

LI-3000C Portable Area Meter

And LI-3050C Transparent Belt Conveyor Accessory

FAST • PRECISE • EASY OPERATION



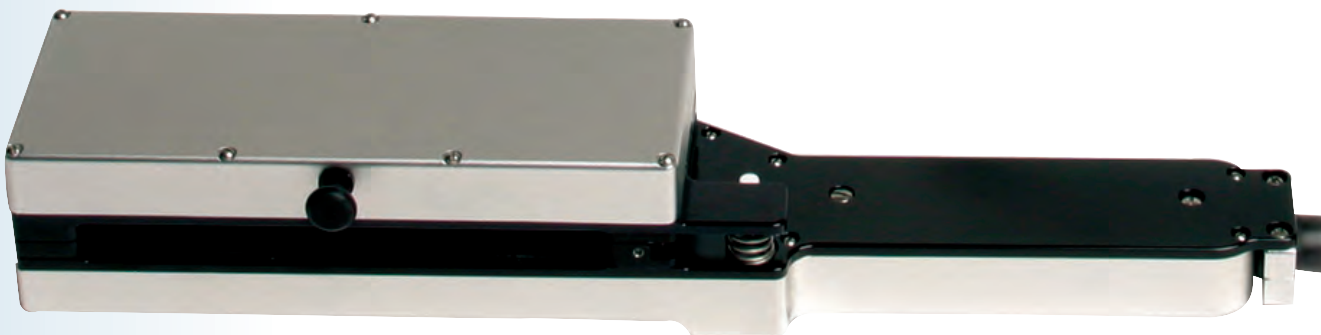
LI-COR®

Biosciences

LI-3000C Portable Area Meter

Leaf Area of Living Plants or Detached Leaves in the Field or Laboratory

- Non-destructive leaf area measurement in the field
- 1 mm² resolution
- Displays and stores individual leaf area, accumulated area, leaf length, average width, maximum width
- Data storage for up to 125,000 individual leaf measurements
- RS-232 and USB ports
- Lightweight for portability
- Precise measurement of perforated and irregular margin leaves
- Easily combined with a belt conveyer system for lab use (using LI-3050C)
- Simple Windows[®] software for file transfer and real-time data collection



The LI-3000C provides a non-destructive, precise method to measure leaf area. Leaf area development or reduction associated with conditions of insect infestation, drought, disease or air pollution can be measured in the field or in growth chambers.

Leaf area can be monitored without damaging the plants. This allows precise evaluation of plant canopy development throughout the growing season. The effects of diminishing the stand density that occurs when plants are harvested for measurement are eliminated. This technique allows area data collection in the field before the detached leaves appreciably shrink or curl. For many experiments, the need to transport samples away from the plot site is eliminated.

The remaining area of insect-damaged leaves can also be measured. Data can be collected from the same plant throughout its life cycle. For severely damaged leaves, a transparent sheath can be used to support the remaining tissue.

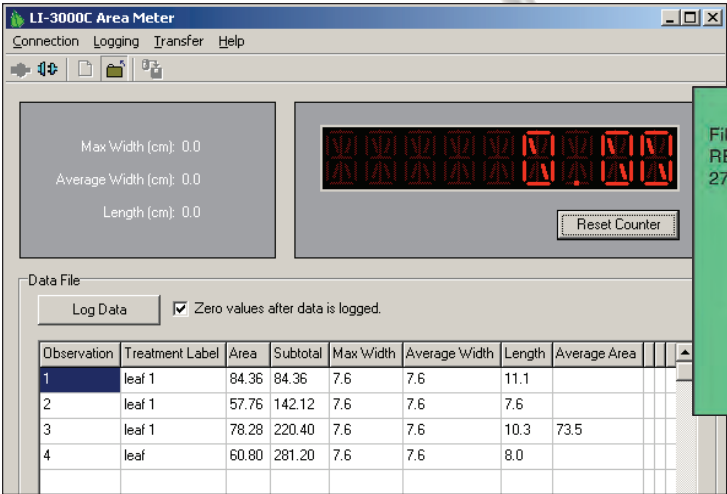
Forest canopy or urban foliage development can be recorded for purposes such as evaluating air pollution effects or pest damage. The LI-3000C's lightweight construction and long-life rechargeable battery (12 hours) provide extensive versatility for field use.



Readout Console Operation

For each leaf area measurement the LI-3000C records values of leaf area, leaf length, average width and maximum width. Each of these values can be shown on the display. Individual leaf area values can also be added to a secondary summing register to collect accumulated leaf area data for leaf area index or whole plant leaf area. After a measurement, the area data are stored using a convenient file system along with a time stamp from the real time clock and an alphanumeric remark to identify the data (e.g., field #, leaf #, plot #, etc).

Interface Software



Data can be collected with the Windows software included....

Sample Data Page						
File: 2]		File Number				
REM: PLOT 12 #6]		Remark				
27 APRIL 2006 14:32:12]		Date and Time				
ENTRY	COUNT	AREA	LENGTH	AV WIDTH	MX WIDTH	
1	0	13.67	2.9	4.7	5.3	Individual measurements
2	0	14.16	5.1	2.8	4.2	
3	0	13.35	3.9	3.4	5.0	
4	0	21.72	4.9	4.4	5.6	
5	4	62.90	16.8	3.7	5.6	
Accumulated data for 4 readings						

... and opened in most spreadsheet or text editor programs.

The Windows® interface software provided collects data files transferred from the LI-3000C console. Data files can be saved separately or combined into a single, larger data file. The LI-3000C supports both RS-232 and USB data transfer.

The interface software also allows the user to monitor data on a computer and store readings in a log file. Realtime Capture Mode, initiated from the LI-3000C console, transmits data directly to the

computer. This feature is most commonly used in combination with the LI-3050C Transparent Belt Conveyor Accessory. Realtime Capture can save time when logging large amounts of data, as files do not need to be transferred to the computer. Log files include individual area, cumulative area, maximum width, average width, length, and average area. Remarks can be entered for each logged value. These files are easily opened in most spreadsheet or text editor programs.

Theory Of Operation

The LI-3000C Portable Area Meter utilizes an electronic method of rectangular approximation providing 1 mm² resolution. The major components are the scanning head and the readout console. Area data are recorded by the readout console as the scanning head is passed over the leaf.

Width Scanning

Object width is scanned by sequentially pulsing a row of 128 narrow-band, red light-emitting diodes (LEDs) located on 1 mm centers in the upper section of the scanning head. The LEDs are located 6.4 mm from the edge of the scanning head, permitting measurement close to the base of the leaf.

The lower section of the scanning head contains a lens-photodiode system which responds to the LED light. When one or more LEDs are masked by some object which passes through the scanning head, the width is measured (i.e. 3 LEDs masked are sensed as 3 mm width). The LEDs and associated digital circuitry provide measurements which are unaffected by leaf transmission properties or ambient light.

Length Scanning

A length encoding cord, with one end held against a stationary object, is drawn out of the scanning head as the head is moved over the leaf. The LEDs are sequentially pulsed once for each 1 mm of cord travel. For example, if a 20 mm width x 100 mm length object

is measured, 20 LEDs will be masked for 100 scanning cycles, resulting in a display of 20.00 cm². Accuracy is unaffected by the scanning speed (1 meter s⁻¹ maximum rate).



Area

The area is integrated and displayed as the scanning head is drawn over the leaf. Leaves with irregular margins or with holes, as in cases of insect damage, are correctly measured by the LI-3000C. As the portion of leaf with the hole passes through the scanning head, the lens-photodiode system senses the LED light. That particular LED location does not contribute to the accumulated area on the display until the LEDs are once again masked by a portion of leaf without a hole.

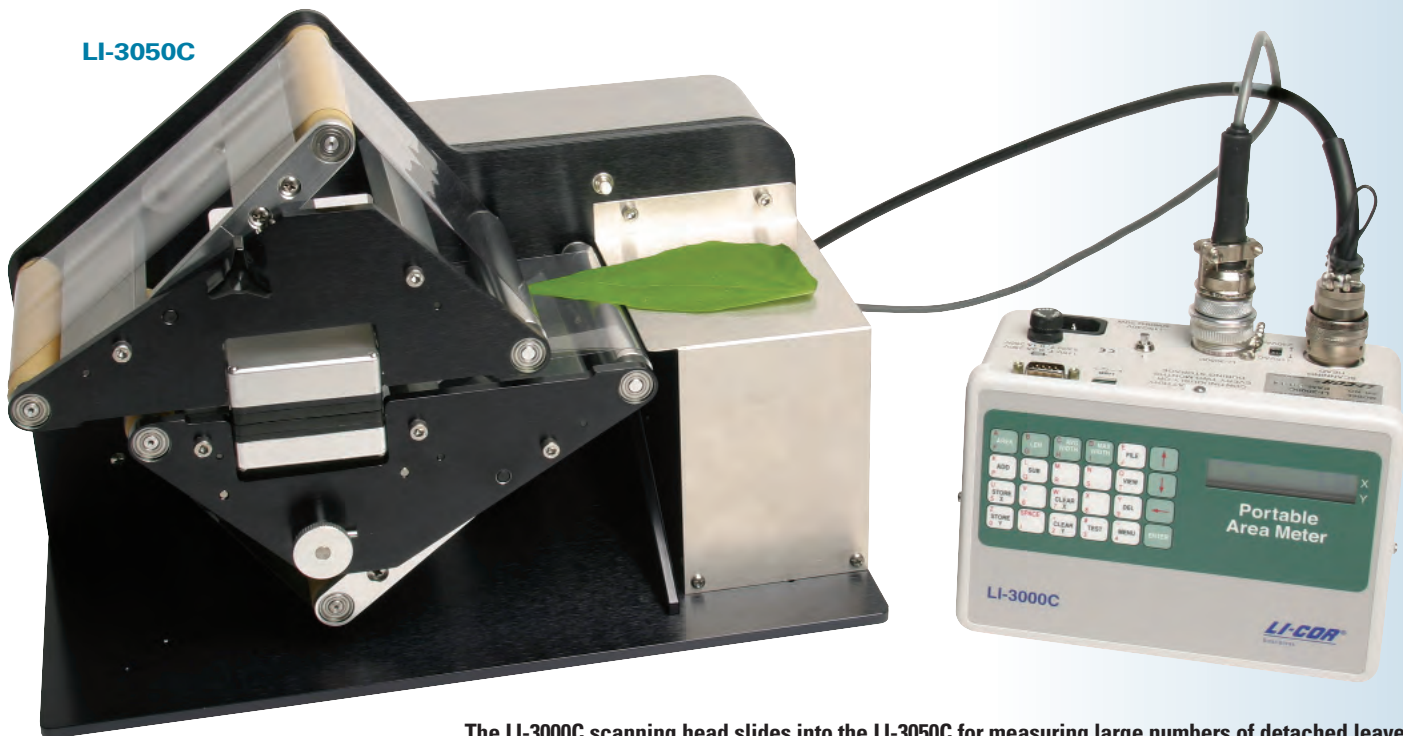
Scanning Head Operation



1) The scanning head is opened and placed over the leaf. The length encoding cord is held stationary against a stable object, usually the stem at the base of the leaf. The scanning head is closed at the base of the leaf and the reset button is pressed to initiate a new measurement.



2) The closed scanning head is drawn over the leaf, allowing the leaf apex to pass through completely.



The LI-3000C scanning head slides into the LI-3050C for measuring large numbers of detached leaves.

LI-3050C – Transparent Belt Conveyor Accessory

Large numbers of detached leaves often are more efficiently measured using the LI-3000C Portable Area Meter in combination with the LI-3050C Transparent Belt Conveyor Accessory. The complete LI-3000C circuitry is utilized to provide a sophisticated laboratory instrument for a broad range of area analysis requirements.

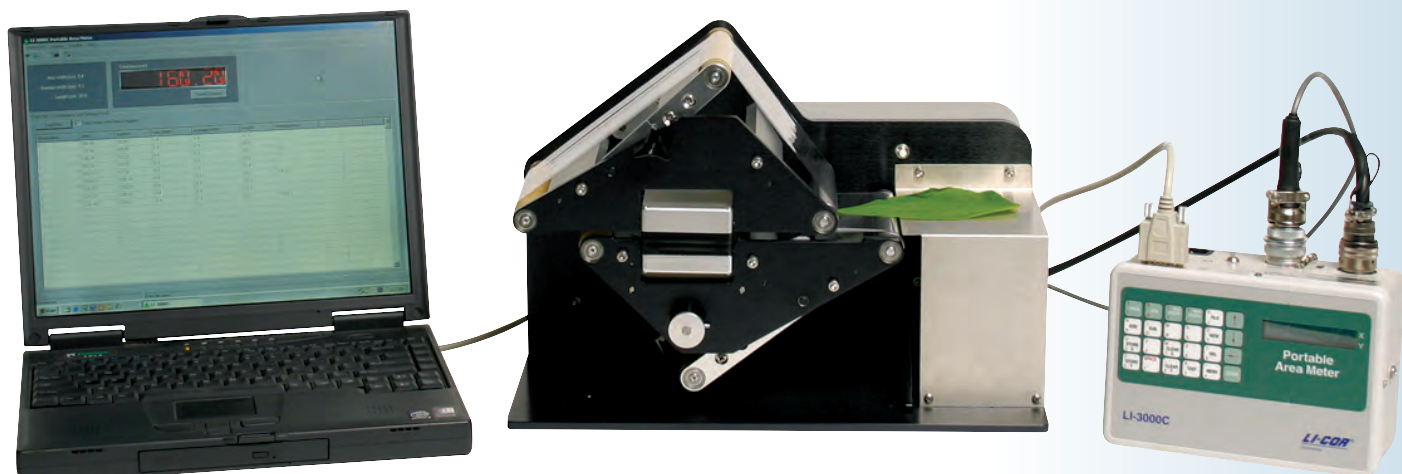
Advantages of the LI-3000C and LI-3050C Combination

- Fast, automatic operation for large numbers of samples
- Accuracy within $\pm 1\%$
- Rugged and durable transparent belts
- Ease of belt cleaning and adjustment
- Rapid logging and storage of individual or cumulative area
- Data can be displayed and logged on a computer

Measurement Process

The two units are coupled by sliding the LI-3000C scanning head into the LI-3050C assembly such that the upper and lower belts pass through the scanning head. In this mode, the conveyor belt moves at a constant speed to provide the encoded length information to the LI-3000C (the length encoding cord is not used).

Samples are placed on the lower transparent belt and allowed to pass through the LI-3000C scanning head. Accumulated area is shown on the LI-3000C display or on a computer screen when using the LI-3000C application software. The measurement is initiated using the reset button located on the front panel of the LI-3050C.



In Realtime Capture Mode, data are transmitted through the LI-3000C (or through the LI-3050C) directly to a computer.

LI-3000C Specifications*

Resolution: 1 mm² (1 mm x 1 mm scanning area).

Accuracy: Within ± 2% for samples > 50 cm².

Display Capacity: Area: 9,999,999.99 cm², Length: 99,999,999.9 cm,
Width: 12.8 cm

Display: 2 line x 16 character LCD

Keyboard: Sealed, 24 key tactile response with audio feedback.

Real Time Clock: Year, month, day, hour, minute, second.

Accuracy: ± 3 minutes per month (0-55 °C).

Internal Memory: More than 2.1 MB of non-volatile FLASH.

Measurement data are maintained even in absence of power.

Memory Capacity: From 65,000 to 125,000 individual leaf area measurements.

Communications: USB 1.1 Compliant, Full Speed, Bus rate @ 12 Mbps;
RS-232 DTE, N, 8, 1, Baud rate fixed at 38,400 bps, hardware flow control.

Sample Dimensions

Width: 127 mm maximum, 1 mm minimum.

Thickness: 8 mm maximum.

Length: 1 meter maximum.

Scanning Speed: Up to 1 m/s. Length encoding cord drawing speed need not be constant. Error message indicates if encoding cord is drawn too fast.

Power Requirement: Internal rechargeable 6V lead-acid battery;
or 115/230 VAC, 50/60 Hz, 20 watt maximum.

User-Replaceable Mains Fuse: 2/10 amp type T for 115 VAC,
1/10 amp type T for 230 VAC, 1/4 x 1 1/4 glass cartridge style.

Battery Capacity: Typically 12-15 hours of continuous operation.

Recharging Time: 5-8 hours, instrument off. Charging circuitry built-in.

Battery Voltage Sensor: Low battery warning occurs approximately 1 hour before automatically shutting off the instrument. Over-voltage warning occurs if battery becomes over-charged. Data are stored in FLASH memory, and is secure in either of these conditions.

Scanning Head

LED Light Source: 6.4 mm from outer edge.

Size: 30.5 cm overall length (12.0 ").

Weight: 680 g (1.5 lb.).

Readout-Control Unit

Size: 19.8 cm L x 15.5 W x 10.1 D (7.8" x 6.1" x 4.0").

Weight: 2.0 kg (4.4 lb).

Operating Temperature: 0 to 55 °C, 5 to 95% RH (non-condensing).

Storage Temperature: -20 to 55 °C, 5 to 95% RH (non-condensing). Long term storage at high temperatures will shorten the life of the internal battery.

LI-3050C Specifications*

Resolution: 1 mm² (1 mm x 1 mm scanning area).

Accuracy: Within ± 1% for samples > 10 cm².

Sample Dimensions

Width: 127 mm maximum, 1 mm minimum.

Thickness: 7.5 mm maximum.

Length: unlimited.

Conveyer Belt Speed: 6.3 cm/s at 60 Hz; 5.4 cm/s at 50 Hz.

Transparent Belts: Rugged clear vinyl.

Power Requirement: 115/230 VAC, 50/60 Hz, 20 Watts maximum

User-Replaceable Mains Fuse: 2/10 amp type T for 115 VAC, 1/10 amp
type T for 230 VAC, 1/4 x 1 1/4 glass cartridge style.

Operating Temperature: 0 to 55 °C. 5 to 95% RH (non-condensing).

Storage Temperature: -20 to 55 °C. 5 to 95% RH (non-condensing).

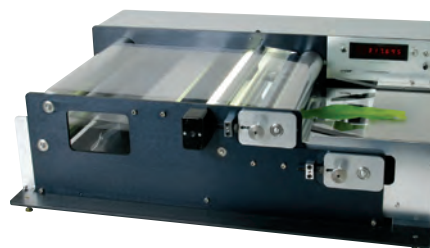
Size: 27.9 cm H x 27.9 W x 38.1 L (11.0" x 11.0" x 15.0")

Weight: 7.7 kg (17.0 lb).

*Specifications subject to change without notice.

LI-COR®

Biosciences



The LI-3000C Area Meter is also available. See www.licor.com for more information.

4647 Superior Street • P.O. Box 4425 • Lincoln, Nebraska 68504 USA
North America: 800-447-3576 • International: 402-467-3576 • FAX: 402-467-2819
envsales@licor.com • envsupport@licor.com • www.licor.com

In Germany – LI-COR Biosciences GmbH: +49 (0) 6172 17 17 771
envsales-gmbh@licor.com • envsupport-gmbh@licor.com

In the United Kingdom, Ireland and Scandinavia – LI-COR Biosciences UK Ltd: +44 (0) 1223 422102
envsales-UK@licor.com • envsupport-UK@licor.com

LI-COR is a registered trademark of LI-COR, Inc. All trademarks belong to their respective owners. These third parties do not endorse, are not affiliated with, and do not sponsor the LI-3000C or other LI-COR products. Copyright 2006, LI-COR, Inc. Printed in the U.S.A.

980-08585
Rev A 0611

The LI-COR board of directors would like to take this opportunity to return thanks to God for His merciful providence in allowing LI-COR to develop and commercialize products, through the collective effort of dedicated employees, that enable the examination of the wonders of His works.

“Trust in the LORD with all your heart and do not lean on your own understanding. In all your ways acknowledge Him, and He will make your paths straight.”

—Proverbs 3:5,6

LI-3100C Area Meter



Fast, Precise, Easy Operation

LI-COR[®]
Biosciences

0.1 mm² resolution



LI-3100C Area Meter

Rapid, Precise Area Measurement of Large or Small Leaves

- Adjustable Resolution: 0.1 or 1 mm²
- High accuracy and repeatability
- Individual or cumulative area
- Fast, continuous operation for large quantities of samples
- Large samples: 25 cm wide, 2.5 cm thick, 1mm² resolution
- Small samples: <1 cm² when using 0.1 mm² resolution
- Adjustable press roller to flatten curled leaves
- LED display
- Windows® software
- USB and Serial ports

Versatility

The LI-3100C Area Meter is designed for efficient and exacting measurement of both large and small leaves. Adjustable resolution settings provide versatility for diverse project requirements.

A wide variety of leaves can be measured, ranging from larger samples such as corn, tobacco, and cotton to smaller samples such as wheat, rice or alfalfa. Small leaves or leaf discs are measured with the same precision as larger leaves. The LI-3100C can also handle conifer needles, perforated leaves and leaves with irregular margins. This is especially important in determining leaf damage and insect feeding trails.

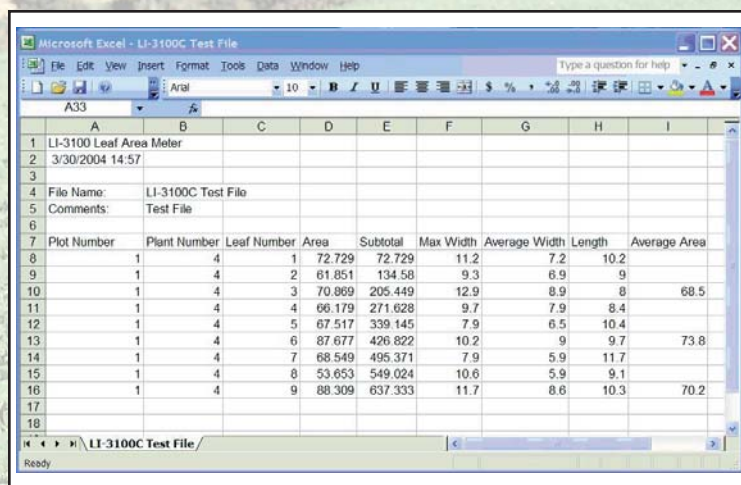
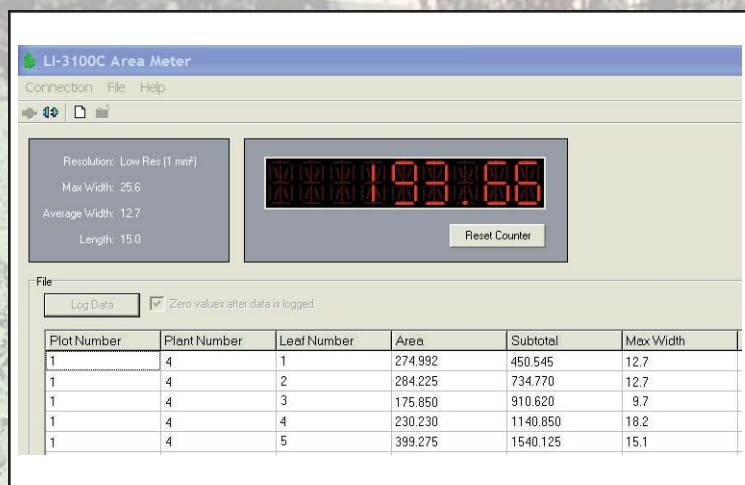
Operation

Samples are placed between the guides on the lower transparent belt and allowed to pass through the LI-3100C. As the sample travels under the fluorescent light source, the projected image is reflected by a system of three mirrors to a scanning camera. This unique optical design results in high accuracy and dependability.

An adjustable press roller flattens curled leaves and feeds them properly between the transparent belts. This provides for accurate measurement of small grasses, legumes, aquatic plants and similar types of leaves.

As samples pass under the light source, the accumulating area in mm² is shown on the LED display or on a computer screen when using the Windows® software. Calibration adjustments are easily accomplished using a standard area calibration disk (included) and turning the calibration screw located near the display.





The Windows® software allows you to save data to a log file containing individual area, average width, maximum width, length, and cumulative area. Log files can be opened with a text editor or spreadsheet program (above, right).

Data Analysis

The LI-3100C Windows® Interface software allows users to monitor data on a computer and store readings in a log file. The log file includes individual area, maximum width, average width, length, and cumulative area. Remarks can be entered for each logged value. Most text editor or spreadsheet programs can open LI-3100C data files.

The Windows® Interface software also features:

- Display of individual area, leaf length, average width, and maximum width
- Indicator of resolution setting on the LI-3100C
- Area counter reset, independent of the LI-3100C LED display
- Support for both USB and serial connections

Simplified Maintenance

Cleaning the LI-3100C is simplified by convenient access to all belt surfaces and mirrors. The transparent belts are rugged and durable. The fluorescent lamp and belts are easy to replace when needed.



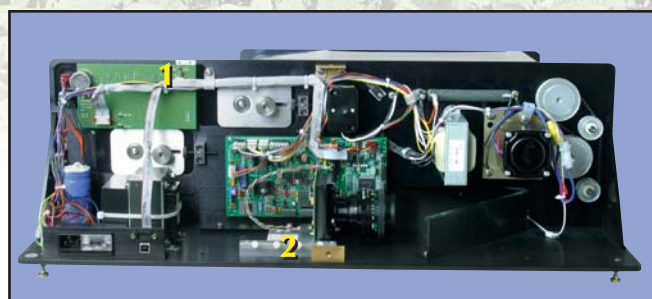
The LI-3100C can be connected to a computer via a serial or USB connection. Simple Windows® software allows you to log data to a file.

Specifications:

Resolution:	1 mm ² or 0.1 mm ² (adjustable)
Scanning Area:	1 mm ² Resolution: 1 mm x 1 mm 0.1 mm ² Resolution: 0.300 mm W x 0.333 mm L
Display Capacity:	1 mm ² Resolution: 999,999.99 cm ² 0.1 mm ² Resolution: 99,999.999 cm ²
Display:	Full 8-digit LED
Width:	25.4 cm max; 1.5 to 3.0 mm minimum
Thickness:	Up to 2 cm, user-expandable to 2.5 cm
Length:	Unlimited
Conveyor Belt Speed:	8.0 cm/s at 60 Hz; 6.7 cm/s at 50 Hz
Light Source:	15 W fluorescent tube
Transparent Belts:	Rugged clear vinyl
Power Requirements:	108-126/216-252 VAC, 48 to 66 Hz, 100 W max
Operating Temperature:	+15 to + 55 C
Storage Temperature:	-20 to + 65 C
Size:	25.0 H x 60.0 W x 73.0 L cm (9.8" x 23.6" x 28.7")
Weight:	43 Kg (95 lb)

Accuracy	Sample Area			
Resolution	10 cm ²	3 cm ²	1 cm ²	0.3 cm ²
1 mm ²	± 2.0%	± 3.0%	± 6.0%	± 10.0%
0.1 mm ²	± 1.0%	± 1.5%	± 3.0%	± 5.0%

Combined accuracy and precision to 99% confidence with correct calibration on verifiable shapes. Better accuracy can be achieved by calibrating the LI-3100C and/or placing the leaf on the middle section of the belt. Use the 0.1 mm² resolution for conifers, roots and other similar objects and expect the accuracy to be about 5% less than normal leaves.



Area-sensing resolution is shifted between 1 and 0.1 mm² with a simple procedure. For 1 mm² resolution, the display is switched for two decimal places (1), and the camera lens is moved to the appropriate pre-marked location (2). For 0.1 mm² resolution, the display is switched for three decimal places, and the camera lens is moved to a second pre-marked location. The lens focus is set by LI-COR.

Ordering Information

LI-3100C	Includes both 0.1 and 1 mm ² resolution, one each 3100TBL and 3100 TBU transparent belts, one 3100LAMP fluorescent lamp, 3100-500 Windows interface software, RS-232 serial cable, USB cable, dust cover and instruction manual
3100TBL	Lower Transparent Belt
3100TBU	Upper Transparent Belt
3100LAMP	Fluorescent Lamp

LI-COR®

Biosciences

Distributors Worldwide

4421 Superior Street • PO Box 4425 • Lincoln, NE 68504 USA • 800-447-3576 • 402-467-3576 • Fax: 402-467-2819

www.licor.com • E-mail: envsales@licor.com

LI-COR is an ISO 9001 registered company. © 2004 LI-COR, inc. Windows is a registered trademark of Microsoft Corporation.