

# **Soil Multi-parameter sensor**

## **INSTRUCTION MANUAL**

**RS485**

**JXBS-3001-TR**

**Ver1.**

# I BRIEF INTRODUCTION

## 1.1 Product Overview

Soil EC water temperature PH nitrogen, phosphorus and potassium seven-in-one sensor is suitable for measuring soil temperature, moisture, total salt content conductivity), soil PH, and nitrogen, phosphorus and potassium. Soil seven-in-one sensors creatively measure conductivity, moisture, temperature, ph , nitrogen, phosphorus and potassium parameters together, greatly facilitating the customer system to assess the soil situation. .

Compared with the original high precision sensor in Germany and the actual drying weighing method of soil, the sensor has high precision, fast response and stable output: it is less affected by the salt content of soil and is suitable for all kinds of soil quality. Can be buried in the soil for a long time, resistance to long-term electrolysis, corrosion resistance, vacuum filling, completely waterproof.

## 1.2 Scope of application

It is widely used in scientific experiments, water-saving irrigation, greenhouse, flowers and vegetables, grassland pasture, soil rapid measurement, plant culture, sewage treatment, grain storage and the measurement of water content and emperature of various particulate matter.

## 1.3 Measurement parameters and hardware parameters

| Parameters  | Content                                |
|---|--|
| <b>Power supply</b>   | 12-24V DC                              |
| <b>Output signal</b>  | RS485                                  |
| <b>Temperature range</b>  | -40 °C - 80 °C                         |
| <b>Temperature accuracy</b>                                       | ± 0.5 °C                               |
| <b>Temperature resolution</b>                                     | 0.1 °C                                 |
| <b>Water measurement range</b>                                    | 0-100%                                 |
| <b>Moisture accuracy</b>  | Within 0-53% ± 3%; within 53-100% ± 5% |
| <b>Water resolution</b>   | 0.10%                                  |
| <b>Electrical conductivity measurement range</b>                  | 0-10000us/cm                           |
| <b>Conductivity resolution</b>                                    | 10us/cm                                |
| <b>PH measurement range</b>                                       | 3-9pH                                  |
| <b>PH measurement accuracy</b>                                    | ± 0.3pH                                |
| <b>PH resolution</b>  | 0.01pH                                 |
| <b>Measurement range of nitrogen, phosphorus and potassium</b>    | 0-1999mg/kg                            |
| <b>Measurement accuracy of nitrogen, phosphorus and potassium</b> | ± 2%F.s                                |
| <b>Resolution of nitrogen, phosphorus and potassium</b>           | 1mg/kg (mg/l)                          |
| <b>Storage environment</b>  | -20 °C - 60 °C                         |

|                               |  |
|-------------------------------|--|
| <b>Working pressure range</b> | 0.9-1.1atm   |
| <b>Response time</b>          | <1s  |
| <b>Protection level</b>       | IP68   |
| <b>Installation mode</b>      | The probe is all embedded or inserted into measured medium |

Note: This is the details of all the measurable parameters of this series of products, please refer to the actual purchase of products.

When measuring the frozen ice soil layer, the water value will be low and inaccurate, which needs to be compensated by the user.

Factory default products are suitable for measuring common loess, black soil, red soil. It is not suitable for absolute moisture measurement of saline-alkali soil, sandy land or other powder-like objects with large salt content.

## 1.4 Method and Meaning of Soil Water Calculation

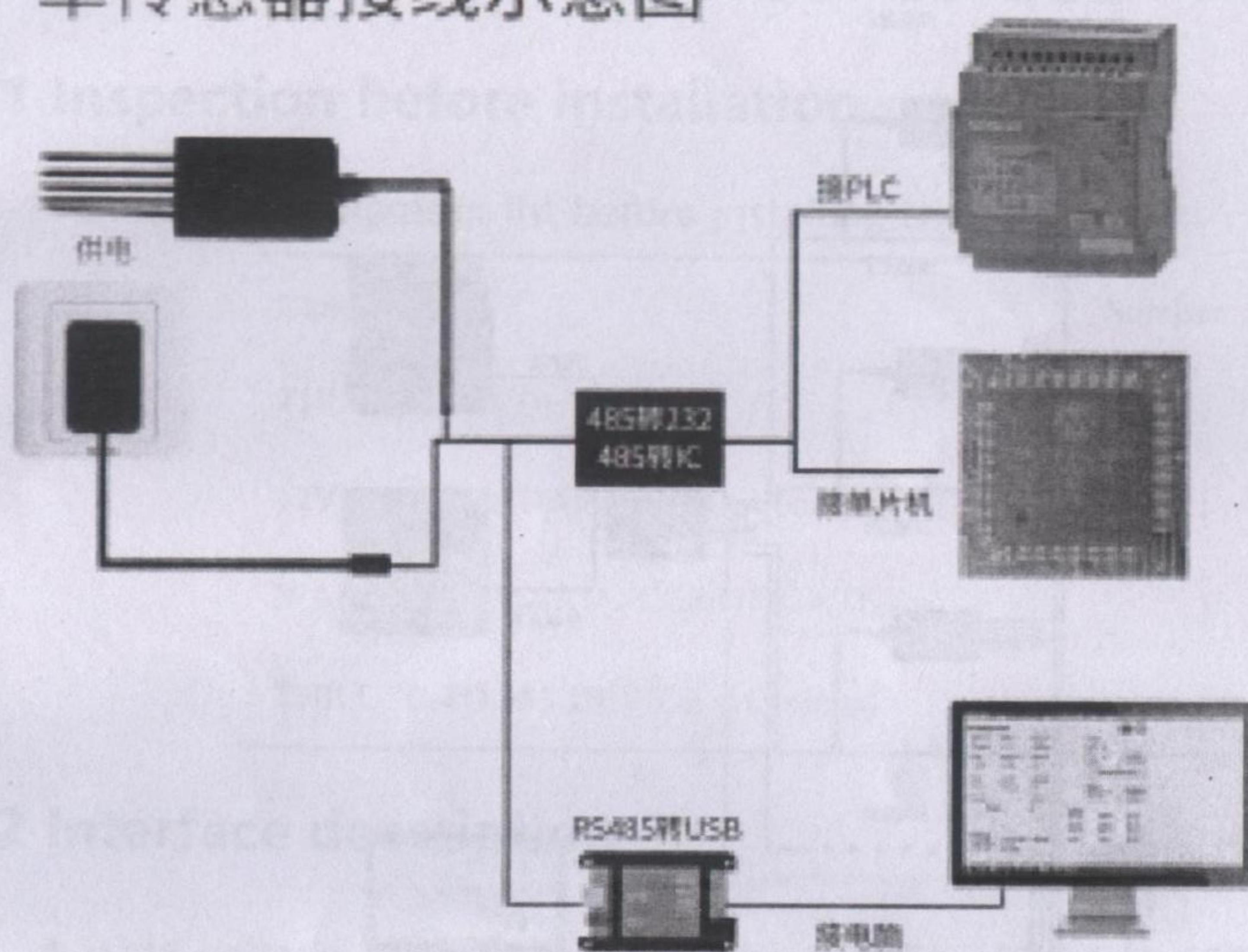
The soil moisture calculated by this sensor is soil volume moisture content (also called soil volume moisture content), which is commonly referred to as "soil moisture" and "soil moisture".

The calculation method of soil volume moisture content is the ratio of the volume of water in soil to the total volume of soil. 0% represents completely dry soil without any moisture, 100% represents completely water without any soil.

## 1.5 System framework diagram

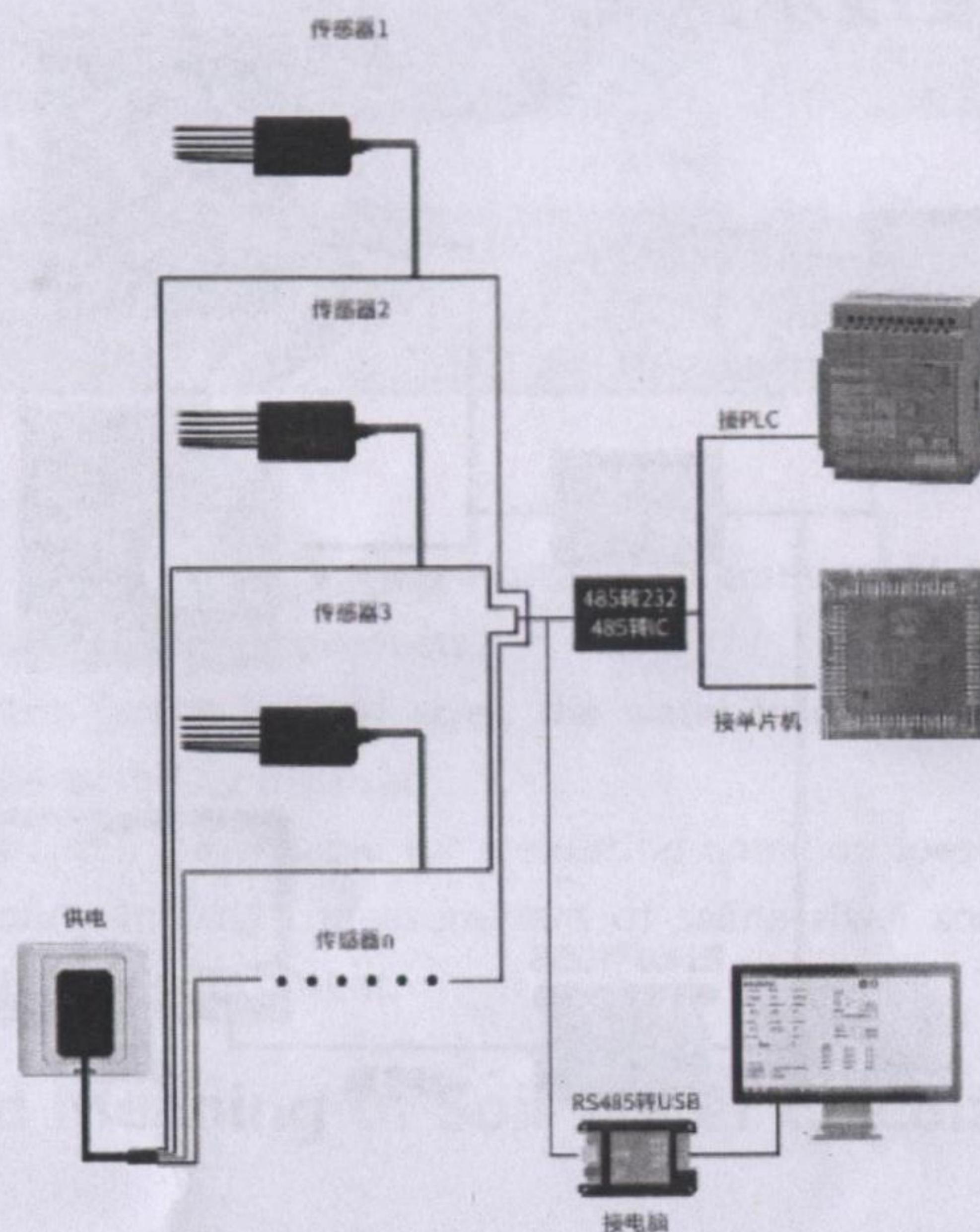
This sensor can be connected to use alone, first use 12 V DC power supply, the equipment can be directly connected with the PLC, with 485 interface can be connected to the through 485 interface chip. Through the modbus protocol specified after the MCU and PLC programming can be used in conjunction with the sensor. At the same time use USB turn 485 can connect with the computer, use our company to provide sensor configuration tools for configuration and testing.

## 单传感器接线示意图



This product can also be used by multiple sensors combined in a 485 bus. In theory, one bus can connect more than 16 485 sensors. If more 485 sensors are needed, more 485 devices can be expanded using 485 repeaters. The other end is connected to the PLC、with 485 interface chip through 485 interface chip, or can be connected to the computer by using USB to 485, the sensor configuration tools provided by our company to configure and test.

## 多传感器接线示意图



## II METHOD OF USE

### 2.1 Inspection before installation

Check the equipment list before installing the equipment:

| Name                             | Number |
|----------------------------------|--------|
| THE SENSOR DEVICE                | 1      |
| 12V POWER ADAPTER (Optional)     | 1      |
| WARRANTY CARD / CERTIFICATE      | 1      |
| THE USB TO 485 DEVICE (Optional) | 1      |

### 2.2 Interface description

A wide voltage power supply can be supplied 12-24 V. 485 signal line wiring attention A/B two lines can not be connected back, the bus between multiple devices address can not conflict. The sequence is illustrated in the following figure



|               | Line Color   | Description                         |
|---------------|--------------|-------------------------------------|
| Power         | Brown        | Power supply Positive ( 12-24V DC ) |
|               | Black        | Power supply Negative               |
| Communication | Yellow color | 485-A                               |
|               | Blue         | 485-B                               |

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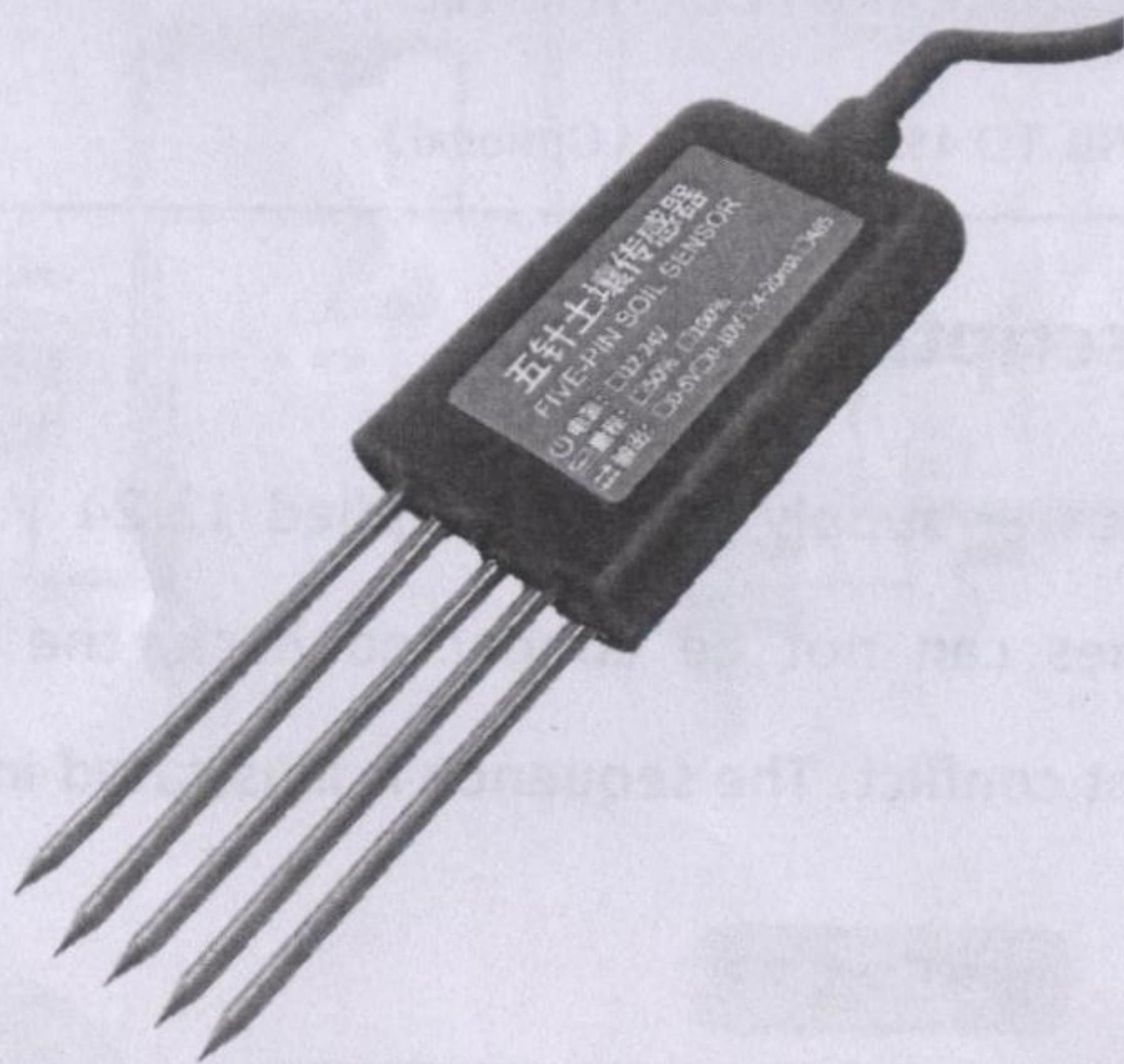
Note: Please be careful not to connect the wrong wiring sequence, the wrong wiring will cause the equipment to burn down.

Factory default to provide 1.25 meters long wire, customers can be required to extend the wire or sequential wiring.

Note that there is no yellow line in the line sequence that may be provided in some factory batches, where the gray line is equivalent to replacing the yellow line.

## 2.3 Product appearance

The following picture shows the appearance of our products:



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## **2.4 Method of Speed Measurement**

Select the appropriate measuring site, avoid the stones, ensure that the steel needle does not touch hard objects, set aside the surface soil according to the required measurement depth, maintain the original degree of tightness of the soil below, hold the sensor vertically inserted into the soil, do not shake left and right when inserted, a small range of measuring points recommended multiple measurements to find the average.

## **2.5 Buried Survey Method**

Vertical excavation >20 cm diameter of the pit, the sensor steel needle horizontal inserted into the pit wall at a given depth, the pit landfill solid, stable for a period of time, can be continuous days, months or more of the measurement and recording.

## **2.6 Points for attention**

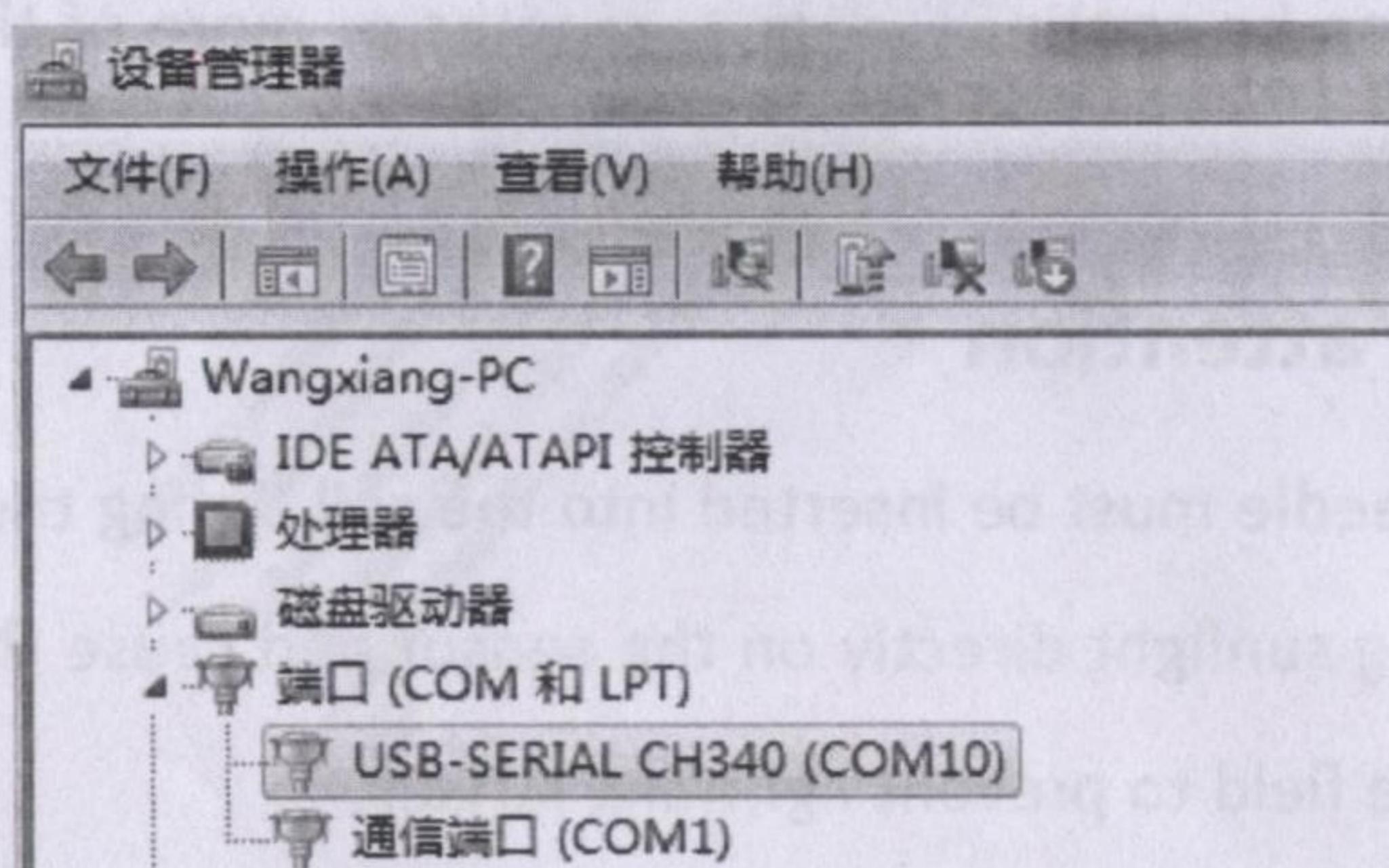
1. The steel needle must be inserted into the soil during the measurement.
2. Avoid strong sunlight directly on the sensor and cause the temperature to be too high. Use in the field to prevent lightning strikes.
3. do not violently bend the steel needle, do not pull the sensor lead wire, do not beat or violently hit the sensor.
4. The sensor protection class IP68 can soak the sensor in the water.
5. Due to the presence of radio frequency electromagnetic radiation in the air it is not suitable to be energized in the air for a long time.

## III CONFIGURATION SOFTWARE INSTALLATION AND USE

Our company provides the matching "SENSOR MONITORING SOFTWARE", which can conveniently use the computer to read the parameters of the sensor, and flexibly modify the device ID and address of the sensor.

### 3.1 Sensor Access Computer

After the sensor is properly connected to the computer via USB to 485 and powered, you can see the correct COM port in the computer ("My Computer - Properties - Device Manager - Port" to view the COM port).



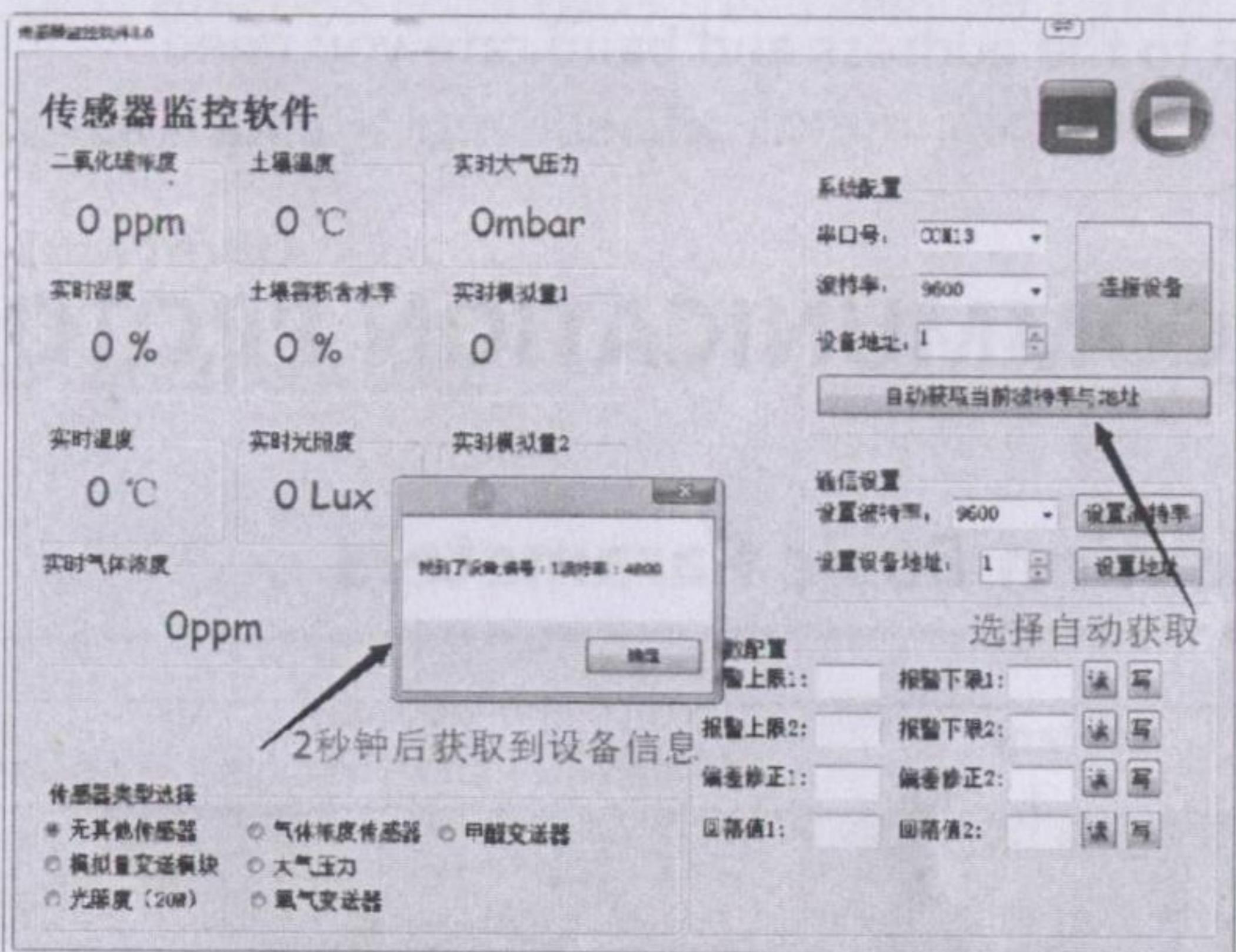
As shown in the figure above, your serial port number is COM10 at this time. Please remember this serial port. You need to fill in the serial port number in the sensor monitoring software.

If the COM port is not found in the device manager, it means that you have not plugged in the USB to 485 or did not install the driver correctly, please contact the technical staff for assistance.

### 3.2 Use of sensor monitoring software

The configuration interface is shown in the figure. first get the serial port

number and select the correct serial port according to the method section 3.1. then click automatically to get the current baud rate and address to automatically detect all devices and baud rates on the current 485 bus. Note that you need to ensure that there is only one sensor on the 485 bus when using software to automatically acquire.



Then click on the connected device to get sensor data information in real time.

If your device is a gas concentration sensor, please select “Gas Concentration Sensor” at the sensor type, “Formaldehyde Transmitter” for the formaldehyde sensor, “Analog Transmitter Module” for the analog transmitter, and “Atmospheric Pressure” for the atmospheric pressure sensor. “Sensor”, the illuminance sensor selects “Optical Light 20W”, the oxygen sensor selects “Oxygen Transmitter”, and the other sensors select the default “No Other Sensor” .

### **3.3 Change baud rate and device ID**

Click on the device baud rate and set address in the communication settings to complete the relevant settings in the case of disconnecting the device, please note that after the settings please restart the device, and then "automatically get the current baud rate and address" after you can find that the address and baud rate have been changed to the address and baud rate you need.

## **IV COMMUNICATION PROTOCOL**

### **4.1 Communication Basic Parameters**

| Parameters  | Content  |
|-------------|--|
| Coding      | 8-bit binary   |
| Data bit    | 8-bit  |
| Parity bit  | no   |
| Stop bit    | 1-bit  |
| Error check | CRC(redundant cyclic code)   |
| BAUD RATE   | 2400bps/4800bps/9600bps can be set, the factory default is 9600bps |

### **4.2 Data frame format definition**

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

Initial structure  $\geq 4$  bytes of time

Address code = 1 byte

Function code = 1 byte

Data area = N bytes

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Error check = 16-bit CRC code

End structure  $\geq 4$  bytes of time

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

Function code: The instruction function of the command sent by the host. This transmitter only uses function code 0x03 (read register data).

Data area: The data area is the specific communication data. Note that the 16-bit data high byte is in front!

CRC code: Two-byte check code.

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### Inquiry frame

| Address Code | Function Code | Register start address | Register length | CRC_L | CRC_H |
|--------------|---------------|------------------------|-----------------|-------|-------|
|--------------|---------------|------------------------|-----------------|-------|-------|

|      |      |      |      |      |      |
|------|------|------|------|------|------|
| 1bit | 1bit | 2bit | 2bit | 1bit | 1bit |
|------|------|------|------|------|------|

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### Answer Frames

| Address Code | Function Code | Effective number of bytes | Data area | Second data area | Nth data area | Check code |
|--------------|---------------|---------------------------|-----------|------------------|---------------|------------|
|--------------|---------------|---------------------------|-----------|------------------|---------------|------------|

|      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|
| 1bit | 1bit | 1bit | 2bit | 2bit | 2bit | 2bit |
|------|------|------|------|------|------|------|

## 4.3 Register address

| Register address | PLC or configuration address | Content                        | Operation |
|------------------|------------------------------|--------------------------------|-----------|
| 0006H            | 40007 (40007)                | PH values(unit 0.01pH)         | Read-Only |
| 0012H            | 40013 (40019)                | Soil moisture(unit 0.1%RH)     | Read-Only |
| 0013H            | 40014 (40020)                | Soil temperature(unit 0.1 °C)  | Read-Only |
| 0015H            | 40016 (40022)                | Soil conductivity(unit 1us/cm) | Read-Only |
| 001EH            | 4001F (40031)                | Soil nitrogen (unit mg/kg)     | Read-Only |
| 001FH            | 40020 (40032)                | Soil phosphorus (unit mg/kg)   | Read-Only |
| 0020H            | 40021 (40033)                | Soil potassium (unit mg/kg)    | Read-Only |
| 0100H            | 40101 (40257)                | Equipment address(0-255)       | R/W       |
| 0101H            | 40102 (40258)                | baud rate(2400/4800/9600)      | R/W       |

## 4.4 Examples of communication protocols and explanations

### 4.4.1 Reading the value of soil temperature and humidity from device address 0x01

#### Inquiry frame

| Address code | Functional code | Register start address | Register length | CRC_L | CRC_H |
|--------------|-----------------|------------------------|-----------------|-------|-------|
| 0x01         | 0x03            | 0x00 0x12              | 0x00 0x02       | 0x65  | 0xCB  |

#### Answer Frames

(e.g. read temperature -10.1 °C and humidity RH 65.8%)

| Address code | Functional code | Effective number of bytes | Humidity values | Temperature values | CRC_L | CRC_H |
|--------------|-----------------|---------------------------|-----------------|--------------------|-------|-------|
| 0x01         | 0x03            | 0x04                      | 0x02<br>0x92    | 0xFF<br>0x9B       | 0x5A  | 0x3D  |

Soil temperature:

Upload as a complement when temperature is below zero

FF9BH( Hexadecimal)=-101=> Temperature=-10.1°C

Soil humidity:

292H( Hexadecimal)=658=>Humidity=65.8%RH

#### 4.4.2 Reading the value of soil moisture from device address 0x01

##### Inquiry frame

| Address code | Functional code | Register start address | Register length | CRC_L | CRC_H |
|--------------|-----------------|------------------------|-----------------|-------|-------|
| 0x01         | 0x03            | 0x00<br>0x12           | 0x00<br>0x01    | 0x25  | 0xCA  |

##### Answer Frames

(e.g. reading RH 7.4% humidity)

| Address code | Functional code | Effective number of bytes | Humidity values | CRC_L | CRC_H |
|--------------|-----------------|---------------------------|-----------------|-------|-------|
| 0x01         | 0x03            | 0x02                      | 0x00<br>0x4A    | 0x39  | 0xB3  |

Soil humidity:

4AH( Hexadecimal)=74=>Humidity=7.4%RH

#### 4.4.3 Reading the value of soil electrical conductivity from device address 0x01

##### Inquiry frame

| Address code | Functional code | Register start address | Register length | CRC_L | CRC_H |
|--------------|-----------------|------------------------|-----------------|-------|-------|
| 0x01         | 0x03            | 0x00<br>0x15           | 0x00<br>0x01    | 0x95  | 0xCE  |

##### Answer Frames

(e.g. reading conductivity of us/cm 1500)

| Address code | Functional code | Effective number of bytes | Electrical conductivity | CRC_L | CRC_H |
|--------------|-----------------|---------------------------|-------------------------|-------|-------|
| 0x01         | 0x03            | 0x02                      | 0x05<br>0xDC            | 0xBA  | 0x8D  |

Soil conductivity:

5DCH( Hexadecimal)= 1500=> Electrical conductivity=1500us/cm

#### 4.4.4 Reading the value of soil PH from device address 0x01

##### Inquiry frame

| Address code | Functional code | Register start address | Register length | CRC_L | CRC_H |
|--------------|-----------------|------------------------|-----------------|-------|-------|
| 0x01         | 0x03            | 0x00<br>0x06           | 0x00<br>0x01    | 0x64  | 0x0B  |

##### Answer Frames

(e.g. reading pH 3.08 pH)

| Address code | Functional code | Effective number of bytes | PH           | CRC_L | CRC_H |
|--------------|-----------------|---------------------------|--------------|-------|-------|
| 0x01         | 0x03            | 0x02                      | 0x01<br>0x34 | 0xB8  | 0x15  |

PH calculation instructions:

0047H( Hexadecimal)=308=>PH=3.08pH

#### 4.4.5 Reading the value of soil NPK from device address 0x01

##### Inquiry frame

| Address code | Functional code | Register start address | Register length | CRC_L | CRC_H |
|--------------|-----------------|------------------------|-----------------|-------|-------|
| 0x01         | 0x03            | 0x00<br>0x1E           | 0x00<br>0x03    | 0x34  | 0x0D  |

##### Answer Frames

( For example, read that nitrogen is 32 mg/kg, phosphorus is 37 mg/kg, potassium is 48 mg/kg)

| Address code | Functional code | Effective number of bytes | Nitrogen content | Phosphorus content | Potassium content | CRC_L    | CRC_H |
|--------------|-----------------|---------------------------|------------------|--------------------|-------------------|----------|-------|
| 0x01         | 0x03            | 0x06                      | 0x00<br>0x20     | 0x00<br>0x25       | 0x00<br>0x30      | 0xB<br>8 | 0x15  |

Nitrogen, phosphorus and potassium content:

0020 H ( hexadecimal) =32=>N=32mg/kg

0025 H ( hexadecimal) =37=>P=37mg/kg

0030 H ( hexadecimal) =48=>K=48mg/kg

#### 4.4.6 Reading the value of soil nitrogen from device address 0x01

##### Inquiry frame

| Address Code | Function Code | Register start address | Register length | CRC_L | CRC_H |
|--------------|---------------|------------------------|-----------------|-------|-------|
| 0x01         | 0x03          | 0x00<br>0x1e           | 0x00<br>0x01    | 0xB5  | 0xCC  |

##### Answer Frames

(e.g. reading that nitrogen content is 32 mg/kg)

| Address Code | Function Code | Effective number of bytes | Nitrogen content | CRC_L | CRC_H |
|--------------|---------------|---------------------------|------------------|-------|-------|
| 0x01         | 0x03          | 0x02                      | 0x00<br>0x20     | 0x5A  | 0x3D  |

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

#### 4.4.7 Reading the value of soil phosphorus from device address 0x01 Inquiry frame

| Address Code | Function Code | Register start address | Register length | CRC_L | CRC_H |
|--------------|---------------|------------------------|-----------------|-------|-------|
| 0x01         | 0x03          | 0x00 0x1f              | 0x00<br>0x01    | 0xE4  | 0x0C  |

#### Answer Frames

(e.g. reading that phosphorus content is 37 mg/kg)

| Address Code | Function Code | Effective number of bytes | Phosphorus content | CRC_L | CRC_H |
|--------------|---------------|---------------------------|--------------------|-------|-------|
| 0x01         | 0x03          | 0x02                      | 0x00<br>0x25       | 0x5A  | 0x3D  |

Phosphorus content:

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

#### 4.4.8 Reading the value of soil potassium from device address 0x01 Inquiry frame

| Address Code | Function Code | Register start address | Register length | CRC_L | CRC_H |
|--------------|---------------|------------------------|-----------------|-------|-------|
| 0x01         | 0x03          | 0x00<br>0x20           | 0x00<br>0x01    | 0x85  | 0xC0  |

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### **Answer Frames**

(e.g. reading that potassium content is 48 mg/kg)

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| Address Code | Function Code | Effective number of bytes | Potassium content | CRC_L | CRC_H |
|--------------|---------------|---------------------------|-------------------|-------|-------|
| 0x01         | 0x03          | 0x02                      | 0x00<br>0x30      | 0x5A  | 0x3D  |

Potassium :

0030 H (16hexadecimal) =48=>Potassium=48mg/kg

## **V APPENDIX**

### **5.1 Quality Assurance and After-sale**

Quality assurance terms follow unblocked Electronic Technology Co., Ltd. sensor after-sale terms, for sensor mainframe circuit partial warranty for two years, gas sensor probe warranty for one year, accessories (shell / plug / cable, etc.) warranty for three months.