Suspended Solids Sensor

Basic User Manual

Contents

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	1~3000mg/L
measurement accuracy	Less than 5% of the measured value
Calibration method	Zero point calibration, slope calibration, multi-point calibration
Operating 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 meters, 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 the concentration of suspended solids in the 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 suspended solids in aqueous solutions.
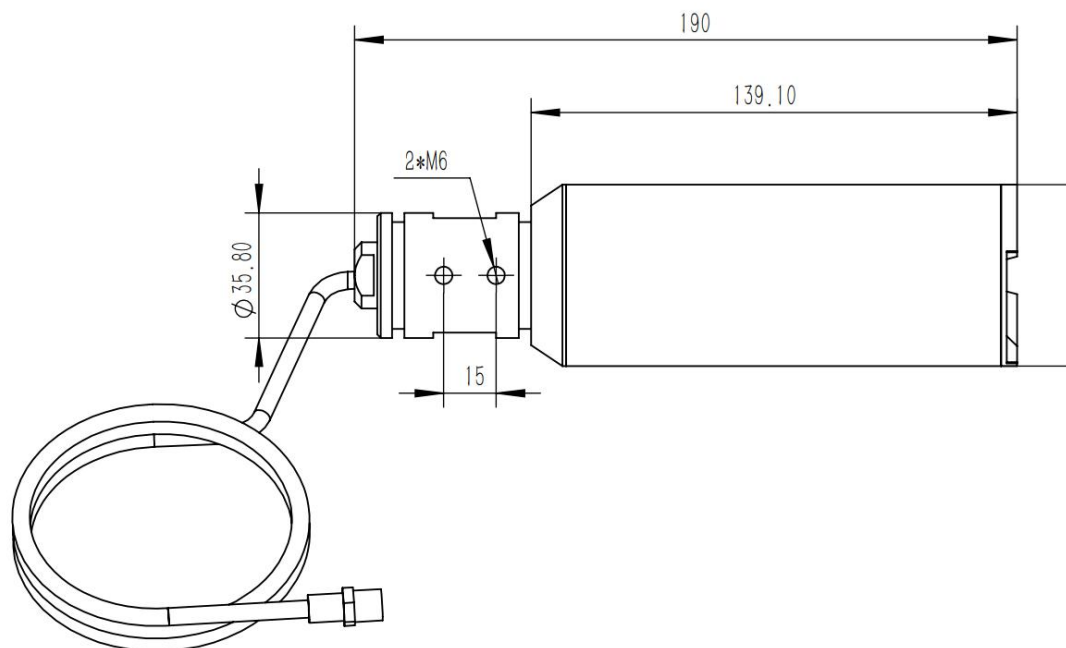
2.3 Dimensions

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.

DN45-60 The railing is provided by the customer
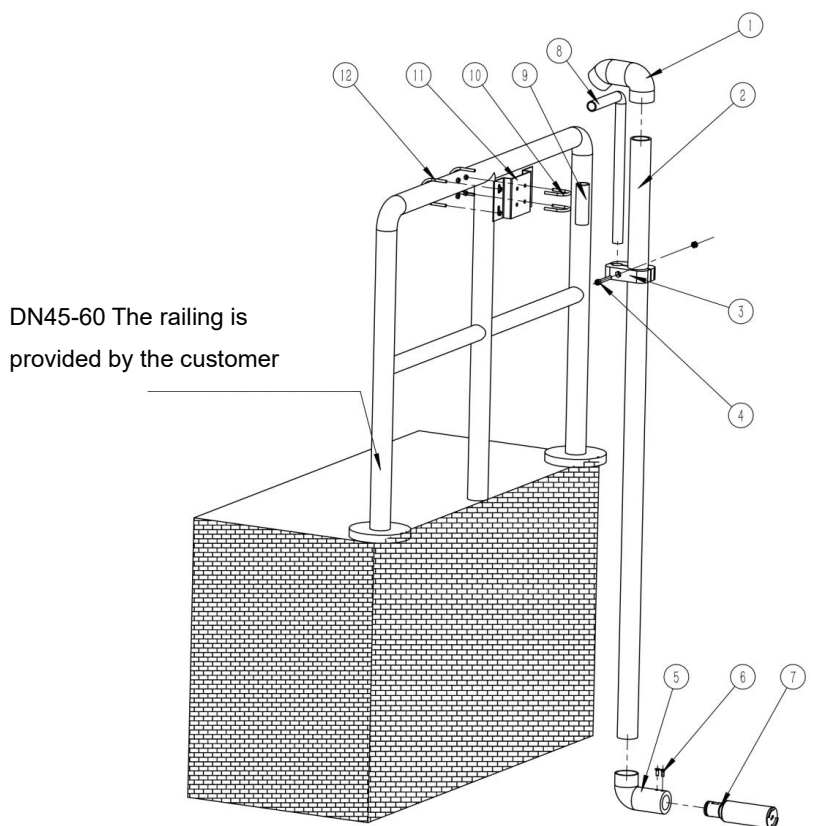
Figure 2 Schematic diagram of railing installation

1-Rainproof elbow	7-Suspended solids sensor
2-Protective line pipe DN44 (outer φ 50) PVC pipe	8-Handle DN22 tube (outer φ 26mm)
3-DN25&DN50 Double pipe clamp	9-Handle sleeve DN26 (Outer φ32)
4-Hexagon socket screws and nuts M8*60	10- M6U type card (DN 40) *2 With 4 nuts
5-Elbow	11- " ⌐ "shaped bracket
6-Countersunk head screws M6*20*2	12- M6U type card (DN 60) *2 With 4 nuts

DN44(outer diameter 50) PVC pipe
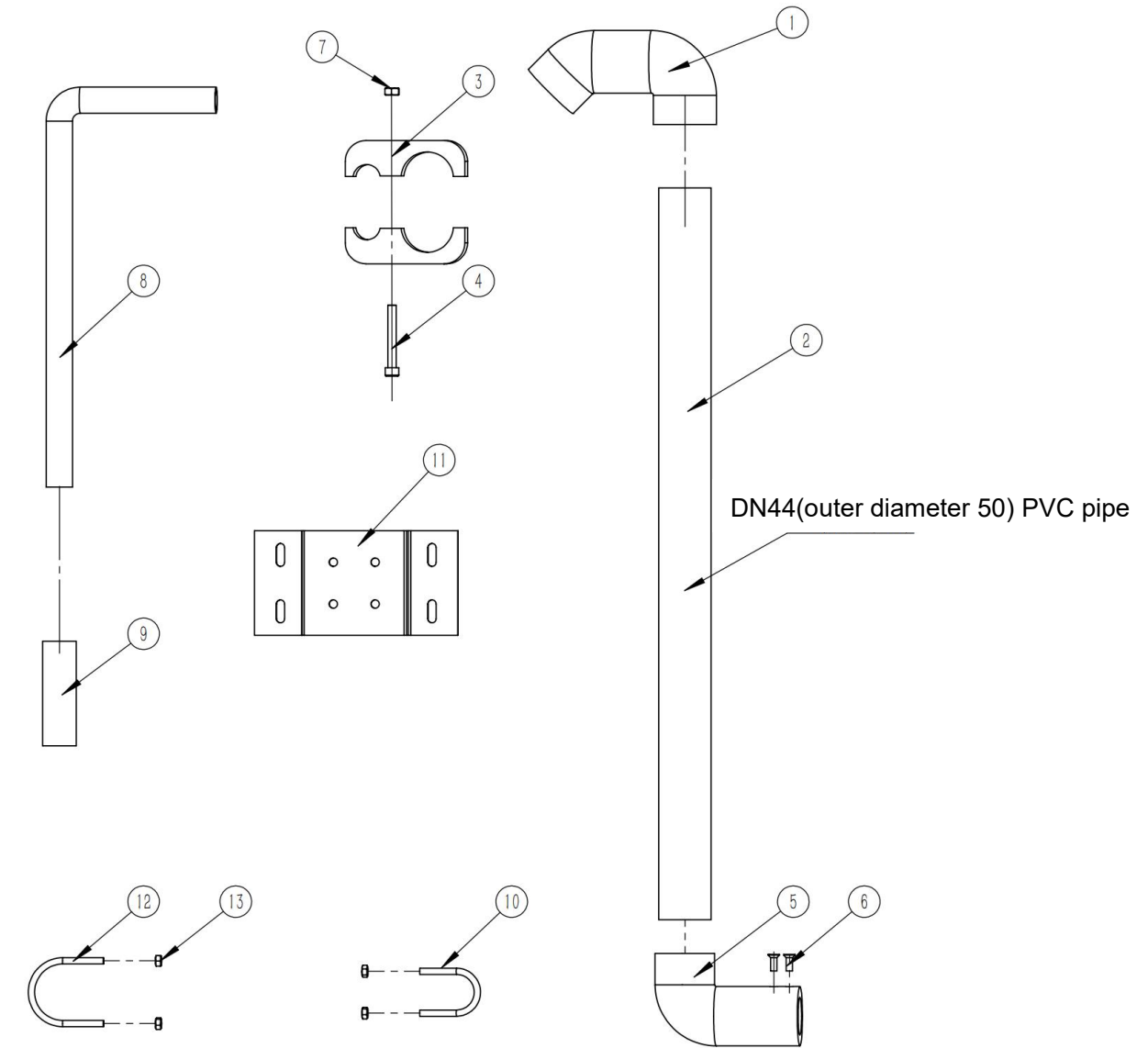
Figure 3 Exploded view of railing installation parts

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	
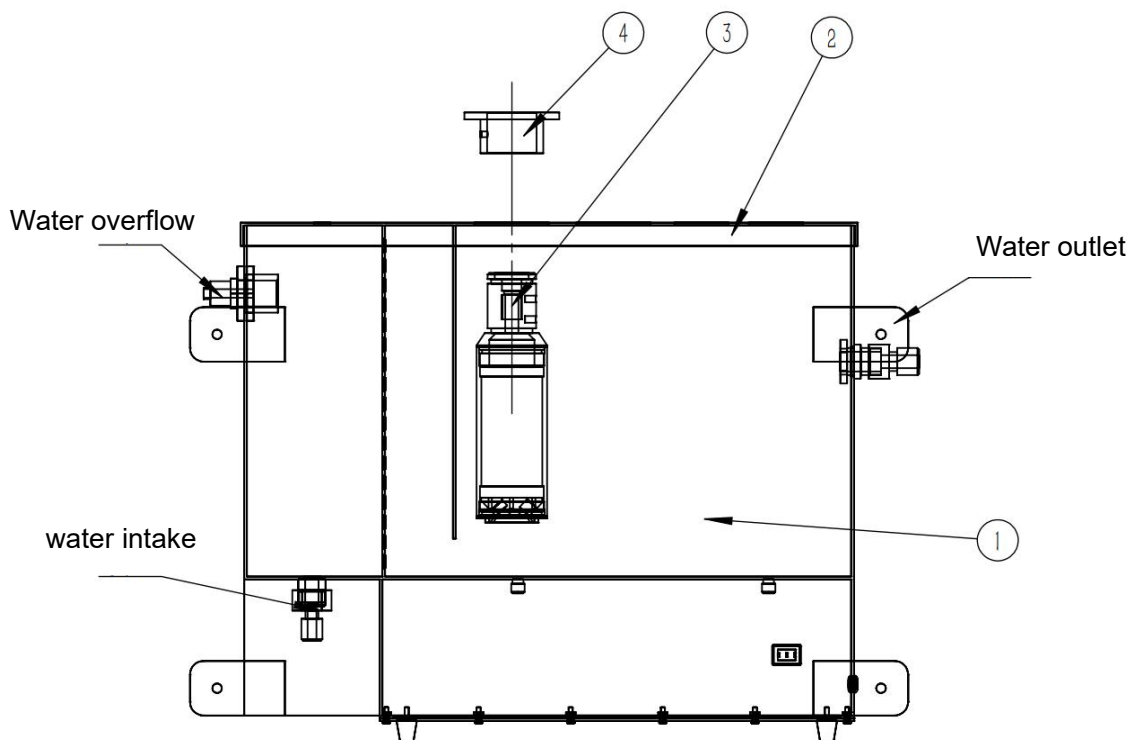
Figure 4 Schematic diagram of flow cell installation

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.

Wire Color	red	black	white	green
Terminal Definition	+12V DC	Power ground	RS485 data A (+)	RS485 data B (-)
Instrument Terminal Symbols	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 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 Switch measurement model

The sensor provides three measurement curves, and the internal calibration curve of the sensor can be switched to different calibration standards by writing the corresponding value to the No. 13 register.

0-Activated sludge standard
1-Diatomaceous earth standard
2-Linear Standard

4.3.2 Zero Point Calibration

Zero-point calibration needs to use clean water (distilled / tap water). The process is as follows:

● Put the sensor into a container with clean water and wait for the sensor measurement value to stabilize;

● Use the 06 function code to write the value 15 to the 15th 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, 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.

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

4.3.3 Slope Calibration

The slope calibration needs to be calibrated using the laboratory dry weighing method. The calibration process is as follows:

- Put the sensor into the container containing the water sample and wait for the sensor measurement value to stabilize;
- Use the 16 function code to write the value -100 to the 16th register;
- Read the "status 2" register value until the register value becomes 0, at which time the sensor obtains the current measurement snapshot;
- Use the method of drying and weighing in the laboratory to obtain the actual suspended matter of the water sample;
- Use the 16 function code to write the actual suspended matter value of the water sample to the 16th register to complete the calibration.

4.3.4 Linear Calibration

Two-point calibration is usually sufficient, for higher accuracy, multi-point calibration can be used, the sensor provides ability to perform linear calibration with up to 10 calibration points.

- In multi-point calibration, the first point is usually the zero point, put the sensor in a container filled with clean water, and wait for the measured value of the sensor to stabilize;
- Use the 16 function code to write the value -100 to the 33rd register;
- Read the value of the "status 2" register until the value of the register becomes 0, at which time the sensor obtains the first measurement snapshot;
- Put the sensor into the container containing water sample 1 and wait for the sensor measurement value to stabilize;
- Use the 16 function code to write the value -100 to the 35th register;
- Read the value of the "status 2" register until the value of the register becomes 0, at which time the sensor obtains the second measurement snapshot;
- Repeat steps 4 to 6 until all measurement snapshots of the water samples to be calibrated are acquired;
- Use the method of drying and weighing in the laboratory to obtain the actual suspended solids value of all water samples;
- Use function code 16 to write a value of 0 to register 33;
- Use function code 16 to write the actual suspended matter value of water sample 1 to register 35;
- Repeat step 10 until the actual suspended matter values of all water samples are written.

Note: The suspended matter value of the water sample used for the calibration point can be selected arbitrarily. It is recommended to select the calibration point uniformly within the actual measurement range.

Note: When calibrating, you need to follow the order of suspended matter values from low to high, and calibrate point by point. Write 0 for unused calibration points, and do not skip the middle calibration point;

Note: The effects of "Suspended Matter Deviation" and "Suspended Matter Factor" will be superimposed on the "Linear Calibration". Before using "Linear Calibration", perform "Restore Calibration" on the electrode or manually set the deviation value to 0, and the factor value setting If it is 1, after linear calibration, you can use "Suspended Matter Bias" and "Suspended Matter Factor" to adjust the sensor zero point and slope.

Note: Linear calibration calibrates at least 2 points and a maximum of 10 points.

4.3.5 Reset Calibration

Use function code 06 to write the value 54 to the 54th 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[note1]	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
SS Measure	4	floating point	2	Read Only	04	Tu output value unit is mg/L
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
SS Offset	9	floating point	2	Read/Write	03/16	The offset value defaults to 0 mg/L
SS Factor	11	floating point	2	Read/Write	03/16	The factor value defaults to 1
Measurement model	13	unsigned integer	1	Read/Write	03/06	0= suspended solids (default), 1= diatomite, 2= linear

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, and the register can be executed. For write operations, the write protection status 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	15	unsigned integer	1	Write Only	06	Write 15 to start zero calibration
Slope CAL	16	unsigned integer	1	Write Only	06	Write 0 to get snapshot, non-0 value to start calibration
Linear CAL point 1	33	floating point	2	Read/Write	03/16	Write the turbidity target value to start the calibration
Linear CAL point 2	35	floating point	2	Read/Write	03/16	Write -100 to get snapshot, other values to start calibration
Linear CAL point 3	37	floating point	2	Read/Write	03/16	Write -100 to get snapshot, other values to start calibration
Linear CAL point 4	39	floating point	2	Read/Write	03/16	Write -100 to get snapshot, other values to start calibration
Linear CAL point 5	41	floating point	2	Read/Write	03/16	Write -100 to get snapshot, other values to start calibration
Linear CAL point 6	43	floating point	2	Read/Write	03/16	Write -100 to get snapshot, other values to start calibration
Linear CAL point 7	45	floating point	2	Read/Write	03/16	Write -100 to get snapshot, other values to start calibration
Linear CAL point 8	47	floating point	2	Read/Write	03/16	Write -100 to get snapshot, other values to start calibration
Linear CAL point 9	49	floating point	2	Read/Write	03/16	Write -100 to get snapshot, other values to start calibration
Linear CAL point 10	51	floating point	2	Read/Write	03/16	Write -100 to get snapshot, other values to start calibration
Reset CAL	54	unsigned integer	1	Write Only	06	Write 54 to reset calibration
Write-protect Switch note2	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 the write protection, and write a value other than 3278 to the "write protection switch" register or power on again to write protection.