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CS650

Soil Water Content Reflectometer 30 cm

Innovative

More accurate in soils with high bulk electrical conductivity

Overview

The CS650 is a multiparameter smart sensor that uses innovative techniques to monitor soil volumetric water content, bulk electrical conductivity, and temperature. It outputs an SDI-12 signal that many of our dataloggers can measure.

This product is supplied with a 3 m cable as standard, other lengths available to order.

Benefits and Features

- More accurate water content measurements in soils with bulk EC up to 3 dS m^{-1} without performing a soil-specific calibration
- Larger sample volume reduces error
- Measurement corrected for effects of soil texture and electrical conductivity
- Estimates soil-water content for a wide range of mineral soils
- Versatile sensor—measures dielectric permittivity, bulk electrical conductivity (EC), and soil temperature

Technical Description

The CS650 consists of two 30-cm-long stainless steel rods connected to a printed circuit board. The circuit board is encapsulated in epoxy and a shielded cable is attached to the circuit board for datalogger connection.

The CS650 measures propagation time, signal attenuation, and temperature. Dielectric permittivity, volumetric water content, and bulk electrical conductivity are then derived from these raw values.

Measured signal attenuation is used to correct for the loss effect on reflection detection and thus propagation time measurement. This loss-effect correction allows accurate water content measurements in soils with bulk EC ≤3 dS m^{-1} without performing a soil specific calibration.

Soil bulk electrical conductivity is also calculated from the attenuation measurement. A thermistor in thermal contact with a probe rod near the epoxy surface measures temperature. Horizontal installation of the sensor provides accurate soil temperature measurement at the same depth as the water content. Temperature measurement in other orientations will be that of the region near the rod entrance into the epoxy body.

Specifications

Measurements Made	Soil electrical conductivity (EC), relative dielectric permittivity, volumetric water content (VWC), soil temperature
Required Equipment	Measurement system
Soil Suitability	Long rods with large sensing volume (> 6 L) are suitable for soils with low to moderate electrical conductivity.
Rods	Not replaceable
Sensors	Not interchangeable
Sensing Volume	7800 cm^3 (~7.5 cm radius around each probe rod and 4.5 cm beyond the end of the rods)
Electromagnetic	CE compliant Meets EN61326 requirements for protection against electrostatic discharge and surge.
Operating Temperature Range	-50° to +70°C
Sensor Output	SDI-12; serial RS-232
Warm-up Time	3 s
Measurement Time	3 ms to measure; 600 ms to complete SDI-12 command
Power Supply Requirements	6 to 18 Vdc (Must be able to supply 45 mA @ 12 Vdc.)
Maximum Cable Length	610 m (2000 ft) combined length for up to 25 sensors connected to the same data logger control port
Rod Spacing	32 mm (1.3 in.)
Ingress Protection Rating	IP68
Rod Diameter	3.2 mm (0.13 in.)
Rod Length	300 mm (11.8 in.)
Probe Head Dimensions	85 x 63 x 18 mm (3.3 x 2.5 x 0.7 in.)
Cable Weight	35 g per m (0.38 oz per ft)
Probe Weight	280 g (9.9 oz) without cable

Current Drain

Active (3 ms)	❱ 80 mA (@ 6 Vdc) ❱ 45 mA typical (@ 12 Vdc) ❱ 35 mA (@ 18 Vdc)
Quiescent	135 µA typical (@ 12 Vdc)

Electrical Conductivity

Range for Solution EC	0 to 3 dS/m
Range for Bulk EC	0 to 3 dS/m
Accuracy	±(5% of reading + 0.05 dS/m)
Precision	0.5% of BEC

Relative Dielectric Permittivity

Range	1 to 81
Accuracy	❱ ±(2% of reading + 0.6) from 1 to 40 for solution EC ≤ 3 dS/m ❱ ±1.4 (from 40 to 81 for solution EC ≤1 dS/m)
Precision	< 0.02

Volumetric Water Content

Range	0 to 100% (with M4 command)
Water Content Accuracy	❱ ±3% (typical with factory VWC model) where solution EC < 3 dS/m ❱ ±1% (with soil-specific calibration)
Precision	< 0.05%

Soil Temperature

Range	-50° to +70°C
Resolution	0.001°C
Accuracy	❱ ±0.1°C (for typical soil temperatures [0 to 40°C] when probe body is buried in soil) ❱ ±0.5°C (for full temperature range)
Precision	±0.02°C

For comprehensive details, visit: www.campbellsci.eu/cs650

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