Five-pin soil multi-parameter sensor

（Type 485）

PR-3002-TR-*-N01

Ver 2.0

目录

第 1 章 Product introduction

1.1 product description

This product has stable performance, high sensitivity, fast response and stable output, and is suitable for various soil types. It is an important tool to observe and study the occurrence, evolution, improvement and water-salt dynamics of saline soil. By measuring the dielectric constant of soil, it can directly and stably reflect the real moisture content of various soils. It can measure the volume percentage of soil moisture, which is a soil moisture measurement method in line with current international standards. It can be buried in the soil for a long time, resistant to long-term electrolysis, corrosion resistance, vacuum potting, and completely waterproof.

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

1.2 Features

■ Low threshold, few steps, fast measurement, no reagents required, unlimited number of tests.
■ The electrode is made of alloy material with special treatment, which can withstand strong external impact and is not easy to be damaged.
■ Completely sealed, resistant to acid and alkali corrosion, and can be buried in soil or directly into water for long-term dynamic testing.
■ High precision, fast response, good interchangeability, probe insertion design ensures accurate measurement and reliable performance.
■ It can also be used for the conductivity of water and fertilizer integrated solution, as well as other nutrient solutions and substrates.

1.3The 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℃
stable schedule		≤5min
Conductivity parameter	range	0-20000us/cm
	Resolution	1us/cm
	Typical accuracy	±3%FS in the range of 0-10000us/cm; ±5%FS in the range of 10000-20000us/cm; (brown soil, 60%, 25℃)
Soil Moisture Parameters	range	0-100%
	Resolution	0.1%
	precision	±2% within 0-50%, @ (brown soil, 30%, 25℃) ±3% within 50-100%, @ (brown soil, 60%, 25℃)
Soil Temperature Parameters	range	-40~80℃
	Resolution	Resolution: 0.1℃
	precision	±0.5℃（25℃）
Soil pH Parameters	range	3~9PH
	Resolution	0.1
NPK parameters	range	0-2999 mg/kg(mg/L)

(input after measurement by the national standard ≤5% (subject to the actual measuring instrument)	Resolution	1 mg/kg(mg/L)
	Typical accuracy	≤5% (subject to the actual measuring instrument)
	Built-in temperature compensation sensor, compensation range 0-50℃	
Conductivity temperature compensation	IP68	
Protection class	Anti-corrosion special electrode	
Pin material	Black flame retardant epoxy resin	
Sealing material	2 meters, cable length can be customized	
Default cable length	45*15*123mm	
Dimensions	RS485 (Modbus protocol)	

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

Shell size
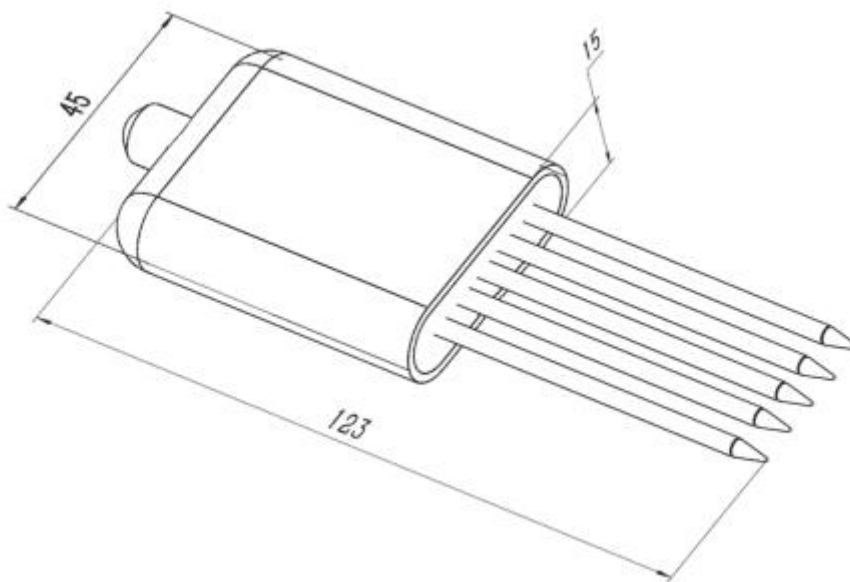
Equipment dimension drawing (unit: mm)

1.4System frame diagram

单接
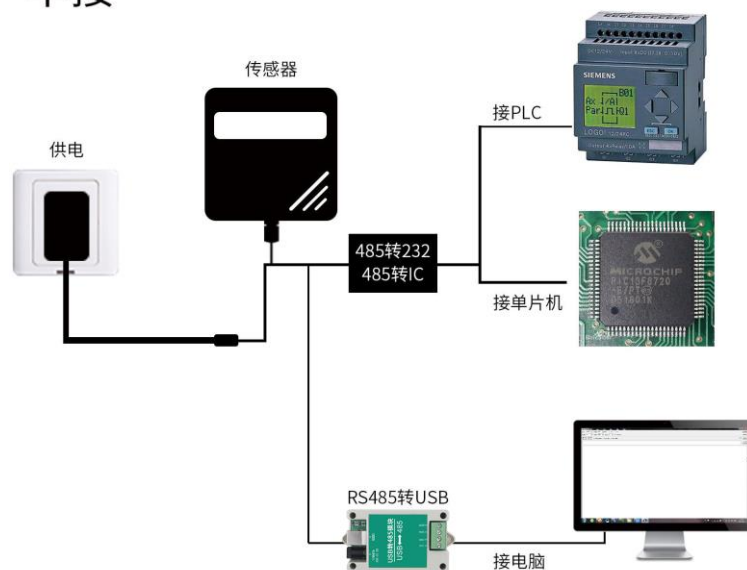
This product can also be used in combination of multiple sensors in a 485 bus. In theory, a bus can have 254 485 sensors, the other end is connected to a PLC with a 485 interface, and the MCU is connected through a 485 interface chip, or USB to 485 can be used to communicate with Computer connection, use the sensor configuration tool provided by our company for configuration and testing (only one device can be connected when using this configuration software).

多接
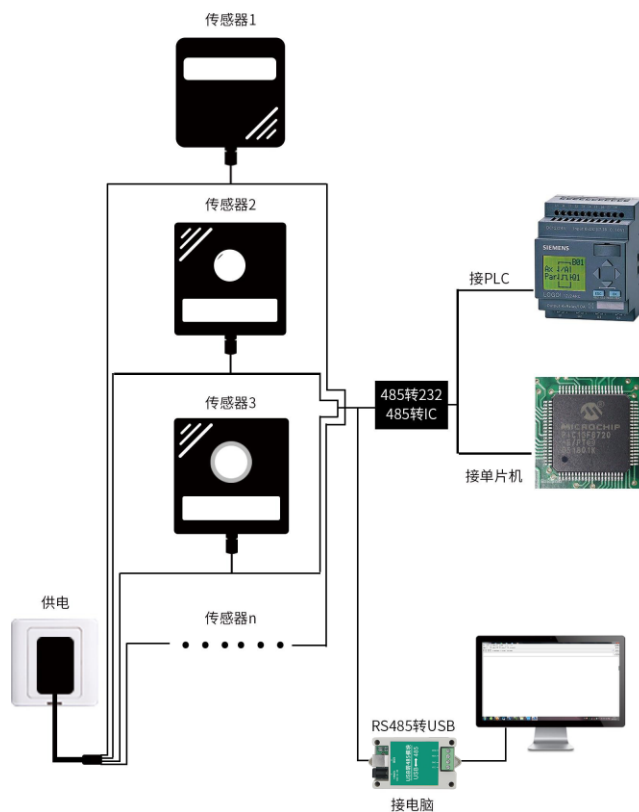
1.5product model

PR-					company code
	3002-				
		TR-			Soil Detection Shell
			NPKPH-		NPK PH
			THNPKPH-		temperature moisture nitrogen phosphorus potassium PH
			ECNPKPH-		Conductivity NPK PH
			ECTHNPKPH-		Conductivity Temperature Moisture Nitrogen Phosphorus Potassium PH
				N01	RS485 (Modbus-RTU protocol)

第 2 章 hardware connection

2.1Equipment pre-installation inspection

Equipment List:

■One set of equipment

■Qualification certificate

■USB to 485 (optional)

2.2Interface Description

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

2.2.1 Sensor wiring

| thread color	illustrate	Remark
brown	Power is positive	4.5~30V DC
black	power ground	GND
yellow	485-A	485-A
blue	485-B	485-B

第 3 章 Instructions

Since the electrode directly measures the conductivity of the soluble salt ions in the soil, the soluble ions in the soil can correctly reflect the conductivity of the soil when the soil volumetric water content is higher than about 20%. In long-term observations, measurements after irrigation or rainfall are closer to the true level. If a quick test is performed, the soil to be tested can be watered first, and the measurement can be performed after the water has fully penetrated.

If you are measuring on a hard surface, you should first drill a hole (the hole diameter should be smaller than the diameter of the probe), then insert it into the soil and compact the soil before measuring; the transmitter should prevent severe vibration and impact, and it should not be knocked with hard objects hit. Since the transmitter is packaged in black, the transmitter will heat up sharply (up to 50°C or more) under strong sunlight. In order to prevent the temperature measurement of the transmitter from being affected by excessive temperature Pay attention to sunshade and protection when using.

3.1 Quick test method

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

避开石块
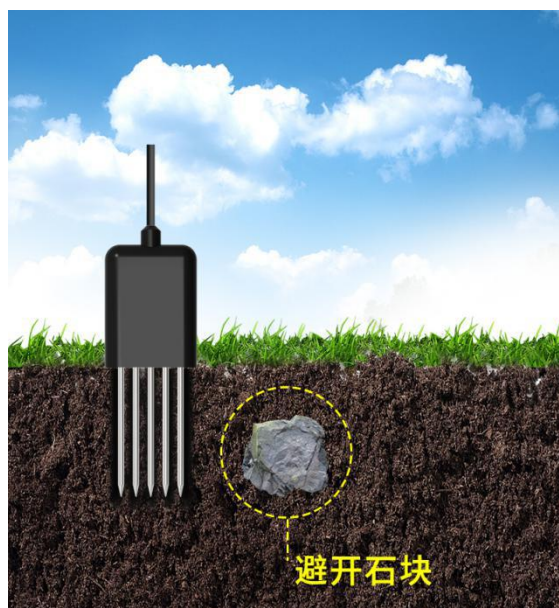
3.2 Buried Surveying

Dig a pit with a diameter >20cm vertically, insert the transmitter steel needle into the pit wall horizontally at a given depth, and fill the pit tightly. Record.

挖过后填实的土地
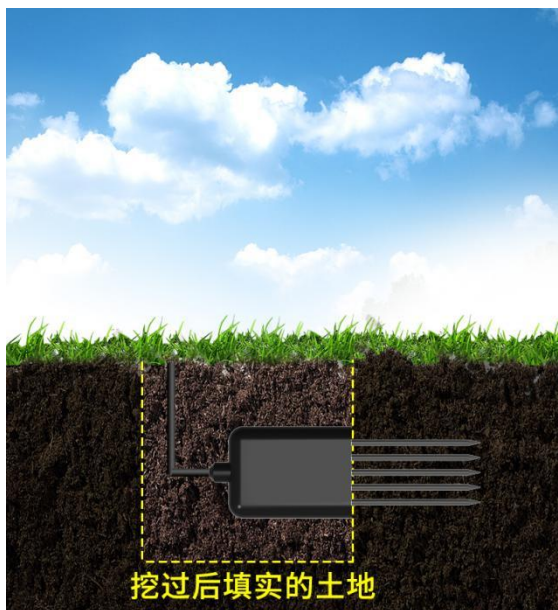
3.3 Precautions

1. The steel needle must be fully inserted into the soil when measuring.

2. Avoid direct sunlight on the transmitter and cause the temperature to be too high. Pay attention to lightning protection when using in the field.

3. Do not bend the steel needle violently, do not pull the lead wire of the transmitter forcibly, and do not beat or violently hit the transmitter.

4. The protection level of the transmitter is IP68, and the entire transmitter can be soaked in water.

5. Due to the existence of radio frequency electromagnetic radiation in the air, it is not suitable to be energized in the air for a long time.
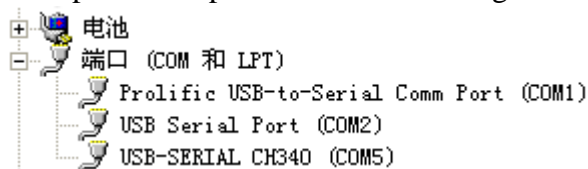
第 4 章 Configuration software installation and use

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

Note that there is only one sensor on the 485 bus when using automatic acquisition by software.

4.1 Sensor connected to computer

After the sensor is correctly connected to the computer via USB to 485 and provides power supply, you can see the correct COM port in the computer (check the COM port in "My Computer - Properties - Device Manager - Port").

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

Configuration Software", find [RS485ControlV 21.exe] 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 (included in the data package) or the driver has not been installed correctly, please contact the technician for help.

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 Chapter 3.1 and select the correct serial port.

②. Click the test baud rate of the software, 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 of use, and at the same time, you can query the current functional status of the device.

④. If the test is unsuccessful, please re-check the wiring of the equipment and the installation of the 485 driver.
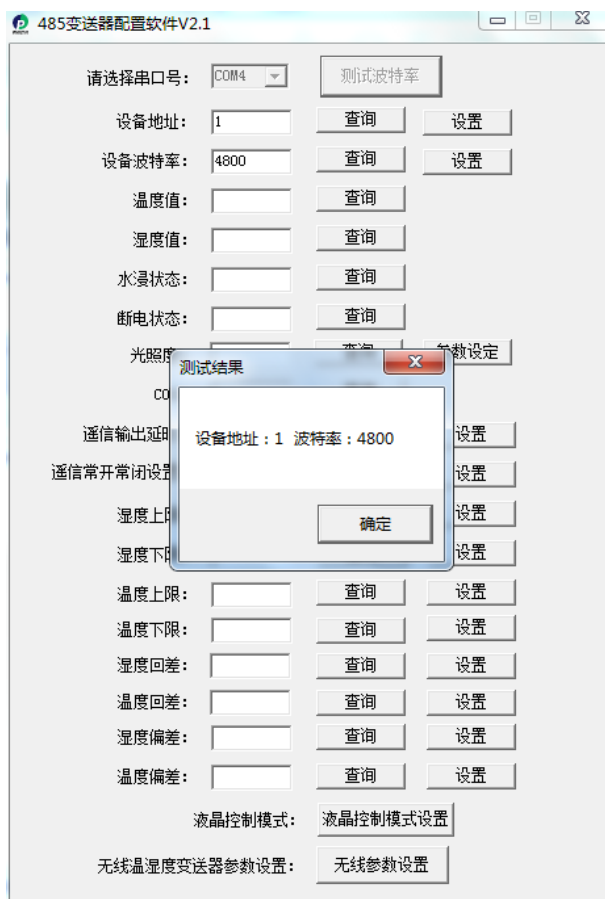
第 5 章 letter of agreement

5.1Communication basic parameters

coding	8 bit binary
data bits	8 bits
parity bit	none
stop bit	1 person
error checking	CRC (Redundant Cyclic Code)
baud rate	2400bit/s, 4800bit/s, 9600 bit/s can be set, the factory default is 4800bit/s

5.2Data Frame Format Definition

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

Initial structure ≥4 bytes of time

Address code = 1 byte

Function code = 1 byte

Data area = N bytes

Error check = 16-bit CRC code

Time to end structure $\geqslant$ 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, pay attention to the high byte of the 16bits data first!

CRC code: two-byte check code.

Host query frame structure:

地址码	功能码	寄存器起始地址	寄存器长度	校验码低位	校验码高位
1 字节	1 字节	2 字节	2 字节	1 字节	1 字节

Slave acknowledgment frame structure：

地址码	功能码	有效字节数	数据一区	第二数据区	第 N 数据区	校验码
1 字节	1 字节	1 字节	2 字节	2 字节	2 字节	2 字节

5.3register address

register address	PLC or configuration address	content	operate	Definition description
0000 H	40001 (decimal)	moisture content	read only	Moisture content real-time value (expanded 10 times)
0001 H	40002 (decimal)	temperature value	read only	Temperature real-time value (expanded 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 (expanded tenfold)
0004H	40005 (decimal)	Temporary value of nitrogen content	read and write	Nitrogen content value written or test value 1
0005H	40006 (decimal)	Temporary value of phosphorus content	read and write	Written phosphorus content value or test value 2
0006H	40007 (decimal)	Temporary value of potassium content	read and write	Written potassium value or test value3
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)
0022 H	40035 (decimal)	temperature coefficient of conductance	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 factor	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 a factor of 10)
0051 H	40082 (decimal)	Moisture content calibration value	read and write	Integer (expanded by a factor of 10)
0052 H	40083 (decimal)	Conductivity calibration value	read and write	integer
0053 H	40083 (decimal)	pH calibration value	read and write	integer
04E8 H	41001 (decimal)	The coefficient of the temporary storage value of nitrogen content is 16 digits higher	read and write	floating point number (IEEE754 standard floating point)
04E9 H	41002 (decimal)	The lowest 16 digits of the coefficient of the temporary storage value of nitrogen content	read and write	
04EA H	41003 (decimal)	Deviation value of nitrogen content temporary value	read and write	integer
04F2 H	41011 (decimal)	The coefficient of temporary storage value of phosphorus content is 16 digits higher	read and write	floating point number (IEEE754 standard floating point)
04F3 H	41012 (decimal)	The low sixteen digits of the coefficient of temporary storage value of phosphorus content	read and write	
04F4 H	41013 (decimal)	Deviation value of temporary storage value of phosphorus content	read and write	integer
04FC H	41021 (decimal)	The coefficient of temporary storage value of potassium content is 16 digits higher	read and write	floating point number (IEEE754 standard floating point)
04FD H	41022 (decimal)	The lowest sixteen digits of the coefficient of temporary storage value of potassium content	read and write	
04FE H	41023 (decimal)	Deviation value of temporary value of potassium content	read and write	integer

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07D0 H	42001 (decimal)	Device address	read and write	1~254 (factory default 1)
07D1 H	42002 (decimal)	Device baud rate	read and write	0 means 2400 1 for 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 example and explanation

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

query frame

地址码	功能码	起始地址	数据长度	校验码低字节	校验码高字节
0x01	0x03	0x00 0x00	0x00 0x04	0x44	0x09

acknowledgment frame

地址码	功能码	返回有效字节数	水分值	温度值	电导率值	PH 值	校验码低字节	校验码高字节
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 complement code.

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

Moisture calculation:

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

Conductivity calculation:

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

PH value calculation:

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

第 6 章 Common problems and solutions

6.1Note no output or output errors

possible reason:

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

②, the baud rate is wrong.

③. The 485 bus is disconnected, or the A and B lines are reversed.

④. If the number of devices is too much or the wiring is too long, power supply should be provided nearby, add 485 booster, and increase 120Ω terminal resistance at the same time.

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

⑥, equipment damage.