Bios International Corporation
10 Park Place
Butler, New Jersey, USA 07405
Phone (973) 492 8400
Toll Free (800) 663 4977
Fax (973) 492 8270

Email sales@biosint.com
Web www.biosint.com

DryCal® DC-Lite Manual

© 2003 • Bios International Corporation

MK01-1 Rev. C 1.09

DryCal® DC-Lite Specifications

Size 5" x 5" x 2.75" • 127 mm x 127 mm x 70 mm
Weight 42 oz • 1200 g
Flow Ranges | Air Flow Accuracy Specifications based on averaged readings. Lower limit is based on self-tested maximum leakage.

Model	Optimum Flow Range (±1%)	Extended Flow Range
L	10–500 ml/min	1 ml/min–500 ml/min
ML	50 ml/min–2 L/min	5 ml/min–5 L/min
M	100 ml/min–7 L/min	10 ml/min–12 L/min
MH	200 ml/min–20 L/min	20 ml/min –20 L/min
H	500 ml/min–30 L/min	50 ml/min–30 L/min

Contact Bios for extended flow range specifications, or visit our website at www.biosint.com/products/dclite_models.htm

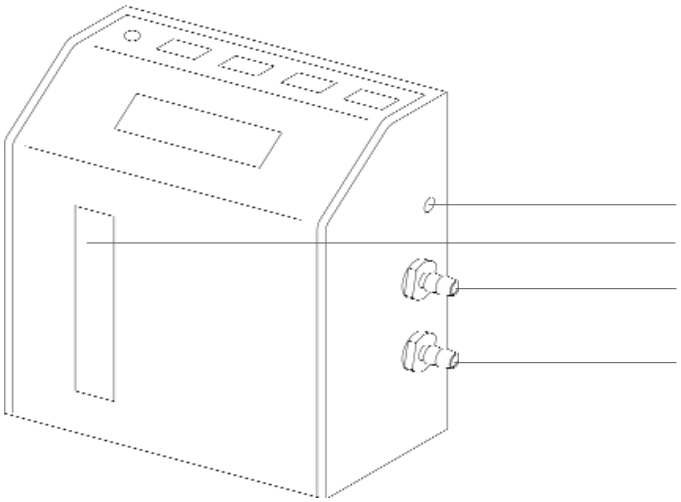
Battery System 6V rechargeable, sealed lead-acid, 6-8 hours typical operation
AC Battery Charger | Power Adapter Wall-mounted, single-station charge, input: 100 to 120 VAC, 60 Hz., output: 12 VDC. Optional input: 200 to 240 VAC, 50 Hz., output 12 VDC.
Operating Modes Single reading, 10 readings, or auto-mode.
Temperature Range 0–55 °C
Humidity Range 0–70% non-condensing
Printer Port Standard parallel (Not compatible with printers that require Microsoft® Windows™)
Warranty Product, 1 year; battery, 6 months

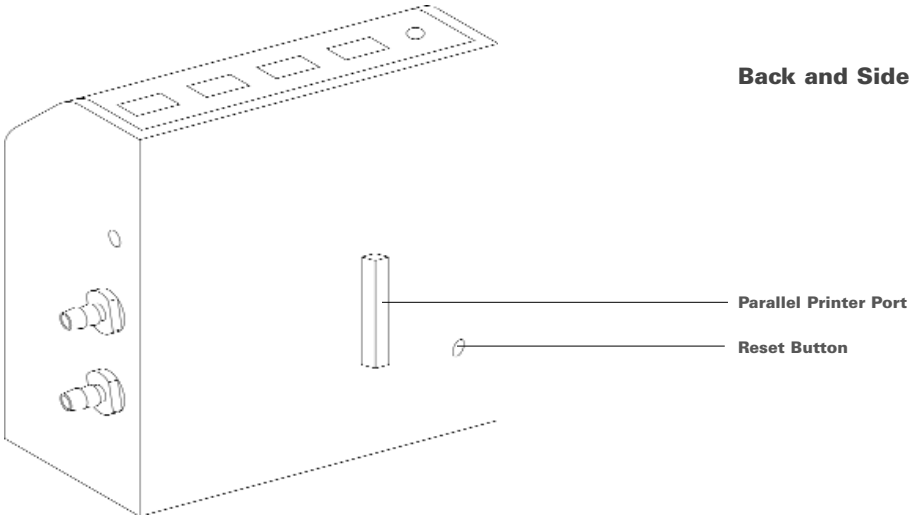
The annual recalibration program offered by Bios is elective and is not included as a warranty item. All specifications are subject to change.

Please contact Bios or visit our web site at www.biosint.com for the most current information.

Table of Contents

1.0 DC-Lite Features





2.0 Unpacking Checklist

Your DryCal DC-Lite has been packaged with care and includes all components necessary for operation. Please take a moment to check that you have received the following items. If you believe you have not received a full shipment or have any other questions, please contact Bios immediately.

Your DryCal DC-Lite Includes

- Single-Station Battery Charger
- Tubing Kit
- Additional High Flow Tubing (with DCL-MH and DCL-H only)
- Certificate of Calibration
- Instruction Manual
- Registration Card

3.0 General Description

The DryCal DC-Lite is a field-portable primary flow calibrator used for industrial hygiene, environmental and laboratory flow measurement applications.
The DC-Lite uses patented dry piston technology and infrared sensors to obtain volumetric flow rates quickly and accurately.

Housed in a small, sturdy case, each unit employs a variety of popular user conveniences such as push-button read and auto-read functions, a large alphanumeric display, battery level indicator, 5-minute automatic shut-off and a parallel printer port for data-logging.

4.0 Theory of Operation

The DryCal DC-Lite can be used to measure air flow rates for either a vacuum flow source (connected to the outlet port) or a pressure flow source (connected to the inlet port). Before a reading is initiated, or between readings, a computer-directed valve performs a bypass function. This allows the air to pass through the DryCal valve, bypassing the flow-measuring cell which is then able to reset.

As a reading is initiated (by pressing the **Read** button) the internal valve closes and the flow source evacuates or pressurizes the air in the flow-measuring cell. The piston rises at the rate of evacuation or pressurization. A precision encoder system provides two finely collimated light beams with a known distance between the beams.

After a suitable acceleration interval the piston breaks the first infrared light beams as it passes. The flow reading is completed when the second infrared beam

is broken. A crystal clock measures the time interval as the piston passes the two infrared light beams. The internal computer then calculates the volumetric flow based upon these parameters.

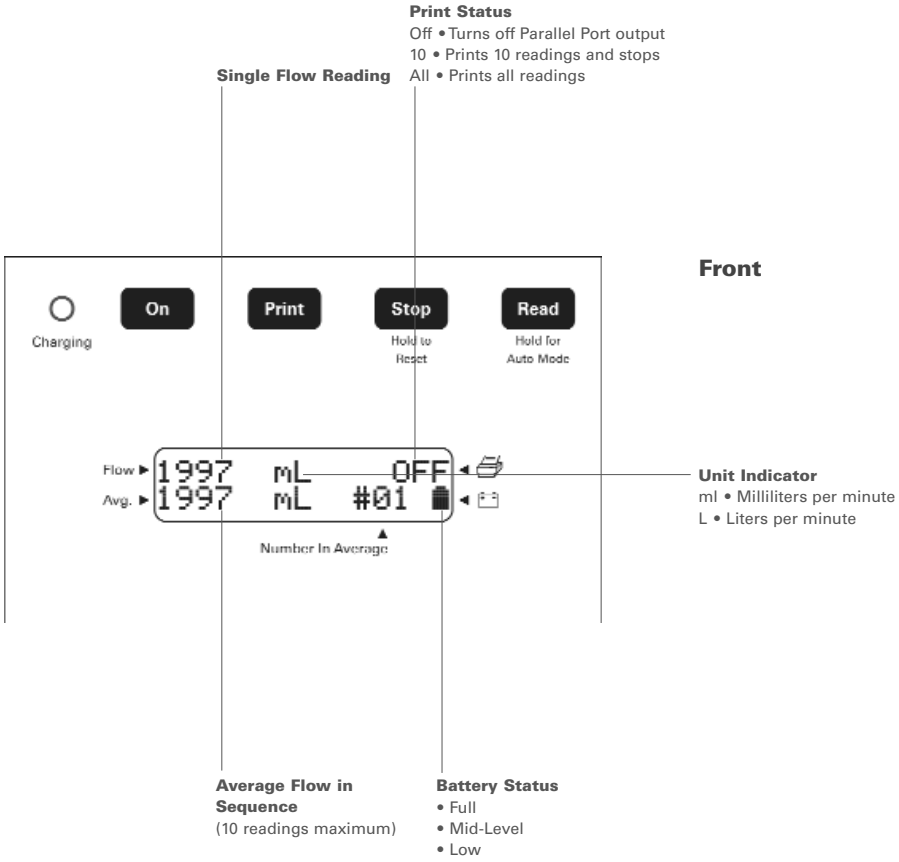
After a completed cycle, the valve is opened by the computer and the piston resets. The flow measurement is instantly displayed on the LCD in milliliters per minute (ml) or liters per minute (L).

Any time the valve is open, the air flow is allowed to pass through the DryCal valve, bypassing the flow-measuring cell.

5.0 Operating Instructions

The following pages will guide you through the operation of your DC-Lite primary flow calibrator.

5.1 DC-Lite Button Panel



5.2 Turning the Power On

The DC-Lite has an energy saving 5-minute auto shut-off feature.

1. Press the **On** button to turn the DC-Lite on.
2. An initializing screen will display the microprocessor revision number, then the standard screen will be displayed.

5.3 Disabling & Re-Enabling the 5-Minute Auto-Shutoff Feature

5-minute auto-shutoff is the default setting for the DC-Lite. This feauture can be disabled if your application requires a longer standby time. The 5-minute auto-shutoff feature must be disabled each time the unit is powered on or reset.

The DC-Lite features protective circuitry that prevents the battery from becoming over-depleted. If the battery is allowed to become too weak, the DC-Lite may automatically shut off due to low battery voltage. This is more likely to occur more if the 5-minute auto-shutoff feature is disabled.

Disabling the 5-minute auto-shutoff feature

1. Press and hold the **Read** button, then press the **On** button (or the **Reset** button if the unit is already on).
2. The display will read, “Auto-Off Disabled” until the **Read** button is released.

Re-enabling the 5-minute auto-shutoff feature

With the unit on, push the **Reset** button.

5.4 Taking Readings

Taking Single Readings

The inlet and outlet ports are located on the right side of the unit. The lower port is for suction (outlet) and the upper port is for pressure (inlet). All successive readings will automatically be used to calculate the average flow. The unit will automatically clear the average after ten readings and begin averaging a new sequence.

A reading has been initiated when the green LEDs in the flow cell viewing window turn on, the valve can be heard closing and the piston begins to move up the flow cylinder.

1. Connect tubing between the flow source and the DC-Lite with sampling medium in-line if the application requires it. Turn the DC-Lite and flow source on.

2 Press and release the **Read** button to obtain a single flow measurement. The flow measurement will appear on the LCD.
3 Continue this procedure to obtain the required number of flow readings.

Taking Auto-Repeat Readings

Readings can be taken continuously in the auto-repeat mode for hands-free operation. The unit will automatically clear the average after ten readings and begin averaging a new sequence.

1 Press and hold the **Read** button until a reading starts then release. This will begin a continuous read session.
2 To stop the continuous read session, press the **Stop** button once. The display will indicate the current flow reading (Flow), the average flow value (Average) and the number of readings in the average (Number in Average) up to 10.

5.5 Resetting the Averaging Sequence

The number of readings in an averaging sequence can be reset to (00) at any time by pressing and holding the **Stop** button for 2 full seconds.

5.6 Printing

The DC-Lite must be turned on prior to connecting a printer cable to the back of the unit. Failure to do so will result in the display reading "Nexus Control." If this occurs, remove the printer cable and reset the unit using the white recessed **Reset Button** located on the back of the unit as described in Section 5.10.

The DC-Lite does not support any printers except those supplied by Bios. The DC-Lite sends basic ASCII text in IBM/Centronics parallel format to a printer. Although it may work with older and some stand-alone, IBM-compatible office printers (printers that do not require drivers to be installed on an attached computer in order to operate), we do not recommend their use.

If you wish to experiment nonetheless, try the "Wide 1" and "Wide 2" formats to test compatibility. You may get one page per line or other incompatible results.

Bios offers the BP-1 stand-alone battery powered printer for hard copy output of DryCal data. This printer is small, portable, convenient and easy to use. It makes an excellent dedicated printer for use with Bios products.

Bios cannot guarantee compatibility with any printer other than the Bios BP-1 portable thermal printer.

Print Setup

1 The flow source should be turned on and connected to the appropriate air boss on the right side of the DC-Lite.
2 Turn the DC-Lite on before connecting the printer cable. Failure to do so will result in the display reading "Nexus Control". If this occurs, remove the printer cable and reset the unit using the white recessed **Reset Button** located on the back of the unit as described in Section 5.10.
3 Plug the printer cable into the parallel printer port located on the back of the DC-Lite. Make sure DC-Lite and the printer are on.

Selecting a Print Setting

After the printer setting selection has been made a print mode selection (All, 10 or Off) must also be made to initiate printing. The **Print** button will toggle between three print settings.

1 The default setting is "Off." When the power is turned on the printer setting will always be in the "Off" position.
2 To engage the printer, press the **Print** button once for the "Print 10" setting (this will allow the printer to print ten readings and stop). Press the **Print** button twice for the "Print All" position (to print continuously).
3 After the printer setting selection has been made, a **Read** mode selection (single or auto) must also be made to initiate the flow measurement process as described in Section 5.4.

5.7 Stop & Reset

A flow reading can be stopped at any time by pressing and releasing the **Stop** button. This process opens the valve and allows air to bypass the flow-measuring cell. The piston will fall to the bottom of the flow-measuring cell.

The DC-Lite can be reset by pressing and holding the **Stop** button for two full seconds. During a reset, the display is cleared and the number of readings in an averaging sequence is reset to zero.

5.8 Resetting a Printed Sequence

When connected to a printer, the reset process initiates a printed heading for a sequence of readings and resets the number of readings in an averaging sequence to zero. The printed heading includes a column for each flow reading (Flow), the running average (Average) and the number of samples in the average (# Samples).

5.9 Printing to a PC

Bios International offers a parallel-to-serial converter kit, part PSC-1, that allows the information from a DC-Lite to be printed to a computer via the HyperTerminal utility included with Microsoft® Windows™.

This information can be imported into many commonly used spreadsheet programs, such as Microsoft Excel or Quattro Pro. The DryCal parallel-to-serial converter kit includes everything you will need to print flow readings from your DryCal to a Windows-based PC.

Bios International only guarantees compatibility with parallel-to-serial converters purchased through Bios International. Bios International does not offer technical support on serial port configuration. For assistance with determing the correct Com Port number or port configuration, please contact your IT professional.

5.10 Hard Reset Button

If for any reason the DC-Lite does not respond to push-button commands, it may be necessary to reset the instrument. For this purpose there is a white recessed button on lower right side of the back panel near the parallel printer port. The button resets the unit back to the initializing screen and the printer setting will revert to the "Off" position. Before resetting, be sure to remove the printer cable from the back of the DC-Lite. Failure to do so will result in the display reading "Nexus Control." If this occurs, remove the printer cable and reset the unit again.

6.0 Battery System

The DryCal DC-Lite is powered by an internal lead-acid battery. The battery will power the instrument for 6–8 hours of continuous use and has a typical service life of approximately 2–5 years, depending on use. The DC-Lite provides a convenient 5-minute automatic shut-off feature to extend battery life. Use of a printer does not affect the battery life.

The DC-Lite can be charged by the Bios single-station charger when plugged into a standard 115V AC power source outlet (220V AC optional). Provided that the battery has sufficient charge to operate the DC-Lite, the DC-Lite can be charged indefinitely using the AC wall adapter provided.

Although the DC-Lite may be plugged into AC power, if the battery is exceptionally weak the DC-Lite may not function. Please read all setup and charging instructions indicated in this manual before using equipment.

6.1 Charging the Battery

Before using your DryCal DC-Lite, be sure that the battery system has been fully charged to ensure that unit will perform without interruption. Using the DC-Lite with a low battery will not affect the product's accuracy.

The DC-Lite is equipped with a battery indicator that provides battery charge indication at three levels. When the battery indicator on the display is empty the unit will continue to operate for a limited period of time before shutting itself off.

To Charge the DC-Lite

To view the actual charging status during the charging period, disconnect the battery charger and wait 3–5 minutes. When the indicator is solid black the battery is fully charged. Bios recommends leaving the DC-Lite on charge when not in use to prevent battery degradation.

1. Connect only the appropriate Bios 12VDC charger, provided with the DC-Lite calibrator, into a standard wall outlet.
2. Insert the charger barrel plug into the charging jack located on the right side of the DC-Lite housing above the inlet and outlet air bosses. A green Charge LED will illuminate while the unit is charging. Full charge takes 8 to 12 hours, and the DryCal can charge while being used.

6.2 Battery Maintenance & Storage

The DC-Lite's lead-acid battery will not exhibit the memory effect common to nickel-cadmium batteries. It may be left on charge for an indefinite time period without damage.

Long-term storage without charging can damage the battery pack, therefore if the DC-Lite cannot be left charging continuously, it should be fully charged at least once every three months and should be placed in storage only after achieving a full charge.

7.0 Isolating the DryCal from Other Instruments

The DryCal DC-Lite will mimic the flow source being used. Therefore, if the flow source exhibits air flow pulsation, Bios recommends the use of an isolation device.

Use of a 25mm, 0.8m filter cassette makes a suitable load for most flow rates used in industrial hygiene applications. This method stabilizes variations in flow due to the slight pulsation caused by the stroke of the pump's piston.

In addition, when taking flow readings with the DryCal DC-Lite, an internal valve closes, placing an insertion pressure spike into the flow stream. Generally, the

pressure spike is invisible to the flow source; however, it can cause an interaction with some instruments (example: some mass flow controllers, Magnehelic manometers and rotameters). The most common solution is to isolate the DryCal with a restriction as described in Sections 7.1–7.4.

7.1 Use with Instruments that Contain Internal Mass Flow Controllers (MFCs)

For some flow instruments with MFCs and large dead volumes (example: some PM 2.5 monitors) results may not correlate between the instrument's display and the DryCal. To eliminate these discrepancies, Bios offers an active regulation device, part DC-IR-H, to provide a constant insertion pressure.

7.2 Use with Personal Air Samplers

The DryCal DC-Lite may be used to calibrate or check the flow rate of personal air samplers. To ensure accurate flow calibrations, Bios recommends the use of an isolating flow restriction as described in Section 7.0. A standard MSHA approved respirable dust filter or equivalent 25–37 mm 0.5 micron casette should be sufficient to provide an appopriate isolation.

7.3 Calibrating Rotameters

When calibrating rotameters the DryCal DC-Lite should be used as a transfer standard only. Do not use the DC-Lite in series with a rotameter. For optimum accuracy, use a rotameter over its mid-range.

1. Attach an isolating load or sample medium, with a pressure drop of about 8 to 12 inches of water column, in series with a stable pump and a DryCal.
2. Calibrate the sampling pump at the desired flow setting (ie: 2.00 Lpm) with the DryCal. When the desired flow setting is obtained, disconnect the DryCal and attach the tubing to the outlet boss of the rotameter.
3. When the rotameter ball stabilizes, mark the rotameter for the true flow rate (2.00 Lpm for example) using tape and a permanent marker to denote the calibrated flow setting or note the point on a rotameter flow chart. Repeat this procedure for any additional flow settings.

7.4 Use with Magnehelic Manometers

High-capacitance spring-loaded gauges such as Magnehelic manometers can cause vibration of the DryCal piston. This is not a defect in the DryCal. The piston is accurately mirroring the transient internal vibrations of the gauge. This type of gauge must be isolated from the DryCal by inserting a suitable restriction between the gauge and the calibrator

8.0 Maintenance, Quality Assurance

Although the DryCal DC-Lite is a rugged instrument, certain care and maintenance requirements must still be met.

Current service and calibration information and pricing can be found at www.biosint.com/service/dclite.htm.

8.1 Maintenance

When not in use always store your DC-Lite in a clean, dry environment. When possible leave the unit on charge. Wipe only with a damp cloth and do not spray with liquid solvents or use abrasive cleaners.

8.2 Leak-Test Procedure

A quality assurance self-test feature is provided to verify proper integrity of the flow cell. It is recommended that the self-check leakage test be conducted periodically as part of an on-going quality assurance program.

Passing the leak test does not ensure proper function of the DC-Lite. It does ensure that total leakage is within the product's allowable limits. To ensure proper function of the DC-Lite annual factory calibration is recommended.

To Initiate the Leak-Test

The leak-test tubing accessory is a short piece of latex tubing with a red plug that is found in the tubing kit shipped with your DC-Lite. Place the leak-test tubing accessory over the top (inlet) air boss. The low flow range DC-Lite requires a miniature leak-test tubing accessory that is supplied in addition to the standard tubing kit. Any maintenance to the DryCal must be performed by Bios maintenance personnel.

1. Press and hold the **Stop** button while pressing the **On** button. If the DC-Lite is already on, press and hold the **Stop** button while pressing the hard reset button on the back of the unit as described in Section 5.10. After a leak-test is initiated, the display will read "Leak Test, Invert & Push Read."
2. Invert the DC-Lite so the piston moves to the top of the cell. While the piston is resting at the top of the cell press the **Read** button and the internal

valve will close. Return the unit to an upright position and it will time the descent of the piston.

3 Place the DC-Lite on a flat, vibration-free surface.

4 Observe the location of the piston to ensure that it is at the top of the cell when the test begins (the test may take as long as 15–20 minutes). If the test is completed successfully, the display will read: "Test OK Push Read."

5 Push the **Read** button as directed and the internal valve will open and the piston will fall.

6 Repeat the test with the leak-test tubing accessory connected to the lower (outlet) air boss. If the unit fails the Leak-test, the display will read: "Maintenance Reqd Push Read."

8.3 Air Containing Particulates

As of January 1, 2001, the DryCal DC-Lite comes standard with either a 5-micron or 30-micron inlet filter inside the inlet fitting (depending on model ordered). Additionally, all older DC-Lites sent in for calibration will be retrofitted with new style inlet filters, free of charge. However, air containing cigarette smoke or other excessive dust and particulates should be additionally pre-filtered. An additional particulate filter, part AF-516, is available for this purpose. The filter should be placed ahead of the DryCal in the flow stream, on the inlet side.

8.4 Return Authorization

Prior to returning your DryCal for repair or recalibration, please contact Bios International for technical support, troubleshooting assistance and an RMA number if necessary.

You can telephone Bios at (800) 663 4977 or (973) 492 8400, or send an email to service@biosint.com.

8.5 Shipment

When shipping the DryCal DC-Lite please ensure that the packaging is adequate to protect the instrument. When possible the DC-Lite should be shipped in the original packaging. Bios International Corp. is not responsible for damage that occurs during shipment.

8.6 Long-Term Storage

DryCal calibrators can remain on charge until needed without causing damage to the battery. If the DryCal is stored for long periods of time the battery should be charged at least once every three months.

Always store DryCal calibrators in a clean, dry environment and recharge the unit prior to use after long-term storage.

8.7 Calibration

As a quality assurance measure, Bios recommends annual calibration of all measurement instruments, although how often you have your DryCal calibrated is an internal quality control decision. The determining factors are whether the unit passes the internal leak-test, quality system requirements if applicable, and the conditions in which the unit is used. Units used in a laboratory setting may require calibration less frequently than a unit that is used in a dusty environment. The annual calibration program is an elective and is therefore not included as a warranty item. "As received" flow test data and expedited "48 hour" turnaround service are also available at an additional cost. Please contact the factory for more information on available calibration services and pricing.

Calibration Includes

- Cleaning (if required)
- Valve adjustment (if required)
- Battery capacity test
- Internal computer program upgrade as necessary
- Mechanical upgrades as necessary
- Dynamic Performance Test
- NIST-Traceable Calibration Certificate

9.0 Calibration Statement

The DC-Lite is dynamically tested by comparing it to a Laboratory Standard primary piston prover of much higher accuracy (±0.25%), but of similar operating principles. Flow generators of ±0.01% stability (included in prover accuracy) are used for the comparison. Use of provers of similar construction to the devices under test assures the validity of the flow generator as a transfer standard.

The primary Laboratory Standards are qualified by direct measurement of their dimensions (diameter, length of measured path, time base) against NIST-traceable gauges and instruments. A rigorous analysis of their accuracy in accordance with the International Guide to Uncertainty in Measurements has been performed, assuring their traceable accuracy. Test procedures assure temperature matching of the Laboratory Standards to the devices under test.

The calibration dates of the laboratory standards for each parameter (diameter,

encoder spacing, time base) are included in our calibration reports, along with identification of the devices used for calibration, their calibration dates and NIST calibration numbers.

10.0 Limited Warranty

The Bios DryCal DC-Lite is warranted to the original end user to be free from defects in materials and workmanship under normal use and service for a period of one year from the date of purchase as shown on the purchaser's receipt. The DC-Lite's battery is warranted for 6 months from the original purchase date. If the unit was purchased from an authorized reseller a copy of an invoice or packing slip showing the date of purchase may be required to obtain warranty service.

The obligation of Bios International Corporation under this warranty shall be limited to repair or replacement (at our option), during the warranty period, of any part which proves defective in material or workmanship under normal use and service provided the product is returned to Bios International Corporation, transportation charges prepaid.

Notwithstanding the foregoing, Bios International Corporation shall have no liability to repair or replace any Bios International Corporation product:

1. Which has been damaged following sale, including but not limited to damage resulting from improper electrical voltages or currents, defacement, misuse, abuse, neglect, accident, fire, flood, act of God or use in violation of the instructions furnished by Bios International Corporation,
2. When the serial number has been altered or removed or
3. Which has been repaired, altered or maintained by any person or party other than Bios International Corporation's own service facility or a Bios authorized service center.

This warranty is in lieu of all other warranties, and all other obligations or liabilities arising as a result of any defect or deficiency of the product, whether in contract or in tort or otherwise. All other warranties, expressed or implied, including any implied warranties of Merchantability and fitness for a particular purpose, are specifically excluded.

In no event shall we be liable for any special, incidental or consequential damages for breach of this or any other warranty, express or implied, whatsoever.

Notes

Notes