

## Product Overview

The Soil Tension Meter (STM) is a stand-alone logging instrument for the measurement of soil matric potential via a tensiometer.

The STM can support up to 5 x ICTGT3 pressure transducers measuring  $\pm 7$  kPa,  $\pm 100$  kPa or  $+200$  to  $-100$  kPa. Tensiometers include designs for soil columns and field sites.

The STM is a fully self-contained unit requiring power input from a 22W solar panel (field applications) or 24V power supply (laboratory applications). Communication is via a USB port or wireless connectivity. The STM is IP-65 rated and has Windows and Mac compatible software for complete logging solutions including look-up tables, scripts and sensor calibration capabilities.



*ICT2100F Tensiometer connected to the Soil Tension Meter*



*Jet Fill Tensiometers connected to the Soil Tension Meter*

## Applications

- Soil column testing
- Moisture retention curves
- Geotechnical engineering
- Soil water potential for irrigation monitoring

## Features

- Precise measurements of soil matric potential
- Live monitoring of sorption and desorption curves
- Flexible sensor calibration, look-up tables, and user scripts
- Up to 5 x sensor capacity
- Stand-alone, wireless data logging, low power requirement
- IP-65 Intrusion Rating

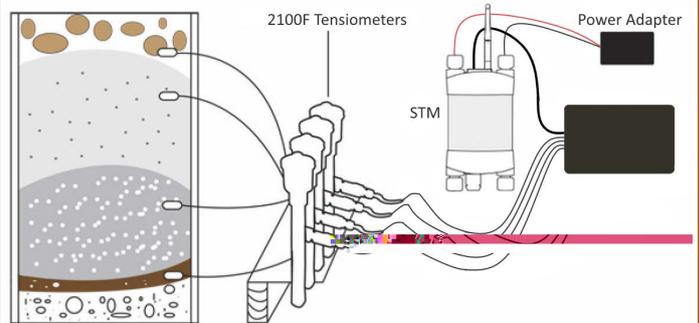
**The STM is ideally used in combination with the SFM1 sap flow meter (tree water use), PSY stem psychrometer (plant water potential), SMM soil moisture meter, SOM soil oxygen meter and the ICT International automatic weather station.**



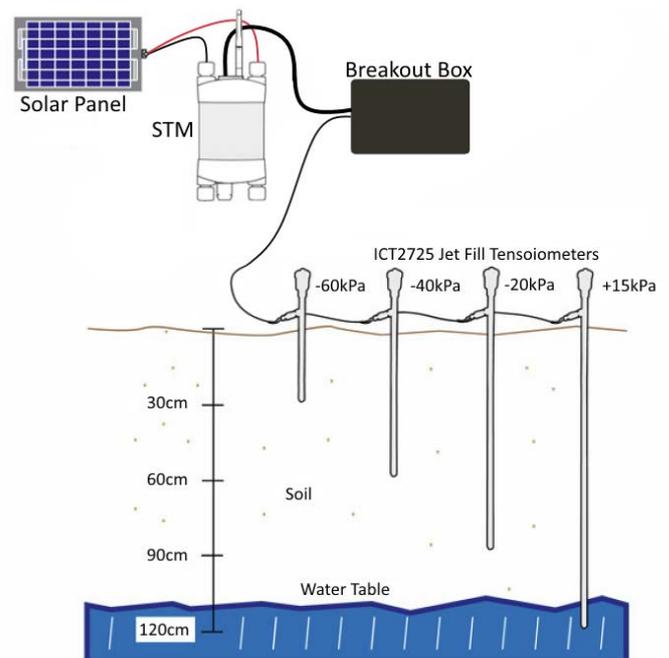
## More Details

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

### ICT2100F Tensiometer Measuring a Soil Column x 4 Depths



### ICT2725 Jet Fill Tensiometers Monitoring Moisture Dynamics Near Infrastructure



- The STM 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.



## Pressure Transducers



### ICTGT3-1:

- Measurement range: -7 to +7kPa
- Accuracy:  $\pm 1\%$
- Resolution: 0.01kPa

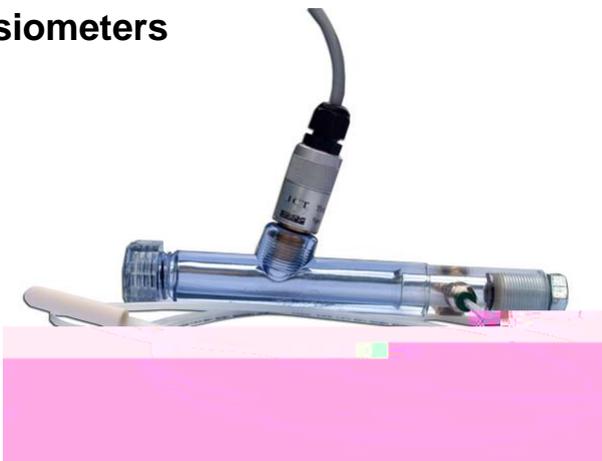
### ICTGT3-15:

- Measurement range: -100 to +100kPa
- Accuracy:  $\pm 1\%$
- Resolution: 0.01kPa

### ICTGT3-30:

- Measurement range: -100 to +200kPa
- Accuracy:  $\pm 1\%$
- Resolution: 0.01kPa

## Tensiometers



### ICT2100F Tensiometer for Soil Columns

Ceramic dimensions: 6mm diameter  
2.5cm length

- 100 kPa air entry value
- Tube length: 1.8m

### Jet Fill Tensiometers for Field Applications

Ceramic dimensions: 2.1cm diameter  
8.2cm length

Tensiometer dimensions:

- 2.1cm diameter
- Lengths from: 15cm, 30cm, 45cm, 60cm, 90cm, 120cm, 150cm



## Equilibrium Water Potential

The water retention properties of coarse textured strata to be used for mine closure and revegetation is studied in large suction cells.

The data obtained is important for the cost effective selection of material and cover thickness at mine closure.

The attainment of equilibrium water potential is tracked by monitoring outflow rate and tensiometry.

## Moisture Dynamics and Infrastructure

The wetting and drying of soils can result in considerable ground movement near and under infrastructure.

Geotechnical Engineers from Railcorp, approached ICT International to assist in installing MP406 volumetric moisture content sensors and **STM with Jet Fill Tensiometers**, in order to monitor moisture dynamics near a railway line.

## Moisture in Sand Stock Piles

Following mining from a quarry sand is typically stockpiled for up to 8 days in order to reach a specific volumetric moisture content for on-selling. Improving the drying process is a goal of quarry operators.

Engineers examined two techniques that have been theorised to improve the drying process: the use of Surfactants and a specially designed drainage system. Sand stock piles were established in a laboratory and MP406 volumetric moisture content sensors and **STM with Jet Fill Tensiometers** were used to monitor moisture dynamics.

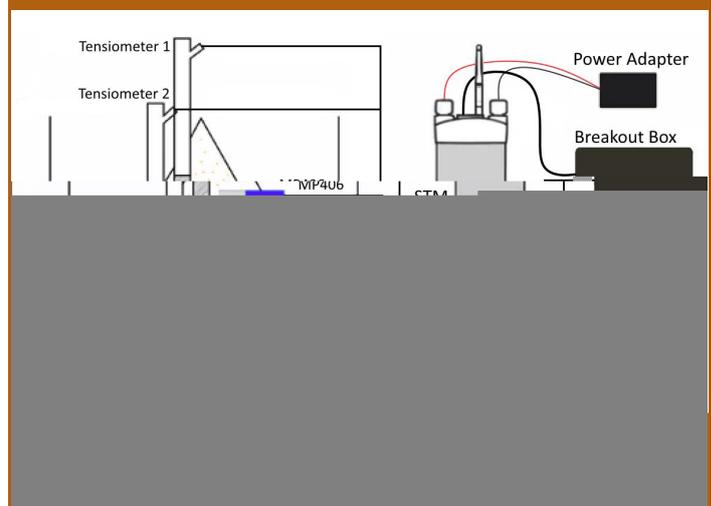
### Large Suction Cell



### Geotechnical engineers monitoring moisture dynamics near a railway line



### Sand stock pile in a laboratory at RMIT



# 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.

## Multi-point Calibration

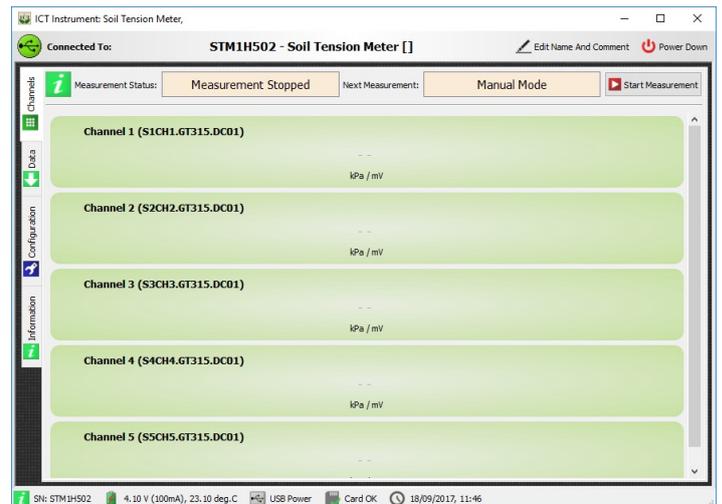
A multi-point calibration is performed by ICT International for each STM package.

## 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 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.



Software Overview

	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				

Example Output File

MCC-Mini  
 22W solar panel  
 STM  
 USB

## 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.



## Solar Panel / Power Supply

### Field Applications:

- 22W Solar Panel
- G1V Battery

### Laboratory / Glasshouse Applications:

- Tæä}•ÁGIXÁÖÖÁQÔVÁÔPGIÁ][, ^!Áæäæ]c^!



Power Supply



Solar Panel

## 4GB Removable Micro SD Card

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



MicroSD Card

## Breakout Board

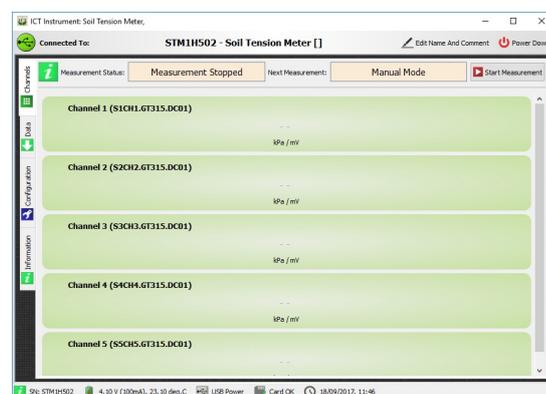
- V@^ÁÛVT can support up to 5x differential sensors



Differential

## Combined Instrument Software

- Ú[-c, æt^Á~[!Áä}•ci~{^}cÁ&[-ä\*~!æcä[}Áæ}áÁæææÁçä•~æ|á•æcä[}
- Set logging intervals, parameters and download



## 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.
- V@^ÁTÔÔËTä}áÁ&[}]^&c•Ác[ÁæÁ&[ { ]~c^!ÁçæÁWUÖ



USB Cable



STM Logging	
<b>Analogue Channels</b>	5 differential
<b>Resolution</b>	0.00001V-24-Bit
<b>Accuracy</b>	0.001V
<b>Minimum Logging Interval</b>	250 ms
<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 (FAT32 Format)
<b>Software Compatibility</b>	Windows 7, 8, 8.1, 10, Mac OS X
<b>Data File Format</b>	Comma Separated Values (CSV) format for compatibility with all software programs
<b>Memory Capacity</b>	4GB MicroSD card included.
<b>Upgradable Firmware</b>	User upgradeable firmware using USB boot strap loader function
Operating Conditions	
<b>Temperature Range</b>	-40°C to +60°C
<b>R/H Range</b>	0 -100%
Power	
<b>Power supply</b>	8-30V DC 2-wire non polarized bus
<b>Power consumption</b>	Current draw is 190 mA maximum at 17 volts, per logger.
<b>Internal Battery Monitoring</b>	Logging of internal battery voltage & charging current
<b>Charging Rate</b>	60 mA to 200 mA variable internal charge rate, maximum charge rate active when the external voltage rises above 16V DC.

Features
<p><b>Power Management</b></p> <ul style="list-style-type: none"> <li>• Internal Lithium-Polymer Battery</li> <li>• Power On/Off Switch</li> <li>• Internal Voltage Regulation</li> </ul> <p><b>Logging</b></p> <ul style="list-style-type: none"> <li>• Stand-Alone Logging</li> <li>• 24-Bit Resolution</li> <li>• MicroSD Expandable Memory</li> <li>• USB Connectivity</li> <li>• Wireless Data Transfer</li> <li>• The STM is IP65 rated</li> <li>• ICT Combined Instrument Software (free)</li> </ul>
Accessories
<ul style="list-style-type: none"> <li>• MCC-Mini</li> <li>• ICT Universal Telemetry HUB</li> </ul>