# Dissolved Oxygen Sensor Calibration Steps and Precautions

We provide the communication protocol for the sensor and a software that can be used for reading and calibration.

Dissolved oxygen sensor supports 1-point or 2-point calibration in % (saturation). One point calibration is 100% saturation dissolved oxygen calibration, mainly changing the K value. 2-point calibration to change K and B values. The following takes 2-point calibration as an example to illustrate the calibration process of the dissolved oxygen sensor (note: please do 2-point calibration after replacing the fluorescent cap).
Notice: The dissolved oxygen value in mg/l is converted from the dissolved oxygen value in saturation, after compensation for temperature, salinity and atmospheric pressure. There is only a temperature sensor inside the sensor, the salinity and atmospheric pressure values need to be input by the user according to the actual value in the field. The sensor will automatically convert the % concentration to mg/l concentration, the two data are stored in different registers, for detailed conversion formulas and register definitions, see the communication protocol.

**Preparation：**
Appliances and raw materials needed:
◆ Anhydrous sodium sulfite powder;
◆ Distilled or deionized water;
◆ Beaker, gloves, stir bar, air pump.
Before calibration, please clean the sensor with clean water and gently wipe the front of the sensor with a soft cloth to ensure that the sensor is not covered by biological or other contaminants. Be careful not to damage the black fluorescent cap on the front of the sensor when cleaning.

**Method 1: Calibration with communication protocol:**
1. Zero point standard solution preparation: prepare a beaker of about 250ml, and pour 200ml of purified water (or distilled water) into the beaker, then add anhydrous sodium sulfite, stir while adding, wait until the anhydrous sodium sulfite does not dissolve and solid crystals appear, and the standard solution at this time is close to 0 oxygen.
2. 100% oxygen environment preparation: prepare a beaker of about 250ml, and pour 200ml of purified water (or distilled water) into the beaker, fully aerate the solution with an air pump (at least 30 minutes).
3. The temperature of the standard solution should be consistent with the ambient temperature.

**Step 1: Change the calibration parameter K of the sensor to 1 and B to 0**
The register definitions of K and B can be found from the communication protocol as

follows:

**1.1 Get user calibration parameters**

Use: Obtain two calibration parameters K, B.

The user calibration parameters K and B can be read from four consecutive MODBUS registers with the starting address of 0x1100

| Starting Address | Number of Registers | Register 1, 2 | Register 3, 4 | MODBUS Function Code |
|---|---|---|---|---|
| 0x1100 | 0x04 | K value | B value | 0x03 |

**1.2 Set user calibration parameters**

Use: Set two calibration parameters K, B.

The user calibration parameters K and B can be set through four consecutive MODBUS registers with the starting address of 0x1100.

| Starting Address | Number of Registers | Register 1, 2 | Register 3, 4 | MODBUS Function Code |
|---|---|---|---|---|
| 0x1100 | 0x04 | K value | B value | 0x10 |

Note: The values of K and B should be written to the sensor at the same time. If one is written alone, the K and B values of the sensor will be wrong. The following takes the slave device address as 0x01, changing K to 1 and B to 0 as an example to illustrate the request frame and response frame of K=1 and B=0.

Request frame: 01 10 11 00 00 04 08 00 00 80 3F 00 00 00 00 81 AE

Respond frame: 01 10 11 00 00 04 C4 F6

After the setting is completed, use the command to obtain user calibration parameters to check whether the setting is successful. The following takes the slave device address as 0x01, the obtained K=1, B=0 as an example to illustrate the request frame and response frame for obtaining the user calibration parameter command.

Request frame: 01 03 11 00 00 04 41 35

Request frame: 01 03 08 00 00 80 3F 00 00 00 00 9E 12

**Step 2: Calibrate user calibration parameters K and B**

1. Take out the sensor from the zero-oxygen water, and wipe the measuring end face of the sensor lightly with a paper towel, put the sensor in a 100% oxygen environment and read the dissolved oxygen saturation value, wait for the DO saturation to stabilize and the value is close to 1 (i.e. the saturation is close to 100%), and record the value as Y.
2. Put the sensor into the prepared zero standard solution and let the front end of the sensor completely immerse in the solution, read the dissolved oxygen saturation value, wait for the data to stabilize, the value is close to 0.01 (i.e. saturation 1%, e.g. 0.015), and record as X.
3. Calculate the values of K and B according to the following formulas:

K=（1-0）/（Y-X）

B= -KX

4. Write the values of K and B to the sensor.
5. After the setting is completed, use the command to obtain user calibration parameters to check whether the setting is successful. For the register definitions of K and B, see the contents of 1.1 and 1.2.

The register definition for obtaining DO saturation is as follows:

| Starting Address | Number of Registers | Register 1, 2 | MODBUS Function Code |
|---|---|---|---|
| 0x2602 | 0x02 | Dissolved oxygen saturation % | 0x03 |

The following takes the slave device address as 0x01 and the read DO saturation as 0.897103 as an example to illustrate the request frame and response frame for reading DO saturation:
Request frame: 01 03 26 02 00 02 6E 83
Respond frame: 01 03 04 8F A8 65 3F 3A 47

**Step 3: Set salinity and atmospheric pressure**
Write the salinity value of the actual water sample on site and the atmospheric pressure value of the site into the sensor. If possible, users can write real-time salinity and atmospheric pressure data to the sensor for more accurate dissolved oxygen measurements.
Addresses where salinity and pressure can be found from the communication protocol are defined as follows:

**3.1 Set salinity**
Use: set the sensor salinity, unit ‰ (ppt), default salinity is 0. This setting is saved when power off.
Salinity can be set by two consecutive MODBUS registers with a starting address of 0x1500.

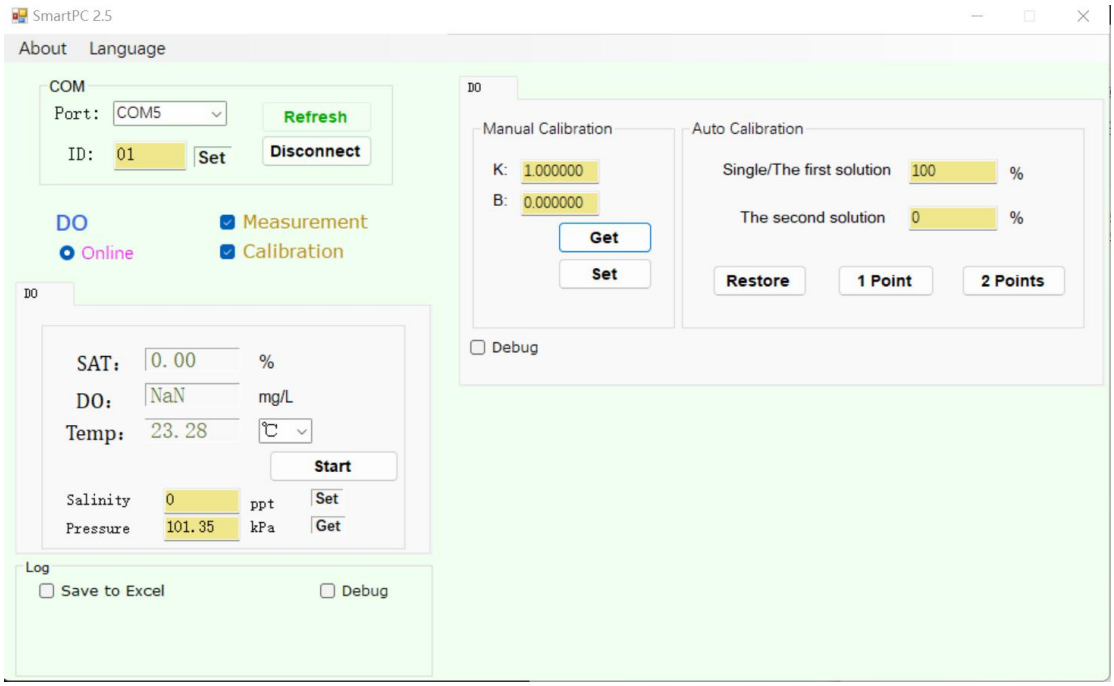
| Starting Address | Number of Registers | Register 1~2 | MODBUS Function Code |
|---|---|---|---|
| 0x1500 | 0x02 | Salinity | 0x10 |

**3.2 Set atmospheric pressure**
Use: set sensor atmospheric pressure, unit kpa, the default is standard atmospheric pressure 101.325kpa, this setting is saved when power off.
The atmospheric pressure can be set through two consecutive MODBUS registers with the starting address of 0x2400.

| Starting Address | Number of Registers | Register 1~2 | MODBUS Function Code |
|---|---|---|---|
| 0x2400 | 0x02 | Atmospheric pressure | 0x10 |

The following takes slave device address 0x01, salinity set to 0.5‰, and atmospheric pressure set to 101kpa as an example to illustrate the request frame and response frame for setting salinity and atmospheric pressure commands.
Set salinity request frame: 01 10 15 00 00 02 04 00 00 00 3F 41 2F
Set salinity response frame：01 10 15 00 00 02 45 C4
Set atmospheric pressure request frame: 01 10 24 00 00 02 04 00 00 CA 42 8E 3F
Set the atmospheric pressure response frame: 01 10 24 00 00 02 4B 38

**Method 2: Use software to calibrate**




The software can read the relevant data of the sensor and calibrate the sensor.The customer only needs to operate according to the software prompt, the software will automatically calculate K and B and write to the sensor.

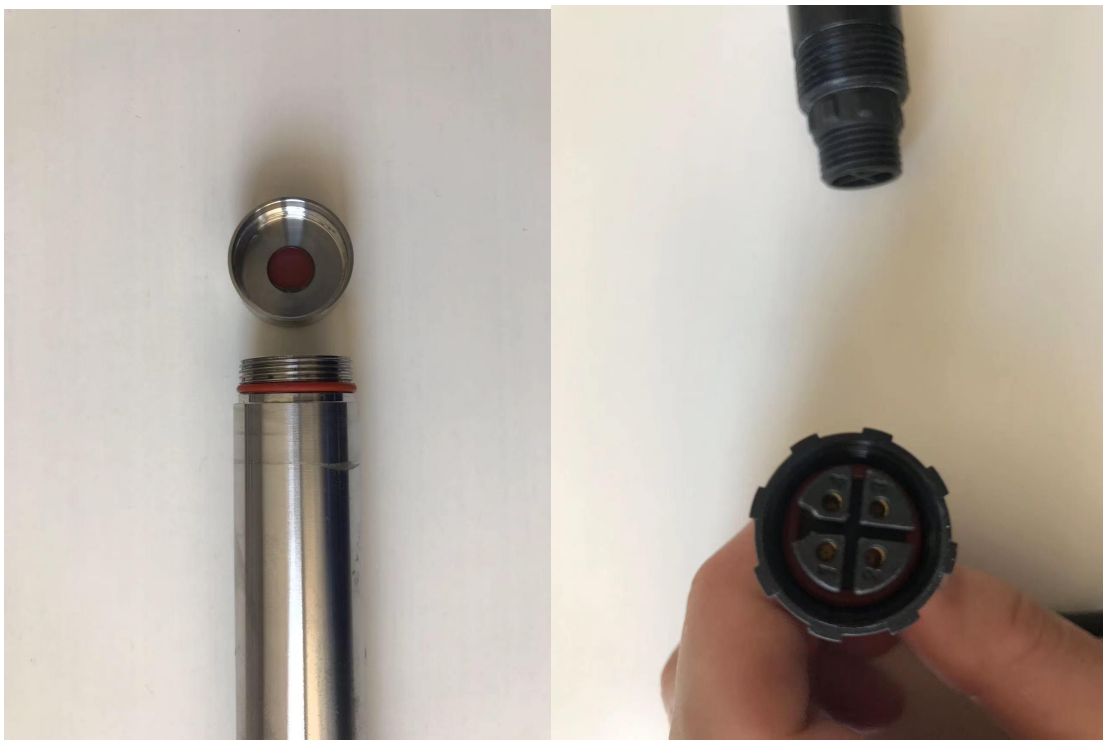
## Maintenance of Dissolved Oxygen Sensor

The fluorescent cap on the front of the dissolved oxygen sensor is a consumable item. In addition to calibrating the sensor regularly, it is also very important to clean the sensor. However, when the sensor still cannot meet the accuracy requirements after calibration, the fluorescent cap needs to be replaced.

To replace the fluorescent cap, just remove the old fluorescent cap from the sensor and screw the new fluorescent cap onto the sensor body. The sensor needs to be calibrated after replacing the new fluorescent cap.

There is a red O-ring at the connection between the fluorescent cap and the sensor body and at the connection between the sensor body and the cable, it is recommended

that the user replace the sealing ring every six months to one year and every time the fluorescent cap is replaced to ensure the sealing effect of the sensor. At the same time, tighten the above two places before use to prevent poor sealing due to loose threads during transportation.



Schematic diagram of sensor fluorescent cap, main body and sealing ring