SZ532-A
Digital pH Sensor
User Manual

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Catalog

Preface

Dear customer：

Thank you for using our product.Reading the entire manual before use is highly recommended for operation and maintenance the instrument and out of unnecessary trouble.

Please observe the operating procedures and precautions in this manual.

To make sure the effective after-sales protection provided by the instrument, please do not use any operation or maintenance other than which mentioned in the manual.

Due to non-compliance with the precautions specified in this manual, any fault and loss caused shall not be covered by the warranty, and the manufacturer shall not bear any relevant responsibility. If you have any questions, please contact our after-sales service department or representative.

Carefully unpack the instrument and accessories from the shipping container, and inspect for possible damage during shipping. Check received parts with items on the packing list. If any parts or materials are damaged or missing, please contact our customer service or the authorized distributor immediately.

Save all packing materials until you are sure that the instrument functions properly. Any damaged or defective items must be returned in their original packaging materials.

1 Overview

Online pH sensor, which uses a rugged industrial electrode and a built-in temperature sensor for automatic temperature compensation, and supports RS485 Modbus digital output. It is ideal for long-term online monitoring.

Features：

The RS-485 output，Modbus protocol compatible;

Automatic temperature compensation;

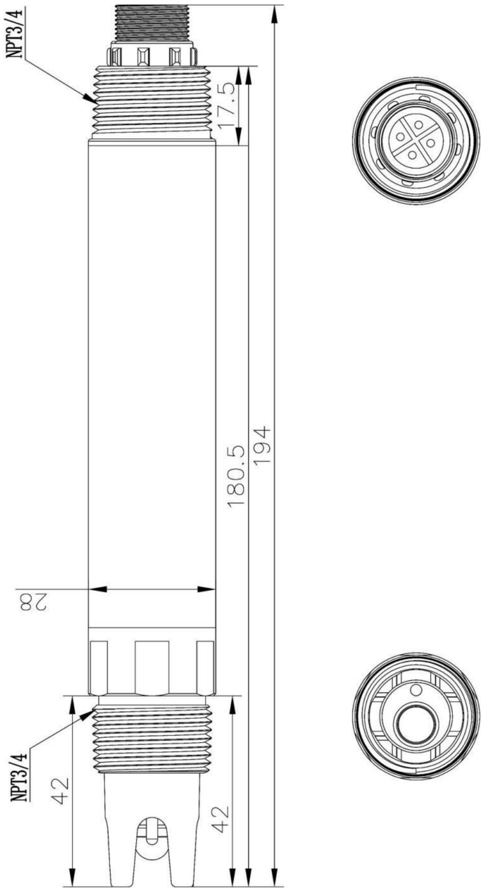
Using high performance industrial online electrode, can work for a long time;

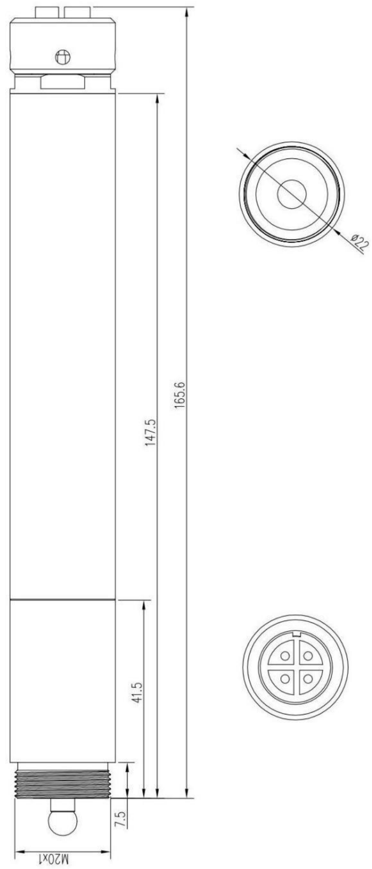
Machine IP68 waterproof.

1.1 Introduction

▲ pH sensor

▲ pH sensor（multi-parameter）



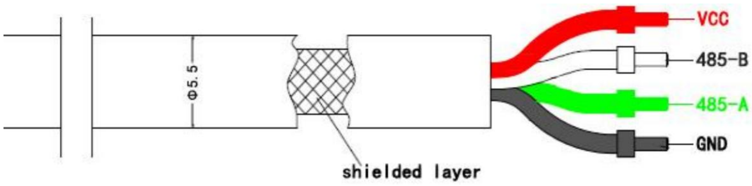


▲ pH Sensor Size

▲ pH Sensor Size（multi-parameter）

1.2 Cable definition

4 wire AWG-24 or AWG-26 shielding wire. OD=5.5mm



1, Red—Power (VCC)

2, White—485 Date_B (485_B)

3, Green—485 Date_A (485_A)

4, Black—Ground (GND)

1.3 Technical Specifications

Name	pH Sensor	pH Sensor（multi-parameter)
Principle	Glass electrode method	Glass electrode method
Range	0-14 pH	0-14 pH
Accuracy	±0.02 pH	±0.02 pH
Resolution	0.01	0.01
Housing IP Rating	IP68	IP68
Maximum Pressure	3 bar	3 bar
Temperature Range	0-50℃	0-50℃
Sensor Interface	Supports RS-485，MODBUS protocol	Supports RS-485，MODBUS protocol
Power	0.3W （Suggested power supply: DC 12-24V, ≥1A）	0.3W （Suggested power supply: DC 12-24V, ≥1A）
Assembly	NPT3/4 thread, submersible mounting	with a multi-parameter parent to connect
Size	Φ28mm*194mm （No protective cover）	Φ22mm*165.6mm （No protective cover）
Probe cable length	10m (default), customizable	none
Body Material	POM+Ti	POM+Ti
Calibration	Two-points or three-points calibration	Two-points or three-points calibration

Note:

The above technical parameters are all data under laboratory standard liquid environment.

Sensor life and maintenance calibration frequency are related to actual field conditions.

2 Installation

2.1 Configuration table

Standard configuration	Number	Remarks
pH Sensor	1	
Wires and Cables	1	10m

2.2 Sensor Installation

(1) Wiring and power supply

① Do not use the sensor cable to pull the sensor! It is required to install sensor in a secure and stable mounting bracket.

② The female and male connector of sensor cable should be screwed tightly to avoid moisture incursio.

③ Make sure power supply voltage is correct before power on.

(2) Sensor installation

① It is recommended to install the sensor vertically with electrodes facing down.

② In consideration of the fluctuation of water level, install the sensor below water level of 30cm, and try to install it in the position where there are no bubbles in the water;

③ The sensor needs to be fixed and installed to avoid knocking of the probe caused by water flow and other factors.

④ Please be careful with the electrode bulb to avoid breaking.

3 Calibration

3.1 Brief description

The pH sensor can be calibrated using our Smart PC software (Please scan the QR code on the right to get our Smart PC software, and refer to the “Help” document in the compressed package to know how to use the software).

SmartPC User Manual:

① Open the SmartPC, Select "Language" in the title bar: English.

② Select the correct port and click "Connect" .

③ Select calibration in the display interface to perform calibration operations. Press F1 for help documentation. Find the pH probe calibration instructions.

④You can also use this tool for measurement and data logging, refer to the help documentation.

3.2 Standard solution and precautions

If high precision is required, we recommend to purchase standard solutions (250ml/bottle is recommended), the pH standard concentration is: 4.00, 6.86, 9.18 (25℃).

Notes:

(1) When the electrode is not in use, it needs to be stored in 3.3mol/L KCL solution or saturated KCl solution;

(2) The electrode should not be exposed to air for too long time;

(3) The electrode should be handled gently to avoid electrode bulb rupture;

(4) After calibrating a standard solution, it is necessary to rinse the electrode with deionized water, and gently wipe it with dust-free paper or cloth, and then put it into the next standard solution;

(5) When the correct operation but the calibration software prompts that the calibration is abnormal or the original MV value of the sensor loses the gradient in the three concentration standard solutions, the electrode may fail.

4 Maintenance schedule and methods

4.1Maintenance cycle

The cleanliness of the measuring window is very important to maintain accurate readings. It is recommended to clean sensor optical windows before testing.

Maintenance task	Frequency
	pH Sensor
Sensor cleaning	Every 2 to 3 weeks
Sensor Calibration	Every 1 month and the specific conditions depend on

4.2 Maintenance methods

（1） **Clean the sensor surface：** Wash the outer surface of sensor with tap water, if there is still residue, using soft brush, for some stubborn dirt, household detergent can be added in tap water to clean.

（2） **Check the cable：** The cable should not be taut during normal operation，The wires inside the cable may break if it is under long term stressed condition.

（3） **Sensor Preservation**： Regular electrode maintenance requires that a electrode be stored in the recommended storage solution between measurements, and that the electrolyte solution be refilled as necessary. 3.3mol/L potassium chloride solution is recommended as the proper storage solution.

4.3 Attention

Probe contains sensitive optical components and electronic components. Ensure that the probe far away from severe mechanical impact.

5 Trouble Shooting

Table 5-1 lists possible problems with sensors and solutions. If your problem is not listed or the solution does not handle your problem, please contact us.

ERROR	POSSIBLE CAUSE	SOLUTION

Communication Failure	Power supply or wiring Failure	Check whether the power supply and wiring are correct according to the instruction
	Interface or protocol issues	1. Use our SmartPC upper computer software to check whether the communication is normal ; 2. Check according to the supporting communication protocol of the product.
Measured value is too high, too Low or instability	Sensor's window is dirty and worn	Clean sensor body, special light window table
	Electrode Aging	Specimen validation evaluation
	Calibration is required	Perform user calibration
Other errors	Contact customer service	

Table 5-1 List of frequently asked questions

6 Quality Assurance

(1) pH sensor warranty period is 1 year, pH sensor (multi-parameter) warranty period is 6 months.

(2) This quality assurance does not cover the following cases.

① Due to force majeure, natural disasters, social unrest, war (declared or undeclared), terrorism, the War or damage caused by any governmental compulsion.

②damage caused by misuse, negligence, accident or improper application and installation.

③ Freight charges for shipping the goods back to our company.

④Freight charges for expedited or express shipping of parts or products covered by the warranty.

⑤Travel to perform warranty repairs locally.

(3) This warranty includes the entire contents of the warranty provided by our company with respect to its products.

① This warranty constitutes a final, complete and exclusive statement of the terms of the warranty, and no person or The agent is authorized to establish other warranties in the name of our company.

② The remedies of repair, replacement, or return of payment as described above are exceptional cases that do not violate this warranty, and the remedies of replacement or return of payment are for our products themselves. Based on strict liability or other legal theory, our company shall not be liable for any other damage caused by a defective product or by negligent operation, including any subsequent damage that is causally related to these conditions.

7 Communication protocols

The RS485 communication protocol uses MODBUS communication protocol, and the sensors are used as slaves.

Data byte format.

Baud rate	9600
Starting position	1
Data bits	8
Stop bit	1
Check digit	N

Read and write data (standard MODBUS protocol)

The default address is 0x01, the address can be modified by register

7.1 Reading data

Host call (hexadecimal)

01 03 00 00 00 01 84 0A

Code	Function Definition	Remarks
01	Device Address	
03	Function Code	
00 00	Start Address	See register table for details
00 01	Number of registers	Length of registers (2 bytes for 1 register)
84 0A	CRC checksum, front low and back high	

Slave answer (hexadecimal)

01 03 02 00 xx xx xx xx

Code	Function Definition	Remarks
01	Device Address	
03	Function Code	
02	Number of bytes read	
XX XX	Data (front low and back high DCBA)	See register table for details
XX XX	CRC checksum, front low and back high	

7.2 Writing data

Host call (hexadecimal)

01 10 1B 00 00 01 02 01 00 0C C1

Code	Function Definition	Remarks
01	Device Address	
10	Function Code	
1B 00	Register Address	See register table for details
00 01	Number of registers	Number of read registers
02	Number of bytes	Number of read registers x2
01 00	Data (front low and back high DCBA)	
0C C1	CRC checksum, front low and back high	

Slave answer (hexadecimal)

01 10 1B 00 00 01 07 2D

Code	Function Definition	Remarks
01	Device Address	
10	Function Code	
1B 00	Register Address	See register table for details
00 01	Returns the number of registers written	
7D 2D	CRC checksum (front low and back high)	

7.3 Calculating CRC Checksum

(1) Preset one 16-bit register as hexadecimal FFFF (i.e., all 1s) and call this register the CRC register.

(2) Iso-oring the first 8-bit binary data (both the first byte of the communication information frame) with the lower 8 bits of the 16-bit CRC register and placing the result in the CRC register, leaving the upper 8 bits of data unchanged.

(3) Shift the contents of the CRC register one bit to the right (toward the low side) to fill the

highest bit with a 0, and check the shifted-out bit after the right shift.

(4) If the shifted out bit is 0: repeat step 3 (shift right one bit again); if the shifted out bit is 1, CRC register and polynomial A001 (1010 0000 0000 0001) for the iso-or.

(5) Repeat steps 3 and 4 until the right shift is made 8 times so that the entire 8-bit data is processed in its entirety.

(6) Repeat steps 2 through 5 for the next byte of the communication information frame.

(7) Exchange the high and low bytes of the 16-bit CRC register obtained after all bytes of this communication information frame have been calculated according to the above steps.

(8) The final CRC register content is obtained as follows: CRC code.

7.4 Register Table

Start address	Command Description	Number of registers	Data format (hexadecimal)
0x3000H	Device address (read and write)	1	2 bytes in total 00~01: Device address The range can be set from 1~254 For example, the data obtained is 02 00 (If the low position is in the front, it means that the address is 2) Take address 15 as an example, then 0F 00 Write the corresponding address (low in front) When the current device address is unknown, you can use FF as a common device address to ask for the current
0x0700H	Get Software and Hardware Rev	2	4 bytes in total 00 ~ 01: hardware version 02 ~ 03: software version For example, reading 0101 represents 1.1
0x0900H	Get SN	7	14 bytes in total 00: reserved 01 ~ 12: serial number 13: Reserved The 12 bytes of the serial number are translated according to ASCII code, i.e. the factory serial number
0x2800	pH value acquisition	2	4 bytes in total 00~03： pH value Obtain the pH value after the temperature compensation

0x2600H	mV/PH value acquisition	4	8 bytes in total 00~03: mV value 04~07: pH value The reading mV value/pH value is 4 bytes of data. (The low position is in the front, DCBA format, and this data needs to be converted to a change floating point number. The conversion method is shown below)
0x2400	Temperature value acquisition	2	4 bytes in total 00~03： Temperature value
0x1100H	pH Two point calibration K/B (read and write)	4	8 bytes in total 00~03： K 04~07： B To read K for example, read out as 4 bytes of data (low bit in front, DCBA format, need to convert this data to floating point, see below for conversion method) To write k, for example, we need to convert k to 32-bit floating point and write it in (DCBA format) **Note: K and b should be read and written together**
0x2300	pH 3-Points calibration steps	2	pH sensor can support three-points calibration. The standard buffer was 4.00 6.86 9.18 （25℃） The standard order of the three-points calibration,the first point： pH 4.00、the second point： pH 6.86、The third point： pH 9.18； **The calibration process is:** Step 1： Clean the electrode and immerse it in pH 4.00 standard solution，At least 1 minute（or wait for the mv value to stabilize）。 Step 2： After mv value stabilization、write in the pH of the marker solution at that point（2 consecutive registers at starting address 0x2300，4 bytes in total，00~03）. Step 3： Repeat the above two steps，perform the second and third point calibration（also wait for the mv value to stabilize、write in the pH value of this calibration point） Step 4： Read the calibration status and determine whether the calibration is successful。**The criteria for successful calibration are:** pH stable for more than 1 minute；

			The deviation of the calibrated measured value from the standard liquid value is within the national standard.
0x0E00	Calibration status gain	1	2 bytes in total 00~01： calibration status, low in front 00： calibrated successfully 01： not a matching calibration standard 02： less than 3 calibration points 04： calibration parameters out of range
0x2900	pH 3-points calibrated electrode parameter settings	12	4 bytes in total 00~03： K1 04~07： K2 08~11： K3 12~15： K4 16~19： K5 20~23： K6 The default parameter is K1=6.86,K2=-6.72,K3=0.04, K4=6.86,K5=-6.56,K6=-1.04

7.5 Conversion algorithms for floating point numbers

7.5.1 Converting floating point numbers to hexadecimal numbers

Step 1: Convert the floating point representation of 17.625 to binary floating point

First find the binary representation of the integer part

$$17 = 16 + 1 = 1 \times 2^4 + 0 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$$

So the binary representation of the integer part 17 is 10001B

Then find the binary representation of the fractional part

$$0.625 = 0.5 + 0.125 = 1 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3}$$

So the binary representation of the decimal part 0.625 is 0.101B

So the floating point number in binary form for 17.625 expressed in floating point form is 10001.101B

Step 2: Shift to find the exponent.

Shift 10001.101B to the left until there is only one place left before the decimal point to get 1.0001101B, and

$10001.101B = 1.0001101\ B \times 2^4$. So the exponential part is 4, which, when added to 127, becomes 131, whose binary representation is 10000011B

Step 3: Calculate the end number

Removing the 1 before the decimal point of 1.0001101B gives the trailing number 0001101B (because the 1 before the decimal point must be 1, the IEEE specifies that only the one after the decimal point should be recorded). An important note for 23-bit trailing numbers: the first bit (i.e. the hidden bit) is not compiled. The hidden bit is the bit to the left of the separator, which is usually set to 1 and suppressed.

Step 4: Symbol bit definition

A positive number has a sign digit of 0 and a negative number has a sign digit of 1, so 17.625 has a sign digit of 0.

Step 5: Convert to floating point

1 digit sign + 8 digits exponent + 23 digits mantissa

0 10000011 00011010000000000000000B (corresponding to 0x418D0000 in hexadecimal)

7.5.2 Converting hexadecimal numbers to floating point numbers

Step 1: Convert hexadecimal number 0x427B6666 to binary floating point number 0100 0010 0111 1011 0110 0110 0110 0110 0110B into sign, exponent and mantissa bits

0 10000100 11110110110110011001100110b

1 digit sign + 8 digits exponent + 23 digits mantissa

Sign bit S: 0 for positive number

Index bit E: 10000100B = $1 \times 2^7 + 0 \times 2^6 + 0 \times 2^5 + 0 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 0 \times 2^0$

=128+0+0+0+0+0+4+0+0=132

Last digit M: 11110110110011001100110B = 8087142

Step 2: Calculating floating point numbers

$$D = (-1)^S \times (1.0 + M/2^{23}) \times 2^{E-127}$$

$$= (-1)^0 \times (1.0 + 8087142/2^{23}) \times 2^{132-127}$$

= 1 x 1.964062452316284 x 32

= 62.85