QuikLaze-50ST

Operator's Manual

NEW WAVE RESEARCH

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Chapter One

Laser Safety And Specifications

Laser Safety

This manual contains information for the proper installation and operation of the QuikLaze Laser Cutter System. The term QuikLaze refers to the QuikLaze-50ST laser systems unless otherwise noted. This system is designed for semiconductor design and failure analysis, micro-electronics machining and research applications. The QuikLaze complies with the Center for Devices and Radiological Health (CDRH) Standard 21 CFR 1040.

The QuikLaze may be mounted on the following microscopes:

	Model	Wavelength
Mitutoyo	FS60	Green, UV3
	FS60Y	IR, Green, UV3
	FS70ZS	Green, UV3
	FS70LS	IR, Green, UV3
	VM Zoom	IR, Green, UV3
Optem	A-Zoom I, II	IR, Green, UV3
USMC	BD100	IR, Green, UV3
Seiwa	PS-888L	IR, Green, UV3

Contact factory for UV4 microscope requirements

The QuikLaze 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 QuikLaze, it is essential that you completely read and understand the OPERATION section of this manual.

Do not attempt to repair the QuikLaze while it is under warranty. Report all problems to your supplier or New Wave Research, Inc. 48660 Kato Road, Fremont CA 94538. Telephone 510-249-1550; Fax 510-249-1551; e-mail lasers@new-wave.com

Optical Safety

The QuikLaze Nd:YAG laser generates high energy infrared radiation that can pose serious risks to eye safety. Infrared radiation is invisible to the eye, so the hazard is not immediately obvious, but the radiation can be focused onto the retina. For this reason it is very important to always wear protective eye wear as appropriate and to be aware of any possible reflections. Refer to ANSI 136.2 "Standards for the Safe Use of Lasers," available from the Laser Institute of America, tel. 407-380-1553.

WARNING: The New Wave Research QuikLaze is a Class IIIb laser system. AVOID DIRECT EXPOSURE TO THE BEAM.

The QuikLaze-50 may be configured as a Class IV laser system and is appropriately marked on the laser head. For these systems AVOID EXPOSURE TO DIRECT OR SCATTERED RADIATION.

BECAUSE THE 1064, 355, 266 AND 213 NM OUTPUT BEAMS OF A Nd:YAG LASER ARE INVISIBLE THEY ARE EXTREMELY DANGEROUS. Infrared radiation passes easily through the cornea, which focuses it on the retina of the eye, where it can cause instantaneous or permanent damage including blindness. AVOID EYE AND SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION.

CAUTION: USE OF CONTROLS, ADJUSTMENTS OR PERFORMANCE OF PROCEDURES OTHER THAN THOSE SPECIFIED HEREIN MAY RESULT IN HAZARDOUS RADIATION EXPOSURE.

Follow the instructions contained in this manual for proper installation and safe operation of your laser. Wear protective eye wear; selection depends on the energy and wavelength of the laser beam as well as operating conditions. Consult ANSI, ACHIG or OSHA standards for guidance.

At all times during installation, operation, maintenance or service of your laser, avoid exposure to laser or collateral radiation exceeding the accessible emission limits listed in "Performance Standards for Laser Products," 21 CFR 1040.10(d).

Electrical Safety

The laser head and power supply contain electrical circuits operating at lethal voltage and current levels. Do not attempt to operate the laser with the power supply cover or laser head cover removed. For service, please contact New Wave Research at 48660 Kato Road, Fremont CA 94538. The phone number for New Wave Research is 510-249-1550, fax 510-249-1551, e-mail: lasers@new-wave.com.

Certain procedures such as changing the flash lamp, water filter, or cleaning optical components require removal of the protective systems. It is important that all safety precautions outlined in this manual are observed by anyone using the laser. The most important rule when working with this laser to perform the above procedures is to turn off the AC line switch.

There are no user serviceable parts on the electrical side of the power supply. New Wave Research must carry out Service procedures on system electronics.

Safety Features

The following features are built into the QuikLaze Nd:YAG lasers to conform to government regulations and provide safe laser operation.

Laser Covers

The QuikLaze laser head is enclosed in a protective housing that prevents access to radiation in excess of Class I limits, except for the output beam, which is Class IIIb or Class IV if so marked. The cover also protects against stray radiation from the QuikLaze. Do not remove the cover, except to perform service procedures by a trained person.

Interlocks

The QuikLaze Nd:YAG laser system has a series of interlocks to prevent accidental exposure to dangerous levels of electricity or radiation. In addition, there are interlocks designed to interrupt laser operation if the laser may be damaged. The interrupts are laser head cover opened, laser head/microscope interlock, remote interlock (2) interrupted (if installed), water temperature too high, or cooling water flow too low.

Exit Shutter

The QuikLaze has an exit beam shutter located on the laser head housing. The laser beam may be blocked by closing the manual shutter, however the laser continues to operate.

Government Regulations

New Wave Research suggests that laser users purchase a copy of the *American National Standard for the Safe Use of Lasers* (ANSI Z136.1-1993) from the Laser Institute of America. This publication provides recommendations for the safe use of lasers and laser systems that operate at wavelengths between 180 nm and 1 mm.

Laser Institute of America
12424 Research Parkway, Suite 125
Orlando, FL 32826
(407) 380-1553

Laser Classification

The governmental standards and requirements specify that the laser must be classified according to the output power or energy and the laser wavelength. The QuikLaze is classified as Class IIIb based on 21 CFR, subchapter J, part II, section 1040-10 (d). In some configurations the laser is a Class IV laser product and is appropriately marked on the laser head. According to the European Community standards, the QuikLaze is classified as Class 3B or Class 4 if so marked based on EN 60825. This manual and other documentation for the QuikLaze refers to the classification as Class 3B (IIIb) or Class 4 (IV).

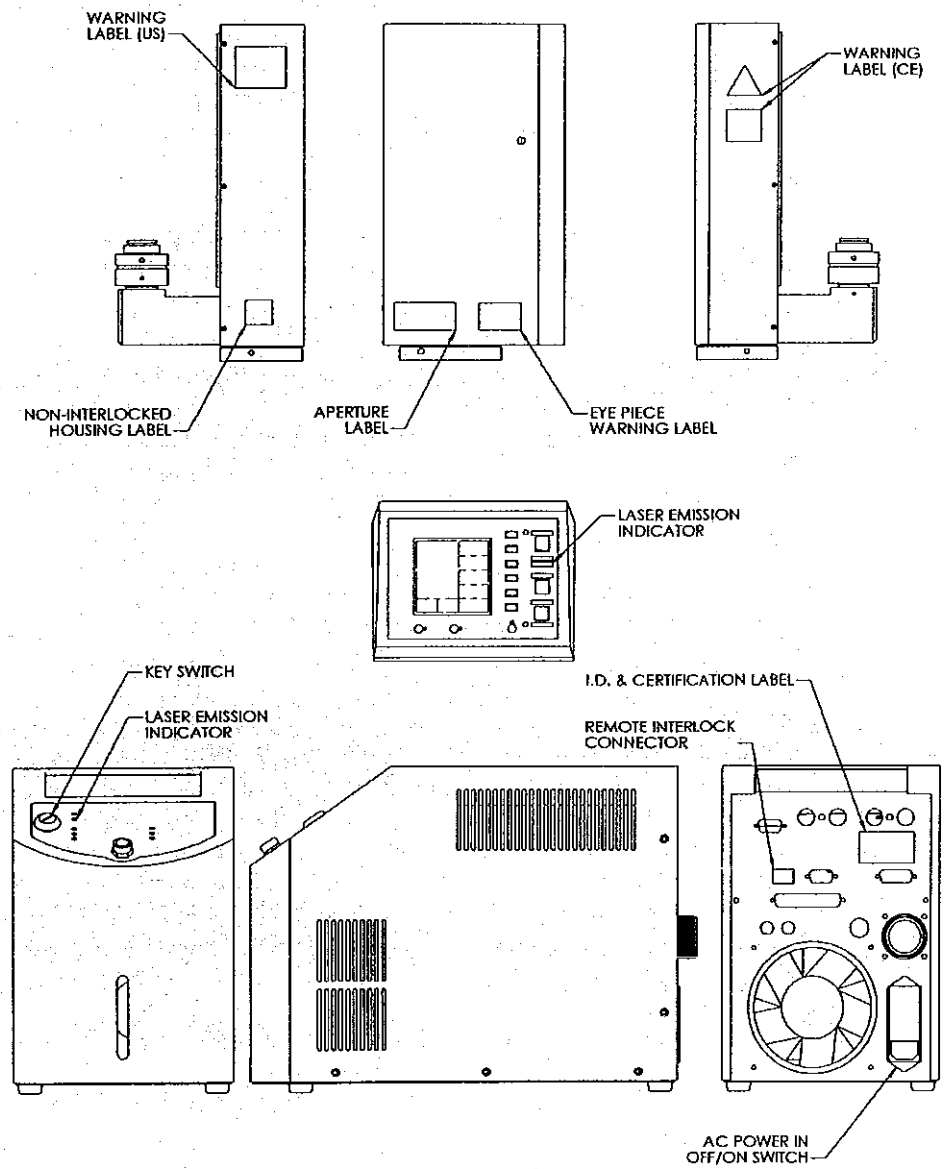
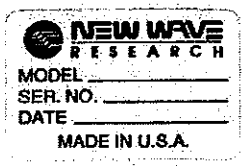
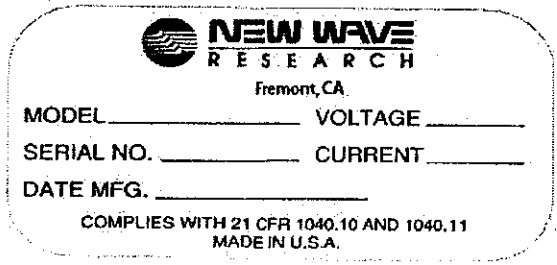


Figure 1-1: CDRH Safety Label Locations

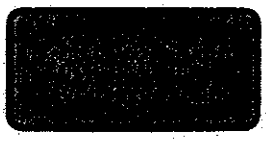


ID Label



ID/Certification Label

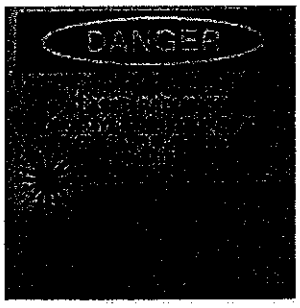
Aperture Label



Aperture Label

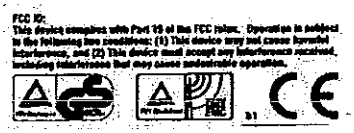
Interlocked Housing Label

Warning Label

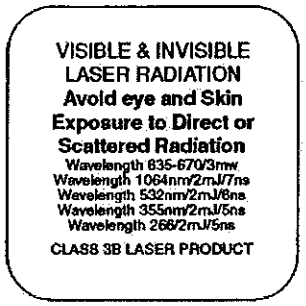


Class IIIb Warning Label

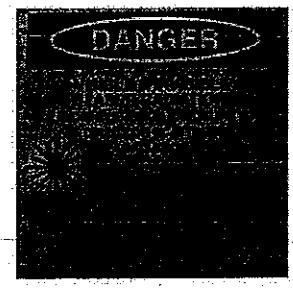
Eyepiece Filter Label



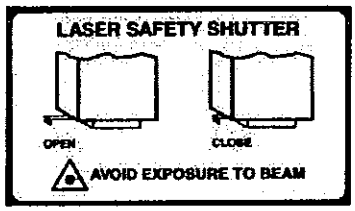
CE Certification Label



Class 3B Warning Label



Class IV Warning Label



Laser Safety Shutter Label

Class 4 Warning Label

Figure 1-2: Label Samples

US & Canada

The QuikLaze II conforms to the requirements of UL 3101 and CAN/CSA-C22.2 No. 1010.1

CE Declaration

Declaration of Conformity

We, New Wave Research, Inc., hereby declare that under our sole responsibility the products:

Single Head Nd:YAG Laser systems

Models Numbers: Polaris I, Polaris II, Polaris III, QuikLaze 20, QuikLaze 30, QuikLaze 40, QuikLaze 50, and QuikLaze 50ST, QuikLaze II.

Are in conformity with the provisions of the following EC Directives, including all amendments, and national legislation implementing these directives:

- **Low Voltage Directive 73/23/EEC**
- **EMC Directive 89/336/EEC**

And that the following harmonized standards have been applied

- **EN61010-1: 2001, EN60825-1: 1994+A11: 1996+A2: 2001 EN61326-1**
- **EN 01326-1: 1997+A1: 1998+A2: 2001**

TUV Report and License Numbers:

P2072123, E2072122, T2072139, C2072486

New Waves Research Inc.,
48660 Kato Road
Fremont, CA 94538
USA

Place: Fremont, CA Date: April 2, 2003

Edward North

Vice President, Quality

Description and Specifications

This section provides an introduction to the QuikLaze Nd:YAG laser. Also, a summary of system specifications is given.

Local or Remote Control

The QuikLaze Nd:YAG laser system can be controlled either from the remote control panel or externally through RS232 and a computer using user developed software.

Safety Interlocks

Two internal interlocks in the laser head (laser head cover off and laser removed from microscope); two internal interlocks in the power supply (water over temperature and low cooling water flow); two external interlocks, and one mechanical shutter on the laser head provide safeguards for the equipment and users.

The two external interlock connectors are located at the rear of the power supply, which can be shorted with the supplied connectors. The interlock connectors include two interlocks: 1) a work piece interlock, "Laser Standby" and 2) an external remote interlock, "System Stop." The work piece interlock is designed to stop the laser from firing if the interlock is opened. When it is closed the laser can resume firing after the Fire button has been pressed. This interlock is labeled "Laser Standby" on the rear of the power supply. The second external interlock labeled "System Stop" is designed to shut down the laser when a switch attached to this interlock is interrupted. Such a switch may be attached to a laboratory door. When the door is opened the laser will shut down. The laser enters a STOP mode and cannot be restarted until the START/STANDBY button has been pressed, the 10 second delay elapsed and the Fire laser button has been pressed. The status of interlocks may be viewed on page 3 "Interlocks" of the remote control panel. The interlock page is shown in Figure 2-7.

Power Supply

The power supply provides the QuikLaze Nd:YAG laser system with power, control electronics and cooling.

The upper portion of the power supply contains the control electronics and power supplies to run the laser.

Water Cooling System

The water-cooling system is required to keep the laser system running within an acceptable temperature range. The maximum cooling water temperature is 50° C or 122° F. The cooling system consists of a water pump, flow switch, reservoir, DI cartridge, heat exchanger and fan. The status of interlocks may be viewed on page 3, Interlocks, of the remote control panel.

QuikLaze Specifications

Following are specifications for the QuikLaze, Class IIIB laser systems.

Typical Pulse Energy (mJ/pulse) – HI/LO Setting (before microscope) – Class IIIB

Model	1064 nm	532 nm	355 nm	266nm
IR	.6/.2[1]			
Green		.6/.2		
IR/Green	.6/.2	.6/.2		
/UV3		.6/.2	.6/.2	
TriLite	.5/.1	.5/.1	.4/.1	
Green/UV4		.5/.1		.25/.08
Maximum energy				
Class 3B	5	2	2	2
Class 4	20	10	7	5

1) Minimum energy at High/Low settings.

Table 1-1: QuikLaze Typical Energy Specifications Before Microscope

Parameter	Specifications
Aperture Range	50x50 um w/50x objective (FS60,70) 40 x 40 um w/50xNUVobj. @ 355 nm 30 x 30 um w/50xUV obj. @ 266 nm 1x1 um w/100x objective 2x2 um w/100x obj. @ 1064 nm
Attenuation Range	100:1 for 532 nm using HI/LO > 40:1 1064 355/266 nm, 355 & 266 nm using HI/LO ranges
Pulse Rate	Single shot or 1-50 Hz

Table 1-2: QuikLaze System Specifications

Wavelength (nm)	Pulse Width (ns)
1064	3-4
532	3-4
355	3-4
266	3-4

Table 1-3: Typical QuikLaze Pulse Widths

Chapter Two

Installation

Introduction

The QuikLaze requires some preparation before it can be used. This chapter provides the information needed to install the complete system for safe operation. The chapter starts with the modifications to the microscope, and then continues to laser preparation. You will need a set of metric hex wrenches, 3, 2.5, 2, and 1.5 mm.

Microscope Conversion

The QuikLaze is designed to operate on specially modified Mitutoyo FS70, FS60, FS50 (Green only) and VM Zoom Microscopes or the Optem A-Zoom microscope. Become familiar with your microscope before attempting to install the QuikLaze. Order laser adapter kits from Mitutoyo for the VM Zoom and from the Optem for the A-Zoom.

	Mitutoyo					Optem
Model	FS60	FS60Y	FS70ZS	FS70LS	VMZoom	AZoom
IR		✓		✓	✓	✓
Green	✓	✓	✓	✓	✓	✓
IR/Green		✓		✓	✓	✓
Green/UV3	✓	✓	✓	✓	✓	✓
Green/UV4					✓*	✓*
TriLite		✓		✓	✓	✓

*Contact factory for UV4 microscope requirements

Table 2-1: Microscope Compatibility

WARNING: Operation of the QuikLaze 50ST laser without the eye protection filter installed may result in SEVERE EYE DAMAGE OR BLINDNESS.

Eye Protection Filter

All microscopes must be fitted with an eye protection filter or a beam blocking mechanism before the laser head unit is installed on the scope. Optem installs the eye protection filter for the A-Zoom when fitted with the laser adapter kit. Mitutoyo installs the eye protection filter in the VM Zoom when fitted with the laser adapter kit. **ENSURE THE EYE PROTECTION FILTER IS INSTALLED BEFORE OPERATING THE LASER.**

To install the eye protection filter on the Mitutoyo FS50, FS60, or FS70, follow these steps:

1) Remove the eyepiece assembly and the three screws that secure the eyepiece to the body of the microscope. (See Figure 1-1.)
2) Place the filter assembly over the eyepiece hole, with the flat side facing out and align the mounting holes with those in the microscope body.
3) Secure the eye protection filter assembly between the body and the eyepiece using the cap screws provided (use a 2 or 2.5 mm hex wrench).

Laser Adapter Ring

To install the laser on the microscope while maintaining strict safety, the adapter ring must be installed on the microscope video port.

The laser adapter ring supplied includes a pin that activates an interlock switch. If the pin is not present, the laser will not fire.

Note: Install the eye protection filter before installing the laser adapter ring.

1) Remove the three cap screws (use a 2.5 mm hex wrench) that secure the old adapter ring to the microscope. (See Figure 1-1)
2) Install the new laser adapter ring with the interlocking pin positioned slightly to the right of front-center of the microscope.
3) Use the three original cap screws to secure it to the microscope.

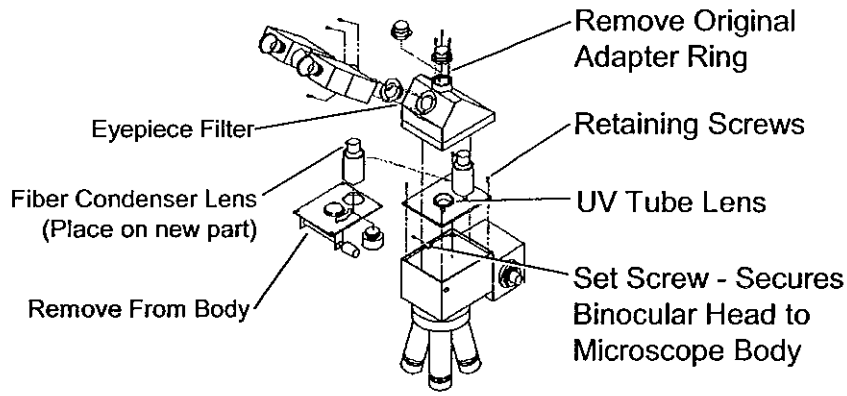


Figure 2-1: FS60 Microscope modifications

Microscope UV Conversion Kit

A UV tube lens kit allows UV3 (355 nm) energy to be transmitted through the Mitutoyo FS70ZS, FS60 and FS60Y. IR (1064 nm) energy cannot be transmitted through the FS60 or FS70ZS. The FS70LS and FS60Y transmit IR energy, so no conversion is required if only the IR or green wavelengths will be used.

The A-Zoom and VMZoom microscope must be ordered with a laser adapter kit suitable for the wavelengths produced by the laser.

FS60 UV Tube Lens Kit Installation

Remove the binocular head by loosening the set screw on the left side of the microscope (2.5 mm hex). The screw is located in the seam separating the binocular head from the main body of the microscope. 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 plastic cap be removed from the zoom knob and a set screw inside the knob loosened to release the knob.

Remove the four screws (3 mm hex) that 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.

Unscrew the ring nut that secures the fiber optic condenser 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 condenser lens assembly onto the FS60 UV tube lens kit mounting plate. Ensure that the aperture lever is facing the back 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 (use a 2.5 mm hex wrench). The screw is located in the seam separating the binocular head from the main body of the microscope. 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 that secure it to the microscope body (use a 3mm hex wrench).

Unscrew the ring nut that secures the fiber optic condenser 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 condenser lens assembly onto the FS60Y UV tube lens kit mounting plate. Ensure that the aperture lever is facing the back edge of the mounting plate so it is accessible once the microscope has been reassembled.

Install the UV tube lens kit plate.

Reinstall the binocular head on the microscope body.

FS70ZS UV Tube Lens Kit Installation

Remove the binocular head by loosening the two set screws on the right and left sides of the microscope (use a 1.5 mm hex wrench). The screws are located just above the seam separating the binocular head from the main body of the microscope. After the screws have been loosened, the binocular head can be lifted from the microscope body..

Unscrew and remove the zoom shaft. Remove the four screws (use a 3.5 mm hex wrench) that secure the zoom mechanism plate to the FS70ZS microscope body.

Remove the two screws securing the small zoom control gear. Remove the three set screws (use a 1.5 mm hex wrench) holding the large plastic gear to the zoom mechanism.

Unscrew the three screws securing the zoom mechanism to the zoom mounting plate.

Install the replacement FS70ZS UV tube lens kit into the large threaded hole in the middle of the zoom mechanism plate.

Reinstall the zoom plate on to the microscope body. Reinstall the binocular head on the microscope body.

Laser Preparation

This section provides power requirements information for the laser. Turn the key switch to the **OFF** position before installing the laser.

Voltage Requirements

The power supply operates on 95-240VAC, 50/60Hz and requires about 400 watts. The external spot marker is set for 100-120VAC or 220-240VAC 50/60Hz and requires about 250 watts.

Power Line Fuse

Two power line fuses are installed on the back panel near the power cord. For 100 - 125 VAC operation two 6.3 amp/250V, SPT, 5 x 20 mm, Time Lag (T.L.), High Breakage Capacity (HBC) fuses are installed. For 200 - 250 VAC operation two 4 amp/250V SPT 5 x 20 mm T.L. HBC fuses are installed. Acceptable fuses are the following:

Manufacturer	105-125 VAC	200-250 VAC
Schurter	19181/6.3A	19181/4A

The multi-function PC board (middle shelf PC board closest to rear of power supply) contains a time lag micro fuse. The fuse is a Schurter 1A/250V micro fuse, part number 0034.6615.

The power supply should be placed on the floor, near the microscope.

Laser Installation

This section provides describes laser and power supply connections.

Laser Head Mounting

The laser head may now be mounted on the microscope. Tighten the set screws that secure the base of the laser head to the laser adapter ring. See Figure 1-2. Use a 2 mm (5/16" standard) hex wrench to tighten the two set screws. The red emission LED should face the operator when standing in front of the Mitutoyo FS microscope. The emission LED faces to the right when mounted on an A-Zoom or VMZoom.

The PS888L is a laser version microscope from Seiwa. The PS888L is capable of supporting IR, Green and UV wavelengths without any modifications to the body of the microscope. The only modification required is the addition of the mounting ring and eyepiece filter.

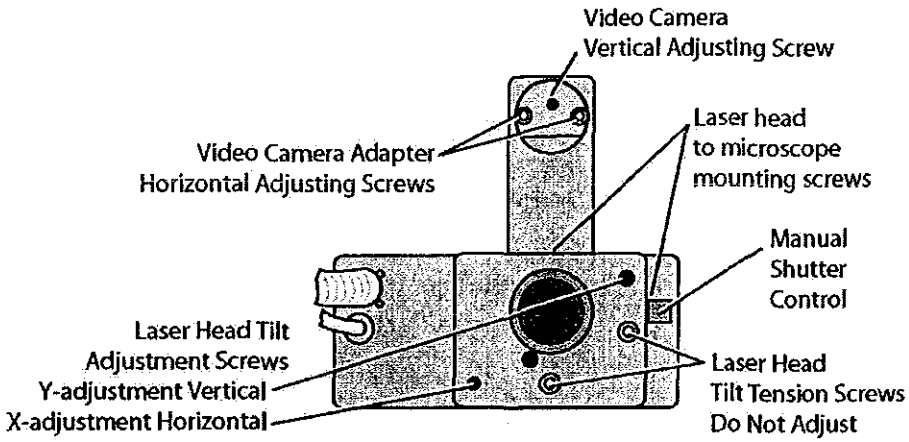


Figure 2-2: Laser Head Mounting/Adjusting screws – bottom view

Electrical Connections

Turn the power supply AC power entry line switch and front panel key switch to the "OFF" position before making any electrical connections. See Figures 1-3 and 1-4.

Laser Umbilical

Connect the large Main Umbilical smaller Secondary Umbilical to the appropriate connectors on the rear panel of the power supply. Be sure to tighten the connector screws to the chassis. Connect the cooling system hoses to the cooling system fittings on the back panel of the power supply. See Figures 1-3 and 1-4.

NOTE: It is very important that the screws and screw ring that secure the umbilical connectors to the power supply are tightened. If they are not tightened damage will occur to the high voltage contacts in the connector causing the system to fail.

Remote Control Panel

Connect the RS232 cable to the back of the remote control panel and to the back of the power supply. Either the remote control panel or a PC (but not both) may be connected to the RS232 connector on the power supply. Secure the cable at both connectors with the thumbscrews. Attach the foot switch to the two-pin connector on the back of the power supply. See Figures 1-3 and 1-4.

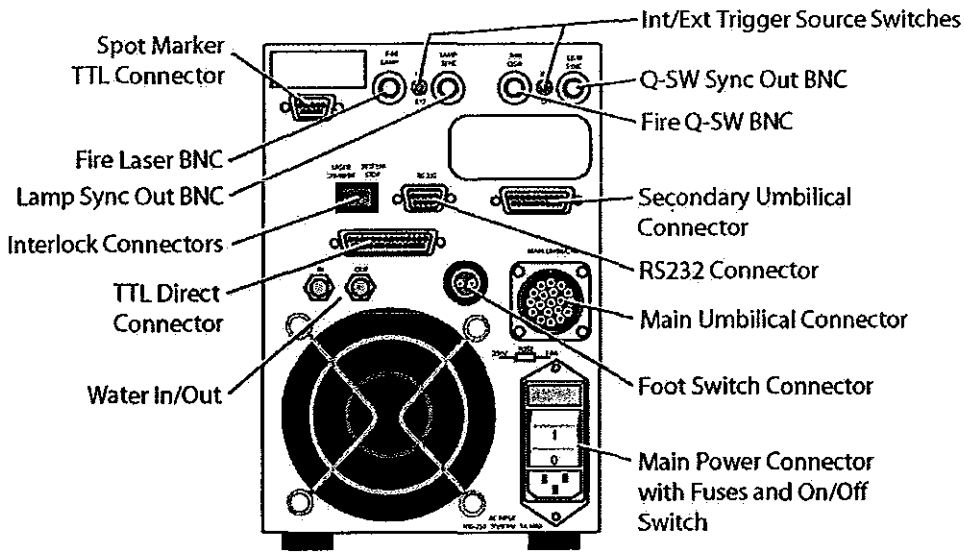


Figure 2-3: Power supply back panel - Mini Tower

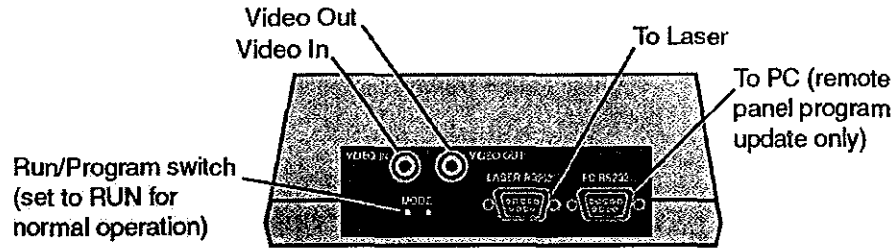


Figure 2-4: Remote Control Panel Connections.

Interlock Connector

Two interlock connectors are supplied with the system and must be installed before the system may be operated. The purpose of the interlock connector is to provide a method of interlocking the operation of the laser with a safety switch that may be installed on dark box or a laboratory door or other location. See Figure 2-3 for the location of the interlock connector.

Once a switch has tripped the interlock circuit, operation of the laser is stopped, and the laser must be restarted. If the "Laser Standby" Interlock is opened the laser stops firing. When this interlock is closed the laser may be fired by pressing the Fire button. If the "System Stop" interlock is opened the laser stops firing. To fire the laser the interlock must be closed, the START/STANDBY button must be pressed, the 10 second delay completed and then the Fire button must be pressed. An external switch may be added to the interlock circuit by cutting the wire in the interlock connector and soldering the switch in series with the interlock wire.

Plug the laser power cord into a utility outlet.

Video Marker

The video marker is standard in the QuikLaze 50ST. If a video system is used, the electrical connections to activate the video overlay marker are as follows.

Using a BNC cable, connect the output from the video camera to the VIDEO IN connector on the remote control panel. Connect a BNC cable from the VIDEO OUT connector on the remote control panel to the video monitor input connector.

Cooling System

Prior to operating the laser, the cooling system must be filled with de-ionized/distilled water. Carefully read and understand the SAFETY section of this manual before filling the cooing system. Take utmost caution to avoid spilling water inside the power supply.

Remove the water-fitting cap on the front panel of the power supply. Use the plastic squeeze bottle to fill the reservoir 80% full with de-ionized or distilled water. If the reservoir is overfilled water will enter the overflow tube and flow out through the bottom of the power supply chassis

NOTE: Only fill the system with de-ionized or distilled water. Use of any other water will damage the system and void the warranty.

Turn the key switch on the power supply to the ON position. Close the manual shutter on the laser head.

Press the START/STANDBY button on the remote control panel to activate the pump. If the pump stops operating push the START/STANDBY button repeatedly until the laser head fills with water and the pump stays on. The water level may be seen through the water level window on the front of the power supply. The pump will stay on at high speed for about 5 seconds and change to a lower speed. If the water temperature exceeds 35°C the pump and fan speed will change to the high-speed setting.

Add additional de-ionized (distilled) water until the reservoir is at least 80% full.

Press the STOP button. Replace the water fitting cap.

Note: The pump may require priming to initiate water flow. This may be done by disconnecting the water hose at the WATER OUT connector on the back of the power supply and forcing water into the system from this connector when the pump is not operating.

Laser Head Alignment

The laser head is internally aligned at New Wave Research. The output beam is aligned to exit the center of the aperture and run along the axial path. No adjustment of the optics inside the laser head is necessary.

The purpose of the alignment procedure is to center the laser beam through the optical path of the microscope. Adjustment screws tilt the laser head, thus affecting alignment. See Figure 2-2 for location of laser head tilt adjusting screws. The procedure to align the laser to the microscope optics is described below. See Chapter 2 for complete instructions on Starting and Stopping the laser.

Adjust the Energy setting to 20 and select energy level and set level to LO on the remote control panel.

Make sure the X and Y aperture are set to 60, which is the default, and select the green (532 nm) wavelength.

Fully open the manual shutter on the laser head. See Figure 2-2 for location of shutter.

Place a white card (see cutout on next page) on the working surface beneath the objective lens, Figure 2-5.

Select a 50x, 80x or 100x objective.

Turn the microscope source light to minimum intensity.

Raise the microscope with the focus adjustment knob, or lower the stage if possible, to increase the size of the white light spot to about one inch (25 mm). See Figure 2-5.

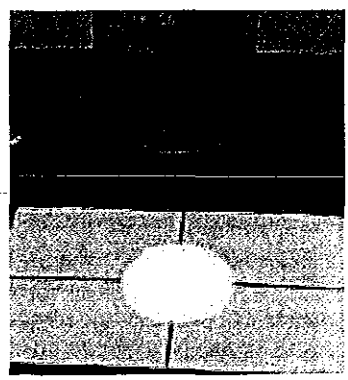


Figure 2-5: Place illumination in center circle on target

Turn the power supply key to the ON position. On the Remote Control Panel, press the START/STANDBY button. Set the trigger switch to CONT and select a repetition rate of 10 Hz. Press the FIRE button and the laser will begin firing.

Adjust the position of the green laser beam on the white card by slightly tilting the laser head. See Figure 2-6. This is done by adjusting the laser head tilt adjustment screws (use a 2.5 mm hex wrench) in the back left corner (Y adjustment) and front right corner (X adjustment) of the base plate. See Figure 2-2. Adjust the laser head tilt screws until the square green laser beam is in the center of the round white microscope spot.

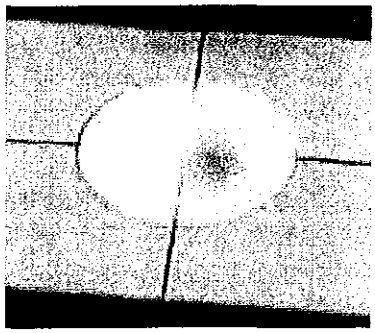
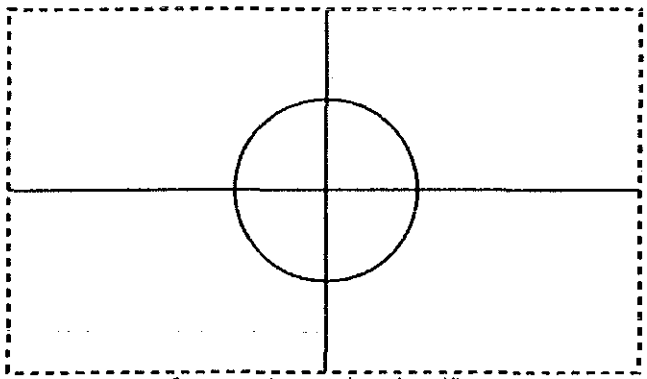


Figure 2-6: Aligning the green laser spot on the white card (see below)

If the green laser spot is not visible, change to a lower magnification objective lens and center the laser beam. Then switch back to a 50x or 100x objective for the final alignment.



LED Spot Marker Illumination (standard)

The LED spot marker illumination is standard in the QuikLaze 50ST. The LED illumination has been built into the laser head assembly. The LED spot marker can be turned on and off, and the light intensity can be increased and decreased via the serial remote box (see Figure 3-4).

External Spot Marker Illumination (optional)

The external spot marker illumination is provided by an optional external 150 watt white light that is fiber coupled to the laser head. It can be installed using the following instructions.

Connect the fiber optic cable from the laser head into the external illuminator.

Plug the external illuminator power cord into a utility strip. The illuminator is turned on and off and the light intensity is increased and decreased by the front panel switch on the illuminator.

Spot Marker Adjustments

The spot marker provides a preview of the cutting region. The location of the spot marker on the video monitor and parfocality with the eyepiece may be adjusted when viewed via the video camera.

Camera Focus

The camera focal plane can be matched to the eyepiece focal plane (parfocality) by adjusting the camera adapter focus ring as described below. See Figure 2-8.

Bring a sample material into focus through the eyepiece. Loosen the focus ring set screw (use a 1.5 mm hex wrench) on the camera adapter. Turn the focus ring to lower or raise the camera until the image is in focus on the video monitor. Retighten the focus ring set screw.

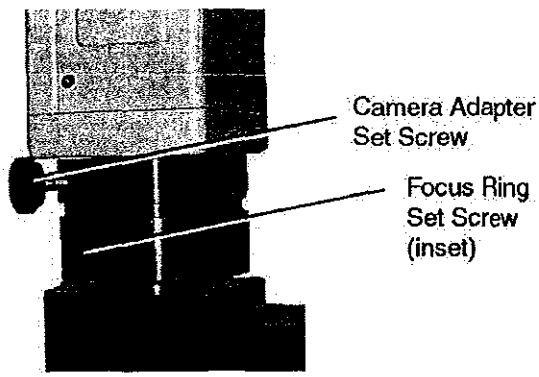


Figure 2-7: Camera Adapter Focus Ring

Centering the Spot Marker

Center the spot marker on the video monitor by adjusting the video camera adjusting screws. The video camera adjusting screws are located on the bottom side of the camera adapter. See Figure 2-2.

Adjust the location of the spot marker image by releasing the two horizontal socket head screws and moving the mounting plate. When the image is properly positioned, re-tighten the screws.

Video Marker Adjustment

The video marker is adjusted at the factory to closely match the size of the laser cut. However, if the video marker does not closely match the size of the laser cut (PAL vs NTSC) or the location, the video marker may be adjusted from the Video Marker page that may be accessed from the Laser Info page. See chapter 3 for additional information.

Computer Interface

The QuikLaze can be controlled via the RS-232 interface by a user developed program.

Attach one end of an RS232 serial cable to the 9-pin RS232 connector on the back of the power supply and the other end to the remote control box. If a PC is going to be used, attach an RS232 cable (not included) from the RS232 connector on the PC to the PC RS232 connector on the remote box. When a PC is used, the PC disables the remote control box completely and will have a full control of the operation of the QuikLaze.

RS232 control is initiated by sending a command from the PC to the laser. See the Serial Communications Protocol manual for further information.

Chapter Three

Controls and Operation

Starting the Laser

After the installation procedure is completed and the laser safety section is thoroughly understood, the laser may be started. All covers must be installed and the reservoir filled with de-ionized (distilled) water. See Figure 3-2 for location of the controls. The key switch on the power supply must be turned to the ON position prior to operation of the laser.

Ensure that the QuikLaze has been properly installed, including the eyepiece filter, and that you have read and understand the SAFETY section of this manual.

1) Ensure that the safety shutter on the bottom of the laser head is closed.
2) Press the AC power switch on the back panel of the power supply to the ON position. The front panel AC ON LED illuminates.
3) Turn the power supply key switch on the front panel of the power supply clockwise to the ON position. QuikLaze-50ST initializes. All the Power Supply Front Panel LEDs blinks once and then shuts off. Only the AC ON LED and RS-232 LED remains on.
4) Note that when the AC ON LED on the front panel of power supply and the LASER EMISSION LED on the Remote Control Panel are illuminated, there is a ten second (10 blinks) delay before laser firing can occur. *Note: The Remote Control Panel also displays the ten second delay period prior to operation.*
5) The Run Page displays on the Remote Control Panel.
6) Ensure that the energy setting on the remote control panel is set to the LO position. Set the energy setting to 20. Please refer to the Remote Control Panel LCD pages for more details on changing the settings prior to operation.
7) Press the STANDBY/START button on the Remote Control Panel. The LASER EMISSION LED lights up. The Power Supply LASER EMISSION LED blinks for ten seconds before laser firing can occur.
8) Press the 4th button on the Remote Control Panel to select the desired trigger setting. Three trigger settings are available:

1 SHOT	1 shot is fired
BURST	1 – 200 shots @ 50 Hz
CONTINUOUS	Continuous shots @ 50 Hz

9) Open the manual shutter when ready to operate safely (see safety section).
10) Open the X-Y aperture to the desired dimension when you are ready to fire the laser.
11) Press the FIRE button or the foot switch when ready to fire laser.

Turning the Laser Off

The laser can be turned off at any time. The standard way to turn the laser off is the following:

1) Press the STOP button on the remote control box.
2) Close the manual external aperture shutter at the base of the laser head.
3) Turn the power supply key switch to the OFF position.
4) If the laser is being turned off at the end of the day, turn the AC power line switch OFF.

Interlocks

The QuikLaze Nd:YAG laser system is equipped with both internal and external interlock switches. The internal interlocks ensure that the laser itself is within operating parameters and will not be damaged. The external interlock can be used to interlock laboratory doors or microscope lifts that can turn off the laser if the interlock switch is tripped.

Internal Interlocks

The QuikLaze Nd:YAG laser system has the following internal interlocks: laser head cover, microscope/laser head interlock, cooling system-high water temperature, and the cooling system low flow.

External Interlocks

The laser may be interlocked so that laboratory or room doors cannot be opened while the laser is running continuously. The connectors on the back of the power supply may be wired so as to disable the laser if an external interrupt switch has been tripped.

If the "STOP LASER" external interlock circuit is opened the laser will stop. The remote control panel LCD screen will display the Interlock status page. To restart the laser, reset the external interlock switch. The laser may then be started using the procedure given above in the section "Starting the Laser." If the LASER STANDBY" interlock is interrupted, reset the interlock switch and press the FIRE button to begin firing the laser.

Triggering and Timing

The QuikLaze is a flexible system to allow triggering the laser internally or externally. If the QuikLaze is triggered internally there are several outputs to simplify synchronizing equipment with the laser.

There are four external BNC connectors located on the back of the power supply. Two of the connectors are inputs for triggering the laser. The other two are outputs used for synchronizing the laser to other equipment. The trigger input impedance is about 1K ohms. A low impedance trigger source should be used to minimize timing errors. The location of the BNC I/O connections is shown in Figures 1-3 and 1-4. The small switches between the BNC connectors are set to the "EXT" position to trigger the laser using an external pulse generator. For normal operation these switches must be set to "INT".

"Fire Laser Input" — A positive 5 volt, 1 ms pulse width, 5 mA nominal, signal is required to fire the laser. This input will fire the flash lamp at a preset time following the external fire laser signal.

Fire Q-SW Input	A positive 5 volt, 1 ms, 5 mA nominal pulse. This pulse should follow the fire laser pulse by about 200 µs.
"Lamp Sync Out"	A 5 volt, 3.5 ms nominal, pulse. A positive transition from 0 volts to +5 volts occurs when the flash lamp is fired.
"Q-Switch Sync Out"	A 5 volt, 6 microsecond nominal pulse. A positive transition from 0 volt to +5 volts occurs when the Q-switch is energized. The laser pulse will exit the laser head approximately 80 ns after the rising edge of this signal.

Laser Controls

Power Supply

The power supply has an ON/OFF switch on the rear panel and the key switch on the front panel. The power switch and key switch must be in the ON position for the laser to operate. The front panel also includes LED indicators showing the status of the laser system. See figure 3-1.

AC Power	Power entry module switch is in the **ON** position and the AC line fuses are good.
Laser ON	Blinks for 10 seconds and turns on to indicate the laser is ready to fire.
Water Flow	Indicates that the cooling water flow is too low.
Water Temp	Indicates that the water temperature is too high.
Interlock	Indicates that the external or work piece interlock is open.
RS232	Indicates that the Laser is under control from a device (remote control panel or PC) connected to the RS232 port.
Flash Lamp	Indicates that the flash lamp switch has been set to EXT. The laser cannot be fired in this mode unless an external trigger signal is supplied to the Flash Lamp BNC.
Q-Switch	Indicates that the Q-switch trigger switch has been set to EXT. The laser cannot be fired in this mode unless an external signal is supplied to the Q-switch BNC and the Flash Lamp BNC with the correct timing.

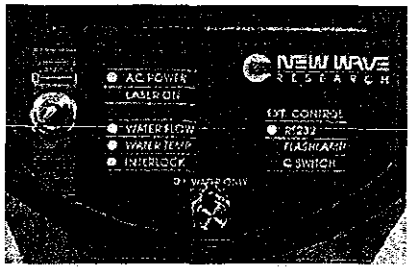


Figure 3-1: Power Supply Front Panel

Remote Control Panel

The remote control panel is a small, microprocessor based unit that communicates with the laser power supply through the RS232 port. See Figure 3-2. It sends the appropriate commands to control the laser and receive laser status. This information is displayed on a 3" x 3" LCD panel. Power to the remote control panel is supplied through pin 1 of the DB9, RS232 connector. An auxiliary +12VDC input connector is provided if the remote control panel firmware will be updated while not connected to the laser.

The remote control panel does not have to be disconnected from the laser RS232 port when PC control of the laser is required. In this case, the PC automatically overrides and disables the remote control box and will have complete control of the QuikLaze.

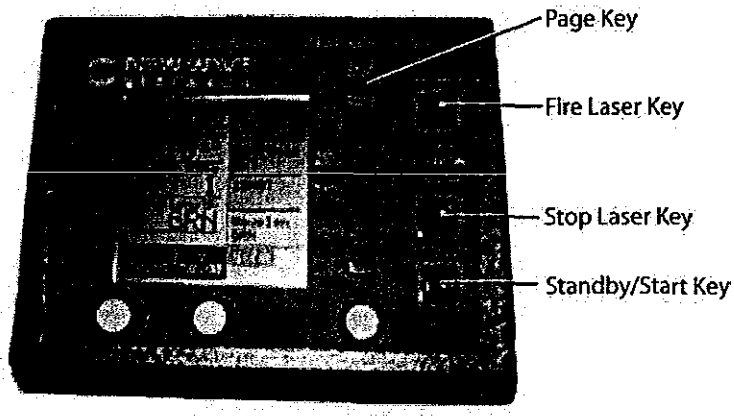


Figure 3-2: Remote Control Panel

Fixed functions and Soft Keys

The remote control panel includes fixed function keys, soft keys, and soft knobs.

Fixed function keys include the PAGE, STOP, START/STANDBY, and FIRE keys. The Page key allows the operator to sequentially select LCD screens (pages). Each time the PAGE key is pressed the next page displays. See Figure 3-2 for the location of fixed and soft keys and knobs.

The STOP key stops the laser from firing and shuts down the high voltage power supply and cooling system. The STOP key stops the laser from any page.

The STARTS/STANDBY key turns on the Laser Emission LED, starts the high voltage power supply and cooling system. The START/STANDBY key may be used to stop the laser from firing, however, the high voltage power supply and cooling system remain on in this mode.

The START/STANDBY key may be pressed from any page. The Run Page is recalled if this page is not already displayed after pressing the START/STANDBY button.

The FIRE button allows the laser to be fired according to the parameters shown on the Run Page. The laser may not be fired until 10 seconds after the first time the START/STANDBY button has been pressed and the Laser Emission LED has been turned on. **The laser may be fired only from the Run Page.**

NOTE: Pressing the FIRE key from any other page recalls the Run Page and does not fire the laser.

The soft keys are the five keys located directly below the Page key. These keys change functions depending upon the page displayed on the LCD screen. The three knobs below the LCD display are "soft" knobs. Their function will change depending upon the page displayed on the LCD screen. The right knob is used to change parameters of the function selected by the "soft" keys. The specific functions of the "soft" keys and knobs are described below in the sections describing the LCD Pages.

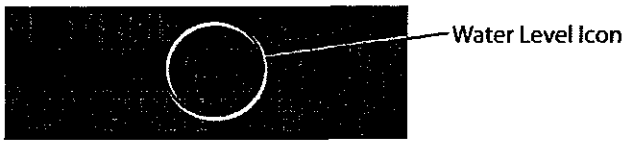
Indicators

LEDs indicate the status of the laser. The status states are STOP, START, STANDBY, and FIRE. The Laser Emission indicator is illuminated when the START/STANDBY key is pressed the first time and 10 seconds before laser emission can occur.

LCD Pages

LCD screens (pages) may be sequentially selected by pressing the PAGE key. The LCD screen is typically divided into four sections. The left section provides laser operational status information; the right section displays labels for the soft keys; the bottom section shows labels for the soft knobs if they are used in a particular screen; and the top section shows the label of the current page being displayed and laser status. Laser status can be the following:

OFF	Laser cooling system and high voltage power supply are OFF.
WAIT	START/STANDBY key has been pressed and laser is in the 10-second delay mode. The status of the delay is shown in a count down timer.
READY	Laser cooling system and high voltage supply are ON. The laser is ready to fire.
*------	Laser is actively firing.
WATER LOW	When the coolant is low, the water-low Icon flashes near the top of the current LCD page.



The LCD pages are the following:

RUN PAGE	allows control of the laser. The laser may be fired only from this page.
SETUPS	allows up to 10 sets of laser parameters to be stored and recalled.
INTERLOCKS	shows the status of internal and external laser interlocks.
LASER INFO	shows laser system information including laser model, serial number, firmware version, manufacturing date, wavelengths, maximum repetition rate, and shot count.

Run Page

The Run Page shown below displays and permits control of laser parameters. The laser may be fired only from the Run Page.

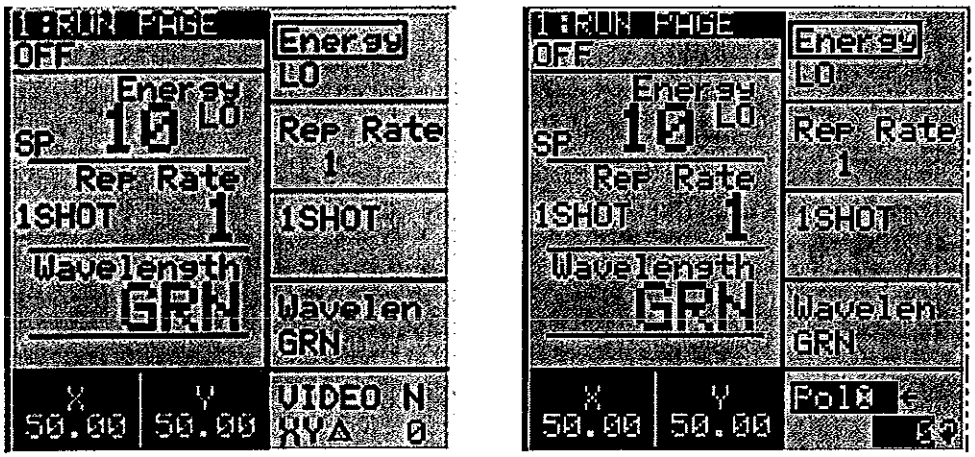


Figure 3-3: Standard Run Page and Run Page with Polarizer Option

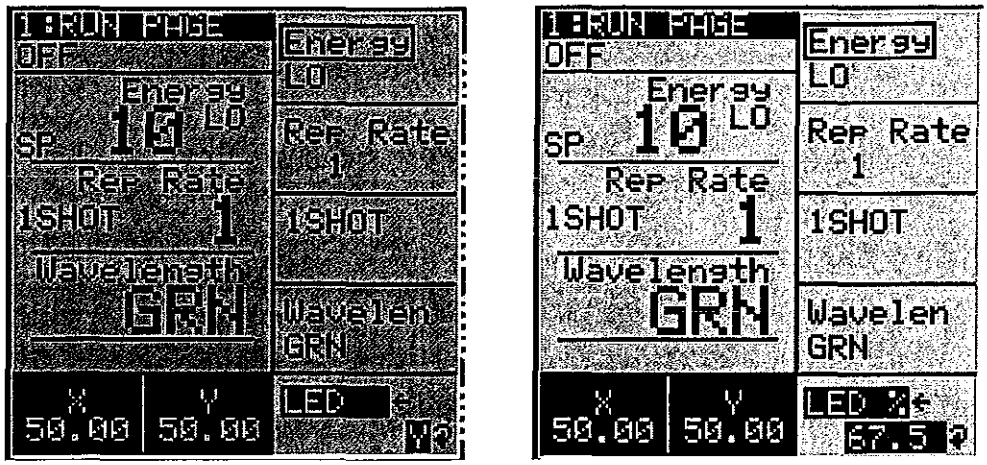


Figure 3-4: Run Page with LED Spot Marker *ON* and LED Spot Marker with percentage set.

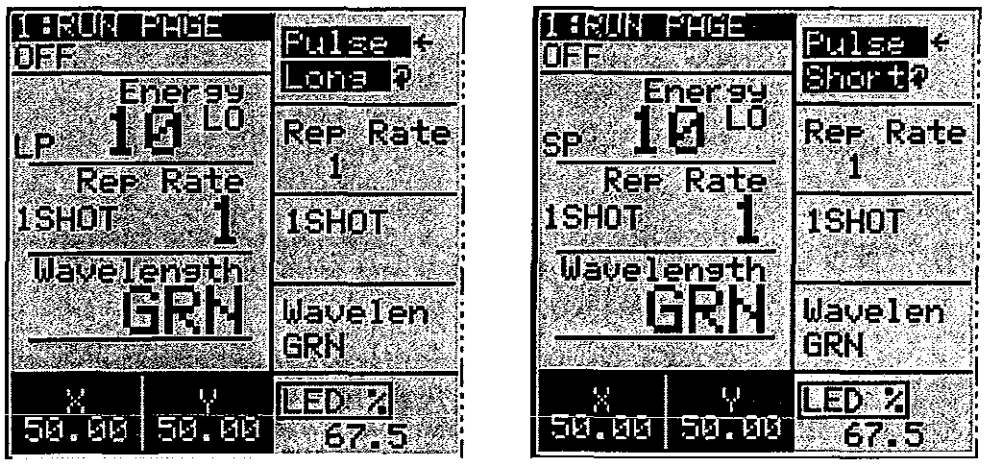


Figure 3-5: Run Page with Long Pulse and Short Pulse selected

The left side of the LCD display shows the operating conditions of the laser including energy level, (0-100), repetition rate (50 Hz max.), trigger setting (Cont. – continuous firing; Burst – 1-200 shots/burst; and 1-Shot modes).

Laser parameters may be changed using the soft keys on the right side of the LCD display. The labels for the soft keys are shown on the right side of the LCD screen. When a soft key is pressed the label color is reversed indicating that parameter has been selected.

The settings may be changed for some laser parameters by pressing the key again or by using the soft knob directly below the column of soft keys.

If the number of settings is three or less, the setting may be changed by pressing the soft key again or by using the soft knob setting. If the number of setting is greater than three, the knob below the soft keys must be used to change the

setting. Settings that may be changed by the soft key have the symbol "□" next to the key. Settings that must be changed with the soft knob have the "↻" symbol next to the key.

The following table summarizes soft key control of laser parameters from the Run Page:

Soft Key Assignment	Variable	Control Method
Energy – Laser energy level (optional feature)	Hi, Low, or 0 – 100	Soft Knob
Repetition Rate – Laser firing rate in Hz for continuous and burst modes	0 – max. Hz	Soft Knob
Trigger Mode – Laser firing mode. The laser is activated in the selected mode by pressing the Fire button or depressing the foot switch.	Continuous, Burst, 1-Shot Burst setting = 1-200 shots	Soft Key Soft Knob
Video XY – Adjusts rotation of the laser aperture – one click adjusts 1°	-90° - +90°	Soft Knob
Video Polarizer (optional) – adjusts in 2° increments	0° - 180°	Soft Knob
Pulse – set to Long or Short pulse		Soft Knob
LED Spot Marker (on/off and brightness)	Y or N; 0 – 100 %	Soft Knob

Table 3-1: Run Page Soft Key Summary

Setups Page

The Setups Page allows up to 10 laser settings to be stored and later recalled. The Setup Page shows the current laser settings and the settings stored in the selected memory location.

A setting to be stored must first be set up on the Run Page. Run Page settings will appear as "Current Settings" in the Setups Page and may be stored. The Setups Page is shown below:

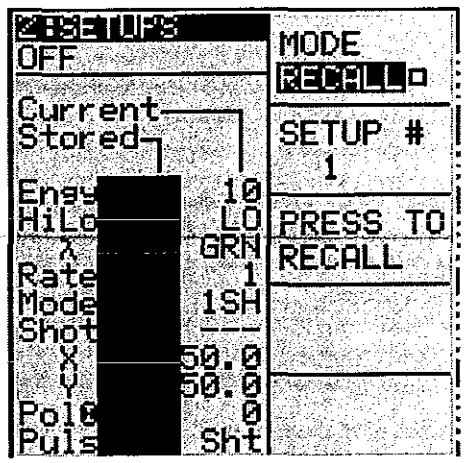


Figure 3-6: Setups Page

The left side of the LCD screen shows the current laser settings that appear on the Run Page and the stored settings in the memory location shown in the "Setup #" label on the right side of the LCD screen. The right side of the LCD screen also includes soft key labels for selecting Store and Recall modes, a Store/Recall key and a key that permits the user to return directly to the Run Page. The Table below summarizes the soft keys assignments for the Setup Page.

Soft Key Assignment	Variable	Control Method
Store/Recall Mode – Selects between Store and Recall modes	Store or Recall	Soft Key
Setting # – memory location	1-10	Soft Knob
Store/Recall – Causes laser settings to be saved and recalled	Store or Recall	Soft Key
Run Page – returns to Run Page		Soft Key

Table 3-2: Setups Page Soft Key Summary

Interlock Page

The Interlock Page shows the status of internal and external laser interlocks. When the laser stops the Interlock Page is automatically recalled allowing the user to determine which interlock may have caused the laser to stop. Pressing the Start/Standby button from the Interlock page will recall the Run Page if the laser successfully starts. The Interlock Page is shown in Figure 2-7.

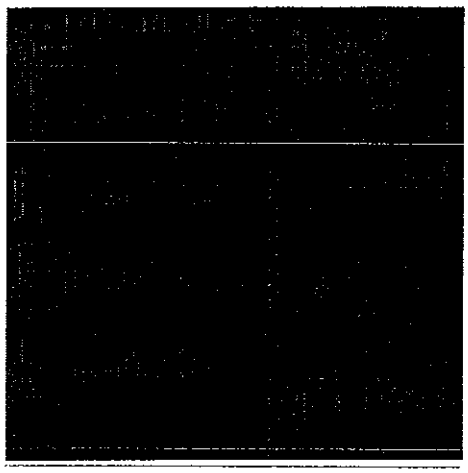


Figure 3-7: Interlock Page

The "Run Page" soft key allows the user to recall the Run Page. The "Reset" soft key causes the remote box microprocessor to reset and reload its program. Settings stored in the Setup Page are not lost when the control panel microprocessor is reset or power is shut off to the laser. The Interlocks are described in the following table:

Interlock	Description	Corrective Action
Flow	Water flow is not sufficient	Check water level and add additional water if necessary.
Temp	Water temperature is too high	Check water level, ambient air temperature, and air flow. Allow laser to cool down before restarting.
Laser Stop	External interlock switch is open	Close External interlock switch. Press Start/Standby button to restart laser. Fire button may be pressed after 10-second delay.
Work Standby	Work Piece interlock switch is open	Close Work piece interlock switch. The Fire button may be pressed to cause the laser to begin firing again.

Table 3-3: Laser Interlock Summary

Laser Info Page

The Laser Info Page shows important information about the laser system including laser model, laser serial number, laser firmware version number, laser date of manufacture, maximum laser repetition rate, wavelengths available and the number of shots that have been fired.

Soft keys are available from this page to access the RUN page and the XY Aperture adjustment and VIDEO MARKER adjustment pages. The Laser Info page is shown in the following figure.

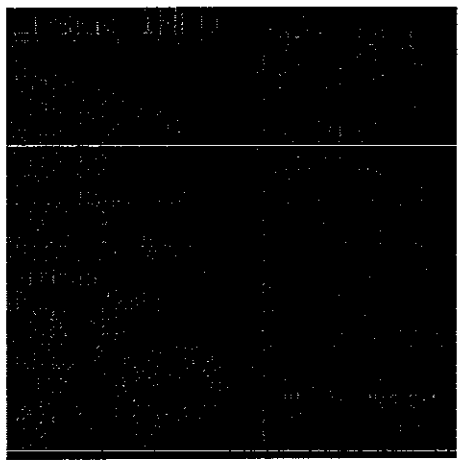


Figure 3-8: Laser Info Page

Chapter Four

Maintenance and Troubleshooting

Introduction

The QuikLaze Nd:YAG laser system will provide years of reliable service if it is kept clean and well maintained. This section describes several procedures that should be performed on a regular basis. The QuikLaze system is designed such that the head and power supply need to be opened only for system maintenance.

Periodic Maintenance Summary

Following is a summary list of weekly, monthly, yearly, and as needed recommended maintenance items. These items should be performed according to the schedule below to ensure proper operation the QuikLaze.

Weekly – Circulate the cooling system water by operating the laser at least 30 minutes per week. This is necessary to help prevent a build up of contaminants in the cooling system.

Monthly – Check cooling water level in the power supply. Keep the water level at 80% of full. Add only de-ionized or distilled water.

Check laser head alignment on the microscope.

Check cooling system for signs of leakage.

Yearly – Replace de-ionization cartridge (see next section for replacement instructions).

Check the energy level of all wavelengths through the appropriate objective lens. Measure energy with a calibrated energy meter after the objective lens, with all controls set to maximum and the XY shutter fully open. Do not focus the laser beam on the detector. Raise the microscope up so that the laser beam fills at least 50% of the detector surface. Energy measurement should be greater than: 1064 nm - 200 uJ; 532 nm - 150 uJ; 355 nm - 60 uJ; and 266 nm - 90 uJ.

As needed – Replace spot marker illuminator lamp - Type EKE lamp, 21 volts, 150 watts.

Replace flash lamp. The need for replacement will depend upon usage. The flash lamp should be good for about 30,000,000 shots.

Replace cooling system pump.

Cooling System

The cooling system is an important part of the QuikLaze Nd:YAG laser system. The cooling system must be maintained periodically to ensure reliable performance. Running the pump allows the de-ionizing filter to purify the water.

Circulate the cooling water by running the laser power supply and pump at least 30 minutes each week. This is essential to prevent the build-up of contaminants in the system, which will be deposited on the flash lamp and laser rod resulting in decreased output energy. If you cannot run the laser at least 30 minutes each week, you must completely drain the cooling system and blow clean dry air through the lines.

WARNING!!! Never add tap water to the cooling system. Only de-ionized or distilled water may be used.

De-ionization Cartridge Replacement

The de-ionization (DI) cartridge must be replaced approximately once every year. The following procedure can be used to replace the de-ionization cartridge.

CAUTION: High-voltage. When changing the water or any other repairs inside the power supply, make sure that power to the system is OFF.

1) Press the STOP button on the remote control panel.
2) Disconnect the WATER RETURN hose from the back of the power supply and hold it over a drain container.
3) Depress the START/STANDBY button on the remote control panel to start the pump. The pump will force the cooling water from the hose into the drain container. Press the START/STANDBY button again until all water has been pumped out of the system. Press the STOP button on the remote to stop the pump.
4) Turn the power supply off with the key, and disconnect the AC power cord from the power supply.
5) Remove the power supply cover.
6) Disconnect the hose from the top of the de-ionization cartridge, Figure 3-1. (White Cylinder)
7) Disconnect the hose leading from the bottom of the de-ionization cartridge, see Figure 3-1.

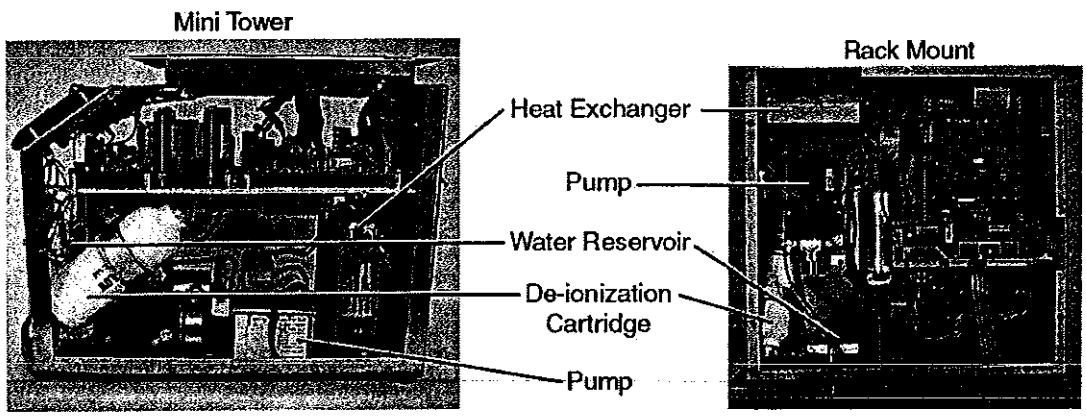


Figure 4-1: Cooling System in the Power Supply

8) Remove the old de-ionization cartridge by sliding it up and out of the power supply. Disconnect the hose from the old de-ionization cartridge.
9) Connect the hose to the bottom of the new de-ionization cartridge. Install the new de-ionization cartridge. Reconnect the water hose to the top of the

cartridge. ***Note: when re-installing the cartridge, it is important to pay attention to the direction of the water flow arrows.***

10) Refill the cooling system with de-ionized or distilled water and run the system briefly to check for leaks before replacing the power supply cover. Disconnect power before replacing cover.

Flash Lamp Replacement

The flash lamp needs to be changed when the specified energy cannot be achieved or if the laser energy fluctuates significantly from shot to shot. This can be seen over the course of several hundred pulses. The flash lamp should be useful for at least 30 million shots. Use the following procedure to install a new flash lamp.

1) Place the power supply at a lower elevation than the laser head.
2) Disconnect all power to the laser and remove the laser head cover.
3) Disconnect both water hoses from the back of the power supply and place them into a drain container. This will allow water to drain from the pump chamber and minimize leakage in the laser head. Connect the two ends of the hoses together after sufficient water has drained from the pump chamber so that you see air in the water line.

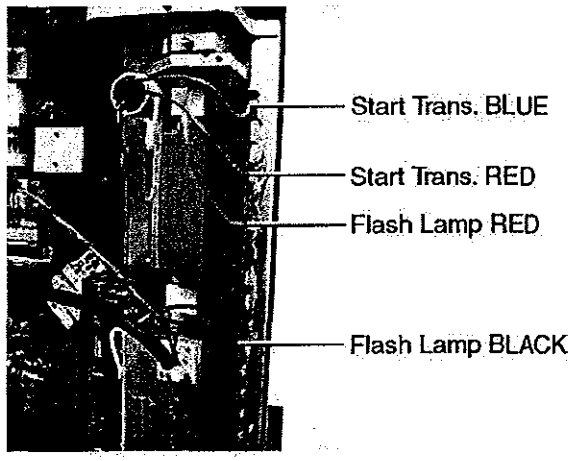


Figure 4-2: Removing Leads to Replace Flash Lamp

4) Remove the small RED and BLUE start transformer leads from the terminal strip, Figure 3-2.
5) Remove the RED and BLACK flash lamp leads from the terminal strip, Figure 3-2.
6) There are four recessed screws that secure the pump chamber to the terminal block and resonator. Turn the four recessed screws counter clockwise to release the pump chamber, Figure 3-3.

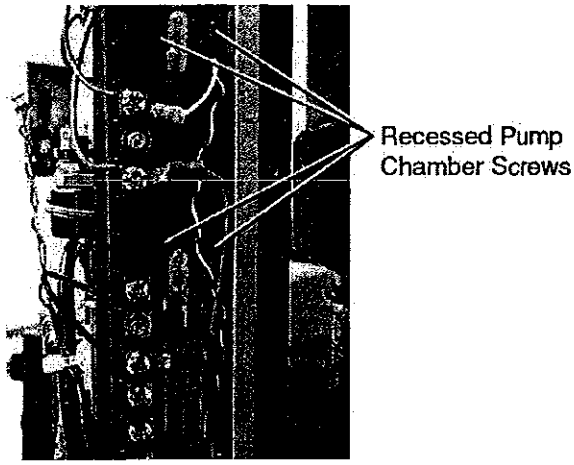


Figure 4-3: Recessed Pump Chamber Screws

7 Remove the pump chamber from the laser head and carefully place it on a clean surface.

8) Remove the pump chamber end caps that secure the flash lamp within the pump chamber, Figure 3-4.

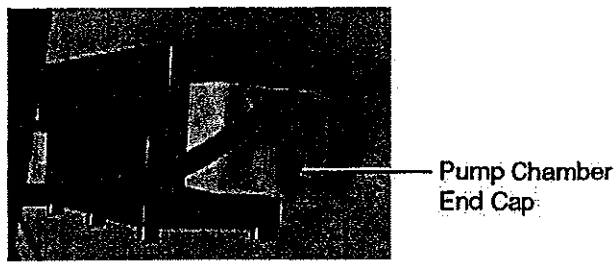


Figure 4-4: Removal of Pump Chamber End Cap

9) Carefully straighten the lamp leads and remove the flash lamp from the pump chamber. Note the position of the RED and BLACK lamp leads.

11) Install the new flash lamp with the RED and BLACK leads on the same side as the original lamp. The RED lamp lead should be at the same end of the pump chamber as the start transformer. Bend the lamp leads so that they are perpendicular to the lamp.

Avoid all contact with the glass surface of the lamp. This may leave grease marks that will degrade lamp performance and may shorten lamp lifetime.

12) Carefully place the o-rings over the flash lamp and slide them into place using tweezers, Figure 3-5. Reinstall the pump chamber end caps and carefully tighten the screws to hold the lamp in place. The flash lamp leads should come straight up from the pump chamber.

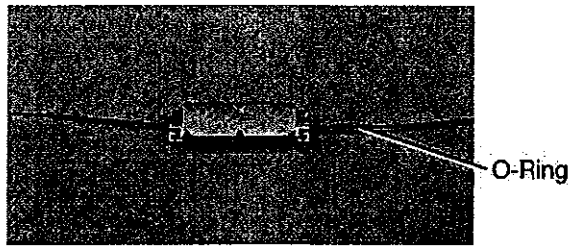


Figure 4-5: Installing O-ring on Flash Lamp

13) Carefully check the two o-rings on the resonator side plate, Figure 3-6. The o-rings seal the pump chamber against water leaks. Ensure that the o-rings are in place, before replacing the pump chamber in the resonator.

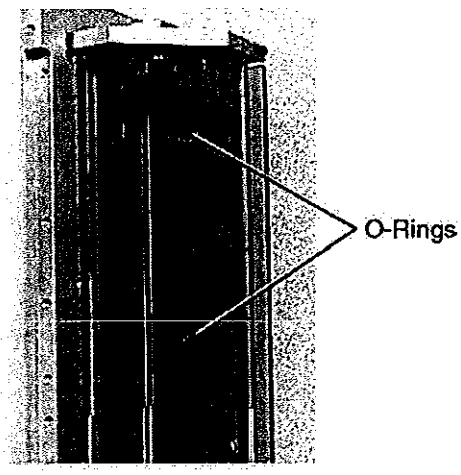


Figure 4-6: Pump Chamber Water Seal O-rings

14) Reinstall the pump chamber. Tighten the four screws to connect the pump chamber to the resonator.

15) Reconnect the RED and BLACK flash lamp leads.

16) Reconnect the cooling water hoses to the power supply

17) Start the power supply and check the cooling system for leaks and adequate water level before replacing the laser head cover. Disconnect power before replacing the laser head cover.

Trouble-shooting

This section lists a number of conditions that may be observed during the lifetime of the QuikLaze Nd:YAG laser system. Following the list of conditions is a set of procedures that may be used for resolving specific conditions to improve laser performance.

Observed Conditions

To use this section, find the observed condition in this section that matches the condition of the laser. Follow the recommended procedure to correct the situation. If the problem cannot be resolved by following the procedure, then phone New Wave Research at 510-249-1550, Fax 510-249-1551, email: lasers@new-wave.com to get technical support for the laser.

Observed Condition	Recommended Procedure
Laser does not start	Procedure 1
Laser does not fire	Procedure 2
Low output energy	Procedure 3
Unstable laser energy	Procedure 4
Clipped laser beam	Procedure 5
Non-uniform beam	Procedure 6
No laser output	Procedure 7

Table 4-1: Observed Conditions

Recommended Procedures

The following procedures should be followed to resolve the observed conditions listed in the section above.

Procedure 1 Laser does not start

If the laser does not start, please check the following points.

The laser AC power cord is plugged in, the outlet has power and the power entry switch has been turned ON.

The key switch on the power supply is turned to the ON position, and the AC power light is illuminated.

All interlocks switches are closed check; external interlocks, laser head cover interlock, laser microscope interlock, flow switch interlock.

Procedure 2 Laser does not fire

Check the Fire Flashlamp and Fire Q-Switch toggle switches on the back of the power supply between the BNC connectors. The switches should be in the INT position for normal operation.

Procedure 3 Low output energy

Make sure that the Hi/Lo switch is in the Hi position.

Check the setting of the attenuator. Increase to at least 50%.

Make sure a 50x or higher magnification objective lens is being used.

Test other locations on the sample for consistency. Flush the cooling system.

Procedure 4 Unstable laser energy

The pulse stability for the QuikLaze Nd:YAG laser is specified as ±7% at 532 nm this is measured at maximum 532 nm energy with the XY aperture fully open and the laser removed of the microscope. If the pulse stability at 532 nm does not meet this specification then check the following.

Check the number of shots on the flash lamp. This can be estimated from the date of the last flash lamp change and the average usage per day. If the number of shots fired exceeds 30 million shots, change the flash lamp.

Experiment with samples of different materials.

Call New Wave Research if it is not possible to improve laser pulse stability by this procedure.

Procedure 5 Clipped laser beam

The output beam of the QuikLaze Nd:YAG laser should be square, symmetric with even energy distribution. Some object in the beam path may clip the laser beam, then the output will appear asymmetric, with a sharp edge. If the output beam is clipped, check the following.

Check the beam path to ensure that there are no foreign objects in the path.

Check that the manual shutter is fully open and completely removed from the beam path and is not clipping the beam.

Check the microscope alignment for each individual objective used for laser cutting.

When you have found the object that is responsible for clipping the beam, correct the situation and ensure that the beam path is fully clear.

Procedure 6 Non-Uniform Energy Distribution

If the energy distribution does not appear to be uniform across the cut area check the following.

Check that the laser beam is not clipping a mount or some other object, and that there are no foreign objects in the beam path.

Check microscope alignment.

Check that the microscope optics are clean, with no dust particles on any surface. Clean the optics if necessary.

If the beam still appears to be non-uniform try cuts on different samples. Try increasing the energy setting. If the laser still makes non-uniform cuts call New Wave Research for service information.

Procedure 7
No Laser Beam Output

Check to ensure the safety shutter on the lower left side of the laser head is in the **OPEN** position.

Check to make sure the X and Y controls are set to at least 30.

Switch to the Green wavelength, set the Energy switch to LO and the Energy attenuator to at least 20. Select a 10x or 20x objective lens, set the Rep. Rate to at least 10 Hz, and then set the trigger switch to CONT. Press the **FIRE** button. Correct the microscope alignment if necessary.

Appendix A

Laser Wavelengths And Cutting Parameters

Laser Wavelengths for Optimum Material Removal

Success in laser trimming, cutting, and ablation is usually determined by the choice of wavelength. Different materials react differently to various wavelengths. Effective removal of metals depends on how much energy is absorbed and how much is reflected. The more energy absorbed, the easier the metal will vaporize and be removed.

In general, metals absorb shorter-wavelength energy better. For example, gold is 1% absorbing at 1064 nm, 40% absorbing at 532 nm, and 45% absorbing at 355 nm. However, there are limits to the effectiveness of shorter wavelengths, which are determined by the microscope optics used.

In the foregoing examples, the Mitutoyo microscope transmitted about 45% of the 1064 nm laser energy, 35% of the 532 nm energy, and only about 17% of the 355 nm energy. In this example, even though gold is more absorbing at 355 nm than at 532 nm, the microscope transmission of laser energy at 532 nm usually makes it the preferred wavelength for cutting gold.

Aluminum can be cut using either 1064 or 532 nm. The absorption is relatively constant from about 1,100 nm to about 400 nm with a slight increase in absorption around 1µm.

A different process removes organic material, such as polyimide. UV energy is able to break the chemical bonds between the carbon-carbon, carbon-oxygen, and carbon-silicon atoms. These bonds break with sufficient energy in the range of 339-445 nm. The third harmonic of an Nd:YAG laser is 355 nm. It is an excellent wavelength for breaking the atomic bonds of the polyimide molecule.

The following table shows the preferred wavelength for vaporizing of ablating various materials commonly found in semiconductor and microelectronic devices.

	Infrared (1064nm)	Green (532nm)	UV (355nm or 266nm)
Metal/Conductors	Aluminum ITO Chrome	Aluminum ITO Chrome Ni-Chrome Ti-Tungsten Copper Gold	
Insulators		Silicon Nitride Silicon Dioxide	Polyimide Teflon Silicon Nitride Kapton
SemiConductors		Polysilicon	Polysilicon
Color Filter Materials	Red	Green	Blue

Table A-1: Recommended Wavelengths for Various Materials

Laser Cutting Parameters

The following table presents a summary of recommended laser settings for various machining operations. The settings are for a New Wave Quiklaze laser system. These settings should be viewed as a starting point from which a finely tuned cutting process can be defined for a specific application. When tuning the cutting process, a non-critical area of the device should be selected for practice.

After the technique has been determined, the laser parameters can be saved as a Laser Micro using LaserExec, the laser control software package that is supplied with every QuikLaze system. LaserExecruns under Windows95 and WindowsNT. It requires a PC with a Pentium (or equivalent) CPU, at least 16MB of RAM, and one available RS232 serial port. For further information on QuikLaze and LaserExec, see the information in the following table of contact New Wave Research.

Sample Material	Cut Size	Microscope Lens	Wavelength	Energy Setting	Energy Range	No. of Shots
LCD repair: remove ITO short	15 x 110 µm	50X NIR	1064 nm	500	High	50
LCD repair: remove chrome short	15 x 220 µm	50X NIR	1064 nm	500	High	100
MCM module: cut gold line	20 x 300 µm 15 µm deep	50X	532 nm	800	High	1200
Thick film resister	30 x 4000 µm	20X	1064 nm	600	High	2000
Semiconductor device: Polyimide removal	130 x 200 µm 3 µm deep	50X NUV	355 nm	300	Low	2000
Trim gold capacitor	25 x 60 µm	20X	532 nm	600	High	3000
Flex circuit: remove Kapton	20 x 100 µm 20 µm deep	50X NUV	355 nm	800	High	1500
Flex circuit: cut copper line	15 x 10 µm	50X NUV	532 nm	800	High	1000

Table A-2: Recommended Laser Settings for Various Laser Machining Operations

90-1087C Quiklaze-50ST Operator's Manual