

*Operator's Manual*  
*New Wave Research, Inc.*  
*LCS 4/EzLaze*  
*Nd:YAG Laser Cutting System*



New Wave Research, Inc.  
47613 Warm Springs Blvd.  
Fremont, CA 94539

# PREFACE

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This manual contains information for the proper installation and operation of the LCS 4/EzLaze Laser Cutter System. This system is designed for semiconductor inspection, design and failure analysis, micromaching and research applications. The LCS 4/EzLaze complies with the Center for Devices and Radiologic Health (CDRH) Standard 21 CFR 1040 with applicable CE regulations. See CE conformance declaration.

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The LCS 4/EzLaze may be mounted on the following microscopes:

Mitutoyo

## Ready Products

FS50 (Green only)

A-Zoom (All Wavelengths)

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**FS60 (Green, Green/UV-355nm)**

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FS60Y (All Wavelengths)

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The LCS 4/EzLaze emits laser radiation that can be harmful to human eyes and skin. To avoid blindness or skin damage you must completely read and understand the SAFETY section of this manual before installing the system. Before attempting to operate the LCS 4/EzLaze, it is essential that you completely read and understand the OPERATION section of this manual.

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Do not attempt to repair the LCS 4/EzLaze while it is under warranty--report all problems to your supplier or New Wave Research, Inc. 47613 Warm Springs Fremont, CA 94539 tel: (510) 249-1550 fax: (510)249-1551.

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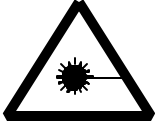
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**Chapter One,  
Laser Safety**



**GENERAL**

Read this section completely before installing or operating the LCS4/EzLaze.



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**WARNING:** The New Wave Research, Inc. LCS 4/EzLaze is a Class IIIb laser system. **AVOID DIRECT EXPOSURE TO THE BEAM.**

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**WARNING:** Improper installation, adjustments, use of controls or performance of procedures other than those specified herein may result in hazardous radiation exposure. The 1064 nm and 355nm output beams are invisible to the human eye. Use appropriate caution to avoid **PERMANENT EYE DAMAGE** or **BLINDNESS.**

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**CAUTION:** Follow the instructions contained in this manual for proper installation and safe operation of the laser system. Wear protective eye gear as appropriate. Refer to ANSIZ 136.2 “Standard for the Safe Use of Lasers”, available from the



Laser Institute of America, tel. (407) 380-1553. Install the eyepiece filter as specified in this manual. Keep your eyes out of the directed and reflected beam paths. Laser radiation reflected off a mirror-like surface is also dangerous.

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**WARNING:** Never look into the laser aperture when the laser is operating or has the potential to fire. At all times, avoid exposure to direct or reflected radiation which exceeds the accessible emission limits listed in “Performance Standards for Lasers Products”, 21 CFR 1040 10(d).

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**DANGER:** **HIGH VOLTAGE AND CURRENT.** The laser head and power supply contain electrical circuits operating at lethal voltage and current levels. Do not remove the cover from the laser power supply or laser head. Serious injury or death may result.

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**CAUTION: THE POWER SUPPLY CORD IS USED AS THE MAIN DISCONNECT DEVICE. ENSURE THAT THE SOCKET-OUTLET IS LOCATED/INSTALLED NEAR THE EQUIPMENT AND IS EASILY ACCESSIBLE.**

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**ATTENTION: LE CORDON D'ALIMENTATION EST UTILISÉ COMME INTERRUPTION GÉNÉRAL. LA PRISE DE COURANT DOIT ÊTRE SITUÉE OU INSTALLÉE A PROXIMITÉ DU MATÉRIAL ET ÊTRE FACILE D'ACCÈS.**

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**VORSICHT: Zur sicheren Trennung des Gerätes vom Netz ist der Netzstecker zu ziehen. Vergewissern Sie sich, daß die Steckdose leicht zugänglich ist.**

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## **INTERLOCKS**

### **Power Supply**

The laser power supply can be interlocked so that doors equipped with an interlock switch will disable the laser when the door is opened. The connector on the back of the power supply (see Fig. 1-0) allows an open interlock circuit to interrupt AC power to the power supply.

To restart the laser, the interlock circuit must be closed and the triggering switch turned to the "START" position to reset the circuit. Then press the "ON" button on the control box and, after a 10 second delay, the system will operate normally. Pins 1 and 2 of the interlock connector are employed for this feature. Interlock switches must be rated for 24VAC at 0.1 amps.

### **Laser Head**

An interlock switch is installed in the laser head which prevents the laser from operating if the laser head is removed from the microscope. The microscope must be fitted with the interlocking activation pin to operate the laser. See Section II, INSTALLATION

### **Safety Labels**

Safety Labels on the system warn of specific dangers. Figure 1-0 shows the locations of the labels. Figure 1-1 through 1-9 shows each label.

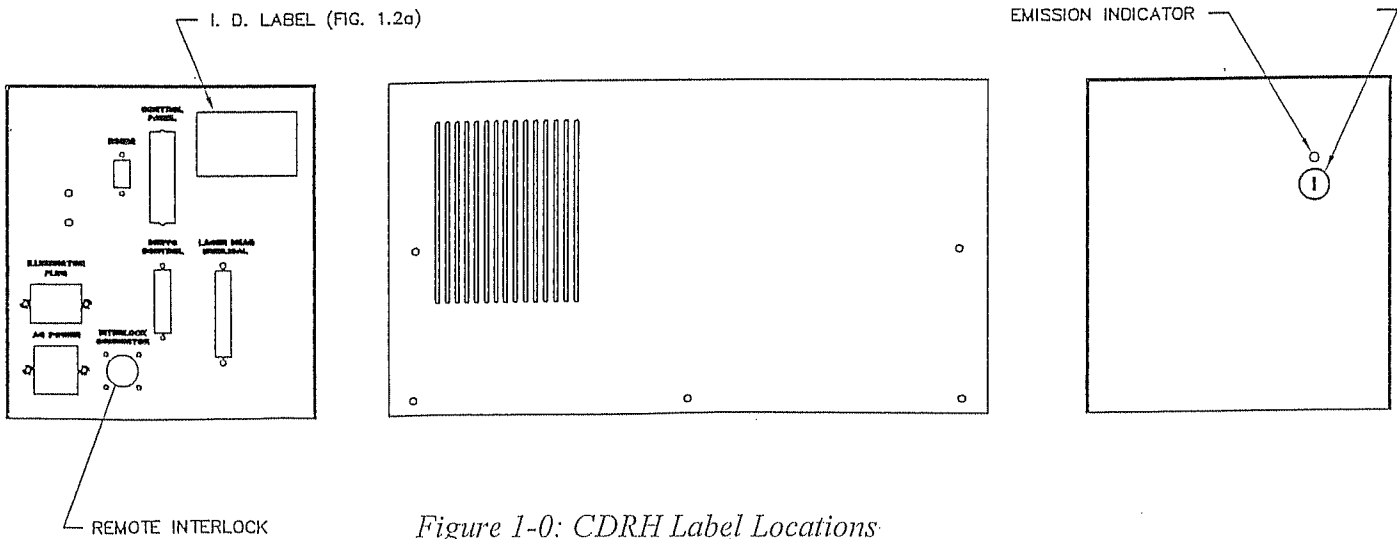
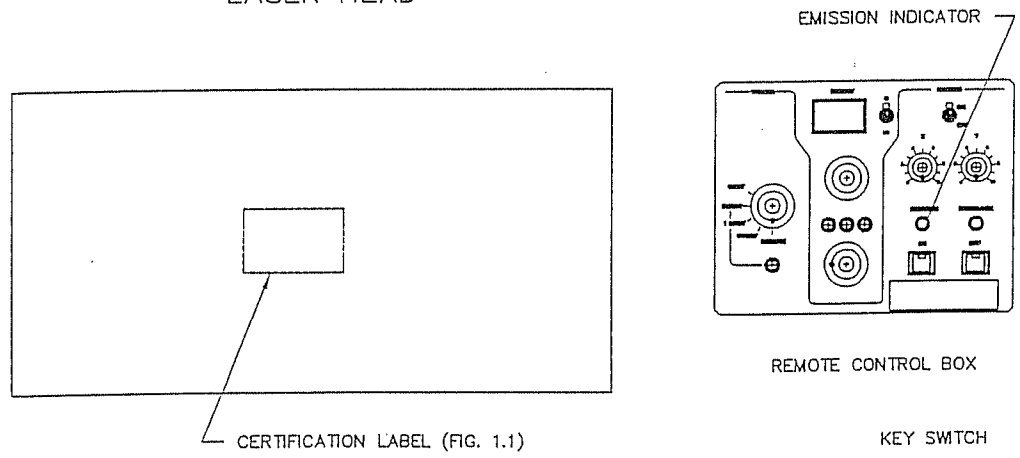
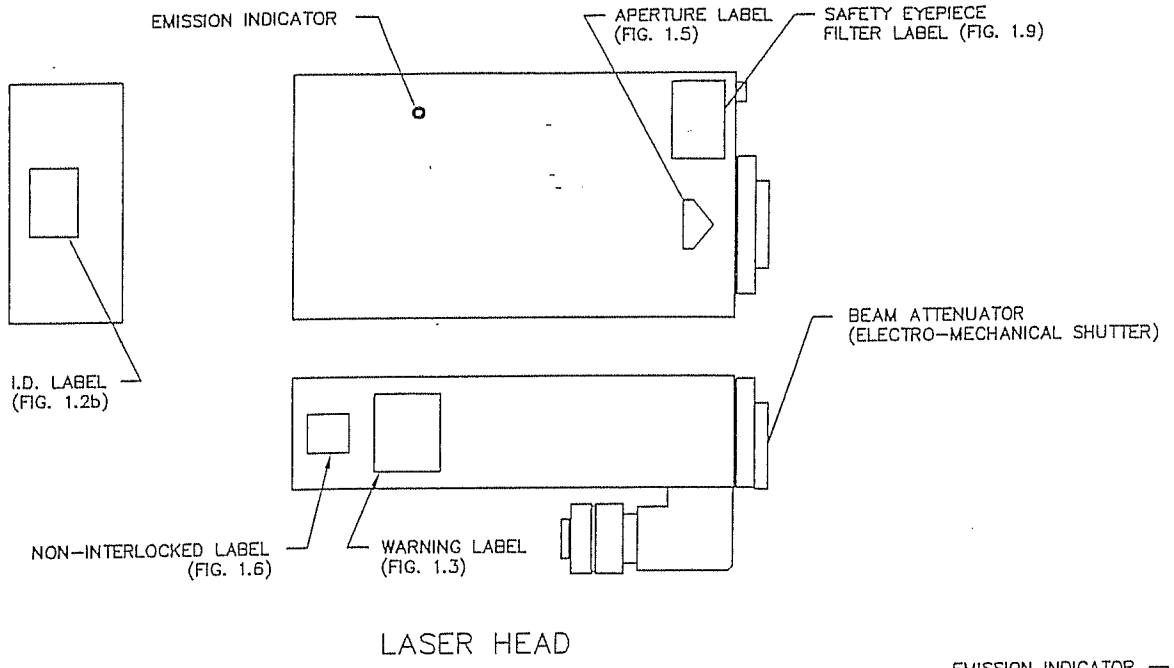


Figure 1-0: CDRH Label Locations

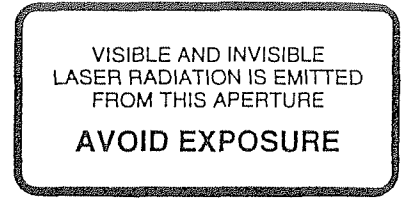
COMPLIES WITH 21 CFR  
1040.10 AND 1040.11

Certification Label  
Fig. 1-1

**AVOID EXPOSURE**  
VISIBLE AND/OR INVISIBLE LASER  
RADIATION IS EMITTED FROM  
THIS APERTURE



Aperture Label  
Fig. 1-5



MODEL \_\_\_\_\_ VOLTAGE \_\_\_\_\_  
SERIAL NO. \_\_\_\_\_ CURRENT \_\_\_\_\_  
DATE MFG. \_\_\_\_\_

COMPLIES WITH 21 CFR 1040.10 AND 1040.11  
MADE IN U.S.A.

I. D. Label  
Fig. 1-2a

**DANGER**

VISIBLE AND INVISIBLE  
LASER RADIATION WHEN  
OPEN AND INTERLOCK  
DEFEATED. AVOID EYE  
OR SKIN EXPOSURE TO  
DIRECT OR SCATTERED  
RADIATION.

Interlocked Label  
Fig. 1-6



MODEL \_\_\_\_\_  
SER. NO. \_\_\_\_\_  
DATE \_\_\_\_\_

MADE IN U.S.A.

I. D. Label  
Fig. 1-2b



Safety Eyepiece Filter Label  
Fig. 1-9

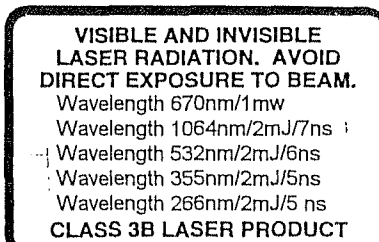


VISIBLE & INVISIBLE\*  
LASER RADIATION  
AVOID DIRECT EXPOSURE  
TO BEAM

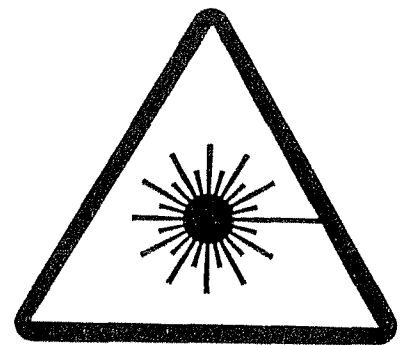


WAVELENGTH 1064nm/2mJ/7ns  
WAVELENGTH 532nm/2mJ/5ns  
WAVELENGTH 355nm/2mJ/4ns  
WAVELENGTH 266nm/2mJ/4ns

\* see manual CLASS IIIb LASER PRODUCT



Warning Labels  
Fig. 1-3



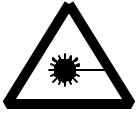
Figures 1-1 through 1-9 CDRH Labels



## **Chapter 2, Installation**



**LASER HEAD/** The LCS 4/EZLaze laser cutting system is designed to operate on specially modified Mitutoyo FS60, FS60(Y), FS50 and A-  
**MICROSCOPE** Zoom microscopes. Become familiar with your microscope before attempting to install the LCS 4. See Fig. 2-1.



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**WARNING: Operation of the laser without the eyepiece filter installed may result in SEVERE EYE DAMAGE or BLINDNESS. Do not continue the laser installation until the eye protection filter has been installed.**

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#### Eyepiece Filter

All FS60 microscopes must be fitted with an eye protection filter or a beam blocking mechanism before the laser head unit is installed on the scope. See Fig. 2-1.

- Remove the eyepiece assembly by removing the three screws which secure the eyepiece to the body of the microscope.
- Place the filter assembly over the eyepiece hole with the flat side
- Facing out. Aligning the mounting holes with those in the microscope body.
- Re-install the eyepiece assembly and secure the eyepiece filter assembly between the body and the eyepiece using the cap screws (2 or 2.5 mm hex) provided.

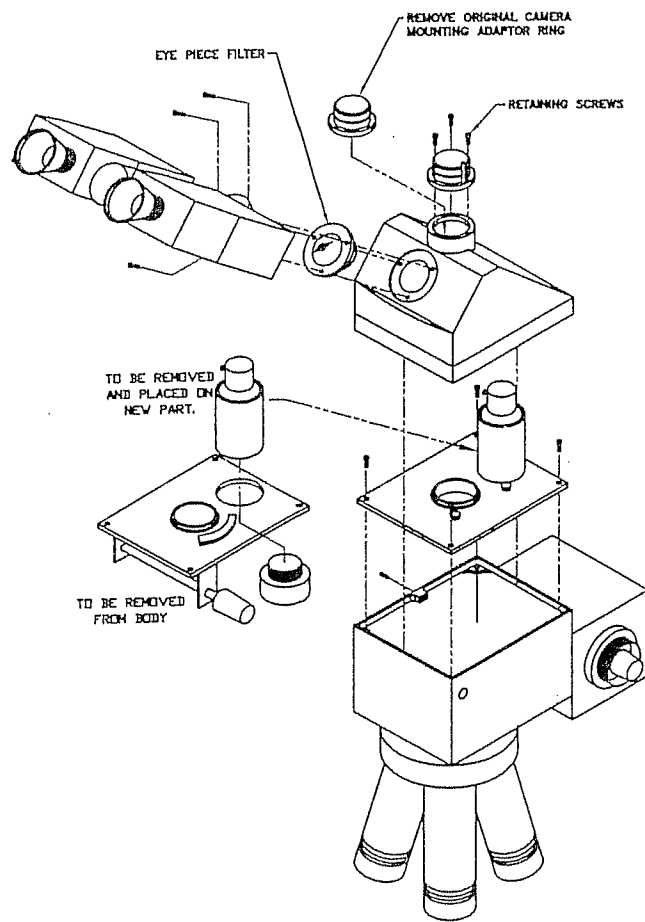


Figure 2-1: Microscope Modification



**Laser Adapter Ring**

To accommodate the laser while maintaining strict safety, the adapter ring on the microscope trinocular head must be removed and replaced with the one provided. The new laser adapter ring has a pin which activates an interlock switch. If the pin is not present, the laser will not fire.

**Note:** Install the eyepiece filter before installing the laser adapter ring.

- Remove the old adapter ring and the three cap screws (2.5mm hex) which secure it to the microscope. See Fig. 2-1.
- Install the new laser adapter ring with the interlocking pin positioned to the right of front/center of the microscope (see Fig. 2-1). Use the three original cap screws to secure it to the microscope.

**Microscope UV Conversion Kit**

A UV tube lens kit allows UV (355nm) energy to be transmitted through the Mitutoyo FS60 and the FS60Y. IR (1064nm) energy can not be transmitted through the FS60. The FS60Y does transmit IR energy (no conversion required).

The A-Zoom microscope requires the Laser adapter kit to mount the LCS 4. Green (532nm) light passes through all the microscopes without conversion. The conversion requirements are summarized below:

*Table 1: Conversion Kits*

Microscope	Transmit IR	Transmit Green	Transmit UV
FS50	N/A	No kit needed	N/A
FS60	N/A	No kit needed	UV tube lens kit
FS60Y	No kit needed	No kit needed	UV tube lens kit
A-Zoom	Laser adapter kit	Laser adapter kit	Laser adapter Kit

**FS60 UV tube lens kit installation**

- Remove the binocular head by loosening the set screw on the left side of the microscope (2.5mm hex). The screw is located in the seam separating the binocular head from the main body of the microscope (see Fig. 2-1). After the screw has been loosened, the binocular head can be lifted from the microscope body.
- Remove the plastic zoom control knob and c-clip from the zoom shaft. Newer Mitutoyo microscopes require that the cap be removed

from the zoom knob and a set screw inside the knob loosened to release the knob.

- Remove the four screws (3mm hex) which secure the zoom mechanism plate or tube lens to the FS60 microscope body.
- Remove the zoom mechanism by lifting the back of the zoom mechanism plate while tilting it to the right (see Fig. 2-1). Unscrew the ring nut which secures the fiber optic lens assembly to the zoom mechanism plate. The lens assembly is often glued and sufficient force must be applied to break the glue.
- Reinstall the fiber optic lens assembly onto the UV tube lens kit mounting plate. Ensure that the aperture is facing the outside edge of the mounting plate so it is accessible once the microscope has been reassembled.
- Install the replacement UV tube lens kit plate.
- Reinstall the binocular head on the microscope body.

#### FS60Y UV tube lens kit installation

- Remove the binocular head by loosening the set screw on the left side of the microscope (2.5mm hex). The screw is located in the seam separating the binocular head from the main body of the microscope (see Fig. 2-1). After the screw has been loosened, the binocular head can be lifted from the microscope body.
- Remove the tube lens plate and the four screws which secure it to the microscope body.
- Unscrew the fiber optic lens assembly from the tube lens plate. The lens assembly is often glued and sufficient force must be applied to break the glue.
- Reinstall the fiber optic lens assembly onto the UV tube lens kit mounting plate. Ensure that the aperture is facing the outside edge of the mounting plate so it is accessible once the microscope has been reassembled.
- Install the replacement UV tube lens kit plate.
- Reinstall the binocular head on the microscope body.

Laser Head  
Mounting

The laser head may now be mounted on the microscope. Tighten the set screws which secure the base of the laser head to the laser adapter ring (see Fig. 2-2). The red emission LED should face the operator when standing in front of the microscope.

**POWER  
SUPPLY  
ELECTRICAL**

Power Line Fuse



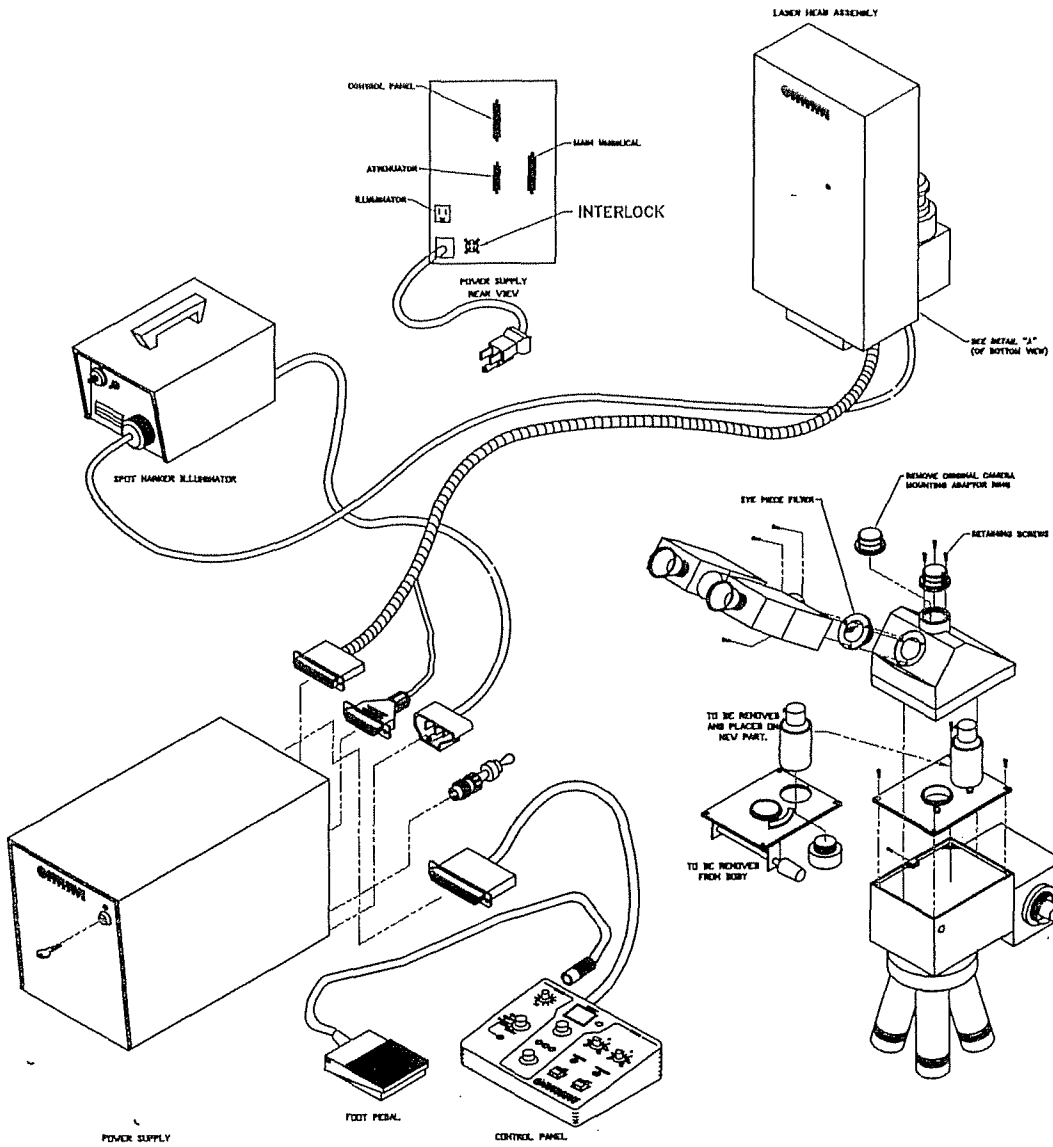
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**DANGER High Voltage and Current. The laser head and power supply contain electrical circuits operating at lethal voltage and current levels. Do not remove the cover from the power supply or laser head. Serious injury or death may result.**

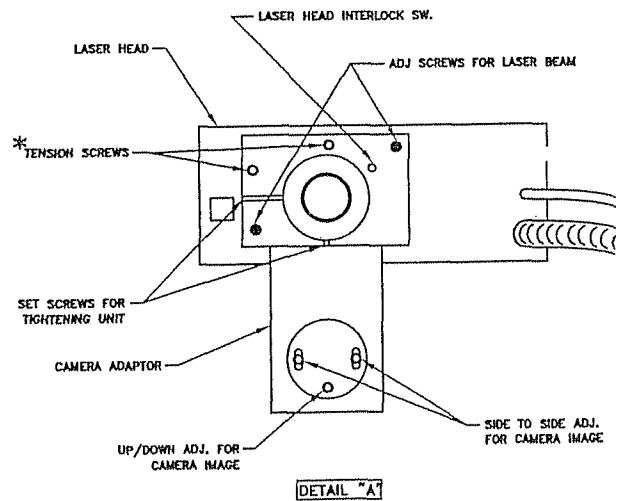
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A power line fuse is installed on the back panel of the power supply near the power cord. A 1 amp slow blow fuse is installed. The following model number fuses or their equivalents may be used:

<u>Manufacturer</u>	<u>100-250VAC</u>
Littlefuse	216.001 250 V/1HA
Schurter	SPT001-2504 250V/1A



\* NOTE: DO NOT ADJUST TENSION SCREWS.



BOTTOM VIEW OF LASER HEAD ASSY  
NOT TO SCALE

Figure 2-2: Laser System Assembly Diagram

Voltage  
Requirements

The power supply has been preset at the factory for the voltage supply available at your location (100-130, or 200- 240VAC). The power supply voltage may be adjusted for 100/115 or 230 VAC operation, if required. use ring set screw.

**Centering the  
Spot Marker**

Center the spot marker on the television monitor by adjusting the video camera mirror on the lower side of the camera adapter.

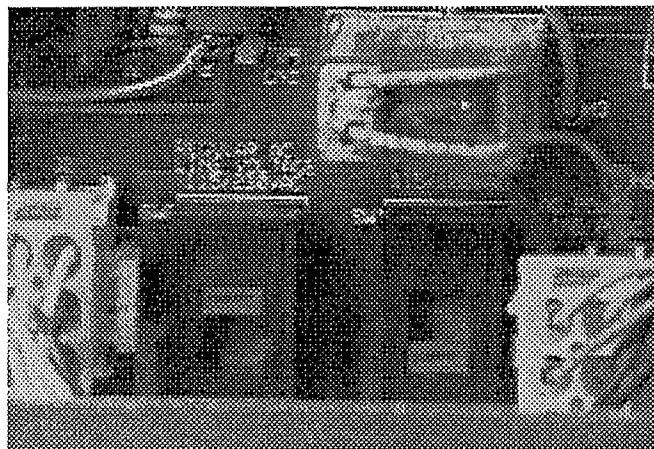
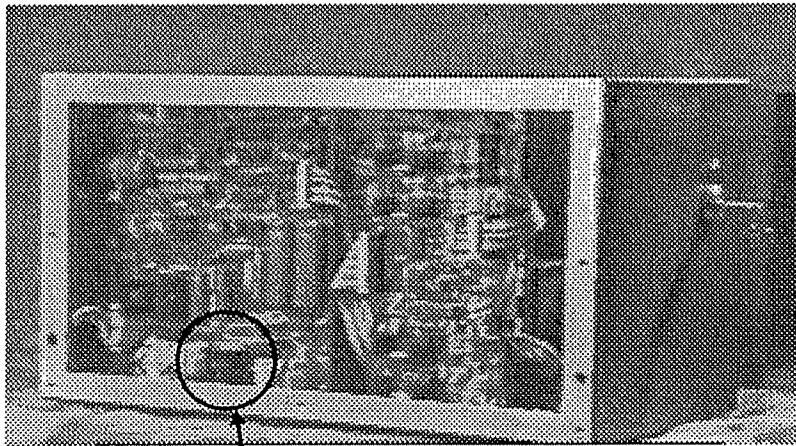
- Adjust the image color by using the set screw (1.5mm hex) on the bottom of the camera adapter port.
- Adjust the spot's image location by releasing the two socketed head screws and rotating the mounting plate. When the image is properly positioned, re-tighten the head screws (see Fig. 2-2, Detail A).

**COMPUTER  
INTERFACE  
ADJUSTMENTS**

The LCS 4 RS232 Computer Interface connector is located on the rear panel of the power supply.

- Attach an RS232 serial cable to the 9 pin connector on the back of the power supply.
- Plug the 9 pin connector into the serial port of a PC or work station.

**Note:** See Computer Interface manual for additional information.



*Figure 2-3: Laser System Installation*

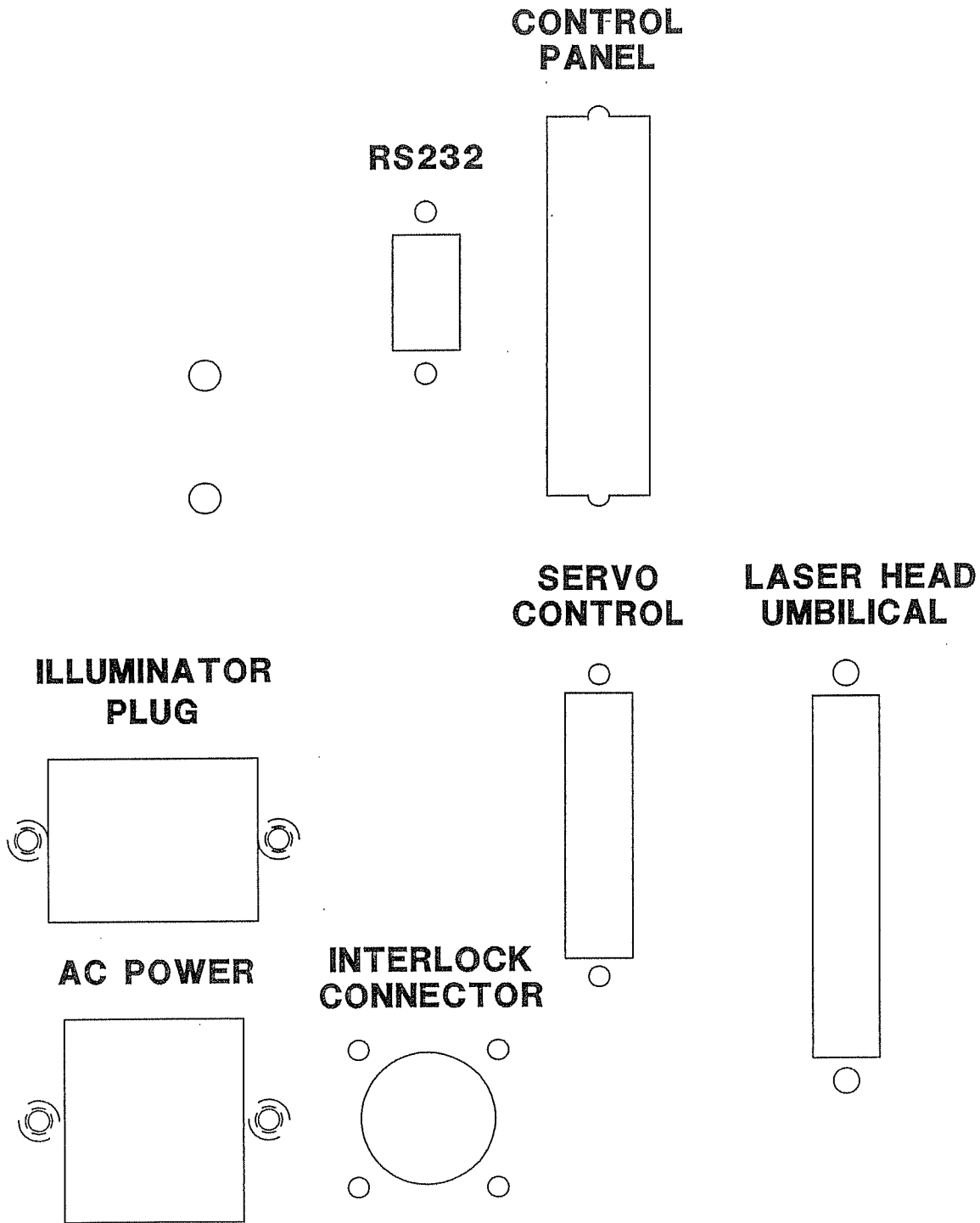
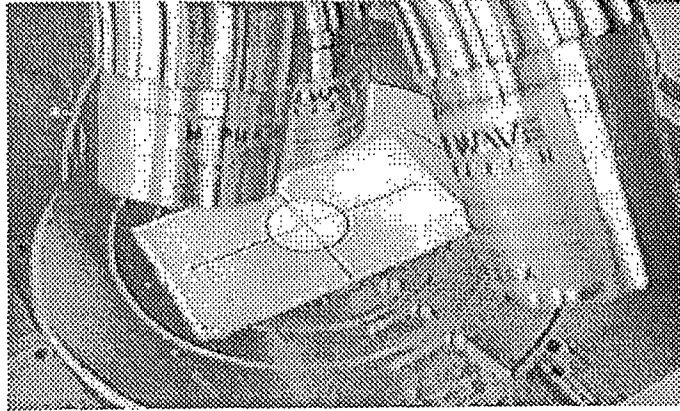
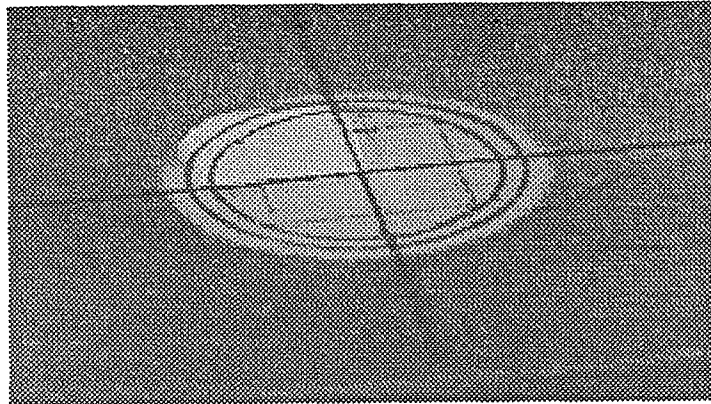


Figure 2-4: Power Supply Rear Panel Connections



Raise microscope to make  
a 1" (25 mm) white circle on a business card



Center laser beam on target  
using the tilt adjusting screws  
on laser mounting plate  
(See Detail A of Figure 2-2)

*Figure 2-5: Laser Head Alignment*



**Chapter Three,  
OPERATION**



## STARTING THE LASER




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**Ensure that the LCS 4/EzLaze has been properly installed and that you have read and understood the SAFETY section of this manual.**

**All laser controls are located on the remote control box except the key switch which is located on the power supply.**

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- Set the energy switch on the remote control box to the “LO” position.
- Turn the triggering switch to the “START” position.
- Turn the key switch on the power supply to the “ON” position.
- Press and hold the green “ON” button until the red Interlock LED is off and the red Emission LED is on. There is a delay of about ten seconds once the emission LED is on until the laser can begin firing.
- Open the X-Y aperture when you are ready to fire the laser.
- Select a firing mode with the triggering switch:

**REMOTE**      Activates the RS232 port on the back of the power supply.

**1 SHOT**        Allows a single pulse to be fired by the control box push button or the foot switch

**BURST**         A burst of pulses (at 5 Hz for 10 seconds for EzLaze) are fired while the push button is depressed. The laser must “rest” for 18 seconds before another 5 Hz burst can be fired. A single shot may be fired immediately.

**CONT.**          Continuous firing of the laser at 1 Hz.

- Set the energy switch to the “HI” or “LO” position as desired and adjust the energy with the attenuator knob (see Fig. 3-1).

## **STOPPING THE LASER**

The laser will not fire when the triggering knob is in the “START” position. Use this position to keep the power supply operating and to maintain the laser in a “no fire” mode.

To shut down the laser and power supply:

- Turn the power supply key to the “OFF” position, OR
- Press the “OFF” button on the remote control box.

## **LASER CONTROLS**

### Triggering Switch

See STARTING THE LASER (page 23).

### Attenuator

The output energy is adjusted using the potentiometer knob located below the LED display on the remote control box. The LED display indicates “000” - “999” (minimum-to-maximum) transmission. The attenuator works for all the available wavelengths. The transmission function of the attenuator is shown in Figure 3-2.

### Energy HI/LO Switch

The energy HI/LO switch is an attenuating feature that changes the maximum transmitted energy available. This switch operates independently from the variable attenuator. The switch has the following two settings:

**HI** Full energy is available from the laser. Variable attenuation is about 40:1 for IR and green and about 20:1 for UV. LED indicates 000 - 999 across the full range.

**LO** Approximately 30% of full energy is available for green and 40% for IR and UV. Variable attenuation is about 100:1 for IR and green and 40:1 for UV (see Figure 3-2). LED indicates 000 - 999 across the lower energy range.

**Note:** The LED display shows 000 - 999 relative to the available energy. that is, an indication of eight hundred with the energy switch in the LO position corresponds to perhaps an indication of only two or three hundred with the energy switch in the HI position. See Fig. 3-2.

Wavelength  
Selector

The LO setting is safer for testing and is also used for low energy applications such as polyimide passivation removal with UV. Ask your New Wave Research sales engineer or representative for application guidelines and useful techniques.

The output wavelength emitted by the laser is selected using the wavelength selector switch located on the remote control box. Select the output wavelength by turning the wavelength selector knob to the corresponding LED indicator:

<u>LED Indicator</u>	<u>Wavelength</u>
Red	1064 nm (IR)
Green	532 nm
Blue	355 nm or 266 nm (UV)

NUV (near ultraviolet) objective lenses must be used to transmit UV (355nm) energy. NIR (near infrared) objectives lenses must be used to transmit IR energy. Green light can pass through standard, NIR or NUV lenses.




---

**Do not use standard objective lenses with IR or UV wavelengths. These wavelengths may damage the standard lenses.**

---

## Spot Marker

The spot marker highlights the area which will be irradiated by the laser pulse. The spot marker and laser both travel through the same X-Y aperture, thus adjusting the aperture determines the shape and size of the area to be irradiated. To achieve the best cut definition, focus the microscope so that the aperture edges are in sharp focus.

- The 150W white light external spot marker is controlled by the ON/OFF switch located on the spot marker chassis. A potentiometer allows variable control of the intensity. If the spot marker power cord is plugged into the outlet on the back of the laser power supply, then the spot marker may be turned ON and OFF using the “Marker” switch on the remote control box.

**Note:** The image of the spot marker is more visible when the microscope’s background lamp is reduced in intensity. Also, the microscope illuminator has a sliding aperture control. Reducing the aperture tends to increase the depth of the

image on the television monitor and the visibility of the spot marker

.

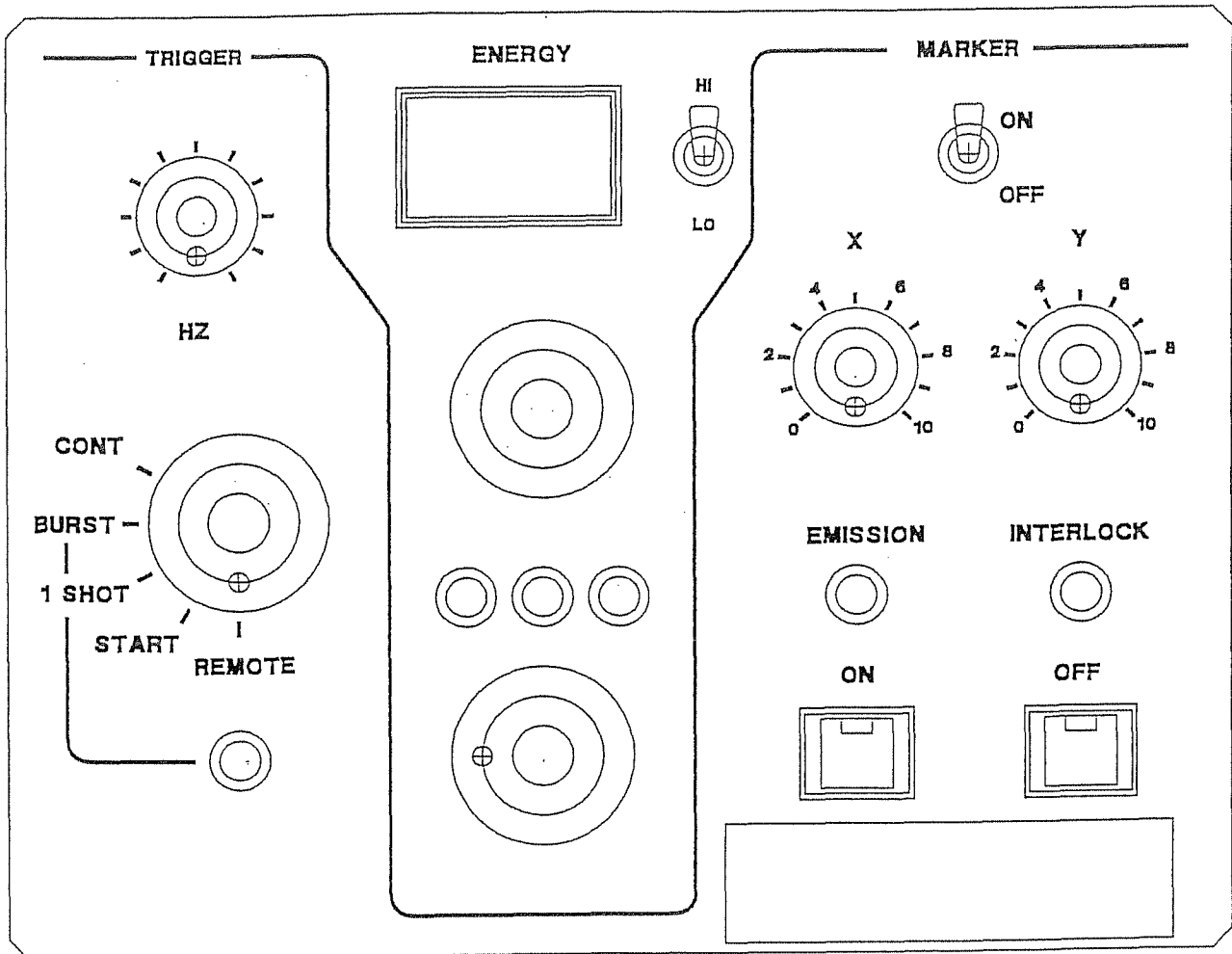


Figure 3-1: System Controls

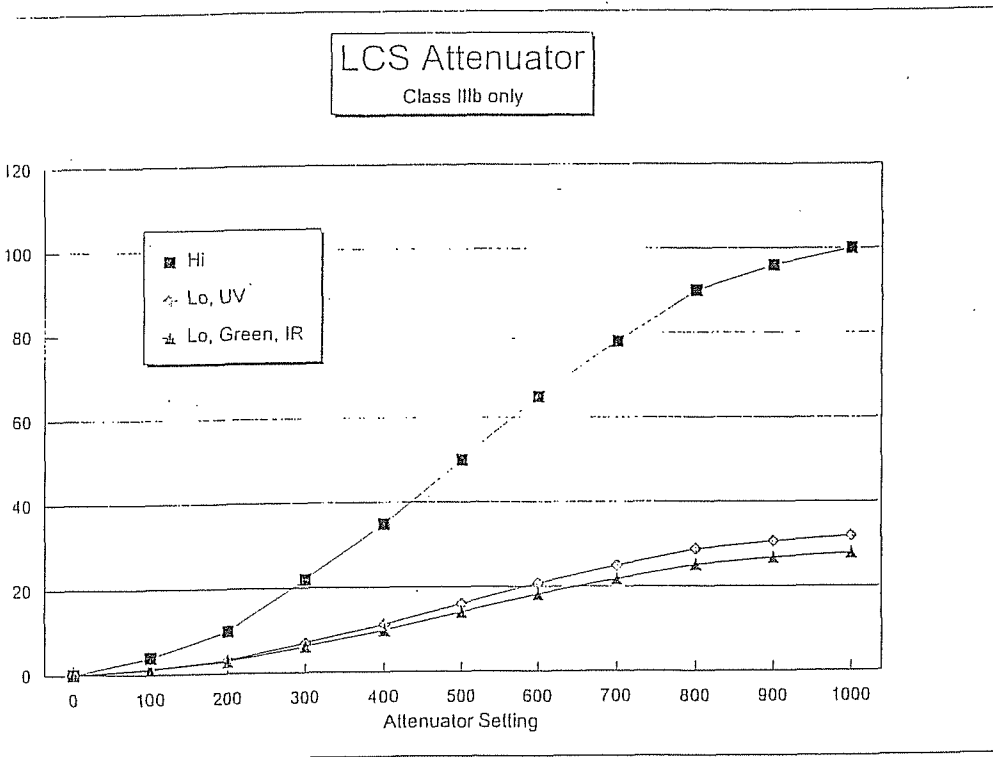


Figure 3-2: Energy vs Attenuator Setting



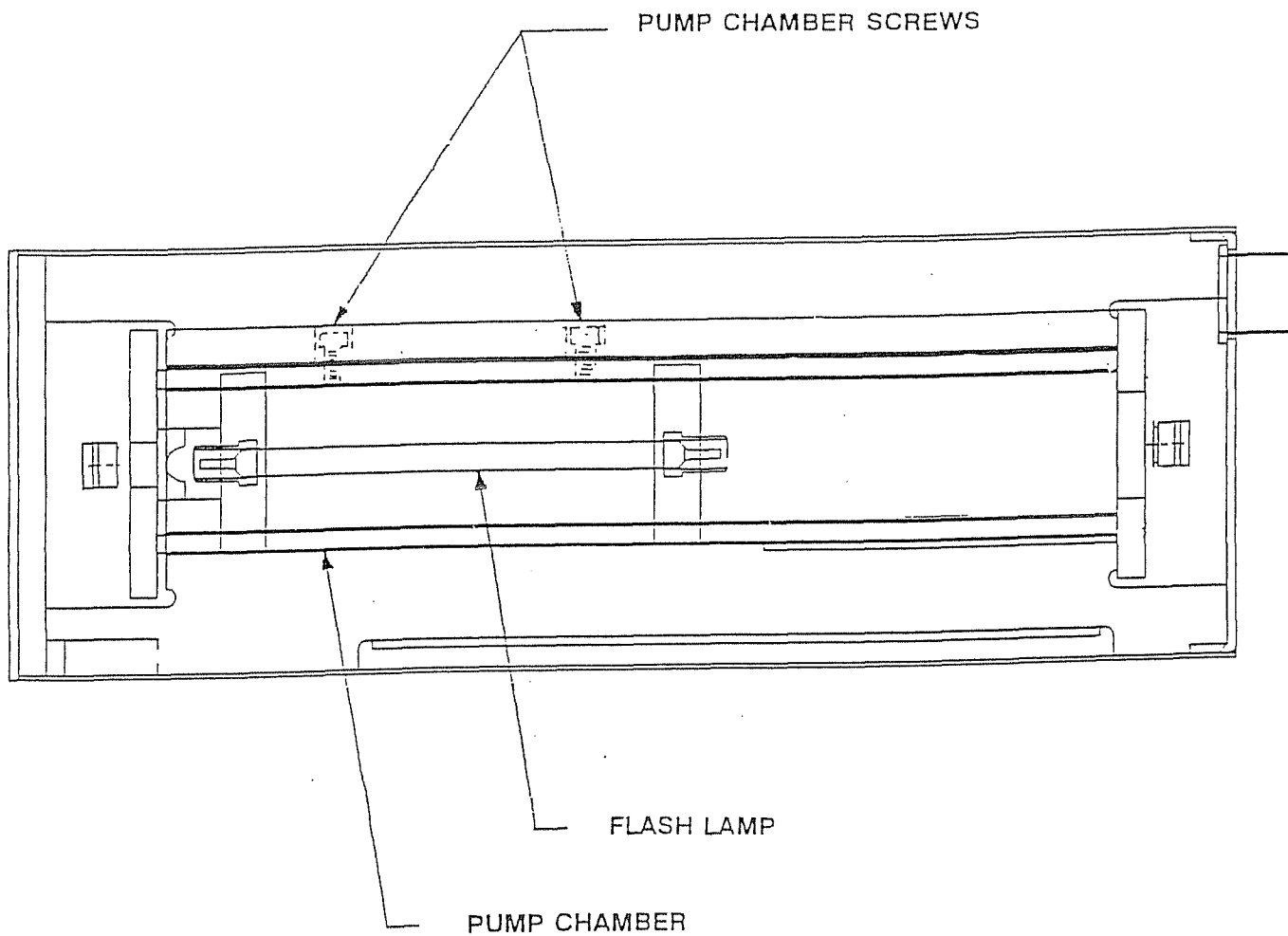
**Chapter Four,  
SERVICE**



## **FLASH LAMP REPLACEMENT**

An aging flash lamp can be noticed by observing the output energy on a test run of several thousand pulses. If there are occasional low energy pulses (perhaps 10-20% lower), then an old flash lamp is indicated. To replace a flash lamp, the following procedures apply:

- Disconnect all power to the laser.
- Remove the laser head cover.
- Remove the Marx bank printed circuit board from the laser head.
- Remove the small RED and BLUE start transformer lead from the terminal strip (see Fig. 4-1).
- Remove the RED and BLACK flash lamp leads from the terminal strip.
- Remove the two recessed screws which secure the pump chamber to the terminal block and resonator.
- Remove the pump chamber end caps which secure the flash lamp (see Fig. 4-1).
- Straighten the lamp leads and remove the flash lamp from the pump chamber. Note the position of the RED and BLACK leads.
- Install the new flash lamp with the RED and BLACK leads on the same side as the original lamp. Bend the lamp leads so that they are perpendicular to the lamp.
- Reinstall the pump chamber.
- Reattach the RED and BLACK lamp leads and RED and BLUE transformer leads to the terminal strip.
- Replace the laser head cover.
- Re-install the laser head on the microscope.



*Figure 4-1: Flash lamp Location*

## **PRODUCT INFORMATION**

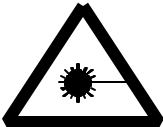
### **PRODUCT WARRANTY**

1. New Wave Research (Manufacture) mechanical, electrical, and optical parts and assemblies are warranted against defects in materials and workmanship for a period of twelve (12) months from date of shipment to end user or fifteen (15) months from date of shipment to supplier whichever is less. The warranty period for flash lamps and nonlinear crystals is 90 days from the date of shipment to the end user or 120 days from the date of shipment to supplier whichever is less. Degradation of optics due to long-term exposure to fourth harmonic, dust, dirt or contamination is not considered a defect. If Manufacturer receives notice of such defects during the warranty period, Manufacturer shall at its option, either repair or replace hardware products which prove to be defective. If equipment fails during the warranty period, end user shall notify Manufacturer and request return authorization. The defective product shall then be returned with a failure report attached, to Manufacturer, freight prepaid. The warranty does not cover consumable supplies such as fuses or illumination or indicator lamps.
2. New Wave Research software and firmware products which are designated by Manufacturer for use with a hardware product, when properly installed on that hardware product, are warranted not to fail to execute their programming instructions due to defects in materials and workmanship for twelve (12) months from date of shipment to end user or fifteen (15) months from date of shipment to supplier. If Manufacturer receives notice of such defects during the warranty period, Manufacturer will repair or replace software media and firmware which do not execute their programming instructions due to such defects. Manufacturer does not warrant that the operation of the software, firmware or hardware shall be uninterrupted or error free.
3. **LIMITATION OF WARRANTY.** The above warranties are contingent upon proper use in the application for which the equipment was intended and does not cover equipment which was modified or disassembled without Manufacturer's approval, was subjected to contamination, abuse or unusual physical or electrical stress, operated outside of Manufacturer

environmental specifications for the product, or failed as a result of Distributor-supplied software or hardware interfacing equipment.

4. THE WARRANTY STATED ABOVE IS EXCLUSIVE AND NO OTHER WARRANTY, WHETHER WRITTEN OR ORAL, IS EXPRESSED OR IMPLIED. MANUFACTURER SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THIS STATED EXPRESS WARRANTY IS IN LIEU OF ALL LIABILITIES OR OBLIGATIONS OF MANUFACTURER FOR ALL DAMAGES INCLUDING, BUT NOT LIMITED TO, CONSEQUENTIAL DAMAGES OCCURRING OUT OF OR IN CONNECTION WITH THE USE OF PERFORMANCE OF MANUFACTURER'S PRODUCT. MANUFACTURE'S LIABILITY IS LIMITED TO A REFUND TO THE END USER OF THE PURCHASE PRICE PAID TO MANUFACTURE FOR THE PRODUCT.

## **TROUBLE SHOOTING GUIDE**



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**DANGER DO NOT ATTEMPT TO REMOVE THE COVERS OF THE LASER HEAD OR POWER SUPPLY. LASER RADIATION AND/OR HIGH VOLTAGES ARE PRESENT INSIDE OF THE LASER HEAD AND POWER SUPPLY. IF AFTER FOLLOWING THE GUIDE BELOW THE LASER STILL DOES NOT FUNCTION CONTACT NEW WAVE RESEARCH OR THE SYSTEM SUPPLIER FOR ASSISTANCE.**

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If the laser fails to operate check the following:

1. Is the key switch on? Is the Trigger switch set to START and the ON button depressed.
2. Is the umbilical from the laser head securely attached to the power supply?
3. Is the interlock plug secured into the socket on the back of the power supply?
4. If a door interlock is utilized, is the switch on the door interlock activated?
5. Is the interlock switch on the laser head in contact with the interlock activator pin which protrudes from the video camera mounting adapter ring?
6. Is the X - Y aperture control set so the aperture is open? Set the X and Y controls to 10 or maximum opening.
7. Is the laser head properly aligned on the microscope head. See Section 2 - Installation.

If the laser power seems to be low check the following:

1. Is the attenuation control set to a high enough setting? Try increasing the setting by an additional 100 points between shots.

2. Is the energy level switch in the "Hi" position?
3. Is the beam sharply focused on the target area?
4. Is the highest power microscope objective, e.g. 50, 80 or 100 X being used?
5. If the microscope is equipped with a polarizer/analyzer option, is the analyzer removed.

If the laser spot marker is dim or off check the following:

1. Reduce the illumination level provided by the microscope illuminator.
2. Is the illuminator plugged in and the illuminator control set to 9 or 10?
3. If no light exits from the spot marker illuminator, replace the lamp. To replace the lamp in the 150 watt illuminator turn the large screw on the top of the illuminator housing 1/4 turn and pull the handle back. The housing will pivot back exposing the lamp when the large screw is released. Remove the lamp from its holding fixture. Release the lamp electrical connector and positioning spring. Replace the lamp with a new one and replace the positioning spring. Place the lamp assembly back into the illuminator housing, position the cover and secure with large screw on the top of the housing. When replacing the lamp take care not to leave finger prints, oil or other contaminants on the lamp. These contaminants may cause the lamp to fail prematurely. The lamp is a type EKE, 21volt, 150 watt projector lamp. If the laser is still not operating after checking the above items, contact the supplier who furnished the laser or the New Wave Research Customer Service Department:

New Wave Research, Inc.  
47613 Warm Springs Blvd.  
Fremont, CA 94539  
Tel: 510-249-1550  
Fax: 510-249-1551



**PRODUCT SPECIFICATIONS**

Laser Type:	Pulsed, air cooled Nd:YAG, Class IIIb		Model Green/UV3			
	<u>TriLite</u>	<u>Model IR/Green</u>	<u>Model Green/UV4</u>	<u>Model IR</u>	<u>Model Green</u>	<u>Model</u>
<u>UV4</u>						
Wavelength:	1064,532 or 355 nm	1064 or 532 nm	532 or 355 nm 532 or 266 nm	1064 nm	532 nm	266 nm
Pulse Width:	7 ns @ 1064 nm; 6 ns @ 532 nm; 5 ns @ 355 nm; 5ns @ 266nm					
Maximum energy:	2.0 mJ @ 1064 nm; 2.0 mJ @ 532 nm; 2.0 mJ @ 355 nm; 2.0 mJ @ 266 nm					
Nominal energy:						
High	.5 mJ @ 1064 nm .5 mJ @ 532 nm .4 mJ @ 355 nm	.6 mJ @ 1064 nm .6 mJ @ 532 nm .6 mJ @ 266 nm	.6 mJ @ 532 nm .6 mJ @ 355 nm	.6 mJ	.6 mJ	.4 mJ
Lo	.2 mJ @ 1064 nm .15 mJ @ 532 nm .16 mJ @ 355 nm	.24 mJ @ 1064 .18 mJ @ 532 nm .24 mJ @ 266 nm	.2 mJ @ 532 nm .24 mJ @ 355 nm	None	.2 mJ	None
Aperture range:	Max: 50 x 50 um w/50x obj. (Mitutoyo FS60); 25 x 25 w/100x Min: 1 x 1 um w/100x obj. (2 x 2 um w/100x obj. @ 1064 nm); 2 x 2 um w/50x objective					
Attenuation range:	>100:1 1064 nm & 532 nm using both the HI and LO ranges. >40:1 355 nm using both the HI and LO ranges.					
Pulse rate:	Single shot or 1Hz in burst mode or continuous or 5 Hz in burst mode for 10 seconds for EzLaze. 18 seconds rest required after 5 Hz burst for 10 seconds.					
Electrical:	90 - 250 VAC; 100 watts 100 - 130 VAC, 1 amp slow blow 200 - 240 VAC, .5 amp slow blow					
Temperature:	70° ± 10° F; 21° ± 5° C					
Laser Head Cables:	Umbilical - 84" (2.1 M); Illuminator fiber - 78" (2 M)					
Illumination System:						
Type II:	150 watt halogen light illumination source with fiber delivery					

Lamp: 21 volt, 150 watts, Type EKE  
Electrical: 115 VAC, 2.0 amps/230 VAC, 1 amp

## ***Environmental***

Temperature:	20C $\pm$ 5C
Humidity:	20% - 80% (non-condensing)
Altitude :	0 - 2000 meters
Pollution Degree:	2
Voltage Fluctuation:	< 10%
Transients:	Category II

## ***Recommended Spare Parts***

Lamp for Spot Marker Illuminator: Type EKE, 21VDC 150 watts

Fuse: T1A Schurter