thread or flange.
- Install the sensor in a pipe with a diameter of at least 30 cm.
- Always mount the sensor in the **upward flowing pipeline** , not in the downward flowing pipeline.
- In the case of horizontal pipe installation, it must be ensured that the front 100 mm of the sensor is completelyimmersed in water.
- The sensor should be installed at least **1.5 m** or **three times the pipe diameter** downstream of the pump, valve or pipe bend.

2.5.2 Installation in open ducts and basins

- When mounted in open ducts or pools, a bracket is required that attaches to the pool wall, as shown in **Figure 2-9** .
- The bracket should be dimensioned according to the local conditions.

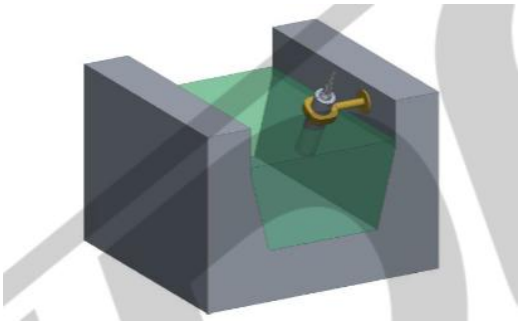

Figure 2-9: Installation in open ducts and basins

To ensure a more accurate and stable measurement when installed in rivers, open canals or basins, the following conditions should be observed:

- The sensor end should be installed at least **10 cm abovethe bottom of the basin or river** to avoid interference from deposits.
- Pay attention to the **orientation of the sensor in the direction of flow (downstream)** to reduce the risk of collision.
- In the presence of large objects such as leaves, a **protective net** should be placed around the sensor.

2.5.3 Installation in water tanks

For mounting in water tanks, a **fixed bracket is** required that attaches to the tank cap, as shown in **Figure 2-10**.

The bracket should be adapted to the local conditions, and the tank opening must be large enough for the sensor to be inserted through the mounting hole.

Figure 2-10: Installation in the water tank

To ensure a more accurate and stable measurement when installed in the water tank, the following conditions should be observed:

- The sensor end should be installed at least **10 cm abovethe bottom of the tank** to avoid interference from possible deposits.

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3 Controller operation

3.1 Introduction of the controller

- The controller has an extensive external interface that enables easy networking of sensors, remote control, fault diagnosis and other functions.

3.2 Display Interface

- After switching on, the controller first switches to the **self-test interface**.
- After 20-30 seconds, the controller displays the **numeric display surface** .
- This displays the **sensor status**, **measurement data**, **system time**, and other information.

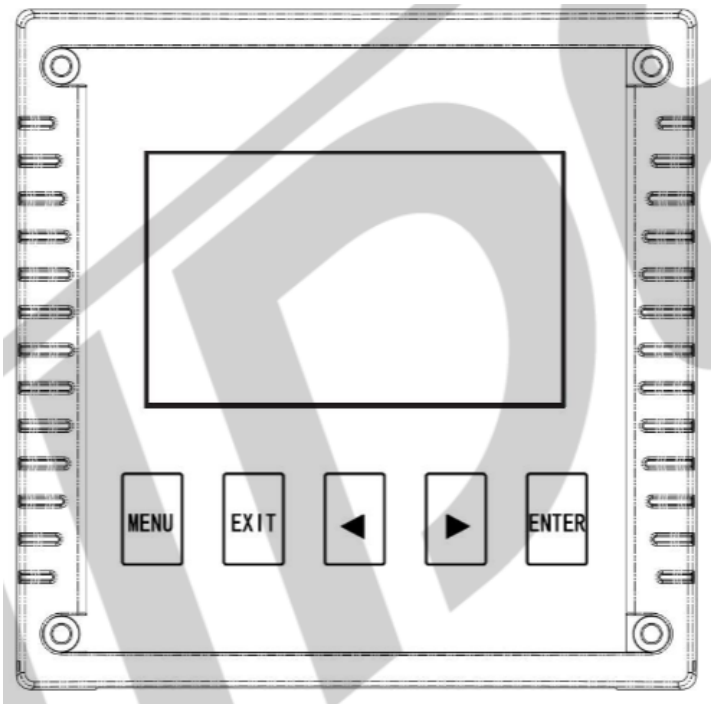

Figure 3-1: Display Interface

Controller button function

Identification	Button Name	Function / Description
MENU	Menu button	Enter the menu below the "Measurement Surface"
EXIT	Back button	Return to the previous interface

Identification	Button Name	Function / Description
Left Displacement Key	Left button	- In the menu: Select the previous menu item (cyclic)- In the submenu: Select the previous parameters (cyclic)
Right Displacement Key	Right button	- In the menu: Selection of the next menu item (cyclic)- In the submenu: Selection of the next parameters (cyclic)
ENTER	Confirmation button	Enter the submenu under "Menu" or confirm changes

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3.3 Controller Settings

- Click on "Controller Menu" **on the numeric display** to open the controller menu.
- When requesting a password, the default password is: **111111**.
- In the menu, the user can select appropriate submenus to set parameters of the controller or to retrieve information.
- **Note:** Changes to the controller's external communication baud rate will not take effect until a **reboot** .

Figure 3-2 Controller Menu Interface

Table 3-1: Overview of Controller Menu Functions

Controller Submenu	Functional description
Device Information	Displays information about the controller and sensor, including model, serial number, date of manufacture, hardware and software version.
Calibration	Calibrate the sensor (see Section 4.2).
Parameter Setting	Adjustment of the measurement range and the number of moving averages.
Analog Quantity	Adjustment of analog outputs.
Relay	Adjustment of relay outputs.
Alarm Settings	Setting the upper and lower alarm limits.
Communication Settings	Setting the external communication address and baud rate of the controller.

3.4 Sensor Settings

- In the menu**, use the left or right button** to select "Parameter Setting" and press **ENTER** to open the submenu.
- Here, set the measurement range and the number of moving averages according to the requirements on site (recommended: **10 times**).

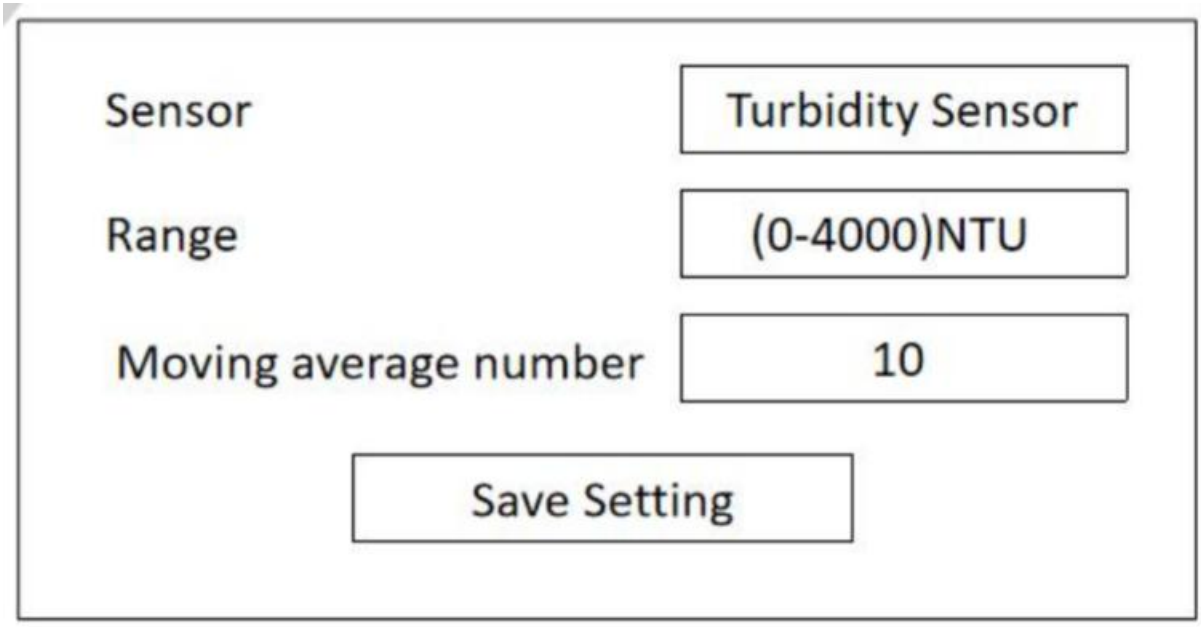

Figure 3-4: Parameter Settings

Analog Output

- In the menu, **use the left or right button** to select "Analog Quantity" and press **ENTER** to open the submenu for the analog configuration.

Settings:
a. **Select working mode:**

- "Disable"
- Turbidity
- "Temperature"

b. **Set analog values:**

- Set the values for **4 mA** and **20 mA** according to the turbidity or temperature readings on site.
- After the setting, click on **"Save Settings"** to save the changes.

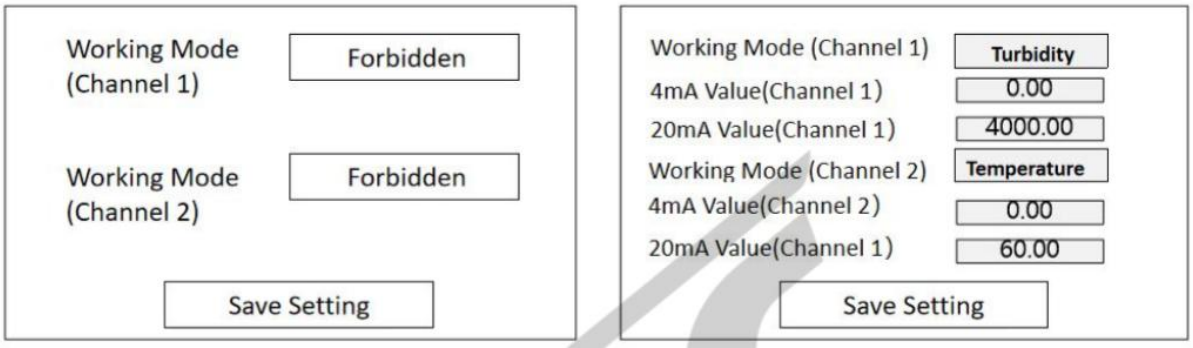

Figure 3-5: Setting the analog sizes (A and B)

Relay Settings

- From the menu, **use the left or right button** to select "Relay" and press **ENTER** to open the relay configuration submenu.

Settings:
a. **Select working mode:**

- "Disable"
- Fault
- "Upper Limit"
- "Lower Limit"
- "Manual"

b. **Setting parameters:**

- Select the relay working mode and the corresponding parameters according to the requirements on site.

- After the setting, click on **"Save Settings"** to save the changes.

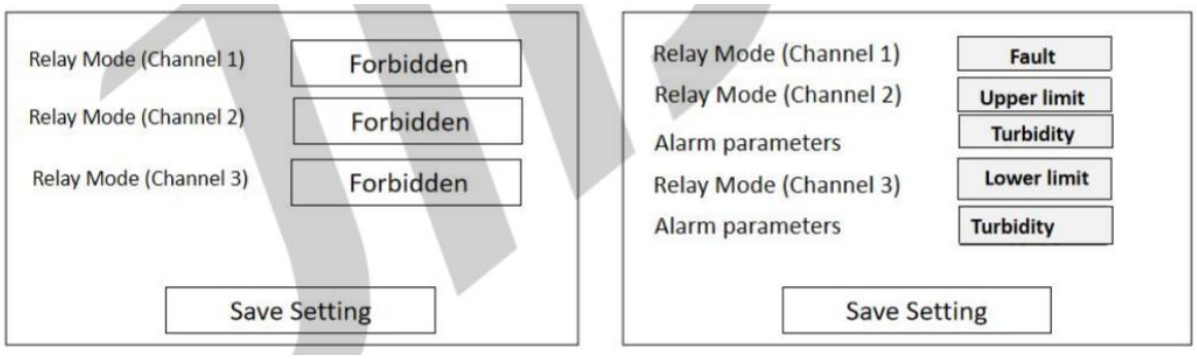

Figure 3-6: Relay Settings (A and B)

Alarm Settings

In the menu**, use the left or right button** to select "Alarm Setting" and press **ENTER** to open the Alarm Settings submenu.

Set the **upper** or **lower alarm limit** according to the requirements on site.

After the setting, click on **"Save Settings"** to save the changes.

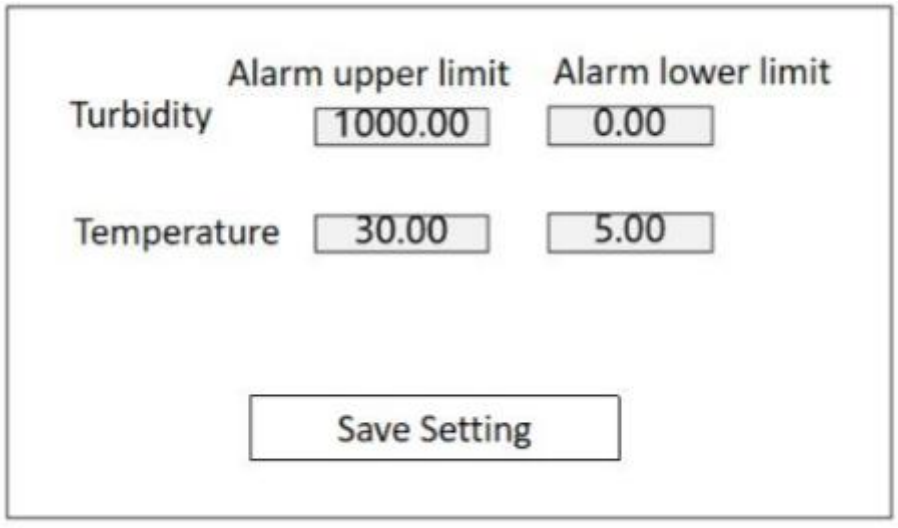

Figure 3-7: Setting the alarm limits

4 Maintenance and troubleshooting

4.1 Routine maintenance

- **Cable check:** Check that all signal and power cables are intact. Damaged cables can prevent the normal operation of the device.
- **Visual inspection:** Inspect the controller and sensor housings for damage or corrosion.
- **Device cleaning:** Clean the controller and sensor regularly. Take special care to carefully clean the **measuring window** with water and a cloth.
- **Replace the cleaning brush:** The cleaning brush should be replaced regularly.
    - Brush strip: **1 year**
    - Brush seat: **3 years**

4.2 Calibration

- During operation, turbidity sensors can be affected by device aging, changes in the measurement particles or the installation environment. To compensate for these effects, the sensor should be calibrated regularly (surface water: **every 3 months**).

Step 1: Entry into the calibration surface

- In the measurement interface**, press the sensor menu button**.
- Enter password **"111111"** to enter the sensor menu.
- Next, click on **"Calibration"** to open the calibration interface, as shown in **Figure 4-1** .

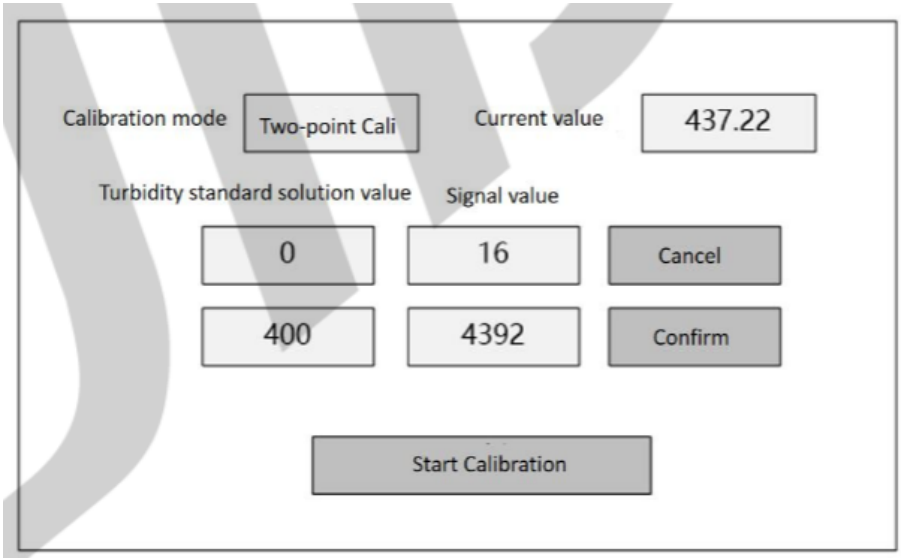

Figure 4-1: Calibration surface

Three calibration modes are available:

1. **One-point calibration:**

- Offset calibration only.
- Suitable for **quick field calibrations** after a multi-point calibration has already been performed.

2. **Two-point calibration:**
    - Linear calibration.
    - Applicable to the range **0-100 NTU.**
3. **Three-point calibration:**
    - Nonlinear calibration.
    - Suitable for measurements above **100 NTU.**

Step 2: Calibration – Data Acquisition

- Prepare the **standard solution** and dip the sensor into it.
- Use a special calibration cup **or a** large cup **during calibration**.
- Place the sensor **at least 10 cm abovethe ground**, the bottom should be black.
- Slowly tilt the sensor into the default solution and wait **30 seconds** for the signal value to be stable before starting calibration.
- Highly concentrated turbidity solutions can lead to rapid sedimentation. In this case, a **stirrer** is required to ensure the uniformity of the solution.

Figure 4-2: Schematic representation of the calibration

Step 2: Calibration – Data Acquisition

- Observe the **signal value** in the Signal Value field.
- Wait for the value to be stable: **difference between maximum and minimum value within one minute < 20**.
- Click on the corresponding **"Confirm" button** to stop the data update.
- Enter the **turbidity value of the standard solution** in the "Turbidity Value" input field.

- Repeat this process for the next calibration stage.

Step 3: Calibration confirmation

- After verifying that the signal values are normal and the data collection is complete, click **"Start Calibration"** to complete the calibration.
- The calibration values are stored in the sensor, and at the same time the **temperature data is automatically recorded** during calibration.

Temperature calibration

- Click on "Temperature" **in the calibration interface** (see Figure 4-3).
- No selection of calibration mode is required.
- Immerse the sensor in the solution.
- After stabilizing the temperature display **, click on "Confirm".**
- Enter the **default temperature value** of the solution in the temperature field.
- Click on **"Start Calibration"** to complete the temperature calibration.

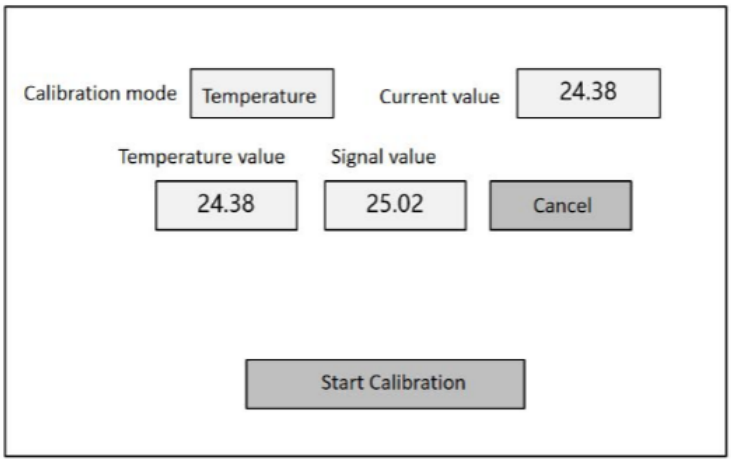

Figure 4-3: Temperature calibration

4.3 Cleaning and storing the sensor

- **Cleanliness of the measurement window:** A clean measurement window is crucial for correct readings.
- **Regular checking:** Check the measuring window regularly for dirt or damage to the cleaning brush.
- **Cleaning:**
    - Gently wipe off **light dirt that the brush does not remove with** damp lens paper or cloth.

- Poorly soluble contaminants can be cleaned with a **low acid concentration** .
- **Do not use:** Alcohol or other organic solvents.

- **Storage:**
  - Store the sensor in a cardboard box when not in use.
  - Protect from light, store at **room temperature** .
  - Make sure that the measuring window and cleaning brush **are not crushed**.

Replacement of the cleaning brush (brush strip)

1. Loosen the screw with a **1.5 mm Allen key** and remove the cleaning brush.

Figure 4-4: Removing the cleaning brush

- **Step 2:** Remove the old brush strip and insert the **new brush strip** .

- **Step 3**: – Installation and attachment of the cleaning brush

- Install and reattach the cleaning brush (or a new cleaning brush) to the drive shaft along with the replaced brush strip. Then tighten the screw to complete the assembly.

Figure 4-6 – Schematic installation of the cleaning brush

4.5 Error Handling

Problem 1: Communication malfunction – controller shows "communication error"

Possible causes:

- Power supply or cable connection faulty
- Incorrect baud rate or address conflict

Method of remedy:

- Check power supply
- Check RS485 wiring (do not swap A/B)
- Check that baud rate and communication address are set correctly

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Problem 2: The reading shows 0 and doesn't change

Possible causes:

- Internal light source defective
- Measuring window heavily soiled

Method of remedy:

- Cleaning the sensor surface
- If you still see 0 → contact customer support

Problem 3: Readings are unstable

Possible causes:

- Air bubbles in the measuring range
- Incorrect calibration
- Interference in the measurement signal

Method of remedy:

- Ensure that there are no air bubbles in front of the measuring optics
- Recalibrate the sensor
- Contact → customer service if you continue

Problem 4: Measured value suddenly rises sharply; Cleaning does not help

Possible causes:

- Foreign objects have become entangled in the cleaning brush
- Cleaning brush has fallen off

Method of remedy:

- Remove the sensor and clean it thoroughly
- If the brush has fallen off → replace the brushes

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5 Reagents Preparation

1. Zero turbidity water

Filter distilled water through a **0.2 µm filter** and collect it in a bottle that has been rinsed twice with filtered water.

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2. 400 NTU standard turbidity solution

1. **Dissolve** $(N_2H_4)H_2SO_4$0.500 g hydrazine sulphate **in** 50 mL of water
2. **Dissolve 5,000 g of hexamethylenetetramine** $(CH_2)_6N_4$in **50 mL of water**
3. Put both solutions in a **1000 mL volumetric flask**
4. **Let stand** for 24 hours at (25 ± 3 °C)
5. Fill up with water to form the mark and mix well

→ result: **400 NTU,** shelf life of 1 month

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3. 4000 NTU standard turbidity solution

1. **Dissolve** 5.00 g hydrazine sulphate **in** 400 mL of water

2. **Dissolve 50.00 g of hexamethylenetetramine** in **400 mL of water**
3. Put both solutions in a **1000 mL volumetric flask**
4. Fill up with water to form the mark and mix well
5. **Let stand for 48 h at (25 ± 3 °C)**

→ result: **4000 NTU,** shelf life of 1 month

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4. Production of other concentrations (example: 2000 NTU)

- Shake 4000 NTU stock solution well
- **Transfer 250 mL** of it into a **500 mL volumetric flask**
- Top up with water to the mark
- Mix vigorously

→ Result: **2000 NTU Standard Solution**

Storage of reagents

- At **room temperature (28 °C):**
  - **2 NTUs**: max. **Shelf life** of 3 days
  - **8 NTU** and **20 NTU:** max. **Shelf life** of 10 days
- At **37 °C** , low turbidity standards deteriorate significantly after **just 1 day**
- **Glass containers** are more stable than plastic
- **Recommended:** Store in a cool place, **< 10 °C**, preferably in glass bottles
- The lower the turbidity, the faster the turbidity decreases during storage
- The higher the temperature, the faster the degradation takes place

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⚠️ **Warning – Safety Notice**

Hydrazine sulfate is toxic and carcinogenic.
When handling, it is essential to observe protective measures:

- Gloves
- Safety Glasses
- Laboratory fume hood
- No skin contact, no inhalation

6. Modbus communication protocol of the sensor

6.1 Protocol description

Tabs

Registration address	Message Address (Hex)	Data Type	R/W	Length	Description
40001	0x0000	Unsigned Int	R	1	Alarm code
40002	0x0001	Float	R	2	Turbidity value (unit: NTU)
40004	0x0003	Float	R	2	Temperature value
40006	0x0005	Unsigned Int	R	1	Signal value
40007	0x0006	Unsigned Int	R/W	1	Measurement range (see table below)
40008	0x0007	Unsigned Int	R/W	1	Average (1–100)
40009	0x0008	Unsigned Int	R/W	1	Cleaning Mode (0x00 Auto, 0x01 Manual, 0x02 One-Time Cleaning)
40010	0x0009	Unsigned Int	R/W	1	Number of cleaning cycles (1–100)
40011	0x000A	Unsigned Int	R/W	1	Cleaning interval in minutes (10 min – 24 h)
40012–40016	0x000B–0x000F	—	—	5	Not Occupied (NC)
40017	0x0010	String	R	8	Product name (16 bytes)
40025	0x0018	String	R	8	Serial number (16 bytes)
40033	0x0020	String	R	1	Hardware version (1 byte)
40034	0x0021	String	R	2	Software version (4 bytes)
40036	0x0023	Unsigned Int	R/W	1	Communication Address (Factory Default: 8)
40037	0x0024	Unsigned Int	R/W	1	Baud Rate (Factory Default: 9600)

Registration address	Message Address (Hex)	Data Type	R/W	Length	Description
40038	0x0025	Unsigned Int	R	1	Device type
40039–40048	0x0026–0x002F	—	—	10	Not Occupied (NC)
40049	0x0030	Unsigned Int	R/W	1	Calibration range (chip)
40050	0x0031	Unsigned Int	R/W	1	1-point signal value
40051	0x0032	Float	R/W	2	1-point calibration value
40053	0x0034	Unsigned Int	R/W	1	2-point signal value
40054	0x0035	Float	R/W	2	2-point calibration value
40056	0x0037	Unsigned Int	R/W	1	3-point signal value
40057	0x0038	Float	R/W	2	3-point calibration value
40059	0x003A	Unsigned Int	R/W	1	Calibration start (1/2/3 point)
40060	0x003B	Float	R/W	2	Temperature calibration parameters
40062	0x003D	Unsigned Int	R/W	1	Temperature calibration start

Measuring Range

Value (Hex)	Area
0x0000	0–100 NTU
0x0001	0–500 NTU
0x0002	0–2000 NTU
0x0003	0–4000 NTU

Alarm code information

The alarm code is **16 bits**. Bit = 0 → no alarmBit = 1 → alarm active

Bit	Alarm description	Alarm Type
Bit 0	Turbidity over area	Warning Alert
Bit 2	Temperature over range	Warning Alert
Bit 3	Light Intensity / Signal Outside Range	Warning Alert
Bit 6	Cleaning condition	Note
Bit 8	Temperature sensor error	Error Alert
Bit 9	Engine failure	Error Alert
Bit 10	Internal Reference Voltage Faulty	Error Alert

Baud rates

Value (Hex)	Baud Rate
0x0000	4800 bps
0x0001	9600 fps
0x0002	19200 bps
0x0003	38400 bps
0x0004	57600 fps
0x0005	115200 bps

6.2 Modbus calibration operation

Turbidity Single-Point Calibration

1. Dip the sensor into standard solution 1
2. Reading Signal Value → Register **40006**
3. Write signal value to **40050**
4. Write the turbidity value of the solution in **40051**
5. Start calibration → **40059 = 0x0001**

Turbidity Two-Point Calibration

1. Sensor in standard solution 1 → signal value in **40050**, NTU in **40051**
2. Sensor in standard solution 2 → signal value in **40053**, NTU in **40054**
3. Start calibration → **40059 = 0x0002**

Turbidity Three-Point Calibration

1. Sensor in standard solution 1 → values in **40050/40051**
2. Sensor in standard solution 2 → values in **40053/40054**
3. Sensor in standard solution 3 → values in **40056/40057**
4. Start calibration → **40059 = 0x0003**

Temperature single-point calibration

1. Write temperature value in **40060**
2. Start calibration → **40062 = 0x0001**

Note

Before turbidity calibration, the calibration measurement range must be set:
40049 = measurement range (as in the table above).
This must be identical to the working area of the sensor.

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7. Modbus communication protocol of the controller

Registration address	Message Address	Data Type	R/W	Length	Description
40001	0x0000	Float	R	2	Turbidity value
40003	0x0002	Float	R	2	Temperature value
40021	0x0020	Int	R	1	Sensor Type
40025	0x0024	Int	R	1	Sensor alarm code