# FiberStar® Welding System

*Round Laser Rail*

8900 Series CNC Workstation

Operation & Maintenance Manual

*(Doc # 14-99990-890-1)*



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# EU Declaration of Conformity

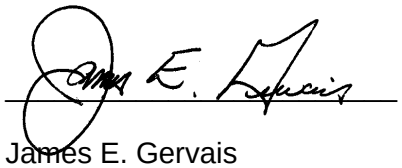
| | |
|---|---|
| **Manufacturer's Name:** | LaserStar® Technologies Corporation |
| **Manufacturer's Address:** | 2461 Orlando Central Parkway<br>Orlando, FL 32809 |
| **Phone / Fax:** | PH: 407-248-1142 |
| **Designation:** | 8900 Series |
| **Model Numbers:** | 5xx-87x-xxx-xxx-xx-xx |
| **Year of Manufacture:** | 2024 |
| **EC Directive(s):** | 2014/35/EU (Low Voltage Directive)<br>2014/30/EU (EMC Directive) |

**Standard(s) to which Conformity is Declared:**

IEC 60825-1:2014
IEC 61010-1:2010 Ed. 3.0
EN 61326-1:2013 (Table 2 Industrial Electromagnetic Environment)
EN 61000-6-2:2005 +AC:2005
EN 61000-6-2:2019
EN 61000-6-4:2007 +A1:2010
EN 61000-6-4:2019

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).



James E. Gervais
President and Chief Operating Officer

Date: January 4, 2024

# Declaration of Compliance

## United States and Canada

**Manufacturer's Name:** LaserStar® Technologies Corporation

**Manufacturer's Address:** 2461 Orlando Central Parkway
Orlando, FL 32809

**Phone / Fax:** PH: 407-248-1142

**Designation:** 8900 Series
**Type:** 5xx-87x-xxx-xxx-xx-xx

**Year of Manufacture:** 2024

**Standard(s) to which Compliance is Declared:**

**UL 61010-1:2012 Ed.3+R:19Jul2019** "Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use; Part 1: General Requirements"

**CAN/CSA C22.2# 61010-12:2012 Ed.3+U1;U2;A1** "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

**CFR Title 47 Chapter 1 Subchapter A Part 15 Subpart B (2020)**

**ISED ICES-003 Published 2016 updated 2019**

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

James E. Gervais
President and Chief Operating Officer

Date: January 4, 2024

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# BACKGROUND

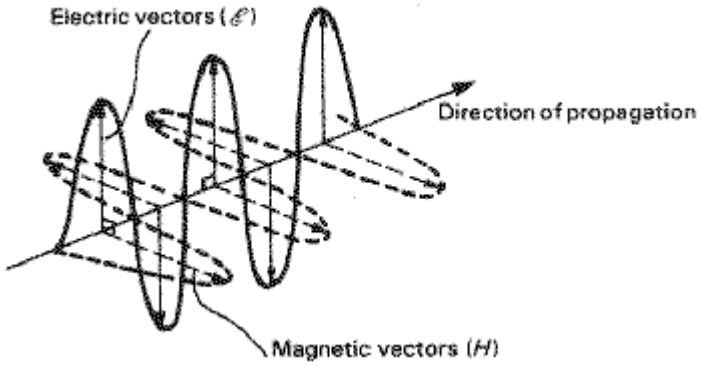
The word “laser” stands for “light amplification by stimulated emission of radiation.” Lasers are possible because of the way the light interacts with electrons. Electrons are atomic particles that exist at specific energy levels. These energy levels are unique and are different for every atom or molecule. 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.

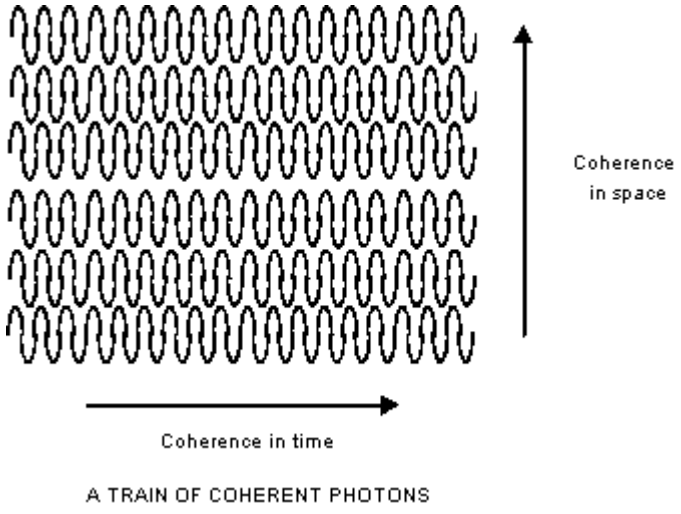
The propagation of light through space can be described in terms of a traveling wave motion. The wave is composed of a combination of mutually perpendicular electric and magnetic fields; therefore, the direction of propagation of the wave is at right angles to both field directions. **Figure 1** shows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



# I. The FiberStar® Welding System

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

- 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.
- High output power: Fiber lasers can have active regions several meters 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.
- 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.
- 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.
- Reliability: Fiber lasers exhibit high vibrational stability, extended lifetime, and maintenance-free turnkey operation.
- High peak power and small pulses enable effective marking and engraving.
- The additional power and better beam quality provide cleaner cut edges and faster cutting speeds.
- 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 75 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), WATTS (CW), %WATTS (power) and PULSE LENGTH (width). Joules and %Watts 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:

- Joules / %Watts influences the welding depth.
- Pulse Length predominantly influences the diameter of the welding point.
- 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® Welder is fast, efficient, portable and in conjunction with fiber optic attached focus head can be used to weld almost all metals and metal alloys quickly, reliably, and precisely. The FiberStar® Welding System can produce both spot welds (single pulse) and seam welds (multi-pulse overlapping spots), including hermetically sound seams.

Many materials can be laser welded including 300 and some 400 series stainless steel, mild steels, nickel alloys, aluminum alloys, titanium, precious metal alloys (gold, silver, and platinum), etc.

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

Adjusting the energy / power of the laser pulses can influence the quality of the welding points. This can be adjusted by means of the Operator Interface Terminal (OIT). With this control you can adjust the intensity of the laser pulses (%Watts), 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 (optional).

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.

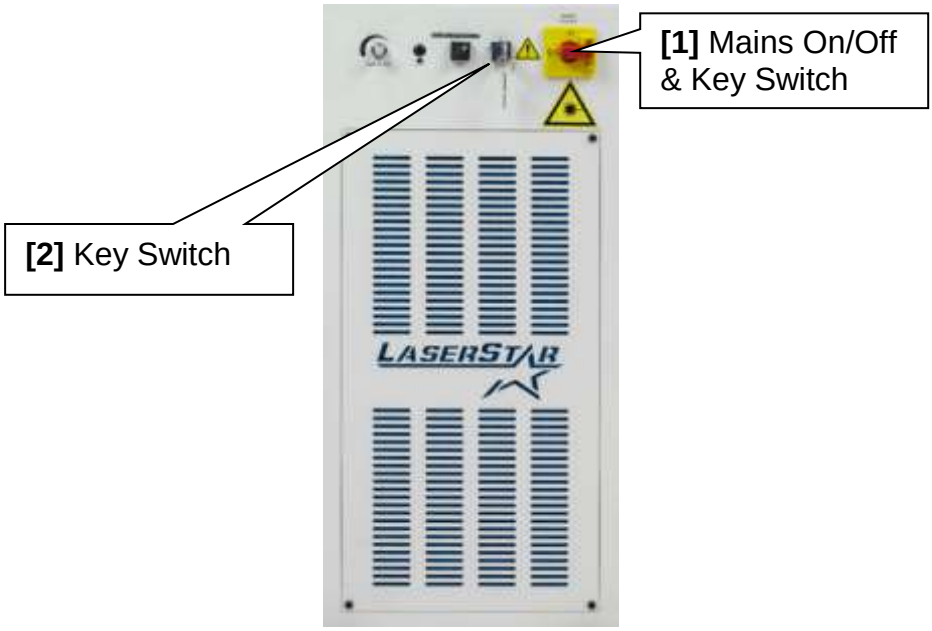



**Figure 1**
**(FiberStar® Welder)**

The **Figure 1** shows the general view of the laser equipment. The individual functional parts are marked by numbers and explained in the following:

1. The Mains ON / OFF Emergency Switch is located on the front of the micro-welding system.

2. Key Switch is located on the front of the welding system.

## Technical Specifications

The modular construction of the FiberStar® Welder 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:

- High-Energy Laser Source
- Microprocessor Control Unit
- Power Supplies
- Foot pedal switch for triggering laser pulses and inert gas supply (argon)

## Specifications

| Laser Source | **Fiber-150W (PM)** | **Fiber-300W (PM)** | **Fiber-450W (*PM*)** | **Fiber-600 (PM)** |
|---|---|---|---|---|
| Emission Wavelength (Typical) | 1070 nm | 1070 nm | 1070 nm | 1070 nm |
| Maximum pulse energy | 15 Joules | 30 Joules | 45 Joules | 60 Joules |
| Maximum Avg. Radiant Power | 150 Watts | 300 Watts | 450 Watts | 600 Watts |
| Maximum Peak Power (Pulse Mode) | 1500* Watts | 3000** Watts | 4500** Watts | 6000** Watts |
| Duty Cycle (Pulse Mode) | 50%* (Max) | 50 %* (Max) | 50 %* (Max) | 50 %* (Max) |
| Rated power (CW) | 250 Watts | 300 Watts | 450 Watts | 600 Watts |
| Single / continuous pulses | Selectable | Selectable | Selectable | Selectable |
| Pulse duration | 0.2-50* ms & CW | 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 | 0-250 Hz |
| Frequency Range (LCD Shutter) | 0-50 Hz | 0-50 Hz | 0-50 Hz | 0-50 Hz |
| Beam Divergence (Collimator Output) | ≤1 milliradians | ≤1 milliradians | ≤1 milliradians | ≤1 milliradians |
| Beam Diameter @ Beam Expander Aperture for F-120, F-160 , F-200 Focus Lens | 35 mm | 35 mm | 35 mm | 35 mm |
| Eye Safety Filters (ESF)-Microscope & View Window | OD 6.5 | OD 6.5 | OD 6.5 | OD 6.5 |
| Laser class | Class: 4 (Operator) | 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) | 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) | 0°C to 50°C (32°F to 122°F) |
| Humidity (operating & storage) | 10% to 90% non-condensing | 10% to 90% non-condensing | 10% to 90% non-condensing | 10% to 90% 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) | 0 to 2000 meters (0 to 6562 feet) |
| Noise Level | ≤ 80 dB | ≤ 80 dB | ≤ 80 dB | ≤ 80 dB |
| W x H x D (cm) | Model dependent | Model dependent | Model dependent | Model dependent |
| Weight | Model dependent | Model dependent | Model dependent | Model dependent |
| Electrical connections* (single phase) | 208-240VAC PH1 50/60Hz 15A | 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 | >1kV on AC Line |
| (*) System was tested and operated without issues with mains supply fluctuations (+10%, -10%) | | | | |

(*)-Maximum duty cycle limit is inversely proportional to peak power: 10% DC = 100% peak, 15%DC = 66.6% peak, 20% etc. to 50%DC = 20% peak and below.

(**)-Maximum pulse duration limit is inversely proportional to peak power: 10ms for 100% peak. 15ms for 66.6% peak, 20ms for 50% peak, etc. to 50ms for 20% peak and below.

## Cooling

- Internal air heat exchanger

- *<u>Maximum</u> 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.)

## Noise Level

(Reference “Technical Specifications” in **Section I)**

## Power Supplies

- Power Supply-Logic Output: 24VDC

- Power Supply-Laser Output: 48VDC

## Control

Microprocessor controller connected to control circuitry for setting of welding parameters

## Optical Viewing System

**Control Circuits for:**

- External safety contacts
- View Shutter within the Beam Bender / Stereo Microscope Assembly
- System Ready

**Miscellaneous**

- Storage of operating parameters
- Remote joysticks for setting laser parameters (optional)
- Laser pulse triggering by means of a two-stage foot pedal switch:
  - First stage: Inert gas supply is enabled.
  - Second stage: Laser pulse is triggered.

## Laser Delivery System (Round Rail)

All components of the high-energy pulse laser are mounted on a round optical rail. The individual components are explained in the following. The numbers in brackets are related to the positions per **Figure 2**.

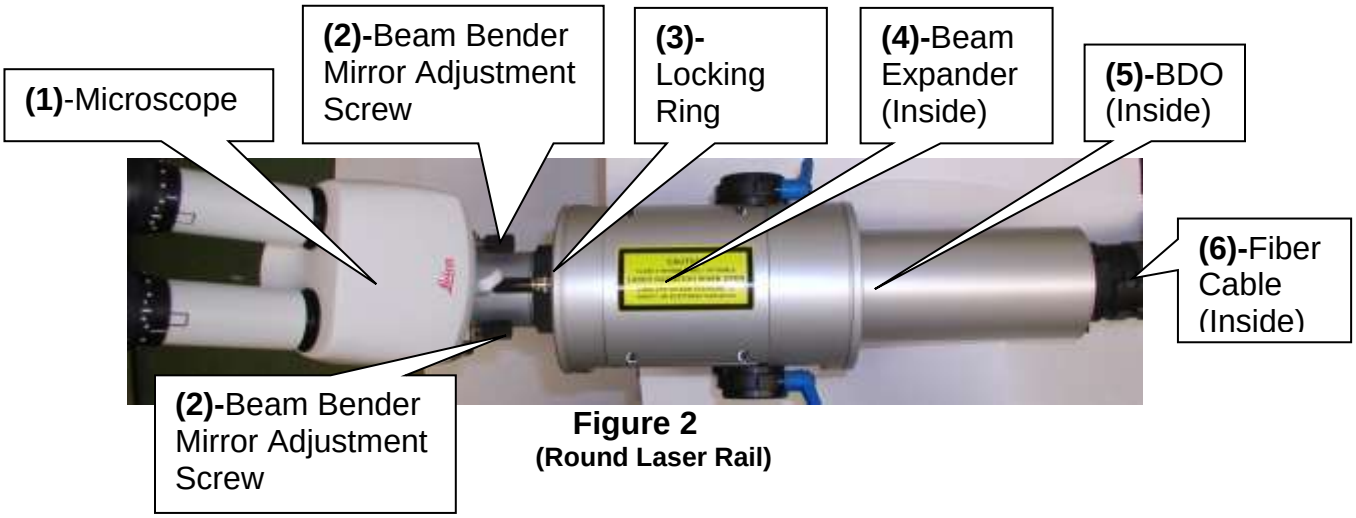



**Figure 2**
**(Round Laser Rail)**

- The Laser Rail mounts a **Microscope (1)** onto the Beam Bender Assembly (Not shown) which contains a View Shutter Assembly (Mechanical or Bi-Stable) and Mirror. **Beam Bender Mirror Adjustment Screws (2)** are used for mirror alignment (set at factory, loosening screws may cause laser to go out of alignment).

- The **Locking Ring (3)** is used to rotate the Beam Bender Assembly so that the laser beam is perpendicular to the weld surface.

- The **Beam Expander (4)** is accessible under cover. (3X-Typical-Model / Option dependent)

- The **Beam Delivery Optic (BDO) (5)** is secured inside rail by a BDO clamp.

- The **Fiber Cable (6)** is inside a conduit for additional protection.

## 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 (i.e.-View Shutter in the optical viewing system.)
- 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 and the laser source are monitored. In case of any malfunction, an error message is displayed on the display of the OIT. The following self-checks and functions will be performed:

  > Operation of the Laser Source

  > Remote Interlock

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 peak wavelength of 1070nm and a maximum peak power which is model dependent.

## Inert Gas Supply / Compressed Air Supply (Optional)

The device has a connecting socket for inert gas.

## Laser Controller External Control Elements


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

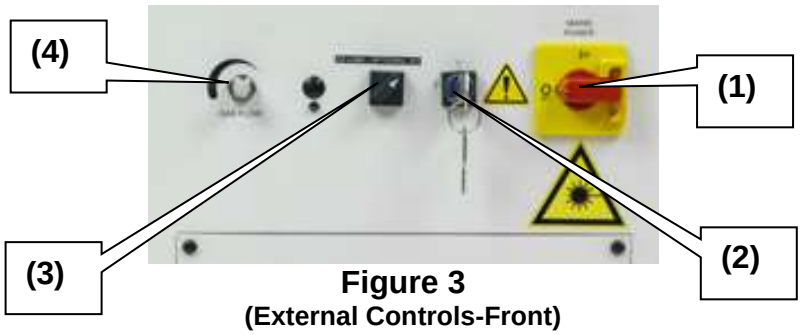



**Figure 3**
**(External Controls-Front)**

**Figure 3** show the location of these control elements. Their function is explained in the following:

**(1)** Mains Switch/Emergency: This switch turns ON or OFF the line voltage of the product. It turns on the water pump only when the Key Switch is "OFF". **This Mains Switch also meets the Emergency OFF function.** It can be turned "Off" (position "0") in case of emergency without preceding actions. The device will be totally disconnected from the line (independent from the polarity of the main plug.)

**(2)** Key Switch: This switch turns on the laser power supply and all the other laser functions, (Note-Requires a key to turn on the balance of the system on.)

**(3)** EZ-LINK™ / OIT Selector Switch: This switch is used to select the following modes:

- EZ-LINK™-This switch position allows direct access to your LaserStar Welding System's internal operating system via a personal computer. (Note: There is an EZ-LINK™ Serial Communications Guide / 03-99990-73.)
- OIT - This switch position allows for RS232 communications between the LaserStar Welding System and the OIT.

**(4)** Gas Flow Control: Controls the flow of the inert gas

## Operator Interface Terminal (OIT)

The display layout is shown in **Figure 5**. The first row shows memory location and description of weld parameters; the second row displays weld parameters-Energy (Joules / J), Power (Watts / W) or %Power (%Watts); Pulse Length (mS); Pulse Rate (Hz); Burst Mode or Pulse Suppression (optional / model specific); Beam Diameter; and Shape. The third row displays Laser status & messages. The fourth row displays operational / mode choices-Memory, Menu,

Help, Ok, and Laser Status. The fifth row displays-Home, Recall, Up / Down arrows, ABC, and Save. (Note: When the OK button indicator is green, the welder is ready to weld. The Laser Enable/Disable button is used to turn the laser source ON or OFF and the button displays the status by text and indicator.)


**Figure 5**
**(Digital Messaging Touch Screen Display)**

All the parameters can be set using the OIT (optional).

**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).

## Foot Pedal

The system is equipped with a two-stage 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 will trigger laser pulse(s). 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 by-passed 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.)

# 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 System 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 fiber 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 60825-1:2014) 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 protective 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 laser protective 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.

If adjustment or maintenance work on the Class 4 laser equipment is necessary, all persons in the laser area must wear the appropriate laser protective eye wear.

**Warning!**

When operated **without** the Workspace Protective Housing or Front Door (model dependant), all persons in the NOHA (Nominal Ocular Hazard Area) must wear appropriate laser protective eye wear (OD>6.5). These laser protective eye wear must meet the safety requirements for the relevant laser output energy / power. The max radiant exposure @ 10cm from laser focus is 52J/cm^2 with a 10mS pulse at 10Hz at maximum peak power. The MPE (Maximum Permissible Exposure) @ 10s exposure is 1.8µJ/cm^2 with a 200us pulse at 500Hz at maximum peak power. The NOHD (Nominal Ocular Hazard Distance) is 24 m from the laser focus (120mm focus lens @ 10s exposure).

These laser protective eye wear must meet the safety requirements for the relevant laser output power. The interlock switches can be bypassed by our service technicians or authorized specialists only for adjustment or maintenance activities.

**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.

**<u>If laser injury or suspected laser injury has occurred, immediately</u>**

- **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® Welding System.

- 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 OHSA 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 60825-1:2014). 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 60825-1:2014) 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 60825-1:2014).

- 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 60825-1:2014)
- 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® Welding System is designed to 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

- 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 60825-1:2014).

- All safety information and warnings attached to the product must be kept in readable condition (see the section entitled LABELING).

## Personnel Training

- 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 60825-1:2014) are allowed to work with the device.

- Trainees are only allowed to work with this product under the supervision of someone who is an experienced user.

## Safety Measures for Normal Use

- Only use the product if all safety mechanisms are functioning properly.

- 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 (model dependent). 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 (model dependent).

## Danger of Electric Shock

- Only authorized personnel are allowed to carry out maintenance work on the power supply.

- 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 (model dependent).

- 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.

- 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 working 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® Welding System.

**Please note**:

- 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!**

**Caution!**

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: (Safety & Informational Labels) (Figure 1-7)

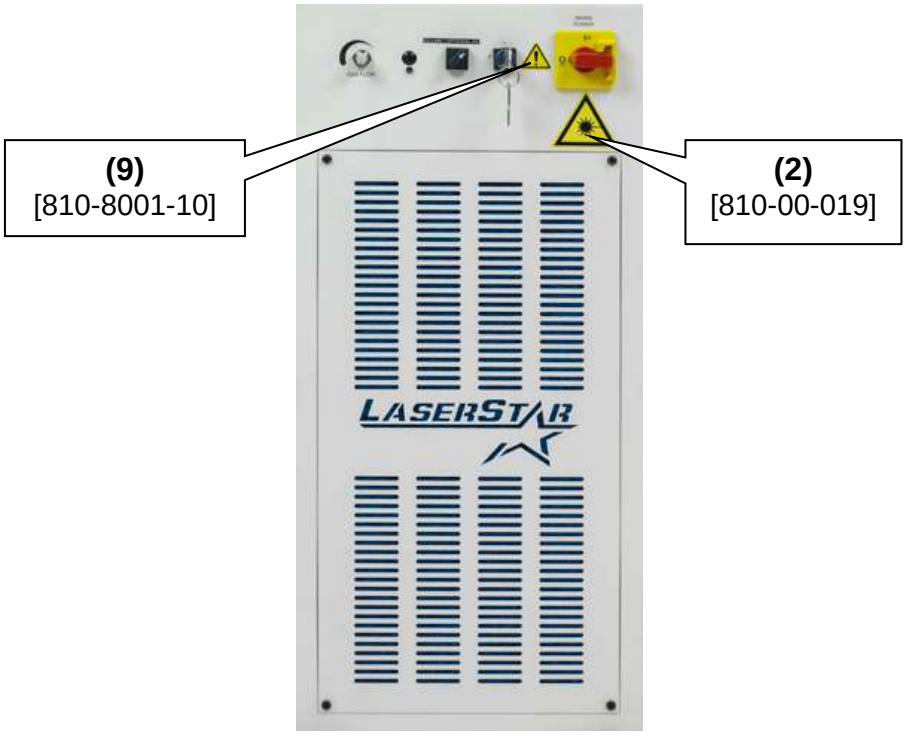



**Figure 1**
**(Front View)**

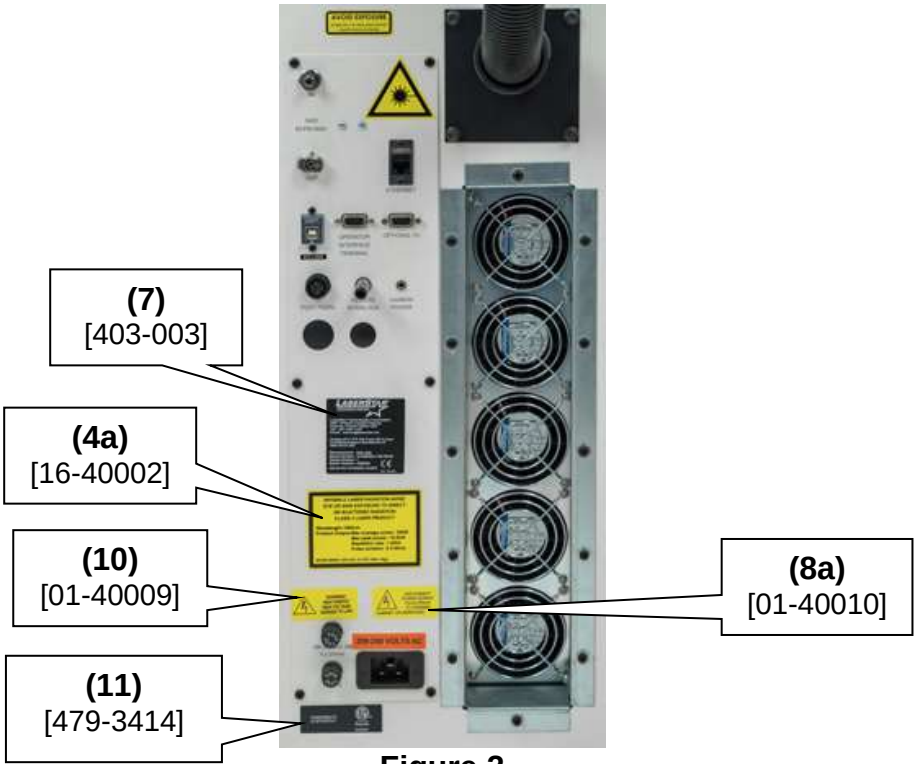



**Figure 2**
**(Rear View)**

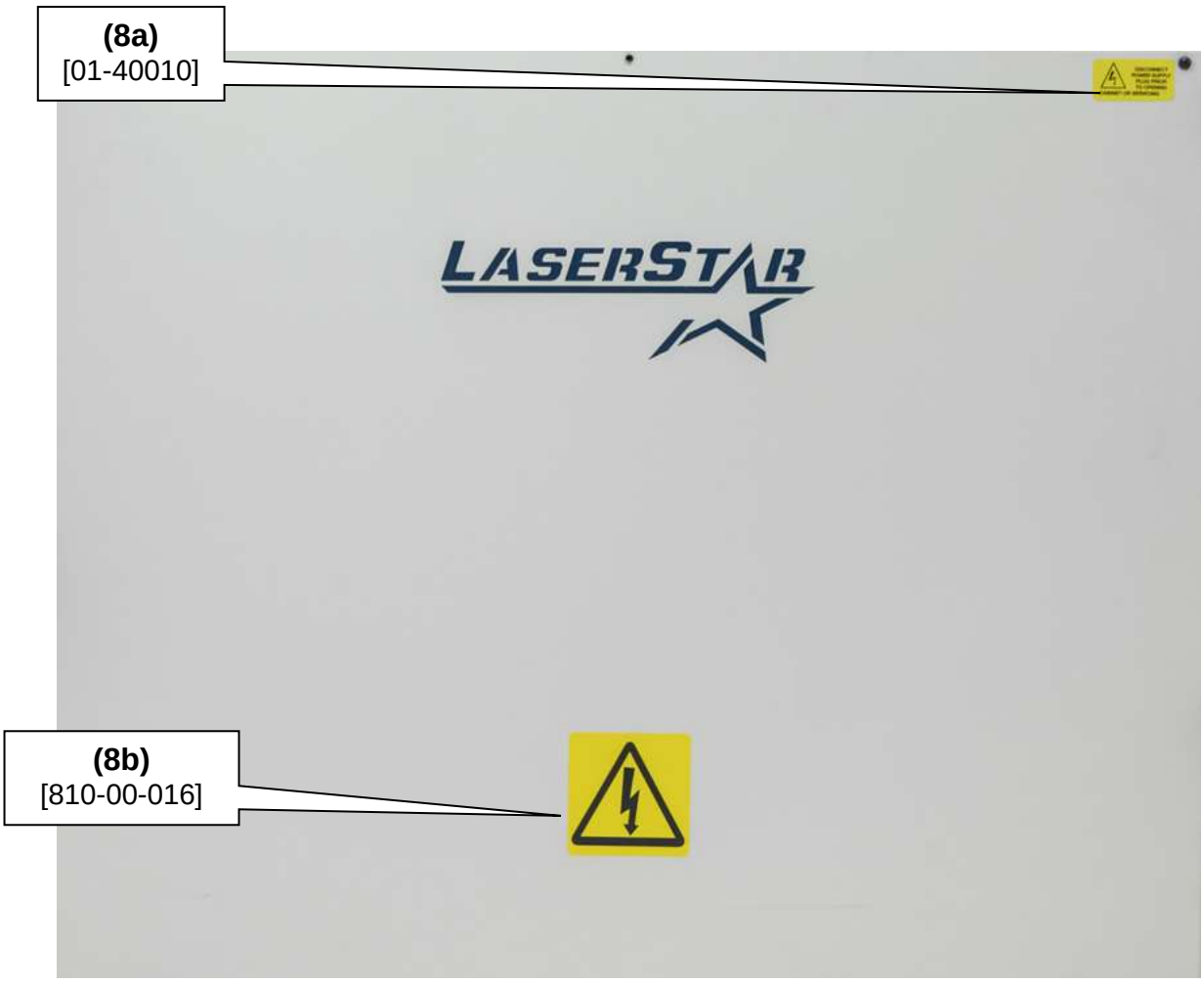



**Figure 3**
**(Side View-right)**

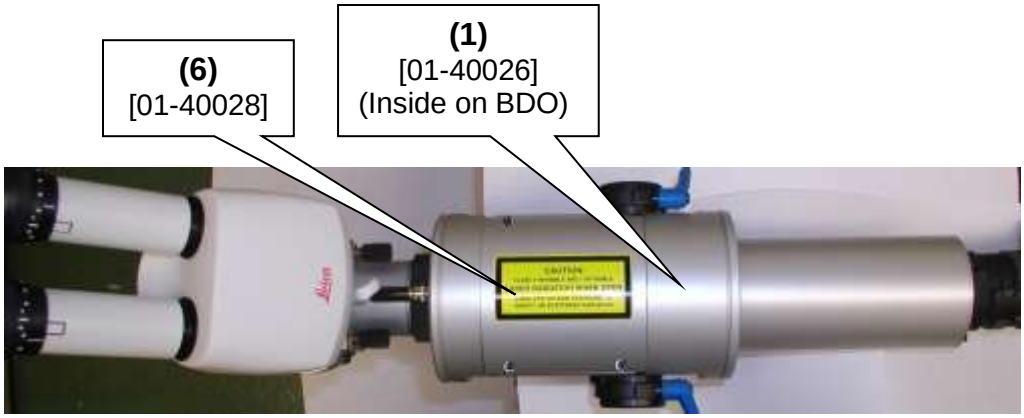



**Figure 4**
**(Laser Rail Assembly-Round)**

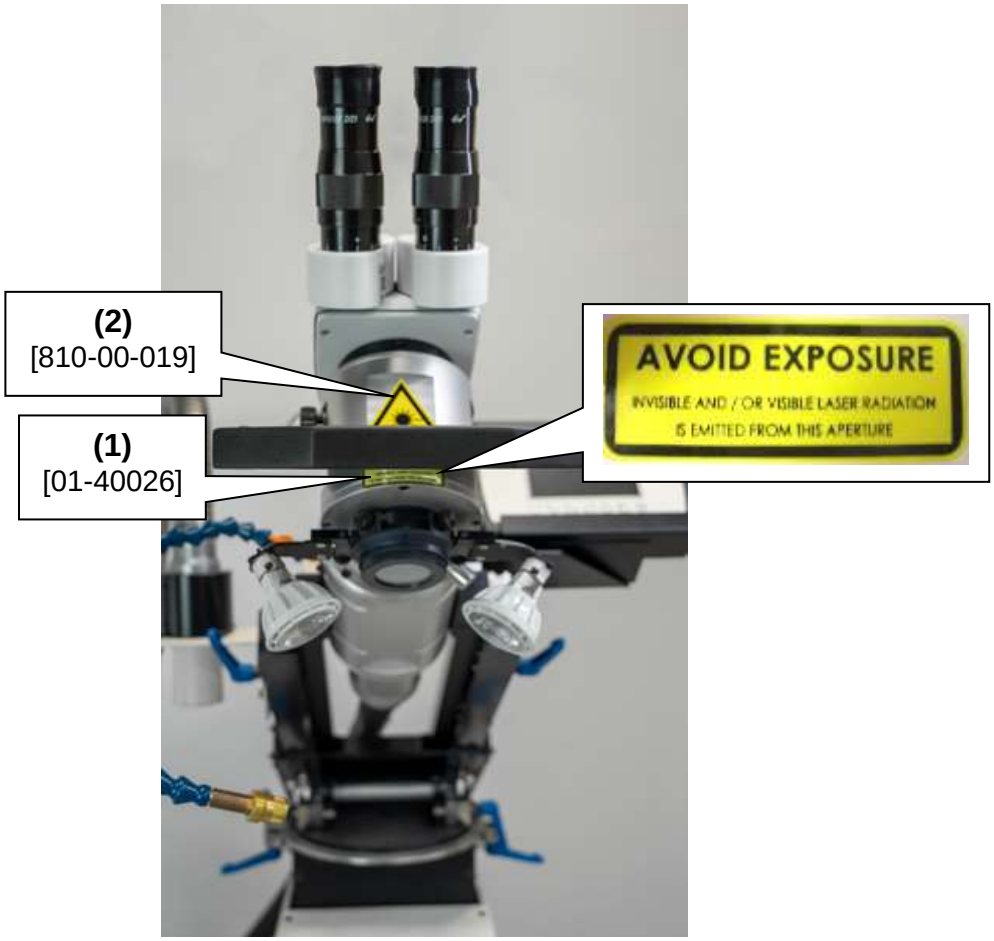



**Figure 5**
**(Beam Bender Assembly with Microscope)**

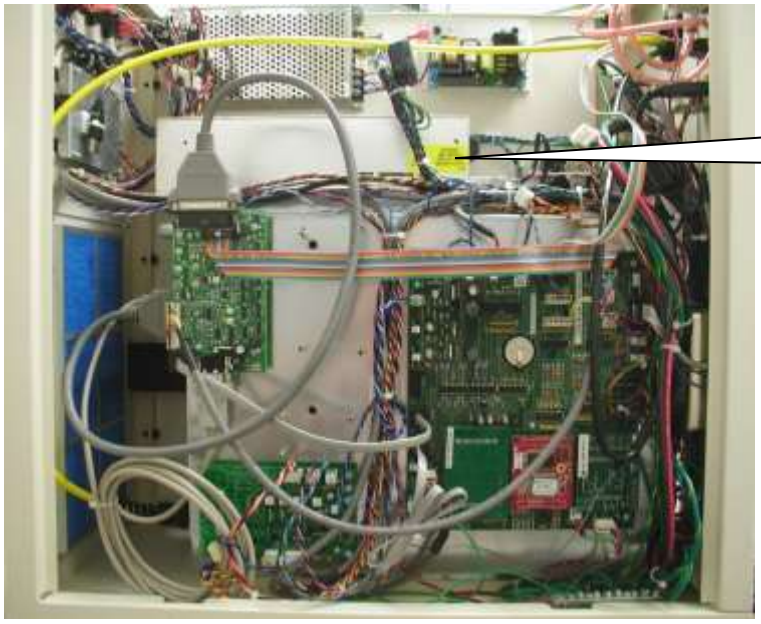
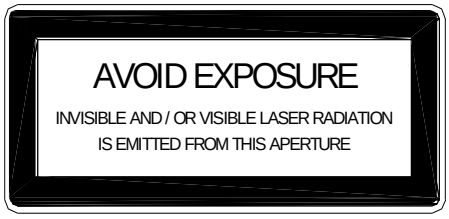



**Figure 6**
**(Laser Source)**


**Figure 7**
**(Label-Power Supply-48VDC)**

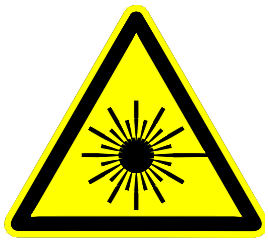
**Label Reproductions:** (Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007)

(1) Aperture Label



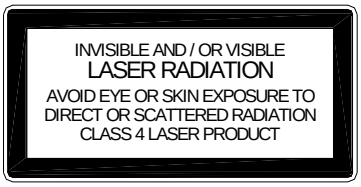

**1**
(01-40026)

(2) Warning Label



**2**
(810-00-019)

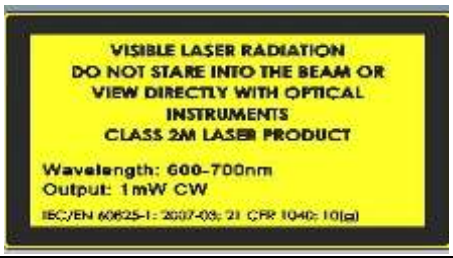
(3) Laser Radiation Explanatory Label




**3**
(01-40025)

(4a & 4b) Radiation Output & Standards Information Labels


**4a**
(16-40002)




**4b**
(13-40002)

(5) Laser Source Label


**5**
(403-XXX)

(6) Non-Interlocked Protective Housing Label


**6**
(01-40028)

(7) Certification and Identification Label (Typical-Model Specific)


**7**

(403-003 / Example)

(8a) Disconnect Power Plug prior to opening cabinet Label and (8b) High Voltage Warning Label/Electrical Hazard: Use caution when opening


**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) 208-240 Volts AC Label**


**11**
(479-3414)

# III. INSTALLATION

This chapter describes the requirements that have to be fulfilled for 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 indoors in a dry location in a room as dust free as possible. The pollution degree of the intended environment is pollution degree 2.

- 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

## Height and Humidity

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

## Unpacking

Caution!

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

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

**The standard parts of delivery are listed in the following:**

- Stand-alone Device-FiberStar® Welding System
- Camera Option
- Operation Manual (USB Version) and Accessories

(**Note**: The delivery can optionally include additional parts. Please compare the delivered parts with your packing slip.)

### Laser Rail-Beam Bender Assembly

The Laser Rail Assembly includes the BDO, beam splitter, beam expander and beam bender assembly. The Beam Bender Assembly is used to bend the laser beam by 90°; provide concentricity adjustment for the laser beam by adjusting the beam bending mirror; support the mounting and adjustment of a camera; allow for rotation of the Beam Bender Assembly; and provide mounting for a Final Focus Lens.

(**Note:** Beam Bender Adjustments are described in the Operation section of this manual.)

(**ATTENTION:** If the Final Focus Lens is removed a protective window must be added to the output of the Beam Bender Assembly to keep out contaminants.)

**Laser Engine Installation**

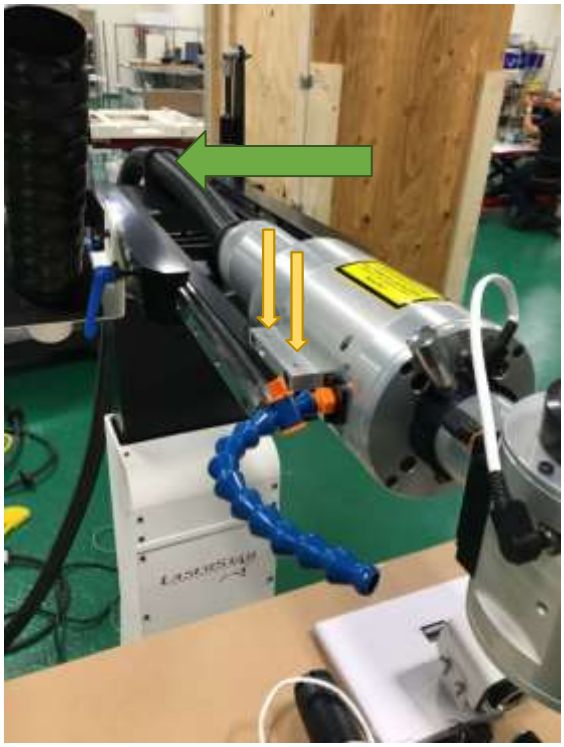
When unboxing the laser engine be careful to not kink the fiber line.

Connect the laser engine power cable (230V) as shown above.

The OIT, or operator interface terminal connects as shown above. The cable plugs into the back of the laser engine into the plug labeled “Operator Interface Terminal.”

The front of the laser engine is where it will be powered on. First the red main power switch is turned to the on position then the key is turned to the on position. A startup screen will be displayed on the OIT for about 14 seconds before showing the laser parameter screen.

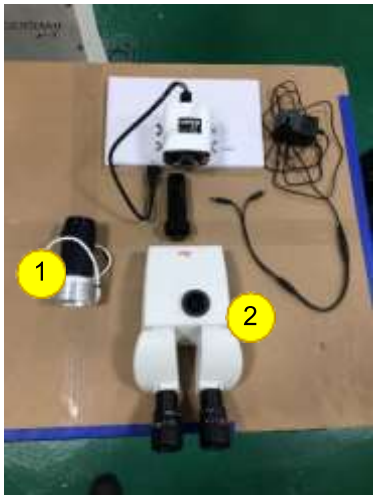
**Laser Head Installation**



When positioning the laser head for the mounting step be careful not to kink the laser fiber or else the laser may not function and need repairing. Hold the laser head between the mounting blocks on the end of the arm and line up the holes with the holes in the blocks. Secure the laser head to the arm with 4x socket head screws [M5x25 mm (88-53801-525) + m5 washer (88-20101-5)], 2 on either side shown by the golden arrows in the photo. Once the laser head is mounted tightly, clamp down the fiber cable in the bracket shown by the green arrow in the photo.

## Viewing System Installation

Model dependent, actual equipment may not look like what is shown




The viewing system and lens assembly can be seen here which includes the lens, extension tube, ring light, scope, camera/screen, camera mount, and power cable. The lens assembly (1) consists of the lens being screwed into the extension tube then the ring light being tightened over the lens. The scope with eyepieces installed is shown as (2) and must be installed before the camera can be mounted on.

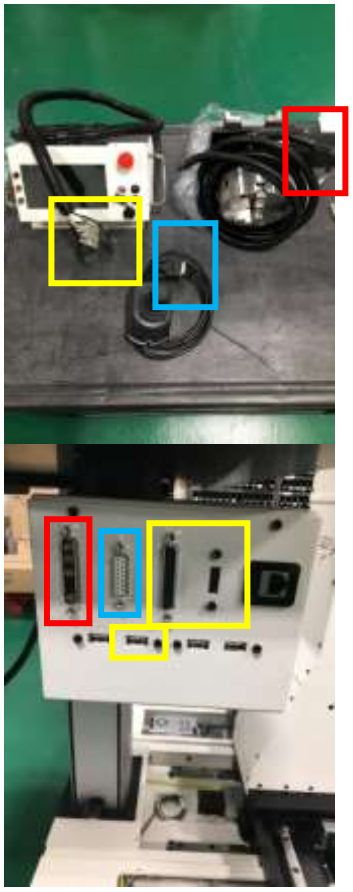

The lens assembly (1) can simply be screwed into the laser head as shown and the light is plugged in below the tube leading to the laser. The scope (2) is mounted onto the top and tightened down with 2 screws (size M2.0) on either side of the middle screw on the mounting ring.

The camera mount is screwed into the camera itself as shown. The power cable has 2 connections on the end: one for the camera and one for the display screen. An HDMI cable included with the camera connects the screen to the camera.

This assembly is then installed onto the top of the scope with the threaded loose ring at the base of the camera mount. This threaded ring allows for the operator to make sure the screen is facing the right direction before being tightened down.

## Table and User Interface Hardware Setup

On the back of the base of the table there is a foot pedal plug, a laser communication plug, and a power plug (230V). All three are connected as shown in the photo above. The other end of the laser communication cable plugs into the back of the laser into the port labeled “Foot Pedal.” Note: It is important to not mix up the foot pedal and the laser communication plugs or else the system will not work properly.



The machine will come with a computer interface, rotary, and joystick with the plugs for them to attach to the table. The inputs for these are found underneath the table on the right side. The plug for the rotary is outlined with a red box, the plug for the joystick is outlined with a purple box, and the 3 plugs for the computer interface are outlined with yellow boxes.

The computer interface has a key to turn the power on, a reset button, a fire button, and an emergency shutoff button. To properly power on the computer system turn the key then press the reset button.

## FiberStar® Welder Locking breaks

Caution!

The FiberStar Welding System should be installed vertically. Once the laser is wheeled to the final location, the breaks can then be set. To set the breaks push the break tab in the downward position. To release the breaks, move the break tabs in the upward position.

Motion table should be leveled to the world using adjustable leveling feet. Feet are adjusted by turning orange knob located at each wheel.

**Caution: All four breaks must be in the upward position prior to wheeling the laser. Pushing or moving the laser with the breaks down may cause damage to the breaks.**

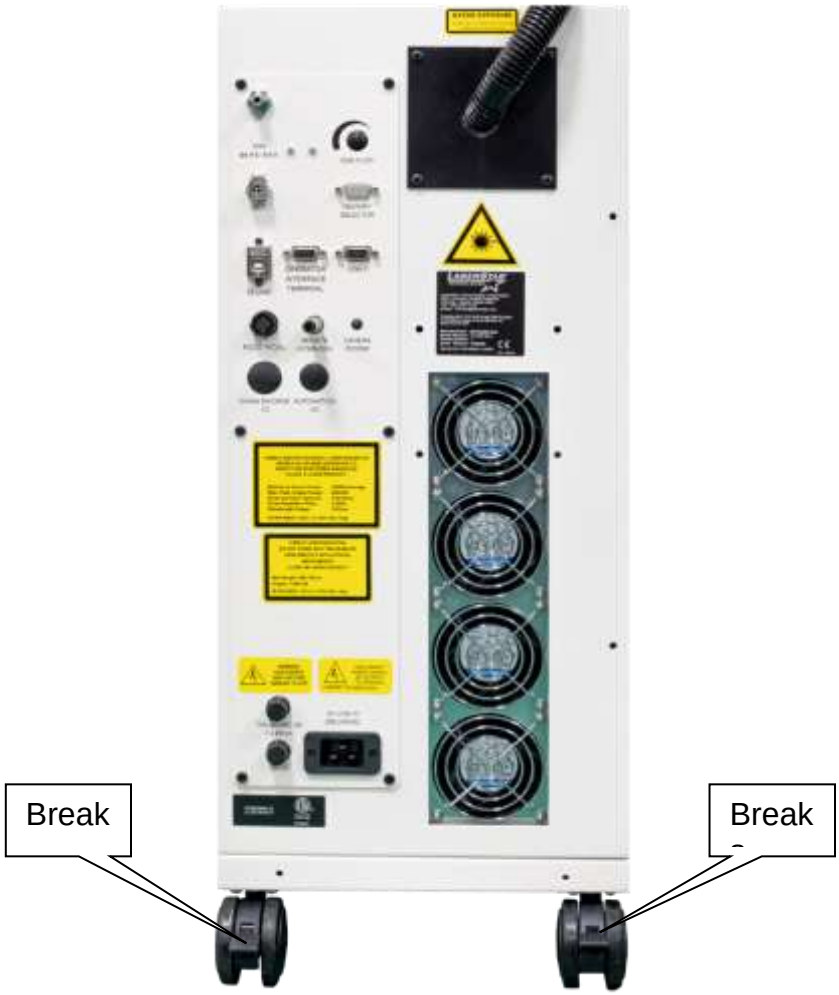



**Figure 1**
**(Rear View Breaks)**

## 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 AC line.)**

**ATTENTION:** The user attached plug must meet all local and national codes and be properly rated for the voltage and current of the system. When replacing detachable "MAINS" supply cord, the user must use a supply cord with the appropriate "RATING".

**DO NOT USE INADEQUATELY "RATED" CORDS or Plugs.**

## 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.

## Welding Shield Installation Instructions

- Install the welding shield to Round Delivery System using (4)-88-53801-410 (M410 Screw) & (4)-88-20311-4 (Lock washer). **(Figure 2)**
- There are two threaded holes on each side of the round delivery system to attach the welding shield.
- **ATTENTION:** Do not use the shield to move the rail and do not lean on the shield.

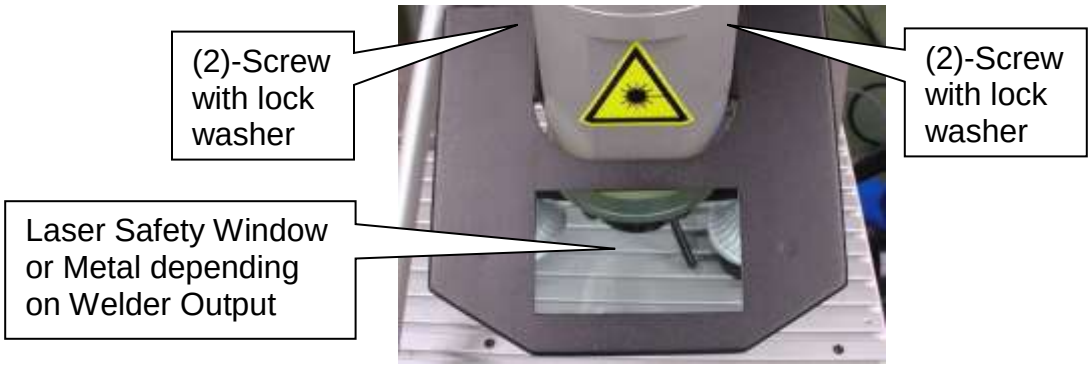



**Figure 5**
**(Welding Shield)**

## External Exhaust System (Optional)

We recommend the use of an external exhaust system with the appropriate air filtration which is dependent on type of material being marked, engraved, welded or cut.

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 - 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. Before use, make sure all the users have read the information in the Safety Section of this manual.

**Caution!**

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 back up using LaserStar's EZ-LINK or a hard copy 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"
  - "ON"-ON means the system is calibrated and ready to weld.
  - "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.
- "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.
- "Laser Beam-Beam Bender Alignment" is used to align the laser beam and the camera.

## Operating Modes (“STD” & “MICRO”)

There are two modes of operating the FiberStar® Welding System. Pulse Mode “STD” 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” 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” has a CW mode (option dependent) that generates a continuous wave output when the foot pedal is depressed (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 mode, the maximum peak power is reduced and the average power is increased. There are two modes:
  - **Micro Pulsed-**All **P³** technology pulse shapes can be used in this mode. The output energy unit of measure is Joules / J.
  - **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.

**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).

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


**Figure 1**
**(Main Screen)**

**Pulse Mode-"STD"**-Press Menu / Press Down arrow to select Standard Pulse Mode / Press Enter / Press Up or Down Arrows to "STD" / Press Enter / Press Exit twice to return to the main screen.

(There is also a way to change modes from the MotionFX Control Screen, detailed in "Jog Traditional.")


**Figure 2**
**(Pulse Mode "MICRO" Selected)**

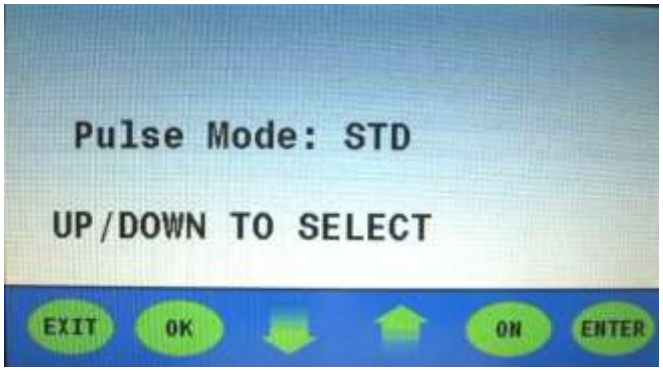



**Figure 3**
**(Pulse Mode Changed from "MICRO" to "STD")**

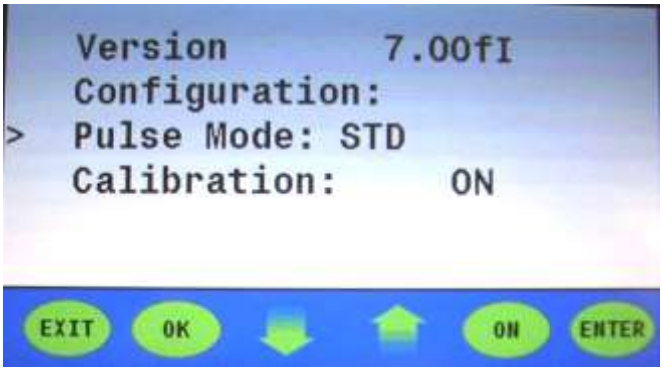



**Figure 4**
**(Pulse Mode "STD" Selected)**

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

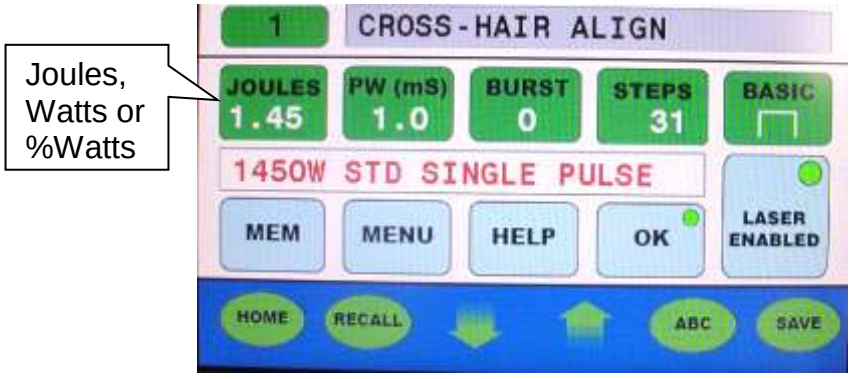



**Figure 5**
**(STD Single Pulse Mode)**

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

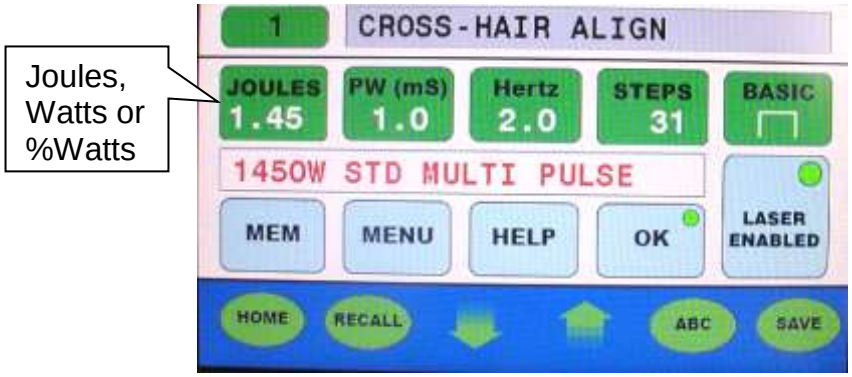



**Figure 6**
**(STD Multi Pulse Mode)**

- **<u>Pulse Mode-“MICRO”</u>**-Press Menu / Select Pulse Mode-STD / Press Enter / Press Up or Down Arrows to “MICRO” / Press Enter / Press Exit twice to return to main screen.)

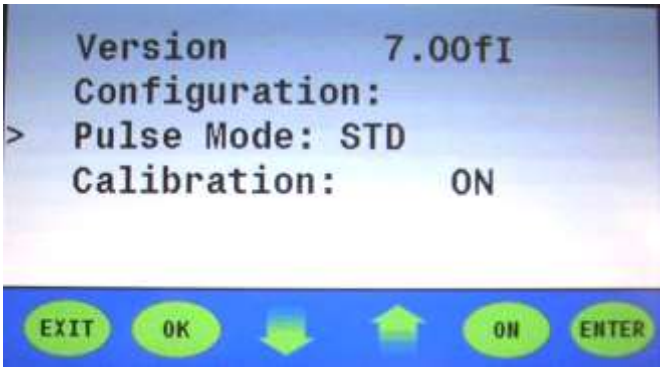



**Figure 7**
**(Pulse Mode “STD” Selected)**

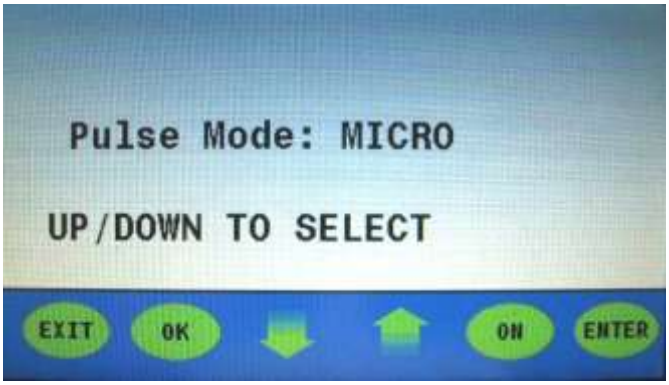



**Figure 8**
**(Pulse Mode Changed from “STD” to “MICRO”)**


**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 (Option Dependent)-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 [model dependent].) 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.

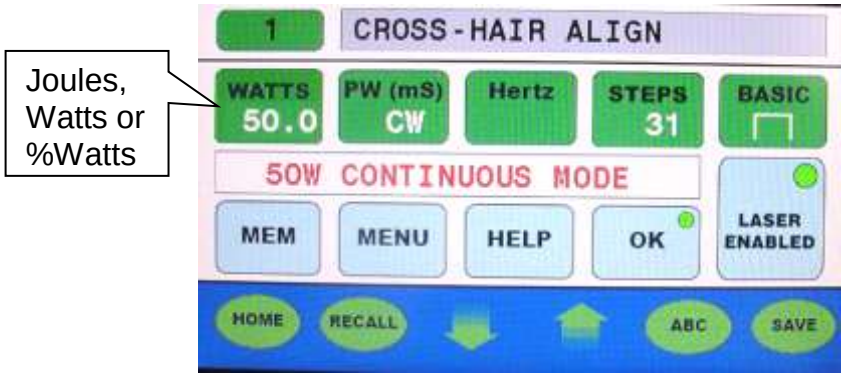



**Figure 12**
**(Continuous Mode)**

## 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 Arrows to "ON" / Press Enter / Press Exit twice to return to the main screen.

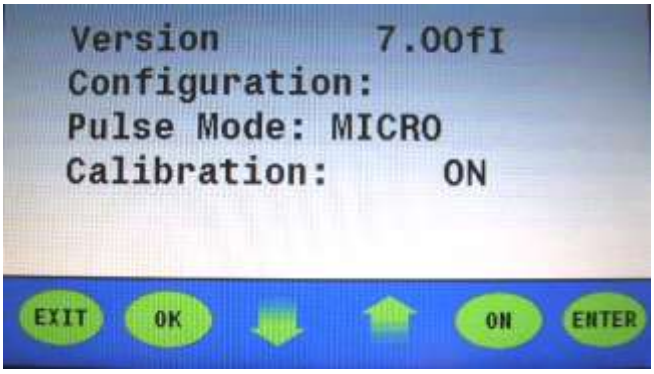



**Figure 13**
**(MICRO Calibration "ON")**

- Calibration STD "ON"- Press Menu / Press Down arrow to select Calibration / Press Enter / Press Up or Down Arrows to "ON" / Press Enter / Press Exit twice to return to the main screen.

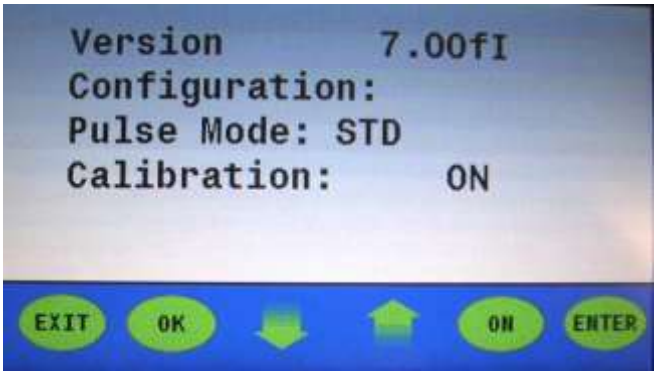



**Figure 14**
**(STD Calibration "ON")**

## 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 |
|---|---|
| | |
| >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 (< 2 seconds) after the Mains Switch, "Laser Not Ready" 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 the error. (Reference the section entitled STATUS INDICATIONS). |
| > Turn the key switch on ("I" position) **Figure 15** | ⊗ The Key Switch should be turned on immediately (<2 seconds) after |

| | |
|---|---|
| | turning on the Mains Switch. The Key Switch supplies power to the laser source. (Note: Reference Mains Switch system response to clear "Laser Not Ready" message.) |
| > Wait until the self-test has completed **Figure16** | ⊗ 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 "Laser Disabled" Button- **Figure 16** (Note: Located in the Digital Message Touch Screen Display.) | ⊗ The indicator located within the button will turn from red to green and the button will read "Laser Enabled" |
| >If operator does not use the machine for ~15 minutes (model dependent) | ⊗ The machine will go into the energy saver / sleep mode. **Figure 17** |

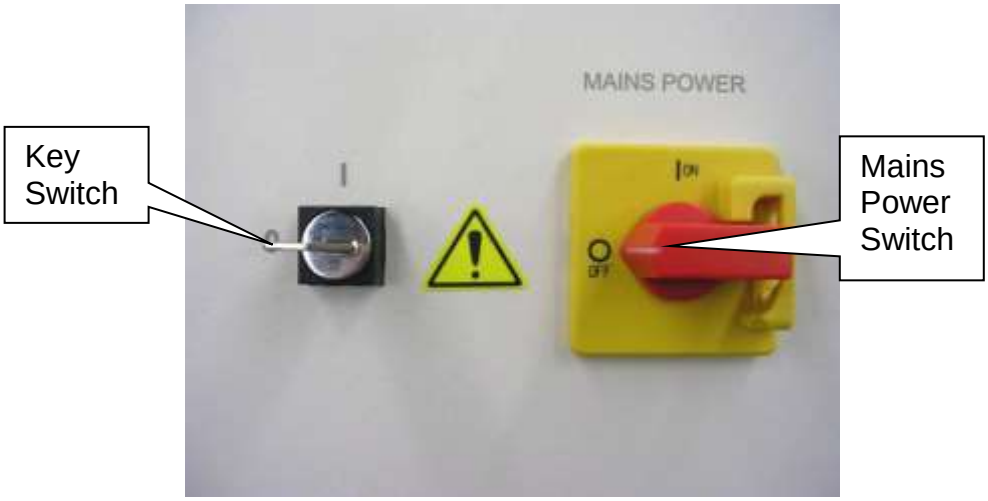



**Figure 15**
**(Switching ON)**


**Figure 16**
**(Digital Messaging Touch Screen Display)**

## Table Power Up Procedure:

Turn on the main power button in the back of the table near the floor.

Make sure the red emergency stop button is out and turn on the key switch.

Press the reset button directly to the right of the key switch, this will boot up the screen and software.

The screen and software will now boot up.

## Motion System Power-up Procedure

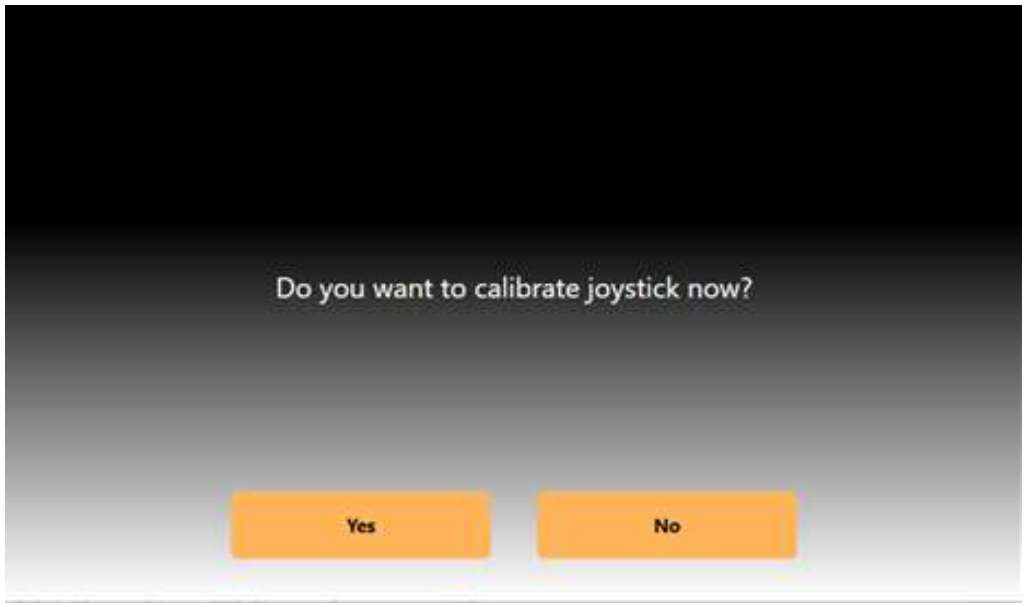
The “connecting to controller” screen will appear.

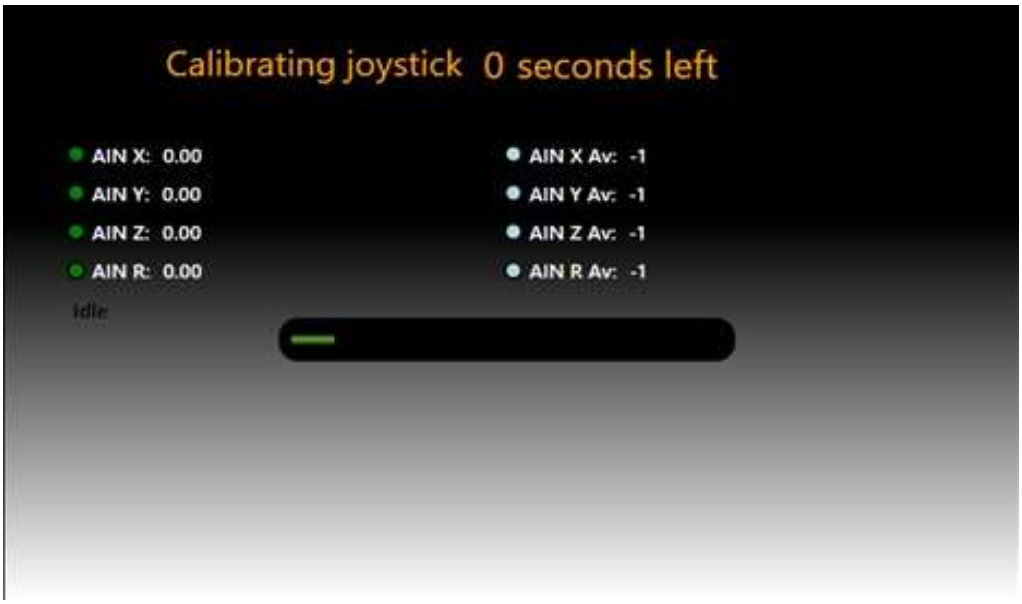


Press the Home button and the motion will home to 0-X, 0-Y and Max Z.

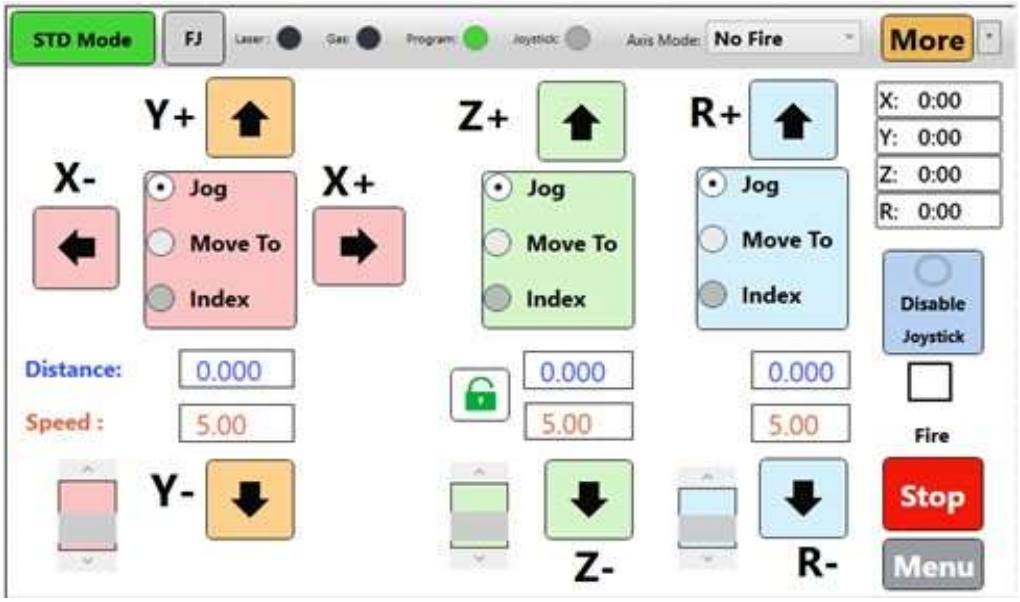
- R Axis is optional and can be turned off/on for this screen, see Jog Traditional section below for more information.

When the homing is completed, the joystick calibration screen will appear. Click “Yes.”

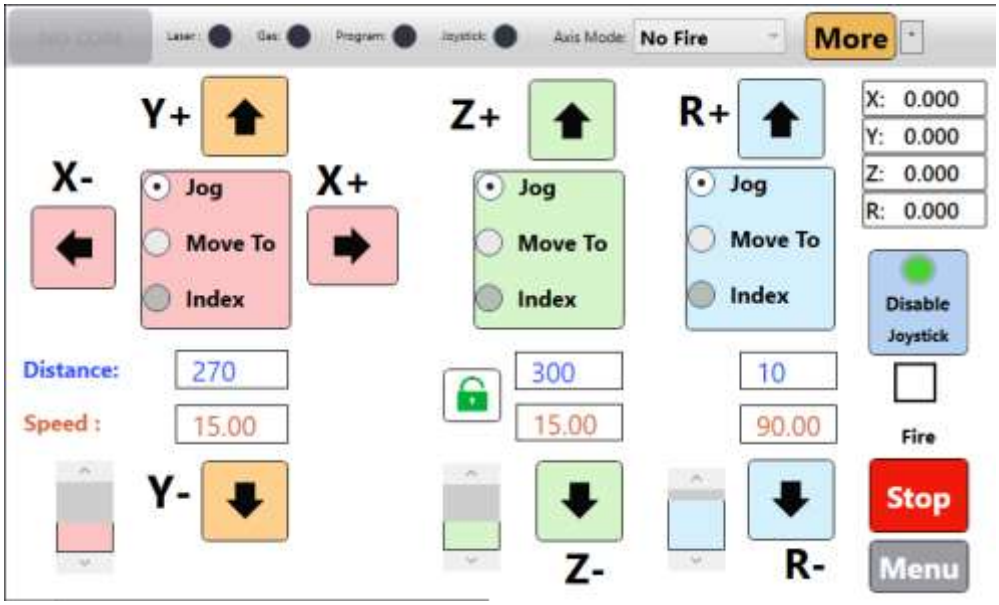



(Note: Make sure not to touch Joystick during calibration as this will cause the joystick to calibrate incorrectly which can lead to axis moving when they shouldn’t.)




After calibration the “Jog Traditional” screen will appear.

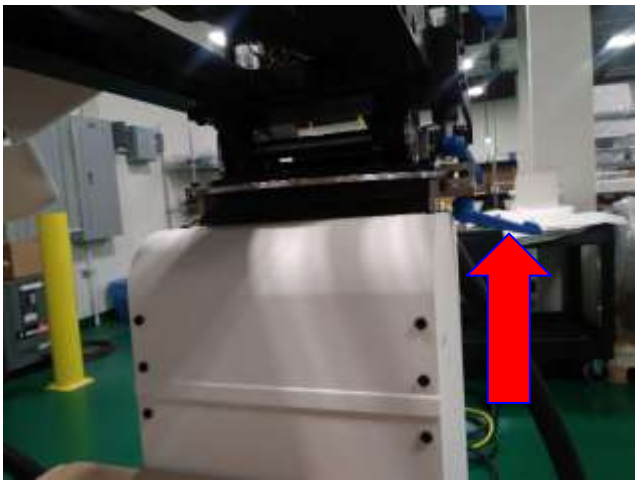



Press the Enable Joystick button. This button will turn green when the joystick is enabled.


Test the joystick by moving the joystick forward and back, then left to right. This will move the X and Y axis.


Twist the top of the joystick counterclockwise to move the motion platform down, clockwise for up. Test the rotation jog by pressing the buttons in the back of the joystick.

Pull out the independent table Z control and test the z table motion by pressing the up and down arrow keys.



Make sure the two blue arm adjustment arms are pointed outward before lowering the laser head all the way down or damage to the adjustment arms could occur.

**Getting Started**

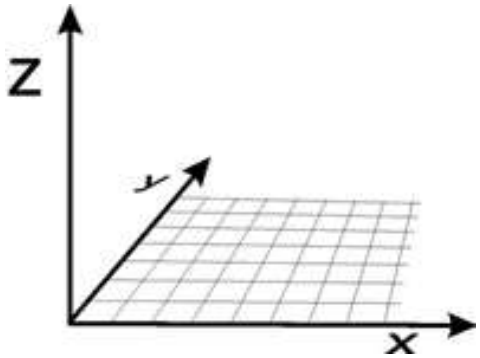
Integrated MotionFX CNC Welding Workstations are configurable with up to four axes of motorized motion (XYZR).

X axis allows linear movement “left” and “right”

Y axis allows linear movement “forward” and “backward”

Z axis allows linear movement “up” and “down”

R axis allows 360° rotational movement




Integrated MotionFX CNC Welding Workstations can be operated in manual mode by using the joystick to control the movements of the motion platform, or the motion can be programmed using G-code logic to instruct the Motion platform where and how to move.

G-code stands for Geometric Code and can be programmed in two modes:

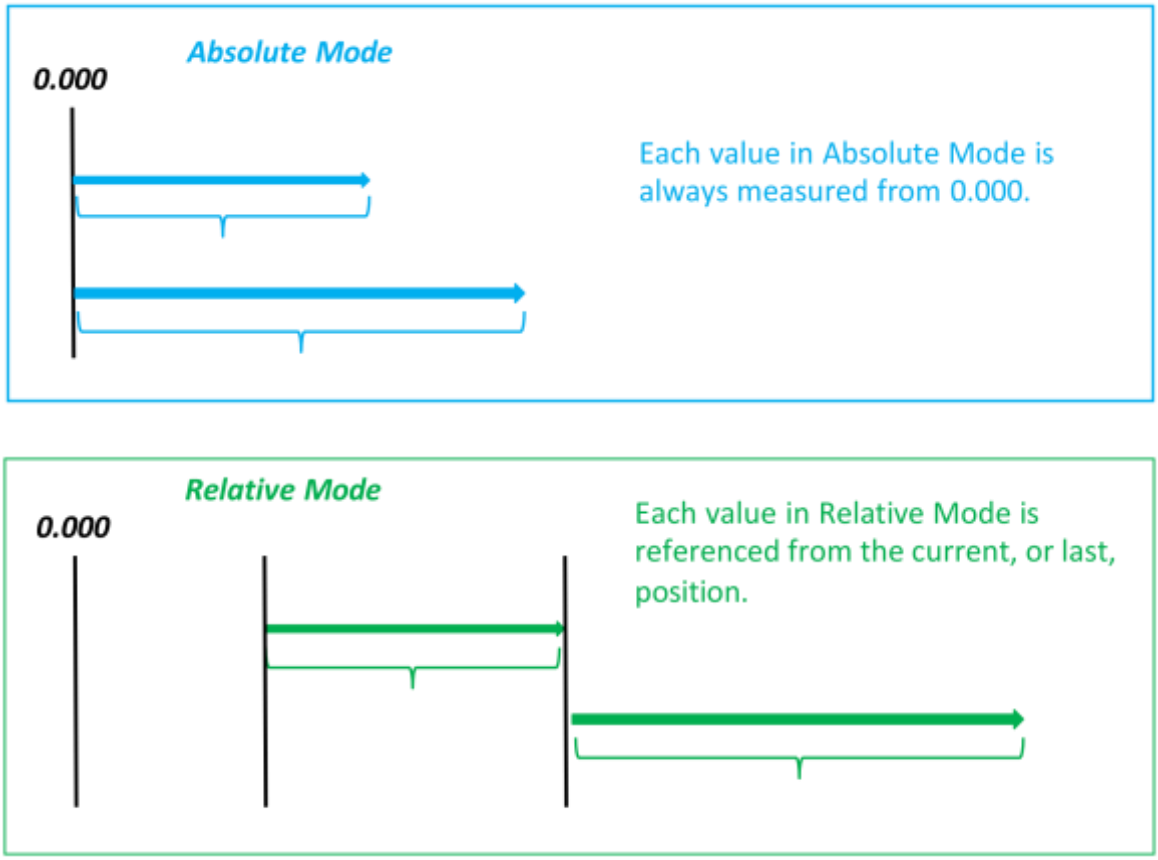
Absolute: Coordinates (G90) are measured from program zero, the program's origin. The value entered is the distance measured in millimeters from 0.

Relative: coordinates (G91) are measured from the current position. The value entered is the distance measured in millimeters from the current position.

**List of G-code Commands:**

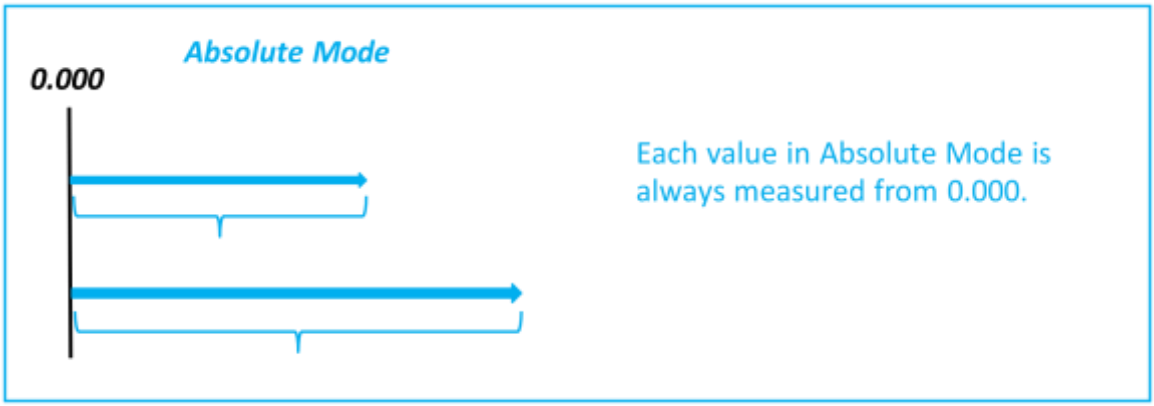
- G90: Switch to absolute coordinates
- G91: Switch to relative coordinates
- G0: Move to coordinate with laser OFF
- G1: Move to coordinate with laser ON
- G2: Clockwise arc
- G3: Counter-clockwise arc
- I: Distance from arc start point to center point on X axis
- J: Distance from arc start point to center point on Y axis

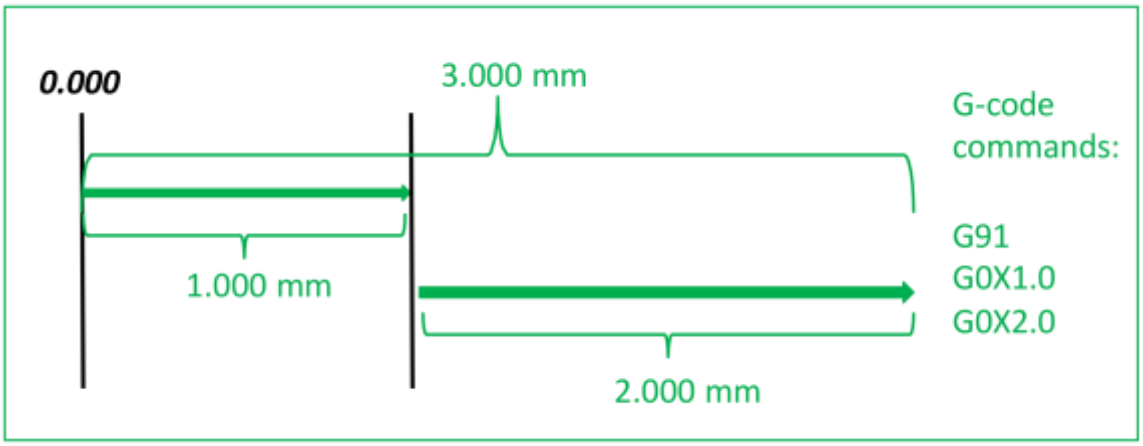
**Absolute versus Relative**




Absolute: Coordinates (G90) are measured from program zero, the program's origin. The value entered is the distance measured in millimeters from 0.

Relative: Coordinates (G91) are measured from the current position. The value entered is the distance measured in millimeters from the current position.




In this example, the G-code is set to Absolute mode (G90):

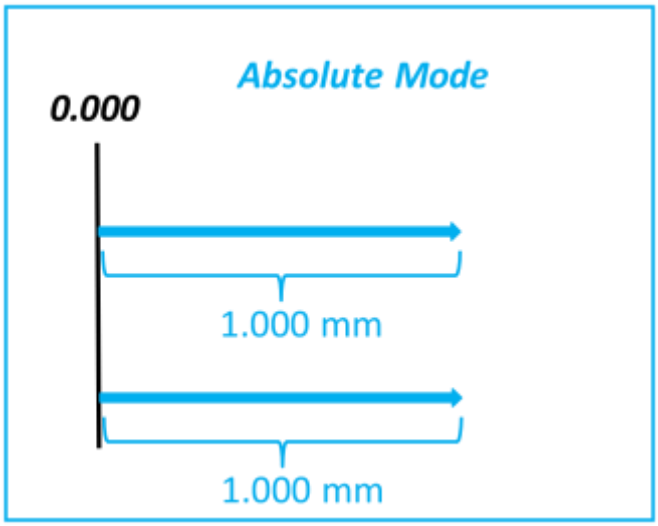
G0X 1.0: The X axis is instructed to move to position 1.0 G0X 2.0: The X axis is instructed to move to position 2.0

Result: The X-axis is at position 2.00

In this example, the G-code is set to Relative mode (G91):

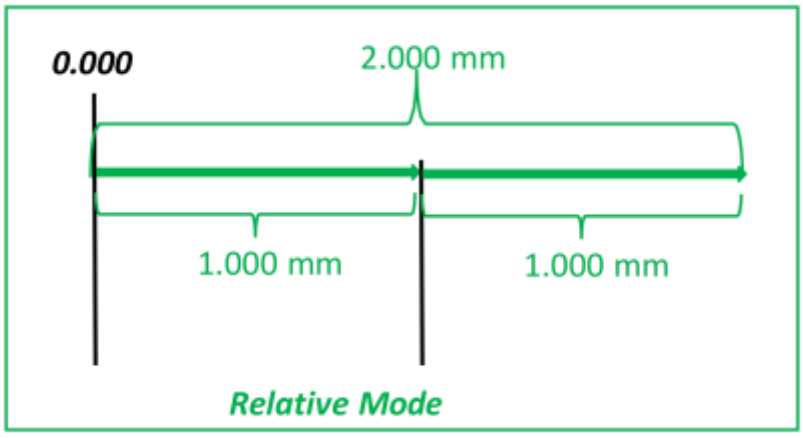
G0X 1.0: The X-axis will move 1mm
G0X 2.0: The X-axis will move another 2mm Result: The X-axis is at position 3.00

Result: The X-axis is at position 3.00




If we gave the same 1.000 mm move command (G0 X1.000Y0.000) twice in Absolute Mode we would still end up at 1.000 mm from 0.000.

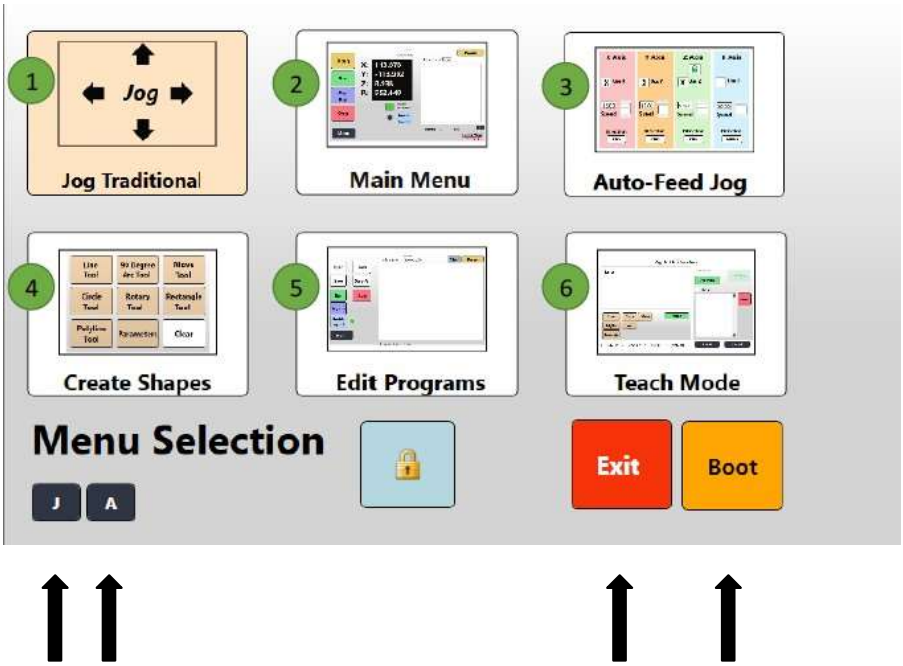
G90 (absolute mode)
G0 X1.000Y0.000
G0 X1.000Y0.000




If we did the same thing in Relative Mode we would end up at 2.000 mm.

G91 (relative mode)
G0 X1.000Y0.000
G0 X1.000Y0.000

## Menu Selection Overview




This menu selection screen also contains a “Boot” button. The “Boot” button allows the user to select a menu that is open upon booting up of the program. To use it the user will press “Boot” then click on which menu they would like to be shown upon opening of the program and that menu will then be highlighted. For example, currently the “Jog Traditional” menu is highlighted meaning that when the program is opened this menu will be on the screen first. The “Exit” button beside the “Boot” button simply closes the program.

Buttons “J” and “A” technically allow you to calibrate the joystick beyond the autocalibration but are primarily for troubleshooting the system and will be used by service

1. The “Jog Traditional” screen is shown upon opening of the program by default. This is the screen used for much of the manual welding, jogging with the joystick/arrow buttons and/or index movement with arrow buttons.

2. The “Main Menu” screen is for loading pre-made programs for automated welding and running them.

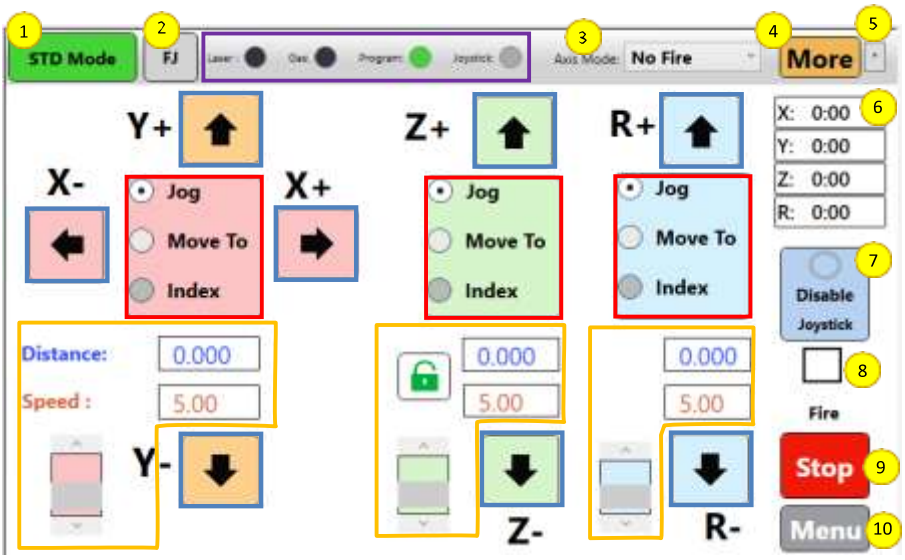
3. The “Auto-Feed Jog” screen is used for on-the-fly fixed speed welding with a foot pedal and/or joystick using axes of your choosing.

4. The “Create Shapes” screen is for creating a program, one shape at a time, for automated welding using specific input coordinates.

5. The “Edit Programs” screen is similar to the “Main Menu” screen with additional options to edit, save, and create new code.

6. The “Teach Mode” screen is similar to the “Create Shapes” screen except that it allows the user to locate the points with the joystick instead of having to know exact coordinates.

## Jog Traditional




1. This box allows you to switch between standard and micro mode (Shown in Standard mode, only applicable to fiber lasers)

2. This box allows you to turn on and off “Fast Jog” mode. When this is enabled holding the joystick button will increase the speed of axis travel. When it is disabled (shown) the joystick button will fire the laser

3. The Axis Mode drop down allows you to change how the laser reacts to movement inputs on this screen

4. The “More” button unlocks this additional window. This window is for homing specific axes and for allowing/disallowing certain axes to move.

5. The “*” button allows you to see the status of the limits of each axis.

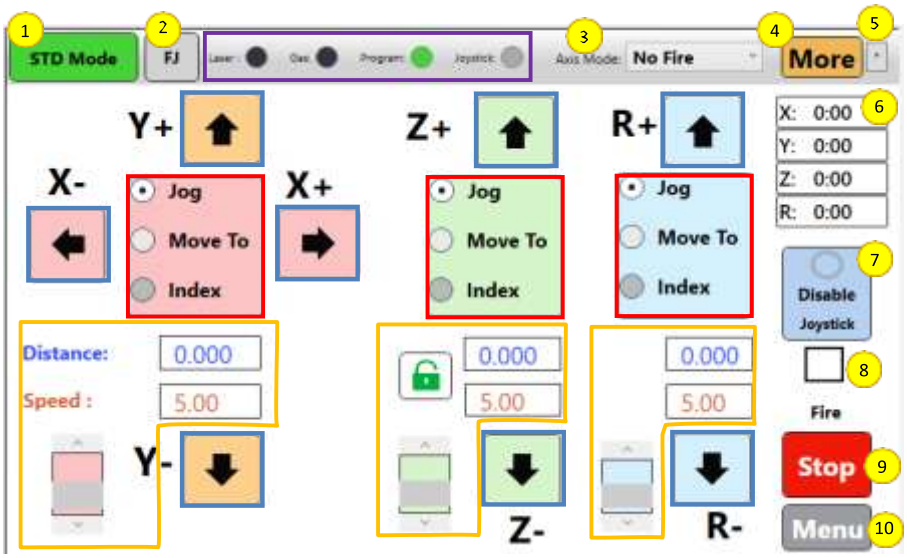
6. This box shows the current position that the platform is currently at (in mm).

7. The joystick button is for enabling/disabling the joystick. When the dot is green and the box says “Disable Joystick” then the joystick is currently enabled. If the dot is gray and the box says “Enable Joystick” then the joystick is currently disabled.

8. The “Fire” box indicates whether or not the laser is enabled. If the box is unchecked the laser will not fire and if checked it will fire upon pressing the joystick button (if joystick is enabled) or fire upon pressing a movement arrow (depending on axis mode selected).

9. The “Stop” button stops all movement and lasing when pressed.

10. The “Menu” button returns back to the Menu Selection screen. Every screen on the “Menu Selection” screen will have this button in order to return back to select a different screen.

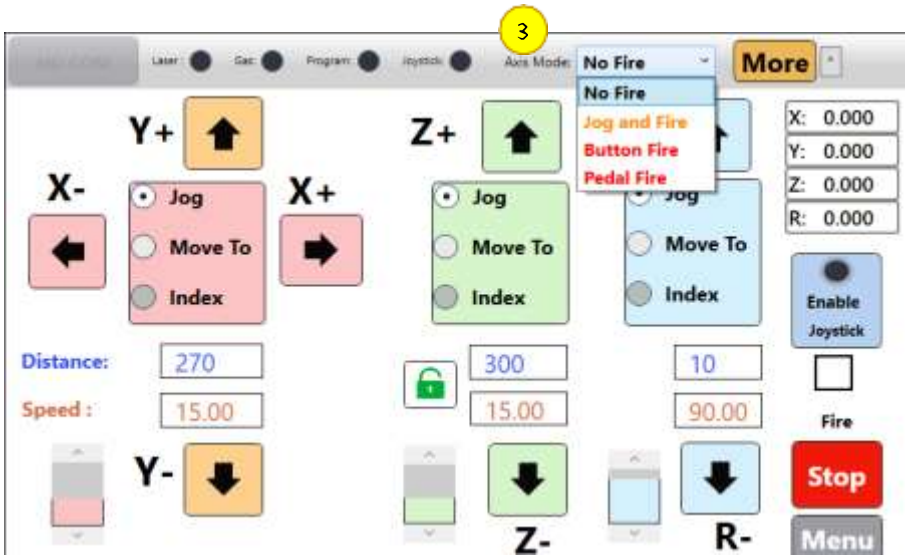



In the red boxes is where you select the type of movement you will perform. “Jog” allows for movement using the on-screen arrows. “Move to” will move to an absolute coordinate location. “Index” will move a specified amount relative to the current location.

In the gold boxes the “Distance” box is the relative distance an index movement will go or the absolute location the move to movement will go to. The “Speed” box is the constant speed the laser will go for move to/index, and the maximum speed for the “Jog” option. There is a slider for adjusting the speed value. Note: units used are mm, mm/s, and degrees/s. The Z axis also has a lock button, this allows the axis to be prevented from moving when enabled.

In the blue boxes are the movement arrows. +Y moves away from the user, -Y towards the user, +X to the right, -X to the left, +Z up toward the ceiling, -Z down toward the floor, R+ rotary clockwise, R- counter-clockwise. For the “Jog” option these buttons are held down but for the “Move to/Index” they are pressed once.

In the purple box there are status indicators for the system. The indicators will light up if the action shown is happening. E.g., “Program:” turns green when a program is running. These indicators appear on other screens with the same function.




The axis modes for the jog traditional screen do as follows:

**No Fire**: Laser will not fire while using x / y / z / r buttons on screen to move motion platform

**Jog and Fire**: The laser will fire while using x / y / z / r buttons on screen to move motion platform

**Button Fire**: Laser will fire using the joystick button while using x / y / z / r buttons on screen to move motion platform

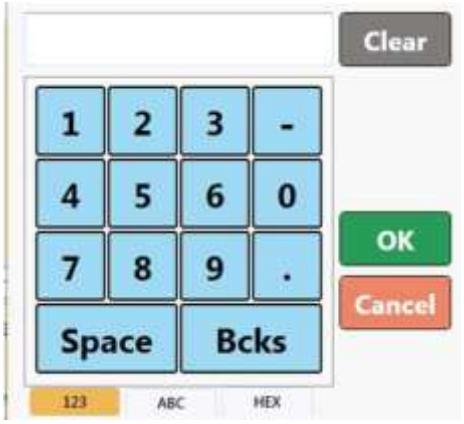
**Pedal Fire**: Laser will fire using the foot pedal while using x / y / z / r buttons on screen to move motion platform

The “More” screen also contains a “Motion Delay” option with a duration of delay (in ms) which allows to start the laser firing before the machine moves. The “Fire Duration” box is for setting how long the laser will be on for after hitting the fire button.

The “Home” button will bring the X, Y, and Z axes back to their original 0mm positions and will set the current rotary position as a new zero. The “Set Zero” button will set the current position to the new zero values in all 4 axes. The “Z Direction” button allows you to swap the positive and negative direction of the Z axis on the Joystick.

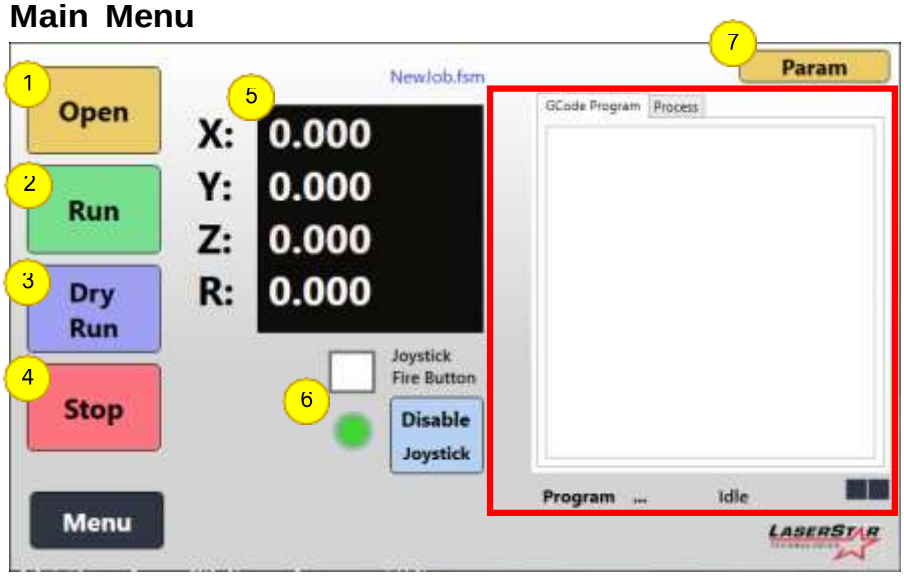
The “Fire” button will fire the laser and the “Stop” will stop all motion and firing until you provide additional input (e.g., pressing the foot pedal or clicking “Home”) The “Enable Motors” button shown will turn axis motors on and switch to read “Disable Motors.”

The “Rotary Connected” check box will enable/disable the rotary device for homing and G-code programs.




When the user clicks on any box with variable text in it the above window will popup, with number, text, and hexadecimal options. This allows the user to type in a desired value for speed or for parameters when applicable. This screen shows up in every menu except for the “Teach Mode” menu.

## Main Menu




In the red box is the currently loaded program. Here you will find the code of the loaded program with the name above it. Below the code is a status that tells if the machine is currently running or if it is idle.

1. The “Open” button allows to open a saved program from a library of created programs.

2. The “Run” button will execute the program and start lasing/moving as commanded in the code block.

3. The “Dry Run” is the same as the “Run” without the laser firing. This is intended to confirm that the program is moving to the correct locations on the part without lasing on it yet.

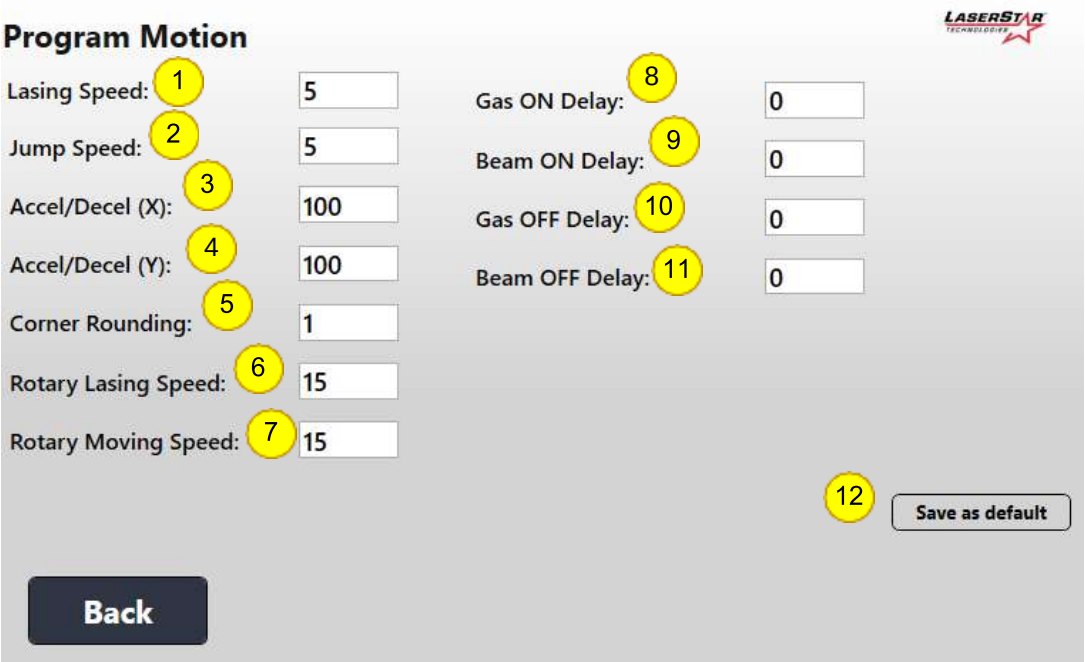
4. The “Stop” button will halt the program thus stopping movement and lasing.

5. This is where you will see the current absolute location of the laser. Note: Moving the table up/down is not accounted for in this Z value.

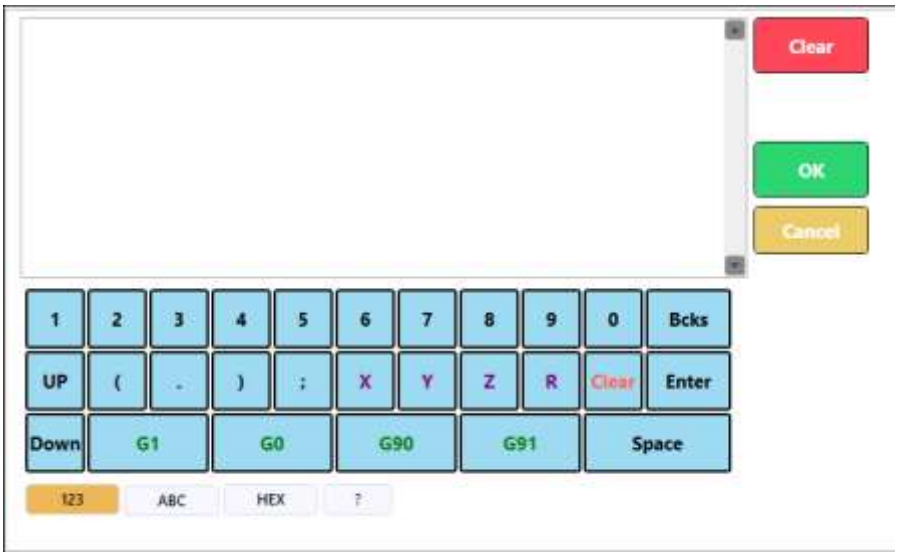
6. Here you will find the joystick enable/disable as well as a checkbox for firing with the joystick. A Green dot means the joystick is enabled and a gray dot means it is disabled. If the fire button box is unchecked then you will not be allowed to fire the laser with the joystick button, on the contrary if checked you can fire with the joystick button.

7. The “Param” button will open another window to set motion parameters during a program. See below for detailed information on each feature.

*** These parameters do not impact operation outside of a program run.**

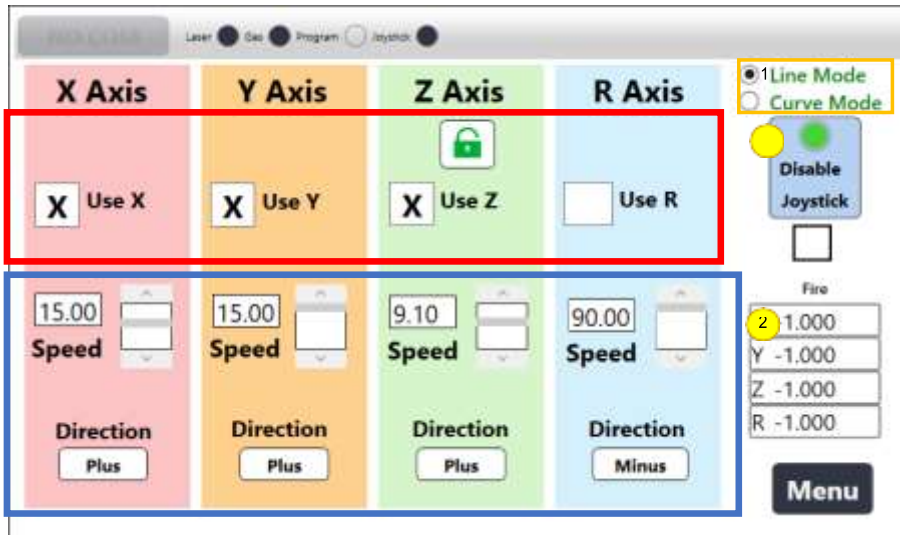



1. The “lasing speed” parameter sets the speed at which the motion device moves while lasing.
2. The “jump speed” parameter sets the speed at which the motion device moves while not lasing.
3. The “accel/decel (X)” parameter sets the acceleration/deceleration of the X axis.
4. The “accel/decel (Y)” parameter sets the acceleration/deceleration of the Y axis.
5. The “corner rounding” parameter changes the speed at which the axis come into a corner. Larger values will lead to sharper corners.
6. The “rotary lasing speed” parameter sets the speed the rotary spins while lasing.
7. The “rotary moving speed” parameter sets the speed the rotary spins while not lasing.
8. The “gas on delay” parameter sets the amount of time that the gas will turn on before motion begins.
9. The “beam on delay” parameter sets the amount of time that the beam is turning on before motion begins (this is cumulative with gas on delay)
10. The “gas off delay” parameter sets the amount of time that the gas will remain on after lasing is complete.
11. The “beam off delay” will set the amount of time the laser will remain on after lasing is complete (this is cumulative with the gas off delay).
12. The “save as default” button will make the current parameters default for all new programs.




Within the main menu the user can click on the code block text box and this window will popup. This allows the user to edit the code that is currently open, although the user cannot save it on this screen. This keyboard is specifically designed for typing in G-code using relative and absolute modes to draw lines or make move commands in the X, Y, Z, and R axes. There are also options for the alphabet keyboard or a hexadecimal keyboard. This screen is applicable to the “Create Shapes” and “Edit Programs” menu options as well.

## Auto-feed Jog




The boxes outlined in red are for enabling or disabling specific axes; this is so that the user can stop an axis from moving that needs to be kept stationary. This applies to both foot pedal and joystick welding. The Z axis can also be locked.

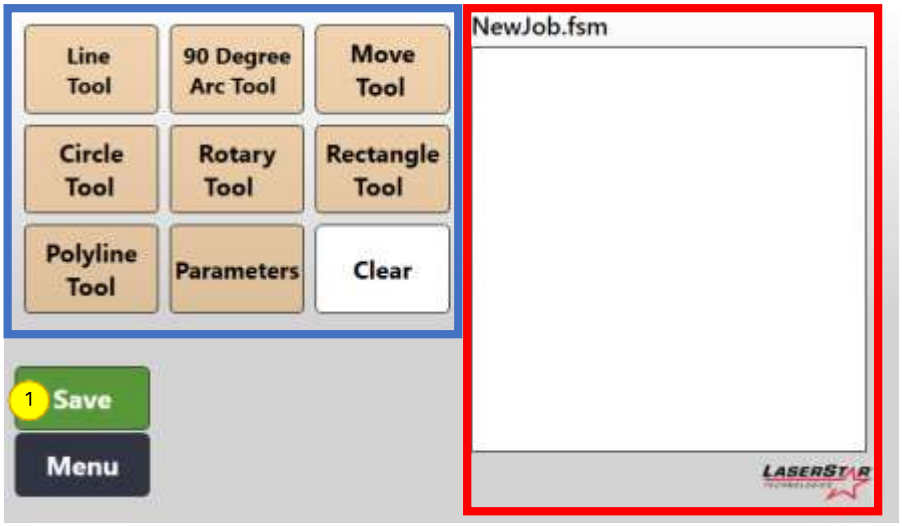
Within the blue box is the speed value/sliders and the direction. The speed for the specific axes can by typed in or the slider can be used to set the speed (in mm/s or degrees/s for rotary). The direction buttons indicate which direction the specific axis will move, in the positive or negative direction.

The items outlined in this box allow you to switch between “Line” and “Curve” mode. Line Mode is faster moving and less responsive to small movements. Curve Mode moves slower and is more responsive to small movements

1 The disable/enable joystick button with the state of the joystick (green for enabled). When the “Fire Button” box is checked then the user is able to fire the laser with the joystick.

2 The position box tells the user what absolute coordinates the laser is currently at.

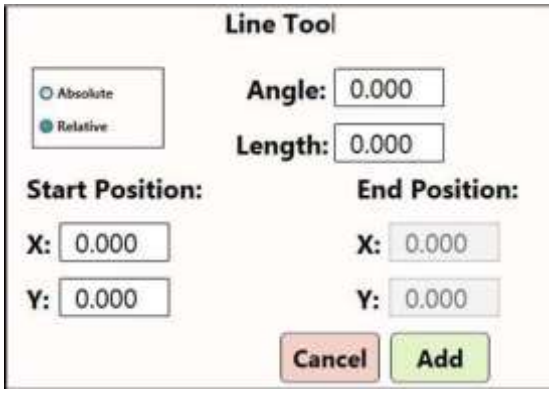
## Creating Shapes



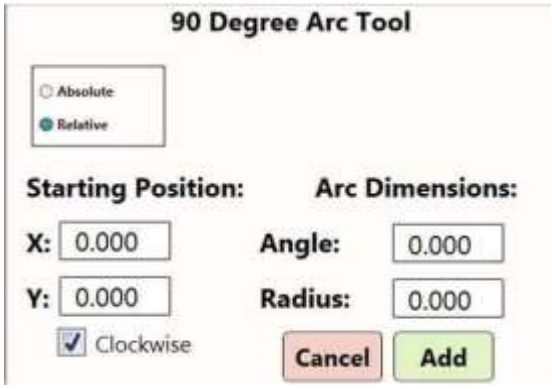

In the blue box all the different shape creating tools are shown. These tools create the appropriate G-code with coordinate/point inputs, so the user does not have to type it out. There is also a "Clear" button which will erase any code added with the tools before a save.

The red box shows the job file name and the code block that is being created by the shape tools.

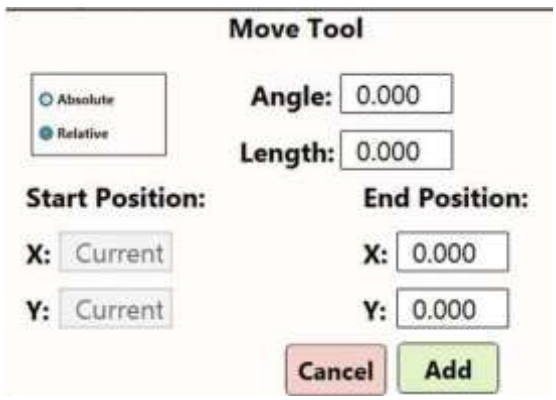
The save button adds in the code shown in the red box to the current job and saves it.



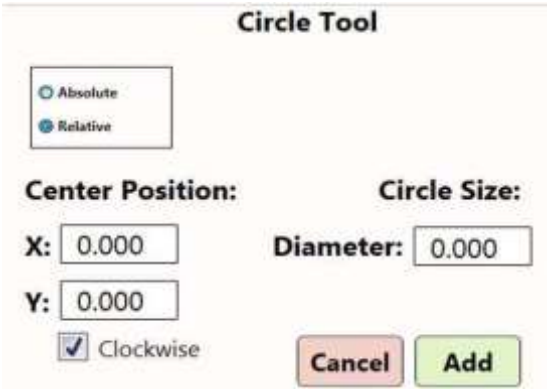

The line tool creates the code for a line using
2 points specified (for absolute) or with an angle and length (for relative).



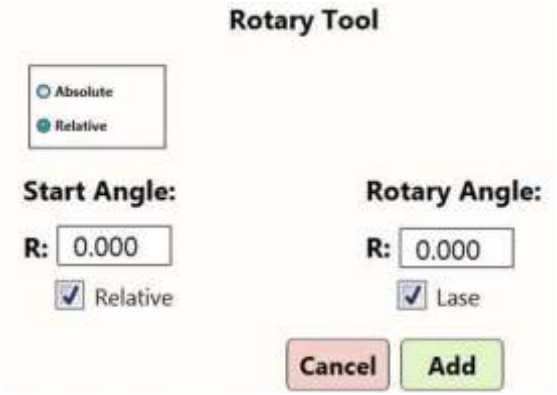

The arc tool creates the code for an arc (a portion of a circle) with a starting point, and angle, and radius; either clockwise or counterclockwise.



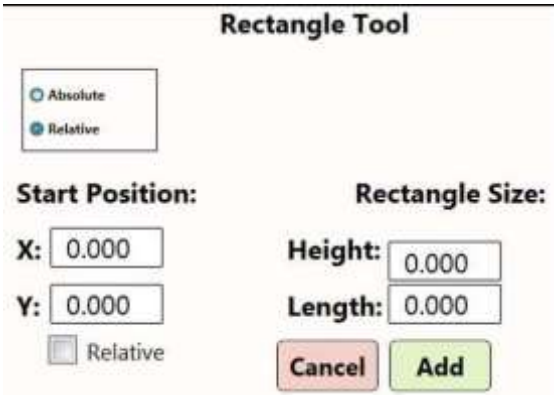

The move tool creates the code for a move to an absolute coordinate. For relative the user can either use angle + length or end position.



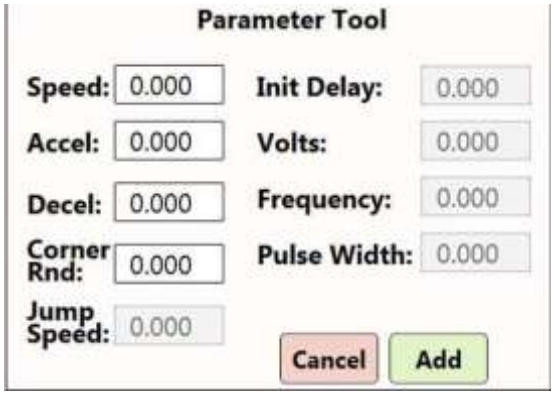

The circle tool creates the code for a circle using a center position and diameter, either CW or CCW.




The rotary tool is essentially a move to/lase to tool for the rotation axis.

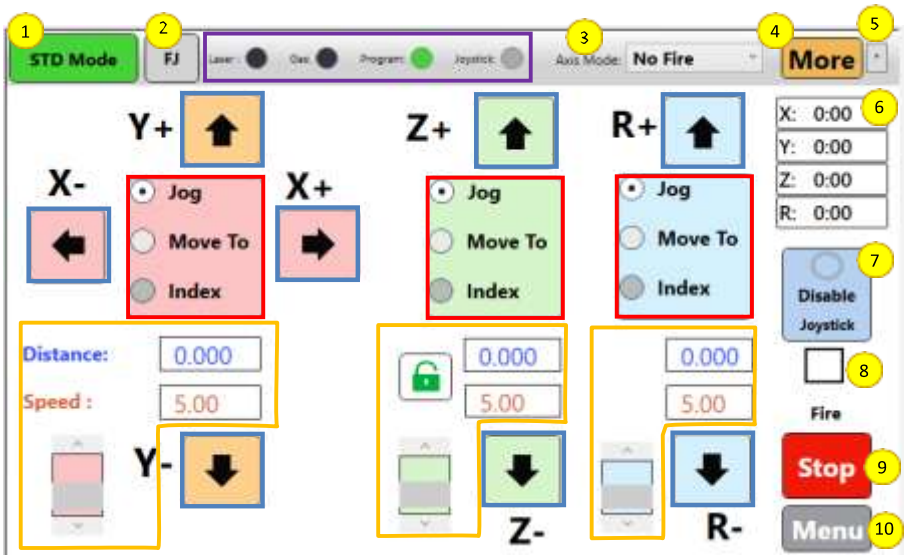



The rectangle tool uses a start position as one corner and the height and length as the change in Y and X coordinates, respectively.




The parameter tool here has the same function as described in the “Main Menu.”

## Edit Programs




1. “Open” lets the user select a program from a file.

2. “New” creates a fresh job with no code.

3. “Save” lets the user save the program currently shown in the code window to the right.

4. Save as” allows the user to save a program with a different name than it currently has.

5. “Run” will execute the code as shown in the code window.

6. “Stop” will halt all motion and lasing.

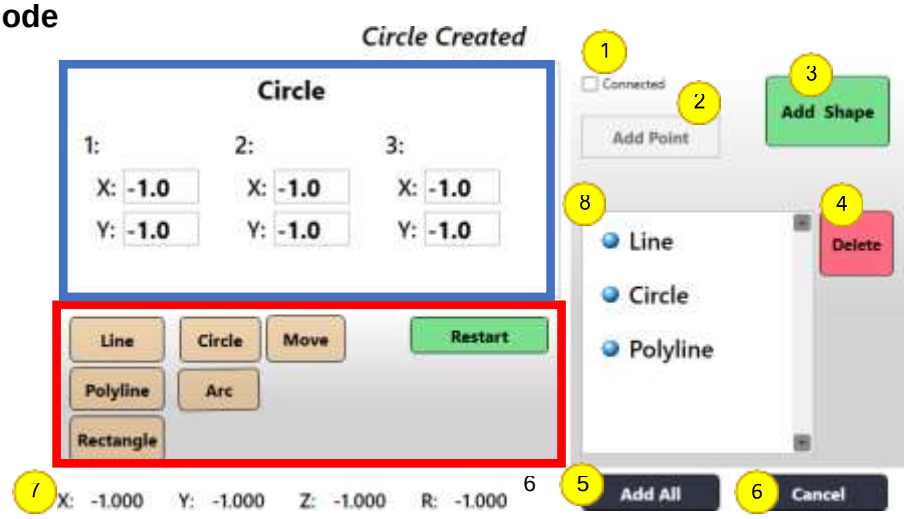
7. “Dry Run” executes the movements but not the lasing of the code.

8. The enable/disable joystick button allows/disallows the user to operate with the joystick; accompanied by green or grey dot indicating state.

9. “Stop” will stop all motion related functions.

10. “Menu” will take you to the menu selection screen

## Teach Mode




The blue box contains the points being used to create a specific shape selected

The red box contains the various shapes that can be created with teach mode. The restart button erases any points in the blue box for a fresh start on the current shape selected.

1. The “Connected” checkbox allows for a lase connecting the current shape to the previous command in the code.
2. The “Add Point” button adds the current location into the blue box as a point for creation of a shape.
3. The “Add Shape” puts the shape currently being specified into the list below when all the points have been input.
4. The “Delete” button allows the user to remove a selected shape from the list to the left before the code is added into the job.
5. The “Add All” button turns the list of shaped above into code and adds it into the job.
6. The “Cancel” button discards anything in the teach mode window and returns back to the menu selection.
7. The current position of the laser is shown here.
8. This is the list of shapes that have been added so far in the order that they will execute.

## Energy Saver / Sleep Mode (Model dependent)

This mode reduces the energy consumption of the machine. Press the ON button to return to the main screen.


**Figure 17**
**(Energy Saver / Sleep Mode-Model Dependent)**

## 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® Welding System, the micro controller monitors the conditions for pulse release on the basis of the following criteria:

- In principle, the remote interlock prevents a laser pulse release.
- A Remote Interlock failure shuts OFF the laser source.

## SETTING OPERATING PARAMETERS

Selecting operating parameters is done by using the Digital Message Touch Screen Display on the Front Panel or Pendant / (Model / Option Dependent).

### DIGITAL MESSAGING TOUCH SCREEN DISPLAY OPERATION (Figure 18)

**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.**

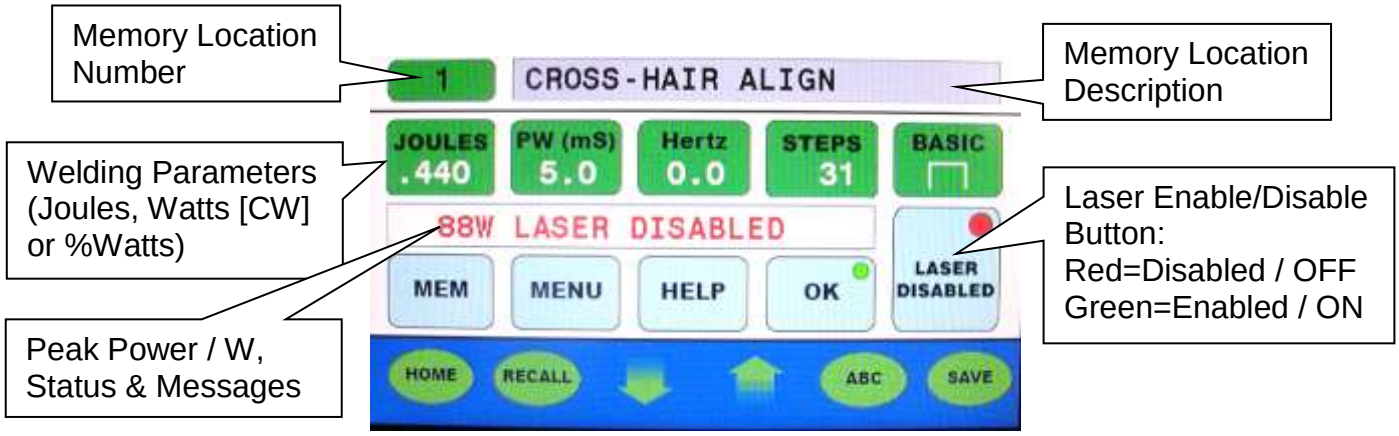
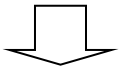



**Figure 18**
**(Digital Messaging Touch Screen Display)**

| Main Screen (Figure 19) | |
|---|---|
| **Button/Indicator/Screen** | **Description** |
| **OK / Red** | System is not ready to operate. The laser cannot be fired. |
| **OK / Green** | System is ready to operate. The laser can be enabled to fire. |
| **OK** | Pressing this button will enter the weld parameters displayed at that time and return the system to the main screen shown in **Figure 18** |
| **Laser Enable/Disable Button** | When the indicator in this button is red, the laser source is disabled / OFF. When the indicator in this button is green, the laser source is enabled / ON. |
| **Memory Location Number- "Number"** | Press this button to change the memory location number. The display will start to blink. Use the Up / Down arrows to change to the desired location number. Press OK to stop blinking. Press RECALL twice to load store values into the weld parameters.<br>• Yellow indicates the weld parameters are from this memory location.<br>• Gray indicates the weld parameters are not from this memory location.<br>(**Note**: Memory locations may be loaded with factory defaults. This is model dependent) |
| **Memory Location Description** | Displays the weld parameter description.<br>• Yellow indicates the weld parameters are from this memory location.<br>• Gray indicates the weld parameters are not from this memory location. |

| | |
|---|---|
| **Welding Parameters**<br>• **JOULES, WATTS (CW) or %WATTS**<br>• **PW (mS)**<br>• **HERTZ , BURST or Pulse Suppression (Optional / Model specific)**<br>• **DIA (mm)**<br>• **SHAPE (P³)** | Displays the current welding parameters:<br>• **Joules (J)**-Press this button to change the value. The display will start to blink. Use the up / down arrows to change the value and then press OK. (Note: All modes except CW mode.)<br>• **Watts (W)**-Press this button to change the value. The display will start to blink. Use the up / down arrows to change the value and then press OK. (Note: CW mode only)<br>• **%Watts (%W)**-Press this button to change the value. The display will start to blink. Use the up / down arrows to change the value and then press OK. (Note: All modes except CW mode.)<br>• **PW (mS)**-Press this button to change the value. The display will start to blink. Use the up / down arrows to change the value and then press OK.<br>• **Hertz / Burst / Pulse Suppression** (Optional / Model specific) **(Note: Use the up / down arrows to select Hertz, Burst or Pulse Suppression.**)<br>○ **Hertz (Hz)**-Press this button to change the value. The display will start to blink. Use the up / down arrows to change the value and then press OK.<br>○ **Burst**-Press this button to change the value. The display will start to blink. Use the up / down arrows to change the value and then press OK.<br>○ **Pulse Suppression** (Optional / Model specific)-Press this button to change the value. The display will start to blink. Use the up / down arrows to change the value and then press OK.<br>• **DIA (mm)**-Press this button to change the value. The display will start to blink. Use the up / down arrows to change the value and then press OK.<br>• **SHAPE**-Press this button to change the P³ shape. The display will start to blink. Use the up / down arrows to change the P³ shape and then press OK.<br>(**Note:** If OK is not pressed, the selected operation will time out and the change will be stored.) |
| **Messages** | Displays the laser status which includes-shutter status, error messages, memory parameters, etc. |
| **MEM** | Memory Features<br>○ 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 21a** |

| | |
|---|---|
| | ○ **Figure 21a** 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.)<br>○ **Figure 21b** 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 18** |
| **HELP** | Press this button to get:<br>• Contact Information<br>• Model Number<br>• Serial Number<br>• Tools / information to aid the user |
| **HOME** | Pressing this button returns system to the main screen- **Figure 18** (**Note:** Press Home button twice to clear "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 24 & 25** |
|  **(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 22 & 23** |
| **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 26 & 27** |

| Version / Configuration Screen (Figure 19) | |
|---|---|
| **Menu Display Screen** | 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.<br>Version: (number)<br>**Version:** (Alpha numeric)<br>**Configuration:**<br>>**Pulse Mode**: STD or MICRO<br>**Calibration:** ON or CAL<br>**Weld Gas:** ON (OFF) (**Up/Dn** arrow & press **ENTER**)<br>**Pre Weld Gas:** 0.00s (**Up/Dn** arrow & press **ENTER**)<br>**Post Weld Gas:** 0.00s (**Up/Dn** arrow & press **ENTER**)<br>**Plse Count:** 0 (**Up/Dn** to select)<br>• CLEAR-To zero/reset-select & press **ON**<br>• BACK-To **not** zero/reset-select & press **ENTER**<br>**Sleep:** Not Applicable<br>**Hours On:** 4.3 (No actions possible)<br>**Plse Total:** 0 (No actions possible)<br>**Fault Lists:** (Press **ON** to view & **ON** to clear)<br>• VIEW-Press **ON**<br>• CLEAR-Press **ON**<br>**Restore Def Memory: Up/Dn** arrow to select<br>• NO-No change-Press **ENTER**<br>• ALL-Reloads LST data & no change to user memory locations-Press **ENTER**<br>• LST-Reloads LST data & clears user memory locations-Press **ENTER**<br>• **ATTENTION:** The user must input desired parameters when returning to Main Screen.<br>**Energy Usage:** 0 (**Up/Dn** to select)<br>• SHOW-Press **ENTER**<br>• SYS-Press **ENTER**<br>• CLEAR-Press **ON**<br>**Frequency Adj:** XX (**Up/Dn** to set value & **ENTER**)<br>**SHTR Opn DLy:** 2.0 ms (model dependent)<br>**SHTR CLs DLy:** 7.5 ms (model dependent)<br>**PW_Sum:** 9 (**Up/Dn** to select)<br>• DIAG-**ON**<br>• BACK-**ENTER**<br><br>**Note:** If the selected item or change is not made in a reasonable amount of time, the display will return to the main screen. **Figure18** |

| | |
|---|---|
| **ENTER** | Pressing this button enters the selected item on ; changes are made using the **up/down** arrows 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/down** arrows 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 22 & 23)** | |
| **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. |

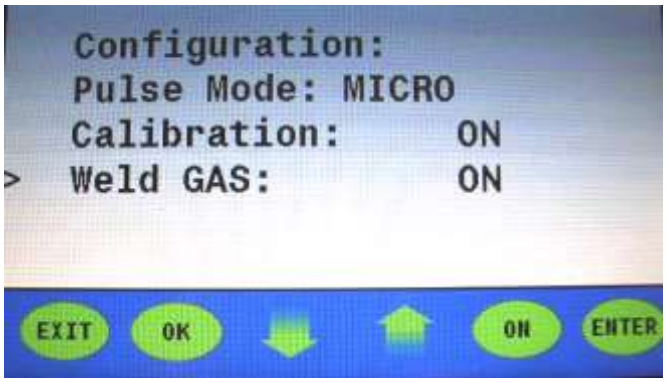



**Figure 19**
**(Menu Screen-Scroll Down to Weld GAS)**


**Figure 20**
**(Main Screen)**

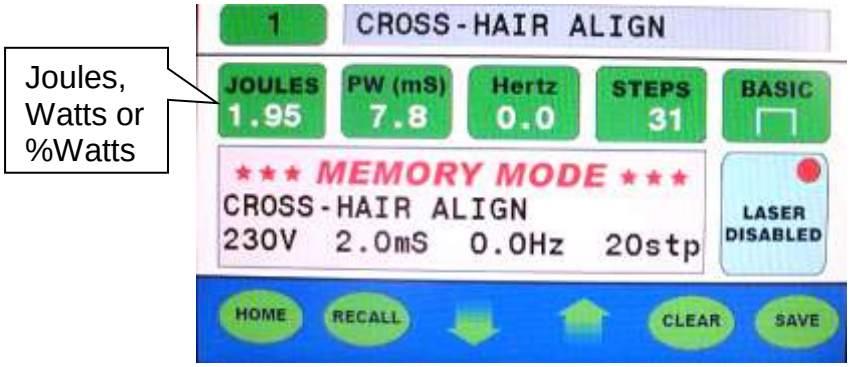



**Figure 21a**
**(Memory Screen)**


**Figure 21b**
**("Clear Memory 4?" by Pressing CLEAR)**


**Figure 22**
**(ABC Screen)**

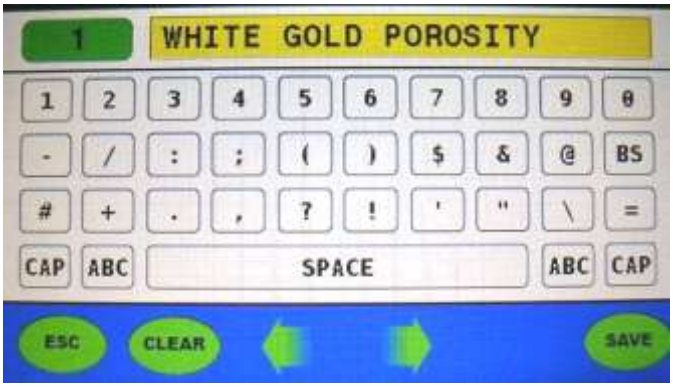



**Figure 23**
**(123 Screen)**

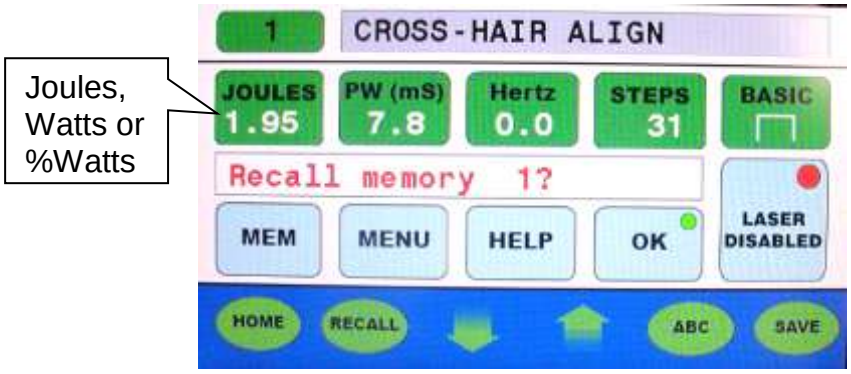



**Figure 24**
**(Recall Screen)**

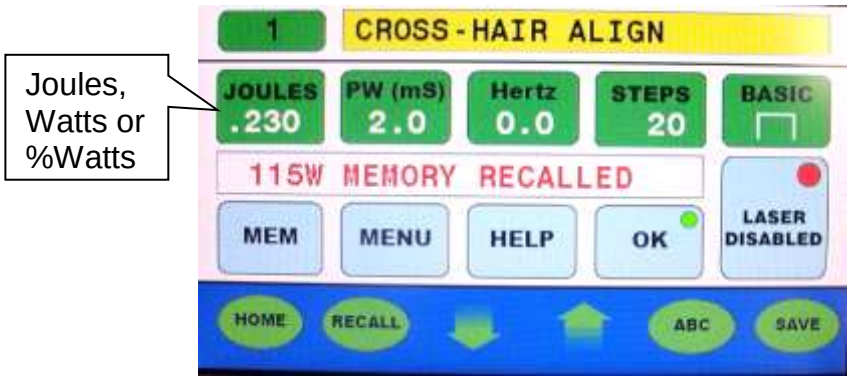



**Figure 25**
**(Memory Recalled Screen)**


**Figure 26**
**(Save Screen)**

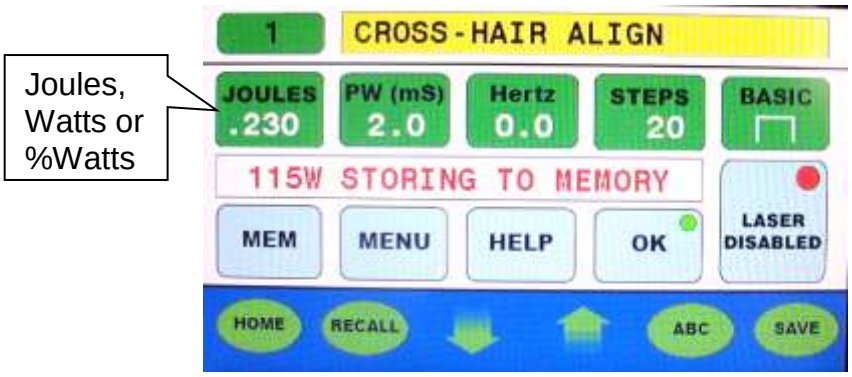



**Figure 27**
**(Storing to Memory Screen)**

## 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 back up using LaserStar's EZ-LINK or a hard copy should be created for all custom memory locations.)

A stored set of parameters consists of the following:

- Joules, Watts or %Watts
- Pulse width
- Single pulse or repetition frequency for continuous pulse
- Explanatory text
- Pulse Profile Shape / $P^3$ Technology

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 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 Remote OIT 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 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 selected memory location weld parameters are only visible while the memory location number is blinking. Once the memory location number stops blinking the weld parameters revert back to the previous values. |
| > Press the recall button on the touch screen twice. | ⊗ The recalled weld parameters will be displayed and the memory location description will change from gray to yellow. |

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

## WELDING

Using the Digital Messaging Touch Screen Display & Red Laser Spotting Diode
(Note: An optional remote Digital Messaging Touch Screen Display can also be used to operate the welder.)

The Red Laser Spotting Diode is used to help locate the spot to be welded. Enable the laser by pressing the Enable/Disable button to display "Laser Enabled" and press the **OK** button three times to turn on the spotting diode. **(Note: Proper eye wear must be worn at all times.)**

| Action of the Operator | System Response |
|---|---|
| > Turn on the red laser spotting diode | ⊗ Press the **OK** three times. |
| > Put the work piece into the welding area | ⊗ Workpiece secured |
| > Set the weld parameters | ⊗ This can be done using the Digital Messaging Touch Screen |
| > Use the red spotting diode to locate the area to be welded | ⊗ To weld-Press the Laser Enable/Disable Button on the Digital Messaging Touch Screen Display (Laser Enabled / Indicator turns green) |
| > Fire the Laser | ⊗ Press the foot pedal (Note: The weld parameters can be optimized by using the Digital Messaging Touch Screen Display.) |

Caution!

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

Use the Digital Messaging Touch Screen Display 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 part above the focal plane.

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

- **Horizontal dimensions:** The exact position is controlled by the red laser spotting diode.

- **Vertical dimension:** The exact positioning is found by moving the focus head or part up and down around the working distance of the focus head.

| Action of the Operator | System Response |
|---|---|
| | |
| > Position the work piece with aid of the red spotting diode. | ⊗ The spotting diode should show the position of the laser focal point in the xy plane |
| > Press the pedal switch half way. | ⊗ The gas supply will be enabled |
| > Fully press the pedal switch until it stops | ⊗ 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. | |
| | |

For different materials, suitable laser parameters (voltage, pulse length, pulse frequency, beam diameter, and multi pulse / P3 [Model Dependent]) 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, the **OK** button indicator will turn red. When the system is ready to fire the **OK** button indicator will turn green. A laser pulse will only be released if the laser is enabled.

## Resetting Pulse Count

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

## Text Entry Mode

Reference **Section IV** / Setting Operating Parameters / Digital Messaging Touch Screen Display Operation / ABC Screen

## Switching OFF

Refer to **Figure 28**

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 to the left.
3. Turn Mains Power switch 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.

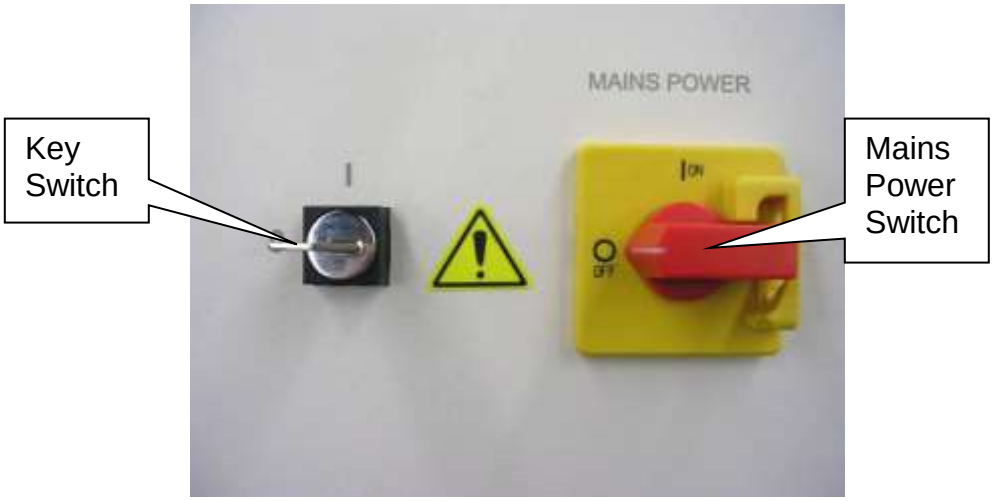



**Figure 28**
**(Switching OFF)**

## EZ-LINK™
**(Hardware standard / Software optional)**

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:

1. Connect and Control Your LaserStar®-Remotely or On-site
2. Create / Edit / Save Memory Parameter Settings
3. Back-Up Memory Cells (Parameters and Descriptions)
4. Monitor Daily System Performance
5. Download System Updates
6. Create Usage History Reports
7. Perform Troubleshooting
8. Run System Diagnostics

## Restricted Access / Password Protection / Password Change Feature **(Option / Model Dependent)**

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 / Restricted Access / Password Protection / Password Change Instructions.**

## Beam Bender-Laser Beam-Microscope Alignment / Adjustment

**Beam Bender-Laser Beam Alignment (Figure 29)**

The alignment for Beam Bender Assembly is shown in **Figure 29**. The adjustments should be done in the following sequence.

1. Loosen the Locking Ring; rotate the Beam Bender Assembly to be perpendicular to the work surface / welding plane; and secure by tightening the Locking Ring.

2. Install the Extension Tube (Not shown) into the Beam Bender Assembly and install the Final Focus Lens (Not shown) into the Extension Tube.

3. Position a copy of the target shown in **Figure 30** on the work surface / welding plane concentric with the OD of the Final Focus Lens (Note: This can be done by moving the Final Focus Lens down to the target or moving the target up to the Final Focus Lens.).

4. The Final Focus Lens should now be repositioned to the working distance of Final Focus Lens from the work surface / welding plane.

5. The Spotting Diode is now turned on per the instructions on **Page 60** / Welding. The target shown in **Figure 30** is used to align the Spotting Diode to the center of the circle using the two Laser Beam Adjustment screws. (**ATTENTION:** If the laser beam is not concentric to the Final Focus Lens, the laser beam will be clipped and power / energy will be lost.)

6. The final working distance is adjusted to achieve an optimum weld.

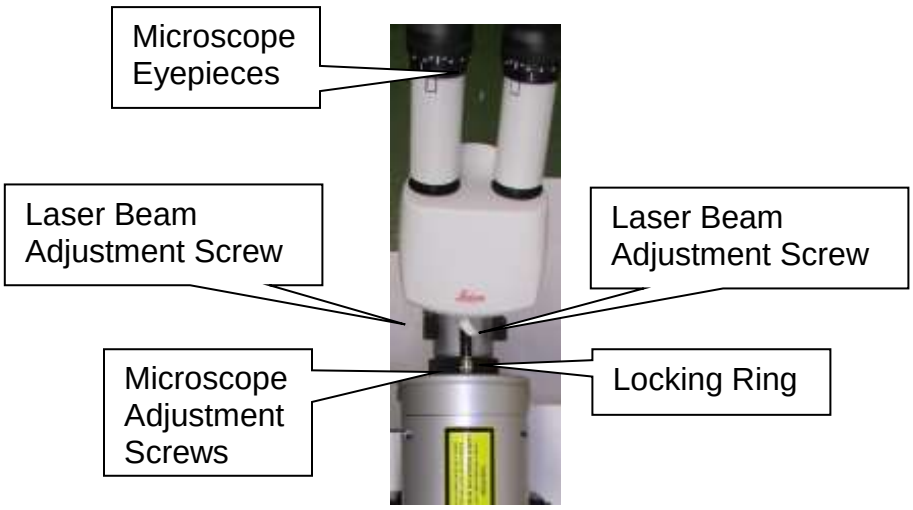



**Figure 29**
**(Laser Beam and Microscope Alignment)**

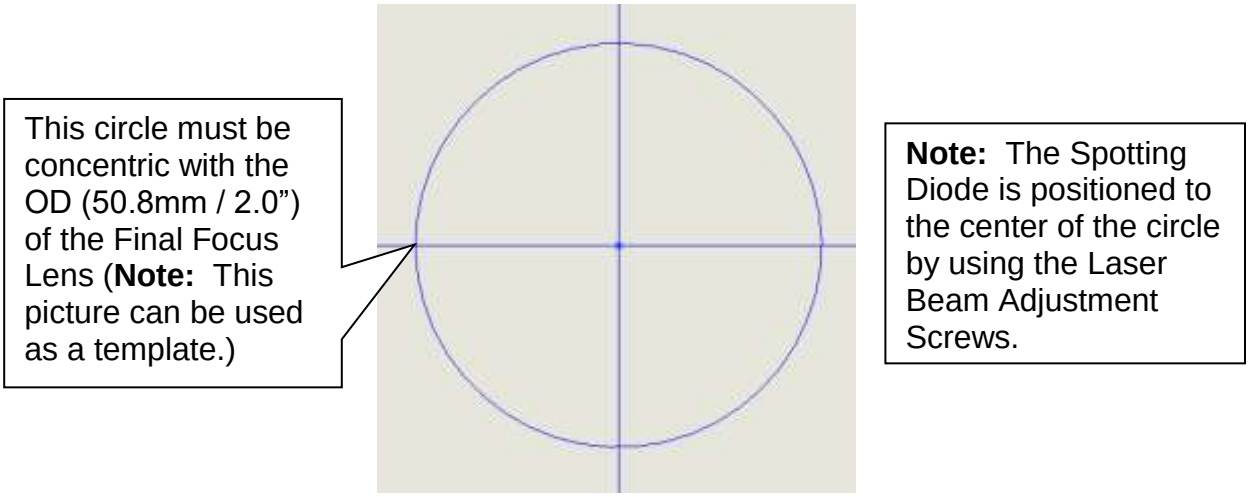



**Figure 30**
**(Align Spotting Diode to Center of Circle / Target)**

## Optical Mounting and Alignment (Binocular & *EZ-VIEW/Cobra*) - Figure 31 & 32

The binocular or EZ-View Cobra® microscope are normally adjusted for normal-sighted persons at the factory. However, it may be necessary to readjust it for specific operators; it the operator wears glasses; or the focus of the cross hair. **Figure 31** shows the microscope mounted on the Beam Bender Assembly. (Note: A 2mm Allen wrench is required.)

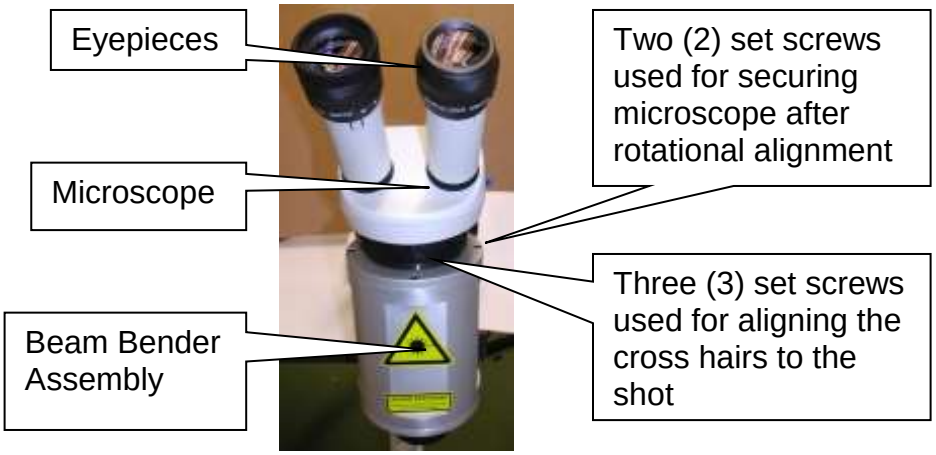



**Figure 31**
**(Microscope Mounting & Cross Hair Alignment)**

**Steps:**

1. Place binocular or ***EZ-VIEW®/Cobra*** microscope into mounting bracket (**Figure 4**).

2. 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.

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

4. Switch on the product (turn only Mains switch to position "I").

5. Ensure eyepieces are pushed onto the eyepiece tube as far as they can go.

6. 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.

7. 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.

8. 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.

9. 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.

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

11. Alignment of crosshair to the shot:

    a. Bring the steel plate into focus using an adjustable Lab Jack or equivalent.
    b. Adjust the parameters to 260 V, 1.0 Ms, 0.0 Hz, 0.5mm.
    c. Make a single shot onto the plate, do not move plate.
    d. 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.

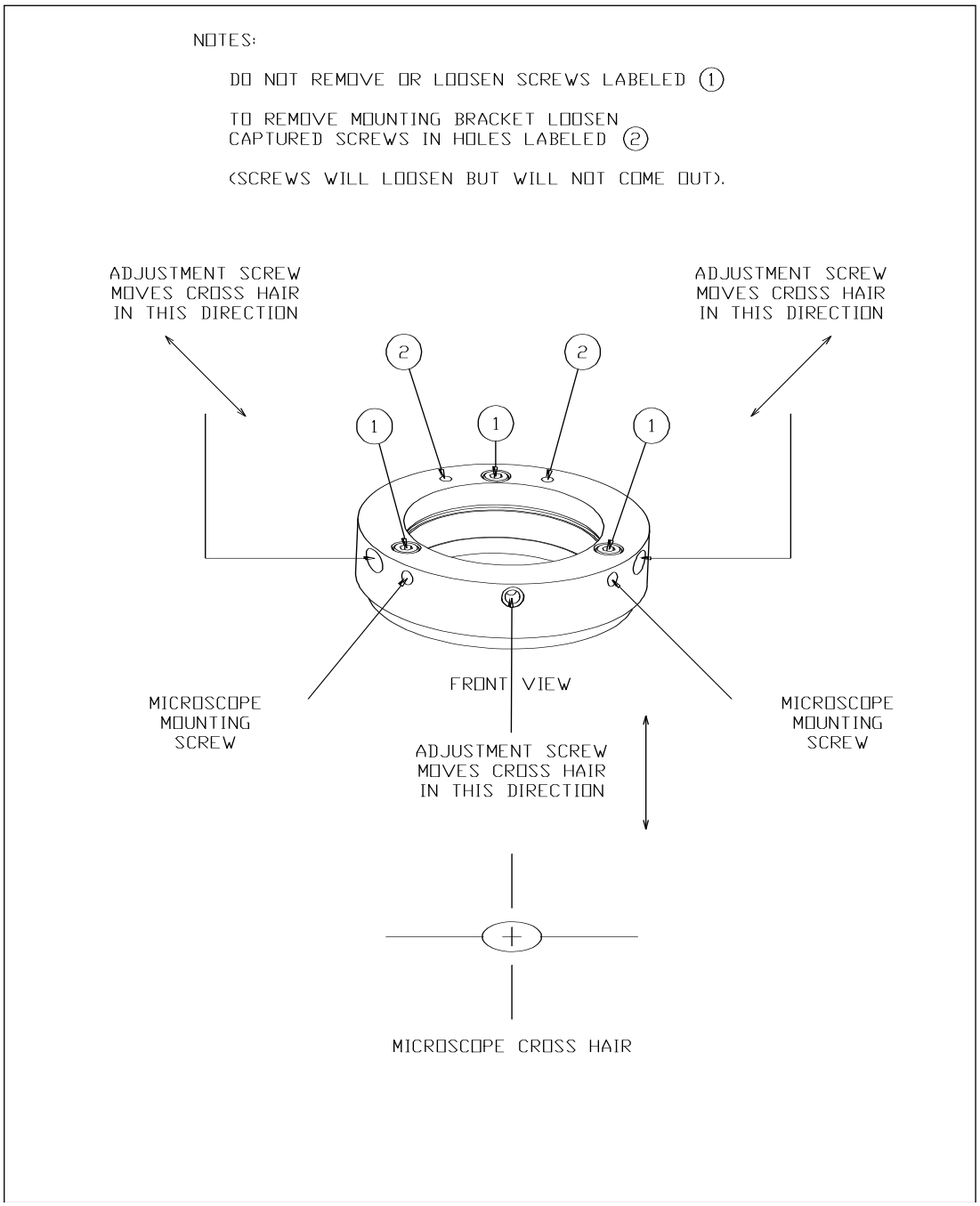



**Figure 32**
**(Cross Hair Alignment)**

# 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!**

Wear proper laser protective EYE WEAR

**Warning!** 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 and accessories.

**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 (System dependent) 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 |
| AIR FILTERS | 90 days | Press to reset |

.

**Digital Messaging Touch Screen Display Maintenance Alerts**


**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 **Protective Disk** on the optional focus head 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. Monthly**

Check and replace all the laser filters (exhaust filter and side panels) as required / if dirty.

**C. Quarterly**

All the above

**D. Yearly**

All the above

## Replacement of the Focus Lens Protective Glass Disk (Model / Option Dependent)

1. Switch OFF the laser

2. Unscrew the knurled ring at the underside of the lens counterclockwise

3. Replace the old protective glass disk with a new one.

4. Make sure the O-ring seal behind the protective disk is properly seated. (Note: Only the edge of the O-ring should be visible looking at the lens face.) (model dependent)

4. 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.

## 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.

<u>Specific Cleaning Information:</u>

- 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.
- Wipe the surface gently; if there is a directional surface texture, wipe in the same direction as the texture.
- Never use acidic or alkaline cleaners, or organic chemicals such as: paint thinner, acetone, toluene, xylene, propyl or isopropyl alcohol, or kerosene.
- 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/>.
- 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.

# 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 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

se of any malfunction of the device that cannot be eliminated by
f the actions described in the sections MAINTENANCE or
OR MESSAGES AND FAULT CLEARANCE, please immediately
ct the service department of LaserStar Technologies

**(Note:** Some error messages will occur with an alarm as shown in **Table 1** other system / error messages will occur in the message line of the display and will require pressing HOME twice to clear. The error will only clear if the cause of the error has been eliminated. **Contact LaserStar Service if the error 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.

## ALARMS

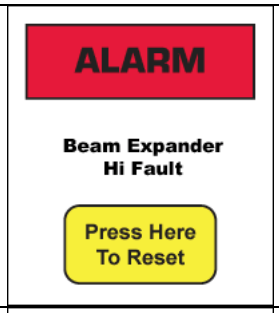
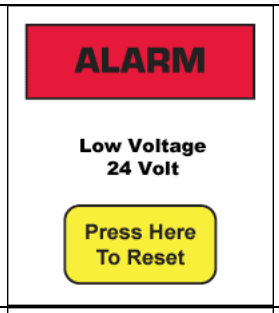
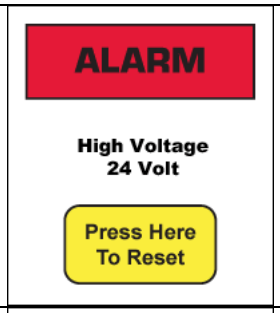
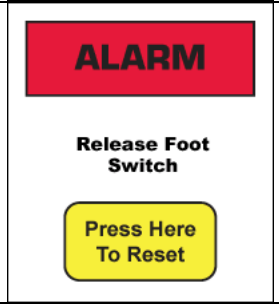
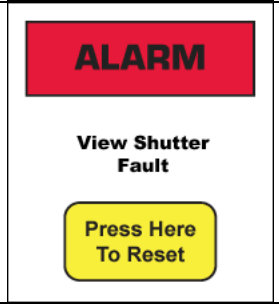
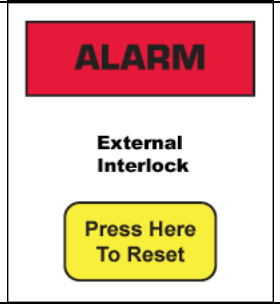
| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| |  | | |  | | |  | |
| |  | | |  | | |  | |

**Table 1**

# VII. PARTS AND ACCESSORIES

| Description | Catalog Number |
|---|---|
| | |
| Air Filter (150 W & 300W model) | 14-64001 |
| Air Filter (450W model) | 14-64001 |
| Alignment Paper | 00-10020 |
| Collimator | Model Dependent |
| Focus Lens Protective Disk | 01-10112 |
| Foot Switch Assembly | 111-30-0003 |
| Foot Switch Extension Cable | 121-36-0013 |
| Fuse 250VAC 3AB FAST Ceramic | 405-4320-115 |
| Laser Protective Eye Wear | 444-004 |
| Laser Protective Eye Wear: Diffuse | 444-001 |
| Laser Source / 150W | 113-30-0151 |
| Laser Source / 300W | 113-30-0303 |
| Memory Backup Battery | 405-3900-001 |
| Operation & Maintenance Manual | 14-99990-890 |
| Power Cord-250VAC 14/3 AWG | 116-36-6509 |
| Power Supply / 24VDC / 6.3A | 405-4000-2463 |
| Power Supply / 48VDC / 32A | 405-4048-032 |
| Rabbit Core Module Programmed | 621-510 |
| Regulator Kit (Inert Gas) | 601-099 |
| Remote Interlock Shorting Cap | 101-36-0036 |
| Trouble Shooting Connector Kit | 121-36-0006 |

# VIII. WARRANTY ORIGINAL EQUIPMENT

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

A) **Limited Warranty** -After reaching out and notifying the LaserStar Technologies Corporation® Service Department about a problem with your laser system, we will, at our option, elect to:

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) **Warranty Exclusions**

1. This warranty does not provide coverage or protection against damage, misuse or abuse of the optical components (damage to the resonator optical output fiber, lenses, mirrors, glass, crystal, etc.) associated with the device;

2. This warranty does not provide coverage or protection against damage, misuse or abuse of the computer hardware;

3. It is required to connect an exhaust device to ensure ablated materials and/or harmful gases are removed from the system which can potentially cause damage to the laser system. Failure to connect an exhaust system can result in voiding the warranty.

4. This warranty does not provide coverage or protection for consumable parts (protective disk, air filter, coolant filter (if required), coolant (if required), cuffs, fuses, halogen lights, LED lamps, final focus lens, etc.).

This warranty is applicable for all equipment, when operated under normal conditions, and in an industrial environment. Any unauthorized use, misuse, neglect, or modification, including use of accessories that have not been previously approved or authorized by LaserStar Technologies Corporation® will void this warranty. Under no circumstance will LaserStar Technologies Corporation® accept liability for loss of use or for any indirect or consequential damage that is the result of customer negligence.

Satisfaction of this warranty, consistent with other provisions herein, is limited to replacement or repair, modification, at the sole discretion of LaserStar Technologies Corporation® and with LaserStar Technologies Corporation® to determine the availability of service personnel, and any absorption of associated service-related expenses.

**The warranty terms previously outlined are valid and will remain in effect only if and when the following obligations are met:**

Prompt written notification is provided to LaserStar Technologies Corporation® upon discovery of an alleged defect;

LaserStar Technologies Corporation® examines the equipment, and to its satisfaction, finds that any defect is not the result of misuse, neglect, improper installation, improper operation or improper maintenance, unauthorized repair, alteration or unusual deterioration or degradation of the equipment or parts thereof, due to the physical environment or an electrical or electromagnetic noise environment.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES WHETHER STATUTORY, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO 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, THIS HAS BEEN APPROVED INDEPENDENTLY, AND IN WRITING BY LASERSTAR TECHNOLOGIES CORPORATION®) AND EXTENDS ONLY TO THE BUYER OR CUSTOMER PURCHASING DIRECTLY FROM LASERSTAR TECHNOLOGIES CORPORATION® OR FROM ANOTHER AUTHORIZED RESELLER.

**Return Authorization:**
Whether your equipment is under warranty and in need of repair or otherwise, you must first contact LaserStar Technologies Corporation® to communicate your issue, schedule service, and obtain prior authorization; such authorization shall be granted for each reasonable request. Unless such authority has been granted, the shipment will be refused. Any and all transportation-related expenses associated with evaluation or repair of your equipment, including any refusal of delivery, are the sole expense of the buyer. When sending equipment to our facility, an RMA or CRA number will be assigned to accompany your laser system; this number should remain clearly marked and visible on the exterior of the shipping container.

**Governing Law:**

The sale and purchase of this equipment, including all terms and conditions thereof, shall be governed in accordance with the Uniform Commercial Code and the laws of the State of Florida.

**Limited Liability**

LASERSTAR TECHNOLOGIES CORPORATION® DOES NOT ASSUME RESPONSIBILITY FOR, NOR WILL IT BE HELD LIABLE FOR (A) FINES OR PENALTIES RELATING TO PENALTY CLAUSES OF ANY VARIETY, OR (B) CERTIFICATIONS NOT OTHERWISE SPECIFICALLY PROVIDED HEREIN, (C) INDEMNIFICATION FROM THE BUYER OR OTHERS (RELATED OR NOT) FOR LIABILITY, CLAIMS, ACTION, DAMAGES, LOSS, FINES, COSTS OR EXPENSES, INCLUDING, WITHOUT LIMITATION, REASONABLE ATTORNEY'S FEES, OF EVERY KIND OR NATURE ASSERTED BY ANY PARTY, AND ARISING DIRECTLY OR INDIRECTLY FROM OR IN CONNECTION WITH EQUIPMENT OR REPAIRS RELATING TO THIS PURCHASE ORDER, OR (D) FOR INDIRECT OR CONSEQUENTIAL DAMAGE UNDER ANY CIRCUMSTANCE.

This warranty does provide coverage or protection against damage or defects resulting from accidents that occur while in transit, unauthorized repairs, alteration, misuse, neglect or failure to follow proper safety and operating instructions, fire, flood, freezing temperatures or acts of God.

**Authorized Equipment Repair Offices:**

| | | |
|---|---|---|
| Corporate Office<br>Sales, Training, Repairs & Manufacturing | Corporate Office<br>Sales, Training, Repairs & Manufacturing | Corporate Office<br>Sales, Training, Repairs & Manufacturing |
| 2461 Orlando Central Pkwy.<br>Orlando, Florida 32809<br>(407) 248-1142 | 2461 Orlando Central Pkwy.<br>Orlando, Florida 32809<br>(407) 248-1142 | 2461 Orlando Central Pkwy.<br>Orlando, Florida 32809<br>(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 laser protective eye wear**

Warning!

During some of the service activities / tests (Simmer / Flashlamp Status, 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, toping 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 Fuse Replacement (Figure 1 & Table 1)

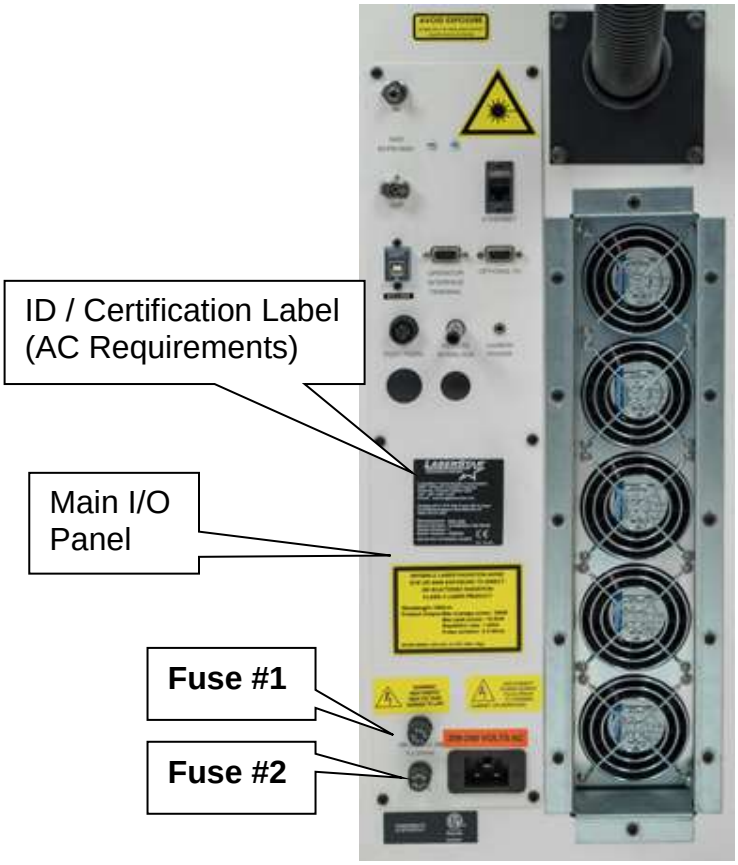



**Figure 1**
**(Rear View)**

### Fuse Replacement Procedure

1. To check or replace any fuse, turn 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. Connect AC power cord and foot pedal cable to the machine
6. Connect AC cord to power source.

| Fuse # | LaserStar Part No. | Specification | Use |
|---|---|---|---|
| **1 & 2** | 405-4320-115 | 15A 250VAC 3AB FAST | System Fuse |

**Table 1**
**(Fuses)**

## Rear Connections (Figure 2)

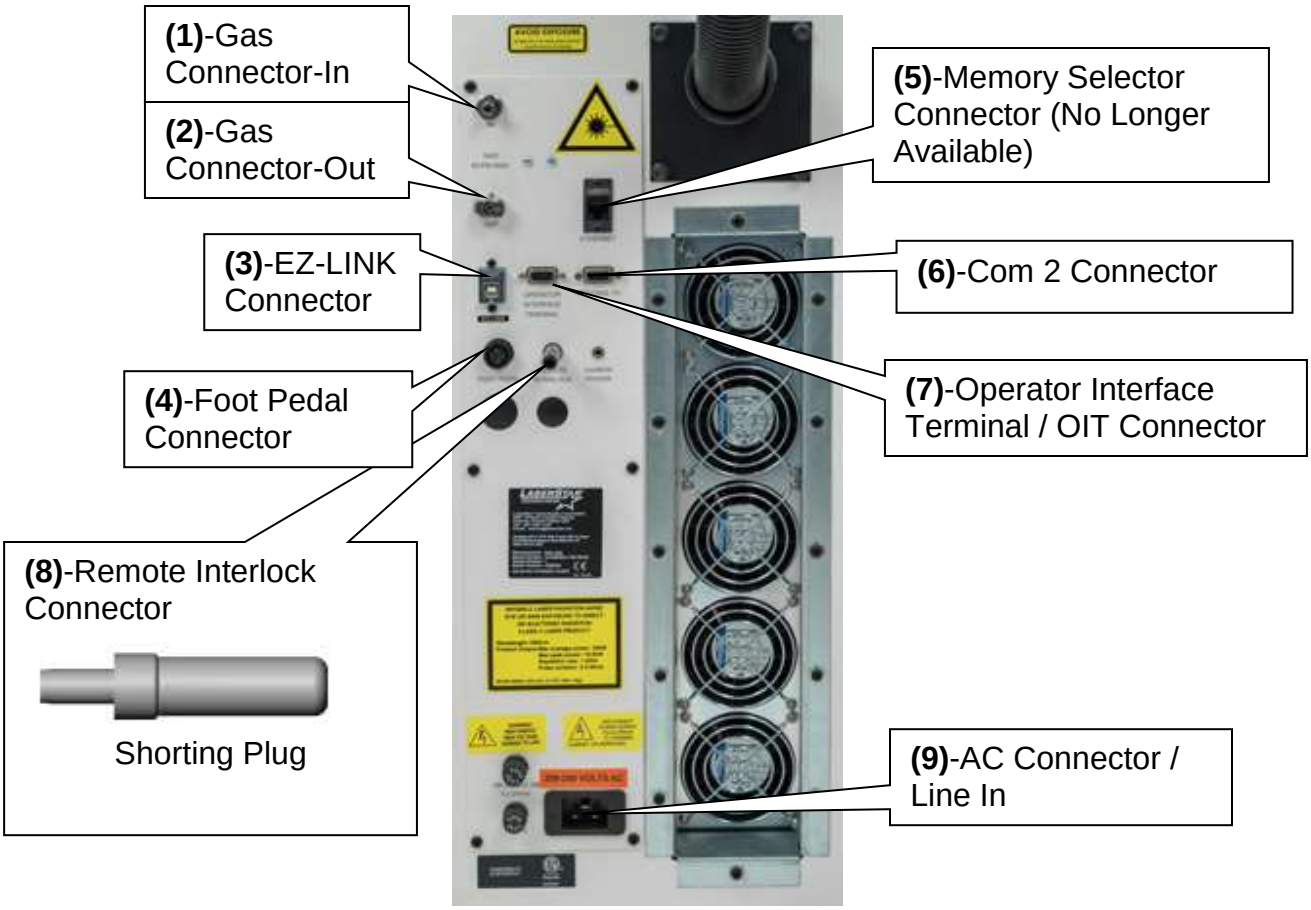



**Figure 2**
(**Main Panel)**

## Rear Connection Descriptions

**(1)** Gas Connector-In: This inert gas input is to provide gas to the application. (Reference “Inert Gas” in **Section III**)

**(2)** Gas Connector-Out: This inert gas output applies gas to the application on depressing the Foot Pedal. (Reference “Inert Gas” in **Section III**)

**(3)** EZ-LINK Connector: EZ-LINK with the optional software provides direct access to the welder’s internal operating system via a personal computer. (Reference EZ-LINK in **Section IV**)

**(4)** Foot Pedal Connector: The Foot Pedal is a two stage switch that triggers pulses and inert gas. (Reference “Foot Pedal Switch” operation in **Section I**)

**(5)** Memory Selector Connector: Diagnostic port for service, connects to the laser engine directly

**(6)** Optional I/O: The serial port I/O provides RS232 communications with the welder and laser controller through the motion controller. (Reference "Welder Serial Port I/O" in **Appendix D**)

**(7)** Operator Interface Terminal Connector (OIT): This port connects the OIT to the laser. The OIT provides all the operating parameters that were previously stored in a specific memory location. (Reference "Remote OIT" in **Appendix A** & reference "Operation" in **Section IV**)

**(8)** Remote Interlock Connector: This input provides a secondary interlock which must be closed. A shorting plug is supplied to by-pass this interlock. (Reference "Remote Interlock Connector" in **Section III)**

**(9)** AC Connector / Line In: This input provides the AC power to the welder. (Reference "Initial Power Connection" in **Section III**)

## Service B: Major Internal System Components

**Control System (Right Side with Panel Removed) (Figure 1)**

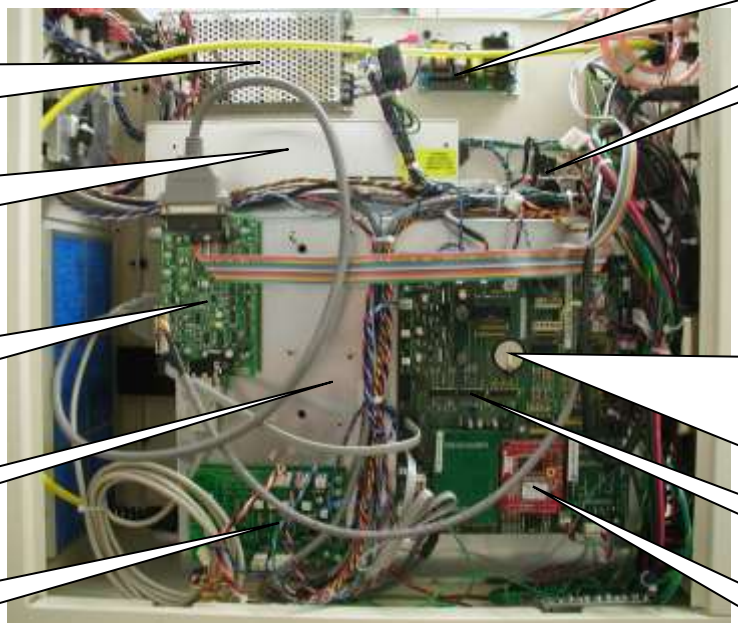



**Figure 1**
**(Control System)**

**Laser Rail Assembly**

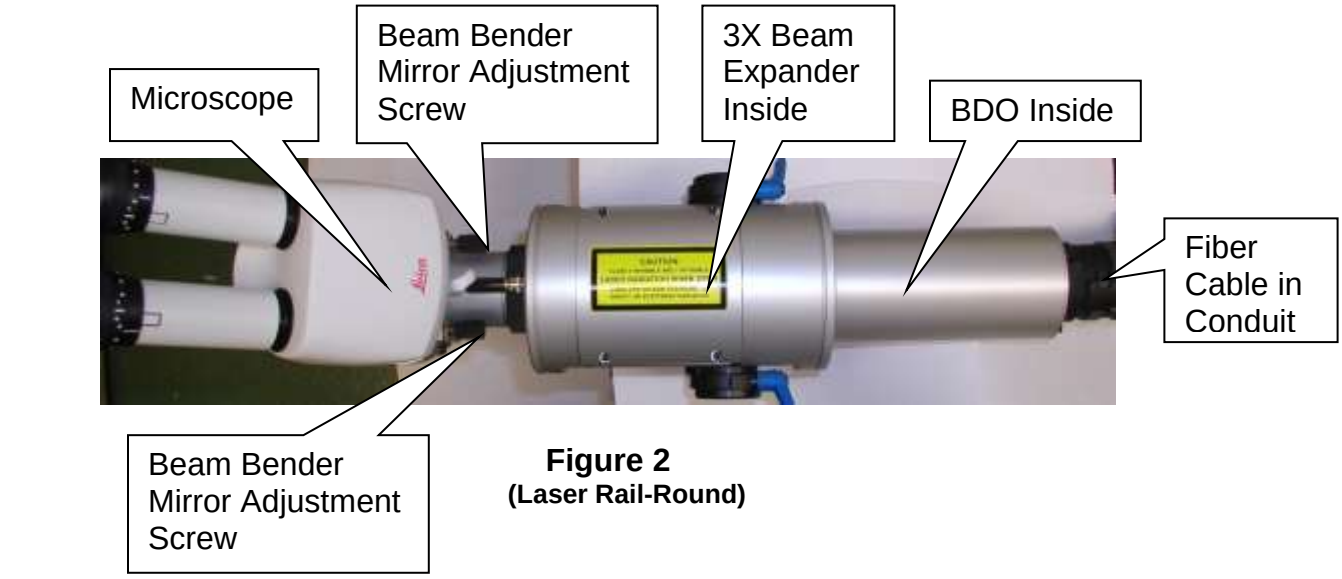



**Figure 2**
**(Laser Rail-Round)**

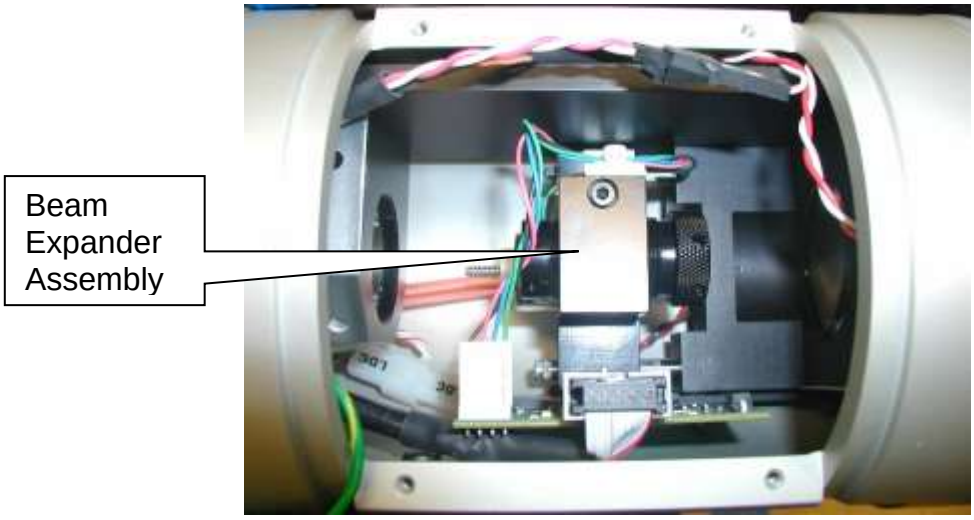



**Figure 3**
**(Laser Rail with 3X Beam Expander)**

## <u>Service C</u>: 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.

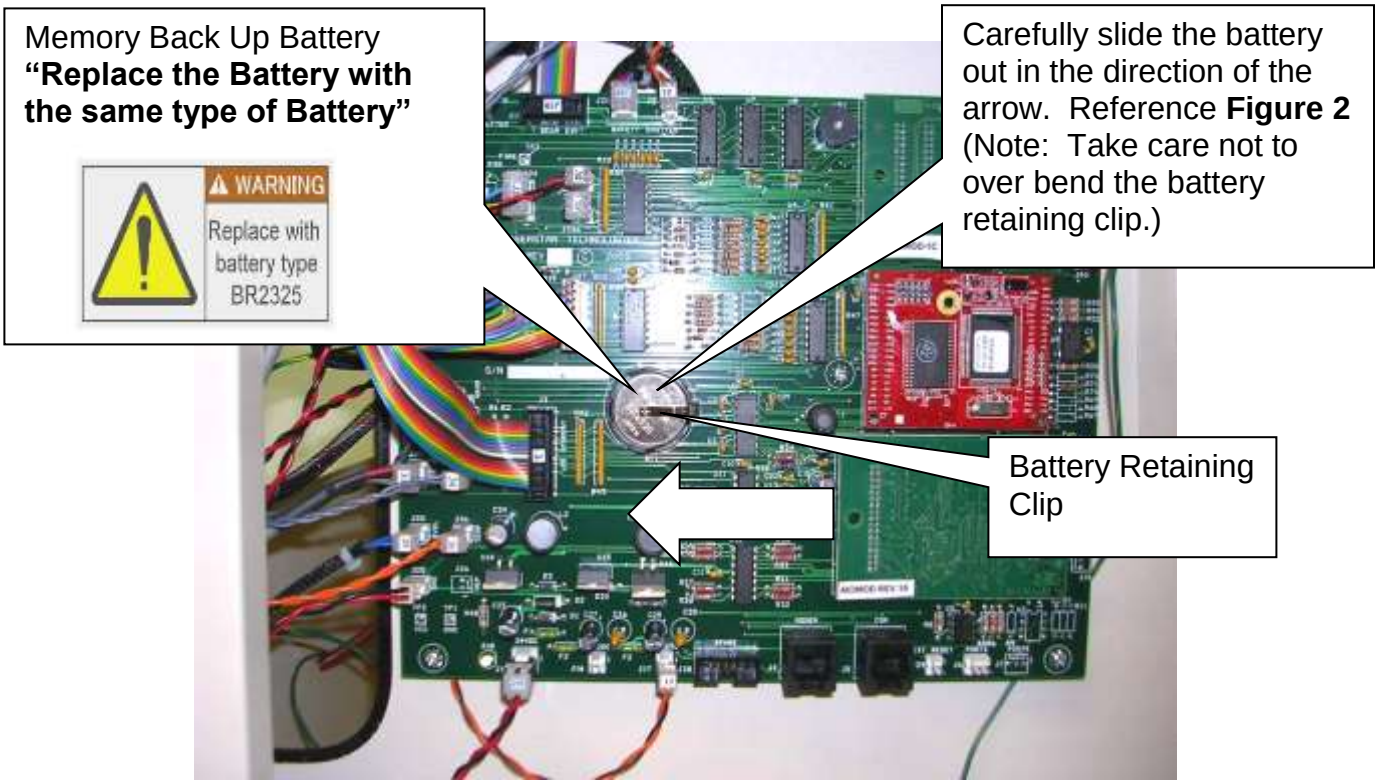



**Figure 1**
**(Control Board with Battery)**

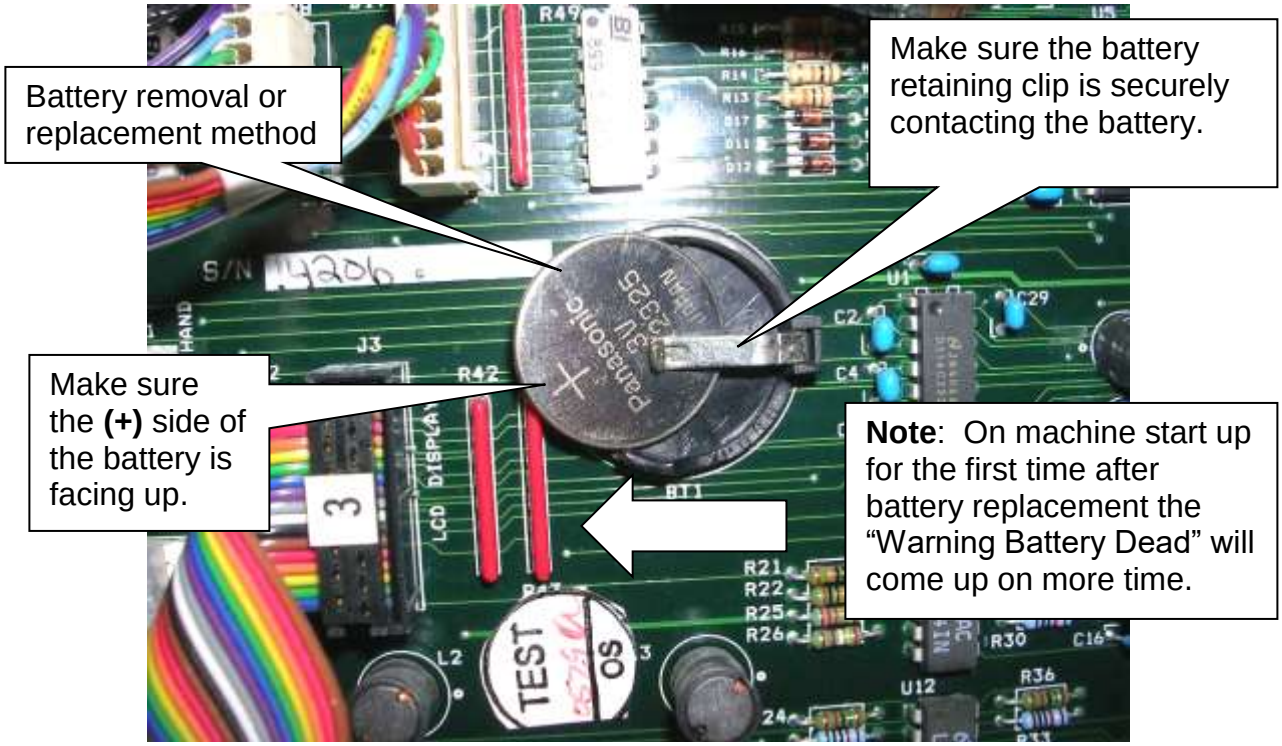



**Figure 2**
**(Battery Replacement)**

# X. APPENDIXES

## Appendix A: Remote OIT / (Operator Interface Terminal)

**Remote/OIT Control Functions** (**Figure 1**)


**Figure 1**
**(Remote Digital Messaging Touch Screen Display OIT)**

For details on how to operate the Remote Digital Messaging Touch Screen Display please reference Section IV / Operation / Setting Operating Parameters section of the manual. Reference the Table of Contents for the exact pages for these instructions. (Note: The Remote Digital Messaging Touch Screen Display operates the same way as the machine based display.)

# Appendix B: Welder Serial Port I/O-(Model / Option Dependent)

**Operation:** The serial I/O through the RS232 connector provides the same capability as EZ-Link I/O through the USB connector for bidirectional communications / control with the LaserStar welder.

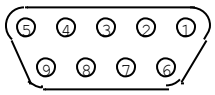
**Connection:** The Serial I/O connector is located on the rear of the laser near the fiber output connector. (**Note**: Reference **Service** for Fuse Replacement, Rear System Description, and Connections.)

## Serial I/O Interface Hardware

**COM 2 PORT, 8000 SERIES WELDERS**

**MECHANICAL SPECS:**

CONNECTOR TYPE: STANDARD FEMALE DB-9




COM 2 CONNECTOR
ON BACK OF LASER

| PIN | FUNCTION |
|---|---|
| 1 | (NOT USED) |
| 2 | TX |
| 3 | RX |
| 4 | (NOT USED) |
| 5 | GND |
| 6 | (NOT USED) |
| 7 | (NOT USED) |
| 8 | (NOT USED) |
| 9 | (NOT USED) |

**ELECTRICAL SPECS:**

SIGNALS:

Standard Serial RS232-C

SETTINGS:

- Baud Rate: 19200bps
- Data Bits: 8
- Parity: None
- Stop Bits: 1
- Flow Control: None

## Appendix C: Restricted Access / Password Protection / Change Password Instructions

The restricted access feature is intended to prevent unintentional or unauthorized changes to the device's welding parameters installation of this feature occurs prior to shipping.

### Enabling Restricted Access and Password (PIN) Protection

1. Press the menu button on the main screen (figure 1).
2. Using the down arrow, scroll to "restrict access" (figure 2).
3. Press the enter button (figure 2) the display will read "no" (figure 3).
4. Using the **up** or **down arrows**, switch to "**yes**" **(figure 4)**.
5. Press "**on**" to enter "**yes**" **(figure 4).**
6. Press the **exit button** twice (2) to return to main screen **(figure 4)** password protection is enabled

**While password protection is enabled, the selectable options on the touchscreen display are restricted the following buttons remain active (figure 1).**

- **Memory location number** (upper left-hand corner of the display)
- **Up** or **down arrows** (select the desired memory location number toggles between **hertz**, **burst**, and **PS**)
- **Recall** (press twice [×2] to load the weld parameters for the selected memory location)
- **MEM** (displays the welding parameters and memory location description **figure 5**)
- **Home** (returns the operator to the main screen)
- **Safety** shutter (opens and closes the device's safety shutter)
- **Help** (obtain support, including field service or guided technical support holds information for the device's model number and serial number)

**(Note: The operator can choose to enable or disable the restricted access and password protection features whenever they need.)**

### Disabling Restricted Access and Password Protection (the default password for this device is: 438)

1. Press the **menu button** on the password screen the first digit "4" will begin to blink **(figure 6)**.
2. Using the **up arrow**, press to assign the first number in the password sequence (to decrease this number, use the **down arrow**).

3. Press the **menu button** on the password screen a (*) is inputted into the field for the first digit. Next, press the **up arrow** to assign the second number the “3” will blink **(figure 7)**.
4. Press the **menu button** on the password screen a (*) is inputted into the field for the second number. Now, press the **up arrow** to assign the third digit the last digit, “8,” will begin blinking **(figure 8)**.
5. Press the **menu button** on the password screen to enter the password and return to the main screen **(figure 1)** password protection is disabled.

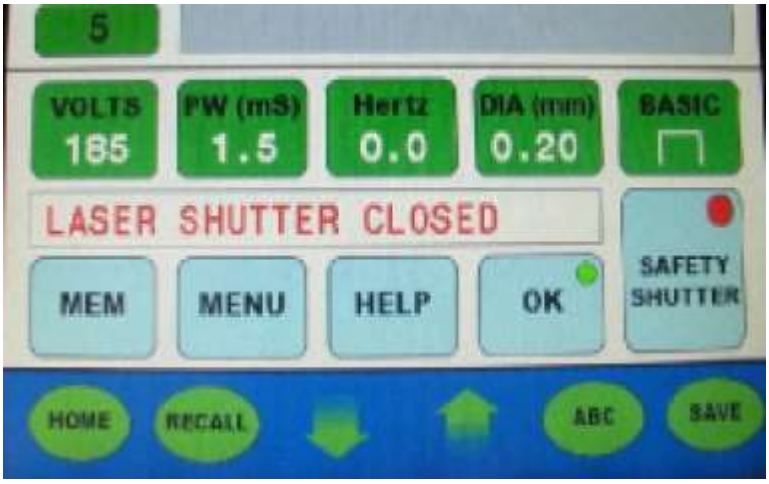



**Figure 1**
**(Main Menu)**

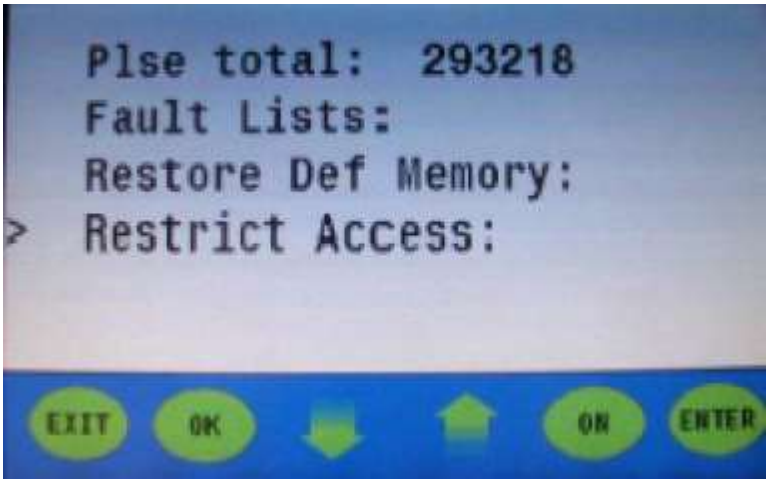



**Figure 2**
**(Use down arrow Restrict Access > Enter)**

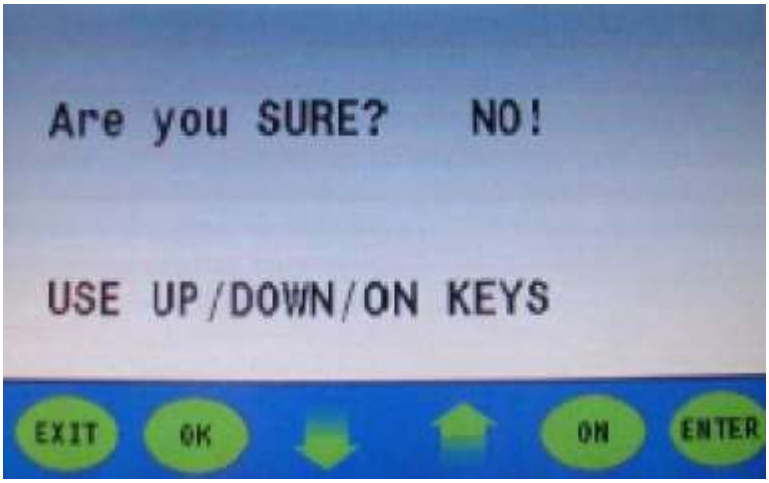



**Figure 3**
**(Up or down arrows used to make selections)**

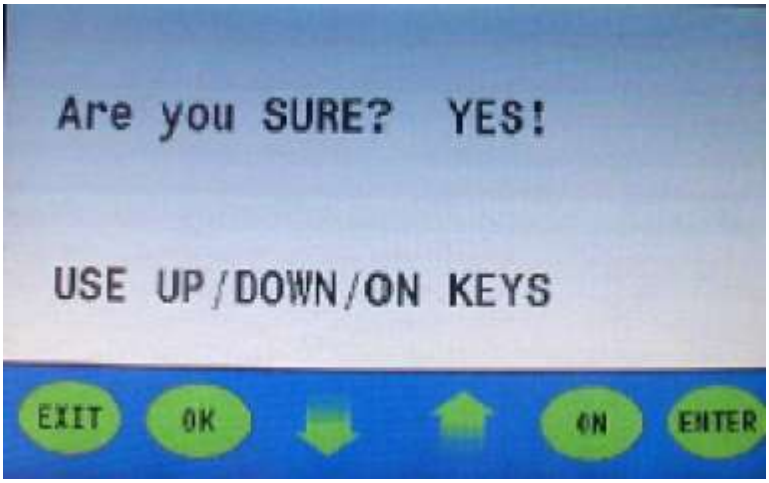



**Figure 4**
**(YES > ON > EXIT > EXIT)**


**Figure 5**
**(Memory mode)**


**Figure 6**
**(Menu > up or down arrow > "4")**


**Figure 7**
**(Menu > up or down arrow > "3")**


**Figure 8**
**(Menu > up or down arrow > "8" > Menu)**

When changing the password for this device, be sure to record the new password and store this information in a safe location. If you need support with password recovery, reach out the LaserStar Technologies Service Department for assistance.

### Changing the Password

1. Press the **menu button** on the main screen **(figure 9)** scroll to **"User Password: Locked"** (the default password for this device is: **438**).

2. Using the **up arrow**, press to assign the first number in the password sequence (to decrease this number, use the **down arrow (figure 11)**.

3. Press the **enter button** a (*) is inputted into the field for the first digit the second number will begin to blink **(figure 12)**. Next, press the **up arrow** to assign the second number.

4. Press the **enter button** a (*) is inputted into the field for the second number. Now, the third digit, the last digit in the password sequence, will begin to blink (**figure 13**).

5. Press the **up arrow** to set the last digit for the password. Next, press the **enter button** to input the new password. Now, return to **"User Password: Unlocked"** on the main screen menu list **(figure 14)**.

6. To select or confirm **"User Password: Unlocked,"** press the **enter button**.

7. To set the first number in the new password sequence, press the **up arrow** (to decrease, use the **down arrow (figure 15)**.

8. Press the **enter button** a (*) is inputted into the field for the first digit the second number will begin to blink **(figure 16)**. Next, press the **up arrow** to assign the second number.

9. Press the **enter button** a (*) is inputted into the field for the second number. Now, the third digit, the last digit in the password sequence, will begin to blink **(figure 17)**.

10. Using the **up arrow**, press to assign the third number in the new password sequence.

11. Press the **enter button** to input the new password and return to **"User Password: Unlocked"** on the menu list **(figure 18)**.

12. Press the **exit button** twice (2) to return to main screen **(figure 9)** returns to the main menu screen and locks the parameters on the touchscreen display.

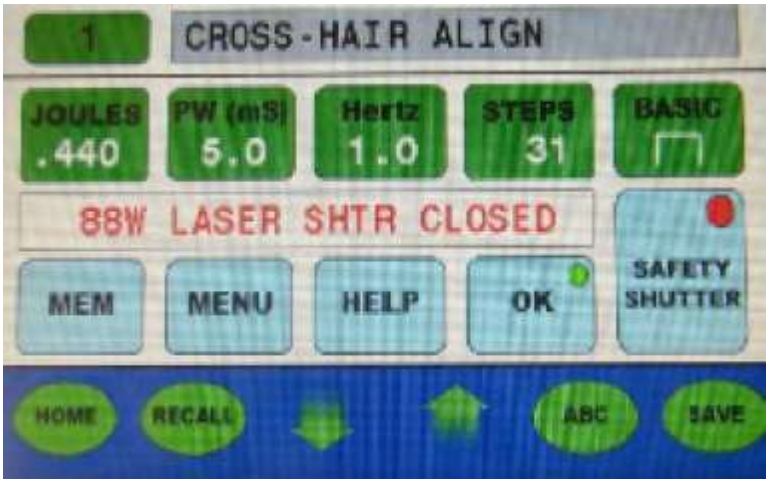



**Figure 9**
**(Main menu)**

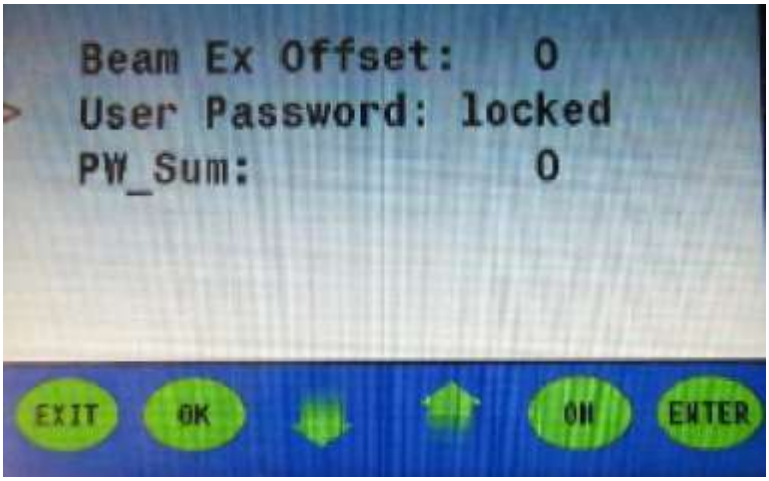



**Figure 10**
**(User password: locked)**

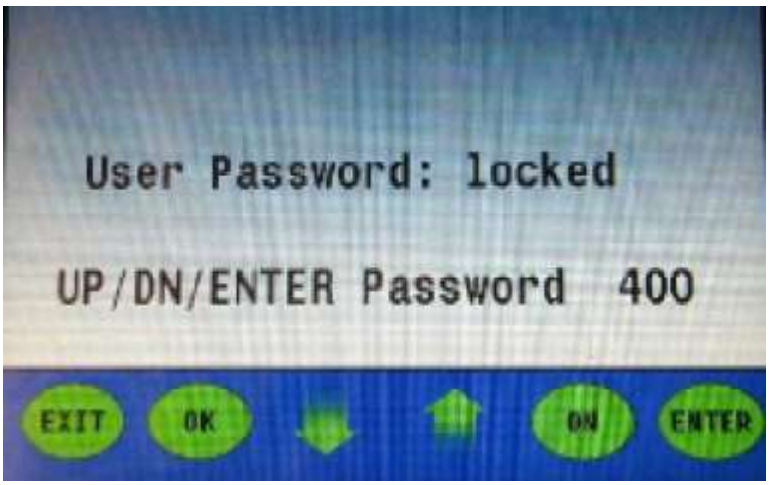



**Figure 11**
**(Password change)**


**Figure 12**
**(Password change)**


**Figure 13**
**(Password change)**

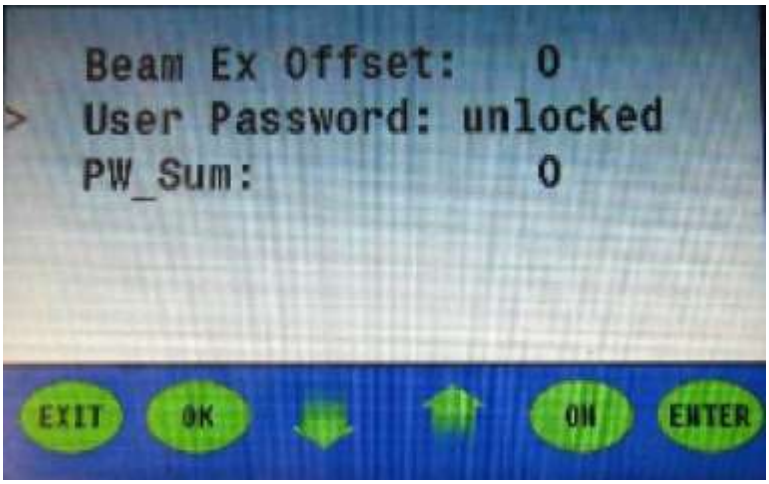



**Figure 14**
**(User password: unlocked)**


**Figure 15**
**(New password)**


**Figure 16**
**(New password)**

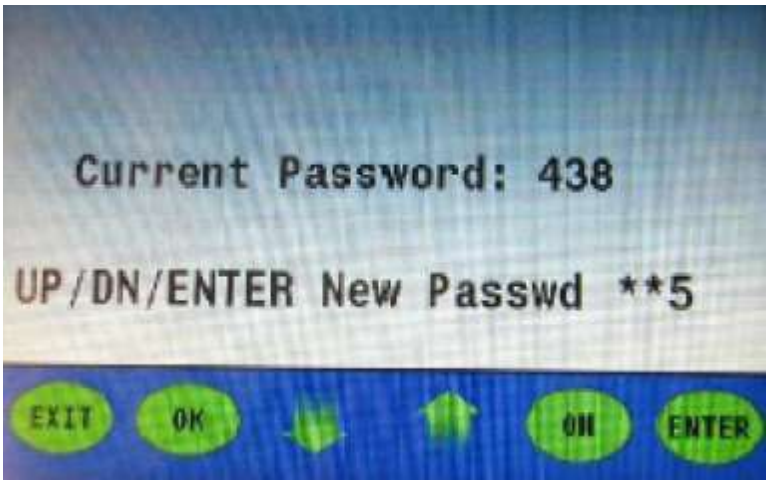



**Figure 17**
**(New password)**

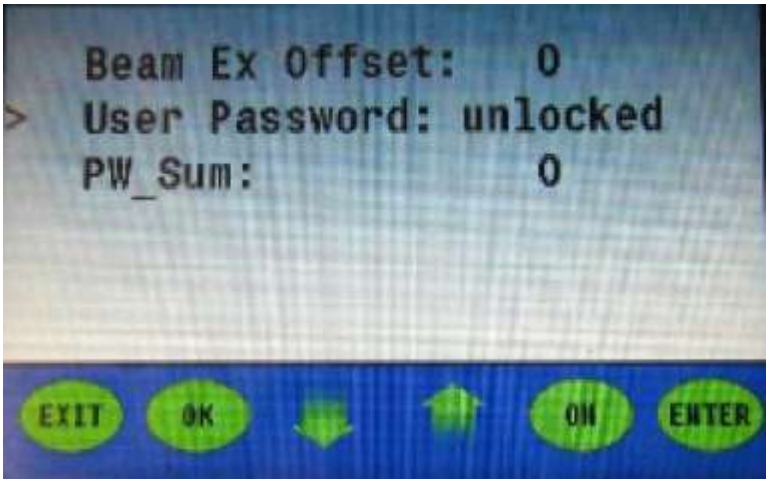



**Figure 18**
**(User password: unlocked)**

# Appendix D: Calibration Procedures

## Calibration

### Tools Needed (supplied or required):

- Power Meter and Power Head (tools for measuring the laser's power and energy)
- Kentek's View-It® IR Infrared Detector (high-efficiency laser-sensitive material provides con venient method for real-time viewing of beam shapes, mode structure, and beam alignment)
- Scale (metric minimum 150mm)
- Laser Safety Glasses
- Vinyl or PVC Gloves (powder-free and DEHP & DOP-free disposable)
- Clean Room or Workspace

(Note: Before starting the process of calibration, be sure to first secure the equipment and work-space, placing the welder into a secure room. The operator or technician calibrating this device must wear appropriate laser safety glasses this is a requirement.)

### Equipment Overview

The FiberStar® 8900 Series welding workstation is a highly specialized, portable, stand-alone, single-user-operated laser welding device designed for metalworking and fabrication. This versatile welding workstation (capable of quickly and precisely welding almost any metal or metal alloy) is well-suited for the industrial workspace and a wide variety of complex assemblies applications, including spot and seam welding, mold repair, and micro-welding.

With welding applications, workpieces to be joined are manually arranged within the illuminated work chamber and then welded together using one or more high-intensity laser pulses.

The welding workstation is equipped with a stereo microscope with cross-hair. This cross-hair (a specialized component inside the welding work chamber) marks the exact position of the laser pulse spot onto the workpiece, ensuring that welding results remain consistent and accurate despite periods of prolonged or continuous use.

In addition to the stereomicroscope with cross-hair, the welding workstation is also equipped with a foot pedal switch with two (2) operating positions, capable of firing either single or continuous laser pulses. The first position (pedal switch slightly depressed) enables the inert gas supply, while the second position (pedal switch fully depressed) releases a laser pulse.

With welding applications, to achieve optimal finalized results, the workpiece must be positioned within the focusing area of the laser beam. Positioning and workpiece height are the determining factors that affect the final results and outcome. **(Note: Workpiece height is correct when the surface of the part remains in focus while under the stereomicroscope.)**

Pulse energy is another factor that can have a direct influence on the quality of the final weld pulse energy output can be adjusted using either the joystick or keypad controls (located inside the welding work chamber). With one control, the intensity of the laser pulse (energy) is affected, and with the other, the pulse length (mS). Settings for additional materials can also be obtained by following the adjustment techniques described.

With certain materials, the quality and outcome of the weld can be improved using argon (inert) gas. This device is equipped with an argon [inert] gas valve.

Welding and cutting processes and applications have potential to generate gases that are hazardous to your health. The gases generated and their concentrations depend on the process used and the gas formation mechanisms. Gases, some of which may be hazardous, are inherent in some processes — either as a shielding gas (to protect the molten weld pool against atmospheric contamination) or for flame processes — as a consumable that is burnt.

**During or after the welding applications process, following exposure to harmful fumes or irritants, the operator may experience the following symptoms:**

- Dizziness
- Headache
- Fatigue
- Intense cough
- Irritation of the eyes, nose or throat

**Because vapors and gases produced during the welding process can be harmful, they must be filtered and extracted from the lasing chamber and operator's workstation with the use of an approved external fume and heavy particle exhaust system.** The external exhaust system can either be purchased separately or through LaserStar Technologies Corporation®. If purchasing an exhaust from another manufacturing entity, be sure to seek approval from LaserStar Technologies Corporation®

**Setup and Preparation (prior to beginning with device calibration)**

- Make sure each of the tables for STD and Micro modes have been cleared.
- Check to be sure the final focus lens is clean. **(Note: The lens must be installed during gain calibration verify the component is in place.)**
- Check to be sure that the chamber lights (and all other ambient light sources) are “off.”
- Verify the laser beam has been defocused on the power head (reduce pulse spot size to 3/4” diameter) this will ensure power head damage is avoided and also improve accuracy.
- Check to be sure that the power meter is set to the lowest range, but still the highest resolution for optimizing accuracy.
- Before taking any measurements, check to be sure that the value for watts (displayed on the power meter) has stabilized. **(Note: The laser is stabilized [and fired] by holding down the foot pedal switch hold down until you notice the value for watts shows little 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.)**

**Gain Calibration: STD Mode (figure 1 and data tables 1 – 2)**

**From the main screen, input the following parameters:**

a) Joules (per ××× watts model)
b) Pulse Width: 3.0mS
c) Frequency: 10Hz
d) Burst (B): 0
e) Basic
f) Watts (per ××× watts model)


**Figure 1**
**(Main screen safety shutter closed)**

## Gain Calibration: STD Mode (150 watt models)

| The settings below are typical and specific to STD (multi-pulse) mode | | | | |
|---|---|---|---|---|
| PW = 3.0mS and Hertz = 10 | | | | PW = 3.0mS and Hertz = 0 |
| Touchscreen Display (actual values shown on display) | | Power / Energy Meter (typical values)* | | Power / Energy Meter (typical values)** |
| Joules (J) | Watts (W, peak power) | Watts (W; average power measured) | Joules (J; W ÷ 10 calculated) | Joules (J, measured)** |
| 2.25 | 750 | 22.50 | 2.25 | 2.249 |

**150 watt models:**

(*) These values are typical. The person or technician calibrating this device should match the joules value (watts ÷ 10) from the power / energy meter, remaining as close as possible to the joules value on the touchscreen display.

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

## Gain Calibration: STD Mode (300 watt models)

| The settings below are typical and specific to STD (multi-pulse) mode | | | | |
|---|---|---|---|---|
| PW = 3.0mS and Hertz = 10 | | | | PW = 3.0mS and Hertz = 0 |
| Touchscreen Display (actual values shown on display) | | Power / Energy Meter (typical values)* | | Power / Energy Meter (typical values)** |
| Joules (J) | Watts (W, peak power) | Watts (W; average power measured) | Joules (J; W ÷ 10 calculated) | Joules (J, measured)** |
| 4.50 | 1500 | 45.0 | 4.50 | 4.49 |

**300 watt models:**

(*) These values are typical. The person or technician calibrating this device should match the joules value (watts ÷ 10) from the power / energy meter, remaining as close as possible to the joules value on the touchscreen display.

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

## Gain Calibration: Micro Mode

## From the main screen, input the following parameters:

a) Joules (per ××× watts model)
b) Pulse Width: -10.0mS
c) Frequency: 10Hz
d) Burst (B): 0
e) Basic
f) Watts (per ××× watts model)


**Figure 2**
**(Main menu safety shutter closed)**

## Gain Calibration: Micro Mode (150 watt models)

| **The settings below are typical and specific to Micro (multi-pulse) mode** | | | | |
|---|---|---|---|---|
| PW = 10.0mS and Hertz = 10 | | | | PW = 3.0mS and Hertz = 0 |
| Touchscreen Display (actual values shown on display) | | Power / Energy Meter (typical values)* | | Power / Energy Meter (typical values)** |
| Joules (J) | Watts (W, peak power) | Watts (W; average power measured) | Joules (J; W ÷ 10 calculated) | Joules (J, measured)** |
| 1.25 | 125 | 12.49 | 1.249 | 1.251 |

**150 watt models:**

(*) These values are typical. The person or technician calibrating this device should match the joules value (watts ÷ 10) from the power / energy meter, remaining as close as possible to the joules value shown on the touchscreen display.

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

## Gain Calibration: Micro Mode (300 watt models)

| The settings below are typical and specific to Micro (multi-pulse) mode | | | | |
|---|---|---|---|---|
| PW = 10.0mS and Hertz = 10 | | | | PW = 3.0mS and Hertz = 0 |
| Touchscreen Display (actual values shown on display) | | Power / Energy Meter (typical values)* | | Power / Energy Meter (typical values)** |
| Joules (J) | Watts (W, peak power) | Watts (W; average power measured) | Joules (J; W ÷ 10 calculated) | Joules (J, measured)** |
| 1.50 | 150 | 14.98 | 1.498 | 1.497 |

**300 watt models:**

(*) These values are typical. The person or technician calibrating this device should match the joules value (watts ÷ 10) from the power / energy meter, remaining as close as possible to the joules value shown on the touchscreen display.

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


**Figure 3**
**(Calibration "On")**

## Calibration Procedure

1. Press the **up** or **down arrow** once three [3] zeros [000] will appear on the right-hand side of "password" **(figure 4)**.
2. Press the **up** or **down arrow** this allows you to set the value for the blinking "0" to "4". Press the **enter button**.
3. Press the **up** or **down arrow** to set the second value in the number sequence, "0" to "3." Next, press the **enter button.**
4. Press the **up** or **down arrow** to set the last value in the number sequence, "0" to "8." Press the **enter button** the display will read: "Calibration: Table" **(figure 5)**.


**Figure 4**
**(Password)**

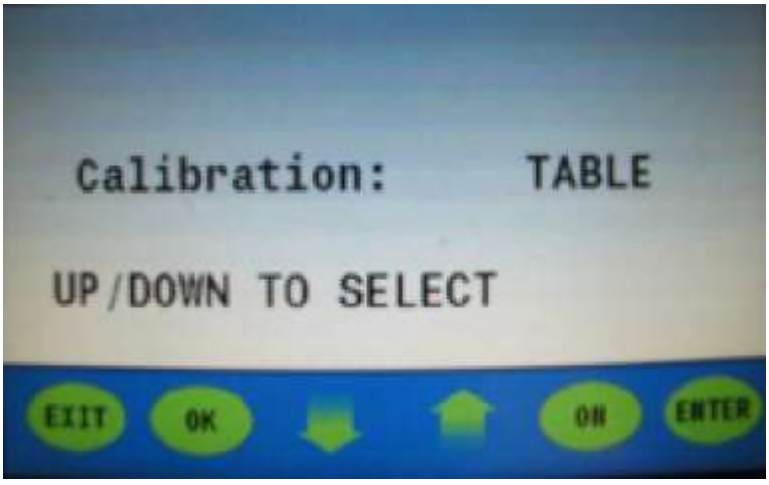



**Figure 5**
**(Calibration: Table selected)**

5. Press the **enter button (figure 6)**.
6. Press the **up** or **down arrow** select “CLR Table.” Next, press the **enter button.**

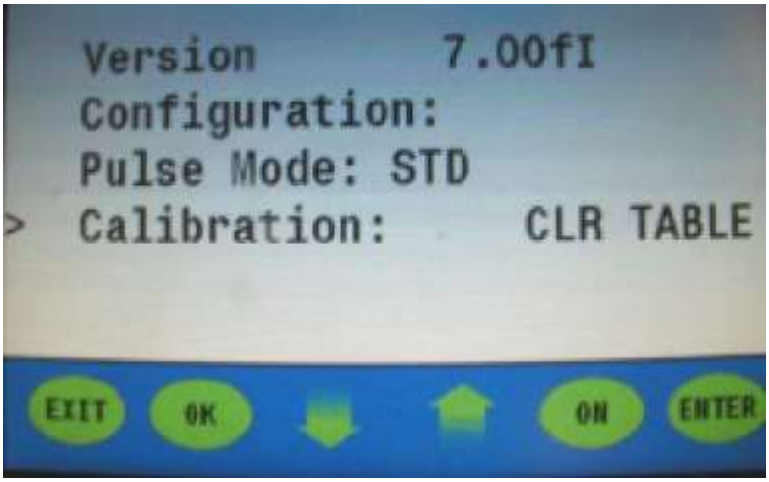



**Figure 6**
**(Calibration CLR table selected)**

7. Press the **exit button** twice (×2) to return to the main menu **(figure 7)**.


**Figure 7**
**(Main menu safety shutter closed [150W models])**

8. Press the **menu button** and scroll down to **calibration**. Press the **enter button**.
9. Press the **up** or **down arrow** select “Gain.” Next, press the **enter button (figure 8)**.

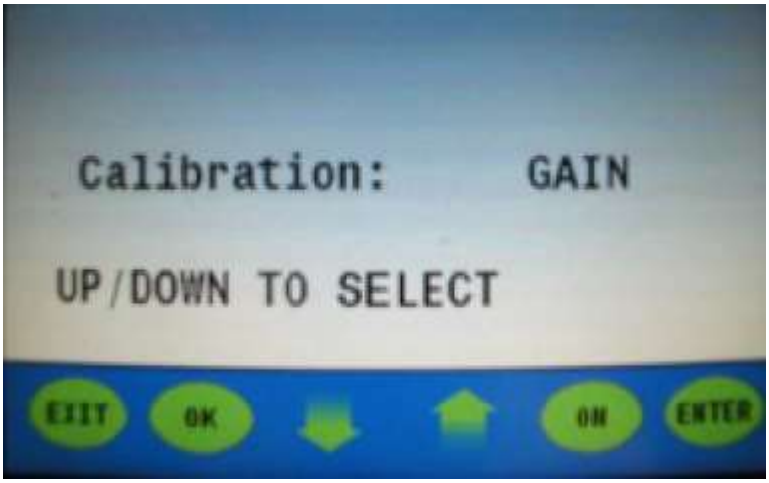



**Figure 8**
**(Calibration gain selected)**

10. Press the **exit button** twice (×2) to return to the main menu.
11. The main menu will display: “125W LASER SHTR CLOSED” (the safety shutter will be closed and the laser will also be disabled).
12. Verify that the parameters on the main screen match those shown in step #1.
13. Press the exit button twice (×2) to return to the main menu.
14. The main menu will display: “125W LASER SHTR CLOSED” (the safety shutter will be closed and the laser will also be disabled).
15. Verify that the parameters on the main screen match those shown in step #1.


**Figure 9**
**(Main menu gain calibration [150W models])**

16. Depress the **foot pedal switch** until the power meter value stabilizes (about 30 seconds).
17. Take a reading. **(Note: The goal is to have the power meter value (W ÷ 10 = J) equal to the joules parameter value shown in the touch screen display.)**
18. Release the **foot pedal switch**.
19. Press the **up** or **down arrow** twice (×2) to adjust the laser output.
20. Repeat **steps #24 – #27** until the power meter value (W ÷ 10 = J) equals the joules parameter value shown on the touchscreen display.
21. Run for 60 seconds to verify that the power meter value (W ÷ 10 = J) equals the parameter value shown on the touchscreen display. If not, repeat **steps #24 – #29**.
22. Close the Safety Shutter or select Laser Disabled Icon.

23. Press the **menu button** and scroll down to **calibration**. Press the **enter button**.
24. Press the **up** or **down arrow** and change Gain to “ON” **(figure 10)**.
25. Press the **enter button**. Next, press the **exit button** twice (x2) to return to the main menu **(figure 11);** calibration is complete.


**Figure 10**
**(Calibration “ON”)**

## Gain Calibration Summary Guide

## Analog Controls

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

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

3. Input the following parameters on the touchscreen display (model and wattage dependent; all values are listed at 50% of the values noted on the corresponding test results sheet and data tables):
    a. Pulse Mode: “STD” (micro-pulse mode, if requested by customer)
    b. Joules (pulse energy)
    c. Milliseconds (pulse width)
    d. Hertz
    e. Watts (peak power)

4. Setup the Power Meter:
    a. Check to be sure the final focus lens is clean. (Note: The lens must be installed during gain calibration; verify the component is in place.)
    b. Check to be sure that the chamber lights (and all other ambient light sources) are “off.”
    c. Verify the laser beam has been defocused on the power head (reduce pulse spot size to ¾” or 19mm diameter).
    d. Select the lowest power range that measures equal the maximum average power noted on the test results sheet.

5. Setup the Menu Icon:
    a. Pulse Mode: “STD” (micro-pulse mode, if requested by customer).
    b. Set calibration to “GAIN.”
    c. Exit to the main menu.

6. Open the Safety Shutter (enables the laser):
    a. Depress the foot pedal switch until the power meter value stabilizes (about 30 seconds).
    b. Take a reading from the device (W ÷ 10 = J).
    c. Release the foot pedal switch.
    d. Press the up or down arrow twice (×2) to adjust the laser's output.
    e. Repeat steps (a – d) until the power meter value (W ÷ 10 = J) equals the joules (J) parameter value shown on the touchscreen display.
    f. Run for 60 seconds to verify that the power meter value (W ÷ 10 = J) equals the parameter value shown in the touchscreen display.
    g. Close the safety shutter and disable the laser by pressing the safety shutter button.

Attention: Be sure to refrain from using the up or down arrows again until completing the next step. Failure to follow this warning 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 (x2); 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 | |
|---|---|---|---|---|---|---|---|---|---|---|
| % linear | Energy Target | Pulse Width | Rate | Peak Power | Avg. Power | Avg. Power | Pulse Energy | Avg. Power Tolerance (±2%) | Avg. Power | Avg. Power |
| % | J | mS | Hz | Calc. W | Calc. W | Actual W | Calc. J | Calc. % | Target W | Actual 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 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| % 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% | 0.900 | 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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| % linear | Energy Target | Pulse Width | Rate | Peak Power | Avg. Power | Avg. Power | Pulse Energy | Avg. Power Tolerance (±2%) | | Avg. Power | Avg. Power |
| % | J | mS | Hz | Calc. W | Calc. W | Actual W | Calc. J | Calc. % | | Target W | Actual 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 | | | | | | |

## Table Calibration: STD Mode & Micro Mode

### Calibration: Overview and Tips

While at the factory, the FiberStar® 8900 Series welding workstation was calibrated using gain calibration gain calibration is generally acceptable for most applications.

If table calibration is necessary, continue with the steps below. (Note: Gain calibration is still a requirement and must be implemented prior to following the steps for table calibration.) The values shown in tables 1 & 2 that follow were recorded while the final focus lens was in place.

In order to enhance the welder's accuracy with specific applications, it is recommended that this device be calibrated using the pulse width and frequency (hertz) closest to the values that will be used for welding applications. When calibrating for a new pulse width and frequency, the operator may calibrate the system at all the joules values listed or only at selected values that are listed in tables 1 or 2. (Note: When calibrating 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. If the user is using both STD and Micro-pulse modes, then tables 1 and 2 should be recalibrated at the appropriate pulse width and frequency.)

Proper calibration requires using the appropriate laser power or energy measuring equipment, which is available for order from our LaserStar Technologies Corporation® e-store. 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 tables 1 & 2.)

There is a separate calibration procedure for both STD Mode and Micro Mode. The required password for both modes is “438.”

**Setup and Preparation (prior to beginning with device calibration)**

The steps that follow should be performed prior to recalibrating (for either STD mode or Micro mode). The screenshots and figures in this section are for the FiberStar® 8900 Series (150 watt model). When calibrating, verify your device's model and refer to the correct watts table for applicable parameter settings or specifications.

- Check to be sure the final focus lens is clean. (Note: The lens must be installed during gain calibration; verify the lens component is in place.)

- Check to be sure that the chamber lights (and all other ambient light sources) are “off.”
- Verify that the laser beam has been defocused on the power head (reduce pulse spot size to 3/4” or 19mm diameter); this helps to improve accuracy and ensures that power head damage is avoided.

**Setup and Preparation (prior to beginning with device calibration continued)**

- When recording measurements, and to further optimize welding results and ensure accuracy, set the power meter to the lowest power range (with the highest resolution). Check that the watts value displayed in the power meter is stabilized. (Note: The laser is stabilized (and fired) by holding down the foot pedal until the watts value shows minimal fluctuation.)

- 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.)

- Check to be sure that the actual table values are documented; these values will be lost if the control board memory battery is removed.

**Table Calibration: STD Mode (figures 1 – 9 & data tables)**

From the main screen, input the following parameters:

a. Joules (per ××× watts model)
b. Pulse Width: 3.0mS
c. Frequency: 10Hz
d. Burst (B): 0
e. Basic
f. Watts (per ××× watts model)


**Figure 1**
**(Main screen laser disabled)**

| Table Calibration: STD Mode (150 watt models) | | | | |
|---|---|---|---|---|
| **The settings below are typical and specific to STD (multi-pulse) mode** | | | | |
| PW = 3.0mS and Hertz = 10 | | | | PW = 3.0mS and Hertz = 0 |
| Touchscreen Display (actual values shown on display) | | Power / Energy Meter (typical values)* | | Power / Energy Meter (typical values)** |
| Joules (J) | Watts (W; peak power) | Watts (W; average 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 |

150 watt models: (*) These values are typical. The person or technician calibrating this device should match the joules value (watts ÷ 10) from the power / energy meter, remaining as close as possible to the joules value shown on the touchscreen 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.

| Table Calibration: STD Mode (300 watt models) | | | | |
|---|---|---|---|---|
| **The settings below are typical and specific to STD (multi-pulse) mode** | | | | |
| PW = 3.0mS and Hertz = 10 | | | | PW = 3.0mS and Hertz = 0 |
| Touchscreen Display (actual values shown on display) | | Power / Energy Meter (typical values)* | | Power / Energy Meter (typical values)** |
| Joules (J) | Watts (W; peak power) | Watts (W; average 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 | 98.5 | 8.95 | 9.02 |

300 watt models: (*) These values are typical. The person or technician calibrating this device should match the joules value (watts ÷ 10) from the power / energy meter, remaining as close as possible to the joules value shown on the touchscreen 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.

**Calibration Procedure**

1. Press the Menu button. Next, scroll down to pulse mode and press Enter (figure 2).

2. Press the up or down arrow to scroll through the available options; select STD.

3. Press Enter. Then, press the Exit button.

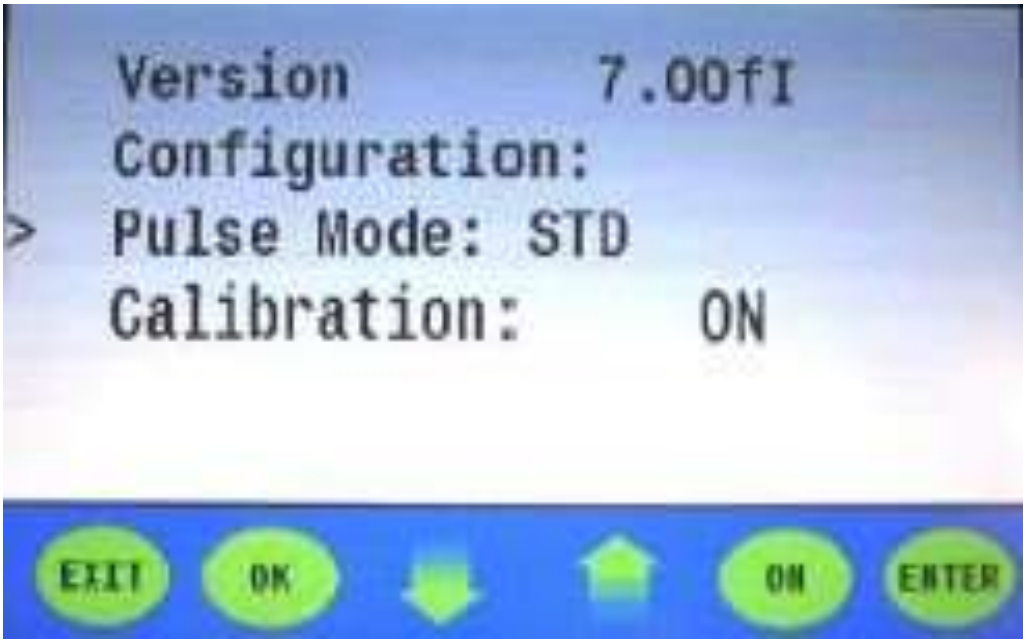



**Figure 2**
**(Pulse mode: STD selected)**

4. Scroll down to “Calibration.” Next, press the Enter button. The display will read: “Calibration: ON” (figure 3).


**Figure 3**
**(Calibration: “on”)**

5. Press the up or down arrow once; three [3] zeros [000] will appear on the right-hand side of “password” (figure 4).


**Figure 4**
**(Password screen)**

6. Press the up or down arrow; this allows you to set the value for the blinking “0” to “4”. Press the Enter button.

7. Press the up or down arrow to set the second value in the number sequence, “0” to “3.” Next, press the Enter button.

8. Press the up or down arrow to set the last value in the number sequence, “0” to “8.” Press the Enter button; the display will read: “Calibration: Table” (figure 5).


**Figure 5**
**(Calibration: Table selected)**

9. Press the Enter button.

10. Press the up or down arrow; select “CLR Table” (figure 6).

11. Next, press the Enter button.


**Figure 6**
**(Calibration: CLR Table selected)**

12. Press the Exit button twice (×2) to return to the main menu.

13. The safety shutter will be closed and the touchscreen will display: “150W LASER DISABLED.”

14. Verify that the parameters on the touchscreen display match those shown in step #1.

15. Press the Menu button and scroll down to Calibration. Press the Enter button.

16. Press the up or down arrow; select “Table.” Next, press the Enter button (figure 7).

17. Press the Exit button twice (×2) to return to the main menu.


**Figure 7**
**(Calibration: Table selected)**

18. Setup the power meter and power head to measure watts. (Note: Check to be sure that the laser beam is defocused. The beam diameter on the power head should be approximately 3/4” in diameter.) The laser will be disabled.

19. Select the Joules button from the main menu. Next, press the up or down arrow and enter either the first or second joules value (displayed in the table on pages 206 or 208 (for correct values, be sure to reference your device's unique certificate or ID label). The laser is enabled and the display will read "150W sCAL MULTI PULSE" (figure 8).


**Figure 8**
**(Calibration: CLR Table selected)**

20. Depress the foot pedal switch until the power meter value stabilizes (about 30 seconds).

21. Take a reading. (Note: The goal is to have the power meter value (W ÷ 10 = J) equal to the joules parameter value shown on the touchscreen display.)

22. Release the foot pedal switch.

23. Press the up or down arrow twice (×2) to adjust the laser's output.

24. Repeat steps #18 – #22 until the power meter value (W ÷ 10 = J) equals the joules parameter value shown on the touchscreen display.

25. Run for 60 seconds to verify that the power meter value (W ÷ 10 = J) equals the parameter value shown on the touchscreen display. If not, repeat steps #18 – #22. The laser will be disabled.

26. Repeat steps #25 – #24 until all values listed in table 2 (noted on pages 208 – 209) have been entered. The laser will still be disabled.

27. Press the Menu button and scroll through the available options; select Calibration. Next, press the Enter button.

28. Press the up or down arrow; change “Table” to “ON” (figure 9). Press the Enter button.


**Figure 9**
**(Calibration: “ON”)**

29. Press the Exit button twice (×2) to return to the main menu (figure 1). Table Calibration is complete.

**Table Calibration: Micro Mode**

From the main screen, and with the laser disable, input the following parameters:

a. Joules (per ××× watts model)
b. Pulse Width: 10.0mS
c. Frequency: 10Hz
d. Burst (B): 0
e. Basic
f. Watts (per ××× watts model)


**Figure 10**
**(Main menu laser disabled)**

| Table Calibration: Micro Mode (150 watt models) | | | | |
|---|---|---|---|---|
| **The settings below are typical and specific to STD (multi-pulse) mode** | | | | |
| PW = 3.0mS and Hertz = 10 | | | | PW = 3.0mS and Hertz = 0 |
| Touchscreen Display (actual values shown on display) | | Power / Energy Meter (typical values)* | | Power / Energy Meter (typical values)** |
| Joules (J) | Watts (W; peak power) | Watts (W; average power measured) | Joules (J; W ÷ 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 | 1.514 | 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 |

150 watt models: (*) These values are typical. The person or technician calibrating this device should match the joules value (watts ÷ 10) from the power / energy meter, remaining as close as possible to the joules value shown on the touchscreen 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.

| Table Calibration: Micro Mode (300 watt models) | | | | |
|---|---|---|---|---|
| **The settings below are typical and specific to STD (multi-pulse) mode** | | | | |
| PW = 3.0mS and Hertz = 10 | | | | PW = 3.0mS and Hertz = 0 |
| Touchscreen Display (actual values shown on display) | | Power / Energy Meter (typical values)* | | Power / Energy Meter (typical values)** |
| Joules (J) | Watts (W; peak power) | Watts (W; average power measured) | Joules (J; W ÷ 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 |

300 watt models: (*) These values are typical. The person or technician calibrating this device should match the joules value (watts ÷ 10) from the power / energy meter, remaining as close as possible to the joules value shown on the touchscreen 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.

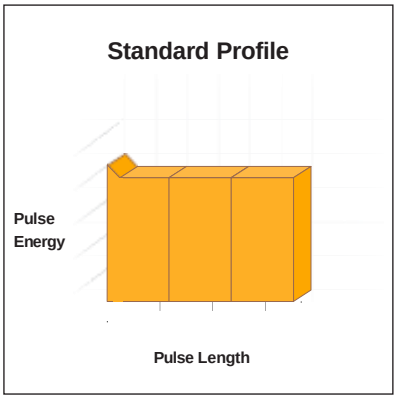
## Appendix E: Pulse Performance Profile Technology

### Background

A pulse of energy from the laser welder consists of a number of characteristics or variables, two of which are pulse power and pulse duration.

The height of a laser pulse is the laser's peak power measured 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 beneath the curve of the pulse height and pulse length is the pulse energy, which is measured in joules.

The standard pulse shape that is emitted from the laser is a rectangle with an initial spike for the first 1/2 millisecond (1/2 mS) or so. This initial spike (diagram below) helps to break down the reflectivity of the metal, resulting in significantly enhanced energy coupling. This spike can be accentuated or removed altogether, as you'll understand from reading this white paper.




A number of variables can affect the dimensions and quality of laser welds. Broadly speaking, welds can be categorized into two (2) "modes:" conduction and keyhole.

With conduction welds, the surface of the metal melts, and through heat conduction, a portion of the metal beneath the laser pulse spot also liquefies. With conduction welds, heat loss through conduction limits the maximum depth of the weld to approximately 1 mm (depending on the material).

Keyhole welds, unlike conduction welds, penetrate much deeper into the surface of the metal, but the process differs. With keyhole welds, in order to cut deeply into the metal material, a channel must be created and some of the material must be vaporized through the process of either vaporization or splatter, metal material is lost.

**Variables that affect melt pool dimensions and the quality of spot welds include:**

+ Spatial energy distribution for the incident beam
+ Pulse height (peak power)
+ Pulse energy (application dependant)
+ Pulse length (duration)
+ Profile shape

**About Pulse Performance Profile ($P^3$) Technology**

The process for profiling a laser pulse requires specifying the percentage of pulse energy that is released for each 1 millisecond (1 mS) section. The individual sections are defined in intervals of: 25%, 50%, 75% or 100% of the total pulse energy output. To benefit from pulse profiling and achieve noticeable results, a minimum 3 millisecond (3 mS) pulse duration must be employed.

The energy required for pulsed laser welding can vary, depending upon the application and profile selected. For example, a pulse profile can be chosen for its slower cooling, surface cleaning, bulk heating or even vaporization of contaminants, and for each application, the energy requirement will differ. When this is the case, the energy required (both voltage and pulse length) will also increase to compensate, ensuring consistent weld penetration, despite the application of a custom profile preset.

These parameter adjustments have the potential to reduce lamp life, processing speed, and/or increase cycle times. However, this is a small price to pay and is almost always worth the noticeable improvement in the quality of the weld.

Conversely, if the initial spike is increased to improve energy coupling or duty-cycle, a Burst profile is used, and this process becomes 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, you should first experiment with a Basic profile, taking note of the energy used (parameter selections) for a particular application. Next, select a recommended pulse profile and execute the application, again checking the energy used (parameter selections). Finally, compare the results of the two processes and choose a profile that meets your quality and processing speed requirements.

**Getting Started**

Normally, a Basic profile is entirely appropriate when welding standard ferrous alloys without plating. However, pulse profiling may have a measurable effect on quality and consistency for welding applications with reflective, very dissimilar or contaminated material. For example, small, hairline cracks may be visible in particular alloys when using a Basic profile. However, when a Ramp Down profile is chosen, a solid, excellent weld is produced.

To determine if Pulse Performance Profile Technology will benefit your applications, it’s important to become familiar with the parameter selections process for your machine. Second, you should understand pulse profiles and how adjustments can affect pulse energy output and impact welding materials. Lastly, work toward process improvements by employing a pulse profile. Try a profile based on its description and recommended use, measuring differences in the weld when compared with a Basic profile.

If, when you experiment with pulse profiles, you find that penetration is sacrificed, be sure to increase the energy (V) when actual processing is taking place. If the results are worse, try a different pulse profile configuration.

After experimenting with various pulse profiles, don't be concerned if you discover that the Basic profile is the best option for your application — at least you've committed to the process of experimentation for the sake of optimization.

### Using $P^3$ Technology

A variety of pulse profiles have been embedded into the laser's micro-welding software seven (7) in total. Each profile has been programmed and stored in a specific memory location.

**The following pulse profiles are preloaded and available for use with the welder:**

- Basic
- Spike
- Ramp Down
- Ramp Up
- Pyramid
- Pre-pulse
- Burst

All pulse profiles are voltage proportional. For each profile, if the voltage increases, the energy per section also increases; the energy output percentage will, however, always remain the same.

The energy per section is proportional to the selected pulse length. To activate the pulse profile, a minimum pulse length of 3 milliseconds (3 mS) is required. As an example, when the pulse length is 3 milliseconds (3 mS), each sections' pulse width will be 1 millisecond (1 mS). If the pulse length is

9 milliseconds (9 mS), each sections' pulse width will be 9 milliseconds (9 mS) divided by 3, which equals 3 milliseconds (3 mS), and so on.

All pulse profiles (with exception of the Basic profile) have a minimum pulse length of 3 milliseconds (3 mS). If a shorter pulse length is selected, the parameter will automatically reset to the default setting.

| **Pulse Profiles: Technical Specifications** | | | | |
|---|---|---|---|---|
| **Imbedded Pulse Profiles (quantity)** | **Pulse Width** | **Energy Levels (per section)** | **Energy Sections (quantity)** | **Section Pulse Width (minimum value)** |
| 7 | 3-20 mS | 5<br>(0%, 25%, 50%,<br>75%, I00%) | 3 | 1 mS |

| **Pre-Programmed Pulse Performance Values** | |
|---|---|
| **Pulse Profile** | **Profile Settings** |
| Basic | 100%, 100%, 100% |
| Spike | 100%, 25%, 25% |
| Ramp Down | 100%, 50%, 25% |
| Ramp Up | 25%, 50%, 100% |
| Pyramid | 50%, 100%, 50% |
| Pre-pulse | 50%, 100%, 75% |
| Burst | 50%, 50%, 50% |

## Switching Pulse Profiles

**There are two (2) methods for changing the pulse profile they are as follows:**

**Keypad:**

1. Press the enter button; the pulse profile (located in the lower right-hand corner of the display) will blink.
2. Press the up or down arrow and scroll through the varying pulse profiles.
3. When the desired profile is displayed, wait for the profile to stop blinking.

## Welding Chamber

1. Press and hold the safety shutter to open (located on the back wall; right-hand side).
2. Using the joystick control (located on the far left), scroll left to right.
3. When the desired profile appears on the display, release the Safety Shutter button.

## Pulse Profiles: Power Level Adjustments (manual configuration)

Some applications may require a variation in the power level that is different than the predefined settings for a particular pulse profile. Using the software, you will have the ability to modify the power level (per tier) for any pre-programmed pulse profile.

**To change the power level, do the following:**

1. Press the enter button on the keypad; the Pulse Profile on the display will blink.

2. Press the “ABC” key on the key pad.

3. Press the up or down arrow and scroll to the desired pulse profile.

4. Press the enter button on the keypad — the pulse profile's power level setting will appear. Using the up or down arrows, change the power level.

5. Press the enter button to confirm (after finalizing the power-level settings for the first tier, the second tier for the pulse profile can be adjusted); settings for the pulse profile (second tier) will appear.

6. Repeat steps #5 and #6 for the second and third tier settings of the pulse profile.

7. Press the enter button twice (x2) to finalize these settings and exit to the main menu.

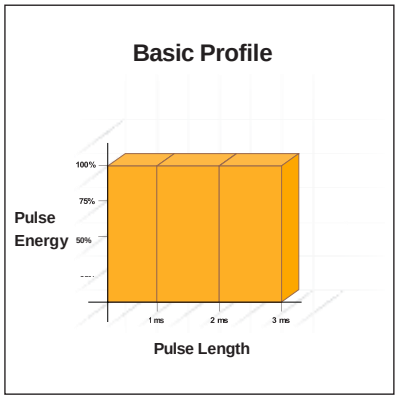
8. Press the enter button twice (x2) to finalize these settings and exit to the main menu.

## Pulse Profiles

### Basic Profile (yellow gold, platinum, and stainless steel)

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

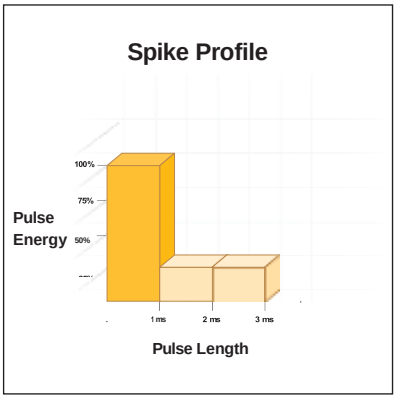
By eliminating the spike, the weld puddle will vibrate less during cooling. Ripples on the melt surface cause by vibration freeze within the puddle, producing a more rigid and less shiny surface. Materials with a low melting point or those with better absorption will not require an initial spike.



**Spike Profile (silver and copper; with silver [use tacking or single-pulse mode])**

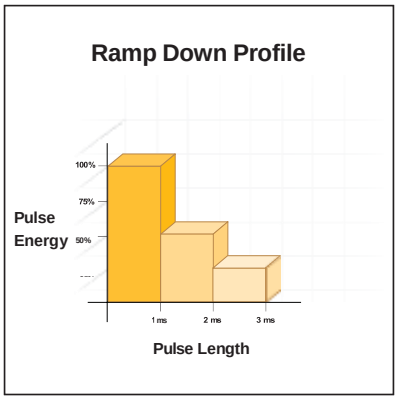
A spike profile is helpful for highly reflective metals with higher conductivity, such a pure copper alloys, silver alloys, and some aluminum alloys or for applications in which the surface is highly reflective and the focused spot is larger.

With this profile, the initial spike in the first section is produced and initiates melting of the material surface. Next, absorption increases (by up to 20 times), ensuring that the remainder of energy from the laser pulse can be lowered. This can reduce the overall energy required, making coupling much more consistent and reducing weld spatter from the process (see diagram below).



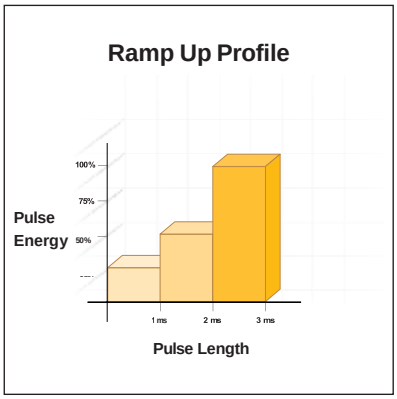

**Ramp Down Profile (silver and aluminum)**

With higher carbon steels, alloys that are prone to cracks, 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.



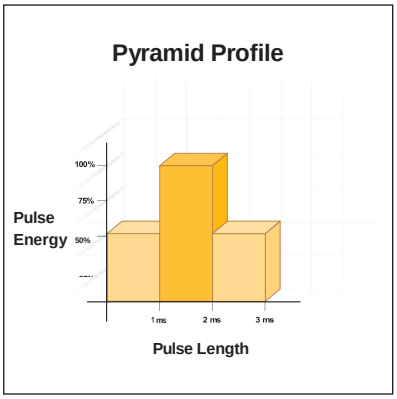
## Ramp Up Profile (white gold)

When welding materials with low melting points and with very low reflectivity or when welding materials with many volatile contaminants or with plating, the Ramp Up profile is helpful (see diagram on next page).




## Pyramid Profile (titanium)

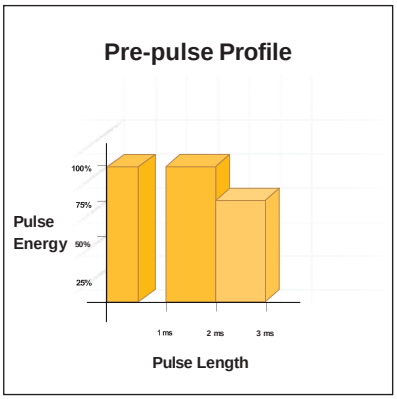
Combines characteristics from both the Ramp Up and Ramp Down profiles and is suitable for welding dissimilar metals that are non-reactive to oxygen.



## Pre-pulse Profile (eyeglasses)

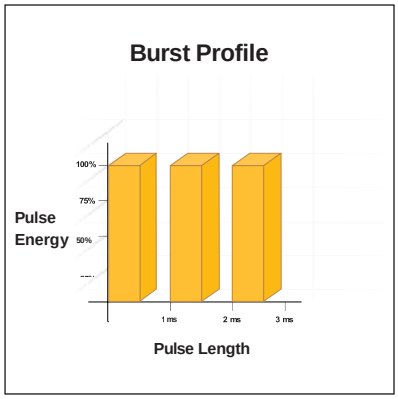
When welding materials that have a low melting or boiling point, a plating or surface covering, or those that contain contaminants, such as pre-tinned electronic parts, anodized parts, painted parts or oil-contaminated parts, a Pre-pulse profile is helpful. Additionally, parts that have varying reflectivity,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

This profile has an initial section with enough energy to vaporize and/or partially weld materials while also ensuring the heat penetrates the material enough that it eliminates all contaminants. Usually, a delay of up to 1/2 millisecond (1 mS) follows to allow the material to get out of the weld zone. Then, the main weld process occurs, striking a consistent surface to ensure creation of a quality weld.




## Burst Profile (pewter, hollow [thin wall], and low-melting pot metal)

Essentially, the Burst profile delivers pulse energy output in repeated cycles with a consistent peak power. It has been shown to have value and a positive effect, increasing the overall weld depth.



## Appendix F: Cleaning, Service, and Maintenance Intervals

The chart on the next page can be used as a resource for tracking cleaning tasks, routine maintenance intervals, and upcoming or anticipated service needs.

Important Advisory:

Routine maintenance is a requirement for ensuring the safe and optimal operation of the welder system. Regular maintenance intervals must be scheduled in accordance with the manufacturer's recommendations and requirements. Use only LaserStar Technologies Corporation® approved parts and accessories. Service personnel must verify the equipment is safe to operate after maintenance is concluded.

## Daily Tasks

- O Wipe laser and chamber.
- O Clean protective disc.

## Weekly Tasks

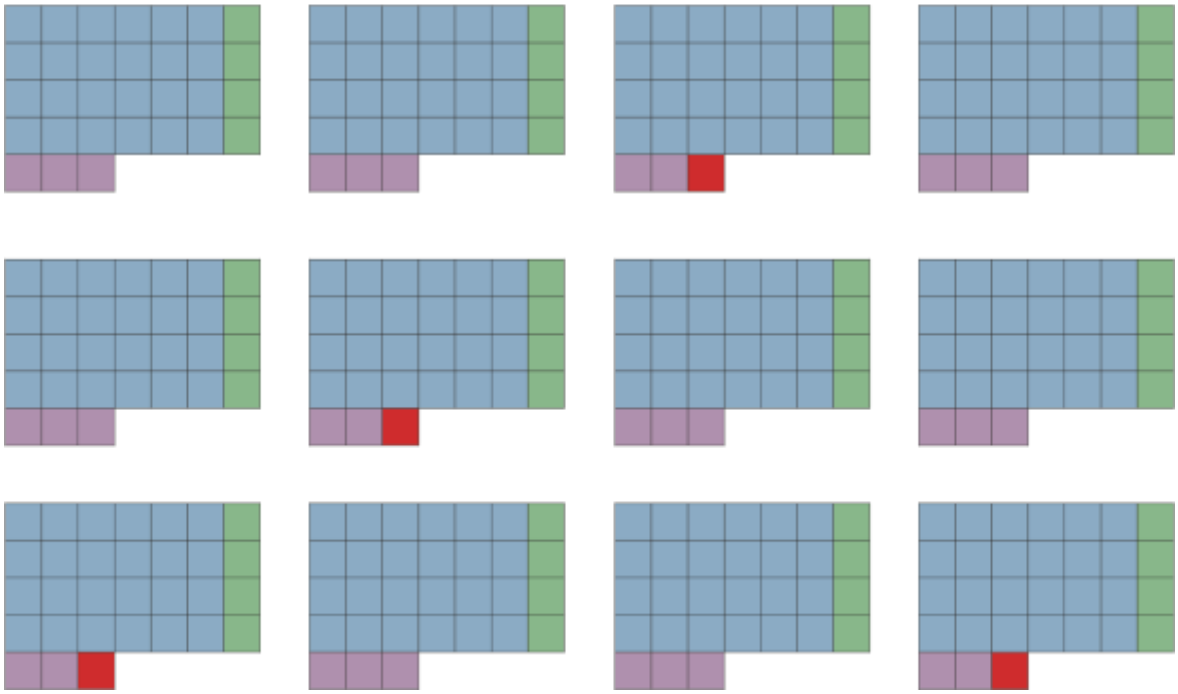
- O Check cross-hair alignment.
- O Clean and inspect window splash protector.

## Monthly Tasks

- O Clean cabinet and heat exchange.
- O Inspect air and exhaust filters.
- O Run energy test.

## Quarterly Tasks

- O Change filter as needed.



If you have additional questions about your machine or would like to provide feedback, a testimonial or present your applications results, please reach out — we'd love to hear from you!

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