

# SMM - Soil Moisture Meter 土壤水分測定器

## Product Overview 製品概要

Soil Moisture Meter (SMM) 土壤水分測定器は、土壌や他の物質の体積含水率を測定するスタンドアロン式の独立した測定器です。

定常波センサー（MP406やMP306）なら最大5台、またキャパシタセンサー（10HSやEC5：静電容量センサー）ならば10台制御することができます。

SMMは屋外なら7Wあるいは11Wの太陽パネルから、屋内ならば12Vの供給電源で動作する完全な独立した測定器です。

データや設定の通信はUSBポートや無線通信（オプション）が可能です。SMMはIP68に準拠し、LUTやセンサー校正などを持つWindowsマシンで動作する測定器です。



MP406's installed in a soil profile



Breakout Board, ICT Instrument & MP406

**SMM** を以下の装置と共に利用することをお勧めします。  
**STM soil water potential, TRM temperature sensor, SFM sap flow meter (tree water use) and PSY stem psychrometer (plant water potential) instruments.**

## Applications アプリケーション

- 土壌体積含水率（%）
- 森林学や集水域水文学
- 灌水管理
- 土壌カラム実験や地球工学
- 埋立地や鉱山での堆積物調査

## Features 特徴

- スタンドアロン式データロガー（無線機能付）
- 最大10台のセンサー接続
- 定常波センサー（誘電率測定）、キャパシタンスセンサーが利用可
- フレキシブルなセンサー校正  
LUT (LookUpTable) 機能  
ユーザースク립ト
- 低電力
- IP-68 防水準拠



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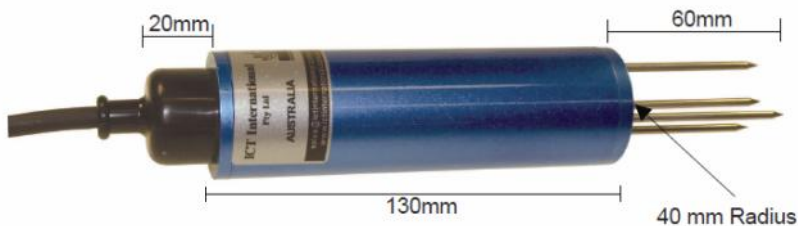
# SMM - Compatible Sensors

## 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



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# 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 use 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.

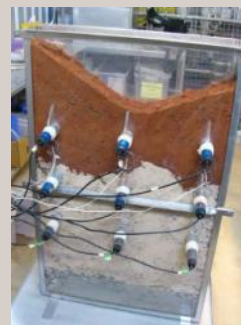
## Landfill Cover and Mine Closure

- 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

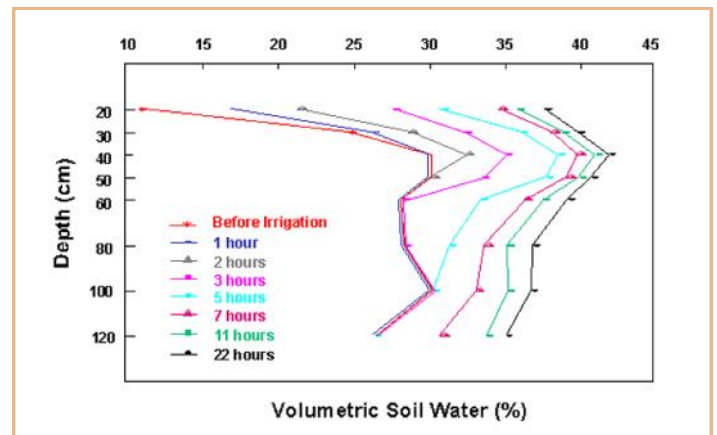


# SMM - Case Studies

## 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.



*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.

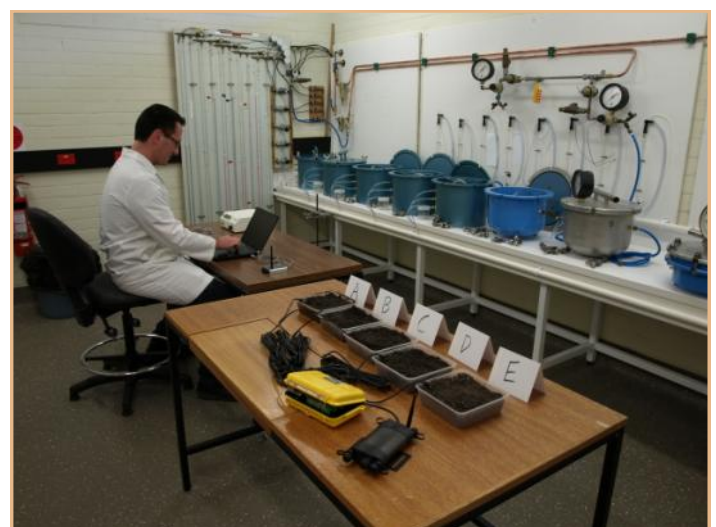
Soil was then distributed into five separate containers and a range of moisture was added to each container from none to complete saturation.

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*



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# Software & Communication

## Software

### Overview

ICT International instruments have customised software support. The software acts as an interface between the user, instrument and sensors. Each instrument has software pre-configured for the sensors it supports.

### Look up Table

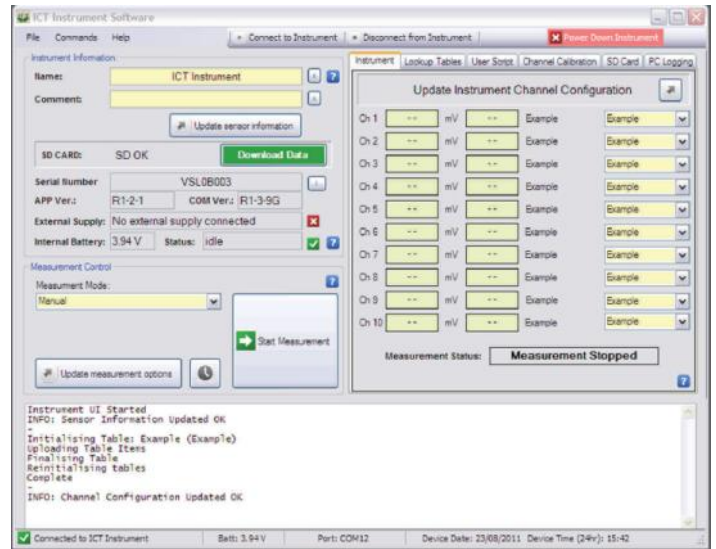
A look-up table is a linear conversion from a mV output from the sensor into any conversion units. A minimum of two values are needed: the lowest mV output and the highest mV output.

### Script

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

### Self Calibration

Individual sensors can be calibrated using the ICT International software. 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.



Software Overview

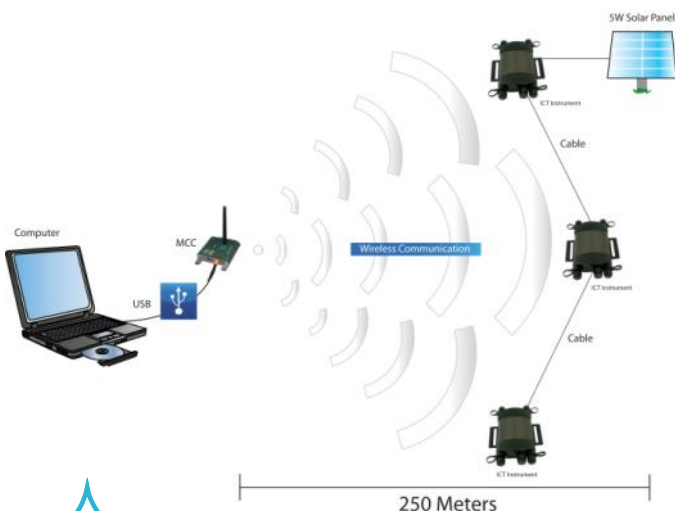
The screenshot shows an 'Example Output File' which is a spreadsheet. The columns are labeled A through H. Row 1 is the header: A: Serial Number (EXAMPLE), B: APP Serial # (4000162), C: APP Ver: (R1-2-4), D: COM Ver: (R1-3-9G), E: Instrument Name: (ICT International Example), F: Comment: (Example), G: Channel: (Slope), H: Intercept. Rows 2-6 show channel configuration for Chan1 through Chan5. Rows 7-21 show a data log with columns for Date, Time, Chan1 (Example), Chan2 (Example), Chan3 (Example), Chan4 (Example), Chan5 (Example), and Internal Battery Voltage. The data shows a steady increase in channel values over time, with the battery voltage remaining stable around 4.00V.

Example Output File

## Communication

### MCC

- Wireless communication with any ICT International instrument within 250m.
- Portable, easy to use via ICT International software interface.
- Connects directly into any Windows based computer via USB cable.
- Multiple channel ports, such as SDI-12, RS232, RS485, SI8, ICT-BUS & ICT Wireless Protocols, for highly flexible interfacing between ICT International instruments and third party devices.



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# Components

## Solar Panel / Power Supply

### Field Applications:

- 7W Solar Panel (standard)
- 11W Solar Panel (high demand)
- 12V Battery (recommended, not supplied)
- Solar charger regulator (recommended with solar panel)

### Laboratory / Glasshouse Applications:

- 12V Switch-mode power adapter  
(Note: must be 12V power output)



Power Supply



Solar Panel 7W or 11W

## 2GB Removable SD Card

- Data stored internally on a 2GB removable micro-SD card
- Memory can handle months to years of data
- Expandable to 4GB, 8GB or 16 GB micro-SD cards.



Micro SD Card

## Breakout Board

- ICT International instruments can support up to 5x differential sensors or up to 10 x single ended sensors.
- Variable voltage excitation is software settable in the ICT Instrument.
- Internal or External power switch.



Differential



Single Ended

## GUI Software

- Customised software interface between user, instrument and sensors.
- Set logging intervals, parameters and data download.
- Look-up tables, user scripts and custom sensor calibration.



Customised software interface

## MCC Wireless / USB Cable

- Communication with instrument is made directly via a supplied USB Cable
- Wireless communication is available with communication distance up to 250m.
- Connect MCC wireless device to USB port of computer.



USB Cable (1.8m length)



MCC Wireless Device



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# SMM Specifications

SMM Logging	
<b>Analogue Channels</b>	5 differential or 10 single ended
<b>Resolution</b>	0.00001V-24-Bit
<b>Accuracy</b>	0.001V
<b>Minimum Logging Interval</b>	1 second
<b>Delayed Start</b>	Suspend Logging, Customised Intervals
<b>Sampling Frequency</b>	10Hz
Data	
<b>Communications:</b>	USB, Wireless Radio Frequency 2.4 GHz
<b>Data Storage</b>	MicroSD Card, SD, SDHC & SDXC Compatible (FAT 32 Format)
<b>Software Compatibility</b>	Windows XP, Vista and Windows 7
<b>Data File Format</b>	Comma Separated Values (CSV) format for compatibility with all software programs
<b>Memory Capacity</b>	2GB expandable to 64GB
Operating Conditions	
<b>Temperature Range</b>	-40 ° C to +80 ° C
<b>R/H Range</b>	0 -100%
<b>Upgradable</b>	User upgradeable firmware using USB boot strap loader function
Power	
<b>Power supply</b>	12V DC 2-wire non polarized bus
<b>Power Consumption</b>	20 mA
<b>Internal Battery Monitoring</b>	Logging internal battery voltage & charging current
<b>Charging Rate</b>	Automatic variable rate of charging to maximise solar panel charging current on full sun days and or under low light cloudy conditions.  Variable current 10 mA to 200 mA

## Features

### Power Management

- Internal Lithium-Polymer Battery
- Power On/Off Switch
- Internal Voltage Regulation
- Optical Isolation Lightning Protection

### Logging

- Stand-Alone Logging
- 24-Bit Resolution
- MicroSD Expandable Memory
- USB Connectivity
- Wireless Data Transfer
- IP68 Water Proof Rating
- Free Windows Utility Configuration Software

## Applications

- Soil Volumetric Moisture Content (%)
- Forest and Catchment Hydrology
- Irrigation Scheduling
- Soil Columns and Geo-Engineering

## Accessories

- MCC
- Quad Band GPRS, GSM, 3-G CDMA Modem



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