Within Trees Manual

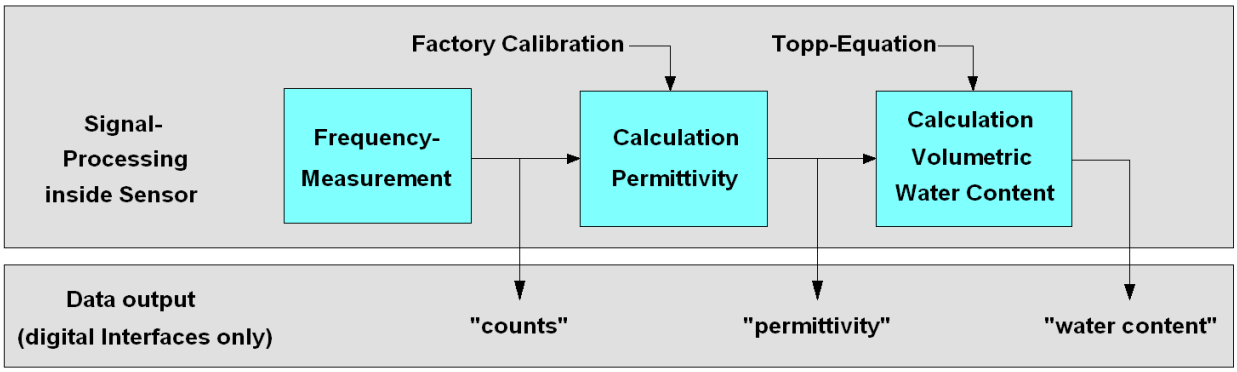
V1.0, February 5th, 2025

Table of Contents

Functional Principle of the SMT100

The SMT100 is a maintenance free capacitive sensor based on the TDT (time domain transmission) principle. This method uses the propagation of electrical signals along the green sensor blade. Higher soil moisture increases the dielectric permittivity of the soil and slows down signal propagation.

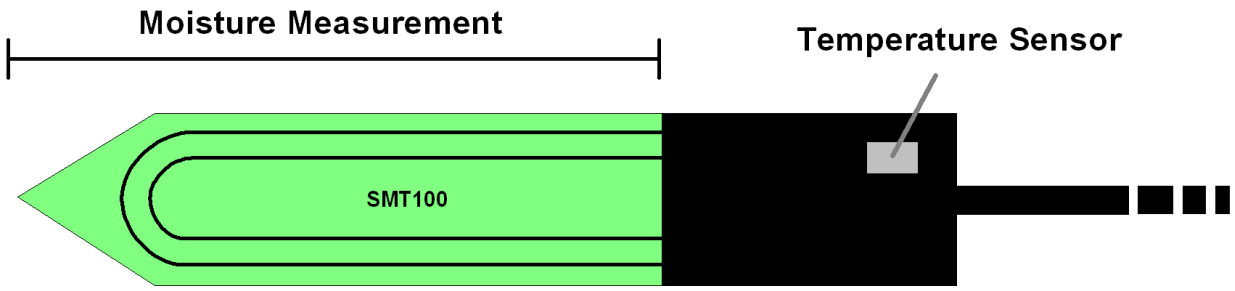
The measurement value is processed by an internal microcontroller, so that the SMT100 (with digital RS-485 or SDI-12 interface) will provide raw data ("counts"), dielectric permittivity of the soil and volumetric water content using the so-called Topp-equation.



Signal processing chain in the SMT 100 sensor

Generally, TDT sensors are using a high measurement frequency (> 150 MHz) which makes them much less affected by the electrical conductivity of the soil. Therefore, TDT sensors can also be used for applications where higher conductivity can be expected (e.g. fertilizer enriched soils).

The integrated temperature sensor is located in the black housing. To measure soil temperature the sensor must be completely embedded in the soil.



SMT100 sensor with green capacitive measurement field and position of temperature sensor

SMT100 Sensor Installation

Installation of a capacitive soil moisture probe is simple. However, there are a few important points which should be considered to achieve a good measurement result.

The next figure shows the correct installation of the SMT100. It is mandatory to fully bury the probe including the black housing. A very good contact to the surrounding soil with no air gaps is very important because air gaps will lead to wrong soil moisture measurements.

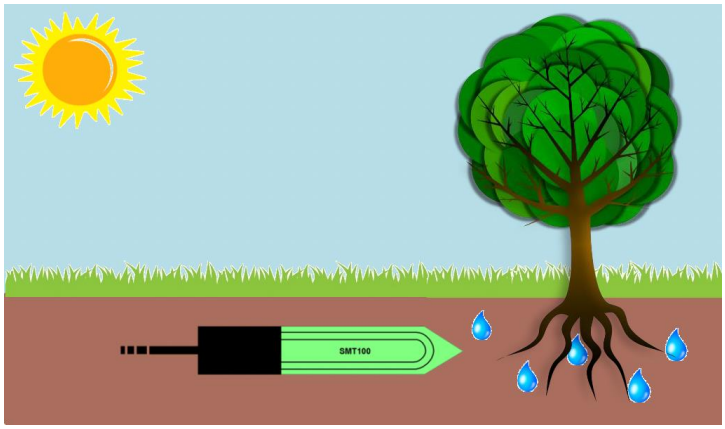
The density of the surrounding soil will influence the measurement signal. Make sure the soil is properly compressed. For irrigation purposes the SMT100 should be installed close to the roots of the plants. The ideal orientation of the sensor is a horizontal position.

It is important to turn the sensor in an upright position so that no water can accumulate on the surface of the green measurement area.

Sometimes it can be useful to embed two or more sensors in different depths. Then it is possible to observe the penetration of the waterfront during the irrigation process. Based on this data the irrigation can be optimized.

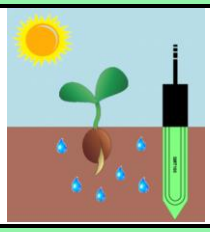
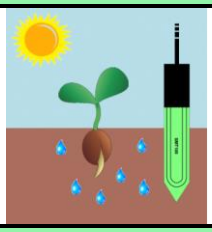
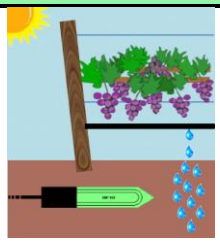
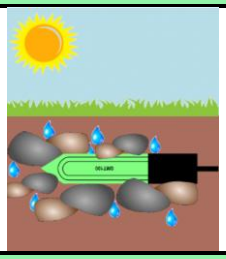
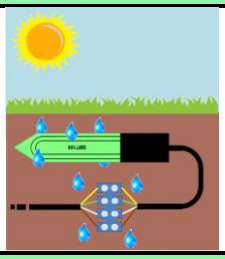
Do not use a hammer for installation of the SMT100. If the soil is very compressed, it is recommended to use a punch or to soften up the soil by adding water.

The cable of the SMT100 is very robust and can be buried directly inside any type of soil. However, sometimes it can make sense to protect the cable against animal bites by using additional ductwork.



Correct installation of the SMT100 soil moisture sensor

Typical Installation Problems

Problem 1	**Problem 2**
Temperature sensor is not buried in the soil	Measurement electrodes not fully buried
	
Wrong temperature measurement	Wrong moisture measurement
Problem 3	**Problem 4**
Large distance between sensor and dripping lines	Sensor is positioned too close to the wall of a pot
	
Sensor reacts too late / no reaction	Wrong moisture measurement
Problem 5	Problem 6
Sensor is inside granular material with air gaps	Cable connections inside the (wet) soil
	
Wrong moisture measurement	Wrong output signal of the sensor

Frequently Asked Questions

Does the sensor have to be silted during installation?

No, it is sufficient to bury and then tamp the soil. However, always make sure that the sensor has good contact with the soil and that there are no air gaps between the sensor and the soil. Air gaps disturb the moisture measurement result.

May the cable be extended?

Yes, the cable may be extended. However, it must be ensured very carefully that the connection is protected against moisture. Under no circumstances should the connection be in the soil. Insulating tape and heat shrinking tubing do not provide sufficient protection against moisture!

Is there a minimum size of the planter?

Yes, the active electrical measuring field of the sensor has a volume of up to one liter and is uniformly distributed around the sensor. The sensor should therefore not be used in planters with a volume of less than 1 liter and should have a sufficient distance to the wall and the bottom of the planters (recommended >5 cm).

Do roots damage the sensor?

No, the sensor is very robust. It does not harm the sensor if roots grow around it.

The sensor does not supply an output signal (any more). What could be the reason?

In most cases, the wires of the cable are connected incorrectly, the power supply is not available properly or there is a cable interruption (animal bite!). Please check the pin assignment and the complete connection cable of the sensor. For sensors with digital interface, check the correct address.

If there is frost, the sensor displays an incorrect soil moisture value?

Capacitive sensors measure the liquid water in the soil. When it freezes, the liquid water turns into ice. However, ice cannot be measured correctly by the sensor. Soil moisture measurement only works up to freezing point. Irrigation at temperatures below the freezing point is normally not useful anyway.

The sensor shows too low values in water.

Make sure that the water container is large enough for the measurement volume of the sensor. The sensor was calibrated in a large water-filled container. A minimum of 10 liters is recommended