OHTS1022 Soil Moisture and Temperature Sensor

1 Product Overview

The OHTS1022 is a composite sensor integrating soil volumetric water content (VWC) and soil temperature measurements. Moisture measurement is based on the Frequency Domain Reflectometry (FDR) principle, achieving high-precision volumetric water content measurement by detecting changes in soil dielectric constant. Temperature measurement utilizes a Class A PT1000 precision platinum resistance temperature detector (RTD), integrating signal conditioning, temperature compensation, and data processing modules. It is designed for long-term buried soil monitoring applications.

The sensor features an integrated sealed structural design with IP68 ingress protection rating, enabling direct burial in soil for long-term operation. It supports multiple standard industrial output interfaces, including voltage signals (0 ~ 2V/0 ~ 5V/0 ~ 10V), current signals (4 ~ 20mA), and RS485 digital interface (Modbus-RTU protocol), ensuring compatibility with various data acquisition terminals and PLC systems.

2 Applications

- Soil moisture monitoring for water-saving agricultural irrigation systems
- Soil environmental parameter acquisition for meteorological observation stations
- Long-term ecological environment monitoring networks
- Crop root zone environment regulation in greenhouses
- Soil water management for grasslands and pastures
- Field soil rapid measurement and surveying
- Substrate monitoring for plant cultivation experiments
- Soil science research and experimental observation

3 Features

- **Integrated Design**: Combined soil moisture and temperature sensing elements in a unified package, reducing field installation complexity
- **Measurement Principles**: FDR (Frequency Domain Reflectometry) for volumetric water content; PT1000 platinum resistance for temperature
- **Structural Characteristics**: 316L stainless steel probes, ABS engineering plastic housing, epoxy resin sealing
- **Protection Rating**: IP68, suitable for long-term burial in soil or immersion in water
- **Electrical Interfaces**: Supports 0~2V/0~5V/0~10V voltage output, 4~20mA current output, and RS485 digital communication
- **Response Characteristics**: Response time <1s, settling time <1s
- **Interchangeability**: Standardized design supporting probe interchangeability

4 Technical Specifications

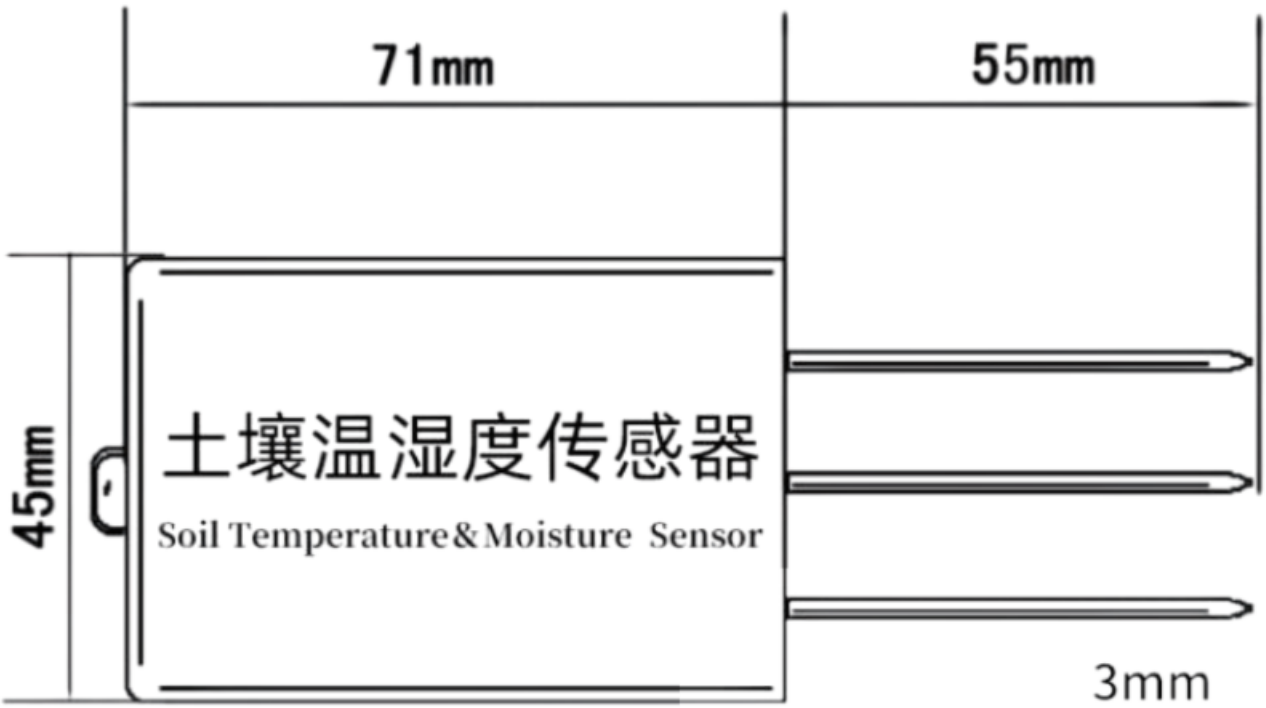
Parameter	Specification	Remarks
Measured Parameters	Soil Volumetric Water Content; Soil Temperature	-
Measurement Units	m^3/m^3 (%); °C	-
Moisture Range	$0 \sim 100\%$ (m^3/m^3)	Optional 30%, 50% range or custom ranges available
Temperature Range	$-30 \sim 70$°C	Customizable to $0 \sim 50$°C or other ranges
Moisture Accuracy	$\pm 2\%$ (m^3/m^3)	Within $0 \sim 50\%$ (m^3/m^3) range
Temperature Accuracy	± 0.2°C	-
Operating Temperature Range	$-30 \sim 70$°C	-
Output Signal Type A	$0 \sim 2$V / $0 \sim 5$V / $0 \sim 10$V	Select one of three
Output Signal Type B	$4 \sim 20$mA	Current loop output
Output Signal Type C	RS485	Standard Modbus-RTU protocol, default address 01
Supply Voltage (Voltage/RS485 Output)	$5 \sim 24$V DC	-
Supply Voltage (Current/High Voltage Output)	$12 \sim 24$V DC	Applicable for $0 \sim 5$V, $0 \sim 10$V, $4 \sim 20$mA
Settling Time	< 1s	-
Response Time	< 1s	-
Measurement Zone	Cylinder with diameter 7cm and height 7cm	Centered on the central probe

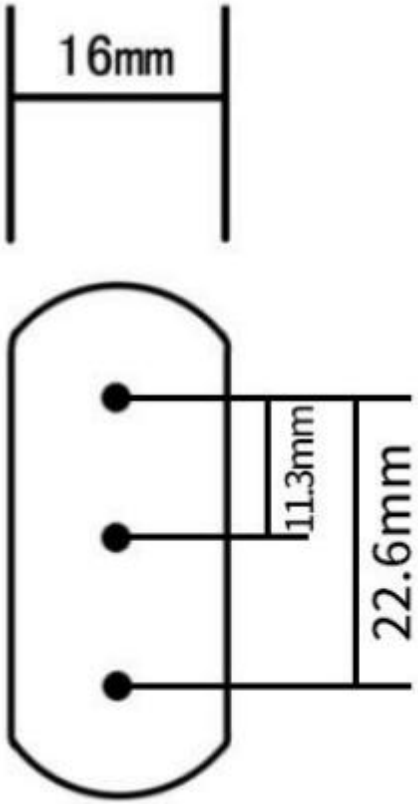
4.1 Current Signal Impedance Requirements

Supply Voltage	9V	12V	20V	24V
Maximum Impedance	125Ω	250Ω	500Ω	$>$ 500Ω

5 Physical Specifications

Parameter	Specification
Probe Length	55mm
Probe Diameter	ϕ3mm
Probe Material	316L Stainless Steel
Housing Material	ABS Engineering Plastic
Sealing Material	Epoxy Resin
Protection Rating	IP68
Cable Length	Standard 2m (Customizable, maximum 1200m)





6 Installation

The sensor is designed for buried installation. The following steps should be observed during installation:

1. **Site Selection and Drilling**: Select a representative soil area and use appropriate tools to drill or excavate. The hole diameter should exceed the sensor probe diameter to avoid forced insertion that may damage the probes.
2. **Insertion Depth**: Insert the sensor probes vertically or horizontally into the soil, ensuring the probes are fully buried in the target measurement layer with full contact between probes and soil to minimize contact errors.
3. **Backfilling**: For drilled installations, backfill soil in layers with moderate compaction to ensure soil density around the probe matches the native state.

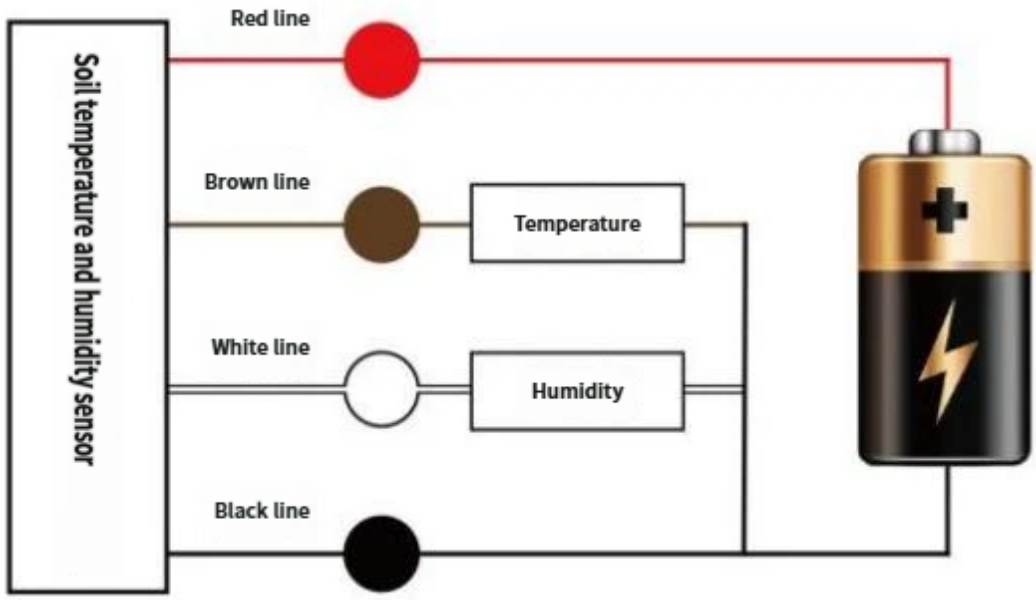
4. **Cable Protection**: The cable extension should be protected by conduit or laid in trenches to avoid direct pulling that may compromise the seal.

Note: Strictly prohibit direct insertion of probes into stones, hard clods, or frozen soil to prevent probe bending or damage. When removing the sensor from soil, grip the sensor body; never pull the cable directly.

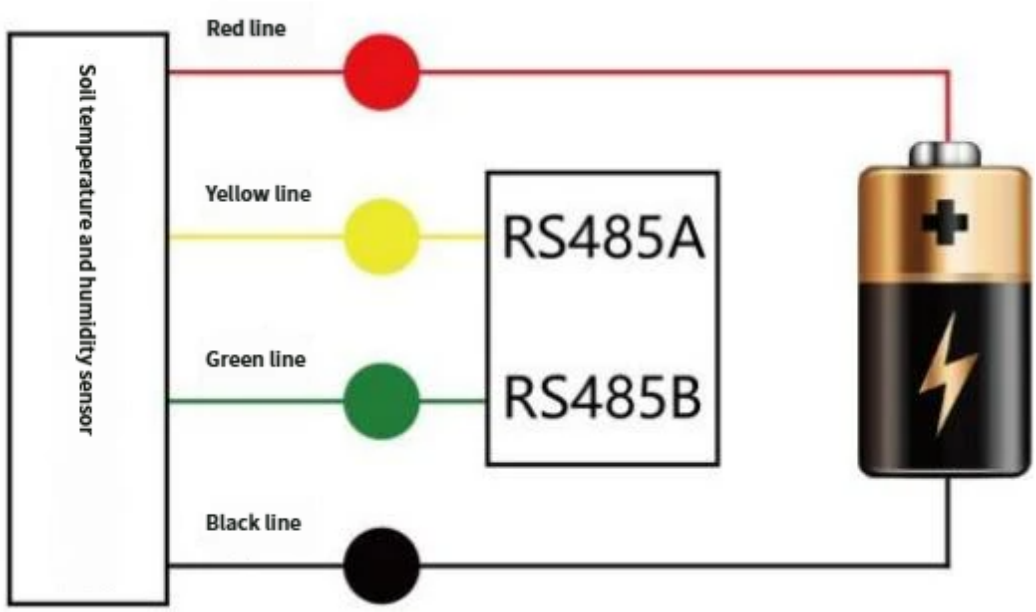
7 Wiring Definition

The sensor provides two wiring configurations corresponding to analog signal output and digital communication interfaces.

Analog Signal Output Wiring (Voltage/4~20mA)



RS485 Digital Communication Wiring



8 Communication Protocol and Data Conversion

8.1 Analog Signal Data Conversion

The conversion relationships between sensor output and soil volumetric water content (θ_v) and temperature (T) are as follows:

Voltage Signal Conversion Formulas:

For $0 \sim 2\text{V}$ output:

$$\theta_v = 50 \times V$$

$$T = 50 \times V - 30$$

For $0 \sim 5\text{V}$ output:

$$\theta_v = 20 \times V$$

$$T = 20 \times V - 30$$

For $0 \sim 10\text{V}$ output:

$$\theta_v = 10 \times V$$

$$T = 10 \times V - 30$$

Current Signal Conversion Formula:

For $4 \sim 20\text{mA}$ output:

$$\theta_v = 6.25 \times A - 25$$

$$T = 6.25 \times A - 55$$

Where:

- V: Voltage value acquired by the data acquisition system, unit V
- A: Current value acquired by the data acquisition system, unit mA
- θ_v: Soil volumetric water content, unit $\%$ (m^3/m^3)
- T: Soil temperature, unit $^\circ\text{C}$

8.2 RS485 Communication Protocol (Modbus-RTU)

Communication Parameters:

- Baud Rate: 9600bps
- Data Bits: 8 bits
- Stop Bits: 1 bit
- Parity: None
- Default Device Address: 0x01

Modifying Device Address:

Use Function Code 0x06 to modify the device address. The target register address is 0x0030.

Example: Changing address from 0x01 to 0x02

Original Address	Function Code	Start Register High	Start Register Low	Target Address High	Target Address Low	CRC16 Low	CRC16 High
0x01	0x06	0x00	0x30	0x00	0x02	0x08	0x04

If the sensor receives correctly, it returns the data via the same path.

Note: If the original address is forgotten, broadcast address 0xFE can be used instead. When using 0xFE, the host can only connect to one slave device, and the returned address remains the original address, which can serve as an address query method.

Querying Measurement Data:

Use Function Code 0x03 to read soil temperature and moisture data. Start register address is 0x0000, reading 2 registers.

Host Request Frame:

Address	Function Code	Start Register Address High	Start Register Address Low	Register Length High	Register Length Low	CRC16 Low	CRC16 High
0x01	0x03	0x00	0x00	0x00	0x02	0xC4	0x0B

Slave Response Frame:

Address	Function Code	Data Length	Register 0 Data High	Register 0 Data Low	Register 1 Data High	Register 1 Data Low	CRC16 Low	CRC16 High
0x01	0x03	0x04	0xFF	0xDD	0x01	0x64	0x5A	0x66

Data Parsing:

- Register 0 (Soil Temperature): 0xFFDD (signed 16-bit two's complement) corresponds to $-3.5^\circ\mathrm{C}$ (Conversion: Value $\times 0.1^\circ\mathrm{C}$)
- Register 1 (Soil Moisture): 0x0164 corresponds to 35.6% ($\mathrm{m}^3/\mathrm{m}^3$) (Conversion: Value $\times 0.1\%$)

9 Precautions

Warnings:

- Incorrect wiring sequence may cause damage to the sensor and connected equipment
- Input voltage exceeding maximum power specifications will cause permanent equipment damage

Cautions:

- Please read this technical documentation completely before use
- Do not insert probes into stones or hard soil clods to avoid probe damage
- When removing the sensor from soil, never pull the cable directly; grip the sensor body instead
- Ensure full contact between the sensor probe and soil/substrate to minimize operational errors and improve measurement accuracy

10 After-Sales Guarantee & Support

This product carries a one-year warranty from the date of shipment. During the warranty period, the company provides free repair or replacement for failures caused by sensor quality issues (excluding human damage). After the warranty period expires, the company provides paid repair services, charging only for cost of materials and labor.

11 Manufacturer Information

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12 Revision History

Version	Revision Date	Revision Content	Prepared By
V1.0	-	Initial Release	-