

Chapter 1 Product Introduction

1.1 Product overview

The soil integrated sensor is suitable for measuring soil temperature, moisture, total soil salt (conductivity), soil pH and nitrogen, phosphorus and potassium. The soil comprehensive sensor creatively measures the seven parameters of conductivity, moisture, temperature, ph, and nitrogen, phosphorus and potassium, which greatly facilitates the customer's systematic assessment of soil conditions. .

Compared with the German original high-precision sensor and the actual soil drying weighing method calibration, the sensor has high accuracy, fast response and stable output: it is less affected by the salt content of the soil and is suitable for various soil qualities. Can be buried in the soil for a long time, resistant to long-term electrolysis, corrosion resistance, vacuum potting, and completely waterproof.

1.2 Scope of application

It is widely used in scientific experiments, water-saving irrigation, greenhouses, flowers and vegetables, grassland pastures, rapid soil testing, plant cultivation, sewage treatment, grain storage, and the measurement of various particulate water content and temperature.

1.3 Measurement parameters and hardware parameters

parameter	content
Power supply	12-24V DC
output signal	RS485
Temperature measurement range	-40℃-80℃
Temperature accuracy	±0.5℃
Temperature resolution	0.1℃
Moisture measurement range	0-100%
Moisture accuracy	±3% in the range of 0-53%; ±5% in the range of 53-100%
Moisture resolution	0.10%
Conductivity measurement range	0-10000us/cm
Conductivity resolution	10us/cm
pH measurement range	3-9pH
pH measurement accuracy	±0.3pH
pH resolution	0.01pH
NPK measurement range	0-1999mg/kg
NPK measurement	±2%F.s

accuracy	
NPK resolution	1mg/kg (mg/l)
Storage environment	-20℃-60℃
Working pressure range	0.9-1.1atm
Response time	<1s
Protection level	IP68
Installation method	Embed all or insert all probes into the measured medium

Note: The details of all measurable parameters of this series of products, please refer to the actual product purchased.

When measuring frozen icy soil layers, the moisture value will be low and inaccurate, requiring user compensation.

The factory default product is suitable for measuring ordinary yellow soil, black soil and red soil. It is not suitable for absolute moisture measurement on saline-alkali soils, sandy soils, or other powdery objects with high salinity. It can still characterize the relative moisture difference. For this type of moisture measurement, you should contact the manufacturer for separate calibration.

1.4 Calculation method and meaning of soil moisture

The soil moisture calculated by this sensor is soil volumetric moisture content (also called soil volumetric moisture content), which is what people call "soil moisture" and

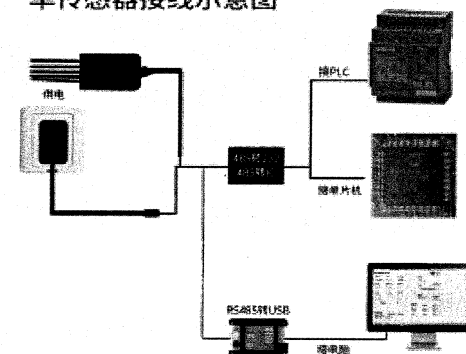
"soil moisture" in a popular sense.

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

1.5 System framework diagram

This sensor can be connected and used alone. First, use 12V DC power supply. The device can be directly connected to a PLC with a 485 interface, and it can be connected to a single-chip microcomputer through a 485 interface chip. The single-chip microcomputer and PLC can be programmed through the specified modbus protocol to cooperate with the sensor. At the same time, use USB to 485 to connect to the computer, and use the sensor configuration tool provided by our company for configuration and testing.

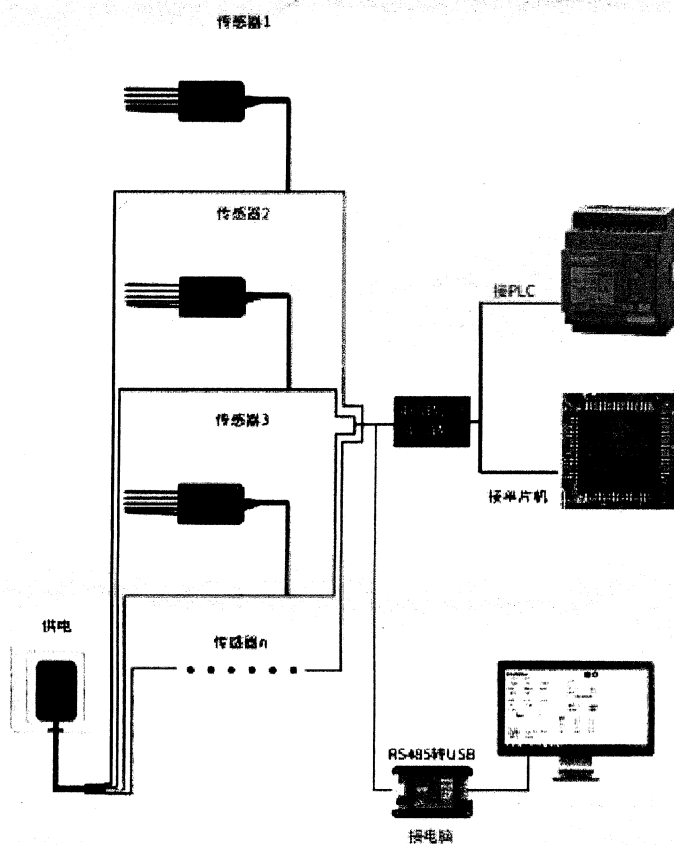
单传感器接线示意图



This product can also be used in combination of multiple sensors on a 485 bus. In theory, one bus can connect more than 16 485 sensors. If you need to connect more 485 sensors, you

can use 485 repeaters to expand more 485 devices. One end is connected to the PLC with 485 interface, and the single-chip microcomputer is connected through the 485 interface chip, or it can be connected to the computer by using USB to 485. Use the sensor configuration tool provided by our company for configuration and testing.

多传感器接线示意图



Chapter 2 How to Use

2.1 Inspection before equipment installation

Please check the equipment list before installing the equipment:

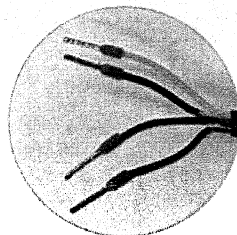
name	Quantity
High precision sensor	1set
12V waterproof power supply	1set (Optional)
USB to 485 device	1set (Optional)
Warranty card/certificate	1 serving

2.2 Interface description

The power interface is a wide-voltage power supply that can output 12-24V. When wiring the 485 signal line, pay attention to the A/B two lines can not be reversed, and the address of multiple set devices on the bus can not conflict. The line sequence description is shown in the following figure (table):

RS485接线说明

线色	说明
电源 棕色	电源正 (12-24VDC)
黑色	电源负
通信 黄色	485-A
蓝色	485-B



	Thread color	Description
power	brown	Power is positive (12-24VDC)
supply	black	Power negative
Communication	Yellow (gray color)	485-A
	blue	485-B

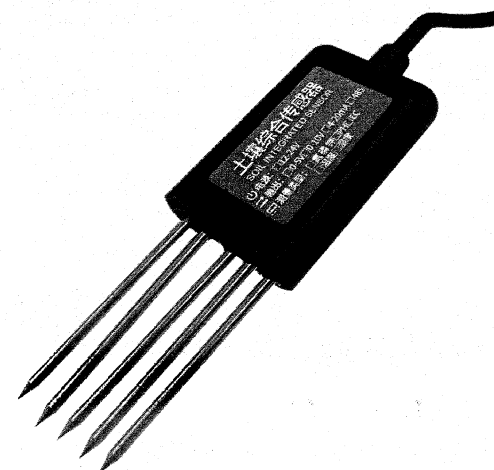
Note: Please be careful not to connect the wrong wiring sequence, the wrong wiring will cause the equipment to burn.

The factory default provides 1.25 meters of wire, customers can extend the wire as needed or wire in order.

Note that there is no yellow line in the line sequence that may be provided in some factory batches. At this time, the gray line is equivalent to replace the yellow line.

2.3 Product appearance

The picture below is the appearance of our product:



2.4 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.

2.5 Buried measurement method

Dig a pit with a diameter > 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.

2.6 Notes

1. All steel needles must be inserted into the soil during measurement.
2. Avoid strong sunlight directly shining on the sensor to cause excessive temperature. Pay attention to lightning protection 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 protection grade is IP68, and the 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.

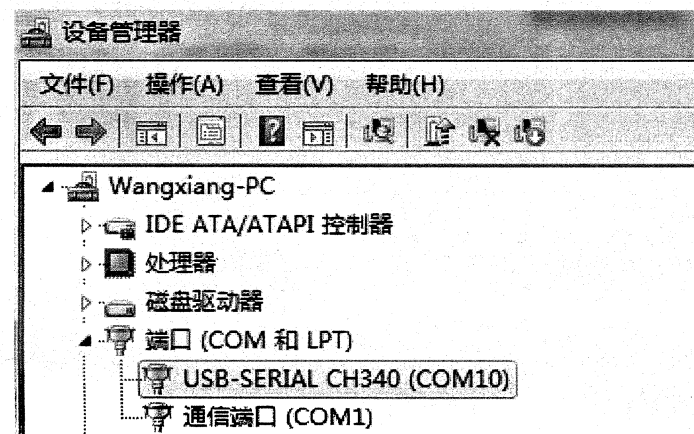
Chapter 3 Configuration Software

Installation and Use

Our company provides supporting "sensor monitoring software", which can easily use the computer to read the parameter of the sensor and modify the device ID and address of the sensor flexibly.

3.1 Connect the sensor to the computer

After connecting the sensor to the computer through USB to 485 and providing power supply, you can see the correct COM port in the computer (check the COM port in "My Computer-Properties-Device Manager-Port").

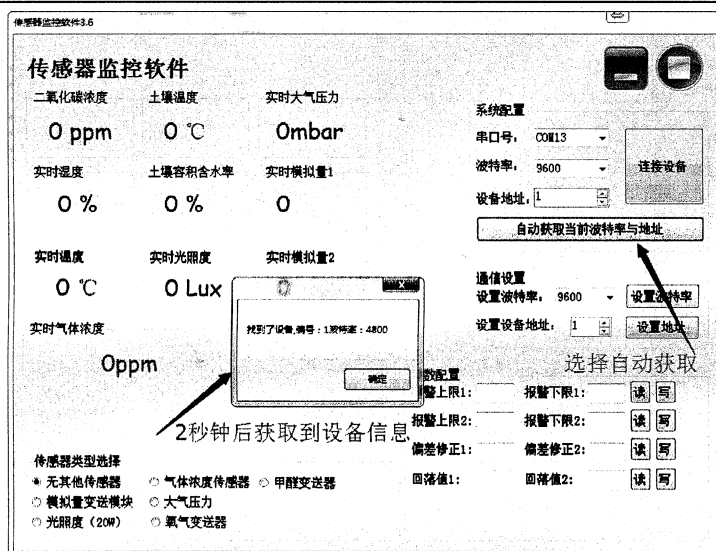


As shown in the figure above, your serial port number is COM10 at this time, please remember this serial port, you need to fill in this serial port number in the sensor monitoring software.

If the COM port is not found in the device manager, it means that you have not inserted the USB to 485 or the driver has not been installed correctly, please contact a technician for help.

3.2 Use of sensor monitoring software

The configuration interface is as shown in the figure. First, obtain the serial port number and select the correct serial port according to the method in chapter 3.1, and then click to automatically obtain the current baud rate and address to automatically detect all devices and baud rates on the current 485 bus. Please note that you need to ensure that there is only one sensor on the 485 bus when using the software to automatically obtain it.



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

If your device is a gas concentration sensor, please select "gas concentration sensor" in the sensor type, "formaldehyde transmitter" for formaldehyde sensor, "analog transmitter module" for analog transmitter, and "atmospheric pressure sensor", illuminance sensor selects "Illuminance 20W", oxygen sensor selects "Oxygen transmitter", and other sensors select the default "No other sensor".

3.3 Modify the baud rate and device ID

When the device is disconnected, click the device baud rate and set address in the communication settings to complete the related settings. Please note that after setting, please restart the device, and then "automatically obtain the current baud rate and address" to find the address And the baud rate has been changed

to the address and baud rate you need.

CHAPTER 2 Basic Communication

2.1 Basic communication parameter

parameter	content
coding	8-bit binary
data bit	8-bit
parity check bit	no
stop bid	1-bit
error checking	CRC(redundant cyclic code)
baud rate	2400bps/4800bps/9600bps Can be set, the factory default is 9600bps

2.2 Data frame format definition

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

Initial structure \geq 4-byte time

Address code = 1 byte

Function code = 1 byte

Data area = N bytes

Error check = 16-bit CRC code

End structure \geq 4-byte time

Address code: the address of the sensor, 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 16bits data in front.

CRC code: two-byte check code.

Interrogation frame						
Address code	Function code	Register start address	Register length	Check code low bit	Check code high bit	
1byte	1bytes	2 bytes	2 bytes	1 byte	1 byte	
Reply frame						
Address s code	Function code	Quantity of valid byte	Data 1 area	Data 2 area	Data N area	Check code
1 byte	1 byte	1 byte	2 bytes	2 bytes	2 bytes	2 bytes

2.3 Register address

register address	PLC or configuration address	content	operating
0006H	40007 (40007)	pH value (unit 0.01pH)	read only
0012H	40013 (40019)	soil humidity (unit: 0.1%RH)	read only
0013H	40014 (40020)	soil temperature (unit: 0.1℃)	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)	device address (0-255)	read only
0101H	40102 (40258)	baud rate (2400/4800/9600)	read and write

2.4 Communication protocol example and explanation

2.4.1 Read the soil temperature and humidity value of the device address 0x01

Interrogation frame					
Address code	Function code	Initial address	Data length	Check code low bit	Check code high bit
0x01	0x03	0x00 0x12	0x00 0x02	0x64	0x0E
Response frame (for example, the temperature is -10.1℃ and the humidity is 65.8%RH)					

Address code	Function code	Effective words	Humidity value	Temperature value	Check code low bit	Check code high bit
0x01	0x03	0x04	0x02 0x92	0xFF 0x9B	0x5A	0x3D

Soil temperature:

Upload in the form of complement when the temperature is below zero

FF9BH(hexadecimal)=-101=>temperature=-10.1℃

Soil moisture:

292H (hexadecimal) = 658 => humidity = 65.8%RH

2.4.2 Read the soil moisture value of the device address 0x01

Interrogation frame

Address code	Function code	Initial address	Data length	Check code low bit	Check code high bit
0x01	0x03	0x00 0x12	0x00 0x01	0X24	0x0F

Response frame (for example, the humidity is 7.4%RH)

Address code	Function code	Quantity of byte	Humidity value	Check code low bit	Check code high bit
0x01	0x03	0x02	0x00 0x4A	0x39	0xB3

Soil moisture:

4AH (hexadecimal)=74=>humidity=7.4%RH

2.4.3 Read the soil conductivity of the device address 0x01

Interrogation frame

Address code	Function code	Initial address	Data length	Check code low bit	Check code high bit
0x01	0x03	0x00 0x15	0x00 0x01	0X95	0xCE

Response frame (for example, read conductivity of 1500us/cm)

Address code	Function code	Quantity of byte	Conductivity	Check code low bit	Check code high bit
0x01	0x03	0x02	0x05 0xDC	0xBA	0x8D

Soil conductivity:

5DCH (hexadecimal) = 1500 => conductivity = 1500us/cm

2.4.4 Read the soil pH of the device address 0x01

Interrogation frame

Address code	Function code	Initial address	Data length	Check code low bit	Check code high bit
0x01	0x03	0x00 0x06	0x00 0x01	0X64	0x0B

Response frame (for example, read the pH is 3.08pH)

Address code	Function code	Quantity of byte	Conductivity	Check code low bit	Check code high bit
0x01	0x03	0x02	0x01 0x34	0xB8	0x03

Instructions for pH calculation:

0047H (hexadecimal)=308=>pH=3.08pH

2.4.5 Read the value of soil nitrogen, phosphorus and potassium at device address 0x01

Interrogation frame

Address code	Function code	Initial address	Data length	Check code low bit	Check code high bit
0x01	0x03	0x00 0x1E	0x00 0x03	0x65	0xCD

Response frame

Address code	Function code	Effective words	Nitrogen content	Phosphorus content	Potassium content	Check code low bit	Check code high bit
0x01	0x03	0x06	0x00 0x20	0x00 0x25	0x00 0x30	0xB1	0x6D

Nitrogen,Phosphorus,Potassium content:

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

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

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

2.4.6 Read the value of soil nitrogen at device address 0x01

Interrogation frame

Address code	Function code	Initial address	Data length	Check code low bit	Check code high bit
0x01	0x03	0x00 0x1e	0x00 0x01	0xE4	0x0C

Response frame

Address code	Function code	Effective words	Nitrogen content	Check code low bit	Check code high bit
0x01	0x03	0x02	0x00 0x20	0xB9	0x9C

Nitrogen content:

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

2.4.7 Read the value of soil phosphorus at device address 0x01

Interrogation frame

Address code	Function code	Initial address	Data length	Check code low bit	Check code high bit
0x01	0x03	0x00 0x1f	0x00 0x01	0xB5	0xCC

Response frame

Address code	Function code	Effective words	Phosphorus content	Check code low bit	Check code high bit
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0x01	0x03	0x02	0x00 0x25	0x79	0x9F
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Phosphorus content: 0025 H (hexadecimal) = 37 => phosphorus = 37mg/kg

2.4.8 Read the value of soil potassium at device address 0x01

Interrogation frame

Address code	Function code	Initial address	Data length	Check code low bit	Check code high bit
0x01	0x03	0x00 0x20	0x00 0x01	0x85	0xC0

Response frame

Address code	Function code	Effective words	Potassium content	Check code low bit	Check code high bit
0x01	0x03	0x02	0x00 0x30	0xB8	0x50

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

CHAPTER 3 APPENDIX

3.1 Warranty and After-Sales

The warranty clauses follow the sensor after-sales clauses of Weihai Jingxun Changtong Electronic Technology Co., Ltd., two years for the sensor host circuit part, one year for gas-sensitive probes, and three months for accessories (housing/plugs/cables, etc.).