

APPLICATIONS

Whole plant water use

Sapflow of very small stem sizes (minimum diameter 2 mm)

Stem sizes < 25 mm

Sapflow on herbaceous or non lignified stems

Sapflow measurements of rice plants

Diurnal changes in sapflow of sugarcane

Sapflow of tomato plants

Estimation of total water use of soybean canopies

Sapflow through the peduncle of a grape vine to the bunch

Water dynamics in the peduncle of mangoes

FEATURES

Measurement options:

- Raw data (mV)
- Calculated sapflow (g/h)

Automatic minimum KSH correction

Power-down function

Independent sensor voltage regulation

Full sensor report option

Ease of programming

Straight forward data output

HyperTerminal access to configuration information

Microprocessor controlled

Plug & Play operation

Digital Dynagage Sensors

The stem heat balance (SHB) method was originally proposed by Sakuratani (1981) to measure the mass flux rate or sapflow in small stemmed herbaceous plants.

The SHB method is based on the energy balance of a stem segment to which regulated heat energy is constantly supplied by an external annular heater.

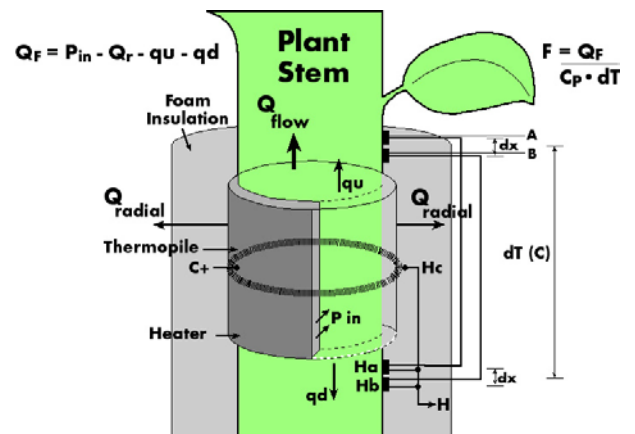
Sakuratani's original design of the (SHB) sensor has been modified by several researchers but the most notable has been: Baker, J.M. and van Bavel, C.H.M., 1987: 'Measurement of mass flow of water in the stems of herbaceous plants' *Plant Cell Environ.*, 10, 777-782. The SHB method is most commonly recognised by the commercial trademark "Dynagage".



Sensor design & principle of measurement

The SHB or Dynagage sap flow sensor consists of a flexible heater, a thermopile to measure radial heat loss, and differential thermocouple pairs to measure the axial temperature differences $q_u - q_d$, (as shown). All

of these sensors and heater are mounted on a cork substrate and housed inside a white, reflective foam, thermal insulating collar. Once the sensor is installed on the stem surface, both the sensor and the stem sections above and below the sensor are completely covered by a heat insulator to minimize thermal perturbations caused by the ambient environment. Power is supplied continuously to the heater from a regulated DC power source.



Plug & Play

ICT International has designed a digital microprocessor based interface that automatically measures and processes the raw micro-volt signals from a Dynagage into a calibrated sapflow measurement in g/h at the point of measurement in the field. The integrated microprocessor holds resident in memory the specific calibration information for a Dynagage such as: stem type, stem size, heater resistance, minimum KSH, measurement frequency and supplies a regulated voltage to the Dynagage. All of the stored parameters and raw measured data is directly available via the sensor report function providing a unique trouble shooting facility for the user.

The digital interface eliminates the need for any complicated programming or wiring of the Dynagage sensor. Each digital interface has its own integrated voltage regulator so any number of Dynagages from all size classes with varying power requirements can be used simultaneously on a single system. There are none of the limitations caused by having a central dual channel regulator (AVRDC) that can only supply two different voltages across the whole system, every digitally interfaced Dynagage is independent of each other.

When used with the ICT Smart Logger, Dynagages become truly Plug & Play providing accurate measurements of sapflow on very small herbaceous stems and can easily be added as an additional measurement parameter to an EnviroStation (weather station) or FieldStation logging system.

Upgrade an analogue system to digital

The digital interface is designed as a separate unit from the Dynagage sensor to

provide complete flexibility for the user. The digital interface can be purchased with a Dynagage of preferred size as part of a complete logging solution or as an independent unit to upgrade existing Dynagage sensors from analogue output to digital output. The digital interface is fitted with standard 7-Pin Mini Hex male connectors making them compatible with all commercial Dynagage sensors. A 50 cm cable transfers the analogue signal from the Dynagage sensor to the interface at which point the signal is converted from analogue to digital. A 5 metre cable then transfers a digital packet of processed sapflow data from the sensor to the Smart Logger.



No cable limitations

Because the signal has been converted from analogue to digital at the point of measurement there is no risk of signal loss due to cable resistance whilst transferring the data to the logger. Dynagage sensors output a very small micro-volt signal that can degrade very quickly over short distances. Using traditional means of data transfer the maximum cable length possible for Dynagage sensors is 30 m. Using the digital interface 100 m cable lengths are standard and can be extended to as long as 4 km provided additional power supplies are located at the point of measurement to overcome the loss of power supply voltage caused by cable resistance over such long distances.

Another great benefit of the digital system is that each Dynagage sensor no longer requires an independent extension cable. Dynagage sensors can now be grouped via a DataBus in any quantity and the data from all sensors transferred back to an SL5 Smart Logger via a single extension cable.

SF1 & SF2 Digital Interfaces

Due to the high and constant power supply requirements of Dynagage sapflow sensors and the large range of input voltages across the full 2 mm to 150 mm gauge range ICT offers two digital interfaces. The SF1 being suitable for Dynagage sizes 2 mm to 25 mm and the SF2 for Dynagage sizes 35 mm to 150 mm. Whilst SF2 interfaces are readily available, due to the practical considerations of power supply and length of clear straight stem required to accurately operate the large Dynagage sizes SGC35 to SGA150, ICT does not recommend this option; instead, ICT recommends that users consider more appropriate methods of measuring sapflow in large diameter, especially lignified plants, such as the Heat Ratio Method (HRM) digital sapflow sensor.

SPECIFICATIONS

Measurement range:

0 to 200 g/h

Accuracy: ± 0.1 g/h

Resolution: 0.01 g/h

Logging frequency: 1 minute

SF1/SF2 Interface output:

Smart Output: Serial data

Raw Data: mV

Sapflow: g/h

Sensor Size Range:

SF1 Digital Interface:

Dynagage sizes SGA2 to SGC25

SF2 Digital Interface:

Dynagage sizes SGC35 to SGA150

SF1/SF2 Interface Power requirements:

Input Power Supply:

5 to 28 V DC

Output Power supply:

0 to 12 V regulated.

Regulated Output Power

Accuracy: 0.001 V

Resolution: 0.0025 V

Cable lengths:

Standard cable length is 5 m
Maximum cable length 4 km
using DataBus communications

Dimensions:

SF1 /SF2 Interface

Length: 80 mm

Width: 40 mm

Depth: 20 mm

Weight: 250 g (including cable)

Related products:

Field Station Unlimited channel logging system

EnviroStation Automatic Weather Station

SL5 Smart Logger

HRM-30 Sapflow Sensor

SHY-LC Stem Hygrometer for in-situ logging of Stem Water Potential

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