

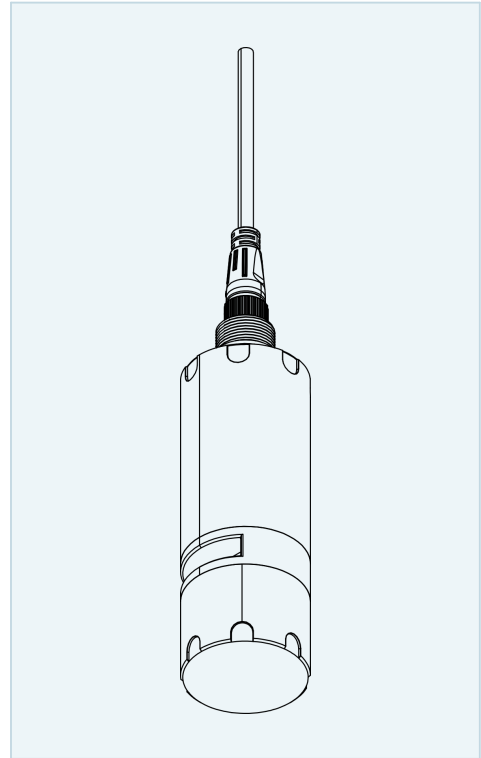
NSDD6

Multispectral Water Quality Sensor - Datasheet

Revision: V0.1

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Contents

01 Overview
02 Features
03 Detection Indicators
04 Application Areas
05 Limiting Parameters
06 Dimensions
07 Technical Parameters
08 Electrical interface
09 Communication protocol
10 Input Register
11 Holding Register
12 Reference commands
13 Maintenance
14 Appendix - Reference for relevant water quality indicators
15 Precautions

Overview

NSDD6 is an advanced spectral water quality sensor with integrated self-cleaning function, designed for real-time online monitoring of multiple physical and chemical indicators of water quality. This product adopts reagent-free optical measurement technology, with zero chemical reagent consumption and no waste liquid generation during the measurement process, completely eliminating secondary pollution. With excellent transient response capability and high-frequency sampling performance, NSDD6 can sensitively capture instantaneous changes in water quality. The product adopts high-reliability industrial design and is widely applicable to various complex working conditions such as surface water, industrial wastewater, domestic sewage, and influent and effluent of sewage treatment plants, providing timely and accurate data support for users' water quality assessment and process control.

Features

- Multi-parameter online detection, capable of detecting up to 6 water quality indicators simultaneously
- Non-contact spectral detection
- No consumables, avoiding secondary pollution
- Temperature correction
- Low power consumption
- Long-distance RS485 communication
- Automatic physical cleaning

Detection Indicators

- TOC (Total Organic Carbon) [Range 0-300 mg/L] [Error <10% F.S.]
- COD (Chemical Oxygen Demand) [Range 0-800 mg/L] [Error <10% F.S.]
- UV254 [Range 0-5] [Error <10% F.S.]
- Turbidity [Range 0-3000 NTU] [Error <5% F.S.]
- Color [Range 0-1000 °] [Error <5% F.S.]
- Water Temperature [Range 0-80℃] [Error <0.5℃]

Application Areas

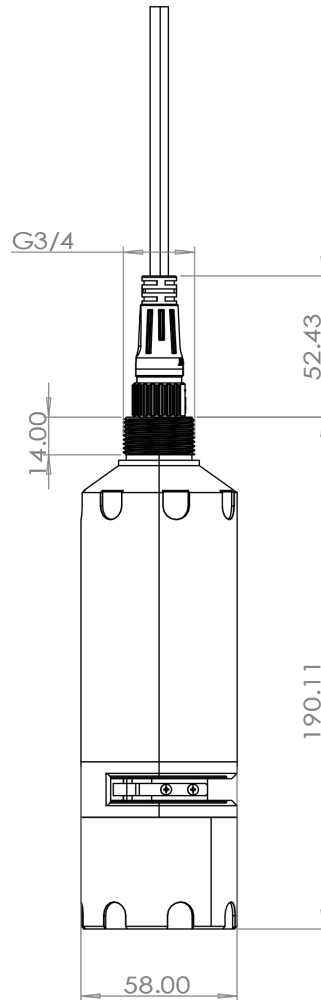
- Rural decentralized sewage treatment devices
- Effluent detection of sewage treatment plants
- Industrial wastewater detection
- Domestic sewage detection
- Surface water quality detection
- Monitoring of river sewage outlets
- River chief system river section monitoring

Limiting Parameters

Parameter	Symbol	Value	Unit
Supply voltage	Vcc	9...36	V
Maximum operating current (during cleaning)	I_max_C	450	mA
Maximum operating current (non-cleaning)	I_max	75	mA
Maximum power consumption (during cleaning)	P_max_C	5.4	W
Maximum power consumption (non-cleaning)	P_max	0.9	W
Digital port voltage	Vio	5.5	V
Operating ambient temperature	Topr	0...60	°C
Storage temperature range	Tstg	-20 ... 70	°C
Pipeline water pressure range	Pre	1	bar
Maximum detection frequency	FD_max	20 s/time	/

NOTE: Exceeding the usage conditions in the above table may cause permanent damage to the sensor!

Dimensions



Unit mm

Technical Parameters

(T=25°C, Vcc=12V DC)

Parameter	Symbol	MIN	TYP	MAX	Unit	Description
Operating voltage	Vcc	9	12	36	V	
Operating current	Iop	70	75	80	mA	During detection
Operating current	Iop	400	450	500	mA	During cleaning
Standby current	Is	55	60	65	mA	
Digital interface voltage	Vio				V	
Communication distance	D	/	1.5	1000	m	
Communication baud rate	BD	/	9600	/	bps	
Response time	T	/	1	3	S	
Recovery time	T _r	15	20	/	S	
Continuous measurement interval	T _{in}	/	20	/	S	

Parameter	Symbol	MIN	TYP	MAX	Unit	Description
TOC indicator	Range	0		300	mg/L	
TOC indicator	Resolution	/	0.01	/	mg/L	
TOC indicator	Consistency	-(0.1+R5%)		+(0.1+R5%)	mg/L	k=2, note 1
TOC indicator	Repeatability	-0.04		0.04	mg/L	
TOC indicator	Accuracy	-10%F.S.		10%F.S.	mg/L	Note 2
COD indicator	Range	0		800	mg/L	
COD indicator	Resolution	/	0.01	/	mg/L	
COD indicator	Consistency	-(0.1+R5%)		+(0.1+R5%)	mg/L	k=2, note 1
COD indicator	Repeatability	-0.04		0.04	mg/L	
COD indicator	Accuracy	-10%F.S.		10%F.S.	mg/L	Note 2
Turbidity	Range	0		3000	NTU	
Turbidity	Resolution		0.01		NTU	
Turbidity	Consistency	-(0.2+R5%)		+(0.2+R5%)	NTU	
Turbidity	Repeatability	-0.5		0.5	NTU	
Turbidity	Accuracy	-5%F.S.		5%F.S.	NTU	
Color	Range	0		3000	Degree	
Color	Resolution		0.01		Degree	
Color	Consistency	-(0.2+R5%)		+(0.2+R5%)	Degree	
Color	Repeatability	-0.5		0.5	Degree	
Color	Accuracy	-5%F.S.		5%F.S.	Degree	
UV254 indicator	Range	0		5	AU/cm	
UV254 indicator	Resolution	/	0.0001	/	AU/cm	
UV254 indicator	Consistency	-0.001		+0.001		k=2
UV254 indicator	Repeatability	-0.001		+0.001		
UV254 indicator	Accuracy	-10%F.S.		10%F.S.		
Temperature	Range	0		80	□	
Temperature	Resolution	/	0.01	/	□	
Temperature	Consistency	-0.5		+0.5	□	
Temperature	Repeatability	-0.2		+0.2	□	
Temperature	Accuracy	-0.5		+0.5	□	
Operating ambient temperature	Topr	0	25	50	□	
Sample water temperature	Ts	0	25	80	□	
Storage temperature	Tstg	-10	25	70	□	
Operating water pressure	Pre	0		1	Bar	
Enclosure protection rating		/	IP68	/		
Dimensions		/	φ58X203	/	mm	

Parameter	Symbol	MIN	TYP	MAX	Unit	Description
Weight		/	580	/	g	

NOTE: Note:

R is the sensor readout, e.g., TOC=2, then consistency is ± 0.2 ; TOC=4, then ± 0.3

FS means full scale. Due to the complexity of water pollutants, only the maximum error is indicated here.

Electrical interface

The sensor uses a 5-core cable. The cable definitions are as follows:

Color	Symbol
Red	VCC
Black	GND
Yellow	A
White	B
Green	Earth

Interface electrical parameters are as follows:

Cable	Symbol	Function	Level requirement
1	VCC	System power supply	9-36V
2	GND	Power supply negative	0
3	A	RS485 non-inverting pin	0-5V
4	B	RS485 inverting pin	0-5V
5	E	System ground	

NOTE: Note:

The sensor has a built-in isolated power supply, and the communication interface uses optocoupler isolation.

A stable power supply greatly affects the detection accuracy and stability of the detector. It is recommended to keep the power supply ripple within 100 mV.

The maximum level of the digital interface should not exceed 5.5 V.

Communication protocol

The sensor is a Modbus slave device.

The communication format and function codes are based on the 'Schneider Modbus Protocol Reference Guide' (PI-MBUS-300).

The sensor communicates with the external interface via RS485 Modbus, with the port configuration as follows:

Baud rate: 9600 bps

Parity: None

Data bits: 8

Stop bits: 1

Protocol configuration

- Baud rate 9600 bps, 8 data bits, 1 stop bit (no parity).
- Use RTU (Remote Terminal Unit) mode.

Data Type

The following data types are supported

Data Type	Length	Address Range
Input Register	16-bit	0,50
Holding Register	16-bit	0,1

Function Code

The function codes listed in the table below are supported. If a function code outside this table is received, it will be considered invalid and an exception response will be returned.

Function Code	Description	Broadcast
0x04	Read Input Registers	Not supported
0x06	Write Single Holding Register	Supported
0x10	Write Multiple Holding Registers	Supported

Exception Response

When there is a problem with the received query message, the device will return an exception response. The function code of this exception response is the original function code plus 0x80, indicating to the master that this response is an exception response. The exception response includes an exception code explaining the cause of the problem.

Function Code	Description	Cause
0x01	Invalid Function	Unsupported function code
0x02	Invalid Data	Invalid address or configuration parameter

Delay Time

There must be a delay time (T1-T2-T3-T4) of 5 ms before and after each frame.

Response time

After the water quality sensor/adaptor receives the query message, it responds after a response time (t1). Therefore, the response time (t1) of this adapter is "delay time (T1-T2-T3-T4) + 20 ms". When the Modbus master receives a response message, it must wait for a time interval (t2) before sending the next query message. This time interval (t2) must be greater than or equal to "delay time (T1-T2-T3-T4) + 20 ms".

Input Register

TOC Data Register (High 16 bits): (Address: 0)

Bit	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Description	TOC[31:16] (TOC value = TOC[31:0] / 100)

TOC Data Register (Low 16 bits): (Address: 1)

Bit	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Description	TOC[15:0] (TOC value = TOC[31:0] / 100)

COD Data Register (High 16 bits): (Address: 2)

Bit	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Description	COD[31:16] (COD value = COD[31:0] / 100)

COD Data Register (Low 16 bits): (Address: 3)

Bit	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Description	COD[15:0] (COD value = COD[31:0] / 100)

Color Data Register (High 16 bits): (Address: 4)

Bit	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Description	Color[31:16] (Color value = Color[31:0] / 100)

Color Data Register (Low 16 bits): (Address: 5)

Bit	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Description	Color[15:0] (Color value = Color[31:0] / 100)

Turbidity Data Register (High 16 bits): (Address: 6)

Bit	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Description	Turbidity[31:16] (Turbidity value = Turbidity[31:0] / 100)

Turbidity Data Register (Low 16 bits): (Address: 7)

Bit	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Description	Turbidity[15:0] (Turbidity value = Turbidity[31:0] / 100)

UV254 Data Register (High 16 bits): (Address: 8)

Bit	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Description	UV254[15:0] (UV254 value = UV254[15:0] / 10000)

UV254 Data Register (Low 16 bits): (Address: 9)

Bit	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Description	UV254[15:0] (UV254 value = UV254[15:0] / 10000)

Temperature Data Register: (Address: 10)

Bit	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Description	Temperature[15:0] (Temperature value = Temperature[15:0] / 100)

Status Register: (Address: 11)

Bit	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Description	☐ / ☐ / ☐ / ☐ / ☐ / ☐ / ☐ / ☐

- Working status: 0 = idle; other values refer to the working mode of the command register in the holding registers
- Detection flag: 0 = no detection performed or detection not completed; 1 = detection completed
- Detection result: 0 = detection failed (currently busy); 1 = detection successful
- Calibration flag: 0 = no calibration performed or calibration not completed; 1 = calibration completed
- Calibration result: 0 = calibration failed; 1 = calibration successful
- Secondary calibration flag: 0 = no secondary calibration performed or secondary calibration not completed; 1 = secondary calibration completed
- Secondary calibration result: 0=secondary calibration failed (busy); 1=secondary calibration successful
- Raw spectrum update flag: 0=raw spectrum not updated; 1=raw spectrum value updated

Device address register: (address: 12)

Bit	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Description	Device address[7:0]: 1-254, default 1

Device ID register (high 16 bits): (address: 13)

Bit	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Description	DEVICE ID[31:16]

Device ID register (low 16 bits): (address: 14)

Bit	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Description	DEVICE ID[15:0]

Holding Register

Working mode register: (address: 0)

Bit	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Description	☐

- Working mode
- 1: Detection
- 3: Baseline calibration
- 4: TOC secondary calibration
- 5: COD secondary calibration
- 6: Color secondary calibration
- 7: Turbidity secondary calibration
- 8: UV254 secondary calibration
- 9: Secondary calibration parameter reset
- 12: Zero point calibration
- 14: Temperature secondary calibration
- Others: Reserved

Command parameter register: (address: 1)

Bit	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Description	Secondary calibration, full-scale calibration parameters[15:0] (parameter is standard solution concentration)

Device address register: (address: 2)

Bit	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Description	Device address[7:0]: 1-254, default 1

Reference commands

Command 1

Set Modbus communication address (default 1)

Set ID to 2: 01 06 00 02 00 02 A9 CB

Response: 01 06 00 02 00 02 A9 CB

NOTE: A9 CB is CRC check; after configuration, the command needs to recalculate the check

Command 2

Read Modbus communication address: when the current address is unknown, use broadcast address 0x00 (broadcast address): 00 04 00 0C 00 01 F0 18

Response: 00 04 02 00 01 45 30

Command 3

Read device ID: (device ID is 32-bit data, 4 bytes)

Send: 01 04 00 0D 00 02 E0 08

Response: 01 04 04 D2 0A C1 48 B3 58

Command 4

Read firmware version:

Send: 01 04 00 16 00 01 D0 0E

Response: 01 04 02 00 09 79 36

Command 5

Read detection parameter configuration:

Send: 01 04 00 15 00 01 20 0E

Response: 01 04 02 01 3F F8 B0

Command 5

Configure detection parameters:

Disable active reporting: 01 06 00 03 00 3F 39 DA

Response: 01 06 00 03 00 3F 39 DA

Enable active reporting: 01 06 00 03 01 3F 38 4A

Response: 01 06 00 03 01 3F 38 4A

Command 6

Read automatic detection interval and enable status:

Send: 01 04 00 4B 00 01 41 DC

Response: 01 04 02 00 00 B9 30

NOTE: 0x0000 automatic detection disabled

Command 6

Configure automatic detection interval and enable status:

Enable automatic detection (example): 01 06 00 0A 00 79 68 2A

Response: 01 06 00 0A 00 79 68 2A

Disable automatic detection: 01 06 00 0A 00 00 A9 C8

Response: 01 06 00 0A 00 00 A9 C8

NOTE: $0x0079 = 121 \text{ (} 121 - 1(\text{enable}) \text{)}/2 = 60 \text{ seconds}$

Command 7

Read periodic self-cleaning interval and enable status:

Send: 01 04 00 4C 00 01 F0 1D

Response: 01 04 02 00 79 78 D2

NOTE: $0x0079 = 121 \text{ (} 121 - 1(\text{enable}) \text{)}/2 = 60 \text{ seconds}$

Command 7

Configure periodic self-cleaning interval and enable status:

Enable periodic self-cleaning (example): 01 06 00 07 00 79 F9 E9

Response: 01 06 00 07 00 79 F9 E9

Disable periodic self-cleaning: 01 06 00 07 00 00 38 0B

Response: 01 06 00 07 00 00 38 0B

NOTE: $0x0079 = 121 \text{ (} 121 - 1(\text{enable}) / 2 = 60 \text{ seconds)}$

Command 8

Water quality detection: (this result data is only for protocol demonstration, same below)

Send: 01 06 00 00 00 01 48 0A

Response: 01 06 00 00 00 01 48 0A

Enable active reporting

Status response: 01 04 02 00 01 78 F0

Detection complete status: 01 04 02 00 30 B9 24

Disable active reporting

Query status: 01 04 00 0B 00 01 40 08

Detecting response: 01 04 02 00 01 78 F0

Detection complete response: 01 04 02 00 30 B9 24

Read detection results

Read TOC: 01 04 00 00 00 02 71 CB

Response: 01 04 04 00 00 2E 46 67 D6

Read COD: 01 04 00 02 00 02 D0 0B

Response: 01 04 04 00 00 0E 44 FF D7

Read color: 01 04 00 04 00 02 30 0A

Response: 01 04 04 00 00 23 DD 22 ED

Read turbidity: 01 04 00 06 00 02 91 CA

Response: 01 04 04 00 00 39 59 29 EE

Read UV254: 01 04 00 08 00 02 F0 09

Response: 01 04 04 00 00 09 83 BC 75

Read temperature: 01 04 00 0A 00 01 11 C8

Response: 01 04 02 09 18 BF 6A

Read all 6 data: 01 04 00 00 00 0B B1 CD

Response: 01 04 16 00 00 2E 46 00 00 0E 44 00 00 23 DD 00 00 39 59 00 00 09 83 09 18 6D 90

NOTE: $0x00002E46 = 11846(0.01\text{mg/L})$

$0x00000E44 = 652(0.01\text{mg/L})$

$0x000023DD = 9181(0.01)$

$0x00003959 = 14681(0.01\text{NTU})$

$0x00000983 = 2435(0.0001)$

$0x0918 = 2328(0.01\text{ }^\circ\text{C})$

Command 9

Baseline calibration

Send: 01 06 00 00 00 03 C9 CB

Response: 01 06 00 00 00 03 C9 CB

Enable active reporting

Status response: 01 04 02 00 03 F9 31

Calibration success status: 01 04 02 00 C0 B9 60

Calibration failure status: 01 04 02 00 40 B8 C0

Disable active reporting

Query status: 01 04 00 0B 00 01 40 08

Calibrating response: 01 04 02 00 03 F9 31

Calibration success status: 01 04 02 00 C0 B9 60

Calibration failure status: 01 04 02 00 40 B8 C0

Command 10

TOC secondary calibration

Send (standard solution 4): 01 10 00 00 00 02 04 00 04 01 90 B3 92

Response: 01 10 00 00 00 02 41 C8

Enable active reporting

Calibrating status response: 01 04 02 00 04 B8 F3

Calibration success status: 01 04 02 03 00 B9 C0

Calibration failure status: 01 04 02 01 00 B8 A0

Disable active reporting

Query status: 01 04 00 0B 00 01 40 08

Calibrating response: 01 04 02 00 04 B8 F3

Calibration success status: 01 04 02 03 00 B9 C0

Calibration failure status: 01 04 02 01 00 B8 A0

COD secondary calibration

Send (standard solution 2): 01 10 00 00 00 02 04 00 05 00 C8 E2 38

Response: 01 10 00 00 00 02 41 C8

Enable active reporting

Calibrating status response: 01 04 02 00 05 79 33

Calibration success status: 01 04 02 03 00 B9 C0

Calibration failure status: 01 04 02 01 00 B8 A0

Disable active reporting

Query status: 01 04 00 0B 00 01 40 08

Calibrating response: 01 04 02 00 05 79 33

Calibration success status: 01 04 02 03 00 B9 C0

Calibration failure status: 01 04 02 01 00 B8 A0

Color secondary calibration

Send (standard solution 10): 01 10 00 00 00 02 04 00 06 03 E8 13 10

Response: 01 10 00 00 00 02 41 C8

Enable active reporting

Calibrating status response: 01 04 02 00 06 39 32

Calibration success status: 01 04 02 03 00 B9 C0

Calibration failure status: 01 04 02 01 00 B8 A0

Disable active reporting

Query status: 01 04 00 0B 00 01 40 08

Calibrating response: 01 04 02 00 06 39 32

Calibration success status: 01 04 02 03 00 B9 C0

Calibration failure status: 01 04 02 01 00 B8 A0

Turbidity secondary calibration

Send (standard solution 20): 01 10 00 00 00 02 04 00 07 07 D0 41 C2

Response: 01 10 00 00 00 02 41 C8

Enable active reporting

Calibrating status response: 01 04 02 00 07 F8 F2

Calibration success status: 01 04 02 03 00 B9 C0

Calibration failure status: 01 04 02 01 00 B8 A0

Disable active reporting

Query status: 01 04 00 0B 00 01 40 08

Calibrating response: 01 04 02 00 07 F8 F2

Calibration success status: 01 04 02 03 00 B9 C0

Calibration failure status: 01 04 02 01 00 B8 A0

UV254 secondary calibration

Send (standard solution 0.3): 01 10 00 00 00 02 04 00 08 0B B8 75 2F

Response: 01 10 00 00 00 02 41 C8

Enable active reporting

Calibrating status response: 01 04 02 00 08 B8 F6

Calibration success status: 01 04 02 03 00 B9 C0

Calibration failure status: 01 04 02 01 00 B8 A0

Disable active reporting

Query status: 01 04 00 0B 00 01 40 08

Calibrating response: 01 04 02 00 08 B8 F6

Calibration success status: 01 04 02 03 00 B9 C0

Calibration failure status: 01 04 02 01 00 B8 A0

Temperature secondary calibration

Send (standard temperature 26): 01 10 00 00 00 02 04 00 0E 0A 28 94 D2

Response: 01 10 00 00 00 02 41 C8

Enable active reporting

Calibrating status response: 01 04 02 00 0E 38 F4

Calibration success status: 01 04 02 03 00 B9 C0

Calibration failure status: 01 04 02 01 00 B8 A0

Disable active reporting

Query status: 01 04 00 0B 00 01 40 08

Calibrating response: 01 04 02 00 0E 38 F4

Calibration success status: 01 04 02 03 00 B9 C0

Calibration failure status: 01 04 02 01 00 B8 A0

NOTE: The standard solution values in these reference commands are for demonstration only; in actual application, replace them with real solution values.

Calculation method (example): standard solution concentration * 100 = 400 = 0x0190

UV254 calculation method: standard solution concentration * 10000

Command 11

Reset secondary calibration parameters

Send: 01 06 00 00 00 09 49 CC

Response: 01 06 00 00 00 09 49 CC

Maintenance

- The sensor has been baseline calibrated at the factory; users can directly perform detection.
- According to ISO 10012-1 "Quality assurance requirements for measuring equipment", the sensor should be zero-point calibrated at least once every three months.
- Strictly observe the sensor's operating temperature and humidity conditions. Excessive temperature may permanently damage the sensor.
- Do not clean the probe with alcohol.
- Do not immerse in corrosive liquids or acidic water samples for extended periods.
- The sensor contains precision optical components. Avoid direct and excessively violent mechanical impact.
- Avoid exposing the sensor to sudden extreme heat or cold, as the optical components may be damaged by severe thermal shock.
- Avoid high-low temperature shock tests with large temperature gradients.
- The installation environment must be free from severe and frequent mechanical vibration, which can cause misalignment of optical components and affect detection accuracy.
- The product may experience accidental vibration and shock during transportation. To avoid impact on measurement results, it is recommended to perform a baseline calibration before initial use.
- Rapid temperature changes in the measured water can reduce detection accuracy.
- When measuring water samples with poor water quality over a long period, it is recommended to increase the frequency of cleaning and baseline calibration.
- During baseline calibration, ensure that the ambient temperature of the detector and the temperature of the purified water used are consistent, both within $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$.
- The sensor can self-correct measurement errors caused by temperature changes to a certain extent, but excessively large temperature differences compared to room temperature (25°C), such as around 10°C or above 35°C , may still introduce additional measurement errors.
- Always use qualified purified water for baseline calibration.
- If not used for a long time, keep the device dry and store in a dark, dry place. It is recommended to perform a baseline calibration before reuse.
- If turbidity readings remain high for an extended period, it is recommended to perform a baseline calibration.
- Strictly follow the packaging and transportation conditions.

Appendix - Reference for relevant water quality indicators

NOTE: National Standard of the People's Republic of China: Standards for Drinking Water Quality (GB5749-2022)			
NOTE: Sanitary Safety and Functional Evaluation of Drinking Water Quality Processors - Reverse Osmosis Treatment Devices			
Type	Indicator	<Limit	Condition
Drinking water	TOC	5 mg/L	
Drinking water	COD (manganese method)	3 mg/L	

Type	Indicator	<Limit	Condition
Drinking water	COD (manganese method)	5 mg/L	Allowed when source water and treatment technology conditions are limited
Drinking water	TDS	1000 PPM	
Centralized and decentralized water supply devices	TOC	5 mg/L	
Centralized and decentralized water supply devices	COD (manganese method)	5 mg/L	
Reverse osmosis treatment device	COD	2 mg/L	
Reverse osmosis treatment device	COD	1 mg/L	Industry standard

Precautions

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