

# SPADE

## Professional Soil Moisture Probe



### SPADE

The SPADE is an efficient soil moisture probe for monitoring water content and soil temperature at representative locations.

The probe can be connected either directly to a common data logger, or be controlled using a bus interface from a PC.

#### How does it work?

The moisture sensor is a ring oscillator based on a digital inverter. This inverter drives a transmission line which end is fed into its input again. This makes the line driver oscillate. The line driver toggles with a frequency determined by the propagation velocity along the transmission line.

If the transmission line is buried in soil, the pulse will interact with the surrounding medium, especially the stored water. The higher the moisture the higher the effective dielectric permittivity, leading to a lower wave propagation velocity and a thus lower frequency of the ring oscillator.

### Soil moisture

The oscillation frequency is related to the dielectric permittivity of the surrounding medium. This relation has been verified using laboratory test series. The relative accuracy of the permittivity is about  $\pm 4\%$ .

The relation between the permittivity and the soil moisture depends on the soil composites and the soil water temperature. Therefore all dielectric techniques require a material and temperature dependent calibration. Alternatively standard or soil type specific calibrations can be used.

### Soil temperature

The temperature sensor DS18B20 is a digital thermometer with a 1-wire bus interface. It measures between  $-55^{\circ}\text{C}$  and  $125^{\circ}\text{C}$  with an accuracy of  $\pm 0.5^{\circ}\text{C}$  from  $-10^{\circ}\text{C}$  to  $85^{\circ}\text{C}$  without calibration or error correction. The maximum resolution of 12 bits corresponds to temperature steps of  $0.0625^{\circ}\text{C}$ .

A unique 48 bit identifier is stored on the ROM of the IC. It can be used for sensor specific external calibration.

# SPADE – Professional Soil Moisture Probe

## Product Features

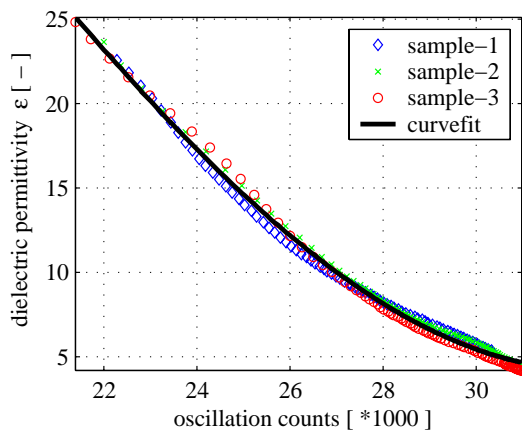
dimensions	
sensitive area	100 x 32 x 2 mm
overall dimensions	220 x 32 x 10 mm
feed line	5 m
range of application	
temperature	-20°C to 85°C
water content	0 to 40 %-vol.
weight	approx. 250 g
power consumption	10mA (max. 60 mA) <sup>1</sup>
voltage supply	5-14 VDC

## Interfaces

analog	i.e. for data logger
voltage output	0-2.8 VDC
digital	RS485
protocol	SDI-12

## Probe Calibration<sup>3</sup>

relation between oscillation and permittivity



## Data Features

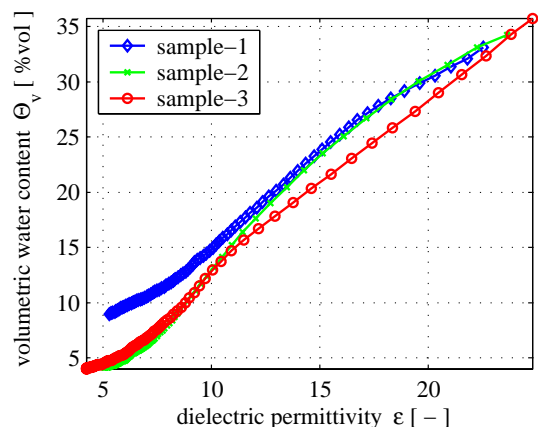
permittivity sensor	ring oscillator
max. range	$\epsilon = 1$ to 85
usual range	$\epsilon = 3$ to 35
relative accuracy	$\pm 4 \%$
max. resolution	$\sim 0.02 \%$
temperature sensor	DS18B20
usual range	-10°C to 60°C
accuracy	$\pm 0.5^\circ\text{C}$
max. resolution	0.0625°C

## Auxiliary Equipment

installation tools	Penetration tool <sup>2</sup> Hammering tool <sup>2</sup>
digital	USB/RS485 interface <sup>2</sup> splitter box <sup>2</sup>

## Soil Calibration<sup>3</sup>

examples for permittivity/moisture relations



Note: Specification is preliminary and subject to change without prior notice.

<sup>1</sup> Maximum power consumption only 25ms during moisture measurement. <sup>2</sup> Not available yet.

<sup>3</sup> Probe and material dependent parameters can be stored on the probe

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