# Soil NPK three-in-one sensor

# （RS485）

**Ver 2.0**

# Catalog

# Chapter 1 Product Introduction

## 1.1 Product overview

The soil nitrogen, phosphorus and potassium sensor is suitable for detecting the content of nitrogen, phosphorus and potassium in the soil, and judging the fertility of the soil by detecting the content of nitrogen, phosphorus and potassium in the soil, thereby facilitating the evaluation of the soil condition by the customer system.

## 1.2 Functions and features

It is widely used in rice fields, greenhouse planting, rice, vegetable planting, orchard nursery, flower and soil research, etc.

## 1.3 Main parameters

| | | |
|---|---|---|
| DC power supply (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) |
| | precise | ±2%FS |
| Response time | ＜1S | |
| Protection level | IP68 | |
| Probe material | stainless steel | |
| Sealing material | Black flame-retardant epoxy resin | |
| Default cable length | 2Meters, the cable length can be customized according to requirements | |
| Shape and size | 45*15*123mm | |
| output signal | RS485(Modbus protocol) | |

Shell size
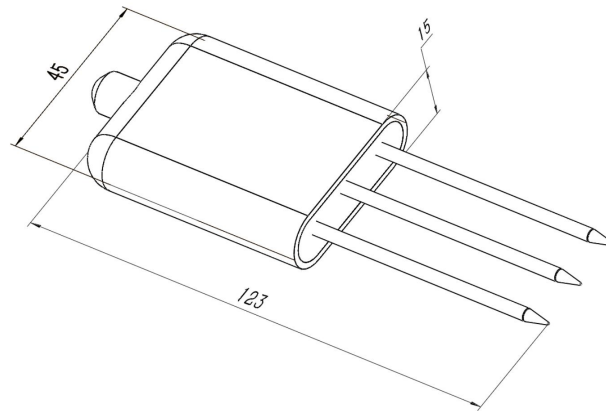


Equipment size drawing (unit: mm)

## 1.4 System framework diagram
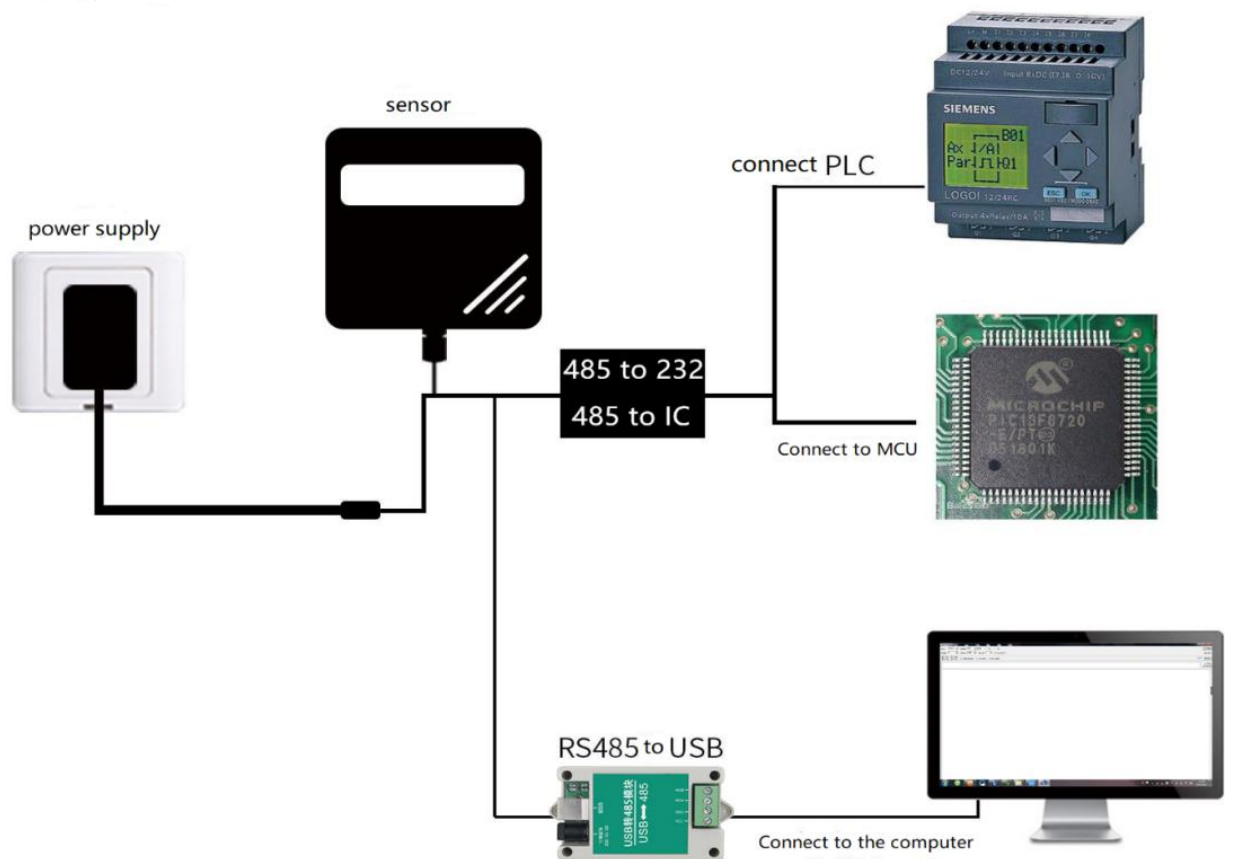
This product can also be used in combination of multiple sensors on a 485 bus. In theory, a bus can be used for 254 485 sensors, and the other end is connected to a PLC with a 485 interface, connect the single-chip microcomputer through the 485 interface chip, or use the USB to 485 to connect to the computer, and use the sensor configuration tool provided by our company for configuration and testing. (only one device can be connected when using the configuration software).

**Multiple connections**
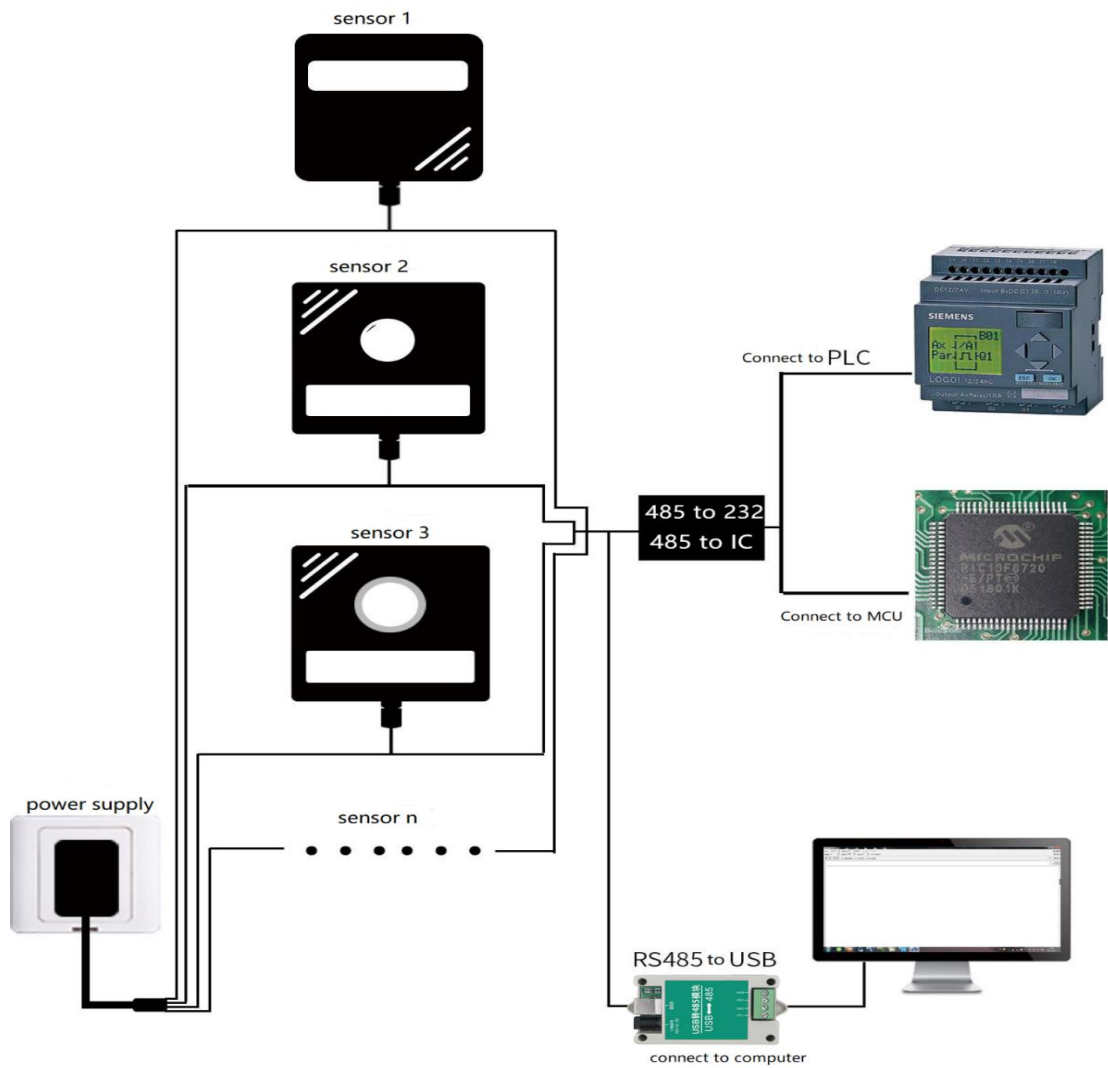
## 1.5 Product selection

| | | | | |
|---|---|---|---|---|
| | 3000- | | | |
| | | TR- | | Soil detection housing |
| | | | N- | Soil nitrogen content transmitter |
| | | | P- | Soil phosphorus content transmitter |
| | | | K- | Soil potassium content transmitter |
| | | | NPK- | Three-in-one transmitter for soil nitrogen, phosphorus and potassium |
| | | | N01 | RS485（Modbusprotocol） |

# Chapter 2 Hardware Connection

## 2.1 Inspection before equipment installation

Equipment List:

■Transmitter equipment 1 set

■Certificate of conformity, wiring instructions, etc.

## 2.2 Interface description

The power interface is a wide-voltage power supply, 5v-30V can be input. 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 | Remarks |
|---|---|---|
| brown | Power is positive | 5~30V DC |
| black | Power ground | GND |
| yellow | 485-A | 485-A |
| blue | 485-B | 485-B |

# Chapter 3 How to Use

## 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 for 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 transmitter steel needle horizontally into the pit wall at a predetermined depth, and fill the pit tightly. After a period of stability, measurement and measurement can be carried out continuously for several days, months or even longer. recording.

挖过后填实的土地
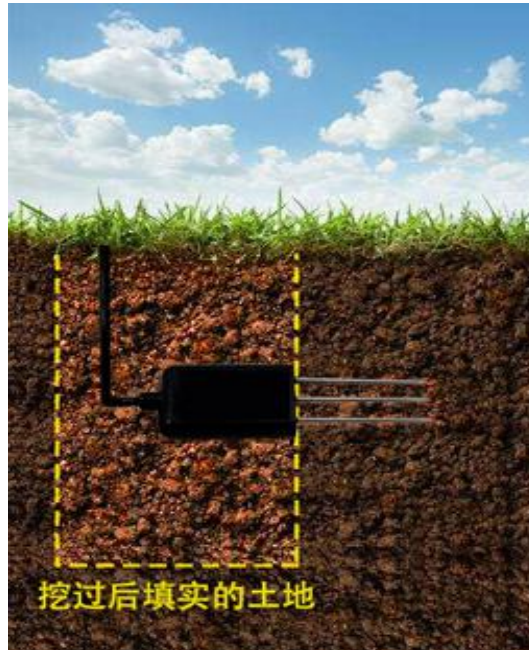
## 3.3 Matters needing attention

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

2. Avoid strong sunlight directly shining on the 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, pull the lead wire of the transmitter forcefully, and do not hit or hit the transmitter violently.

4. The transmitter's protection level is IP68, and the transmitter can be completely immersed 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").
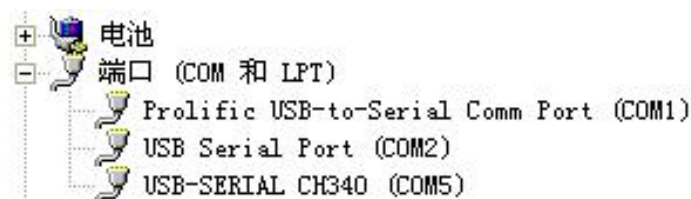


Open the data package, select "Debugging Software" --- "485 Parameter Configuration Software", find and open it.

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 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.
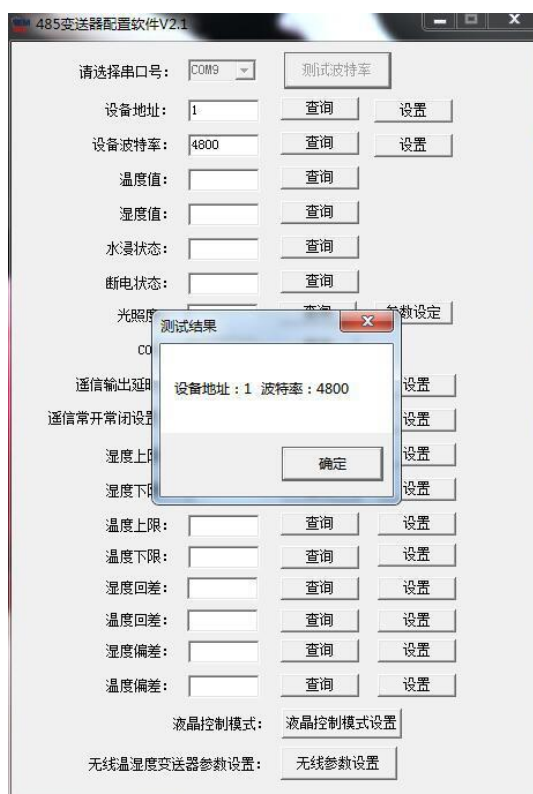


Note: The device address of the test result: 1;Baud rate: 4800

# Chapter 5 Communication Protocol

## 5.1 Basic communication parameters

| Code | 8-bit binary |
|------|------|
| Data bit | 8-bit |
| Parity bit | Do not |
| Stop bit | 1 digit |
| Error checking | CRC (Redundant Cyclic Code) |
| Baud rate | Can be set to 2400bit/s, 4800bit/s, 9600bit/s, the factory default value 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 machine response frame structure:

| address code | function code | Number of valid bytes | First 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 | Operation | Definition description |
|---|---|---|---|---|
| 001E H | 40031 (Decimal) | Nitrogen content | Read only | Real-time value of nitrogen content |
| 001F H | 40032 (Decimal) | Phosphorus content | Read only | Real-time value of phosphorus content |
| 0020 H | 40033 (Decimal) | Potassium content | Read only | Potassium content real-time value |
| 03E8 H | 41001 (Decimal) | Sixteen higher nitrogen content coefficient | Read and write | actual value (IEEE754 standard floating point type) |
| 03E9 H | 41002 (Decimal) | Sixteen lower nitrogen content coefficient | Read and write | |
| 03EA H | 41003 (Decimal) | Nitrogen content calibration value | Read and write | Integer |
| 03F2 H | 41011 (Decimal) | Sixteen higher phosphorus content coefficient | Read and write | Real value (IEEE754 standard floating point type) |
| 03F3 H | 41012 | Sixteen lower | Read and | |

| | (Decimal) | phosphorus content coefficient | write | |
|---|---|---|---|---|
| 03F4 H | 41013 (Decimal) | Phosphorus content calibration value | Read and write | Integer |
| 03FC H | 41021 (Decimal) | Sixteen higher potassium content coefficient | Read and write | Real value (IEEE754 standard floating point type) |
| 03FD H | 41022 (Decimal) | Sixteen lower potassium content coefficient | Read and write | |
| 03FE H | 41023 (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 means 2400 1 means 4800 2 means 9600 |

## 5.4 Communication protocol example and explanation

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

Interrogation frame

| address c ode | function code | starting address | Data length | Check code low bit | High bit of check code |
|---|---|---|---|---|---|
| 0x01 | 0x03 | 0x00  0x1E | 0x00  0x01 | 0xE4 | 0x0C |

Response 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 |

Calculation of nitrogen content:

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

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

Interrogation frame

| address code | function code | starting address | Data length | Check code low bit | High bit of check code |
|---|---|---|---|---|---|
| 0x01 | 0x03 | 0x00 0x1F | 0x00 0x01 | 0xB5 | 0xCC |

Response frame

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

Phosphorus content calculation:

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

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

Interrogation frame

| address code | function code | starting address | Data length | Check code low bit | High bit of check code |
|---|---|---|---|---|---|
| 0x01 | 0x03 | 0x00 0x20 | 0x00 0x01 | 0x85 | 0xC0 |

Response 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 reversed.

④ If the number of equipment is too much or the wiring is too long, power supply should be nearby, add 485 booster, and add 120Ω terminal resistance.

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

⑥ Equipment damage.