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Five-pin soil multi-parameter sensor (Type 485)

SN-3002-TR-*-N01

Ver 2.0



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No. Chapter 1 Product Introduction

1.1 Product Overview

This product has stable performance and high sensitivity.Fast response, stable output, suitable for all kinds of soil.It is an important tool for observing and studying the occurrence, evolution, improvement and water-salt dynamics of saline soil. By measuring the dielectric constant of the soil, it can directly and stably reflect the true moisture content of various soils. It can measure the volume percentage of soil moisture and is a soil moisture measurement method that meets the current international standards.It can be buried in the soil for a long time, is resistant to long-term electrolysis, corrosion, vacuum potting, and is completely waterproof.

It is suitable for temperature, humidity, conductivity and pH value testing in soil moisture monitoring, scientific experiments, water-saving irrigation, greenhouses, flowers and vegetables, grasslands, rapid soil testing, plant cultivation, sewage treatment, precision agriculture and other occasions.

1.2 Features

■Low threshold, few steps, fast measurement, no reagents required, and unlimited number of tests.

■ The electrodes are 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, can be buried in the soil or directly put into water for long-term dynamic detection.

■ High precision, 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 solutions, as well as other nutrient solutions and substrates.

1.3 Main parameters

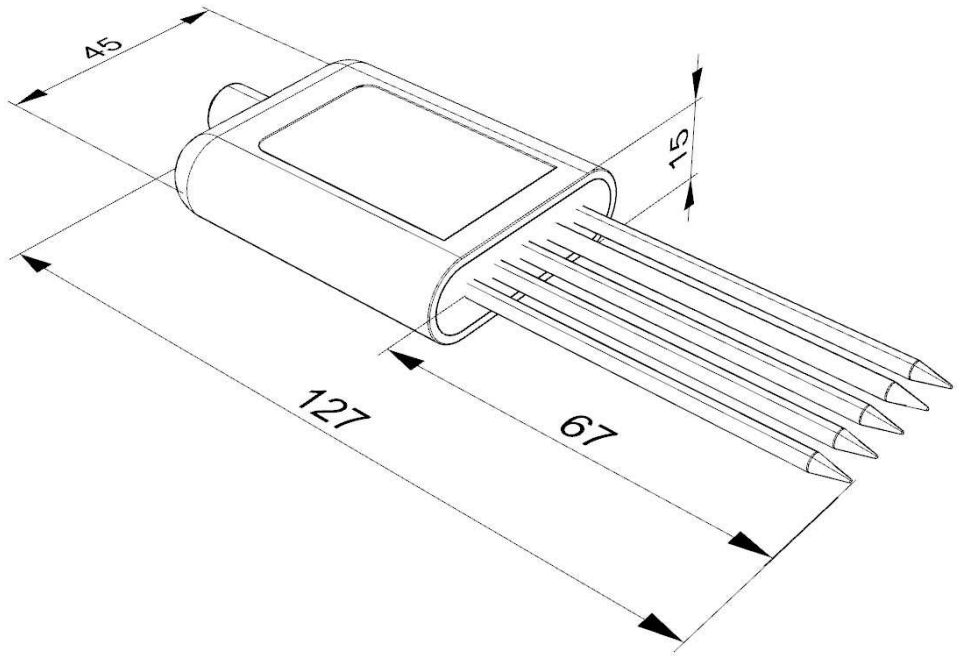
DC power supply (default)	DC 4.5-30V
Maximum power consumption	0.5W(24V DC power supply)
Operating temperature	-20℃~+60℃

Core chip temperature resistance	85℃	
Stabilization time	≤5min	
Conductivity parameters	Range	0-20000μS/cm
	Resolution	1μS/cm
	Typical accuracy	±3%FS in the range of 0-10000μS/cm; ±5%FS in the range of 10000-20000μS/cm; (Brown soil, 60%, 25℃)
Soil moisture parameters	Range	0-100%
	Resolution	0.1%
	Accuracy	0-50% within ±2%, @(Brown soil, 30%, 25℃) 50-100% within ±3%, @(Brown soil, 60%, 25℃)
Soil temperature parameters	Range	-40~80℃
	Resolution	Resolution: 0.1℃
	Accuracy	±0.5℃(25℃)
Soil pH parameters	Range	3~9PH
	Resolution	0.1
NPK parameters (Input after measurement by national standard instrument)	Range	0-2999 mg/kg(mg/L)
	Resolution	1 mg/kg(mg/L)
	Typical accuracy	≤5% (subject to the actual measuring instrument)
Soil fertility	Range	0-3000 mg/kg(mg/L)
	Resolution	1 mg/kg(mg/L)
	Typical accuracy	≤5% (subject to the actual measuring instrument)
Conductivity temperature	Built-in temperature compensation sensor,	

compensation	compensation range 0-50℃
Protection level	IP68
Pin material	Anti-corrosion special electrode
Sealing material	Black flame retardant epoxy resin
Default cable length	2m, cable length can be customized as required
Dimensions	45*15*123mm
Output signal	RS485 (ModBus protocol)

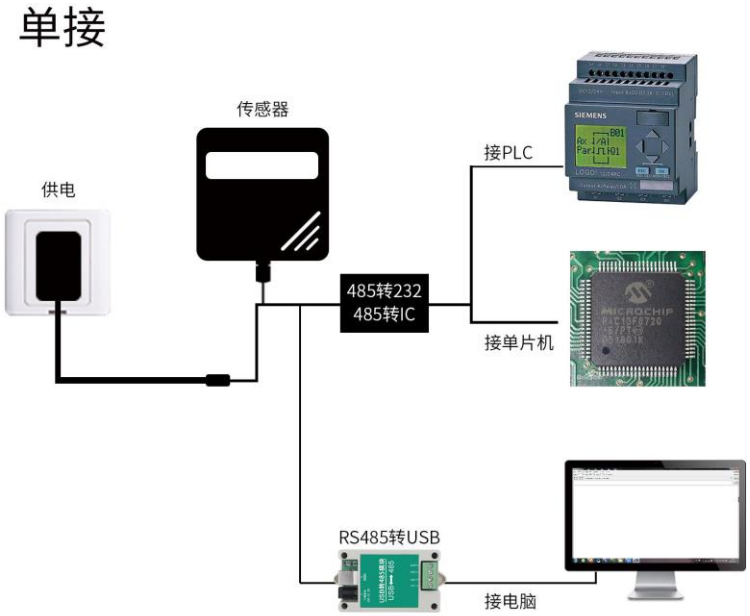
Note: The performance data stated above was obtained under test conditions using our company's test system and software. In order to continuously improve our products, our company reserves the right to change design features and specifications without prior notice.

Shell size



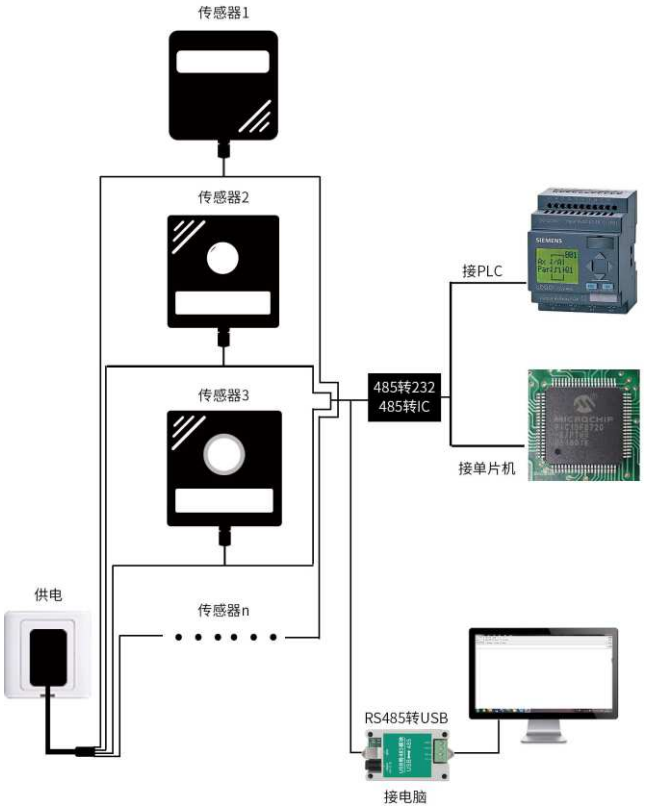
Equipment dimensions (unit: mm)

1.4 System Framework Diagram



This product can also be used by combining multiple sensors on a 485 bus. Theoretically, one bus can hold 254 485 sensors. The other end can be connected to a PLC with a 485 interface, connected to a single-chip microcomputer through a 485 interface chip, or connected to a computer using a USB to 485 converter. 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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1.5 Product Selection

SN-					Company Code
	3002-				
		TR-			Soil testing enclosure
			NPKPH-		NPK PH
			THNPKPH-		Temperature, moisture, nitrogen, phosphorus, potassium, PH
			ECNPKPH-		Conductivity NPK PH
			ECTHNPKPH-		Conductivity Temperature Moisture NPK PH
				N01	RS485 (ModBus-RTU protocol)

Chapter 2 Hardware Connection

2.1 Equipment inspection before installation

Equipment List:

■1 device

■Certificate of Compliance

■USB to 485 (optional)

2.2 Interface Description

The wide voltage power input is 4.5~30V. When wiring the 485 signal line, please note that the A/B lines cannot be connected in reverse, and the addresses of multiple devices on the bus cannot conflict.

2.2.1 Sensor Wiring

Line Color	illustrate	Remark
brown	Power positive	4.5~30V DC
black	Power Ground	GND
yellow	485-A	485-A
blue	485-B	485-B

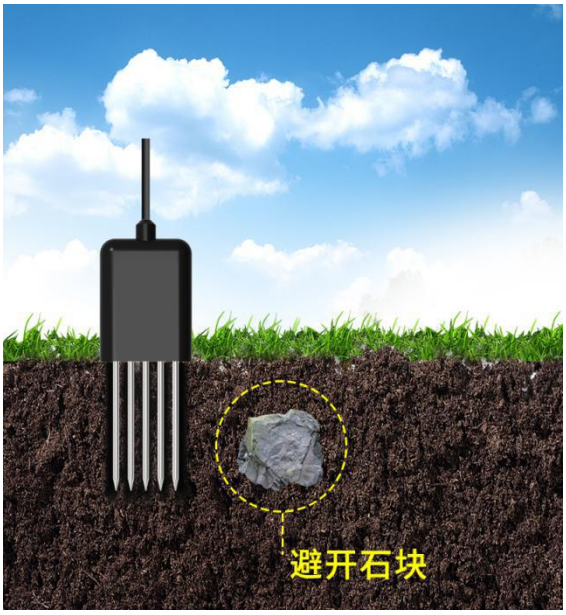
Chapter 3 How to use

Since the electrode directly measures the conductivity of soluble salt ions in the soil, the soluble ions in the soil can correctly reflect the conductivity of the soil only when the soil volume moisture content is higher than about 20%. In long-term observation, the measured value after irrigation or rainfall is closer to the actual level. If a quick test is performed, water the soil to be tested first, and then measure after the water has fully penetrated.

If measuring on a harder surface, you should first drill a hole (the hole diameter 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 hit with hard objects. Since the transmitter is packaged in black, it will heat up rapidly (up to 50°C or more) under strong sunlight. In order to prevent excessive temperature from affecting the temperature measurement of the transmitter, please pay attention to sunshade and protection when using it in the field or outdoors.

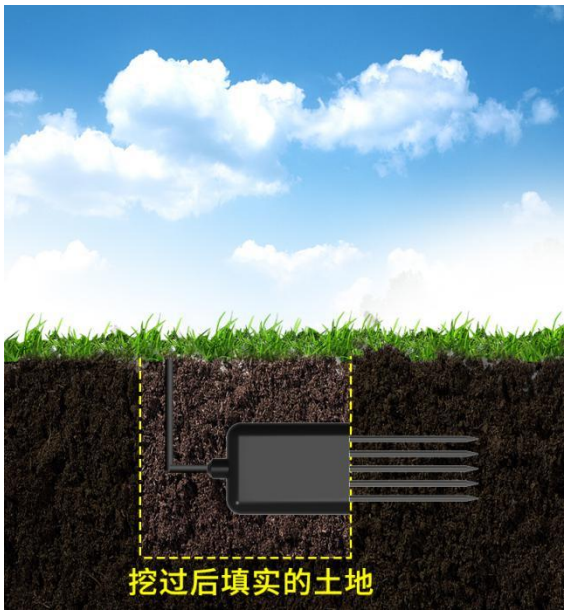
3.1 Rapid test method

Select a suitable measuring location, avoid stones, ensure that the steel needle does not hit hard objects, discard the topsoil according to the required measuring depth, maintain the original tightness of the soil below, hold the sensor firmly and insert it vertically into the soil. Do not shake it left or right during insertion. It is recommended to measure multiple times within a small range of a measuring point to obtain the average value.



3.2 Buried measurement method

Dig a pit vertically with a diameter of >20cm, insert the transmitter steel needle horizontally into the pit wall at a predetermined depth, fill the pit tightly, and after a period of stability, you can perform measurements and records for days, months or even longer.



3.3 Notes

1. When measuring, the steel needle must be completely inserted into the soil.
2. Avoid strong sunlight directly shining on the transmitter to avoid overheating. Be careful to prevent lightning strikes when using it outdoors.
3. Do not bend the steel needle violently, do not pull the transmitter lead wire hard, and do not drop or hit the transmitter violently.
4. The protection level of the transmitter is IP68, and the entire transmitter can be immersed in water.
5. Due to the presence of radio frequency electromagnetic radiation in the air, it is not advisable to keep the device powered on in the air for a long time.

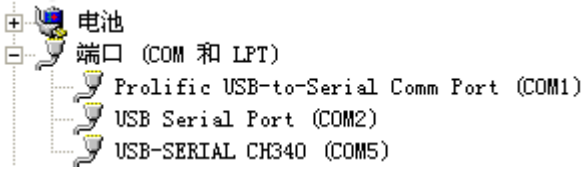
Chapter 4 Configuration Software Installation and Usage

Our company provides the matching "485 parameter configuration software", which can conveniently use the computer to read the parameters of the sensor and flexibly modify the device ID and address of the sensor.

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

4.1 Sensor connected to computer

After the sensor is correctly connected to the computer via USB to 485 and powered, the correct COM port can be seen on the computer (check the COM port in "My Computer - Properties - Device Manager - Port").



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

Just open it.

If the COM port is not found in the device manager, it means that you have not installed the USB to 485 driver (in the data package) or the driver is not installed correctly. Please contact the technician for help.

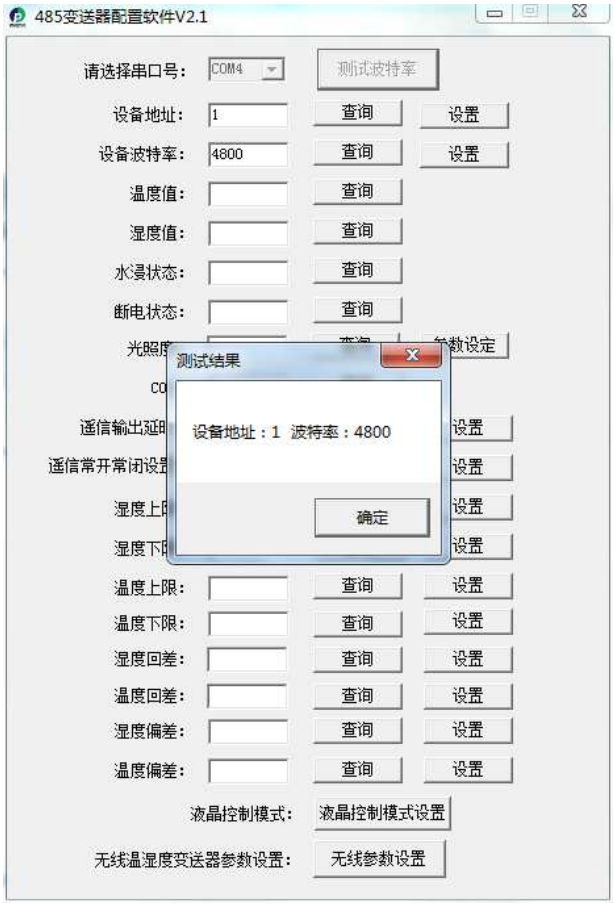
4.2 Use of sensor monitoring software

①、Configure the interface as shown in the figure. First,Use the method in Section 4.1 to obtain the serial port number 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 according to the needs, and query the current functional status of the device.

④. If the test fails, please recheck the device wiring and 485 driver installation.



Chapter 5 Communication Protocol

5.1 Basic communication parameters

coding	8-bit binary
Data bits	8-bit
Parity bit	none
Stop bits	1st
Error checking	CRC (Redundant Cyclic Code)
Baud rate	2400 bit/s, 4800 bit/s, 9600 bit/s can be set, the factory default is 4800 bit/s

5.2 Data frame format definition

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

Time when initial structure ≥ 4 bytes

Address code = 1 byte

Function code = 1 byte

Data area = N bytes

Error checking = 16-bit CRC code

End structure ≥ 4 bytes

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

Function code: This product uses function codes 0x03, 0x06, 0x10, etc.

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

CRC code: a two-byte check code.

Host inquiry frame structure:

Address code	Function code	Register start address	Register length	Check code low	Check code high digit
1 byte	1 byte	2 bytes	2 bytes	1 byte	1 byte

Slave response frame structure:

Address code	Function code	Number of valid bytes	Data Zone 1	Second data area	Nth data area	Check code
1 byte	1 byte	1 byte	2 bytes	2 bytes	2 bytes	2 bytes

5.3 Register Address

Register Address	PLC or configuration address	content	operate	Definition
0000 H	40001(decimal)	Moisture content	Read-only	Real-time value of moisture content (expanded 10 times)
0001 H	40002(decimal)	Temperature value	Read-only	Real-time temperature value (expanded 10 times)
0002 H	40003(decimal)	Conductivity	Read-only	Conductivity real-time value
0003 H	40004(decimal)	pH	Read-only	Real-time pH value (expanded ten times)
0004H	40005 (decimal)	Temporary value of nitrogen content	Read and Write	The nitrogen content value or test value to be written
0005H	40006 (decimal)	Phosphorus content temporary value	Read and Write	Phosphorus content value or test value to be written
0006H	40007 (decimal)	Potassium content temporary value	Read and Write	Potassium content value or test value to be written 3
0007 H	40008(decimal)	salinity	Read-only	Salinity real-time value (for reference only)
0008 H	40009(decimal)	Total Dissolved Solids TDS	Read-only	TDS real-time value (for reference only)

000C H	40013(decimal)	Fertility	Read-only	Fertility real-time value
0022 H	40035(decimal)	Temperature coefficient of conductivity	Read and Write	0-100 corresponds to 0.0%-10.0% Default 0.0%
0023 H	40036(decimal)	Salinity coefficient	Read and Write	0-100 corresponds to 0.00-1.00 Default 55 (0.55)
0024 H	40037(decimal)	TDS coefficient	Read and Write	0-100 corresponds to 0.00-1.00 Default 50 (0.5)
0050 H	40081(decimal)	Temperature calibration value	Read and Write	Integer (expanded by 10 times)
0051 H	40082(decimal)	Moisture content calibration value	Read and Write	Integer (expanded by 10 times)
0052 H	40083(decimal)	Conductivity calibration value	Read and Write	Integer
0053 H	40084(decimal)	pH calibration value	Read and Write	Integer
04E5H	41254(decimal)	Fertility coefficient high sixteen digits	Read and Write	Floating point numbers (IEEE754 standard Floating point type
04E6H	41255(decimal)	Fertility coefficient low sixteen digits	Read and Write	
04E7H	41256(decimal)	Fertility deviation	Read and Write	Integer
04E8H	41257(decimal)	Nitrogen content temporary value coefficient high sixteen digits	Read and Write	Floating point numbers (IEEE754 standard Floating point type
04E9H	41258(decimal)	Nitrogen content temporary value coefficient low sixteen digits	Read and Write	
04EA	41259(decimal)	Deviation of temporary nitrogen content value	Read and Write	Integer
04F2H	41267(decimal)	Phosphorus content temporary value coefficient high sixteen digits	Read and Write	Floating point numbers (IEEE754 standard Floating point type

04F3H	41268(decimal)	Phosphorus content temporary value coefficient low sixteen digits	Read and Write	
04F4H	41269(decimal)	Deviation of temporary phosphorus content value	Read and Write	Integer
04FCH	41277(decimal)	Potassium content temporary value coefficient high sixteen digits	Read and Write	Floating point numbers (IEEE754 standard Floating point type
04FD H	41278(decimal)	Potassium content temporary value coefficient low sixteen digits	Read and Write	
04FEH	41279(decimal)	Deviation of temporary potassium content value	Read and Write	Integer
07D0H	42001(decimal)	Device Address	Read and Write	1~254 (factory default 1)
07D1 H	42002(decimal)	Device baud rate	Read and Write	0 represents 2400 1 represents 4800 2 for 9600

1: When the 0004H register is not written, the value in the register is f1 (conductivity measurement value). After the 0004H register is written, the register stores the written value.
2: When the 0005H register is not written, the value in the register is f2 (conductivity measurement value). After the 0005H register is written, the register stores the written value.
3: When the 0006H register is not written, the value in the register is f3 (conductivity measurement value). After the 0006H register is written, the register stores the written value.

5.4 Communication protocol examples and explanations

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

Inquiry frame

Address code	Function code	Starting address	Data length	Checksum lowbyte	Check code highbyte
0x01	0x03	0x00 0x00	0x00 0x04	0x44	0x09

Response frame

Address code	Function code	Return valid Number of	Moisture value	Temperature value	Conductivity value	pH	Check code Lowbyt	Check cod

		bytes					e	e highbyte
0x01	0x03	0x08	0x02 0x92	0xFF 0x9B	0x03 0xE8	0x00 0x38	0x57	0xB6

Temperature calculation:

When the temperature is lower than 0 ℃, the temperature data is uploaded in the form of compleme code.

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

Moisture calculation:

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

Conductivity calculation:

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

PH value calculation:

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

Chapter 6 Common Problems and Solutions

6.1 Note No Output or Output Error

Possible causes:

①. The computer has a COM port, but the selected port is incorrect.

②. The baud rate is wrong.

③、485 bus is disconnected, orThe A and B lines are connected reversely.

④. If there are too many devices or the wiring is too long, power supply should be provided nearby, a 485 enhancer should be added, and a 120Ω terminal resistor should be added.

⑤. The USB to 485 driver is not installed or is damaged.

⑥. Equipment damage.