Instruction Manual

AM400
Portable Leaf Area Meter

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L.MAN-AM400

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1. Introduction

The AM400 is a portable measuring instrument, designed to determine the area of leaves and other flat objects. Measurements are made optically using a simple scanning process.

Both measurements and the scanned shape may be stored in the SD card and measurements are displayed in a choice of imperial or metric units.

The light weight, compact size and battery powered operation makes the AM400 suitable for both laboratory and field use.

1.1 Description

The unit consists of two parts, a control unit with built in scanner and a scanner baseplate. Operation is by means of a large graphic display, four `soft-keys' a rotary ‘thumb wheel’ knob and button.

The baseplate, scanner, and a universal voltage USB power adaptor are shipped together in a moulded plastic carry-case.

1.1.1 Scanner

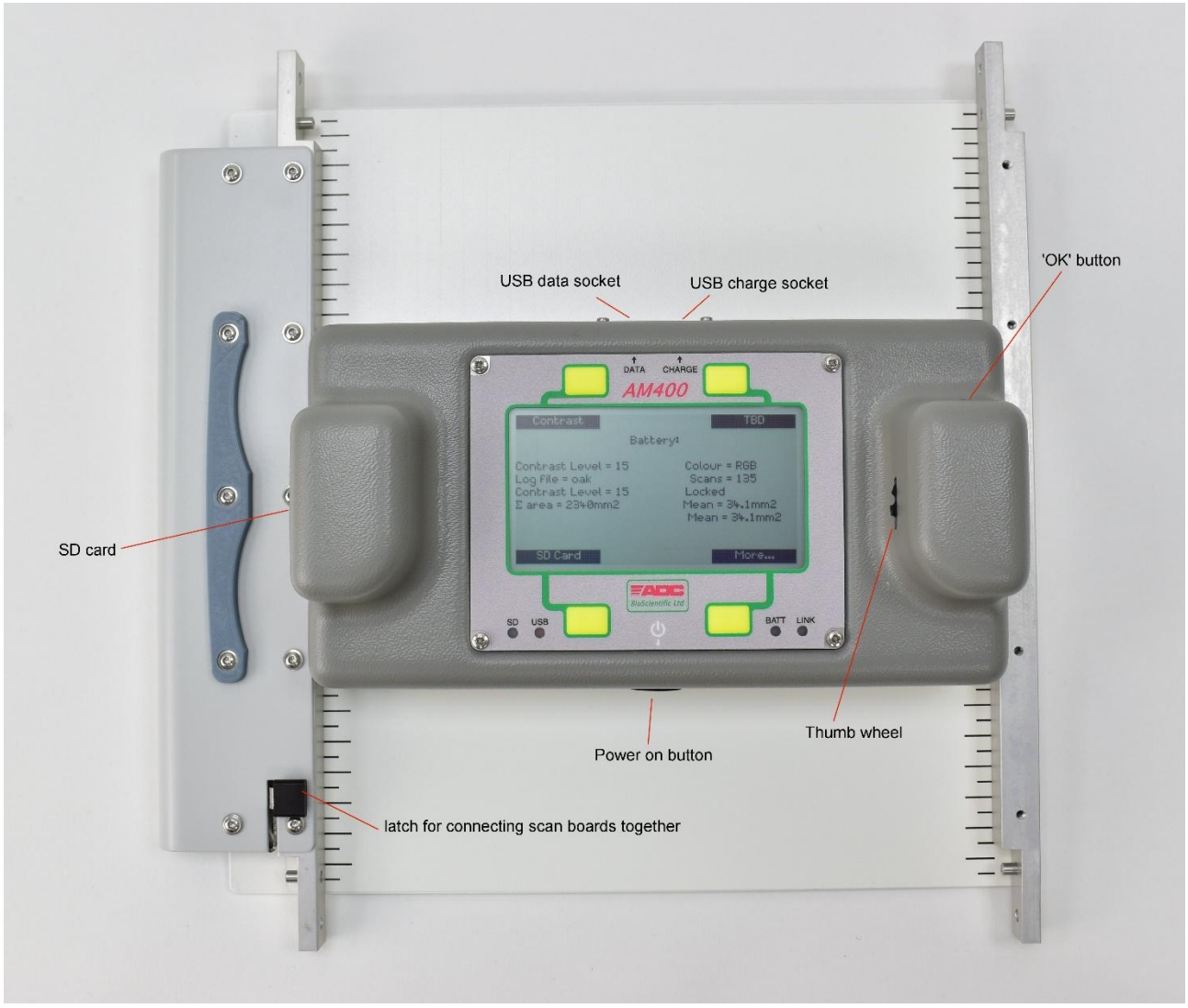


Figure1

The scanner has a display on the upper face (see Figure 1), with four soft-keys. A symbol on the LCD display adjacent to each key identifies the key’s function.

The “ON” key (used to switch the unit on) is labelled ⏻, is a black disc on the lower face shown in fig 1.

When viewed from above, the left hand USB C socket is for future use and right hand one is for charging the battery and powering the device directly from mains power.

On the left face there is a socket for a SD card

On the right hand pillar there is a thumb wheel style of rotary knob for scrolling up and down menus, for setting the contrast, and for alpha and numeric entry, and a push button which has a function that is dependent on the position in the menu, to enter (OK) the setting or for starting a scan.

1.1.2 Base Plate

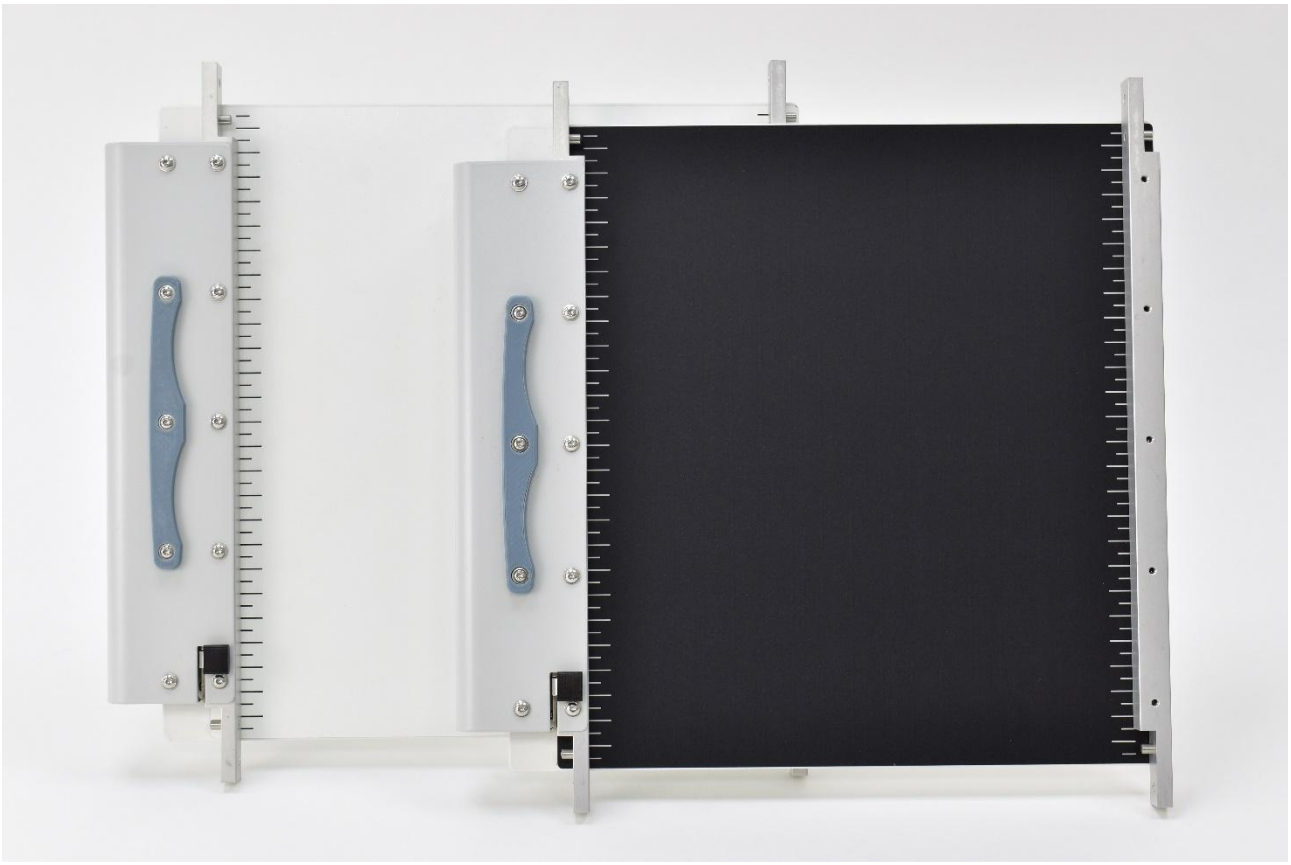


Figure 2

Two arrangements of the base plate are shown in figure 2. The baseplate is supplied with a replaceable underlay sheet which is marked along both edges with 5 mm and 1 cm distance reference lines. This sheet is reversible with one side being black, shown on the right arrangement and the other white, as on the left. The side should be chosen which gives the best images for the current leaf type. It is most easily removed by lifting it in the middle so that the edges are pulled from under the side rails.

The base plate is also supplied with a clear overlay sheet which is replaceable. It has a tab in the top right corner to allow it to be easily lifted. The leaf is positioned under the overlay sheet, which holds the leaf flat and provides a smooth running surface for the scanner.

The part number for a replacement underlay and overlay is given in Spares and Accessories.

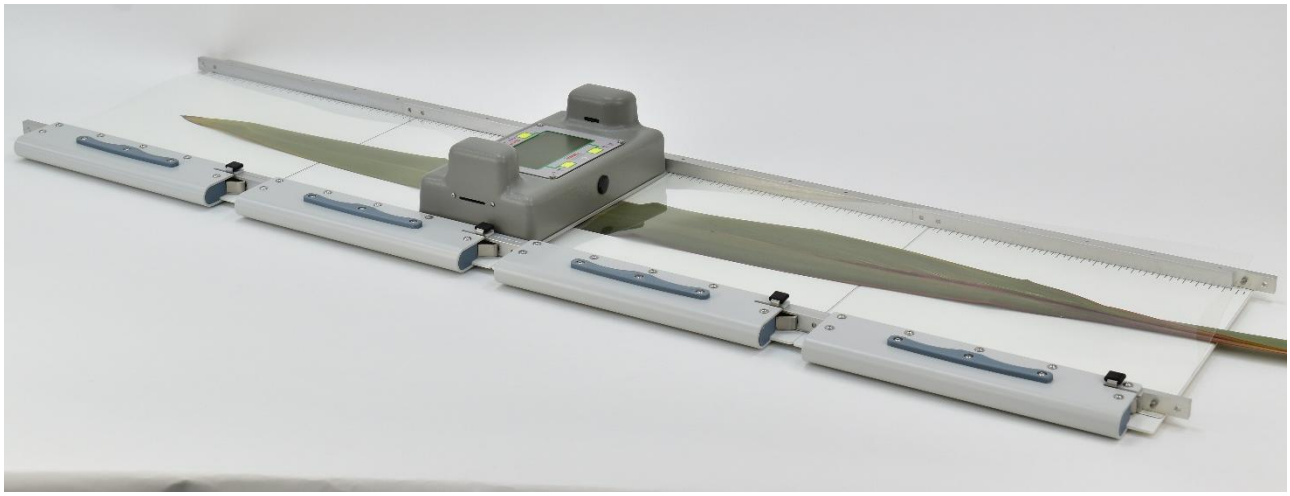


Figure 3

The side rails of the baseplate protrude top and bottom as shown in Figure 2 above. This is to allow baseplates to be securely clipped together for long leaves to form a rigid scanning platform of unlimited length. This is shown in Figure 3.

To accommodate extended baseplates, the underlay and overlay sheets are available in four-unit-lengths as well as the standard single-unit length, see Spares and Accessories for part numbers. The four-unit-lengths sheets may be cut to a length corresponding to the number of baseplates that the user wishes to connect together.

1.2 Setting up

The charger supplied by ADC BioScientific Ltd will be suitable for the majority of local power supply outlets.

If an alternative is being used, before using the charger / mains adapter for the first time, ensure that the charger unit is appropriate for the local power supply. The type supplied is self-adjusting.

It is necessary to fully charge the battery before using the unit for the first time, or after storage.

2. Quick Start Guide

The following instructions are designed to get the first-time user up and running as quickly as possible. Later sections give in-depth information about the various options.

2.1 Switching On

Insert an SD card in the left hand slot if one is not already present. Note that the AM400 will only read and recognise a card which has been inserted before switch-on. If the card is removed during operation, and the reinserted the AM400 will need to be power cycled for the card to be recognised again.

Press the black circular on button ⏻ in the middle of the front panel for at least half a second (the electronics does not respond immediately in order to avoid accidental operation). The screen will show the copyright message and the software version number. There is a hold key which freezes the copyright page to allow time for the software version, and serial number to be noted in the event of a customer enquiry. The hold can be pressed a second time to continue, and it also allows the display contrast to be adjusted for optimum viewing.

If the unit will not stay on, the battery is exhausted and must be recharged (see Section 13.1).

The screen then shows useful details such as the selected log file, sum of the area and perimeter, number of scans stored, and battery charge state.

The instrument is now ready to measure.

2.2 Inserting the object to be measured

Lift the plastic film, which is hinged from the left, and lay the leaf or other object onto the centre of the white scanning surface[1]. Lay the film back over the sample, so that it is held down flat and free from creases.

2.3 Taking a measurement

A measurement can be taken whenever **'tap the scan button to scan'** appears at the top of the display. The procedure is as follows:

1) Select a log file if one has not already been selected. This can be done using SD Card File Menu , select using up and down , √ More , where there is the choice of using an auto-generated file name e.g. log-001, or renaming it. For simplicity press √ More twice to accept the suggested filename, then press X Return to return to the top level page.
2) Position the leaf or other object on the board or other surface ensuring that the object is within the width of the scanning area and cover with the clear sheet.
3) Position the scanner so that the scanner top edge is at least 20.5mm before the start of the object.
4) On the top level screen, press √ More to access the page showing **'tap the scan button to scan'**. Momentarily press the scanner button next to the rotary control knob (thumb wheel). When the display shows **'measure.'** proceed with the scan.
5) Roll the scanner over the object with a smooth steady motion, pressing down with a gentle pressure[2].
6) View progress on the screen. When the object is fully scanned, momentarily press the scan button again.

[1] The leaf symbol shown in lower-right corner of the display should be set to a dark leaf on a light background for normal scanning. The `white on black' mode, which requires a black background, is intended for light objects. *Normal mode is assumed here.*

[2] If the scanner is moved too quickly, or in a `jerky' way, the USB light will flash momentarily

2.4 Saving Scans

Scans are stored in a file that can be given a filename by the user, or the AM400 will allocate one. Each scan is saved as an image (.bmp) file together with a .csv file containing its scan number, date and time, area, perimeter, width, length, ratio factor, shape factor, the contrast setting, and calibration scale factors.

When scanning is completed, the measurements will be shown on screen.

*If the image on the display is fuzzy, patchy or too dark, the contrast control must be adjusted to darken or lighten the image (see Figure 0). Press **X** to discard the scan, then repeat from step 1 in 2.4 above.*

Press the scanner button again briefly to store the scan, or discard to discard it. Further options are described in section 4. This also initiates the calculation and display of the perimeter.

Unless discarded, the measurements and the scanned image are stored in the currently selected file (see section 5.2).

Repeat the steps described in sections 2.3 and 2.4 as required.

2.5 Switching off

Simply press the soft key labelled ⏻ (power off). If necessary, press the return key repeatedly until the correct symbol appears.

The AM400 software can also switched off by pressing the black power button for at least 10 seconds.

3. Measuring (scanning)

3.1 Principle of operation

The AM400 uses an optical scanner to take the measurement. This consists of a handheld unit with a light source and Contact Image Sensor (CIS) array which is passed over the object to be measured. A roller with rubber tyres underneath the scanner is used to measure travel distance, and for every 1/100" of movement, a narrow strip of the object is visualised by the CIS array. This strip of image is decoded by the AM400 controller to form the mimic image on the screen, and to determine maximum length, maximum width, area, and perimeter. Data is stored on the SD card only.

3.2 Selection of scan mode

The AM400 offers two scan modes: black image on white background on white (normal) and white on black. The choice of mode depends on the colour of the leaf or other object. Lighter leaves will often scan better in white on black mode.

The choice is made by using the soft Invert key showing either a black leaf on a white background or a white leaf on a black background and by selecting the white or black side of the scanning background sheet. The current mode is indicated by the symbol next to the soft key label. Either black on white (for normal mode) or white on black (for light coloured leaves). Changing the mode takes effect from the next scan.

3.3 Selection of scan colour

The illumination colour can be chosen from any combination of red, green and blue. Red and green together produce a lime green; green and red produce a turquoise; red and blue produce a magenta and all three together produce white. To change the scan colour use the Illumination Colour (up/down) Confirm X Return keys before doing a scan. If you are uncertain as to the best colour to use, try green as we have found that gives the best results.

3.4 Leaf damage studies

Leaf damage studies can be performed by scanning a leaf twice, once in normal mode to measure the healthy (dark) area, then change to a black background and scan again in white on black to determine the (light) diseased area or vice versa. Alternatively it can be performed using the contrast control as follows. Adjust the contrast control such that the whole leaf is measured and store this as a new file, then adding the area to the running total, **∑area+**. Adjust the contrast control such that just the healthy leaf is measured and store this subtracting the area from the running, Σarea+ Σarea-. The displayed image can be used to gauge the correct contrast adjustment.

3.5 Preparation

The scanner head is designed to run over smooth, clean, flat surfaces. This means that leaves, and other surfaces that are small or may be wet or otherwise contaminated should be placed under the clear plastic film on the scan board. If the integral scan board is not used, a suitable piece of clear plastic film must be used instead.

3.6 Choice of background

The background sheet is reversible and is white on one side and black on the other. It also has 5mm and 10 mm distance marks along each edge.

A black background is used for white on black mode, and a matt surface will give best results. Craft paper gives a good non-reflective surface.

For normal mode, the whiter the better is the rule. A smooth reflective surface that and can be easily wiped clean is best.

For either mode, the background and overlay sheet must be kept clean to avoid the scanner registering dirt and so exaggerating the area measurement.

3.7 Starting the scan (measurement)

The AM400 is ready to measure whenever **'push button on scanner to scan'** is shown on the display.

The scanning procedure is as follows:

1) Place the target object under the clear film on the scan board or other suitable background.

Position the object centrally, and square with the scanning guide rails (if length and width measurements are of interest). Objects which go off the scanning area to either the left or the right will cause scanning errors.

2) Align the scanner with the object to be measured

Make sure the scanning point is 2 cm from the top edge of the scanner.

3) Momentarily press the scan button, which is located on the front of the right hand tower.

4) Whilst applying light downward pressure, pull the scanner slowly and smoothly over the object(s). Jerky movements will cause measurement errors.

Progress can be monitored by watching the image build up on the display.
Direction of travel should be top to bottom. During the scan the SD light will flicker indicating that data is being written to the SD card. If the scan is too fast, the USB light will flash.

5) When the object(s) is/are fully scanned, momentarily press the scanner button. The measurements are displayed automatically.

6) Saving Scan options at this point are described in section 4

3.8 Scanning errors

If the scanner is moved too quickly, or in a 'jerky' way, the scan will be aborted with a warning message. It takes a finite time to read a line of data from the CIS module, if the scanner is moved too fast such that a new line is requested before the current line of data can be read then it is lost causing measurement errors. If a number of lines are read at the maximum frequency then it is assumed that some data is lost and the scan aborted. To provide warning of this, the 'USB' LED on the scanner will flash before this condition is reached giving the opportunity to slow down before the image is aborted.

4. Scan Options

When a scan has been completed and the scan is about to be saved, the options offered are as follows:

- Save the scan measurements, add area to running total if the $\Sigma+$ button has a tick
- Save the scan measurements, subtract the area from the running total if the $\Sigma-$ button is ticked
- Save the scan measurements, running total unaffected if neither $\Sigma+$ or $\Sigma-$ are ticked
- Discard the scan.

4.1 Contrast adjustment

As the measurement is an optical process, the scanner must be adjusted to 'see' the area of the leaf or other object, and totally reject the background. The first menu page that appears after the copyright message has a contrast key that can unlock (shown with a tick) or lock (shown with a cross) the contrast threshold setting. This key automatically sets to the lock position after a scan. When it is in the unlocked mode, the adjustment to set the threshold between black and white can be made with the thumb wheel located in the tower on the right-hand side of the scanner head while the scan is in progress. When the thumbwheel is moved forward the image from the scanner is made darker and the contrast value increases and vice versa.

It is a simple task to perform test scans to obtain a clear, solid image. The scanner responds immediately to adjustment, allowing the control to be moved during a test scan to get the optimum setting quickly. When the contrast level has been set satisfactorily, the 'scan' button is pressed, the test scan is stopped and discarded, and the contrast level is saved and locked. The contrast level can be set between 8 and 240.

4.2 Display whilst scanning

As the scanner is moved, the display shows a scaled representation of the object under the scanner. This allows the operator to see immediately if the contrast adjustment is correct, if the chosen area is being scanned, and if dirt or other factors are affecting the measurement.

4.3 Tips for getting accurate results

The following should be noted to obtain repeatable, accurate results:-

- Scan at an even pace.

  The scanner does not distinguish between forward and backward directions. Movement the AM400 backwards over a previous scan will add to the scan area.

  Set the contrast control for a clear, solid image.

  If necessary do several test scans with different contrast settings. The contrast setting is not particularly critical for most objects, but requires careful adjustment for patchy or pale leaves.

- Press down lightly while scanning.

  This ensures that the rubber roller makes good contact and so does not slip. In addition, bumps in the scanned surface tend to affect the light level under the scanner, causing shadows. Where possible, press thick fleshy leaves flat before scanning.

- Ensure that the object is fully scanned.

  Do not press the button to stop the scan too soon. Ensure the background surface is clean.

  Dirt may be `seen' by the scanner, increasing the measured area.

4.4 Measurement methods

Details about how the various measurements are made are given here to enable the user to avoid common sources of error, and to explain the limitations of the AM400.

4.4.1 Area

The scanner chops the image into tiny dots, 1/100" square[3]. Each dot can be either black or white, and the AM400 simply counts the black dots when in the black-on-white mode, or, white dots in white-on-black mode. It follows then that area is not dependant in any way on the measured length and width values. It also follows that dirt and shadows will cause the area to read high.

4.4.2 Length

The AM400 measures the longest black area (white area for white-on-black mode) over the length of the scan. This means that if several objects are placed on the scan board along the axis of scan, and each is separated from the next by a short space, then the measured length is that from the start of the first object to the end of the second. If the objects touch one another, the length will be the total length of all the objects. This is illustrated in Figure 4. Case 1 shows two objects which, although separate horizontally, are treated as one continuous length. When there is a separation in the vertical plane, as in Case 2, the length will be the total of the two objects and the white space between them.

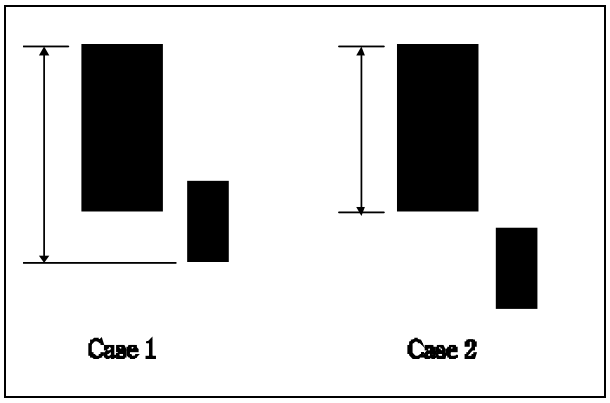


Figure 4 - *Calculating length*

4.4.3 Width

Width is measured by checking each 1/100" strip from the scanner in turn, keeping tally of the widest individual stretch of area. If the objects touch, as in Case 1, then the overall width is calculated.

If a number of leaves are laid out and scanned, then the width given is that of the widest part of the widest leaf. This is shown in Figure 5, Case 2

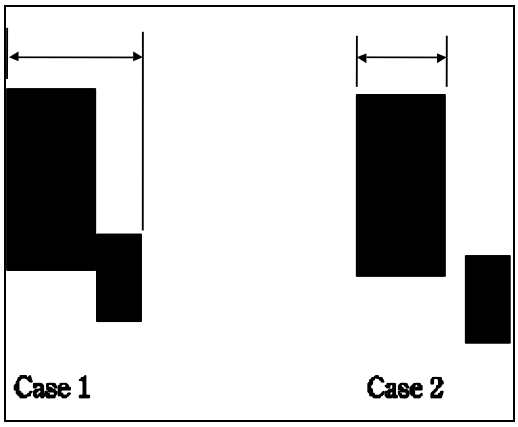


Figure 5 *– Calculating width*

Naturally it follows from sections 4.4.2 and 4.4.3 above that, for an object that is not circular, the measured length and width will depend on the orientation with respect to the scanner. Area measurement is not affected in this way.

[3] Note that on the AM400 display, one dot represents about three dots from the scanner.

4.4.4 Perimeter

The perimeter measurement is made on the image following a scan based on an algorithm developed by Steve Prashker of Carleton University, Canada. The perimeter measurement made is that of the first image in the scan. If two images are scanned which overlap, then the measurement made will be the total of both images. Further, if an image has a hole or multiple holes in it, then the total perimeter of the hole(s) will be included. Each image pixel is a square with side length of 0.254 mm. So the perimeter of a single pixel hole in the leaf adds 1.016 mm to the perimeter length.

4.4.5 Units of measurement

The AM400 offers three units: inches, millimetres and centimetres. Mixed units are not permitted.

4.4.6 Selecting units

Units of measurement for scanning are set from the second page of the Tools menu (spanner symbol) Tools , More , Inch/mm . Press the Select key until the desired unit is selected.

It is not necessary to turn off the AM400, or to reset after changing units. The new setting will take effect immediately. Note that it only applies to the displayed data at scan time; it has no effect on the stored data on the SD card, which is always in mm.

4.5 Running total (Σ), of area

Each scan area can be added or subtracted from a running total which is displayed on screen at scan time. It is not stored on the SD card.

A `+' is marked on the SD card alongside each scan that contributed towards the total, and a `-' by each scan that was subtracted. If there is neither a '+' or a '–', the scan area has not been used.

4.6 Calculated Parameters

Two calculations are made from the measurements, namely the ratio and shape factor and are defined below. These values are displayed after each scan.

4.6.1 Ratio Factor

The ratio factor, sometimes called the aspect ratio is the ratio of the leaf length to its maximum width. It is calculated from the equation:

$$r = \frac{l}{w}$$

where r is the ratio factor,
w is the maximum width, and
l is the length

4.6.2 Shape Factor

The shape factor is the ratio of the leaf area to the leaf perimeter, corrected so that the shape factor of a circle is equal to 1. It is calculated from the equation:

$$f = \frac{4\pi a}{p^2}$$

Where f is the shape factor,
a is the area, and
p is the perimeter

5. Storing and Deleting Scans

5.3 Storing the scan image

In addition to storing measurements, the AM400 stores the scan images as bitmaps in the resolution of the scan (100 dots per inch), making subsequent identification of scan measurements easy.

5.4 Deleting stored scans

There are two possibilities:

Using the SD card file menu more more review delete individual scans and the corresponding data can be reviewed and deleted. See section 6.2

Using SD card file menu (select with up/down) menu delete, whole files can be deleted can be deleted or renamed.

6. Reviewing Stored Results

Stored results may be reviewed on the display.

6.1 Starting review

Press the data log file menu options review key. The details for the first scan will appear.

The key functions are as follows:

↓	down arrow	Show previous scan
↑	up arrow	Show next scan

If the up or down arrow key is held for more than 2 seconds, the scan increment changes to 10

6.2 Reviewing scan images

The scan image will be shown alongside the measurements of a stored image.

6.3 Data format

The AM400 stores the images on the CSD card as bitmaps (bmp) and the scan measurements on the SD card in comma-delimited ASCII format (CSV), which is recognised by the great majority of spreadsheet and database programs. The data contains the scan number, the date, time, area, a symbol indicating whether the area is to be added or subtracted from the total, perimeter, width, length, ratio factor, shape factor, contrast setting, calibration factor for width and for length. Measurements stored on the card are always in mm even if the on-screen units have been set to cm or inches.

7. Setting the Date and Time

Date and time are maintained continuously by the AM400, and are stored along with each set of scan measurements.

7.1 Checking date / time

Press the tools (spanner) key to access the set-up options screen. The date and time, are shown.

7.2 Setting the date

1) Press the tools (spanner) key to access the set-up options screen.
2) press the date key.
3) set the desired format.
4) use + and - or the thumb wheel to set the year, then √ more to enter it
5) use + and - or the thumb wheel to set the month, then √ more to enter it
6) use + and - or the thumb wheel to set the day of the month, then √ more to enter it
7) use the √ more to return

At any point, the X return key can be used to cancel the changes and exit.

7.3 Setting the time

1) Press the tools (spanner) key to access the set-up options screen.
2) Press the time (time, clock face) key,
3) Use + and - or the thumb wheel to set the required hour, using 24 hour clock, then √ more to enter it
4) use + and - or the thumb wheel to set the minutes past the hour then √ more to enter it
5) use + and - or the thumb wheel to set the seconds then √ more to enter it
6) use the √ more to return

At any point, the X (return) key can be used to cancel the changes and exit.

8. Charging the Batteries

8.1 Recharging

The AM400 incorporates an automatic battery charger which terminates at the end of the charging sequence to protect the battery allowing unattended operation. The usual charging sequence is to start at a high rate for fast charging, then reducing to a 'topoff' charge when the battery is nearly full. However if the battery is severely depleted the high fast charge rate is proceeded by a lower rate pre-charge. Charging current can be supplied from the supplied USB C mains adapter, which will fully charge the unit in less than 12 hours. Other USB type C mains adaptors may be used but the charging time will be extended if they are of lower power.

A portable alternative to a USB mains adaptor is a 'power bank' of the type that is used to extend the run time of mobile phones and tablets. The power bank should have a current rating of at least 1A, at which rating the area meter might make several attempts to start before it is successful, and only charge the internal battery at a minimal rate. A 2A rating will ensure an immediate start and will also charge the battery at a reasonable rate

To re-charge the battery, plug the power cable into the socket marked 'charge' on the top panel. If the AM400 is initially switched off, it will power-up and display the start-up screen showing the software version etc., then if no buttons are pressed, it will display the battery status bar and a message that the battery is being charged. To exit this mode and use the AM400 with USB power connected, press and hold the black on/off button in the middle of the front face for up to 20 seconds. Alternatively, while it is displaying the start-up screen, if the Hold is held down, the AM400 will switch to the display contrast menu, from which the Return key will jump to the main menu page

If the AM400 is switched on when the USB power is connected, it will remain on unless the user turns it off, in which case, the battery charging will continue.

The unit can be left indefinitely connected to the USB adaptor at the end of the charge cycle and it may be operated whilst charging, although doing so will increase the charging time.

Battery charging is switched off automatically when the battery is re-charged.

8.2 Charge indicator lights

The 'BATT' indicator LED will illuminate when the battery is being charged at any of the rates mentioned above. When the 'BATT' indicator goes out, the battery pack is full and the charging current is removed.

8.3 Battery charge indicator

When the AM400 is initially powered off, and then connected to the USB charger, the state of the battery is shown as a bar on the screen with a solid black bar indicating full charge. Further information is available on the Tools , More, More Information page.

8.4 Storage

For maximum battery life, the unit should be stored with the battery about half charged, and it should be reconnected to the charger every 6 months for a top-up charge to around 50%.

- *Do not attempt to charge if the temperature is above 40ºC, or below 10ºC , as this may damage the battery.*

8.5 Battery life

The batteries can be expected to last for about 500 charge-discharge cycles before running time falls to an unacceptable level.

WARNING

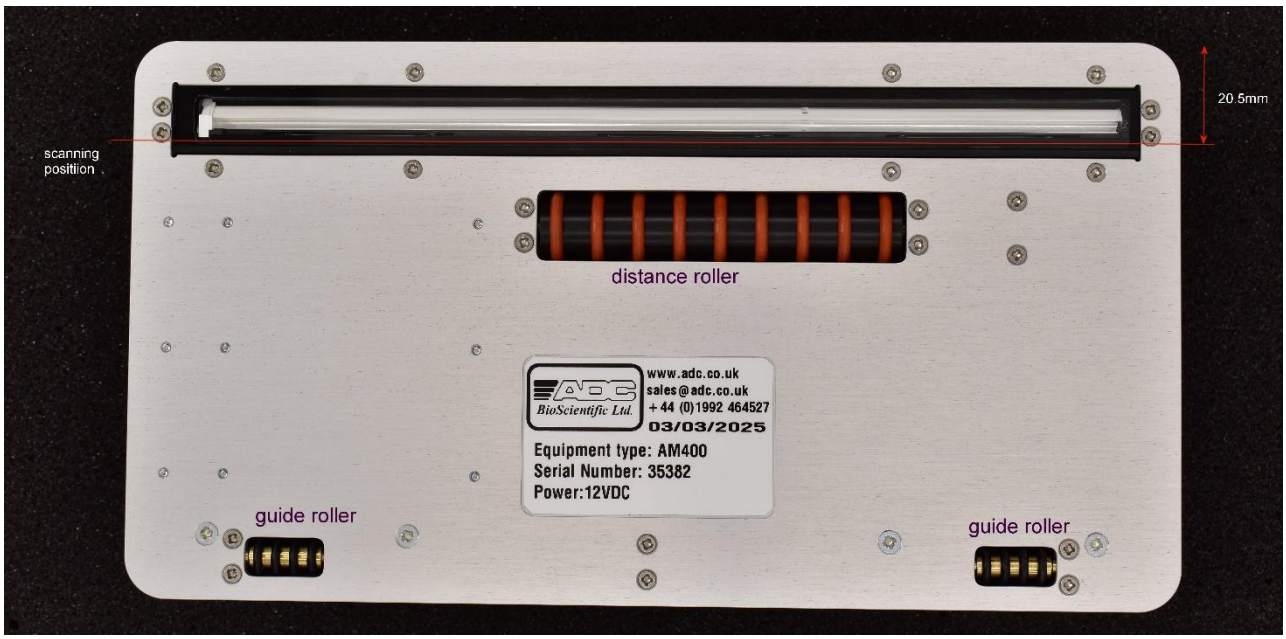
Although the AM400, when running from internal battery power is a field portable instrument, THE CHARGER / ADAPTER IS FOR INDOOR USE ONLY.

9. Maintenance

9.1 Scanner head

The scanner head must be kept clean, particularly underneath, as shown below, to ensure that results are consistently accurate. Ensure that the scanner window is clean before each measurement. Blowing on the scanner will usually remove any dust particles that may have settled on the window, but if necessary, wipe the window with a damp, lint-free cloth.

The position of the scanning line is 20.5mm from the front edge of the scanner.



Never use solvents or other cleaning agents that may attack the plastic.

The rubber rollers must also be kept clean to avoid slipping. Simply rotate the roller in short steps using a finger, wiping with a barely damp lint-free cloth.

Do not wet the roller as it may carry moisture into the scanner head causing damage

9.2 Main Unit/scan board

The main unit requires only cleaning, particularly the plastic film and white surface onto which objects are placed. Barely dampen a soft cloth with a weak detergent solution for cleaning, and polish off with a dry, lint-free cloth.

Avoid bending back the plastic film too sharply when cleaning, as it may crease or split.

The plastic film may become scratched and less transparent with use, and so should be replaced.

The AM400 is supplied with a reversible underlay film, black one side and white the other. The film can be removed by lifting it in the middle. The scanner can be used without the underlay film if desired.

Replacement films can be obtained from ADC BioScientific or their authorised distributor (see Spares and Accessories section).

9.3 Replacing the film

The film is retained with spring loaded balls which click into holes in the edge of the film sheet. Pull out the old film and discard, then slide under the new sheet ensuring that the slots in the film line up with the screws. Align the film so that it is square and properly seated under the guide.

9.4 Display contrast adjustment

The display contrast is automatically adjusted with temperature, but if the display becomes faint and hard to read, or excessively dark, the contrast can be adjusted by means of the first menu page that is reached after power-on:

To change the display contrast, press and hold the hold the hold key. The next menu page allows the display contrast to be adjusted with the darker and lighter keys.

If the display contrast is so poor that the hold key is invisible, the AM400 may be restarted by holding the power switch in for at least 10 seconds, then pressing where the hold key will be invisibly located at the top right, then pressing the bottom left key to make the display lighter or the bottom right key for darker.

9.5 Calibration

The AM400 can be calibrated for the accuracy of the scanned distance in the unlikely event that recalibration is needed. The procedure involves scanning a solid circular image of 150mm diameter in a slightly different way than a normal scan: press Tools More Calibrate (scan the image) (momentarily press the scan button). The AM400 should then report that the calibration has been successful.

9.6 Replacing the battery

Caution!

Static electrical discharge can cause damage to the area meter electronics. Where possible, an anti-static bracelet should be worn and the work undertaken on a conductive surface.

Take the following precautions when changing internal parts:

Ensure that you touch the metal baseplate to discharge any static before touching the internal electronics. Work with sleeves rolled up, particularly if wearing man-made fibre clothing.

The AM400 uses a single lithium-iron (aka lithium–ion) battery pack. Suitable replacements with the correct connectors fitted are available from ADC BioScientific or their authorised distributor (see section 10)

To replace the battery pack:

1) Ensure that the A400 is switched off.
2) Remove the four screws in the corners of the display area, and the 4 smaller screws around the SD card slot and USB slots, which secure the lid.
3) Lift off the lid. Disconnect the battery connector under the right hand corner of the main board.
4) Remove the 8 M2.5 screws attaching the main board, and lift it off partially (it is still attached with a ribbon cable underneath to the roller assembly)
5) Remove the 6 M2 screws and crinkle washers holding the battery cover in place, and remove the battery pack complete with its metal support cage.
6) Unclip the AM400-142 clear insulation sheet that is on top of the battery pack. Note the position of a notch in one corner to miss the support pillar.
7) Carefully remove the battery pack from its cage. It is attached with strong double sided adhesive strips, which it might be necessary to cut through with a knife, but if you do so be extremely careful not to cut into the battery pack. Doing so is potentially dangerous.
8) Replace the battery pack and sticky pads with new.
9) Replace the new pack in the holder, and replace its 6 screws and crinkle washers.

10) Replace the main board and its 8 screws.

11) Reconnect the battery connector.

12) Re-assembly is the reverse of step 1, 2, and 3.

Fully charge the new battery before use.

9.7 Software reset

In the event that the software locks, the AM400 can be switched off and reset by pressing and holding the black power-on button for up to 20 seconds, provided that it is not being charged via the USB connector. In normal operation, if the power-on button is pressed for just two seconds then released, the AM400 will switch off.

9.8 Fitting a software update

In the event that a firmware update is necessary, the new code can be loaded from a file supplied by ADC. The file is called AM400_CM7.BIN and the user needs to copy it onto the SD card into the root directory. The SD card is then inserted into the AM400 card slot .

For further information, contact ADC BioScientific.

10. Spares and Accessories

10.1 Accessories

Description	ADC part no.	Qty.
Replacement guide board overlay, clear.1x long. Installed.	M AM400-107	1
Replacement guide board underlay, black & white. 1x long. Installed.	M AM400-112	1
Mains adapter/charger, worldwide. Supplied.	M 299-534	1
USB A to USB C cable 1metre	M.994-285	1
Secure Digital card 32G. Supplied.	M.197-730	1

10.2 Spare parts

ADC BioScientific or their authorised distributor can provide a full range of spare parts for the AM400.

A range of the more common parts is listed here for convenience.

Description	ADC BioScientific part no.
Scanner Guide Board assy	M.AM400-024
Battery set	M.192-100
Replacement front panel membrane	M AM400-102
User Guide (this manual)	L MAN-AM400
Replacement guide board overlay, clear, 4xlong	M.AM400-111
Replacement guide board underlay, B & W, 4xlong	M.AM400-114
Battery pack 3.6V Lithium Iron 1 off	M.192-100
Sticky pads for battery 4 off	M.884-857

11. Specifications

Accuracy / Repeatability		Linear measurements: ±1% reading Areas: ±2% of reading Perimeter: ±5% of reading
Battery life		Typically 300+ scans per charge. Charge time typically less than 13 hours.
Charger/Adapter		USB type C. Input: 90-264V, 47-63Hz. Output 5V DC nominal, at 3.0 amp maximum. Internal overload protection. UK,EU,US & AUS heads
Display		128 x 240 pixel LCD graphics backlit.
Memory		SD card
Data port		USB type C for future use
Scanner		Hand held unit with internal illuminator and CIS array. 100 dpi resolution, continuously variable contrast control Illumination by any combination of red, green and blue
Max. scan width		183mm (7.2")
Temperature range		Operating: -20 to 55°C. Usage at temperatures <0 will reduce runtime. Charging: 10 to 40°C
Dimensions	Scanner unit	116mm x 217mm x 72mm (4.5" x 8.5" x 2.8")
	Guide Plate	290 x 285 (11.4” x 11.2”
Weight	Scanner unit	775g
	Guide plate	785g
	USB charger	105g