YANTAI
研泰进出口
Yantai Import and Export

HCT-4 Conduit Soil Monitor

Manual

Intelligent sensors and solution Related to Sun, Air, Soil and Water！

Address: Room 102, Floor 1, Block C, Building 1, No.19, Hexie Street, Handan Economic Development Zone, Hebei Province, China.
Website: www.yantaisensor.com

Table of contents

I. Product Description

Product Description:

The tubular soil monitor developed by our company is an intelligent device meticulously designed for the precise monitoring of soil moisture.

Leveraging advanced sensing technology, stable data transmission solutions, and a long-lasting power supply design, it effectively meets soil monitoring needs across diverse environments—such as farmlands, orchards, greenhouses, and woodlands—providing reliable data support for agricultural production, vegetation cultivation, and environmental research.

The monitor transmits data to an IoT platform via 4G wireless networks, allowing users to view information in real-time on computers and mobile phones; this convenient and efficient approach fully satisfies a wide range of operational requirements.

Product selection:

Model	Output Method
HCT-4/485	RS485 output, Modbus RTU communication protocol
HCT-4/G	4G (default transmission to proprietary cloud platform via 4G; supports API integration; customization available for third-party cloud platform integration)

II. Functional Features

1. Supports multi-device networking and simultaneous data acquisition from multiple sites, enabling grid-based management of regional soil moisture. The sensors are compatible with various soil types—such as loam, sandy soil, and clay—and adapt well to complex soil environments.

2. Supports simultaneous measurement of soil temperature and humidity at standard depths of 10 cm, 20 cm, 30 cm, and 40 cm. Customization is available.

3. Enables real-time data monitoring and automatic upload to a designated cloud platform, allowing users to view data remotely via PCs, smartphones, and other devices. Additionally, the standard model features Bluetooth connectivity for convenient on-site configuration and data viewing.

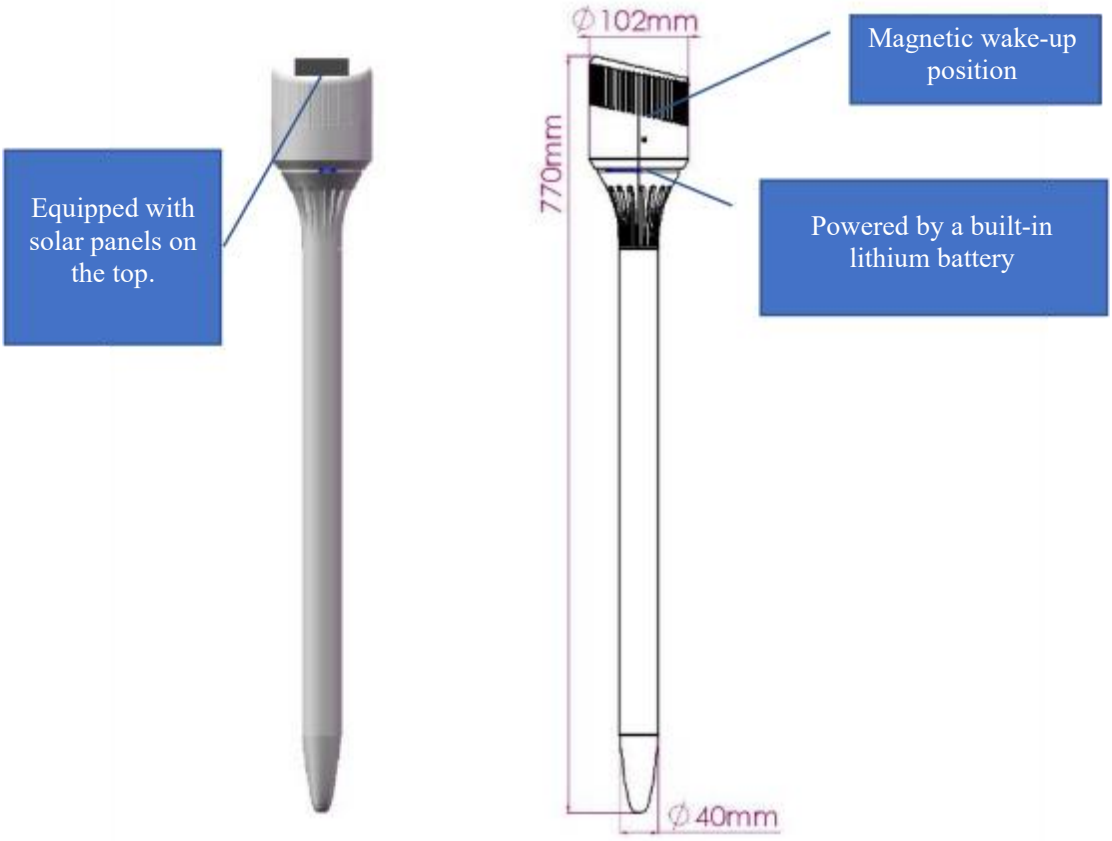
4. Features a data resume function. In remote areas with poor connectivity, the device automatically caches data during signal interruptions and resumes transmission immediately upon network recovery, ensuring no data loss.

5. Utilizes a low-power design and is equipped with a solar power module. On a full charge, the device operates for over 60 days even during continuous overcast or rainy weather, effectively reducing maintenance costs.

6. Offers data transmission options for both domestic and international markets to facilitate use by overseas customers. (Please notify sales staff in advance if the international version is required.)

7. Expandable customization options include: GPS positioning for enhanced location accuracy; and monitoring capabilities for parameters such as ambient temperature, ambient humidity, atmospheric pressure, and dew point temperature.

III. Dimensions and Structure



IV. Technical Specifications

1. Soil moisture parameters

Measurement range: 0～ 100% VOL (Volume moisture content)

Measurement accuracy: Error ≤ 3%Vol within the range of 0-50% Vol

Resolution: 0.1%VOL

2. Soil temperature parameters

Measurement range: -20℃～60℃

Measurement accuracy: ±0.5℃

Resolution: 0.01℃

3. General Parameters

Item	Parameter
Sampling interval	Adjustable from 10 minutes to 24 hours (customizable) (Default 30 minutes)
Measurement principle	FDR frequency domain reflection method
Measurement area	90% of the impact is within a 10cm diameter area surrounding the sensor. Cylindrical measuring carrier
Storage capacity	8MB (the capacity of historical data that can be stored after a network outage)
Data View	Web Remote viewing via web-based system platform, local Bluetooth access
Transmission method	By default, data is transferred to the proprietary cloud platform via 4G. Supports API integration Optional RS485 output, Modbus RTU communication protocol . Optional integration with third-party cloud platforms.
Power supply method	4G transmission: Solar panels + Built-in lithium battery power supply RS485 Output: DC12-24V
Power consumption	Power consumption in static state is less than 10 μA , Power consumption during sampling 80 mA;
IoT SIM card	Standard three-year cost
Work environment	-20℃～65℃
Shell material	PVC+ASA
Structural appearance	Integrated tubular (column-type)
Equipment size	diameter 102mm, high 770mm
Sealing material	Epoxy resin
Protection level	IP68

V. Specifications for Site Selection of Soil Moisture Monitoring and Data Collection Points

1. General Principles

The selection of representative plots for soil moisture monitoring requires comprehensive consideration of landform types, soil characteristics, meteorological conditions, hydrogeological backgrounds, and the distribution patterns of dominant crops. Site selection is conducted using the county-level administrative division as the basic unit; representative monitoring zones are selected based on regional landform classifications and the zoning of key crop cultivation areas.

2. Layout based on landform types

Hilly areas: Monitoring points should preferably be located in areas with gentle slopes and large plot sizes; avoid placing sampling points at the bottom of gullies or on plots with steep slopes.

Plain areas: Select plots with flat terrain and good drainage—where water does not easily accumulate—to serve as representative monitoring areas.

3. Specific plot requirements

Plots should be located at least 10 meters away from the edges of representative zones and transportation routes; the terrain must be generally flat, avoiding low-lying areas prone to waterlogging.

A minimum distance of 20 meters must be maintained from hydraulic structures such as ditches and flood discharge channels to prevent lateral seepage from interfering with accurate soil moisture monitoring data.

Special note for hydrological station sites: Do not place sampling points in station vegetable gardens to avoid interference from manual irrigation; instead, select open areas within the station grounds, keeping a distance from buildings such as houses and perimeter walls.

VI. Installation and Use

1. Sensor Installation

Installation Precautions

- Prepare the necessary tools (basin, water, soil auger (or shovel), and sieve).
- Drill the hole vertically downwards.
- Drill to the appropriate depth and check for a high concentration of stones; if many stones are present, it is recommended to select a different location.

- Backfill with soil slurry and insert the sensor vertically (this is crucial, as it is fundamental to ensuring data accuracy).
- Verify the installation depth to ensure the "0 mark" is flush with the ground surface.

Step 1: Drilling

Using a soil auger, drill a hole vertically into a suitable location; the hole should be sized to fit the sensor, and the ground-level mark on the auger should align with the soil surface. Apply moderate downward pressure while twisting the auger with both hands; withdraw the auger every 10 cm or so to clear out the soil, then repeat the process until the desired depth is reached. If excessive rocks are encountered during this process, select a different location.

Step 2: Prepare the mud slurry

Select a container of appropriate size. Sieve the excavated soil and add a suitable amount of water to create a mud slurry. Stir the mixture thoroughly until it reaches the ideal consistency—where it holds its shape when squeezed by hand without crumbling upon release—ensuring it is neither too thin nor too thick, as this would prevent full contact between the sensor and the soil.

Step 3: Backfilling

Pour the slurry into the drilled hole, filling it to a depth of at least two-thirds of the hole's total depth.

Insert the sensor into the borehole that has been backfilled with slurry, ensuring that the sensor's "0" mark is flush with the ground surface, as shown in the figure below:

2. Installation Instructions:

If using a shovel to dig the hole, excavate a pit of the appropriate depth and place the device inside. Next, select and use the loose, moist soil from the surrounding area to backfill around the device, then compact the soil firmly. Afterward, gently withdraw the conduit and pour slurry into the resulting hole.

Do not press down on or twist the device forcefully during installation.

3. Data Retrieval and Wake-up

Wake-up method: The device is factory-configured to wake up automatically every 30 minutes and transmit a data record. To wake it up manually, slide a magnetic key across the designated "magnetic wake-up zone" on the device; upon hearing a "beep," the device will power on and automatically transmit a data record to the cloud.

Viewing methods: Web portal, WeChat Mini Program, and Bluetooth app.

4. Platform Operation and Data Query

Users can log in to the platform to view current data and historical records, export data to Excel, etc.

VII. Troubleshooting Common Faults

Fault phenomenon	Possible reasons	Solution
Device fails to wake up	Improper use of the magnet for wake-up; battery is depleted	Slide the magnet at a steady speed across the wake-up position. Place in a sunny location to charge the battery. If the device still fails to power on after charging, return it to the factory for inspection and repair
No data uploaded to the cloud	Weak carrier network signal; Update time not yet reached; Data SIM card issue	Check if the mobile phone has a signal; if there is no signal, the RTU cannot report data. Wait for automatic upload or use a magnet to wake up the device for an upload. Contact the manufacturer to check the status of the data SIM card. For RS485 versions with no communication: check the power supply, RS485 wiring, communication parameter configuration, and whether communication commands are

		sent correctly.
Excessive data error	The grout was not compacted or did not adhere tightly to the soil during installation	Reinstall, ensuring uniform grout filling and tight contact with the soil. Check for magnetic equipment interference in the measurement area and keep away from such equipment.
Unable to connect via Bluetooth	Distance is too great, or the device is not in Bluetooth mode	Move closer to the device (within 10 meters); wake up the device and ensure the mobile app has been granted Bluetooth permissions.

VIII. After-Sales Service and Warranty

Warranty Commitment: The product comes with a 12-month warranty starting from the date of delivery (excluding issues caused by failure to follow technical specifications, other forms of human-induced damage, or force majeure).

After-Sales Commitment: Users may consult via telephone regarding technical issues and receive clear solutions. In the event of product quality defects, the item may be returned to the factory for repair or replacement.

After-Sales Hotline: 0310-8033736

IX. MODBUS RTU Communication Protocol

(Applicable to HCT-4/485 RS485 output tube-type soil moisture monitor)

Baud rate: 9600

Data bits: 8

Stop bits: 1

Check digit: None

CRC Note:

In the following descriptions, the two-byte CRC16 used in the MODBUS RTU protocol follows the MODBUS standard: the low byte is transmitted first, followed by the high byte.

The following descriptions assume a sensor address of 0xFF (the default sensor address).

Error Code Response Policy:

The sensor does not return an error code when receiving an invalid command (including cases of CRC16 checksum errors). The host system should consider the command transmission failed if no response is received within 200ms of sending the command, and may re-send the command.

Standard MODBUS Register Specifications

Important Note: In MODBUS commands, the register quantity or length parameter is specified in units of 16-bit words (two bytes, with the high byte first and low byte second), rather than in 8-bit bytes.

Users must ensure that the register address and quantity parameters in the commands fall within the ranges specified for this system. If these parameters exceed the specified ranges, the sensor's output behavior will be unpredictable. Users should ensure that MODBUS commands comply with the requirements of this manual during host software development and support a minimum polling interval of once per second (1s).

Internal registers: Read using function code 03, write using function code 06.

Register address	Operate	Content
0x0001	Read-only	Soil moisture 1: a hexadecimal value scaled up by a factor of 10; for example, 012D represents a soil moisture value of 30.1% VOL.
0x0002	Read-only	Soil Temperature 1: A hexadecimal value scaled up by a factor of 20 (e.g., 1194 represents a soil temperature of 25°C).
0x0003	Read-only	Soil moisture 2: a hexadecimal value scaled up by a factor of 10; for example, 012E represents a soil moisture value of 30.2% VOL.
0x0004	Read-only	For soil temperature, add 20 to the value represented by the hexadecimal number (scaled by a factor of 100); for example, `119E` indicates a soil temperature of 25.1°C.
0x0005	Read-only	Soil moisture 3: a hexadecimal value scaled up by a factor of 10; for example, 012F represents a soil moisture value of 30.3% VOL.
0x0006	Read-only	Soil temperature 3: a hexadecimal value scaled up by a factor of 100 (e.g., 11A8 represents a soil temperature of 25.2°C).
0x0007	Read-only	For a soil moisture value of 4, the hexadecimal representation is scaled by a factor of 10; for example, `0130` indicates a soil moisture value of 30.4% VOL.
0x0008	Read-only	Soil Temperature 4: A hexadecimal value scaled up by a factor of 100 (e.g., 11B2 represents a soil temperature of 25.3°C).

Communication example:

1. Command to read multiple input registers (2 real-time data points)

Send: FF 03 00 01 00 02 80 15

FF	03	00 01	00 02	80 15
System address	Function code	Register address	Number of registers	CRC16 check bits

Answer: FF 03 04 01 2D 11 94 79 F6

FF	03	04	01 2D 11 94	79 F6
System address	Function code	Data segment bytes	Data segment data	CRC16 check bits

Data segment values:

Soil moisture 1 = (0x01 * 256 + 0x2D) / 10 = 30.1% VOL

Soil temperature 1 = (0x11 * 256 + 0x94) / 100 - 20 = 25°C

2. Command to read the system address register

System address supports the range 0x01–0xFF (decimal 1–255); the factory default is 0xFF.

Send: 00 03 00 00 00 01 85 DB

00	03	00 00	00 01	85 DB
Fixed code	Function code	Register address	Number of registers	CRC16 check bits

Answer: 00 03 02 00 FF C5 C4

00	03	02	00 FF	C5 C4
Fixed code	Function code	Data segment bytes	Data segment data	CRC16 check bits

The data in the data segment is 0xFF, representing system address 0xFF.

3. Command to modify the internal register (system address) (change address to 0x01)

Send: 00 06 00 00 00 01 49 DB

00	06	00 00	00 01	49 DB
Fixed code	Function code	Register address	Number of registers	CRC16 check bits

Answer: 00 06 00 00 00 01 49 DB (indicates successful modification)