

# Sensation Soil moisture sensor



**User manual | EN**

**Guide for the professional user**



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Leading Agri Yield Management





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# Introduction and operation of the Sensetion

## Introduction

- If you purchase this device, you will own a soil moisture sensor that enables you to easily determine the moisture content of the soil.
- For an optimal use of the Sensetion, you have to carefully read this user manual, follow the instructions and properly maintain the device.
- This device is intended for use in both outdoor and indoor agriculture and horticulture.
- Always keep this user manual with the Sensetion. The user manual can also be downloaded from the Dacom website: <http://en.dacom.nl/products/sensetion/manual/>.

## Safety

- To ensure correct installation, the Sensetion is fitted with a sharp screw tip! To avoid injuries, handle this device with care!
- If you feel a strong resistance in the soil during installation, the Sensetion may get damaged. Immediately stop pushing and turning, remove the Sensetion from the hole by turning in the opposite direction and perform the installation at a new location.

**To prevent injuries and damage,  
please use the original packaging during  
transport and storage**

**PLEASE NOTE  
SHARP SCREW TIP**

## Description

The Sensetion is a 'smart & simple' to use soil moisture sensor with a mobile app. The Sensetion is equipped with intelligent sensor technology and is easy to install. The soil moisture is measured in a layer of 25 cm. The measured data is collected and sent by means of an integrated GPRS data logger. A solar panel provides the necessary energy. Together with the Sensetion app you will have access to the current soil moisture status on your smartphone anytime and anywhere:

- optimising cultivation from the palm of your hand
- 'smart' integrated system: rugged and waterproof according to IP-67
- 'simple' irrigation advice: current soil moisture status of your fields
- easy to install yourself

The Sensetion measures the **volumetric soil moisture content** based on measurable changes in the **dielectric constant** of a soil layer. Soil moisture is the most influential factor in this regard. These changes are converted into a DC voltage.

The volumetric soil moisture content is the ratio between the water volume (soil moisture) and the total volume of the soil sample to be measured. The dimensionless parameter is expressed as a soil moisture percentage (Vol.-%) or as a ratio ( $m^3.m^{-3}$ ).

When putting the Sensetion into use, it is set to an average soil type. This provides a good indication of the current soil moisture status. In addition, the Sensetion boasts unique extra features that ensure even more accurate measurement results.

The accuracy of the Sensetion is enhanced by your own location-specific setting of the soil type. The Sensetion app lets you choose between 15 types of soil (see **Fine-tuning** on page 7 and the **Soil type table** on page 11).

## Operation

The Sensetion consists of a completely integrated waterproof housing with electronics. The electronics allow the soil moisture to be measured and wirelessly communicated without an external power supply. The end of the measuring tube is fitted with a screw tip, allowing easy installation of the Sensetion into a pre-drilled undersized hole.

The soil moisture is measured by 2 measuring cells of 10 cm each. Via an SDI-12 protocol, the analogue signal is converted to digital data which by default is stored in the integrated data logger and sent to the Dacom database 4 times per hour. The maximum storage capacity is 4 Mb. SDI-12 is an asynchronous, ASCII, serial communications protocol for intelligent sensors that can monitor specific environmental data with low power consumption.

Each Sensetion is calibrated during its production to ensure an accurate standard output. The included app allows you to adjust the type of soil and the measuring range, ensuring even more accurate measurement results thanks to the **location-specific settings**.



Figure 1 Construction

## Creating a Sensetion account

Prior to the installation, a Sensetion account should be created. There are two ways to do this: directly via the Sensetion app or via the Dacom website: <http://en.dacom.nl/sensetion-register/>.

### Creating a Sensetion account using the Sensetion app

Download the **Sensetion app** in the App Store® or the Google Play Store® and install the app on your smartphone. On the home screen, click on 'Register'. Enter a **valid e-mail address** on the registration screen, enter a **password** and click on 'Register'. Dacom will only use your e-mail address to send you service messages. An e-mail with a **validation link** will be sent to the e-mail address you entered. Confirm the link in the e-mail. The Sensetion account has now been created. Log in using your user name and password. The Sensetion can now be installed and added to the account.

### Creating a Sensetion account via the Dacom website

Go to My Sensetion (web version of the Sensetion app) via the customer login on the Dacom website: <http://en.dacom.nl/sensetion-register/> and click on 'Register'. Enter a **valid e-mail address** and enter a **password**. Dacom will only use your e-mail address to send you service messages. An e-mail with a **validation link** will be sent to the e-mail address you entered. Confirm the link in the e-mail. The Sensetion account has now been created. Log into the Sensetion app using your user name and password (see **Creating a Sensetion account using the Sensetion app** on page 5). The Sensetion can now be installed and added to the account.

# Putting into use

## Installation

The installation of the Sensetion is very simple. An example of an installation can be seen on the Dacom website: <http://en.dacom.nl/products/sensetion-2/installation-video/>.

1. Use the **auger** (see **Figure 2 Sensetion installation set** on page 6) to **drill an undersized hole with a depth of at least 60 cm at the selected spot in the field**. Pre-drilling a hole is necessary for a proper installation. Otherwise, the Sensetion may be damaged, causing it to stop working correctly!
2. **Put the Sensetion** in the undersized hole and turn it clockwise into the soil **up to the black marker line** using the twist tool (see **Figure 2 Sensetion installation set** on page 6), thereby aiming the **solar panel south (in the southern hemisphere north)**. The installation should be carried out using the **Sensetion installation set**.
3. In the **Sensetion app**, click on the '+' sign at the top of the screen 'Field overview'. Use a smartphone to **scan the QR-code** on the back of the Sensetion. The software is activated via a GPRS connection.
4. Enter a **name for the field** in which the installation is carried out, select the **type of soil** and click on 'Save'. If no specific GPS coordinates are to be determined, click on 'Save without location'.
5. **Activate the Sensetion by moving the magnet in the twist tool once from top to bottom on the right side next to the solar panel**. Make sure that the magnet is located at the correct side of the twist tool and that the solar panel is aimed at you. You will hear a beep shortly after. The installation is now complete and after a short time an indication of the **current soil moisture status** can be read out! A demonstration of the Sensetion app can be seen on the Dacom website: <http://en.dacom.nl/products/sensetion-2/demo-app/>.
6. To **adjust the field name and/ or type of soil**, click on the relevant field in the screen 'Field overview'. Here you can also find **unique extra features** to ensure an optimal **fine-tuning** of the Sensetion (see **Fine-tuning** on page 7).

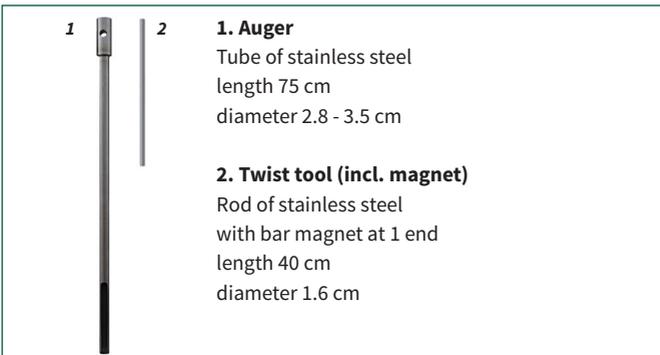


Figure 2 Sensetion installation set

## General tip

**Rocks** near the tube and **'air bubbles'** in the measurement area will have an adverse effect on the measurement value. The 'air bubbles' can occur if you insert the Sensetion in an **oversized hole** or a previously **used installation point**. A **coarse soil structure** (including stones) or **mole tunnels** can also cause 'air bubbles'. So, take this into consideration when installing the Sensetion.

## Fine-tuning

The Sensetion boasts unique extra features that ensure even more accurate measurement results.

First, you can **adjust the type of soil**. Select 1 of the 15 types of soil (see **Soil type table** on page 11). This can be done based on your knowledge of the field or by means of a soil sample. All types of soil have a different soil moisture availability. So, if the Sensetion ‘knows’ exactly what type of soil it is in, it will provide more accurate measurement results!

Secondly, you can **fine-tune the measurement value of the available soil moisture** based on the specific composition of the soil in your field. The basic types of soil show small variations. Depending on this, the value measured by the Sensetion may vary slightly from your own perception of soil moisture. This can be adjusted by sliding the tab ‘Available soil moisture’ to the left (= less moist) or to the right (= more moist). This will create an optimal fine-tuning of the Sensetion.

Finally, you can **adjust the warning point** (= lower limit of sufficient available soil moisture) by sliding the tab ‘Alert’ to the left (= less moist) or to the right (= more moist). When adjusting the measurement value of the available soil moisture, this will automatically be adjusted accordingly. If the current soil moisture status of your field colours red on the Sensetion app with a message (irrigate), you are advised to irrigate.

## Moving the Sensetion

There may be several reasons to move the Sensetion to another location. **Depending on the reason of the relocation, the Sensetion will need to be turned off or decoupled.**

### Moving the Sensetion within the same field and your own account

If you want to measure the available soil moisture at another location within the same field using your own account, you should **turn off the Sensetion**.

1. Use the Sensetion app to turn it off.
  - Click on the ‘+’ sign in the ‘Field overview’
  - Scan the QR-code on the back of the Sensetion and turn off the Sensetion (the Sensetion will remain visible in the field overview in grey)or go to My Sensetion (web version of the Sensetion app) via the customer login on the Dacom website:  
**<http://en.dacom.nl/sensetion-login/>**
  - Log in with user name and password
  - Select the Sensetion
  - Switch the ‘on/ off’ button to ‘OFF’
2. Use the twist tool to turn the Sensetion counterclockwise until it is out of the soil. **The Sensetion may not be removed from the soil by pulling on the sensor head!** This may cause the head of the tube to come off, resulting in irreparable damage to the Sensetion!
3. Install the Sensetion at the new location (see **Installation** on page 6) and turn the Sensetion on following the steps described in section 1.

## Installation in another field and/ or linking the Sensetion to another account

If you want to install the Sensetion in another field and/ or link it to another account, the **Sensetion should be decoupled**.

1. Use the Sensetion app to decouple it.
  - Click on the '+' sign in the 'Field overview'
  - Scan the QR-code on the back of the Sensetion and click on 'Decouple Sensetion'
  - Click on 'OK' in the message 'The Sensetion has been decoupled from your account' (the Sensetion is no longer visible in the field overview)
2. Uninstall the Sensetion (see **Moving the Sensetion within the same field and your own account**, section 2 on page 7).
3. Install the Sensetion in the other field and/ or add it to another account (see **Installation** on page 6).

## Placing in storage

If you want to store the Sensetion, the **Sensetion should be decoupled**.

1. Decouple and uninstall the Sensetion (see **Installation in another field and/ or linking the Sensetion to another account**, section 1 and 2 on page 8).
2. Store the Sensetion. Considering the batteries, the storage place should preferably be not be too cold and with a lot of sunlight. To prevent damage and breakage, it is best to hang the Sensetion vertically against a wall.
3. **Place the Sensetion 2 entire days outside in the sunlight once a month and 1 week before the start of the new growing season.** This will prevent the batteries from being discharged excessively and ensures a longer lifespan of the batteries! Please make sure that the solar panel is placed in the sunlight and faces south (in the southern hemisphere north).
4. **Reset the Sensetion after charging by moving the magnet in the twist tool once from top to bottom on the right side next to the solar panel.** Make sure that the magnet is located at the correct side of the twist tool and that the solar panel is aimed at you. Once the Sensetion is sufficiently charged, you will hear a beep shortly after.

# Technical explanation on soil moisture

## Soil moisture supply

Only a portion of the total amount of soil moisture is readily available to the plant. We call this the ‘readily available soil moisture’. The amount of available soil moisture depends primarily on the organic matter content and the particle size distribution within the soil, or in other words, how fast water seeps away. The crop should be irrigated once the amount of available soil moisture is likely to become too low. The soil moisture deficit determines the number of millimetres to be irrigated. This will prevent dehydration due to the water seeping away.

## Soil moisture terms

**Maximum Available Soil Moisture (MASM):** is the difference between the amount of soil moisture at field capacity and the amount at the wilting point.

**Field capacity (FC):** is the amount of water that a saturated soil can still retain after 2 to 3 days against the force of gravity. The FC is important for the soil moisture supply to the crop. The field capacity, in fact, determines the availability of water-soluble nutrients for the plant, the flushing of nutrients and the irrigation. Once the field capacity has been reached, the soil is not yet completely saturated with water. There is still air in the large- and medium-sized pores. So, in case of precipitation, it is possible for the soil to contain more water than at field capacity. The field capacity depends on the distribution of the pore size.

**Saturation:** occurs when all the voids in the soil are completely filled with water. Although there is a lot of water available for the crop, the water uptake will be very limited due to the lack of oxygen. If the situation in excess of the field capacity persists, the plant will die.

**Seepage:** is water that drains to soil layers below the root zone.

**Wilting Point (WP):** the (permanent) wilting point is the level of moisture content of the soil where the plant is not able to absorb any more water from the soil and, therefore, will wilt and die.

**Readily Available Soil Moisture:** is the difference between the amount of soil moisture at field capacity and the amount at the refill point.

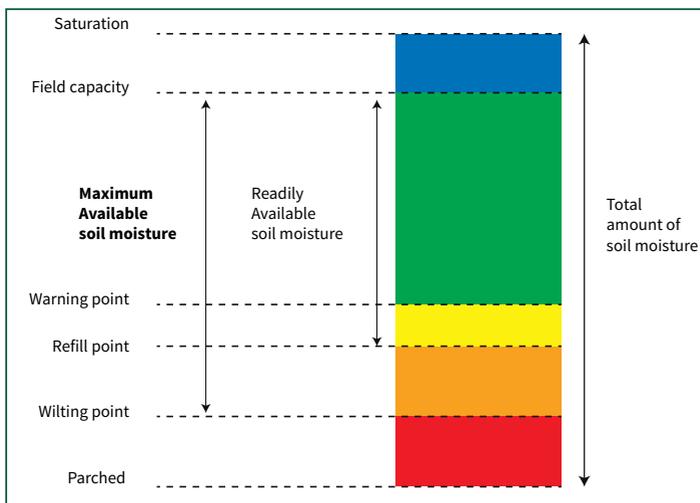


Figure 3 Soil moisture terms

# Power supply, integrated data storage and communication

## Power supply

The operation of the Sensetion is possible thanks to an entirely autonomous power supply. This fully integrated system consists of a monocrystalline solar panel, 2 rechargeable batteries and an optimised charging circuit. The power management capacity is more than adequate to perform many measurements, data logging and communication.

## Data storage and communication

The Sensetion measures the soil moisture content once every 15 minutes. The measurement data are stored in the internal memory. Depending on the power level, these data are sent to a database between 1 and 4 times every 4 hours via a GPRS connection. The internal memory is 4 Mb. After the installation of the Sensetion, after a short time, a measurement result and advice will be displayed in the field overview of the Sensetion app. For a good indication of the current soil moisture status, it is recommended to leave the Sensetion at the same location throughout the growing season.

## Maintenance, troubleshooting and repair

The Sensetion is sealed during the manufacture and, therefore, watertight (norm IP-67). The Sensetion is made of new durable materials for rugged outdoor use and requires no specific maintenance. For a long-lasting and reliable operation, the following points should be observed:

- 1. Do not remove the sealed Phillips screws at the bottom of the sensor head!** In this case, the Sensetion can no longer be sealed watertight. This allows **unwanted entry of moisture**, causing the Sensetion to stop working. **No repairs** may be carried out! Once the sealing has been broken, the warranty will be void.
- 2. The Sensetion may not be removed from the soil by pulling on the sensor head!** Use the twist tool to turn the Sensetion counterclockwise until it is out of the soil.
- 3. If the Sensetion has not been used for a prolonged period of time, the Sensetion should be placed 2 entire days outside in the sunlight once a month and 1 week before the start of the new growing season.** This will prevent the batteries from being discharged excessively and ensures a longer lifespan of the batteries!

## Troubleshooting and repair

Any possible failures and problems can usually be solved by yourself or be repaired. Visit the Dacom website: <http://en.dacom.nl/products/sensetion/faq/> which shows a list of handy problem solvers. This will help you find the solution for the failure step by step.

## Warranty

The Sensetion is tested for correct operation before the device leaves the factory. For the duration of 1 year, from the date the Sensetion was put into use, Dacom guarantees that any defect in materials or manufacturing defects will be repaired free of charge. To qualify for warranty, please contact [services@dacom.nl](mailto:services@dacom.nl). For the warranty terms and conditions, please refer to the Dacom website: <http://en.dacom.nl/general-terms-and-conditions/>.

## Electromagnetic Compatibility (EMC)

The Sensetion meets the provisions of the EU Directive 2014/30/EC (EMC Directive) and complies with the applicable standards on the condition that the measuring tube of the Sensetion has been installed in the soil or other material up to the black marker line during the measurements.

Failure to install the Sensetion this way may result in interference with nearby radio equipment. Should such interference occur anyway, relocating and reinstalling the Sensetion at a distance of approximately 1 to 2 metres suffices.

The installation of several Sensetions at a close distance of each other will not result in any mutual interference.

## Disassembly of the Sensetion after its lifespan

### Correct disposal of a used battery of this product



**Pb** This marking on the Sensetion, manual or packaging indicates that the batteries in this product should not be thrown away, mixed with other waste, at the end of their lifespan. The chemical symbol Pb indicates that the lead content in the battery is higher than the reference level in the Directive 2013/66/EC. If the used batteries are not handled correctly, these substances can be harmful to human health or the environment.

To protect natural resources and to promote material reuse, please separate your waste batteries from other types of waste and offer them for recycling to the free collection system for accumulators and batteries in your area.

## Soil type table

Type of soil	% Sand	% Silt	% Lutum	% Org. Matter	Field Capacity mm	Field Capacity in/ ft.
1 Sand	70 - 100	< 10	< 10	< 1	9	1.1
2 Loamy sand	70 - 85	< 20	10 - 20	4 - 6	25	3.0
3 Sandy loam	50 - 100	5 - 40	15 - 20	0.3 - 2	31	3.7
4 Loamy sand (humic)	70 - 80	< 30	10 - 20	6 - 9	36	4.3
5 Peaty sand	50 - 80	< 20	< 5	18 - 20	37	4.4
6 Silt loam	20 - 50	50 - 80	< 20	4 - 5	38	4.6
7 Silt (loess)	< 20	80 - 100	< 10	2.5 - 5	43	5.2
8 Sandy loam (humic, muck)	< 50	50 - 80	< 10	20 - 60	52	6.2
9 Loam	< 50	30 - 50	10 - 14	1 - 2.5	33	4.0
10 Sandy clay loam	< 40	< 50	14 - 25	3.5 - 9.5	35	4.2
11 Clay loam	< 40	< 40	25 - 35	1 - 3.5	45	5.4
12 Clay	< 30	< 35	35 - 65	1 - 9.5	60	7.2
13 Peaty clay	< 20	< 30	10 - 64	18 - 45	63	7.6
14 Clayey peat	< 10	< 25	10 - 80	30 - 65	59	7.1
15 Peat				85	69	8.3

# CE Declaration of Conformity

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Phone: +31 591 632 474

Product : **Soil moisture sensor**  
Model : **Sensation**

On behalf of Dacom, based in Emmen in The Netherlands, the undersigned declares that the soil moisture sensor model Sensation complies with the provisions of the directives:

- 2014/30/EC (February 26, 2014) on electromagnetic compatibility;  
Applicable standards: ETSI EN 301 489-1 V1.9.2, ETSI EN 301 489-7 V1.3.1;
- 2014/53/EC (April 16, 2014) on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity;  
Applicable standard: ETSI EN 301 511 V9.0.2;
- 2011/65/EC (June 8, 2011) on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS);
- 2013/56/EC (November 20, 2013) on the use of batteries and accumulators;
- 2012/19/EC (July 4, 2012) on waste electrical and electronic equipment (WEEE).

Emmen, February 2015



Janneke W.M. Hadders  
CEO Dacom

# Product specifications soil moisture sensor

## Specifications

Type number	Sensation V1.0
Measurement principle	Volumetric soil moisture determination ( $m^3.m^{-3}$ or Vol.-%)
Measurement value	Full measurement range is $0.0 m^3.m^{-3}$ to $1.0 m^3.m^{-3}$
Measurement volume	>95% Of the soil moisture measurement takes place in a cylinder ground around the tube with a diameter of 20 cm and a length of 25 cm
Environmental factors	Prolonged use in almost all soil types under extremely wet conditions (even in water) with no failures or corrosion (IP-67 up to 5 metres) For use in temperatures from $-15^{\circ}C$ to $75^{\circ}C$
Stabilisation time	Up to 60 minutes after being put into use
Response time	Less than 1 ms
Operation mode	Soil moisture measurement and data logging once every 15 minutes Data transmission 1 to 4 times every 4 hours Internal memory 4 Mb for maximum 1,000 values
Integrated power supply	Solar panel: 4.0 - 4.8V DC regulated Batteries: 2 Cyclone sealed lead acid batteries, 2V/2.5 Ah Power consumption: 19 mA, 23 mA maximum
Integrated modem	Cinterion BGS2-E/BGS2-W, omnidirectional quad-band Frequency: GSM 850/900/1800/1900MHz For use in temperatures from $-30^{\circ}C$ to $85^{\circ}C$ Fully compliant with EU RoHS Directive
Cover material	ASA Luran S 777K/PVC
Dimensions	141 cm x 10.4 cm x 11.3 cm
Weight	Approximately 1,370 gramme





## Getting started

- 1. Download the Sensetion app in the App Store® or the Google Play Store®**
- 2. Create a Sensetion account using the app:**
  - a. Click on 'Register'.
  - b. Enter a valid e-mail address and enter a password.
  - c. Confirm the information and click on 'Register'. A confirmation e-mail will be sent to you.
  - d. Confirm the validation link in the e-mail.
  - e. Log in using your user name and password.
- 3. Installation of the Sensetion** (an example of an installation can be seen on the Dacom website: <http://en.dacom.nl/products/sensetion-2/installation-video/>):
  - a. Use the auger to drill an undersized hole with a depth of at least 60 cm at the selected spot in the field.
  - b. Put the Sensetion in the undersized hole and turn it clockwise into the soil up to the black marker line using the twist tool and aim the solar panel south (in the southern hemisphere north).
  - c. In the Sensetion app, click on the '+' sign at the top of the screen 'Field overview'.
  - d. Use your smartphone to scan the QR-code on the back of the Sensetion.
  - e. In the app, enter a name for the Sensetion, select the type of soil and click on 'Save'.
  - f. Activate the Sensetion by moving the magnet in the twist tool from top to bottom once on the right side next to the solar panel. You will hear a beep shortly after.
- 4. Current soil moisture status** (a demonstration of the Sensetion app can be seen on the Dacom website: <http://en.dacom.nl/products/sensetion-2/demo-app/>):
  - a. Start the Sensetion app.
  - b. An indication of the current soil moisture status can be read out in the field overview after a short time.



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Leading Agri Yield Management

