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Daruifuno

# **Turbidity Sensor**

Basic User Manual

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Model: OPTU85

Version 1.0



# Contents

<b>Chapter 1 Specification</b> .....	1
<b>Chapter 2 Basic Information</b> .....	2
2.1 Security Information.....	2
2.2 Overview.....	2
2.3 Dimensions.....	3
<b>Chapter 3 Installation</b> .....	4
3.1 Sensor Installation.....	4
3.2 Sensor Wiring.....	5
<b>Chapter 4 Use</b> .....	6
4.1 Communication Protocol.....	6
4.2 Read Measuring Values.....	6
4.3 Calibrate Measuring Values.....	6
4.3.1 Zero Point Calibration.....	6
4.3.2 Factor Calibration.....	6
4.3.3 Linear Calibration.....	7
4.4.4 Reset Calibration.....	7
<b>Chapter 5 Maintenance</b> .....	8
5.1 Maintenance Cycle.....	8
5.2 Cleaning.....	8
<b>Appendix A Modbus Register Information</b> .....	9

### **Guarantee**

Our company seriously warrants each of the instrument for one year (12 months) from the specific date of delivery. Consumables and consumable parts in the equipment are not covered by the warranty. The terms of this warranty shall not apply if damage to the instrument occurs beyond the warranty period, or in the opinion of the company, the breakage or destruction of the instrument is due to improper use, lack of maintenance, improper installation, improper modification, abnormal environmental conditions, etc. The company's obligation under this warranty is limited to providing replacement or repair of this product, as the case may be. The product must be thoroughly cleaned to remove any contaminated chemicals before it is accepted for replacement or repair. Our obligations shall not exceed the price of the product itself. In no event shall the company be liable for damage caused by incidental or consequential damages, whether to persons or objects. The company shall not be liable for any other loss, damage or expense of any kind, including economic loss resulting from the installation, use or improper use of the product.

- For details, please refer to the product's quality promise with the product, and keep this manual and the quality promise properly.

## Chapter 1 Specification

Product specifications are subject to change without notice.

Measuring Principle	Infrared scattering principle independent of color
Measuring Range	0~1000NTU(OPTU850) / 0~4000NTU (OPTU851)
Measuring Accuracy	Less than 5% of the measured value
Calibration Method	Zero point calibration, slope calibration, multi-point calibration
Operate Temperature	0~45°C
Work Pressure	≤4bar
Waterproof Level	IP68
Power Requirements	12VDC, Power consumption about 50mA
Main Material	Stainless steel+POM
Shell Size	Diameter 52mm, length190mm
Weight	Approximately 700 grams (without cable)
Cable	PUR(Polyurethane) sheath, standard 10 m, length can be customized

## Chapter 2 Basic Information

### 2.1 Security Information

Please read this manual completely before unpacking, installing and operating this equipment. Pay special attention to all precautions. Otherwise, it may cause serious personal injury to the operator or damage the equipment.

### 2.2 Overview

The sensor is based on the 90-degree infrared scattering method of the ISO 7027 standard, and measures turbidity value of sample according to the intensity of light scattered by the suspended particles in the water sample.

The sensor uses near-infrared LED as the light source, even if there is color in the sample, it will not affect the measurement result. The unique protective structure design of the sensor detection surface can protect the sensor detection window to the greatest extent and avoid accidental collisions during installation and use to damage the sensor measurement surface.

The sensor is suitable for sewage plants, water plants, water stations, surface water, environmental protection water treatment, metallurgical electronics, mining, paper industry, semiconductors and other fields, and can continuously monitor the concentration of turbidity in aqueous solutions.

### 2.3 Dimensions

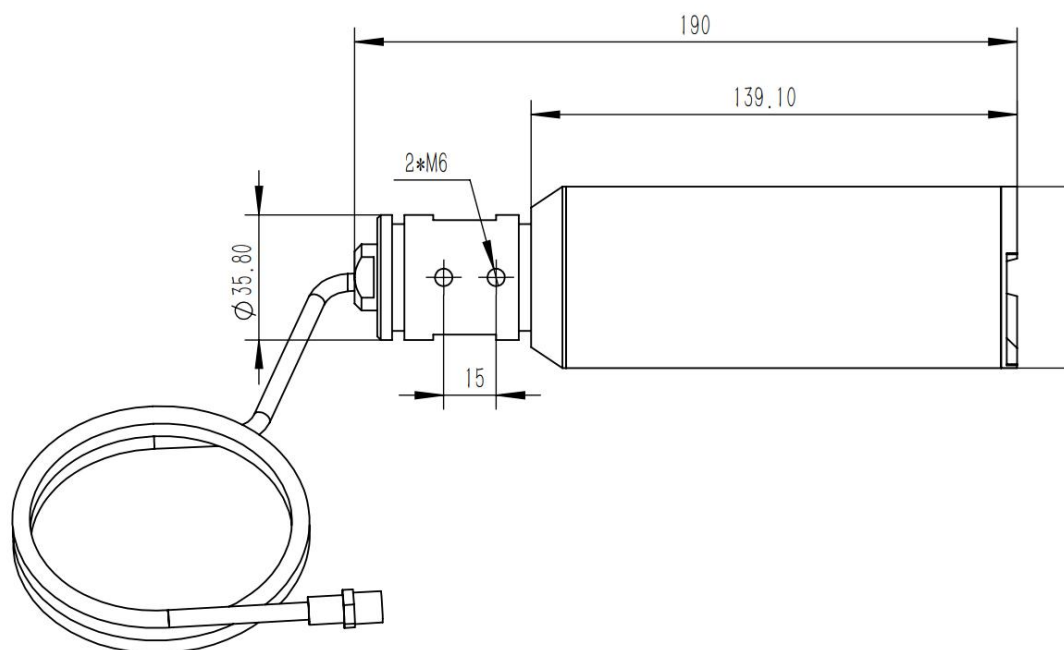


Figure 1 Dimensions of the sensor

## Chapter 3 Installation

### 3.1 Sensor Installation

Refer to the pictures in this section to install and fix the sensor. To ensure that the sensor can measure safely and accurately, the following conditions must be met during installation:

- There should be no walls within at least 10cm around the detection surface of the sensor;
- The sensor detection surface avoids directly facing the light or facing the highly reflective surface;
- When installed in an aeration pool, the sensor installation angle should be 90° to reduce the influence of air bubbles on the measurement;
- The sensor installation direction should be parallel to the water flow direction.

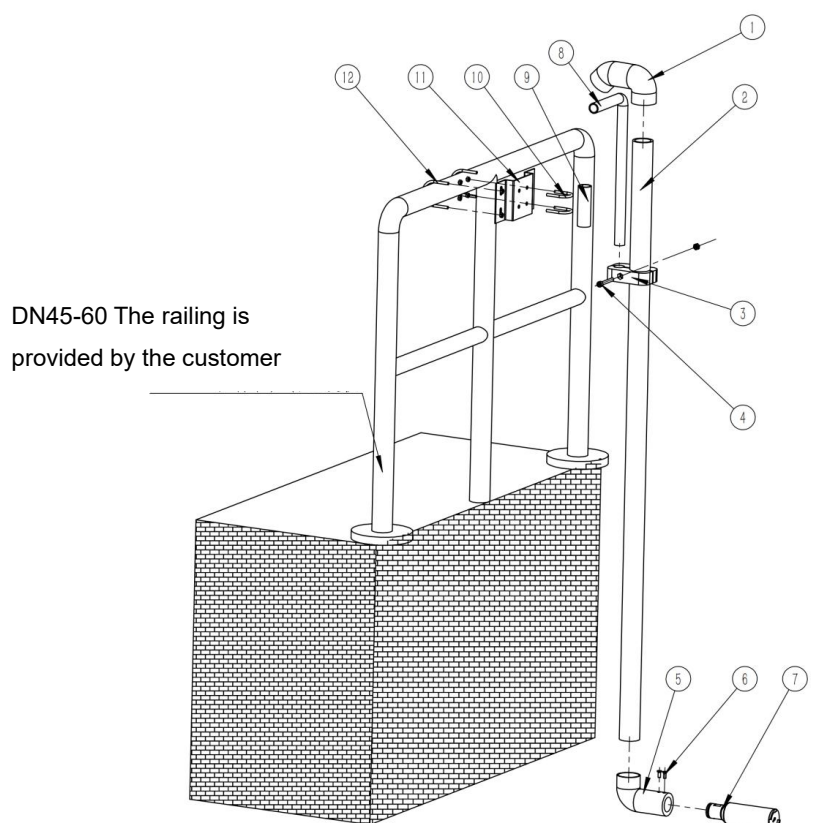


Figure 2 Schematic diagram of railing installation

1-Rainproof elbow	7-Turbidity sensor
2-Protective line pipe DN44 (outer $\phi$ 50) PVC pipe	8-Handle DN22 tube (outer $\phi$ 26mm)
3-DN25&DN50 Double pipe clamp	9-Handle sleeve DN26 (Outer $\phi$ 32)
4-Hexagon socket screws and nuts M8*60	10- M6U type card (DN 40) *2 With 4 nuts
5-Turbidity Elbow	11- “└┘”shaped bracket
6-Countersunk head screws M6*20*2	12- M6U type card (DN 60) *2 With 4 nuts

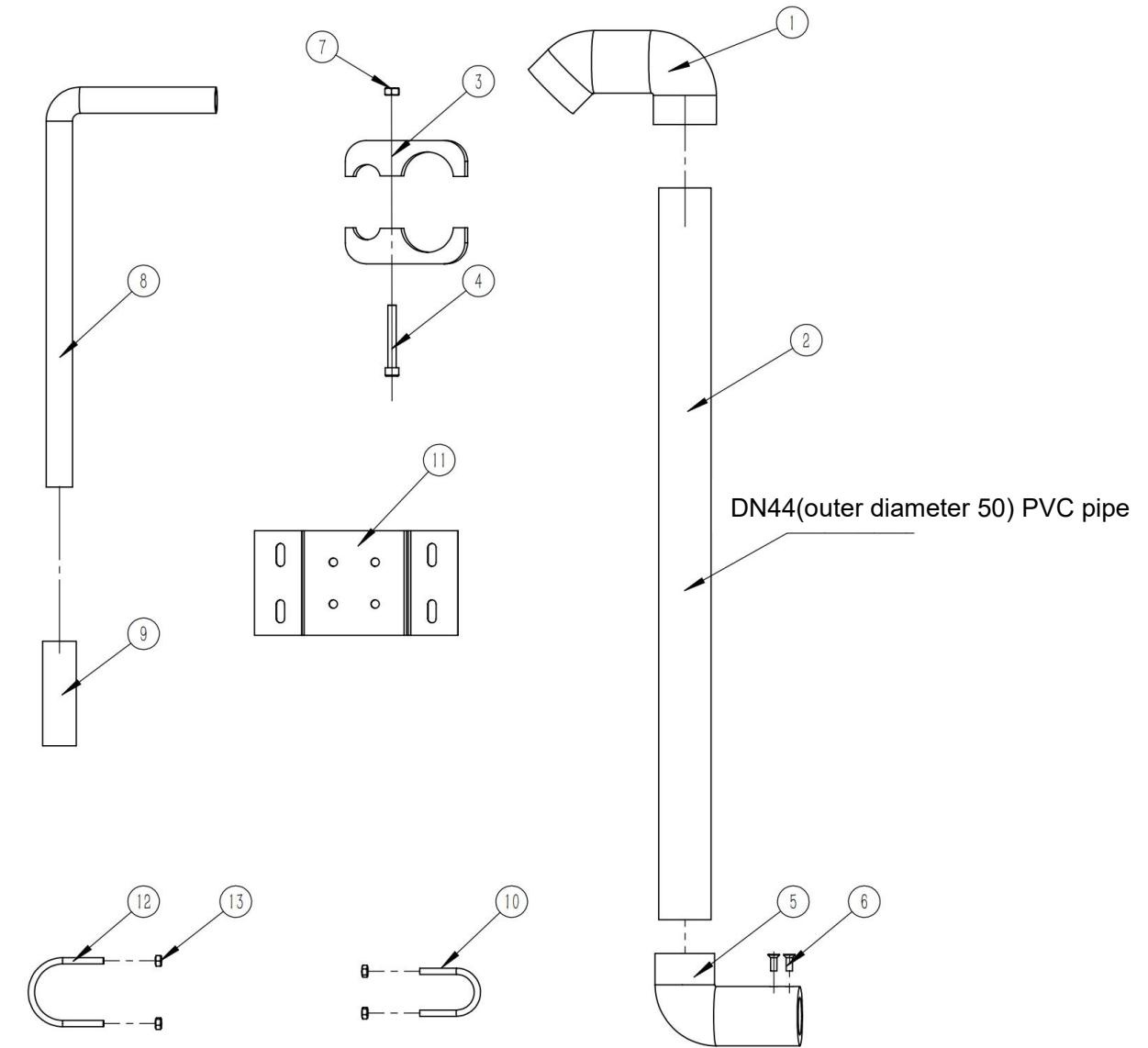


Figure 3 Exploded view of railing installation parts

1- Rainproof Elbow	8- Handle DN22 tube (outer diameter 26mm)
2- Protective line pipe DN44 (outer diameter 50) PVC pipe	9- Handle sleeve DN26 (outer diameter 32)
3- DN25&DN50 Double pipe clamp	10- M6U type card (DN 40) *2
4- Hexagon socket screws and nuts M8*60	11- “└┘”shaped bracket
5- Elbow	12- M6U type card (DN60)
6- Countersunk head screws M6*20*2	13- M6 Hex nuts*8
7- M8 Hex nuts	



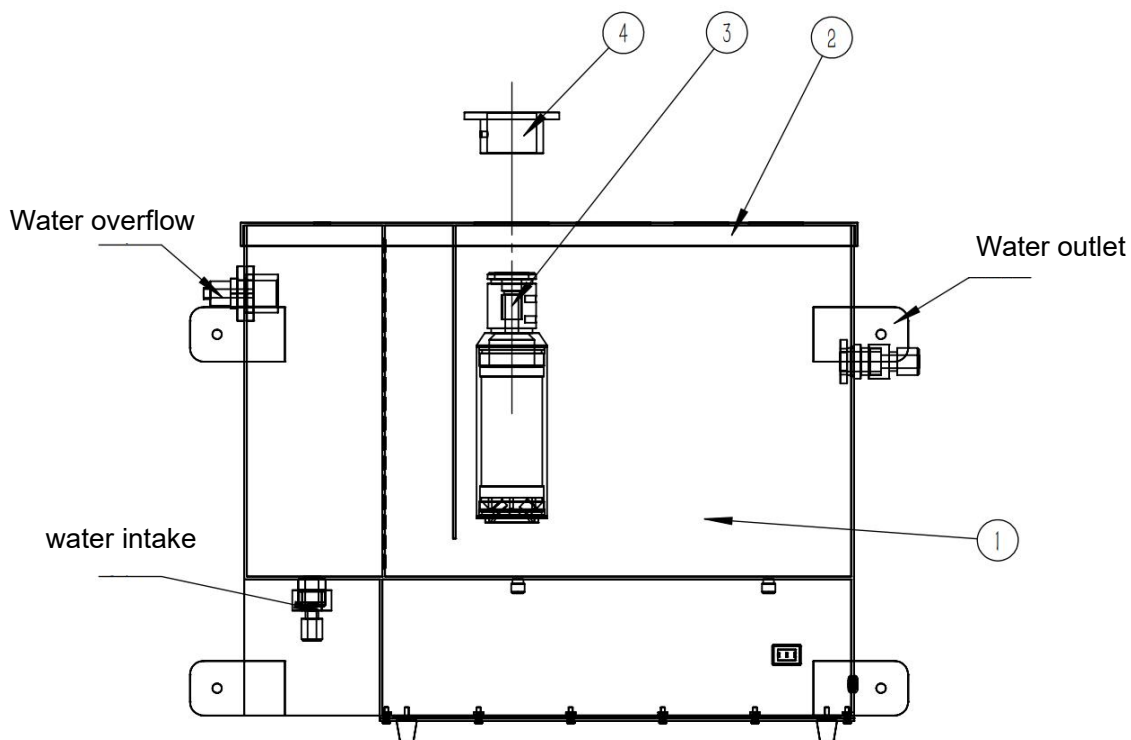


Figure 4 Schematic diagram of flow cell installation

1-Flow cell	3-sensor
2-Flow cell cover	4-Sensor fixing flange

### 3.2 Sensor Wiring

The sensor is correctly connected as defined in the table below.

<b>Wire Color</b>	red	black	white	green
<b>Terminal Definition</b>	+12V DC	Power ground	RS485 data A (+)	RS485 data B (-)
<b>Instrument Terminal Symbols</b>	V+	V-	AS	BS

## Chapter 4 Use

### 4.1 Communication Protocol

The sensor communication is RS485 Modbus-RTU, please refer to Modbus related protocol description for specific communication protocol.

The default communication parameters of the sensor are: communication address=1, baud rate=9600, parity bit=none, stop bit=1 bit, the information parameters can be modified by referring to the register description in Appendix A

**Note: Before performing any write operation, disable the write protection feature (write the value 3278 to the 800 register).**

### 4.2 Read Measuring Values

Sensor measurements can be read by connecting the meter or using other Modbus master devices.

Please refer to Appendix A for the Modbus register address of the device.

The sensor measurement data is 4-byte floating point data, and the data sequence is little endian-word section swap, pay attention to the conversion order.

### 4.3 Calibrate Measuring Values

**Note: Before performing any write operation, disable the write protection feature (write the value 3278 to the 800 register).**

#### 4.3.1 Zero Point Calibration

Zero-point calibration needs to use zero-turbidity water. The calibration process is as follows:

- Put the sensor into a container with zero turbidity water and wait for the sensor measurement value to stabilize;
- Use the 06 function code to write the value 14 to the 14th register;
- Read "status 2" register value until the register value becomes 0, the calibration is over.

**Note: The calibration should be performed in a black light-proof container as far as possible, to ensure that there are no air bubbles on the surface of the optical window at the front of the sensor, and the front of the sensor is at least 10cm away from the bottom or side wall of the container.**

#### 4.3.2 Factor Calibration

Set the 7th register "turbidity factor" to correct the sensor measurement slope.

For example, if the measured value using the sensor is 80NTU and the standard fluid is 100NTU, the factor should be set to:

Factor=100/80=1.25

**Note: Please use "Zero Calibration" to calibrate the electrode zero point before using factor correction.**

### 4.3.3 Linear Calibration

Two-point calibration is usually sufficient, for higher accuracy a multi-point calibration can be used, the sensor provides up to 8 calibration points for linear calibration.

- During multi-point calibration, the first point is usually the zero point, put the sensor in a container with zero turbidity water, and wait for the sensor measurement value to stabilize;
- Use the function code 16 to write the value 0 to the 17th register;
- Read the "state 2" register value until the register value becomes 0;
- Put the sensor into the container containing the turbidity standard solution and wait for the sensor measurement value to stabilize;
- Use the function code 16 to write the standard liquid turbidity value to the 19th register;
- Read the "state 2" register value until the register value becomes 0;
- Repeat steps 4 to 6 until all points to be calibrated are calibrated.

**Note:** *The standard solution value used for the calibration point can be selected arbitrarily. It is recommended to select the calibration point evenly within the actual measurement range.*

**Note:** *When calibrating, the turbidity value needs to be arranged in the order from low to high, point by point calibration, the unused calibration points need to be written 0, and the intermediate calibration points cannot be skipped;*

**Note:** *"Offset" and "Factor Correction" effects will be superimposed on the "Linear Calibration". Before using "Linear Calibration", perform "Reset Calibration" on the electrode or manually set the offset value to 0 and the factor value to 1. After the linear calibration, you can use "offset" and "Factor Correction" to adjust sensor zero and slope*

**Note:** *Linear calibration calibrates at least 2 points and a maximum of 8 points.*

### 4.3.4 Reset Calibration

Use function code 06 to write the value 53 to the 53rd register to reset the sensor calibration parameters to the factory state.

## Chapter 5 Maintenance

The sensor contains precision photoelectric components. Please make sure that the sensor will not be subject to any strong mechanical impact during use. There are no user maintenance parts inside the sensor.

### 5.1 Maintenance Cycle

Maintenance work	Maintenance frequency
Visual inspection	Every month
Check calibration	Monthly (according to the environmental conditions of use)
Seal maintenance	Every 2 years

***Note: The sensor seal should be maintained by the manufacturer's service department every 2 years. If it is not maintained regularly, water may enter the sensor and seriously damage the sensor.***

### 5.2 Cleaning

Keeping the sensor's measurement window clean is critical for accurate measurement, and the measurement window should be checked every month for stains. Cleaning agent and cloth can be used to clean the measuring window when maintenance is required.

## Appendix A Modbus Register Information

Items	Register	Data Type	Length	Access Type	Function Code	Description
State 1 <sup>note1</sup>	0	unsigned integer	1	Read Only	04	The lowest bit is write-protected, and the remaining bits are reserved
State 2	1	unsigned integer	1	Read Only	04	When not 0, the sensor is calibrating
Tu Measure	2	floating point	2	Read Only	04	Tu output value unit is NTU
Internal Humidity	6	floating point	2	Read Only	04	internal humidity value unit is 0.01%
Serial Number	8	string	6	Read Only	04	Serial number in 12-bit ASCII
Firmware Version	14	unsigned integer	1	Read Only	04	Version number x100
Address	0	unsigned integer	1	Read/Write	03/06	Communication address range 1~254, default 1
Baud Rate	1	unsigned integer	1	Read/Write	03/06	0=4800, 1=9600 (default)
Parity Bit	2	unsigned integer	1	Read/Write	03/06	0=none (default), 1=odd, 2=even
Stop Bit	3	unsigned integer	1	Read/Write	03/06	1=1STOP (default), 2=1.5STOP, 3=2STOP
Average Times	4	unsigned integer	1	Read/Write	03/06	Average times 1~10
Turbidity Offset	5	floating point	2	Read/Write	03/16	The offset value defaults to 0NTU
Turbidity Factor	7	floating point	2	Read/Write	03/16	The factor value defaults to 1

**Note 1:** When the lowest bit of the register is "0", it means write protection is enabled. In this state, writing data to any writable register is invalid (except for the "write protection switch" register). When it is "1", it means write protection is disabled. The register write operation is performed, and the write protection state is controlled by the "write protection switch" register.

## Appendix A Modbus Register Information

Items	Register	Data Type	Length	Access type	Function Code	Description
Zero point CAL	14	unsigned integer	1	Write Only	06	Write 14 to start calibration
Linear CAL point 1	17	floating point	2	Read/Write	03/16	Write the turbidity target value to start the calibration
Linear CAL point 2	19	floating point	2	Read/Write	03/16	Write 0 to clear calibration, write non-0 to start calibration
Linear CAL point 3	21	floating point	2	Read/Write	03/16	Write 0 to clear calibration, write non-0 to start calibration
Linear CAL point 4	23	floating point	2	Read/Write	03/16	Write 0 to clear calibration, write non-0 to start calibration
Linear CAL point 5	25	floating point	2	Read/Write	03/16	Write 0 to clear calibration, write non-0 to start calibration
Linear CAL point 6	27	floating point	2	Read/Write	03/16	Write 0 to clear calibration, write non-0 to start calibration
Linear CAL point 7	29	floating point	2	Read/Write	03/16	Write 0 to clear calibration, write non-0 to start calibration
Linear CAL point 8	31	floating point	2	Read/Write	03/16	Write 0 to clear calibration, write non-0 to start calibration
Reset CAL	53	unsigned integer	1	Write Only	06	Write 53 to reset calibration
Write-protect Switch <small>note2</small>	800	floating point	2	Write Only	16	Write 3278 Disable "write protection"

**Note 2:** The write protection is enabled every time the sensor is powered on. Write a value of 3278 to the "write protection switch" register to disable write protection. Write a value other than 3278 to the "write protection switch" register or power on again to make the write protection be protected.





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