



Manual

**Digital Soil
Moisture Meter**

hydroFarm

HFM3030

Revision A

06/2023
MAN_HFM3030

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To facilitate understanding and highlighting important aspects, some information is formatted as follows.

Note:

They present some detail or better explain some point of the text.

ATTENTION:

Indicate points to be observed by the user for correct use and maintenance of the equipment.

CAUTION:

They warn of situations that can permanently damage the equipment or cause other serious damages.

www.falker.com.br

falker@falker.com.br

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1 Introduction

The *HidroFarm* - Electronic Soil Moisture Meter - is an equipment that allows the measurement of soil volumetric moisture in a simple and direct way. It allows the technician responsible for the rapid identification of soil moisture content to control the availability of water to the crop and, if necessary, providing information for immediate change of water management in the analyzed area.

The measurement is made by an electromagnetic measure called ISAF (High Frequency Soil Impedance), which is proportional to the humidity. With innovative technology, *HidroFarm* analyzes moisture at a higher measurement volume and reduces the influence of other soil factors.

This manual covers all aspects related to the use of the equipment and guidelines for starting to use the Web Application and Falker Water App, which allows the visualization and analysis of collected data. However, this document is not an agronomic manual, and does not include post-measurement actions related to the treatment of volumetric soil moisture index.

Thank you for choosing Falker!

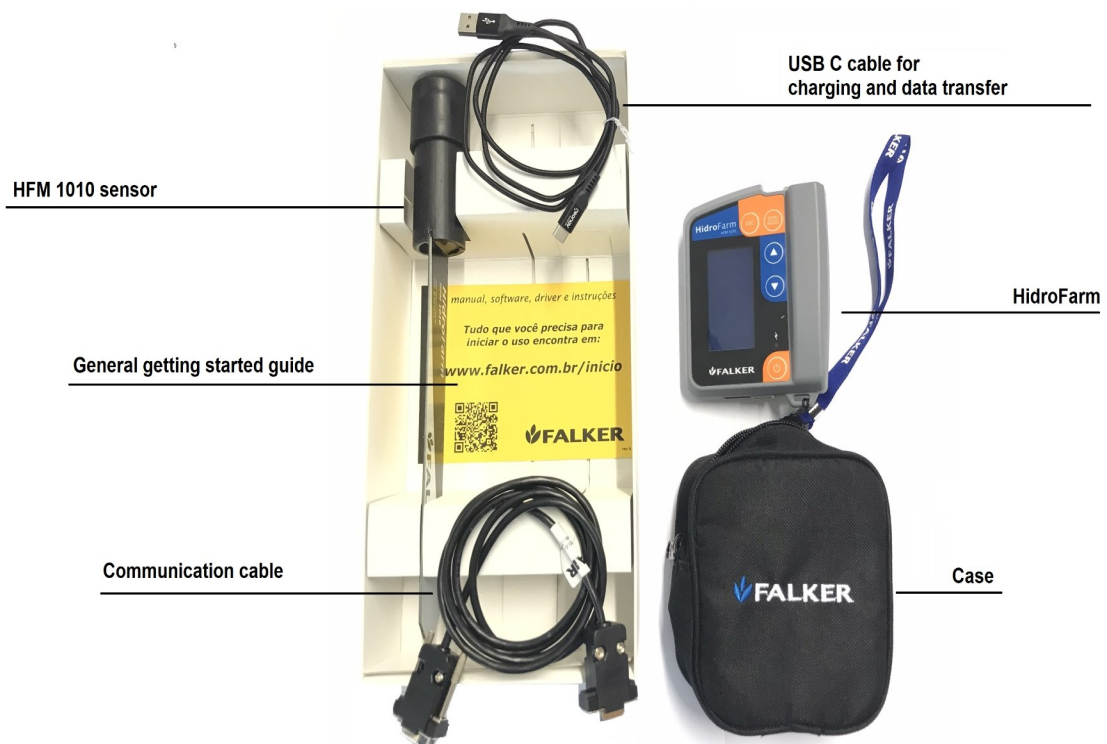


2 The Equipment

The equipment is supplied in a canvas case, suitable for use in the field. The following items are provided:

- Electronic equipment HFM3030
- 1 HFM1010 Sensor
- Connection cable with **HidroFarm** Sensor
- Protective case
- Handle safety strap
- Warranty term
- General Start Guide
- USB-A – USB-C Cable

Figure 1: Equipment Set



ATTENTION:

As an accurate measurement device, the HFM3030 must be transported with care. The equipment's case was designed to protect it in the best possible way for transport, but combined with the practicality of use. It is not a package to be transported as cargo.

2.1 Accessories

In addition to the items that come with the equipment, the following codes can be used to purchase accessories or replacement items.

Tabela 1: Accessories Commercial Codes

FLK9020	USB-A - USB-C Cable
FLK9030	USB-A Output Socket Charger
HFM8200	HidroFarm Sensor Connection Cable
HFM1010	ISAF Soil Moisture Sensor 20 cm
HFM8330	Extender for sensor installation - 30 cm

3 Basic concepts

This chapter presents some basic concepts for the user to carry out a correct interpretation of the results obtained with the equipment, since the determination of moisture is an essential factor for the success of several interventions carried out in the soil..

3.1 Volumetric Humidity x Gravimetric Humidity

HidroFarm informs users the value of soil volumetric moisture in%, ie the volume of water contained in a given volume of soil sample. It is the same moisture that is obtained in the evaluation with undisturbed samples, withdrawn with rings of known volume. Volumetric moisture may be related to gravimetric moisture. Therefore, it is necessary to know the soil density, since the gravimetric moisture refers to the percentage of the sample weight corresponding to the water. The following formula can be used to establish a relation:

- Gravimetric Humidity

$$U_g = \frac{\text{mass of water (g)}}{\text{mass of soil (g)}} \times 100$$

- Volumetric Humidity

$$U_v = (U_g \times 100) \times D_s$$

from density to density alone (g / cm³), to gravimetric umidation (%) and to volumetric umidation (%).

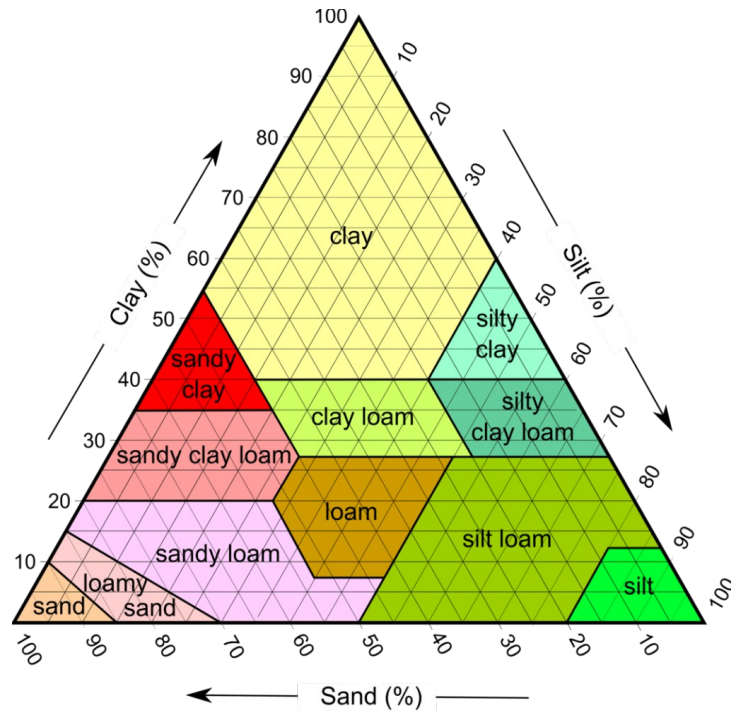
The density of water as 1 g / cm³ is considered in the formulas cited above.

3.2 Point of Permanent Wilt and Field Capacity

There are two soil attributes that are fundamental for the understanding and use of soil moisture data: the permanent wilting point (PMP) and the field capacity (CC). The PMP is the moisture content at which the plant can no longer draw water from the soil. CC is the maximum capacity of the soil to retain water, above which losses occur due to percolation of water in the profile or through surface runoff. These two factors are variable according to the soil class. For a better understanding of these factors, it is recommended to read the **Nota de Aplicação - Aplicações do HidroFarm - NAP_HFM2010_001**, available on the Falker website.

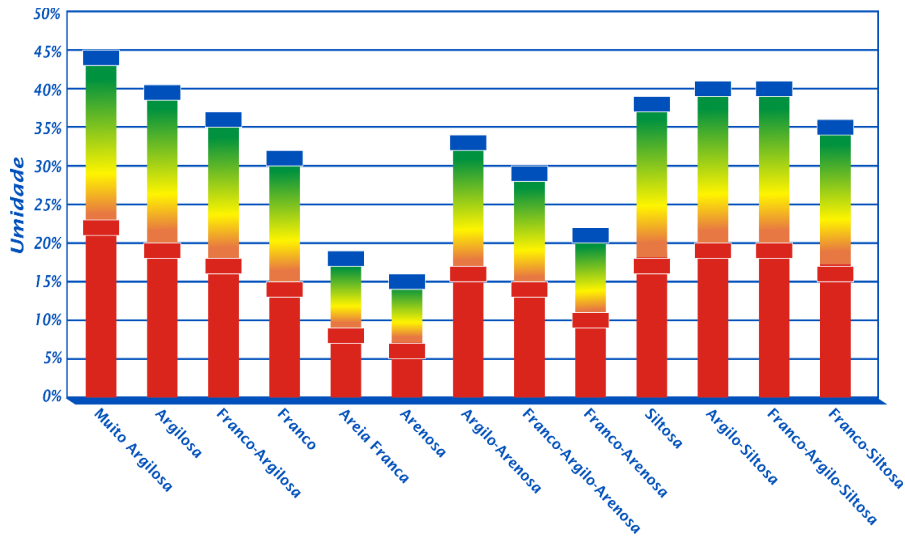
It is quite usual to manage irrigation systems with the use of these attributes, triggering the systems before the soil reaches the PMP content and turning off when the field capacity humidity is reached, reducing water losses, reducing irrigation costs and increasing productivity. The determination and classification of the type of the soil in which it is being worked can be done with the data of% of clay that is obtained in physical analyzes of the soil, using the triangle of figure 2.

Figure 2: Soil texture classes triangle






The graph of Figure 3 shows the soil texture classes and their respective average CC and PMP points for most volumetric moisture content cultures read in **HidroFarm**.

Figura 3: Moisture content ranges for soil classes.



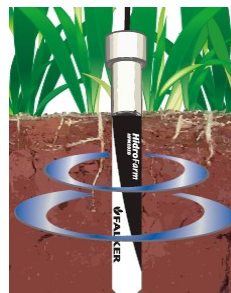
Subtitle

-  **CC** - Field Capacity:
Maximum humidity for soil water storage.
-  Range of available soil water to plants.
-  **PMP** - Permanent Withering Point:
Humidity in which the plant dies from dehydration.

3.3 Measurement range

The value reported by the meter refers to the average soil volumetric moisture present at a distance of 15 cm from the sensor and along its 20 cm length. See section 8 for more details.

Figure 4: Example of the area of coverage of the waves emitted by the sensor.



This feature may lead to an incorrect interpretation of the *HidroFarm* values. Soon after a rainfall, natural or via central pivot, it is possible that only part of the soil profile has been moistened, because the front of soil wetting takes some time to expand and stabilize according to the soil type, being this time larger in clayey soils, which have a large presence of micropores. Therefore, if the wetting front has reached only 10 cm, it means that we will have another 10 cm of dry soil that will be in contact with the plate. Thus, the reported value will be the average humidity of the 10 cm wet and the other 10 cm dry.

The frequency range at which moisture is measured greatly reduces the interference of factors such as texture and salinity, ensuring accuracy within the limits of the equipment.

ATTENTION:

In order to obtain a measurement with greater accuracy than those described in this manual, a specific sensor calibration is recommended. There are several methodologies available for this.

3.4 One-off measures

It is not possible to perform specific measurements of humidity with the sensor, such as determining the exact humidity at 15 cm depth. If the sensor is installed horizontally, at 15 cm depth, it will perform the average reading in an area of 30 cm in diameter, that is, the range from 0 to 30 cm deep.

3.5 Measurement of humidity in organic materials

The use of the HidroFarm sensor to measure grain moisture or organic maintenance is advisable only after a specific evaluation. The presence of large air gaps between the particles of the material may impair the quality of the measurement. A specific calibration is therefore required in these cases.

The standard equipment calibration was developed for mineral soils.

3.6 Sensor life

The sensor is made from materials resistant to time exposure, mainly based on fiberglass. When permanently installed in the ground, it must be maintained with the protective cap.

The biggest cause of sensor wear is the installation process and its friction with the ground. In case of successive installations, the soil texture and presence of stones will determine the useful life. In soils without gravel, tests were carried out with a useful life of more than 400 installations.

3.7 Comparing measurements

Several studies have shown that soil moisture can vary greatly over small ranges. With this, it can not be guaranteed that two sensors, installed side by side, will provide the same reading.

4 Installation

Among the applications and ways of using HidroFarm we can highlight the continuous monitoring and the instant measurement.

Continuous monitoring occurs when the user leaves the sensor installed in a particular location and performs periodic measurements. This form of use presents advantages as to the quality of the data obtained, because with the sensor permanently installed, the soil around this tends to be structured in a natural way, improving the contact with the active area of the sensor.

An instantaneous measurement can also be made with HidroFarm and, for this type of measurement, a greater attention is paid to the installation procedures described below.

HidroFarm measures soil moisture using electromagnetic principles. Electromagnetic waves are emitted and the response of the soil to these waves is analyzed. The water presents different responses of the structure of the soils. The technology used is unique, called ISAF (High Frequency Ground Impedance). For proper operation, it must be completely buried, with the active area in permanent contact with the ground..

For best results with measurements, the sensor must be installed using one of the following methods:

- Direct insertion (item 4.1)
- Insertion using auxiliary tool (item 4.2)

To keep the sensor installed at greater depths, the HFM8330 extender must be used. Further details on the installation and use of this accessory can be found in item 4.3

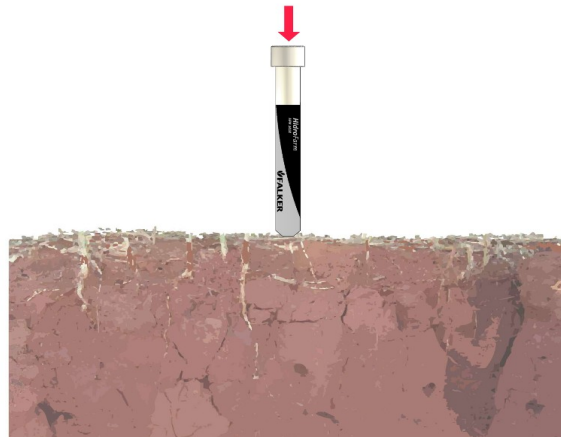
4.1 Direct Insertion

This method can only be used on soils with low compaction. It consists of drilling the soil with the sensor itself.

To drill the ground with the sensor, grasp it with one hand in an upright position and then press it down with the other hand, without making lateral movements or exerting impacts on it.

This method is most appropriate when the instantaneous measurement of data is required, since the soil structure is little affected.

Figure 5: Direct insertion of the sensor into the ground

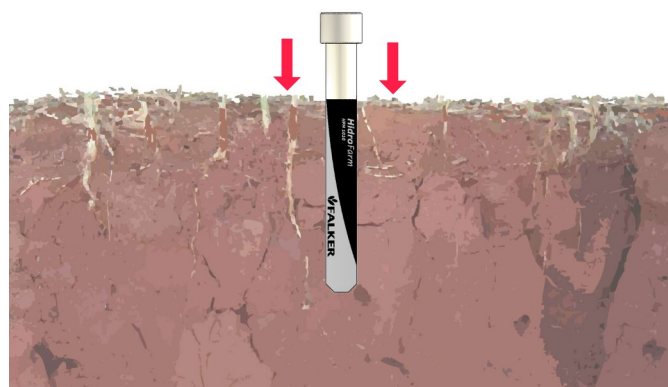


CAUTION:

If you notice that due to the force applied to the sensor to bury it in the ground, any deformation or torsion occurs in your active area, immediately interrupt the direct insertion procedure and start using the auxiliary tool insertion method. Otherwise, the sensor may be permanently damaged.

To finish this installation step, lightly press the ground on the sides of the sensor so that there is direct and complete contact between the sensor and the ground.

Figure 6: Ensuring contact between the ground and the sensor

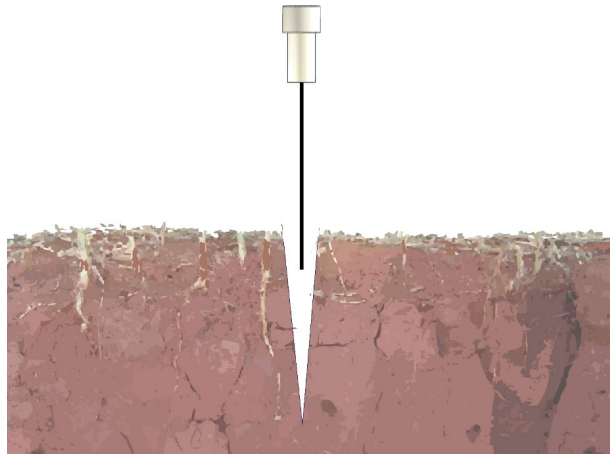


4.2 Insertion using Auxiliary Tool

If it is not possible to drill the ground with the sensor itself, use a cutting tool (cutting blade, knife) to create only an incision, a "tear" in the ground, facilitating sensor entry.

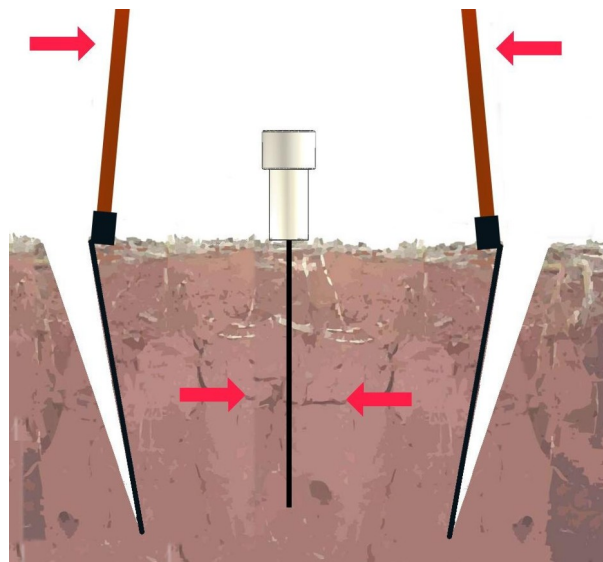
This method presents lower initial precision because it changes the soil structure around the sensor. If the sensor is installed a long time, this method can be used without loss in data quality, since the soil will tend to its natural condition over time.

Figure 7: Insertion of the sensor into a tear made in the ground



After insertion of the sensor into the created incision, the contact between soil and the sensor must be guaranteed. The best way to ensure this contact throughout the sensor is to insert a cutting blade about 20 cm away from where the sensor was installed on both sides and press the ground towards the sensor.

Figure 8: Use of cutting blade to ensure contact between the ground and the sensor



ATTENTION:

The entire active area of the sensor must be in contact with the ground.

Note:
The longer the sensor remains installed at the same point, the greater its accuracy due to the accommodation of the soil in its surroundings. Therefore, if feasible, keep the sensor installed at the same point and perform the measurements over time without changing the sensor position.

4.3 Using and Installing the Extender

To keep the sensor permanently installed at greater depths, it is necessary to use the optional extender for sensor installation - 30cm - HFM8330. This accessory allows the installation of the sensor up to 30 cm depth, which allows the evaluation of the range of 30 cm to 50 cm from the soil profile.

For installation, remove the topsoil from the depth required to assess the range of interest.

Install the sensor as recommended in 4.1 or 4.2.

Note:
Even for the measurement in deeper layers, it is necessary a maximum contact of the soil particles with surface of the sensor, in order to guarantee a high precision in the obtaining of the humidity of the ground.

Connect the extension cable to the sensor. Attach the extender sleeve to the sensor handle.

Apply the silicone that comes with the accessory and wait about 15 minutes to ensure the silicone is dry.

Figure 9: Sensor installed in the subsurface of the floor together with the extender after opening the trench



Replace the removed soil to open the hole, leaving it again at the same level as the soil.

ATTENTION:
Insert the sensor into the ground without the extender. Installing the sensor with the extender may cause it to break.

Figure 10: Sensor and extender installed and ready for measurement.



Place the cap that was used on the sensor at the end of the extender, aiming at protecting the connector.

Note:
Soil moisture located in the layer immediately above where the sensor is located does not interfere with the measurement..

4.4 Connection Between Meter and Sensor

With the sensor installed in the ground, remove the sensor cover, taking care not to displace the sensor and cause the soil to disintegrate in its surroundings.

Connect one end of the communication cable to the meter and the other to the sensor.

Turn on the meter and verify that the letter “S” appears in the lower left corner of the main screen. It indicates that the meter has detected the sensor and is able to take measurements. During measurements, the connection to the sensor is graphically represented on the screen..



Note:
For connection between the sensor and the meter when using the extender, repeat the same steps as in this item.

ATTENTION:
HidroFarm uses electromagnetic waves to perform moisture measurement. Therefore, when making a measurement, stay away from the sensor and do not allow the cable to come into contact with the ground, thus avoiding interference. Always keep the same pattern in measurements to ensure repeatability of .

ATTENTION:
When the sensor is not in use, keep it with the cap as the connector is sensitive to moisture.

5 Operation

5.1 Basic Operation

To turn on the device, press the on/off  located on the down side of the panel. To turn off, hold down the on/off button  at least for five seconds.

When using the HFM3030 for the first time, the language and local operating time of the equipment are defined..

Figure 11: First use screens







To set time, GPS signal is required. If a message of no GPS signal is displayed, go to an outdoor place.

If it is not possible to perform this operation, it will be possible to set the time at another moment, in the device settings menu. To start the use without setting time, turn off and turn on the device so the the Gps no signal message will be displayed.

5.2 Basic operation

Figure 12: User interface



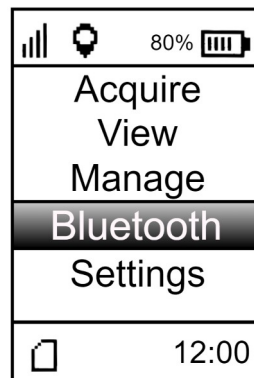
The operation of the device is done with the following buttons     and the screen, where the measurement values, warnings and user information as the state of charge, memory occupation and GPS signal are displayed.

When turning on the device, after an initialization screen, the main screen appears. The following information is displayed on this screen: battery level and GPS position indication at the top. Also time indication (only when GPS is receiving data) and memory usage are displayed at the bottom.

The memory usage is shown by the icon (memory card) represented by the filling steps, which indicate the memory usage.

The icon with 4 vertical bars indicates the device's GPS signal strength. If it has a signal, the main screen also indicates the time, based on data from the GPS itself.





Figure 13: Main screen



In the main screen, there are 5 options:

- **Acquire:** menu used to acquire new data.
- **View:** menu used to visualize acquired..
- **Gerenciar:** menu que permite definir referência, adicionar, editar ou apagar trabalho.
- **Bluetooth:** menu that allows to enable or disable Bluetooth and display its status.
- **Settings:** menu of the device's settings.

All the above menu offer their own options.

The navigation between the menu options is done by the following buttons  e . The button  selects the chosen option. The button  returns to the previous screen.

5.3 Data acquisition

Utilize o menu “Aquisição” para realizar medições.

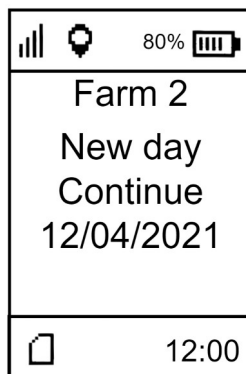
After selecting the “Acquire” menu, the work selection screen will be opened, as shown in the figure 5 below.

Figure 14: Work selection



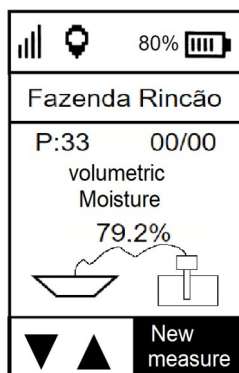
After selecting the desired work, the following screen will be displayed:

Figure 15: “New day” or “Continue” screen



There is the option to continue one day work or start a new day. After selection, the calibration screen will open.

Figure 16: Measurement screen

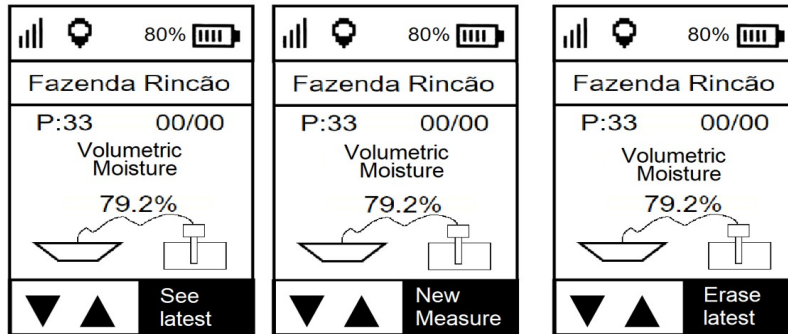


To perform measurements, the user must access the “Measurement” option in the menu. Obtaining data with HidroFarm is a quick and simple procedure.

In measurement mode, pressing , the meter will communicate with the sensor and read the moisture.

The data obtained in the measurement, as well as its attributes, are automatically stored in the equipment's memory. If the data was obtained in error, the user can erase it and redo the measurement. On the measurement screen, using the directional arrows, four features can be accessed.

Figure 17: Resources of the measurement screen



- **See latest:** feature used to check measurements taken at the current point.
- **New measure:** Performs a measurement.
- **Erase latest:** delete the last measurement at the current point.

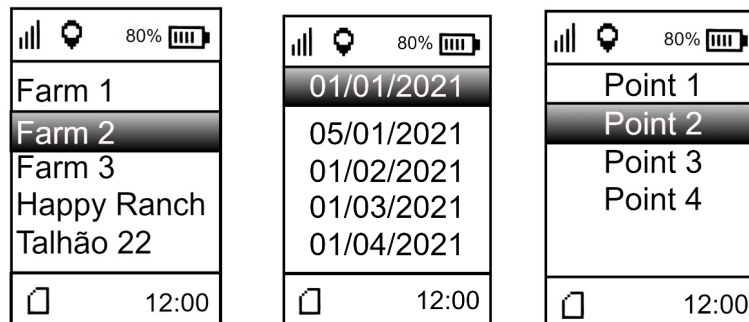
CAUTION:
For equipment conservation, avoid impacts, falls and exposure to rain

5.4 Data visualisation

HidroFarm has basic features for viewing data on the equipment itself, without the need for data transfer.

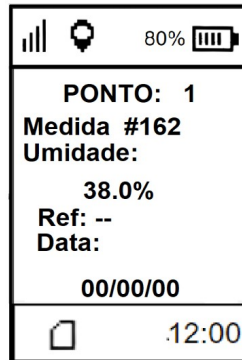
In the “View” menu, the job selection will open. After selecting the job, the date selection shown in the figure below will open.

Figure 18: Home screens for choosing the point to be viewed



After selecting the point, the measurement visualization screen opens..

Figure 19: View point measurements

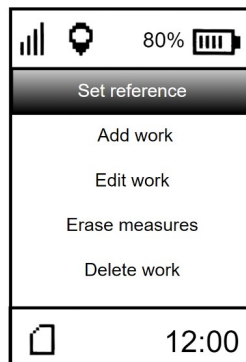


In “Measurement”, the identification of the humidity measurement carried out at the point in question is presented. In “Humidity” the humidity value of that measurement is displayed. The reference and measurement date are shown at the bottom..

5.5 Manage

When selecting the “Manage” menu, the following screen opens.

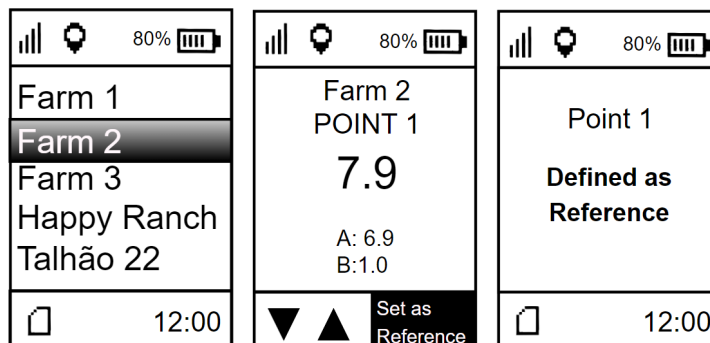
Figure 20: “Manage” screen



- **Set reference:** sets the average of the measurements of a point as a reference in any measurement view.
- **Add work:** Adds a new work.
- **Edit work:** Edit an existing work.
- **Erase measures:** deletes all measures for a given work.
- **Delete work:** Deletes an existing work.

When clicking on the “Set reference” menu, a screen will appear for choosing the work where the point you want to define as a reference is located. When selecting the work, the screen will appear containing the existing points in that work, using the directional buttons it is possible to choose the desired point. To select the desired point, use the enter key.

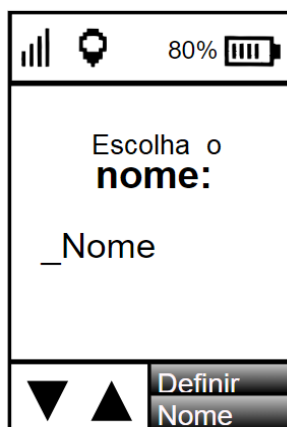
Figura 21: Telas definir referência



By clicking on the “Add work” menu, the screen for choosing the name of the new work will open. To choose the letters, use the directional arrows. To confirm the letter, use the enter key. After choosing the name, the screen for choosing the number of points that will compose the new work is opened. Finally, it is necessary to choose the number of measurements that will be part of each point. The figure 16 below shows the chaining of screens in the “Add work” menu.

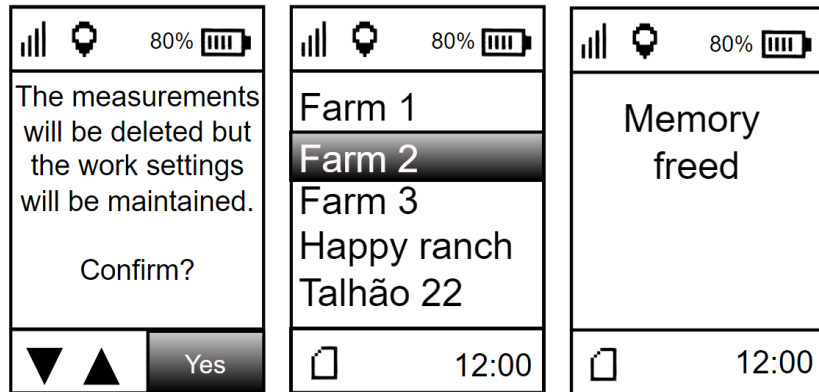
Selecting the “Edit work” menu, it is possible to edit the name, number of points and number of measurements of an existing work. The figure below shows the screen in the “Edit work” menu.

Figure 22: Edit work



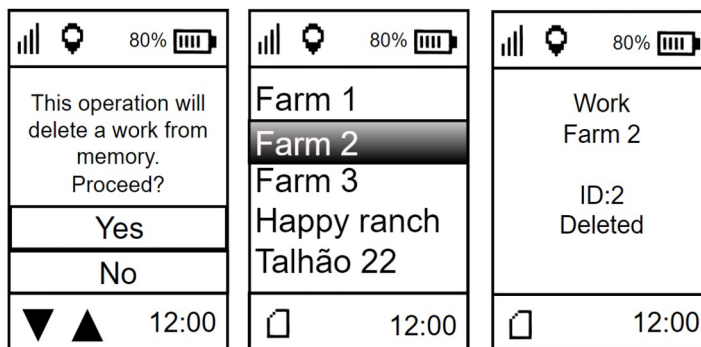
By selecting the “Delete measurements” menu, a warning screen will open informing you that the measurements will be deleted but the structure will remain. On the same screen, confirmation is required to continue. On the next screen, you are asked to select the work that will have its measurements deleted. The last screen is the confirmation of the action. The figure below shows the chaining of screens in the delete measurements menu.

Figure 23: Delete measurements



By choosing the “delete work” menu, it is possible to delete the entire structure of a previous work. The first screen that opens tells you what the operation will do and requires confirmation to proceed. On the second screen, the work to be deleted must be chosen. The last screen is confirmation that the action was done correctly.

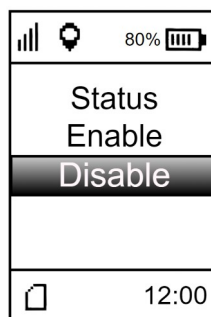
Figure 24: Delete work



5.6 Bluetooth

Selecting the “Bluetooth” menu opens the following options

Figure 25: Bluetooth screen

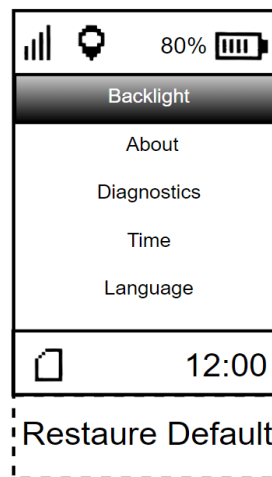


In “status” option it is possible to check if the bluetooth is enabled or disabled. Selecting “enable” the bluetooth will be activated. By selecting “Disable”, bluetooth will be disabled.

5.7 Settings

When selecting the settings menu, the following screen opens.


Figure 26: Settings




In “Backlight” option it is possible to change the intensity of the equipment screen brightness. In “About” it is possible to check information about how many measurements are stored in the memory, the battery charge level and the battery temperature. In the “Diagnostics” menu some more specific information about the battery, GPS, Memory, Sound, LEDS can be obtained.

5.8 Internal GPS

The HidroFarm model 3030 already has an internal GPS, which allows georeferencing all measurements, and even recording the date and time they were taken. This model does not need an external antenna or cables and accessories for it. As an indication, the HidroFarm screen will have two icons for checking the GPS signal.

 An icon identifies whether the equipment was able to calculate the current position. For this, it is necessary to have at least 3 satellites visible by the equipment, since the GPS signal depends on the triangulation between satellites so that the current position is known. Position accuracy will depend on signal quality..

 The other icon identifies the signal strength.

The 4 levels indicate the accuracy of the data acquired by the GPS. For better precision, it is always recommended to wait for the signal to remain with 4 bars, aiming at greater precision in the acquired coordinate. Depending on weather or environmental conditions such as clouds and trees, it may not be possible to get all 4 bars.

5.9 Screens

The chaining of the screens is mainly done by the keys. Following the screen navigation scheme presented below, in addition to carrying out the moisture index measurements, we can also view these measurements and configure equipment settings.





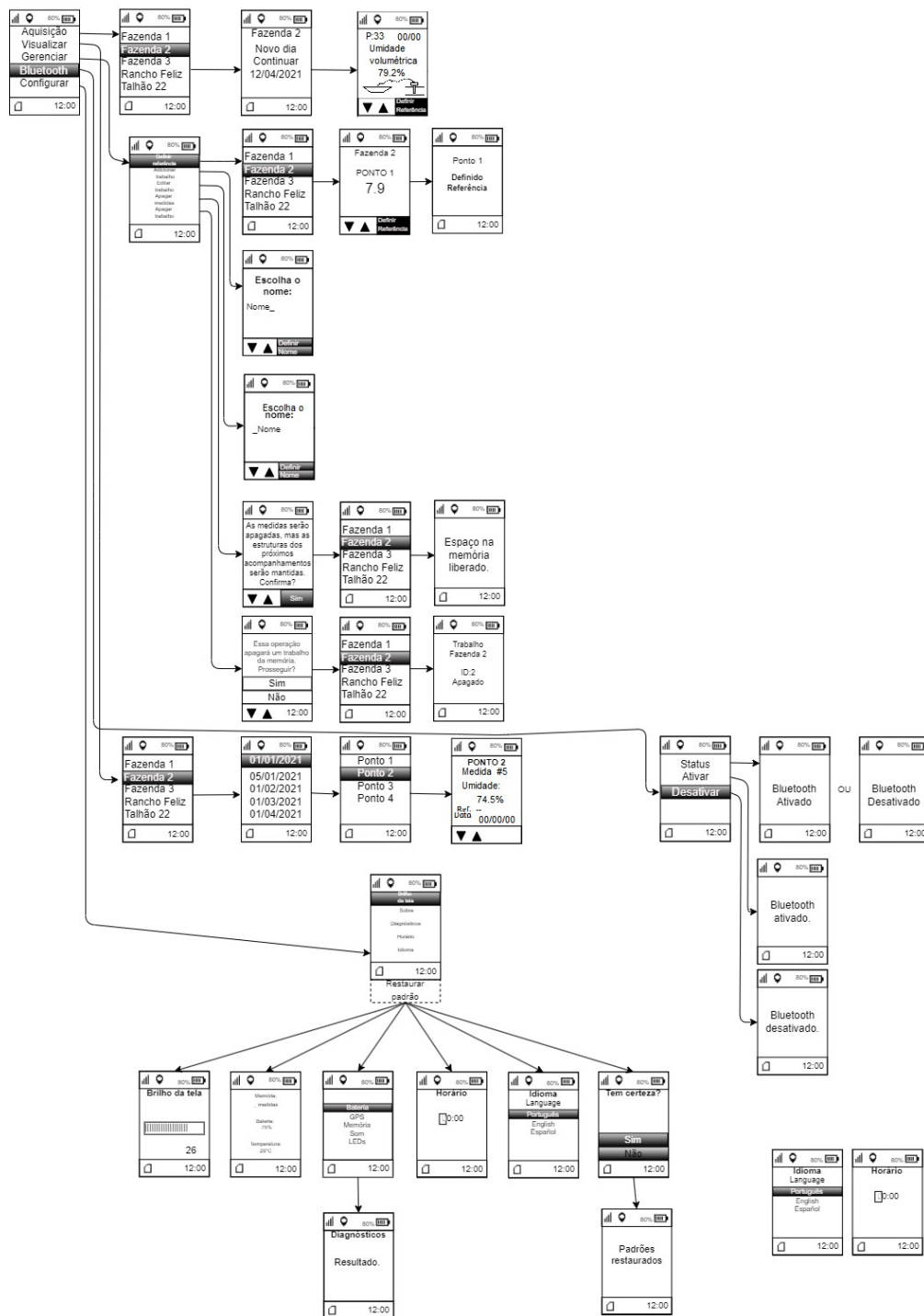
Navigation between the different screens of the equipment is simple and intuitive, using the keys as commands.  and  to change settings, view measurements, etc., and the keys  and  to enter and exit a screen respectively.

Figura 27: Device screen chaining



5.10 Falker Water - Data Visualization and Analysis



The Web Application could be access in:

water.falker.com.br

And the App is available for Android devices on the Google Play Store platform. Search for "Falker Water"

HidroFarm has a specific Web Application and App for viewing and analyzing the collected data.

In an online system, with data saved in the cloud and automatic synchronization between the Web and the App, you can access information from anywhere for analysis or sharing. It also allows the generation of measurement reports for presentation.

Note:
The Falker WATER System for transferring and analyzing data on the computer is constantly evolving.
Follow the directions directly in the system.



The System also allows customizing and exporting reports to present the measurement results, including graphs, parameters and attributes of the collected data.

5.11 Data transfer

Data transfer can be done in two ways:

- **Data transfer can be done in two ways.**

The data must then be uploaded to the Falker Water web system via a computer. Windows will open a directory called, "HFM2BOOT" where the file will be available to be copied. The file format is ".FH2".

- **Bluetooth:** pair the equipment with a smartphone and transfer measurements from the equipment to the App via Bluetooth. The first moment the smartphone receives an internet signal, it will automatically synchronize the data in the cloud, in the Falker Water system.

6 Basic maintenance

6.1 Battery charging

The HidroFarm has an internal battery that must be charged with the original cable, connected to a charger with safe USB output or to a device with USB. Avoid using chargers that are not approved by the responsible bodies..

The connector compartment is protected by a sliding cover. Access is given by moving the cover to the right.

Figure 28: Output access



During charging, the red LED is on. When charging is complete, the LED turns off.

6.2 Device cleaning




Always keep the equipment clean, removing any dirt resulting from contact with the plants with a dry cloth.

The equipment is not waterproof. However, it has external resistance to splashes, so care should be taken in the region of the USB C connector.

If calibration difficulties occur due to dirt in the measurement chamber, it is necessary to clean it using only a small piece of cotton or cotton swab. If necessary, moisten it with water only. Do not use any chemicals.

6.3 Software atualization

The equipment's embedded software, which controls its operation, can be updated by the user himself with files provided by Falcker.

To do this, you must enter the mode called "Bootloader". With the equipment turned off and disconnected from the charger, keep the keys pressed  and . Keeping the two keys pressed, turn on the equipment using the key . The equipment will remain with the display off or with the indication of "Bootloader". Okay, now the equipment has entered Bootloader mode.

After that, connect the equipment to the computer, using the same charging cable.

The computer will recognize chlorofiLOG as a removable media, which can be located by clicking on “My Computer”, in computers with Windows.

Select the file provided by Falker (revxxx.fs2), select the file and drag it to the **HidroFarm** folder in “My Computer”. The update process will happen automatically, and it only takes a few seconds.

CAUTION:

Do not attempt to update using files that you are not sure have been supplied by Falker and are suitable for your device version. Attempting to update with unlisted files may lead to maintenance at Falker.

Updating the equipment software is an existing feature to allow the equipment to be updated and the eventual addition of new functions without the need to return the equipment to Falker.

6.4 Another questions

If you need other maintenance or have questions not covered in this manual, please contact Falker.

www.falker.com.br

falker@falker.com.br

In case the above instructions are not enough and the problem persists, please contact Falker.

7 Technical specifications

The following table presents the main technical information of the equipment.

Table 2: Technical specifications

HFM3030	
Precision with factory calibration	±3%*
Measurement Scale	0 to 60%**
Measurement Resolution	0,1%
Duration of a Measurement	Less than 2s
Memory Capacity	20.000 measures
Measurement Volume	Cylinder of approx. 15cm radius and 20cm depth***
Operating Temperature	0 to 50 °C
electrical supply	Internal rechargeable battery via USB-C connector****
Battery Life	More than 20 hours of use
User Instructions	Graphic LCD Screen with BackLight sound indication
keys	4 for operation, 1 on/off
Equipment Weight	250 g (with battery)
GPS receiver	integrated internal
Communication	USB and Bluetooth
App/Software Web	Falker Water

*Factors such as soil salinity, texture and pH can interfere with this value. A specific calibration after installation can be done to increase accuracy.

**Where 0% completely dry soil and 60% total porosity completely filled with water.

***For subsurface installation, extension cables are required. Extender is sold separately.

****Compatible with cell phone chargers. Charger is sold separately.

7.1 Dimensional information

Equipment dimensions are shown in the figure.

Figure 29: Dimensions in mm



7.2 Anatel homologation for equipment HFM3030i

This product contains the Bluetooth card approval code 05118-16-10070.

