

FiberStar[®] Welding Workstation

7600 Series Operation and Maintenance Manual

(Doc # 31-99990-760-2)

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EU Declaration of Conformity

Manufacturer's Name: LaserStar Technologies Corporation

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Designation: 7600 Series

Model Numbers: 5xx-76xx series & 5xx-76xx XL Series

Year of Manufacture: 2019

EC Directive(s): 2014/35/EU (Low Voltage Directive)
2014/30/EU (EMC Directive)

Standard(s) to which Conformity is Declared:

IEC 60825-1:2014 Ed. 3.0
IEC 61010-1:2010 Ed. 3.0
IEC 61000-6-2 Ed. 2.0 (2005-03)
IEC 61000-6-4 Ed. 2.0 (With A1:2011)

This declaration is issued under sole responsibility of LaserStar Technologies Corporation. The object of this declaration is in conformity with relevant Union harmonization legislation.

I, the undersigned, hereby declare that the equipment specified above conforms to the above standards and fulfills the provisions of the EU directive(s).

A handwritten signature in black ink, appearing to read "James E. Gervais", is written over a horizontal line.

James E. Gervais
President and Chief Operating Officer

Date: March 05, 2019



Declaration of Compliance

United States and Canada

Manufacturer's Name: LaserStar Technologies Corporation

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Designation: 7600 Series

Type: 5xx-76xx series & 5xx-76xx XL Series

Year of Manufacture: 2019

Standard(s) to which Compliance is Declared:

UL 61010-1:2012 Ed. 3+R:29 Apr2016 "Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use; Part 1: General Requirements"

CSA C22.2#61010-1-12:2012 Ed.3+U2 "Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use; Part 1: General Requirements"

Code of Federal Regulations (CFR) Title 21, Part 1040.10, 1040.11 for laser products

FCC 47CFR Part 15 Subpart B (2017) Unintentional radiators Class A Verification

Listing: ETL Mark-Control Number-4006074

I, the undersigned, hereby declare that the equipment specified above conforms to the above identified standards as described in the test record.

A handwritten signature in black ink, appearing to read "James E. Gervais", is written over a horizontal line.

James E. Gervais
President and Chief Operating Officer

Date: March 05, 2019

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BACKGROUND

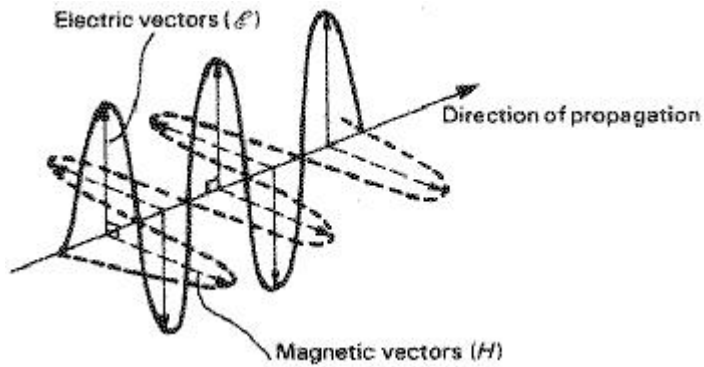
The word “laser” stands for “light amplification by stimulated emission of radiation.” Lasers are possible because of the way the light interacts with electrons. Electrons are atomic particles that exist at specific energy levels. These energy levels are unique and are different for every atom or molecule. The energy levels can be compared to orbits or rings around the sun or nucleus. Electrons in outer rings are at higher energy levels than those in the inner rings. A flash of light can bump electrons to higher energy levels by the injection of energy. When an electron drops from an outer ring to an inner ring or level, the excess of energy is given off as light. The wavelength or the color emitted is related to the amount of energy released. Depending on the particular lasing medium or material, specific wavelengths are emitted.

A fiber laser is a laser in which the active gain medium is an optical fiber doped with rare-earth elements such as erbium, ytterbium, neodymium, etc. They are related to doped fiber amplifiers, which provide light amplification without lasing. Solid-state lasers or laser amplifiers where the light is guided due to the total internal reflection in a single mode optical fiber are instead called fiber lasers. The guiding of light allows extremely long gain regions providing good cooling conditions; fibers have high surface area to volume ration which allows efficient cooling. In addition, the fiber’s wave guiding properties tend to reduce thermal distortion of the beam.

The fiber laser is often designed using a double clad fiber. This type of fiber consists of a fiber core, an inner cladding and an outer cladding. The index of the three concentric layers is chosen so that the fiber core acts as a single-mode fiber for the laser emission while the outer cladding acts as a highly multimode core for the pump laser. This lets the pump propagate a large amount of power into and through the active inner core region, while still having a high numerical aperture (NA) to have easy launching conditions.

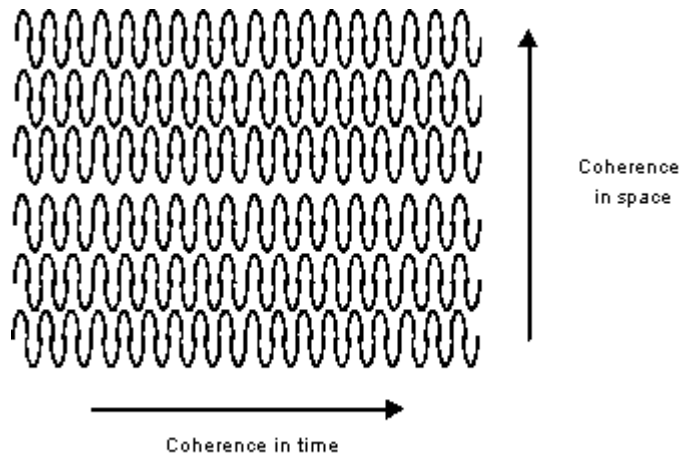
The propagation of light through space can be described in terms of a traveling wave motion. The wave is composed of a combination of mutually perpendicular electric and magnetic fields; therefore, the direction of propagation of the wave is at right angles to both field directions. **Figure 1** shows an *electromagnetic wave*.

Fig. 1 The electromagnetic wave



The concept of laser light is better understood by the definition of its properties. Laser light has three properties: monochromatic, coherent, and collimated. When all emitted photons bear constant phase relationship with each other in both time and phase the light is said to be coherent. It is also monochromatic (one color) due to the specificity and purity of the medium used. Last, the light is contained in a very narrow pencil, almost collimated (see **Figure 2**).

Fig. 2 A train of coherent photons



A TRAIN OF COHERENT PHOTONS

I. The *FiberStar*® Welding Workstation

The *FiberStar*® Welding Workstation is based on a fiber laser. Some of the advantages of a fiber laser are:

- J Light is already coupled into a flexible fiber: The fact that the light is already in a fiber allows it to be easily delivered to a movable focusing element. This is important for laser cutting, welding, and folding of metals and polymers.
- J High output power: Fiber lasers can have active regions several kilometers long, and so can provide very high optical gain. They can support kilowatt levels of continuous output power because of the fiber's high surface area to volume ratio, which allows efficient cooling.
- J High optical quality: The fiber's wave guiding properties reduce or eliminate thermal distortion of the optical path, typically producing a diffraction-limited, high-quality optical beam.
- J Compact size: Fiber lasers are compact compared to rod or gas lasers of comparable power, because the fiber can be bent and coiled to save space.
- J Reliability: Fiber lasers exhibit high vibrational stability, extended lifetime, and maintenance-free turnkey operation.
- J High peak power and small pulses enable effective marking and engraving.
- J The additional power and better beam quality provide cleaner cut edges and faster cutting speeds.
- J Lower cost of ownership.

The fiber laser produces a very high energy density light beam, many times higher than is possible with normal light at the focal point of a lens. The energy -“**hot light**”- created at the focal point in a relatively short time (0.5 to 20 ms) heats the work piece beyond its melting point and thus enables a weld.

The area affected is in a limited range of only approximately 0.20 to 2 mm, depending on the material. The laser light welds two metals together and thus permits safe, durable, precise and non-warp joining of parts in the form of a spot or seam. Because of the very short time of the laser pulse, the zone of heat influence is limited to the immediate vicinity of the welded spot or seam.

The characteristics of a laser pulse, and thus the effect on the material, can be influenced by the operating parameters Joules (energy) and Pulse Length (width). The joules has influence on the amplitude; the pulse length influences the width of the laser pulse.

In practice, the effect of both parameters while welding metals is as follows:

-) The joules first influences the welding depth.
-) The pulse length predominantly influences the diameter of the welding point.
-) The focus influences the welding depth as well as the diameter of the welding spot. When increasing the diameter, the welding depth is reduced at the same time.

System Description

The FiberStar® Workstation™ is a movable, stand-alone, single-user operated product that can be used to weld almost all metals and metal alloys quickly, reliably, and precisely.

The parts that are to be joined are manually arranged together under visual control and welded together by means of one or more laser pulses.

The product is equipped with a stereo microscope with a crosshair to facilitate the exact positioning of the parts. The crosshair marks the exact position on the work piece where the laser pulse spot will occur.

Good welding results will only be obtained if the work piece is exactly positioned with regard to the height (i.e. within the focusing area of the laser beam). The height is correct if the surface of the work piece is in focus under the stereo microscope.

Adjusting the energy of the laser pulses can influence the quality of the welding points. This can be adjusted by means of joysticks or the touch screen. With one of these controls you can adjust the intensity of the laser pulses (Energy), and the pulse length (ms). Settings for other materials can be obtained by following the adjustment technique described.

The quality of the weld can be increased for certain materials by using inert gas. This product is equipped with a separate inert gas connection.

The vapor produced during welding can be extracted from the welding chamber/area via a Filtration Exhaust Unit.

A foot pedal switch with two operating positions can fire a single or multiple laser pulses. The first position (pedal switch slightly pressed) enables the inert gas supply, and the second position (pedal switch fully pressed) releases the laser pulse.



Figure 5
(FiberStar® Welding Workstation)

The FiberStar Welding Workstation (**Figure 5**) shows the general view of the laser equipment. The individual functional parts are marked by numbers and explained in the following:

1. Stereo Microscope
2. The main on/off emergency switch and key-operated switch are located on the right-hand side of the welding chamber/area.
3. Exhaust Outlet and Filter (in rear of laser)
4. Digital Messaging Touch Screen Display
5. Protective Observation Window
6. Hand openings (2)
7. Welding Chamber / Area Enclosures (2)
(*)-Removable automation chambers available on most models.
8. Welding Chamber / Area / Internal

9. Welding Chamber / Area Access Door(s)
10. Microprocessor and control system (inside cabinet)
11. Laser Source (Inside Cabinet on left side)
12. EZ-LINK USB connector / Rear of machine (EZ-LINK Communication Software)
13. Wheel Locks (2)

Welding Chamber / Area (Refer to **Figure 5**)

-) The welding chamber/area **(8)** is accessible through hand openings **(6)** welding chamber/area access door(s) **(9)**.
-) The work pieces within the illuminated welding chamber/area can be observed via an observation window **(5)** to facilitate a coarse positioning of the work pieces. The observation window is a special laser protective window that absorbs laser radiation as well as the ultraviolet component of the plasma light.
-) The Stereo Microscope **(1)** on top of the welding chamber/area facilitates an easy and precise adjustment of the work pieces.

Technical Specifications

The modular conception of the FiberStar® Workstation facilitates time-saving repairs by changing complete modules (functional units) in case of a failure. The product consists of the following modules assembled in a mobile working table:

-) Welding Chamber/Area with Stereo Microscope and work piece illumination
-) High-Energy Laser Source / QCW Fiber Laser
-) Microprocessor Control Unit
-) Power Supplies
-) Inert Gas Supply
-) Foot pedal switch for triggering laser pulses and inert gas supply (argon)
-) Welding chamber / area exhaust system with filter

Specifications

Laser Source	Fiber-150W (PM)	Fiber-300W (PM)	Fiber-450W (PM)
Emission Wavelength (Typical)	1070 nm	1070 nm	1070 nm
Maximum pulse energy	15 Joules	30 Joules	45 Joules
Maximum Avg. Radiant Power	150 Watts	300 Watts	450 Watts
Maximum Peak Power (Pulse Mode)	1500* Watts	3000** Watts	4500** Watts
Duty Cycle (Pulse Mode)	50%* (Max)	50 %* (Max)	50 %* (Max)
Rated power (CW)	250 Watts	300 Watts	450 Watts
Single / continuous pulses	Selectable	Selectable	Selectable
Pulse duration	0.2-50* ms & CW	0.2-50** ms & CW	0.2-50** ms & CW
Frequency Range (Laser Source)	0-250 Hz	0-250 Hz	0-250 Hz
Frequency Range (LCD Shutter)	0-50 Hz	0-50 Hz	0-50 Hz
Beam Divergence (Collimator Output)	1 milliradians	1 milliradians	1 milliradians
Beam Diameter @ Beam Expander Aperture for F-120, F-160 , F-190 Focus Lens	35 mm	35 mm	35 mm
Eye Safety Filters (ESF)-Microscope & View Window	I, AB7	I, AB7	I, AB7
Laser class	Class: 4 (Operator)	Class: 4 (Operator)	Class: 4 (Operator)
Ambient Temperature (operating)	10°C to 30°C (50°F to 86°F)	10°C to 30°C (50°F to 86°F)	10°C to 30°C (50°F to 86°F)
Ambient Temperature (storage)	0°C to 50°C (32°F to 122°F)	0°C to 50°C (32°F to 122°F)	0°C to 50°C (32°F to 122°F)
Humidity (operating & storage)	10% to 95% non-condensing	10% to 95% non-condensing	10% to 95% non-condensing
Elevation (above sea level)	0 to 2000 meters (0 to 6562 feet)	0 to 2000 meters (0 to 6562 feet)	0 to 2000 meters (0 to 6562 feet)
Noise Level	80 dB	80 dB	80 dB
W x H x D (without microscope or camera)	56x112x102 cm (22x44x40 in)	56x112x102 cm (22x44x40 in)	56x112x102 cm (22x44x40 in)
Weight	100 kg (220 lbs)	108 kg (237 lbs)	120 kg (265 lbs)
Electrical connections* (single phase)	208-240VAC PH1 50/60Hz 15A	208-240VAC PH1 50/60Hz 15A	208-240VAC PH1 50/60Hz 15A
(*)-Surge Suppression is required.	>1kV on AC Line	>1kV on AC Line	>1kV on AC Line

150 Watt Model

(*)-Maximum duty cycle limit is inversely proportional to peak power: 10% for 1500W, 15% for 1000W,, 50% for 300W and lower.

(**)-Maximum pulse duration limit is inversely proportional to peak power: 10ms for 1500W, 15ms for 1000W,, 50ms for 300W and lower.

300 Watt Model

(*)-Maximum duty cycle limit is inversely proportional to peak power: 10% for 3000W, 15% for 2000W,, 50% for 600W and lower.

(**)-Maximum pulse duration limit is inversely proportional to peak power: 10ms for 3000W, 15ms for 2000W,, 50ms for 600W and lower.

450 Watt Model

(*)-Maximum duty cycle limit is inversely proportional to peak power: 10% for 4500W, 15% for 3000W,, 50% for 900W and lower.

(**)-Maximum pulse duration limit is inversely proportional to peak power: 10ms for 3000W, 15ms for 2000W,, 50ms for 600W and lower.

Cooling

-) Internal air heat exchanger
-) *Maximum ambient temperature, 30C*

Inert Gas (Pressure Regulator)

-) Maximum operating pressure 3.8 bar (55 psi / 0.38 MPa)
-) Minimum operating pressure 0 bar (0 psi / 0 MPa)

Inert Gas (Flow Regulator)

-) **Typical Flow Range** 10 to 30 CFH
- (Note: The flow rate should be adjusted to achieve the required surface finish at the lowest flow rate to minimize the cost of the inert gas.)

Power Supplies

-) Power Supply-Logic Output: 24VDC
-) Power Supply-Laser Output: 48VDC

Control

Microprocessor controller connected to control circuitry for setting of welding parameters

Control Circuits for:

-) External safety contacts
-) Viewing Shutter within the Stereo Microscope
-) System Ready

Optical Viewing System

-) Various optical viewing systems with crosshair with various magnifications
-) Observation window for direct observation of the working area
-) Illumination of the welding chamber/area with adjustable brightness by means of a control in the chamber/area

-) View shutter closes automatically for a short time with each laser pulse to protect the eyes. There is no view shutter on workstations with the flat screen viewing system.

View Path and Laser Beam Path (Figure 6)

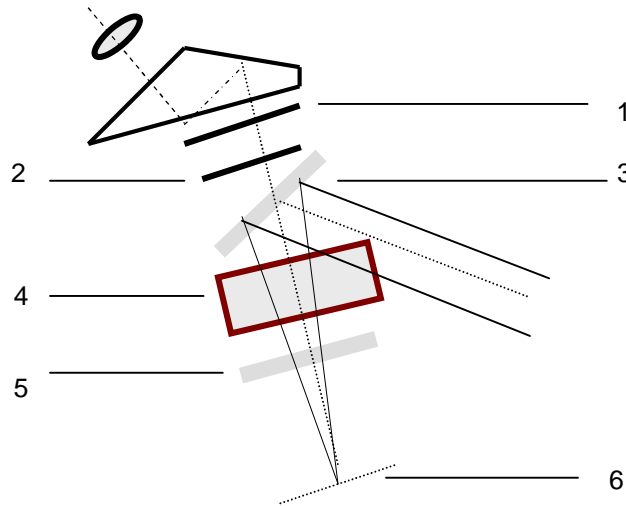


Figure 6
(View Path and Laser Beam Path)

The laser beam is fed into the optical path of the stereo microscope via a highly reflective mirror **(3)**.

-) A special laser-focusing lens **(4)** concentrates the laser beam to the work piece in the focusing plane. This laser lens acts also as the focusing lens of the stereo microscope.
-) The laser-focusing lens is protected against working dust and metal dashes by a protective glass lens **(5)**.
-) The view shutter **(2)** protects the eyes against laser radiation and the plasma light including the ultra violet components that is produced during the welding pulse. The view shutter, a light-blocking shutter, is only positioned into the optical path for the short period of the laser pulse and thus blacks out the field of view for a moment. A laser pulse can only be released if the view shutter is correctly closed. There is no view shutter on the Flat Screen System.
-) The IR & UV absorbing filter **(1)** protects the eyes against laser radiation and the plasma light including the ultra violet components that is produced during the welding pulse and thus guarantees that no laser radiation hits the eye of the operator.

Miscellaneous

-)]]]] Storage of operating parameters
-)]]]] Motor-driven beam expander for welding point diameter
-)]]]] Removable plate for inserting larger work pieces
-) Accessible joysticks for setting laser parameters
-) Inert gas supply through adjustable nozzles close to the work zone
-) Laser pulse triggering by means of a two-stage foot pedal switch:
 - first stage: inert gas supply
 - second stage: laser pulse triggering

Laser Delivery System (Rail)

All components of the high-energy pulse laser are mounted on an optical rail. The individual components are explained in the following. The numbers in brackets are related to the positions of **Figure 7**.

-) The collimator clamp **(1)** contains the collimator optics. Laser energy is delivered to the collimator by a BDO / fiber cable **(2)**.

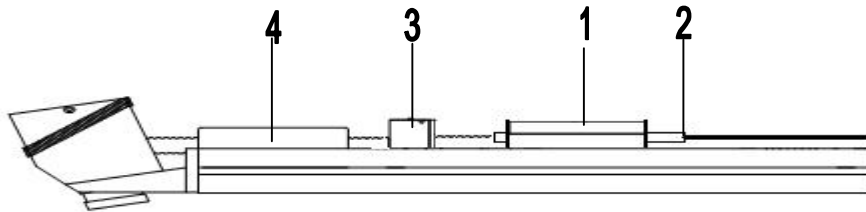


Figure 7
(Laser Rail)

-) In closed state, the laser shutter **(3)** prevents the delivery of laser energy to the work chamber. It will always be closed, for example, if the hand enclosure is opened.
-) The diameter of the laser beam can be set by means of a beam-expander **(4)** driven by a stepper motor. This changes the diameter of the focal spot and the energy densities of the laser beam.

-) The laser beam is fed onto the optical path of the stereo microscope via a highly reflective mirror and is focused on the work piece located in the focusing plane by the laser-focusing lens.

Microprocessor Control Unit

The microprocessor board is mounted underneath the welding rail and can easily be serviced from the side of the product. It controls:

-) The laser source for laser pulse generation
-) All operating and indicating elements
-) The safety elements (view shutter in the optical viewing system and laser shutter)
-) Performs interlock circuits safety checks

When the power is turned “on,” the microprocessor carries out a series of self-tests. In addition to the electronic components, the laser source, the laser shutter and the view shutter are monitored. In case of any malfunction, an error message is displayed on the display of the control panel.

The following self checks and functions will be performed:

-) Operation of the Laser Source
-) Laser shutter
-) Welding chamber/area closed

In case of malfunction of one or more functions, the laser source will be shut down and as a consequence, any laser function will be deactivated. The laser source can only be switched “on” again if all faults have been eliminated.

Laser Source

The laser source is a self-contained fiber resonator emitting laser light with a typical wavelength of 1070nm.

Inert Gas Supply

The device has a connecting socket for inert gas nozzle. The welding chamber / area has a flexible inert gas nozzle. (**ATTENTION:** Please make sure these flexible plastic gas lines are not positioned near the work lights (especially the Halogen lights).

Foot Pedal

There is a two-stage foot pedal for activating the inert gas supply of argon and triggering laser pulses (see the section entitled FOOT PEDAL SWITCH).

Exhaust Unit

The top of the welding chamber/area contains an opening through which the vapor produced by welding is exhausted.

If the filtered air is not to be exhausted into the work area, the exhausted air can be directed elsewhere by an adapter with a corresponding hose. The exhaust connector is located in the rear of the laser.

Control Elements External to the Welding Chamber/Area



Caution!

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

Figure 8 shows the location of these control elements. Their function is explained in the following:

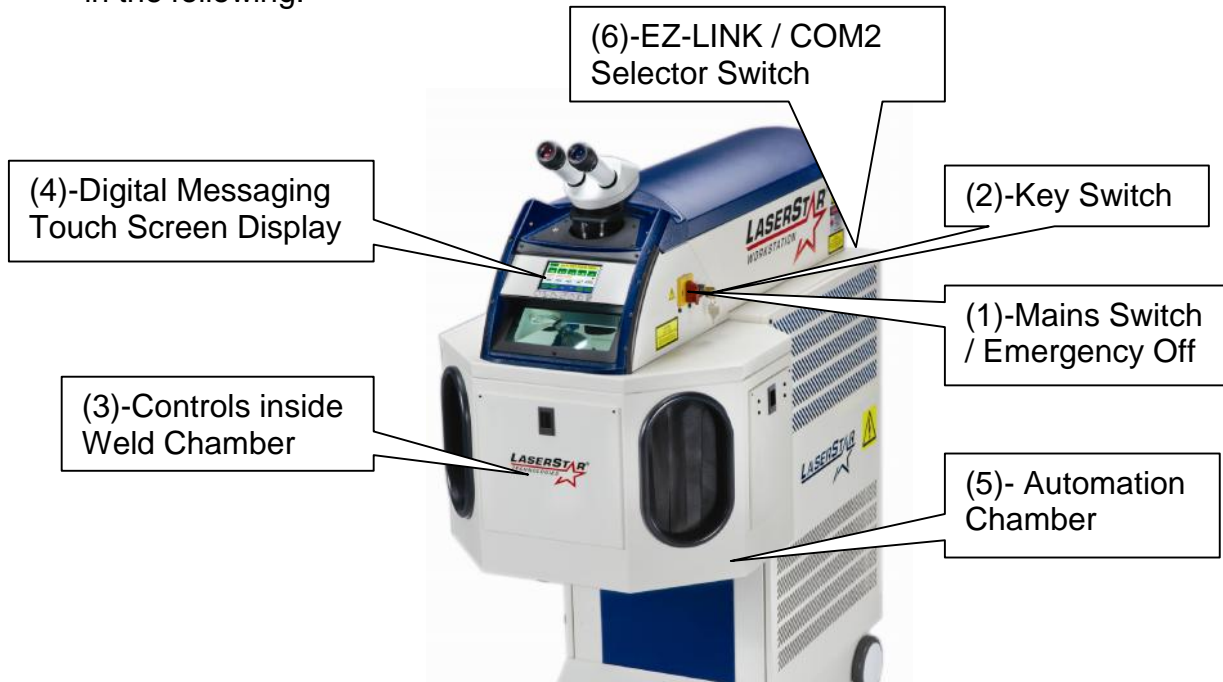


Figure 8
(External Controls [Front & Right Side View])

- (1) Mains Power (Mains) Switch/Emergency Off: This switch turns on or off the line voltage of the product. The switch directly powers the DI water pump. This Mains Power switch also meets the emergency-off function. It can be turned “off” (position “O”) in case of an emergency without turning off the Key Switch. (Note: Complete disconnect from AC power requires disconnecting the AC plug in the rear of the machine.)
- (2) Key Switch: The laser power supply and, as a consequence, all laser functions, can only be switched “on” with the aid of the key switch.
- (3) Joystick, Safety Shutter Button, Gas control and Dimmer control are inside the welding chamber.
- (4) Digital Messaging Touch Screen Display: Indicates machine status-Joules or Watts, Pulse Width, Hz, Memory Mode; Integrated Preventive Maintenance Alerts; Pre programmed Application Parameters, Alarms, etc.

- (5) Automation Chamber: **Welders with an automation chamber that can be removed should require that all personnel in the Nominal Hazard Zone (NHZ) must wear the appropriate eye protection.**
- (6) EZ-LINK / COM 2 Selector Switch: This switch is used to select the COM 2 port or the EZ-LINK port.

Control Elements in the Welding Chamber / Area

On the rear wall of the welding chamber / area (**Figure 9**) there is one joystick, a rotary light control, 2 rotary gas flow controls (optional) and a safety shutter push button.

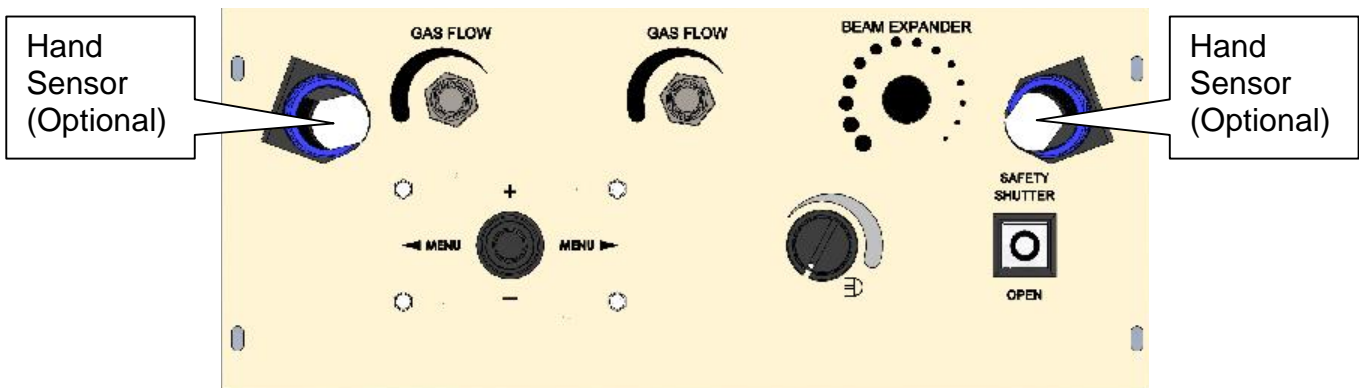


Figure 9
((Welding Chamber / Area Controls-Single Joysticks))

Description of Controls:

Gas Flow Control These controls are used to control the flow of inert gas. The right control is for the center fixed tube nozzle assembly & the left control is for the left flexible tube and nozzle assembly.

Brightness This control allows you to control the brightness of the lights in the welding chamber / area.

Joystick The left to right motion is used to select weld parameters and the up or down motion is used to change the values or P³ shape.

Hand Sensor Hand Sensors are used to detect that the hands are in position to fire the laser. (Model / Option dependent)

Digital Messaging Touch Screen Display

The display layout is shown in **Figure 10**. The first row shows memory location and description of weld parameters; the second row displays weld parameters-Energy (Joules / J) or Power (Watts / W) , Pulse Length (mS); Pulse Rate (Hz), Burst Mode or Pulse Suppression (optional / model specific); Beam Diameter; and Shape. The third row displays Laser Shutter status & messages. The fourth row displays operational / mode choices-Memory, Menu, Help, Ok, and Safety Shutter Status. The fifth row displays-Home, Recall, Up or Down arrow, ABC, and Save. (Note: When the OK button indicator is green, the welder is ready to weld. The Safety Shutter button is used to open and close the safety shutter and displays the status.)

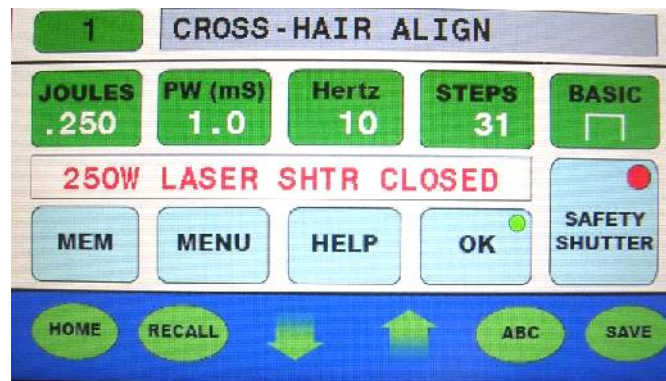


Figure 10
(Digital Messaging Touch Screen Display)

All the parameters can be set using either the joystick(s) & buttons (except pulse width suppression) in the welding chamber/area (reference the section entitled Control Elements in the Welding Chamber / Area) **or** by using the Digital Messaging Touch Screen Display.



Attention: Human fingers (**not finger nails**) should be used to extend the lifetime of the touch screen display. Inappropriate items (i.e.-pencils, pointers, pens, etc.) can cause the touch screen to have erratic or faulty operation and will reduce the lifetime and void the warranty. Even with the use of a proper stylus the lifetime will be dramatically reduced **by ~ 90%** (1/10 of the human finger lifetime).

Calibration

The system has been calibrated at the factory using “Gain Calibration” (Reference **Service F**). Gain Calibration will dynamically maintain the set power even as the laser source diodes age. This feature also allows the system gain to be calibrated to a power meter at one set point and will maintain the calibration over a wide range of parameters. This virtually eliminates the need to perform “Table Calibration” (Reference **Service G**).

Foot Pedal

The system is equipped with a foot pedal for triggering pulses and the inert gas. The foot pedal is connected to the product by flexible cables and can be positioned as required by the operator.

The foot pedal that triggers the pulses has two operating positions with the following functions:

-) Press the pedal switch part way until you feel initial resistance and the inert gas supply is switched “on.”
-) Fully pressing the foot pedal down until it stops triggers laser pulses. The inert gas supply remains “on” until the foot pedal has been totally released (if inert gas supply is connected to the device).

If several laser pulses are to be released one after the other, the following options are available:

-) You can release the foot pedal slightly after each pulse and then push it right down again.
-) If the pulse frequency is set for continuous-pulse mode (HZ), the laser can release a continuous series of pulses by depressing and holding down the foot pedal.
-) If the Burst Mode (B) is set, the laser will release the number of pulses that the operator chooses by depressing and holding the foot pedal.

Remote Interlock Connector

In addition to the foot pedal switch connector, there is a remote interlock connector available to readily connect the device to a secondary interlock circuit such as an entry door into a specific laser room. The remote interlock can be bypassed using the remote interlock shorting cap, p/n 101-36-0036. (Note: Refer to the Installation Section for instructions on connecting or bypassing this feature.)

Locking Brake

The front wheels of the system are equipped with a locking brake to secure the product at the installation site against unintentional movement

Pressing the brake lever down will activate the brake.

II. SAFETY

Radiation produced by laser light is capable of melting, burning or vaporizing almost any material. The composition of the work piece dictates the vapors or gases generated; therefore, safety precautions are necessary.

The FiberStar® Welding Workstation is designed exclusively for welding metals and metal alloys. To use it for any other purpose or for anything beyond this is to use it improperly. **LaserStar® Technologies Corporation** does not accept any liability for any damages resulting from improper use. Proper use also includes:

-) Following all the instructions and heeding all the information in this Manual.
-) Carrying out all the necessary inspections and maintenance work.

In addition to general information on the safety regulations that ensure safe operation of the system, this section also contains information on other dangers that cannot be eliminated either by design or by structural means. This information is marked in the Manual with safety symbols, which are required by OSHA/CDRH



Warning!

Indicates a **possible threat to life and health**. Failure to heed this can cause **serious damage to health** and even **critical injuries**.



Caution!

Indicates a **possibly dangerous situation**. Failure to heed this can cause **minor injuries or damage to property**.



This symbol draws your attention to **important** Information on the correct use of the system. Failure to heed this information can cause malfunctions/problems in or around the product.



This symbol draws your attention to **operating tips** and particularly useful information that will help you use **all the functions** of your LaserStar to the **best effect**.

General Information

This laser system is a Class 4 laser. It is a solid-state laser with a high optical output power. The laser power beam is an invisible laser radiation/emission beam with a wavelength of 1070 nm (near infrared range). The visible laser/guide beam radiation has a wavelength 600-700 nm. (Note: The visible secondary radiation from both beams can cause dazzle effects if watched for any length of time.)

The laser radiation generated by this device is both visible and non visible to the human eye due the wavelength as described in the previous paragraph.



Warning!

The eye is particularly endangered by this infrared (invisible) laser radiation, because its effect is multiplied by the eye lens and focused on the retina. The high radiation intensity on the retina causes extreme local heating and burns the tissue of the retina. This results in reduction or even loss of eyesight. Therefore, when working with direct access to the laser beam (maintenance, repair), always wear eye protection.

Always follow the OSHA regulations, ANSI Z136.1-2014, Safe Use of Lasers, on accident prevention for laser radiation or the equivalent national or international regulations (e.g. IEC Directive 60825-1) working with the laser equipment.



If a modification by the user affects any aspect of the performance data or intended functioning as described in the relevant standards, of a previously classified laser device, the person or organization that undertook the modification is responsible for obtaining a new classification and new labeling for the device. This person or organization then assumes the status of “manufacturer.”

The mandatory protective laser eye wear, with an OD >6.5 (Order No. 444-001), provide protection against direct, reflected and scattered radiation. But even if you are wearing protective laser eye wear, never look directly at the beam. Intense laser radiation is capable of destroying the protective filter. Danger exists through: directed radiation, reflected radiation and/or diffused scattered radiation. (**Note:** In **Class 4** operation of the product, the protective laser eye wear will normally protect against the hazards of collateral radiation (e.g. ultraviolet, visible, infrared radiation). However, if a concern exists that the accessible collateral radiation

might be hazardous, the end user is responsible to consider the MPE values required for the various materials being processed.)



Warning!

When operated **without** the Workspace Protective Housing or Front Door, all persons in the NOHA (Nominal Ocular Hazard Area) must wear appropriate protective laser eye wear ($OD > 6.5$). These protective laser eye wear must meet the safety requirements for the relevant laser output energy/power. The max radiant exposure @ 10cm from laser focus is $32\text{J}/\text{cm}^2$. The MPE (Maximum Permissible Exposure) @ 1s exposure is $30\text{uJ}/\text{cm}^2$. The NOHD (Nominal Ocular Hazard Distance) is 150m from the laser focus (120mm focus lens @ 1s exposure).



Warning!

Although the skin can withstand considerably higher radiation intensity than the eye tissue, burning destroys the tissue. The extent to which this happens depends on the time of exposure to and the intensity of the irradiation. Appropriate protective clothing should be worn to protect the skin whenever necessary.

If laser injury or suspected laser injury has occurred, immediately

- ⌘ **Switch off the laser,**
- ⌘ **Notify your laser safety officer and safety specialist,**
- ⌘ **Consult a doctor or go to the hospital.**

Fire Hazard

Because of the high output power of a Class 4 laser, a wide range of material can be set on fire. Appropriate fire prevention measures must therefore be taken when the path of the beam is open.

Paper (circuit diagrams, leaflets or even posters on the wall), curtains that are not impregnated with fire retardant, thin wooden panels or similar materials can be easily set on fire by direct or reflected laser radiation. Moreover, containers holding flammable or explosive cleaning agents (e.g. used for maintenance) should be kept away from areas exposed to the laser beam.

FUNDAMENTAL SAFETY INFORMATION

Information on the Operating Instructions

-) Knowledge of the safety information and the safety regulations is the prerequisite for safe and trouble-free operation of this product.
-) This Manual contains important information on the safe operation of the FiberStar welder.
-) All those who work with the product must follow these operating instructions, especially the safety information.
-) Moreover, all regulations for accident prevention valid for the current place of installation must be complied with, especially the OSHA regulations, ANSI Z136.1-2014, Safe Use of Lasers, on accident prevention for laser radiation or the equivalent national or international regulations (e.g. IEC Directive 60825-1). There may also be various state, municipalities or local requirements or regulations.

Organizational Measures

The employer must provide the necessary personal safety equipment (in this case eye protection is required only for maintenance purposes when there is direct access to the laser beam).

The requirements of the OSHA regulations, ANSI Z136.1-2014, Safe Use of Lasers, or the equivalent national or international regulations (e.g. IEC Directive 60825-1) have to be fulfilled.

Maintain the Laser as instructed in the Operation Manual.

Requirements of the Employer

The employer must ensure not to allow anyone to work with this product unless they:

- |) Are familiar with the basic regulations concerning safety at work and accident prevention and have been instructed in the use of this product;
- |) Have read and understood the chapter concerning safety and the warnings in this Manual and have confirmed this by their signature;
- |) Have been instructed as to the dangerous effects of laser radiation in

accordance with the valid OSHA regulations, ANSI Z136.1-2014, Safe Use of Lasers about accident prevention for laser radiation or the equivalent national or international regulations (e.g. IEC Directive 60825-1).

-) Operating personnel are to receive instruction at regular intervals.

Requirements of Personnel

Before operation, all those who work with the product must undertake to:

-) Comply with the basic regulations on safety at work and accident prevention for laser radiation, OSHA or
-) The equivalent national or international regulations (e.g. IEC Directive 60825-1)
-) To read the chapter concerning safety and warnings in this Manual and confirm this by their signature.

Dangers when working with the Product

The FiberStar Workstation is designed according to the state-of-the-art and meets the approved safety regulations. Nevertheless, its use can still endanger life and limb (of the user or third parties) or damage the product or other material assets. The product is only to be used:

-) For the intended purpose (see the information on proper use) and is in perfect condition from the point of view of safety.
-) Malfunctions that may have negative consequences for safety must be resolved immediately.

Protective Devices

-) Whenever the laser product is used, all safety mechanisms must be checked for correct mounting and function.
-) Safety mechanisms may only be removed when the laser device has been switched "off" and measures have been taken to prevent it from being restarted.

Informal Safety Measures

- J The Operating Instructions must always be kept at the installation site. In addition to the operating instructions, the generally valid regulations, well as the local ones on accident prevention and environmental protection, must be complied with, especially the OSHA regulations, ANSI Z136.1-2014, Safe Use of Lasers on accident prevention for laser radiation or the equivalent national or international regulations (e.g. IEC Directive 60825-1).
- J All safety information and warnings attached to the product must be kept in readable condition (see the section entitled LABELING).

Personnel Training

- J Only personnel properly trained and instructed about the dangers of laser radiation as required by the OSHA regulations, ANSI Z136.1-2014, Safe Use of Lasers, on accident prevention for laser radiation or the equivalent national or international regulations (e.g. IEC Directive 60825-1) are allowed to work with the device.
- J Trainees are only allowed to work with this product under the supervision of someone who is an experienced user.

Safety Measures for Normal Use

- | J Only use the product if all safety mechanisms are properly functioning.
- J Check the product at least once a week for visible external damage and for the proper functioning of the safety mechanisms (e.g. defective protective viewing windows or interlock circuits). Check the Welding Chamber/Area, enclosures and door(s) for proper function and any damage. Only use the product if there is no damage to the Welding Chamber/Area Door, Enclosures, Protective Flaps, Guards, Welding Chamber/Area View Window or any structure that could allow laser energy to EXIT the device.

Danger of Electric Shock

- J Only authorized personnel are allowed to carry out maintenance work on the power supply.
- J The product must always remain closed. Only authorized personnel using the appropriate tools are allowed to open the product.

If any work has to be carried out on voltage-carrying parts, a second person must be there who can switch the device “off” at the power switch, if necessary (see the section entitled NOTES ON MAINTENANCE).

Particularly Dangerous Points

-) Particularly dangerous points must be labeled as such. The various Warning Labels and their location on the product are described in the section entitled “LABELING.”
-) There is increased danger when the welding chamber / area is open and the interlock switches are simultaneously bridged.
-) Above all, never trigger a laser pulse while your hands or fingers are positioned directly in or under the crosshair of the stereo microscope.

Emission of Noxious Gases and Vapors

-) Avoid welding vapor by correct use of the inert gas.
- i**) The laser radiation produced by this laser product is capable of melting, burning or vaporizing almost any material. Depending on the composition of the work piece, gases and vapors dangerous to health may be produced. The user should filter air exhausted as required by OSHA regulations (see “Installation”).
-) Do not use this product on non-metallic materials, especially plastics.

Structural Modifications to the Laser Product

-) Do not make any modifications or additions to the laser product.
-) All structural modifications require the written approval of LaserStar Technologies®.
-) Immediately replace all parts that are not in perfect condition.
-) Only use **original LaserStar Technologies** replacement and consumable parts.

IMPORTANT: There is no guarantee that parts purchased from companies other than **LaserStar Technologies Corporation** will meet the stipulated requirements as to safety and performance.

Safety Officer

When Class 4-laser equipment is installed, the employer must appoint a competent Laser Safety Officer in writing. In the case of Class 1 laser equipment, a Laser Safety Officer need only be present when the service technician is carrying out maintenance or service activities on the laser equipment with direct access to the laser beam. This assumes that the service technician bypasses the interlock switches or removes protective covers.

Due to the training and experience in the field of laser radiation, the Laser Safety Officer should fully understand the safety procedures and equipment used. The Laser Safety Officer bears full responsibility for the safe operation of the laser equipment and the correct implementation of mandatory safety measures. The Laser Safety Officer may receive appropriate training from an approved body (e.g. an institution providing insurance against occupational accidents). The Laser Safety Officer may receive training from LaserStar Technologies on the proper use of the FiberStar Workstation.

Please note:



Caution!

-) This laser product may only be used for the intended purpose.
-) Never aim the laser beam at humans or animals.
-) Any person involved in the operation, maintenance or repair of the laser product must have read and understood the operating and safety instructions for the laser equipment.

WHAT TO DO IF YOU RECEIVE A BURN

If a laser pulse has burned your fingers or hand, you should have the wound treated. Depending on the degree of the burn, you should undergo medical treatment. Although a small burn is not particularly critical, you should still make sure that no infection results.

Scattered Radiation!

Scattered radiation can also cause minor burns on the skin of your hand. Depending on the material, its reflective properties and the selected pulse energy, scattered radiation can also be dangerous. Only under very unfavorable circumstances will the scattered radiation reach intensities that can cause slight burns, because the laser pulses are very short.

Normal exposure of the skin to low levels of scattered radiation at the wavelength of 1070 nm can be regarded as physiologically safe. The infrared laser radiation acts like normal heat radiation.

LABELING: Figure (1-10)-Labeling: Housing, Front, Sides and Etc.

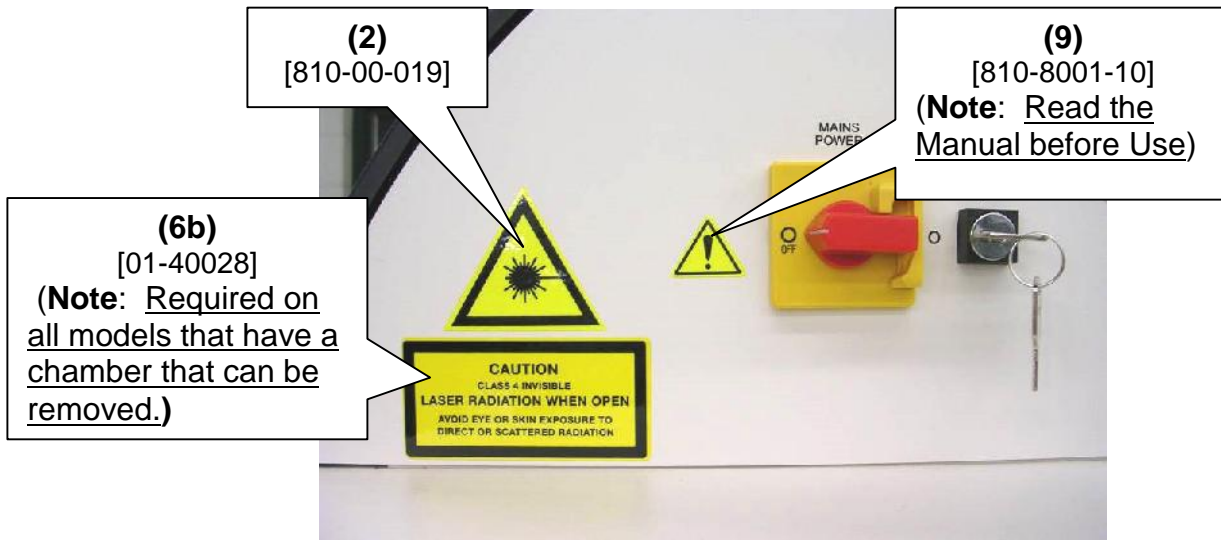


Figure 1
(Mains Power & Key Switch)

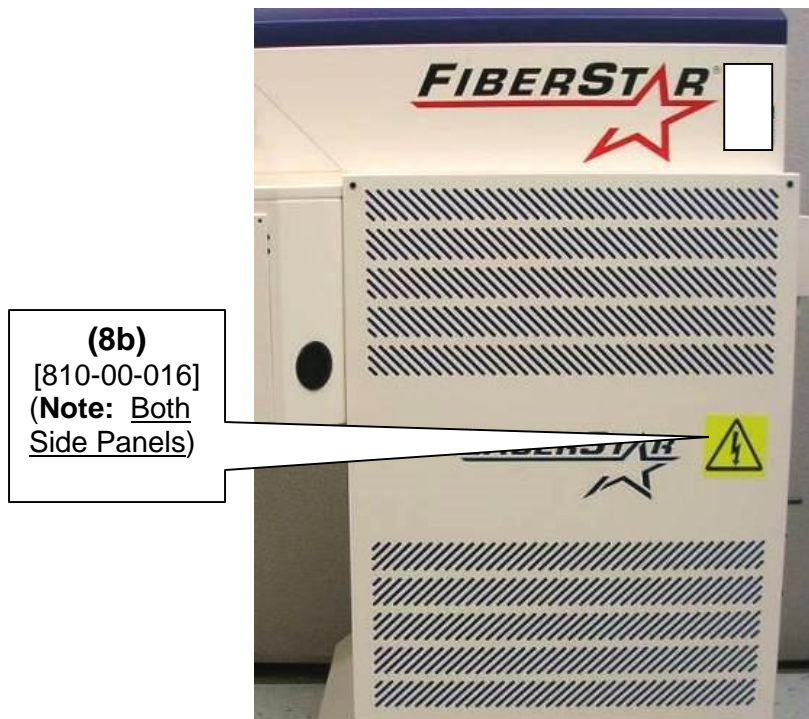


Figure 2
(Right Side View-Typical)

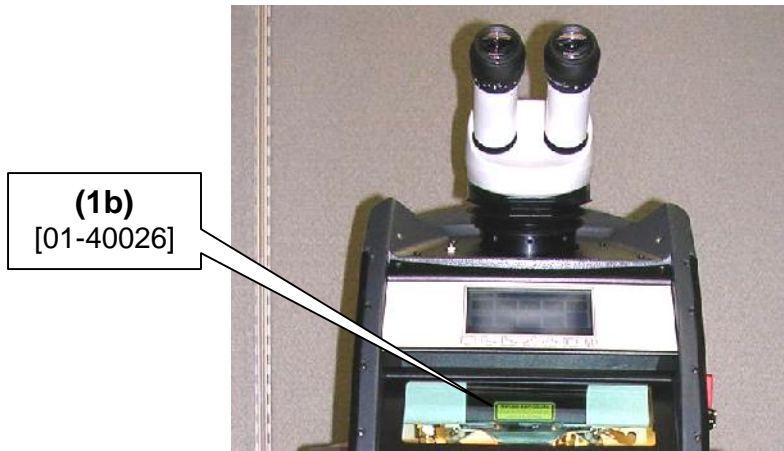


Figure 3
(View Window)

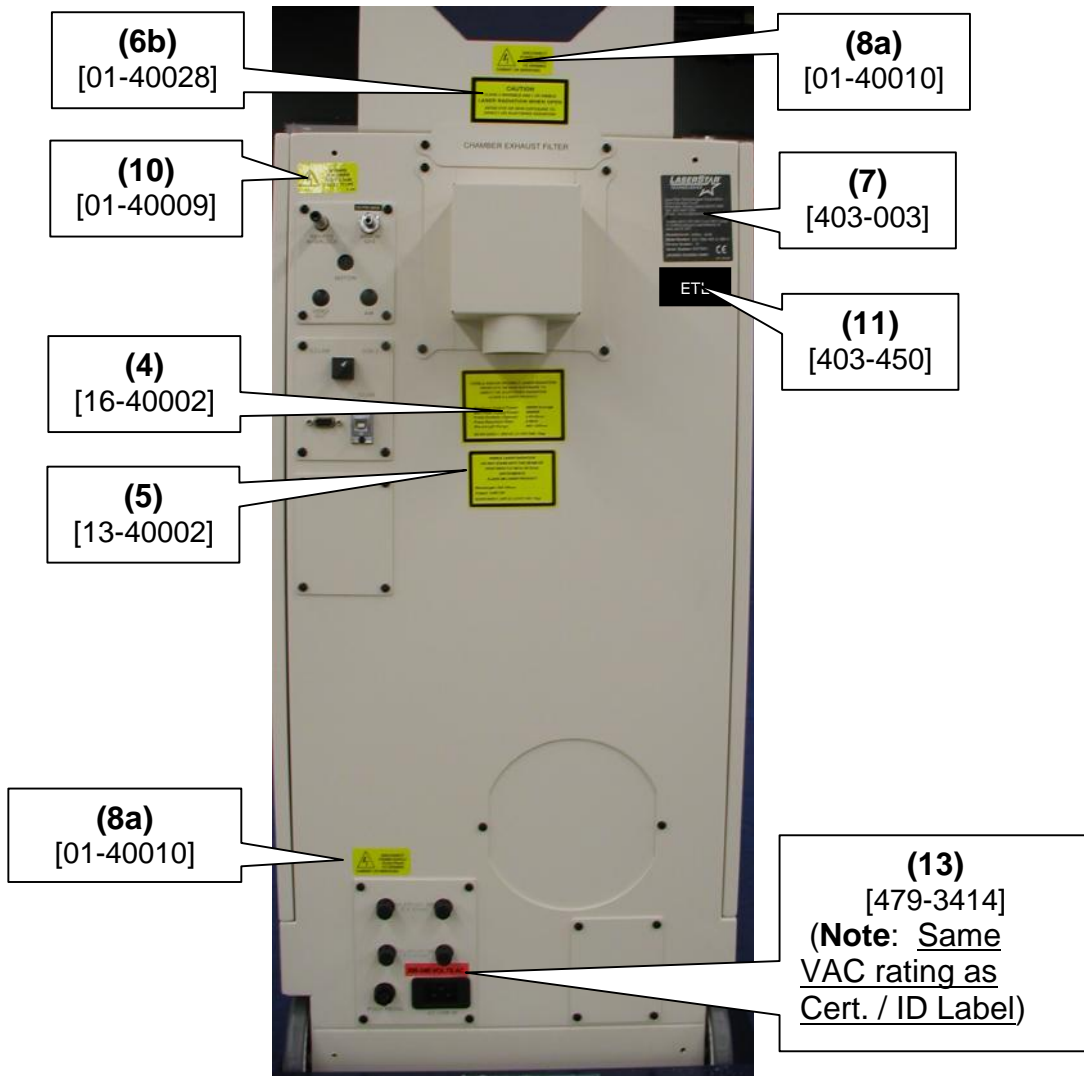


Figure 4
(Rear View)

(6b)
[01-40028]
(Note: Access panels with interlocks will not require this label)



(6b)
[01-40028]
(Note: Required on all models that have a chamber that can be removed.)

(6b)
[01-40028]
(Note: Access panels with interlocks will not require this label)

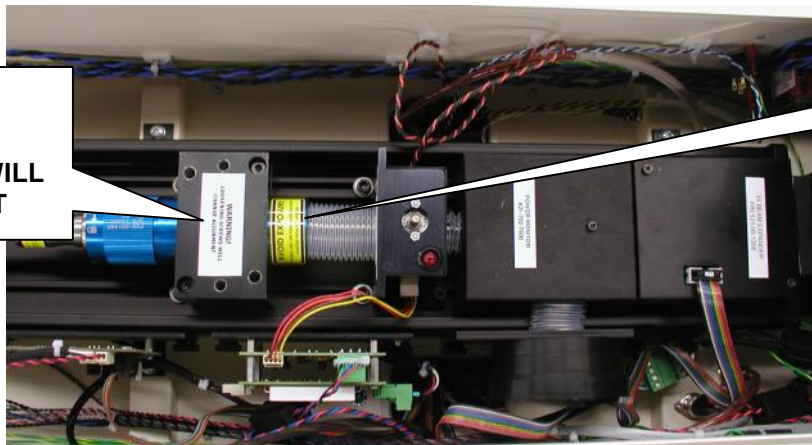
Figure 5
(Removable Welding Chamber-Right Side)

(6b)
[01-40028]
(Note: Access panels with interlocks will not require this label)



Figure 6
(Removable Welding Chamber-Left Side)

(14)
WARNING!
LOOSENING SCREWS WILL CHANGE ALIGNMENT



(1b)
[01-40026]

Figure 7
(Collimator Assembly)



Figure 8
(Laser Rail Focus Head Assembly)

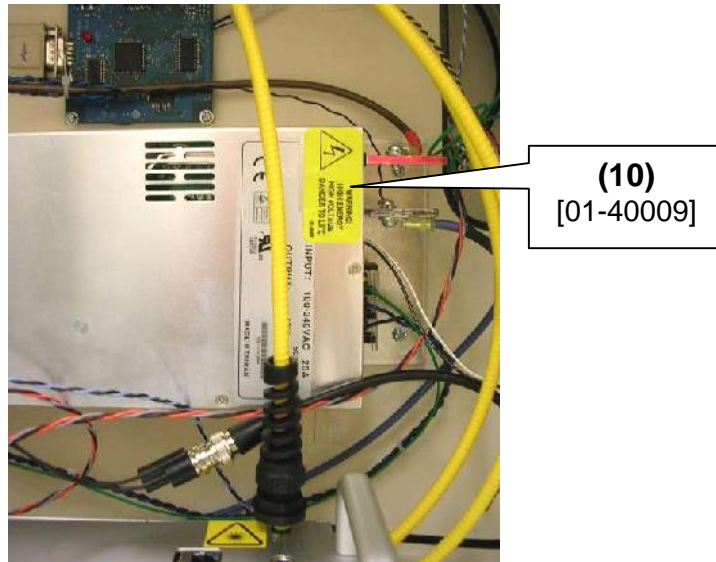


Figure 9
(Power Supply-48VDC)



Figure 10
(Laser Source)

Label Reproductions: (Model Dependent) (Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated July 26, 2001)

(1a or 1b) Aperture Label (Model Dependent)

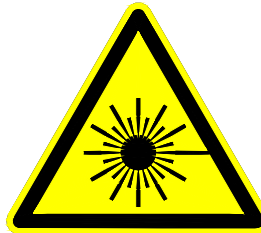


1a
(71-40026)



1b
(01-40026)

(2) Warning Label



2
(810-00-019)

(3a or 3b) Laser Radiation Explanatory Label (Model Dependent)

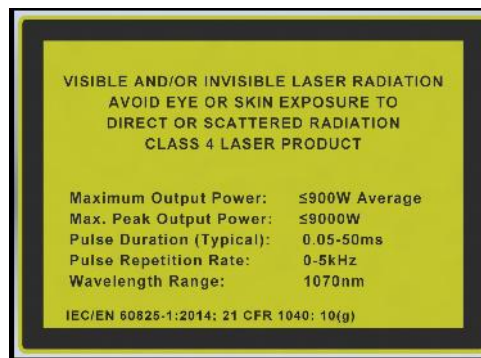


3a
(71-40025)



3b
(01-40025)

(4) Invisible Radiation Output and Standards Information Label (Model Dependent)



4
(16-40002)

(5) Visible Radiation Output and Standards Information Label (Model Dependent)



5
(13-40002)

(6a or 6b) Non-Interlocked Protective Housing Label (Model Dependent)



6a
(71-40028)



6b
(01-40028)

(7) Certification and Identification Label (Model Dependent)



7
(403-003)

- (8a) Disconnect Power Plug prior to opening cabinet Label**
(8b) High Voltage Warning Label: Use caution when opening (Model Dependent)



8a
(01-40010)



8b
(810-00-016)

- (9) The user has to read the manual prior to use label.**



9
(810-8001-10)

- (10) Warning! High Energy / High Voltage / Danger To Life**



10
(01-40009)

- (11) ETL Certification Label (Model Dependent)**



11
(403-450)

(12) Laser Source Model Number / Serial Number



12
(403-470)

(13) 208-240 Volts AC Label



13
(479-3414)

(14) Warning Label for Top of Collimator Holder (Make on Label Maker-Scale 1:1 / Arial Bold)



14
(TBD)

III. Installation

This chapter describes the requirements that have to be fulfilled for a faultless operation of the product. Information is also given on the installation, setup and transportation of the product.

Requirements

To guarantee a faultless operation of the product, the following requirements have to be met:

Installation Site. The installation site has to meet the following requirements:

-) The product has to be installed in a room as dust-free as possible.
-) Do not expose the product to direct sunlight.
-) The minimum spacing between the product and any walls must be 12 inches (300mm) from the back and sides for proper ventilation.
-) The product should not be positioned so it is difficult to operate the disconnecting device.
-) The product may be connected to the installation site's optional external filtration or exhaust system by connecting a user provided hose from the exhaust outlet on back of the product to the installation site's external filtration or exhaust system.



Caution!

When choosing the installation site, take into consideration that for servicing, the ability to limit laser area is required (see the regulations about accident prevention for laser radiation OSHA, ANSI Z136.1-2014, Safe Use of Lasers, or equivalent national or international regulations (e.g. IEC Directive 60825 -1))

Ambient Conditions

Temperature: Reference **Section I** / Specifications

Storage: Reference **Section I** / Specifications (Note: If the device contains cooling water, do not store or transport it below 3°C (frost risk)).

Height and Humidity

Height and Humidity: Reference **Section I** / Specifications

Unpacking



The laser product has been tested thoroughly before shipping and has been delivered in faultless condition. Check the packaging for transport damages before unpacking.

Caution!

- 1) Take the product - if possible unpacked – to the final installation site.
- 2) Carefully remove the packaging, if any.
- 3) Check the product for possible transport damages.

The standard parts of delivery are listed in the following:

- 1) Stand-alone Device FiberStar® Workstation
- 2) Viewing System
- 3) Operation Manual and Accessories

The delivery can optionally include additional parts. Please compare the delivered parts with your packing slip.

Laser Source

The laser source has been installed into the FiberStar Workstation cabinet @ the factory.

Initial Power Connections



The activities described in this section should only be performed by our service technicians or authorized skilled personnel. For damages to persons or property caused by improper connection of the device, warranty claims are out of question.

Power Conditions & Connections



Caution-Check the VAC label & ID label on the rear of the machine and compare with the power conditions at the installation site.

AC Voltage Input / Inlet (AC Disconnect)

The AC Voltage Input / Disconnect is used to supply AC power to the machine. (Note: Disconnecting this plug removes all AC power from the machine.) All switches (Mains Power Switch and Key Switch) on the machine should be in the OFF position before applying the AC voltage.

The model of the machine determines the AC requirements. Make sure your AC supply agrees with the specification on the Identification label (located on the rear of the machine) which includes the model number, serial number, AC requirements, etc. **(ATTENTION: Make sure the machine is grounded. The ground wire must be connected for safe and reliable system operation. Surge suppression is required for above 1kV on the AC line.)**

Note: When replacing detachable “MAINS” supply cord, the user must use a supply cord with the appropriate “RATING”. **DO NOT USE INADEQUATELY “RATED” CORDS.**

Remote Interlock Connector

For connection to a secondary interlock system, the product is equipped with a remote interlock connector. The product will not generate a laser pulse unless this connector is closed.

If you are not connecting the remote interlock to an additional interlock system, the shorting connector, p/n 101-36-0036, must be installed on the laser to enable laser operation.

-) The shorting connector is included in the bag in the work chamber / area with the key for the key switch.
-) Refer to **Section IX / Service A / Figure 2** for the location of the remote interlock connector.
-) Insert the shorting connector in the mating socket on the rear power panel to enable operation of the laser.
-) Tighten the locking ring by turning until finger tight.

The remote interlock connector may be used to readily connect the workstation to a secondary interlock circuit such as an entry door into a specific laser room. To

connect the Remote Interlock to a secondary interlock circuit, the following requirements must be adhered to:

-) The shorting jumper under the plastic cover of the connector must be removed before wiring.
-) The wiring should be routed away from all power wiring and not to exceed thirty (30) feet (nine (9) meters) in length.
-) The interlock is to be a voltage free “form A” contact (normally open) that is held closed to enable laser operation.
-) A licensed professional in compliance with applicable electric codes should perform the wiring. The shorting connection in the connector, p/n 101-36-0036 must be removed and wired to the secondary interlock circuit.

External Exhaust System (Optional)

The Class 1 enclosures are equipped with an exhaust connection (2.0”/50.8mm) on the rear of the enclosure. We recommend the use of an external exhaust system with the appropriate air filtration (dependent on type of material being marked, engraved or cut) and enclosure extraction/vacuum (laser power & enclosure size determine the required “CFM” [200 to 400 CFM / typical range / application dependent]).



Warning!

Process vapors with particulates can be a fire or explosion hazard depending on particulate material and concentration. Consult your Safety Department regarding if the concentration level of fumes with particulates from your material processing process exceeds the level permissible by the “safety limit” set by your local authority in order to ensure that the equipment is adequate for your application. Filters should be changed before the change filter indicator is red.

Inert Gas

For the inert gas (example-argon, nitrogen, etc.) connection, the product is equipped with a quick-acting, compressed-air connector for connecting plastic tubing. Specifications:

Inert Gas (Pressure Regulator)

-) Maximum operating pressure 3.8 bar (55 psi / 0.38 MPa)
-) Minimum operating pressure 0 bar (0 psi / 0 MPa)

Inert Gas (Flow Regulator)

-) Typical Flow Range 10 to 30 CFH

(Note: The flow rate should be adjusted to achieve the required surface finish at the lowest flow rate to minimize the cost of the inert gas.)

Disassembling (Preparation for Transport)

To prepare the product for transport over minor distances, you only have to unplug the power supply and the inert gas supply and loosen the locking brake(s) on the front wheels.

IV. OPERATION



Caution!

Caution - Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure. If the product is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

The next sections describe the usage of the product. The following symbolism is used:

The symbol “>” marks actions that have to be carried out by the operator.

In most cases, actions of the operator in any form will cause reactions of the product that are marked by the symbol |

|
ATTENTION: Custom memory locations / (1-79) for parameters are saved in flash memory and should not be lost if the battery backup is removed or fails. However, the non-stored parameters in the display will be lost. Good practice suggests that a computer backup using LaserStar’s EZ-LINK or a hard copy backup should be created for all custom memory locations. |

Initial Operation

After having properly finished all activities described in the section **Initial Power Connections**, the user / operator should thoroughly read this section / “**IV Operation**”. The main topics in this section are:

-) “Operating Modes” describes the difference between Pulse and CW modes and how to enter these modes.
-) Calibration “ON” or “CAL”
 - o “ON”-ON means the system is calibrated and ready to weld.
 - o “CAL”-CAL means the system is ready to be calibrated. There is a calibration file for the STD or MICRO modes. Reference **Service / Calibration Procedure for STD & MICRO Modes** for specific instructions on system calibration.
-) “Switching On” instructs the operator on the sequence for turning on the system.
-) “Microscope Installation and Alignment” describes the proper way to align the microscope.
-) “Setting Operating Parameters” provides a detail description on the functions of the Digital Messaging Touch Screen Display.
-) “Welding” provides instructions on firing the laser.
-) “Switch Off” instructs the operator on the sequence for turning off the system.

Operating Modes (Pulse & CW)

There are two modes of operating the FiberStar welder. Pulse Mode “STD” / (Pulse Mode) delivers the maximum peak power (displayed in Watts / W in the touch screen display), but maximum pulse duration and maximum duty cycle are limited to certain values. Pulse Mode “MICRO” / (CW mode pulsed) has lower peak power (displayed in Watts / W in the touch screen display), but supports all the P3 technology shapes. (**Note:** The Pulse Mode “MICRO” also has a CW mode continuous that while the foot pedal is depressed generates a continuous output (Watts / W)). The peak power is displayed by (W / Watts) in the message line of the display.

-) **Pulse Mode –“STD”**-In this **Pulse** mode the maximum peak power is considerably higher than the MICRO Pulse Mode or the Continuous Mode, however the maximum pulse duration and the maximum duty cycle are limited to certain values. The output energy unit of measure is Joules / J. There are four (4) **P³** technology pulse shapes, (basic, ramp down, spike and burst), that can be used in this mode.
-) **Pulse Mode-“MICRO”**-In this **CW** mode, the maximum peak power is reduced and the average power is increased. There are two CW modes:
 - o **MICRO Pulsed (CW)**-All **P³** technology pulse shapes can be used in this mode. The output energy unit of measure is Joules / J.
 - o **Continuous (CW)**-In this mode the laser generates a continuous output while the foot pedal is depressed. The output power unit of measure is Watts / W.

The following display screens will provide directions for entering the different modes: (**Note:** The laser shutter must be closed to enter the Menu Screen.)



Attention: Human fingers (**not finger nails**) should be used to extend the lifetime of the touch screen display. Inappropriate items (i.e.-pencils, pointers, pens, etc.) can cause the touch screen to have erratic or faulty operation and will reduce the lifetime and void the warranty. Even with the use of a proper stylus the lifetime will be dramatically reduced **by ~ 90%** (1/10 of the human finger lifetime).

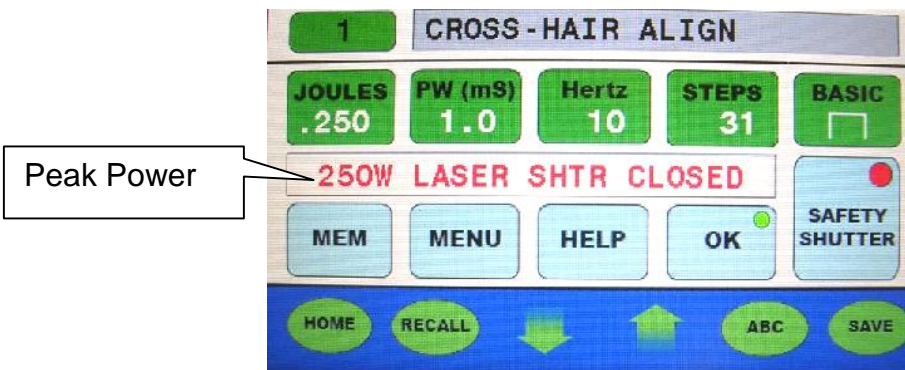


Figure 1
(Main Screen)

Pulse Mode-“STD”-Press MENU / Press Down arrow to select Standard Pulse Mode / Press ENTER / Press Up or Down Arrow to “STD” / Press ENTER / Press EXIT twice to return to the Main Screen.

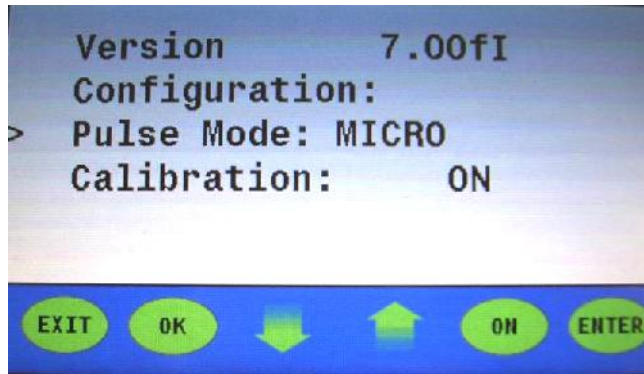


Figure 2
(Pulse Mode “MICRO” Selected)

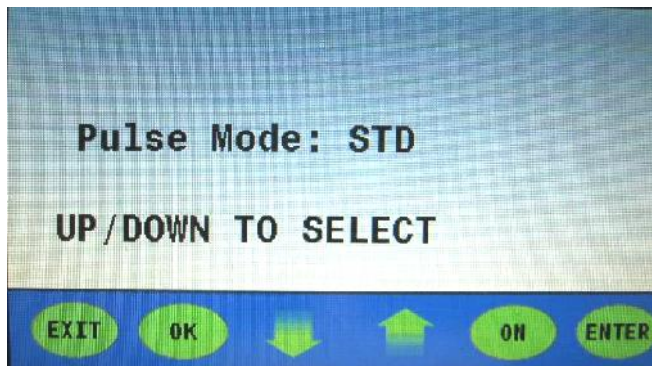


Figure 3
(Pulse Mode Changed from “MICRO” to “STD”)

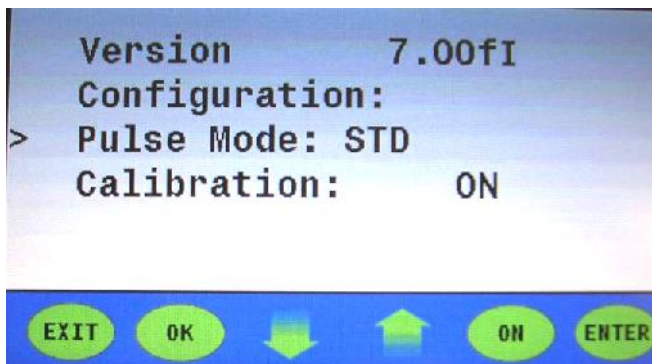


Figure 4
(Pulse Mode “STD” Selected)

- Standard (STD) Single Pulse Mode
(Note: In this mode there are four **P³** profiles (basic, ramp down, spike and burst) that can be used.)

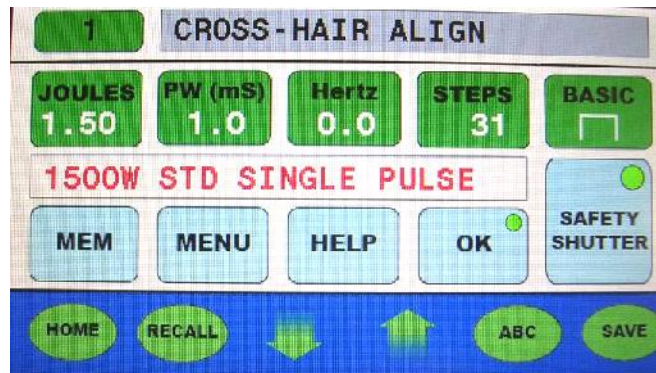


Figure 5
(STD Single Pulse Mode)

- Standard (STD) Multi Pulse Mode
(Note: In this mode there are four **P³** profiles (basic, ramp down, spike and burst) that can be used.)



Figure 6
(STD Multi Pulse Mode)

-) **Pulse Mode-“MICRO”**-Press MENU / Select Pulse Mode-STD / Press ENTER / Press Up or Down Arrow to “MICRO” / Press ENTER / Press EXIT twice to return to main screen.)

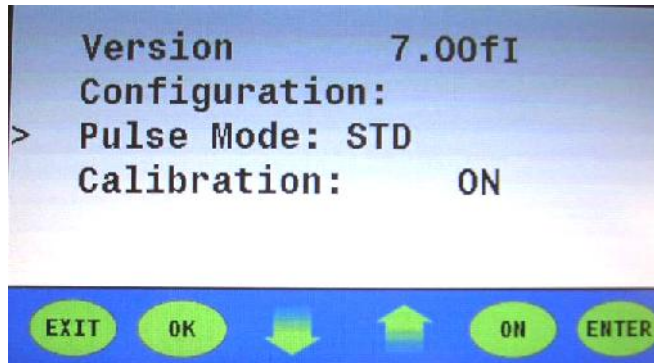


Figure 7
(Pulse Mode “STD” Selected)

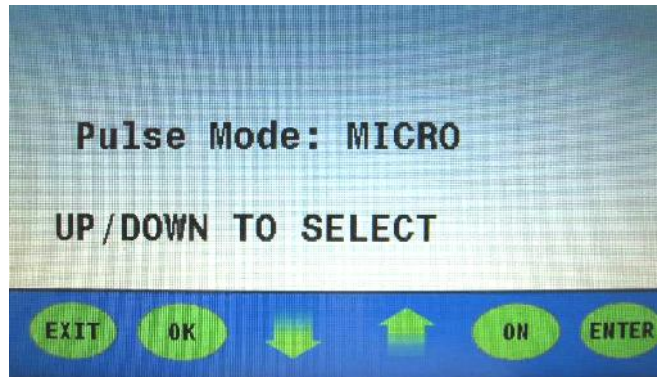


Figure 8
(Pulse Mode Changed from “STD” to “MICRO”)

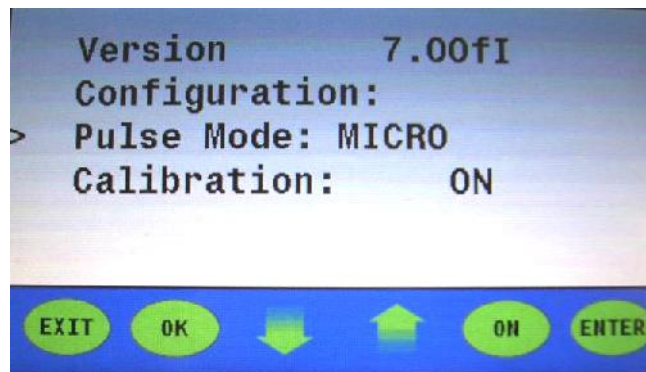


Figure 9
(Pulse Mode “MICRO” Selected)

MICRO Single Pulse Mode-In this mode all the **P³** profiles may be used up to 50 ms pulse widths. Pulse widths greater than 50 ms will only operate with the Basic Profile or Burst mode.



Figure 10
(MICRO Single Pulse Mode)

- MICRO Multi Pulse Mode-In this mode all the **P³** profiles may be used up to 50 ms pulse widths. Pulse widths greater than 50 ms will only operate with the Basic Profile or Burst mode.

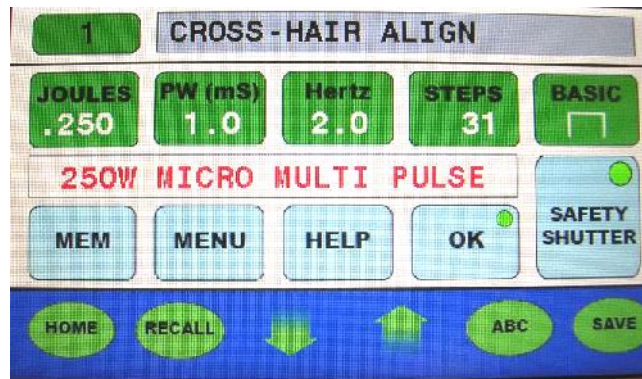


Figure 11
(Micro Multi Pulse Mode)

- Continuous CW Mode-This mode can be entered from the MICRO Pulse Mode by selecting pulse width and pressing the up arrow until CW is displayed in the PW button. (**Note:** The last PW number to be displayed before entering the CW mode is 75 ms.) The message line will also display the continuous mode. In this mode the laser generates a continuous output when the foot pedal is depressed. The power is expressed in Watts.



Figure 12
(Continuous Mode)

Calibration “ON” or “CAL”

There are two choices for the calibration selection. “ON” means the STD or MICRO modes have been calibrated. The STD & MICRO modes each have their own calibration file. “CAL” means the laser is in the mode to be calibrated. “CAL” should only be selected when the laser is being calibrated. A detail description of the CAL / calibration process can be found in the **Service Section** of this manual.

- Calibration MICRO “ON”- Press MENU / Press Down arrow to select Calibration / Press ENTER / Press Up or Down Arrow to “ON” / Press ENTER / Press EXIT twice to return to the Main Screen.

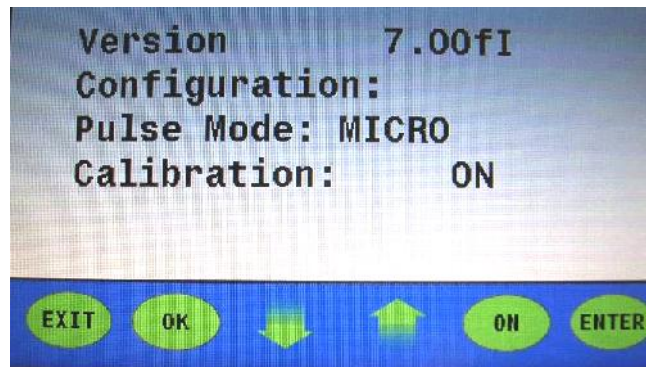


Figure 13
(MICRO Calibration “ON”)

- Calibration STD “ON”- Press MENU / Press Down arrow to select Calibration / Press ENTER / Press Up or Down Arrow to “ON” / Press ENTER / Press EXIT twice to return to the Main Screen.

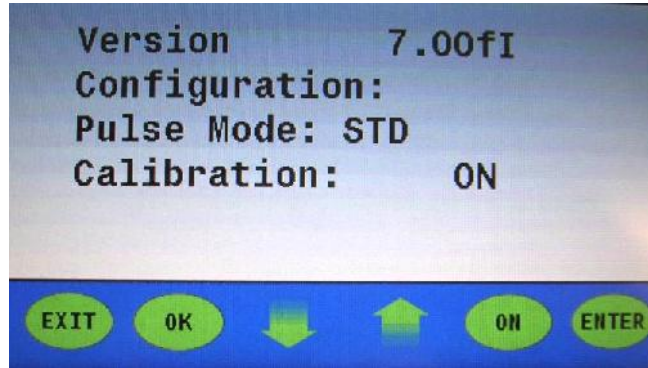


Figure 14
(STD Calibration “ON”)

Switching “ON”

After having properly finished all activities described in the section “**Initial Power Connections**” and having read / understand the information in “**Operating Modes**”, the welder is ready to be switched on.

The **SWITCHING ON** instructions follow:

SWITCHING ON

Action of Operator	System Response
Ψ Turn the Mains Switch on (“I” position) Figure 15	The Digital Messaging Touch Screen Display will turn on. The device carries out a series of self-tests. If any failure occurs, an error message will be indicated in the display. (Note: If the Key Switch is not turned on immediately after the Mains Switch, an error / PS Out of Range will be displayed in the message part of the display. Press HOME after turning on the Key Switch to clear this error. Other errors may require pressing HOME twice to clear (Reference the section entitled STATUS INDICATIONS).
> Turn the key switch on (“I” position) Figure 15	The Key Switch should be turned on immediately after turning on the Mains Switch. The Key Switch supplies power to the laser source. (Note: Reference

	prior system response to clear the message.)
> Wait until the self-test has completed Figure 16	The indicator located within the “OK” display button in the Digital Message Touch Screen Display will turn from red to green when the system is ready to weld.
> Press the Safety Shutter Button- Figure 16 (Note: Located in the Digital Message Touch Screen Display.)	The indicator located within the “Safety Shutter” button in the Digital Message Touch Screen Display will turn from red to green when the shutter is open. (Note: On models that have hand sensors the Safety Shutter indicator will blink red to green until the operator’s hands are in position in the work chamber.)

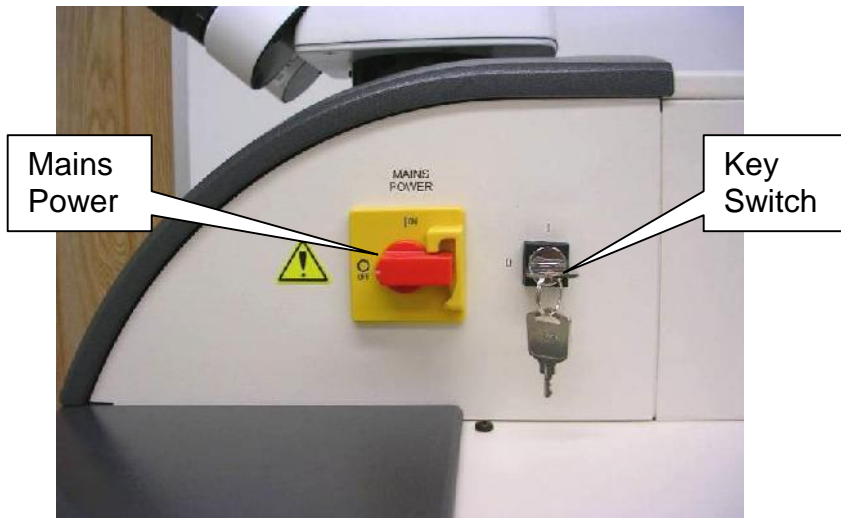


Figure 15
(Switching ON)

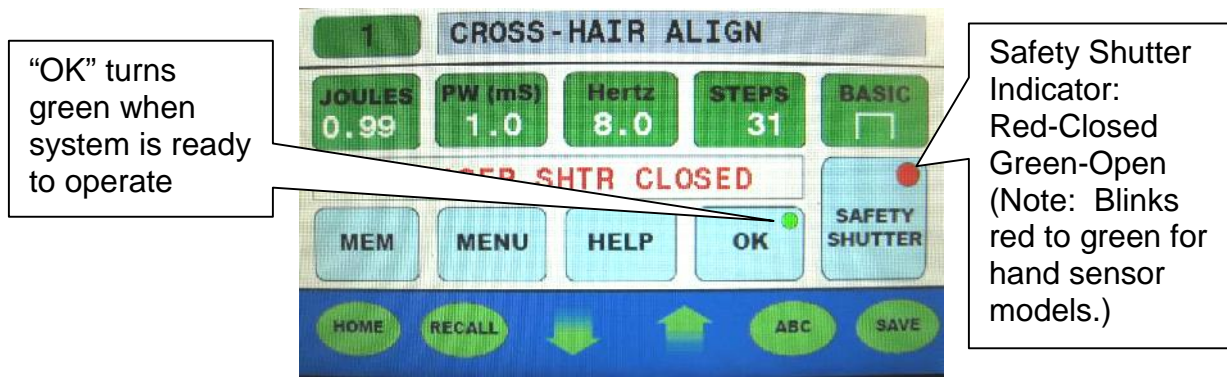


Figure 16
(Digital Messaging Touch Screen Display)

Flexible Gas Lines



Caution!

The flexible plastic gas lines are located in the work chamber area or external on some models without a work chamber.

ATTENTION: Please make sure these flexible plastic gas lines are not positioned near the work lights (especially the Halogen lights). The flexible plastic gas lines may melt (catch on fire) and drip hot melted plastic onto the operator's hands / arms or the work piece.

Adjusting the Binocular Stereo Microscope (Figure 17)

The binocular stereo microscope is factory adjusted for normal-sighted persons. It may be necessary to readjust it for specific operators or if the operator wears glasses or to adjust the focus of the cross hair.

-) Switch on the product (turn only mains switch to position "I").
-) Ensure eyepieces are pushed onto the eyepiece tube as far as they can go.
-) Put a sample item in the visual field of the stereo microscope so that it is sharp (in focus) when seen with the left eye open and the right eye closed. Fix the sample item in this position.
-) Look with the right eye through the right eyepiece and turn the right adjustment ring so that the cross hair appears sharp and in focus through the right eyepiece.
-) Rotate the entire eyepiece using the lower portion of the eyepiece to orientate the cross hair to the desired orientation. Refocus the cross hair if needed.
-) Adjust the distance of the two eyepieces that both visual fields (that appear bright) of both eyepieces completely overlap each other, i.e. while observing the test item with relaxed eyes, one single round visual field appears.

After this adjustment, the test item and cross hair will appear sharp through both eyepieces at the focus plane of the laser.

Optical Mounting and Alignment (Binocular & EZ-VIEW/Cobra)

-) Place binocular or **EZ-VIEW®/Cobra** stereo microscope into mounting bracket.
-) Secure scope by tightening two Mounting screws.

(Referring to diagram, the **mounting** screws are located between the center adjustment screw and the left and right adjustment screws.

-) For **EZ-VIEW®/Cobra** Stereo Microscope, plug scope into power connector above red switch.

-) Alignment of crosshair to the shot:
 - 1) Bring stainless steel plate or equivalent into focus using an adjustable Lab Jack or equivalent.
 - 2) Adjust the system parameters to mark the plate.
 - 3) Make a single shot onto the plate, do not move plate.
 - 4) Use the three Adjustment screws (refer to diagram) to align the shot in the cENTER of the Crosshair.

CAUTION: DO NOT REMOVE OR OVER TIGHTEN ADJUSTMENT SCREWS

-) Make an additional single shot onto the plate to ensure correct alignment.

-) Check alignment periodically.

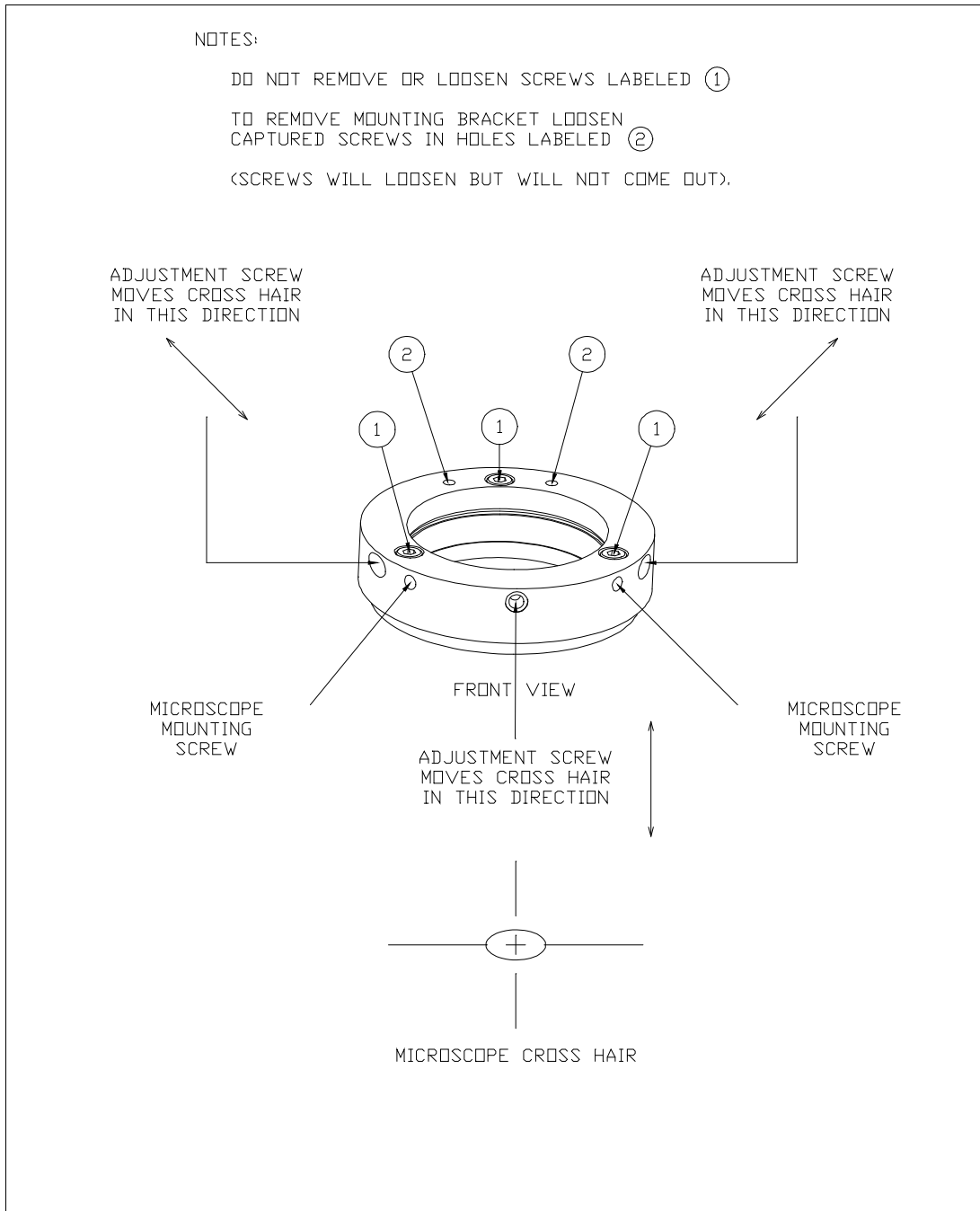


Figure 17
(Stereo Microscope Set Up)

SETTING OPERATING PARAMETERS

Selecting operating parameters is done by using the Digital Message Touch Screen Display or the Joystick.

DIGITAL MESSAGING TOUCH SCREEN DISPLAY OPERATION (Figure 19)

Note: When pressing a button on the Digital Messaging Touch Screen Display, please make sure you press the button in the center. An off center button press may result in an unwanted action.

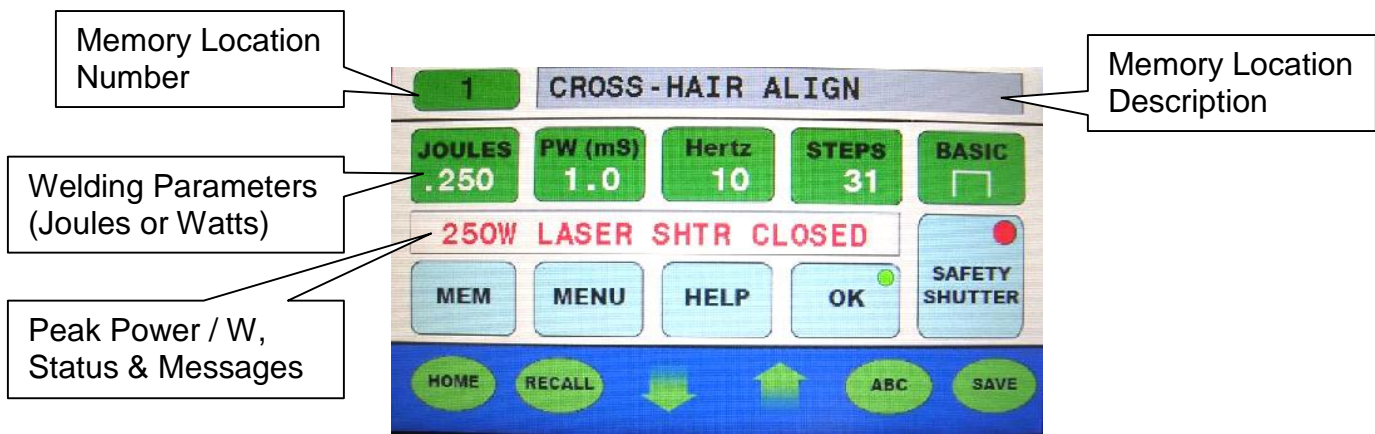
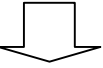



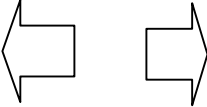
Figure 19
(Digital Messaging Touch Screen Display)

Main Screen (Figure 19)	
Button/Indicator/Screen	Description
OK / Red	System is not ready to operate. Safety shutter will not open.
OK / Green	System is ready to operate. The safety shutter can be opened.
OK	Pressing this button will enter the weld parameters displayed at that time and return the system to the Main Screen shown in Figure 19
SAFETY SHUTTER-Red	When the indicator in this button is red, the shutter is closed. Press to open.
SAFETY SHUTTER-Green	When the indicator in this button is green, the shutter is open. Press to close.
Memory Location Number- "Number"	Press this button to change the memory location number. The display will start to blink. Use the Up or Down arrow to change to the desired location number. Press OK to stop blinking. Press RECALL twice to load store values into the weld parameters.) Yellow indicates the weld parameters are from this memory location.

	<p>) Gray indicates the weld parameters are not from this memory location. (Note: Memory locations may be loaded with factory defaults. This is Model dependent.)</p>
Memory Location Description	<p>Displays the weld parameter description.</p> <p>) Yellow indicates the weld parameters are from this memory location.</p> <p>) Gray indicates the weld parameters are not from this memory location.</p>
<p>Welding Parameters</p> <p>) JOULES or WATTS</p> <p>) PW (mS)</p> <p>) HERTZ , BURST or Pulse Suppression (Optional / Model specific)</p> <p>) DIA (mm)</p> <p>) SHAPE (P³)</p>	<p>Displays the current welding parameters:</p> <p>) Joules (J)-Press this button to change the value. The display will start to blink. Use the up or down arrow to change the value and then press OK. (Note: All modes except CW mode.)</p> <p>) Watts (W)-Press this button to change the value. The display will start to blink. Use the up or down arrow to change the value and then press OK. (Note: CW mode only)</p> <p>) PW (mS)-Press this button to change the value. The display will start to blink. Use the up or down arrow to change the value and then press OK.</p> <p>) Hertz / Burst / Pulse Suppression (Optional / Model specific) (Note: Use the up or down arrow to select Hertz, Burst or Pulse Suppression.)</p> <ul style="list-style-type: none"> o Hertz (Hz)-Press this button to change the value. The display will start to blink. Use the up or down arrow to change the value and then press OK. o Burst-Press this button to change the value. The display will start to blink. Use the up or down arrow to change the value and then press OK. o Pulse Suppression (Optional / Model specific)-Press this button to change the value. The display will start to blink. Use the up or down arrow to change the value and then press OK. <p>) DIA (mm)-Press this button to change the value. The display will start to blink. Use the up or down arrow to change the value and then press OK.</p> <p>) SHAPE-Press this button to change the P³ shape. The display will start to blink. Use the up or down arrow to change the P³ shape and then press OK.</p> <p>(Note: If OK is not pressed, the selected operation will time out and the change will be stored.)</p>
Messages	<p>Displays the laser status which includes-shutter status, error messages, memory parameters, etc.</p>
MEM	<p>Memory Features</p>

	<ul style="list-style-type: none"> ○ Pressing this button will display the stored parameters & description of the memory location number which is displayed in the upper left corner of the display. Figure 22a ○ Figure 22a screen allows the user to clear the parameters & description for the selected memory location by pressing the CLEAR button on the screen. ○ ATTENTION: All information in this memory location will be lost. (Note: The parameters & description for factory default memory locations will also be cleared by this CLEAR button but can be restored by going to the Main Screen / Menu / Restore Def Memory / LST.) ○ Figure 22b verifies that the user wants to CLEAR this memory-“Clear memory 4?”. Pressing CLEAR again will clear the memory. Pressing HOME will return to the Main Screen without clearing this memory location.
MENU	Pressing this button enters the version / configuration display screen. Figure 19
HELP	Press this button to get: <ul style="list-style-type: none">) Contact Information) Model Number) Serial Number) Tools / information to aid the user
HOME	Pressing this button returns system to the main screen- Figure 19 (Note: Press Home button twice to clear “600W PS Out of Range”)
RECALL	Press the recall button twice after the memory location has been selected. (Note: The second button activation is in response to a question “Recall memory XX ” The memory location description will change from gray to yellow in color when the weld parameters are from the memory location number.) Figure 25 & 26
 (DOWN/DN)	Pressing this button will decrease the selected weld parameter values/shape; reduces memory location number; and selects Menu function (>).
 (UP)	Pressing this button will increase the selected weld parameter values/shape; increases memory location number; and selects Menu function (>).
ABC	Pressing this button will enter the Alpha/Numeric keypad display. This display is used to add description of weld operation in the selected memory location. Figure 23 & 24
SAVE	Pressing this button twice will store the displayed weld parameters into memory location number displayed in the upper left corner. (Note: The second button

	activation is in response to a question “Store in memory XX ?”) Figure 27 & 28
Version / Configuration Screen (Figure 20)	
Menu Display Screen	<p>Press the UP or DOWN arrow to move the cursor (>) to the selected item. Press “ENTER” to enter the mode. Use the UP or DOWN arrow to change the mode (i.e.- on or off) or change the value (i.e.-0.50s). The change is stored by pressing “ENTER”. EXIT button returns to the menu screen.</p> <p>Version: (number) Configuration: Version: (Alpha numeric) >Pulse Mode: STD or MICRO Calibration: ON, CLR TABLE, GAIN & TABLE Weld Gas: ON (OFF) (Up/Dn arrow & press ENTER) Pre Weld Gas: 0.00s (Up/Dn arrow & press ENTER) Post Weld Gas: 0.00s (Up/Dn arrow & press ENTER) Sleep: Not Applicable Plse Count: 0 (Up/Dn to select)) CLEAR-To zero/reset-select & press ON) BACK-To not zero/reset-select & press ENTER Hours On: 4.3 (No actions possible) Plse Total: 0 (No actions possible) Fault Lists: (Press ON to view & ON to clear)) VIEW-Press ON) CLEAR-Press ON Restore Def Memory: Up/Dn arrow to select) <u>NO</u>-No change-Press ENTER) <u>ALL</u>-Reloads LST data & no change to user memory locations-Press ENTER) <u>LST</u>-Reloads LST data & clears user memory locations-Press ENTER Energy Usage: 0 (Up/Dn to select)) SHOW-Press ENTER) SYS-Press ENTER) CLEAR-Press ON Frequency Adj: XX (Up/Dn to set value & ENTER) Beam Ex Offset: ± 12 (Up/Dn to set value & ENTER) PW_Sum: 9 (Up/Dn to select)) DIAG-ON) BACK-ENTER</p> <p>Note: If the selected item or change is not made in a reasonable amount of time, the display will return to the Main Screen.</p> <p>Figure19</p>
ENTER	Pressing this button enters the selected item on ; changes are made using the up or down arrow or the ON button; and then press ENTER to store the results.

EXIT	Press this button once or twice to exit the version/configuration screen and return to the Main Screen.
OK	Pressing this button enters the selected item; changes are made using the up or down arrow or the ON button; and then press ENTER to store the results.
ON	Pressing this button resets the pulse count / plse count. when the pulse count is selected.
ABC Screen (Figure 23 & 24)	
ESC	Press this button to return to the Main Screen.
CLEAR	Pressing this button completely clears the memory location description.
	Pressing these arrows to select the alpha numeric characters.
SAVE	Press this button to save memory location description.
BS	Press this button to delete the last character.
CAP	Press this button to change from lower or upper case letters.
123	Press this button to change back and forth between letters & numbers.

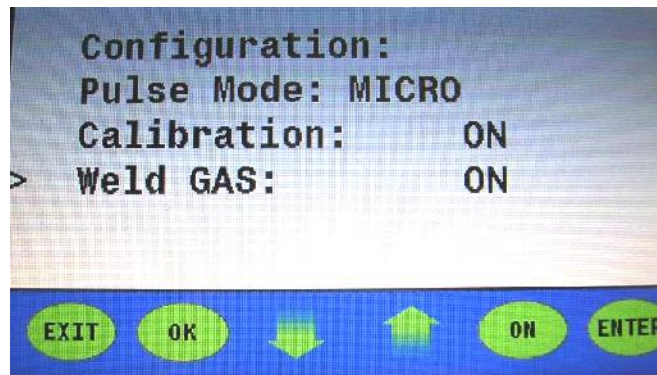


Figure 20
(Menu Screen-Scroll Down to Weld GAS)



Figure 21

(Main Screen)

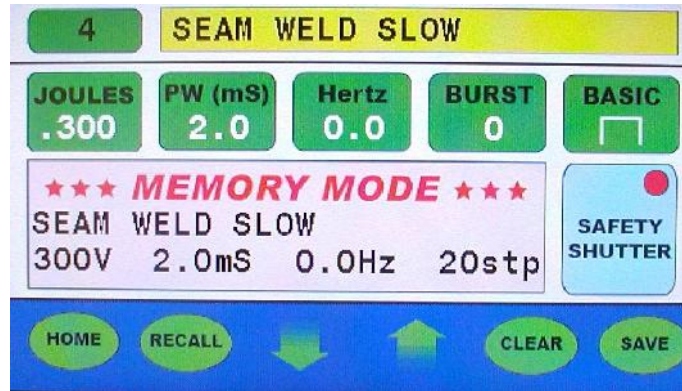


Figure 22a
(Memory Screen)



Figure 22b
("Clear Memory 4?" by Pressing CLEAR)



Figure 22
(Memory Screen)



Figure 23
(ABC Screen)

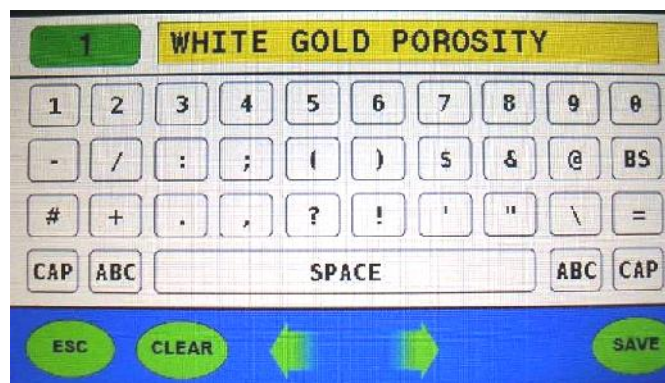


Figure 24
(123 Screen)



Figure 25
(Recall Screen)



Figure 26
(Memory Recalled Screen)



Figure 27
(Save Screen)

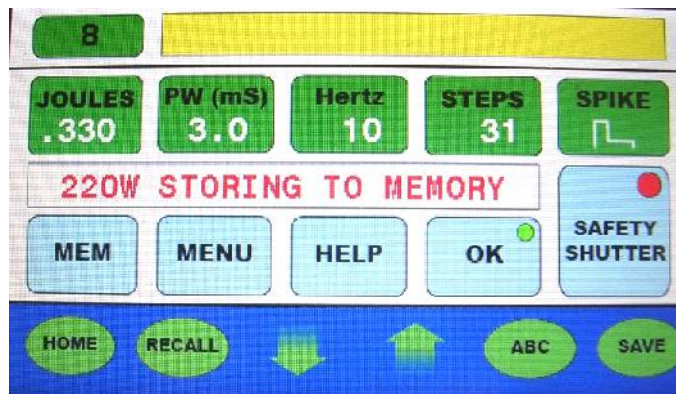


Figure 28
(Storing to Memory Screen)

JOYSTICK OPERATION



You can select and set all the operating parameters using the joysticks in the welding chamber area (Reference **Section I** / The LaserStar® Workstation / Control Elements in Welding Chamber / Area / Joystick.).

STORING OPERATING PARAMETERS

The product's controller has memory locations in which sets of operating parameters (each optimized for specific applications or materials, for example) can be stored so that you can subsequently work with the same tried-and-tested operating data. (**Note:** Reference Appendix A for details on Pulse Shaping)

In order to identify the different memory locations more easily, you can assign them user definable texts. Memory locations may already have default designations, but you can change these as required (Note: The default values can be reloaded at any time. Reloading the default values will erase any parameters that were added by the user. (**ATTENTION:** Custom memory locations / (1-79) for parameters are saved in flash memory and should not be lost if the battery backup is removed or fails. However, the non-stored parameters in the display will be lost. Good practice suggests that a computer backup using LaserStar's EZ-LINK or a hard copy backup should be created for all custom memory locations.))

A stored set of parameters consists of the following:

-) Joules or Watts
-) Pulse width
-) Single pulse or repetition frequency for continuous pulse
-) Focus setting
-) Explanatory text
-) Pulse Profile Shape / P³ Technology
-) Beam Expander Offset: The beam expander offset allows the user to maintain the same screen value for "DIA", but the actual beam diameter is the screen value ± the offset value. The beam expander offset value can be found by selecting "Menu" and scrolling down to "Beam Ex Offset" and press "ENTER". Use the Up or Dn arrow to change the value and then press "ENTER". Reference Operation / Setting Operating Parameters / (Version / Configuration Screen / Menu Display Screen for adjustment range / values.

ATTENTION:

- When storing parameters in a selected memory location, the beam expander offset values displayed in the “Menu” at that time will be stored in that memory location.
-) If the user is not using parameters from a selected memory location, the beam expander offset value may be from the last recalled memory value.
-) Restoring factory memory defaults **will erase** any user modifications to this memory location. (**Note:** The user should keep a backup copy of all memory location settings / parameters.)

You can use the Digital Messaging Touch Screen Display to save operating parameters into a specific memory location.

To store sets of parameters, proceed as follows:

Action of the Operator	System Response
> Select the memory location to be used by pressing the memory location number key in the upper left corner of the display and then use the arrow keys to change the location number. The joystick inside the work chamber can be used to select the memory location.	The selected memory location number is displayed
> Press the Save key twice on the display or twice inside the welding chamber / area to store the values	The values / shape are stored and displayed in the welding parameter line of the display

Note: To store parameters with text use the ABC Screen on the Digital Messaging Touch Screen Display.

RECALLING STORED PARAMETERS

You can use the Digital Messaging Touch Screen Display to recall operating parameters that you have previously stored in a specific memory location (reference the section entitled STORING OPERATING PARAMETERS).

To recall sets of parameters, proceed as follows:

Action of Operator	System Response
> Select the memory location to be used by pressing the memory location number key in the upper left corner of	The selected memory location weld parameters are only visible while the memory location number is blinking.

<p>the display and then use the arrow keys to change the location number. Press the recall button twice to display the values in the parameter line of the display. The joystick inside the work chamber can be used to select the memory location.</p>	<p>Once the memory location number stops blinking the weld parameters revert back to the previous values.</p>
<p>> Press the recall button on the touch screen twice or press the recall button in the work chamber area twice.</p>	<p>The recalled weld parameters will be displayed and the memory location description will change from gray to yellow.</p>



If there are not yet any parameter values stored in the selected memory location number, the set values remain unchanged.

WELDING (Digital Messaging Touch Screen Display or Joystick)

Action of the Operator	System Response
<p>> Put the work piece into the welding chamber/area</p>	
<p>> Set the weld parameters</p>	<p>This can be done using the Digital Messaging Touch Screen Display or by using the Joystick(s).</p>
<p>> *Put both hands through the hand openings into the welding chamber / area</p>	<p>To weld-Press the Safety Shutter Button on the Digital Messaging Touch Screen Display (Indicator turns green) or press the safety shutter button inside the work chamber (Button turns red).</p>
<p>>Fire the Laser</p>	<p>Press the foot pedal (Note: The weld parameters can be optimized by using the Digital Messaging Touch Screen Display or the Joystick(s).)</p>



Caution!

(*)-Do not position your hands in or under the crosshair. Pressing the pedal switch will release a laser pulse causing burning

The operator can use the rotary control / dimmer control located in the welding chamber / area to set the brightness on the work piece. Check the brightness through the stereomicroscope. The appropriate brightness depends on the properties of the work piece material.

Use the Digital Messaging Touch Screen Display or the Joystick(s) to set the required welding parameters.

For inert gas welding, the gas outlet at the end of the gas tube is to be positioned near to the laser focal point. A position adequate for most applications is at the edge of the visual field of the stereomicroscope above the focal plane.

The exact positioning of work pieces must be carried out in all three dimensions:

Ñ **Horizontal dimensions:** The exact position is controlled by the crosshair.

Ñ **Vertical dimension:** The exact positioning is found if the surface of the work piece appears sharp (in focus).

Action of the Operator	System Response
> Look through the stereomicroscope and join the work pieces together. Adjust them as necessary.	The crosshair shows the exact position of the laser focal point.
> If the welding point appears sharp within the crosshair, press the pedal switch half way.	The gas supply will be enabled
> Fully press the pedal switch until it stops	The view shutter shortly blacks out, the visual field and the laser pulse will be released.
> If several laser pulses are to be released one after the other, in single-pulse mode, the pedal switch must be slightly released and then fully depressed again. In continuous pulse mode, laser pulses with the set frequency are released continuously for as long as the pedal switch remains fully depressed.	
When you have finished welding, lay down the work piece in the welding Chamber / area and pull both hands out of the hand openings.	



For different materials, suitable laser parameters (joules, pulse length, pulse frequency, beam diameter, and multi pulse / P3 and the appropriate flow rate of argon (inert) gas has to be determined by trial and error. In many cases the quality of a welding point can be improved by placing several laser pulses shortly one after the other on the same welding point.

After each laser pulse and after changes to the joules value, the **OK** button indicator will turn red. When the system is ready to fire the **OK** button indicator will turn green. This recovery time is between 0.1 and 3 sec. (depending on the set values for Joules and Pulse Length).

The view shutter is controlled electronically. A laser pulse will only be released if the view shutter operates properly. Additionally, there is an optical filter in the viewing optic that blocks UV and laser light.

Resetting Pulse Count-Reference **Section IV / Operation / Setting Operating Parameters / Digital Messaging Touch Screen Display Operation / Version Configuration Screen / Menu Display Screen (MENU)**

Text Entry Mode-Reference **Section IV / Operation / Setting Operating Parameters / Digital Messaging Touch Screen Display Operation / ABC Screen**

Switching OFF-Refer to Figure 29



1. **ATTENTION:** The Key Switch & Mains Power Switch must be left “ON” for 10 minutes to cool down the system prior to switching “OFF”.
2. Turn Key Switch (2) to the left.
3. Turn Mains Power switch (1) to the left (position “0”).
4. Close inert gas valves off (gas cylinder valve).

Pull out the key and keep it in a safe place only accessible for authorized personnel.

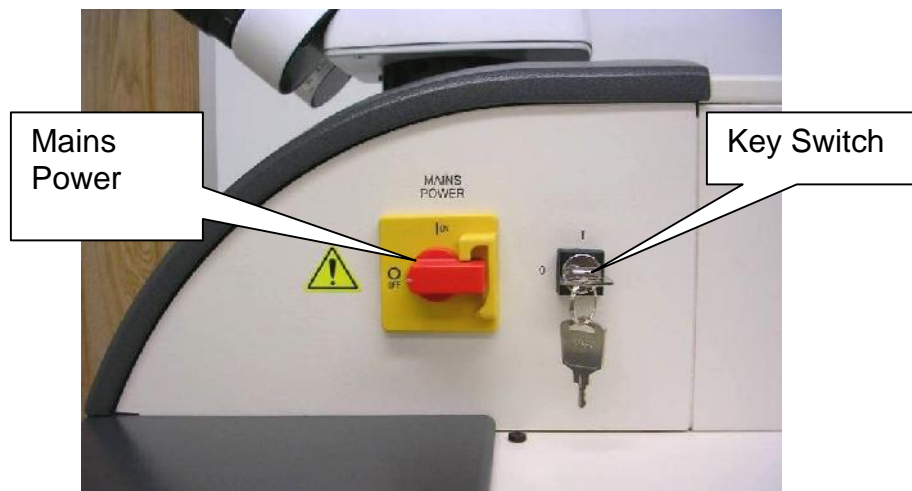


Figure 29
(Switching OFF)

Status Monitoring and Indications

During the self-test, immediately after the device has been switched on, and during operation, the current status of the laser is indicated by plain text messages in the Digital Messaging Touch Screen Display. If the indicator is green in the “OK” button, the system is ready to weld.

In the LaserStar® Workstation, the micro controller monitors the conditions for pulse release on the basis of the following criteria:

-) If the safety shutter is open, a laser pulse can only be released via the pedal switch.
-) In case the safety shutter is closed, the operator cannot release a laser pulse. (This is to avoid unplanned laser pulse release.)
-) In principle, the remote interlock prevents a laser pulse release.
-) A Remote Interlock failure shuts off the laser source / engine power supply.

EZ-LINK™ (hardware / software)

LaserStar®'s EZ-LINK™ Software provides direct access to your LaserStar® welding system's internal operating system via a personal computer. This feature offers many advanced communication features allowing the user to perform a wide range of tasks. Some of the Key features are:

-) Connect and Control Your LaserStar®-remotely or On-site
-) Create / Edit / Save Memory Parameter Settings
-) Back-Up Memory Cells (Parameters and Descriptions)
-) Monitor Daily System Performance
-) Download System Updates
-) Create Usage History Reports
-) Perform Troubleshooting
-) Run System Diagnostics

Restricted Access / Password Protection / Password Change Feature

The restricted access / password protected feature is used to prevent unauthorized changes to the weld parameters. This feature is installed in the welder system at LaserStar prior to shipment. The user can then enable or disable the restricted access feature / password protection at any time. For instructions on using this feature, please reference **Appendix A / Restricted Access / Password Protection / Password Change Instructions**.

V. MAINTENANCE



During maintenance activities with an opened device, OSHA regulations about accident prevention for laser radiation or equivalent national or international regulations (e.g. EC Directive 608 or IEC Publication 825) absolutely must be followed!

Warning! WEAR PROPER PROTECTIVE LASER EYE WEAR

Routine maintenance is required to ensure proper operation. These must be scheduled according to the manufacturer's recommendations. Prior to maintenance and/or service, several safety rules must be followed:

-) Disconnect systems, subsystems and auxiliary equipment by turning them "off" and disconnecting them from any power sources or live components.
-) Ensure that the disconnected equipment is secured against being switched "on" again inadvertently (e.g. by operator error) or automatically (e.g. by vibrations). Secure the mains switch with a padlock or remove the fuses. Use any mechanical locking device provided. Ensure that clear warning signs are in place while the work is being carried out.
-) Check if the equipment is "live" using a voltmeter or a voltage tester. Measure the conductors against each other and against the protective ground conductor to check whether they are "live."
-) Always **ground first**. Short-circuit the capacitors in low-voltage systems and devices. Short-circuit the capacitors and high-voltage lines in high-voltage systems and devices. Do not forget to remove the grounding and shorting jumpers when you have completed the work.
-) If there is a risk of touching "live" components near to where you are working and it is not possible to disconnect these components from the voltage source, they must be covered with sufficiently strong and reliable insulating material, or some other method must be used to prevent direct contact. Cover with plastic sheeting/paneling or rubber matting.
-) The service personnel must verify the product is in a safe state after maintenance or service is completed.
-) Use only LaserStar approved parts & accessories.



Warning!

NEVER WORK ALONE when performing service or maintenance activities. A second person, who should be at least familiar with the risks posed by laser radiation and high voltages, should always be present during service and maintenance activities. In the event of an emergency, this person can turn off the laser equipment and provide first aid.

HIGH VOLTAGE



Caution!

This laser device complies with all generally recognized technical standards and regulations. This includes OSHA, EC, EN, DIN and VDE standards. This laser is ignited and operated using dangerous high voltage (>1 kV), so special care has to be taken when working on the lamp power supply. When taking measurements on electrical or electronic components of this Class 4 laser product while it is “on,” the required clearances have to be maintained. You must also bear in mind that the high-voltage capacitors used to produce the ignition energy and the high operating voltages take some time to discharge via the discharge resistance after the lamp power supply has been turned “off.” Always comply with the relevant safety regulations (OSHA, or equivalent national standards) when working on electrical equipment of this kind.

Maintenance Intervals



Maintenance Interval Alert Reminders: The laser is equipped with the following maintenance interval reminders that will appear in the system display at the intervals indicated in the table below. **(Note: The user should perform the following maintenance tasks at the recommended intervals to optimize machine performance and minimize premature machine failure.)**

Alert	Interval	Reset Method Table 1 (Digital Message Touch Screen Display)
PROTECTIVE DISC	7 days	Press to reset
CLEAN WELD CHAMBER/AREA	30 days	Press to reset
AIR FILTERS	90 days	Press to reset

Digital Messaging Touch Screen Display Maintenance Alerts



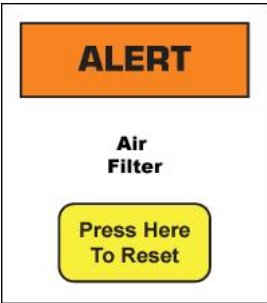
 <p>ALERT</p> <p>Protective Disc</p> <p>Press Here To Reset</p>
 <p>ALERT</p> <p>Clean Chamber</p> <p>Press Here To Reset</p>
 <p>ALERT</p> <p>Air Filter</p> <p>Press Here To Reset</p>

Table 1

The following maintenance should be performed in addition to the maintenance alerts discussed above.

A. Daily

1. The surface of the cabinet should be cleaned with a damp cloth or glass cleaner. Never use strong cleaning agents (i.e. powders or solvents).
2. The Laser Protective Window should be visually checked for cracks, voids or other damage. If damaged, the laser must not be used until the Laser Protective Window is replaced. Refer to section “Replacement of the Splash Protective Window and Laser Protective Window”
3. The **Protective Disk**, located inside the welding chamber/area, should be unscrewed from the focusing lens and cleaned with a lens cleaning solution. The recommended solvent is Isopropyl Alcohol-70% (**Flammable**) or LaserStar preferred cleaning solution PN:810-2353 & LaserStar preferred wipes PN:810-2356 (qty 1) or 810-2354 (qty 90).

Note: Metal splashes will adhere to the protective disk and a replacement disk will be needed. There is a danger of a local heating at these splash points on the protective disk that may result in possible cracking or destroying of the focus lens. Never install a protective disk with the side that has the metal splashes in the up position.

B. Weekly

1. Check the alignment of the crosshair to the laser spot. For a step-by-step procedure on alignment refer to the section on Stereo Microscope Mounting and Alignment in this Manual.
2. The Plastic Splash Protector behind the laser protective window should be cleaned and checked for scratches, cracks or holes.

C. Monthly

1. Inspect the welding chamber/area protective housings i.e., arms cuffs, chamber/area door and flaps for damage. The laser must not be used if any of the protective housings are damaged. Contact LaserStar for Service.
2. Check and replace the laser filters (exhaust filter and side panel filters) as required / if dirty.

D. Quarterly: All the above

E. Yearly: All the above

Replacement of the Focus Lens Protective Glass Disk

1. Switch off the laser, turn mains switch to "0." Wait five minutes for halogen lamps to cool.
2. Insert hands in hand openings.
3. Unscrew the knurled ring at the underside of the lens counterclockwise, take it off and pull it out of the welding chamber/area as horizontally as possible.
4. Replace the old protective glass disk with a new one.
5. Screw the knurled ring together with the new glass at the underside of the lens by turning it clockwise. The protective glass prevents the lens from being damaged by mechanical influences such as metal splashes or dust.

In order to reduce losses by absorption, the protective glass has an antireflection coating on both sides.

Replacement of the Splash Protective Window and Laser Protective Window

The observation window is a combination of two pieces:

1. The laser protective window (outside) prevents the emission of laser radiation light.
2. The splash-protective window (inside) protects the laser protective window from soiling and damage.
3. Loosen both the hexagon socket screws on the sidewalls of the welding chamber/area until the angle brackets can be rotated or removed while pressing your hand from inside against the frame of the protective window.
4. First tip the lower edge of both protective windows inside and then pull them down into the welding chamber/area.
5. Separate both windows. Clean the laser protective window with a safe glass cleaner. If the laser protective window is being replaced, clean it prior to installation.
6. Remove the protective foils from the new splash protective window and clean it on both sides with alcohol.



Caution!

**DO NOT SCRATCH THE SPLASH
PROTECTIVE WINDOW**

7. Put the laser protective window with the labels showing up onto the splash protective window. Put both windows from inside into the assigned openings of the cover.
8. Take good care that the laser protective window is located on the outside surface and fully seated in frame.
9. The two angle brackets over the hexagon socket screw head and the washer, apply light pressure to push them against the two windows, and then tighten the hexagon socket screws. The windows must fit well to the front elements of the frame and must not clatter after being fitted.

Filter Replacement for the Chamber Area Exhaust

1. Turn off the key and the mains power switch. Unplug the power cord.
2. Remove filter cover on the rear of the laser by removing the two screws.
3. Remove the filter and replace.
4. Reinstall filter cover and 2 screws
5. Plug in mains cord and turn mains power switch
6. Check for fan coming on and air being exhausted out of exhaust outlet at rear of the cabinet.



Warning!

DO NOT CLEAN THE FILTER

Beating or blowing out with compressed air will destroy the filter medium. The pollutants attached to the filter will get into the air of the working area.

Digital Messaging Touch Screen Display Cleaning Instructions

It's important to realize the touch panel is sensitive to chemicals, much as is a pair of glasses with plastic lenses (usually polycarbonate with a glare reduction coating). In fact, the cleaning kit often supplied with a pair of such glasses is just the ticket for safely cleaning your touch panel screen; it typically includes a micro-fiber cloth and a gentle cleaning solution and can usually be had for \$10 or so.

Specific Cleaning Information:

-) Use a soft lint-free cloth. The 3M Microfiber Lens Cleaning Cloth is especially recommended for cleaning touch panels without requiring liquid cleaner.
-) The cloth maybe used dry, or lightly dampened with a mild cleaner or Ethanol.
-) Be sure the cloth is only lightly dampened, not wet. Never apply cleaner directly to touch panel surface; if cleaner is spilled onto touch panel, soak it up immediately with absorbent cloth.
-) Cleaner must be neither acid nor alkali (neutral pH).
-) When using cleaner, avoid contact with the edges of the film or glass.

- J Wipe the surface gently; if there is a directional surface texture, wipe in the same direction as the texture.
- J Never use acidic or alkaline cleaners, or organic chemicals such as: paint thinner, acetone, toluene, xylene, propyl or isopropyl alcohol, or kerosene.
- J Suitable cleaning products are commercially available pre-packaged for use; one example of such a product is Klear Screen™ <http://www.nushield.com/products_main_klear.htm>, or commercially available off-the shelf retail brands such as Glass Plus® Glass and Surface Cleaner made by Reckitt-Benckiser <<http://www.glassplus.com/>>.
- J Use of incorrect cleaners can result in optical impairment of touch panel and/or damage to functionality.

NOTE: Most products contain 1-3% Isopropyl Alcohol by volume, which is within acceptable limits for Resistive Touch Panel cleaning use.

CAUTION: Many products contain Ammonia, Phosphates, and / or Ethylene Glycol, which are NOT ACCEPTABLE; check product content label carefully.

Collimator



If the collimator is removed from the collimator clamping block, the laser alignment will be lost. Reference Service / Major Components for identification & location of the collimator. Contact LaserStar Service for support in re-alignment.

Warning!

VI. TROUBLESHOOTING

General Information

All major system messages and faults will be displaced in the Digital Messaging Touch Screen Display. System messages will be displayed in the third line of the display. Faults will be displayed with an “ALARM” message in a box in the middle of the display (Table 1). Once the cause of the fault has been eliminated, press the reset box within the Alarm box or turn the key switch off and then on.

(Note: A reset will not be accepted if the reason for the failure has not yet been eliminated.)



Warning!

During maintenance activities with an opened device, OSHA regulations about accident prevention for laser radiation or equivalent national or international regulations (e.g. EC Directive 608 or IEC Publication 825) absolutely must be followed!

WEAR PROPER LASER PROTECTIVE LASER EYE WEAR

Service

In case of any malfunction of the product that cannot be eliminated by one of the actions described in the sections MAINTENANCE or ERROR MESSAGES AND FAULT CLEARANCE, please immediately contact the service department of LaserStar Technologies Corporation.



Warning!

Service activities may only be performed by service technicians of LaserStar Technologies Corporation or properly trained personnel.

LaserStar Technologies Corporation

One Industrial Court
Riverside, Rhode Island 02915 USA
Tel: 401-438-1500
E-mail: service@laserstar.net



In case of any malfunction of the device that cannot be eliminated by one of the actions described in the sections MAINTENANCE or SYSTEM MESSAGES, ALARMS AND FAULT CLEARANCE, please immediately contact the service department of LaserStar Technologies.

(Note: Some system / fault / error messages will occur with an alarm as shown in **Table 1** other system messages will occur in the message line of the display and will require pressing HOME twice to clear. The system message will only clear if the cause of the fault has been eliminated. **Contact LaserStar Service if the message cannot be cleared.)**

SYSTEM MESSAGES / ALARMS		POSSIBLE REASON*
Display	Extended Description	
Right Hand Sense	-	The right hand proximity sensor is not seeing the operator's hand in the machine.
Left Hand Sense	-	The left hand proximity sensor is not seeing the operator's hand in the machine.
Right Door Sensor	-	Front chamber/area door is open or the door right side interlock switch is open.
Left Door Sensor	-	Front chamber/area door is open or the door left side interlock switch is open.
Front Door Open	-	Front door of the chamber/area is open.
External Interlock	-	Remote Interlock "By pass plug" not installed or external door switch open.
STD Single Pulse	-	Depressing the foot pedal will only produce one STD laser pulse.
STD Multi Pulse	-	Hertz (HZ) activated. Depressing the foot pedal will produce STD multiple laser pulses.
MICRO Single Pulse	-	Depressing the foot pedal will only produce one MICRO laser pulse.
MICRO Multi Pulse	-	Hertz (HZ) activated. Depressing the foot pedal will produce MICRO multiple laser pulses.
Continuous Mode	-	In this mode the laser puts out a continuous output while the foot pedal is depressed.
Burst Pulse Mode	-	Burst (B) activated. Depressing the foot pedal will produce the number of laser pulses that the operator has selected.
Store in Memory X?	-	Save key depressed. Parameters are ready to be stored in (X) memory location.
Storing To Memory	-	Save key depressed. Parameters are stored into a memory location.
Memory Recalled	-	Recall key depressed. A saved memory location is being activated.
Clear Memory X?	-	Press Clear key to delete data in memory location (X).
Laser SHTR Closed	Laser Shutter Closed	The Open Shutter (O) button has not been pressed to allow the safety shutter to open.
Warning Dead Battery	-	Control Board Memory Backup battery needs to be

		replaced. Use CLT# 405-3900-001 or 3V Lithium 2325
5 VDC Fault	-	The 5VDC power supply is out of range or has no output. Contact LaserStar Service
High Voltage 24 Volt	-	The 24VDC power supply output is above the operating limit. Contact LaserStar Service
Low Voltage 24 Volt	-	The 24VDC power supply output is below the operating limit. Contact LaserStar Service
Beam Expander Fault	-	Beam Expander “zero” signal not detected. Contact LaserStar Service (Note: Operation can continue. However, beam diameter is not changing.)
Beam Expander Hi Fault	-	Beam Expander “Full Limit” signal not detected. Contact LaserStar Service (Note: Operation can continue. However, beam diameter is not changing.)
Beam Expander Low Fault	-	Beam Expander “Low Limit” signal not detected. Contact LaserStar Service (Note: Operation can continue. However, beam diameter is not changing.)
Laser Shutter Fault	-	Machine detecting a safety shutter fault. If fault still active, cycle power, if still active contact LaserStar Service.
View SHTR Fault	View Shutter Fault	Message will flash in display; view shutter is not tripping one or both of the open and close sensors. Contact LaserStar Service
Joystick Stuck	-	This fault will only show up on system start up. Make sure the joystick is in the central position. Deflect joystick and let it return to the central / inactive position and see if the fault message is cleared. If alarm still active, cycle power, if still active contact LaserStar Service.
Release Foot Switch	Foot Switch Closed	Machine was turned on with the Foot Switch depressed or there is a short in the Foot Switch. Contact LaserStar Service
Aiming Beam Alarm	Aiming Beam Alarm	Close Laser Shutter, Press Home Key at least 2 times to reset. If alarm still active, cycle power, if still active contact LaserStar Service.
Back Reflection	High Back Reflection Level	Press Home Key at least 2 times to reset. Slightly angle the part being welded. If problem persists, contact LaserStar Service.
Command Overflow	Command Buffer Overflow	Press Home Key at least 2 times to reset. If alarm still active, cycle power, if still active contact LaserStar Service.
Critical Error	-	Contact LaserStar Service
Duty Cycle High	Duty Cycle Too High	Press Home Key at least 2 times to reset. Set the Laser power to mid-range and fire laser. If alarm still active, cycle power, if still active contact LaserStar Service.
Fiber Interlock	Fiber Interlock Active	Verify laser engine output fiber is fully seated in collimator and locked into place. Press Home Key at least 2 times to reset. If alarm still active, cycle

		power, if still active contact LaserStar Service.
Ground Leakage	GND Leakage	Press Home Key at least 2 times to reset. If alarm still active, cycle power, if still active contact LaserStar Service.
High Avg Power	High Average Power	Press Home Key at least 2 times to reset. Reduce hertz rate and retest. If alarm still active, cycle power, if still active contact LaserStar Service.
PS Failure	Power Supply Failure	Verify Key Switch is on, Press Home Key at least 2 times to reset. If alarm still active, cycle power, if still active contact LaserStar Service.
PS Out Of Range	Power Supply Out Of Range	Verify Key Switch is on, Press Home Key at least 2 times to reset. If alarm still active, cycle power, if still active contact LaserStar Service.
Pulse Energy High	High Pulse Energy	Press Home Key at least 2 times to reset. Reduce pulse energy and retest. If alarm still active, cycle power, if still active contact LaserStar Service.
Pulse Too Long	Pulse Too Long	Press Home Key at least 2 times to reset. Decrease pulse width and retest. Verify Foot pedal is functioning correctly. For external activation, verify signal pulse length within specification. If alarm still active, cycle power, if still active contact LaserStar Service.
Pulse Too Short	Pulse Too Short	Press Home Key at least 2 times to reset. Increase pulse width and retest. Verify Foot Switch / FootPedal is functioning correctly. For external activation, verify signal pulse length within specification. If alarm still active, cycle power, if still active contact LaserStar Service.
Temp Low	Low Temperature	Laser system temperature too low. Ensure room temperature within specification. Press Home Key at least 2 times to reset. If alarm still active, cycle power, if still active contact LaserStar Service.
Overheat	Overheat	Laser system temperature too high. Ensure room temperature within specification. Press Home Key at least 2 times to reset. If alarm still active, cycle power, if still active contact LaserStar Service.

(*)-Contact LaserStar Service if system / fault / error message cannot be cleared.

Note: Messages may not be in all models.

VII. Parts and Accessories

Description	Catalog Number
Air Filter Kit	611-101
Alignment Paper	00-10020
BDO / Collimator	405-3780-060
Beam Expander-3X	121-00-1308
Control Board, FiberStar 7600	121-30-2008
Filter, Air, 5.25" x 5.25" (Chamber)	01-64004
Filter, Air 26 3/4" x 20 3/4" x 1/2" (Side Panel)	11-64004
Focus Lens Protective Disk	01-10112
Foot Switch Assembly	111-30-0003
Fuse 15A 250VAC 3AB FAST Ceramic	405-4320-115
Fuse 1A 250VAC SB 5x20	405-4320-001
Laser Source / 150W	113-30-0151
Laser Source / 300W	113-30-0303
Laser Protective Eye Wear	444-004
Protective Laser Eye Wear: Diffuse	444-001
Laser Source / 150W	405-3772-151
LED Lamp	405-2460-800
Memory Backup Battery	405-3900-001
Operation & Maintenance Manual	31-99990-760-2
Power Cord-250VAC 14/3 AWG	116-36-6509
Power Monitor Kit	621-702-7600
Power Supply Assembly / 12VDC / 1.66A	127-30-0166
Power Supply / 24VDC / 6.3A	405-4000-2463
Power Supply / 48VDC / 32A	405-4048-032
Protective Window, Plexi-Glass	11-10071
Rabbit Core Module	621-510
Regulator Kit (Inert Gas)	601-099
Remote Interlock Shorting Cap	101-36-0036
Trouble Shooting Connector Kit	121-36-0006
Vane Bumper	01-10088
Vane Bumper Kit	601-088
Window, View, US, 100x200	01-10069
Window, Protective Plexi-glass	01-10071

VIII. WARRANTY ORIGINAL EQUIPMENT

LaserStar Technologies Corporation (“LaserStar”) warrants for a period of one (1) year, (2) years, or (3) years, depending on your purchase, from the date of invoice that equipment will be free from defects in materials and workmanship as determined at the date of shipment. Please reference the equipment purchase invoice for warranty period details.

A) **Limited Warranty** - After notifying LaserStar’s service department of a problem, at our option we will:

1. Immediately send a replacement part; or
2. Request defective part or complete machine be returned to LaserStar’s Service Department for our inspection and repair or replacement; or
3. Schedule a Service Technician to inspect and repair or replace defective part at buyer’s facility.

B) **Not Covered Under Warranty**

1. This warranty does not cover any damage, misuse, or abuse to any and all optical components (lens, mirrors, glass, crystal, etc.) associated with the laser system.
2. This warranty does not cover any damage, misuse, or abuse to any and all computer hardware.
3. This warranty does not cover consumable parts (flashlamp, protective disk, flash lamp connectors, water filters, air filters, De-ionized water & filters, cuffs, fuses, halogen lamps, LED lamps, F-Theta Lens,).

The machinery warranty applies to all products when used in a normal industrial environment. Any unauthorized use, misuse, neglect, modification, or use with non-LaserStar approved or authorized accessories will make these warranties null and void. Under no circumstance will LaserStar have any liability for loss of use or for any indirect or consequential damages. Satisfaction of this warranty, consistent with other provisions herein, will be limited to the replacement or repair or modification of, or issuance of a credit for the equipment involved, at LaserStar’s option, with LaserStar to determine the availability of service personnel and any absorption of associated service expenses, such warranty satisfaction available only if (a) LaserStar is promptly notified in writing upon discovery of an alleged defect and (b) LaserStar’s examination of the subject: product discloses, to its satisfaction, that any defect has not been caused by misuse, neglect, improper installation by purchaser, improper operation, improper maintenance, repair or alteration, accident, or unusual deterioration or degradation of the equipment or parts thereof due to physical environment or due to electrical or electromagnetic noise environment.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES WHETHER EXPRESSED, IMPLIED OR STATUTORY INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE and therefore excludes certifications or the like for equipment performance, use or design with respect to any standard, regulation or the like (unless and to the extent independently approved in writing at LaserStar Technologies Corporation headquarters) AND EXTENDS ONLY TO BUYER OR CUSTOMER PURCHASING DIRECTLY FROM LASERSTAR FROM AN AUTHORIZED RESELLER.

Return of Equipment to Authorized LaserStar Facility

Authority for return of equipment for repair, whether under the Warranty Clause or otherwise, must be obtained from LaserStar®. Such authority shall be granted for each reasonable request. Unless such authority has been granted, shipment will be refused. Any and all transportation expenses associated with the evaluation or repair of LaserStar's laser machines is the sole expense of the Buyer. Authority for return of equipment for repair MUST have a RMA or CRA number assigned and clearly marked on the exterior of the container.

Governing Law

The sale and purchase of the equipment, including all terms and conditions thereof, shall be governed by the Uniform Commercial Code and laws of the State of Rhode Island.

Limited Liability

IN NO EVENT WILL LASERSTAR ASSUME RESPONSIBILITY FOR OR BE LIABLE FOR (A) PENALTIES OF PENALTY CLAUSES OF ANY DESCRIPTION, OR (B) FOR CERTIFICATIONS NOT OTHERWISE SPECIFICALLY PROVIDED HEREIN AND/OR FOR INDEMNIFICATION OF BUYER OR OTHERS FOR COSTS, DAMAGES OR EXPENSES, EACH ARISING OUT OF OR RELATED TO THE EQUIPMENT OR SERVICES OF THIS ORDER, OR C) FOR INDIRECT OR CONSEQUENTIAL DAMAGES UNDER ANY CIRCUMSTANCES.

This warranty does not cover defects or damages resulting from accidents while in transit, alterations, unauthorized repairs, failure to follow proper safety and operating instructions, misuse, fire, flood, freezing temperatures, and acts of God.

Authorized Equipment Repair Offices:

LaserStar Technologies Corporation
1 Industrial Court, Riverside, Rhode Island 02915 USA
Tel: 401-438-1500

LaserStar Technologies Corporation
2453 Orlando Central Parkway, Orlando, Florida 32809
Tel: 407-248-1142

IX. SERVICE

(Note: Reference safety rules described in the Maintenance Section of this manual.)



Warning!

Service activities may be performed by service technicians from LaserStar® Technologies Corporation; properly trained personnel; personnel supervised by trained personnel (in person or by phone); or by personnel who have read & understand the service directions in the Operation & Maintenance Manual.



Warning!

During service activities with an opened device, OSHA regulations about accident prevention for laser radiation or equivalent national or international regulations (e.g. EC Directive 608 or IEC Publication 825) absolutely must be followed!

Wear proper protective laser eye wear



Warning!

During some of the service activities / tests (Tri-Door Chamber, DI Water, etc.) the Mains AC Power and Key Switch will need to be on for part of the test. **Extreme care must be taken when observing the state of internal led indicators, topping off the DI Water Bottle, purging air from the cooling system. Do not touch any electronic component or wire with the Mains AC Power on (Unplug the machine or switch off the circuit breaker and wait 5 minutes before servicing.)**

LaserStar Technologies is not responsible for machine damage caused by personnel that have not been properly trained or supervised.

In case of any malfunction of the product that cannot be eliminated by one of the actions described in the sections MAINTENANCE, TROUBLESHOOTING, and SERVICE, please document your results from and E-mail this information to service@laserstar.net. Make sure you include the machines model number and serial number with all correspondence. Please then follow up the E-mail with telephone call to Service.

LaserStar® Technologies Corporation

One Industrial Court
Riverside, Rhode Island 02915 USA
Tel: 401-438-1500
E-mail: service@laserstar.net

Service A: Fuse Replacement, Rear System Description & Connections

Rear System Description & Connections (Figure 1, 2 & 3)

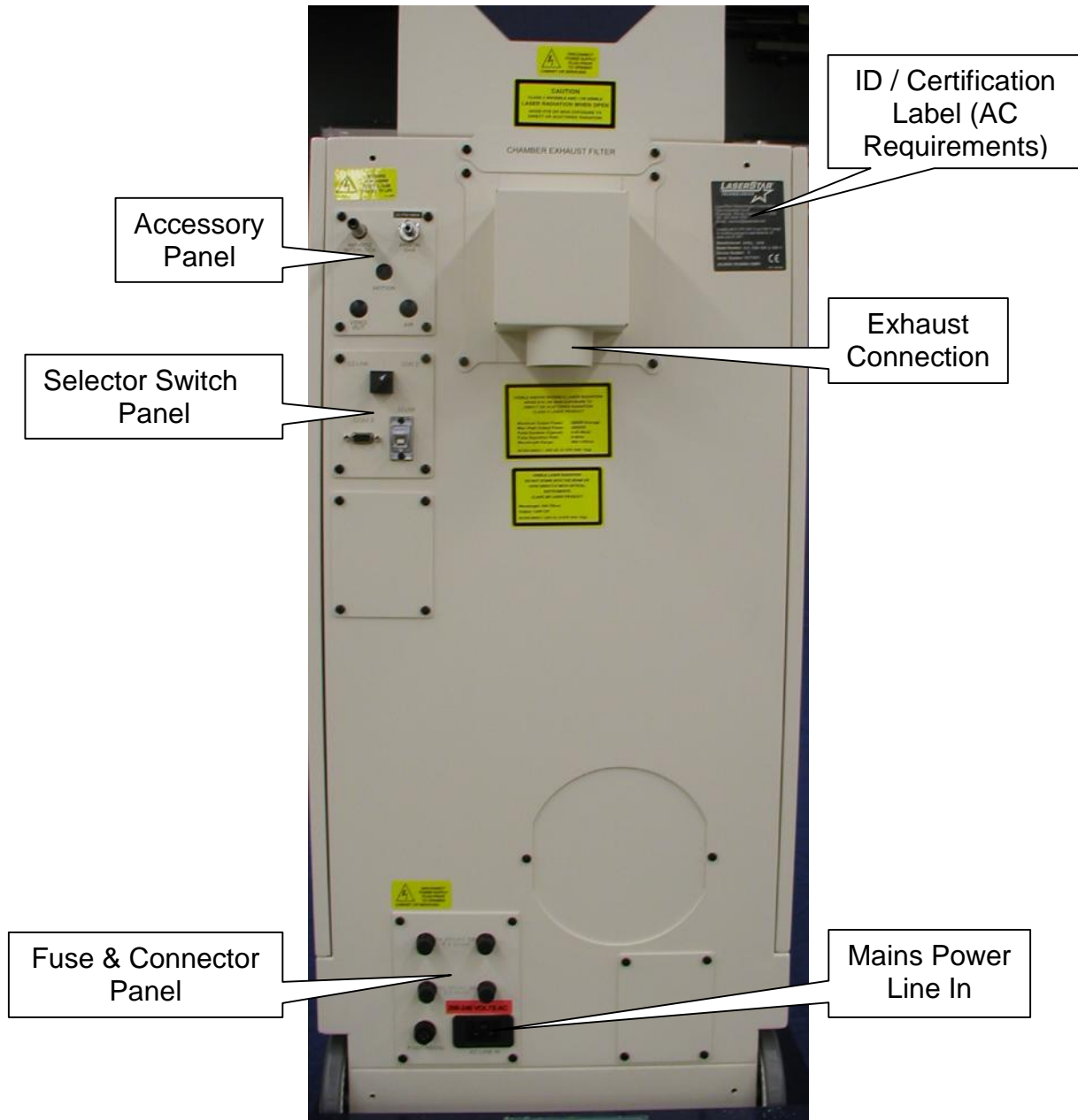


Figure 1
(Rear System Description)

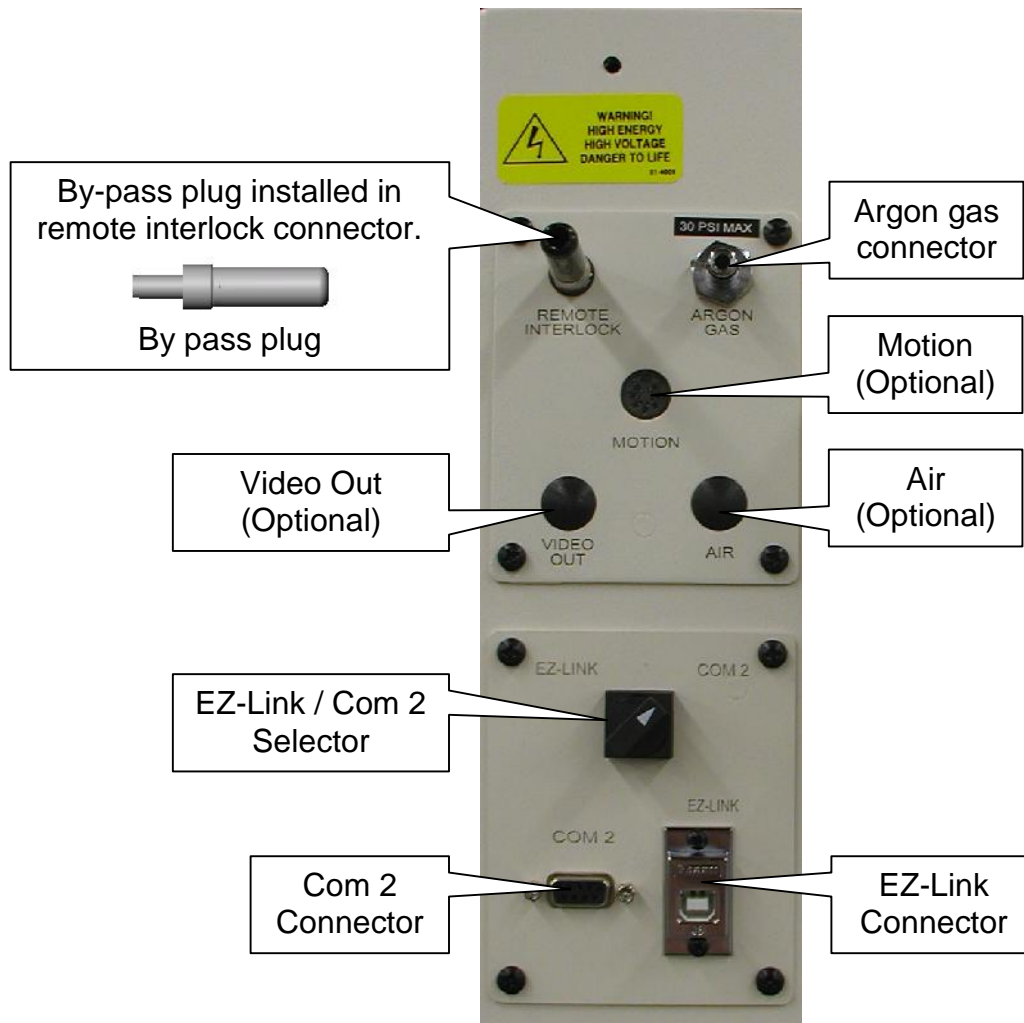


Figure 2
(Accessory & Selector Switch Panels)

Fuse Replacement & Foot Pedal Connection (Figure 3 and Table 1)

Fuse Replacement Procedure

1. To check or replace any fuse, shut off key switch and mains power switch.
2. **Remove AC power cord from the source power and from the product.**
3. Remove foot pedal cable
4. Remove external fuses and check or replace as needed (**Figure 2**)
5. Check and replace as needed
6. Replace the right side panel
7. Connect AC power cord and foot pedal cable to the machine
8. Connect AC cord to power source.

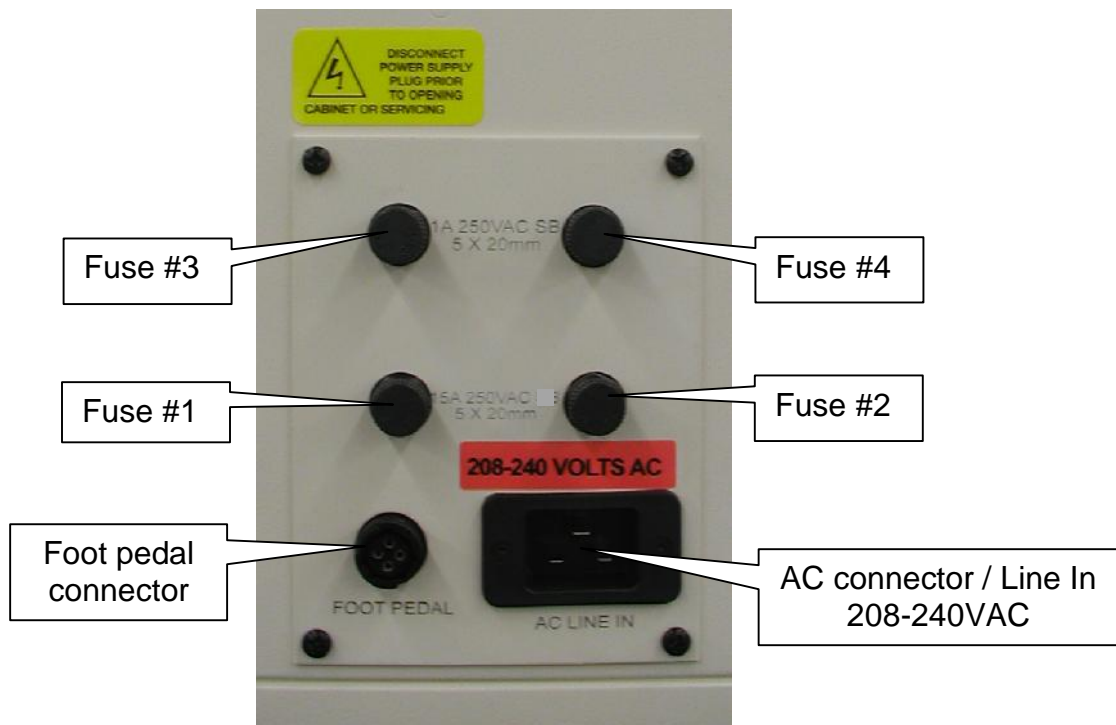


Figure 3
(Fuses and Connector Panel)

Fuse #	LaserStar Part No.	Specification	Use
1 & 2	405-4320-115	15A 250VAC 3AB FAST Ceramic	48VDC & 24VDC Power Supplies, etc.
3 & 4	405-4320-001	1A 250VAC SB 5x20	Exhaust Fan

Table 1
(Fuses)

Service B: Major Internal System Components

Control System (Right Side / Remove Panel)

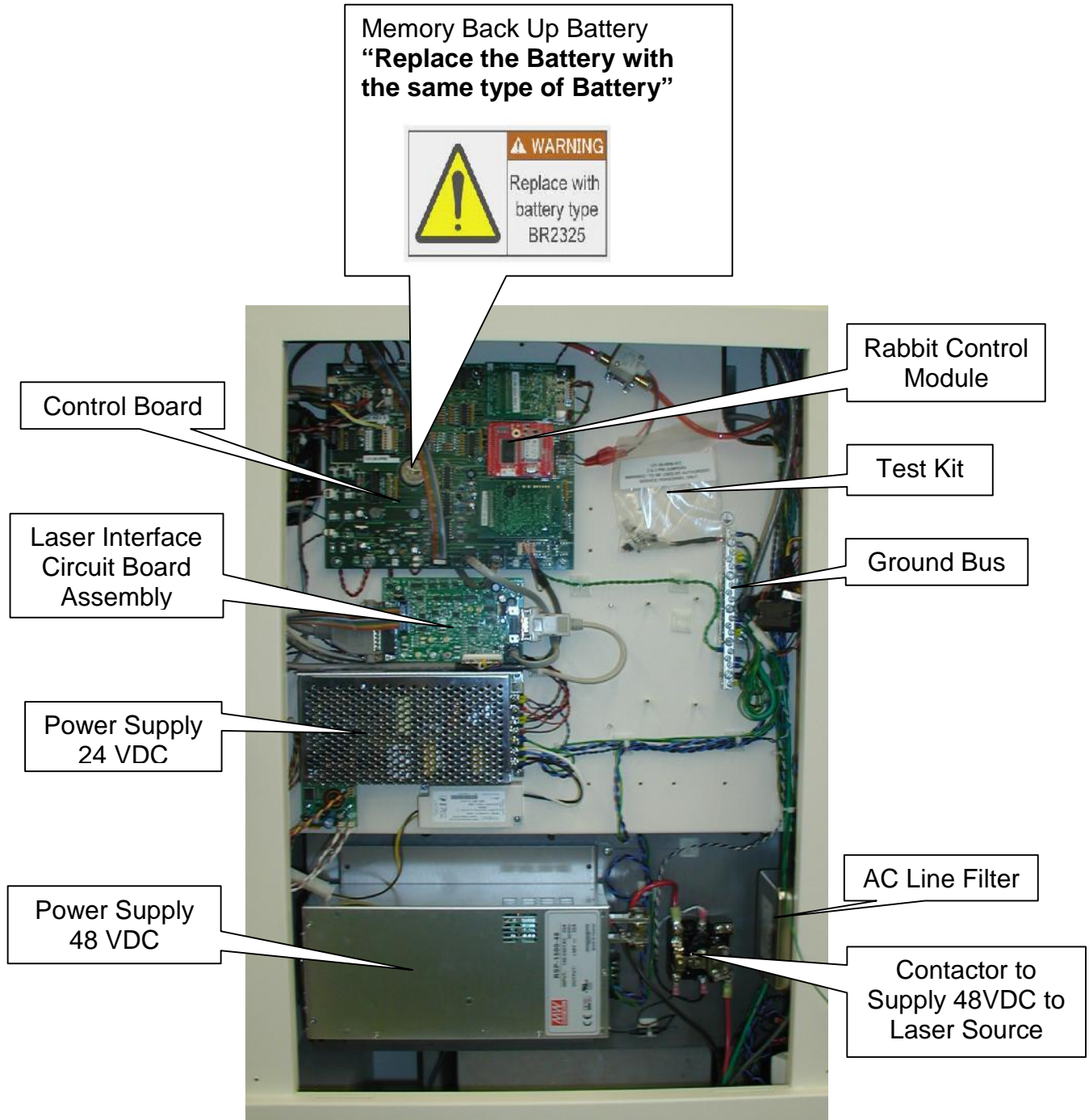


Figure 1
(Control System)

Laser Source (Left Side / Remove Panel)

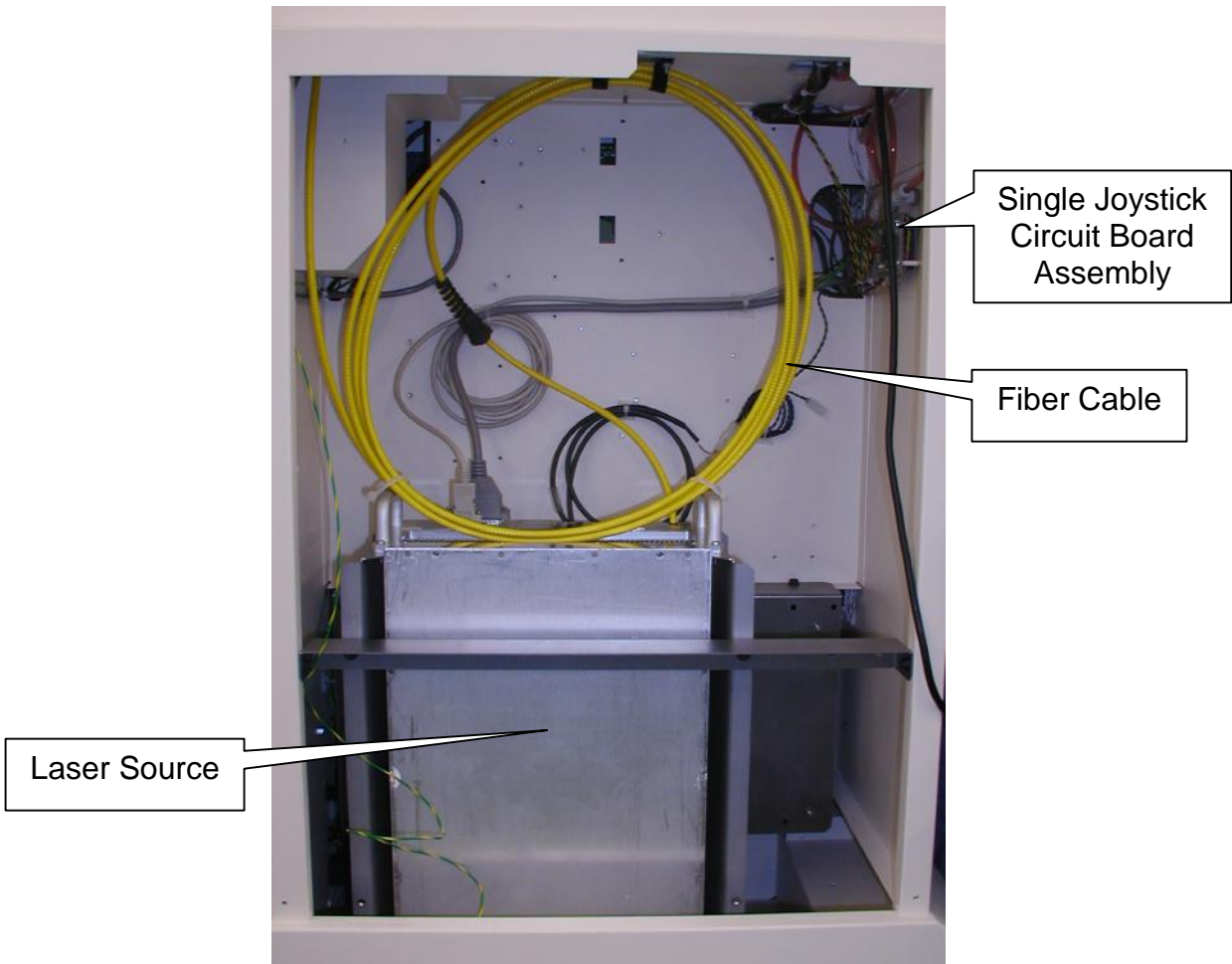
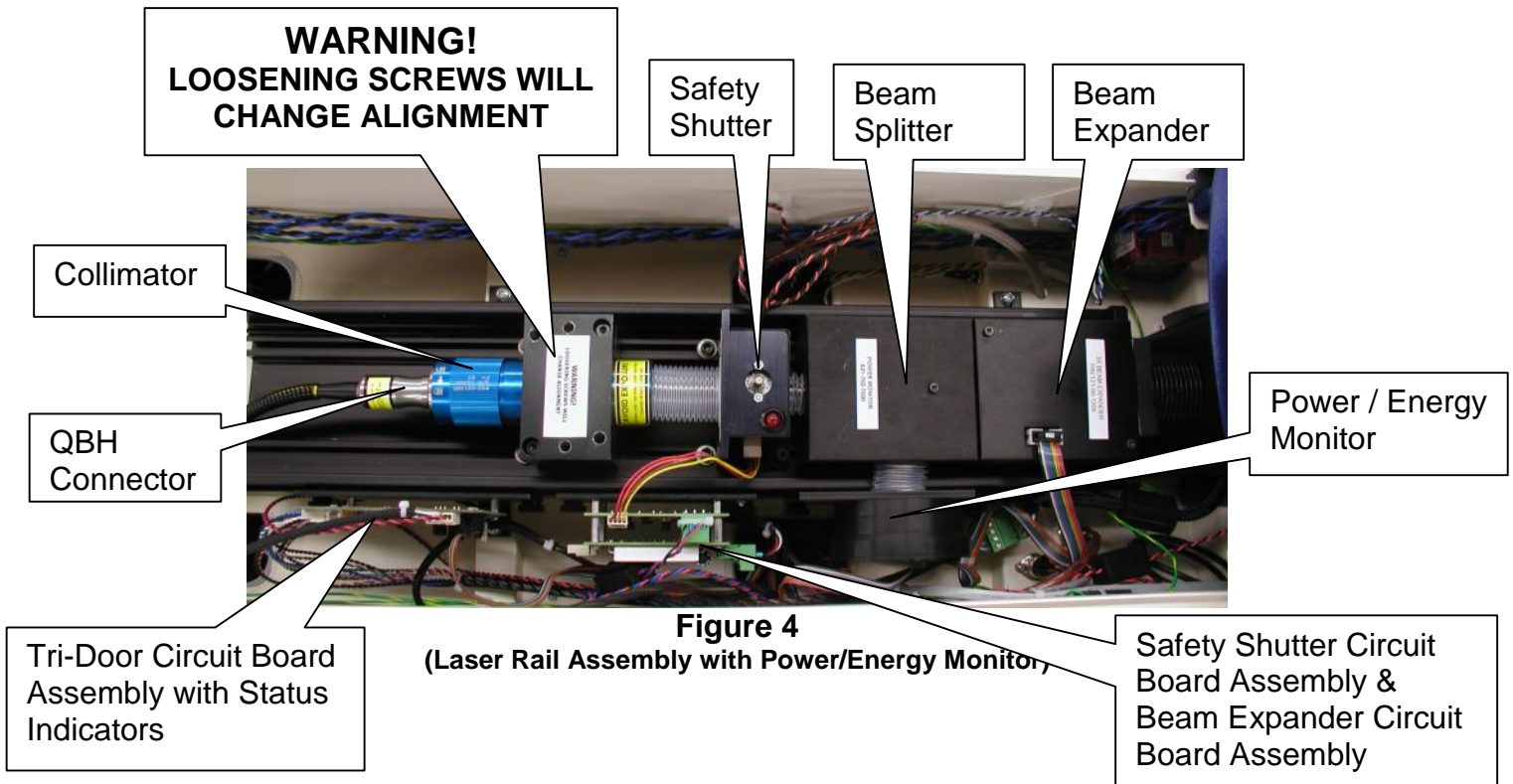
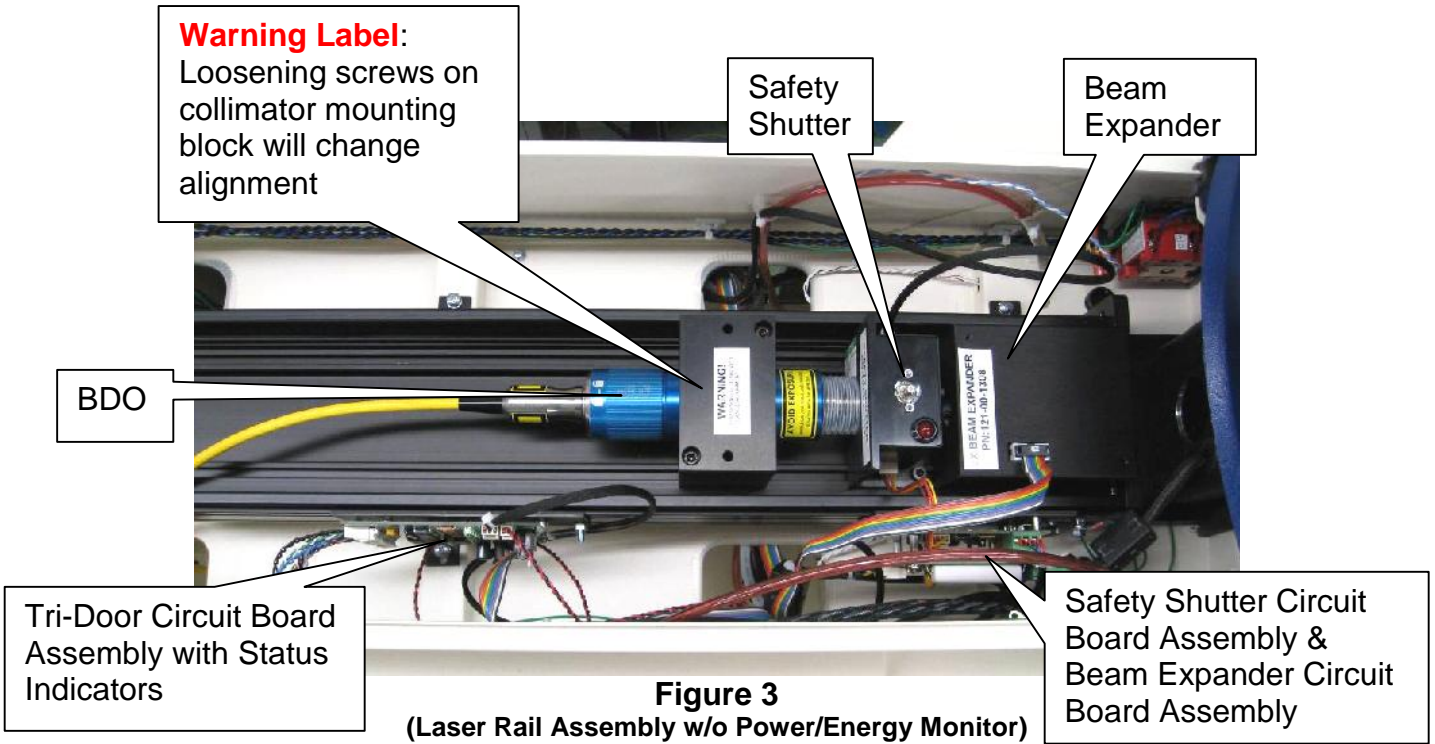


Figure 2
(Laser Source)

Laser Rail Assembly (Top / Remove Top Cover)



Service C: Control Board Memory Battery Replacement (Figure 1-2)

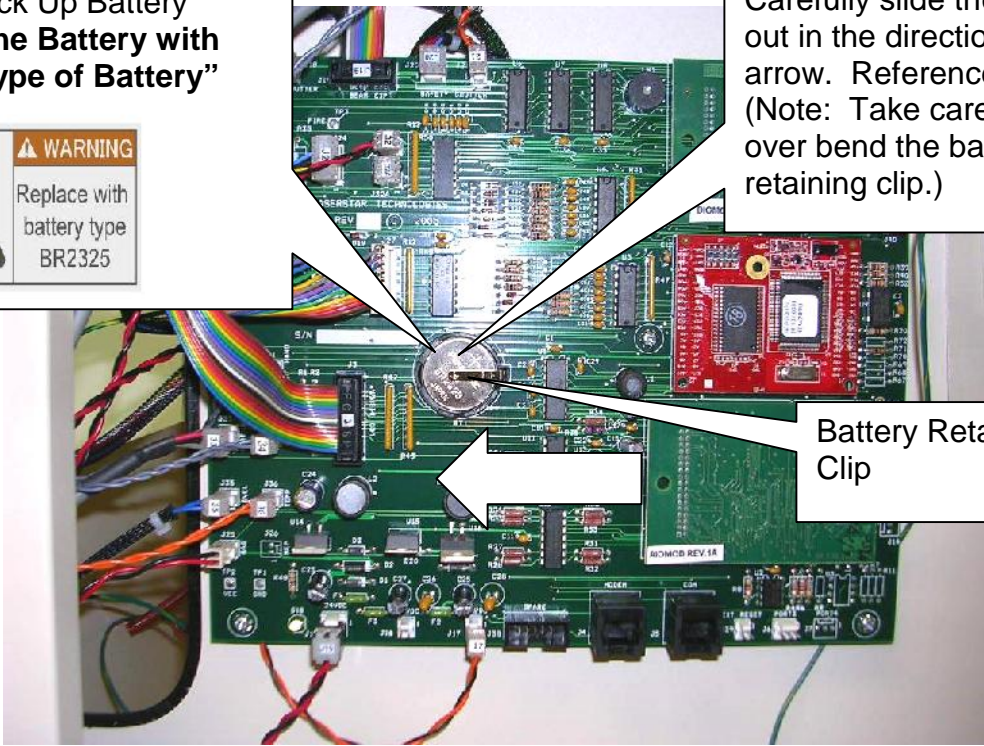
The control board has a battery that provides power to the memory when the machine is turned off. When this battery fails, the display panel will have the following message “Warning Battery Dead”. A replacement battery can be purchased from LaserStar Technologies Corporation. The LaserStar part number is 405-3900-001. (Note: A replacement battery may be purchased at a reputable retailer. Make sure the battery is the same battery.)

1. Make sure the laser is “Off”, turn the Key-switch to “O”/Off, turn Mains Power switch to "O"/Off.
2. Make sure the AC power is “Off”-Pull out the mains plug or shut off the wall disconnect switch.
3. Remove the right side panel and disconnect the ground wire on the panel (Note: When removing the ground wire pull on the clip not on the wire.)
4. **Figure 1** shows the location of the battery. Make sure you read all the notes/instructions on **Figure 1**.
5. **Figure 2** shows the battery removal and replacement process. Make sure you read all the notes/instructions on **Figure 2**.
6. After installing the battery replace the right side panel and make sure the ground wire is connected.
7. Start the machine. The “Warning Battery Dead” message will come up in the display. The next time you start the machine you should not see this message.

Memory Back Up Battery
"Replace the Battery with
the same type of Battery"



Carefully slide the battery out in the direction of the arrow. Reference **Figure 2** (Note: Take care not to over bend the battery retaining clip.)



Battery Retaining Clip

Figure 1
(Control Board with Battery)

Battery removal or replacement method

Make sure the battery retaining clip is securely contacting the battery.

Make sure the (+) side of the battery is facing up.

Note: On machine start up for the first time after battery replacement the "Warning Battery Dead" will come up on more time.

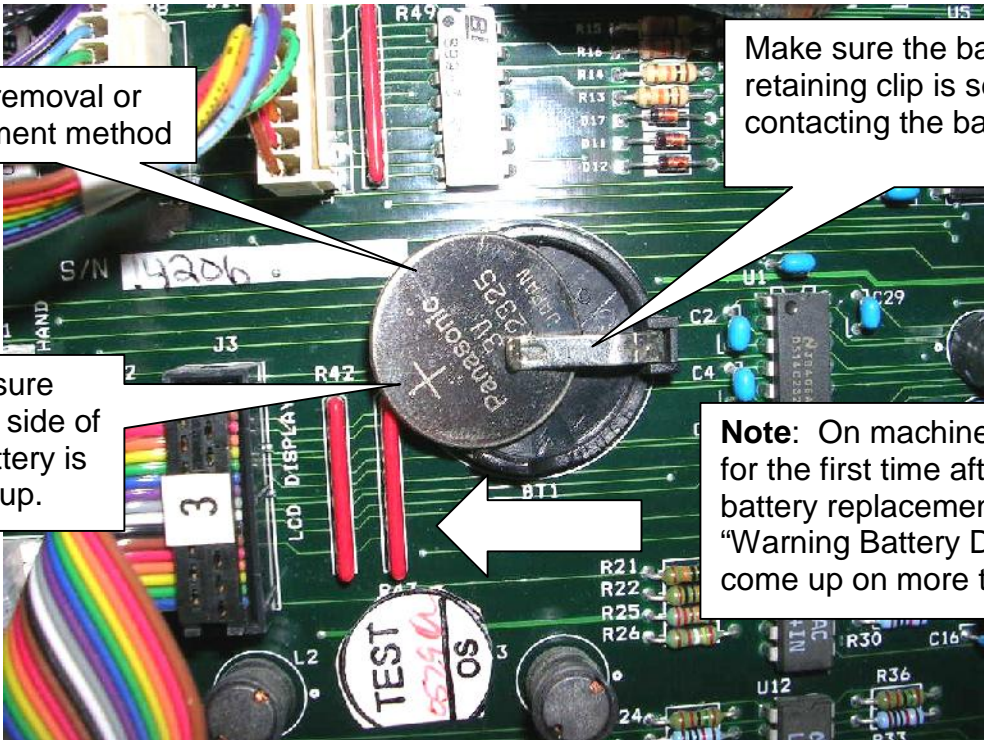


Figure 2
(Battery replacement)

Service D: Mechanical View Shutter Bumper Replacement (Model / Option Dependent)

- J Turn off the Mains Power, the Key Switch, and unplug the AC power cord or circuit breaker.
- J Remove the stereo microscope from the mounting bracket/ring by loosening the (2) screws with an M2 Allen wrench. **Figure 1**
- J Remove the stereo microscope mounting bracket/ring by removing the (2) M2.5 screws on the back side of the retaining ring. (**Note:** Do not remove the (3) screws labeled (1).) **Figure 2**
- J Remove the View Glass Retainer **Figure 3**
- J Remove the View Glass Window **Figure 4** (Note: Keep the window clean)
- J Remove the plastic plug **Figure 4 & 5**
- J Remove the bumper by first moving the view shutter vane to the middle- **Figure 6**
- J Lift the bumper out with a pair of tweezers. (Note: The bumper may be in two parts) **Figure 7 & 8**
- J Move the shutter vane back to the middle and install the new bumper. **Figure 9 & 10**
- J Install the plastic plug & the View Glass Window. **Figure 11**
- J Install the View Glass Retainer **Figure 12**
- J Install the stereo microscope mounting bracket (Note: Make sure the View Glass Retainer does not interfere with the bracket) **Figure 13**
- J Install the stereo microscope with the (2) set screws **Figure 14**
- J Plug in the machine & make sure the stereo microscope cross hairs are still aligned. **Figure 15** (Note: Refer to the “Optical Mounting and Alignment” section of the Operation & Maintenance Manual)

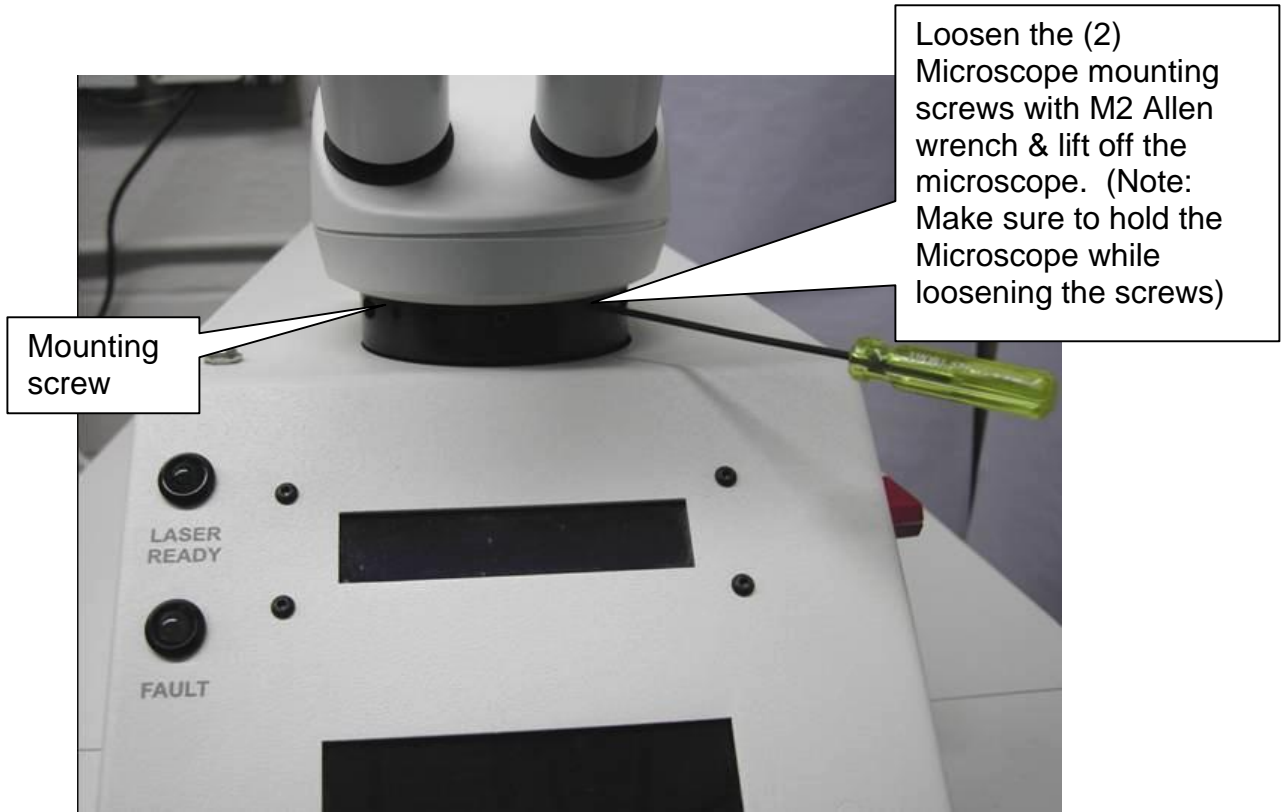


Figure 1

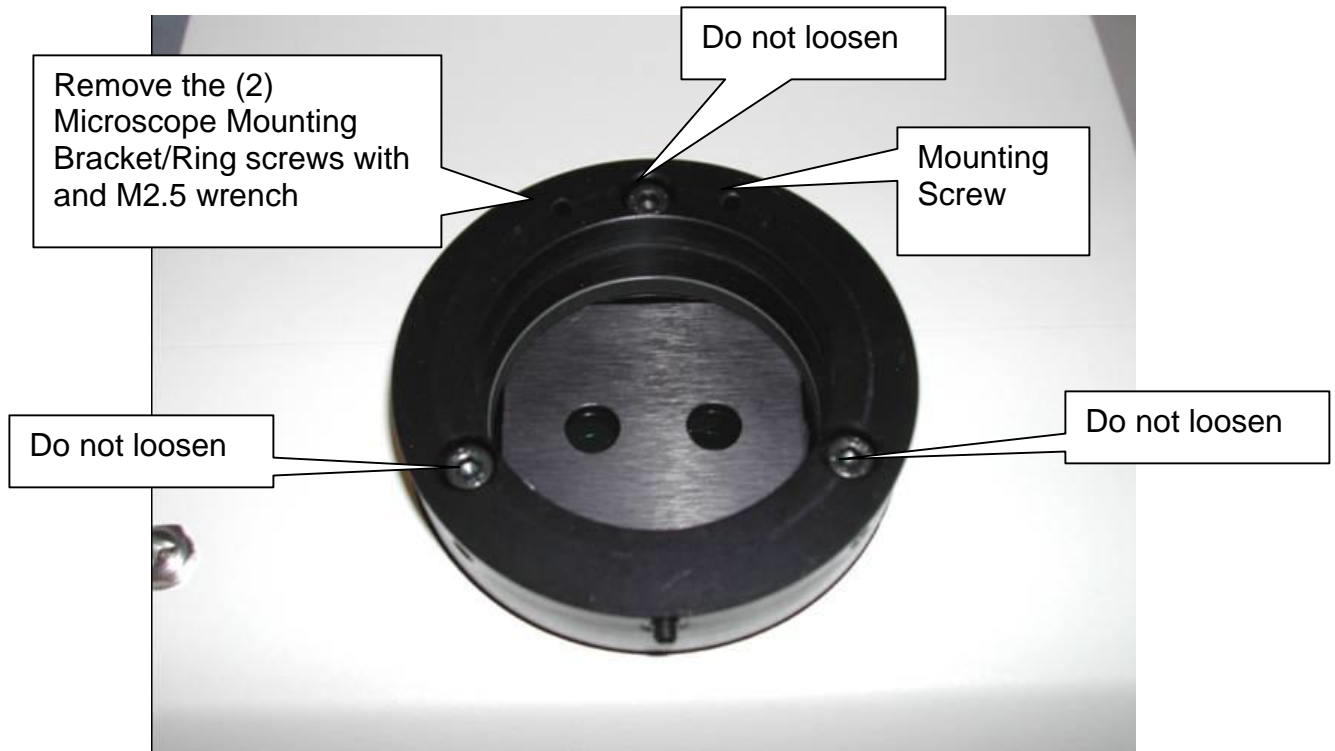


Figure 2

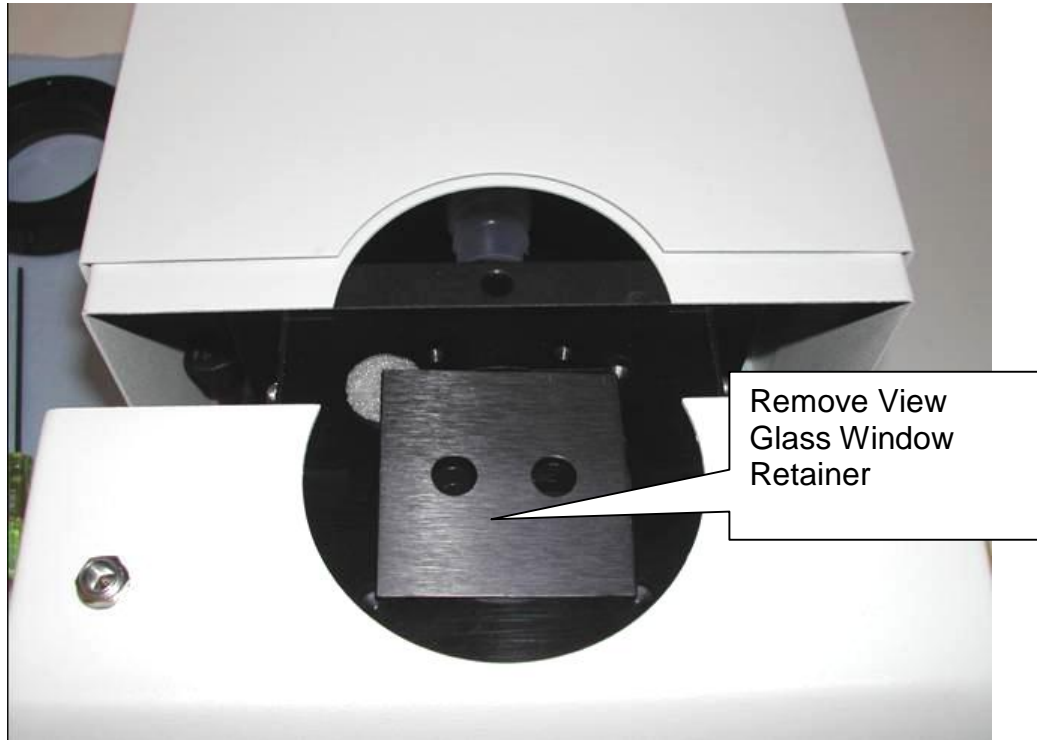


Figure 3

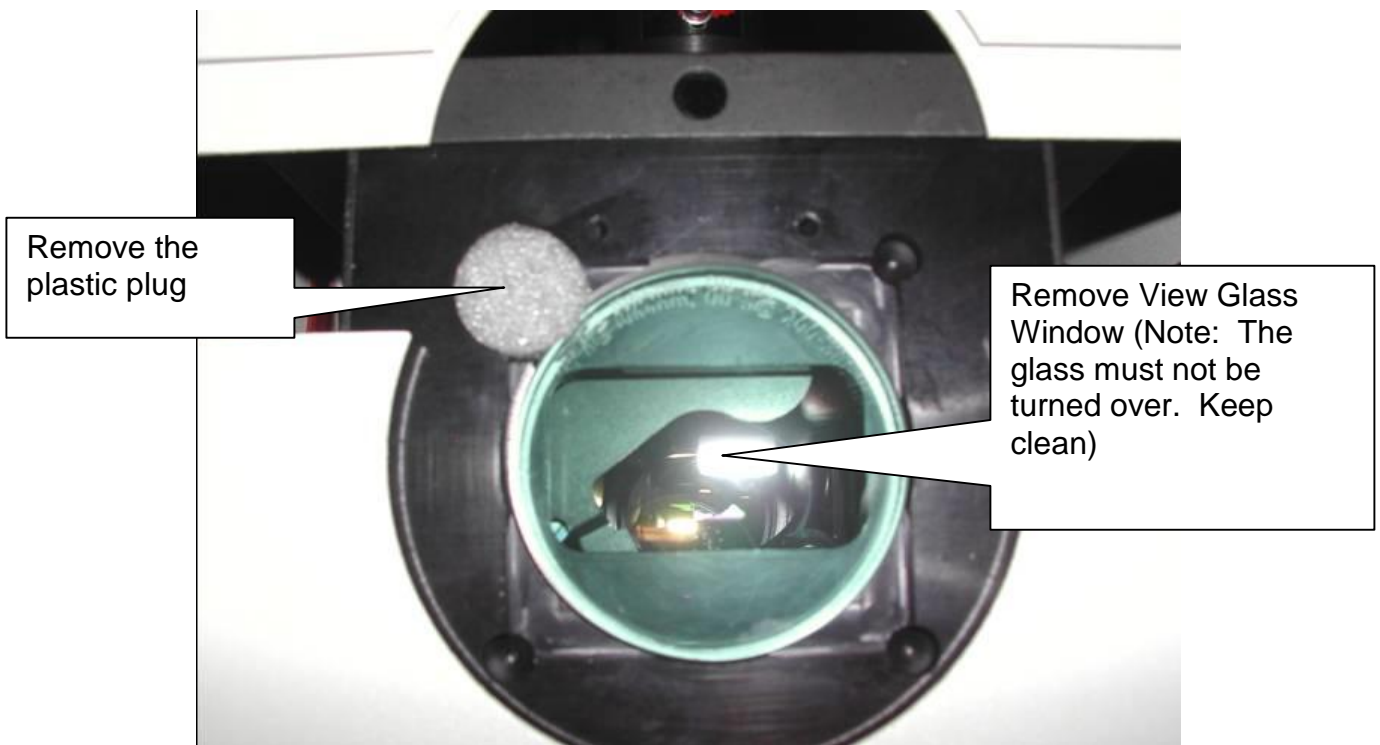


Figure 4

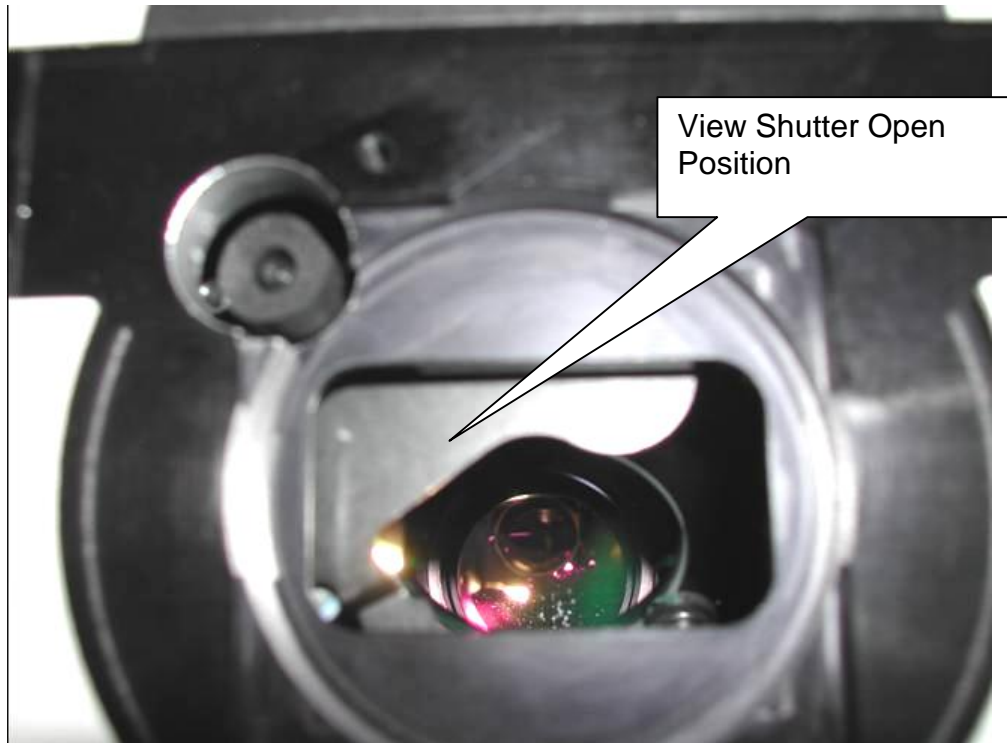


Figure 5

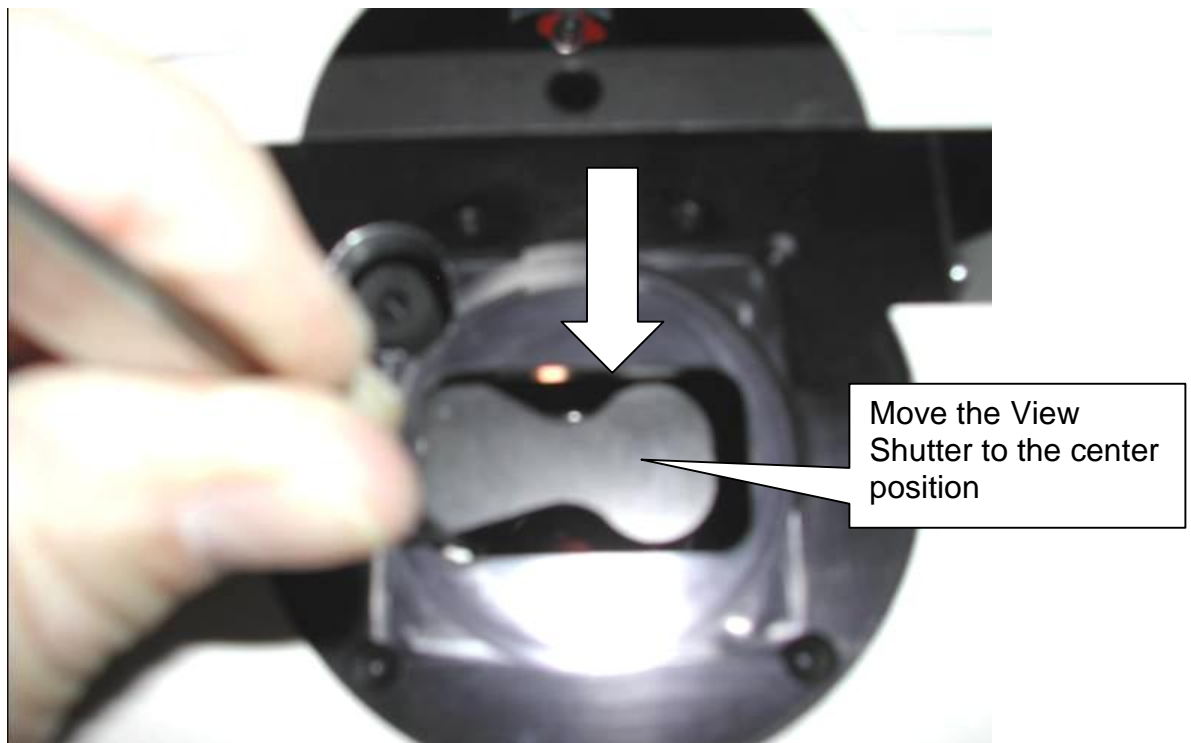


Figure 6

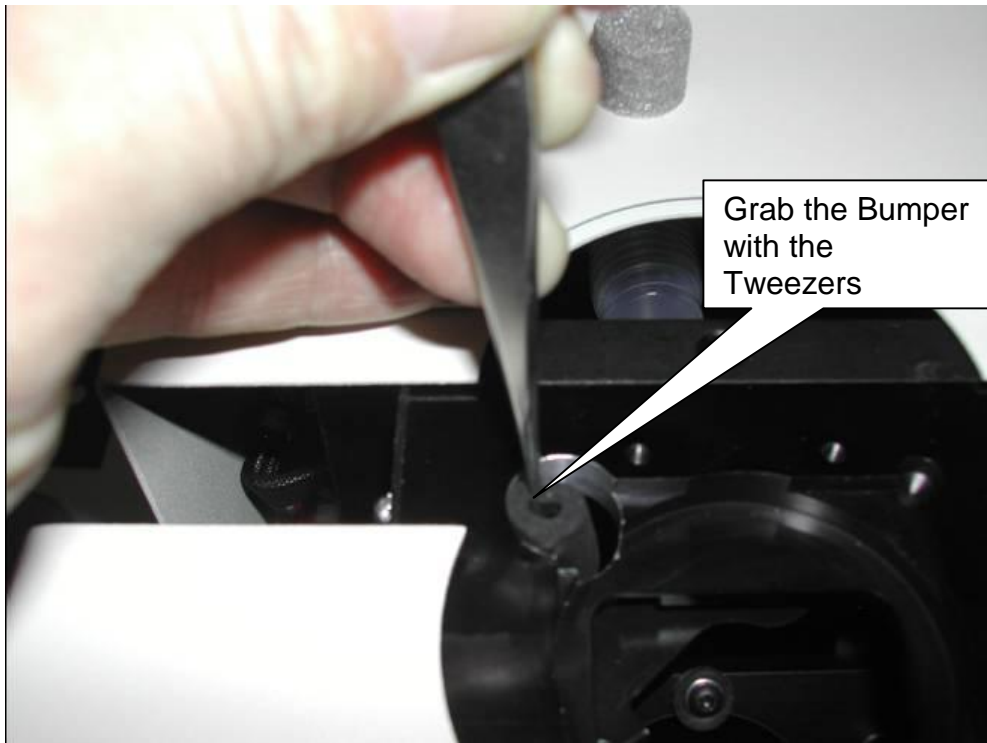


Figure 7

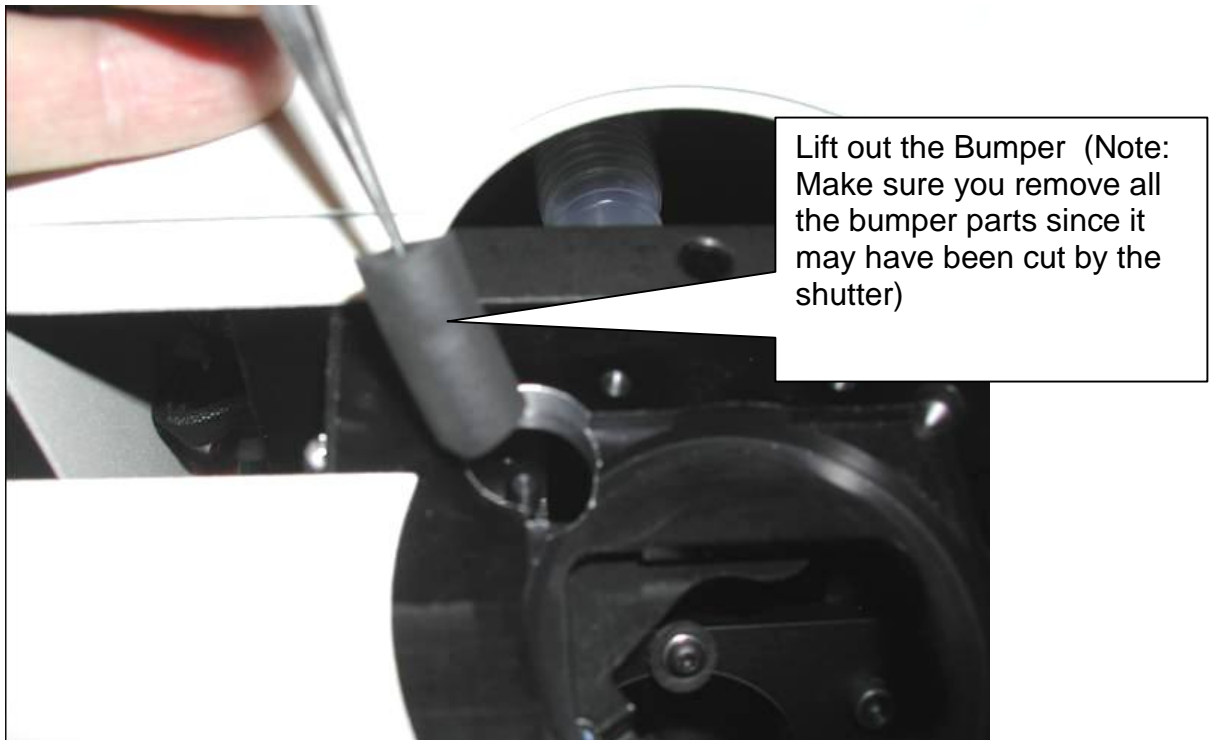


Figure 8

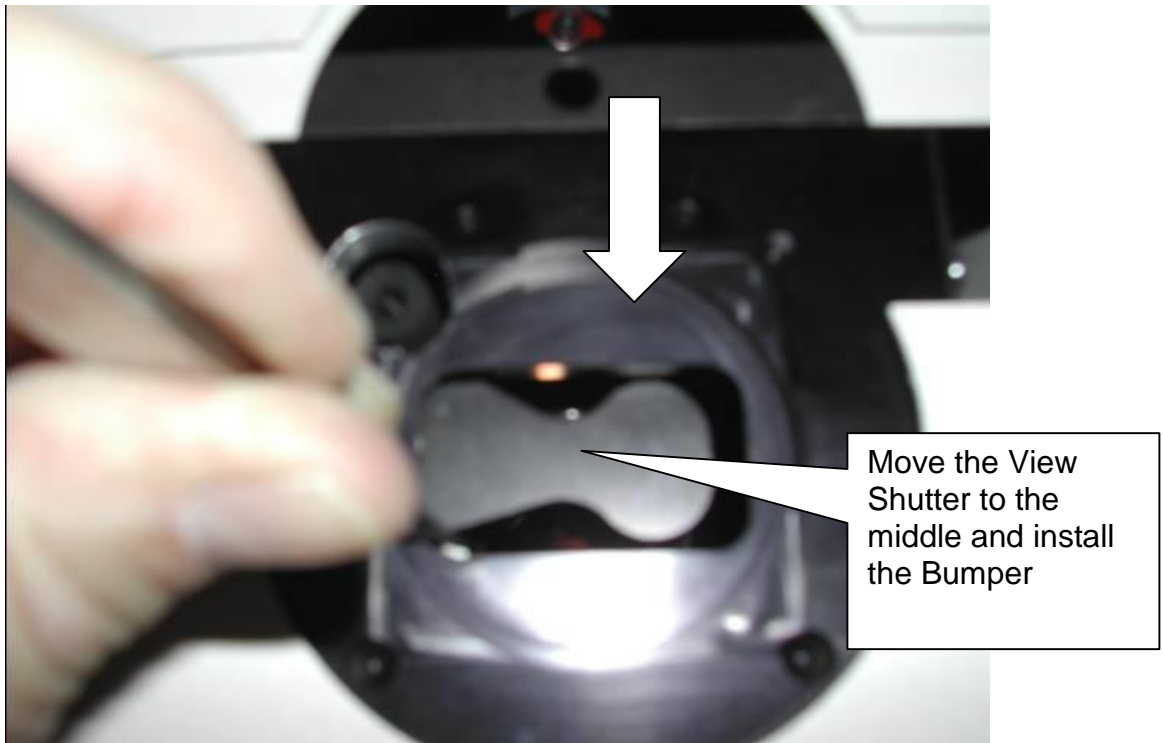


Figure 9

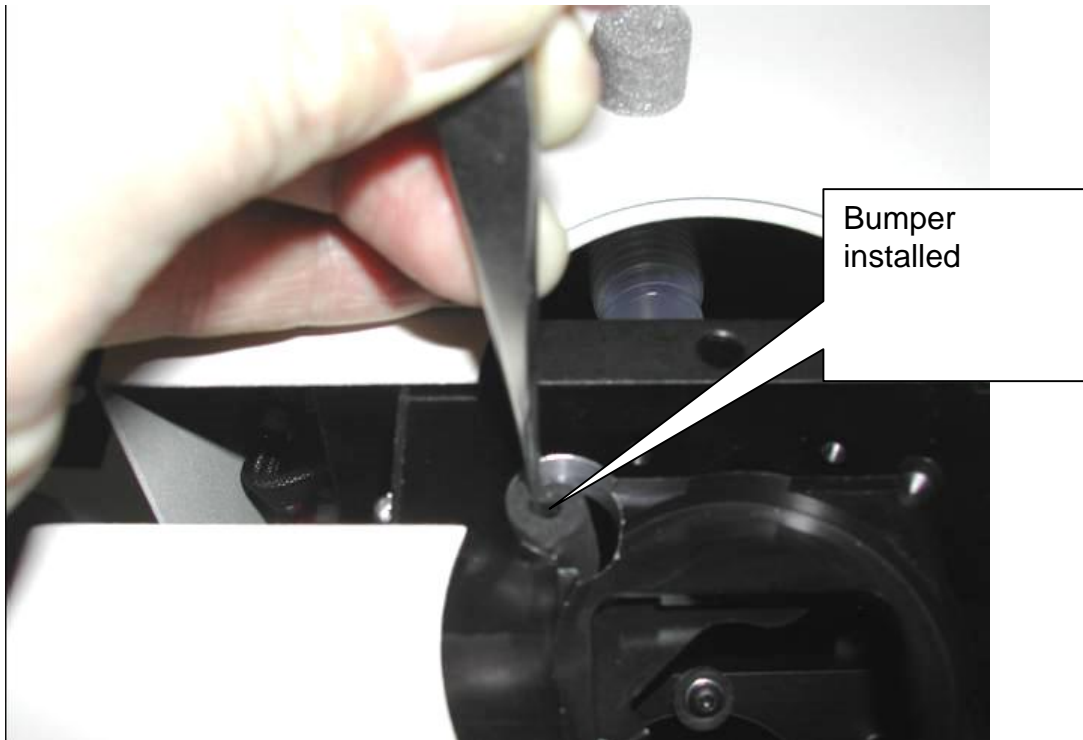


Figure 10

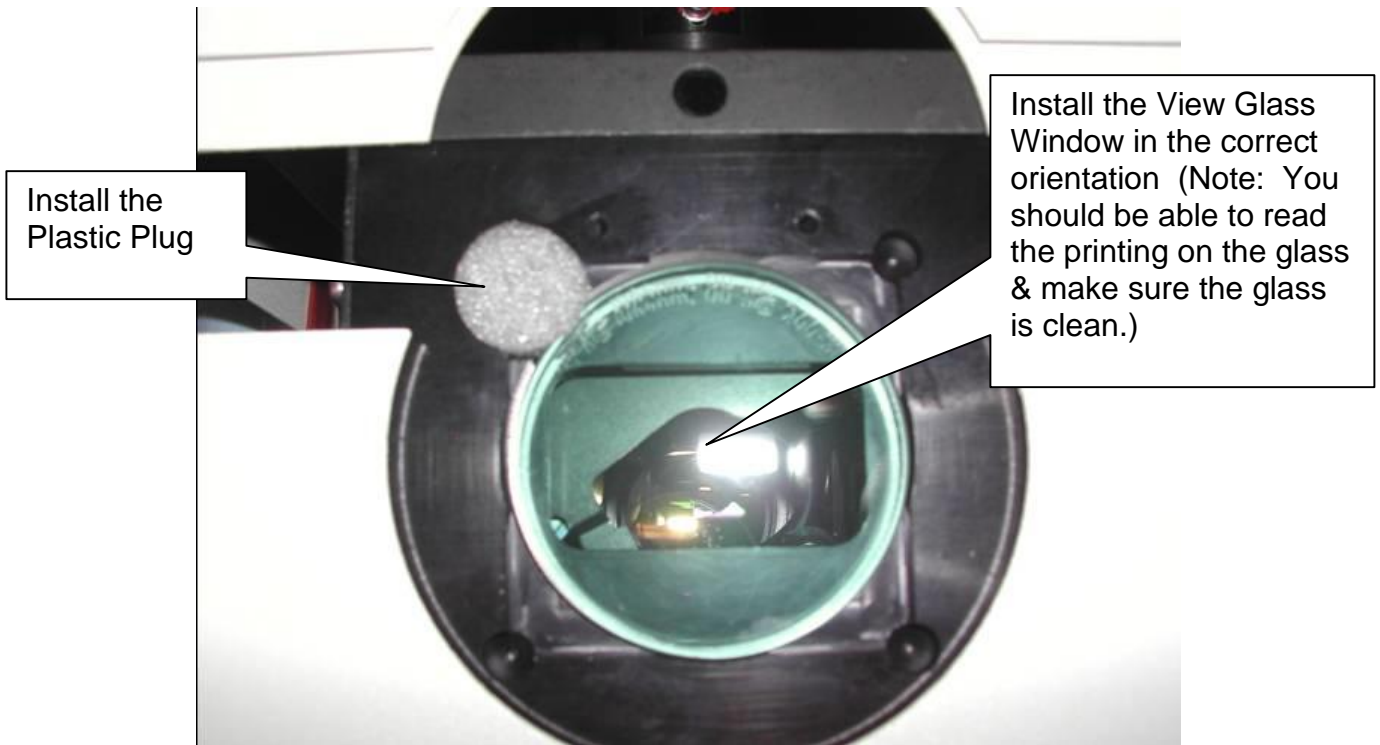


Figure 11

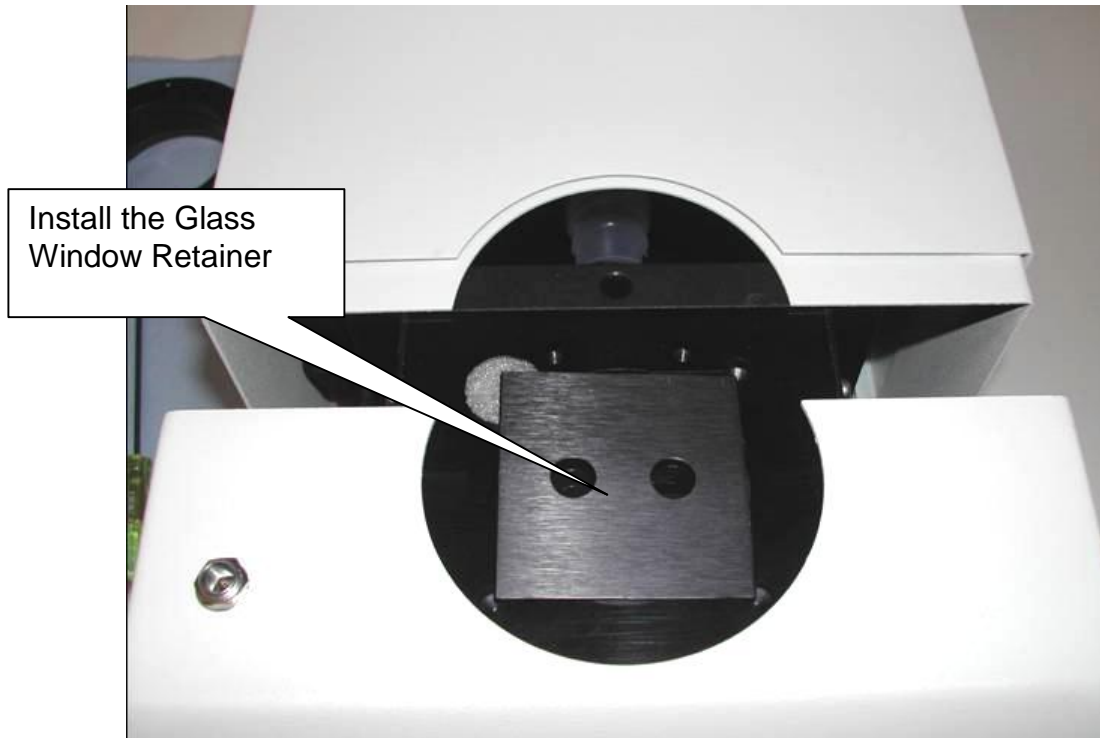


Figure 12

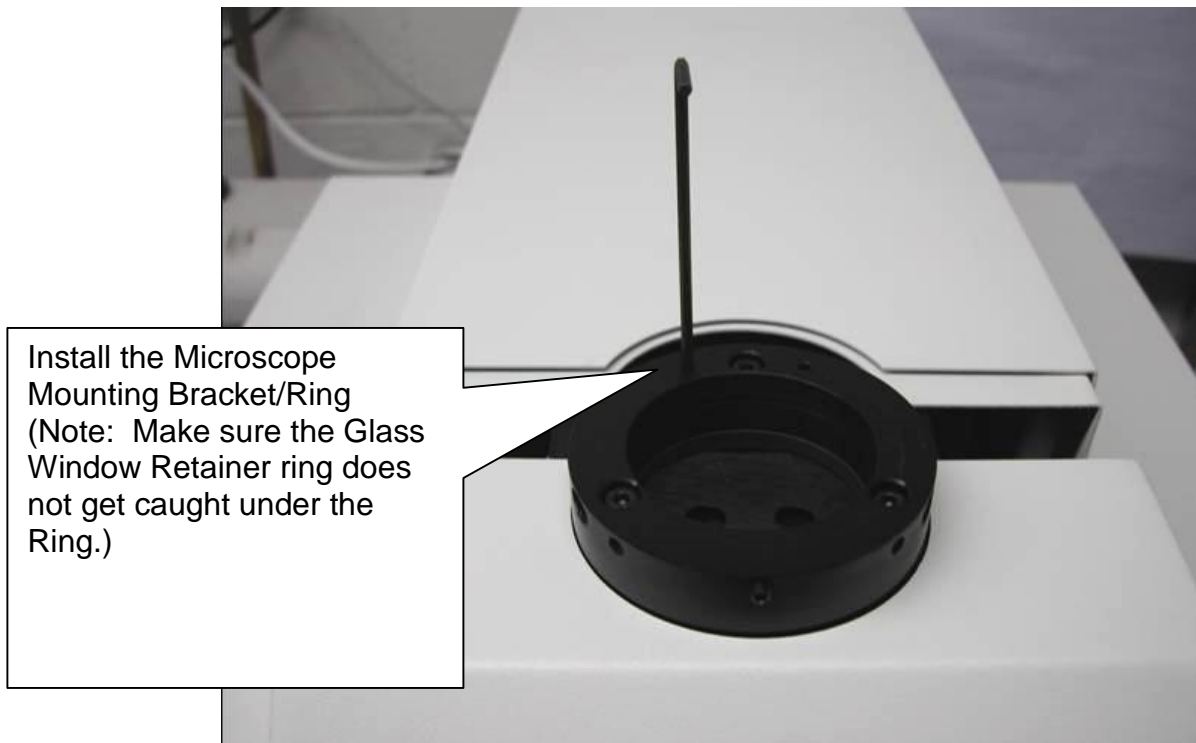


Figure 13

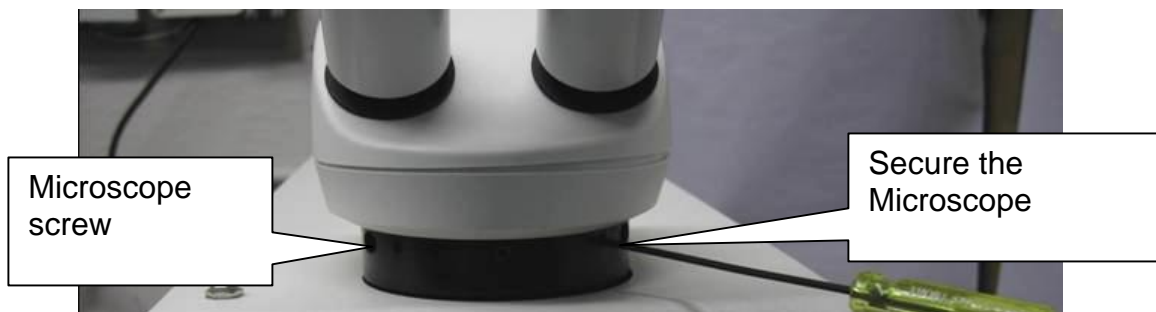


Figure 14

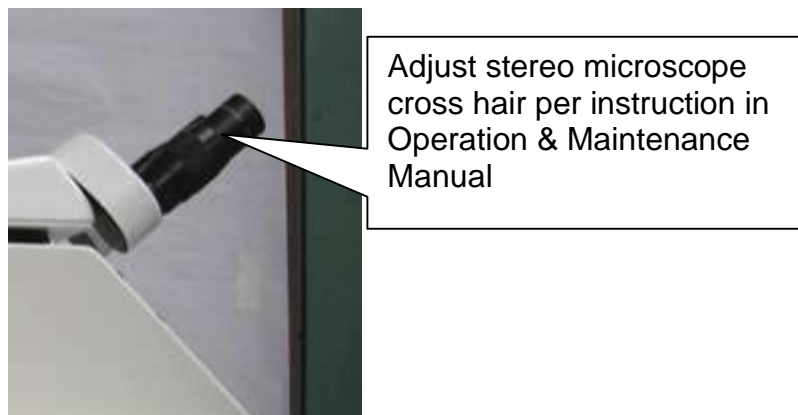


Figure 15

Service E: Chamber Door(s) Interlock Sensors

The following figures can be used to trouble shoot the sensors in the chamber doors. If the middle line of Digital Messaging Touch Screen Display displays-Left Door Open, Right Door Open or Front Door Open the welder will not fire. If the doors appear to be closed proceed to **Figure 4 & Table 1** to troubleshoot cause of failure.

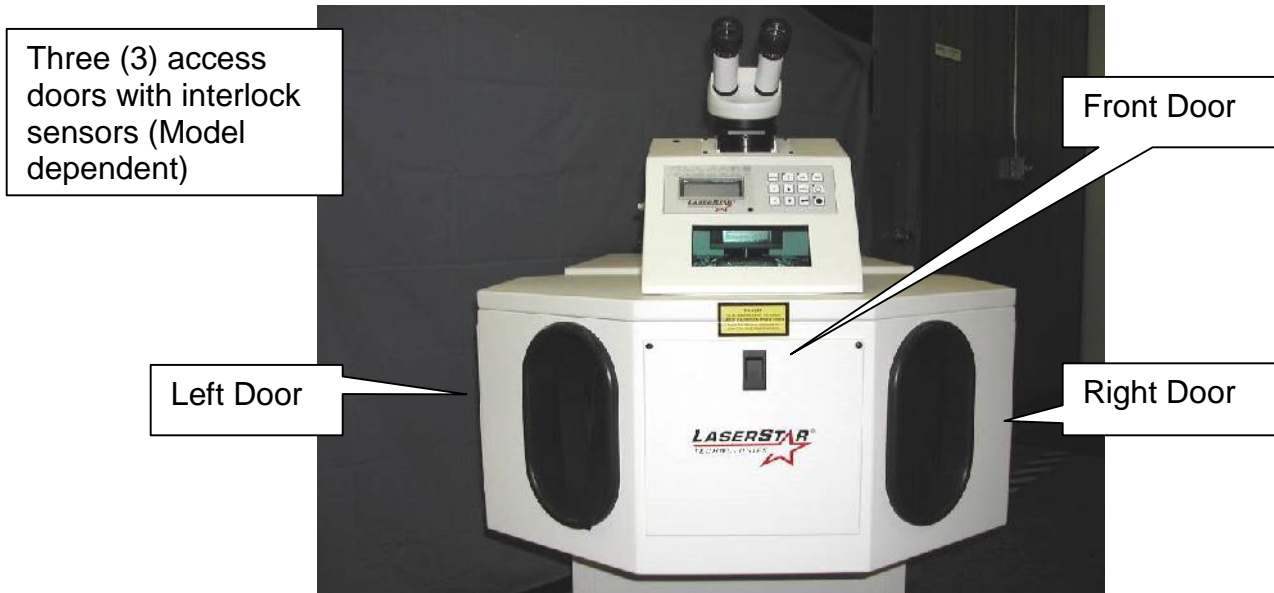


Figure 1
(Tri-Door Front View)

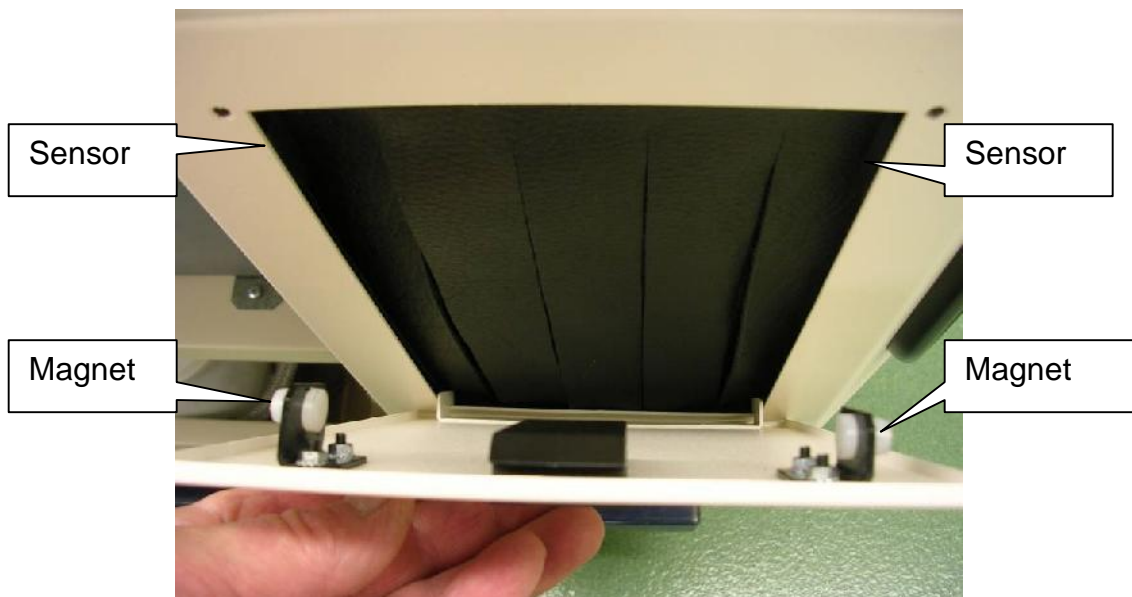
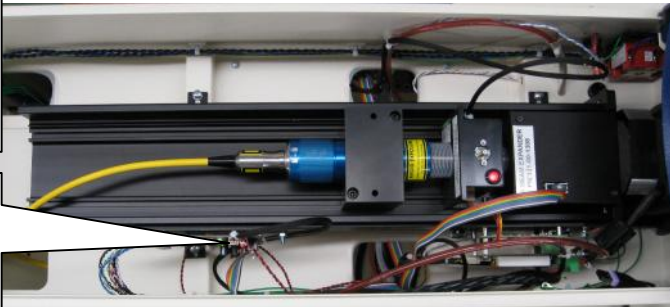


Figure 2
(Left Door with Sensors)

Remove Machine Top Cover (Note: Screws located in rear of machine. Disconnect Ground wire.)



Tri-Door Sensor Circuit Board Assembly (Shown in Figure 4 / below)

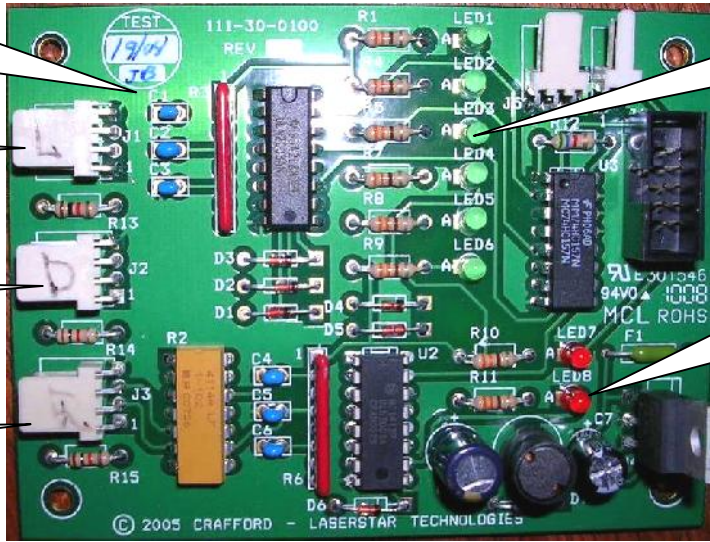
Figure 3
(Tri-Door Sensor Circuit Board Assembly)

Tri-Door Circuit Board Assembly

J1

J2

J3



Green Indicators

Red Indicators

Figure 4
(Tri-Door Circuit Board Assembly Status Indicators)

Led Indicators			All Doors	Left Door	Front Door	Right Door
Door	Number	Color	Okay	Not Okay	Not Okay	Not Okay
Left	1	Green	On	Off	On	On
Left	2	Green	On	Off	On	On
Front	3	Green	On	On	Off	On
Front	4	Green	On	On	Off	On
Right	5	Green	On	On	On	Off
Right	6	Green	On	On	On	Off
All	7	Red	On	Off	Off	On
All	8	Red	On	On	Off	Off

Table 1
(Led Indicator Status)

X. APPENDIXES

**Appendix A: Restricted Access / Password Protection /
Password Change Instructions.**

Restricted Access / Password Protection / Password Change Instructions For 990-191

**(Doc#-90-99990-191)
(Version 191.2 January 2017)**

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Operation: The restricted access feature is used to prevent unauthorized changes to the weld parameters. This feature should be set up at LaserStar per customer request prior to shipping the welder system. The customer can then enable or disable the restricted access feature / password protection at any time. The default factory password is “438”. Instructions to change the password are included in this document.

Restricted Access Instructions

Enable / Turn “ON” Restricted Access / Password Protection-Password protection is turned “ON” by the following steps.

- Press “MENU” on Main Screen **(Figure 1)**
- Scroll to “Restrict Access” using the DN (Down) Arrow **(Figure 2)**
- Press “ENTER” **(Figure 2)**
- Display reads “NO” **(Figure 3)**
- Use UP or DN Arrow to display “YES” **(Figure 4)**
- Press “ON” to enter “YES” **(Figure 4)**
- Press “EXIT” twice to return to Main Screen **(Figure 4)**
- Main Screen **(Figure 1)**
- Password protection is enabled / “ON”

Password Protection “ON” restricts the usable buttons on the touch screen display. The following buttons on the Main Screen are still active. **(Figure 1)**

- Press the memory location number in upper left corner of the screen
- Use the UP/DN arrows to select the desired memory location number
- Press “RECALL” twice to load the weld parameters for the selected memory location
- Press “MEM” to view weld parameters & description **(Figure 5)**
- Press “HOME” to return to Main Screen
- Use UP/DN arrows to toggle between “Hertz”, “Burst” & PSS
- Press “SAFETY SHUTTER” to open (or close) the shutter
- Press the Foot Pedal to fire the laser (Not on Main Screen)
- “HOME” button can be used at any time to return to the Main Screen
- “HELP” button provides Field Service & Technical Support Information, Welder Model Number and Welder Serial Number.

Disable / Turn “OFF” Restricted Access / Password Protection- Password protection is turned “OFF” by the following steps. The factory default password is “438”. **(Figure 6)**

- Press “MENU” on the Password Screen and the first digit “0” will blink **(Figure 6)**

- Press the “UP” arrow to set the first number (Note: DN can be used to decrease the number)
- Press “MENU” on the Password Screen and a (*) will be loaded into the first digit and the second digit “0” will start to blink (**Figure 7**)
- Press the “UP” arrow to set the second number
- Press “MENU” on the Password Screen and a (*) will be loaded into the second digit and the third digit “0” will start to blink (**Figure 8**)
- Press the “UP” arrow to set the third number
- Press “MENU” on the Password Screen to enter the password and return to the Main Screen (**Figure1**)
- Password protection is disabled / “OFF”

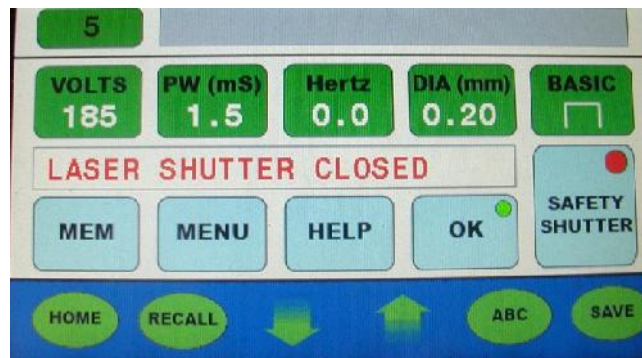


Figure 1
(Main Screen>Menu)

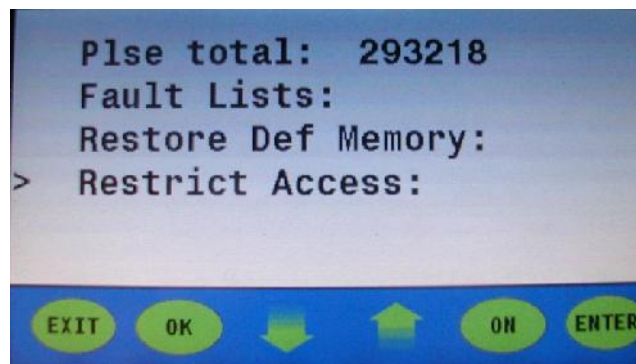


Figure 2
(Down Arrow>Restrict Access>Enter)

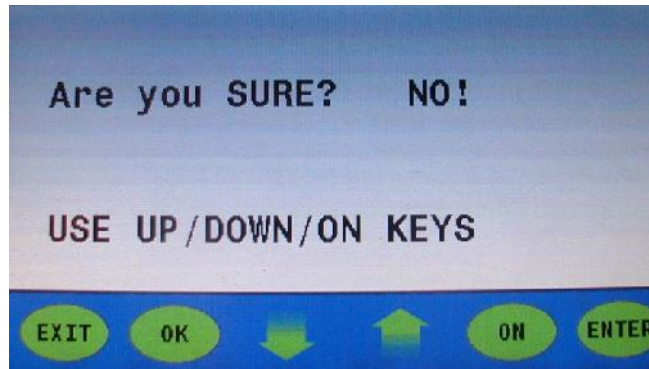


Figure 3
(Up or Down Arrow>NO or YES)

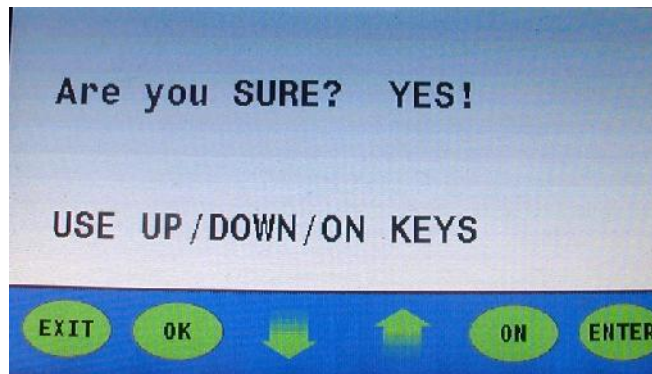


Figure 4
(YES>ON>EXIT>EXIT)



Figure 5
(MEM)

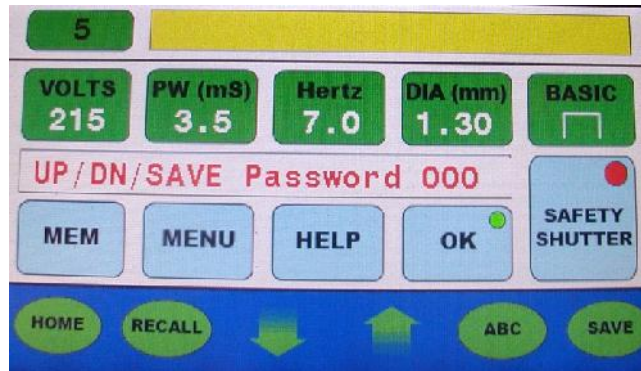


Figure 6
(MENU>UP/DN ARROWS>"4")



Figure 7
(MENU>UP/DN ARROWS>"3")

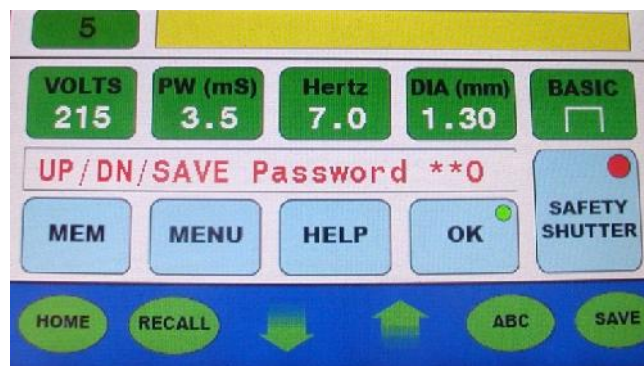


Figure 8
(MENU>UP/DN>"8">MENU)

Password Change Instructions

(ATTENTION: Please make sure you keep a record of the new password. If you forget your new password, please call LaserStar Service.)

- Press “MENU” on the Main Screen **(Figure 9)**
- Scroll to “User Password: locked”
- The factory default password is “438”
- Press the “UP” arrow to set the first number-“4” **(Figure 11)** (Note: DN can be used to decrease the number)
- Press “ENTER” and a (*) will be loaded into the first digit and the second digit “0” will start to blink **(Figure 12)**
- Press the “UP” arrow to set the second number-“3”
- Press “ENTER” and a (*) will be loaded into the second digit and the third digit “0” will start to blink **(Figure 13)**
- Press the “UP” arrow to set the third number-“8”
- Press “ENTER” to enter the password and return to “User Password: unlocked” on the menu list **(Figure14)**
- Press “ENTER” on “User Password: unlocked”
- Press the “UP” arrow to set the first number of the new password **(Figure 15)** (Note: DN can be used to decrease the number)
- Press “ENTER” and a (*) will be loaded into the first digit and the second digit “0” will start to blink **(Figure 16)**
- Press the “UP” arrow to set the second number of the new password
- Press “ENTER” and a (*) will be loaded into the second digit and the third digit “0” will start to blink **(Figure 17)**
- Press the “UP” arrow to set the third number of the new password
- Press “ENTER” to enter the password and return to “User Password: unlocked” on the menu list **(Figure18)**
- The new password in this example is “555”
- Press “EXIT” twice to return to the Main Screen **(Figure 9)** **(Note: Returning to the Main Screen locks parameters on the touch screen display.)**

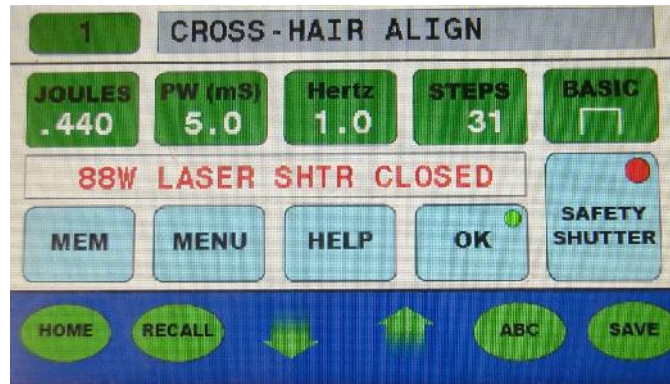


Figure 9
(Main Screen)

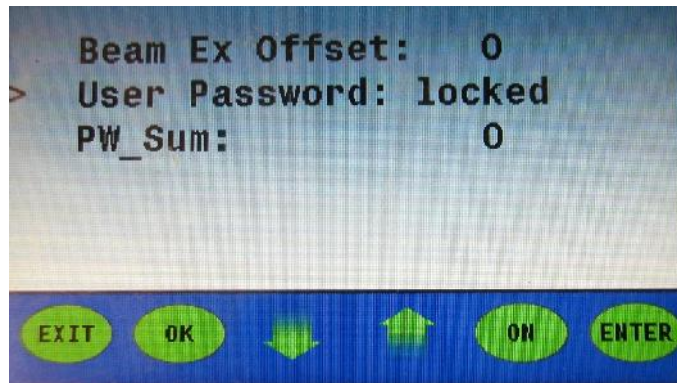


Figure 10
(User Password: locked)

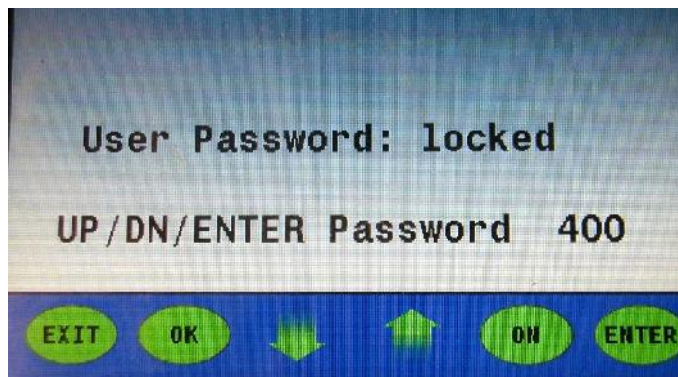


Figure 11
(Password: 1st Digit-"4")

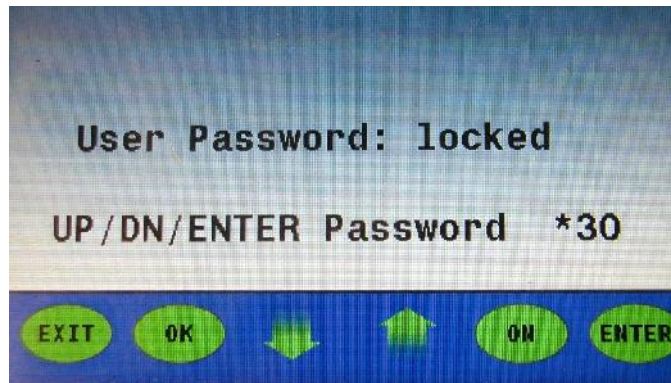


Figure 12
(Password: 2nd Digit-"3")

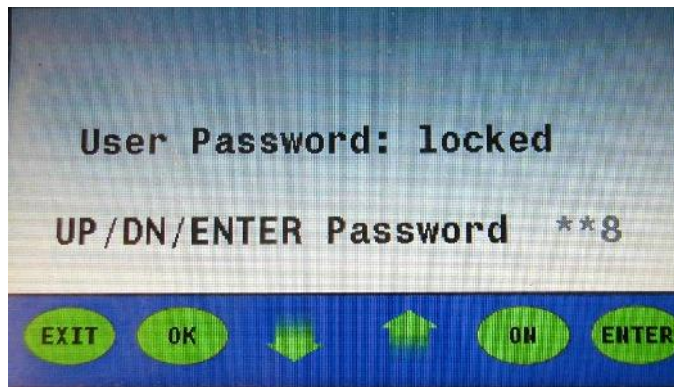


Figure 13
(Password: 3rd Digit-"8")

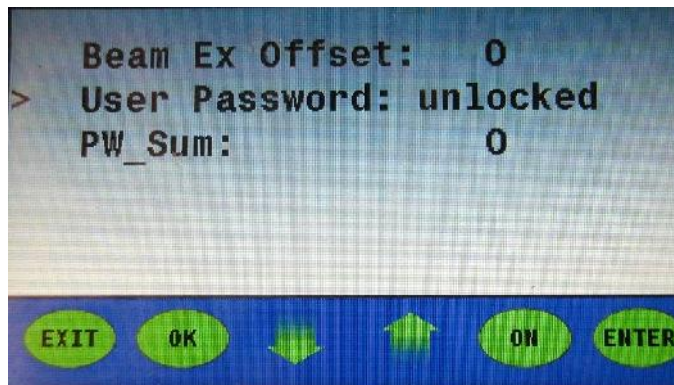


Figure 14
(User Password: unlocked)

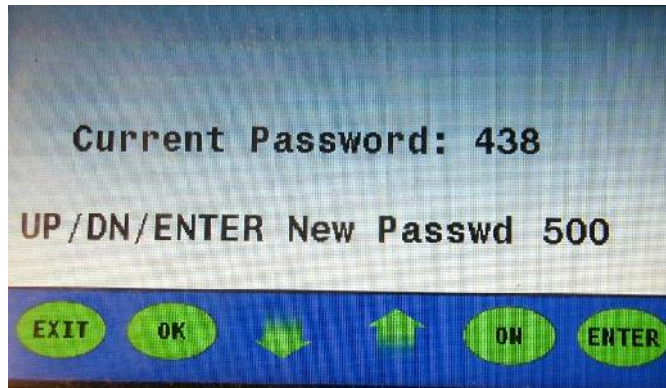


Figure 15
(New Password: 1st Digit-"5")

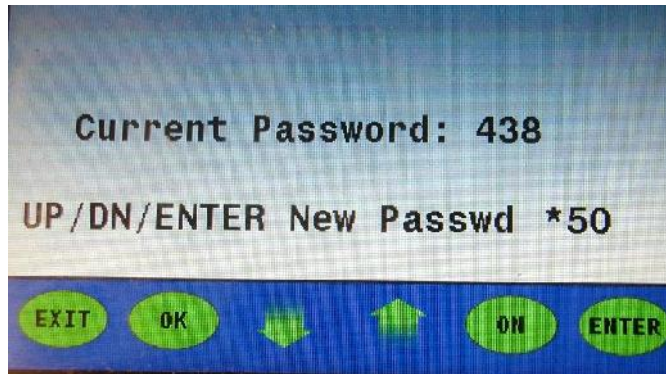


Figure 16
(New Password: 2nd Digit-"5")

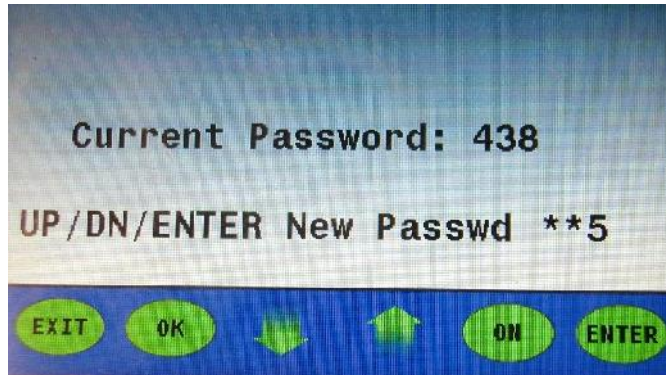


Figure 17
(New Password: 3rd Digit-"5")

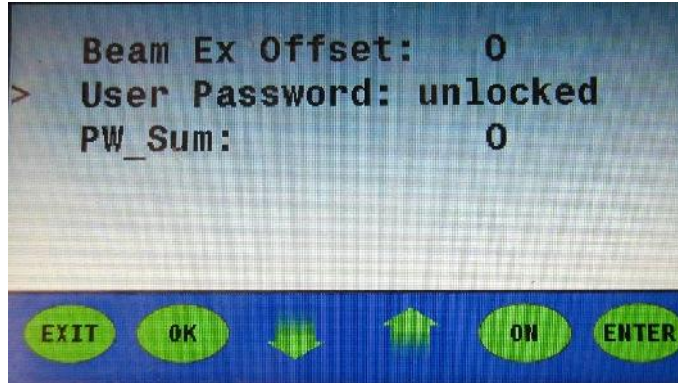


Figure 18
(User Password: unlocked)

Appendix B: Calibration Procedures

FiberStar[®] ***Laser Systems***

“GAIN” & “TABLE” Calibration Procedure for Joules with Safety Shutter 7600 & 8600 Series with QCW Fiber Lasers

(Doc#-16-99990-QCW-J-SS)

(Version 8.0 January 2017)

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	• STD Mode Table Calibration Procedure	
	• MICRO Mode Table Calibration Procedure	

I. Tools/Supplies Required

- Laser Power Meter and Power Head
- View-it Infrared Detector/VW-IR
- Metric Scale (150mm/minimum)
- Laser Safety Glasses
- Clean Room Vinyl/PVC Gloves (**Powder-Free/DEHP & DOP Free**)

Note: Make sure welder is in a secure room and the tester should be wearing the appropriate laser safety glasses.

II. System Description

The FiberStar® Workstation™ and the Dual Component Systems are single-user operated products that can be used to weld almost all metals and metal alloys quickly, reliably, and precisely.

The parts that are to be joined are manually arranged together under visual control and welded together by means of one or more laser pulses.

The product is equipped with a stereo microscope with a crosshair to facilitate the exact positioning of the parts. The crosshair marks the exact position on the work piece where the laser pulse spot will occur.

Good welding results will only be obtained if the work piece is exactly positioned with regard to the height (i.e. within the focusing area of the laser beam). The height is correct if the surface of the work piece is in focus under the stereo microscope.

Adjusting the energy of the laser pulses can influence the quality of the welding points. This can be adjusted by means of joysticks or the keypad. With one of these controls you can adjust the intensity of the laser pulses (Energy), and the pulse length (ms). Settings for other materials can be obtained by following the adjustment technique described.

The quality of the weld can be increased for certain materials by using inert gas. This product is equipped with a separate inert gas connection.

The vapor produced during welding can be extracted from the welding chamber/area via a Filtration Exhaust Unit.

A foot pedal switch with two operating positions can fire a single or multiple laser pulses. The first position (pedal switch slightly pressed) enables the inert gas supply, and the second position (pedal switch fully pressed) releases the laser pulse.

III. Setup Actions / Steps Prior to Starting "GAIN" Calibration

- Make sure the "Tables" for STD & MICRO are cleared.
- Make sure the Final Focus Lens is clean. (Note: Final Focus lens should be installed for "GAIN" calibration.)
- Make sure all the chamber lights (or other ambient light sources) are off.
- Make sure the laser beam is defocused on the power head to a spot size of (~ $\frac{3}{4}$ ") diameter to avoid power head damage and improve accuracy.
- Make sure the power meter is set on the lowest range / highest resolution to optimize accuracy.
- Make sure the watts value displayed in the power meter stabilizes when taking the measurement. (Note: The laser is fired / stabilized by holding down the foot pedal until the watts value has minimum change.)
- Select the new calibrated value that is closest to the nominal value. (Note: The closest new calibrated value may be plus or minus the nominal value.)

IV. "GAIN" Calibration using STD Mode (Preferred Method)

STD Mode Gain Calibration Procedure: (Figure 1-10 & Table 1 / XXXW)

1. On the Main Screen put in the following Parameters. (Figure 1)
 - a. Joules-_____per XXXW Model
 - b. Pulse Width-3.0ms
 - c. Frequency-10Hz
 - d. Burst-0
 - e. Basic
 - f. Watts-_____ per XXXW Model

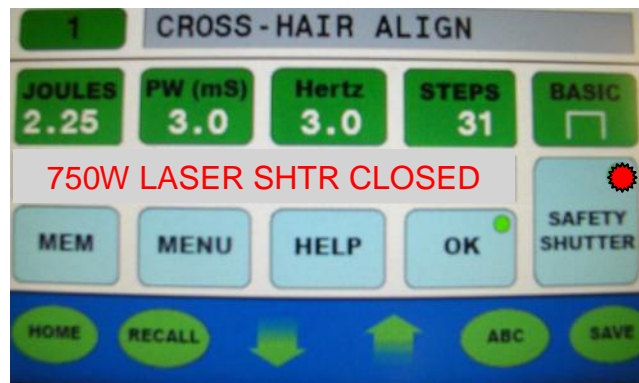


Figure 1

(Main Screen-Safety Shutter Closed / Laser Disabled-150W Model)

Model-150W (PM)				
STD Mode Gain Calibration / gCal Multi Pulse				
PW=3.0 mS & Hertz=10				PW=3.0mS Hertz=0
Touch Screen Display (Actual Values in Display)		Power / Energy Meter (Typical Values*)		Power / Energy Meter (Typical Values**)
Joules / J	Watts / W (Peak Power)	Watts / W (Avg. Power) (measured)	Joules / J (W ÷ 10) (calculated)	Joules** / J (measured)
2.25	750	22.50	2.25	2.249

**Table 1 / 150W
(STD Mode Gain Calibration for-Typical)**

(*)-These values are typical. The person calibrating the system should match the Joules value (Watts÷10) from the power / energy meter as close as possible to the Joules value in the Touch Screen Display.

(**)-The measured Joules value should be the average of at least 3 (minimum) measurements.

Model-300W (PM)				
STD Mode Gain Calibration / gCal Multi Pulse				
PW=3.0 mS & Hertz=10				PW=3.0mS Hertz=0
Touch Screen Display (Actual Values in Display)		Power / Energy Meter (Typical Values*)		Power / Energy Meter (Typical Values**)
Joules / J	Watts / W (Peak Power)	Watts / W (Avg. Power) (measured)	Joules / J (W ÷ 10) (calculated)	Joules** / J (measured)
4.50	1500	45.0	4.50	4.49

**Table 1 / 300W
(STD Mode Gain Calibration for-Typical)**

(*)-These values are typical. The person calibrating the system should match the Joules value (Watts÷10) from the power / energy meter as close as possible to the Joules value in the Touch Screen Display.

(**)-The measured Joules value should be the average of at least 3 (minimum) measurements.

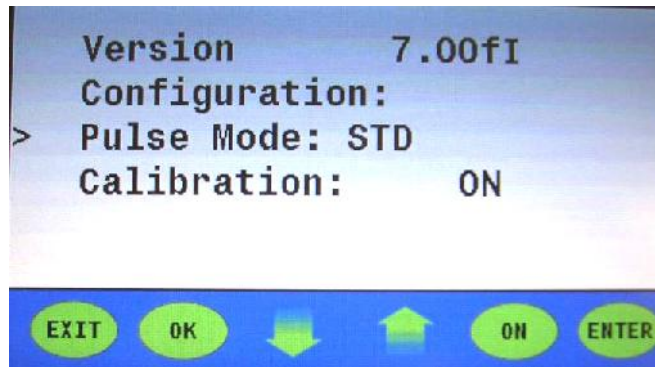
Model-450W (PM)				
STD Mode Gain Calibration / gCal Multi Pulse				
PW=3.0 mS & Hertz=10				PW=3.0mS Hertz=0
Touch Screen Display (Actual Values in Display)		Power / Energy Meter (Typical Values*)		Power / Energy Meter (Typical Values**)
Joules / J	Watts / W (Peak Power)	Watts / W (Avg. Power) (measured)	Joules / J (W ÷ 10) (calculated)	Joules** / J (measured)
6.75	2250	67.50	6.75	6.74

**Table 1 / 450W
(STD Mode Gain Calibration-Typical)**

(*)-These values are typical. The person calibrating the system should match the Joules value (Watts÷10) from the power / energy meter as close as possible to the Joules value in the Touch Screen Display.

(**)-The measured Joules value should be the average of at least 3 (minimum) measurements.

2. Press the MENU Icon / Button to open the Menu Screen.
3. Scroll down to Pulse Mode and press ENTER. **(Figure 2)**
4. Press the up or down arrow to select STD mode. **(Figure 2)**
5. Press ENTER and then press EXIT.



**Figure 2
(Menu Screen with "Pulse Mode: STD" Selected)**

6. Scroll down to Calibration and press ENTER.
7. The display will read "CALIBRATION: ON" **(Figure 3)**

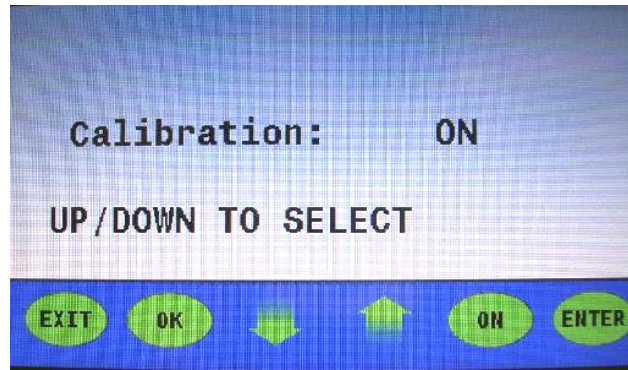


Figure 3
(“Calibration: ON” Screen)

8. Press the up or down arrow once and three “0”s / (000) will show up to the right of the word “Password”. **(Figure 4)**
(Note: The password to be entered is “438” / factory default or a new password / “XXX” created / entered by the user.)

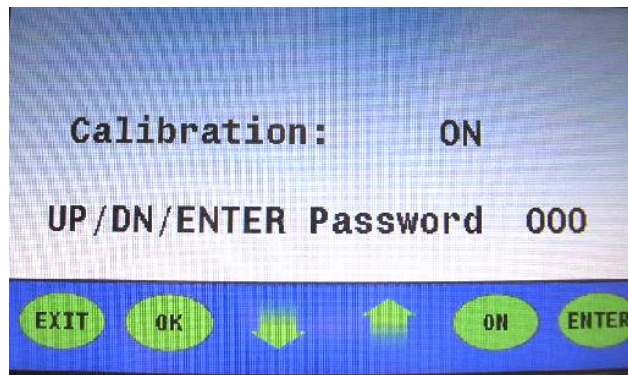


Figure 4
(Password Screen)

9. Press the up or down arrow to set the value for the first blinking “0” to “4” and then press ENTER.
10. Press the up or down arrow to set the value for the next blinking “0” to “3” and then press ENTER.
11. Press the up or down arrow to set the value for the last blinking “0” to “8” and then press ENTER.
12. The display will read “Calibration: TABLE”. **(Figure 5)**

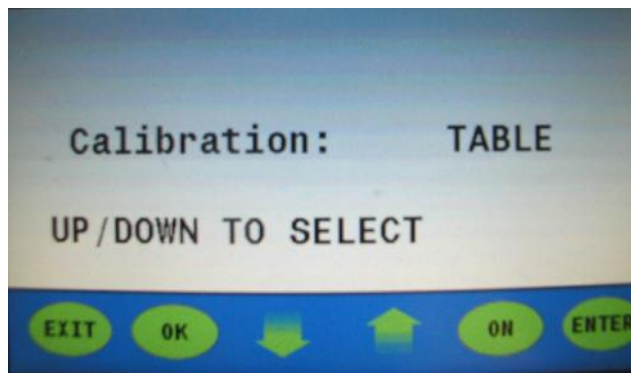


Figure 5
(“Calibration: TABLE” Screen)

13. Press ENTER.

14. Press the up or down arrow to select "CLR TABLE" and then press ENTER.

(Figure 6)

15. Press ENTER.

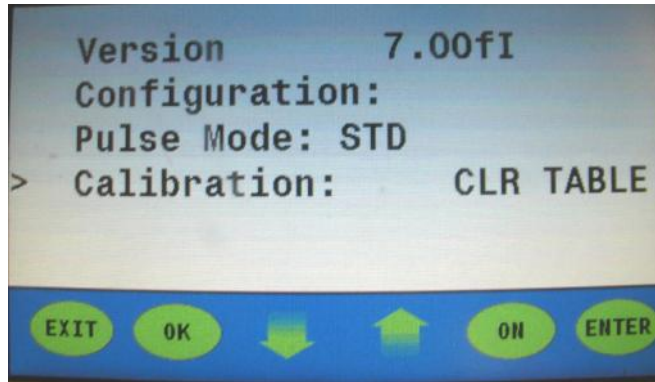


Figure 6

(Menu Screen with "Calibration: CLR TABLE" Selected)

16. Press EXIT twice to return to the Main Screen. **(Figure 7)**

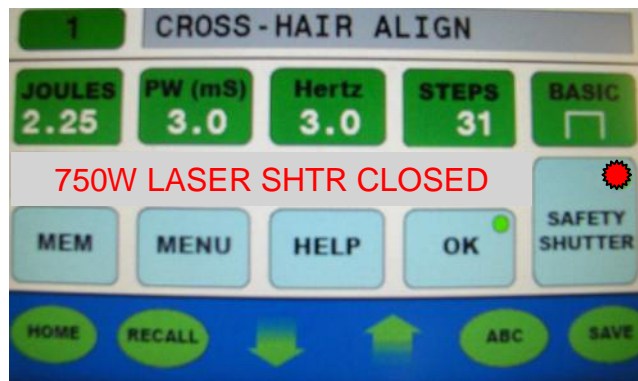


Figure 7

(Main Screen-Safety Shutter Closed / Laser Disabled)

17. Press MENU and scroll down to calibration and press ENTER.

18. Press the up or down arrow to select "GAIN" and then press ENTER. **(Figure 8)**

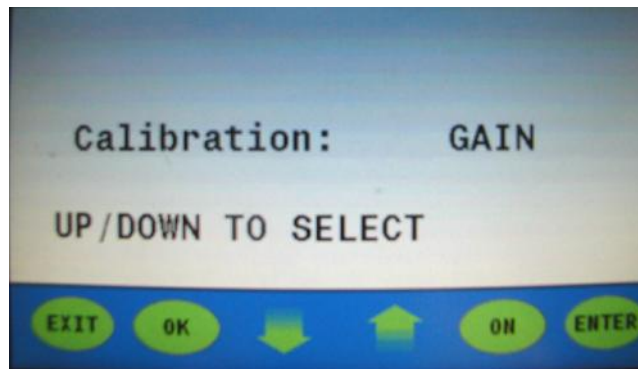


Figure 8

("Calibration: GAIN" Screen)

19. Press EXIT twice to return to the Main Screen
20. Main Screen Display should read "750W LASER SHTR CLOSED" with Safety Shutter closed / Laser Disabled.
21. Verify the parameters on the Main Screen (**Figure 1**) match the parameters in step (1).
22. Set up Power Meter & Power Head to measure watts (**Note:** Make sure the beam is out of focus / defocused. The beam diameter on the Power Head should be approximately (3/4") diameter.)
23. Safety Shutter opened / Laser Enabled and the display should read "750W gCAL MULTI PULSE". (**Figure 9**)



Figure 9

(Main Screen-GAIN Calibration-Safety Shutter Open / Laser Enabled-"750W gCAL MULTI PULSE"-150W Model)

24. Depress the Foot Pedal Switch until the power meter value stabilizes (~30) seconds
25. Take a reading (Note: The goal is to have the power meter value ($W \div 10 = J$) equal the Joules / J parameter value shown in the touch screen display.)
26. Release the Foot Pedal Switch
27. Press the UP or Down arrows (2X) to adjust the laser output
28. Repeat steps (24 to 27) until the power meter value ($W \div 10 = J$) equals the Joule / J parameter value shown in the touch screen display
29. Run for (~60) seconds to verify that the power meter value ($W \div 10 = J$) equals the parameter value shown in the touch screen display, if not repeat steps (24 to 29)
30. Close the Safety Shutter / Laser Disabled.
31. Press the MENU button; scroll down to calibration; and press ENTER.
32. Press the up or down arrow to change "GAIN to "ON". (**Figure 10**)

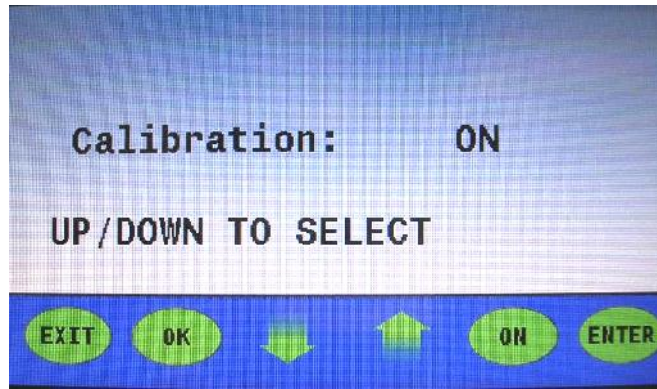


Figure 10
("Calibration: ON" Screen)

33. Press ENTER.
34. Press EXIT twice to return to the Main Screen. **(Figure 1)**
35. Calibration is complete.

V. "GAIN" Calibration using MICRO Mode (Customer Request)

MICRO Mode Gain Calibration Procedure: (Figure 11-20 & Table 2)

1. On the Main Screen put in the following Parameters. **(Figure 11)**
 - a. Joules-____ per **XXXW** Model
 - b. Pulse Width-10.0ms
 - c. Frequency-10Hz
 - d. Burst-0
 - e. Basic
 - f. Watts-____ per **XXXW** Model

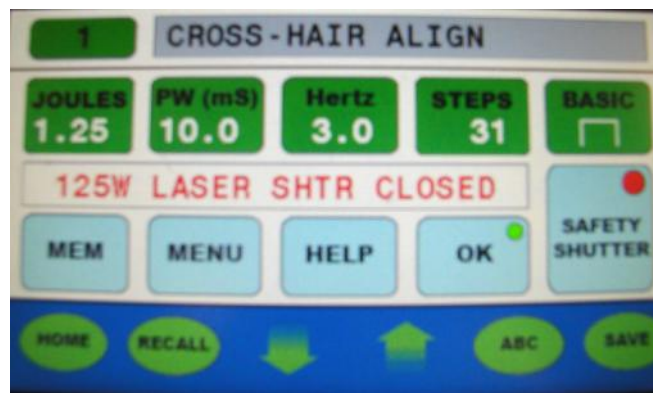


Figure 11
(Main Screen-Safety Shutter Closed / Laser Disabled)

Model-150W (PM)				
MICRO Mode Gain Calibration / gCAL Multi Pulse				
PW=10.0 mS & Hertz=10				PW=3.0mS Hertz=0
Touch Screen Display (Actual Values in Display)		Power / Energy Meter* (Typical Values)		Power / Energy Meter (Typical Values)
Joules / J	Watts / W (Peak Power)	Watts / W (Avg. Power) (measured)	Joules / J (W ÷ 10) (calculated)	Joules** / J (measured)
1.25	125	12.49	1.249	1.251

**Table 2 / 150W
(MICRO Mode Gain Calibration Table-Typical)**

(*)-These values are typical. The person calibrating the system should match the Joules value (Watts÷10) from the power / energy meter as close as possible to the Joules value in the Touch Screen Display.

(**)-The measured Joules value should be the average of at least 3 (minimum) measurements.

Model-300W (PM)				
MICRO Mode Gain Calibration / gCAL Multi Pulse				
PW=10.0 mS & Hertz=10				PW=3.0mS Hertz=0
Touch Screen Display (Actual Values in Display)		Power / Energy Meter* (Typical Values)		Power / Energy Meter (Typical Values)
Joules / J	Watts / W (Peak Power)	Watts / W (Avg. Power) (measured)	Joules / J (W ÷ 10) (calculated)	Joules** / J (measured)
1.50	150	14.98	1.498	1.497

**Table 2 / 300W
(MICRO Mode Gain Calibration Table-Typical)**

(*)-These values are typical. The person calibrating the system should match the Joules value (Watts÷10) from the power / energy meter as close as possible to the Joules value in the Touch Screen Display.

(**)-The measured Joules value should be the average of at least 3 (minimum) measurements.)

Model-450W (PM)				
MICRO Mode Gain Calibration / gCAL Multi Pulse				
PW=10.0 mS & Hertz=10				PW=3.0mS Hertz=0
Touch Screen Display (Actual Values in Display)		Power / Energy Meter* (Typical Values)		Power / Energy Meter (Typical Values)
Joules / J	Watts / W (Peak Power)	Watts (Avg. Power) (measured)	Joules / J (W ÷ 10) (calculated)	Joules** / J (measured)
2.25	225	22.50	2.250	2.249

**Table 2 / 450W
(MICRO Mode Gain Calibration Table-Typical)**

(*)-These values are typical. The person calibrating the system should match the Joules value (Watts÷10) from the power / energy meter as close as possible to the Joules value in the Touch Screen Display.

(**)-The measured Joules value should be the average of at least 3 (minimum measurements.)

2. Press the Menu Icon / Button to open the Main Screen.
3. Scroll down to Pulse Mode and press ENTER (**Figure 12**)
4. Press the up or down arrow to select MICRO mode.
5. Press ENTER and the press EXIT



**Figure 12
(Menu Screen with Pulse Mode: MICRO" Selected)**

6. Scroll down to Calibration and press ENTER
7. The display will read "CALIBRATION: ON" (**Figure 13**)

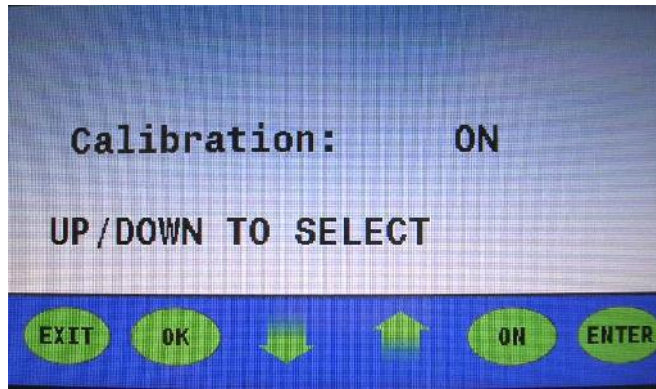


Figure 13
(“Calibration: ON” Screen)

8. Press the up or down arrow once and three “0”s / (000) will show up to the right of the word “PASSWORD”. **(Figure 14)**
(Note: The password to be entered is “438” / factory default or a new password / “XXX” created / entered by the user.)

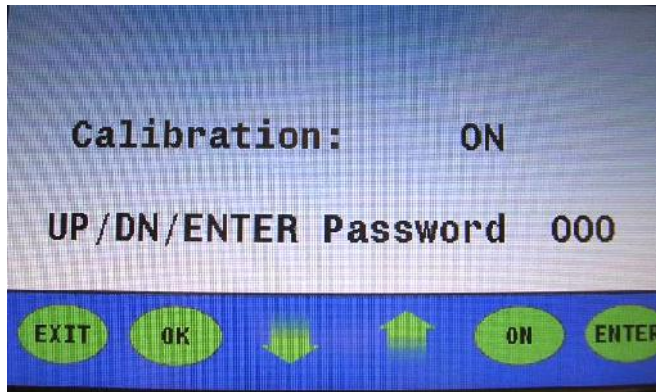


Figure 14
(Password Screen)

9. Press the up or down arrow to set the value for the blinking “0” to “4” and then press ENTER.
10. Press the up or down arrow to set the value for the next blinking “0” to “3” and then press ENTER.
11. Press the up or down arrow to set the value for the last blinking “0” to “8” and then press ENTER.
12. The display will read “Calibration: TABLE”. **(Figure 15)**

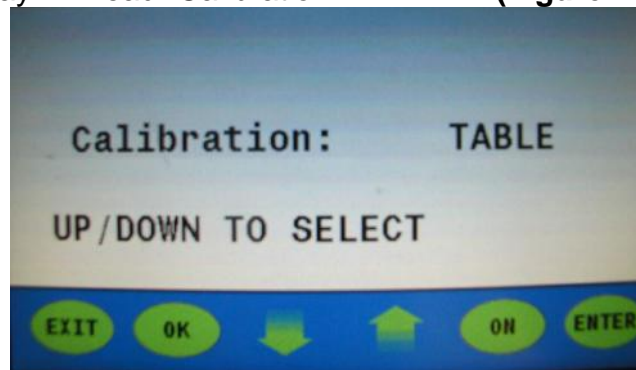


Figure 15
(“Calibration: TABLE” Screen)

- 13. Press ENTER. **(Figure 16)**
- 14. Press the up or down arrow to select "CLR TABLE".
- 15. Press ENTER.

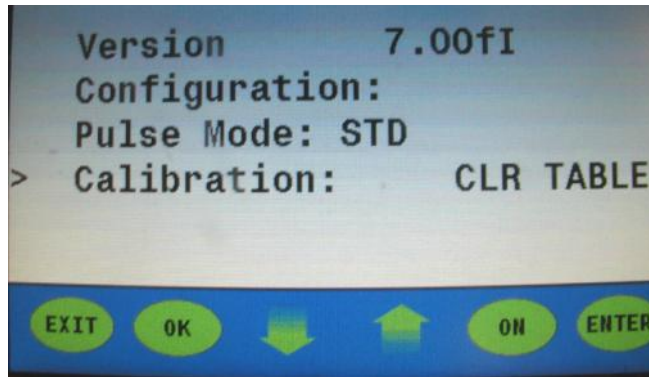


Figure 16
(Menu Screen with "Calibration: CLR TABLE" Selected)

- 16. Press EXIT twice to return to the Main Screen. **(Figure 17)**

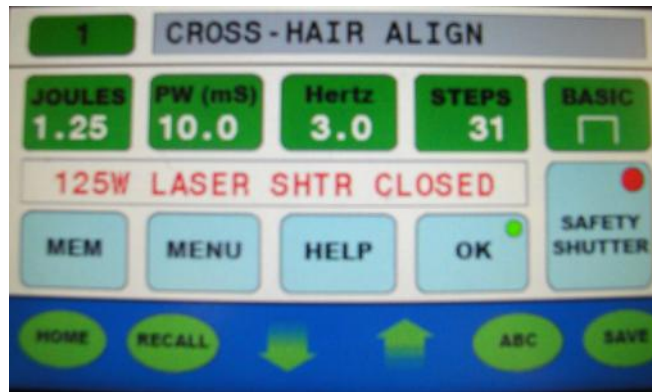


Figure 17
(Main Screen-Safety Shutter Closed / Laser Disabled-150W Model)

- 17. Press MENU and scroll down to Calibration and press ENTER.
- 18. Press the up or down arrow to select "GAIN" and then press ENTER. **(Figure 18)**

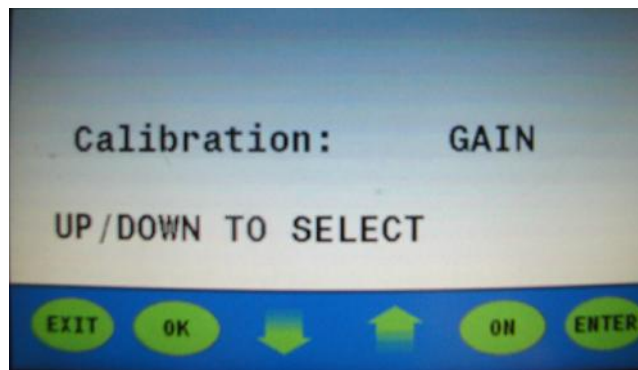


Figure 18
(“Calibration: GAIN” Screen)

19. Press EXIT twice to return to the Main Screen.
20. Main Screen should display "125W LASER SHTR CLOSED" with the Safety Shutter closed / Laser Disabled.
21. Verify the parameters on the Main Screen (**Figure 10**) match the parameters in step (1).
22. Set up Power Meter & Power Head to measure watts (**Note:** Make sure the beam is out of focus / defocused. The beam diameter on the Power Head should be approximately (3/4") diameter.)
23. Open the Safety Shutter / Laser Enabled and the display should read "125W gCAL MULTI PULSE". (**Figure 19**)



Figure 19

(Main Screen-GAIN Calibration-Safety Shutter Open / Laser Enabled-"125W gCAL MULTI PULSE"-150W Model)

24. Depress the Foot Pedal Switch until the power meter value stabilizes (~30 seconds)
25. Take a reading (Note: The goal is to have the power meter value ($W \div 10 = J$) equal the Joules / J parameter value shown in the touch screen display.)
26. Release the Foot Pedal Switch
27. Press the UP or Down arrows (2X) to adjust the laser output
28. Repeat steps (24 to 27) until the power meter value ($W \div 10 = J$) equals the Joules / J parameter value shown in the touch screen display
29. Run for (~60) seconds to verify that the power meter value ($W \div 10 = J$) equals the parameter value shown in the touch screen display, if not repeat steps (24 to 29)
30. Close the Safety Shutter or select Laser Disabled Icon
31. Press the MENU button; scroll down to calibration; and press ENTER.
32. Press the up or down arrow to change "GAIN to "ON". (**Figure 20**)

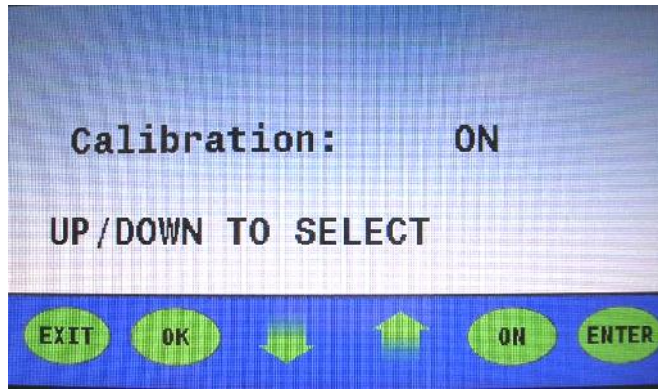


Figure 20
(“Calibration: ON” Screen)

- 33. Press ENTER
- 34. Press EXIT twice to return to the main screen. **(Figure 11)**
- 35. Calibration is complete

VI. Summary Guide for "GAIN" Calibration (Analog Control)

1. Select Menu Icon: (Passcode-438)
 - a. Pulse Mode: "MICRO"
 - b. Calibration: "ON"
 - c. Enter passcode
 - d. Calibration: "TABLE"
 - e. Select "CLR TABLE"
 - f. Press "ENTER"
 - g. Press "EXIT" twice

2. Select Menu Icon: (Passcode-438)
 - a. Pulse Mode: "STD"
 - b. Calibration: "ON"
 - c. Enter passcode
 - d. Calibration: "TABLE"
 - e. Select "CLR TABLE"
 - f. Press "ENTER"
 - g. Press "EXIT" twice

3. Input the following parameters in to the Touch Screen Display: (Model / Wattage dependent / 50% values from Test Results Sheet or Tables)
 - a. Pulse Mode: "STD" (Note: "MICRO" mode if requested by customer)
 - b. ___ Joules / Energy (50% value from Test Results Sheet)
 - c. ___ Milliseconds / Pulse Width (50% value from Test Results Sheet)
 - d. ___ Hertz / Hz (50% value from Test Results Sheet)
 - e. ___ Watts / Peak Power (50% value from Test Results sheet on Message Line of Display)

4. Setup Power Meter:
 - a. Make sure the final focus lens is clean (Note: Final Focus lens should be installed for calibration.)
 - b. Laser beam should be defocused on power head (~3/4"/19mm spot size)
 - c. Select lowest power range that will measure up to the max. avg. power value from the Test Results Sheet
 - d. Make sure that the chamber lights or ambient background lights are "OFF"

5. Select Menu Icon:
 - a. Pulse Mode: "STD" (Note: "MICRO" mode if requested by customer)
 - b. Calibration set to "GAIN"
 - c. Exit to Main Screen

6. Open the Safety Shutter or select Laser Enable Icon:
 - a. Depress the Foot Pedal Switch until the power meter value stabilizes (~30 seconds)
 - b. Take a reading ($W \div 10 = J$)
 - c. Release the Foot Pedal Switch
 - d. Press the UP or Down arrows (2X) to adjust the laser output

- e. Repeat steps (a to d) until the power meter value ($W \div 10 = J$) equals the Joules / J parameter value shown in the touch screen display
- f. Run for ~60 seconds to verify that the power meter value ($W \div 10 = J$) equals the parameter value shown in the touch screen display
- g. Close the Safety Shutter or select Laser Disabled Icon

ATTENTION: Do not use the up or down arrows again for any reason until completing the following step. Failure to follow these instructions may result in corrupting the previous "GAIN" adjustment.

7. Select Menu:
 - a. Scroll down to calibration
 - b. Calibration: "ON"
 - c. Press "ENTER"
 - d. Press "EXIT" twice
8. "GAIN" calibration is complete

VII. “STD” Mode Test Results (150W)

Machine Model Number: _____ Machine Serial Number: _____

Fiber Model Number: _____ Fiber Serial Number: _____

Date Tested: _____ “GAIN” Calibration*: **STD** or MICRO (Circle One)**

Test Person: _____ Assembly Person: _____

STD Mode: pulse width = 3ms, rate=10Hz, [*] “GAIN” calibrated at linear / 50% values, [**] Preferred

STD MODE									
% linear	Energy Target	Pulse Width	Rate	Peak Power	Avg. Power	Avg. Power	Pulse Energy	Avg. Power Tolerance (±2%)	
%	J	mS	Hz	Calc. W	Calc. W	Actual W	Calc. J	Calc. %	
10.0%	0.450	3	10	150	4.50				
20.0%	0.900	3	10	300	9.00				
30.0%	1.350	3	10	450	13.50				
40.0%	1.800	3	10	600	18.00				
50.0%	2.250	3	10	750	22.50				
60.0%	2.700	3	10	900	27.00				
70.0%	3.150	3	10	1050	31.50				
80.0%	3.600	3	10	1200	36.00				
90.0%	4.050	3	10	1350	40.50				

“MICRO” Mode & “CW” Mode Test Results (150W)

Machine Model Number: _____ Machine Serial Number: _____

Fiber Model Number: _____ Fiber Serial Number: _____

Date Tested: _____ “GAIN” Calibration*: STD** or MICRO (Circle One)

Test Person: _____ Assembly Person: _____

MICRO Mode: pulse width = 10ms, rate=10Hz, [*] “GAIN” calibrated at linear / 50% values, [**] Preferred

MICRO MODE									CW	
%	Energy	Pulse	Rate	Peak	Avg.	Avg.	Pulse	Avg.	Avg.	
linear	Target	Width		Power	Power	Power	Energy	Power	Power	
%	J	mS	Hz	Calc.	Calc.	Actual	Calc.	Calc.	Target	Actual
				W	W	W	J	%	W	W
20.0%	0.500	10	10	50	5.00				50	
									100	
30.0%	0.750	10	10	75	7.50				150	
									200	
40.0%	1.000	10	10	100	10.00				250	
50.0%	1.250	10	10	125	12.50					
60.0%	1.500	10	10	150	15.00					
70.0%	1.750	10	10	175	17.50					
80.0%	2.000	10	10	200	20.00					
90.0%	2.250	10	10	225	22.50					

VIII. “STD” Mode Test Results (300W)

Machine Model Number: _____ Machine Serial Number: _____

Fiber Model Number: _____ Fiber Serial Number: _____

Date Tested: _____ “GAIN” Calibration*: STD** or MICRO (Circle One)

Test Person: _____ Assembly Person: _____

STD Mode: pulse width = 3ms, rate=10Hz, [*] “GAIN” calibrated at linear / 50% values, [**] Preferred

STD MODE									
%	Energy	Pulse	Rate	Peak	Avg.	Avg.	Pulse	Avg.	
linear	Target	Width		Power	Power	Power	Energy	Power	
%	J	mS	Hz	Calc.	Calc.	Actual	Calc.	Calc.	
				W	W	W	J	%	
10.0%	0.900	3	10	300	9.00				
20.0%	1.80	3	10	600	18.0				
30.0%	2.70	3	10	900	27.0				
40.0%	3.60	3	10	1200	36.0				
50.0%	4.50	3	10	1500	45.0				
60.0%	5.40	3	10	1800	54.0				
70.0%	6.30	3	10	2100	63.0				
80.0%	7.20	3	10	2400	72.0				
90.0%	8.10	3	10	2700	81.0				

“MICRO” Mode & “CW” Mode Test Results (300W)

Machine Model Number: _____ Machine Serial Number: _____

Fiber Model Number: _____ Fiber Serial Number: _____

Date Tested: _____ “GAIN” Calibration*: STD** or MICRO (Circle One)

Test Person: _____ Assembly Person: _____

MICRO Mode: pulse width = 10ms, rate=10Hz, [*] “GAIN” calibrated at linear / 50% values, [**] Preferred

MICRO MODE									CW	
%	Energy	Pulse	Rate	Peak	Avg.	Avg.	Pulse	Avg.	Avg.	
linear	Target	Width		Power	Power	Power	Energy	Power	Power	
%	J	mS	Hz	Calc.	Calc.	Actual	Calc.	Calc.	Target	Actual
				W	W	W	J	%	W	W
20.0%	0.600	10	10	60	6.00				60	
									100	
30.0%	0.900	10	10	90	9.00				150	
									200	
40.0%	1.20	10	10	120	12.0				250	
									300	
50.0%	1.50	10	10	150	15.0					
60.0%	1.80	10	10	180	18.0					
70.0%	2.10	10	10	210	21.0					
80.0%	2.40	10	10	240	24.0					
90.0%	2.70	10	10	270	27.0					

IX. “STD” Mode Test Results (450W)

Machine Model Number: _____ Machine Serial Number: _____

Fiber Model Number: _____ Fiber Serial Number: _____

Date Tested: _____ “GAIN” Calibration*: **STD** or MICRO (Circle One)**

Test Person: _____ Assembly Person: _____

STD Mode: pulse width = 3ms, rate=10Hz, [*] “GAIN” calibrated at linear / 50% values, [**] Preferred

STD MODE									
% linear	Energy Target	Pulse Width	Rate	Peak Power	Avg. Power	Avg. Power	Pulse Energy	Avg. Power Tolerance (±2%)	
%	J	mS	Hz	Calc. W	Calc. W	Actual W	Calc. J	Calc. %	
10.0%	1.350	3	10	450	13.50				
20.0%	2.700	3	10	900	27.00				
30.0%	4.050	3	10	1350	40.50				
40.0%	5.400	3	10	1800	54.00				
50.0%	6.750	3	10	2250	67.50				
60.0%	8.100	3	10	2700	81.00				
70.0%	9.450	3	10	3150	94.50				
80.0%	10.800	3	10	3600	108.00				
90.0%	12.150	3	10	4050	121.50				

“MICRO” Mode & “CW” Mode Test Results (450W)

Machine Model Number: _____ Machine Serial Number: _____

Fiber Model Number: _____ Fiber Serial Number: _____

Date Tested: _____ “GAIN” Calibration*: STD** or MICRO (Circle One)

Test Person: _____ Assembly Person: _____

MICRO Mode: pulse width = 10ms, rate=10Hz, [*] “GAIN” calibrated at linear / 50% values, [**] Preferred

MICRO MODE									CW	
%	Energy	Pulse	Rate	Peak	Avg.	Avg.	Pulse	Avg.	Avg.	
linear	Target	Width		Power	Power	Power	Energy	Tolerance	Power	Power
%	J	mS	Hz	Calc.	Calc.	Actual	Calc.	Calc.	Target	Actual
				W	W	W	J	%	W	W
20.0%	0.900	10	10	90	9.00				75	
									150	
30.0%	1.350	10	10	135	13.50				225	
									300	
40.0%	1.800	10	10	180	18.00				375	
									450	
50.0%	2.250	10	10	225	22.50					
60.0%	2.700	10	10	270	27.00					
70.0%	3.150	10	10	315	31.50					
80.0%	3.600	10	10	360	36.00					
90.0%	4.050	10	10	405	40.50					

X. "Table" Calibration Procedure for STD & MICRO Modes

Description: The FiberStar Welder has been calibrated at the factory using only Gain Calibration. Gain Calibration should be acceptable for most applications.

If Table Calibration is required, the following procedure should be used. (Note: Gain Calibration is still required prior to doing Table Calibration.) The values shown in **Table 1 / XXXW & Table 2 / XXXW** are measured out of the **Final Focus Lens**.

To enhance the welder accuracy for a specific application, it is recommended that the user calibrate the welder at the pulse width and frequency / hertz that is closest to the values that will be used for welding. When the system is recalibrated for a new pulse width and frequency, the user may calibrate the system at all the Joules values listed or only at selected values that are listed in **Table 1 / XXXW** or **Table 2 / XXXW**. (**Note 1:** When calibrating only an individual value, all values between this new calibrated value and the nearest table value (on each side of this new calibrated value) will be recalculated. **Note 2:** If the user may be using both (STD & MICRO) modes, then **Table 1 / XXXW** and **Table 2 / XXXW** should be recalibrated at the appropriate pulse width and frequency.)

Proper calibration requires using the appropriate laser power / energy measuring equipment which is available from LaserStar. These measurements should be taken out of the **Final Focus Lens**. The power meter should be placed at a distance from the final focus lens such that the beam size is defocused to approximately 3/4" diameter. (**Note:** This calibration procedure creates an approximation of the energy / joules over the watts range specified in **Table 1 / XXXW** or **Table 2 / XXXW**.)

There is a separate calibration procedure for both the STD Mode and the MICRO Mode. The calibration password for both modes is "438".

ATTENTION: The following are actions / steps to take prior to recalibrating for either STD Mode or MICRO Mode.

- **Note: All Screens / Figures are based on the 150W Model. When calibrating, refer to model / Watts specific table for actual parameters.**
- **Note: Laser Enabled=Safety Shutter Open; Laser Disabled=Safety Shutter Closed**
- **Make sure the Focus Lens is clean.**
- **Make sure all the ambient lights (Chamber lights-Model dependent) are off.**
- **Make sure the laser beam is defocused on the power head to a spot size of (~3/4") diameter to avoid power head damage and improve accuracy.**
- **Make sure the power meter is set on the lowest range / highest resolution to optimize accuracy.**
- **Make sure the watts value displayed in the power meter stabilizes when taking each measurement.** (Note: The laser is fired / stabilized by holding down the foot pedal until the watts value has minimum change.)
- **Select the new calibrated value that is closest to the nominal value.** (Note: The closest new calibrated value may be plus or minus the nominal value.)

- **Make sure the actual table values are documented because these values will be lost if the control board memory battery is removed.**

STD Mode Table Calibration Procedure-Joules: (Figure 1-9 & Table 1 / XXXW)

1. On the Main Screen put in the following parameters. **(Figure 1)**
 - a. Joules-.450 /150W Model
 1. **Note:** Select the first Joule value from the Table for each model [150W, 300W, etc.]
 2. **Note:** The (9) specific Joules calibration values are shown in **Table 1 / XXXW**. When in the CAL mode, the display will read one of the (9) Watts values from **Table 1 / XXXW** followed by "STD MULTI PULSE".
 - b. Pulse Width-3.0ms
 - c. Frequency-10Hz
 - d. Burst-0
 - e. Basic
 - f. Watts-150/150 Model (9 Watts values calculated based on 9 Joules values in **Table 1 / XXXW**)
 1. **(Note:** Select the first Watts value from the Table for each model [150W, 300W, etc.]



Figure 1
(Main Screen-Laser Disabled)

Model-150W (PM)				
STD Mode Calibration / sCal Multi Pulse				
PW=3.0 mS & Hertz=10				PW=3.0mS Hertz=0
Touch Screen Display (Actual Values in Display)		Power / Energy Meter (Typical Values*)		Power / Energy Meter (Typical Values**)
Joules / J	Watts / W (Peak Power)	Watts / W (Avg. Power) (measured)	Joules / J (W ÷ 10) (calculated)	Joules** / J (measured)
.450	150	4.55	.455	.453
.900	300	8.78	.878	.880
1.35	450	13.55	1.355	1.345
1.80	600	18.04	1.804	1.810
2.25	750	22.49	2.249	2.247
2.70	900	26.95	2.695	2.690
3.15	1050	31.00	3.100	3.120
3.60	1200	35.7	3.57	3.56
4.05***	1350	40.3	4.03	4.04
4.50***	1500	44.8	4.48	4.51

**Table 1 / 150W
(STD Mode Calibration Table-Joules-Typical)**

(*)-These values are typical. The person calibrating the system should match the Joules value (Watts÷10) from the power / energy meter as close as possible to the Joules value in the Touch Screen Display.

(**)-The measured Joules value should be the average of at least 3 (minimum) measurements.

(***)-Measurements taken out of the Final Focus Lens / Focus Head versus the BDO may not reach these values.

Model-300W (PM)				
STD Mode Calibration / sCal Multi Pulse				
PW=3.0 mS & Hertz=10				PW=3.0mS Hertz=0
Touch Screen Display (Actual Values in Display)		Power / Energy Meter (Typical Values*)		Power / Energy Meter (Typical Values**)
Joules / J	Watts / W (Peak Power)	Watts / W (Avg. Power) (measured)	Joules / J (W ÷ 10) (calculated)	Joules** / J (measured)
.900	300	8.87	.887	.906
1.80	600	17.94	1.794	1.760
2.70	900	27.02	2.702	2.690
3.60	1200	35.9	3.59	3.620
4.50	1500	45.0	4.50	4.494
5.40	1800	54.1	5.41	5.38
6.30	2100	63.2	6.32	6.24
7.20	2400	72.2	7.22	7.12
8.10***	2700	81.2	8.12	8.08
9.00***	3000	89.5	8.95	9.02

**Table 1 / 300W
(STD Mode Calibration Table-Joules-Typical)**

(*)-These values are typical. The person calibrating the system should match the Joules value (Watts÷10) from the power / energy meter as close as possible to the Joules value in the Touch Screen Display.

(**)-The measured Joules value should be the average of at least 3 (minimum) measurements.

(***)-Measurements taken out of the Final Focus Lens / Focus Head versus the BDO may not reach these values.

Model-450W (PM)				
STD Mode Calibration / sCal Multi Pulse				
PW=3.0 mS & Hertz=10				PW=3.0mS Hertz=0
Touch Screen Display (Actual Values in Display)		Power / Energy Meter (Typical Values*)		Power / Energy Meter (Typical Values**)
Joules / J	Watts / W (Peak Power)	Watts / W (Avg. Power) (measured)	Joules / J (W ÷ 10) (calculated)	Joules** / J (measured)
1.35	450	13.65	1.365	1.359
2.70	900	26.34	2.634	2.640
4.05	1350	40.65	4.065	4.035
3.60	1800	54.12	5.412	5.430
5.40	2250	67.47	6.75	6.741
8.10	2700	80.85	8.09	8.07
9.45	3150	93.0	9.30	9.36
7.20	3600	107.1	10.71	10.68
10.80***	4050	120.9	12.09	12.12
13.5***	4500	134.4	13.44	13.53

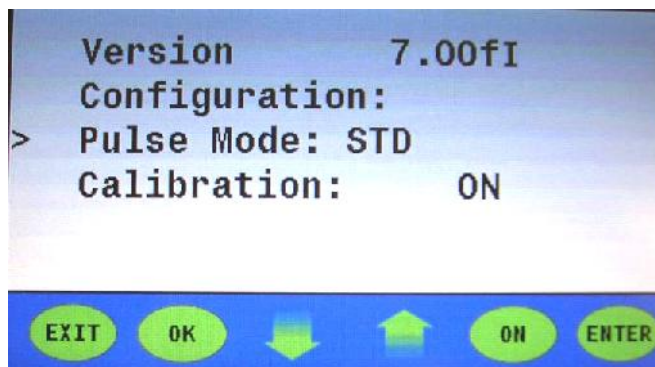
**Table 1 / 450W
(STD Mode Calibration Table-Joules-Typical)**

(*)-These values are typical. The person calibrating the system should match the Joules value (Watts÷10) from the power / energy meter as close as possible to the Joules value in the Touch Screen Display.

(**)-The measured Joules value should be the average of at least 3 (minimum) measurements.

(***)-Measurements taken out of the Final Focus Lens / Focus Head versus the BDO may not reach these values.

2. Press the MENU Icon / Button to open Menu screen.
3. Scroll down to Pulse Mode and press ENTER. **(Figure 2)**
4. Press the up or down arrow to select STD.
5. Press ENTER and press EXIT.



**Figure 2
(Menu Screen with "Pulse Mode: STD" Selected)**

6. Scroll down to Calibration / press ENTER
7. The display will read "CALIBRATION: ON" (**Figure 3**)

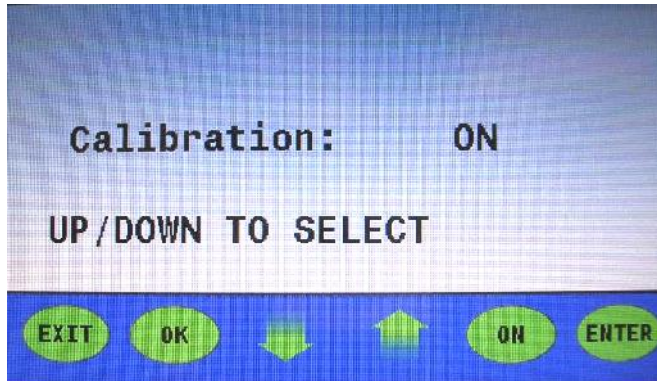


Figure 3
(“Calibration: ON” Screen)

8. Press the up or down arrow once and three “0”s / (000) will show up to the right of the word “Password”. The first digit will be blinking. (**Figure 4**)
(**Note:** The password to be entered “438”.)

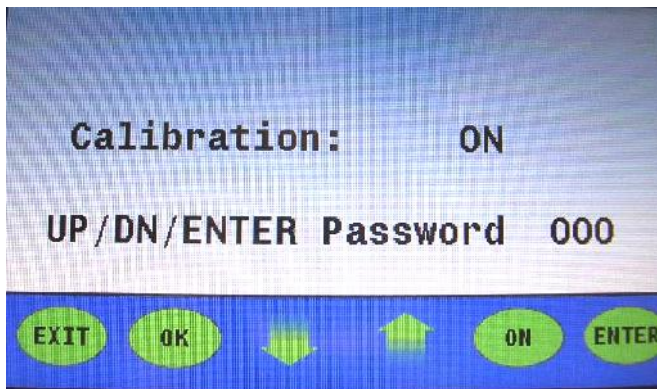


Figure 4
(Password Screen)

9. Press the up or down arrow to set the value for the blinking “0” to “4” and then press ENTER.
10. Press the up or down arrow to set the value for the next blinking “0” to “3” and then press ENTER.
11. Press the up or down arrow to set the value for the last blinking “0” to “8” and then press ENTER.
12. The display will read “Calibration: TABLE”. (**Figure 5**)

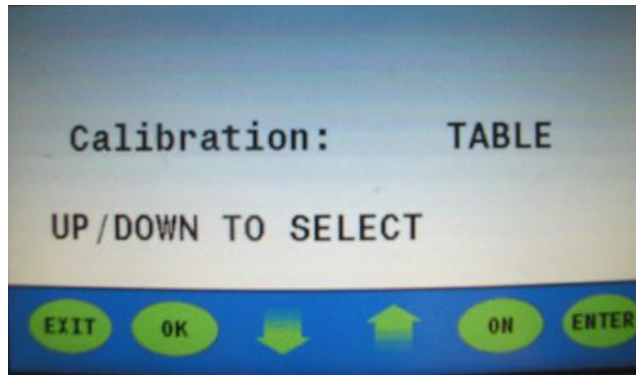


Figure 5
(“Calibration: TABLE” Screen)

13. Press ENTER.
14. Press the up or down arrow to select “CLR TABLE”. **(Figure 6)**
15. Press ENTER.

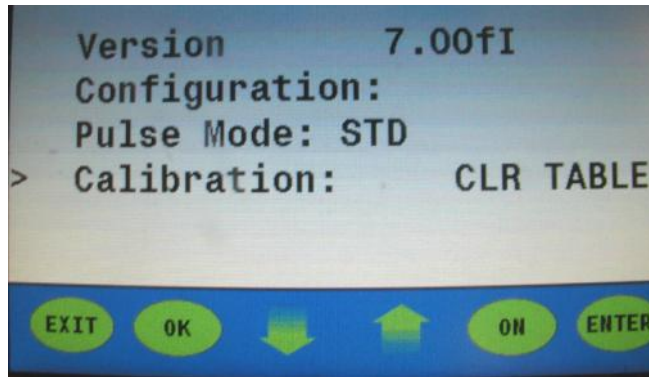


Figure 6
(Menu Screen with “Calibration: CLR TABLE” Selected)

16. Press EXIT twice to return to the Main Screen. **(Figure 1)**
17. Main Screen should display “150W LASER DISABLED”
18. Verify the parameters on the Main Screen match the parameters in step “1”. **(Figure 1)**
19. Press MENU and scroll down to Calibration and press Enter.
20. Press up or down arrow to select TABLE. **(Figure 7)**
21. Press ENTER.
22. Press EXIT twice to return to Main Screen

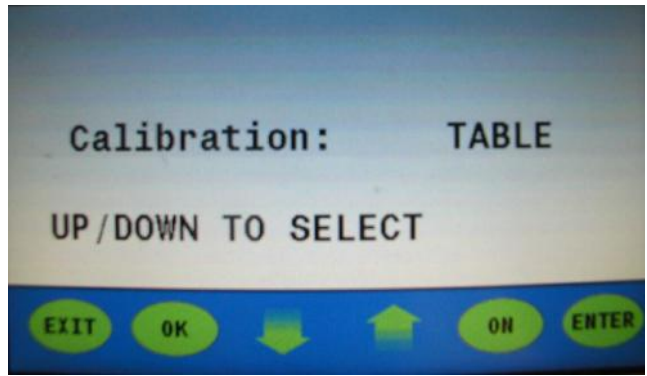


Figure 7
(“Calibration: TABLE” Screen)

- 23. Set up Power Meter & Power Head to measure watts (**Note:** Make sure the beam is out of focus / defocused. The beam diameter on the Power Head should be approximately (3/4”) diameter.)
- 24. Laser Disabled.
- 25. Press the Joule button on the Main Menu and press the up or down arrow to enter the first or next Joule value from **Table 1 / XXXW**.
- 26. Laser Enabled and the display should read “150W sCAL MULTI PULSE”.
(**Figure 8**)



Figure 8
(Main Screen-TABLE Calibration-Laser Enabled-“150W sCAL MULTI PULSE”)

- 27. Depress the Foot Pedal Switch until the power meter value stabilizes (~30) seconds
- 28. Take a reading (Note: The goal is to have the power meter value ($W \div 10 = J$) equal the Joules parameter value (as close as possible) shown in the touch screen display.)
- 29. Release the Foot Pedal Switch
- 30. Press the UP or Down arrows (2X) to adjust the laser output
- 31. Repeat steps (27 to 31) until the power meter value ($W \div 10 = J$) equals the Joules parameter value (as close as possible) displayed in the touch screen display
- 32. Run for (~60) seconds to verify that the power meter value ($W \div 10 = J$) equals the Joules parameter value (as close as possible) displayed in the touch screen display, if not repeat steps (27 to 32)

33. Laser Disabled
34. Repeat steps 25 to 33 until all values in **Table 2** have been entered.
35. Laser Disabled
36. Press the MENU button and scroll down to calibration and press ENTER.
37. Press the up or down arrow to change "TABLE" to "ON". **(Figure 9)**

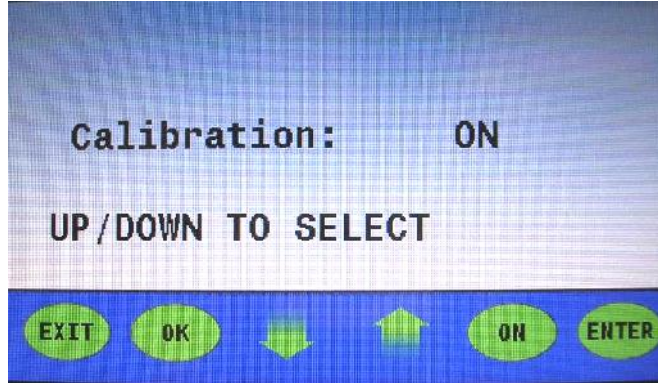


Figure 9
(“Calibration: ON” Screen)

38. Press ENTER
39. Press EXIT twice to return to the Main Screen. **(Figure 1)**
40. Table calibration is complete.

MICRO Mode Table Calibration Procedure-Joules: (Figure 10-18 & Table 2 / XXXW)

1. On the Main Screen put in the following Parameters with the Laser Disabled. **(Figure 10)**
 - a. Joules-.500 / **150W** Model
 1. **Note:** Select the first Joule value from the Table for each model [150W, 300W, etc.]
 2. **Note:** The (8) specific Joules calibration values are shown in **Table 2 / XXXW**. When in the CAL mode, the display will read one of the eight Watts values from **Table 2 / XXXW** followed by “MICRO MULTI PULSE”.
 - b. Pulse Width-10.0ms
 - c. Frequency-10Hz
 - d. Burst-0
 - e. Basic
 - f. Watts-50 (8 Watts values calculated based on 8 Joules values in **Table 2 / XXXW**)
 1. **(Note:** Select the first Watts value from the Table for each model [150W, 300W, etc.]



Figure 10
(Main Screen-Laser Disabled)

Model-150W (PM)				
MICRO Mode Calibration / μCAL Multi Pulse				
PW=10.0 mS & Hertz=10				PW=3.0mS Hertz=0
Touch Screen Display (Actual Values in Display)		Power / Energy Meter* (Typical Values)		Power / Energy Meter (Typical Values**)
Joules / J	Watts / W (Peak Power)	Watts / W (Avg. Power) (measured)	Joules / J (W \div 10) (calculated)	Joules** / J (measured)
.500	50	5.20	.520	.505
.750	75	7.61	.761	.755
1.00	100	10.14	1.014	1.020
1.25	125	12.75	1.275	1.270
1.50	150	15.16	1.516	1.510
1.75	175	17.65	1.765	1.755
2.00	200	20.15	2.015	2.010
2.25***	225	22.54	2.254	2.251
2.50***	250	24.90	2.490	2.485

Table 2 / 150W
(MICRO Mode Calibration Table-Joules-Typical)

(*)-These values are typical. The person calibrating the system should match the Joules value (Watts \div 10) from the power / energy meter as close as possible to the Joules value in the Touch Screen Display.

(**)-The measured Joules value should be the average of at least 3 (minimum) measurements.

(***)-Measurements taken out of the Final Focus Lens / Focus Head versus the BDO / Collimator may not reach these values.

Model-300W (PM)				
MICRO Mode Calibration / μCAL Multi Pulse				
PW=10.0 mS & Hertz=10				PW=3.0mS Hertz=0
Touch Screen Display (Actual Values in Display)		Power / Energy Meter* (Typical Values)		Power / Energy Meter (Typical Values**)
Joules / J	Watts / W (Peak Power)	Watts / W (Avg. Power) (measured)	Joules / J (W \div 10) (calculated)	Joules** / J (measured)
1.00	100	10.40	1.04	1.01
1.50	150	15.22	1.52	.755
2.00	200	20.28	2.03	1.51
2.50	250	25.50	2.55	2.54
3.00	300	30.32	3.03	3.02
3.50	350	35.30	3.53	3.51
4.00	400	40.30	4.03	4.02
4.50***	450	45.08	4.51	4.50
5.00***	500	49.80	4.98	4.97

**Table 2 / 300W
(MICRO Mode Calibration Table-Joules-Typical)**

(*)-These values are typical. The person calibrating the system should match the Joules value (Watts \div 10) from the power / energy meter as close as possible to the Joules value in the Touch Screen Display.

(**)-The measured Joules value should be the average of at least 3 (minimum) measurements.

(***)-Measurements taken out of the Final Focus Lens / Focus Head versus the BDO / Collimator may not reach these values.

Model-450W (PM)				
MICRO Mode Calibration / μ CAL Multi Pulse				
PW=10.0 mS & Hertz=10				PW=3.0mS Hertz=0
Touch Screen Display (Actual Values in Display)		Power / Energy Meter* (Typical Values)		Power / Energy Meter (Typical Values**)
Joules / J	Watts / W (Peak Power)	Watts / W (Avg. Power) (measured)	Joules / J (W \div 10) (calculated)	Joules** / J (measured)
1.50	150	15.60	1.56	1.52
2.25	225	22.83	2.28	2.27
3.00	300	30.42	3.04	3.06
3.75	375	38.25	3.83	3.81
4.50	450	45.48	4.55	4.53
5.25	525	52.95	5.30	5.27
6.00	600	60.45	6.05	6.03
6.75***	675	67.62	6.76	6.75
7.50***	750	74.70	7.47	7.46

Table 2 / 450W
(MICRO Mode Calibration Table-Joules-Typical)

(*)-These values are typical. The person calibrating the system should match the Joules value (Watts \div 10) from the power / energy meter as close as possible to the Joules value in the Touch Screen Display.

(**)-The measured Joules value should be the average of at least 3 (minimum) measurements.

(***)-Measurements taken out of the Final Focus Lens / Focus Head versus the BDO / Collimator may not reach these values.

2. Press the Menu Icon / Button to open Menu screen.
3. Scroll down to Pulse Mode and press ENTER. **(Figure 11)**
4. Press the up or down arrow to select MICRO.
5. Press ENTER and press EXIT.

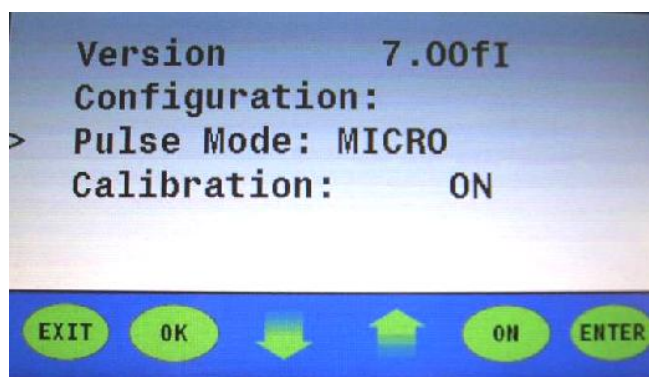


Figure 11
(Menu Screen with "Pulse Mode: MICRO" Selected)

6. Scroll down to Calibration and press ENTER
7. The display will read "CALIBRATION: ON" (**Figure 12**)

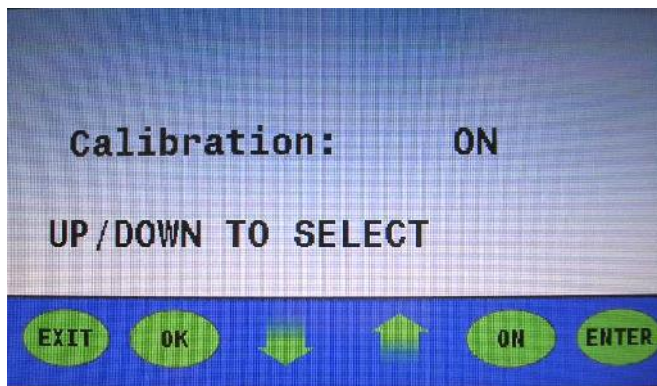


Figure 12
(“Calibration: ON” Screen)

8. Press the up or down arrow once and three “0”s / (000) will show up to the right of the word “Password”. The first digit will be blinking. (**Figure 13**)
(**Note:** The password to be entered is “438” / factory default or a new password / “XXX” created / entered by the user.)

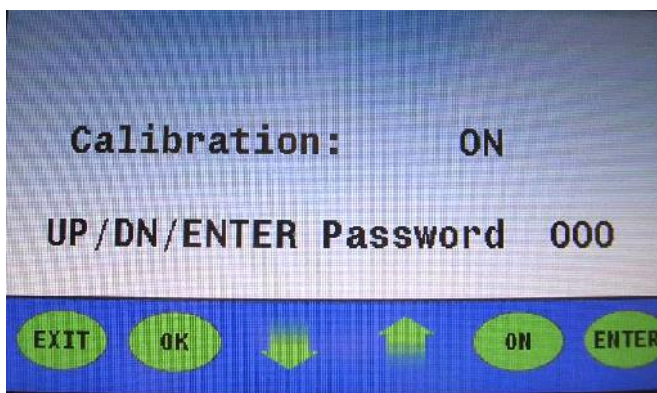


Figure 13
(Password Screen)

9. Press the up or down arrow to set the first value for the blinking “0” to “4” and then press ENTER.
10. Press the up or down arrow to set the next value for the next blinking “0” to “3” and then press ENTER.
11. Press the up or down arrow to set the last value for the last blinking “0” to “8” and then press ENTER.
12. The display will read “Calibration: TABLE”. (**Figure 14**)

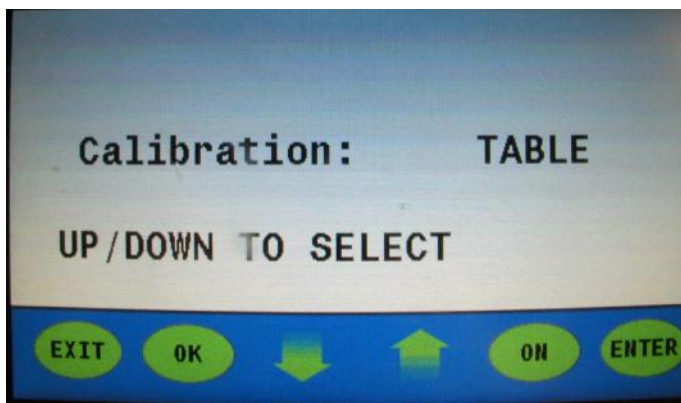


Figure 14
(“Calibration: TABLE” Screen)

13. Press ENTER.
Press the up or down arrow to select “CLR TABLE”. **(Figure 15)**
14. Press ENTER.

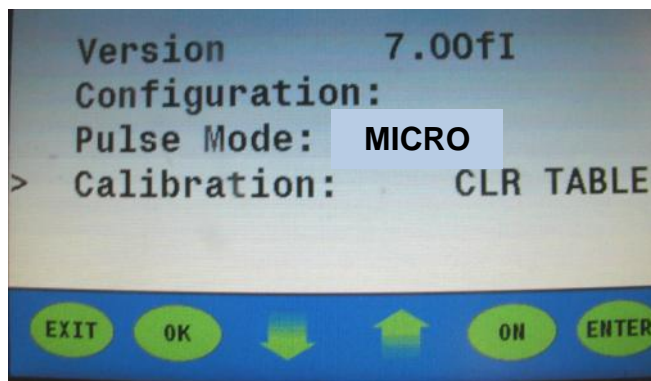


Figure 15
(Menu Screen with “Calibration: CLR TABLE” Selected)

15. Press EXIT twice to return to the Main Screen. **(Figure 10)**
16. Main Screen should display “50W LASER DISABLED”.
17. Verify the parameters on the Main Screen match the parameters in step “1”.
(Figure 10)
18. Press MENU and scroll down to Calibration and press Enter.
19. Press up or down arrow to select TABLE. **(Figure 16)**
20. Press ENTER.
21. Press EXIT twice to return to Main Screen

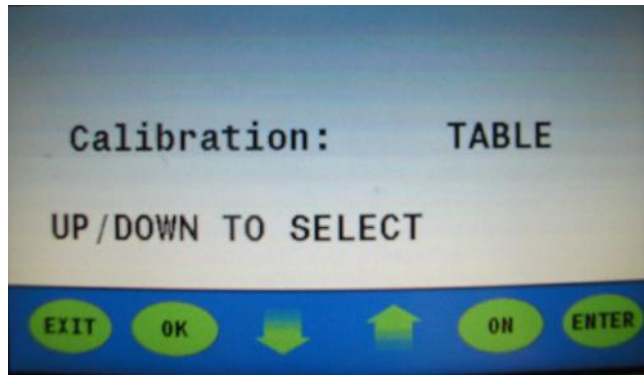


Figure 16
(“Calibration: TABLE” Screen)

22. Set up Power Meter & Power Head to measure watts (**Note:** Make sure the beam is out of focus / defocused. The beam diameter on the Power Head should be approximately (3/4”) diameter.)
23. Laser Disabled.
24. Press the Joule button on the Main Menu and press the up or down arrow to enter the first or next Joule value from **Table 2 / XXXW**.
25. Laser Enabled and the Main Screen display should read “50W μ CAL MULTI PULSE”. (**Figure 17**)



Figure 17
(Main Screen-Table Calibration-Laser Enabled-“50W μ CAL MULTI PULSE”)

26. Depress the Foot Pedal Switch until the power meter value stabilizes (~30) seconds
27. Take a reading (Note: The goal is to have the power meter value ($W \div 10 = J$) equal the Joules parameter value (as close as possible) shown in the touch screen display.)
28. Release the Foot Pedal Switch
29. Press the UP or Down arrows (2X) to adjust the laser output
30. Repeat steps (26 to 30) until the power meter value ($W \div 10 = J$) equals the Joules parameter value (as close as possible) displayed in the touch screen display
31. Run for (~60) seconds to verify that the power meter value ($W \div 10 = J$) equals the Joules parameter value (as close as possible) displayed in the touch screen display, if not repeat steps (26 to 31)

32. Laser Disabled.
33. Repeat steps 24 to 32 until all values in **Table 2 / XXXW** have been entered.
34. Laser Disabled.
35. Press Menu button and scroll down to Calibration and press ENTER.
36. Press the up or down arrow to change "TABLE" to "ON". **(Figure 18)**

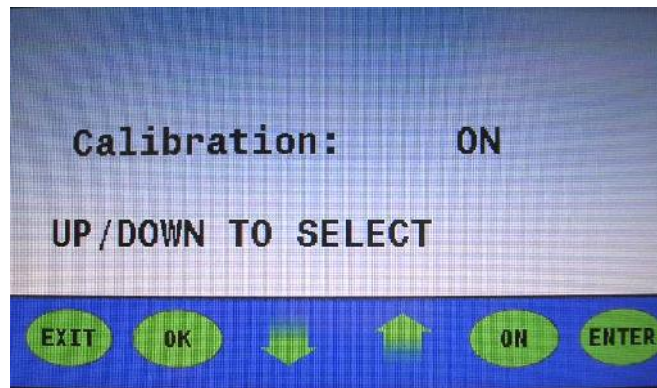


Figure 18
("Calibration: ON" Screen)

37. Press ENTER
38. Press EXIT twice to return to the Main Screen. **(Figure 10)**
39. The calibration is complete.

Appendix C: Pulse Performance Profile Technology

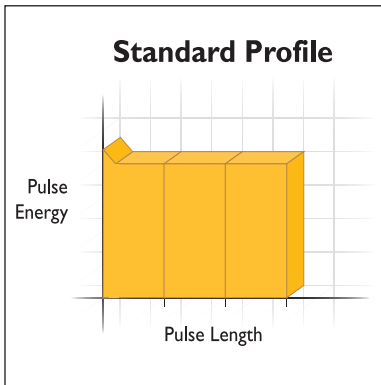
Fundamentals of Laser Welding



Background

A pulse of LaserStar energy consists of a number of characteristics or variables. Two of these variables are the power and duration of the pulse.

The height of a laser pulse is the laser's peak power in kW. The pulse can be charted so that the pulse height is shown on the Y-axis and the length or duration is shown along the X-axis. The area under the curve of the pulse height and length is the pulse energy in joules.



A standard pulse shape from the LaserStar is a rectangle pulse with an initial spike for the first half millisecond or so. This initial spike helps break down the reflectivity of the metal to get good energy coupling started. The spike can be removed or accentuated, as you'll see later in this technical guideline.

A number of variables can affect the dimensions and quality of laser welds. Broadly speaking, welds can be categorized into two "modes:" conduction welds and keyhole welds.

In conduction welds, the surface of the metal melts and through heat conduction into the metal, a portion of the metal beneath the laser spot melts. Heat loss through conduction limits the maximum depth of the weld to approximately 1mm depending on the material.

Keyhole welds are much deeper than conduction welds. In order to penetrate deeply into the metal, some of the metal must be vaporized to create a channel. Some metal is lost through vaporization or splatter.

The variables that affect the melt pool dimensions and quality of spot welds include:

- The spatial energy distribution of the incident beam
- The peak pulse power of the pulse
- The pulse energy
- The pulse length
- The profile shape of the pulse energy

Fundamentals of Laser Welding



About P³ Technology

Profiling a LaserStar pulse is simply selecting the percentage of pulse energy that is released for each one millisecond (1MS) section. Each individual section is defined at 25%, 50%, 75% or 100% of total pulse energy output. To benefit from pulse profiling, a minimum of a three millisecond (3MS) pulse duration must be employed to achieve noticeable results.

The energies required for pulsed laser welding can vary depending upon the pulse profiles selected.

If certain profiles are chosen for slower cooling or surface cleaning, then the energy is not always being used to increase penetration. Instead, it may be directed at vaporization of contaminants or bulk heating. When this is the case, the energy required (parameter selections: Voltage and Pulse-length) will increase to achieve the same weld penetration before a custom profile was applied. The parameter adjustments may reduce lamp life, reduce process speeds, and/or increase cycle times. However, it is a small price to pay and almost always worth the weld quality improvements.

Conversely, if the initial spike is increased to improve energy coupling or duty cycle, Burst Profiles are used, then the process can become much more efficient. Less energy per pulse is used with pulse profiling for the same task.

When in doubt about which pulse profile may be most beneficial, first set up a process with a Basic Profile and note the energy used (parameter selections) for a particular application. Next, select a recommended pulse profile for the same application and compare the energy used (parameter selections). Finally, compare the two different process results and choose a profile that meets your quality and process speed requirements.

Fundamentals of Laser Welding



Getting Started

Normally, a Basic Profile is quite adequate when welding standard ferrous alloys without plating. However, when welding applications with reflective, very dissimilar or contaminated materials, pulse profiling may have a measurable effect on quality and consistency.

For example, a particular alloy may produce small, hair-line cracks with a Basic Profile. However, when a Ramp Down Profile is used the alloy produces a solid, excellent weld because the heat is reduced in steps.

To determine if Pulse Performance Profile Technology will benefit your applications, one must first become familiar with the parameter selection process of your LaserStar micro-welding product.

Second, you must be sure to understand what each Pulse Profile change means in terms of pulse energy output and the impact on the material.

Then, start process improvements by employing a pulse profile. Try a profile based on its description and recommended use and measure any differences you see in the weld compared to a Basic Profile. If you lose penetration, then increase the energy (V) where the real processing should take place. If the results are worse, try a different pulse profile scheme.

After trying various pulse profiles, do not be concerned if the best pulse profile for your application seems to be the Basic Profile – at least you will know that it really is optimized.

Fundamentals of Laser Welding



Using P³ Technology

The following seven (7) Pulse Profiles have been imbedded into your LaserStar micro-welding software. Each profile has been programmed/imbedded in a specific memory location.

All pulse profiles are voltage proportional. For a specific profile, if the voltage increases, the energy per section increases, but the percentage of the energy output remains the same.

The energy per section is proportional to the selected pulse length. A minimum of a 3 MS pulse length is required to activate the pulse profile. If the pulse length is 3 MS, then each section's pulse width is 1 MS. If the pulse length is 9 MS, then each section's pulse width is 9 MS divided by 3, which equals 3 MS, and so on.

All pulse profiles (except Basic) have a minimum pulse length of 3 milliseconds. The parameter display will automatically default to this setting and reset if a shorter pulse length is selected.

Technical Specifications:

Number of imbedded pulse profiles:	7
Pulse width:	3 – 20 MS
Energy levels per section:	5 (0%, 25%, 50%, 75%, 100%)
Number of energy sections:	3
Section pulse width minimum value:	1 MS

Pre-Programmed Pulse Performance Values:

Description	Profile Description
Basic Profile	100%, 100%, 100%
Spike Profile	100%, 25%, 25%
Ramp Down Profile	100%, 50%, 25%
Ramp Up Profile	25%, 50%, 100%
Pyramid Profile	50%, 100%, 50%
Pre-Pulse Profile	50%, 100%, 75%
Burst Profile	50%, 50%, 50%

Fundamentals of Laser Welding



Directions to Change Pulse Profiles:

There are two methods to change the Pulse Profile, they are as follows:

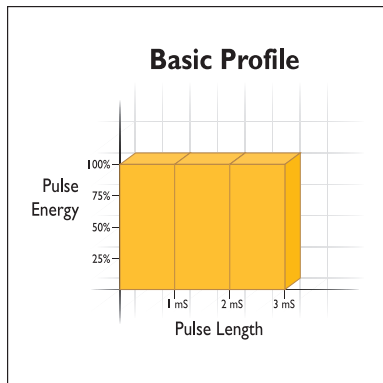
1. From Keypad:
 - a. Press the “Enter Key.” The Pulse Profile in the lower right corner of the display will blink.
 - b. Press the Up or Down arrow keys to scroll through the different profiles.
 - c. When the desired profile is displayed, wait for the profile to stop blinking.
2. From inside of the welding chamber:
 - a. Press and hold the “Shutter Open” button on the right side of the back wall.
 - b. Scroll with the MS joystick, the far left joystick, move left to right.
 - c. When desired profile appears on the display, release the shutter button.

Directions to customize the power levels in each Pulse Profile manually

Some applications may require variations of these levels. The software has the ability to customize the power levels in each section of the Pulse Profile. To change the power levels manually, do the following:

1. Press the “Enter” key on the keypad. The Pulse Profile will blink.
2. Press the “ABC” key on the key pad.
3. Press the Up or Down arrow keys to scroll to the desired Pulse Profile.
4. Press the “Enter” key on the keypad. The setting of the first section of the Pulse Profile will appear.
5. Press the Up or Down arrow to change the power level.
6. Press the “Enter” key to accept the desired power level. Then the second section of the Pulse Profile will appear.
7. Repeat steps 5 and 6 for the second and third sections of the Pulse Profile.
8. Press “Enter” two more times to exit this menu.

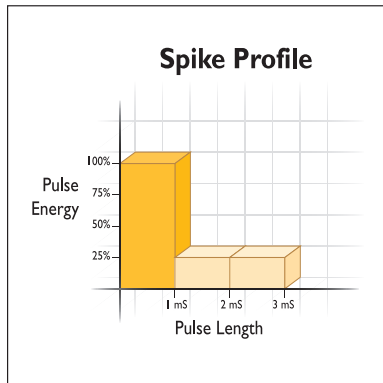
Fundamentals of Laser Welding



Basic Profile is used by Yellow Gold, Platinum and Stainless Steel.

For very low penetration welds that require excellent cosmetics, or when welding volatile materials such as low melting point alloys, a basic pulse profile that suppresses the initial higher peak power spike can be beneficial.

By eliminating the spike, the weld puddle will vibrate less during cooling. Ripples on the melt surface caused by vibrations freeze in the puddle producing a less smooth and shiny surface. Materials with low melting points or very good absorption do not require the initial spike.



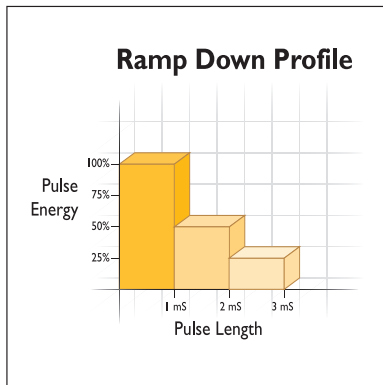
Spike Profile used with Silver and Copper.

(Recommended for Silver for tacking or single pulse mode.)

A spike profile can be helpful with highly reflective metals with very high conductivity such as high pure copper alloys, silver alloys and some aluminum alloys, or in any application where the surface is very reflective and the focused spot is larger.

In this profile, the initial spike in the first section is produced to start melting the surface, then the absorption increases by up to 20 times, so the rest of the laser pulse energy can be much lower. This can reduce the energy needed to weld materials, making coupling much more consistent, and reducing weld spatter from the process.

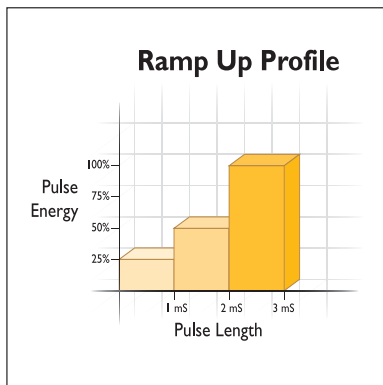
Fundamentals of Laser Welding



Ramp Down is used with Silver and Aluminum.

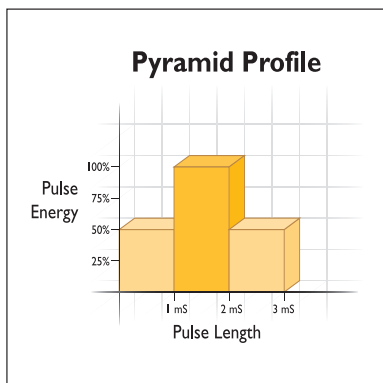
(Recommended for Silver in core welding or multi-pulse mode.)

With higher carbon steels, crack sensitive alloys, casting alloys with voids or contaminants or when the materials to be welded have very dissimilar melting points, a ramp down profile can be a huge benefit in the reduction of cracks and porosity (voids) in the weld.



Ramp Up Profile is used with White Gold.

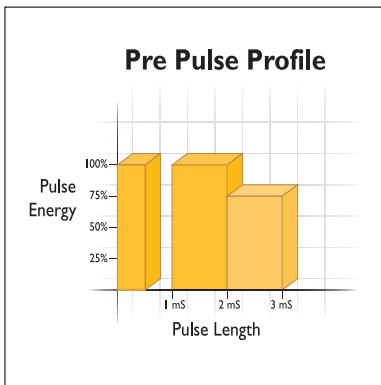
When welding materials with low melting points of very low reflectivity or when welding materials with lots of volatile contaminants or plating, the ramp up profile is helpful.



Pyramid Profile is used with Titanium.

This profile combines both the ramp up and ramp down characteristics and is suitable when welding dissimilar metals but non-reactive to oxygen.

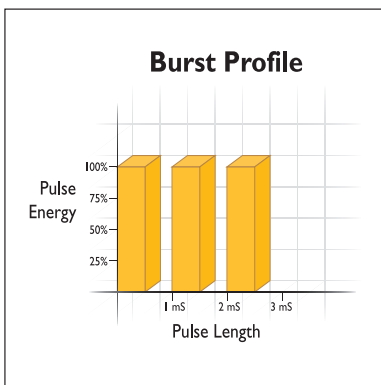
Fundamentals of Laser Welding



Pre Pulse Profile is used with Eyeglasses.

When welding materials that have a low melting or boiling point, a plating or surface covering, or contaminants such as pre-tinned electronic parts, anodized parts, painted parts or oil-contaminated parts, a pre-pulse profile can help. Also, parts that have varying reflectivity due to coating differences, oxidation or surface finish can benefit from a pre-pulse profile.

This pulse profile has an initial section with enough energy to vaporize and/or partially weld the materials and get heat into the part to get eliminate contaminants. This is usually followed by a delay of up to .5 MS to allow the material to get out of the weld zone and then the main weld process occurs striking a consistent surface to create a good weld.



Burst Profile is used with Pewter, Hollow (thin wall) and Low Melting Pot Metal.

Essentially, this profile delivers the pulse energy output in repeated cycles with consistent peak power. It has been found to have value in increasing the weld depth.

Fundamentals of Laser Welding

RECOMMENDED PRE-PROGRAMMED PARAMETER SETTINGS 40 JOULE iWELD LASER SYSTEM

NOTE: Beam diameter based on number of clicks open to the right.

WHITE GOLD POROSITY
205V 6.0MS 3.0HZ 3 CLICKS

PLATINUM POROSITY
250V 4.0MS 3.0HZ 3 CLICKS

WHITE GOLD RE-TIP
206V 4.5 MS 3.0HZ 6 CLICKS

PLATINUM RE-TIP
248V 3.9MS 3.0HZ 4 CLICKS

WHITE GOLD SIZE THIN
220V 9.0MS 2.0HZ 3 CLICKS

PLATINUM SIZE THIN
300V 5.5MS 2.0HZ 4 CLICKS

WHITE GOLD SIZE THICK
230V 9.5MS 2.0HZ 3 CLICKS

PLATINUM SIZE THICK
330V 7.0MS 2.0HZ 4 CLICKS

YELLOW GOLD POROSITY
235V 6.0MS 2.0HZ 3 CLICKS

JUMP RINGS
240V 4.0MS 2.0HZ 2 CLICKS

YELLOW GOLD RE-TIP
235V 4.5MS 3.0HZ 4 CLICKS

TITANIUM
240V 5.0MS 2.0HZ 3 CLICKS

YELLOW GOLD SIZE THIN
245V 4.0MS 2.0HZ 3 CLICKS

HOLLOW
195V 2.5MS 14.0HZ 0 CLICKS

YELLOW GOLD SIZE THICK
285V 6.5MS 2.0HZ 3 CLICKS

PEWTER
215V 2.5MS 4.0HZ 5 CLICKS

SILVER POROSITY
275V 5.0MS 2.5HZ 3 CLICKS

WHITE BASE METAL
220V 3.0MS 4.0HZ 5 CLICKS

SILVER RE-TIP
238V 2.5MS 3.0HZ 4 CLICKS

EYEGASSES
230V 4.5MS 2.0HZ 3 CLICKS

SILVER SIZE THIN
295V 5.0MS 2.0HZ 3 CLICKS

STAINLESS STEEL
245V 5.0MS 2.0HZ 3 CLICKS

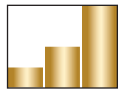
SILVER SIZE THICK
305V 6.5MS 2.0HZ 3 CLICKS

CROSSHAIR ALIGN
250V 5.0MS 0.0HZ 4 CLICKS

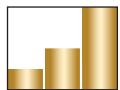
NOTE: The above parameter combinations are suggested starting points for 40 Joule iWeld Laser Systems and are subject to change based on flashlamp age and the alloy's surface condition.

Fundamentals of Laser Welding

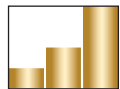
RECOMMENDED PRE-PROGRAMMED PARAMETER SETTINGS 40 & 60 JOULE iWELD LASER SYSTEM WITH P3



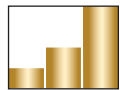
WHITE GOLD POROSITY
190V 3.5MS 3.0HZ 0.50MM
Ramp Up Profile



WHITE GOLD RE-TIP
195V 3.5MS 3.0HZ 0.50MM
Ramp Up Profile



WHITE GOLD SIZE THIN
200V 4.0MS 2.0HZ 0.50MM
Ramp Up Profile



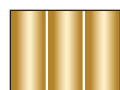
WHITE GOLD SIZE THICK
210V 4.5MS 2.0HZ 0.45MM
Ramp Up Profile



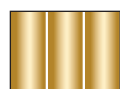
YELLOW GOLD POROSITY
220V 3.0MS 2.0HZ 0.60MM
Basic Profile



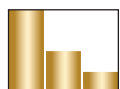
YELLOW GOLD RE-TIP
210V 3.0MS 3.0HZ 0.60MM
Basic Profile



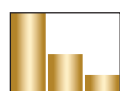
YELLOW GOLD SIZE THIN
210V 3.0MS 2.0HZ 0.40MM
Basic Profile



YELLOW GOLD SIZE THICK
220V 4.0MS 2.0HZ 0.45MM
Basic Profile



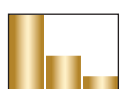
SILVER POROSITY
255V 3.0MS 2.0HZ 0.70MM
Ramp Down Profile



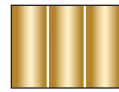
SILVER RE-TIP
240V 3.0MS 2.0HZ 0.70MM
Ramp Down Profile



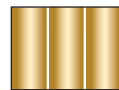
SILVER SIZE THIN
250V 3.0MS 2.0HZ 0.40MM
Ramp Down Profile



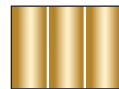
SILVER SIZE THICK
270V 3.5MS 2.0HZ 0.30MM
Ramp Down Profile



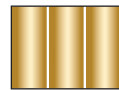
PLATINUM POROSITY
234V 3.0MS 2.0HZ 0.60MM
Basic Profile



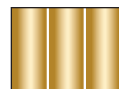
PLATINUM RE-TIP
225V 3.0MS 3.0HZ 0.60MM
Basic Profile



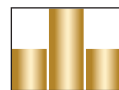
PLATINUM SIZE THIN
235V 3.0MS 2.0HZ 0.40MM
Basic Profile



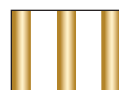
PLATINUM SIZE THICK
240V 4.0MS 2.0HZ 0.35MM
Basic Profile



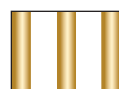
JUMP RINGS
185V 5.0MS 2.0HZ 0.70MM
Basic Profile



TITANIUM
225V 3.5MS 2.0HZ 0.55MM
Pyramid Profile



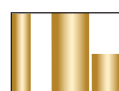
HOLLOW
200V 3.0MS 1.1HZ 0.35MM
Burst Profile



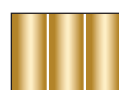
PEWTER
180V 3.0MS 1.0HZ 0.55MM
Burst Profile



WHITE BASE METAL
195V 3.5MS 2.0HZ 0.70MM
Burst Profile



EYEGASSES
190V 3.5MS 2.0HZ 0.55MM
PrePulse Profile

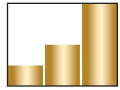


STAINLESS STEEL
215V 3.0MS 2.0HZ 0.50MM
Basic Profile

NOTE: The above parameter combinations are suggested starting points for 40-60 Joule iWeld Systems (990 Series) and are subject to change based on flashlamp age and the alloy's surface condition.

Fundamentals of Laser Welding

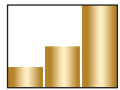
RECOMMENDED PRE-PROGRAMMED PARAMETER SETTINGS 80 JOULE iWELD LASER SYSTEM WITH P3



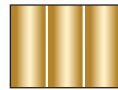
WHITE GOLD POROSITY
190V 3.7MS 3.0HZ 0.70MM
Ramp Up Profile



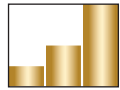
PLATINUM POROSITY
213V 2.5MS 2.0HZ 0.80MM
Basic Profile



WHITE GOLD RE-TIP
193V 3.3MS 3.0HZ 0.65MM
Ramp Up Profile



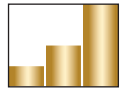
PLATINUM RE-TIP
215V 2.5MS 2.0HZ 0.80MM
Basic Profile



WHITE GOLD SIZE THIN
204V 3.5MS 2.0HZ 0.70MM
Ramp Up Profile



PLATINUM SIZE THIN
220V 3.0MS 2.0HZ 0.65MM
Basic Profile



WHITE GOLD SIZE THICK
211V 3.7MS 2.0HZ 0.80MM
Ramp Up Profile



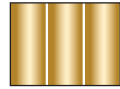
PLATINUM SIZE THICK
230V 3.5MS 2.0HZ 0.75MM
Basic Profile



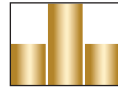
YELLOW GOLD POROSITY
205V 3.1MS 2.0HZ 0.70MM
Basic Profile



JUMP RINGS
218V 3.2MS 2.0HZ 0.75MM
Basic Profile



YELLOW GOLD RE-TIP
207V 2.5MS 3.0HZ 0.80MM
Basic Profile



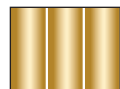
TITANIUM
216V 3.0MS 2.0HZ 0.65MM
Pyramid Profile



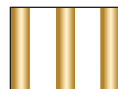
YELLOW GOLD SIZE THIN
210V 3.3MS 2.0HZ 0.60MM
Basic Profile



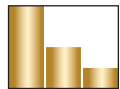
HOLLOW
205V 3.0MS 7.0HZ 0.35MM
Burst Profile



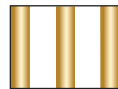
YELLOW GOLD SIZE THICK
225V 4.0MS 2.0HZ 0.70MM
Basic Profile



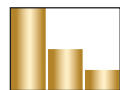
PEWTER
185V 3.0MS 9.0HZ 0.55MM
Burst Profile



SILVER POROSITY
235V 3.5MS 3.0HZ 0.70MM
Ramp Down Profile



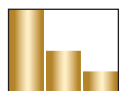
WHITE BASE METAL
200V 3.5MS 2.0HZ 0.80MM
Burst Profile



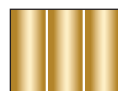
SILVER RE-TIP
235V 3.0MS 2.0HZ 0.80MM
Ramp Down Profile



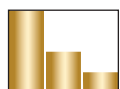
EYEGASSES
190V 3.5MS 2.0HZ 0.80MM
PrePulse Profile



SILVER SIZE THIN
250V 4.0MS 2.0HZ 0.50MM
Ramp Down Profile



STAINLESS STEEL
198V 2.5MS 3.0HZ 0.75MM
Basic Profile



SILVER SIZE THICK
265V 5.0MS 1.0HZ 0.70MM
Ramp Down Profile

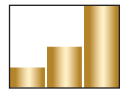


CROSS-HAIR ALIGN
205V 2.0MS 0.0HZ 0.70MM
Basic Profile

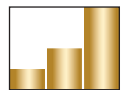
NOTE: The above parameter combinations are suggested starting points for 80 Joule iWeld Systems (990 Series) and are subject to change based on flashlamp age and the alloy's surface condition.

Fundamentals of Laser Welding

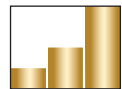
RECOMMENDED PRE-PROGRAMMED PARAMETER SETTINGS 100 JOULE iWELD LASER SYSTEM WITH P3



WHITE GOLD POROSITY
185V 3.7MS 3.0HZ 0.70MM
Ramp Up Profile



WHITE GOLD RE-TIP
188V 3.3MS 3.0HZ 0.65MM
Ramp Up Profile



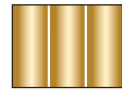
WHITE GOLD SIZE THIN
199V 3.5MS 2.0HZ 0.70MM
Ramp Up Profile



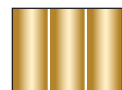
WHITE GOLD SIZE THICK
206V 3.7MS 2.0HZ 0.80MM
Ramp Up Profile



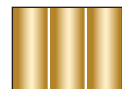
YELLOW GOLD POROSITY
200V 3.1MS 2.0HZ 0.70MM
Basic Profile



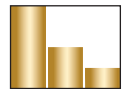
YELLOW GOLD RE-TIP
202V 2.5MS 3.0HZ 0.80MM
Basic Profile



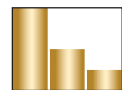
YELLOW GOLD SIZE THIN
204V 3.3MS 2.0HZ 0.60MM
Basic Profile



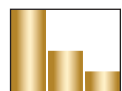
YELLOW GOLD SIZE THICK
220V 4.0MS 2.0HZ 0.70MM
Basic Profile



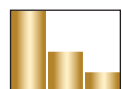
SILVER POROSITY
230V 3.5MS 3.0HZ 0.70MM
Ramp Down Profile



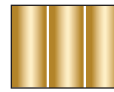
SILVER RE-TIP
230V 3.0MS 2.0HZ 0.80MM
Ramp Down Profile



SILVER SIZE THIN
245V 4.0MS 2.0HZ 0.50MM
Ramp Down Profile



SILVER SIZE THICK
260V 5.0MS 1.0HZ 0.70MM
Ramp Down Profile



PLATINUM POROSITY
208V 2.5MS 2.0HZ 0.80MM
Basic Profile



PLATINUM RE-TIP
210V 2.5MS 2.0HZ 0.80MM
Basic Profile



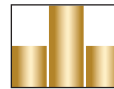
PLATINUM SIZE THIN
215V 3.0MS 2.0HZ 0.65MM
Basic Profile



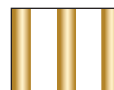
PLATINUM SIZE THICK
225V 3.5MS 2.0HZ 0.75MM
Basic Profile



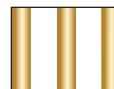
JUMP RINGS
213V 3.2MS 2.0HZ 0.75MM
Basic Profile



TITANIUM
211V 3.0MS 2.0HZ 0.65MM
Pyramid Profile



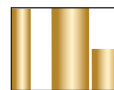
HOLLOW
200V 3.0MS 8.0HZ 0.35MM
Burst Profile



PEWTER
180V 3.0MS 10.0HZ 0.55MM
Burst Profile



WHITE BASE METAL
195V 3.5MS 2.0HZ 0.80MM
Burst Profile



EYEGASSES
185V 3.5MS 2.0HZ 0.80MM
PrePulse Profile



STAINLESS STEEL
193V 2.5MS 3.0HZ 0.75MM
Basic Profile

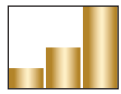


CROSS-HAIR ALIGN
200V 2.0MS 0.0HZ 0.70MM
Basic Profile

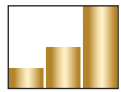
NOTE: The above parameter combinations are suggested starting points for 100 Joule iWeld Systems (990 Series) and are subject to change based on flashlamp age and the alloy's surface condition.

Fundamentals of Laser Welding

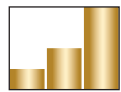
RECOMMENDED PRE-PROGRAMMED PARAMETER SETTINGS 80 JOULE LASERSTAR SYSTEMS WITH P3



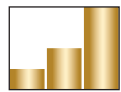
WHITE GOLD POROSITY
185V 3.0MS 3.0HZ 0.70MM
Ramp Up Profile



WHITE GOLD RE-TIP
190V 3.0MS 3.0HZ 0.40MM
Ramp Up Profile



WHITE GOLD SIZE THIN
180V 3.0MS 2.0HZ 0.40MM
Ramp Up Profile



WHITE GOLD SIZE THICK
195V 3.0MS 2.0HZ 0.30MM
Ramp Up Profile



YELLOW GOLD POROSITY
220V 2.3MS 3.0HZ 0.70MM
Basic Profile



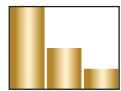
YELLOW GOLD RE-TIP
210V 2.6MS 3.0HZ 0.40MM
Basic Profile



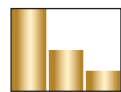
YELLOW GOLD SIZE THIN
210V 2.0MS 2.0HZ 0.40MM
Basic Profile



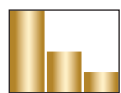
YELLOW GOLD THICK
235V 3.0MS 2.0HZ 0.30MM
Basic Profile



SILVER POROSITY
255V 3.0MS 2.0HZ 0.70MM
Ramp Down Profile



SILVER RE-TIP
250V 3.0MS 2.0HZ 0.40MM
Ramp Down Profile



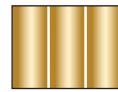
SILVER SIZE THIN
250V 3.0MS 2.0HZ 0.40MM
Ramp Down Profile



SILVER SIZE THICK
280V 4.0MS 2.0HZ 0.30MM
Ramp Down Profile



PLATINUM POROSITY
230V 2.3MS 2.0HZ 0.70MM
Basic Profile



PLATINUM RE-TIP
230V 3.0MS 2.0HZ 0.40MM
Basic Profile



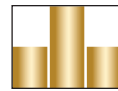
PLATINUM SIZE THIN
235V 2.0MS 2.0HZ 0.40MM
Basic Profile



PLATINUM SIZE THICK
240V 4.0MS 2.0HZ 0.30MM
Basic Profile



JUMP RINGS
185V 5.0MS 2.0HZ 0.70MM
Basic Profile



TITANIUM
190V 3.0MS 2.0HZ 0.55MM
Pyramid Profile



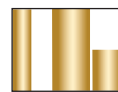
HOLLOW
200V 3.0MS 8HZ 0.35MM
Burst Profile



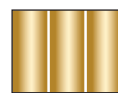
PEWTER
165V 3.0MS 3.0HZ 0.55MM
Burst Profile



WHITE BASE METAL
200V 8.5MS 3.0HZ 0.80MM
Burst Profile



EYEGASSES
160V 3.0MS 2.0HZ 0.55MM
PrePulse Profile

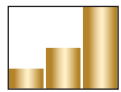


STAINLESS STEEL
220V 3.0MS 2.0HZ 0.50MM
Basic Profile

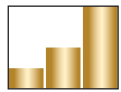
NOTE: The above parameter combinations are suggested starting points for 80 Joule LaserStar Welding Systems (7000 Series) and are subject to change based on flashlamp age and the alloy's surface condition.

Fundamentals of Laser Welding

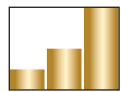
RECOMMENDED PRE-PROGRAMMED PARAMETER SETTINGS 80 JOULE LASERSTAR SYSTEMS WITH P3 AND SOFT-TOUCH



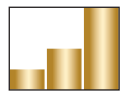
WHITE GOLD POROSITY
205V 6.0MS 2.0HZ 0.40MM
Ramp Up Profile



WHITE GOLD RE-TIP
208V 6.5MS 3.0HZ 0.45MM
Ramp Up Profile



WHITE GOLD SIZE THIN
215V 8.5MS 2.0HZ 0.40MM
Ramp Up Profile



WHITE GOLD SIZE THICK
220V 9.5MS 2.0HZ 0.40MM
Ramp Up Profile



YELLOW GOLD POROSITY
225V 3.0MS 3.0HZ 0.50MM
Basic Profile



YELLOW GOLD RE-TIP
227V 3.5MS 3.0HZ 0.40MM
Basic Profile



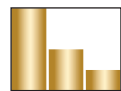
YELLOW GOLD SIZE THIN
233V 3.7MS 3.0HZ 0.50MM
Basic Profile



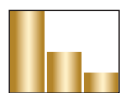
YELLOW GOLD SIZE THICK
250V 7.0MS 2.0HZ 0.60MM
Basic Profile



SILVER POROSITY
265V 5.0MS 2.5HZ 0.65MM
Ramp Down Profile



SILVER RE-TIP
265V 5.0MS 2.0HZ 0.70MM
Ramp Down Profile



SILVER SIZE THIN
285V 4.7MS 2.0HZ 0.50MM
Ramp Down Profile



SILVER SIZE THICK
310V 6.5MS 1.5HZ 0.60MM
Ramp Down Profile



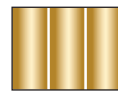
PLATINUM POROSITY
236V 2.9MS 2.0HZ 0.65MM
Basic Profile



PLATINUM RE-TIP
238V 3.0MS 3.0HZ 0.70MM
Basic Profile



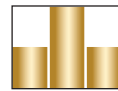
PLATINUM SIZE THIN
245V 4.1MS 2.0HZ 0.40MM
Basic Profile



PLATINUM SIZE THICK
250V 4.5MS 2.0HZ 0.40MM
Basic Profile



JUMP RINGS
230V 4.0MS 3.0HZ 0.65MM
Basic Profile



TITANIUM
230V 4.5MS 2.0HZ 0.70MM
Pyramid Profile



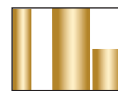
HOLLOW
225V 3.7MS 5.0HZ 0.35MM
Burst Profile



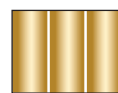
PEWTER
225V 5.0MS 3.0HZ 0.75MM
Burst Profile



WHITE BASE METAL
233V 5.5MS 3.0HZ 0.80MM
Burst Profile



EYEGGLASSES
200V 4.6MS 2.0HZ 0.50MM
PrePulse Profile

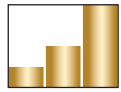


STAINLESS STEEL
228V 4.0MS 2.0HZ 0.60MM
Basic Profile

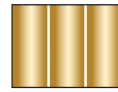
NOTE: The above parameter combinations are suggested starting points for 80 Joule LaserStar Welding Systems (7000 Series) with Soft-Touch and are subject to change based on flashlamp age and the alloy's surface condition.

Fundamentals of Laser Welding

RECOMMENDED PRE-PROGRAMMED PARAMETER SETTINGS 100 JOULE LASERSTAR SYSTEMS WITH P3



WHITE GOLD POROSITY
185V 3.0MS 3.0HZ 0.70MM
Ramp Up Profile



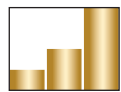
PLATINUM POROSITY
230V 2.3MS 2.0HZ 0.70MM
Basic Profile



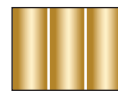
WHITE GOLD RE-TIP
190V 3.0MS 3.0HZ 0.40MM
Ramp Up Profile



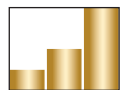
PLATINUM RE-TIP
230V 3.0MS 2.0HZ 0.40MM
Basic Profile



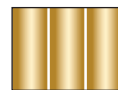
WHITE GOLD SIZE THIN
180V 3.0MS 2.0HZ 0.40MM
Ramp Up Profile



PLATINUM SIZE THIN
235V 2.0MS 2.0HZ 0.40MM
Basic Profile



WHITE GOLD SIZE THICK
195V 3.0MS 2.0HZ 0.30MM
Ramp Up Profile



PLATINUM SIZE THICK
240V 4.0MS 2.0HZ 0.30MM
Basic Profile



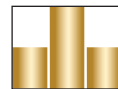
YELLOW GOLD POROSITY
220V 2.3MS 3.0HZ 0.70MM
Basic Profile



JUMP RINGS
185V 5.0MS 2.0HZ 0.70MM
Basic Profile



YELLOW GOLD RE-TIP
210V 2.6MS 3.0HZ 0.40MM
Basic Profile



TITANIUM
190V 3.0MS 2.0HZ 0.55MM
Pyramid Profile



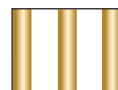
YELLOW GOLD SIZE THIN
210V 2.0MS 2.0HZ 0.40MM
Basic Profile



HOLLOW
200V 3.0MS 8HZ 0.35MM
Burst Profile



YELLOW GOLD THICK
235V 3.0MS 2.0HZ 0.30MM
Basic Profile



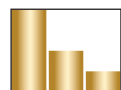
PEWTER
165V 3.0MS 3.0HZ 0.55MM
Burst Profile



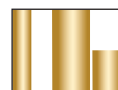
SILVER POROSITY
255V 3.0MS 2.0HZ 0.70MM
Ramp Down Profile



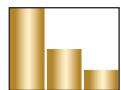
WHITE BASE METAL
200V 8.5MS 3.0HZ 0.80MM
Burst Profile



SILVER RE-TIP
250V 3.0MS 2.0HZ 0.40MM
Ramp Down Profile



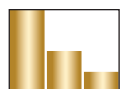
EYEGASSES
160V 3.0MS 2.0HZ 0.55MM
PrePulse Profile



SILVER SIZE THIN
250V 3.0MS 2.0HZ 0.40MM
Ramp Down Profile



STAINLESS STEEL
220V 3.0MS 2.0HZ 0.50MM
Basic Profile

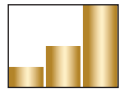


SILVER SIZE THICK
280V 4.0MS 2.0HZ 0.30MM
Ramp Down Profile

NOTE: The above parameter combinations are suggested starting points for 100 Joule LaserStar Welding Systems (7000 Series) and are subject to change based on flashlamp age and the alloy's surface condition.

Fundamentals of Laser Welding

RECOMMENDED PRE-PROGRAMMED PARAMETER SETTINGS 100 JOULE LASERSTAR SYSTEMS WITH P3 AND SOFT-TOUCH



WHITE GOLD POROSITY
205V 6.0MS 3.0HZ 0.40MM
Ramp Up Profile



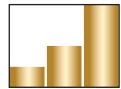
PLATINUM POROSITY
240V 4.0MS 2.0HZ 0.55MM
Basic Profile



WHITE GOLD RE-TIP
208V 6.5MS 3.0HZ 0.45MM
Ramp Up Profile



PLATINUM RE-TIP
244V 4.3MS 3.0HZ 0.70MM
Basic Profile



WHITE GOLD SIZE THIN
218V 9.0MS 2.0HZ 0.40MM
Ramp Up Profile



PLATINUM SIZE THIN
255V 5.5MS 2.0HZ 0.40MM
Basic Profile



WHITE GOLD SIZE THICK
225V 10.0MS 2.0HZ 0.40MM
Ramp Up Profile



PLATINUM SIZE THICK
275V 6.5MS 1.5HZ 0.60MM
Basic Profile



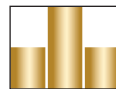
YELLOW GOLD POROSITY
225V 3.5MS 3.0HZ 0.50MM
Basic Profile



JUMP RINGS
230V 5.0MS 2.0HZ 0.65MM
Basic Profile



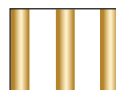
YELLOW GOLD RE-TIP
227V 3.5MS 3.0HZ 0.40MM
Basic Profile



TITANIUM
245V 6.0MS 2.0HZ 0.60MM
Pyramid Profile



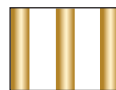
YELLOW GOLD SIZE THIN
240V 4.0MS 2.0HZ 0.50MM
Basic Profile



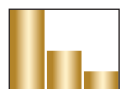
HOLLOW
225V 3.7MS 5.0HZ 0.35MM
Burst Profile



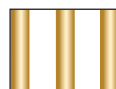
YELLOW GOLD SIZE THICK
260V 7.5MS 1.5HZ 0.60MM
Basic Profile



PEWTER
228V 7.0MS 3.0HZ 0.80MM
Burst Profile



SILVER POROSITY
265V 5.0MS 2.5HZ 0.65MM
Ramp Down Profile



WHITE BASE METAL
239V 7.5MS 2.0HZ 0.70MM
Burst Profile



SILVER RE-TIP
250V 3.0MS 3.0HZ 0.45MM
Ramp Down Profile



EYEGASSES
225V 5.0MS 2.0HZ 0.50MM
PrePulse Profile



SILVER SIZE THIN
300V 3.9MS 1.5HZ 0.45MM
Ramp Down Profile



STAINLESS STEEL
230V 4.5MS 2.0HZ 0.65MM
Basic Profile

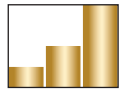


SILVER SIZE THICK
330V 4.6MS 1.5HZ 0.50MM
Ramp Down Profile

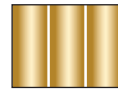
NOTE: The above parameter combinations are suggested starting points for 100 Joule LaserStar Welding Systems (7000 Series) with Soft-Touch and are subject to change based on flashlamp age and the alloy's surface condition.

Fundamentals of Laser Welding

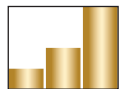
RECOMMENDED PRE-PROGRAMMED PARAMETER SETTINGS 100 JOULE LASERSTAR SYSTEMS WITH P3 AND SOFT-TOUCH (3X BEAM EXPANDER)



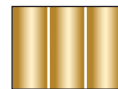
WHITE GOLD POROSITY
200V 4.8MS 3.0HZ 0.40MM
Ramp Up Profile



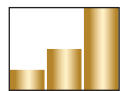
PLATINUM POROSITY
233V 2.7MS 2.0HZ 0.60MM
Basic Profile



WHITE GOLD RE-TIP
203V 5.0MS 3.0HZ 0.45MM
Ramp Up Profile



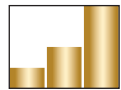
PLATINUM RE-TIP
235V 2.9MS 3.0HZ 0.70MM
Basic Profile



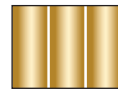
WHITE GOLD SIZE THIN
207V 6.0MS 3.0HZ 0.45MM
Ramp Up Profile



PLATINUM SIZE THIN
240V 3.8MS 2.0HZ 0.45MM
Basic Profile



WHITE GOLD SIZE THICK
210V 7.0MS 2.0HZ 0.50MM
Ramp Up Profile



PLATINUM SIZE THICK
245V 4.2MS 2.0HZ 0.40MM
Basic Profile



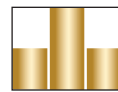
YELLOW GOLD POROSITY
223V 2.4MS 3.0HZ 0.60MM
Basic Profile



JUMP RINGS
225V 2.7MS 3.0HZ 0.80MM
Basic Profile



YELLOW GOLD RE-TIP
225V 2.7MS 3.0HZ 0.70MM
Basic Profile



TITANIUM
225V 4.0MS 2.0HZ 0.70MM
Pyramid Profile



YELLOW GOLD SIZE THIN
229V 3.0MS 3.0HZ 0.60MM
Basic Profile



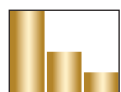
HOLLOW
220V 3.5MS 7.5HZ 0.15MM
Burst Profile



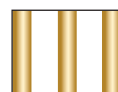
YELLOW GOLD SIZE THICK
234V 4.5MS 2.0HZ 0.60MM
Basic Profile



PEWTER
197V 5.0MS 3.0HZ 0.50MM
Burst Profile



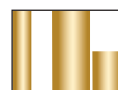
SILVER POROSITY
248V 3.3MS 3.5HZ 0.60MM
Ramp Down Profile



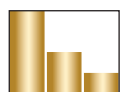
WHITE BASE METAL
213V 8.0MS 3.0HZ 0.80MM
Burst Profile



SILVER RE-TIP
247V 3.0MS 3.0HZ 0.80MM
Ramp Down Profile



EYEGASSES
195V 4.3MS 2.0HZ 0.60MM
PrePulse Profile



SILVER SIZE THIN
280V 4.5MS 2.0HZ 0.50MM
Ramp Down Profile



STAINLESS STEEL
225V 3.5MS 2.0HZ 0.70MM
Basic Profile

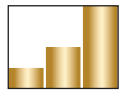


SILVER SIZE THICK
300V 6.0MS 2.0HZ 0.60MM
Ramp Down Profile

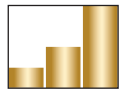
NOTE: The above parameter combinations are suggested starting points for 100 Joule LaserStar Welding Systems (7000 Series) with Soft-Touch and 3X Beam Expander and are subject to change based on flashlamp age and the alloy's surface condition.

Fundamentals of Laser Welding

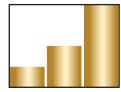
RECOMMENDED PRE-PROGRAMMED PARAMETER SETTINGS 120 JOULE LASERSTAR SYSTEM WITH P3



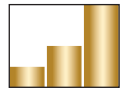
WHITE GOLD POROSITY
195V 4.0MS 3.0HZ 0.55MM
Ramp Up Profile



WHITE GOLD RE-TIP
193V 3.6MS 3.0HZ 0.40MM
Ramp Up Profile



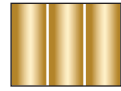
WHITE GOLD SIZE THIN
195V 4.5MS 2.0HZ 0.40MM
Ramp Up Profile



WHITE GOLD SIZE THICK
210V 7.0MS 2.0HZ 0.50MM
Ramp Up Profile



YELLOW GOLD POROSITY
220V 2.3MS 3.0HZ 0.70MM
Basic Profile



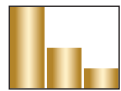
YELLOW GOLD RE-TIP
210V 2.6MS 3.0HZ 0.40MM
Basic Profile



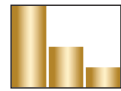
YELLOW GOLD SIZE THIN
210V 2.0MS 2.0HZ 0.40MM
Basic Profile



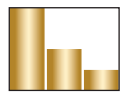
YELLOW GOLD SIZE THICK
233V 3.0MS 2.0HZ 0.45MM
Basic Profile



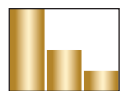
SILVER POROSITY
255V 3.0MS 2.0HZ 0.70MM
Ramp Down Profile



SILVER RE-TIP
246V 3.0MS 2.0HZ 0.55MM
Ramp Down Profile



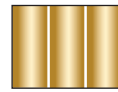
SILVER SIZE THIN
250V 4.0MS 2.0HZ 0.50MM
Ramp Down Profile



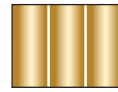
SILVER SIZE THICK
300V 4.5MS 1.5HZ 0.50MM
Ramp Down Profile



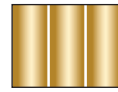
PLATINUM POROSITY
230V 2.3MS 2.0HZ 0.70MM
Basic Profile



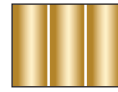
PLATINUM RE-TIP
224V 2.4MS 3.0HZ 0.60MM
Basic Profile



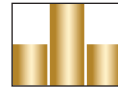
PLATINUM SIZE THIN
250V 2.5MS 2.0HZ 0.50MM
Basic Profile



PLATINUM SIZE THICK
255V 4.0MS 2.0HZ 0.50MM
Basic Profile



JUMP RINGS
185V 5.0MS 2.0HZ 0.70MM
Basic Profile



TITANIUM
210V 4.5MS 2.0HZ 0.55MM
Pyramid Profile



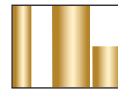
HOLLOW
202V 3.3MS 7.0HZ 0.35MM
Burst Profile



PEWTER
195V 4.3MS 3.0HZ 0.55MM
Burst Profile



WHITE BASE METAL
205V 8.5MS 3.0HZ 0.80MM
Burst Profile



EYEGASSES
193V 4.0MS 2.0HZ 0.55MM
PrePulse Profile

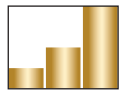


STAINLESS STEEL
220V 3.0MS 2.0HZ 0.60MM
Basic Profile

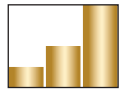
NOTE: The above parameter combinations are suggested starting points for 120 Joule LaserStar Welding Systems (7000 Series) and are subject to change based on flashlamp age and the alloy's surface condition.

Fundamentals of Laser Welding

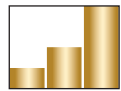
RECOMMENDED PRE-PROGRAMMED PARAMETER SETTINGS 120 JOULE LASERSTAR SYSTEM WITH P3 AND SOFT-TOUCH



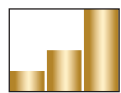
WHITE GOLD POROSITY
205V 4.8MS 9.5HZ 0.50MM
Ramp Up Profile



WHITE GOLD RE-TIP
215V 3.5MS 4.0HZ 0.45MM
Ramp Up Profile



WHITE GOLD SIZE THIN
215V 4.8MS 3.0HZ 0.40MM
Ramp Up Profile



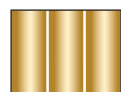
WHITE GOLD SIZE THICK
225V 5.5MS 3.0HZ 0.40MM
Ramp Up Profile



YELLOW GOLD POROSITY
216V 4.5MS 6.0HZ 0.70MM
Basic Profile



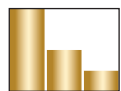
YELLOW GOLD RE-TIP
207V 2.6MS 4.0HZ 0.40MM
Basic Profile



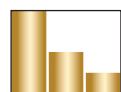
YELLOW GOLD SIZE THIN
225V 2.0MS 2.0HZ 0.35MM
Basic Profile



YELLOW GOLD SIZE THICK
240V 3.7MS 2.0HZ 0.40MM
Basic Profile



SILVER POROSITY
248V 3.1MS 7.5HZ 0.70MM
Ramp Down Profile



SILVER RE-TIP
248V 3.0MS 4.0HZ 0.80MM
Ramp Down Profile



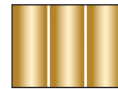
SILVER SIZE THIN
310V 7.0MS 2.5HZ 0.25MM
Ramp Down Profile



SILVER SIZE THICK
380V 7.0MS 1.5HZ 0.30MM
Ramp Down Profile



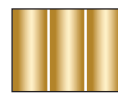
PLATINUM POROSITY
237V 3.5MS 8.0HZ 0.35MM
Basic Profile



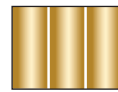
PLATINUM RE-TIP
239V 3.7MS 8.0HZ 0.45MM
Basic Profile



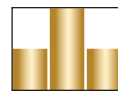
PLATINUM SIZE THIN
290V 3.8MS 3.0HZ 0.35MM
Basic Profile



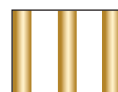
PLATINUM SIZE THICK
310V 4.5MS 3.0HZ 0.40MM
Basic Profile



JUMP RINGS
225V 5.0MS 2.0HZ 0.40MM
Basic Profile



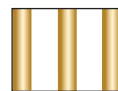
TITANIUM
250V 6.0MS 2.0HZ 0.45MM
Pyramid Profile



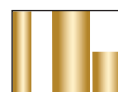
HOLLOW
218V 3.9MS 10.0HZ 0.20MM
Burst Profile



PEWTER
200V 3.0MS 8.0HZ 0.70MM
Burst Profile



WHITE BASE METAL
204V 3.5MS 8.0HZ 0.70MM
Burst Profile



EYEGASSES
212V 4.0MS 2.0HZ 0.70MM
PrePulse Profile

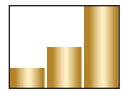


STAINLESS STEEL
225V 4.0MS 5.0HZ 0.80MM
Basic Profile

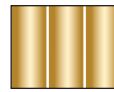
NOTE: The above parameter combinations are suggested starting points for 120 Joule LaserStar Welding Systems (7000 Series) with Soft-Touch and are subject to change based on flashlamp age and the alloy's surface condition.

Fundamentals of Laser Welding

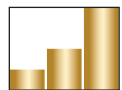
RECOMMENDED PRE-PROGRAMMED PARAMETER SETTINGS 150 JOULE LASERSTAR SYSTEM WITH P3



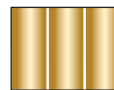
WHITE GOLD POROSITY
190V 4.0MS 3.0HZ 0.70MM
Ramp Up Profile



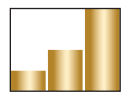
PLATINUM POROSITY
220V 2.5MS 3.0HZ 0.70MM
Basic Profile



WHITE GOLD RE-TIP
190V 3.5MS 3.0HZ 0.55MM
Ramp Up Profile



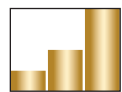
PLATINUM RE-TIP
220V 2.0MS 3.0HZ 0.80MM
Basic Profile



WHITE GOLD SIZE THIN
195V 4.5MS 2.0HZ 0.45MM
Ramp Up Profile



PLATINUM SIZE THIN
235V 2.5MS 2.0HZ 0.50MM
Basic Profile



WHITE GOLD SIZE THICK
200V 5.0MS 2.0HZ 0.40MM
Ramp Up Profile



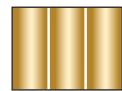
PLATINUM SIZE THICK
240V 4.0MS 2.0HZ 0.40MM
Basic Profile



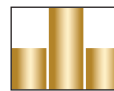
YELLOW GOLD POROSITY
210V 2.0MS 3.0HZ 0.70MM
Basic Profile



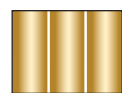
JUMP RINGS
185V 5.0MS 2.0HZ 0.70MM
Basic Profile



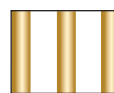
YELLOW GOLD RE-TIP
200V 2.5MS 3.0HZ 0.70MM
Basic Profile



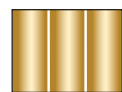
TITANIUM
205V 3.5MS 2.0HZ 0.55MM
Pyramid Profile



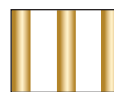
YELLOW GOLD SIZE THIN
205V 4.0MS 2.0HZ 0.50MM
Basic Profile



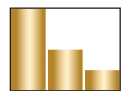
HOLLOW
195V 3.0MS 8.0HZ 0.30MM
Burst Profile



YELLOW GOLD SIZE THICK
210V 4.5MS 2.0HZ 0.50MM
Basic Profile



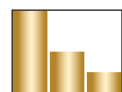
PEWTER
175V 4.5MS 3.0HZ 0.60MM
Burst Profile



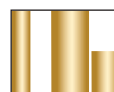
SILVER POROSITY
250V 3.0MS 3.0HZ 0.70MM
Ramp Down Profile



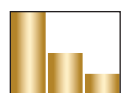
WHITE BASE METAL
200V 4.5MS 3.0HZ 0.80MM
Burst Profile



SILVER RE-TIP
220V 3.0MS 3.0HZ 0.80MM
Ramp Down Profile



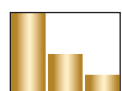
EYEGASSES
195V 4.5MS 2.0HZ 0.80MM
PrePulse Profile



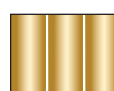
SILVER SIZE THIN
250V 3.0MS 2.0HZ 0.40MM
Ramp Down Profile



STAINLESS STEEL
210V 3.5MS 2.0HZ 0.75MM
Basic Profile



SILVER SIZE THICK
260V 5.0MS 1.5HZ 0.65MM
Ramp Down Profile



STAINLESS STEEL
200V 2.0MS 0.0HZ 0.75MM
Basic Profile

NOTE: The above parameter combinations are suggested starting points for 150 Joule LaserStar Welding Systems (7000 Series) and are subject to change based on flashlamp age and the alloy's surface condition.