Conductivity Soil Temperature Moisture Nitrogen Phosphorus Potassium Transmitter (Type 485)

PR-3000-TR-ECTHNPK-N01

Ver 2.0

Chapter 1 Product Introduction

1.1 Product overview

The sensor has stable performance and high sensitivity, and 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, which is a soil moisture measurement method that meets the current international standards.

The sensor is 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.

1.2 Features

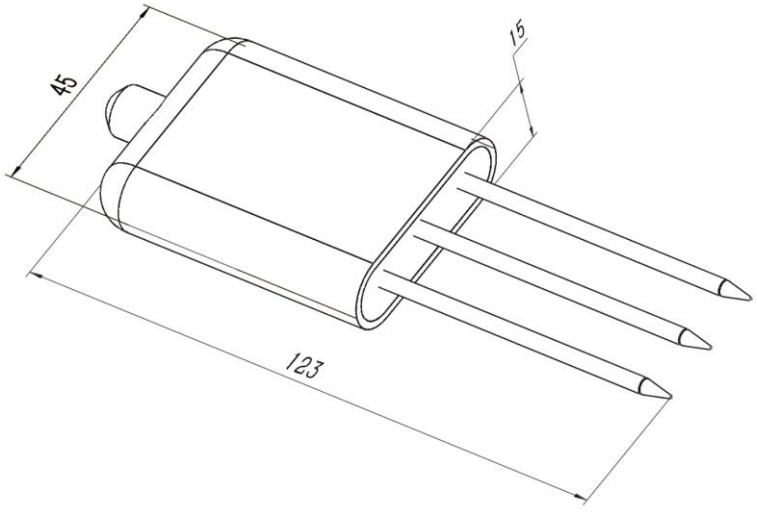
■ The six parameters of soil moisture content, electrical conductivity, temperature and nitrogen, phosphorus and potassium are combined into one.
■ Low threshold, few steps, fast measurement, no reagents, unlimited detection times.
■ It can also be used for the conductivity of water and fertilizer integrated solutions, as well as other nutrient solutions and substrates.
■ The electrode is made of specially treated alloy material, which can withstand strong external impact and is not easy to damage.
■ Completely sealed, resistant to acid and alkali corrosion, can be buried in the soil or directly into the water for long-term dynamic testing.
■ High precision, fast response, good interchangeability, probe insertion design to ensure accurate measurement and reliable performance.

1.3 The main parameters

DC power supply (default)	DC 4.5-30V	
Maximum power consumption	0.7W（24V DC Power supply）	
Working temperature	-40℃~+60℃	
Core chip temperature resistance	85℃	
Conductivity parameter	Range	0-20000us/cm
	Resolution	10us/cm

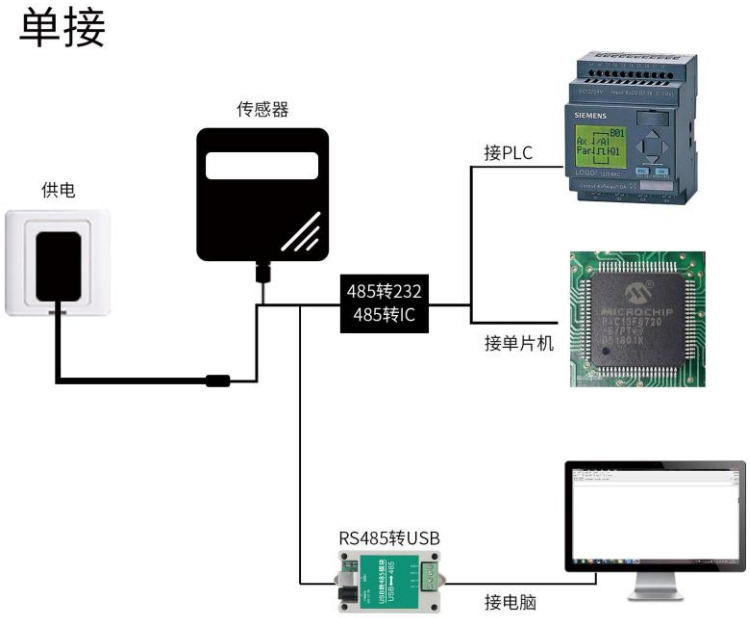
	Precision	0-10000us / cm within the range of ± 3%; 10000-20000us / cm within the range of ± 5%
Soil moisture parameters	Range	0-100%
	Resolution	0.1%
	Precision	0-50%内±2%，50-100%内±3%(棕壤，60%,25℃)
Soil temperature parameter	Range	-40~80℃
	Resolution	分辨率：0.1℃
	Precision	±0.5℃（25℃）
NPK parameters	Range	1-1999 mg/kg(mg/L)
	Resolution	1 mg/kg(mg/L)
	Precision	±2%FS
Conductivity temperature compensation	Built-in temperature compensation sensor, compensation range 0-50℃	
Protection level	IP68	
Probe material	Anti-corrosion special electrode	
Sealing material	Black flame-retardant epoxy resin	
Default cable length	2 meters	
Dimensions	45*15*123mm	
Output signal	RS485(Modbus 协议)	

Shell size



Equipment size drawing (unit: mm)

1.4 System frame diagram



This product can also be combined with multiple sensors on a 485 bus. In theory, one bus can be used for 254 485 sensors, and the other end is connected to a PLC with a 485 interface, and a single-chip microcomputer is connected through a 485 interface chip, or USB to 485 can be used. Computer connection, use the sensor configuration tool provided by our company to configure and test (only one device can be connected when using the configuration software)。

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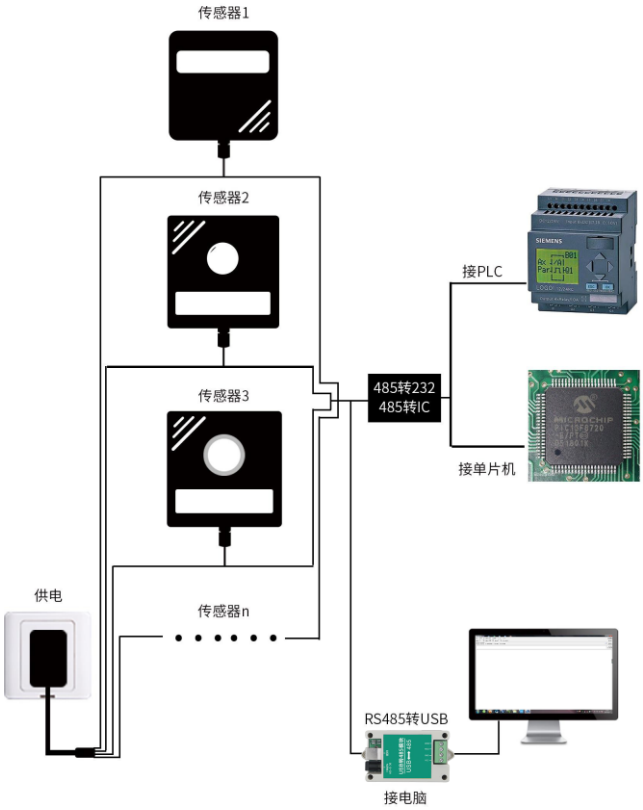


Chapter 2 Hardware Connection

2.2 Interface description

The power interface is a wide-voltage power supply that can input 4.5~30V. When wiring the 485 signal wire, pay attention to the two wires A and B that cannot be reversed, and the addresses of multiple devices on the bus cannot be conflicted

.2.2.1 Sensor wiring

Thread color	Description	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 the soluble salt ions in the soil, the soil volumetric water content must be higher than about 20% when the soluble ions in the soil can accurately reflect the conductivity of the soil. In the long-term observation, the measured value after irrigation or rainfall is closer to the true level. If you are performing a quick test, you can water the soil to be tested first, and perform the measurement after the water is fully penetrated.

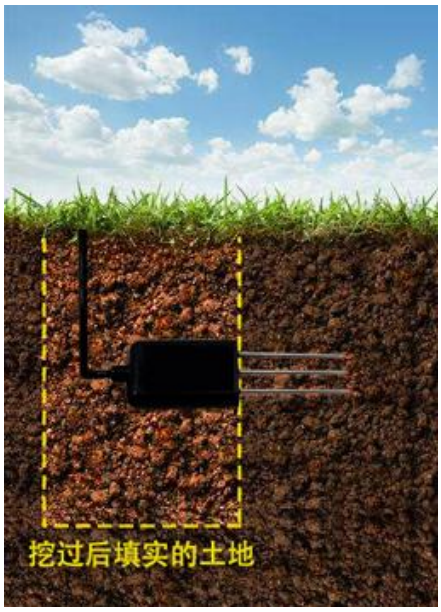
If you are measuring on a hard surface, you should drill holes first (the diameter of the probe should be smaller than the diameter of the probe), then insert the soil and compact the soil before measuring; the sensor should be protected from severe vibration and impact, let alone knocked with hard objects. Because the sensor is a black package, the sensor will heat up rapidly (up to 50℃) under strong sunlight. In order to prevent excessive temperature from affecting the temperature measurement of the sensor, please pay attention to shading and protection when using it in the field or in the field.

3.1 Quick test method

Select a suitable measurement location, avoid rocks, ensure that the steel needle does not touch hard objects, throw away the surface soil according to the required measurement depth, maintain the original tightness of the soil below, hold the sensor vertically and insert it into the soil. Do not shake left and right. It is recommended to measure multiple times to find the average value within a small range of a measuring point.

3.2 Buried measurement method

Dig a pit with a diameter of >20cm vertically, insert the sensor needle horizontally into the pit wall at a predetermined depth, and fill the pit tightly. After a period of stability, measurement and recording can be carried out for several days, months or even longer.



3.3 Matters needing attention

1. All steel needles must be inserted into the soil during measurement.

2. Avoid strong sunlight directly shining on the sensor 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, pull the lead wire of the sensor forcefully,

and do not hit or hit the sensor violently.

4. The sensor's protection grade is IP68, and the entire sensor can be soaked in water.

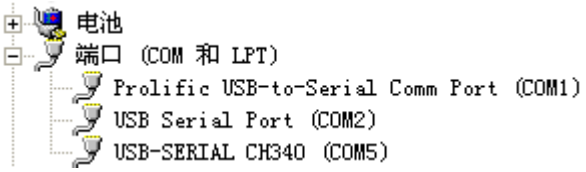
5. Due to the presence of radio frequency electromagnetic radiation in the air, it is not suitable to stay in the air for a long time with electricity.

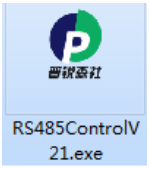
Chapter 4 Configuration Software Installation and Use

Our company provides the supporting "485 parameter configuration software", which can conveniently use the computer to read the parameters of the sensor, and at the same time flexibly modify the device ID and address of the sensor.
Note that you need to ensure that there is only one sensor on the 485 bus when using the software to obtain it automatically.

4.1 Connect the sensor to the computer

After connecting the sensor to the computer through USB to 485 and supplying power, 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 "Debug software" --- "485 parameter configuration software", find and open. 

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 a technician for help.

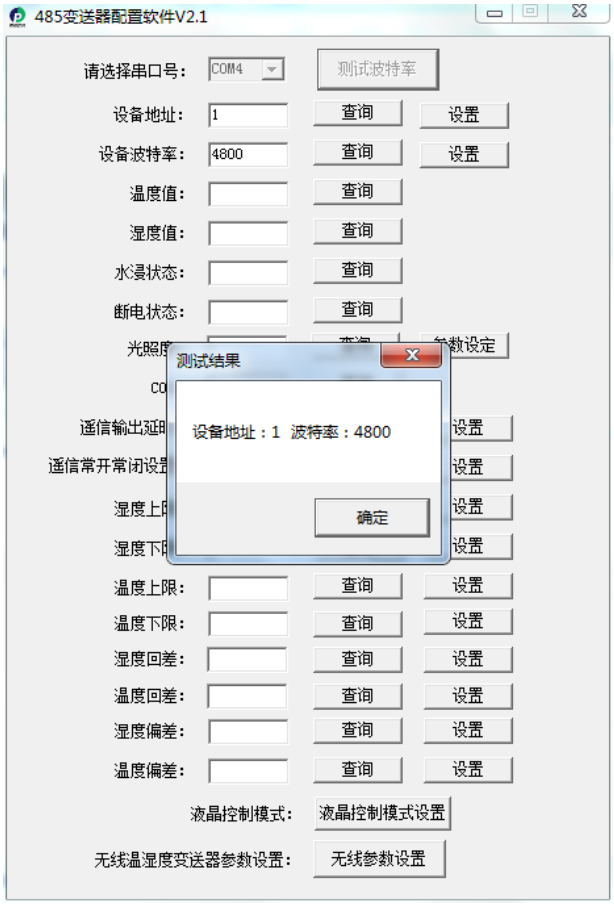
4.2 Use of sensor monitoring software

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 function status of the device.

④. If the test is unsuccessful, please recheck the equipment wiring and 485 driver installation.



Chapter 5 Communication Protocol

5.1 Basic communication parameters

Code	8-bit binary
Data bit	8-bit
Parity bit	NO
Stop bit	1 bit
Error checking	CRC (Redundant Cyclic Code)
Baud rate	2400bit/s、4800bit/s、9600 bit/sCan be set, the factory default is 4800bit/s

5.2 Data 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 ≥ 4 bytes

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

Function code: The command function instruction issued by the host, this transmitter only uses function code 0x03 (read register data).

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：

Address code	Function code	Register start address	Register length	Check code low bit	High bit of check code
1 byte	1 byte	2 byte	2 byte	1 byte	1 byte

Slave response frame structure：

Address code	Function code	Number of valid bytes	Data area	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)	Moisture content	Read only	Real-time value of water 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	Real-time conductivity value
0003H	40004 (Decimal)	Nitrogen content	Read only	Real-time value of nitrogen content
0004H	40005(Decimal)	Phosphorus content	Read only	Phosphorus content real-time value
0005 H	40006 (Decimal)	Potassium content	Read only	Potassium content real-time value
0006 H	40007 (Decimal)	salinity	Read only	Salinity real-time value
0007H	40008 (Decimal)	Total dissolved solids TDS	Read only	TDS real-time value
0022 H	40035 (Decimal)	Conductivity temperature coefficient	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	Integer (expanded by 10 times)

			write	
0051 H	40082 (Decimal)	Water content calibration value	Read and write	Integer (expanded by 10 times)
0052 H	40083 (Decimal)	Conductivity calibration value	Read and write	Integer
02E8 H	40745 (Decimal)	Sixteen higher nitrogen content coefficient	Read and write	True value (IEEE754 standard floating point type)
02E9 H	40746 (Decimal)	Sixteen lower nitrogen content coefficient	Read and write	
02EA H	40747 (Decimal)	Nitrogen content calibration value	Read and write	Integer
02F2 H	40755 (Decimal)	Sixteen higher phosphorus content coefficient	Read and write	True value (IEEE754 standard floating point type)
02F3 H	40756(Decimal)	Sixteen lower phosphorus content coefficient	Read and write	
02F4 H	40757 (Decimal)	Phosphorus content calibration value	Read and write	Integer
02FC H	40765 (Decimal)	Sixteen higher potassium content coefficient	Read and write	True value (IEEE754 standard floating point type)
02FD H	40766 (Decimal)	Sixteen lower potassium content	Read and write	

		coefficient		
02FE H	40767 (Decimal)	Potassium content calibration value	Read and write	Integer
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 for 2400 1 for 4800 2 for 9600

Note: The conductivity moisture equipment has no temperature value and its calibration value register

5.4 Communication protocol example and explanation

5.4.1 Example: Read the conductivity and temperature and moisture value of the device (address 0x01)

Interrogation frame

Address code	Function code	Start address	Data length	Check code low byte	Check code high byte
0x01	0x03	0x00 0x00	0x00 0x03	0x05	0xCB

Reply frame

Address code	Function code	Returns the number of valid bytes	Moisture value	Temperature value	Conductivity value	Check code low byte	Check code high byte
0x01	0x03	0x06	0x02 0x92	0xFF 0x9B	0x03 0xE8	0xD8	0x0F

Temperature calculation:
When the temperature is lower than 0 ℃, the temperature data is uploaded in the form of complement code.
Temperature: FF9B H (hexadecimal) = -101 => temperature = -10.1℃
Moisture calculation:
Moisture: 292 H (hexadecimal) = 658 => Humidity = 65.8%, that is, the soil volumetric moisture content is 65.8%.
Conductivity calculation:
Conductivity: 3E8 H (hexadecimal) = 1000 => Conductivity = 1000 us/cm

5.4.2 Example: Read the real-time value of nitrogen content of device address 0x01

Interrogation frame

Address code	Function code	Start address	Data length	Check code low byte	Check code high byte
0x01	0x03	0x00 0x03	0x00 0x01	0x74	0x0A

Reply frame

Address code	Function code	Returns the number of valid bytes	Nitrogen content	Check code low byte	Check code high byte
0x01	0x03	0x02	0x00 0x20	0xB9	0x9C

Nitrogen calculation：
Nitrogen content: 0020 H (hexadecimal) = 32 => Nitrogen = 32mg/kg

5.4.3 Example: Read the real-time value of the phosphorus content of the device address 0x01

Interrogation frame

Address code	Function code	Start address	Data length	Check code low byte	Check code high byte
0x01	0x03	0x00 0x04	0x00 0x01	0xC5	0xCB

Reply frame

Address code	Function code	Returns the number of vali	Phosphorus content	Check code low byte	Check code high byte

		d bytes			
0x01	0x03	0x02	0x00 0x25	0x79	0x9F

Phosphorus content calculation:

Phosphorus content: 0025 H (hexadecimal) = 37 => Phosphorus = 37mg/kg

5.4.4 Example: Read the real-time value of potassium content of device address 0x01

Interrogation frame

Address code	Function code	Start address	Data length	Check code low byte	Check code high byte
0x01	0x03	0x00 0x05	0x00 0x01	0x94	0x0B

Reply frame

Address code	Function code	Returns the number of valid bytes	Potassium content	Check code low byte	Check code high byte
0x01	0x03	0x02	0x00 0x30	0xB8	0x50

Potassium content calculation:

Potassium content: 0030 H (hexadecimal) = 48 => potassium = 48mg/kg

Chapter 6 Common Problems and Solutions

No output or output error

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 wires are connected reversely.

④. Too much equipment or too long wiring, power supply nearby, add 485 booster, and add 120Ω terminal resistance at the same time.

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

⑥ The equipment is damaged.