

AT

Delta-T Devices

www.delta-t.co.uk

Soil Moisture Measurement



The **ML3 ThetaProbe** measures soil moisture and temperature with class-leading accuracy.

- Soil moisture with $\pm 1\%$ accuracy
- Built-in temperature measurement
- Simple data logger or meter connection
- Extendable cable system
- Burable - IP68

Exceptional performance

The ML3 ThetaProbe's class leading $\pm 1\%$ accuracy, stability, build quality, and reliability have made it the preferred choice of thousands of researchers worldwide.

The ML3 is easy to use. Simply insert the probe into the soil, connect to your data logger or meter, provide 5-14 V DC at 18 mA and within seconds you can be accurately measuring soil moisture.

A built-in thermistor enables the ML3 to simultaneously measure soil temperature and soil moisture at depth (probe must be fully buried). ML3 cables and connectors are extendable, buriable and environmentally protected to IP68.

The salinity response of the ML3 has been characterised at EC values up to 2000 mS.m^{-1} . It also has a wide operating temperature range, with tests demonstrating that the ML3 can operate down to -40°C (non-flexing cables).

Installation

ThetaProbes are robust, buriable and maintenance-free. They can be inserted into augered holes or positioned in the wall of a trench (which is then carefully back-filled). Optional extension tubes assist placement and removal.

Data logging and readout

The ML3 can be logged by any Delta-T data logger, and many loggers from other manufacturers.




For portable applications the ML3 connects to the HH2 Moisture Meter - and these can be ordered together in convenient form as the **ThetaKit** - see page 9. (NB: the HH2 does not provide temperature indication from the ML3).

Applications

- Environmental research
- Sports turf and golf

For information on the **ML3 ThetaKit** See page 9



Feature	Description	Advantage
 4-rod arrangement	3 rods are arranged around a central rod. This creates a defined cylindrical zone of measurement, 60 mm long x approximately 30 mm diameter.	<ul style="list-style-type: none"> • Retains soil closer to central rod in case of drying and cracking (other designs, and particularly flat PCB sensors, don't do this) • Measurements can be made close to the soil surface
 Replacement rods	Made of 3 mm diameter, resilient, 304 austenitic stainless steel, with sharpened tips. The exposed rod length is 60 mm.	<ul style="list-style-type: none"> • Withstands repeated insertion in soil. Replaced at low cost if bent or damaged • Highly resistant to corrosion • Sharp, narrow rods minimise errors due to soil compaction by the rods
 Compact cylindrical shape	The ThetaProbe has a 40 mm diameter body, with threaded end. Extension tubes (0.5 and 1.0 m) screw onto this thread. Case sealed to IP68.	<ul style="list-style-type: none"> • Easy to insert and remove from augered holes • Rapid attachment of extension tubes • Handy size for portable use • Rugged and buriable to 5 m

Brief Specification (full spec on page 14)	
Water content	
Accuracy	$\pm 0.01 \text{ m}^3.\text{m}^{-3}$
Range	0 to $0.5 \text{ m}^3.\text{m}^{-3}$
Temperature	
Accuracy	$\pm 0.5^\circ\text{C}$, 0 to $+40^\circ\text{C}$ $\pm 0.75^\circ\text{C}$, -20 to $+60^\circ\text{C}$ [1]
Output	0 to 1.0 V differential
Power	5 to 14 V, 18 mA for 1 s
Sample Volume	$\sim 60 \times 30 \text{ mm}$ diameter
Size	158 x 40 mm diameter
Environmental	IP68, -40 to $+70^\circ\text{C}$

Ordering Information	
ML3	ML3 ThetaProbe Sensor NB: Order cable separately.
ML3 ThetaKit	Includes ML3 ThetaProbe, SMSC/d-HH2 Cable, 4 spare rods, HH2 Meter, USB-RS232 adapter cable, insertion kit and case.
ML-RODS-3	Pack of 12 spare rods.
ML/INK 1	Insertion kit for pre-forming holes in hard soils.
See page 13 for cables and accessories	

[1] Figures apply to sensor only and exclude logger or cabling errors

Soil Moisture - Portable Kits

Most of our soil moisture sensors are available in kit form providing a convenient solution for fast and accurate spot checking of soil moisture. These kits come complete with readout units, accessories and carry cases.

SM150 Kit

- Complete low-cost kit
- $\pm 3\%$ accuracy

The SM150 Soil Moisture Kit is an affordable and easy-to-use tool for obtaining reliable moisture measurements with minimal soil or substrate disturbance. The kit's low price and simplicity make it ideal for student projects.



The kit comprises an SM150T Soil Moisture Sensor, a dedicated readout meter and a carry case. The cable and connector are watertight - an essential requirement for potentially wet environments.

The meter displays volumetric water content (% volume)*.

Ideal for horticulture

The SM150 Kit comes with substrate calibrations for perlite, coir, peat, and mineral wool, as well as soils - providing a rapid, rugged solution for checking the uniformity of growing conditions for many types of growing media.

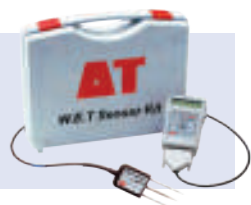
Simple operation

The readout meter is lightweight and is very easy to use, being a readout-only device (no data recording or PC complications). Operation is simple - just insert the SM150T into the soil or substrate and press the Read button to make a reading.

See page 4 for Ordering Information.

Brief Specification	
Accuracy	$\pm 3\%$ (with soil specific calibration)
Range	0 -100% soil water content
Power	2 x AAA batteries approx 10,000 readings
Sampling volume	70 mm x 55 mm diameter cylinder
Environmental	Waterproof (IP68 for sensor only)
Memory	No storage of readings

For information on the WET Kit See page 7



ML3 ThetaKit

- Class leading $\pm 1\%$ soil moisture accuracy
- Complete kit with readout unit and case

The ML3 ThetaKit provides researchers with a portable tool for highly accurate, near instantaneous measurement of moisture levels in soils and substrates.



The ThetaKit is easy to use. Simply switch the connected HH2 Moisture Meter on, insert the probe pins fully into the soil, and press the HH2's "Read" button to display the moisture measurement*. Readings can then be stored with a single button press (if required) - and downloaded to PC later.

The kit comprises an ML3 ThetaProbe Soil Moisture Sensor, an HH2 Moisture Meter (readout unit), replacement sensor rods, and a carry case.

See page 5 for Ordering Information.

Ideal for sports turf

The ThetaKit enables fast and precise soil moisture management, enabling turf health to be accurately monitored.



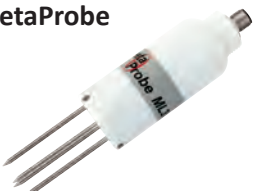


ML3 ThetaKit

Brief Specification	
Accuracy	$\pm 1\%$ (with soil specific calibration)
Range	0 -100% soil water content
Power	9 V PP3 battery approx 5000 readings
Sampling volume	60 mm x 30 mm diameter cylinder
Environmental	Waterproof (IP68 - for sensor only)
Memory	Up to 1500 readings

* Please note that although the SM150T and ML3 both have a built-in temperature sensor, their accompanying hand held meters do not measure or display temperature.

Soil Moisture Sensor Specifications

	Soil water content	Multi-parameter	
Sensor	PR2 and PR2 SDI-12	SM150T	ML3 ThetaProbe
			
Measurement	Volumetric water content	Volumetric water content and soil temperature	Volumetric water content and soil temperature
Accuracy	$\pm 0.04 \text{ m}^3.\text{m}^{-3}$ (4%) With soil-specific calibration	$\pm 0.03 \text{ m}^3.\text{m}^{-3}$ (3%) With soil-specific calibration	$\pm 0.01 \text{ m}^3.\text{m}^{-3}$ (1%) With soil-specific calibration
Soil moisture measurement range	Full accuracy over: 0 to $0.4 \text{ m}^3.\text{m}^{-3}$	Full accuracy over: 0 to $0.7 \text{ m}^3.\text{m}^{-3}$	Full accuracy over: 0 to $0.5 \text{ m}^3.\text{m}^{-3}$
	Full range: 0 to $1.0 \text{ m}^3.\text{m}^{-3}$	Full range: 0 to $1.0 \text{ m}^3.\text{m}^{-3}$	Full range: 0 to $1.0 \text{ m}^3.\text{m}^{-3}$
Salinity range	50 to $400 \text{ mS}.\text{m}^{-1}$	50 to $500 \text{ mS}.\text{m}^{-1}$	50 to $500 \text{ mS}.\text{m}^{-1}$
	Salinity errors included in specification	Salinity errors $< 0.035 \text{ m}^3.\text{m}^{-3}$ from 0.05 to $0.4 \text{ m}^3.\text{m}^{-3}$. Can be calibrated up to $2,000 \text{ mS}.\text{m}^{-1}$	Salinity errors $< 0.035 \text{ m}^3.\text{m}^{-3}$ from 0.05 to $0.4 \text{ m}^3.\text{m}^{-3}$. Can be calibrated up to $2,000 \text{ mS}.\text{m}^{-1}$
Temperature range	Full accuracy over: 0 to 40°C	Full accuracy over: 0 to 40°C	Full accuracy over: 0 to 40°C
Output	0 to 1.0 V differential See page 12 for PR2 SDI-12	0 to 1.0 V differential Corresponding to 0 to $\sim 0.6 \text{ m}^3.\text{m}^{-3}$	0 to 1.0 V differential Corresponding to 0 to $\sim 0.6 \text{ m}^3.\text{m}^{-3}$
	PR2/6: x6 outputs, PR2/4: x4	Resistance 5.8 Ω to 28k Ω for temp sensor	Resistance 5.8 Ω to 28k Ω for temp sensor
Power requirement	5.5 to 15 V PR2/6: $\sim 120 \text{ mA}$ for 1 s PR2/4: $\sim 80 \text{ mA}$ for 1 s See page 12 for PR2 SDI-12	5 to 14 V, $\sim 18 \text{ mA}$ for 1 s	5 to 14 V, $\sim 18 \text{ mA}$ for 1 s
	Minimum 7.5 V with 100 m cable	Minimum 5.5 V with 100 m cable	Minimum 5.5 V with 100 m cable
Environmental	IP67 (when installed in access tube)	IP68 , -40 to $+70^\circ\text{C}$	IP68 , -40 to $+70^\circ\text{C}$
Sample volume	$\sim 95\%$ sensitivity within a cylinder of diameter 200 mm	$\sim 55 \times 70 \text{ mm}$ diameter	$\sim 60 \times 30 \text{ mm}$ diameter
	Sample volume is weighted towards soil immediately surrounding the rods or rings	Sample volume is weighted towards soil immediately surrounding the rods	Sample volume is weighted towards soil immediately surrounding the rods
Dimensions and weight	PR2/6: length 1350 mm PR2/4: length 750 mm Both: 25.4 mm diameter	Overall: 158 x 40 mm dia Rods: 60 mm x 3.2 mm dia	Overall: 158 x 40 mm dia Rods: 60 mm x 3.2 mm dia (Rods are replaceable)
	PR2/6: 1.2 kg, PR2/4: 0.8 kg	Weight: 0.1 kg (excl. cable)	Weight: 0.1 kg (excl. cable)
Sensor calibrations	Individual sensors are interchangeable	Individual sensors are interchangeable	Individual sensors are interchangeable
	Recalibration advised every 3 years (depending on use)	Recalibration advised every 5 years (depending on use)	Recalibration advised every 5 years (depending on use)
Soil calibrations	Generalised Mineral and Organic soil calibrations are supplied	Generalised Mineral and Organic soil calibrations are supplied	Generalised Mineral and Organic soil calibrations are supplied
Applications	Provides rapid moisture content readings in a vertical soil profile. Used in access tubes for easy insertion and removal. Can be left installed for data logging or used with the HH2 for multi-site portable readings.	High quality entry level sensor suited to precision agriculture and research. It is a cost effective alternative where ML3 levels of accuracy are not required. It combines research-grade soil moisture and temperature measurement (when fully buried).	Versatile, high accuracy sensor recognized as the "gold standard" for the precise determination of soil moisture content. Also provides soil temperature when fully buried.