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JXCT®



JXBS-3001-NPK-RS

Soil NPK Sensor User Manual

RS485 Modbus
Version: 2.0
Date: 2020-10-24
Status: Released

www.jxct-iot.com

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 temperature of various particulate matter.

1.3 Measurement parameters and hardware parameters

Parameters	Content
Power supply	5-24V DC
Output signal	RS485
Temperature range	-40℃-80℃
Temperature accuracy	±0.5℃
Temperature resolution	0.1℃
Water measurement range	0-100%
Moisture accuracy	±3% Within 0-53%; ±5% within 53-100%
Water resolution	0.10%
Electrical conductivity measurement range	0-10000us/cm
Conductivity resolution	10us/cm
PH measurement range	3-9pH
PH measurement accuracy	±0.3pH
PH resolution	0.01pH
Measurement range of NPK	0-1999mg/kg
Measurement accuracy of NPK	±2%F.s
Resolution of NPK	1mg/kg(mg/l)
Storage environment	-20℃-60℃
Working Pressure Range	0.9-1.1atm
Response Time	<1s
Protection Level	IP68

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.

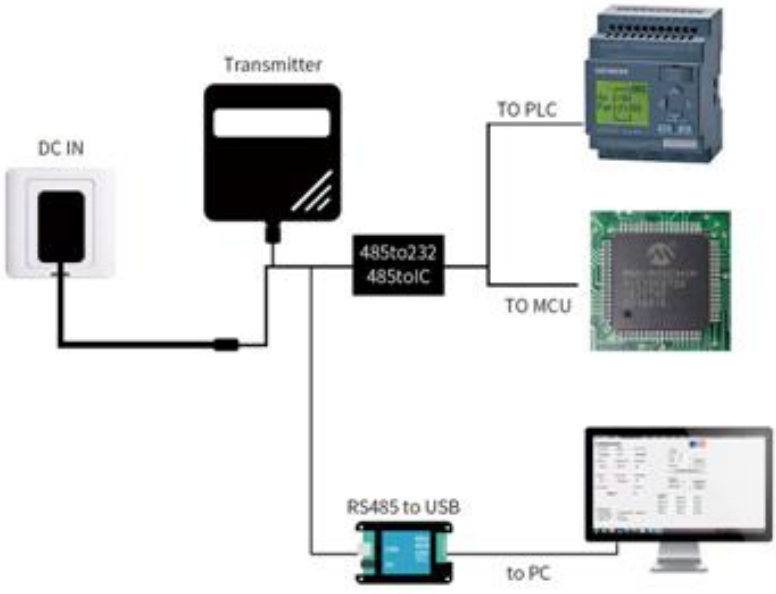
1.4 Method and Meaning of Soil Water Calculation

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

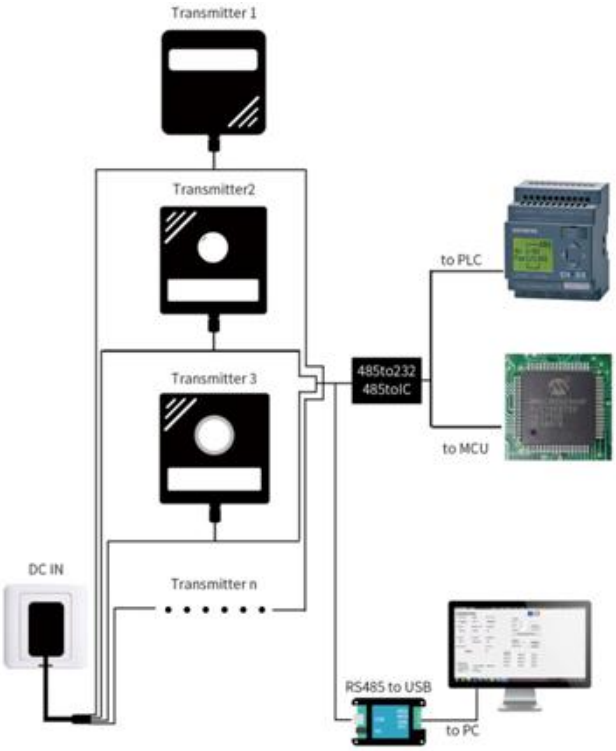
This sensor can be connected to use alone, first use 12 V DC power supply, the equipment can be directly connected with the PLC, with 485 interface can be connected to the through 485 interface chip. Through the modbus protocol specified after the MCU and PLC programming can be used in conjunction with 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.



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

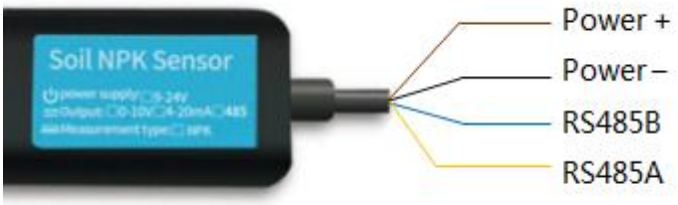
connected to the computer by using USB to 485, the sensor configuration tools provided by our company to configure and test.



II . Instruction of Wiring & Installation

2.1 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 picture:



Function	Cable Color	Specs
Power	Brown	Power supply +
	Black	Power supply -
Communication	Yellow (grey)	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 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 Surface Measurement Method

Select the appropriate measurement location, avoid the stone, ensure that the steel needle will not touch the hard object, throw off the topsoil according to the required measurement depth, keep the original soil tightness under the ground, hold the sensor vertically into the soil, insert It is not allowed to sway from side to side. It is recommended to measure the average for multiple measurements within a small range of one measurement point.





2.4 Buried Measurement Method

Vertically dig pits with a diameter of >20cm, insert the sensor steel needle horizontally into the pit wall at a given depth, fill the pits tightly, and stabilize for a period of time, then measure and record for several days, months or even longer.



2.5 Remarks

1. The steel needle must be inserted into the soil during the measurement.

2. Avoid strong sunlight directly on the sensor for high temperature. 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

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).



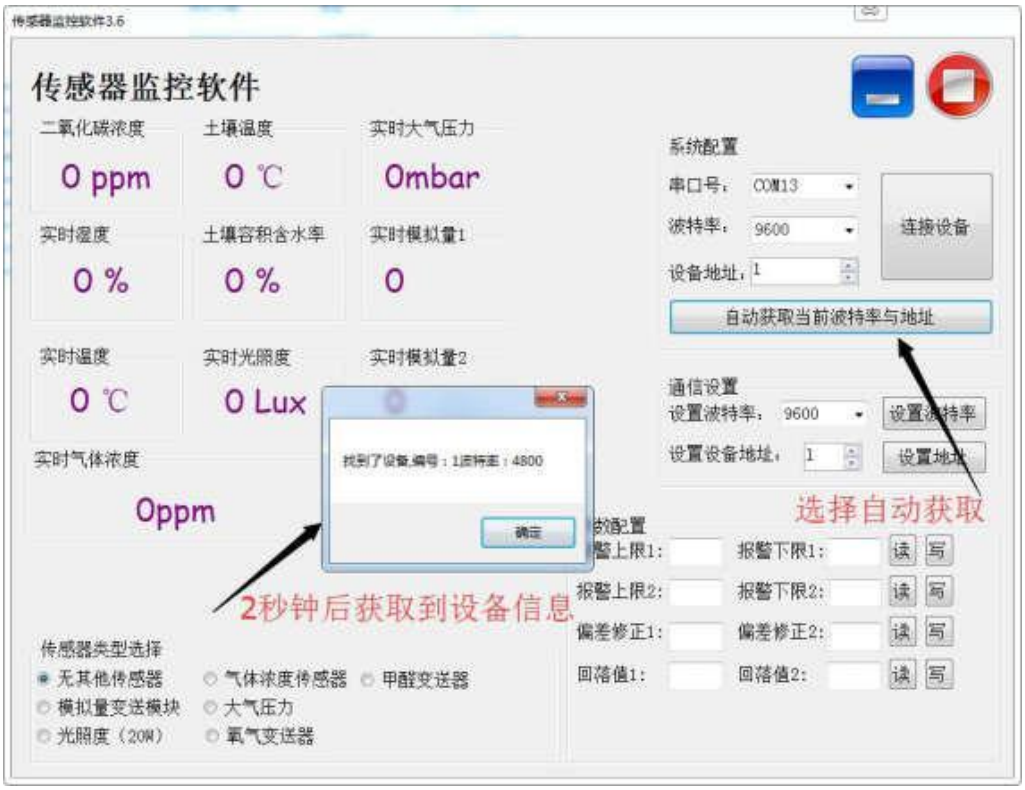
As shown in the figure above, your serial port number is COM10 at this time. Please remember this serial port. You need to fill in the serial port number in the sensor monitoring software.

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 ≥ 4 bytes of time

Address code = 1 byte

Function code = 1 byte

Data area = N bytes

Error check = 16-bit CRC code

End structure ≥ 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.

Inquiry Frame					
Address Code	Function Code	Register start address	Register Length	CRC_L	CRC_H
1bit	1bit	2bit	2bit	1bit	1bit

Answer Frames						
Address Code	Function Code	Effective number of bytes	Data area	Second Data Area	Nth Data Area	Check Code
1bit	1bit	1bit	2bits	2bits	2bits	2bits

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℃)	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)	Read & Write
0101H	40102(40258)	Baud Rate (2400/4800/9600)	Read & Write

4.4 Examples of communication protocols and explanations

4.4.1 Reading soil temperature & humidity value 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	0x64	0x0E

Answer Frame ((e.g. read temperature -10.1℃ and humidity RH 65.8%)						
Address Code	Function Code	Effective number of bytes	Humidity Values	Temperature Values	CRC_L	CRC_H
0x01	0x03	0x04	0x02 0x92	0XFF 0x9B	0x5A	0x3D

Soil temperature:
Upload as a complement when temperature is below zero
FF9BH(Hexadecimal)=-101=> Temperature=-10.1℃ 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 0x12	0x00 0x01	0x24	0x0F

Answer Frame (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 0x4A	0x39	0xB3

Soil humidity:

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

4.4.3 Read Soil electrical conductivity value from device address 0x01

Inquiry frame

Address code	Functional code	Register start address	Register length	CRC_L	CRC_H
0x01	0x03	0x00 0x15	0x00 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 0xDC	0xBA	0x8D

Soil conductivity:

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

4.4.4 Read 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 0x06	0x00 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 0x34	0xB8	0x03

PH calculation instructions:
0047H(Hexadecimal)=308=>PH=3.08pH

4.4.5 Read 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 0x1E	0x00 0x03	0x65	0xCD

Answer Frames

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

Address Code	Function Code	Effective Bytes Qty	Nitrogen Value	Phosphorus Value	Potassium Value	Check Code Low	Check Code High
0x01	0x03	0x06	0x00 0x20	0x00 0x25	0x00 0x30	0xB1	0x6D

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 Read 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 0x1e	0x00 0x01	0XE4	0x0C

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

Address Code	Function Code	Effective Number of bytes	Nitrogen Value	CRC_L	CRC_H
0x01	0x03	0x02	0x00 0x20	0Xb9	0x9C

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

4.4.7 Read 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 0x01	0Xb5	0xCC

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 0x25	0x79	0x9F

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 0x20	0x00 0x01	0x85	0xC0

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

Address Code	Function Code	Effective number of bytes	Potassium content	CRC_L	CRC_H
0x01	0x03	0x02	0x00 0x30	0X B8	0x50

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