

# Five pin soil four parameter sensor

## (Type 485)

### Chapter 1 Product Introduction

#### 1.1 Product Overview

This product has stable performance, high sensitivity, fast response, and stable output, suitable for various soil types. It is an important tool for observing and studying the occurrence, evolution, improvement, and water salt dynamics of saline soil. Measuring the dielectric constant of soil can directly and stably reflect the true moisture content of various soils. The volume percentage of soil moisture that can be measured is a soil moisture measurement method that meets current international standards. It can be buried in the soil for a long time and resistant to long-term electrolysis,

Corrosion resistant, vacuum filled, completely waterproof.

Suitable for soil moisture monitoring, scientific experiments, water-saving irrigation, greenhouse, flowers and vegetables, grassland and pasture, soil rapid measurement, plant cultivation, sewage treatment, precision agriculture and other occasions of temperature, humidity, electrical conductivity, pH testing.

#### 1.2 Functional characteristics

■ Low threshold, few steps, fast measurement, no reagent required, unlimited detection times. The electrode is made of specially treated alloy material, which can withstand strong external impact and is not easily damaged.

■ Completely sealed, resistant to acid and alkali corrosion, and can be buried in soil or directly put into water for long-term dynamic testing.

High accuracy, fast response, good interchangeability, and probe insertion design ensure accurate measurement and reliable performance.

It can also be used for the conductivity of water fertilizer integrated solutions, as well as other nutrient solutions and substrates.

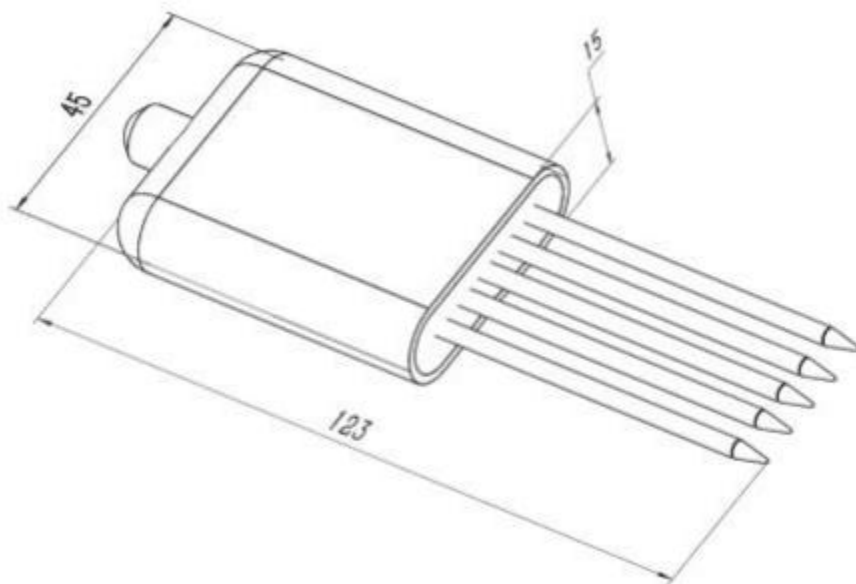
■ High pH measurement accuracy, fast response speed, and good interchangeability.

#### 1.3 Main parameters

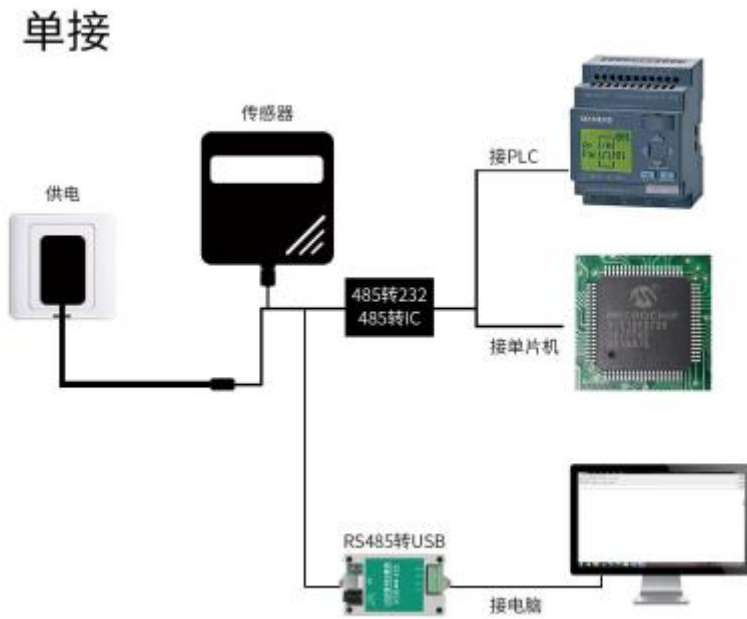
DC power supply (default)	DC 4.5-30V	
Maximum power consumption	0.5W (24V DC power supply)	
working temperature	-20℃~+60℃	
Core chip temperature resistance	85℃	
Stabilization time	≤5min	
Conductivity parameters	range	0-20000us/cm
	resolution ratio	1us/cm
	precision	± 3% FS within the range of

		0-10000us/cm; ± 5% FS in the range of 10000-200000us/cm
Soil moisture parameters	range	0-100%
	resolution ratio	0.1%
	precision	± 2% within 0-50%, @ (brown soil, 30%, 25 °C) ± 3% within 50-100%, @ (brown soil, 60%, 25 °C)
Soil temperature parameters	range	-40~80℃
	resolution ratio	Resolution: 0.1 °C
	precision	±0.5℃ (25℃)
Soil PH parameters	range	3~9PH
	resolution ratio	0.1
Conductivity temperature compensation	Built-in temperature compensation sensor, compensation range 0-50 °C	
Protection level	IP68	
Pin material	Special anti-corrosion electrode	
sealing material	Black flame retardant epoxy resin	
Default cable length	2M	
Overall dimensions	45*15*123mm	
output signal	RS485 (Modbus protocol)	

#### Housing dimensions

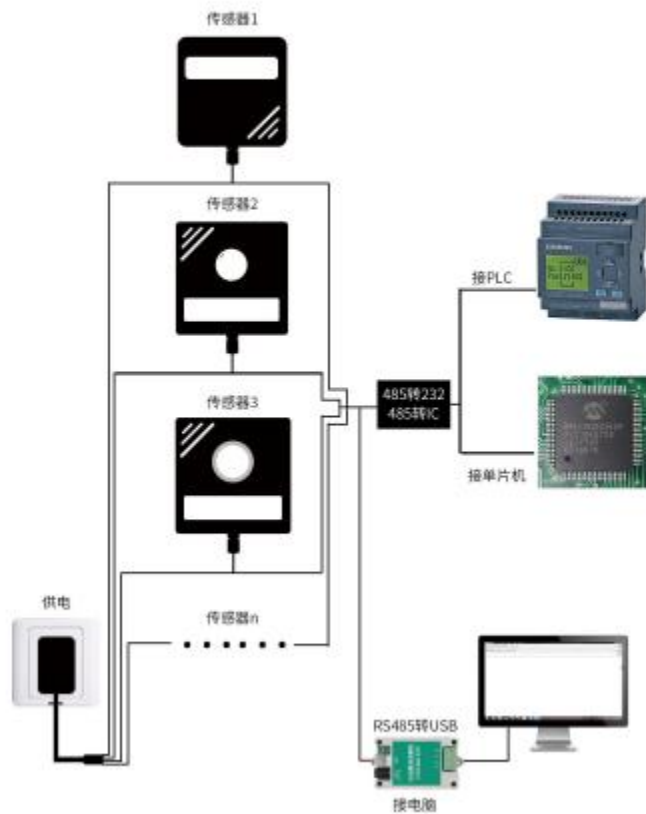


#### 1.4 System framework diagram



This product can also be used with multiple sensors combined on a 485 bus. Theoretically, one bus can have 254 485 sensors, and the other end is connected to a PLC with a 485 interface. A microcontroller is connected through a 485 interface chip, or a USB to 485 connection can be used to connect to a computer. Use the sensor configuration tool provided by our company for configuration and testing (only one device can be connected when using this configuration software).

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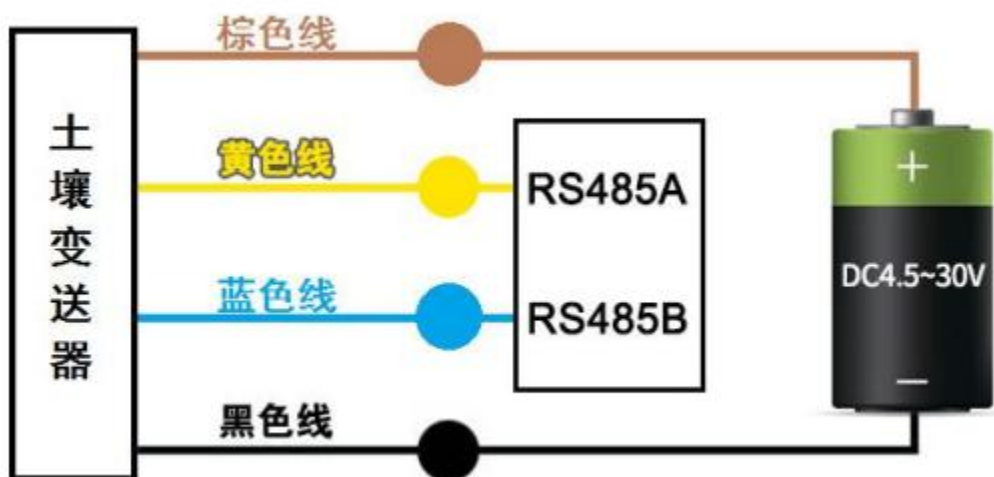
## Chapter 2 Hardware Connections

### 2.2 Interface Description

The wide voltage power input can be 4.5~30V. When wiring the 485 signal line, pay attention to the fact that the A/B lines cannot be reversed, and the addresses of multiple devices on the bus cannot conflict.

#### 2.2.1 Sensor wiring

Linear color	explain	remarks
Brown	Power supply positive	4.5~30V DC
Black	Power supply ground	GND
yellow	485-A	485-A
blue	485-B	485-B



## Chapter 3 Usage

Because the electrode directly measures the electrical conductivity of soluble salt ions in soil, it is necessary for the soluble ions in soil to accurately reflect the electrical conductivity of the soil when the soil volume moisture content is higher than about 20%. During long-term observation, the measured values after irrigation or rainfall are closer to the true level. If rapid measurement is to be carried out, the measured soil can be watered first, and the measurement can be carried out after the water has fully penetrated.

If measuring on a hard surface, first drill a hole (the aperture should be smaller than the probe diameter), then insert it into the soil and compact the soil before measuring; The transmitter should be protected from severe vibration and impact, and should not be knocked with hard objects.

Due to the black packaging of the transmitter, it can cause a sharp temperature rise (up to over 50 °C) under strong sunlight. To prevent excessive temperature from affecting the temperature measurement of the transmitter, please pay attention to shading and protection when using in the field or outdoors.

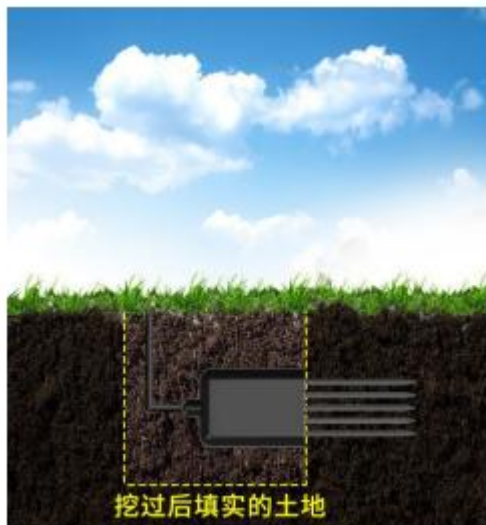
### 3.1 Quick test method

Select a suitable measurement location, avoid rocks, and ensure that the steel needle does not touch hard objects. Throw away the topsoil according to the required measurement depth to maintain the original tightness of the underlying soil. Hold the sensor tightly and insert it vertically into the soil. Do not shake left and right when inserting. It is recommended to measure multiple times within a small range of a measurement point to obtain an average value.



### 3.2 Buried measurement method

Dig a pit with a diameter of  $>20\text{cm}$  vertically, insert the transmitter steel needle horizontally into the pit wall at a predetermined depth, and fill the pit tightly. After stabilizing for a period of time, measurements and records can be conducted for consecutive days, months, and even longer.



### 3.3 Precautions

1. When measuring, the steel needle must be fully inserted into the soil.
2. Avoid excessive temperature caused by direct sunlight on the transmitter. Pay attention to lightning protection during field use.
3. Do not bend the steel needle violently, do not forcibly pull the transmitter lead wire, and do not fall or violently hit the transmitter.
4. The protection level of the transmitter is IP68, which can immerse the entire transmitter in water.
5. Due to the presence of radio frequency electromagnetic radiation in the air, it is not advisable to remain energized in the air for a long time.

6. Calibration should be carried out before each measurement. It is recommended to calibrate once every 1 month for long-term use, and the calibration frequency should be based on Adjust for different application conditions (soil quality, moisture content, salt content, pH, etc.).

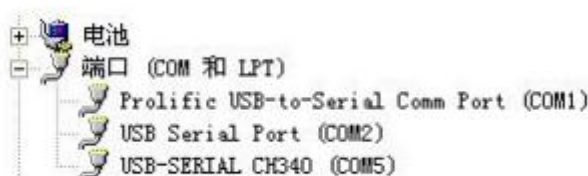
## Chapter 4 Configuration Software Installation and Use

Our company provides a supporting "485 parameter configuration software", which can easily use a computer to read the parameters of the sensor, while flexibly modifying the device ID and address of the sensor.

Note that when using software for automatic acquisition, it is necessary to ensure that there is only one sensor on the 485 bus.

### 4.1 Sensor access to computer

After connecting the sensor to the computer through USB 485 and providing power, you can see the correct COM port in the computer (see the COM port in "My Computer - Properties - Device Manager - Port").



Open the data package, select "Debugging Software" - "485 Parameter Configuration Software",



find it and open it

If no COM port is found in the device manager, **it means that you have not installed the USB to 485 driver (included in the data package) or have not installed the driver correctly.** Please contact a technician for assistance.

### 4.2 Use of sensor monitoring software

- ① The configuration interface is shown in the figure. First, obtain the serial port number according to the method in Section 3.1 and select the correct serial port.
- ② Click the test baud rate of the software, and the software will test the baud rate and address of the current device. The default baud rate is 4800bit/s, and the default address is 0x01.
- ③ Modify the address and baud rate as needed, and query the current functional status of the device.
- ④ If the test is not successful, please recheck the equipment wiring and 485 drive installation.

## Chapter 5 Communication Protocol

### 5.1 Basic communication parameters

code	8-bit binary
Data bits	8-bit
Parity bit	nothing
Stop bit	1 bit
Error checking	CRC (Redundant Cyclic Code)
Baud rate	2400 bit/s, 4800 bit/s, and 9600 bit/s can be set, and the factory default is 4800 bit/s

### 5.2 Data frame format definition

Modbus-RTU communication protocol is adopted, and the format is as follows:

Time for initial structure  $\geq$  4 bytes

Address code=1 byte

Function code=1 byte

Data area=N bytes

Error check=16 bit CRC code

Time to end structure  $\geq$  4 bytes

Address Code: Refers to the address of the transmitter, which is unique in the communication network (factory default 0x01).

Function code: The instruction function indication issued by the host.

Data area: The data area is specific communication data. Note that the high byte of 16bits data comes first!

CRC code: A two byte check code.

Host query frame structure:

Address code	Function code	Register Start Address	Register length	Check code low bit	Check code high bit
1 byte	1 byte	2 byte	2 byte	1 byte	1 byte

Slave response frame structure:

Address code	Function code	Valid Bytes	Data Zone 1	Second data area	Nth data area	Check code
1 byte	1 byte	1 byte	2 byte	2 byte	2 byte	2 byte

### 5.3 Register Address

Register Address	PLC or configuration address	content	operate	Definition Description
0000 H	40001 (decimal)	Water content	read only	Real time value of water content (expanded by 10 times)
0001 H	40002 (decimal)	Temperature value	read only	Temperature real-time value (expanded by 10 times)
0002 H	40003 (decimal)	conductivity	read only	Conductivity



				real-time value
0003 H	40004 (decimal)	PH value	read only	PH real-time value (tenfold increase)
0007 H	40008 (decimal)	salinity	read only	Real-time salinity value (for reference only)
0008 H	40009 (decimal)	Total dissolved solids TDS	read only	TDS real-time value (for reference only)
0022 H	40035 (decimal)	Conductivity temperature coefficient	Reading and writing	0-100 corresponds to 0.0% - 10.0%, default 0.0%
0023 H	40036 (decimal)	Salinity coefficient	Reading and writing	0-100 corresponds to 0.00-1.00 Default 55 (0.55)
0024 H	40037 (decimal)	TDS coefficient	Reading and writing	0-100 corresponds to 0.00-1.00 Default 50 (0.5)
0050 H	40081 (decimal)	Temperature calibration value	Reading and writing	Integer (expanded by 10 times)
0051 H	40082 (decimal)	Water content calibration value	Reading and writing	Integer (expanded by 10 times)
0052 H	40083 (decimal)	Conductivity calibration value	Reading and writing	integer
0053 H	40083 (decimal)	PH calibration value	Reading and writing	integer
07D0 H	42001 (decimal)	Device Address	Reading and writing	1-254 (factory default 1)
07D1 H	42002 (decimal)	Device Baud Rate	Reading and writing	0 for 2400 1 for 4800 2 for 9600

#### 5.4 Communication protocol examples and explanations

Example: Read the parameter value of the conductivity, temperature, moisture, PH, four-in-one device (address 0x01)

Inquiry frame

Address code	Function	Start Address	Data length	Check code	Check code
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	code			low byte	high byte
0x01	0x03	0x00 0x00	0x00 0x04	0x44	0x09

Reply frame

Address code	Function code	Returns the number of valid bytes	Moisture value	Temperature value	Conductivity value	PH value	Check code low byte	Check code high byte
0x01	0x03	0x08	0x02 0x92	0xFF 0x9B	0x03 0xE8	0x00 0x38	0x57	0xB6

Temperature calculation:

When the temperature is below 0 °C, the temperature data is uploaded in the form of a complement.

Temperature: FF9B H (hexadecimal)=- 101=>Temperature=- 10.1 °C

Moisture calculation:

Moisture: 292 H (hexadecimal)=658=>Humidity=65.8%, that is, the soil volume moisture content is 65.8%.

Conductivity calculation:

Conductivity: 3E8 H (hexadecimal)=1000 Conductivity=1000 us/cm

PH value calculation:

PH value: 38H (hexadecimal)=56=>PH value=5.6

## Chapter 6 Common Problems and Solutions

### 6.1 Note that there is no output or output error

Possible causes:

- ① "The computer has a COM port, and the port selected is incorrect."
- ② Baud rate error.
- ③ The 485 bus is disconnected, or the A and B lines are connected reversely.
- ④ If the number of equipment is too large or the wiring is too long, power should be supplied nearby, with a 485 booster added, and a 120 Ω terminal resistor added.
- ⑤ The USB to 485 drive is not installed or damaged.
- ⑥ Equipment damage.