

Open Farmer Kit

How it works

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Powered by:

Polifactory, Politecnico di Milano's
FabLab and Makerspace

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POLIFACTORY
POLITECNICO MILANO 1863



**Distributed
Design**

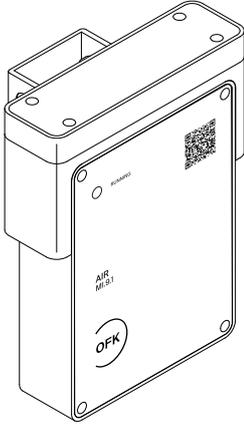


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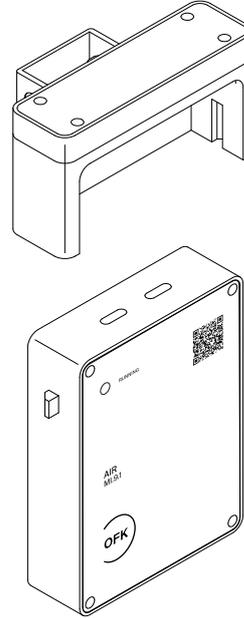


The Air module operates in complete autonomy and does not need to be handled by the urban farmer. It monitors air temperature, humidity, PM 10 and PM 2.5 levels hourly and transmits them to the Operational module.
An LED indicator "RUNNING" will light up whenever the module is collecting and sending data.
In case of malfunction or failure to send data, it is possible to remove the form from the structure by pulling it off its base.

1



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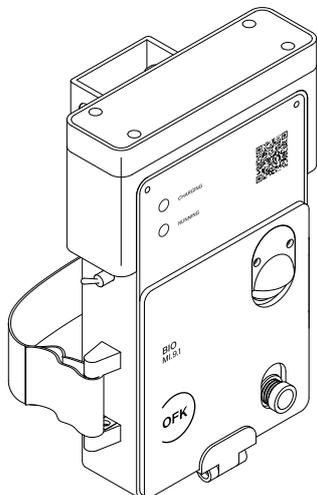


The Bio module monitors the presence and variety of local pollinators. It is equipped with a PIR motion sensor, a camera, and an SD card. On the front of the module is a flip-top with colored stickers that act as an attractor for pollinators. The PIR sensor, when it detects motion, gives input to the camera to take a picture, which is saved on the SD card. A Velcro strap allows the module to be placed in different places by attaching it to poles, trees, branches, or various supports.

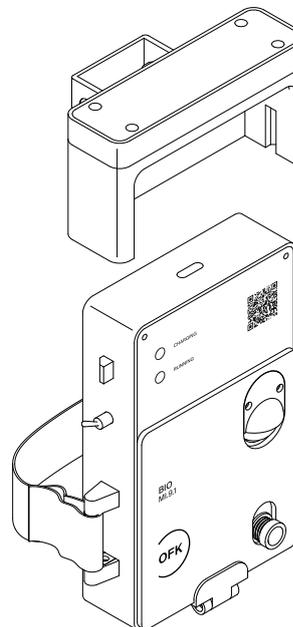
Each monitoring session should last around three hours, preferably at pollinator activity time, such as in the morning.

To retrieve photos, after a few days of monitoring, open the cover of the module, take out the SD card and save the photos to a device.

1



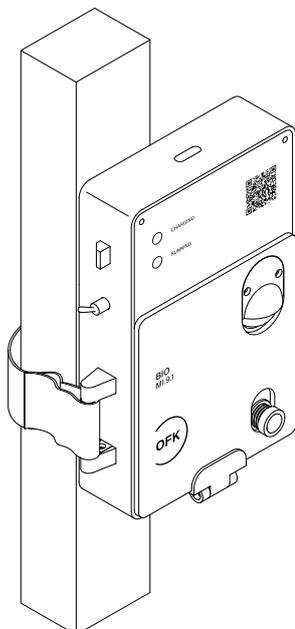
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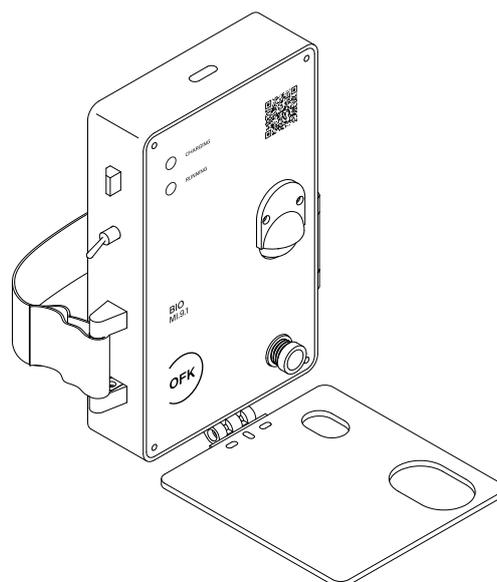
Make sure that the "CHARGING" LED is on

Detach the module from the base

3



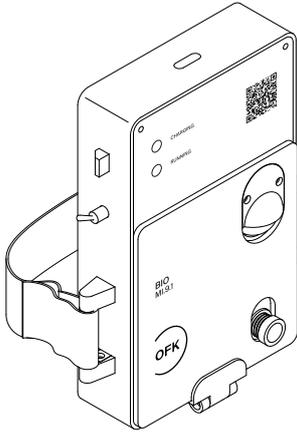
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Attach the module to a stand using the Velcro strap

Flip the front plane, turn on the module, make sure the "RUNNING" LED is on and leave it in place for about three hours

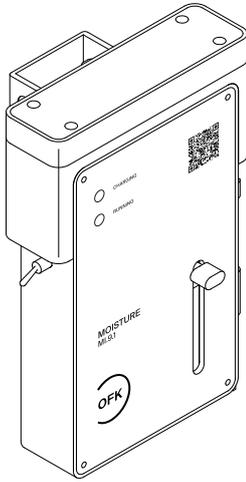
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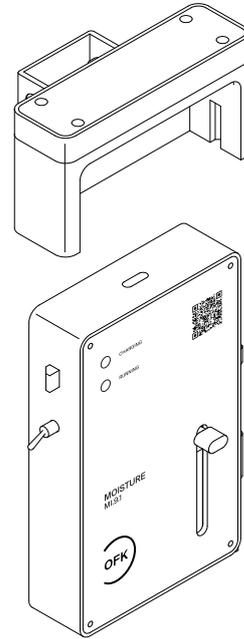
Turn off the module, close the shelf and place it back into the charging base. To retrieve photos open the cover by unscrewing the screws and take the SD card

The Moisture module measures soil moisture. It is equipped with a moisture sensor, a GPS to geolocate the measurement, and a LoRa module to send the data to the Operational module.
Perform monitoring whenever you consider it necessary. In case of malfunction or failure to send data, it is possible to remove the form from the structure by pulling it off its base.

1



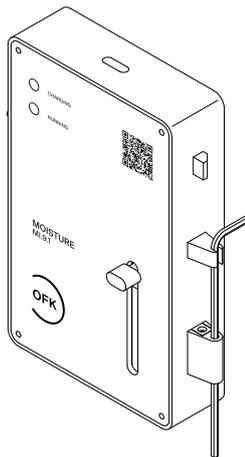
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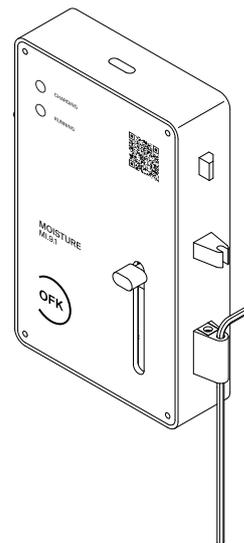
Make sure that the "CHARGING" LED is on

Detach the module from the base

3



4

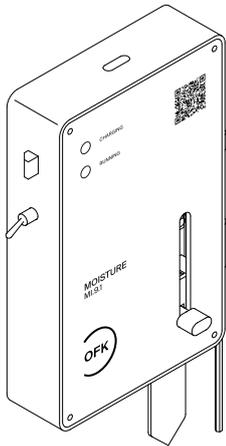


Place the module on the soil to be monitored

Drive the stake into the ground

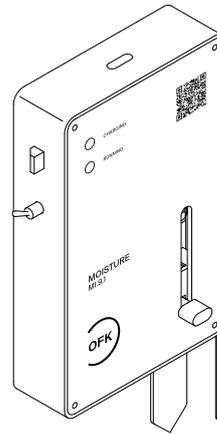


5



Slide the sensor via the slider into the ground and turn on the module via the side switch. Wait until the "RUNNING" LED stops blinking and turns green

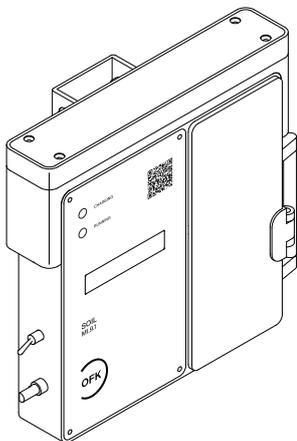
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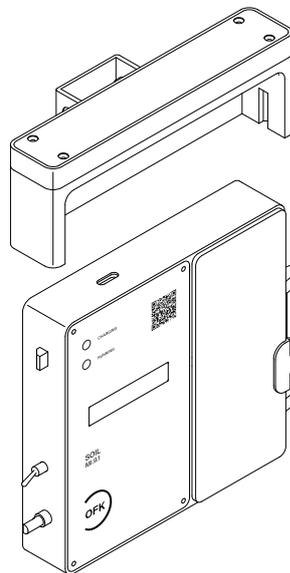
Turn off the device, if necessary clean the sensor with a tissue

The Soil module deals with the monitoring of soil health and fertility. It is equipped with the HI3895 soil test kit from Hanna Instruments . The kit reliably measures the most important elements for plant growth, namely pH, nitrogen (N), potassium (K), and phosphorus (P). The module is equipped with a screen, encoder, GPS and LoRa module to geolocate and send the measured data to the Operational module. It also contains the essential materials for analysis, such as testers, pipette, test tubes and result comparison cards. In addition equip yourself with a small container (a glass is fine), water and a cloth.

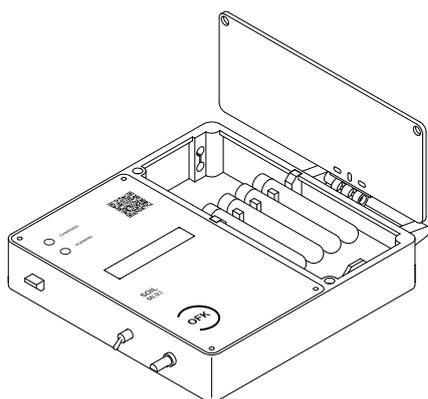
Your soil should be tested prior to seeding, planting and fertilizing as well as when other soil, manure or compost has been added and not only when the plants do not seem to be in a tip top condition (yellow leaves or stunted growth)

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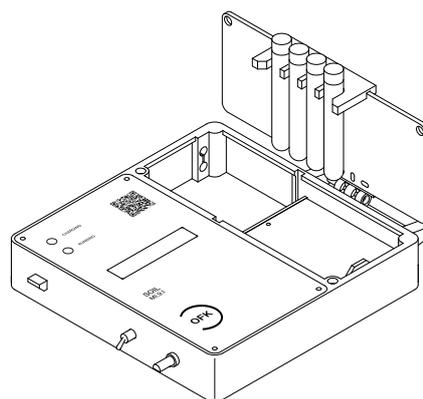
Make sure that the "CHARGING" LED is on

2


Detach the module from the base

3


Place the module on the ground near the ground to be analyzed and open the door

4


Take out the holder with the tubes and place it on the top of the lid. Analyze the soil following the instructions found in the next page

Sampling

1. Extracting Soil Sample: with a large field, take 1 or 2 samples per 1000 m² acre of homogeneous areas. Even for smaller areas, 2 samples are recommended (the more the samples, the better the end-results). If you have a small garden or plot, 1 sample is sufficient
2. Avoid extracting samples from soil presenting obvious anomalies
3. Sample quantity: take the same quantity of soil for each sample. For example, use bags with similar dimensions (1 bag per sample)
4. Depth of extraction:
 - General: dig and discard the 5 cm (2") of topsoil
 - For lawns: take the sample at a depth of 5 to 15 cm (from 2" to 6").
 - For other plants (flowers, vegetables, shrubs): from 20 to 40 cm of depth (8" to 16")
 - For trees: Samples from 20 to 60 cm of depth (8" to 24").
5. Mix all the samples together to obtain a homogeneous mixture of soil

Reading the color card

The pH, phosphorus, and nitrogen tests use colorimetric trace, Low, Medium or High. If the color of the test tube falls between two standard colors, e.g. between Medium and High, the test result is then Medium-High. Eight different readings are possible, Trace, Trace-Low, Low, Low-Medium, Medium, Medium-High, High, and very-High.

The potassium test utilizes a turbidimetric method. To obtain the test results, rest the tube against the color-card over the reading area. Stand with the light source behind your back. Start at Trace, look through the tube, and go to Low, Medium or High until you see the white line in the middle of the reading area of the color-card. The test result is obtained in Trace, Low, Medium or High.

Performing the test

pH test

Add half a teaspoon of soil to the test tube and fill it to the lower graduation mark with water (2.5 ml): use the graduated card for the measure. For best results, use bottled or distilled water. Add the content of one packet of HI 3895-pH reagent, replace the cap and shake gently for 30 seconds. Allow the tube to stand for 5 minutes. Match the color with the pH color-card and read the pH value.

Nitrogen, Phosphorus, Potassium - General extraction procedure

Add the following to a clean can or a coffee jar:

Field soil: 1.5 cup of soil and 8 cups of water

Garden soil: 1 cup of soil and 8 cups of water

Greenhouse soil: 1 cup of soil and 16 cups of water

For best results, use bottled or distilled water. Stir or shake gently for at least one minute and make sure that all the soil is moistened. Allow to stand until the soil settles (from 30 minutes to 24 hours depending on the soil texture). The clearer the extract becomes, the better the results, however, a little cloudiness will not affect the accuracy of the test.

Nitrogen test

Use the pipette to transfer 2.5 ml of the clear general soil extract (above) to a clean test tube. Add the content of one packet of HI 3895-N reagent to the tube, replace the cap and shake well for 30 seconds to dissolve the reagent. Allow the tube to stand for 30 seconds, match the pink color with the Nitrate color-card.

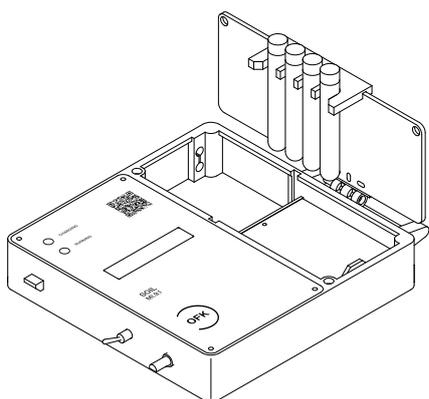
Phosphorus test

Use the pipette to transfer 2.5 ml of the clear general soil extract (see above) to a clean test tube. Add the contents of one packet of HI 3895-P reagent to the tube, replace the cap and shake well for 30 seconds to dissolve the reagent. Match the blue color against the Phosphorus color-card for the P concentration.

Potassium test

Use the pipette to add 0.5 ml of the clear general soil extract (above) to a clean test tube. Fill the tube to the lower graduation mark (2.5 ml) with water. Add the content of one packet of HI 3895-K Reagent to the tube, replace the cap and shake well for 30 seconds to dissolve the reagent. Match the test tube against the Potassium reading-card. Don't transfer any soil. To avoid agitation of the soil, squeeze the bulb of the pipette before inserting the pipette into the soil extract solution.

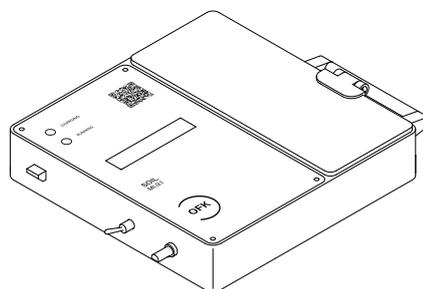
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Once you have finished analyzing the samples compare the results with the cards provided. Turn on the module via the side switch and use the rotary encoder, also on the side, to enter the results on the screen. Submit results

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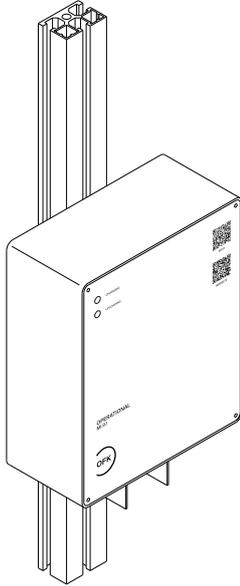


If necessary, clean the used components with the cloth and some water, reposition them inside the module, and turn off

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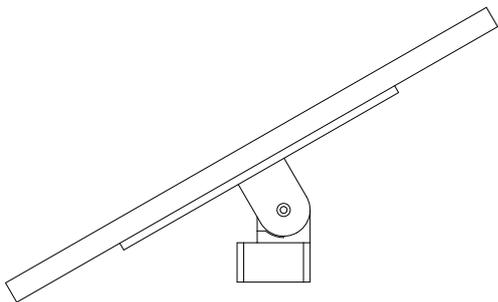
The Operational module is responsible for receiving data from the various modules and uploading it to the cloud server. It is equipped with a LoRa module for receiving data, an SD card for temporary data storage, and a WiFi shield for uploading data to the server. The module also handles the sorting of energy from the panel for charging the monitoring modules. The module has two LEDs, "CHARGING" and "RUNNING," the first indicates the actual operation of the battery and power sorting system. The second indicates when the module is uploading data to the server. This occurs every half hour.

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The solar panel above the module is connected directly to the solar charge controller and consequently to the battery. The panel has two possible angles, 30° and 60°, respectively the indicated inclinations for Milan in the summer and winter months.

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