

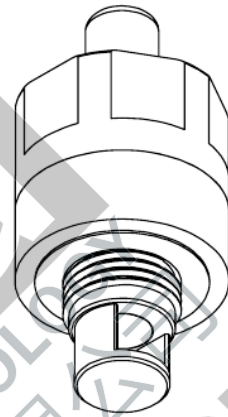
NSDD-Lite3

Multispectral Water Quality Sensor - User Manual

Revision: V0.1

Orome Electrical (Zhuhai) Co., Ltd.

www.oromee.com | info@oromee.com



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Warning

WARNING: All personnel who are or will be responsible for using, maintaining, or repairing this product must carefully read this manual. Only when used, maintained, and repaired in accordance with the manufacturer's instructions can this product achieve its designed performance. Users should understand how to set correct parameters and interpret the obtained results. For safety reasons, this device must be operated and serviced by qualified personnel. Please read and understand this manual completely before operation or maintenance.

WARNING: To reduce the risk of electric shock, turn off the power before opening the instrument or performing maintenance. Never operate the instrument while it is open. Only service this product in areas known to be non-hazardous.

Proper disposal of end-of-life products

EU Directive 2012/19/EU: Waste Electrical and Electronic Equipment (WEEE). This symbol indicates that this product must not be disposed of as general industrial or household waste, but must be handed over to an appropriate WEEE disposal facility. For disposal information, contact your local authority, distributor, or manufacturer.

Precautions

This product is a precision optical device. Handle and store with care.

- Ensure that the lenses on both sides of the sensor detection chamber are free from dirt, impurities, and bubbles.
- Use a soft, damp cloth to clean the lens surface. Do not use organic solvents.
- For optimal performance, it is recommended to calibrate the sensor periodically.

WARNING: If the sensor malfunctions, do not attempt to repair it yourself. Contact the manufacturer or an authorized service center. Replacement parts may affect safety.

1. Standard item list

The items included with the NSDD-Lite3 vary depending on the purchased version. The complete list of items is as follows:

Item	Description
A	Sensor main unit
B	Sealing gasket
C	Connection cable (0.5 m)
D	Test report / Certificate of conformity

2. General information

The NSDD-Lite3 is an online spectral water quality sensor that can detect organic matter indicators in water in real time. The sensor requires no chemical reagents and does not cause secondary pollution to water quality. It is suitable for applications such as commercial water purifiers, central water purifiers, ultrapure water machines, secondary water supply equipment, industrial pure water detection, seawater desalination, laboratory and medical equipment. Users can obtain multiple water quality parameters in real time to promptly assess water quality conditions.

Features

- Multi-parameter online detection, up to 4 water quality indicators simultaneously.
- Non-contact spectral detection, no consumables and avoids secondary pollution.
- Built-in temperature correction, low power consumption.
- UART / RS485 communication optional.
- Pressure-resistant design, can be used long-term in 1.5 MPa environments.

Detection Indicators

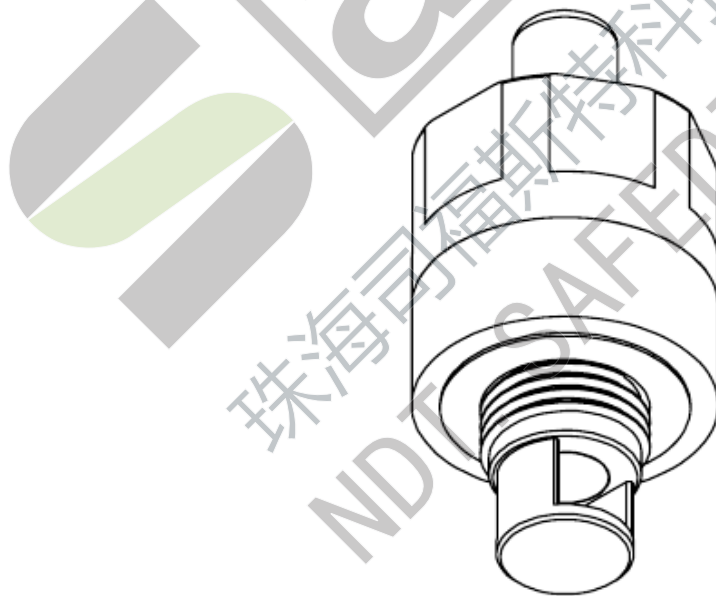
Indicator	COD	TOC	UV254	Temperature
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Application Areas

- Commercial water purification equipment and ultrapure water machines.
- Secondary water supply equipment / pump rooms.
- Industrial production pure water detection and seawater desalination.
- Laboratory and medical equipment.

3. Product Structure Description

The product consists of a flat washer, sensor body, communication cable, and terminal block. Material is 316L stainless steel, weight 185 g +/- 5 g.



NSDD-Lite3 Product Appearance

4. Electrical Interface

The sensor external control board interface uses an XHB 2.54 mm 4-PIN socket.

Pin	Symbol	Function	Level requirement
1	VCC	Power supply (red)	5 V
2	GND	System ground (black)	0 V
3	RX	UART data receive (blue)	0-5 V
4	TX	UART data transmit (white)	0-5 V

NOTE: The sensor has a built-in isolated power supply, and the communication interface uses optocoupler isolation. Stable power supply is important for detection accuracy and stability; it is recommended to keep power supply ripple within 20 mV. The digital interface level must not exceed 5.5 V.

5. Product Installation

WARNING: Regardless of the installation method, ensure that the detection chamber is completely filled with the water sample to be tested, and free of foreign objects and bubbles.

Installation Method 1: Flow-through Installation

NSDD-Lite3 can be optionally equipped with a standard G1/2 threaded mounting tee for reliable sensor fixation and connection to different pipelines. During installation, ensure the detection chamber direction is consistent with the water flow direction. It is recommended to use the original sealing gasket; if using PTFE tape or other sealing materials, do not block the detection chamber.

Installation Method 2: Through-board Installation

Through-board installation is suitable for online detection scenarios such as water tanks and vessels. Proper sealing must be ensured during installation.

Installation Precautions

- Filter bubbles in the pipeline water flow to reduce external detection interference.
- Ensure stable and reliable connection of electrical interfaces.
- This sensor is suitable for drinking water and cannot be used for turbid liquids such as sewage to avoid contaminating the internal detection window.
- Large bubbles formed by dissolved gases can cause instantaneous readings to rise; they should be filtered as much as possible.
- Stability can be improved by taking multiple measurements and averaging, but the interval between adjacent measurements must not be less than 5 s.
- The internal pressure of the pipeline must not exceed 1.5 MPa.

6. Daily Maintenance

NSDD-Lite3 is a high-reliability commercial water quality sensor, but maintenance is still required. The unified maintenance principle is to keep the detection chamber free of foreign objects and ensure the lenses on both sides are clean. It is recommended to clean regularly, or check when detection results show significant fluctuations.

When cleaning, remove the sensor and wipe the lenses on both sides of the detection chamber with a soft, clean cloth until free of foreign objects. For stubborn dirt, a neutral detergent can be used, followed by rinsing with pure water and reinstalling.

WARNING: Do not use organic solvents for cleaning.

7. Product Usage

NSDD-Lite3 can be used independently or in conjunction with other sensors. The detection chamber end reaches IP68, and the rear end reaches IP66; identify correctly during installation.

First Commissioning

After receiving a new sensor, it is recommended to perform a baseline calibration. See the user commands in the communication protocol in Section 10.

Daily Use

When the detection chamber is kept clean, the sensor can stably detect TOC, COD, UV254, and temperature. If the detection results deviate significantly from actual values, or after maintenance, it is recommended to re-perform baseline calibration.

8. Technical Parameters

Limiting Parameters

Parameter	Symbol	Value	Unit
Supply voltage	Vcc	-0.3...5.5	V
Maximum Operating Current	I_max	50	mA
Maximum Power Consumption	P_max	250	mW
Digital port voltage	Vio	-0.3...5.5	V
Operating ambient temperature	Topr	0...50	°C
Storage temperature range	Tstg	-10...70	°C
Pipeline water pressure range	Pre	0...1.5	MPa
Maximum detection frequency	FD_max	5 s / time	/

WARNING: Exceeding limit parameters may cause permanent damage to the sensor.

Electrical and Communication Parameters (T=25 °C, Vcc=5 V)

Parameter	Symbol	MIN	TYP	MAX	Unit	Description
Operating voltage	Vcc	4.5	5	5.5	V	
Operating current	Iop		45	50	mA	During Detection
Standby current	Is	20	23	30	mA	Standby
Digital interface voltage	Vio		3	5	V	
Communication distance	D	/	100	100	cm	
Communication baud rate	BD	/	115200	/	bps	
Response time	T	/	1	3	s	
Recovery time	T_r	3	5	/	s	
Continuous measurement interval	T_in	3	5	/	s	

Measurement Performance

Indicator	Item	MIN	TYP	MAX	Unit	Description
TOC	Range	0		20	mg/L	
TOC	Resolution	/	0.1	/	mg/L	
TOC	Consistency	-(0.1+R5%)		+(0.1+R5%)	mg/L	k=2, Note 1
TOC	Repeatability	-0.04		+0.04	mg/L	
TOC	Accuracy	-15% F.S.		+15% F.S.	mg/L	Note 2
COD	Range	0		20	mg/L	
COD	Resolution	/	0.1	/	mg/L	
COD	Consistency	-(0.1+R5%)		+(0.1+R5%)	mg/L	k=2
COD	Repeatability	-0.04		+0.04	mg/L	
COD	Accuracy	-15% F.S.		+15% F.S.	mg/L	Note 2
UV254	Range	0		0.5	AU/cm	
UV254	Resolution	/	0.0001	/	AU/cm	
UV254	Consistency	-0.001		+0.001		k=2
UV254	Repeatability	-0.001		+0.001		
UV254	Accuracy	-15% F.S.		+15% F.S.		Note 2
Temperature	Range	0		80	°C	
Temperature	Resolution	/	0.01	/	°C	
Temperature	Consistency	-0.5		+0.5	°C	
Temperature	Repeatability	-0.2		+0.2	°C	
Temperature	Accuracy	-0.5		+0.5	°C	

Other Parameters	Symbol	MIN	TYP	MAX	Unit
Operating ambient temperature	Topr	0	25	50	°C

Other Parameters	Symbol	MIN	TYP	MAX	Unit
Sample water temperature	Ts	0	25	80	°C
Storage temperature	Tstg	-10	25	70	°C
Operating water pressure	Pre	0		1.5	MPa
Pipe Interface			G1/2		
Enclosure protection rating		/	IP66	/	
Housing Diameter		/	38	/	mm
Weight		/	185	/	g

NOTE: Note 1: R is the sensor reading. For example, when TOC=2, the consistency index is +/-0.2; when TOC=4, it is +/-0.3. Note 2: F.S. means full scale. Due to the complex nature of water pollutants, only the maximum error is indicated: 0-4 is range 1, maximum accuracy error +/-0.6; 4-8 is range 2, maximum error +/-1.2; 8-20 is range 3, maximum error +/-3.

9. Baseline Calibration

Preparation Before Calibration

- Use a soft, clean cloth to clean the lenses on both sides of the detection chamber. Do not use organic solvents.
- Connect the sensor cable and connect it to the computer USB port via a USB-to-TTL module.
- Run the serial debugging tool and open the corresponding COM port.
- Place the sensor in pure water, ensuring there are no foreign objects or bubbles in the detection chamber.

Calibration Operation

- Execute the calibration command and wait for about 5 seconds.
- After receiving the completion prompt, the calibration is finished.

WARNING: During calibration, the detection chamber should be completely immersed in pure water, and avoid environmental changes such as vibration or sudden power failure.

10. Communication Protocol

The sensor uses a UART interface. Port configuration: 115200 bps, no parity, 8 data bits, 1 stop bit.

Response	HEX
NACK	55 AA FF
ACK	55 AA 00

No.	Command (HEX)	Function	Return
1	55 AA 04 0A 00 05 00 00 00 FF	Water Quality Detection	Detection Result
2	55 AA 02 0A 00 03 00 00 00 FF	Baseline Calibration	Calibration Status

Water Quality Detection Command

Send:

```
55 AA 04 0A 00 05 00 00 00 FF
```

Detection complete, return:

```
30 09 31 09 30 09 30 0D 0A
54 4F 43 5F 73 20 3D 20 32 30 2E 31 30 20 6D 67 2F 4C 0D 0A
54 4F 43 5F 77 20 3D 20 32 30 2E 31 30 20 6D 67 2F 4C 0D 0A
43 4F 44 20 20 20 3D 20 32 30 2E 31 30 20 6D 67 2F 4C 0D 0A
54 44 53 20 20 20 3D 20 30 20 6D 67 2F 4C 0D 0A
54 44 53 5F 74 20 3D 20 30 20 6D 67 2F 4C 0D 0A
54 44 53 5F 63 20 3D 20 30 20 6D 67 2F 4C 0D 0A
45 43 20 20 20 20 3D 20 30 20 75 73 2F 63 6D 0D 0A
55 56 32 35 34 20 3D 20 30 2E 35 30 30 31 0D 0A
54 45 4D 50 20 20 3D 20 32 2E 35 34 0D 0A
57 51 49 20 20 20 3D 20 32 30 0D 0A
```

Convert the above hexadecimal data to ASCII to obtain water quality parameters. Example parsing result: TOC_w=20.10 mg/L, COD=20.10 mg/L, UV254=0.5001, TEMP=2.54. 20 3D 20 represents the character ' = ', and the characters after it are the detection result.

Baseline Calibration Command

Send:

```
55 AA 02 0A 00 03 00 00 00 FF
```

Calibration complete, return:

```
55 AA 51 0B 00 0B 01 01 01 XX FF
```

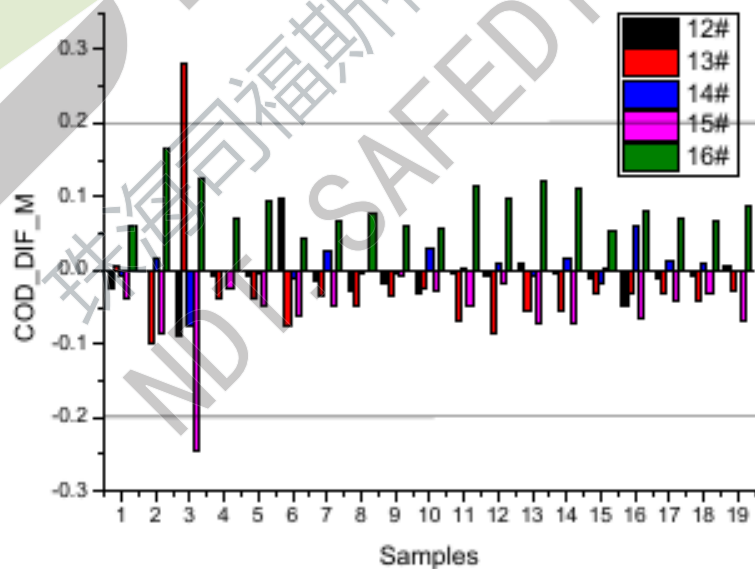
The 9th byte of the return frame is the calibration status: 00 indicates failure, 01 indicates success. The second-to-last byte XX is the CRC8 checksum of all preceding bytes. Baseline calibration must use pure water.

```

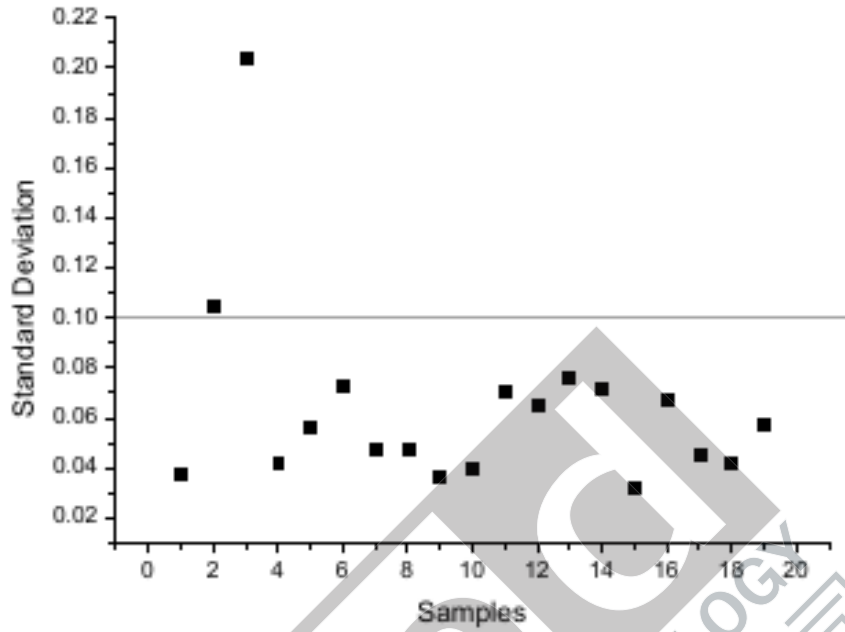
unsigned char get_crc8(unsigned char *p_buf, unsigned int length)
{
    unsigned char i, tmp, crc_val, crc = 0;
    do {
        tmp = crc ^ *p_buf;
        crc_val = 0;
        for (i = 0; i < 8; i++) {
            if ((crc_val ^ tmp) & 0x01) {
                crc_val ^= 0x18;
                crc_val >>= 1;
                crc_val |= 0x80;
            } else {
                crc_val >>= 1;
            }
            tmp >>= 1;
        }
        crc = crc_val;
        p_buf++;
    } while (--length);
    return crc;
}

```

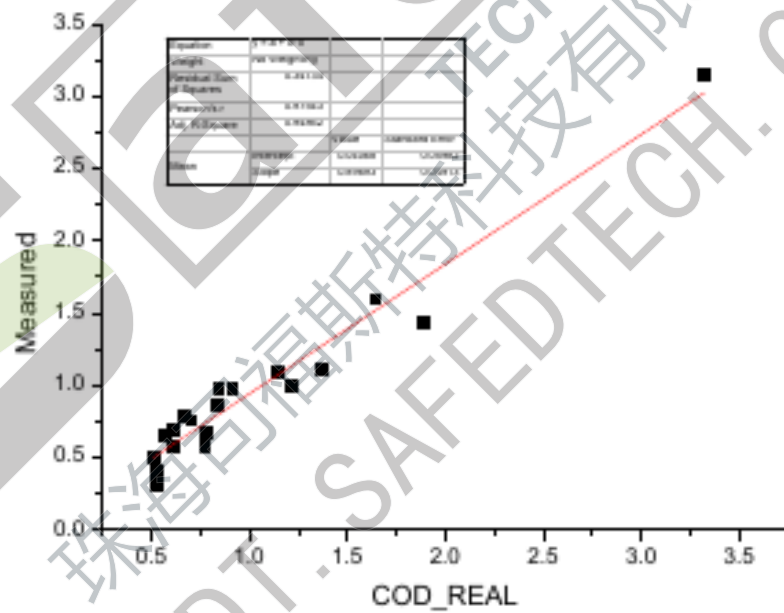
11. Sample Testing



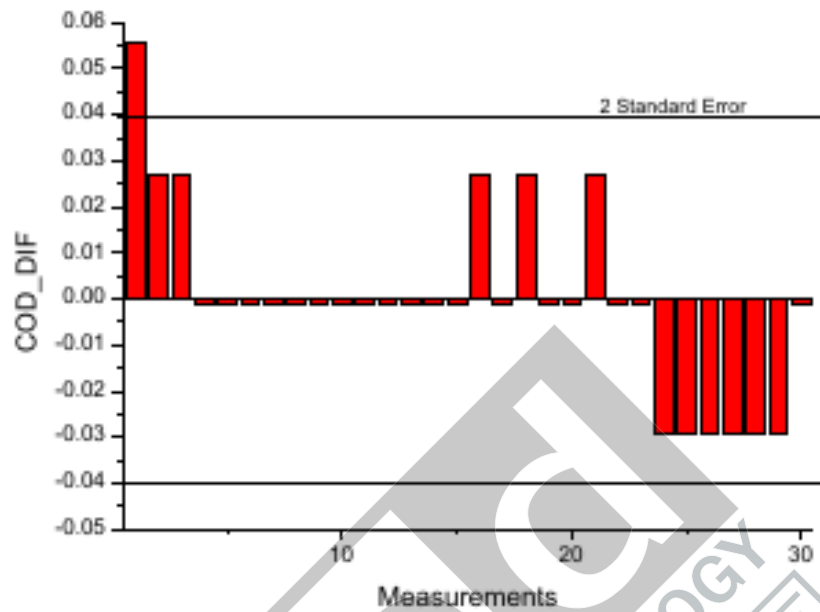
Consistency evaluation: difference between the measured values of 5 sensors and the average value



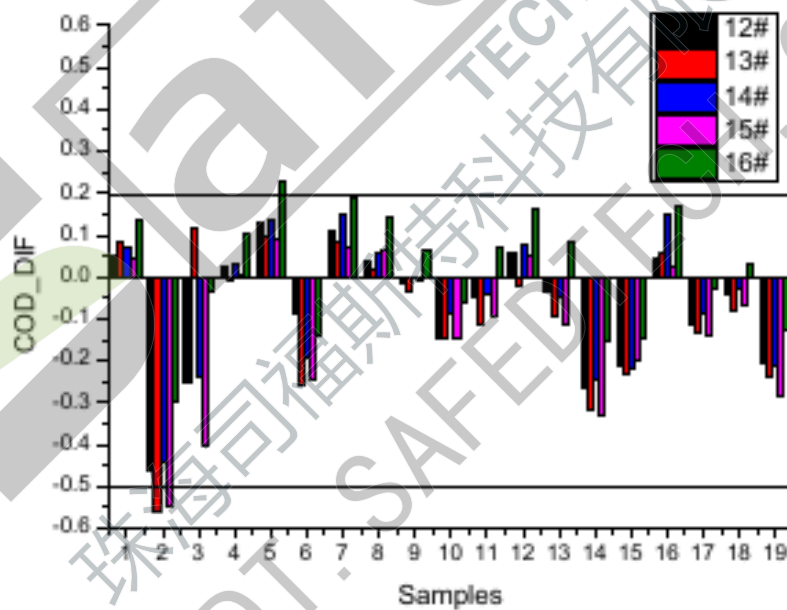
Consistency evaluation: standard deviation of the measured values of 5 sensors



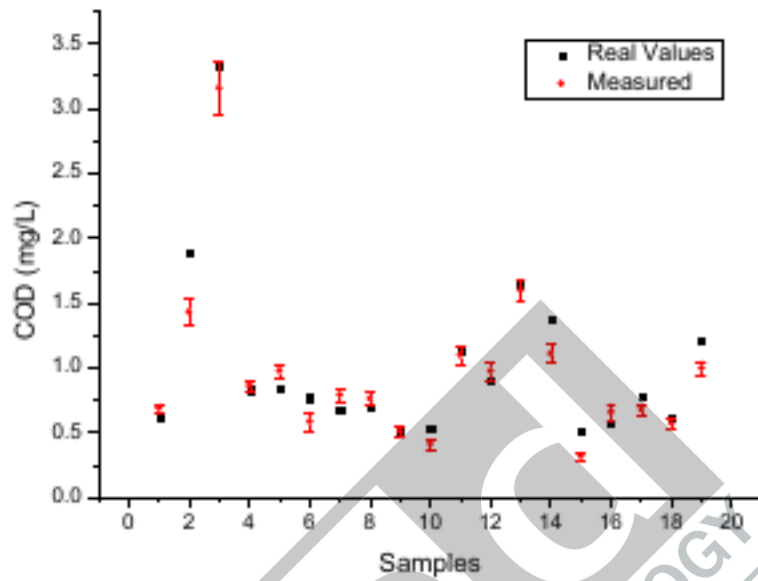
Correlation: measured value vs. true value



Repeatability: difference between measured value and average value



Accuracy: difference between the measured values of 5 sensors and the true value in different water samples



Accuracy: measured value vs. true value for different water samples

NOTE: The above tests were conducted using 5 randomly selected sensors at room temperature 25 °C.

12. Product Warranty

This product is provided with a 12-month limited warranty. Within 12 months from the date of purchase, the company provides quality assurance under conditions of non-artificial damage.

WARNING: The product must be used within the technical parameter range. Damage caused by exceeding the limit parameters is not covered by the warranty. Damage caused by unauthorized disassembly without manufacturer permission is not covered by the warranty.