NiuBoL TECHNOLOGIES

SOIL PARAMETER TESTER

Sensor User Manual & Android App Operation Guide



USB Soil Sensor and Android App

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Important Notices

- Use a USB cable capable of data transfer to connect the device. Do not use a charging-only cable.
- Keep water away from the USB port, circuit board, and probe wiring connections.
- Maintain the USB connection and power supply during a device firmware update. Do not disconnect the cable or interrupt power.
- Before first use or after changing soil types, check the calibration parameters and recalibrate if necessary.

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1 Product Introduction

1.1 Product Overview

This product is a multiparameter sensor for soil environment testing. It measures soil temperature, soil moisture, electrical conductivity (EC), and pH, and estimates reference values for nitrogen (N), phosphorus (P), potassium (K), and salinity based on conductivity and temperature. The device communicates with an Android mobile App through a USB virtual serial port. Users can view real-time measurements, save records, export data, configure parameters, and update device firmware in the App.

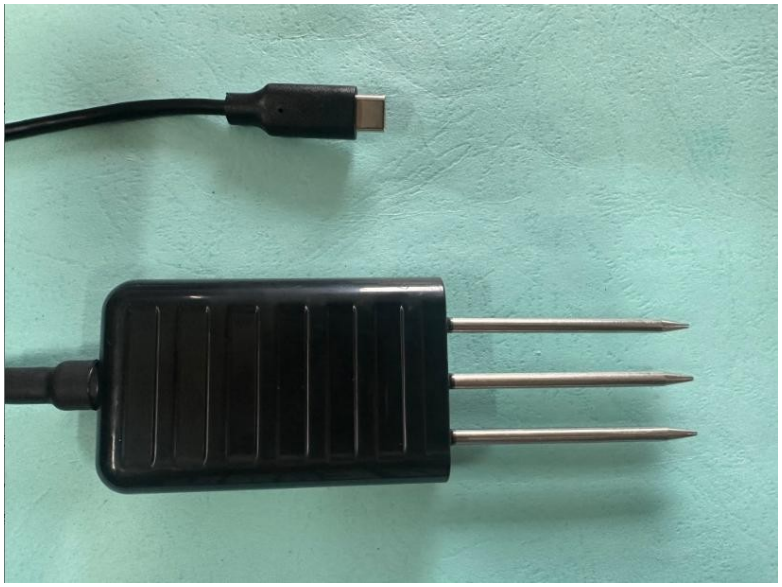


Figure 1-1 Sensor Housing and Probe

1.2 Key Features

- Real-time measurement and display of eight soil parameters.
- USB connection to the mobile App without requiring an additional serial-port driver.
- Chinese/English interface switching.
- Saving measurement records, adding notes, and viewing historical data.
- Exporting CSV files (readable in Excel).
- Sending historical data to a designated email address.
- Reading and configuring temperature, soil moisture, conductivity, and NPK coefficients.
- Selecting a firmware file in the App to upgrade device firmware.

1.3 Package Contents

No.	Item	Quantity	Description
1	Multiparameter Soil Sensor	1 unit	Includes sensor probe
2	USB Data Cable	1 cable	For power and communication
3	User Manual	1 copy	Electronic or printed version

2 Safety and Operating Environment

2.1 Power Supply and Connection

- The device is powered through USB. A standard 5 V USB power source or the phone USB port is recommended.
- The recommended operating current is less than 100 mA. Do not use a power source with excessive voltage.
- The phone must support USB OTG, and the USB cable must support data transfer.
- When connecting or disconnecting USB, hold the connector instead of pulling the cable.

2.2 Operating Environment

- Avoid prolonged use in strong acids, strong alkalis, highly corrosive liquids, or high-temperature environments.
- Protect the device from strong impact, dropping, and bending of the probe or cable.
- The USB interface and circuit board are not waterproof. Never allow water ingress or use them in high-humidity environments where condensation can occur.
- Prevent the probe from striking stones, metal, or other hard objects during measurement.

2.3 Measurement Precautions

- Fully insert the probe into the soil to ensure good contact, with no obvious air gaps.
- For repeated measurements at the same location, wait until the reading stabilizes before recording.
- Soil type, water content, and compaction can affect measurements; interpret results according to actual conditions.
- When storing the device for an extended period, wipe the probe and body dry and keep them in a dry, ventilated place.

3 Hardware and Connections

3.1 Device Components

The device consists mainly of a sensor probe, measurement and processing circuitry, and a USB communication interface. The sensor probe collects soil signals, and the device processes the data before transmitting it to the mobile App via the USB virtual serial port.

3.2 USB Connection

Connection steps:

1. Confirm that the phone supports USB OTG.
2. Connect the sensor to the phone using a USB data cable.
3. If the phone displays a USB permission prompt, select Allow.
4. Open the App and tap "Connect Device" on the home screen.
5. Select the corresponding USB device from the device list.

> *If there is no response after connection, verify that the cable supports data transfer rather than charging only, and check that USB OTG is enabled on the phone.*

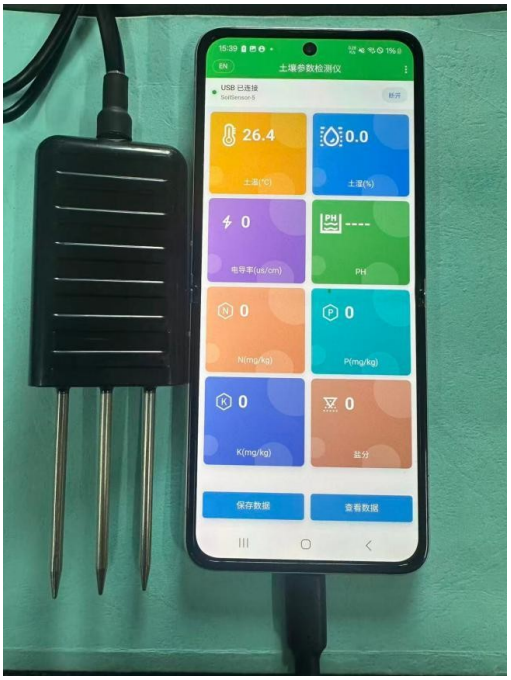


Figure 3-1 Sensor Connection Example

4 Getting Started

4.1 Installing the App

- Install the App supplied with the device on an Android phone.
- When you open the App for the first time, select Allow if the system requests USB permission.

4.2 Powering On and Connecting

Step	Action	Expected Result
1	Connect the sensor to the phone using a USB data cable	The phone detects a USB device
2	Open the App	The Soil Parameter Tester home screen appears
3	Tap "Connect Device"	A list of available USB devices appears
4	Select the corresponding device	Status changes to "USB Connected"
5	Insert the probe into the soil	Readings on the data cards begin updating



Figure 4-1 App Device Connection Dialog

4.3 Viewing Real-Time Data

After connection succeeds, the home screen displays eight data cards. By default, the App reads the current data once every two seconds. Wait until the probe readings stabilize before saving or recording values.

> *If a data card displays "----", the parameter has no current output or its data is invalid. Check the output configuration and calibration parameters in Parameter Settings.*

5 App Interface Overview

5.1 Home Screen

Area	Function	Description
Upper left	Language switch	Switch between Chinese and English
Top center	Page title	Displays "Soil Parameter Tester"
Upper right	Parameter settings	Opens the parameter read/write and firmware update page
Connection bar	USB connection status	Shows connected/disconnected status, device name, and connection button
Data area	Eight parameter cards	Displays real-time measurements
Bottom	Save Data / View Data	Saves current readings or opens history



Figure 5-1 App Home Screen

5.2 Eight Parameter Cards

Parameter	Display Label	Unit	Displayed Precision	Description
Temp	Soil Temperature	°C	1 decimal place	Soil temperature
Humi	Soil Moisture	%	1 decimal place	Soil moisture
EC	Conductivity	µS/cm	Integer	Soil electrical conductivity
PH	pH	—	2 decimal places	Soil acidity/alkalinity
N	N	mg/kg	Integer	Nitrogen reference value
P	P	mg/kg	Integer	Phosphorus reference value
K	K	mg/kg	Integer	Potassium reference value
Salt	Salinity	—	Integer	Salinity reference value

5.3 Language Switching

Tap the language button at the upper left of the home screen to switch between Chinese and English. The page text, exported column headers, and email contents use the currently selected language.

6 App Operating Instructions

6.1 Connecting and Disconnecting USB

To connect:

- Confirm that the sensor is connected to the phone using a USB data cable.
- Tap "Connect Device" on the home screen.

- Select the corresponding device from the device list.
- After a successful connection, the status displays "USB Connected".

To disconnect:

- Tap "Disconnect" on the right side of the home-screen connection bar.
- Or unplug the USB data cable.

> *If data does not appear for an extended period after connection, disconnect and reconnect the device, and confirm that the probe is inserted into the soil.*

6.2 Saving Data

Tap "Save Data" on the home screen, enter a note for the measurement, and then tap "Save". The App saves all eight current parameters, the date and time, and the note. The history can store up to 200 records; older records are removed when the limit is exceeded.

Action	Description
Tap "Save Data"	Opens the note entry dialog
Enter a note	For example: East Greenhouse, Test Point 1, After Rain
Tap "Save"	Saves the current measurements and note
View history	Tap "View Data" on the home screen or go to "Historical Data"



Figure 6-1 Save Data Note Dialog

6.3 Historical Data and Export

- The history page displays saved data in time order, including timestamps and notes.
- Tap "Save as Excel" to export a CSV file, which can be opened directly in Excel.
- Tap "Send to Email" to send the current historical data to a specified email address.
- Tap "Clear All Data" to delete all historical records. Confirm before proceeding.

Column headers in exported tables follow the current App language: Chinese headers in the Chinese interface and English headers in the English interface.

> *Email sending requires an internet connection on the phone and a correctly configured email service. If the email is not received, check the spam folder and network connection first.*



Figure 6-2 Historical Data Screen

6.4 Parameter Settings

Open "Parameter Settings" in the upper-right corner of the home screen. On first entry, tap "Read" to retrieve the device's current parameters before making any changes.

Item	Content	Description
Version	Device firmware version	Displayed after reading
Coarse adjustment coefficients	Temperature, soil moisture, conductivity	Adjust the scaling of the corresponding parameters
NPK coefficients	K/B values for nitrogen, phosphorus, potassium	Adjust the NPK estimation calculation
Read	Read current parameters	Recommended before making changes
Set	Write modified parameters	Saves changes to the device
Upgrade	Open firmware upgrade	A confirmation dialog appears before upgrading

> *Parameter settings affect measurement results. Do not change coefficients casually without suitable calibration conditions. Verify measurements against known conditions after making changes.*



Figure 6-3 Parameter Settings Screen

6.5 Device Firmware Upgrade

The App supports upgrading the device firmware via USB. Upgrading only updates the device firmware and does not change the calibration parameters. Use the upgrade file supplied by the device manufacturer. Do not use files from unknown sources.

Upgrade steps:

1. Connect the device and open "Parameter Settings".
2. Tap "Upgrade", read the prompt, and select "Start Upgrade".
3. The device restarts automatically and enters upgrade mode. USB briefly disconnects at this stage.
4. On the upgrade screen, tap "Connect Upgrade Device" and select the USB device in upgrade mode.
5. Tap "Select Upgrade File" and select the manufacturer-supplied BIN file.
6. Tap "Start Upgrade" and wait until progress and log output are complete.
7. After a successful upgrade, the device restarts automatically. Reconnect it to resume use.



Figure 6-4 Upgrade Page, Progress, and Log

> *Do not unplug USB, turn off the phone, or interrupt sensor power during the firmware upgrade. If the upgrade fails, reconnect the upgrade device and repeat the upgrade.*

6.6 Sending Data to Email

The Historical Data page supports "Send to Email". After entering the recipient's email address, the App generates a table from the current historical data and sends it.

If the email is not received, check the inbox, spam folder, and phone network connection.



Figure 6-5 Send to Email

7 Data Information

7.1 Meaning of Displayed Values

The App displays soil temperature and moisture to one decimal place, pH to two decimal places, and electrical conductivity, N, P, K, and salinity as integers. A card shows "----" if a parameter has no output or the data is invalid.

7.2 Calibration and Reference Values

- Soil moisture, electrical conductivity, pH, and other parameters may require calibration at the factory or before use. Calibration parameters affect the displayed readings.
- pH measurement should be calibrated using standard buffer solutions. Without calibration, pH values are suitable for trend reference only.
- N, P, K, and salinity are estimated from electrical conductivity and temperature. They are reference values and cannot replace laboratory testing.
- Different soil types, moisture contents, temperatures, and compaction levels may lead to different readings. Compare values under consistent conditions.

7.3 Data Storage and Export

Location / Format	Contents	Description
App local storage	Real-time data and historical records	Stored in the mobile App
Historical records	Time, note, and eight parameters	Up to 200 records
CSV file	Tabular data	Can be opened in Excel
Email	CSV attachment	Sent to a designated email address

8 Troubleshooting

Symptom	Possible Cause	Solution
USB device not found on home screen	Charging-only cable, OTG disabled, or USB permission denied	Use a data cable, enable OTG, reconnect USB, and allow USB permission
No data after connecting	Device not connected, probe not inserted, or unstable USB connection	Reconnect, insert the probe, and wait for readings to update
Parameter displays "----"	No output for parameter or invalid data	Check read values and output configuration under Parameter Settings
Saved record cannot be found	Save failed or the history exceeded 200 records	Save again and check the Historical Data page
Exported file cannot be opened	File is in CSV format	Open with Microsoft Excel or WPS Spreadsheet
Email sending fails	Network issue or email service not configured	Check network, recipient address, and spam folder
Upgrade device not found	Device has not completed restarting or USB has not re-enumerated	Wait a few seconds, then tap Connect Upgrade Device again
Upgrade interrupted	USB disconnected, power lost, or incorrect upgrade file	Reconnect the upgrade device and retry with the correct BIN file
Cannot exit upgrade mode	No executable firmware is currently installed on the device	Complete the upgrade; do not force an exit
Some text does not change after switching languages	Page has not refreshed	Return to the home screen or reopen the relevant page

9 Technical Specifications

Item	Specification
Main MCU	GD32F303CBT6
Flash / SRAM	128 KB / 32 KB
Communication Interface	USB CDC Virtual Serial Port
Power Supply	USB 5 V bus-powered
Recommended Operating Current	Less than 100 mA
Measured Parameters	Soil temperature, soil moisture, conductivity, pH, N, P, K, salinity
App Platform	Android, with USB OTG support
App Languages	Chinese / English
Historical Records	Up to 200 entries
Data Export	CSV (readable in Excel)
Firmware Upgrade	USB + BIN file selected in App

> *Technical specifications may change with hardware revisions. Refer to the actual device label and documents supplied with the product.*

10 Maintenance and Care

- After each use, remove soil and residue from the probe. Rinse it with clean water and wipe it dry.
- Do not scrape the sensitive areas of the probe with hard objects, as this may damage the measuring surface.
- Do not immerse the USB port, circuit board, or cable connectors in water.
- For long-term storage, dry the device and keep it in a cool, dry place.
- Inspect the probe and cable periodically for damage. Stop using the device if abnormalities are found.
- Periodic calibration is recommended according to use frequency and measurement requirements.

10.1 Calibration Recommendations

If a measured value differs significantly from the actual value, or if the soil type or probe is changed, review the calibration parameters. Calibration should be carried out under stable, known conditions. Keep a record of the original parameter values so they can be restored if necessary.

11 Quick Operating Procedures

Routine Measurement

Insert probe → Connect USB → Open App → Connect Device → Wait for readings to stabilize → Save Data → View History / Export.

Parameter Check

Parameter Settings → Read → Check coefficients → Modify → Set.

Firmware Upgrade

Connect Device → Parameter Settings → Upgrade → Confirm → Wait for restart → Connect Upgrade Device → Select file → Start Upgrade → Wait for success.

> *When requesting technical support, provide the device version, App version, issue symptoms, and operating steps to help identify the problem promptly.*