



DLI 100 Light Meter

PRODUCT MANUAL

Item # 3405, 3405B, 3405B3



Spectrum[®]
Technologies, Inc.

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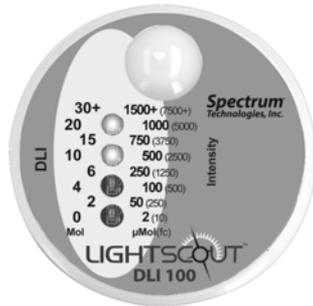
Thank you for purchasing a LightScout DLI 100 Light Meter. Please read this manual thoroughly before using your instrument.

The DLI 100 accurately measures the PAR light that falls on it over a 24 hour period (the Daily Light Integral, or DLI), giving you the ability to match a plant's light requirements with the actual light conditions at that location.

There are two generations of DLI 100 meters. They are the same functionally, but differ in details. The differences are identified throughout the manual by marking information as “3405” or “3405B”.

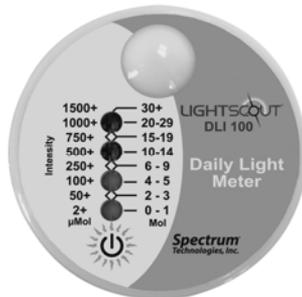
3405—First Generation

- Aluminum Spike
- Button on the shoulder
- Uses CR2032 battery (included)
- Sold in a 3-pack box



3405B—Second Generation

- Plastic Spike
- Button on the face
- Uses three A76/LR44/L1154 batteries (included)
- Individually packaged in a bubble package (3-pack sold as item 3405B3)



Both feature:

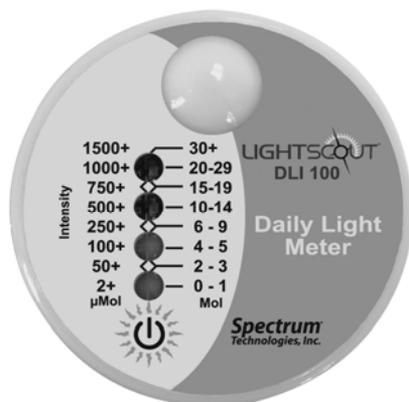
- Simple, one button operation
- An affordable, first step in measuring light
- Measure PAR light (Photosynthetically Active Radiation - the range between 400 and 700 nm)
- With the push of a button, the meter runs for 24 hours and calculates your Daily Light Integral (DLI)
- Real-time intensity levels are shown every 4 seconds in $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ (or footcandles)
- Packaged in sets of 3 light meters (3405, 3405B3)
- Approximate battery life: 100 DLI calculations

QUICK START

- 1. Decide where you want to measure** Page 5
The DLI 100 comes as a set of three units so you can compare the amount of light received in multiple places on the same day.
- 2. Start measuring** Pages 6-8
Press the button on the shoulder of each DLI 100. The LEDs will light upward, and will blink every 4 seconds to show the current light intensity. Read the value from the right side of the LEDs.
- 3. Wait 24 hours**
The DLI 100 will sum the light measurements for 24 hours to compute the Daily Light Integral (DLI).
- 4. Read the Daily Light Integral (DLI)** Pages 6-8
After 24 hours the DLI 100 will blink every second for the next hour to show the DLI value. Use the numbers to the left of the LEDs. If the display is dark, press the button to wake it and see the value for 10 seconds.
- 5. Act on what you've learned** Pages 9-10
If you've learned that your plants aren't getting enough light, what are you going to do to change that?
- 6. Repeat**
Choose other areas and repeat the process for maximum benefit.

Important: Your mother was right. Don't run with scissors, and because of the spike on the DLI 100, be careful with it as well.

Do not store the DLI 100 upside-down. Aside from the danger from the spike, irrigation water can gather in the screw holes, enter the unit, and damage the circuit board.



3405: Your DLI 100 is shipped with a sheet of matte plastic protecting the display. Remove it before using the light meter.

WHERE TO MEASURE?

The DLI 100 is available as a set of three units (3405, 3405B3) so you can simultaneously compare the amount of light received in multiple places, without the uncertainty caused by environmental differences across multiple days.

Use a “Control”

Use two of your DLI 100s to measure two locations of primary interest—on a greenhouse bench, or on a shaded green or tee box at a golf course. Use the third as a “control” - let it receive the maximum light, either outside your greenhouse, or in full sun, far from the trees.

In a Greenhouse

Place DLI 100s where you can compare light levels and DLI (Daily Light Integral) with and without hanging plants and shades. Use pots with soil or media to hold the DLI 100 upright. Place the third DLI 100 outside to measure transmission loss through the structure.

Shaded Tees and Greens

Use the DLI 100 to compare the light received by healthy and stressed areas of tees and greens. By placing one unit in the stressed area, one in a healthy area, and the third nearby with full sun, areas of destructive shade can be documented, and the minimum light level necessary can be determined.

In the Crop Canopy

To measure the incident light and/or DLI at, in, or below the crop canopy, secure the DLI 100 at the proper location and height. For low plants, this can be as simple as inserting the spike into the ground or into a container filled with soil or media. For taller crops, set a plastic or metal pipe into the ground, and slip the DLI 100 spike into the top to hold it at the desired height.

Please consult with your Spectrum representative to discuss expected results as well as additional ways to use your DLI 100 Light Meter.

USING THE DLI 100

Place the DLI 100 in the ground at the desired location for evaluating the amount of available sunlight. In a greenhouse insert the meter into a container of similar size (containing substrate only) to that of the crop being grown, so that the meter receives the same amount of light at the same height as the growing crop. Ensure that the face of the unit is generally parallel to the ground.

Light Gathering Mode

To turn the DLI 100 press the power button located on the face of the device. When the power is applied, the four LEDs will illuminate sequentially from bottom to top. Thereafter, one or more LEDs will flash every 4 seconds, indicating the amount of light currently being received.

The DLI 100 measures the actual light intensity every 20 seconds, then displays that value every 4 seconds until the next measurement is made.

Note: While the DLI 100 is gathering data, pressing the power button will turn off the unit (the four LEDs will illuminate sequentially from top to bottom), and the measurement process will be cancelled. Pressing the button again will start a new 24 hour measurement period.

DLI Display Mode

After 24 hours of continuous operation, the device will stop accumulating light measurements. One or more LEDs will flash every second for one hour to indicate the Daily Light Integral (DLI) for that location. The device will shut itself off after displaying the DLI value for one hour, but the DLI measurement will be retained in memory.

The last DLI value computed can be retrieved from memory by pressing the power button to turn on the unit. The DLI value will flash every second for 10 seconds. **Important: After 10 seconds the DLI value will be erased, and a new 24 hour measurement period will begin. Pressing the button again before 10 seconds has elapsed will turn the unit off and save the DLI value.**

READING THE DISPLAY—3405

The DLI 100 Light Meter has 4 LEDs that are used to indicate different levels of light - both intensity and Daily Light Integral (DLI).

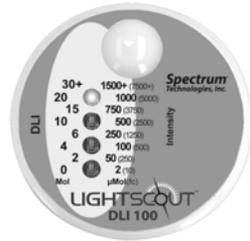
The LEDs flash once every four seconds during the Light Gathering Period. Numbers to the **right** of the LEDs indicate the current light intensity in $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ (micromoles). A sunlight approximation of foot candles can be obtained by multiplying the value by 5.

Numbers to the **left** of the LEDs are used to display the **DLI** value in $\text{mol}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$. The LEDs flash once per second.

One LED

When one LED is flashing, read the number next to it. The light level will be *at least* that number. In the image to the right:

During the Light Gathering period, by reading the **right** numbers, the light intensity would be in the range 1000-1499 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ (“1000” is lit, and the top of the range is less than 1500, the next number up).

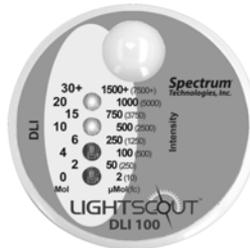


In DLI Display mode, by reading to the **left**, the DLI value would be in the range 20-29 $\text{mol}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$

Two LEDs

If the light level is between two LEDs, then both flash. In this case, use the number between them. For the image to the right::

During the Light Gathering period, by reading the **right** numbers, the light intensity would be in the range 750-999 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ (“750” is between the two lit LEDs, and the top of the range is less than 1000, the next number up).



In DLI Display mode, by reading to the **left**, the DLI value would be in the range 15-19 $\text{mol}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$

Four LEDs

Under the highest light levels, all four LEDs flash. The numbers at the top of the display (1500+, 30+) provide the “at least” values for these light levels.

READING THE DISPLAY—3405B

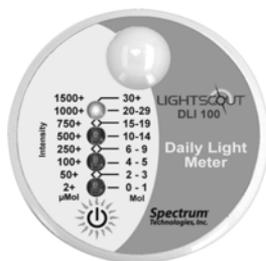
The DLI 100 Light Meter has 4 LEDs that are used to indicate different levels of light - both intensity and Daily Light Integral (DLI).

3405B: The LEDs flash once every four seconds during the Light Gathering Period. Numbers to the **left** of the LEDs indicate the current light intensity in $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ (micromoles). A sunlight approximation of foot candles can be obtained by multiplying the value by 5.

Numbers to the **right** of the LEDs are used to display the **DLI** value in $\text{mol}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$. The LEDs flash once per second.

One LED

When one LED is flashing, read the number next to it. The light level will be *at least* that number. In the image to the right:



During the Light Gathering period, by reading the **left** numbers, the light intensity would be in the range 1000-1499 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ (“1000” is lit, and the top of the range is less than 1500, the next number up).

In DLI Display mode, by reading to the **right**, the DLI value would be in the range 20-29 $\text{mol}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$

Two LEDs

If the light level is between two LEDs, then both flash. In this case, use the number between them. For the image to the right:



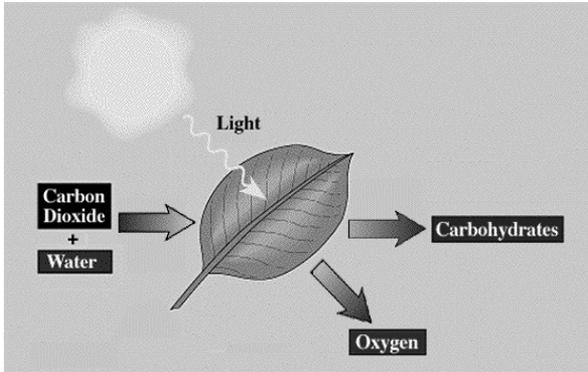
During the Light Gathering period, by reading the **left** numbers, the light intensity would be in the range 750-999 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ (“750” is between the two lit LEDs, and the top of the range is less than 1000, the next number up).

In DLI Display mode, by reading to the **right**, the DLI value would be in the range 15-19 $\text{mol}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$

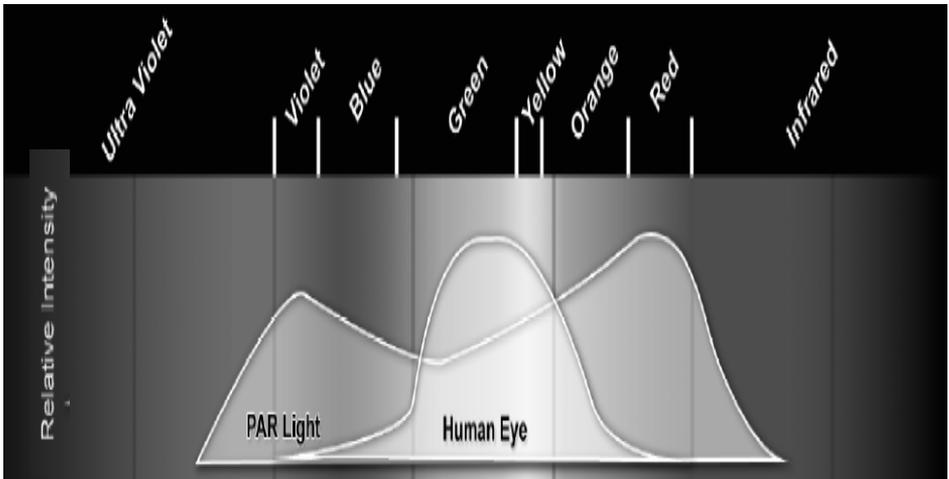
Four LEDs

Under the highest light levels, all four LEDs flash. The numbers at the top of the display (1500+, 30+) provide the “at least” values for these light levels.

LIGHT INTENSITY



The light that drives photosynthesis in plants is Photosynthetically Active Radiation, or PAR light. This is also referred to as Quantum light, because it is measured in units of moles striking an area over time. Though PAR light ranges from 400 to 700nm, the region brightest to human eyes is the area of least effect on plants.



Light meters measure light intensity – the instantaneous amount of light delivered to an area. During the 24-hour light gathering period, the DLI 100 functions as a light meter.

Top image: <http://snhs-plin.barry.edu/cell-biology/photo1.gif>

CUMULATIVE LIGHT (DLI)

If photons were raindrops, light meters would show the intensity of a rainstorm. A five-minute rainstorm may look impressive, but often provides less water than an all-day drizzle. As cumulative rainfall is measured with a rain gauge, the cumulative quantity of light is measured using the DLI 100, or a light sensor with a data logger. The daily total of quantum light is called the Daily Light Integral, or DLI, and is measured in units of $\text{mol}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$ (commonly, moles/day). DLI quantifies the light available to plants to perform photosynthesis.

On a sunny winter day in the middle latitudes, a plant receives about 9 moles/day. If it is cloudy, the DLI drops to 3 moles/day. In the summer, the DLI for a sunny day is about 26 moles/day and 12 moles/day for a cloudy day.

Each type of plant has a different DLI range for optimal growth. DLI is directly correlated with plant quality, and a minimum amount of light is required for marketable plants.

Effect of light intensity on plant growth and quality

Relative Light Level	Daily Light Integral (DLI) $\text{mol}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$	Light intensity at Noon $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$	Generalized Plant Growth Response
Very Low	2 to 5	100 to 200	Poor quality
Low	5 to 10	200 to 400	Minimum acceptable quality
Medium	10 to 20	400 to 800	Good quality
High	20 to 30	800 to 1,200	Excellent quality
Very high	30 to 60	1,200 to 2000	Excellent quality

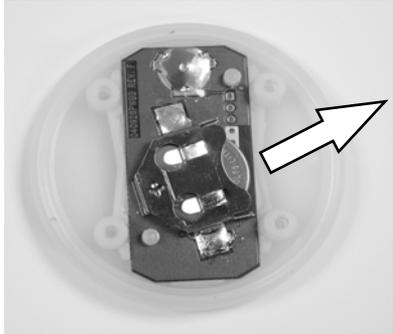
Table 1. Generalized plant responses to different light levels.

Please note that it is not possible to convert a single light intensity reading to DLI. Additionally, temperature is an important factor of plant growth and quality (table adapted from Hamrick, Debbie ed. Ball Red Book. Batavia, IL: Ball Publishing. 2003).

REPLACING THE BATTERY

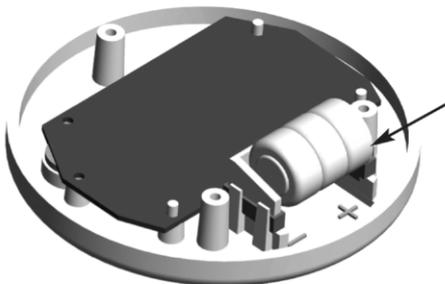
3405: The LightScout DLI 100 Light Meter uses a standard 3V Lithium CR2032 battery. A battery is projected to record 60 days, depending on the measured light intensity. To change the battery:

1. Remove the four screws from the back, and lift the top off the meter. Do not lose the clear gasket (O-ring).
2. Turn the top over, and use screwdriver to gently push the old battery out.
3. Slide the new battery in, with the "+" side toward you.
4. Replace the top and the gasket on the case. It will fit securely only one way—the sensor dome is on the side opposite the power button. Tighten the four screws.



3405B: The LightScout DLI 100 Light Meter uses three cell batteries A76/LR44/AG13/L1154. To change the battery:

1. Remove the three screws from the underside of the unit.
2. Lift off and turn over the top of the DLI 100.
3. Remove the batteries.
4. Clean the battery contacts prior to installing batteries.
5. Batteries must be installed in the correct direction and polarity (see image below).
6. Re-align the top of the DLI 100 with the base. Replace and tighten the screws.



Arrange batteries
as depicted here

WARRANTY

This product is warranted to be free from defects in material or workmanship for one year from the date of purchase. During the warranty period Spectrum will, at its option, either repair or replace products that prove to be defective. This warranty does not cover damage due to improper installation or use, lightning, negligence, accident, or unauthorized modifications, or to incidental or consequential damages beyond the Spectrum product. Before returning a failed unit, you must obtain a Returned Materials Authorization (RMA) from Spectrum. Spectrum is not responsible for any package that is returned without a valid RMA number or for the loss of the package by any shipping company.



DECLARATION OF CONFORMITY

Spectrum Technologies, Inc.
12360 S. Industrial Dr. East
Plainfield, IL 60585 USA

Item Number: 3405, 3405B
Description: LightScout DLI 100 Light Meter
Type: Electrical equipment for measurement, control, and laboratory use
Directive: 2004/108/EC
Standards: EN 61326-1:2006
EN 61000-4-2:1995, including A1:1998 and A2:2001
EN 61000-4-3:2002
EN 55011:2007

Michael J. Dunning, Weather Products Manager

January 4, 2010

Spectrum[®] **Technologies, Inc.**

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