Farm21

User manual

FS21

Smarter Farming

Preface

By purchasing the Farm21 FS21 field sensor, you own a field sensor that allows you to monitor several important field conditions.

This document is the user manual and contains all the information for correct, efficient and safe use of the FS21.
This user manual is addressed to the end user. Read this information carefully before installing or using the FS21.
This user manual contains all essential information to start with the FS21.
This includes a description of the system functions and a step-by-step guide for the FS21 installation process.
Always store this information with the FS21 for use in the future.

Due to regular upgrades this user manual is subjective to change. For the most up-to-date version of this manual go to:
www.farm21.com/documentation

Table of contents

1   Box content

This box contains:	Not included:
• FS21 main module	• USB power adapter
• Soil moisture add-on	• USB-C charging cable
• Quickstart guide	• Soil peg

See shop.farm21.com/products for available accessories.

2   Intended use

The FS21 is designed and intended to give professional crop growers real-time insight in the conditions of their fields.
The FS21 is intended for use in both outdoor and indoor agriculture and horticulture. Measurements should be used in consultation with other information sources.

⚠ **WARNING**
• **Keep the FS21 out of reach from children, infirm persons or animals.**

3   Specifications

General

Model	FS21
Dimensions	66.5 × 6.5 × 6.5 cm
Weight	250 g
Power	Rechargable 18.650 mAh battery
Operating voltage	3.6 V
Frequency range	700 - 2100 MHz
Maximum transmission power	33.0 dBm
Antenna gain	2.0 - 5.0 dBi
Battery life expectancy	1 year (using default measurement interval)
Battery type	Lithium
Default measurement interval	Once per hour
Internal memory	Lasts 1 year (using default measurement interval)

Operating temperature	-20 °C – +60 °C
Certification	CE, UKCA, RCM, FCC, ISED

Air Temperature

Sensor position	12 cm above ground level
Output	Degrees Celsius (°C)
Measurement range	-20 °C – +60 °C
Accuracy	±1°C

Air Humidity

Sensor position	12 cm above ground level
Output	Relative Humidity (%RH)
Measurement range	-20 °C – +60 °C
Accuracy	±2 %RH (@25°C and 20%RH to 80%RH)

Soil Temperature

Sensor position	10 cm & 20 cm below ground level
Output	Degrees Celsius (°C)
Measurement range	-20 °C – +60 °C
Accuracy	± 1 °C

Soil Moisture

Sensing zones	0- 10 cm, 10-20 cm, 20-30 cm below ground level
Output	Volumetric water content (%)
Measurement range	From 0 % to field capacity (55 % for clay, 40 % for sand)
Accuracy	± 3 % with Farm21 soil calibration and correct installation

Connectivity

Network protocol	NB-IoT, LTE-M and 2G
Transmission interval	Once every 6 hours (default)

4 Safety instructions

⚠ WARNING

- Ensure you have fully read and understood the instructions in this document before you install or use the FS21. Keep the packaging and this document for future reference.
- Only use the FS21 as described in this document.
- Do not use the FS21 if a part is damaged or defective. Replace a damaged or defective FS21 immediately
- Do not drop the FS21 and avoid bumping.
- The FS21 may only be serviced by a qualified technician for maintenance to reduce the risk of electric shock.
- Do not dismantle, open or shred cells or batteries.
- Do not expose cells or batteries to heat or fire. Avoid storage in direct sunlight.
- Do not short-circuit a cell or a battery. Do not store cells or batteries haphazardly in a box or drawer where they may short-circuit each other or be short-circuited by other metal objects.
- Do not subject cells or batteries to mechanical shock.
- In the event of a cell leaking, do not allow the liquid to come in contact with the skin or eyes. If contact has been made, wash the affected area with copious amounts of water and seek medical advice.
- Keep cells and batteries clean and dry.
- Rechargeable cells and batteries need to be charged before use. Always use the correct charger and refer to the manufacturer's instructions or equipment manual for proper charging instructions.
- Do not leave the battery on prolonged charge when not in use.
- After extended periods of storage, it may be necessary to charge and discharge rechargeable cells or batteries several times to obtain maximum performance.
- Do not expose the inside of the FS21 to water or moisture.
- Do not attempt to repair the FS21. If the FS21 does not operate correctly, replace it with a new FS21.
- The FS21 does not contain any self-serviceable parts.
- Do not use aggressive chemical cleaning agents such as ammonia, acid or acetone when cleaning the FS21.
- Keep the FS21 out of reach from children, infirm persons or animals.

5 Explanation of the symbols on the product or packaging

CE	CE - This symbol indicates that the FS21 features a CE marking to demonstrate conformity to all product relevant European directives.
FCC	FCC - The FS21 emits electromagnetic interference which is under the limits approved by the Federal Communications Commission.
(recycle symbol)	Recycle - Adhere to the relevant legal requirements when disposing the FS21. Your FS21 contains valuable materials which can be recovered or recycled. Leave the FS21 at a local civic waste collection point.
RCM	RCM - The manufacturer represents a declaration that the FS21 complies with all applicable ACMA legal and technical requirements.
UKCA	UKCA - This symbol indicates that the FS21 features a UKCA marking to demonstrate conformity to all product relevant British directives.

6 The product

The Farm21 FS21 field sensor is a two-piece product consisting of a soil moisture add-on and a FS21 main module. The weatherproof casing protects the electronics against the elements whilst allowing for measurement. Apart from charging the battery, the FS21 does not require any user maintenance.

6.1 FS21 components
For this product two parts can be distinguished:
- The bottom part, the soil moisture add-on, is inserted into the soil.
- The upper part, the FS21 main module, remains above ground level.

The soil moisture add-on houses three soil moisture sensors (depth 0-10 cm, 10-20 cm and 20-30 cm) and two soil temperature sensors (depth -10 cm and -20 cm).
The FS21 main module contains the electronics for data communication, a USB port for charging, a sim card and an antenna connector. Besides the communication components, the FS21 main module also houses an air humidity and temperature sensor.
A QR-code can be found on the outside of the casing and is used to register the sensor to the dashboard (see 'Activate and link the FS21 to the dashboard').

6.2 The battery

This FS21 main module houses a rechargeable battery that does not require user maintenance.

In order to measure air humidity and to prevent pressure build-up in the casing, two semi-permeable membranes are part of the casing.

> ⓘ For accurate air humidity measurements it is important to keep the humidity sensor free of dirt and debris. Also make sure no water or dirt enters the FS21 when the casing is open.

7   Main parts
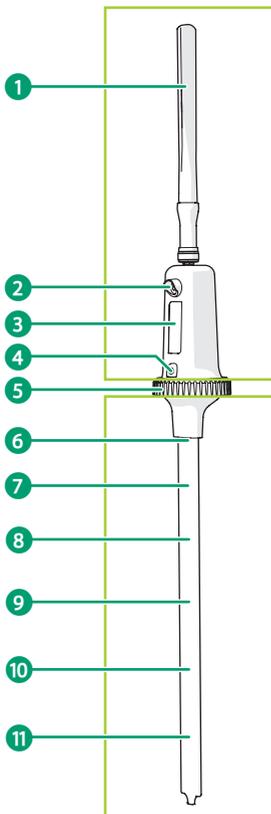
FS21 main module
1. Antenna
2. Humidity / Temperature sensor
3. Farm21 QR code
4. Vent

Connection part
5. Screw ring

Soil moisture add-on
6. Soil level
7. Soil moisture sensor – 10 cm
8. Soil temperature sensor – 10 cm
9. Soil moisture sensor – 20 cm
10. Soil temperature sensor – 20 cm
11. Soil moisture sensor – 30 cm

Figure 1
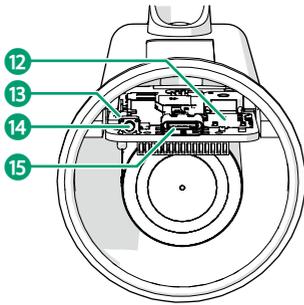
Function parts
12. SIM card slot
13. Indicator LEDs
14. Power button
15. USB-C port

Figure 2

8   Before use

8.1   Creating a new Farm21 dashboard account

For enabling and installing a Farm21 sensor, a Farm21 account is needed.
To create this account:
1. Go to app.farm21.com/register to create a Farm21 account.
2. Fill in the required fields.
3. Press register.
   You will now automatically log in to your new Farm21 account.

8.2   Charging the battery

> ℹ️ The FS21 is delivered with a partially charged battery. For optimal battery life, fully charge the battery before first use.

1. Open the FS21 by unscrewing the ring in a counter clockwise direction (when looking from the top).
2. Remove the soil moisture add-on from the FS21 main module.
3. Screw the antenna to the FS21 main module.
4. Plug a USB-C cable into the USB-C port.
5. Plug the other end of the cable into a USB power adapter.
6. Plug the USB power adapter into the power outlet.
7. Press and hold the power button for 5 seconds until the indicator LED blinks green. The orange indicator LED switches off when the battery is fully charged.
8. Unplug the USB-C cable from the FS21.

9. Press and hold the power button for 10 seconds to enter deep sleep mode.
10. Screw the FS21 main module and soil moisture add-on back together. Make sure the locating pins align and the rubber O-ring is correctly installed.

> **ⓘ** To charge the FS21, ensure that the charger is capable of an output of 5V and at least 0,5 Ampere.

9 Installing the product

9.1 Enabling the FS21

> **ⓘ** The FS21 is delivered in a disabled state.

1. Open the FS21 by unscrewing the ring in a counter clockwise direction (when looking from the top).
2. Remove the soil moisture add-on from the FS21 main module.
3. Press and hold the power button for 0.5 seconds to enable the FS21.

The status indicator LED blinks green and a short beep sounds to indicate that the FS21 is now enabled.

After the FS21 is enabled, it will attempt to connect to the network.

Once a connection has been established a first measurement is sent to the Farm21 servers.

The FS21 status indicator in you dashboard should state 'connected'.

4. Screw the FS21 main module and soil moisture add-on back together. Make sure the locating pins align and the rubber O-ring is correctly installed.

9.2 Scanning the QR-code

Sensors are added to your Farm21 dashboard account by scanning the QR-code at the front of the sensor. In order to scan this code a smartphone or tablet with build in camera and appropriate software is required. Depending on your smartphone/tablet the scanning procedure differs slightly.

> **ⓘ** In order to read the QR-code it is important that there is enough ambient light for the camera to work. The QR-code has to be in focus and the camera should not be too close or too distant. If this does not improve the reading, try using a different QR-code scanner.

iOS

When using iOS 11 or later, a QR-scanner is build-in with the standard camera application.

1. Open the camera application and focus on the QR-code (no need to take a picture).
   A direct link to the Farm21 dashboard will now appear on the top of your screen.
2. Tap on the link to open the Farm21 dashboard.

> **i** If you are using an older version of iOS, go to the App Store, search for 'QR code scanner' and install a QR code scanner. Use this application to scan the Farm21 QR-code.

Android

When using Android, a QR-scanner is build-in with the standard camera application.

1. Open the camera application and focus on the QR-code on the sensor (there is no need to take a picture).

> **i** If this function is not available go to the Play Store, search for 'QR code scanner' and install a QR-code scanner. Use this application to scan the Farm21 QR-code.

9.3   Activate and link the FS21 to the dashboard

After scanning the QR-code on the sensor you are automatically redirected towards the Farm21 dashboard. A 'sensor activation page' will be prompted.

1. Fill in all the details for this particular sensor.
2. Login with your Farm21 account, if you are not logged in already.
   Each sensor requires the parameters as shown.
3. Fill in the required details and press 'submit' to add this sensor to your account.

> **i** The set sensor location is based on the current location of your mobile device at the point of registration. This can be adjusted later in the dashboard by selecting the correct sensor location on the map.

Name	Enter a name for this sensor.
Calibration type	Select the type of soil this sensor will be placed in. This setting determines what calibration profile is selected for this sensor.
Select a field	Select a field in which the sensor will be located in. Farm21 sensors have to be assigned to a field.
Location	Click 'Find my location' or leave as is. For this function your browser on your device should have access to your current location. The map allows you to check if the location is accurate. The sensor location can be adjusted later.
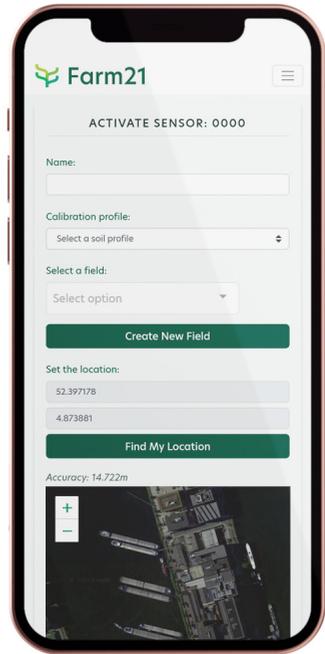
9.4 Placing the FS21 in the soil
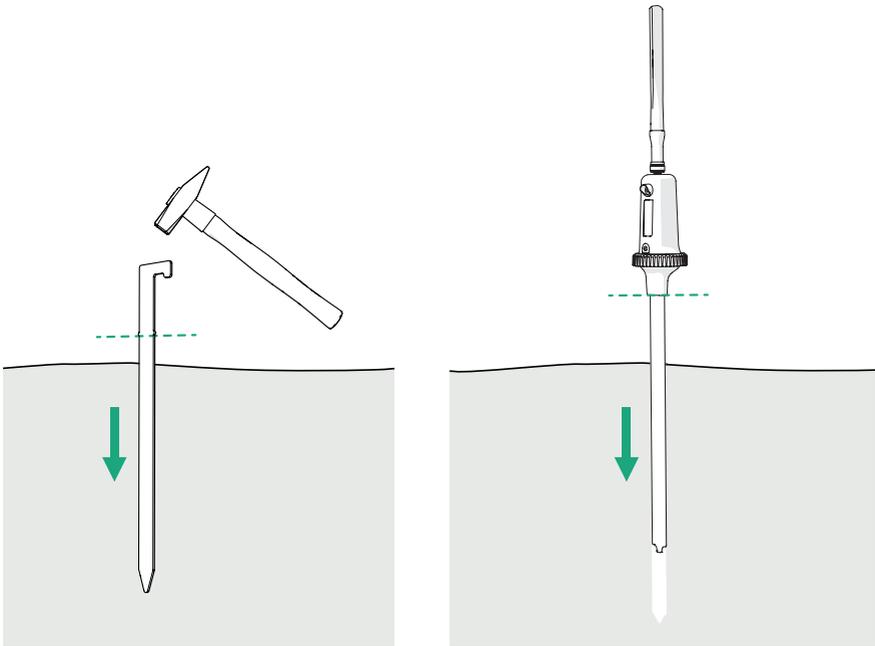
Figure 3

When placing the FS21 in the ground it is important to ensure a good physical connection between soil and sensor.
It is recommended to use a soil peg to create a guiding hole.

> ℹ See shop.farm21.com/products for available accessories.

1. Find a suitable spot to place the FS21. This can be based on your knowledge of the field, previous field scans or most representable area.

> ℹ The soil peg can either be pushed or hammered into the soil. Adding water helps to soften the soil in case of dry ground.

2. Remove the soil peg from the ground by pulling onto the upper lip of the soil peg.

> ℹ The hammer can be used to give sufficient grip since the soil peg might be fairly stuck in the ground.

3. Push the soil moisture add-on in a straight line into the soil. Eliminating side to side movement.
4. Do not apply too much force when pushing the FS21 into the soil, the soil moisture add-on should not flex more than 3 cm.

> ℹ️ Applying too much force onto the FS21 might cause the lower part of the sensor to break, resulting in sharp exposed edges. Do not use excessive force or tools during installation and ensure the lower part of the sensor does not flex more than 3 cm.

5. Make sure the FS21 is placed in between the crops, not on a driving track. Be aware that weeding machines can damage the sensor.
6. Mark the location of the FS21 using a marking stick to quickly locate a sensor without referring to the GPS coordinates.

9.5   Obtaining the data

Directly after enabling, the FS21 will attempt to connect to the network. Once a connection is established the FS21 will give a confirmation beep. After this the data is sent to the Farm21 platform every 6 hours. The Farm21 platform dashboard creates a visual representation of the data points to create a clear overview.
The data is only available for you and is secured by your personal login credentials.

9.6   Error codes

The FS21 communicates potential errors through LED sequences.
To check these error codes please visit: www.farm21.com/documentation

10   Troubleshooting

For troubleshooting your FS21 go to: www.farm21.com/faq
Here you will find answers to the most frequently asked questions.
When you are encountering any failures or other problems, please contact us at:
support@farm21.com

11 Maintenance & storage

> ⚠ **WARNING**
> * **Do not attempt to repair the FS21. If the FS21 does not operate correctly, replace it with a new FS21.**
> * **The FS21 does not contain any self-serviceable parts.**
> * **Do not clean the inside of the FS21.**
> * **Do not use aggressive chemical cleaning agents such as ammonia, acid or acetone when cleaning the FS21.**

11.1 Maintenance

Clean the outside of the soil moisture add-on after each use by using a wet piece of cloth.

> ℹ Cleaning the soil moisture add-on ensures a good soil contact in the next installation round.

11.2 Storage

1. Clear any dirt from the sensor using a damp cloth before storing the FS21.
2. Press and hold the power button for 10 seconds to enable deep sleep mode to prevent the FS21 from taking readings while in storage.
3. Store the FS21 in a warm and dry location.

12 Warranty

The FS21 is tested for correct operation before the FS21 leaves the factory. The warranty period is 12 months after delivery of the hardware.
For the duration of one year, Farm21 guarantees that any defect in materials or manufacturing defects will be repaired free of charge. The rights under the warranty lapse if the defects or damage are wholly or in part caused by improper use or incorrect treatment, or if they are in any other way attributable to the customer.

To qualify for warranty, please contact support: support@farm21.com

13 Disclaimer

Specifications and information in this document are subject to change without notice. Farm21 products are not warranted or authorized for use as critical components in medical, lifesaving, or life-sustaining applications, or other applications where a failure would reasonably be expected to cause severe personal injury or death.

14   Disposal

Please dispose of old devices in an environmentally friendly way.
Your FS21 contains valuable, recyclable materials which should be recycled. Please therefore dispose of your FS21 via a suitable collection systems.

15   Electromagnetic compatibility (EMC)

The FS21 meets the provisions of the EU Directive 2014/30/EU (EMC Directive) on the condition that the FS21 sensor has been installed properly. Should such interference occur anyway, relocate the FS21 sensor.

16   Declaration of Conformity

We, Farm21, as manufacturer, declare that the FS21 is in compliance with Directive 2014/53/EU.

The complete EU Declaration of Conformity can be found and downloaded via:
www.farm21.com/documentation

For other compliant-related information, please contact support:
support@farm21.com
www.farm21.com

Danzigerbocht 39G
1013 AM Amsterdam
The Netherlands
+31 (0)20 299 1621

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