



## Introduction

The soil nitrogen, phosphorus and potassium sensor has stable performance and high sensitivity. It can judge the fertility of the soil by detecting the content of nitrogen, phosphorus and potassium in the soil to evaluate the soil condition. It is suitable for soil moisture monitoring, scientific experiments, agricultural irrigation, greenhouses, flowers and vegetables, etc. Grassland pasture, soil quick test, plant cultivation and other occasions.

Appropriate nitrogen, phosphorus and potassium content is an important condition for plant growth. Too much or lack of nitrogen, phosphorus and potassium will affect the growth of crops.

### The sensor has the following characteristics:

- (1) It can be used to measure the nitrogen, phosphorus and potassium content of the integrated water and fertilizer solution, as well as other nutrient solutions and substrates.
- (2) The electrode is made of alloy material with special treatment, which can withstand strong external impact and is not easy to be damaged.
- (3) Completely sealed, resistant to acid and alkali corrosion, and can be buried in soil or directly into water for long-term dynamic testing.

- (4) High precision, fast response, good interchangeability, accurate measurement of probe insertion design, and reliable performance.
- (5) Perfect protection circuit.

## Parameter

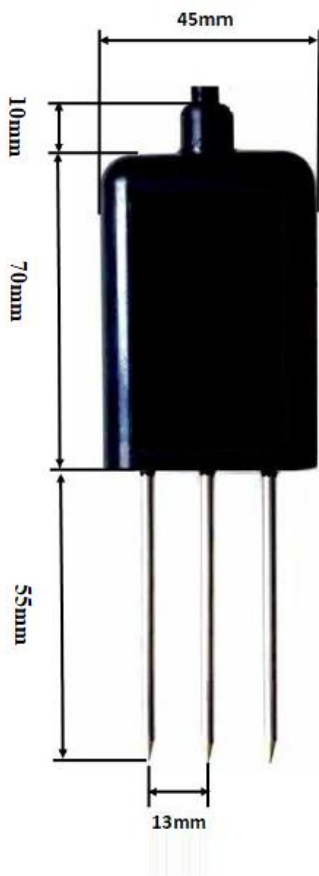
Soil N,P,K	Range	0-2000mg/kg
	Resolution	1mg/kg(mg/l)
	Accuracy	±2%F.s
voltage	DC 12V	
Out put	RS 485	
Static power consumption	10mA@12V DC	
IP rate	IP68	
Dimensions	45*15*135mm	
Operating Environment	-40~85°C	
Sealing material	Black epoxy resin	

## Connection method

- (1) If equipped with the weather station produced by our company, directly use the sensor cable to connect the sensor to the corresponding interface on the weather station.
- (2) If the sensor is purchased separately, the line sequence of the sensor supporting line is:

Line Color	Definition
Red	+
Black	-
Yellow	RS485+
Blue	RS485-

## Dimensions



## Installation and Measurement

In long-term observations, measurements after irrigation or rainfall are closer to the true level. If the NPK 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.

(1) Quick measurement method: Select a suitable measurement location, avoid stones, ensure that the electrode does not touch hard objects such as stones, and plan the topsoil according to the required measurement depth to maintain the original tightness of the soil below. , Hold the sensor body vertically and insert it into

the soil, do not shake it back and forth, left and right when inserting, and ensure that it is in close contact with the soil. In a small range of a measuring point, it is recommended to measure multiple times to obtain an average.

(2) Buried measurement method: According to the required depth, vertically dig a pit with a diameter greater than 20 cm, and the depth is according to the measurement needs, and then insert the sensor steel needle into the pit wall horizontally at a given depth, and bury the pit and compact it to ensure that the electrode and the soil in close contact. After a period of stabilization, measurements and recordings can be made for days, months, or even longer.

If you are measuring on a hard surface, you should first drill a hole (the hole should be smaller than the diameter of the probe), then insert it into the soil and compact the soil before measuring. The sensor should be protected from severe vibration and shock, and cannot be hit with hard objects. Since the sensor is packaged in black, the sensor 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 sensor, please pay attention to shading and protection when using it in the field or outdoors.

## MODBUS Communication protocol

Communication parameters: baud rate 9600, 8 data bits, no parity bit,

The interval between two communications should be at least 1000ms.

### 【1】 Write the device address

Send: 00 10 Address CRC16 (5 bytes)

Return: 00 10 CRC16 (4 bytes)

Description: 1. The address bit of the read and write address command must be 00.

2. Address is 1 byte, the range is 0-255.

For example: send: 00 10 01 BD C0

Return: 00 10 00 7C

### [2] Read the device address

Send: 00 20 CRC16 (4 bytes)

Return: 00 20 Address CRC16 (5 bytes)

Description: Address is 1 byte, the range is 0-255.

For example: send: 00 20 00 68 返回: 00 20 01 A9 C0

### A. Read real-time data:

Suppose the device address is: 0x01, the valid range is 0~254, and 0 is the broadcast address.

Such as sending: 01 03 00 00 00 03 05 CB

No.	implication	Excursion	byte count	explanation
1	Device address	0	1	Unique address of the device
2	Opcodes	1	1	Fixed value 0x03
3	Register start number	2	2	The first register number read

4	Read the number of registers	4	2	3 sensor parameters
5	CRC16 Check	6	2	low front high back

The device returns:

01 03 06 xx xx xx xx xx xx CRC16

No.	implication	Excursion	byte count	explanation
1	address field	0	1	Address(0x01)
2	Opcodes	1	1	Read only (0x03)
3	Data Length Field	2	1	Length of data
4	Data Field	3	2	N: 0~2000mg/kg
		5	2	P: 0~2000mg/kg
		7	2	K: 0~2000mg/kg
5	Check Field	9	2	low front high back

Opcode: fixed at 0x03, that is, read operation, other operations are not supported.

Register address starting number: range 0-15, indicating the first register number to be read.

Number of registers: the range is 1~16, which means that the last register number + 1 is read.

The read data does not include the register content of this number, but is only used as an end marker, and its value must be greater than or equal to the "start number".

### B. The device returns a data frame:

01 03 06 xx xx xx xx xx xx CRC16

Data length: does not contain itself, only the number of bytes in the data field. Maximum 6, minimum 0.

Determined according to the "start number" and "number of registers" of the read instruction sequence.

Data length = (end number – number of registers)\*2

Communication example (obtain data of 3 sensors, obtain a single sensor and so on):

Send: 01 03 00 00 00 03 05 CB

Return: 01 03 06 00 5C 00 4A 00 8A E2 F8

00 5C is the nitrogen content, which is a hexadecimal integer, converted to decimal is 92, that is, the nitrogen content is 92 mg/kg.

00 4A is the phosphorus content, which is a hexadecimal integer, converted to decimal is 74, that is, the phosphorus content is 74mg/kg.

00 8A is the potassium content, which is a hexadecimal integer, converted to decimal is 138, that is, the potassium content is 138mg/kg.

### C. Calculation of CRC16 check code

- 1) Preset a 16-bit register as hexadecimal FFFF (that is, all 1s); call this register a CRC register;
- 2) XOR the first 8-bit binary data (that is, the first byte of the communication information frame) with the lower 8 bits of the 16-bit CRC register, and place the result in the CRC register;
- 3) Shift the contents of the CRC register to the right by one bit (toward the lower bit) and fill the highest bit with 0, and check the shifted out bit after the right shift;
- 4) If the shift out bit is 0: repeat step 3 (shift right one bit again);  
If the shift-out bit is 1: XOR the CRC register with

the polynomial A001 (1010 0000 0000 0001);

- 5) Repeat steps 3 and 4 until right-shifting 8 times, so that the entire 8-bit data has been processed;
- 6) Repeat step 2 to step 5 to process the next byte of the communication information frame;
- 7) After all bytes of the communication information frame are calculated according to the above steps, the high and low bytes of the obtained 16-bit CRC register are exchanged;
- 8) The content of the CRC register finally obtained is the CRC16 code. (CRC code is in the order of low front and high back)

### Instructions

Wire the sensor according to the instructions in the wiring method, then insert the sensor probe pin into the soil to be measured, turn on the power supply and the switch of the collector, and the soil parameters at the measurement point can be obtained.

### Notice

1. Please check whether the packaging is in good condition, and check whether the product model is consistent with the selection;
2. Do not connect with live power. After the wiring is completed and checked, the power can be turned on;
3. The length of the sensor line will affect the

output signal of the product. Do not arbitrarily change the components or wires that have been soldered when the product leaves the factory. If you need to change it, please contact the manufacturer;

4. The sensor is a precision device, please do not disassemble it by yourself, or touch the surface of the sensor with sharp objects or corrosive liquid, so as not to damage the product;

5. Please keep the verification certificate and qualification certificate, and return it together with the product during maintenance.