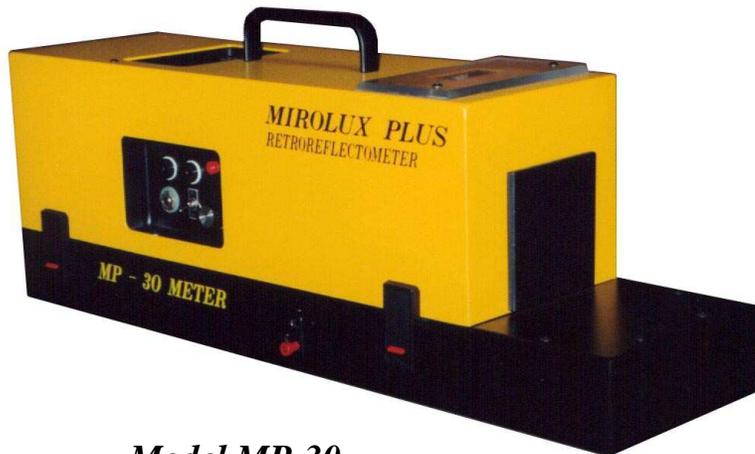# MIROLUX PLUS

RETROREFLECTOMETER INSTRUCTION MANUAL
Models MP-30 and MP-12

Model MP-30

Model MP-12

MIROLUX PLUS

MIROLUX PLUS

Thank you for purchasing the Mirolux Plus retroreflectometer, a portable and modular retroreflectometer that is designed to test highway paint traffic markings for luminous reflectivity. The Mirolux Plus is available in two configurations, as the MP-30, a 30-Meter retroreflectometer and the MP-12, a 15-meter retroreflectometer.

The MP-30 retroreflectometer uses the entrance and observation angles specified by the European Committee for Standardization (CEN), the Federal Highway Administration (FHWA), and ASTM's E-1710 standard. The MP-12 is an updated replacement for our venerable Mirolux 12 model, of which over 610 units have been sold throughout the United States, Canada, Brazil, Columbia, and Japan.

Through thoughtful design, both retroreflectometers incorporate many of the same components and features. This enables this single instruction manual to address the functionality and use of each model. Where specifications are different between the two models, the differences will be highlighted.

Receipt of Instrument

The Mirolux Plus should be unpacked carefully upon receipt making sure that no defects occurred during shipment. If any defects did occur, they should be reported immediately to Mirolux Products, Inc.

Typically, the shipment consists of the following items:

- ZERO aluminum carrying case containing:
    - Mirolux Plus retroreflectometer
    - Two 5.7 amp/hour battery packs
    - Two AC to DC quick charge battery chargers
    - Handle extension
    - White/black test panel
    - Tool to remove bottom plate
    - Extra fuses

Features of Mirolux Plus Retroreflectometer

- Reliable performance evaluation of horizontal road markings using the entrance and observation angles corresponding to a 30-meter geometry as specified by the CEN, FHWA, and ASTM standard E – 1710 (**MP-30 Meter model only**).

- Modular construction allows users to configure their Mirolux Plus as a 15-meter or 30-meter retroreflectometer, or both through purchasing all three components

- Direct measurement in (millicandelas/M$^{2)}$)/LX

- Measurement on dry or wet surfaces in daylight or darkness

- Portable, self-contained operation

- Durable construction using heavy gauge aluminum, U-channel design, heavy-duty hardened fasteners, and epoxy coatings

- Digital LCD readout

- Two rechargeable 5.7 amp/hour batteries

- Two, five-hour quick chargers

- Diagnostic test points for troubleshooting

- Removable bottom plate allows customers to clean the photocell chamber. This eliminates the single largest reason the original Mirolux 12 was returned to the factory for maintenance

- Internal and external calibration methods for performance assessment and accuracy

- Light weight and low cost

Putting Unit Into Service / Calibration

1. Assess battery condition:

    - Toggle the Main Power and Lamp Switches to their "on" positions (Figures 1 and 2)

    - Press red Battery Test Button (Fig. 1)

    - Reading on the display should be "117" to "130" (11.7-13.0 volts)

    - Readings below "117" indicate a battery that requires recharging

    - Press the Battery Test Button again to begin calibrating the machine

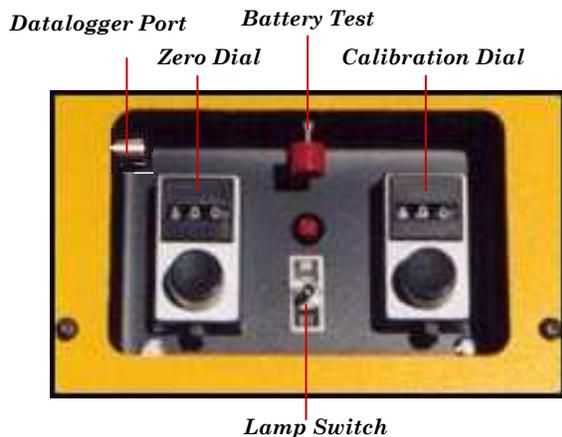   - Turn off the lamp to continue calibration prior to use

MIROLUX PLUS

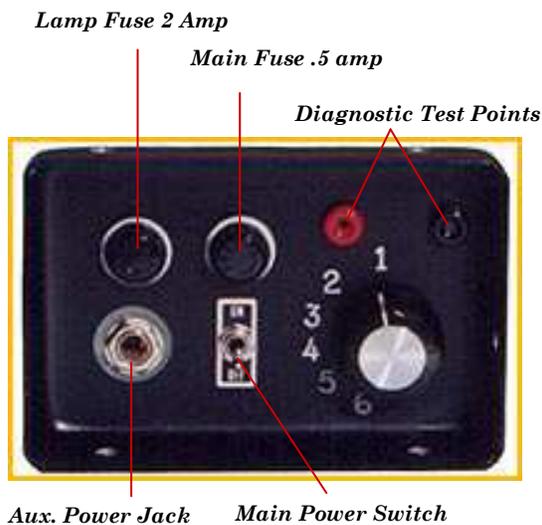*Figure 1 - Top Control Panel*

Figure 2 - Side Control Panel

2. Place the Mirolux Plus on a flat, dry, clean surface in the vicinity of the road marking test area.

3. Allow <u>one to three</u> minutes to allow the electronics to stabilize (*longer in cold temps.*).

4. Unlock the Zero Dial (Fig. 1) and adjust until "000" reads on the digital display. *Note: Both the Zero Dial and Calibration Dial have small levers at their bases that keep settings secure. Move the levers to the left to change settings, and back to the right to lock the dials. The numbers on the dials themselves are for factory calibration purposes only. If the dial readings ever approach 100 or 900 while*

performing normal calibration, the machine may soon require cleaning and recalibration since little calibration adjustment remains.

5. After approximately thirty seconds, the digital display should remain at "000". If necessary, readjust the Zero Dial to obtain "000" on the display.

6. With the digital display at "000", turn on the lamp and allow to warm up for one to three minutes **or** until reading stabilizes (Fig. 1).

Figure 3 - Battery Location/Calibration Door Control

7. Ensure that the Calibration Door is in its closed position (Fig. 3).

8. Unlock the Calibration Dial and adjust until the digital display matches the factory labeled Internal Calibration Number recorded next to the display.

9. Place the unit on the white side of the test panel and open the Calibration Door. The reading on the display should be close to the R_L value marked on the reverse side of the panel ($\pm$ 5). Ensure that the Mirolux Plus is placed squarely on the test panel, and that the test panel is on a <u>flat</u> surface. *Though the test panel is of heavy gauge aluminum, irregularly shaped surfaces or debris under the panel will cause the test panel to flex, causing erroneous readings.*

Important Note: The Internal Calibration Number marked on the label near the display is for reference purposes to bring the instrument near calibration. For a variety of reasons, this number can shift. The main reason is a buildup of dust/dirt within the photocell chamber. **The Mirolux Plus should always be calibrated to the test panel to ensure accurate readings**

and proper calibration. Calibrate to the test panel by placing the Mirolux Plus on the test panel. Open the Calibration Door, and adjust the Calibration Dial until the reading matches the panel's R_L value. Close the Calibration Door and record the display value as your temporary Internal Calibration Number.

10. Place the unit on the black test panel. The reading should equal the value marked on the rear of the panel, plus or minus 5 points (+/- 005). Readings outside this range indicate cleaning, and possible recalibration of the instrument are necessary.

11. The Mirolux Plus is now ready for use

12. Carefully place the unit on the area to be tested, ensuring it is stable. Place the Mirolux Plus lengthwise on the stripe to be measured and facing the direction of traffic flow.

13. Open the Calibration Plate and allow the reading to stabilize.

14. When the display stabilizes, record the reading.

15. Proceed to the next area, place the machine on the stripe to be measured, and record the reading.

*Important Note: Approximately every 10 minutes check the battery level (#1 above) **and** the Internal Calibration Number while in use (see #7 through #10 above). **If the battery level is below 11.7 volts ("117"), readings may be inaccurate**. The battery should be recharged and replaced with a fresh one (see battery replacement procedures below).*

Battery

Mirolux Products, Inc. has updated the design of its battery pack to make it easier to use. It is now a simple drop-in design with no wires to physically connect and disconnect. In addition, the battery pack is a 3-lead variety that incorporates a safety feature that stops charging in the event of a short circuit, excessive current drain, or overheating.

The 10 cell drop-in Ni-Cad battery pack is located at the front of the machine (Fig. 3).

Figure 4
charger / battery

To Remove Battery

Grasp the edges of the black plastic base (Fig. 3 and 4) and simply pull the battery out of its compartment. Upon removal, notice that there is a jack at the top left of the pack as you look at it head-on. Upon replacement, you must orient the battery in the same way to ensure a positive connection.

To Install Battery

Slide the battery pack into the machine with the jack properly oriented. You should feel a positive engagement as the battery is completely inserted.

Note: When the battery output is below 11.7v ("117" on display), it should be removed and recharged.

Recharging Battery

Every two to three weeks the battery should be discharged in the unit by turning on the power supply and lamp until the voltage reading is below 10.0-volts (This corresponds to a reading of "100" on the display. Remember to press the Battery Test Button in Figure 1 when checking the voltage). This could take up to five hours depending on the battery's state of charge. This procedure will ensure that the Ni-Cad batteries do not develop a memory that will reduce their capacity.

To charge the batteries, remove them from the instrument. Insert the quick charger's plug into the battery, then plug the charger into a 110-volt AC wall outlet. The quick chargers that are supplied require five to six hours to fully charge the batteries.

Note: The quick chargers are specifically engineered for the 5.7 amp/hour batteries provided by Mirolux Products, Inc. Both the batteries and quick chargers have built-in safety features to stop charging in the event of a short circuit, excessive current drain, or overheating. The chargers should not be used with any batteries other than the 5.7 amp/hour 3-lead variety provided by Mirolux Products, Inc.

Auxiliary Power Jack

The Mirolux Plus retroreflectometer is equipped with an Auxiliary Power Jack on the Side Control Panel (Fig. 2). Instead of using the supplied battery packs, the Mirolux Plus can be powered by any 12-volt DC source. This includes a car battery or 110-volt AC

household current that has first passed through a portable 12-volt power supply *(**never** attempt to directly connect the Mirolux Plus to 110-volt AC current)*. Mirolux Products, Inc. can supply a 25-foot long cord equipped with the correct plugs to connect the Mirolux Plus to a vehicle's cigarette lighter or power port, or any 12-volt power supply.

To use, simply connect the Mirolux Plus to the alternate power source using the available cord and ensure the alternate power source is turned on. The Mirolux Plus will then automatically turn on. ***Note that the lamp must still be turned on manually.***

Important Note: When using the Auxiliary Power Jack, the Power On/Off Switch of the Mirolux Plus should be left in the "OFF" position.

Operating Tips

- For best results, store and operate your Mirolux Plus between 40ºF and 100ºF. Avoid excessive temperatures, including the trunk of a car. In temperatures below approximately 40ºF, allow the unit to warm up for 15-20 minutes before use by turning on the main power and lamp.

- Place the Mirolux Plus squarely on surface to be tested. **Clear the area of all debris** (stones, gravel, etc.).

- When taking a reading, the Mirolux Plus should be oriented to face the same direction as the flow of traffic.

- The Mirolux Plus can provide accurate readings **only** on sound pavement. Attempting to obtain readings on striping that has been applied to pavement with large cracks, depressions, holes, or heaving will produce values that are inconsistent with the remainder of the area being tested. Readings should not be attempted on a section of pavement displaying the above conditions. Move to a nearby area of pavement that is flat and level.

- Variability of Readings

  - The type of glass spheres, their position, and the quantity applied to the marking material will affect readings produced by the Mirolux Plus.

- The type and quantity of pigment, and the presence of dirt, dust, water, wear, etc. on the tested surface will affect the readings.

- Due to its high sensitivity, very slight changes in the position of the Mirolux Plus on the traffic marking will produce different readings.

- The Calibration Plate should be opened only when taking readings. Keeping it closed at other times will help seal the sensitive area surrounding the photocell from dust.

- Avoid allowing water to enter the unit.

- Once calibrated and warmed up, leave the lamp on. It should be turned off only when measurements have been completed.

- ***Handle the test panel with care! Dirt or even minor abrasion will alter its retroreflective value, making calibration inaccurate!***

Maintenance

The optics of the Mirolux Plus are protected against dirt and dust. No maintenance of the lenses or light source is necessary.

It is recommended that the outside cover be cleaned with a damp rag and a non-abrasive mild household cleaner. Avoid allowing water to enter the unit.

*Caution: **The optics housing should not be opened under any circumstances. The internal geometry has been precisely set at the factory and disturbance of the hardware could alter the geometry and negate any guarantee of proper operation. If altered, the internal geometry can only be adjusted in the factory.***

Lamp: The halogen lamp is the key component of the optical system and should never be handled. Disturbing the lamp may alter its position, resulting in inaccurate readings.

Cleaning
The Mirolux Plus has been redesigned to help avoid the most common reason our Mirolux 12 was returned for service. The build up of dust, dirt, and glass

4 Screws

Figure 5

4
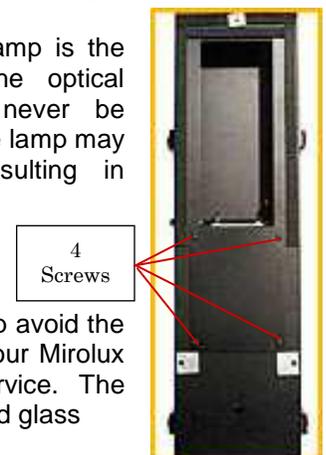
MIROLUX PLUS

beads in the photocell chamber raise the internal reflectivity and causes incorrect readings. This is apparent if you test your reading on the black test panel. Normal readings should be "000", plus or minus 10 (-010 to 010). Readings above 010 indicate the Mirolux Plus requires cleaning of the chamber. The Mirolux Plus has a removable plate (Fig. 5) on its base that can be easily removed with the *supplied tool*, allowing the use of a non-abrasive, non-volatile cleaner with a lint free cloth to carefully clean the chamber. Care should be taken not to clean the photocell itself or to damage its wires. Upon replacement of the plate, readings on black should be within the values specified above.

Technical Support and Service

Mirolux Products, Inc. offers technical support via telephone, fax, and E-mail. Factory service is available with normally a three to five day turnaround time depending on the production schedule. Rush repairs along with overnight delivery are available, but the factory must be consulted to discuss options.

Visit our Web site at **www.miroluxproducts.com** to see the latest offerings, product information and links to related sites.

Accessories

Extra battery chargers/batteries	Dataloggers	Sunshields
Test panels	Foam rubber bottom seal replacement kits	220-volt converters
25-foot auxiliary power cords	12-volt DC power sources and inverters	Handle extensions

Specifications of the MP-30 and MP-12 Retroreflectometers

Readout: Three-Digit Digital Display

Light Source: 12-volt, 12-watt Halogen lamp

Standard Calibration: Internal - Calibration Door / External - Test Panel

Controls For: Power On/Off, Lamp On/Off, Zero Adjustment, Calibration Adjustment, Battery Check, Calibration Door open/close, Diagnostic Test Points for troubleshooting

Power Requirements: 12-volt DC

Power Source: 12-volt, 5.7 amp/hour high capacity rechargeable Ni-Cad battery, 110-volt AC current passed through a 12-volt power supply via the unit's auxiliary power jack, or any 12-volt power supply (i.e.: automotive power port or cigarette lighter). 220-volt AC current can also be used to charge batteries in certain foreign locations when passed through an available converter.

Dimensions: **MP-30:** 22 in. long, 6 in. wide, 7.5 in. high
MP-12: 18 in. long, 6 in. wide, 7.5 in. high

Weight in use: **MP-30:** 15.5 lbs.   **MP-12:** 14.5 lbs.
Shipping weight: **MP-30:** 43.5 lbs.   **MP-12:** 42.5 lbs.

Measurement Geometry (The MP-30's geometry complies with ASTM Standard E-1710, adopted by the FHWA for retroreflectometer design)

Entrance Angle: 88.76 degrees (co-entrance angle of 1.24 degrees)   **MP-12:** 86.5 degrees
Observation Angle: **MP-30:** 1.05 degrees   **MP-12:** 1.5 degrees
Baseplate Opening: **MP-30:** 3.5 x 9 inches   **MP-12:** 3.5 x 3.5 inches
Illuminated Area: **MP-30 and MP-12:** 3.5 x 3.5 inches
Measurement Range: **MP-30 and MP-12:** $R_L = 0 - 2000$

MIROLUX PLUS

Diagnostic Test Point Functions

Position	Function	Normal Range
1	Battery's state of charge in volts	Battery test value $\pm$ 0.3 volts
2	+ 6 voltage test	6.0 $\pm$ 0.4 volts
3	– 6 voltage test	-6.0 $\pm$ 0.4 volts
4	Lamp voltage	9.5 $\pm$ 0.3 volts
5	Display readout	Display value $\pm$ 10
6	DC/DC converter output	10 – 13.5 volts

* All tests should be performed with a fully charged battery

Troubleshooting Based on Test Point Values

Problem	Cause	Solution
Position 1 value outside of range*	Weak battery Potentiometer out of adjustment	Charge battery and check Contact factory
Position 2 value outside of range	Faulty capacitors or voltage regulator	Contact factory
Position 3 value outside of range	Faulty transistors, resistors, diodes, or voltage regulator	Contact factory
Position 4 value outside of range*	Voltage regulator out of adjustment	Adjust
Position 5 value outside of range	Faulty display or board components	Contact factory
Position 6 value outside of range	Faulty DC/DC converter	Replace DC/DC converter

*Non-critical items that can be adjusted when convenient.

General Troubleshooting

Problem	Cause	Solution
No reading on display	Power off Dead battery Poor battery connection Blown electronics fuse Bad display	Turn on power Charge battery Reinsert battery Replace fuse Contact factory
No illumination from lamp	Main power switch or lamp power switch not turned on Blown lamp fuse Blown lamp Poor connection	Turn on both switches Replace lamp fuse Replace lamp Tighten connections
Reading of test panel is out of spec.	Adverse conditions Out of calibration Dirty / worn test panel Dirty photocell chamber	Calibrate to test panel (see #10 on page 2) Recalibrate Contact factory Clean photocell chamber

MIROLUX PLUS

Switching of Modular Components (_for combination systems only_)

The MP-12 and MP-30 both use the same electronic subassembly that includes the yellow cover and the electronic package housed within it. A customer can easily measure retroreflectivity according to a 15-meter or 30-meter geometry simply by swapping the electronic subassembly from a 15-meter baseplate assembly to a 30-meter baseplate assembly and vice versa.

When switching the electronic subassembly from one baseplate to the other, the customer has a couple of tasks to perform to ensure accurate readings. The following procedures should be followed:

1. Remove the battery.
2. Remove the electronic subassembly by disconnecting the four latches (press down on the red tab of the latch while simultaneously pulling out on the bottom of the latch to free it).
3. **A switch located on the base of the subassembly must be switched to the geometry that corresponds to the baseplate it will be installed on, either to "15 meter" or "30 meter."**
4. Carefully install the electronic subassembly onto the desired baseplate and secure the four latches.
5. Install the battery.
6. Follow the normal calibration steps beginning on page 1 of this manual.

MIROLUX PLUS

Datalogger Setup and Operation
Quick Start Guide

Shown slightly smaller than actual size

The datalogger offered by Mirolux Products, Inc. is extremely easy to configure and use. It is compact, lightweight and convenient to operate, and it assigns a date and time stamp to each reading that is stored. Prior to shipment, Mirolux Products, Inc. will install the unit's battery and configure each datalogger to the proper parameters. Upon receipt, the user must perform some simple steps to begin using the datalogger. (Figures 1, 2, and 3 can be found at the end of these directions.) **Note: Within these directions, you will see the reference to click on something to activate it. This references your left mouse button. You will either have to single click or double click depending on the configuration of your computer.**

1. **Installing the EasyLog Software**
- Insert the disk into the floppy drive. Click on "Start", choose "Run", and type "a:\install" in the dialog box and click "OK." (If your floppy drive is not identified as the "a" drive, type the proper drive letter to install the program.) The software installs itself onto the hard disk. A new EasyLog Program Group and Program Icon are then created.

2. **Setting up the Datalogger**
- Connect the supplied communications cable between the PC's COM port and the datalogger.
- Click on Start, Programs, Easylog, then the EasyLog Program Icon to run the software.
- Select "**Search"** to allow the software to search for the connected datalogger (Figure 1).
- After identifying the datalogger, click on the "**Setup**" button (Figure 1), then on the "**Advanced**" button to double check the pre-set Mirolux factory calibration settings identified below (refer to Figure 2).
  - Under **Sensor Type**, ensure the setting is set to "**voltage -2 to 2V**".
  - Under **Display Symbols**, **Units** should be set to "**V**" and **Scaler** should be set to "**none.**"
  - The **Sample Rate** and **Storage** fields should be identified as "**One Shot.**"
- Click on "**OK**" to continue.

3. **Starting a log**
- Click on the "**Start Log**" button (Figure 1) to prepare the datalogger to store data. The screen in Figure 3 will appear. Here you can check the box "**Show Active**" that allows you to confirm the unit is functioning through the presence of a blinking icon on the datalogger's LCD. Note that the icon will only be present after the unit has been instructed to start logging
- Click on the "**Start**" button (Figure 3) to initialize the datalogger *(A data value will only be stored when the button on the datalogger is depressed. This is identified as the "one-shot" mode.)* The unit should now be disconnected from the computer and attached to the retroreflectometer with the second communication cable that is provided. (You should hear an audible click when attaching the cable to the datalogger) (See Figure 1, page 2 of this manual for the location of the datalogger's port).
- After attaching the datalogger to the retroreflectometer, simply place the retroreflectometer at a point where you wish to measure retroreflectivity.   Depress the small button on the face of the datalogger. The value that is recorded will appear on the datalogger's display. Simply continue measuring and recording readings as required.

8

4. **Stopping a log**
- Remove the datalogger from the retroreflectometer.
- Connect the communications cable between the PC COM port and the datalogger.
- Start the EasyLog software as described in Step 2 above.
- Select "**Search"** to allow the software to search for the connected datalogger (Figure 1).
- Click on "**Stop Log**" (Figure 1) to terminate the datalogger's ability to log any more data points and place it in a power saving mode.
- Click on the "**OK**" button to confirm you wish to terminate the logging of data.

5. **Saving Logged Data**
- Click on the "**Save Data**" button (Figure 1) and enter a name for the file. By default, the file will be stored in the C:\easylog folder. You may notice a small "**Transferring Data**" window appear as the data is stored to the file name you have chosen. By default, the file is saved as a text file (.txt).

6. **Presenting Saved Data**
- *You cannot use the "graph data" function of the EasyLog software using the "one-shot" logging mode (Figure 1).*
- You can now view the data by opening any compatible text editing software such as Word™, Excel™, or the Windows Notepad™ to view the data.
- To view the data in Excel™ you will have to follow a few steps that will allow Excel™ to properly display the data. Choose File, Open, and direct the program to the **c:\easylog** folder. Instruct Excel™ to look at "**all files**," then choose your data's file name. Follow the screens by clicking "Next" "Next" then "Finish." (During this process, make sure the "delimiting" option is selected on the first screen.)
- If you are using Word™ or a similar product, direct the software to open the file you just created in the **C:\easylog** directory.

7. **The Battery**
- The battery is a 3.6-volt lithium battery that is readily available at electronics distributors or camera shops. Replacement of the battery requires the removal of four Allen cap screws using the supplied tool and Allen fitting (located with the spare fuses), separation of the case and replacement of the battery.
- Note that after replacing a run-down battery, the datalogger may need to be recalibrated. With the datalogger hooked up to the computer, follow the steps in number 2 above, ensuring all values are set as specified. Then, click on the **"Calibrate"** button (see Figure 1). Simply click on the "**Default**" button to calibrate the unit. This should allow the datalogger to record accurate readings.
- In some instances, after choosing the "**Default**" button, the datalogger may record readings that are 1-4 points different than the value on the Mirolux's display. In these instances, you should manually calibrate the datalogger.
- Hook up the datalogger to both the Mirolux and the computer, then click on the "**Calibrate**" button.
- Turn on the Mirolux with the lamp off and set the display to a reading of "000."
- Click within the box next to the "**Level 1**" button, then enter the value ".000". (Make sure you don't forget the decimal point before the value!), then click on the "**Level 1**" button.
- Now turn on the lamp and adjust the right dial to obtain the highest reading possible on the display.
- Click within the box next to the "**Level 2**" button, and enter the value on the Mirolux's display. Again, do not forget the decimal point before the value! Then click on the "**Level 2**" button.
- Click on the "**Done**" button to complete the calibration of the unit.

Additional Information on subsequent uses of the datalogger

- The datalogger has a large amount of memory that can store up to 8,000 data points. However, to ensure the memory does not become full, you should clear the memory after the data for a specific project or location has been downloaded to a computer. To clear the memory, click on the "**Clear log**" button on the **Setup** screen (Figure 2). Follow the steps outlined above to collect new data.
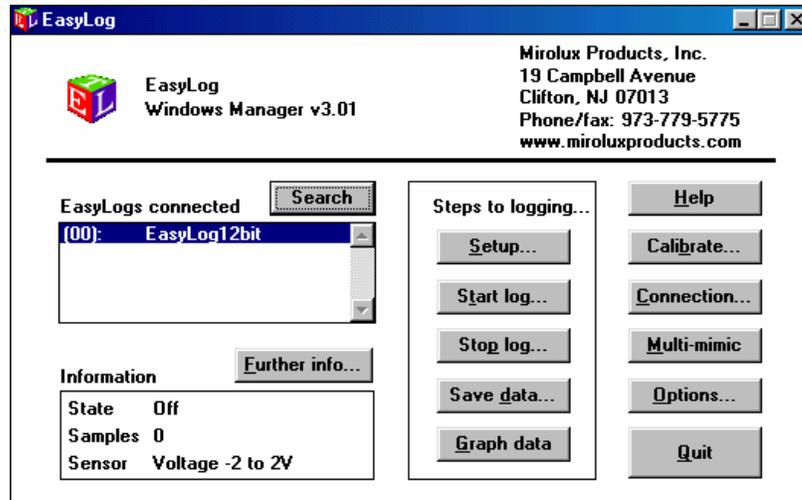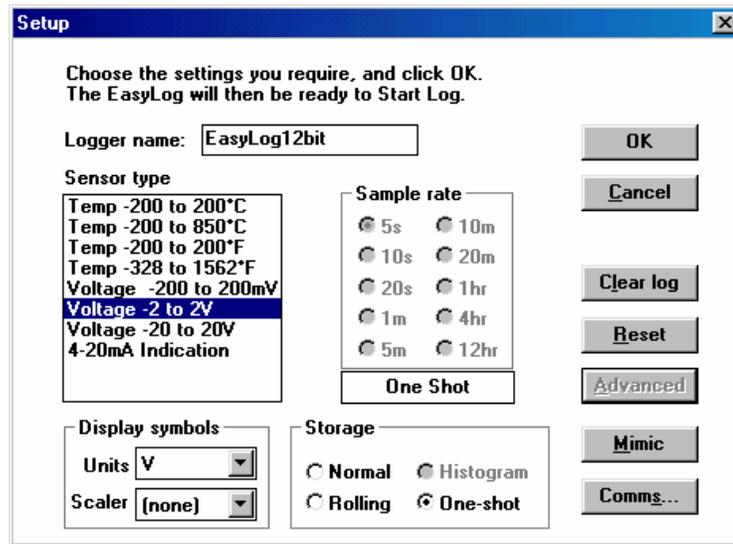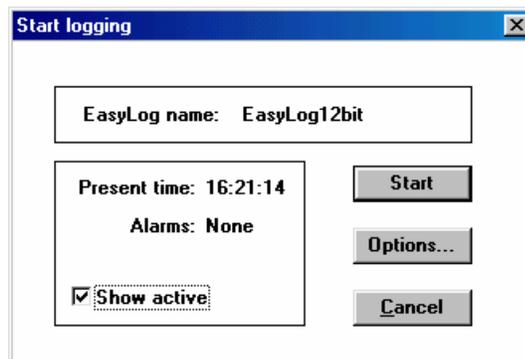
MIROLUX PLUS

Figure 1 – Main Software Screen

Figure 2 – Setup Screen

Figure 3 – Start Logging Screen