
LASER Area Meter CI - 202 Instruction Manual



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INTRODUCTION

Congratulations on the purchase of your new CI-202 Portable Leaf Area Meter. Making leaf measurements in the field or laboratory is now very easy with the CI-202 Portable Leaf Area Meter. This state-of-the-art instrument has been designed to be the most portable leaf area measurement system available. Although you are anxious to use your new meter, please take the time to read this manual first.



Figure 1. CI-202 Portable Leaf Area Meter

CI-202 Specifications

Scanner:	675 nm Laser Diode
Resolution:	0.025mm ²
Max. Measuring Width:	150mm
Max. Scanning Speed:	127 mm/second
Area Units:	cm ²
Accuracy:	±1% for samples > 10cm ²
Data Storage:	8,000 Measurements
Computer Interface:	USB 2.0
Display:	16 characters × 2 line LCD
Battery:	7.2V rechargeable NiMH
Battery Life:	15hrs
Operating Temperature:	0-50°C
Weight:	1.50 Kg

Features

- ♦ Non-destructive measurements
- ♦ Measures area, length, width and perimeter
- ♦ Calculates shape factor and aspect ratio
- ♦ Area resolution down to 0.025mm²
- ♦ Will store up to 8,000 Measurements
- ♦ Single self-contained instrument with built-in LCD display
- ♦ Samples may be scanned on the scan board.
- ♦ No calibration required

OPERATING INSTRUCTIONS

The CI-202 is a self-contained, hand-held instrument with a built-in display and batteries. It contains an optical scanner to measure width,.

Taking a measurement can be as simple as turning the instrument on, inserting a leaf on the scan board, and scanning. The instrument does the rest.

To turn the instrument on or off, press the ON/OFF button. When the instrument comes on, a copyright notice will appear for 1/2 second. Following this, several words will appear on the display with the word “Measure” appearing in the upper left-hand corner of the display. You are now in the CI-202 menu system.

Note: when there are no files to store data to, the measure menu items will not be available.

To correct this situation, create a file.

Menus and What They Do

The CI-202 menu system allows you to quickly and easily operate the instrument without constantly referring to this manual. Whenever possible, the screen associated with a menu item will give you information about choices that you can make. Usually, the top line of the screen will contain information about where you are, and the bottom line will contain information about buttons to press to change the current status.

Measure

In the measure mode, the top line of the screen will show the word “Measure” on the left, and the name of a file on the right. The bottom line of the screen will have the word “start” in brackets on the left, and the four direction arrows on the right.

Measure	file00
<start>	←→↑↓

The options are:

- ♦ to select another mode with the up or down arrow keys
- ♦ to select another file (if there is more than one file) with the right or left arrow keys
- ♦ to take measurements

To start measuring, Hit the enter key or the start key. This begins the measurement process. The motor will start spinning up to speed as soon as the button is pressed, and the display will read “Stabilizing”, then “Spinning Up”, then “Measuring”. At this point, move the scan head down the scan board. When the scan head has been drawn out completely, the instrument will stop automatically and display results of the measurement. At this point, preview the results, and decide whether it should be saved and to which file it should be saved to. The enter key will cause the scanner to start and then the instrument will start measuring; if motion is not detected within a few seconds, the scanner will shut down. The start key does the same thing, but if it is held down, the scanner keeps spinning until you are ready to measure.

The display will show the name of the current file in the upper left-hand corner of the screen, parameter name in the lower left-hand corner and parameter value in the lower right-hand corner of the screen.

<pre>file00 area = 44.04 cm²</pre>

NOTE: Because of the amount of information displayed on this screen, the CI-202 cannot display any prompts in this mode.

To bring another parameter into view, press the RIGHT or LEFT arrow key. Repeatedly pressing the right arrow key will step you through area, length, width, perimeter, aspect ratio and shape factor, in that order. Only parameters that can be saved to the current file will be displayed. If changes are required before data is saved, use the up and down arrow keys to step through the files. To discard the measurement, press the STOP button. Another measurement may be taken at this time, if required. Depending on the set-up of the automatic save function of the instrument (see Set-up Auto Store parameter section in the main section of this manual) the measurement will or will not be saved.

To save the measurement, press the SAVE button. If the instrument is able to save this measurement, the word “saved” will flash on the bottom line of display to confirm the data saved. If there is insufficient storage space to save the measurement, the instrument will flash the message “no room!” on the bottom line of the display.

View Data

In the view mode, the top line of the display will show the word “View” on the left and the name of a file on the right. The bottom line will show the word “enter” on the left and the four direction arrows on the right.

<pre>View file00 <enter> ←→↑↓</pre>

The options are:

- ♦ to select another mode with the up or down arrow keys
 - ♦ to select a file (if there is more than one file) with the right or left arrow keys
 - ♦ to view battery life
 - ♦ to view voltages
- ♦ start the viewing process by pressing the START/ENTER button

Once you have selected a file to view and pressed the ENTER button, you will be able to look at the data in the file. The top line of the screen will have the file name at the left. On the right will be the word “total”.

file00	total
area =	345.0 mm ²

Note: *Because of the amount of information displayed on this screen the CI-202 cannot display any prompts in this mode.*

One of three things will be displayed: the most current measurement sequence number, the average of all measurements, or the total of all measurements. The bottom line will display the parameter name on the left side and the parameter value on the right side.

To bring another parameter into view, press the RIGHT or LEFT arrow key. Repeatedly pressing the right arrow will display area, length, width, perimeter, aspect ratio and shape factor in that order. To bring another measurement into view, press the UP or DOWN arrow key. Pressing the UP arrow key will display the total values for all measurements in the file in the following order: The first value shown is the average value for all of the measurements in the file, the most recent measurement in the file and on through the first measurement taken. Next, return to the total again. Think of this view mode as a computer spreadsheet that only allows the user to view one cell at a time.

To return to the main view mode, press the STOP/RESET key.

To view battery life, arrow right or left until “View Battery” is displayed. Hit enter and it will display battery life left.

Manipulate Files

The CI-202 gives an expanded ability to organize data collection by using a file structure similar to that used by personal computers. The CI-202 has up to 256 files available. Select a unique name for each file to control the data stored in each file to optimize the amount of data stored for research that is carried out.

The file mode capabilities are: Clear, Delete, Create, and Close files. While in the *file mode*, the top line of the screen will read “files” on the left and one of the words “Clear”, “Delete”, “Create”, or “Close” on the right. The bottom line of the display will read “enter” on the left and the four direction arrows on the right.

The options are:

- ♦ to select another mode, use the up or down arrow keys
- ♦ to select a particular action to carrying out on files, use the right or left arrow keys
- ♦ to start the selected action, use the START/ENTER key

Transfer Data from a File

Data can be downloaded from the CI-202 to a PC at any time the instrument is idle. Plug in the USB cable to both the instrument and the PC and run the CI202DF.exe program on the PC. A window will open that allows you to download files, save files to the PC, and print files.

The four possible actions available on the file mode are as follows:

Clear a File

When the START/ENTER key is pressed, “clear filename” is displayed on the top line, indicating the unit is ready to clear the file with the name filename. Selecting enter will clear the data from the selected file, but keep the filename active for future data collection.

clear	file00
<enter><stop>	←→↑↓

Delete a File

Pressing START/ENTER when “Delete files” is displayed on the top line indicates the unit is in the *delete file mode*. This mode will erase a file completely from memory. In this mode, the top line of the display reads “Delete” on the top left line and the name of a file on the right. The bottom line of the display reads “enter” on the left and the up and down direction arrows on the right.

Delete	file00
<enter>	←→↑↓

To delete a file, use the UP or DOWN arrow keys to select a file. Once a file is selected to be deleted, press the START/ENTER key. The instrument will confirm the deletion with the line “<erase> <stop>”. To delete the file, press the SAVE key. To escape without deleting the file, press the STOP key.

Create a File

When the START/ENTER key is pressed, “Name: Files” is displayed on the top line, indicating the unit is in *create files* mode. The top line of the screen will read “Name” on the left, and a file name (e.g. “file00”) on the right. The bottom line will read “enter” at the left, “erase” at the center, and the four direction arrows at the right.

Name:	file00
enter	erase ←→↑↓

NOTE: *The STOP key can be pressed at any time to abort the file creation process and to return to this point.*

Pressing the arrow keys will allow an alpha or numeric selection for a six-character file name. The right and left arrow keys select which character in the file name to edit and the up and down arrow keys are to choose a character. The chart below lists the available characters.

! " # \$ % & ' () * + , - x / 0 1 2 3 4 5 6 7 8 9 ; : < = > ?
@ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [\] ^ _

Pressing the SAVE/ERASE key in the "Create files" mode deletes the character under the cursor. Also, characters cannot be inserted. After naming the created file, press the START/ENTER key twice to continue the file creation process by entering Parameter Set-Up. Should the file name be identical to another file name, the instrument will display the message “duplicate name” on the top line of the display and “enter” on the bottom. All the data is stored no matter what the YES/NO flag is set to for area, length width, perimeter, ratio, and factor. If the Root Length flag is set to YES, then only length is stored, but the record length and number of measurements possible is unchanged.

When entering file Parameter set-up, the top line of the display reads the name of a parameter at the left and the word “yes” or “no” at the right. This indicates whether the particular parameter will be flagged for display. The bottom line of the display will read “enter” at the left and the four direction arrows at the right.

Note: *“Root Length” Parameter must be set to “No” when “Setup Measure” mode is set to measure “Leaf.”*

area	yes
<enter>	←→↑↓

To set a flag for a parameter, select the parameter and press the DOWN key. The word on the top right of the display will change from “yes” to “no” and that parameter will be flagged to not display. To set the flag to display a parameter, select the parameter and press the UP arrow key; the word at the top right of the display will change from “no” to “yes”.

Once finished setting up the parameters for the file, press the ENTER key. The file confirmation screen will appear. Press ENTER, again, for confirmation to create the file, or press STOP to abort the process.

file00	created
<enter>	<stop>

Close a File

Closing a file will move all temporary records to the file system. This will keep the records from being lost should the battery be unplugged while the instrument is on. It may also assist in downloading the temporary records to a PC.

Set-Up Instrument

The CI-202 has a number of utility functions that allow the user to manage the instrument’s capability. These functions are accessed using the *setup* mode. When the instrument is in the *setup* mode, the top line of the display reads “Setup” on the left and one of the words “Measure”, “scanner”, “auto save”, or “storage” on the right. The bottom line of the display reads “senter” on the left and the direction arrows on the right.

Setup	Measure
<enter>	←→↑↓

The options are:

- ♦ To select another mode using the up or down arrow keys
- ♦ To select an area to set-up using the right or left arrow keys
- ♦ To begin the set-up process by pressing the START/ENTER key

Set-Up Measure Parameter

Pressing the START/ENTER key when the “Setup Measure” is displayed on the top line allows the unit to select between Leaf Area or Root length modes.

Measure = Leaf
<stop><save> ←→↑↓

Use the up or down arrow keys to modify the value. Once satisfied with the set-up parameters, press the SAVE key. To avoid saving the parameters, press the STOP key to abort the process.

Set-Up Scanner Thresholds

NOTE: *Normally, there is no need to adjust the threshold of the CI-202 because the instruments are factory-adjusted to a threshold level that is ideal for “all-around” use.*

Manual Threshold Adjustment

First, adjust the threshold with the CI-202 over the reflective tape of the scan board. Select “Setup Scanner” in the display window and press START. Select “HiThrld” and press START again. Write down the threshold value displayed. Place a piece of white paper so it covers about half of the laser scan area starting at the right hand side (away from the rail). Select “LoThrld” and press START. Again, write down the threshold value displayed.

First, calibrate the instrument alone with the instrument over the reflective tape of the scan board. Select “Setup-Scanner” from the menu, then select “Manual” and press ENTER. The motor should spin and the laser should come on. The display should show something like this:

<p>T = 47 w = 0 <stop></p>
--

The “t” value is the threshold and the “w” is the width (in pixels) that the instrument is reading. Use the up/down arrows to adjust the “t” value to 10 above the LoThrld value you wrote down above. The HiThrld value must be at least 15 more than the new “t” value.

Press STOP to shut off the laser and motor, press STOP again and press SAVE if you want to keep the new threshold. Press the down arrow to get back to the Measure display. Press both the left and the right arrows at the same time. The CI-202 will turn on the laser for a short period while it measures the width. Press the up arrow and then the ENTER key to get back into the setup scanner menu. Press the SAVE and STOP keys at the same time. A new display will appear that allows you to see the precharge and other factory settings. Do not make any changes to these settings. Press STOP and then STOP again. The instrument will ask Save changes? Press SAVE. Test the instrument to see if it is working.

If the instrument malfunctions after manual threshold adjustment, contact CID, Inc. for assistance.

Set-Up Storage (check space or erase)

Pressing the START/ENTER key when “Setup storage” is displayed on the top line indicates the unit is in the *storage setup* mode. It will always start by indicating the total amount of storage space that is in the instrument for files and data.

The top line of the display will read “space =” to the left, and the number of bytes to the right (16 bytes are used per measurement record). The bottom line of the display will read “stop” on the left, and the up and down arrows on the right. Press the stop key to escape this mode, or the up and down arrow keys to reach the format storage menu.

space =	128k
<stop>	↑↓

Pressing the START/ENTER key when “format storage” is displayed on the top line indicates the unit is in the *storage format* mode. Be careful! Formatting the storage space of the CI-202 will erase all data and all files. This is convenient when starting a new year’s work, for example, but treat this command with care.

In the format storage mode the top line of the display will read “Clear all data”. The bottom line of the display will have the word “stop” to the left and “enter” to the right.

Clear all data
<stop> <erase>

To delete every file in your instrument, press the ENTER key. The instrument will erase all data from memory, leaving the maximum possible amount of memory for use. To stop the deleting process, press the STOP key.

Note: when there are no files to store data to, the measurement menu items will not be available. To correct this situation, create a file.

Set-Up Auto Store Parameter

Pressing the START/ENTER key when “Setup auto store” is displayed indicates the unit is in the *setup auto store* mode. This allows the user to set-up the instrument to automatically store measurements, and to start a new measurement without explicitly saving the old one. This mode is convenient when taking fast, repetitive measurements and when it is not necessary to review each measurement.

In the *auto store setup* mode, the top line of the display will read “auto store =” on the left and either “yes” or “no” on the right. The bottom line of the display will read “stop” and “save” and the directional arrows.

auto save = yes
<stop> <save> ↑↓

To set the instrument up to automatically store measurements press, the UP arrow key to bring the word “yes” onto the display, then press the SAVE key to save the configuration. To set the instrument up to automatically discard measurements, press the DOWN arrow key to bring the word “no” onto the display, then press the SAVE key to save the configuration. To avoid changing the configuration, press the STOP key.

THEORY OF OPERATION

Overview of the Parts of the Instrument

The CI-202 consists of a number of sub-systems. It has a laser width scanner that is capable of measuring the width of an object in its objective 500 times a second to a resolution of 0.1 mm. The entire instrument is controlled by a microcomputer system that allows the user unparalleled flexibility in configuring the instrument to make measurements accurately, easily and quickly.

The Width Scanner

When the instrument is in the scanning mode, a rotating mirror causes a laser beam to scan across the objective 500 times a second. This beam is reflected off the special surface of the scan board and received by a light sensor inside the unit. The level from this sensor is compared to a threshold. The output of the “comparator” is fed to the microcontroller, which monitors the intervals during the width scan.

Computing the Parameters

The CI-202 measures only two parameters directly: width and length. From these it derives area, perimeter, aspect ratio, and shape factor from each scan.

Each time the meter senses the leaf has progressed 1 mm, the computer will check if the width reading is a non-zero value.

If the width measurement is non-zero, the computer takes the following actions:

The width measurement is added to the area accumulator.

If the width measurement is greater than the currently stored maximum width, the maximum width is updated.

The perimeter increment is calculated and added to the perimeter accumulator. This perimeter increment is calculated using the function:

$$\Delta p = \sqrt{4\Delta l^2 + (W_0 - W_1)^2}$$

Where Δp is the perimeter increment,

Δl is the length increment (always 1 mm),

W_0 is the current width measurement, and

W_1 is the previous width measurement.

If the width measurement reaches zero and the instrument is not operating as part of the conveyer attachment, the measurement stops and is displayed.

Computing Aspect Ratio and Shape Factor Information

Aspect ratio and shape factor information can be easily determined from other calculated values. These derived quantities are not stored but calculated, whenever necessary, for the purposes of display or data dumping. The calculations used are shown below.

Aspect ratio is the ratio of the leaf length to its maximum width. It can be calculated from the equation:

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

Where r is the aspect ratio,

W_m is the maximum width, and

l is the length.

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 one. It can be calculated from the equation:

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

Where f is the shape factor,

a is the area, and

p is the perimeter.

Charging the Battery

When “Low Battery” is displayed, the battery is discharged below the recommended operating level. Measurements may continue for another 15 minutes; however, we recommend the battery be recharged as soon as possible. To charge the battery, plug the instrument into a computer USB port or the supplied charger. The instrument should be turned on while plugged into the USB port of a computer to get the fastest charging. Charge for at least 14 hours to get full charge on the batteries. Storing a battery in a discharged state could permanently damage it.

Care and Cleaning

Treat the CI-202 as any other fine optical instrument. Keep the lens clean and free from scratches. When not in use, keep the instrument in its protective case. Use only a mild detergent and damp cloth to clean the exterior areas of the instrument. Use a high quality lens cleaning cloth to clean the window. Do not submerge or use an overly wet cloth to clean the instrument. Do not drop the instrument. For an extended storage period, we recommend storing the instrument in a cool and dry place.



**CI-202
PRODUCTION TEST CHECK SHEET**

SERIAL NUMBER:	RMA #
SHIP DATE:	ROM VERSION:

TESTING FUNCTION	
THRESHOLD SET:	
PRECHARGE:	SCAN WIDTH:
SCAN TIME:	STEP LEN:
DATA DUMP:	FINAL:

INITIAL TEST DATE:	BY:
ENVIRONMENTAL TEST DATE:	BY:
FINAL CHECK TEST DATE:	BY:

NOTES: _____

CID Hardware Warranty

Important: Please read

Seller's Warranty and Liability: Seller warrants new equipment of its own manufacturing against defective workmanship and materials for a period of one year, of a single shift operation, from date of receipt of equipment - ***the results of ordinary wear and tear, neglect, misuse, accident and excessive deterioration due to corrosion from any cause is not to be considered a defect.*** Any defect must be called to the attention of CID, Inc., Camas, Washington, USA, in writing, within 90 days after receipt of the unit.

Seller's liability for defective parts is limited to the repair or replacement of any part of the instrument without charge, if CID, Inc.'s examination discloses that part to have been defective in material or workmanship, and in no event shall exceed the furnishing of replacement parts F.O.B. the factory where originally manufactured. No equipment may be repaired or altered by anyone not authorized by CID, Inc.

Material and equipment covered hereby, which is not manufactured by Seller, is to be covered only by the warranty of its manufacturer. Seller shall not be liable to the Buyer for loss, damage, or injury to persons (including death), or to property or things, whatsoever, including, but without limitation, products processed by the use of the equipment; or for damages of any kind or nature (including, but without limitation, loss of anticipated profits), occasioned by or arising out of installation, operation, use, misuse, nonuse, repair, or replacement of said material and equipment, or out of the use of any method or process for which the same may be employed. The purchaser is to pack, ship, or deliver the instrument to CID, Inc., in Camas, Washington, USA, within 30 days after CID, Inc. has received written notice of the defect at the customer's expense. No other arrangements may be made unless otherwise approved in writing by CID, Inc.

The use of this equipment constitutes Buyer's acceptance of the terms set forth in this warranty. There are no understandings, representations, or warranties of any kind, express, implied, statutory, or otherwise (***including, but without limitation, the implied warranties of merchantability and fitness for a particular purpose***), not expressly set forth herein.