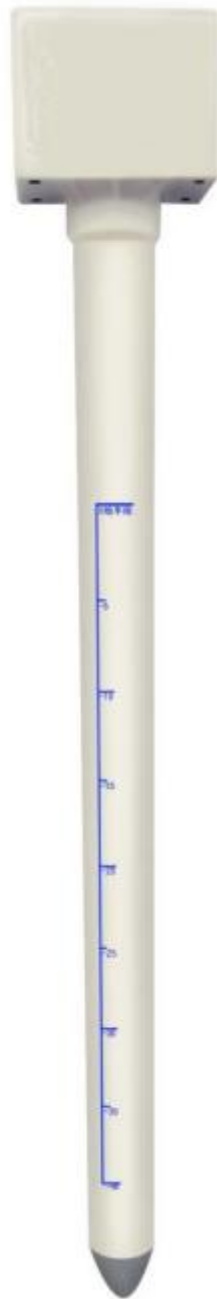
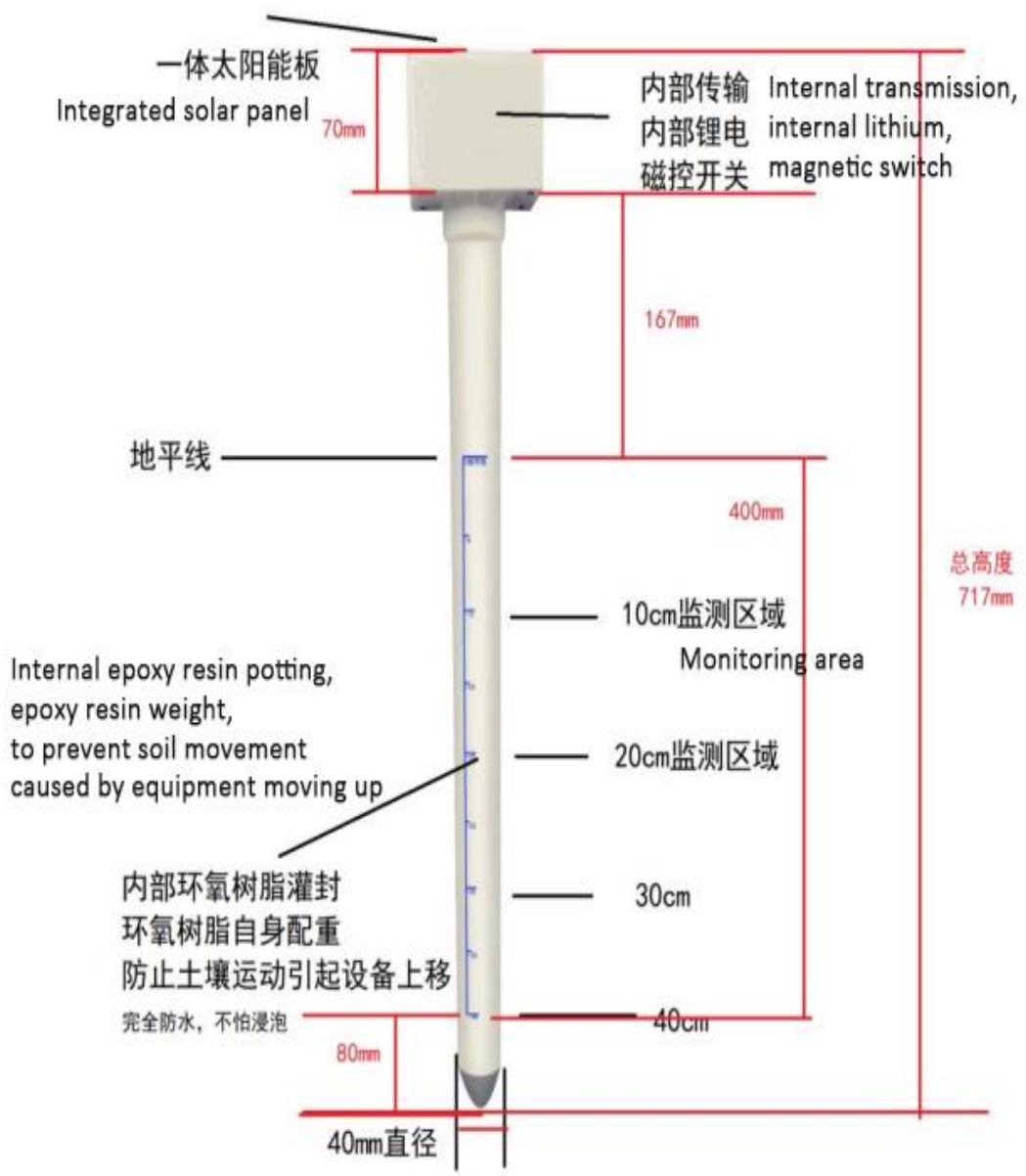


HCS-5 Catheter type soil moisture monitor





Applied range

The conduit-type soil moisture monitor is the latest product developed by our company. The equipment uses high-precision chips, advanced algorithms and Internet of Things technology. It can measure soil parameters at multiple depths and upload it to the data center via RS485 output or 4G network. This product can be widely used in real-time monitoring of soil temperature and humidity in farmland, forest areas, grasslands, and irrigated areas. It can also be used in water conservancy and land disaster industries to provide data support for monitoring natural disasters such as landslides and debris flows.

Features

- The product design is flexible and can measure soil temperature and humidity at any depth between 10-80cm (usually 10cm layer). The default is 4-layer, 5-layer, and 8-layer standard tubes. Support customization.
- It is composed of sensing, collection, transmission and power supply parts, with integrated design and easy installation.
- It has domestic version and international version data transmission scheme, which is convenient for users outside the mainland. (For international version, please inform the sales staff in advance)
- The collector configuration software uses the WeChat applet to connect to the mobile phone through Bluetooth. The device can be controlled on any Android or Apple mobile phone equipped with the WeChat APP, realizing in-depth interaction, configuration and remote sending between the mobile APP and the device. (Some functions are currently open to users)
- The sensor has a built-in high-efficiency lithium battery, and the RTU adopts a low-power consumption design. When fully charged, it can work for more than 180 days in continuous rainy days.
- Adopting a magnetic switch design, the magnet that comes with the machine can be used to control the collector on and off. Prevent the site from being accidentally shut down in the wild.
- Using cloud platform storage technology, the data sent each time can be saved to an independent cloud platform or a third-party platform that meets the "Hydrological

Monitoring Data Communication Protocol SL651-2014". It supports MQTT service docking with third-party platforms and supports protocol customization. Default API interface docking.

- Other functions: power display, network positioning.
- Extensible elements: GPS positioning, more accurate positioning; parameter expansion such as temperature, humidity, air pressure, dew point temperature, and body temperature.
- Extensible functions: Open the user's quadratic calibration function (function of cubic term + quadratic term + linear term + constant) to provide more accurate data for professional scientific researchers. Users can provide data, and our company assists in calculating the coefficients of the function.

Technical Data

Measurement parameter	Soil volumetric moisture content (soil moisture)
Unit	% (m ³ /m ³), or %Vol (volume moisture content, volume moisture content)
Humidity range	0~100%Vol
Resolution	0.1%Vol
Accuracy	Error within effective range ≤3%Vol
Measurement area	90% of the influence is within the 10cm diameter cylindrical measurement carrier surrounding the sensor
Accuracy drift	none
Sensor linear discrete deviation probability	1%
Measured parameter	soil temperature
Soil temperature range	-40~+60°C

Resolution	0.1°C
Accuracy	±0.5°C
Stabilization time	about 1 second after power on
Sensor working voltage	sensor input is 5-24V DC
Sensor operating current	quiescent current 4mA, acquisition current 35mA
Sensor waterproof level	IP68
Working temperature	-40°C~+80°C
RTU power consumption	standby 10μAh, transmission 100mAh
Transmission	Default 4G output to own platform. Optional RS485 and other outputs, optional third-party docking.
Actual power supply capacity of solar panels	≤0.6W
RS485 output type Power supply	DC5-24V, current less than 25mA.

Equipment communication protocol and wiring

- ◆ "Hydrological Monitoring Data Communication Protocol SL651-2014"; TCP protocol; other third-party customized protocols, MQTT, API interface, etc.
- ◆ The RTU and sensing section are connected via internal cables. IoT Card costs for 3 years (one year for international version).
- ◆ Solar panel Lithium battery internal wiring for power supply.

Collection location selection

The selection of representative plots for moisture monitoring should consider the representativeness of its landform, soil, meteorological and hydrogeological conditions and plant species. The collection scope can be based on the county level, and representative plots should be selected within the county level unit. Several areas (representative reference basis can refer to the types of landforms and the regional scope of key crops). If it is located in a hilly area, the detection point should be set in a plot with a small slope gradient and a large area, and should not be collected at the bottom of a ditch or in a plot with a large slope. Representative plots in plain areas should be collected from plots that are flat and not prone to water accumulation. Detailed collection plots should be in flat plots that are more than 10m away from the edges of representative plots and roadsides. They should avoid low-lying places that are prone to water accumulation, and keep a distance of more than 20m from ditches and flood channels to avoid water seepage from ditches. affect soil moisture content. For the collection of plots in the hydrological station, it is strictly prohibited to do it in the middle of the vegetable field in the station to avoid watering the ground from affecting the collection accuracy. It is recommended to choose a collection point in a relatively open location, not close to houses or walls;

Sensor installation and data reporting

1. Installation precautions

- (1) Observe the data through the platform and confirm that the data is normal.
- (2) Prepare tools for installation (pot, water, shovel (or soil drill), sieve with 2-4mm pores) (2) Drill holes should be vertically downward;
- (3) Drill holes to a suitable depth and pay attention to whether there are stones. If there are many stones and rocks, it is recommended to re-select the site;
- (4) Backfill mud and insert sensors vertically. (Very important, it is the basis for the accuracy of the reflected data);
- (5) Confirm the installation depth of the sensor, and the horizon is level with the ground.

2. Sensor installation

(1) Choose a relatively flat installation position and directly use a soil drill to drill holes in the ground:

(2) Remove the blue pipe cover at the bottom of the pipe soil drill, take out the handle, and turn the two handles clockwise. Screw in both ends of the pair of wires respectively; as shown below:



(3) Insert the pipe-type soil drill vertically along the center hole of the flange, press down with appropriate force and rotate your hands left and right in parallel until the required depth is reached (this process can feel whether there are stones in the soil. If there are too many stones, Need to re-select the site). During the drilling process, the soil drill needs to be lifted out every 10cm to the maximum depth and shaken hard to throw out the soil in the pipe. You can also use an extended screwdriver handle or a hammer handle (you cannot use a hammer to hit the pipe body to avoid causing damage to the pipe). Pipe body deformation) Knock the lower pipe body of the soil drill to shake out the soil, or use a screwdriver to dig the soil from the bottom until all the soil falls. Use a ruler to measure the drilling depth, which should be 7-8cm deeper than the measured depth of the sensor; as shown below:



(4) Sieve the soil taken out by drilling and mix it into mud; as shown below



(5) Pour the mud into the drilled ground hole, and the penetration amount should reach at least $\frac{2}{3}$ of the depth of the ground hole; as shown below



(6) Insert the sensor into the ground hole that has been backfilled with mud, and the position marked with the horizon on the sensor can be flush with the ground. As shown below:



3.The collector’s sound recognition

One “beep” sounds mean power on;

two “beep beep” sounds means power off.

System settings, data reporting, data query

1. Equipment switching on and off and configuration

1) Use your mobile phone to scan the QR code to view the data, and use a magnetic thumbtack to power on the sensor (the default in China is the power-on state. Restart after swiping the magnet, and data will be uploaded upon power-on).

2) If configuration is required, you can enter the mini program and click "Click to connect to Bluetooth". After 2 seconds, a button will appear at the bottom of the interface. Clicking the button will prompt "Connection successful". (This function is optional and is generally set according to user requirements before leaving the factory. configured)

2. Data reporting

Each time the sensor is turned on, the RTU will automatically report a test report data to the receiving center. First installation completed

After completion, turn on the sensor for about 1 minute to view the last reported data.

3. Platform operation and data query

You can log in to the platform to view real-time data, historical records, data export, etc.

Problem judgment and solution

problem description	Solution
1. No boot sound	Go to a sunny place to illuminate the solar panel and charge the sensor for at least one day; If it still cannot be turned on after charging, please return it to the factory for inspection and repair;
2. Unable to collect data	Whether the sensor is inserted into the soil or in the

	<p>measuring carrier;</p> <p>If the cause cannot be determined, it can be returned to the factory for inspection and repair;</p>
<p>3. Unable to submit data (no communication)</p>	<p>Check whether the mobile phone has signal. If there is no signal, RTU cannot report data;</p> <p>After ruling out other causes, it can be returned to the factory for maintenance;</p> <p>The RS485 version has no communication. You can check whether the power supply and RS485 wiring and communication parameters are configured correctly, and whether the communication instructions are sent correctly.</p>

Note: This hardware, WeChat applet, and PC may be updated at any time without prior notice unless there are special circumstances!

Modbus RTU communication protocol

Baud rate: 9600; Data bits: 8; Stop bit: 1; Parity bit: None

CRC Description:

In all the following descriptions, the CRC16 two-byte in the MODBUS RTU protocol follows the MODBUS regulations: the low byte comes first and the high byte comes last.

1.2 Return error code regulations: The sensor will not return error codes when receiving error instructions (including CRC16 verification errors).

The host computer can consider the instruction failed when it cannot receive the return data 100ms after the instruction is issued, and can resend the instruction.

2.1 Special note on standard MODBUS register description:

The number or length of registers in MODBUS commands are two bytes with 16 bits as one unit (high byte first, low byte after), rather than single byte 8 bits as one unit.

The user should ensure that the range of the two parameters, address and number of registers in the command, is within the range specified by this system. If it exceeds the range, the output result of the sensor will be unpredictable. The user should ensure that the MODBUS commands comply with the requirements of this manual in the design of the host computer software.

Internal register: use function code 03 to read; function code 06 to write

No.	Register address	Parameter Description	Note
	0x0100	Device address, default 0x0100	
1 layer	0x0020	Soil volume moisture content 1 layer (10cm depth), a hexadecimal number magnified 100 times, such as 0x00E1 means $225/10=22.50\%Vol$	
	0x0021	Soil temperature layer 1, (10cm depth), hexadecimal number magnified 100 times, such as 0x00E1 It means $225/10=22.50^{\circ}C$. Negative numbers are represented using two's complement numbers.	
2 layer	0x0022	Soil volumetric moisture content 2	
	0x0023	soil temperature 2	
3 layer	0x0024	Soil volumetric moisture content 3	
	0x0025	soil temperature 3	
4 layer	0x0026	Soil volumetric moisture content 4	
	0x0027	soil temperature 4	
5 layer	0x0028	Soil volumetric moisture content 5	

	ox0029	soil temperature 5	
6 layer	ox002A	Soil volumetric moisture content 6	
	ox002B	soil temperature 6	
7 layer	ox002C	Soil volumetric moisture content 7	
	ox002D	soil temperature 7	
8 layer	ox002E	Soil volumetric moisture content 8	
	ox002F	soil temperature 8	

Note: The address data is expressed in hexadecimal. For example: the read and write value of address 20 (decimal) is 0x14.