



EMS Brno

Data Acquisition Environment

Hardware – Software – Cloud application

www.emsbrno.cz

Sap flow system EMS 64

based on MicroSet 6X
controlling unit with
embedded datalogger



Main features:

- Tissue heat balance method with variable power and constant dT
- External heating and internal temperature measuring of stem tissue
- No overheating of stem tissues
- Extremely high efficiency > low energy consumption
- Power requirements proportional to sap flow rate – fits to solar powering
- Manufactured by EMS



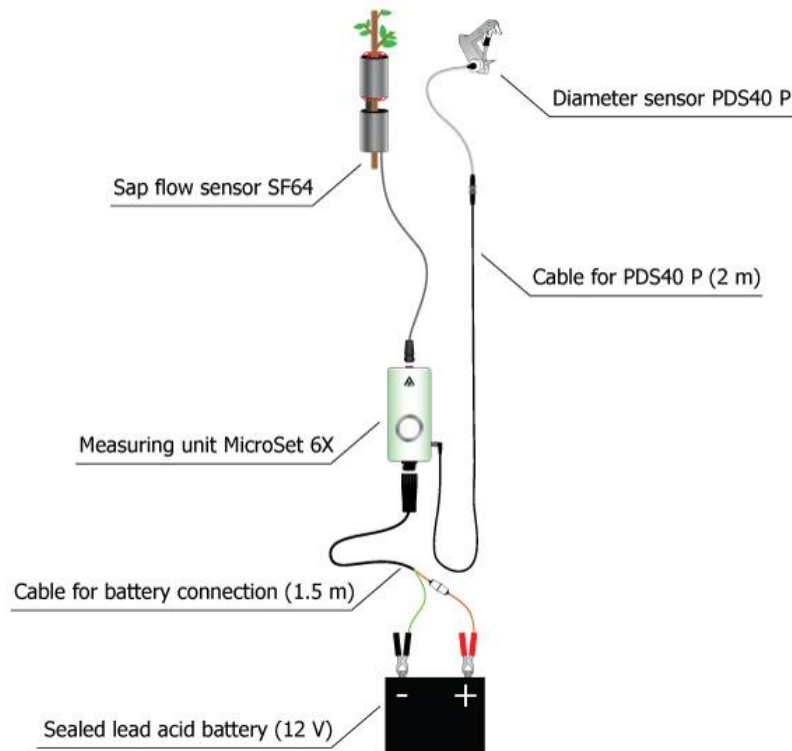
Specification:

- Two sensor sizes for diameters 6 to 12 and 10 to 20 mm
- Constant temperature difference adjustable to 2, 4 or 8 K
- Daily power consumption 0.2 to 1.2 Ah ($dT=4$ K; $U_b=12$ V) according to sap flow rate



System description

Measuring system consists of the MicroSet 6X controlling unit with embedded datalogger, sap flow sensor SF 64 (6-12 or 10-20 mm), pivot diameter sensor PDS40P, weather shield and connecting cables.



System components

Measuring unit MicroSet 6X

Electronic unit is controlling the temperature difference at measuring point at the preset level, calculates sap flow values in terms of kg/h and store the data. It has a two-digit display which, when activated by the magnetic head of communication cable, shows the status of the unit, mainly operating errors. Since the measuring unit contain built-in datalogger, it does not need additional data acquisition equipment.



Sap flow sensor SF 64

Sensor intended for continuous measurement of volumetric sap flow in stems with diameter between 6 to 20 mm (two dimensions of sap flow sensors according to the stem thickness - 6 to 12 and 10 to 20 mm). The sensor consists of two similar cylindrical parts. Each part wraps the stem with insulation foam. One part contains linear heating elements which are gently pressed to the stem by soft foam. A needle thermocouple is inserted to the stem in radial direction at the level of upper edge of heating elements (in direction of water movement). Second cylinder has no heater and it just covers the reference needle thermocouple located with respect to the thermal symmetry. The water passing



along the sensor is warmed and the heating power is controlled in order to keep the temperature difference between needles. Then, the input power is directly proportional to the amount of water passing the sensor in terms of kg/hr.

Weather protection set

The measuring point at the stem is protected against ambient factors, mainly against direct sun irradiation by means of reflective insulating weather shield. It reflects the sunshine and reduces the effect of the ambient temperature on the heat field. It also protects sensor against heavy rain and wind although a little wetness on the stem does not affect measurements. Approximately 30 cm of free stem is demanded for proper sensor installation.



Stem diameter sensor PDS40 P

Sensor designed for long-term measurement of diameters of small stems or branches in the range between 5 and 40 mm. The sensor is designed with respect to easy and fast installation. The sensor is connected to the MicroSet 6X.



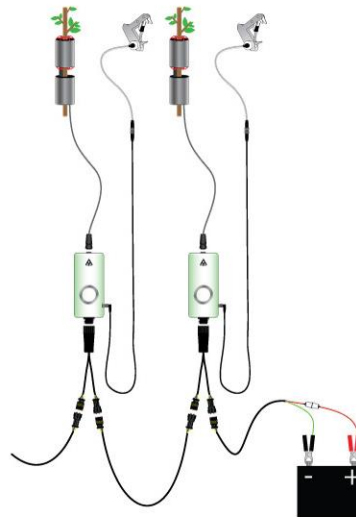
Powering

In terms of measurement layout there are two possibilities of powering – individual and in network. Sensors can be spread over large area with individual batteries, or they can be connected as a chain to one big battery or solar powering system.

Individual powering:



Network powering:



Accessories

Installation tools

The drill is necessary for drilling holes for sensor needles (0.8 mm diameter) in xyloid stems. It is strongly recommended to use a drill with controlled revolutions. The drill should keep revolutions nearly independent to drilling load in order to avoid overheating or burning plant tissues.



Specification:

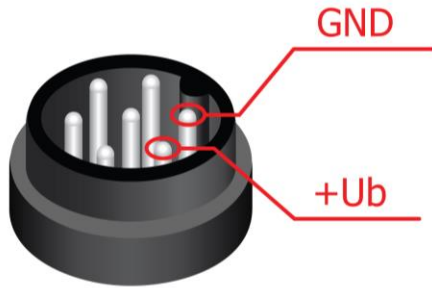
Sap Flow MicroSet 6X

Heating method	external heating of stem, internal measurement of dT
Sap flow values unit	kg/h
Preset temperature difference	2, 4 or 8 K
Sap flow range (dT=2K)	0 to 1.37 kg/h
Sap flow range (dT=4K)	0 to 0.68 kg/h
Sap flow range (dT=8K)	0 to 0.34 kg/h
Operating voltage range	8.5 – 16 V DC
Starting voltage for measurement	11.7 V
Shut-down voltage for measurement	10.5 V
Absolute maximum voltage	30 V DC
Maximum current consumption	ca 400 mA
Maximum heating power	3.2 W (limited)
Average efficiency	better than 85 %
Daily power consumption	0.2 to 1.2 Ah (dT=4 K; Ub=12 V) (according to the sap flow rate)
Memory capacity	256 kB; ca 120,000 readings; non-volatile
Back-up battery	SAFT 14250 keeps internal clock
Communication	Infrared (with IrDA/USB special cable)
Dimensions	160 x 80 x 60 mm; 500 g
Operating environment	-20 to 50 °C; 0 to 100% RH
Sap flow sensor connection	6-pin Switchcraft EN3 P6 connector female
Powering connection	Amphenol C16 connector male
Diameter sensor connection	3-pin M8 connector female

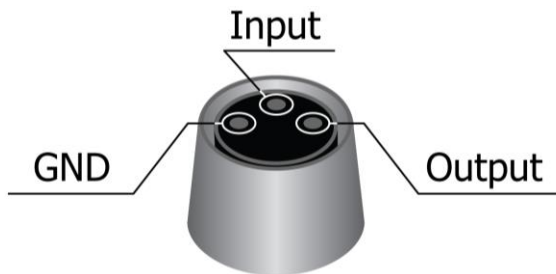
Sap flow sensor SF64

Stem diameter range	6 to 20 mm covered by two sensor types: 6 to 12 mm and 10 to 20 mm
Temperature sensing element	two thermocouples in stainless needles (T-type)
Thermocouple needles diameter	0.8 mm
Thermosensor arrangement	two needles placed in a distance 12 cm, inserted in radial direction into the stem
Sensor heater resistance	100 ohm ($\pm 10\%$)
Necessary stem length for sensor installation (incl. radiation shield)	30 cm

Sap flow measuring unit MicroSet 6X
Amphenol C16 male connector wiring



Sap flow measuring unit MicroSet 6X
female connector for PDS40P wiring



Standard M8 male connector cable wiring



- Brown - Output
 - Black - Input
 - Blue - GND
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