

SMM - Soil Moisture Meter

Product Overview

The Soil Moisture Meter (SMM) is a stand-alone logging instrument for the measurement of volumetric moisture content of soils and other materials.

The SMM can support up to 10 x standing wave sensors (MP406 or MP306) or up to 10 x capacitance sensors (10HS or EC-5).

The SMM is a fully self-contained unit requiring power input from a 20Volt/20W solar panel (field applications) or 24V DC power supply (laboratory applications). Communication is via a USB port or ICT wireless connectivity. The SMM logger is IP-65 rated and is controlled by a Windows and Mac driven GUI (Combined Instrument Software) for complete logging solutions including look-up tables, scripts and sensor calibration capabilities.



MP406 sensors installed in a soil profile



Breakout Box, SMM Logger & MP406

The SMM is ideally used in combination with the STM (soil tension meter) for soil water potential, SOM (soil oxygen meter) for soil oxygen concentration, TSM (temperature sensor meter), SFM1 (sap flow meter) for tree water use and the PSY1 stem psychrometer for plant water potential.

Applications

- Soil volumetric moisture content (%)
- Forest and catchment hydrology
- Irrigation scheduling
- Soil columns and geo-engineering
- Landfill cover and mine closures

Features

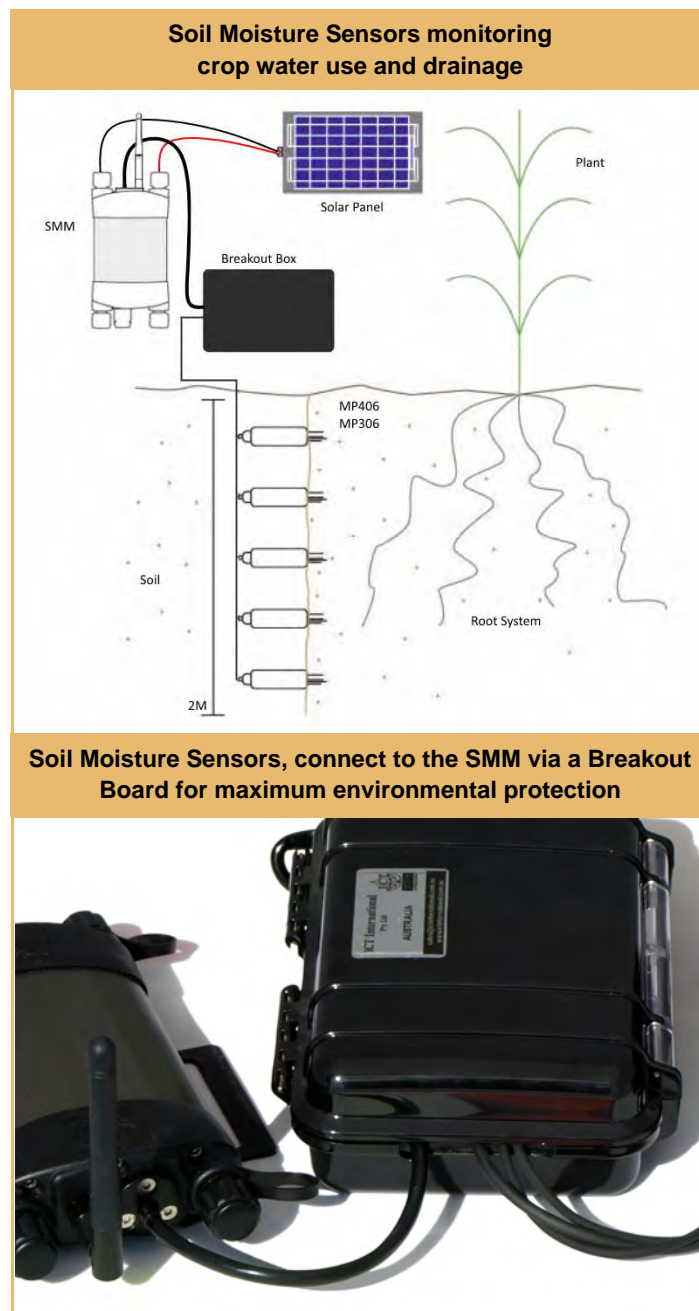
- Stand-alone, wireless data logging
- Up to 10 x sensor capacity
- Standing wave or capacitance measurement principle
- Flexible sensor calibration, look-up tables, and user scripts
- Low power requirement
- IP-65 weather proof rated logger



SMM - Soil Moisture Meter

More Details

- The SMM is a stand-alone instrument and does not have extensive cabling and power requirements. All data is stored within the unit on a removable MicroSD card.
- Communication with the SMM is made either with a USB or ICT wireless connection. Wireless is capable of ranges up to 250m.
- The SMM is controlled by a Windows and Mac compatible configuration software CIS (Combined Instrument Software). The software is GUI based and extremely user-friendly. Custom calibration equations or data can be entered and edited via the software. Real-time measurements, diagnostics and sensor configuration can easily be made.
- The SMM has a 2 wire bus plug connection for external power supply input. There is no chance of incorrect wiring of positive and negative wires because the SMM is non-polarized.
- The SMM has an internal lithium-polymer battery that is kept charged by an external power supply (20W solar panel or 24V DC mains adapter).



- The SMM logger is IP65 rated and has been demonstrated to operate in extreme environmental conditions. Units are being used in diverse environments from hot Australian deserts, tropical Amazon rainforests, temperate German forests, Indian agricultural fields and North American Arctic cold.



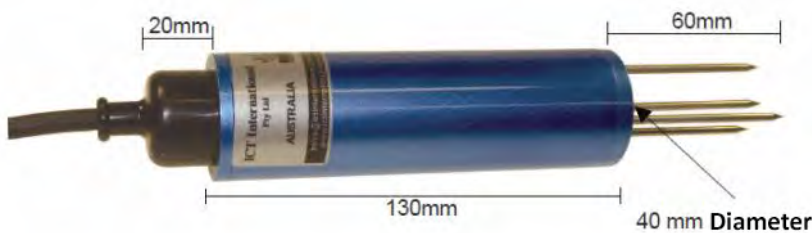
SMM - Compatible Sensors

MP306



- Standing wave soil moisture probe
- Measurement range: 0 to 100% VWC
- Accuracy: $\pm 1\%$ VWC
- Resolution: 0.01% VWC
- Compact size

MP406



- Standing wave soil moisture probe
- Measurement range: 0 to 100% VWC
- Accuracy: $\pm 1\%$ VWC
- Resolution: 0.01% VWC

10HS



- Capacitance soil moisture probe
- Measurement range: 0 to 57% VWC
- Accuracy: $\pm 2\%$ VWC
- Resolution: 0.1% VWC

EC-5

- Capacitance soil moisture probe
- Measurement range: 0 to 60% VWC
- Accuracy: $\pm 2\%$ VWC
- Resolution: 0.1% VWC
- Compact size



SMM - Applications

Assessing Water Movement

- A series of soil moisture sensors installed down a soil or other profile and supported by SMM can measure changes in moisture content during dry-down or wetting events. Data can be used in models of water movement.

Plant Physiology and Ecohydrology

- Root zone activity of crops, trees and other plants. Total moisture uptake by plants and related variables in water balance budgets such as run-off, drainage and transpiration. Data can be incorporated into ecohydrology models.

Irrigation Scheduling

- Spatial assessment of irrigation efficiency. Monitoring of soil moisture content to automatically determine stop/start irrigation events. Monitoring of crops to determine upper and lower tolerance limits of soil moisture content. Determination of field capacity and wilting point. Assessment of drainage infrastructure and water wastage following irrigation.

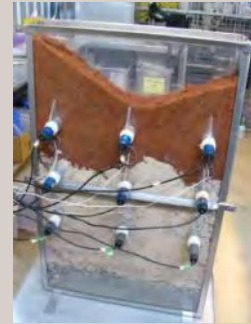
Landfill Cover and Mine Closure

- Soil column laboratory experiments. Testing of geo fabrics and other materials for their efficacy in landfill and mining projects. Long-term monitoring of dam walls, caps and other physical structures.

Engineering and Industrial

- Monitoring of sand moisture content for concrete mixtures. Assessment of water content along building foundations. Moisture content of Fly Ash for further use in concrete mixtures.

Modeling Water Movement



Landfill-GCL & Phytoremediation Performance



Mine Closure-Cover Design Modeling & Performance Monitoring



Railway Embankment



SMM - Case Studies

Deep Drainage of Irrigation Water

A common problem encountered when irrigating light textured soils is deep drainage. For example, it was found that following furrow irrigation it was taking too long for moisture to travel the length of a furrow down a field.

A series of soil moisture sensors were employed and *Figure 1* shows how moisture content down a 120cm soil profile changed over 72 hours. Increases in moisture content at 120cm depth indicated drainage was an issue.

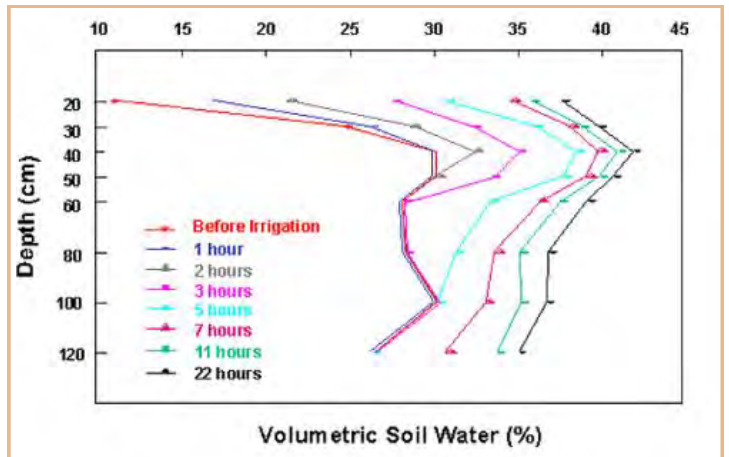


Figure 1. Deep Drainage of Irrigation Water

Unsaturated Behaviour of Geotextiles

Geotextiles are becoming more common in engineering applications. A research project at Monash University, Australia, developed a one dimensional soil-geotextile column test apparatus for experimentally measuring the unsaturated nonwoven geo-textiles hydraulic parameters under conditions of surface water infiltration.

MP406 sensors monitored the advancement of the infiltration wetting front throughout the experiment.

Moisture Release Curve (Soil Moisture Characteristics)

MP306 sensors were calibrated against a sandy clay soil using the calibration feature of the SMM. A large sample of sandy-clay soil was then air-dried.

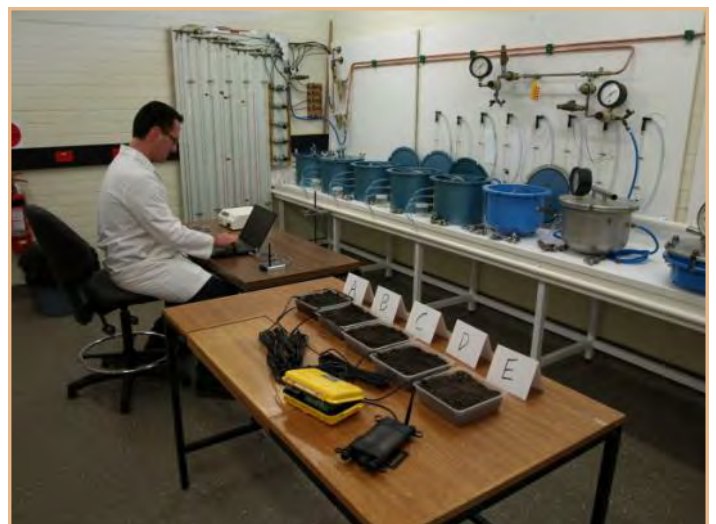
Soil was then distributed into five separate containers and a range of moisture was added to each container from none to complete saturation.

MP306 sensors were installed in each container and % VWC measurements made via a SMM.

Using a Decagon WP4C, soil water potential measurements were made and a moisture release curve was constructed.



Soil Column Testing at Monash University



Calculating a Moisture Release Curve



Software & Communication

Software Overview

ICT Combined Instrument Software acts as an interface between the user, instrument and sensors. CIS enables sensors and logging intervals to be configured, and spot measurements can be made.

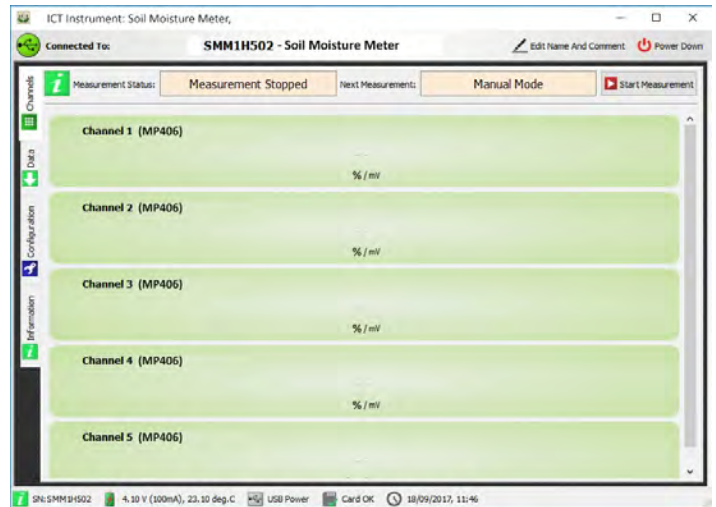
Look up Table

A look-up table is a conversion from a voltage output from the sensor into any conversion units.

A minimum of two values are needed in most cases.

Script

For more complex conversions, such as exponential, logistic or polynomial equations, users can enter scripts.

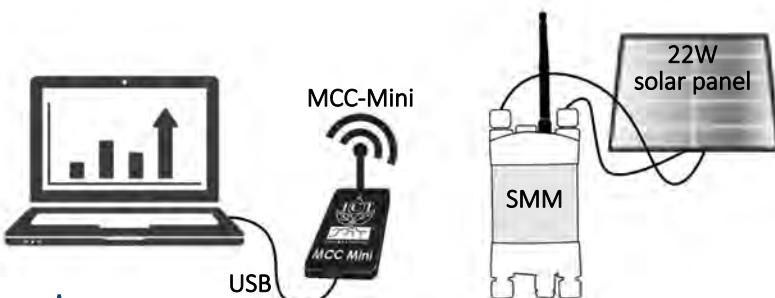


Software Overview

Self Calibration

Individual sensors can be calibrated using ICT International CIS. A minimum three point calibration curve is required. Statistical analysis of calibrated data is automatically performed. Calibration curves can be saved, retained and modified. Calibration of individual sensors allows absolute precision data collection.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Serial Number:	SMM3B708													
2	Instrument Name:	ICT VSL													
3	Comment:														
4	Date	Time	Chan1 (VS	Chan3 (VS	Chan5 (VS	Chan7 (VS	Internal B	Internal B	External P	External P	External P	Diagnostic Message			
5	26/07/2017	3:40:10	26.338	32.993	23.476	25.935	4.19	24.2	present	0	0				
6	26/07/2017	3:50:10	26.338	32.991	23.475	25.935	4.19	24.2	present	0	0				
7	26/07/2017	4:00:10	26.335	32.991	23.475	25.934	4.19	24.2	present	0	0				
8	26/07/2017	4:10:10	26.335	32.988	23.474	25.933	4.19	24.2	present	0	0				
9	26/07/2017	4:20:10	26.333	32.991	23.474	25.933	4.19	24.2	present	0	0				
10	26/07/2017	4:30:10	26.333	32.988	23.473	25.933	4.19	24.2	present	0	0				
11	26/07/2017	4:40:10	26.332	32.988	23.472	25.933	4.19	24.2	present	0	0				
12	26/07/2017	4:50:10	26.331	32.99	23.472	25.932	4.19	24.2	present	0	0				
13	26/07/2017	5:00:10	26.333	32.987	23.472	25.932	4.19	24.2	present	0	0				
14	26/07/2017	5:10:10	26.331	32.987	23.472	25.932	4.19	24.2	present	0	0				
15	26/07/2017	5:20:10	26.33	32.987	23.472	25.932	4.19	24.2	present	0	0				
16	26/07/2017	5:30:10	26.328	32.987	23.471	25.932	4.19	24.2	present	0	0				
17	26/07/2017	5:40:10	26.328	32.989	23.47	25.931	4.19	24.2	present	0	0				
18	26/07/2017	5:50:10	26.328	32.983	23.47	25.93	4.19	24.2	present	0	0				
19	26/07/2017	6:00:09	26.325	32.984	23.47	25.93	4.19	24.2	present	0	0				
20	26/07/2017	6:10:10	26.324	32.984	23.469	25.93	4.19	24.2	present	0	0				
21	26/07/2017	6:20:10	26.321	32.983	23.468	25.929	4.19	24.2	present	0	0				
22	26/07/2017	6:30:10	26.322	32.983	23.467	25.929	4.19	24.2	present	0	0	<i>Example Output File</i>			



Wireless Communication: MCC-Mini

- Wireless communication with any ICT International instrument within 250m.
- Portable, easy to use via CIS.
- Connects directly into any Windows or Mac based computer via USB cable.



Components

Solar Panel / Power Supply

Field Applications:

- 20W Solar Panel, approximately 20 Volts.
- 24V Battery

Laboratory / Glasshouse Applications:

- Mains 24V DC ICT CH24 power adapter



Power Supply



Solar Panel

4GB Removable MicroSD Card

- Data stored internally on a 4GB removable SDHC MicroSD card.
- Storage for months to years of data.



MicroSD Card

Breakout Board

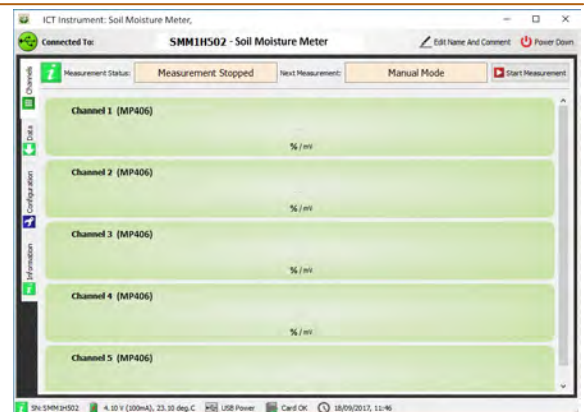
- The SMM1 can support up to 10 single ended sensors.



Single Ended

Combined Instrument Software

- Software for instrument configuration and data visualisation
- Set logging intervals, parameters and download data.



MCC-Mini Wireless / USB Cable

- Communication with instrument is made directly via a supplied USB Cable
- Wireless communication is available with communication distance up to 250m.
- The MCC-Mini connects to a computer via USB



USB Cable



SMM Specifications

SMM Logging	
Analogue Channels	Up to 10 single ended.
Resolution	0.00001V-24-Bit
Accuracy	0.001V
Minimum Logging Interval	250 ms
Delayed Start	Suspend Logging, Customised Intervals
Sampling Frequency	10Hz
Data	
Communications:	USB, Wireless Radio Frequency 2.4 GHz
Data Storage	MicroSD Card, SD, SDHC & SDXC Compatible (FAT 32 Format)
Software Compatibility	Windows 7, 8, 8.1, 10. Mac OS X
Data File Format	Comma Separated Values (CSV) format for compatibility with all software programs
Memory Capacity	4GB microSD card included.
Upgradable Firmware	User upgradeable firmware using USB boot strap loader function
Operating Conditions	
Temperature Range	-40°C to +60°C
R/H Range	0 -100%
Power	
Power supply	8-30V DC 2-wire non polarized bus
Power Consumption	170 mA @ 17Volts DC
Internal Battery Monitoring	Logging of internal battery voltage & current draw / supply voltage
Charging Rate	60 mA to 200 mA variable internal charge rate, maximum charge rate active when the external voltage rises above 16V DC.

Features
Power Management <ul style="list-style-type: none"> • Internal Lithium-Polymer Battery • Power On/Off Switch • Internal Voltage Regulation
Logging <ul style="list-style-type: none"> • Stand-Alone Logging • 24-Bit Resolution • MicroSD Expandable Memory • USB Connectivity • Wireless Data Transfer • The SMM logger is IP65 rated • ICT Combined Instrument Software (free)
Applications
<ul style="list-style-type: none"> • Soil Volumetric Moisture Content (%) • Forest and Catchment Hydrology • Irrigation Scheduling • Soil Columns and Geo-Engineering
Accessories
<ul style="list-style-type: none"> • MCC-Mini • ICT Universal Telemetry Hub
