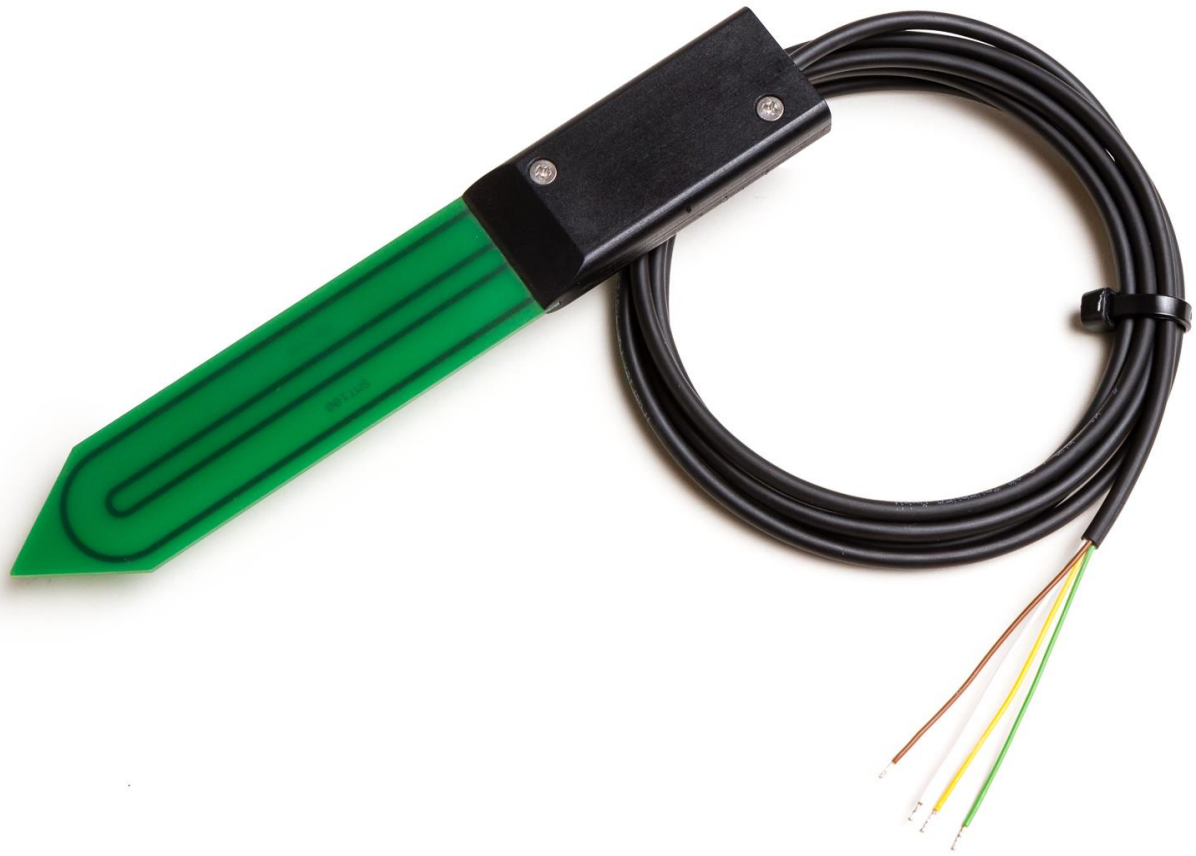
truebner

true excellence in instrumentation



Manual

Soil moisture sensor SMT100

English

www.truebner.de

Content

1 Important notes 2

2 Technical data and wiring 3

3 Functional principle of the SMT100 6

4 Sensor installation 7

5 Frequently asked questions 9

1 Important notes

Dear customer,
we are pleased that you have decided to buy a quality product from TRUEBNER GmbH. TRUEBNER sensors offer highest reliability, longevity and correspond to the latest state of technology. In order to be able to fully utilize the performance of our sensors and to enjoy them for many years, please read this operating manual carefully. We assume no liability for damages caused by improper or incorrect use.

This operating manual is intended for the soil moisture and temperature sensor SMT100, in the following manual referred to as "sensor" for short.

The warranty period is 12 months. If a defect occurs within this warranty period, please notify us immediately. If technical changes are made to the sensor, the warranty claim will become void.

Manufacturer contact details:

TRUEBNER GmbH
Burgunderstr. 42
67435 Neustadt
Germany
e-mail: info@truebner.de
URL: http://www.truebner.de

Technical changes and additions to the description / instructions are reserved.
No liability is assumed for the content, in particular for damage caused by existing, non-existent or incorrect information.
Passing on and changing these operating instructions is not permitted unless expressly approved.

2 Technical data and wiring

Technical data of the soil moisture sensor SMT100 (all interface options):

Total length of sensor	ca. 182 mm
Length of green measurement field	ca. 113 mm
Width of green measurement field	ca. 30 mm
Thickness of green measurement field	ca. 1.6 mm
Weight incl. 10m cable	ca. 255 g
Standard cable length	10 m
Cable specification	4 x 0.25 mm^2
Cable jacket material	very robust polyurethane (PUR)
Measurement frequency	> 150 MHz
Measurement principle	TDT (time domain transmission)
Measurement signal	symmetric, bipolar differential
Measurement range	0 – 100 % VWC (volumetric water content)
Accuracy soil moisture measurement	typ. +/- 2% in reference soil up to 50% VWC
Accuracy soil moisture measurement	typ. +/- 3% in reference soil up to 100% VWC
Accuracy temperature measurement	typ. +/- 0.5 °C full range

Specific technical data of the soil moisture sensor SMT100 with RS-485 interface:

Supply voltage range	4.0 - 28.0 VDC *
Current consumption idle	typ. ca. 5 mA
Current consumption during moisture measurement	ca. 40 mA for less than 50 ms
Resolution soil moisture measurement	0.1 % VWC
Range temperature measurement	-20 to +85 °C
Resolution temperature measurement	0.01 °C
Communication protocols	ASCII/T-Bus or Modbus
Baudrate	9600 (fixed)

Specific technical data of the soil moisture sensor SMT100 with SDI-12 interface:

Supply voltage range	4.0 - 28.0 VDC *
Current consumption idle	typ. < 2 mA
Current consumption during moisture measurement	ca. 40 mA for less than 50 ms
Resolution soil moisture measurement	0.1 % VWC
Range temperature measurement	-20 to +85 °C
Resolution temperature measurement	0.01 °C

Specific technical data of the soil moisture sensor SMT100 with analog interface:

Supply voltage range	4.0 - 28.0 VDC *, at least 2 V higher than maximum output signal range, see the following examples
Supply voltage for output signal range 0 - 1 V	4.0 - 28.0 VDC
Supply voltage for output signal range 0 - 3 V	5.0 – 28.0 VDC
Supply voltage for output signal range 0 - 5 V	7.0 – 28.0 VDC
Supply voltage for output signal range 0 - 10 V	12.0 – 28.0 VDC
Output voltage range standard version	0 – 10 V
Other output voltage ranges	Factory setting according to order
Current consumption idle	typ. < 4 mA
Current consumption during soil moisture measurement	ca. 40 mA for less than 50 ms
Internal measurement update rate	ca. 1 measurement per second
Resolution soil moisture measurement	10 bit (ca. 0.1 % VWC)
Range temperature measurement	-40 to +60 °C
Resolution temperature measurement	10 bit (ca. 0.1 °C)
Startup time until output is stable	< 500 ms
Impedance output signal	< 100 Ohm

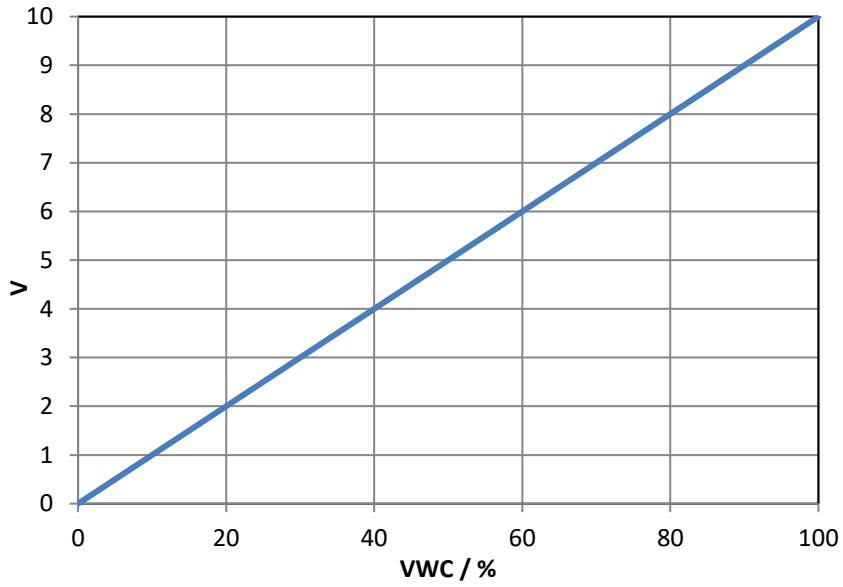
* not suited for 24 VAC supply from irrigation valves

Wiring

Color	SMT100 – RS-485	SMT100 – SDI-12	SMT100 analog
brown	+ Vcc	+Vcc	+Vcc
white	GND	GND	GND
green	A (RS-485 signal)	SDI-12 data line	Output signal temperature
yellow	B (RS-485 signal)	not connected	Output signal moisture

Output signal diagrams of soil moisture sensor SMT100 with analog interface:

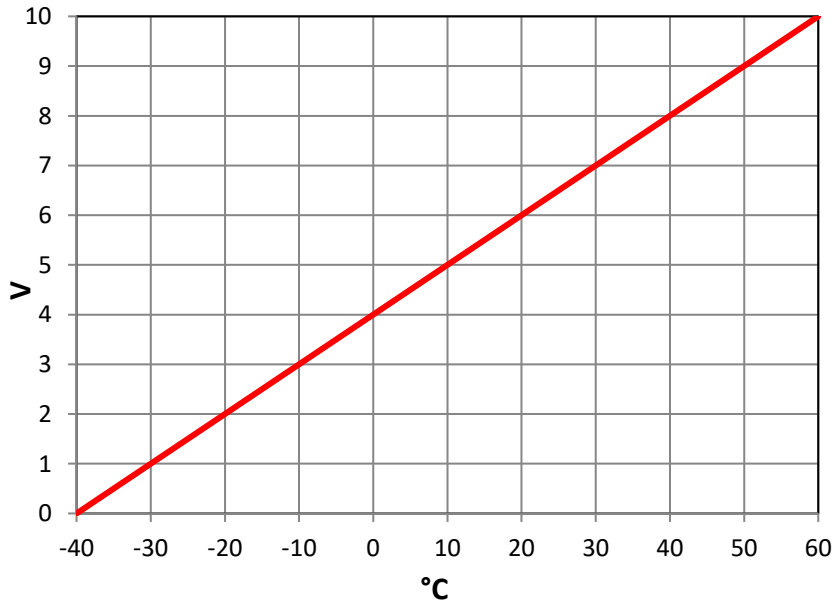
Output voltage [V] versus soil moisture [VWC] for standard version 0-10 V:



Equation for calculating the VWC from the measured output voltage U: VWC [%] = (U * 10)

Example: U = 2,5 Volt → VWC [%] = (2,5 * 10) = 25 %

Output voltage [V] versus temperature [°C] for standard version 0-10V:



Equation for calculating the temperature T from the measured output voltage U:

T [°C] = (U – 4.0) * 10 Example: U = 6.5 Volt → T [°C] = (6.5 – 4.0) * 10 = 25 °C

3 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.

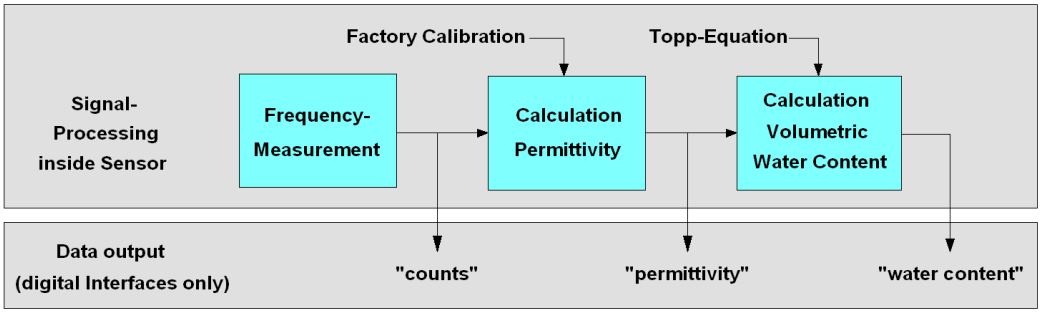


Figure 1: Signal processing chain in the sensor SMT100

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. In order to measure soil temperature the sensor has to be completely embedded in the soil.

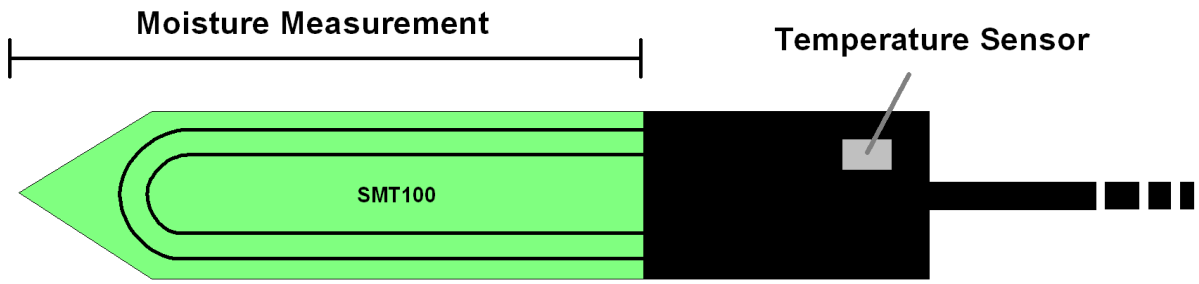


Figure 2: Sensor SMT100 with green capacitive measurement field and position of temperature sensor

4 Sensor installation

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

Figure 3 shows the correct installation of the SMT100. It is mandatory to fully burry 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 purpose 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 be accumulated 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 directly be buried inside any type of soil. However, sometimes it can make sense to protect the cable against animal bites by using an additional ductwork.

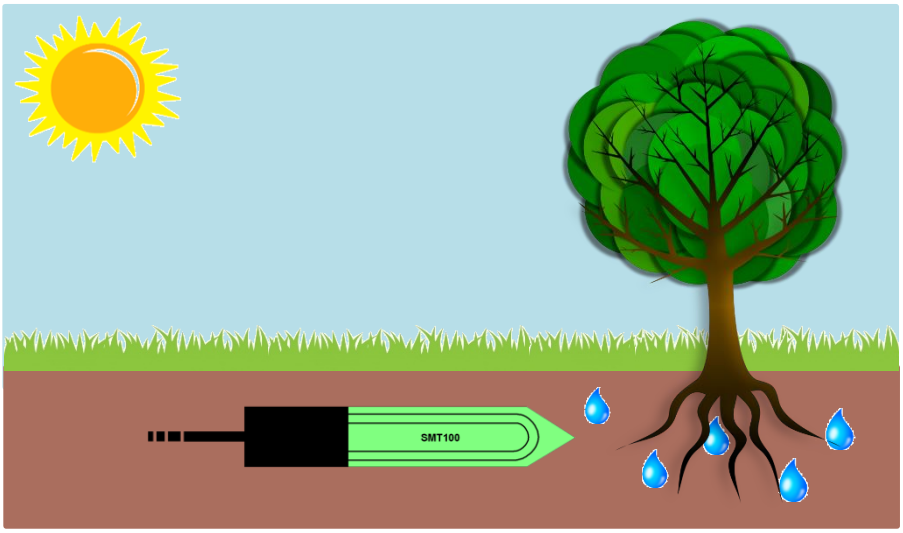
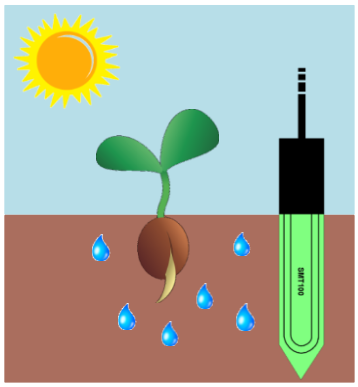


Figure 3: Correct Installation of the Soil Moisture Sensor SMT100

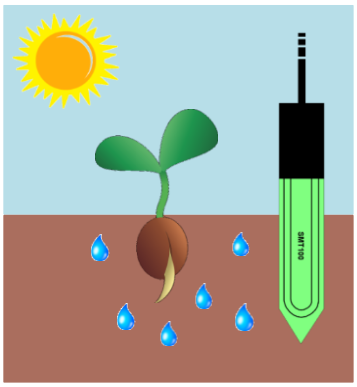
Typical installation problems:



Problem 1:

Temperature sensor is not buried in the soil

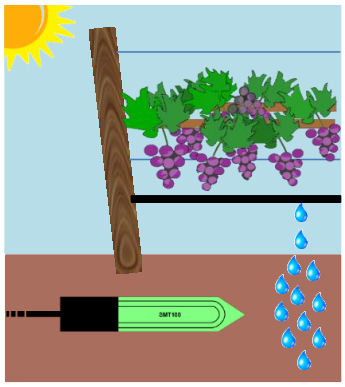
→ Wrong temperature measurement



Problem 2:

Measurement electrodes not fully buried

→ Wrong moisture measurement



Problem 3:

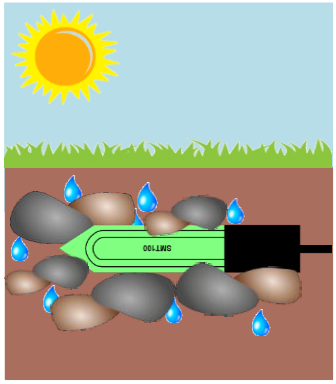
Large distance between sensor and dripping lines

→ Sensor reacts to late / no reaction

Problem 4:

Sensor is positioned to close to the wall of a pot

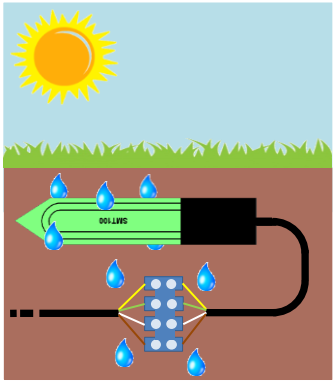
→ Wrong moisture measurement



Problem 5:

Sensor is inside granular material with air gaps

→ Wrong moisture measurement



Problem 6:

Cable connections inside the (wet) soil

→ Wrong output signal of the sensor

5 Frequently asked questions

1) Does the sensor has 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.

2) 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!

3) 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 litre and should have a sufficient distance to the wall and the bottom of the planters (recommended >5 cm).

4) Do roots damage the sensor?

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

5) 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.

6) 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.

7) Sensor shows too low values in water.

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