

485 Soil Nitrogen- Phosphorus-Potassium Sensor User Manual



Applicable Product Model: AT-So-NPK

Thank you for purchasing our product. Please read this manual carefully and operate strictly in accordance with the product instructions.

After reading, please keep it properly for future reference.

Table of Contents

I. Product Overview	5
1.1 Introduction	5
1.2 Scope of Application	5
1.3 Precautions	5
1.4 Product Features	6
1.5 Product Dimensions	6
II. Product Parameters	7
2.1 Technical Parameters	7
2.2 Installation Methods and Precautions	7
2.2.1 Rapid Measurement Method	7
2.2.2 Buried Measurement Method	8
2.2.3 Precautions	8
III. Instructions for Use	9
3.1 Unboxing Inspection	9
3.2 Reading and Modifying Address (Depending on Situation) ..	9
3.3 Port Description	9
3.4 Software Installation and Usage	10
3.4.1 Connecting the Sensor to a Computer	10
3.4.2 Using the Sensor Monitoring Software	11
IV. Communication Protocol	12
4.1 Basic Communication Parameters	12
4.2 Communication Protocol Examples and Explanation	12
4.2.1 Data Register Address	12
4.2.3 Reading Soil NPK Value from Device Address 01	13

4.2.4 Reading Soil Nitrogen Value from Device Address 01	13
4.2.5 Reading Soil Phosphorus Value from Device Address 01	13
4.2.6 Reading Soil Potassium Value from Device Address 01	14
4.2.7 Changing Device Address 01 to 02	14
V. After-Sales Service	14
VI. Revision Record	15
VII. Contact Information	15

User Notice

- 1 .For a better user experience, please read this manual carefully before installation, operation, and maintenance.
If you encounter any issues afterward, contact customer service for assistance.
- 2 .Please follow the operating procedures and precautions described in this manual. If you have any questions during installation or use, please contact us.
- 3 .When receiving the equipment, please open the package carefully and check whether the device and accessories have been damaged during transportation.
If any damage is found, please contact us immediately and keep the original packaging to facilitate return or replacement.
- 4 .Our company shall not be responsible for any failures or damages caused by improper use or operation not in accordance with the instructions.
- 5 .The content described in this manual may be updated or modified as the product evolves.
Such updates will not be notified separately, and our company shall not be liable for any consequences arising from such changes.

I. Product Overview

• 1.1 Introduction

This product adopts the MODBUS-RTU protocol and uses an RS485 interface. It is designed to measure the content of nitrogen, phosphorus, and potassium (NPK) in soil. By detecting the soil's nitrogen, phosphorus, and potassium levels, the fertility of the soil can be evaluated, thereby improving agricultural production efficiency and optimizing the ecological environment.

• 1.2 Scope of Application

Widely suitable for water-saving agriculture irrigation, large-scale planting, hydroponics, vegetable cultivation, orchard nurseries, flower breeding, and scientific experiments.

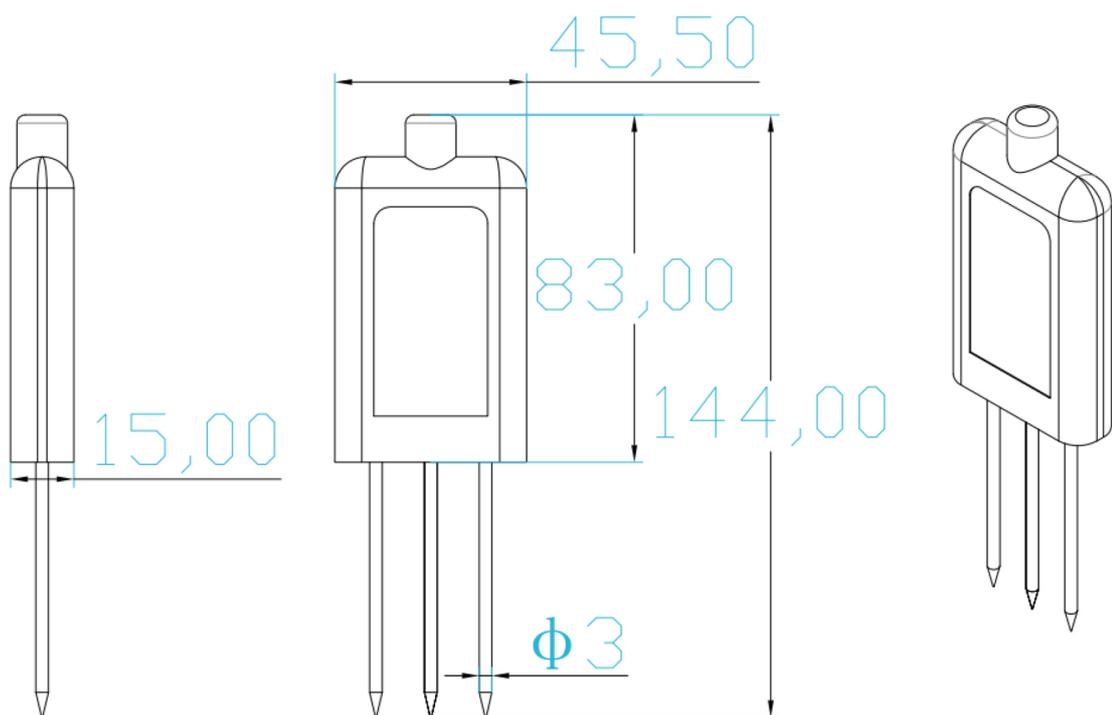
• 1.3 Precautions

- ▶ Users must not disassemble the device themselves to avoid product damage. Always disconnect the power before installing or removing the transmitter.
- ▶ The main sensor body and cables should be kept away from high-voltage sources and heat sources.
- ▶ The sensor must be supplied with a reliable and stable power source with minimal ripple. Avoid high-power interference equipment to prevent inaccurate measurements (such as inverters, motors, etc.).
- ▶ Prevent corrosive chemicals, oil, or dust from directly damaging the sensor. Do not use the sensor in environments with condensation or extreme temperatures. Avoid long-term use in harsh conditions to prevent thermal shock.
- ▶ Strictly prevent water intrusion into the device. Water entering the internal components will cause irreversible damage.

• 1.4 Product Features

- ▶ Can be buried in soil for long-term use; resistant to long-term electrolysis and corrosion.
- ▶ High measurement accuracy, reliable performance, fast response, and efficient data transmission.
- ▶ Vacuum-sealed, fully enclosed, fully waterproof.
- ▶ Easy to use and easy to install.

• 1.5 Product Dimensions



The product uses a three-pronged probe to measure nitrogen, phosphorus, and potassium. Each probe has a diameter of approximately 3 mm. The overall product dimensions are: length about 144 mm, thickness about 15 mm, and width about 45.5 mm.

II. Product Parameters

- 2.1 Technical Parameters

Parameter	Specification
DC Power Supply	12–24V DC
Output Method	RS485 interface, standard Modbus-RTU communication protocol
Device Address	Default: 1
Baud Rate	Default: 9600
Operating Environment	Temperature: –40°C to 80°C Humidity: 0–80% RH, non-condensing
Average Power Consumption	300mW
NPK Measurement Range	0–1999mg/kg
NPK Resolution	1mg/kg
Measurement Accuracy	±2%F. s
Protection Level	IP68

- 2.2 Installation Methods and Precautions

2.2.1 Rapid Measurement Method

Select an appropriate measurement location, avoiding stones to ensure the steel probe does not strike hard objects. Insert the sensor vertically into the soil to the required measurement depth, ensuring the deeper layer remains compact and undisturbed. Hold the sensor firmly and insert it straight into the soil—do not rock it left or right. Multiple measurements within a small area are recommended to obtain an average value.

- **2.2.2 Buried Measurement Method**

Dig a vertical hole with a diameter of approximately 20 cm.

Insert the sensor probe horizontally into the wall of the hole at the required depth. Backfill the soil tightly.

After the soil has stabilized for a period of time, continuous measurements can be taken over several days or even longer durations.

- **2.2.3 Precautions**

- ▶ The entire sensor or the full length of the probe must be completely inserted into the medium. When the measured area contains frozen soil layers, the moisture readings may be inaccurate and require user compensation.
- ▶ Avoid exposing the sensor to strong light or direct sunlight, which may cause excessive temperature rise. When used outdoors, take precautions against lightning.
- ▶ Do not bend the steel needles forcefully. Do not pull the sensor cable with excessive force. Avoid dropping or striking the sensor violently.
- ▶ The sensor has an IP68 protection rating and can be immersed in water.
- ▶ Due to electromagnetic interference in air, do not keep the sensor in an energized state for a long time while exposed in air.
- ▶ When measured soil contains frozen layers, moisture readings may be inaccurate and require user correction.

III. Instructions for Use

- **3.1 Unboxing Inspection**

Remove the sensor from the package and check whether the sensor surface is intact, whether the lead wire is complete, and whether the quantity is correct. The factory default provides a 1.0-meter cable, and customers may request longer cables if needed.

- **3.2 Reading and Modifying the Address (Depending on Requirements)**

The device's default address is "1", and the default baud rate is "9600". Our company can provide customized device addresses and baud rates according to customer requirements. Customers may also use our dedicated software to modify the device address and baud rate themselves (see Section 3.4 for modification instructions). Available address range: 1–247.

- **3.3 Unboxing Inspection**

The sensor supports a wide DC input range of 9–24V.

When wiring the RS485 signal lines, pay attention to A/B polarity — the two wires cannot be reversed. Multiple devices on the same bus must not have address conflicts.

The color code for the communication wiring is shown below:

485 Communication Wire Color	Description
Red	+
Black	–
Yellow	A
Green	B

Note: Please ensure correct wiring order. Incorrect wiring may cause device damage. Some batches may not include a yellow wire in the RS485 cable; in such cases, a gray wire may be used to replace the yellow wire.

• 3.4. Software Installation and Usage

We provide a supporting software tool called “Sensor Assistant” .

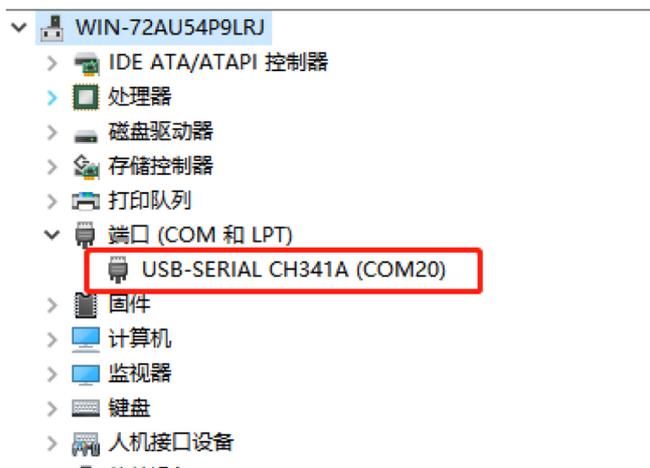
Please contact us if needed. This software allows you to conveniently read the sensor parameters from your computer and modify the device ID and address if required.

• 3.4.1. Connecting the Sensor to the Computer

After installing the driver, connect the sensor to the computer using a USB-to-RS485 converter, and supply power to the device.

Once properly connected, you should be able to see the correct COM port on your computer

(you can check it under “Device Manager” → “Ports (COM & LPT)”).



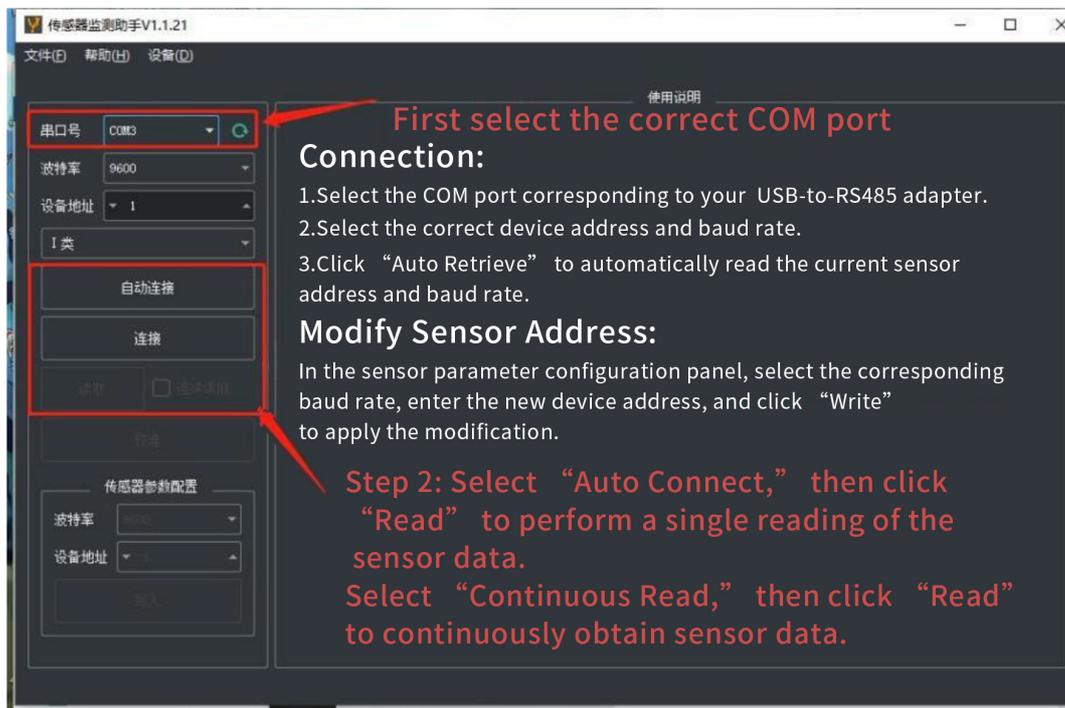
As shown in the figure, your current COM port is COM20.

Please remember this port number, as you will need to enter it in the Sensor Monitoring Software.

If the COM port does not appear in Device Manager, it means that the USB-to-RS485 converter is not properly connected, or the driver has not been correctly installed. Please contact technical support for assistance.

• 3.4.2 Using the Sensor Monitoring Software

As shown in the configuration interface, first obtain the COM port number according to the method described in Section 3.4.1, then select the correct port. Next, click the button to automatically retrieve the current baud rate and address, which allows the software to automatically detect all devices and baud rates on the current RS485 bus.



When using the automatic retrieval function, ensure that there is only one sensor on the RS485 bus. After clicking “Connect Device,” real-time sensor data can be obtained immediately.

When the device is already connected, select the desired baud rate and address in the communication settings to complete the configuration. After modifying these settings, please restart the device. Then click “Automatically retrieve current baud rate and address,” and you will see that the device’s address and baud rate have been successfully updated to the values you set.

IV. Communication Protocol

- 4.1 Basic Communication Parameters

Parameter	Content
Encoding	8-bit binary
Data Bits	8 bits
Parity	None
Stop Bit	1 bit
Error Check	CRC-16 (Modbus)
Baud Rate	Factory default 9600 bps; supports 2400 / 4800 / 19200

- 4.2 Communication Protocol Examples and Description

4.2.1 Data Register Addresses

Register Address	PLC Mapping Address	Description	Operation
0000H	40001	Nitrogen content (mg/kg)	Read Only
0001H	40002	Phosphorus content (mg/kg)	Read Only
0002H	40003	Potassium content (mg/kg)	Write Only
003EH	40063	Modify device address register	Write Only

- 4.2.2 Data Frame Format Definition

The Modbus-RTU communication format is defined as follows:

Request Frame :

Address	Function Code	Starting Address	Number of Registers	CRC
1 Byte	1 Byte	2 Bytes	2 Bytes	2 Bytes

Response Frame :

Address Code	Function Code	Data Length	Returned Data Content	Checksum
1 byte	1 byte	1 byte	N bytes	2 bytes

The address code, also known as the device address, is the unique identifier of the device on the communication network (factory default is 01).

This device supports Function Code 03 and 06.

Note: Data is transmitted in high byte first, low byte after.

The data returned by the device is in hexadecimal and must be converted to decimal before interpretation.

• 4.2.3 Read Soil N-P-K Values from Device Address 01

Request Frame: 01 03 00 00 00 03 05 CB

Response Frame: 01 03 06 00 23 00 2A 00 35 05 6D

According to the above returned data, the soil N-P-K values are:

Soil Nitrogen Content: 0023H (hex) = 35 (decimal) = 35 mg/kg

Soil Phosphorus Content: 002AH (hex) = 42 (decimal) = 42 mg/kg

Soil Potassium Content: 0035H (hex) = 53 (decimal) = 53 mg/kg

• 4.2.4 Read Soil Nitrogen Value from Device Address 01

Request Frame: 01 03 00 00 00 01 84 0A

Response Frame: 01 03 02 00 27 F8 5E

According to the returned data, the soil nitrogen value is:

0027H (hex) = 39 (decimal) = 39 mg/kg

• 4.2.5 Read Soil Phosphorus Value from Device Address 01

Request Frame: 01 03 00 01 00 01 D5 CA

Response Frame: 01 03 02 00 2E 38 58

002EH (hex) = 46 (decimal) = 46 mg/kg

- **4.2.6 Reading Soil Potassium Value from Device Address 01**

Request Frame: 01 03 00 02 00 01 25 CA

Response Frame: 01 03 02 00 3B F9 97

The returned soil potassium value in this example is:

003BH (hex) = 59 (decimal) = 59 mg/kg

- **4.2.7 Changing Device Address from 01 to 02**

Request Frame: 01 06 00 3E 00 02 69 C7

Response Frame: 01 06 00 3E 00 02 69 C7

V. After-Sales Service

Common Issues

Problem Description	Possible Causes	Solutions
Sensor Assistant connection failed	<ol style="list-style-type: none"> 1. Wrong COM port selected 2. Multiple devices on the bus 3. RS485 bus disconnected 4. Insufficient power supply 5. Driver not installed 6. Device damaged 	<ol style="list-style-type: none"> 1. Wrong COM port selected 2. Connect only one device 3. Check wiring for looseness 4. Verify power is DC 9–24V 5. Contact us for driver installation support 6. Contact us for after-sales service
Missing Accessories	Omission during shipping	Contact us for replacement shipment
Data becomes inaccurate after some time	<ol style="list-style-type: none"> 1. Module blockage 2. Module damaged 3. Device water ingress 	<ol style="list-style-type: none"> 1. Clean surface debris regularly to avoid blockage 2. Contact us for after-sales service 3. Contact us for after-sales service

VI. Revision Record

Revision Date	Version	Revision Notes
2023. 9	V1. 12	Version revised

VII. Contact Information

Company Name:

Accusensor Industrial Co., Ltd.

Headquarters Address:

No. 9, Chenggong Street, Tucheng Industrial Park,
Tucheng District, New Taipei City 236043, Taiwan (R.O.C.)

Telephone:

+886-2-2268-3268

Website:

<https://accusensor.com.tw/zh-TW>