

Dendrometer

Radius Dendrometer (Type DR6)

For measuring changes in radius of plant stems



User Manual

1. Introduction

Thank you for purchasing the Ecomatik Dendrometer Model DR6. This is a highly precise sensor designed for continuous measurement of tree radius changes, suitable for both indoor and outdoor conditions.

This manual is intended to assist you in installing and operating your DR6 dendrometer with minimal difficulty and optimal results. Please read it carefully before installation, and refer to it if you encounter any issues with the sensor in the future.

The dendrometer serves as the sensor component of a measuring system, meaning it should be connected to a data logger for continuous data recording. The dendrometer is compatible with most types of data loggers. Ecomatik offers a low-cost, specialized data logger for dendrometers, the DL18, as well as IoT telemetry measurement nodes (LoRa or NB-IoT).

2. Product Description

As shown below, the radius dendrometer consists of:

- 1x Sensor body with 5 m cable. The cable length is extendable to 100 m
- 2x Knurled nuts
- 1x Knurled screw
- 1x Triangular suspension with locking collar
- 1x Angled wood mounting screw

Please contact us should you miss anything of these items.



Delivery scope of DR6 dendrometer

The standard cable length is 5 m. if you ordered cable extension, the cable length is the ordered extension + 5 m.

To meet the requirements of different loggers, there are 2 different types of cables: **cable with plug** and **cable without plug** . Cable with plug can only be connected to Dendrometer Logger DL18. Cable without plug can be connected to other loggers.

3. Safety Information

The sensor is protected from rain water, but it is not waterproof. Please do not immerse the sensor in water. Avoid any tension between the cable and sensor during handling and

operation. Pay attention to connections to data logger. Wrong connections will provide wrong readings.

4. Installation

4.1 Cable Extension

The standard version is delivered with 5 m cable. It can be extended up to 100 m. Cable type 4×0.14 mm² with shield is recommended for extensions.

4.2 Tools for installation

Required:

- cord to pull relieve the sensor cable

Optional/Eventual:

- cordless drill with 3 mm drill bit
- cable straps
- tree resin

4.3 Mounting

1. Insert the angled wood mounting screw through the locking collar of the triangular suspension and screw the knurled screw into the collar's thread. The triangular suspension can now be slid along the screw shaft and fixed in place using the knurled screw.
2. Remove any loose dead bark from the area where the sensor will be installed, ensuring no damage to the living tissue beneath the bark.
3. In most cases, pre-drilling is not necessary. However, for very hard wood types, pre-drilling may be required. If needed, drill a hole ($\varnothing=3$ mm, 3.5 cm deep) 43 mm above the desired measuring position.
4. Loosen the knurled screw of the locking collar so that the triangular suspension sits loosely on the wood screw shaft and does not rotate with it. Use the angled part of the wood screw as a handle to screw it into the stem until the thread is fully inserted (approx. 4 cm). Optionally, dip the wood screw tip in tree resin before inserting it into the trunk.
5. Attach the dendrometer body to the triangular suspension using the two knurled nuts.
6. With the knurled screw of the locking collar still loose, position the dendrometer so that the sensor head sits securely on the stem surface, and the sensor rod is pushed in by about 2-3 mm. Then, tighten the knurled screw of the locking collar to secure the position.
Note: When installing just before the frost period, the sensor rod should be pushed in by 5 mm, as the stem diameter may shrink significantly during freezing temperatures.
7. Secure the cable to the tree stem or branch to protect the sensor from accidental pulls or dragging of the cable. This can be done using rope or cable straps. Ensure there is no tension between the sensor and cable.
Make sure that no rainwater can travel along the cable into the sensor casing.

5. Wiring and Logger Configuration

The dendrometer is compatible with most data loggers. In the following we describe the connection with Dendrometer Logger (DL18), Campbell Logger (i.a. CR350 or CR1000X) or loP telemetry measurement nodes. Please contact us if your logger is not described here.

Dendrometer Data Logger (DL18)

The DL18 is a battery powered, waterproof logger for connecting 4 dendrometers. It is a very effective data logger for dendrometer measurement under outdoor conditions. For details please see the user manual of the DL18.

Campbell Data Logger (CR350 or CR1000X)

The dendrometers are typically measured in two-wire half-bridge mode, which provides a precise, true ratiometric measurement. One CR350 can support two dendrometers in single-ended mode, while the CR1000X can support up to 16 dendrometers in single-ended mode. To connect additional dendrometers, a multiplexer is required.

Single-ended Voltage Mode (e.g. 2 dendrometers)

Connection		
	Cable Color	Input Port
1 st dendrometer	Yellow	1H
	Green	Ground
	Brown	Vx1
	White	Ground
2 nd dendrometer	Yellow	1L
	Green	Ground
	Brown	Vx1
	White	Ground
Program Syntax:		
<u>CR1000X:</u>		
BrHalf (DR6,1,mv5000,1,Vx1,1,4000,True ,0, _50Hz,25400,0)		
<u>CR350:</u>		
BrHalf(DR6, 1,mV2500, 1, Vx1, 1, 2500, True, 0, _50Hz, 25400, 0)		

An interval 0.5-hour for data collection can reveal the diurnal course of diameter changes very well.

6. Adjustment and maintenance

Ensure that no falling branches, fruits, or snow land on the sensor. While the sensor is protected against water droplets, it is not waterproof.

When the sensor is properly installed, it will function under outdoor conditions without the need for further maintenance.

Depending on the tree's growth rate, the sensor may need to be reset after several months or years of use. When the output approaches 25.4 mm, the sensor should be re-set.

Carefully loosen the knurled screw in the locking collar until the sensor can be moved along the wood fixation screw. Slide the sensor away from the stem surface until the sen-

sensor rod is pushed in by approximately 2-3 mm. If the reset occurs just before the frost period, the sensor rod should be pushed in by 5 mm, as the stem diameter can shrink significantly during freezing temperatures.

7. Technical Specification

Name of the Sensor	Radius dendrometer Type DR6
Use area	For measuring radius growth of fast growing trees
Suitable for plant size	Diameter > 5 cm
Limitation	Tree trunk is injured by drilling (the damage can be minimized if using tree resin).
Range of the sensor	25.4 mm
Resolution	The measurement resolution is determined i.a. by the data logger. To detect changes as small as 1 μm , the logger must have a noise-free resolution of at least 14.6 bits within the measurement range from 0 to the full-scale output voltage of the dendrometer (= Vex). Examples of loggers that meet this requirement include: DL 18, DL 18 BLE, loP-M-S8, loP-M-M8, CR350, CR1000, etc.
Accuracy	Dendrometer dependent: Max. $\pm 1.97\%$ of reading (stable offset) Dependent on the connected data logger, e.g.: CR1000X: $\pm(0.04\%$ of reading + $10\mu\text{m}$), DL18: $\pm 0.1\%$
Temperature coefficient of the sensor	$< 0.2 \mu\text{m} / ^\circ\text{C}$ in the whole range
Linearity	$< 0.7\%$
Environment	Outdoor condition: -25 to 70°C air temperature, 0 to 100% relative air humidity
Weight of the sensor	33 g without cable
Power supply	Stabilized Vex 0.5 – 10 VDC, power consumption practically zero
Material	Stainless steel and Aluminium
Cable length	5 m, extendable up to 100 m