EzLaze 3

Nd:YAG Laser Cutting System

Operator's Manual

NEW WAVE RESEARCH

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Part No. 90-1537A

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Preface

This manual contains information for proper installation and operation of the EZLaze 3 and accessories. The EZLaze 3 laser systems comply with the CDRH (Center for Device and Radiological Health) Standard 21 CFR 1040.

The EZLaze 3 systems are Class IIIb and Class IV lasers and emit laser radiation that can be harmful to your eyes and skin. It is essential that the safety section of this manual is read and understood before installing this laser and that the user follows the instructions given for safe laser operation.

Do not attempt to repair the laser while it is under warranty. Report all problems to New Wave Research, Inc. for warranty repair.

Table of Contents

Chapter One

Safety

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

Safety Precautions

Read the following safety precautions and operator's manual prior to powering up or operation to avoid personal injury and prevent damage to the EzLaze 3 Laser Cutting System or any interfacing devices. Use the system only as specified.

The standard EzLaze 3 is classified as a Class 3b laser device, but may be configured as a Class 4 laser system. For these systems AVOID EXPOSURE TO DIRECT OR SCATTERED RADIATION. Class 4 and Class 3b lasers can produce instantaneous and permanent blindness or serious injury to the eye or skin and require stringent safety measures during operation and maintenance.

- Follow the instructions and precautions in this manual for proper installation and safe operation of your laser.
- Use protective eyewear. Selection of laser safety goggles depends on the energy and wavelength of the laser beam as well as operating conditions.

Consult ANSI, ACGIH and OSHA standards for safety guidance.

WARNING: The EzLaze 3 laser system contains internal components that present severe electrical and radiation hazards. Improper operation or servicing can result in death, blindness, other injury or material damage. Only qualified personnel should operate or service this equipment.

The EzLaze 3 Laser Cutting System presents numerous health and safety hazards. These dangers, which are discussed in greater detail in the remainder of this chapter, include but are not limited to:

Eye Damage from Direct or Reflected Laser Beam Exposure
Skin Damage, including increased risk of cancer, from Direct or Reflected Laser Beam Exposure
Fire Danger from Laser Beam and Electrical Components
Electrical Shock Hazard

Laser light poses safety hazards that are not associated with conventional light sources. Special precautions must be observed when operating, maintaining or servicing the EzLaze 3 Laser Cutting System. The safe use of high-powered lasers requires that each operator be fully trained and that all personnel working in proximity to the laser are aware of the dangers involved.

Optical Safety

Lasers are classified by the US Food and Drug Administration according to the health hazards associated with exposure to their emitted beam, based on power and wavelength. The standard EzLaze 3 Laser Cutting System is classified as a Class 3b, but Class 1 and Class 4 versions are available. These special configurations are clearly marked and documented as Class 1 or 4.

- Class 4 lasers can produce instantaneous and permanent blindness or serious personal injury to the eye or skin through direct or scattered exposure and require stringent safety measures during operation and maintenance.
- Class 3b lasers can produce instantaneous and permanent blindness or serious personal injury to the eye or skin through direct exposure and require stringent safety measures during operation and maintenance. Diffuse reflections may pose some hazard.
- Class 1 lasers are not known to cause biological injury.

The standard EzLaze 3 is classified as a Class 3b device, but may be configured as a Class 4 laser system. For these systems AVOID EXPOSURE TO DIRECT OR SCATTERED RADIATION. Class 4 and Class 3b lasers can produce instantaneous and permanent blindness or serious injury to the eye or skin and require stringent safety measures during operation and maintenance.

- Follow the instructions and precautions in this manual for proper installation and safe operation of your laser.
- Use protective eyewear. Selection of laser safety goggles depends on the energy and wavelength of the laser beam as well as operating conditions.

Consult ANSI, ACGIH and OSHA standards for safety guidance.

The EzLaze 3 Laser Cutting System utilizes a high-power Nd:YAG laser which can produce high-intensity laser beams in the Ultraviolet (UV), visible and Infrared (IR) portions of the spectrum. The specific wavelengths produced are 266, 355, 532 and 1064 nm.

Infrared and Ultraviolet radiation are invisible and so the hazard they present is not immediately obvious. Direct or reflected exposure to the laser beam can cause blindness or vision impairment without warning. Reflected energy can be dangerous whether specular or diffuse. It is extremely important that anyone who might be exposed to direct or reflected Class 4 or Class 3b laser radiation wear suitable safety glasses.

Skin Exposure Safety

Laser radiation is emitted as a narrow beam of almost parallel rays, the intensity of which will remain high even at some distance from the laser. Although the radiation is non-ionizing, exposure can cause damage to living tissue as a result of heat produced during radiation absorption. The radiation of an Nd:YAG laser beam lies outside the visible range.

In general, the maximum permissible radiation exposure for skin is several times greater than for the eye. Safety measures with regard to radiation hazards are therefore based mainly on dangers to the eye, but exposure to the skin should be carefully avoided as well.

Direct or reflected laser radiation can cause burns as well as an increased risk of cancer.

Fire Safety

The energy of the Nd:YAG laser of the EzLaze 3 Laser Cutting System is sufficient to produce a fire hazard if directed carelessly. The laser beam, or its reflection, can ignite wood, paint, alcohol or other volatile substances.

Electrical Safety

The EzLaze 3 Laser Cutting System meets CE safety and emission standards.

The Laser Head and Power Supply of the EzLaze 3 laser system contain electrical circuits operating at lethal levels of voltage and current. Do not operate the laser system with either Power Supply or Base Module covers removed except during maintenance procedures described in this manual.

There are no user serviceable internal components in the EzLaze 3 Laser Cutting System. New Wave Research must carry out all service procedures. General rules of electrical safety should be followed at all times

Safety Features

The following safety features are incorporated into the EzLaze 3 Laser Cutting System and conform to government regulations to provide safe laser operation.

System Housings

Laser Head Cover

The EzLaze 3 laser head is enclosed in a protective housing that limits the emission of dangerous radiation to the output beam, which is Class 3b in the standard configuration. The cover protects against stray radiation from the EzLaze 3 and should be removed only by trained personnel performing periodic maintenance.

Power Supply Cover

The EzLaze 3 power supply is enclosed in a protective housing that limits exposure to dangerous electrical hardware. This cover should be removed only by trained personnel performing periodic maintenance.

Interlocks

The EzLaze 3 Laser Cutting System features the following interlocks which prevent operation in specific unsafe conditions:

System Stop (External) Remote Interlock — This interlock disables the laser, putting it in the STOP mode, based on some remote triggering event, such as a door opening. Use of a remote interlock is recommended, but the system is supplied with a jumper that can be used to replace the interlock if appropriate for the installation.

Laser Standby (Workpiece) Remote Interlock — This interlock disables the laser, putting it in the STANDBY mode, based on some remote triggering event, such as a door opening. It provides a less-disruptive alternative to the System Stop Remote Interlock. Use of a remote interlock is recommended, but the system is supplied with a jumper that can be used to replace the interlock if appropriate for the installation.

Laser Head Cover Open — The Laser Head Cover should be opened by service personnel only.

Eye Protection Filter

New Wave Research provides an Eye Protection Filter with each EzLaze 3 Laser Cutting System. An Eye Protection Filter or Beam Blocker must be installed on any microscope to be fitted with a laser system. This filter, which is installed between the eyepiece assembly and the main body of the microscope, prevents dangerous laser radiation from exiting the eyepiece.

Laser Safety Shutter

The EzLaze 3 has a manually operated exit beam shutter located at the camera adapter interface. The laser beam may be blocked by closing the shutter. Do not use the exit beam shutter as a method of blocking the beam for more than a few seconds. Turn off the laser if the output beam is not needed for longer time periods.

Applicable Regulations

Laser Classification

Governmental standards and regulations specify that laser-based products be classified according to the output power or energy, and laser wavelength. The standard EzLaze 3 Laser Cutting System is classified as a Class 3b device based on 21 CFR, subchapter J, part II, section 1040-10(d) and EN 60825-1, clause 9 of the European Community Standards.

Optional configurations are available that are classified as Class 4 or Class 1 devices. These special configurations are clearly marked and documented as Class 1 or 4.

Laser Classification documentation for both the United States and the European Community is provided in the Appendix of this manual.

All EzLaze 3 Models produce Class 4 laser radiation internally within the Laser Head. With the Laser Head housing removed, any EzLaze 3 system can emit Class 4 laser radiation.

General Laser Safety

Class 3b and Class 4 laser beams are intense enough to burn skin, clothing or paint. They can ignite volatile substances such as alcohol, or other solvents. The beam may also cause damage if reflected from some other surface. For this reason it is important that the following precautions are observed:

- Keep the protective cover on the laser head at all times.
- Avoid looking at the output beam, even diffuse reflections are hazardous.
- Treat back reflections from any optic surface as you would the main laser beam. Even though the energy of such reflections is only a fraction of that contained in the main beam, it is sufficient to cause serious bodily harm, especially to the eye.
- Use protective eyewear at all times. Selection depends on the wavelength and the intensity of the radiation, the conditions of use, and the visual function required.
- Make sure that the eyepiece filter is properly installed on the microscope before installing the laser on to the microscope.
- Operate the laser at the lowest beam intensity possible, given the requirements of the application.
- Expand the beam wherever possible to reduce beam intensity.
- Avoid blocking the output beam or its reflection with any part of the body.
- Use an IR detector or energy detector to verify that the laser beam is off before working in front of the laser.
- Establish a controlled access area for laser operation. Limit access to those trained in the principles of laser safety.
- Maintain a high ambient light level in the laser operation area to constrict the pupil of the eye, reducing the possibility of injury.
- Post warning signs prominently near the laser operation area.
- Provide enclosures for beam paths whenever possible.
- Set up an energy absorbing target to capture the laser beam, preventing unnecessary reflections and scattering.
- Do not open laser head or power supply. Dangerous voltages and laser energies are present.

New Wave Research recommends that laser users become more familiar with laser safety practices and the applicable regulations than is possible by reading this manual. The American National Standards

Institute (ANSI) publishes a good overview titled 'American National Standard for the Safe Use of Lasers' (ANSI Z136.1-1993). This publication provides recommendations for the safe use of lasers and laser systems that operating at wavelengths between 180 nm and 10 um. The publication is available from:

Laser Institute of America
12424 Research Parkway, Suite 125
Orlando, FL 32826
(407) 380-1553
www.laserinstitute.org/publications/ safety_bulletin/laser_safety_info/

Location of Safety Labels

The EzLaze 3 Cutting System is shipped with numerous safety labels affixed in prominent locations on the exterior of and inside the unit. These labels provide important warnings to persons operating the device and should left in place.
Images of these labels and their locations are depicted in Figures 1 and 2.

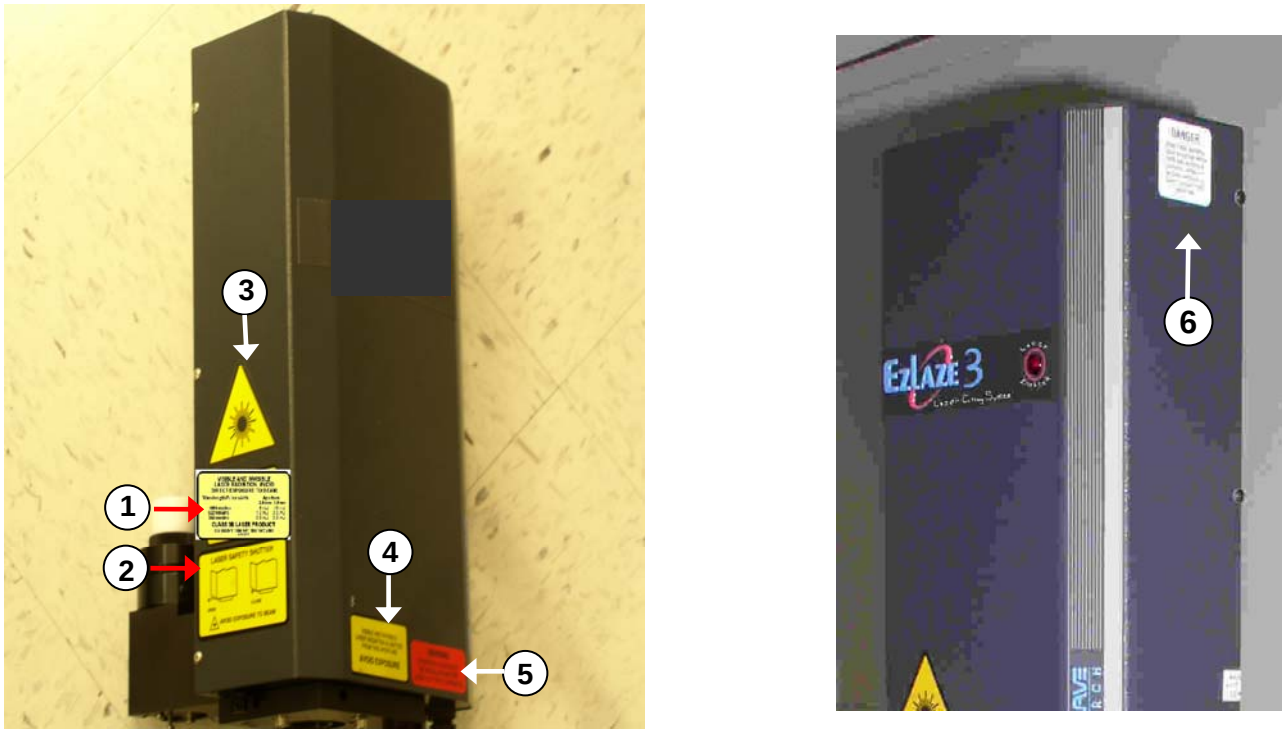
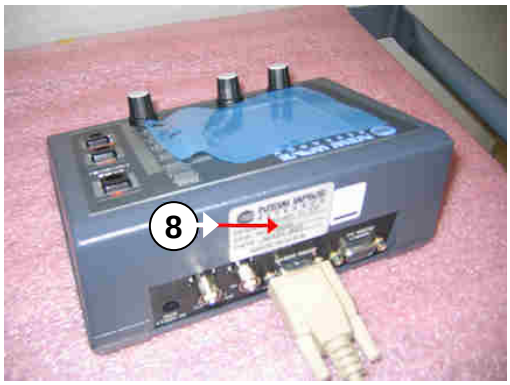


Figure 1-1: Hazard Label Placement



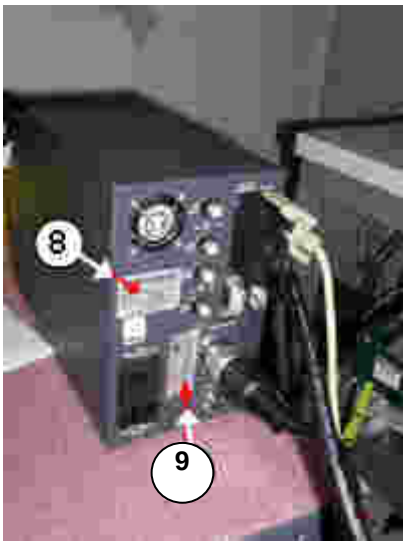
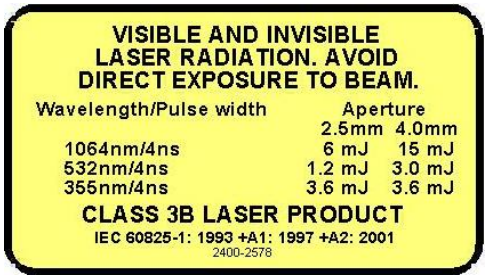


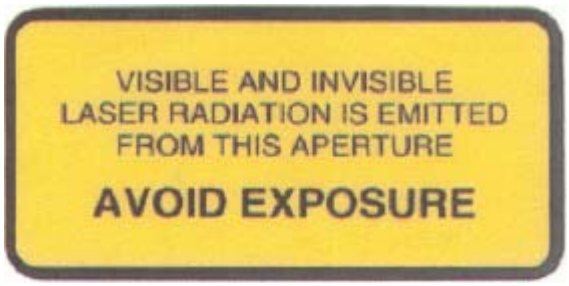
Figure 1-2: Certification & ID Label placement



1 Class IIIb or Class IV Laser Warning labels (label matches system classification, no similar label for Class 1 systems)

2 Manual Shutter label

3 Laser Warning label

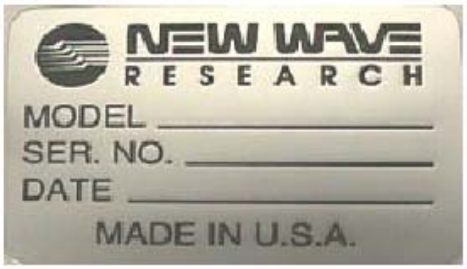


4 Aperture warning label

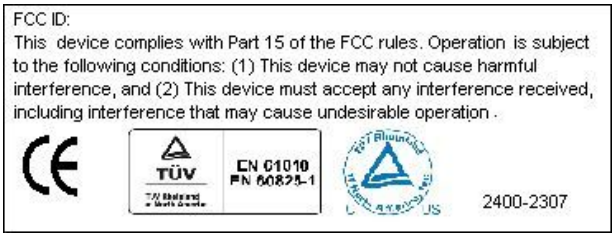
5 Eyepiece filter label

6 Non-Interlocked Housing label

7 Certification & ID label



8 Serial Number label



9 CE label

Declaration of Conformity

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

hereby declare that under our sole responsibility the products:

Air cool Laser System, (Laser Ablation System)

Models: Orion, Ezlaze 3 and Ez Mark

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: 1997+A1:1998+A2:2001 Class A
EN55011: 1999 Class A, EN61000-4-2, EN61000-4-3, EN61000-4-4
EN61000-4-5, EN61000-4-6, EN61000-4-11

TUV Report and License No's:

30380463, S72041937

Fremont, CA **December 1, 2005** Signature

Napoleon Greene, Vice President

UL & CSA

The Ezlaze 3 conforms to the requirements of UL 3101 and CAN/CSA-C22.2 No. 1010.1

Chapter Two

System Description

System Description

The EzLaze 3 Laser Cutting System is a small air-cooled, flash lamp pumped Nd:YAG, Q-switched laser system designed for Semiconductor Failure Analysis and Micromachining applications. It is available in a numerous versions which provide a range of working wavelengths suited to the principal materials used in semiconductor devices. Multiple interface options allow the EzLaze 3 to be mounted on the leading types of failure analysis microscopes. The EzLaze 3 is optimized for applications requiring low weight and simplicity rather than high repetition rates. The air-cooled architecture eliminates the weight and complexity of a liquid cooling loop and allows the EzLaze 3 to be made smaller and lighter than comparable liquid-cooled lasers and nearly maintenance-free. It is capable of continuous 1 Hz. operation and 50 shot bursts at 5 Hz.

The EzLaze 3 provides great flexibility in defining cutting characteristics. User-selectable wavelengths (1064 nm, 532 nm, 355 nm and/or 266 nm) and precise energy control allow the operator to match the beam to the job. An internal shutter produces highly uniform cuts from 50 µm x 50 µm (with 50X objective) to 1 µm x 1 µm (with 100X objective). With the optional rotating shutter, cut orientation can be shifted +/- 90˚ in 1˚ increments.

The EzLaze 3 Laser Cutting System can be controlled via a Remote Control Panel or a properly configured PC. The Remote Control Panel or controlling PC allows the laser to be controlled and operated from a convenient location rather than from the normally floor-mounted power supply. (For size of power supply, see Table A-2 on 75.)

The EzLaze 3 laser system uses a robust stable resonator design. Energy level and beam divergence are relatively insensitive to repetition rate and thermal load.

The EzLaze 3 may be mounted on the following microscopes:

	Model	Wavelength
Mitutoyo	FS60 FS60Y FS70ZS FS70LS VM Zoom	Green, UV3 IR, Green, UV3 Green, UV3 IR, Green, UV3 IR, Green, UV3
Motic	PSM-1000	IR, Green, UV3
Optem	A-Zoom I, II	IR, Green, UV3
Seiwa	PS-888L	IR, Green, UV3
USMC	BD100	IR, Green, UV3

Contact your New Wave Research representative for UV4 microscope requirements.

Power Supply

The Power Supply houses the electrical components necessary to power and control the laser. Status-indicating LEDs are located on the front panel.

Remote Control Panel

The Remote Control Panel is a microprocessor-based device which connects to the Power Supply through a 6 ft. cable attached to the 9-pin D-sub port. The multiple screens viewable on the LCD display provide full control of the laser parameters and access to stored user-defined laser setup pages. Soft buttons and fixed-use controls allow operation and control of the EzLaze 3 laser system from a convenient location.

External Control

Alternatively, the EzLaze 3 Nd:YAG laser system can be operated externally by 2 different methods:

- by a computer using the RS232 port.
- via the External Triggering Input BNC ports on the rear panel of the Power Supply.

Laser Head

The Laser Head module, which houses the laser and associated optical components, employs a flash lamp-pumped Nd:YAG rod to generate radiation at 1064 nm. The well-designed, unique resonator is very compact and insensitive to vibration and temperature variation. The Laser Head requires no internal adjustments in normal operation.

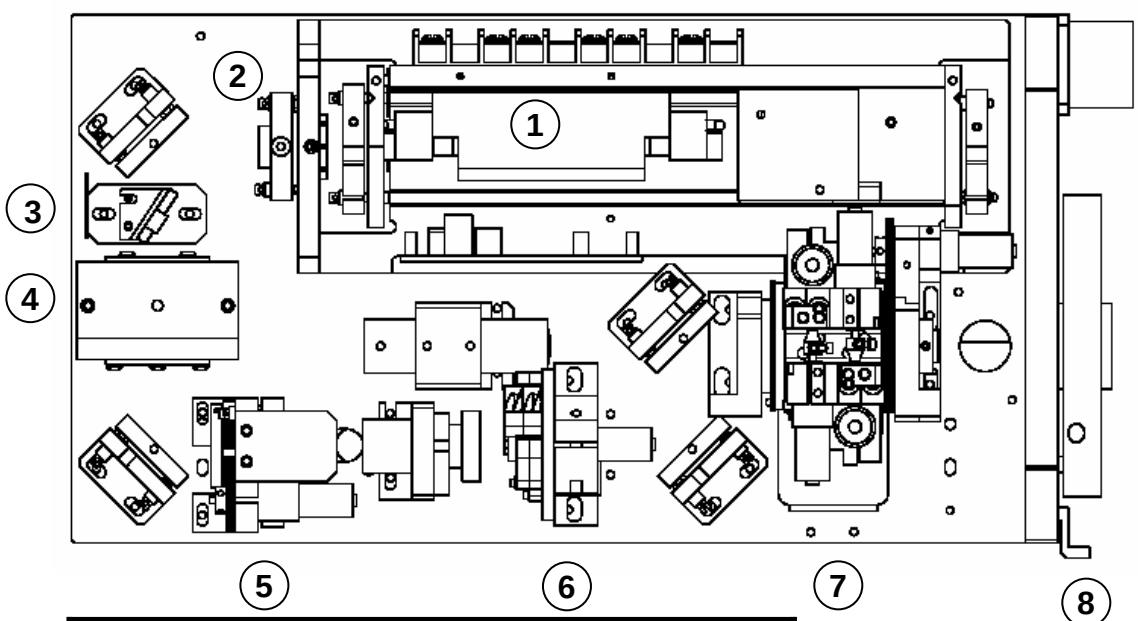
The Laser Head is configured to be installed on a standard microscope camera port and can be used on the leading types of failure analysis microscopes.

Second Harmonic Generation

The 1064 nm laser pulse exits the IR head and then different harmonic wavelengths may be generated if these options have been installed. The second harmonic at 532 nm is generated by passing the IR beam through an angle-tuned KTP crystal. The EzLaze 3 uses Type II phase-matching in KTP to generate the second harmonic, so the polarization of the IR beam must be adjusted to maximize SHG intensity. Dichroic mirrors separate the second harmonic from the fundamental light and direct the 532 nm beam to the output port. The second harmonic light is vertically polarized.

Polarizer

The Polarizer eliminates vertically polarized light and transmits horizontal light, allowing the attenuator to work correctly with an IR beam.



1	Laser Resonator	5	Optical Attenuator
2	Second Harmonic Generator (SHG)	6	Wavelength Selector
3	Polarizer	7	XY Shutter
4	Third Harmonic Generator (THG)	8	Safety Shutter

Figure 2-1: System Components

Third Harmonic Generation

The third harmonic at 355 nm may be generated in the EzLaze 3 if the option has been installed. The third harmonic at 355 nm is generated by combining one photon at 532 nm with one photon at 1064 nm. This is accomplished a non-linear crystal BBO. The third harmonic light is vertically polarized.

Optical Attenuator

The optional optical attenuator serves to precisely control the laser output energy without affecting beam quality.
The servo motor controlled attenuation is set by inputs from the Remote Control Panel or controlling computer. The polarizer is permanently aligned to transmit vertically polarized light, maintaining the polarization of the output beam.

Fourth Harmonic Generation

The fourth harmonic of Nd:YAG at 266 nm can be generated by doubling the 532 nm second harmonic light. This is done by placing the correct BBO crystal in the optical path and combining two photons at 532 nm to give one photon at 266 nm.

Wavelength Selector

The Wavelength Selector Wheel rotates to place the filter combination required for the selected output beam into the beam path. The position of the filter wheel is used to produce the HI or LO energy beam and to determine the wavelength of the output beam (in multiple wavelength models).

XY Shutter

The XY shutter is used to control the shape, size and orientation of the output beam so that it can be matched to the required cut. The shutter has two blades in the X and Y orientation that move in and out to control the output beam's dimensions. Optional upgrades increase the resolution of the dimensional control and allow the shutter aperture to be rotated through 180 degrees.

Laser Safety Shutter

The EzLaze 3 has a manually operated exit beam shutter located at the camera adapter interface. The laser beam may be blocked by closing the shutter. The manual shutter is intended to be used as a safety device when the laser is not being fired, rather than as an on/off control during operation. Turn off the laser if the output beam is not needed for longer time periods.

Safety Interlocks

The EzLaze 3 laser system features the following interlocks which prevent operation in specific unsafe conditions:

System Stop (External) Remote Interlock — This interlock disables the laser, putting it in the STOP mode, based on some remote triggering event, such as a door opening. Use of a remote interlock is recommended, but the system is supplied with a jumper that can be used to replace the interlock if appropriate for the installation.

Laser Standby (Workpiece) Remote Interlock — This interlock disables the laser, putting it in the STANDBY mode, based on some remote triggering event, such as a door opening. It provides a less-disruptive alternative to the System Stop Remote Interlock. Use of a remote interlock is recommended, but the system is supplied with a jumper that can be used to replace the interlock if appropriate for the installation.

Laser Unmounted — This interlock disables the laser, putting it in the STOP mode, when the pin on the Laser Adapter Ring is not detected and prevents the laser from operating when not mounted on a microscope.

Laser Head Cover Open

Umbilical Detached

These interlocks should only be defeated to allow maintenance as described in this manual and never to facilitate unsafe operation.

Chapter Three

Installation and Setup

Site Requirements

Electrical Requirements

Voltage:	100-240 VAC
Current:	1 A
Frequency:	50/60 Hz

The EzLaze 3 Laser Cutting System is designed for use with grounded electrical outlets only. This is an important safety feature. Operating the system ungrounded will result in an increased risk of electrical shock and equipment damage.

The system will arrive with a power cord conforming to North American, European, Japanese or UK standards depending on the shipping address or customer request. If the local standard is not listed here, installers will need to provide compatible power cords. The cord should be the 3-conductor type with an IEC C13 (straight) plug on the equipment side (Volex V1625 is acceptable).

Power Line Fuses

Fuse Identification	***Voltage (VAC)***	***Description***	***Acceptable Part***
Power Supply AC Power Entry Module	100-240	1 amp / 250 V, SPT, 5x20mm, Time-Lag, High Breaking Capacity (2)	Schurter P/N: 0001.2504

Workspace Requirements

The EzLaze 3 Laser Cutting System should be used and stored in a clean, dry controlled environment meeting the specified environmental conditions. After storage or shipment, the EzLaze 3 should be allowed to stabilize at the ambient operating temperature before use.

WARNING: Operation of the EzLaze 3 laser without the eye protection filter installed on the host microscope may result in SEVERE EYE DAMAGE OR BLINDNESS.

Eye Protection Filter

All microscopes must be fitted with an eye protection filter, in addition to any beam blocking mechanism that may be fitted, before a laser head is installed. New Wave Research supplies an Eye Protection Filter with every EzLaze 3 configured for installation on an eyepiece-equipped microscope. Eye Protection Filter installation is discussed below for each compatible microscope:

Eye Protection Filter Installation Procedures

Mitutoyo FS50, FS60 series and FS70 series, Motic PSM-1000

1. Remove the eyepiece assembly and the three screws that secure the eyepiece to the body of the microscope. (See Figure 3-1.)
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).

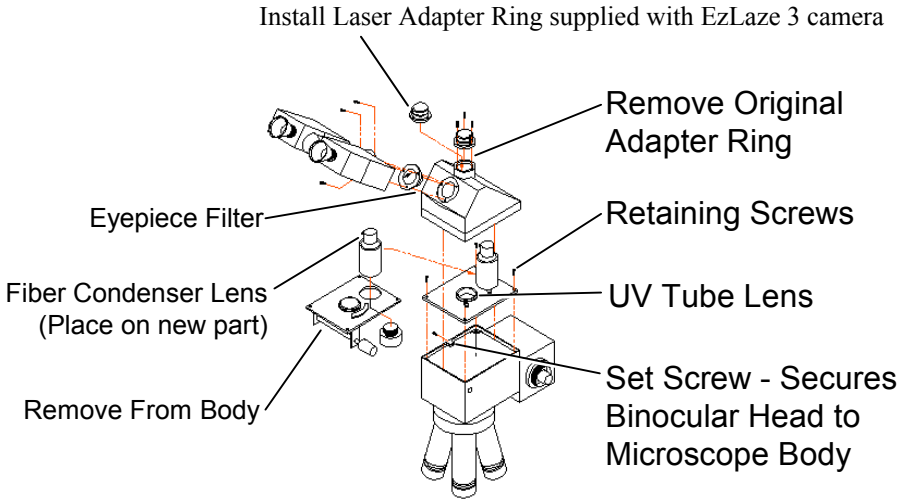


Figure 3-1: FS60 Microscope modifications

Mitutoyo VMZoom

Manufacturer installs the eye protection filter when fitted with the laser adaptor kit.

Optem AZoom

Manufacturer installs the eye protection filter when fitted with the laser adaptor kit.

Seiwa PS888L

The eyepiece has an additional mounting adapter for the eye filter. The filter is installed as follows:

1. Remove the eyepiece (3 screws).
2. Remove the eyepiece mounting adapter (3 screws).
3. Align the filter with the holes on the mounting ring. The filter should be installed with the filter ring facing outwards (opposite of the normal arrangement).
4. Mount the eyepiece mounting ring and the filter together on the body of the microscope with the filter between the body of the microscope and the eyepiece mounting adapter.
5. Mount the eyepiece on the eyepiece mounting adaptor.

Laser Adapter Ring

Fitting of the Laser Adapter Ring to the camera port is necessary prior to installation of the EzLaze 3 on the microscope. The laser adapter ring supplied with the EzLaze 3 is configured to position the laser for optimum focus and cut quality and also includes a pin that closes the laser unmounted 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.

Microscope Conversion for UV Wavelengths

The EzLaze 3 Laser Cutting System is designed for installation on the industrial microscopes listed in the below table and modified as discussed in this section. Due to wavelength limitations of the microscope optics, some models are incompatible with particular versions of the EzLaze 3 as indicated. Become familiar with your microscope before attempting to install the EzLaze 3.

EzLaze 3 model	Mitutoyo						Optem	Seiwa	Motic
	FS50	FS60	FS60Y	FS70ZS	FS70LS	VMZoom	AZoom	PS888L	PSM1000
IR			●		●	●	●	●	●
Green	●	●	●	●	●	●	●	●	●
IR/Green			●		●	●	●	●	●
Green/UV3		●	●	●	●	●	●	●	●
Green/UV4						● *	● *	● *	
TriLite			●		●	●	●	●	●

***Contact New Wave Research for UV4 microscope requirements**

Table 2-1: Microscope Wavelength Compatibility

Microscope UV Conversion Kit

Modification of the following microscopes is necessary for compatibility UV3 (355 nm) light. If installing a version of the EzLaze 3 which doesn't produce UV3 (355 nm) light, this modification is not necessary. Without modification, the microscope optics will be damaged by UV3 radiation.

Mitutoyo FS60

Install the UV3 Tube Lens as follows:

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 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.

Mitutoyo FS60Y

Install the UV3 Tube Lens as follows:
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 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.

Mitutoyo FS70ZS

Install the UV3 Tube Lens as follows:
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 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.

Mitutoyo VMZoom
Must be ordered with a laser adapter kit suitable for the EzLaze 3's working wavelengths.

Optem AZoom
Must be ordered with a laser adapter kit suitable for the EzLaze 3's working wavelengths.

Laser Installation

Prior to mounting the Laser Head on the microscope, the microscope's camera mounting ring needs to be replaced by the Laser Adapter Ring shipped with the EzLaze 3. This replacement ring has a protruding post which closes the Laser unmounted interlock mechanism and mounts to the microscope in the same manner as the original.

Before installing the laser head, remove the eyepiece filter warning label from the laser head's aperture.

The laser head may now be mounted on the microscope. The red "Laser Enabled" LED lens should face the operator when standing in front of the Mitutoyo FS microscope. The LED lens faces to the right when mounted on an A-Zoom or VMZoom.
With the Laser Head in place, use a 2 mm hex wrench to tighten the four headless set screws set into the laser mounting plate. See Figure 3-2. Use a 2 mm hex wrench inserted into the holes to tighten the four set screws.

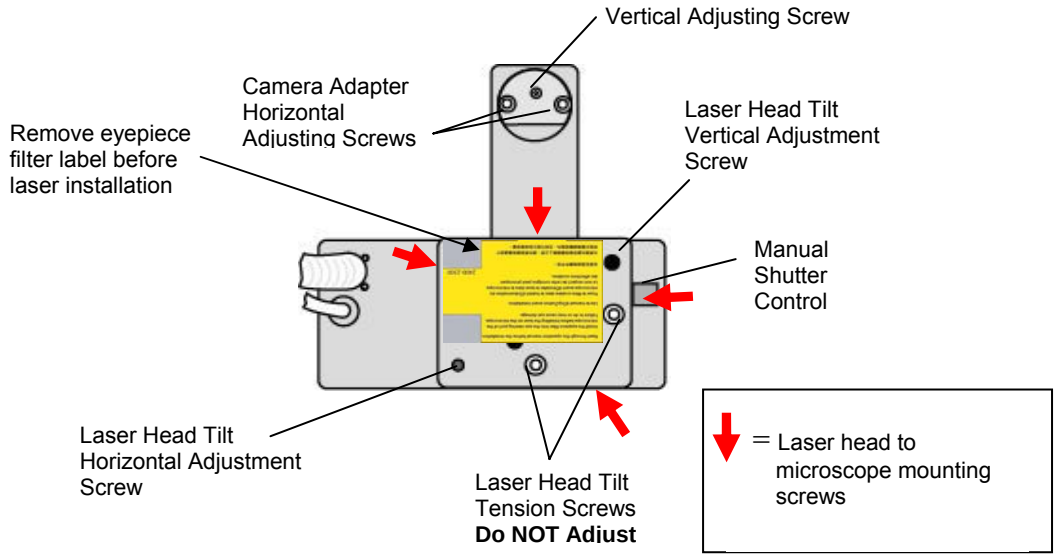


Figure 3-2: Laser Head Mounting/Adjusting Screws (bottom view).

Setup

Before making any electrical connection:

- Turn the AC Power Entry Line Switch on the rear panel of the Power Supply to the OFF position
- Turn the Key Switch on the front panel of the Power Supply to the OFF position

Umbilical Connection

Connect the large Main Umbilical and Secondary Umbilical to the appropriate connectors on the rear panel of the power supply and Laser Head. See Figure 3-3.

NOTE: It is very important that the screws and locking ring that secure the umbilical connectors to the power supply are tightened before operation. Failure to tighten these can lead to high voltage arcing and damage to the connector causing the system to fail.

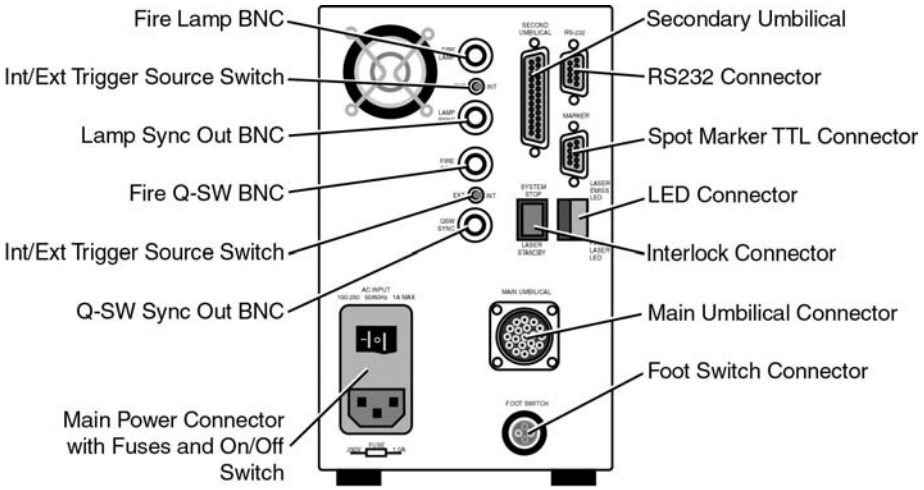


Figure 3-3 Power Supply Back Panel

Connection of Remote Control Panel

The Remote Control Panel is connected to the power supply through a 6 foot 9 pin DB Male/Female Straight Through Extension cable. Connect the Remote Control Box to the RS-232 9-pin D-sub port on the rear panel of the power supply. Secure the cable at both connectors by tightening the screws.

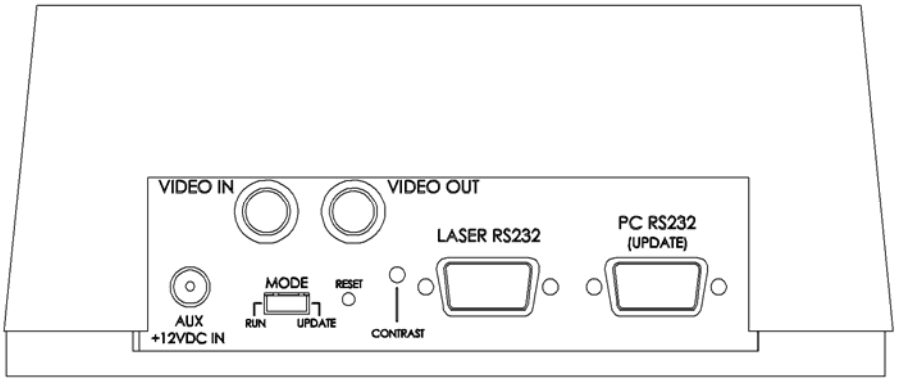


Figure 3-4 Remote Control Rear Panel

If the EzLaze 3 laser system is to be operated by a computer, it can be linked to the RS232 (Update) DB-9 port on the back of the Remote Control Panel. The Remote Control Panel will detect an operating computer connected to this port and deactivate while passing the incoming signals through to the Power Supply.
Alternatively, the computer can be connected directly to the RS232 (DB-9) port on the rear panel of the Power Supply.

Connection of Optional Foot Control Attachment

Attach foot switch to the two-pin connector on rear of power supply.

Remote Interlock Connection

The EzLaze 3 laser system is provisioned for the installation of 2 Remote Interlocks which connect to ports on the back of the Power Supply.
System Stop Remote Interlock — This interlock disables the laser, putting it in the STOP mode, based on some remote triggering event, such as a door opening. Use of a remote interlock is recommended, but the system is supplied with a shorting connector that can be used to replace the interlock if appropriate for the installation.
Laser Standby Remote Interlock — This interlock disables the laser, putting it in the STANDBY mode, based on some remote triggering event, such as a door opening. It provides a less-disruptive alternative to the System Stop Remote Interlock. Use of a remote interlock is recommended, but the system is supplied with a shorting connector that can be used to replace the interlock if appropriate for the installation.

External Laser Firing LED

The EzLaze 3 is equipped with terminals to illuminate an optional remote LED when the laser fires. The LED should be connected across these terminals and be located in a visible location. It will receive a 10 mA, 12 V signal when the laser fires. Shorting the pins or leaving them open will not affect operation of the unit.

External Laser Ready LED

The EzLaze 3 is equipped with terminals to illuminate an optional remote LED when the laser is powered and ready to fire. The LED should be connected across these terminals and be located in a visible location. It will receive a 10 mA, 12 V signal when the AC Power Switch on the Power Supply rear panel and the Key Switch on the Power Supply front panel are in the ON position. Shorting the pins or leaving them open will not affect operation of the unit.

Video Spot Marker

The video spot marker system inserts an artificial representation of the laser spot into the video camera output signal. Under some conditions, this marker may be easier to see than the projected spot markers. The electrical connections to activate the video spot marker are as follows. See Figure 3-5. 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.

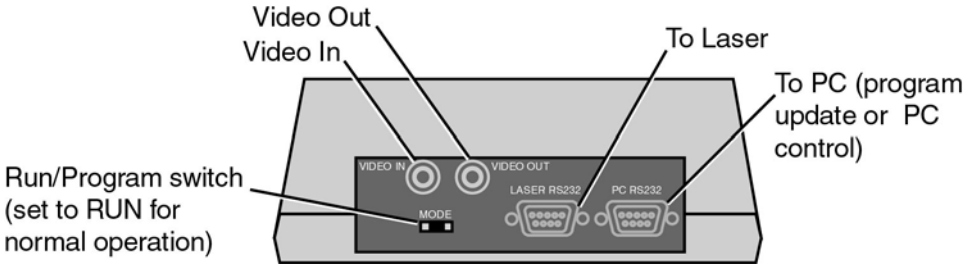


Figure 3-5: Remote Control Panel Connections.

Laser Head Alignment

The laser head is internally aligned at New Wave Research prior to shipment so that the output beam is exits down the center axis of the aperture. 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 3-2 for location of laser head tilt adjusting screws. (See Chapter 2 for complete instructions on Starting and Stopping the laser.) The following procedure describes how to align the laser to the microscope optics:

1) Turn the power supply key to the ON position and press the

STANDBY/START button. Set the mode to CONT and select a repetition rate of 1Hz.
2) Adjust the Energy level to 0 in the LO setting.
3) Set the X aperture to 100 and the Y aperture 50 and select the green (532 nm) wavelength if available. Fully open the manual shutter on the laser head. See Figure 1-2 for location of shutter.
4) Place a white card on the working surface beneath the objective lens. (See Figure 1-5)
Select a 50x, 80x or 100x objective. If the system being adjusted is an IR-only model, an IR Viewing Card must be used for this purpose (Item # VC-VIS/IR from Thor Labs, Inc. is suitable).
5) Turn the microscope source light to minimum intensity and adjust the spot size, using the microscope focus or stage vertical position, to about one inch (25 mm) diameter.

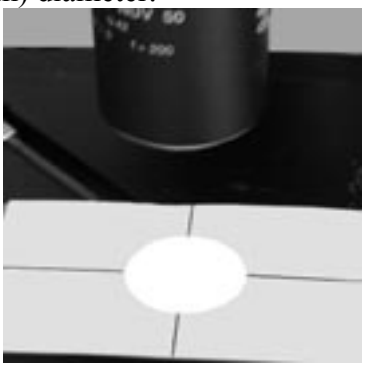


Figure 3-6: Center illumination in circle on target

6) Press the FIRE button and the laser will begin firing.
7) Staying in the LO setting, increase the energy level until the beam spot is visible. Do not increase the energy level beyond the minimum needed for visibility. 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, 80x or 100x objective for the final alignment.
8) Center the laser spot within the larger illuminated spot by adjusting the laser head tilt adjustment screws (See Figure 1-6) with a 2.5 mm hex wrench. These adjustment screws are located in the back left corner (Y adjustment) and front right corner (X adjustment) of the base plate, which mates the laser head to the microscope (See Figure 1-2).

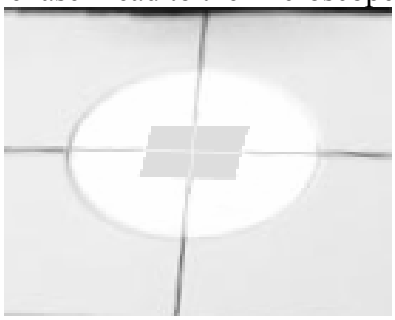


Figure 3-7: Aligning the green laser spot on the white card

Spot Marker Illuminator

The projected spot marker is provided to indicate the area that will illuminated by the laser with the system's current setup. The Spot Marker Illuminator is projected along the laser beam path and so encounters the same optical hardware as the beam itself will. While the divergence of the spot marker beam is greater than that of the laser, this is not significant over the distances involved and the projected spot marker is a reliable representation of the laser spot.

The EzLaze 3 is offered with 2 types of Spot Marker Illuminator:

- **Internal LED Spot Marker —** This blue LED device is mounted inside the laser head and requires no setup. To maximize visibility, the marker can be made to blink on and off and can be varied in brightness.
- **External Spot Marker —** This traditional incandescent device uses a 150 watt white light coupled into the laser head by a fiber lightguide. The lightguide extending from the laser head plugs into the illuminator adapter. The illuminator is turned on and off and the light intensity is increased and decreased by the front panel switch on the illuminator.

XY Shutter Aperture Calibration

Calibrate the range of operation of the XY Shutter by the following procedure:

1. Using the Page button on the Remote Control Panel, scroll down to the LASER INFO page.
2. Select XY SETUP using the appropriate soft key to go to the Apertures Setup Page.
3. Select X APER MIN POS using the appropriate soft key.
4. Turn the Left Control Knob clockwise until a value greater than 15 is displayed in the X Position window, then counterclockwise until the shutter closes.
5. Select Y APER MIN POS using the appropriate soft key.
6. Turn the Left Control Knob clockwise until a value greater than 15 is displayed in the Y Position window, then counterclockwise until the shutter closes.
7. Exit the Apertures Setup Page. Return to the LASER INFO page and verify that a value of 0 is displayed.

Exit the Apertures Setup Page. The calibration will be saved automatically.

Chapter Four

Controls and Operation

Controlling the EzLaze 3

The EzLaze 3 can be operated with any of the following control setups:

1. Operation with the Remote Control Panel
2. Operation with a computer running New Wave Research's LaserExec or other custom software. The computer can be linked to the EzLaze 3 in two ways:
   a) Directly connected to the RS232 (DB-9) port on the power supply rear panel.
   b) Connected to the RS232 (Update) DB-9 port on the rear of the Remote Control Panel. In this configuration, the Remote Control Panel becomes inactive and simply relays the control signals.

Remote Control Panel

The Remote Control Panel is a microprocessor-based device which connects to the Power Supply through a 6 ft. cable attached to the 9-pin D-sub RS-232 port and allows operators to control and operate the EzLaze 3 laser system from a convenient location. The multiple screens viewable on the 3"x3"LCD display give access to a wide range of operating parameters and stored user-defined laser setup pages. Control is affected through soft buttons and knobs whose functions are defined by the screen being displayed and four fixed-use buttons.

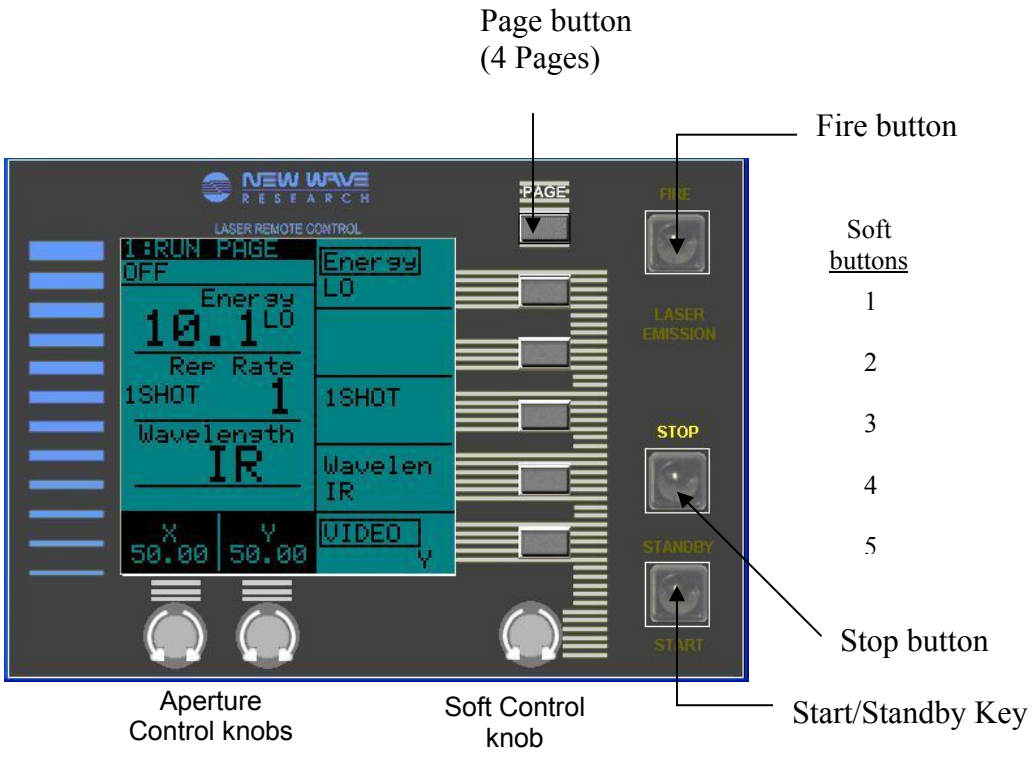


Figure 4-1 Remote Control Panel

Fixed Function Controls

The Remote Control Panel has four fixed-function buttons located on the right side of the front panel. Their functions are described below:

START / STANDBY button — Places the laser in the STANDBY mode from the STOP or RUN modes. In STANDBY, the laser is not firing but the fire button is enabled. Once the laser is in STANDBY mode, pushing this button again has no effect. This button is functional regardless of the page displayed on the LCD and will return the screen to the Run page when pressed.

When pressed in the STOP mode, the laser will go into STANDBY after a safety interval of 10 seconds. The following will illuminate immediately:

- LASER EMISSION indicator on the Remote Control Panel
- Laser Enabled light on the Laser Head
- START indicator on the Remote Control Panel.

After the 10 second safety interval, the START indicator will go out and the STANDBY indicator will illuminate.

When pressed in the RUN mode, the laser goes into the STANDBY mode immediately. The FIRE indicator will stop blinking. The LASER EMMISSION indicator and the Laser Enabled light on the Laser Head remain illuminated.

STOP button — Used to place the system in the STOP mode from the STANDBY or RUN mode. This button is functional regardless of the page displayed on the LCD.

FIRE button — Used to fire the laser, placing it in the RUN mode, according to the parameters shown on the Run Page. The laser can only be fired from the Standby mode with the Run Screen displayed on the LCD, and pressing the button outside of these conditions will recall the LCD to the Run page but will not fire the laser. When the system is in the RUN mode, the FIRE indicator will illuminate.

PAGE button — Used switch between the four pages of the LCD display.

Aperture Control Knobs — The two aperture control knobs, located beneath the LCD screen, control the X and Y dimension of the XY Shutter from the Run page as indicated on the screen.

Soft Controls

The five soft buttons are located to the right of the LCD screen directly below the Page key. This manual will identify them as buttons #1 (top) thru #5 (bottom), although the actual buttons are unmarked. The functions of these buttons are indicated on the adjacent section of the LCD and change with each page displayed.

The Soft Control Knob is located below the soft buttons. It controls the parameter selected thru the soft buttons and highlighted on the LCD screen.

The functions of each of the soft controls is described for each LCD page in the following sections:

LCD Pages

The four LCD screens (pages) may be sequentially selected by pressing the PAGE button. The LCD pages are:

RUN Page – allows control of the laser. The laser may be fired only from this page.

SETUPS Page – allows up to 10 sets/recipes of laser parameters to be stored and recalled.

INTERLOCKS Page - shows the status of internal and external laser interlocks.

LASER INFO Page– shows laser system information including laser model, serial #, firmware version, manufacturing date, wavelengths, maximum repetition rate, and shot count.

VIDEO Setup – Accessed from the LASER INFO page. Allows setup of the video marker.

XY APERTURE Setup - Accessed from the LASER INFO page. Allows software adjustment of the XY shutter so that 0 = closed and 120 = fully open.

Note: To change laser parameters, the parameter of interest (i.e. Repetition Rate, etc.), must first be selected on the LCD display by pressing the adjacent soft button. When the parameter is selected, the value is highlighted on the display. After the parameter is selected, it may be changed using the soft Control Knob on the lower right side of the control panel. Please refer to the Run Page in the following section.

Page 1: Run Page

The Run Page as shown in Figure 4-3 below displays and permits control of laser parameters. The laser may be fired only from the Run Page.

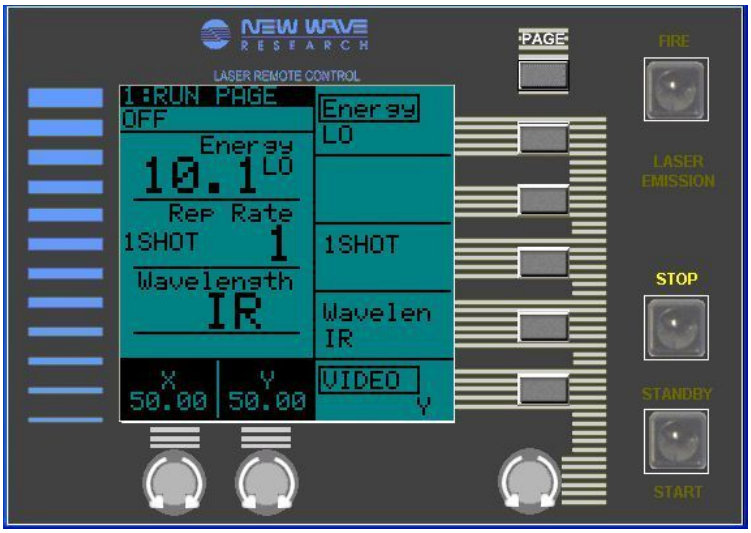


Figure 4-2 Run Page

Table 4-1 summarizes soft button control of laser Parameters from the Run Page

Soft button	Assignment	Variable	Control Method
#1	Energy HI/LO Setting Laser Output Energy	HI/LO 0-100 (non-linear, not a percentage) 100 setting produces maximum energy output	Soft button – select and toggle Control knob - input
#2	not used		
#3	Trigger Mode – Switches between the laser firing modes.	- 1 Shot - Burst (1-50 shots) - Continuous	Soft button – select Control knob - input (Burst mode only)
#4	Wavelength – laser wavelength selection	IR / Green / UV (depending on model)	Soft button – select and input
#5	Video Marker	On / Off	Soft button – select Control knob - input
Present if option is fitted	LED Spot Marker	On / Off	
	Spot Marker brightness	0-100	
	LED Spot Marker blink	On / Off	
	XY Shutter Rotation	+/- 90˚	
	Polarizer Rotation	0 - 180˚	

Table 4-1 Run Page Soft Key Summary

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

Left Screen

1: RUN PAGE – screen identifier
Laser Mode display – OFF, WAIT, READY *-------- or BURST LOCK

Energy – displays laser Energy HI/LO setting and energy level

Rep Rate – displays selected mode and repetition rate (repetition rate displays in 1 Shot mode, but has no effect)

Wavelength - displays the selected wavelength

XY Aperture – displays current X and Y settings
X setting is controlled by the left control knob
Y setting is controlled by the right control knob

Energy HI/LO Switch

The energy HI/LO switch is a power adjusting 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 30:1 for green and about 20:1 for IR and UV. LCD display indicates 000 – 100 across the full range.

LO Approximately 30% of maximum energy for green and 40% of maximum energy for IR and UV is available. Variable attenuation is about 100:1 for IR and 40:1 and UV. The LED indicates 00 – 100 across the reduced energy range. The Low Range is not available for IR-only systems.

Note: The LCD display shows 000 – 100 in both the HI and LO Energy settings. This display is a non-linear indication of what portion of the available energy will be emitted. An indication of 80 with the energy switch in the LO position corresponds to a setting of 30 with the energy switch in the HI position for the Green wavelength and approximately 40 for the IR & UV3 wavelengths.

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

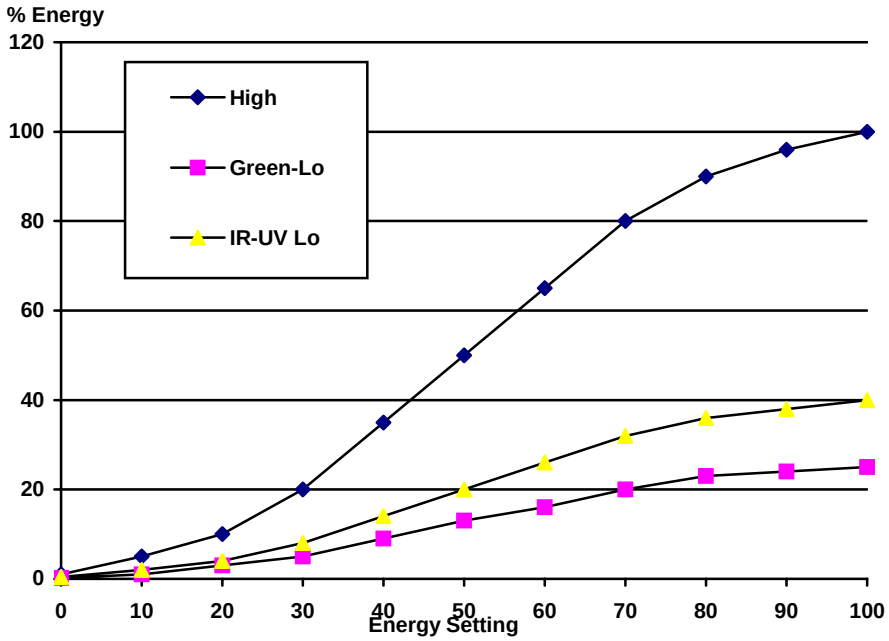


Figure 4-3: Energy level vs. Energy control setting

Page 2: Setups Page

The Setups Page as shown in Figure 4-4 allows up to 10 laser configurations to be stored or recalled. Each configuration needs to be created on the Run Page then stored/saved on the Setups Page.

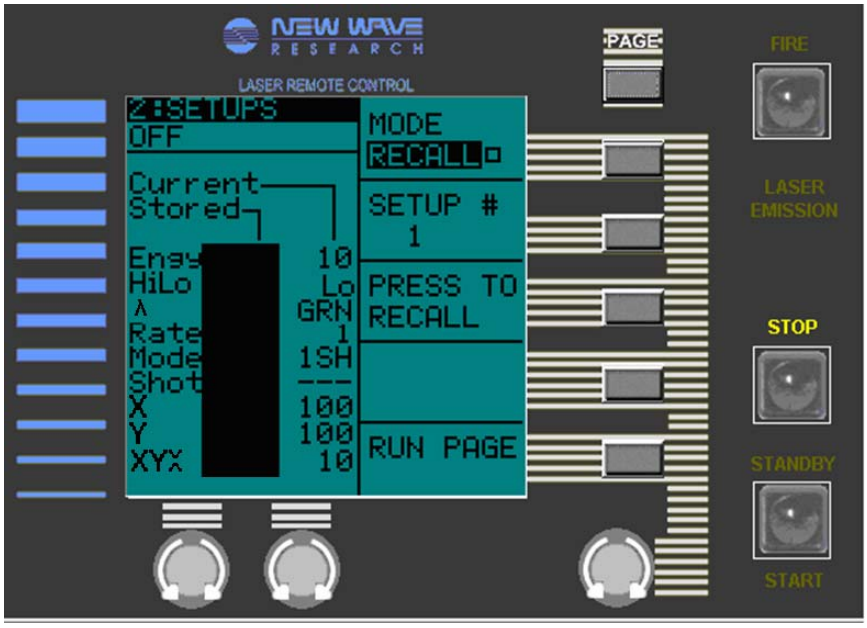


Figure 4-4 Setups Page

Table 4-2 below summarizes the soft keys assignments for the Setups Page:

Soft button	Assignment	Variable	Control Method
#1	Control Panel Mode – Switches the Control Panel between the following modes: Store - allows storage of new setup configurations Recall – allows retrieval of previously stored setup configurations	Store or Recall	Soft button – select & input
#2	Memory Location – Selects the setup configuration to be displayed in the **Stored** window when in Recall mode	1-10	Soft button – select Control knob - input

Soft button	Assignment	Variable	Control Method
#3	Memory Input / Output – pressed to update or apply selected Setup # In **Recall** mode - Press to accept the Stored setup configuration. Accepted configuration will then replace the setup in Current window. In **Store** mode – Press to save the Current setup configuration. Current configuration will then replace the setup in Stored window.	none	Soft button – input
#4	Not used		
#5	Run Page – Press to call up the RUN page		Soft button – initiate

Table 4-2 Setups Page Soft Key Summary

Left Screen

2: SETUPS – screen identifier
Laser Mode display – OFF, WAIT, READY *-------- or BURST LOCK

Current – this column displays the current setup configuration as entered on the RUN page
Stored – this column displays the setup parameters stored in the selected memory location.

Engy – displays Laser energy level
HiLo – displays Energy HiLo setting
Λ – displays wavelength
Rate – displays Repitition Rate (displays in the 1 Shot mode, but has no effect)
Mode – indicates the Trigger mode selected:
1SH – 1 shot
BUR – Burst mode
CON – Continuous mode
Shot – displays the number of shots commanded in the Burst mode
X - displays Shutter X-axis setting
Y - displays Shutter Y-axis setting
XYΘ - displays XY Shutter rotational setting

Page 3: Interlocks Page

The Interlock Page as shown in Figure 4-5 below displays the status of internal and external laser interlocks. The Interlock Page is automatically displayed whenever an interlock is tripped, indicating the fault condition. Pressing the Start/Standby button from the Interlock page will recall the Run Page if the laser successfully starts.

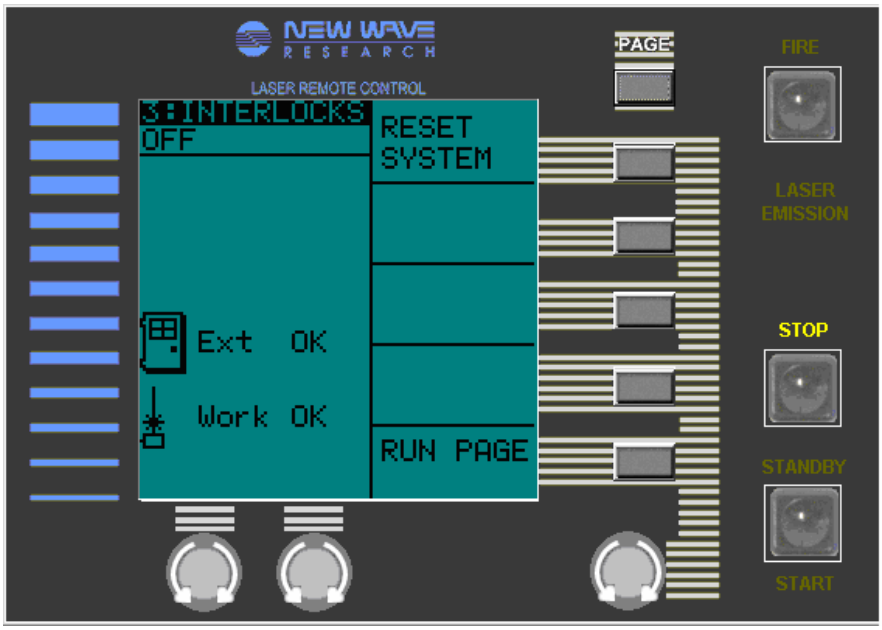


Figure 4-5 Interlock Page

Soft button	Assignment	Variable	Control Method
#1	Reset System – pressed to cause the Control Panel microprocessor to reload it's program. Stored setup configurations are not lost during this process	none	Soft button – initiate
#2	Not used		
#3	Not used		
#4	Not used		
#5	Run Page – Press to call up the RUN page		Soft button – initiate

Table 4-3 Laser Interlock Summary

Left Screen

3: INTERLOCKS – screen identifier
Laser Mode display – OFF, WAIT, READY *-------- or BURST LOCK

Ext - Indicates the status of the System Stop (External) Remote interlock: FAIL or OK.
Work - Indicates the status of the Laser Standby (Work Piece) Remote interlock interlock: FAIL or OK.

Page 4: Laser Info Page

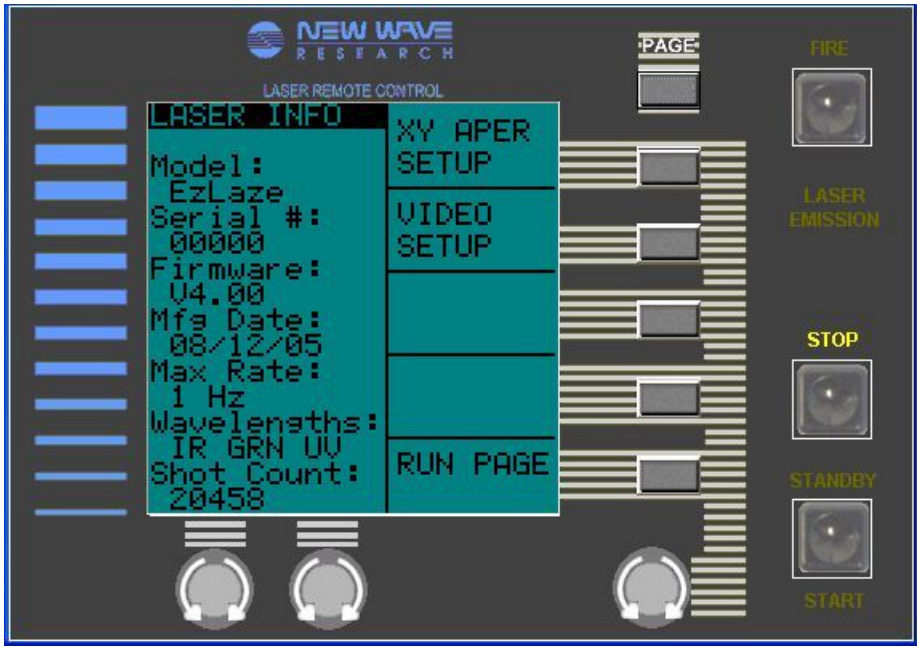


Figure 4-6 Laser Info Page – Replace Polaris with EzLaze 3

Soft button	Assignment	Variable	Control Method
#1	Go to **XY Aperture Setup page**		Soft button – initiate
#2	Go to **Video Setup page**		Soft button – initiate
#3	Not used		
#4	Not used		
#5	Run Page – Press to call up the **RUN page**		Soft button – initiate

Left Screen LASER INFO – screen identifier

Model - identifies system model
Serial # - serial number of the EzLaze 3 Laser Cutting System. This number applies to all components of the system (Laser Head, Power Supply and Remote Control Panel)
Firmware # - software version
Max Rate - Maximum repetition rate (Hz) specified for the laser
Wavelengths - lists the laser output wavelengths produced in the shipped configuration. Reconfigurations performed in the field will not be reflected in this display.
Shot Count – Counts the total number of laser shots produced by the system. This number should be recorded each time the flashlamp is changed so that the flashlamp aging can be tracked.

Page 4-1:
Apertures Setup Page

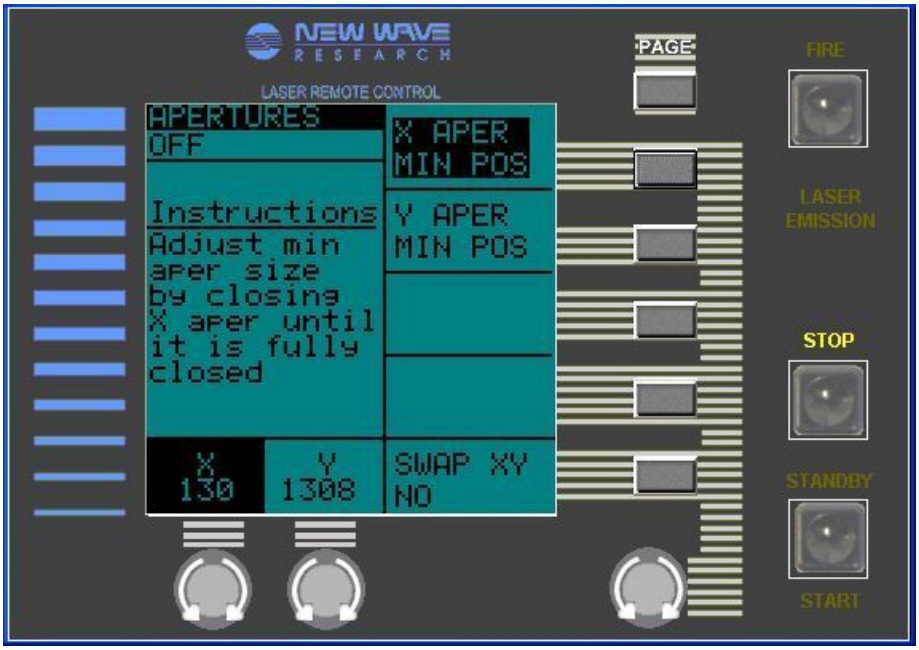


Figure 4-7 Apertures Setup Page

Soft button	Assignment	Variable	Control Method
#1	X axis Aperture calibration		Soft button – select Left Aperture Control knob - calibrate
#2	Y axis Aperture calibration		Soft button – select Right Aperture Control knob - calibrate
#3	Not used		
#4	Not used		
#5	Swap XY	Yes / No	Soft button – select Control knob - input

Left Screen

APERTURES – screen identifier
Laser Mode display – OFF, WAIT, or READY *--------
_____

XY Aperture Calibration Instructions

XY Shutter position windows

Page 4-2: Video Marker Setup Page

Figure 4-8 Video Marker Setup Page

Soft button	Assignment	Variable	Control Method
#1	Marker Gain		Soft button – select Left Control knob - calibrate
#2	Marker Position		Soft button – select Middle Control knob - calibrate
#3	XY Aperture Size		Soft button – select Left & Middle Control knobs - adjust
#4	Color Selection		Soft button – select and toggle
#5	Line Width Selection		Soft button – select Control knob - calibrate

Left Screen

MARKER – screen identifier
Laser Mode display – OFF, WAIT, READY or *--------

Video Calibration Instructions

XY Shutter position windows

Rear Panel

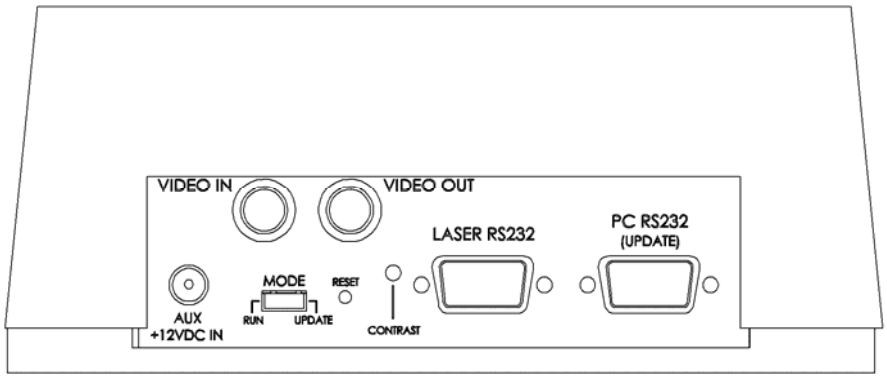


Figure 4-9: Serial Remote Box, Rear Panel

AUX +12VDC IN — Power input for use when updating the Remote Control Panel software. Power to the Remote Control Panel is normally provided by the Power Supply via the RS232 port, but this port is provided so that software updates may be accomplished remotely from the EzLaze 3 Power Supply.
MODE — Switches the Remote Control Panel between the RUN mode (the normal position) and the UPDATE postion (used to load software updates).
RESET — Pushing this recessed button causes the Remote Control Panel microprocessor to reload its software without erasing any of the stored setup configurations.
Contrast — Adjusts the contrast of the LCD display.
LASER RS232 — Control interface with the Power Supply.
PC RS232 — This port is used when controlling the Orion laser system with an external computer or when downloading software. The Control Panel will detect this connection and all front panel controls (including the STOP button) will be disabled. The LCD will display a LOCKOUT screen.

Laser Head

Manual Laser Beam Shutter — The shutter mounted externally at the beam aperture can be operated manually to block the laser beam. It should not be used for this purpose for more than a few seconds at a time.

Power Supply

Rear Panel

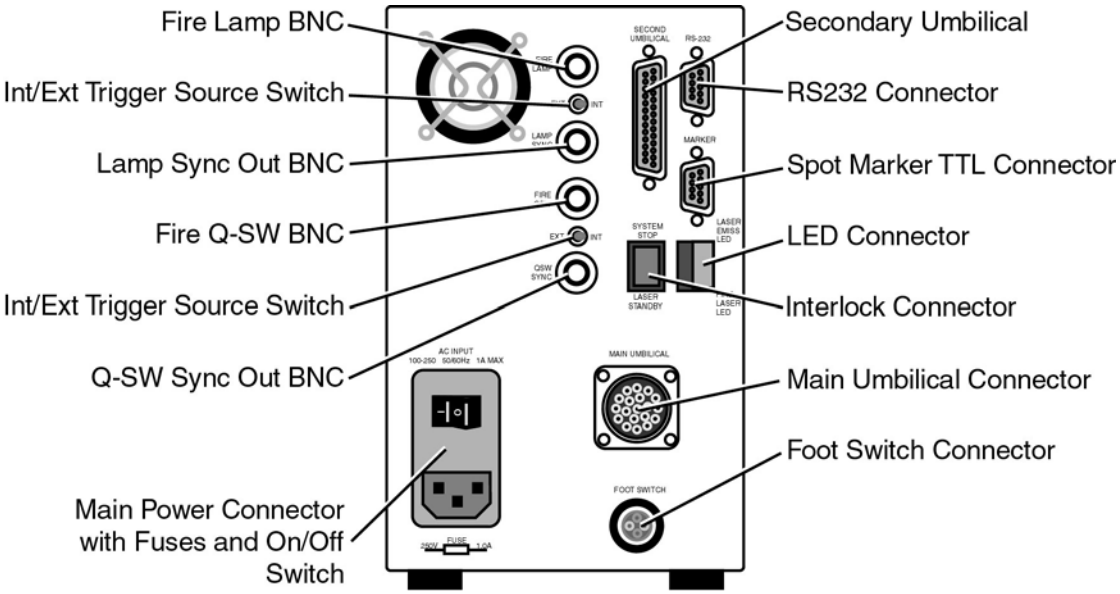


Figure 4-10 Power Supply Back Panel

External Triggering Inputs and Outputs

Flashlamp Interface

Lamp INT/EXT Trigger Select Toggle Switch – should be kept in the INT position

Lamp Fire BNC Input – not used

Lamp Sync BNC Output – not used

Q-Switch Interface

Q-Switch INT/EXT Trigger Select Toggle Switch – should be kept in the INT position

Q-Switch Fire BNC Input – not used

Q-Switch Sync Out – not used

Secondary Umbilical Connection – Connects to the secondary umbilical and carries control signals to the Laser Head.

RS232

The RS232 port is used to connect the Power Supply to the Remote Control Panel or controlling computer.

Marker – not used

LED Ports

LASER EMISS LED

These terminal support an optional user-supplied remote LED which is illuminated when the laser fires. The LED should be connected across these terminals and be located in a visible location. It will receive a 10 mA, 12 V signal when the laser fires. Shorting the pins or leaving them open will not affect operation of the unit.

External Laser Ready LED

These terminals support an optional user-supplied remote LED which is illuminated when the laser is powered and ready to fire. The LED should be connected across these terminals and be located in a visible location. It will receive a 10 mA, 12 V signal when the AC Power Switch on the Power Supply rear panel and the Key Switch on the Power Supply front panel are in the ON position. Shorting the pins or leaving them open will not affect operation of the unit.

Remote Interlock Connection

The EzLaze 3 Laser Cutting System is provisioned for the installation of 2 Remote Interlocks which connect to ports on the back of the Power Supply.

System Stop Remote Interlock — This interlock disables the laser, putting it in the OFF mode, based on some remote triggering event, such as a door opening. Use of a remote interlock is recommended, but the system is supplied with a shorting connector that can be used to replace the interlock if appropriate for the installation.

Laser Standby Remote Interlock — This interlock disables the laser, putting it in the STANDBY mode, based on some remote triggering event, such as a door opening. It provides a less-disruptive alternative to the System Stop Remote Interlock. Use of a remote interlock is recommended, but the system is supplied with a shorting connector that can be used to replace the interlock if appropriate for the installation.

Front Panel

The power supply contains the power entry module on the rear panel that switches main power off to the system and the key switch on the front panel that switches power to the high voltage power supply. The power entry module 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. The LED's monitor the following functions. See figure 4-1.

AC Power LED Illuminates when the AC Power entry module switch is in the On position and the AC line fuses are good.

EMISSION LED Indicates that the laser is ready to fire. This LED blinks for 10 seconds upon startup (as a safety delay) then stays ON once the laser is enabled.

RS232 Indicates that the Laser is under control from a device (remote control panel or PC) connected to the RS232 port. The remote control panel.

EXT INTLK Indicates that the system is disabled due to the System Stop external interlock being open. After closing the interlock, the Key Switch must be cycled before the laser can be fired.
WKPS INLK Indicates that the system is disabled due to the System Standby (work piece) interlock being open. After closing the interlock, the interlock must be closed before the laser can be fired.
FAULT Indicates that the system is disabled due to a fault condition. The fault condition must be corrected before the laser can be fired. Contact your NWR representative.
EXT LAMP Indicates that the Lamp INT/EXT Trigger Select Toggle Switch is set to EXT. The laser cannot be fired in this mode unless an external trigger is supplied to the FIRE LAMP BNC with the correct timing.
EXT QSW Indicates that the Q-Switch INT/EXT Trigger Select Toggle Switch is set to EXT. The laser cannot be fired unless an external trigger is supplied to the Q-SW BNC with the correct timing.

Figure 4-11

Chapter Five

Operating Procedures

Use of controls, adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Before starting the EzLaze 3 Laser Cutting System, the installation must be complete and the operator must have read and understood this manual, particularly the Safety section. All covers must be installed and the reservoir filled with de-ionized (distilled) water. See Figure 2-1a for location of controls on the control panel. The following startup procedure should be followed:

Starting the Laser

1) Close the safety shutter on the bottom of the laser head.

2) Plug the laser power cord into the appropriate single phase power source. Place the power switch on the AC entry module to the ON position.

3) Ensure that Flashlamp INT/EXT Trigger Select Toggle Switch and Q-Switch INT/EXT Trigger Select Toggle Switch are both in the INT position.

4) Turn the power supply key switch clockwise to the ON position.

5) Set the Energy Setting to LO by pressing the corresponding soft key to select and then again to toggle between HI and LO

6) Press the START/STDBY button on the Remote Control Panel to place the laser in the Standby mode. This enables the FIRE button. The following LEDs will blink for a 10 seconds safety delay period, then illuminate steadily:

- EMMISSION on the Power Supply front panel
- LASER EMMISSION on the Remote Control Panel

7) Set the Trigger Mode as follows:

a. Select the Trigger Mode by pressing Soft Button #3. Toggle through the following settings by pressing again:

- 1 SHOT
- BURST (1-50) Input burst length setting using the Control Knob. After a 5 Hz, 50 shot (the maximum possible) burst, the EzLaze 3 will go into the Standby mode for 20 seconds as the pump chamber cools.
- CONTINUOUS

1. 8) Open the safety shutter when ready to operate.
2. 9) Open the X-Y Aperture to the desired size.
3. 10) Press the Fire button on the Remote Control Panel to initiate laser firing according to the desired trigger setting.

Notes on maximum operating rate

The EzLaze 3 can operate continuously at a maximum repetition rate of 1 Hz. Sustained operation at higher rates (in the burst mode, for instance) exceeds the laser's ability to dissipate heat and will trigger an automatic cool-down period during which the laser cannot be fired. This cool-down period, indicated by "Burst Lock" displayed in the operating mode position of the Remote Control Panel or LaserExec display, is triggered and governed by the following formula:

> The automatic cool-down period is triggered whenever the following formula yields a positive value:
>
> **Cool-down period = 30 seconds minus time taken for previous 50 shots**

In the following examples, assume that the laser has been inactive for the previous 30 seconds:

1. If the laser is operated at its maximum rate in the burst mode (50 shots at 5 Hz):

Cool-down period = 30 - 10 = 20 seconds	The 20 second cool-down period will begin after the burst is completed.

2. If the laser is operated as follows: 30 shots at 5 Hz, 5 second wait, 30 shots at 5 Hz

Cool-down period = 30 – 15 = 15 seconds	The 15 second cool-down period will stop the 2nd burst after 4 sec.

Turning the Laser Off

The laser can be turned off at any time by one of the following actions:

4. 1) Press the STOP button on the Remote Control Panel.

5. 2) Turn the power supply key switch counter clockwise to the OFF POSITION.

3) Turn off the AC Power entry module switch on the rear panel of the power supply.

Interlocks

The EzLaze 3 Laser Cutting System features the following interlocks which prevent operation in specific unsafe conditions:

- **System Stop (External) Remote Interconnect** — This interlock disables the laser, putting it in the OFF mode, based on some remote triggering event, such as a door opening. Activation of this interlock will be indicated by the EXT INTLK LED on the Power Supply front panel and on the Interlocks page on the Remote Control Panel. If activated, the laser will be disabled until the interlock is closed and reset by cycling the key Switch.
- **Laser Standby (Work Piece) Remote Interlock** — This interlock disables the laser, putting it in the STANDBY mode, based on some remote triggering event, such as a door opening. Activation of this interlock will be indicated by the WKPS INTLK LED on the Power Supply front panel and on the Interlocks page on the Remote Control Panel. If activated, the laser will be disabled until the interlock is closed.
- **Laser Head Cover Open**
- **Laser Adapter Ring Interlock**
- **Main Umbilical Detached**

These interlocks should be defeated by the user only as described in this manual.

If tripped, the fault will be indicated on the front panel of the Power Supply and the Remote Power Supply and the laser will be disabled. Follow the above procedure to restart the laser.

Spot Marker

The EzLaze 3 Laser Cutting System is offered with two alternative spot markers: one using an internal blue LED illuminator and the other based on a traditional external incandescent illuminator. Space constraints prevent both types of spot marker being fitted to the same system. Both project a beam of light down the path followed by the laser to create a spot highlighting the area that will be lased by the system at its current setting. The spot marker beam passes through the same optics and XY Aperture as the laser so the spot marker image viewed through the microscope or monitor is an accurate representation of the laser footprint. To achieve the best cut definition, the microscope should be focused so that the spot marker edges are sharp.

The operation and brightness of the Blue LED Spot Marker is controlled from the Run page of the Remote Control Panel or via a controlling computer. To maximize the visibility of the Blue LED Spot marker, it can be placed in a Blink mode.

The 150W white light external spot marker brightness is controlled by the front panel potentiometer located on the illuminator.

NOTE: The image of the spot marker is more visible when the microscope's background lamp is reduced in intensity. Also, the microscope fiber optic illuminator has an adjustable aperture control at the input location of the fiber into the microscope. Reducing the aperture increases the viewing depth of focus and enhances the visibility of the spot marker.

Video Spot Marker

The Video Spot Marker is a representation of the area to be lased by the system at its current settings that is inserted into the microscope camera's video signal. Under some conditions, the Video Spot Marker will be more visible than either of the projected spot markers. The size and position track the position of the laser's XY Aperture Shutters. The appearance of the marker can be adjusted and different settings stored for each available wavelength. The settings are automatically recalled when a new wavelength is selected.
If the system is equipped with a Rotational Shutter, the Video Sport marker will appear as four dots, rather than a solid box. The four dots represent corners of a square, and will rotate to match the settings of the rotational shutter.

Chapter Six

Maintenance and Troubleshooting

The EzLaze 3 Cutting System is a high power laser system and it is important to keep the laser clean and well maintained. This section describes several procedures that should be performed on a regular basis to ensure that the laser system works properly for many years.

Periodic Maintenance

Following is a summary list of monthly, yearly and as needed recommended maintenance items. These items should be performed according to the schedule below to ensure proper operation of the EzLaze 3.

Frequency	Procedure
Annual	Check the optical output power at each working wavelength
	Check laser for proper alignment with microscope

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.
Note: New Wave Research uses a Molectron detector – model EM500 + J25LP-110 pyroelectric detector.

Routine Maintenance

Remote Control Panel Firmware Updates

Firmware updates are distributed by email and are provided with complete installation instructions. The Remote Control Panel incorporates an auxiliary +12VDC input power connector, allowing the device to be powered without connection to the Power Supply. +12VDC power to the remote control panel is normally supplied through the DB9, RS232 connector.

Power Line Fuse Selection

The EzLaze 3 laser system accepts single-phase 250W, 50-60 Hz electrical from 100-240 VAC, but should have fuses installed matching the local voltage. Two fuses as specified below are located in the fusebox located above the AC Power Switch on the rear panel of the Power Supply.

Fuse Identification	*Voltage (VAC)*	*Description*	*Acceptable part*
AC Power Entry Module	*100-240*	*1 Amp / 250 V SPT, 5x20mm, time-lag, high breaking capacity*	

White Light Spot Marker Adjustment

The White Light Spot Marker indicates the aimpoint of the laser system and should appear in the center of the field of view on the monitor. Over time or due to shock or vibration, the system may drift out of alignment.

Realignment of the Spot Marker is accomplished by repositioning the mirror at the elbow of the camera adaptor (see figure 6-1).

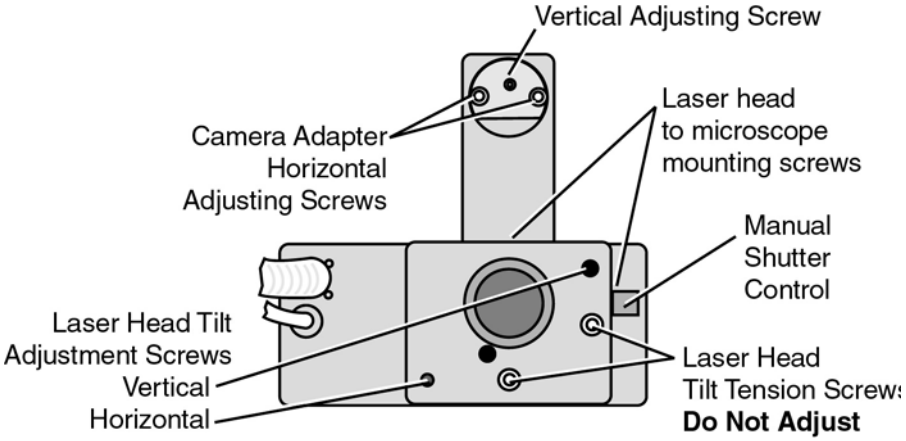


Figure 6-1: Laser Head Mounting/Adjusting screws (bottom view).

Y-axis Adjustment: Rotate the Vertical Adjusting Screw to move the White Light Spot Marker in the Y-axis on the monitor image.

X-axis Adjustment: To move the White Light Spot Marker in the X-axis on the monitor image, loosen both Horizontal Adjusting Screws. Adjust the position of the circular panel manually until the Spot Marker is centered, then lock it in place by tightening both screws.

Adjusting the Optional Video Spot Marker

The appearance and characteristics of the video spot marker are controlled through the Remote Control Panel. See the Controls section of this manual.

Adjusting the 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 6-2)

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.

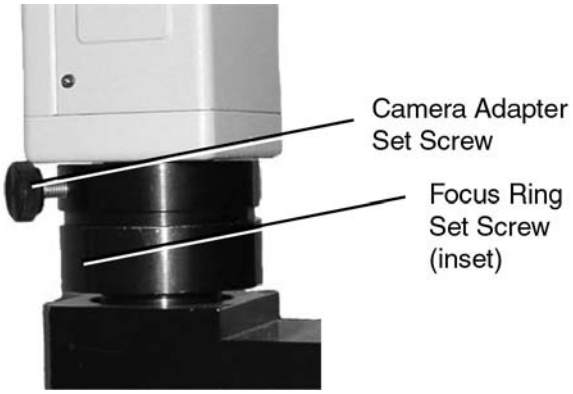


Figure 6-2: Camera Adapter Focus Ring

Troubleshooting

This section lists a number of problems that may occur during the lifetime of the EzLaze 3 Nd:YAG laser system and recommends steps users can take to resolve the problem or identify the root cause. If these measures fail to resolve the problem, contact New Wave Research for assistance.

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 contact New Wave Research, Phone 510-249-1550, Fax: 510-249-1551, Email: customer-service@new-wave.com to get technical support for the laser.

Laser fails to start

If the laser does not start, please check the following points. As a precaution, the Pulse Energy level should be set very low during troubleshooting.

- The laser AC power cord is plugged in and the outlet has correct voltage and power.
- The power switch on the AC power entry module is in the ON (I) position.
- The key switch on the power supply is turned to the ON position, and the AC power light is illuminated.
- The umbilical from the laser head is securely attached to the power supply.
- The external interlock is not tripped or that the shorting plug is secured in the socket on the back of the power supply.
- All interlocks switches are closed; external interlocks, laser head cover interlock, laser microscope interlock, flow switch interlock.

Laser does not fire

Check the Fire Flash lamp 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.

Laser starts, but no light is emitted

When the laser is in the standby mode pressing the fire button will cause the laser to begin firing. The Laser Emission LED on laser head and the Laser Emission indicator on the Remote Control Panel should flash at the rep rate the laser is firing. Check the following:

- Check that the laser safety shutter is open.
- Check that the Energy level is not set too low.
- Check that the flashlamp and trigger select switches on back of the power supply are both in the INT (up) position.

Low Output Energy

If the laser output energy is low, please check the following points:

- Check that the energy level is not set too low.
- Ensure that the attenuator setting is not too low.
- Make sure that the Hi/Lo switch is in the Hi position.
- Check the setting of the attenuator. Increase to at least 500.
- Make sure a 50x or higher magnification objective lens is being used.
- Test other locations on the sample for consistency.

Unstable Laser Energy

The pulse stability for the EzLaze 3 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 shot counter for 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 different material samples.
- Call New Wave Research if it is not possible to improve laser pulse stability by this procedure.

Clipped Laser Beam

The output beam of the EzLaze 3 Nd:YAG laser should be rectangular in shape with even energy distribution. An object in the beam path may clip the laser beam, resulting in an output beam which appears irregular. If the output beam appears clipped, check beam path through the microscope for obstructions. If none are found:

- Cease operation of the laser and contact your New Wave Research representative.
- 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.

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, please call New Wave Research for service information.

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 trigger switch to CONT with a rep. rate of 5Hz max. Press the Fire button. Correct the microscope alignment if necessary.

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 6-2). 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.

Appendix

Specifications

		1064 nm	532 nm	355 nm	266 nm	Classification
Model						
IR Only	Energy (H/L)	.6 mJ/.2 mJ				Class 3b
IR Hi-Energy option		2.5 mJ/.8 mJ				Class 4
Green Only			.6 mJ/.2 mJ			Class 3b
Green Hi-Energy option		2.5 mJ/.8 mJ				Class 4
IR/Green		.6 mJ/.2 mJ	.6 mJ/.2 mJ			Class 3b
Green/UV3			.6 mJ/.2 mJ	.6 mJ/.2 mJ		Class 3b
Green/UV4			.6 mJ/.2 mJ		.25 mJ/.075 mJ	Class 4
TriLite UV3		.5 mJ/.15 mJ	.5 mJ/.15 mJ	.4 mJ/.15 mJ		Class 3b
Cut Size (with single pulse)						
Minimum with 100X objective		2μ x 2μ	1μ x 1μ	1μ x 1μ	2μ x 2μ*	
Maximum with 50x objective		50μ x 50μ	40μ x 40μ	30μ x 30μ	30μ x 30μ	
Pulse Width (nsec)		3 – 4	3 – 4	3 – 4	3 – 4	
Repetition Rate		1 shot, 1 Hz continuous; 5 Hz for 50 shots followed by 20 sec cool-down period				

Environmental Requirements

Voltage	100 - 240 VAC (laser), 100 -120/240 VAC (illuminator), 50/60 Hz
Temperature (operating)	10° – 30° C (50° – 86° F)
Temperature (non-operating)	0° – 50° C (32° – 122° F)
Relative Humidity	20% – 80% non-condensing
Power	100 - 240 VAC (laser), 50/60 Hz, 100 watts laser; 215 watts illuminator

Table A-1: EzLaze 3 Models and Typical Energy Specifications

	Laser Head	Power Supply	Control Panel
Length	6.25” / 159 mm	5” / 126 cm	7.0” / 178 mm
Height	11.75” / 298 mm	8.12” / 206 mm	3.25” / 83 mm
Width	6.375” / 166 mm	11.4” / 289 mm	5.0”/127 mm
Weight	8.5 lb. / 3.6 kg	9 lb. / 13.6 kg	2 lb. / 0.9 kg
Umbilical	8 ft / 2.4 m	-	10 ft / 3 m

Table A-2: EzLaze 3 Physical Characteristics

Parameter	Specifications
Aperture Range	50x50 um w/50x objective (FS60,70)
	40 x 40 um w/50xNUV obj. @ 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

Table A-3: EzLaze 3 Aperture and Attenuator Specifications

Shutter Specifications[1]

	Standard	Hi-Resolution
XY Control		
Fully Open X/Y Dimension (mm)	2.5	2.5
Resolution (µm)	11.5	2.1
# of Steps	240	1308
Full Movement Time (sec)	1.1	2.7
Optional Rotational Control		
Range of Motion (deg)	180	180
Resolution (deg)	1	1
Axis Position Tolerance (µn	.25	.25
Movement Time (sec)	3	3

[1]The XY shutter resolution specs apply to the shutter itself, not the projected image. To derive the image resolution, divide the shutter resolution figure by the power of the objective lens in use.

Applications

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 B-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 PCLaze, the laser control software package that is supplied with every QuikLaze system. PCLaze runs 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 PCLaze, 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

Note: the information in this table is presented as an example and is subject to change.

Table B-1: Recommended Laser Settings for Various Laser Machining Operations

Recommended Spares

The following parts require periodic replacement and may be ordered from New Wave Research. To minimize downtime, it is recommended that the indicated quantities be kept on hand.

Part	Part Number	Quantity
Flash Lamp	0002-0036	1

Optional Class 1 Enclosure

Safety

Read the following safety precautions and operator's manual prior to powering up or operation to avoid injury and prevent damage to the Class 1 Enclosure or associated equipment. Use the system only as specified.

The standard EzLaze 3 and QuikLaze are classified as Class 4 devices - Class 4 and Class 3b lasers can produce instantaneous and permanent blindness or serious injury to the eye or skin and require stringent safety measures during operation and maintenance. The Class 1 Enclosure is designed to prevent emission of hazardous levels of laser energy and, when fitted to an EzLaze 3 or Quiklaze Laser Cutting System, permits operation as a Class 1 Laser Device. Improper operation or servicing can result in death, blindness, other injury or material damage. Only qualified personnel should operate or service this equipment Operators should be aware of the dangerous levels of laser energy within the enclosure and:

- Follow the instructions and precautions in this manual for proper installation and
- Follow the instructions and precautions in this manual for proper installation and safe operation of your laser and enclosure.
- Consult ANSI, ACGIH and OSHA standards for safety guidance.

Use of controls, adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Safety Features

The following safety features are incorporated into the Class 1 Enclosure and conform to FDA and CE regulations to allow safe laser operation.

System Housings

The Class 1 Enclosure creates a light-tight barrier around the working area to prevent emission of dangerous levels of laser energy. The lower component is constructed of aluminum plate, anodized in flat black to minimize reflections. The upper component uses a similar plate as the upper surface and laser-blocking acrylic windows as side panels to allow observation of and access to the working area.

The lower component telescopes into the upper, but is constructed so that the two halves cannot be separated without disassembly.

Access to the working area is provided by upward-hinging doors on the front and left side of the upper component. The door edges are fitted with sealing strips which block beam paths through slight gaps that might occur.

The Class 1 Enclosure seals around the microscope body and post in order to prevent laser energy in excess of Class 1 requirements from escaping.

Interlocks

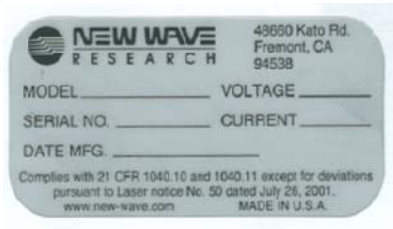
The doors on the front and left side of the enclosure are each fitted with redundant microswitches on an interlock circuit which must be connected to the Laser Standby Remote Interlock of the incorporated laser system (located on the back of the Power Supply) to prevent operation while the doors are opened. Details of the interlock operation and reset can be found in the main body of the incorporated laser's operating manual.

Two interlock defeat tools are provided to allow operation of the incorporated laser with one or both doors open. These tools are provided for regulatory compliance and operation of the incorporated laser with the doors open is not normally required.

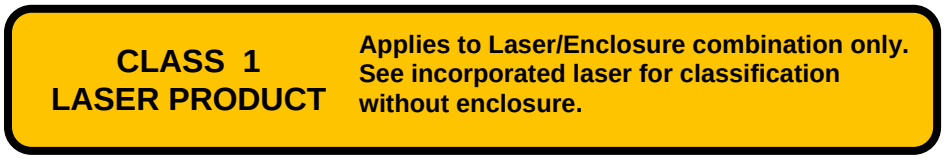
This laser system is Class 1 ONLY when the laser is inside the enclosure and the enclosure's interlocks are engaged. If interlocks are removed or defeated, the laser system is NOT a Class 1 product.

Laser Safety Warning label

Interlocked Door label

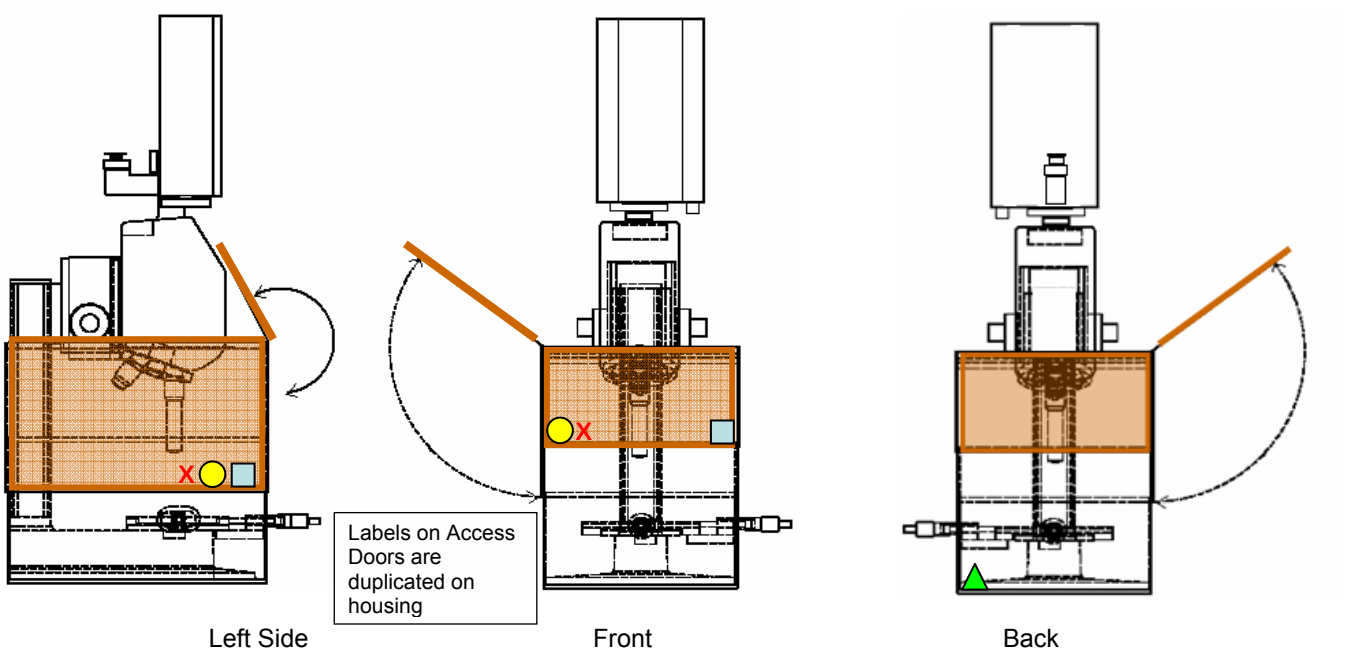


Certification and ID label



Class 1 Enclosure Laser Product label

Class 1: Hazard Labels



Access Doors / Viewing Windows constructed of laser-blocking Acrylic

Interlocked Door label

Laser Safety Warning label

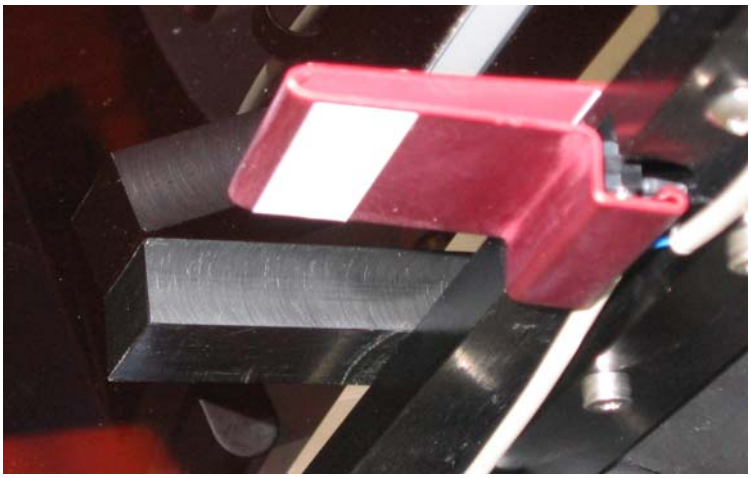
X Class 1 Enclosure Laser Product label

Certification and ID label

Hazard Label Locations

The door interlock circuit on the Class 1 Enclosure must be connected to the remote interlock port on the incorporated laser. The EzLaze 3 and QuikLaze operator's manuals describe implementation of the remote interlock as optional, which is appropriate for a Class 3b laser system, but it is absolutely required for safe operation when these systems are incorporated into the Class 1 Enclosure. The loopback jumper mentioned in these manuals is not shipped with systems including the Class 1 Enclosure.

To defeat the safety interlock, the door of interest should be held open using the support arm mounted to the top of the enclosure. The tool is clipped over the interlock microswitch to depress



the actuator arms and close the interlock circuit (see Figure 3). Clipping the tool over the microswitch is best accomplished by engaging the enclosure top with the straight upper half of the tool and then pulling down on the lower half of the tool to open it up as it is slipped over the microswitch. With the interlock defeated, the Class 1 Enclosure is ineffective and the system becomes a Class 3b or Class 4 laser device, depending on the model of laser installed. All appropriate precautions must be taken.

Interlock defeat tool in place on interlock microswitch.

System Description

The Class 1 Laser Enclosure is offered as an option on EzLaze 3 and Quiklaze Laser Cutting Systems. By containing dangerous levels of laser radiation, it permits operation of these devices as Class 1 Laser Products. For certification as a Class 1 Laser Product, a device may not emit hazardous levels of laser energy.

The Class 1 Laser Enclosure consists of a telescoping light-tight box that mounts to and around the stand/stage/post/microscope assembly. The box consists of an upper and lower component, sealed around the microscope assembly and to each other to prevent hazardous emissions. The lower component is constructed of black anodized aluminum

plate. The upper component consists of a black anodized aluminum top with side viewing windows of laser-blocking acrylic material.

Access to the sample area is provided by doors on the front and left side. These doors are equipped with redundant microswitches on an interlock circuit for connection to the Laser Standby Remote Interlock so that opening either will prevent operation of the laser.

Nominal Dimensions[1]

Height	12 ½"
Width	I2"
Depth	I5 ¾"

[1] Nominal dimensions of a unit built for a 3" stage. These apply to the enclosure only and do not include microscope, stand, stage drive or laser since these will vary by installation.

Installation / Setup

Site Requirements

Any environment suitable for an EzLaze 3 or QuikLaze-equipped microscope will be adequate for the Class 1 Laser Enclosure. It has no power requirements. The space selected should have at least Class 18 inches of clearance to the left to allow for operation of the door and side-access to the working space. Access to the back will be extremely helpful if coarse repositioning of the microscope is required.

Assembly

The Enclosure is shipped assembled and mounted on the microscope. To prepare the unit for use:

1. Remove the foam packing from inside the enclosure.
2. Install the micrometer sleeves into the X and Y micrometer barrels, which project from the front and left panels of the lower enclosure component. The sleeves simply thread into the barrels and, when installed, operate like a conventional micrometer.
3. Install the door interlock cable. Plug the metal quick-connect connector end into the port on the right panel of the lower enclosure. The plastic connector plugs into the Remote Interlock port on the back of the incorporated laser.
4. Reposition the stop collar on the microscope post to limit the downward travel of the microscope block. This device is provided to prevent the objectives from contacting the stage and should be positioned so that the objectives can still be focused on the work but cannot be made to touch the stage. The stop collar is adjusted through the right access door with a hex wrench.

Operating Procedures

Coarse Positioning - The telescoping configuration of the enclosure allows coarse positioning of the microscope on the post over a 4.25" range. The stop collar should be in place before this operation is undertaken. Coarse positioning is accomplished by releasing the focus block clamp from the post so that the upper enclosure, microscope and laser head can be moved vertically. As the enclosure top/microscope/laser head

assembly can weigh up to 40 lbs, and provides no convenient handhold, this is a 2-man operation (see Figure 4).

Coarse positioning of the microscope.

1. Open the front and side doors. The door can be held open by the pivoting arms mounted on top of the housing.
2. One man in front of the enclosure should reach into the enclosure and support the weight of the top assembly at the microscope body. Take care not to lift up on either open door during this process – they will break.
3. The second man at the back of the enclosure should release the focus block clamp from the post and reclamp it in the new position.

Fine Positioning - Fine positioning of the microscope over a 2" range is accomplished using the focus knob in the normal manner.

Maintenance and Troubleshooting

No maintenance of the Class 1 Laser Enclosure is required.

Periodic Inspection

It is recommended that the unit be checked for light-tightness annually or when physical damage is suspected. This is best accomplished by placing a battery operated unshielded white-light lamp inside the enclosure in the sample working area and darkening the room lights. During a walkaround, look for any direct white light which would indicate a breach. An indirect glow from reflected white light, particularly around the seals, is not a problem. Light filtered through the laser-blocking viewing windows is easily distinguished from leaks by color and is also OK. If any direct white light is visible from outside the Enclosure, it is no longer a Class 1 device and should not be used as such.

Spare Parts

Door interlock microswitches	Cherry DGClass 1.T85
Interlock back panel socket	LEMO EHG.OB.302

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