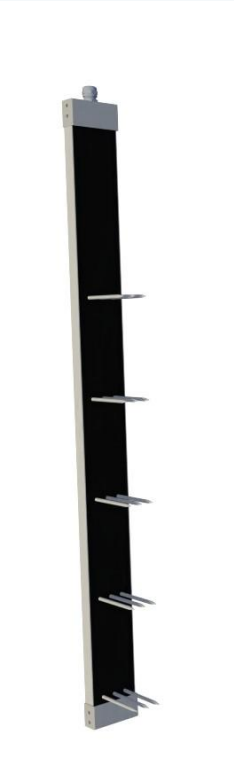
Product Introduction



NBL-S-TM-MD The multi-layer probe-type soil temperature and moisture sensor offers stable performance and high sensitivity. It is an important tool for observing and studying the occurrence, evolution and reclamation of saline soils, as well as soil water-salt dynamics. It can simultaneously measure soil temperature, moisture and salinity, and is suitable for soil moisture monitoring, scientific experiments, agricultural irrigation, greenhouses, flowers and vegetables, grassland and pasture, rapid soil testing, plant cultivation, and other applications.

An appropriate moisture level is essential for plant growth. Excessive or insufficient water can adversely affect crop growth. The moisture sensor measures the volumetric percentage of water in soil, which is a commonly used method for soil moisture measurement. In soil analysis, salinity is an important comprehensive indicator, and measuring soil electrical conductivity can directly reflect the level of mixed soluble salts.

Key Features

1. The number of measurement layers and the spacing between layers can be flexibly adjusted.
2. Integrates three parameters: soil temperature, soil moisture and electrical conductivity.
3. The electrodes are made of specially treated alloy material, providing strong resistance to mechanical impact and reducing the risk of damage.
4. Fully sealed and resistant to acid and alkali corrosion. The sensor can be buried in soil or directly immersed in water for long-term dynamic monitoring.
5. High accuracy, fast response and good interchangeability. The probe-insertion design provides precise measurement and reliable performance.
6. Complete protection circuitry.

NBL-S-TM-MD Technical Specifications

Soil Temperature	Range	-40 to 80 °C
	Resolution	0.01 °C
	Accuracy	±0.5 °C
Soil Volumetric Water Content (soil moisture)	Range	0-100%
	Resolution	0.01%
	Accuracy	±5%
Soil Salinity	Range	0-5500 mg/L
	Resolution	1 mg/L
	Accuracy	±10%
Power Supply	DC 12-24 V	
Static Power Consumption	20 mA @ 12 V DC	
Protection Rating	IP68	
Operating Environment	-40 to 85 °C	
Sealing Material	Black epoxy resin	

Wiring

1. When used with a weather station supplied by our company, connect the sensor to the corresponding port on the weather station using the sensor cable.

2. When the transmitter is purchased separately, use the following wire definitions:

Wire Color	Communication-Type Output
Red	Power +
Black	Power Ground
Yellow	A+ / TX
Blue	B- / RX

Installation and Measurement

Because the electrodes directly determine the conductivity of soluble salt ions in the soil, the soil volumetric water content should be above approximately 20% so that the soluble ions can properly reflect the soil electrical conductivity. For long-term monitoring, readings taken after irrigation or rainfall are generally closer to the actual condition. For rapid testing, water may first be applied to the test location; measure after the water has fully infiltrated.

1. Rapid measurement: Select a suitable location and avoid stones or other hard objects that could contact the electrodes. Remove the surface soil to the required measurement depth while maintaining the original compaction of the soil below. Hold the sensor body firmly and insert it vertically into the soil. Do not rock it forward, backward or sideways during insertion. Ensure close contact with the soil. At one measurement point, it is recommended to take several readings within a small area and calculate the average.

2. Buried measurement: According to the required depth, dig a vertical pit with a diameter greater than 20 cm and to the required depth. Insert the sensor steel probes horizontally into the pit wall at the designated depths. Backfill and compact the soil to ensure close contact between the electrodes and soil. After stabilization, measurements can be recorded continuously for days, months or longer. For hard ground, drill holes first (the hole diameter should be smaller than the probe diameter), insert the probes, compact the soil, and then measure. Protect the sensor from severe vibration or impact and never strike it with a hard object. Because the sensor has a black enclosure, strong sunlight may cause the sensor temperature to rise rapidly (above 50 °C). To avoid affecting temperature measurement, provide shading and protection during field or outdoor use.

MODBUS Communication Protocol

Communication parameters: Baud rate 9600, 8 data bits, no parity. The interval between two communication transactions should be at least 1000 ms.

[1] Write Device Address

Send: 00 10 Address CRC16 (5 bytes)
Response: 00 10 CRC16 (4 bytes)

Notes:

1. The address byte in the read/write address command must be 00.

2. Address is 1 byte, with a range of 0-255.

Example send: 00 10 01 BD C0
Example response: 00 10 00 7C

[2] Read Device Address

Send: 00 20 CRC16 (4 bytes)
Response: 00 20 Address CRC16 (5 bytes)

Note: Address is 1 byte, with a range of 0-255.

Example send: 00 20 00 68
Example response: 00 20 01 A9 C0

[3] Read Data

Example: 4-layer sensor, device address 01

Send: 01 03 00 00 00 0C CRC16
Response: 01 03 18 01 23 01 46 02 32 01 20 01 41 02 40 01 21 01 45 02 36 01 1D 01 3F 02 2A CRC16

Layer 1: 01 23 is the temperature data, corresponding to 29.1 °C; 01 46 is the moisture data, corresponding to 32.6%; 02 32 is the salinity data, corresponding to 562 mg/L.

Layer 2: 01 20 is the temperature data, corresponding to 28.8 °C; 01 41 is the moisture data, corresponding to 32.1%; 02 40 is the salinity data, corresponding to 576 mg/L.

Layer 3: 01 21 is the temperature data, corresponding to 28.9 °C; 01 45 is the moisture data, corresponding to 32.5%; 02 36 is the salinity data, corresponding to 566 mg/L.

Layer 4: 01 1D is the temperature data, corresponding to 28.5 °C; 01 3F is the moisture data, corresponding to 31.9%; 02 2A is the salinity data, corresponding to 554 mg/L.

Appendix: CRC16 Checksum Calculation

1. Preset a 16-bit register to hexadecimal FFFF (all bits set to 1). This register is called the CRC register.

2. XOR the first 8-bit data byte (the first byte of the communication frame) with the lower 8 bits of the 16-bit CRC register, and store the result in the CRC register.

3. Shift the CRC register one bit to the right (toward the least significant bit), fill the most significant bit with 0, and check the bit shifted out.

4. If the shifted-out bit is 0, repeat Step 3. If the shifted-out bit is 1, XOR the CRC register with polynomial A001 (1010 0000 0000 0001).

5. Repeat Steps 3 and 4 until 8 right shifts have been completed, so that the entire 8-bit data byte is processed.

6. Repeat Steps 2 to 5 for the next byte of the communication frame.

7. After all bytes in the communication frame have been processed, swap the high and low bytes of the resulting 16-bit CRC register.

8. The final CRC register value is the CRC16 checksum. Note: the CRC bytes are transmitted low byte first, high byte second.

Precautions

1. Check that the packaging is intact and confirm that the product model matches the ordered configuration.
2. Never wire the sensor while power is applied. Power on only after wiring has been completed and checked for correctness.
3. Sensor cable length can affect the output signal. Do not modify the factory-soldered components or wires without authorization. If changes are required, contact the manufacturer.
4. The sensor is a precision device. Do not disassemble it or touch the sensor surface with sharp objects or corrosive liquids, as this may damage the product.
5. Keep the calibration/inspection certificate and product conformity certificate. Return them together with the product if repair is required.

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