SFM1 Sap Flow Meter

Product Overview

The SFM1 Sap Flow Meter is a self contained, stand-alone instrument for the measurement of sap flow or transpiration in plants. The SFM1 is a complete package containing sap flow sensors, data logger, interface software and internal battery which can be charged with an external solar panel. The SFM1 Sap Flow Meter is a new model which replaces the HRM30 sap flow measurement sensor.

Utilising the Heat Ratio Method (HRM) principle the SFM1 Sap Flow Meter is able to measure high, low and reverse flow rates in both small woody stems & roots as well as large trees. Like the Heat Field Deformation (HFD) principle, the HRM Sap Flow Meter is the only instrument that can measure zero flow and reverse sap flow rates. The SFM1 Sap Flow Meter is the most powerful and flexible instrument for the direct measurement of plant water use.

The Heat Ratio Method

Developed by the University of Western Australia and partner organisations, ICRAF and CSIRO, the HRM principle has been validated against gravimetric measurements of transpiration and used in published sap flow research since 1998.

Burgess, S.S.O., et.al. 2001 An improved heat pulse method to measure low and reverse rates of sap flow in woody plants Tree Physiology 21, 589-598.

Heat Ratio Method (HRM) is an improvement of the Compensation Heat Pulse Method (CHPM). Being a modified heat pulse technique, power consumption is very low, using approx 70 mAmp per day at a 10 minute temporal sampling interval under average transpiration rates.

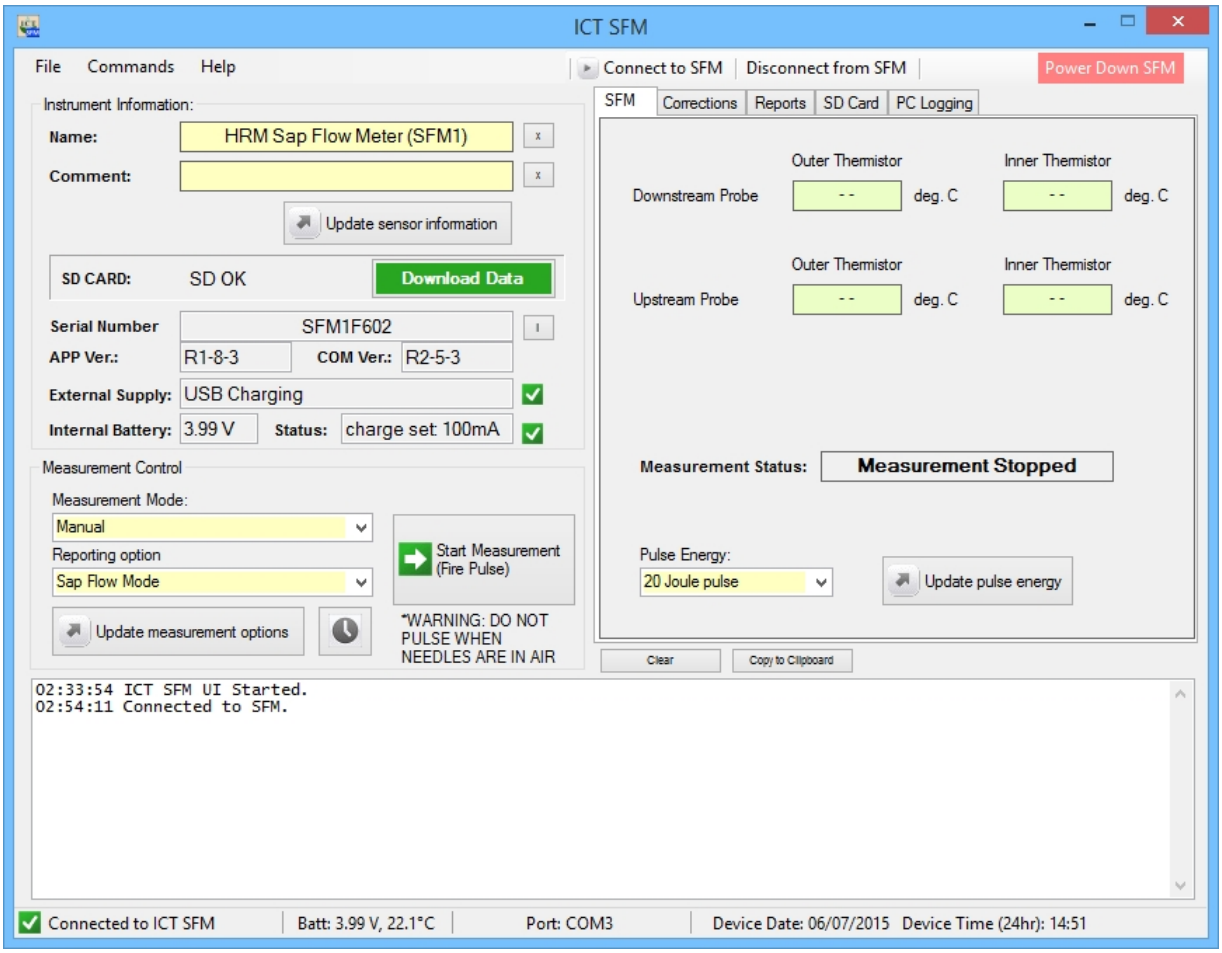
The HRM needles have two radial measurement points for the charaterisation of radial sap flow gradients making measurements more accurate. Through microprocessor control, the inner measurement point can be activated or deactivated dependent on the specific wood anatomy of the species being measured. This provides a great flexibility in stem diameter range from >10 mm diameter woody stems or roots to the world's largest Redwood trees.

This enables water flows to be monitored in stems and roots of a wide range of different species, sizes and environmental conditions including, drought or water stress.

Instrument Design

The HRM probes consists of three 35mm long needles integrally connected to a 16-bit microprocessor. The top and bottom probes contain two sets of matched and calibrated high precision thermistors located at 7.5mm and 22.5mm from the tip of each probe. The third and centrally located needle is a line heater that runs the full length of the needle to deliver a uniform, and exact pulse of heat through the sapwood.

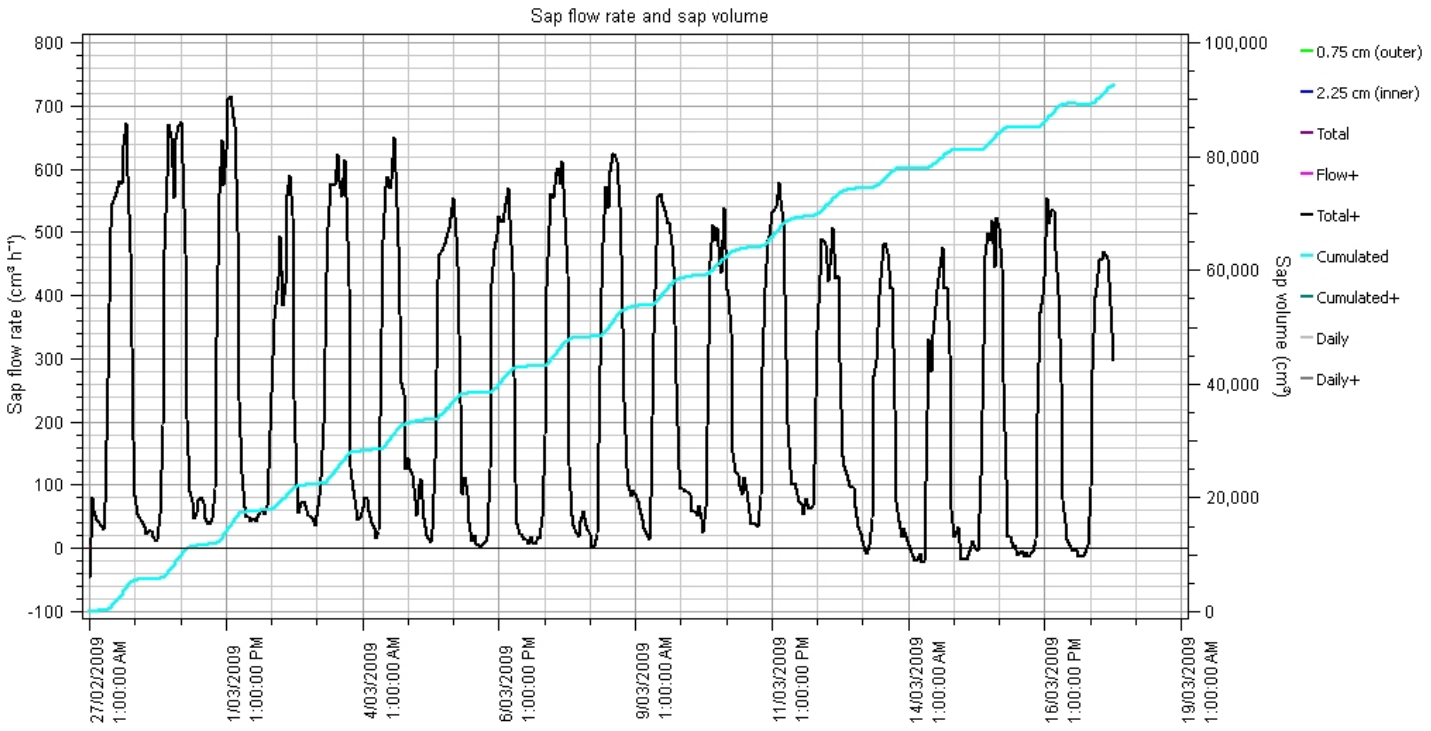
Instrument Configuration & Operation



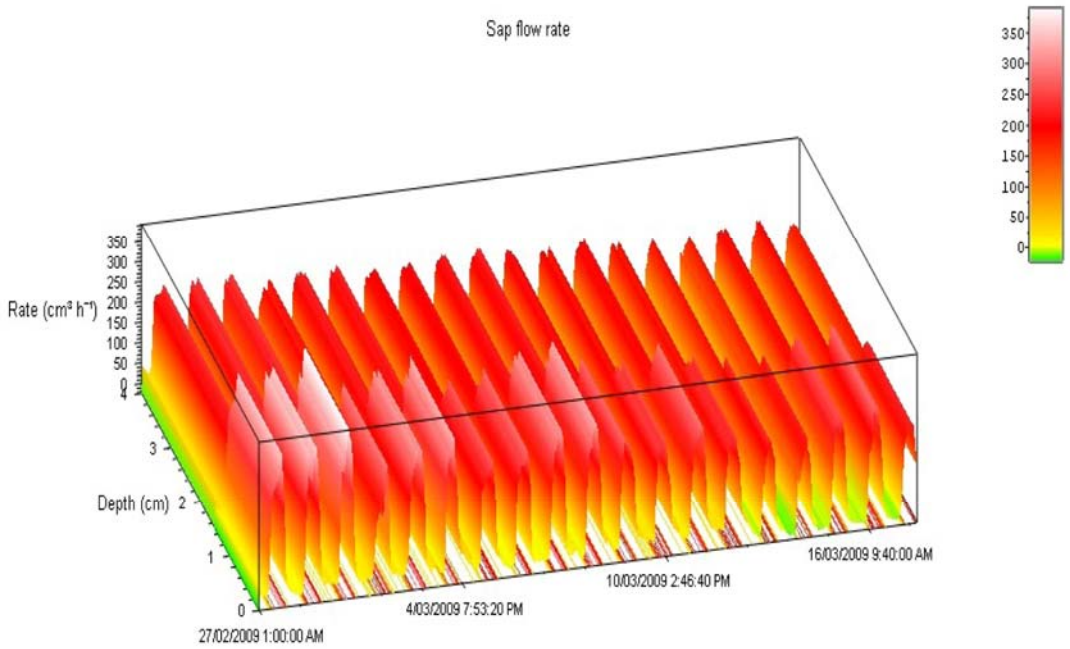
All aspects of the instrument's operation and calculations are controlled by the microprocessor, which automatically converts the analogue microvolt signals to a calibrated output. Programming variables such as heat pulse interval, energy input, probe spacings, and measurement frequency are all stored in non-volatile memory.

The HRM Sap Flow Meter also displays information such as external battery status, Serial Number, firmware version, SD Card Status, Measurement interval, Data reporting options, & correction factors. The utility software enables the Sap Flow Meter to be used in manual mode. This provides the ability to evaluate the efficacy of pulse intervals by viewing the raw measured temperatures on screen. Subsequent reports can then be viewed, detailing the duration of time the heat pulse required to deliver the exact amount of heat energy in Joules, the temperature rise following the previous heat pulse, temperature ratios between measurement points, sap velocity or sap flow.

Data Analysis



Data can be manually processed using a spreadsheet such as Excel by opening the comma separated values (CSV) file provided by the Sap Flow Meter. More powerful and immediate processing can be achieved by directly importing the data file into the Sap Flow Tool Software; thus providing instant 2 dimensional and 3D graphing of the raw heat pulse velocity and processing of sap velocity and sap flux. The entire data set can be instantly reprocessed if correction factors require modification or additional information becomes available.



SFM1 Specifications

Measurement	
Output Options	**Raw Temperatures:** °C **Heat Pulse Velocity** cm hr^{-1} **Sap Velocity:** cm hr^{-1} **Sap Flow:** cm^3 hr^{-1}(Litres hr^{-1})
Range	-100 to +100 cm hr^{-1}
Resolution	0.01 cm hr^{-1}
Accuracy	0.5 cm hr^{-1}
Response Time	120 seconds
Data	
Computer Interface	USB, Wireless RF 2.4 GHz
Data Storage	MicroSD Card
Memory Capacity	Up to 16GB, 4GB microSD card included.
Operating Conditions	
Heat Pulse	**User Adjustable:** 20 Joules (default) approx. Equivalent to a 2.5 second heat pulse duration, auto scaling. **User Adjustable:** Minimum interval, 3 minutes, recommended minimum 10 minutes.
Power	
Power supply	960mAh Lithium Polymer battery
Battery Life	A. 1 day at hourly logging interval @ 20 Joules B. Unlimited with optional 11W Solar panel
Charging Voltage	8-30V DC
Dimensions	
Sensor Design	Probe Diameter: 1.3 mm Probe Length: 35 mm Thermocouples: 2 per probe
Dimensions	Length: 170 mm Width: 80 mm Depth: 35 mm
Weight	400g

Features

Power Management

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

Logging

- Stand-Alone logging
- MicroSD Expandable Memory
- USB Connectivity
- Wireless Data Transfer
- IP65 Rated Water Proof Enclosure
- Free Windows -
  -Utility Configuration Software

Applications

- Low & Zero Sap Flow Rates
- Reverse Sap Flow Rates
- Night Time Water Loss
- Stem Sizes>10mm
- Sap Flow in Roots
- Arid Ecosystems & Drought
- Radial Sap Velocity Profiles
- Sap Flow of Grapevines

Accessories

- SFT - Sap Flow Tool Software
- MCC- Wireless RF Modem
- SFM1-IK: Installation Kit
- SFM-55 Pack of 10 replacement SFM drill bits, size #55.
- SP11- 11 Watt Solar Panel
- SP22- 22 Watt Solar Panel