RS-NPK-N01-TR
Soil nitrogen, phosphorus, potassium three-in-one fertility sensor
(Type 485)
user's Guide

Document version：V1.0

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1.product description

1.1product description

The soil nitrogen, phosphorus, and potassium three-in-one fertility sensor is suitable for detecting the content of nitrogen, phosphorus, and potassium in the soil, and determining the fertility of the soil by detecting the content of nitrogen, phosphorus, and potassium in the soil, thereby facilitating the systematic assessment of the soil condition. Can be buried in the soil for a long time, resistant to long-term electrolysis, corrosion resistance, vacuum potting, completely waterproof.

The sensor is widely used in soil nitrogen, phosphorus, potassium detection, precision agriculture, forestry, soil research, geological exploration, plant cultivation and other fields.

1.2Features

1) Low threshold, few steps, fast measurement, no reagents required, unlimited detection times.

2) High measurement accuracy, fast response speed and good interchangeability.

3) The electrode is made of a specially treated alloy material, which can withstand strong external force and is not easy to be damaged.

4) Completely sealed, resistant to acid and alkali corrosion, can be buried in the soil for long-term dynamic testing.

5) Probe insertion design ensures accurate measurement and reliable performance.

1.3 technical parameter

DC powered (default)		DC 5-30V
Maximum power consumption		≤0.15W （@12V DC，25℃）
Operating temperature		0℃~55℃
NPK parameters	Range	1-1999 mg/kg(mg/L)
	Resolution	1 mg/kg(mg/L)
	Precision	±2%FS
Response time		＜1S
Protection class		IP68
Probe material		stainless steel
Sealing material		Black flame retardant epoxy resin
Default cable length		2 meters, cable length can be customized
Dimensions		45*15*123mm
output signal		RS485(Modbus protocol)

1.4product model

RS-			Company code
	N-		Soil nitrogen content transmitter

P			Soil phosphorus content transmitter
K			Soil potassium content transmitter
NPK			Soil nitrogen, phosphorus, potassium three-in-one transmitter
	N01-		RS485 (Modbus-RTU protocol)
		TR	Soil testing enclosure

2.Dimensions
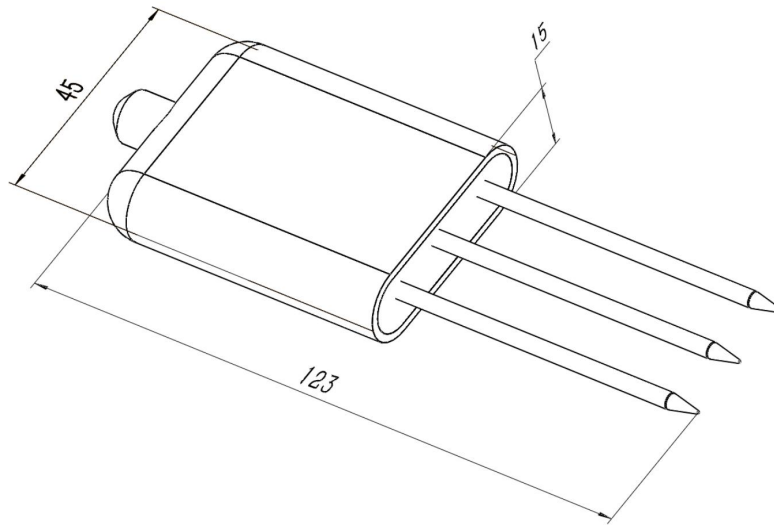
Equipment dimension drawing (unit: mm)

3.Instructions

3.1 Quick test method

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

3.2 Buried survey

Vertically dig a pit with a diameter of> 20cm, insert the sensor steel needle horizontally into the pit wall at a predetermined depth, bury the pit tightly, and stabilize it for a period of time, then you can perform continuous measurement for several days, months, or even longer.

3.3 Precautions

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

2. Avoid direct sunlight on the sensor, which will cause excessive temperature. Pay attention to lightning protection in the field.

3. Do not bend the steel needle violently, do not pull the sensor lead wire with force, and do not beat or violently

hit the sensor.

4. The protection grade of the sensor is IP68, which can soak the sensor in water.

5. Due to the presence of radio frequency electromagnetic radiation in the air, it should not be energized in the

air for a long time.

4.Equipment installation instructions

## 4.1 Check before equipment installation

Equipment List:

■1 sensor device

■Certificate of conformity, warranty card

4.2 Interface Description

Wide voltage power input can be 5 ~ 30V. When wiring the 485 signal line, pay attention that the two lines A

and B cannot be reversed, and the addresses between multiple devices on the bus must not conflict.

4.3 Wiring instructions

Thread color	Description	Note
brown	Power supply	5~30V DC
black	Negative power	GND
yellow	485-A	485-A
blue	485-B	485-B
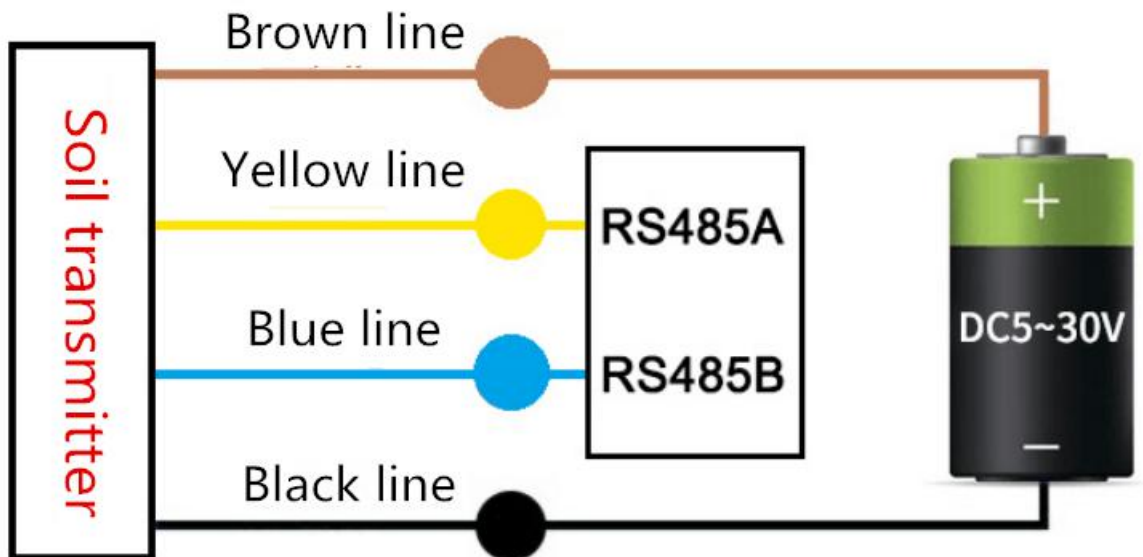
5.Configuration software installation and use
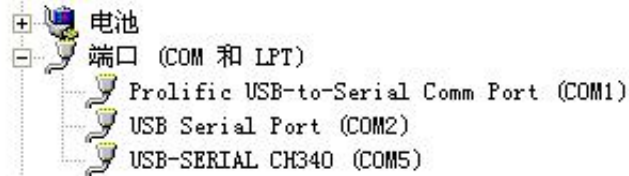
5.1 Software selection

Open the package and select "Debugging Software" --- "485 Parameter Configuration Software" and

find Just open it.

5.2 parameter settings

① Select the correct COM port (check the COM port in "My Computer-Properties-Device Manager-Port"). The following figure lists several different 485 converter driver names.

② Connect only one device and power on. Click the software to test the baud rate. 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 can query the current function status of the device.

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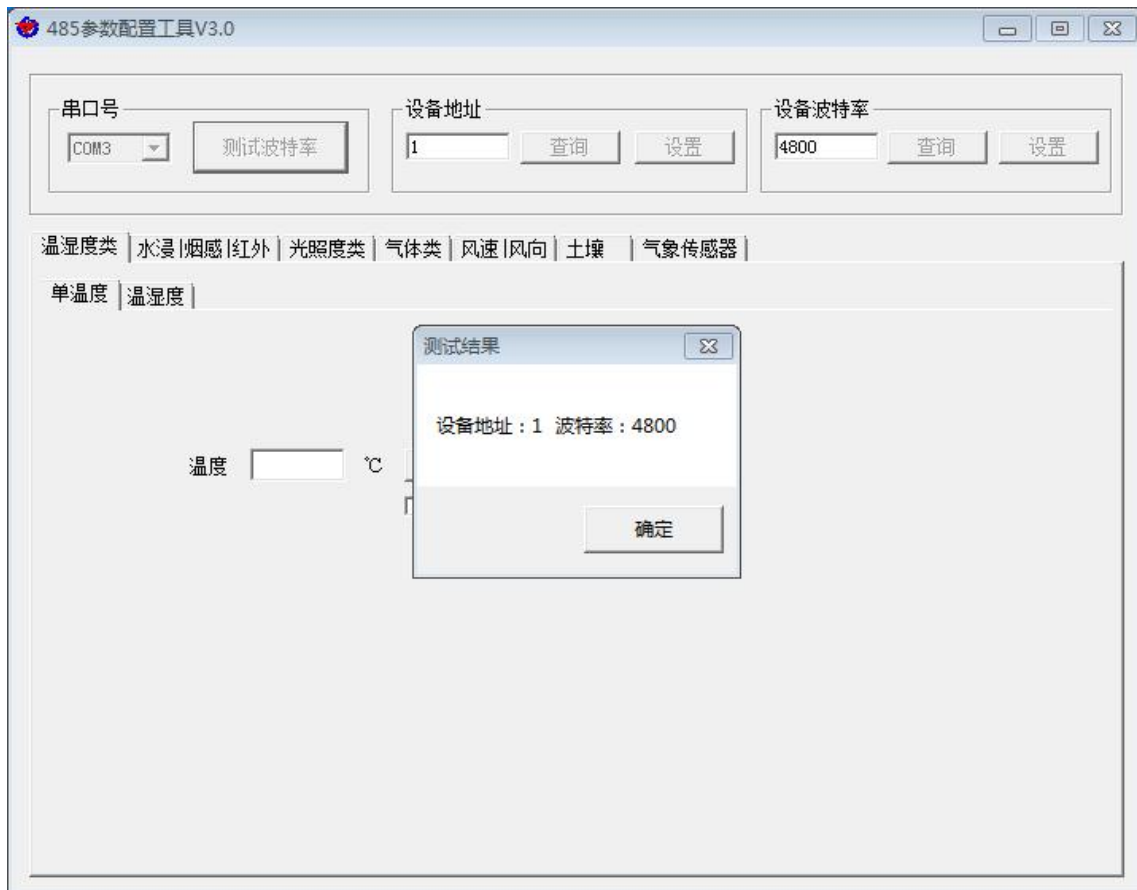
6.letter of agreement

6.1Basic 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	Can be set, factory default is 4800bit / s

6.2 Data frame format definition

Modbus-RTU communication protocol is adopted, 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

Ending structure ≥ 4 bytes of time

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

Function code: Function instruction of the command sent by the host.

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

CRC code: two-byte check code.

Host inquiry frame structure:

address code	function code	Register start address	Register length	Checksum low byte	Checksum high byte
1byte	1byte	2byte	2byte	1byte	1byte

Slave response frame structure:

address code	function code	Number of valid bytes	Data area	Data area 2	Data N area	Checksum low byte	Checksum high byte
1byte	1byte	1byte	2byte	2byte	2byte	1byte	1byte

6.3 Register address

Register address	PLC or configuration address	content	operating	Definition
001E H	40031 (Decimal)	Nitrogen content	Read-only	Real-time nitrogen content

001F H	40032 (Decimal)	Phosphorus content	Read-only	Real-time value of phosphorus content
0020 H	40033 (Decimal)	Potassium content	Read-only	Real-time potassium content
03E8 H	41001 (Decimal)	Nitrogen content coefficient High sixteen	Read and write	actual value (IEEE754 standard floating point)
03E9 H	41002 (Decimal)	Nitrogen content coefficient Lower sixteen	Read and write	
03EA H	41003 (Decimal)	Calibration value of nitrogen content	Read and write	Integer
03F2 H	41011 (Decimal)	Phosphorus content coefficient High sixteen	Read and write	actual value (IEEE754 standard floating point)
03F3 H	41012 (Decimal)	Phosphorus content coefficient Lower sixteen	Read and write	
03F4 H	41013 (Decimal)	Calibration value of phosphorus content	Read and write	Integer
03FC H	41021 (Decimal)	Potassium content coefficient High sixteen	Read and write	actual value (IEEE754 standard floating point）
03FD H	41022 (Decimal)	Potassium content coefficient Lower sixteen	Read and write	
03FE H	41023 (Decimal)	Calibration of potassium	Read and write	Integer
07D0 H	42001 (Decimal)	Device address	Read and write	1~254（Factory default1）
07D1 H	42002 (Decimal)	Device baud rate	Read and write	0 for 2400 1 for 4800 2 for 9600

6.4 Communication protocol example and explanation

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

Inquiry frame

address code	function code	starting address	Data length	Checksum low byte	Checksum high byte
0x01	0x03	0x00 0x1E	0x00 0x01	0xE4	0x0C

Response frame

address code	function code	Returns the number of valid bytes	Nitrogen content	Checksum low byte	Checksum high byte
0x01	0x03	0x02	0x00 0x20	0xB9	0x9C

Calculation of nitrogen content:

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

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

Inquiry frame

address code	function code	starting address	Data length	Checksum low byte	Checksum high byte
0x01	0x03	0x00 0x1F	0x00 0x01	0xB5	0xCC

Response frame

address code	function code	Returns the number of valid bytes	Phosphorus content	Checksum low byte	Checksum high byte
0x01	0x03	0x02	0x00 0x25	0x79	0x9F

Calculation of phosphorus content:

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

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

Inquiry frame

address code	function code	starting address	Data length	Checksum low byte	Checksum high byte
0x01	0x03	0x00 0x20	0x00 0x01	0x85	0xC0

Response frame

address code	function code	Returns the number of valid bytes	Potassium content	Checksum low byte	Checksum high byte
0x01	0x03	0x02	0x00 0x30	0xB8	0x50

Calculation of potassium content:

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

7.Common problems and solutions

7.1 Device cannot be connected to PLC or computer

possible reason:

1) The computer has multiple COM ports, and the selected port is incorrect.

2) The device address is wrong, or there are devices with duplicate addresses (the factory defaults are all 0x01).

3) Baud rate, check mode, data bit, stop bit error.

4) The 485 bus is disconnected, or the A and B wires are reversed.

5) Too many devices or wiring is too long, you should supply power nearby, add 485 booster, and increase 120

Ω terminal resistance.

6) The USB to 485 driver is not installed or damaged.

7) The equipment is damaged.

8. Contact information

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9. Document history

V1.0 Document Creation