485 Soil Temperature, Moisture, and Electrical Conductivity 3-in-1 Sensorr
User Manual

Applicable Product Model: AT-So-THEC

Thank you for purchasing our product.

Please read this manual carefully and operate strictly in accordance with the instructions. After reading,

please keep the manual properly for future reference.

Table of Contents

User Notice

1 . For a better user experience, please read this manual carefully
   before installation, operation, and maintenance.
   Please keep the manual properly for future reference
   and assistance.

2 . Please follow the operation procedures and precautions
   described in this manual. If you encounter any questions
   during installation or use, please contact us.

3 . Please carefully open the package upon receiving the device
   and check whether the equipment and accessories were damaged
   during transportation.
   If any damage is found, please contact us immediately and keep
   the original packaging for return and handling.

4 . Our company is not responsible for any damage or malfunction
   caused by improper or incorrect use.

5 . The contents of this manual may be updated or modified as
   the product continues to improve.
   Our company reserves the right to make changes without
   prior notice and shall not bear any consequences arising therefrom.

I. Product Overview

• 1.1 Introduction

This product is used for measuring soil temperature, moisture, and electrical conductivity (EC). Based on the principle that the moisture content in soil and the dielectric constant of soil show a good linear relationship, the sensor can directly and stably reflect the true volumetric water content of different types of soil. It measures the volumetric percentage of soil water, which complies with the internationally recognized method of measuring soil moisture.
The "soil moisture" or "soil water content" commonly referred to here is absolute volumetric water content.

• 1.2 Application Range

Widely used in scientific experiments, water-saving irrigation, greenhouse cultivation, flower and vegetable production, grassland improvement, soil rapid testing, plant cultivation, sewage treatment, grain storage, and various granular material temperature, moisture, and electrical conductivity measurements.

• 1.3 Precautions

▶ Users must not disassemble the device to avoid damage;
the sensor must be powered off before installation.

▶ Keep the sensor housing and communication cables away from high-voltage power sources and heat sources.

▶ Ensure the power supply provided to the sensor is stable. Use a regulated and reliable power source. Avoid unstable voltage, high-frequency noise, or mechanical vibration, which may cause inaccurate readings.

▶ Prevent chemical reagents, oil, and dust from entering the sensor. Avoid condensation and long-term use in extreme temperature environments. Prevent rapid temperature shock.

1.4 Product Features

▶ Equipped with a high-precision German original sensor for comparison with the actual soil oven-drying method; features high accuracy, fast response, and stable output.

▶ Can be inserted into soil for long-term use;
resistant to long-term electrolysis and corrosion.

▶ Epoxy-vacuum encapsulated, fully sealed, completely waterproof.

▶ Easy to use and simple to install.

1.5 Product Dimensions
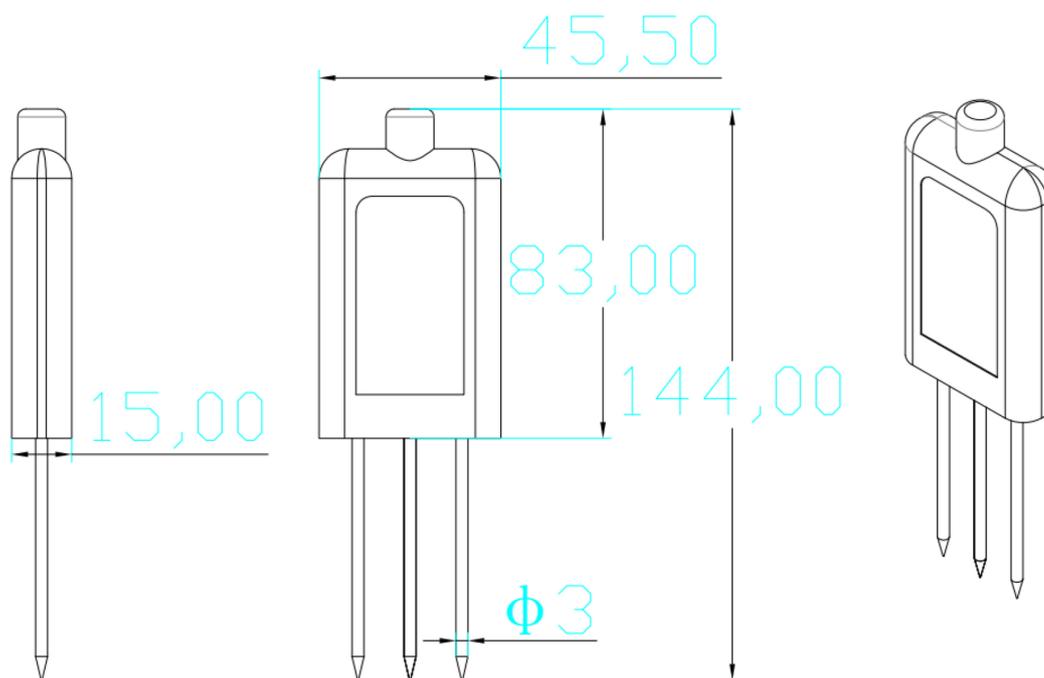
This product uses three-pronged probe needles to measure soil moisture and electrical conductivity. Each probe needle has a diameter of approximately 3 mm. The overall product length is about 144 mm, thickness about 15 mm, and width about 45.5 mm.

II. Product Parameters

- ## 2.1 Technical Parameters

Parameter Name	Parameter Value
DC Power Supply	12–24V DC
Output Method	RS485 interface, standard Modbus-RTU protocol
Device Address	Default 1
Baud Rate	Default 9600
Average Power Consumption	150mW
Measurement Range	Temperature: −40°C to 80°C Moisture: 0–100% Electrical Conductivity: 0–10,000 μS/cm
Accuracy	Temperature: ±0.5°C Moisture: ±3% (0–53%), ±5% (53–100%) Electrical Conductivity: ±3%
Resolution	Temperature: 0.1°C Moisture: 0.1% Electrical Conductivity: 1 μS/cm
Response Time	＜1S
Protection Level	IP68

2.2 Installation Methods and Precautions

2.2.1 Rapid Measurement Method

Choose an appropriate measurement location, avoid stones, and ensure the probe needles will not strike hard objects. Insert the probe to the depth required by the measurement method, ensuring the soil beneath remains in its original compact state. Insert the probe vertically into the soil and avoid shaking it left or right. For a single measurement point within a small area, it is recommended to take multiple readings and use the average value.

2.2.2 Buried Measurement Method

Dig a vertical hole approximately 20 cm in diameter.
Insert the sensor probe horizontally at the desired depth, then refill and compact the soil. After allowing the soil to stabilize for a period of time, continuous measurements may be taken for several days or even long-term monitoring and recording.

2.2.3 Precautions

▶ When performing measurements, ensure the entire sensor or probe needles are completely inserted into the medium. If the soil is frozen, moisture readings may be inaccurate and require user compensation.

▶ Avoid exposing the sensor to strong sunlight, as direct radiation may cause the sensor temperature to rise excessively. Be cautious of lightning when used outdoors.

▶ Do not forcibly bend the probe needles, pull the sensor cable, or drop or strike the sensor violently.

▶ With IP68 protection, the sensor can be fully submerged in water.

▶ Because electromagnetic radiation exists in the air, long-term suspended operation in the air is not recommended.

▶ When the soil is frozen, moisture readings may be inaccurate, requiring user compensation.

III. Instructions for Use

- ## 3.1 Unboxing Inspection

Remove the sensor from the package and check whether the sensor's appearance is intact and whether the lead wires are undamaged and of correct quantity. The default factory-supplied cable length is 1.0 meter. Customers may extend the cable length if needed.

- ## 3.2 Reading and Modifying the Device Address (If Required)

The factory default device address is "1", and the default baud rate is "9600". Our company can modify the device address and baud rate before shipment based on customer requirements. Users may also modify the device address and baud rate through our supporting software (see Section 3.4 for modification details). The configurable device address range is 1–247.

- ## 3.3 Interface Description

The sensor supports 9–24V DC power input.
When connecting the RS485 communication wires, pay attention that the A/B lines must not be reversed. Multiple devices on the same bus must not have conflicting addresses.
The corresponding wire colors are as follows:

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

Important Note: Please ensure correct wiring. Incorrect wiring may cause sensor damage. In some batches, the 485 communication cable may not include a yellow wire; in such cases, a gray wire is used as the replacement for the yellow (A) wire.

- ## 3.4. Configuration Software Installation and Use

We provide the supporting "Sensor Assistant" software.
Please contact us to obtain it. It can conveniently read the sensor parameters through the computer and also modify the device ID and address of the sensor.

- ## 3.4.1. Connecting the Sensor to the Computer

After installing the driver, connect the sensor to the computer through a USB–to–RS485 converter. After providing power, you should be able to see the correct COM port in your computer
(you can check the COM port in "Device Manager" → "Ports (COM & LPT)" as shown below).
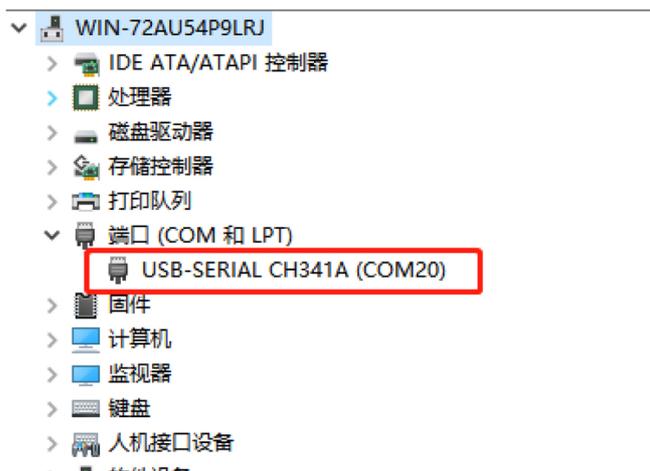
As shown in the figure above, your current COM port is COM20.
Please remember this COM port number—you will need to enter it into the sensor monitoring software.
If no COM port is found in Device Manager, it means that the USB-to-RS485 adapter is not connected or the driver has not been installed correctly.
Please contact technical support for assistance.

- ## 3.4.2. Using the Sensor Monitoring Software

The configuration interface is shown in the figure.

First, obtain the COM port according to the method described in Section 3.4.1 and select the correct port. Then click "Automatically retrieve current baud rate and address" to automatically detect all devices and baud rates on the current 485 bus.

Please note that when using the software's automatic detection function, only one sensor should be connected on the 485 bus.

After that, click "Connect Device" to obtain real-time sensor data.
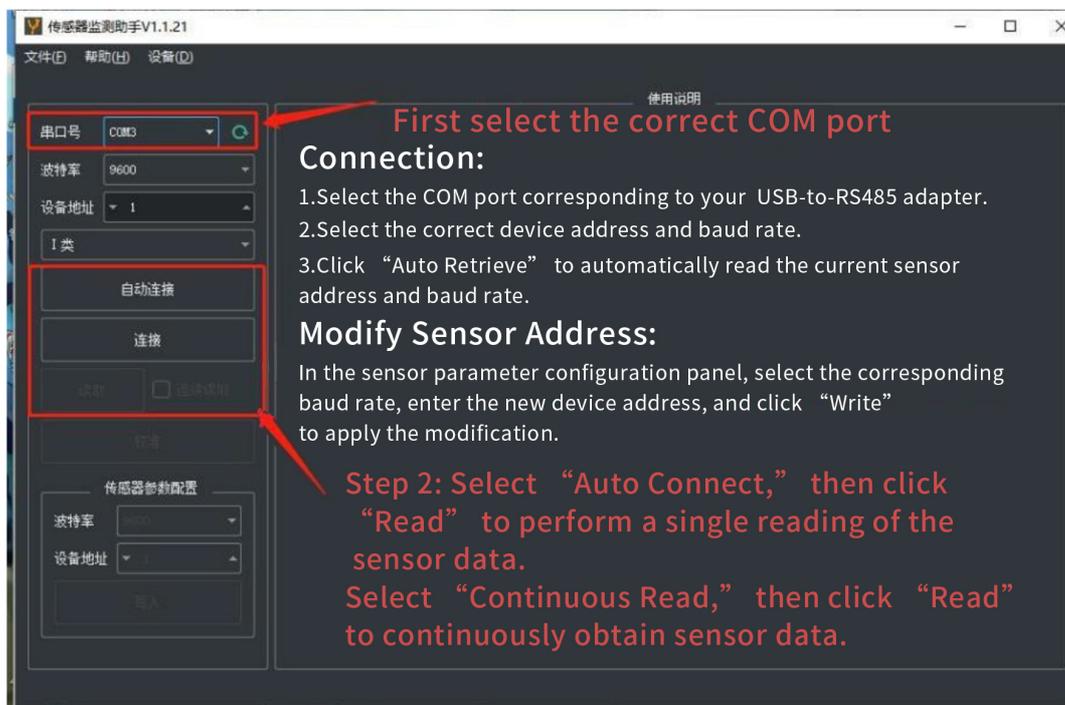
When the device is already connected, simply select the desired baud rate and address in the Communication Settings to complete the configuration. Please note that after changing these settings, you must restart the device.

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 new values you selected.

IV. Communication Protocol

4.1. Basic Communication Parameters

Parameter	Description
Encoding	8-bit binary
Data Bits	8 bits
Parity	None
Stop Bit	1 bit
Error Check	CRC–16 (Modbus)
Baud Rate	Default 9600 bps, supports 2400 / 4800 / 19200

4.2. Communication Protocol Examples and Explanation

4.2.1. Data Register Addresses

Register Address	PLC Address	Content	Operation
0004H	40005	Soil moisture (unit: 0.1%)	Read-only
0005H	40006	Soil temperature (unit: 0.1°C)	Read-only
0006H	40007	Soil electrical conductivity (unit: 1 µS/cm)	Read-only
003EH	40063	Modify address register	Write-only

4.2.2. Data Frame Format Definition

Using the Modbus-RTU communication standard, the data frame format is defined as follows:

Query Frame:

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

Response Frame:

Address	Function Code	Data Length	Returned Data	CRC Check
1 byte	1 byte	1 byte	N bytes	2 bytes

The address code refers to the device address and is the unique identifier of the device on the communication network (factory default: 01).

This device supports function codes 03 and 06.

Note: The high byte comes first, followed by the low byte.

The returned data must be converted from hexadecimal to decimal before use.

- ## 4.2.3. Reading Soil Temperature and Moisture Values from Device Address 01

    Query Frame: 01 03 00 04 00 02 85 CA

    Response Frame: 01 03 04 02 92 00 FB 1B E5

    According to the returned example:

    Moisture: 0292H (hexadecimal) = 658 (decimal) / 10 = 65.8%

    Temperature: 00FBH (hexadecimal) = 251 (decimal) / 10 = 25.1°C

- ## 4.2.4. Reading Electrical Conductivity (EC) from Device Address 01

    Query Frame: 01 03 00 06 00 01 64 0B

    Response Frame: 01 03 02 00 9B F9 EF

    The electrical conductivity value returned in the above example is:
    009BH (hexadecimal) = 155 (decimal) = 155 µS/cm

- ## 4.2.5. Changing Device Address from 01 to 02

    Query 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

roblem Description	Possible Cause	Solution
Sensor Assistant fails to connect	1. Incorrect COM port selected 2. Multiple devices on the bus 3. RS485 bus disconnected 4. Insufficient power supply 5. Driver not installed 6. Device malfunction	1. Select the correct COM port 2. Connect only one device 3. Check whether wiring is secure 4. Check if power supply is DC9–24V 5. Contact us for driver installation assistance 6. Contact us for after-sales service
Missing accessories	Leakage	Contact us for replacement
Data becomes inaccurate after a period of time	1. Sensor probe fouled 2. Sensor module damaged 3. Device water ingress	1. Clean the probe surface regularly as needed to avoid fouling 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 updated

VII. Contact Information

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