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# Digital DEX Dendrometer Installation and User Manual

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## Introduction

The DEX Dendrometers are factory calibrated at the time of assembly. The Multiplier calculated for each Dendrometer is supplied on a calibration sheet. The multiplier is equal to  $1/\text{calibration constant}$ .

Each dendrometer is identified with a serial number, found on the sensor flex band, and the certificate should match the serial number. Each sensor can be re-calibrated by the customer with the optional calibration kit, an inside micrometer. The sensor does not need to be calibrated each time it is installed, however the zero offset does need to be entered into the microprocessor of the smart interface.

## Installation and Zero Set

The zero offset procedure needs to be performed when the absolute size is to be logged. If the user only wants growth or diurnal changes zero offset procedure is not necessary. The installation process is as follows:

- 1) Find a relatively smooth surface on opposing sides of the trunk or branch to be measured. Clean or sand the dead bark from the trunk if it will interfere with a solid contact with the trunk at the point of attachment. Select the best fitting anvils supplied with the sensor. One anvil is designed to screw into the fixed arm. The adjustable screw has a slip in anvil,  $25\text{ mm} \times 25\text{ mm}$ , installed with a light slip on force. Adjust the dendrometer screw with the adjusting knob and make a trial fit of the dendrometer on the stem while supporting the device by hand. If there is a tendency of the device to slip into another position, due to the shape of the stem, make a note that this will be the best position to affix the sensor.
- 2) Using a circumference tape or a caliper, measure the circumference and divide by 3.14, recording the beginning diameter of the trunk. This reading will be used as a reference point for the growth readings to be obtained from the dendrometer.
- 3) Attach one end of a 60 cm length of medium test fishing line to the hole drilled in the right arm of the dendrometer and tie the other end to the left arm. The holes are drilled into the centre of gravity to minimise any support forces on the flex bank not related to the trunk or fruit growth. Place a Velcro strip around the trunk, and through the suspension line. Support the assembly as it is held into position, and close the Velcro strap around the trunk.
- 4) Attach the connecting cable to the trunk or stem with a second Velcro strap so that there is slack in the cable. Position the cable so that there is a minimum of force on the dendrometer from the weight of the cable. Take additional precautions to prevent accidental contact to the cable from equipment, animals or people that may pull on the cable and reposition the sensor.

The use of a fixed stake to support the dendrometer is not recommended, because any bending of the plant will cause forces on the flex bank to register as noise in the readings. If necessary to suspend the dendrometer in a vertical plane, as opposed to a horizontal plane, in the case of branch measurements of fruit growth studies, it is recommended to add two more drill holes on each arm opposite the existing suspension holes. These additional holes will aid suspension in a variety of angles.

- 5) Install the dendrometer around the stem and tighten down on the adjustment screw until there is contact between the stem and the clamp. Tighten adjustment screw 2 or 3 more turns to apply slight pressure to the stem. Tighten the locking nut with a spanner wrench so that the adjuster screw will not turn thereafter.

- 6) Enter the four-wire bridge instruction for your logger as follows:
- 7) After the trunk or fruit grows up to 5–7 mm, reset the sensor and start a new zero value. This is to maintain the fit of the sensor with a minimum of pressure on the plant. The sensor is tested to perform up to a 13 mm growth without breaking, or losing the accuracy of the patented flex arm assembly, however it is not an ideal geometry and may have difficulty fitting normally between 7–13 mm growth. However it is nice to know that if you forget to reinstall the sensor, it will not break. Do not flex the sensor over the 13 mm expansion or we will not be able to guarantee against breakage in the strain gauges.

## Optional Calibration Kit

Calibration of the DEX range of electronic dendrometers (DEX20, DEX70, DEX100 & DEX200) is most easily performed by using the DEX Calibration Kit (Model # DEXCC).

The calibration kit includes a high precision inside Micrometer and custom anvil to accommodate the 2 cm long micrometer extension arm that is fitted with a rounded stainless cap nut. This helps to ensure a firm fit of the micrometer within the dendrometer without the need to apply force to the micrometer by tightening the adjustment screw with the adjusting knob.

When calibrating, use the set of spherical anvils supplied to fit the calibration tool between the anvils without slippage. If necessary use small strips of masking tape inside the anvils to make slippage less likely. Remove the masking tape later to make your readings in the field. At first one may make readings between 0–7 mm, and then fit a calibrated 6 mm spacer between the inside micrometer and the custom anvil. Then proceed to record values for inside diameters between eight and ten mm. Due to the geometry between 11 and 13 mm, it is not recommended to routinely count on these readings, and thus it is best to leave this off of a calibration curve fit. Note that the DEX devices are most accurate between growths of around five to seven mm.

The DEX range of dendrometers are factory calibrated using an excitation of 500 mV. If a change in excitation voltage is made the calibration should be performed with that specific set up in order to be as accurate a possible. Also, be aware if calibrating for use with other loggers they may also require a voltage regulator to maintain a standard excitation voltage with which to supply the dendrometer.

The dendrometer does not need to be calibrated each time it is used, however the multiplier and zero offset from the calibration does need to be entered into a bridge command whenever a dendrometer is added or changed in the setup procedure for a logger.

## DEX Dendrometer Calibration Procedure

To begin a calibration, connect the dendrometer to the logger and view the output in real time.

Set the inside micrometer to 0.00 mm. Adjust the dendrometer with the custom calibration anvil fitted with sufficient firmness so that the micrometer is just held in place without slippage.

Be sure to place the dendrometer lying flat on a firm bench and maintain this same position throughout the calibration to ensure uniformity for each measurement. This will also allow the adjustment arm of the micrometer to rest on the bench and take any strain off it that may cause the micrometer to slip or drop out of the dendrometer.

Ensure that the voltage output from the micrometer is adjusted as close to 0.00 mV as possible to ensure you receive the full range of measurement from your dendrometer. Generally, a voltage output of  $\pm 0.100$  to 0.400 mV is an acceptable place to start at 0.00 mm. Now tighten the locking nut on the Adjustment Screw of the Dendrometer. Using the "DEXCalibrationSheet.xls" (available from [www.ictinternational.com.au/faqDEX.htm](http://www.ictinternational.com.au/faqDEX.htm)) record the voltages at each measurement distance.

Please note due to the scale of the micrometer the graduations marked are actually as follows: 10 on the micrometer is 0.20 mm, 20 on the micrometer is 0.40 mm, 30 on the micrometer is 0.60 mm and 40 on the micrometer is 0.80 mm. From this point on each 1 mm on the micrometer = 1.00 mm.

After adjusting the micrometer at each distance, position it carefully in the centre of the anvils of the dendrometer where the zero reading was made and record the measurement on the calibration sheet. Repeat this for each distance.

After completing the measurements for each distance as recorded on the DEX calibration sheet transfer these readings to the DEXCAL.xls file. This spreadsheet is available via our web site [www.ictinternational.com.au/faqDEX.htm](http://www.ictinternational.com.au/faqDEX.htm), it contains an "Example Page" and a "Calibration Template" to use.

Enter the results from the Calibration Sheet into the Column heading "Readings". The Read-Offset is then calculated by subtracting the zero reading from the reading recorded at each distance measured. For example, if the zero reading was 0.400 mV then 0.400 mV must be subtracted from each reading. This is done automatically by the equation in the spreadsheet.

The Excel graph is forced through zero, and an offset was subtracted. For this reason the linear formula is  $y = mx$  ( $b = 0$ ) ( $m = \text{cal constant mV/mm}$ ). For your records make sure you update the DEX Model # and Serial # of the Calibration graph by clicking on the text and editing it.

Finally, to calculate the DEX Calibration Multiplier in (mm/mV), divide 1 by the slope  $y$  (mV/mm) to provide the answer in mm/mV and again update the graph by clicking on the text and editing it. You can then print this page so that you have a hard copy record of the current calibration. Also, save the calibration file using the "Save As" function to a meaningful file name such as the date of the calibration e.g. DEXFAQ091400.xls or DEX25-091400.xls if you have multiple sized dendrometers. In practice, the multiplier to convert a signal in mV is set into a logger command so the output is displayed in mm. The initial offset may be entered upon positioning the dendrometer on a stem to enable the measurement of absolute size. However, this is entirely optional since the growth rate is the difference between the initial reading and the subsequent readings.