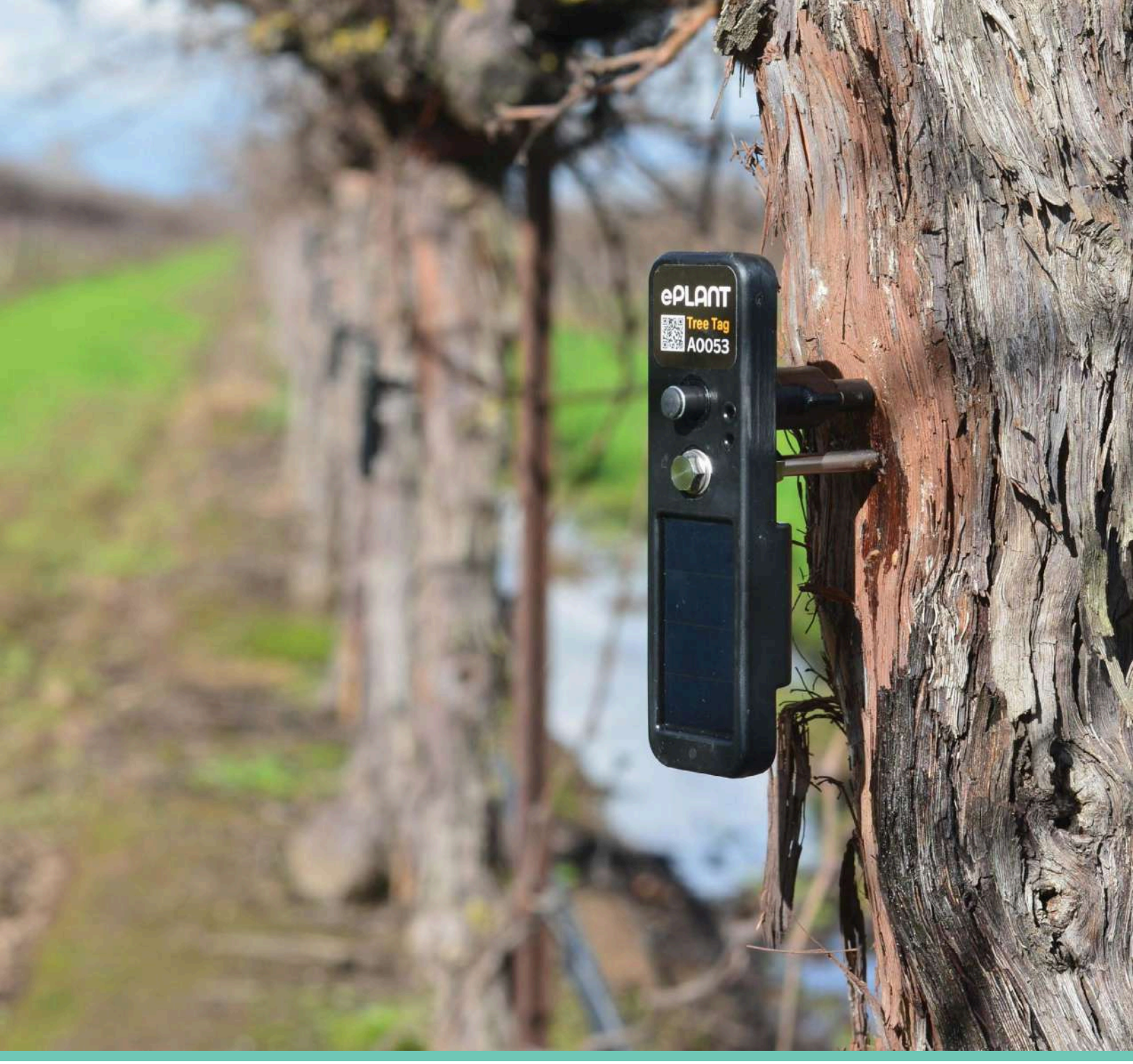


ePLANT

Plant Health Care Reimagined

V4.3

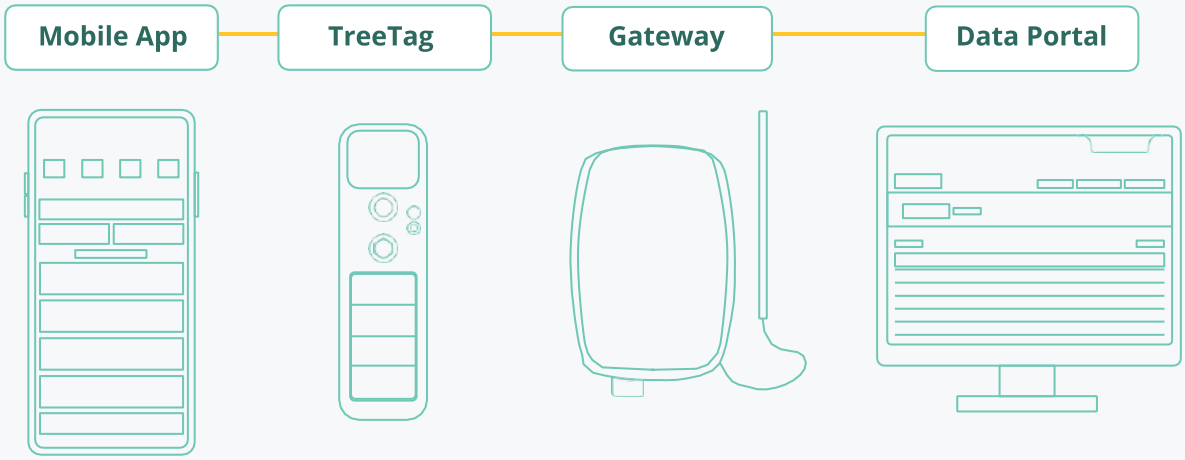


The ePlant TreeTag

The ePlant TreeTag consists of a sensor suite integrated with a small polymer-composite board to be mounted directly on a woody tree or vine. Data is transmitted via radio to a gateway with Internet connectivity, where it is sent to ePlant's cloud infrastructure. The raw and cleaned data is accessible to the user in near real-time via the online Data Portal or programmatically through the Application Programming Interface (API). A mobile phone app is supplied for powering up the device via NFC (near-field communication).



The TreeTag is powered by an advanced hybrid battery/capacitor that is recharged with a miniature photovoltaic panel. Mounting is accomplished by threading a small anchor into the xylem of the tree, and the TreeTag is then secured to the anchor with a captive screw system. The ePlant TreeTag system additionally provides a robust network for data storage, manipulation, analysis, and access.



CAPABILITIES

Dendrometer

The ePlant TreeTag's point dendrometer measures the radial increment of the extensible tissue below the outer layer of the cork at micron (0.001 millimeter) resolution and at a frequency of 5 to 15 minutes over the estimated ten year lifespan. Its plunger has 13 mm of stroke which, on a typical tree, is sufficient for 1—2 years of growth before the mounting screw would need to be adjusted.

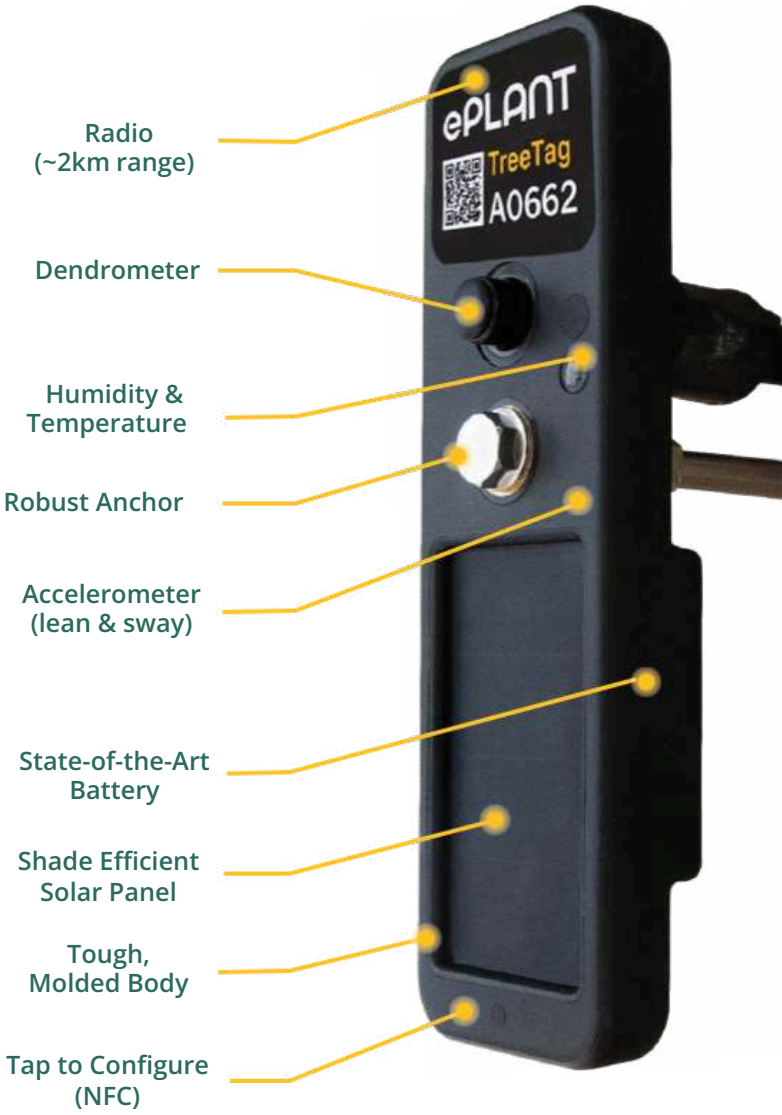
Dendrometry captures information about the hydraulic status and growth of the tree. As the trunk and main branches directly link the root zone to the canopy, they are ideal reference points to gather information about the soil-plant-atmosphere continuum. Dendrometry has been used in research to quantify the effects of water deficit in relation to soil water availability and the transpirational driving forces of the atmosphere. In general, any disturbances or trends in any part of the continuum can be captured with dendrometry. In addition, growth is measured and can be linked to carbon sequestration using existing allometric equations.

Accelerometer

The ePlant TreeTag's accelerometer is a three-axis MEMS (microelectromechanical system) device. Its output is translated into a lean angle relative to the TreeTag's upright position, and a direction relative to the TreeTag's mounting position. At installation time, these are zeroed so the angle and direction can be presented as changes over time. A lean angle that increases over time can be an indicator of an unstable tree. This data is useful to arborists, growers, and organizations interested in risk mitigation related to unstable trees. Effects of extreme weather events can be quantified. Though not yet utilized by the system, the accelerometer has activity sensing capability that will be used for detecting strikes or other events in future updates.

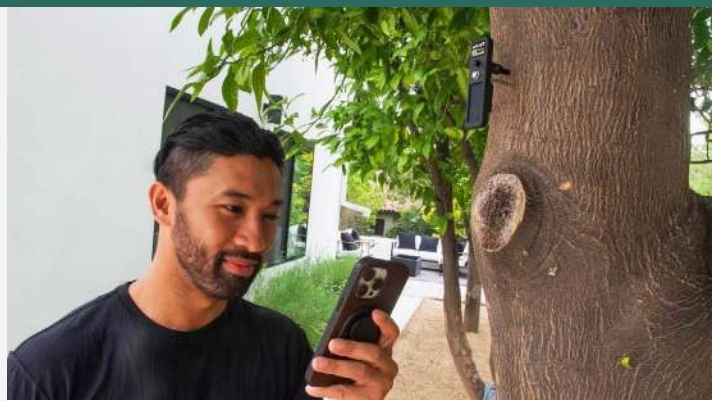
Environmental Sensors

The ePlant TreeTag's environmental sensors comprise a board-mounted temperature and humidity module and a light measurement via the photovoltaic panel. The dendrometer and accelerometer signals are influenced by these environmental variables. Through environmental monitoring, one can isolate these relationships and learn about other influences, such as soil water deficit. Additionally, thermal effects to the system are normalized out of the signals.



Sensor Suite

- Dendrometer for physically measuring the radial increment of the xylem and/or phloem.
- Three-axis accelerometer for measuring progressive trunk lean.
- Environmental sensors to aid in interpretation of the dendrometer and accelerometer signals.
  - Light via the photovoltaic panel
  - Temperature and humidity via an onboard module



CAPABILITIES

Power System

Hybrid capacitor technology can sustain many days of operation during extreme low light situations, but in general the TreeTag is expected to maintain continuous operation in subarctic latitudes indefinitely because of the ultra-low power consumption and the performance of the photovoltaic panel.

Robustness

Encapsulation with a UV-stable (ultraviolet) polymer ensures extreme weather resistance. The single-board design is physically robust and tolerant of rough handling.

Wireless Performance

TreeTags can be expected to transmit data consistently over 1—2 kilometers, though any radio frequency range estimate is subject to obstructions and terrain. The low-power long-range 900 MHz radio system is enhanced by an acknowledgment protocol that helps ensure data consistency, and the TreeTag will store up to one year of data, guarding against gateway or Internet outages. A FUOTA (firmware update over the air) capability enables both bug fixes and feature enhancements without operator involvement. Default data rate includes all sensor outputs every five minutes, uplinked every 20 minutes. One gateway is expected to handle traffic from several thousand devices.

Scale

While a small number of TreeTags can provide a plethora of useful information about a set of trees, by offering a low-cost, quickly installed, low maintenance system, ePlant has ensured that customers can cost-effectively deploy many sensors per acre. This enables A-B and statistical comparisons in growth, water stress, and environmental responses. Tapping into the wider data set of plant responses, regional and national trends can be identified and predicted.

Data Access

Customers can access their data through the web-based Data Portal or programmatically via a RESTful API (Application Programming Interface). The Data Portal offers intuitive tools for data visualization, downloads, and processed insights. It also provides an operational dashboard with a map view, allowing users to monitor TreeTag deployments in real time







TreeTag Specs

Dimensions (Height x Width)	98 x 29 mm	3.9 x 1.1 inch
Weight (Excluding Mount Screw)	51 grams	1.8 oz
Mounting Specifications (Screws Included)		
Required Driver (Mount and Retainer)	1/4 inch hex socket	
Drill Diameter for Light Wood	1/8 inch	
Drill Diameter for Dense Wood	9/64 inch	
Minimum Hole Depth	38 mm	1.5 inch
Mounted Max Distance From Tree	50 mm	2.0 inch
Sensor Specifications		
Dendrometer Resolution	0.001 mm (1 micron)	
Dendrometer Measurement Range	10 mm	
Dendrometer Range Between Stops	12 mm	
Dendrometer Temperature Sensitivity	< 0.5 micron/°C	
Relative Humidity Resolution	1 %	
Relative Humidity Measurement Range	0—100 %	
Humidity Accuracy (Typical) *	+/- 2 %	
Temperature Resolution	0.1 °C	
Temperature Measurement Range	-10 to 82.4 °C	
Temperature Accuracy (Typical) *	+/- 0.2 °C	
Lean Angle Resolution	0.044°	
Lean Direction Resolution	13.8°	
Operating Temperature Range	-15 to 80 °C	
Storage Temperature Range	-25 to 70 °C	

*SHT30-DIS-F used for temperature and relative humidity.
Detailed specifications available from sensirion.com



Mission

ePlant's mission is to create advanced technology products that keep trees and vines healthy and growing. The ePlant TreeTag is the first truly scalable tree and vine monitoring system that does just that.

For more information visit **ePlant.bio**