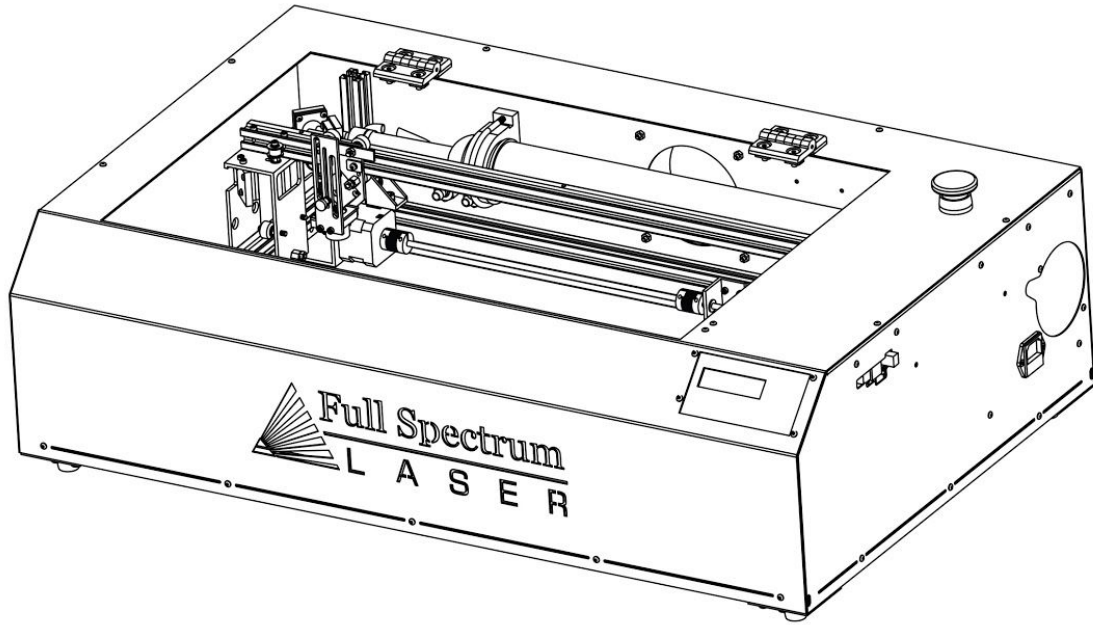


H-Series 20x12 Desktop CO2 Laser

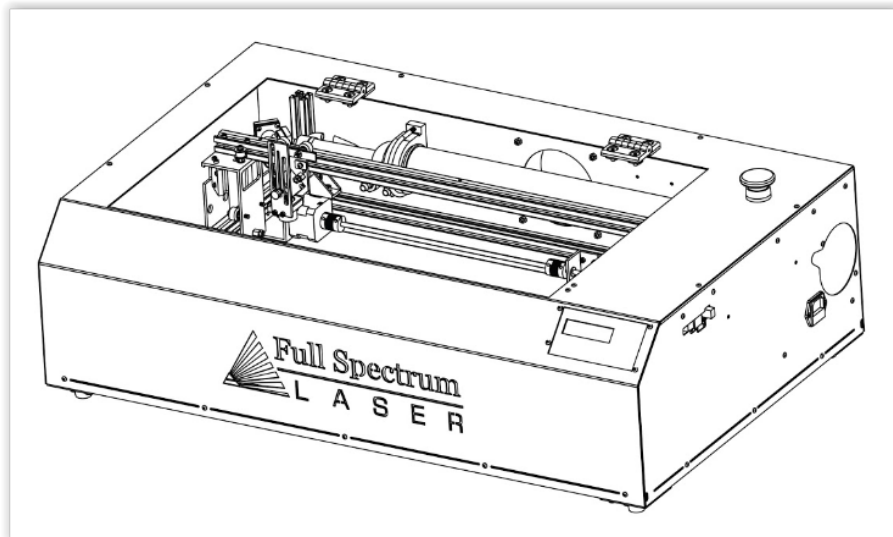
User Manual



H-Series (5th Gen) Hobby Laser

User Manual

Congratulations on your purchase of a Full Spectrum Laser H-Series (5th Gen) Laser Cutter. With proper usage and upkeep, your hobby laser cutter should provide years of productive output. This user manual will guide you through the safety guidelines and operation of your machine. It is recommended that you familiarize yourself with this manual before using your laser cutter. For more information and product selection, please visit www.fslaser.com.



Compliance Statement

The Full Spectrum Laser HL40-5g "Hobby Advanced" Laser System is a class 3R laser product, as defined in International Standard IEC 60825-1.

The Full Spectrum HL40-5g complies with 21 CFR 1040.10 and 1040.11, the Federal Performance Standards for Light-Emitting Products, except for deviations pursuant to Laser Notice No. 50, dated July 16, 2001. The Center for Devices and Radiological Health of the US FDA issued Laser Notice No. 50 to permit manufacturers to classify and manufacture their products in accordance with the International Standard.

21 CFR 1040 and IEC 60825-1 require that certification, identification and warning labels be placed on laser products. Reproductions of the labels found on the Full Spectrum Hobby Advanced Laser System follow, with locations specified:

TABLE OF CONTENTS

SAFETY FIRST

- [Safety Icons](#)
- [General Safety](#)
- [Laser Safety](#)
- [Fire Safety](#)
- [Electrical Safety](#)
- [Safety Stickers](#)

UNBOXING

- [H-Series Hobby Laser Parts List](#)
- [Additional Recommended Tools](#)
- [Unboxing Your H-Series Hobby Laser](#)

INSTALLATION AND ASSEMBLY

- [Assembly Stage One: Remove Zip Ties](#)
- [Assembly Stage Two: Connect the Exhaust](#)
- [Assembly Stage Three: Connect the Water Pump](#)
- [Assembly Stage Four: Assemble the Air Compressor \(Recommended\)](#)
- [Assembly Stage Five: Connect Electrical Power](#)
- [Assembly Stage Six: Connecting the Ethernet Cable](#)
- [Assembly Stage Seven: Install RetinaEngrave Software](#)
- [Focus Lens Adjustment](#)
- [Laser Tube Test](#)
- [Mirror Alignment](#)
- [Focusing](#)
- [Laser Head Adjustment](#)

USER INTERFACES

- [H-Series Hobby Laser Touchscreen Interface](#)
- [Validating Control Card](#)
- [RetinaEngrave Interface](#)

OPERATIONS

- [Engraving](#)
- [Cutting](#)
- [Designating Layers](#)
- [Design Tab](#)
- [Workspace Tools](#)

HARDWARE MAINTENANCE

- [Replacing the Laser Tube](#)
- [Replacing the Power Supply](#)
- [Belt Installation](#)

[Appendix A: Troubleshooting](#)

[Appendix B: Rotary Attachment Installation](#)

[Appendix C: Quick Start Steps](#)

[Appendix D: H-Series Support Videos](#)

[Appendix E: Warranty Information](#)

SAFETY FIRST

Safety Icons

Familiarize yourself with these icons. They indicate areas that require special attention.



Attention Icon: Calls attention to an important point or offers a “Pro Tip” of general usefulness.



Caution Icon: Warns of important area of caution not covered by other icons.



Fire Icon: Warns of potential fire hazards.



Shock Icon: Warns of potential electrical hazards.



CO2 Gas icon: Warns of potential gas leaks and associated hazards.



Laser Icon: Warns of potential dangers associated with laser usage.



Fragile Icon: Warns of fragile parts or materials, such as glass.



Laceration Icon: Warns of potential sharp edges that could cause cuts or injury.



Level Icon: Indicates the need for a level surface.



Temperature Icon: Warns of potential temperature issues with your machine.



Safe Disposal Icon: Calls attention to proper disposal of waste materials.

General Safety



ALWAYS have a clean, level and open work space to unbox and place your laser cutter.



ALWAYS be aware that the laser tube is made of glass and is therefore extremely fragile and can cause severe lacerations if broken.



ALWAYS be aware that the laser tube is filled with CO₂ gas. While carbon dioxide is a class 2.2 gas (non-flammable and non-toxic), release of this gas from the laser tube will render your laser inoperable.



NEVER modify, disassemble, or in any way alter the construction of the laser and never start up a system that has been modified or disassembled.



ALWAYS inspect the laser cutter for damage and breakage before use. It is the responsibility of the user to ensure all safety precautions are correctly assembled and working properly before operating the machine.



NEVER leave the laser system unattended during operation.



KEEP YOUR LASER SYSTEM CLEAN – A build up of cutting and engraving residue and debris is dangerous and can create a fire hazard. Keep your laser system clean and free of debris. Regularly remove the cutting grid to clean any small pieces that have gotten stuck or fallen through.



DO NOT disassemble the machine or remove any of its protective covers.



NEVER place hands or fingers into moving parts such as cooling fans.

Laser Safety



The output of the CO2 engraving laser is fully contained in a Class 1 enclosure during normal operation. The laser cabinet has a safety interlock switch that deactivates the laser if the door is opened during operation, and no special precautions are necessary to operate the high power laser safely. However, the output beam of the Alignment Laser (visible red diode laser) is accessible to the operator during normal operation, giving the total system an overall rating of Class 3R. Class 3R lasers have minimal safety concerns when used properly and handled with care. Follow these safety guideline at all times:

NEVER operate the machine with any of the panels removed. Be aware that removal of any portion of the cabinet will expose the laser system and greatly increase the risk of injury and/or fire. Personal injury and fire risks are especially pronounced if the machine is operated with the bottom panel removed. Remember that the CO2 laser beam is invisible!

NEVER engrave or cut any material containing PVC or vinyl. These materials (along with other chlorine/ chloride containing materials) produce a corrosive vapor that is extremely harmful to humans and will destroy your machine. Your warranty will be void if your machine is damaged by corrosion from engraving or cutting PVC or vinyl.

NEVER engrave or cut any unknown material. The vaporization/melting of many materials, including but not limited to PVC and polycarbonates, can give off hazardous fumes. Please refer to the MSDS sheet from the material manufacturer to determine the response of any work material to extreme heat (burning/fire hazard).

ALWAYS use the air assist, especially while vector cutting. Vector cutting movements are relatively slow and apply an extremely large amount of heat to the workplace. This buildup of heat can create a significant fire risk.

NEVER operate the Alignment Laser without the focus lens in place. The unfocused beam can be reflected out of the chassis.

NEVER operate the machine without a properly operating ventilation system. Most materials produce an irritating smoke when engraved. Some materials, including but not limited to: paint, varnish, composition board, and plastics, produce compounds that can be harmful if concentrated.

NEVER look into the beam of the Alignment Laser (visible red diode laser).

NEVER aim any laser towards an aircraft or vehicle that is in motion. The bright light can flash-blind, cause glare, or distract the pilot or driver.

The standard reference for laser safety is the American Standard for the Safe Use of Lasers, Z136.1-2000, developed by the American National Standards Institute (ANSI). This reference is the basis for many of the federal regulations for laser and laser system manufacturers, and for the Occupational Safety and Health Administration (OSHA) laser safety guidelines. It contains detailed information concerning proper installation and use of laser systems. While the ANSI standard itself does not have the force of law, its recommendations, including warning signage, training, and the designation of a laser safety officer, may be compulsory under local workplace regulations when operating laser systems above Class I. It is the operator's responsibility to ensure that the installation and operation of the Full Spectrum Laser Hobby Laser System is performed in accordance with all applicable laws. Copies of ANSI Standard Z136.1-2000 are available from:

LASER INSTITUTE OF AMERICA
12424 RESEARCH PARKWAY, SUITE 125
ORLANDO, FL 32826
(407) 380-1553.

Fire Safety



Laser cutting and engraving systems can present a significant fire hazard due to the extremely high temperatures generated by the laser beam. While the objective of most cutting and engraving operations is to vaporize material without burning, most materials capable of being cut or engraved are inherently combustible and can ignite. Usually this is a small flame of burning material issuing from the cut zone which self extinguishes due to the air assist or de-powering of the beam. However, it is possible for the flame to propagate and set fire to the machine and its surroundings.



Pro Tip! Experience shows that vector cutting with the laser has the most potential to create an open flame. Acrylic in all its different forms has been shown to be especially flammable when vector cutting with a laser.

ALWAYS keep a properly maintained and inspected 5lb or larger fire extinguisher on hand. Full Spectrum Laser recommends a Halogen fire extinguisher or a multi-purpose dry chemical fire extinguisher. Halogen extinguishers are more expensive than a dry chemical, but offer certain advantages should you ever need to use an extinguisher. The Halogen extinguisher discharges a clean, easily removable substance that is not harmful to the mechanics or wiring of the laser system. The dry chemical extinguisher discharges a sticky, corrosive powder that is very difficult to clean up.

BE AWARE that stacking materials (especially organic materials such as paper) can lead to increased risk of flame propagation or work piece ignition.

NEVER operate your machine unattended. There is a significant risk of fire if the machine is set improperly, or if the machine should experience a mechanical or electrical failure while operating.

ALWAYS keep the area around the machine clean and free of clutter, combustible materials, explosives, or volatile solvents such as acetone, alcohol, or gasoline.

ALWAYS use air assist when vector cutting.

BE CAREFUL when vector cutting. Many materials have the potential to burst suddenly into flames – even materials that may be very familiar to the user. Always monitor the machine when it is operating.

NEVER CUT PVC (polyvinyl chloride) under any circumstances.

NEVER store any flammable materials in the inside of the device or in the immediate vicinity of the device. Debris and leftover produced materials within the machine must be removed to prevent fire hazard.

ALWAYS have on hand a first-aid kit designed for the initial treatment of burns and smoke inhalation. Be sure to store this kit in an area that is outside risk areas.

Woodshop Dust Fire Safety Considerations*

Before processing materials the user must verify whether harmful materials can be generated and whether the filter equipment of the exhaust system is suitable for the harmful materials. We emphasize that it is the responsibility of the user, to consider the national and regional threshold values for dust, fogs and gases when selecting the filters and the exhaust system. (The values for the maximum workplace concentration must not be exceeded.)

Be mindful of large quantities of fuel in the form of wood and wood products, sawdust, and flammable materials such as paints, oil finishes, adhesives, solvents, and liquid propane for internal combustion engines.

Preventing the buildup of dust is one of the key means for controlling fire and explosion hazards. The principal engineering control technology for control of dust is exhaust ventilation. The primary work practice control is good housekeeping.

Dust collection is best accomplished at the source-at the point of operation of the equipment, if feasible. For many pieces of equipment, well-designed ducts and vacuum hoods can collect most of the dust generated before it even reaches the operator.

Very fine dust that manages to escape point-of-source collection can be captured from above by general exhaust points located along the ceiling. These control technologies are effective for most equipment, excepting machines that commonly produce the very finest dust or large quantities of dust.

**These guidelines come from the U.S. Department of Labor*

Electrical Safety



The power supply is capable of outputting DC 20,000V at up to 20mA—always make sure to give the supply capacitors adequate time to discharge before accessing the electronics area. This power is also provided to the discharge terminals on the laser tube itself. Your laser shipped with silicone terminal covers that prevent access to bare wiring—notify Full Spectrum Laser support and immediately cease operations if these covers ever slip and expose bare wire.

DO NOT open any of the machine's access panels while the unit is plugged in. Opening a panel may expose the operator to the unit's AC input power. The AC input power is potentially lethal and is located on the far right within the cabinet.

NEVER make or break any electrical connections to the system while the unit is turned on.

NEVER access the electronics area with hands or tools unless the unit is disconnected from power for at least one hour.

NEVER replace the installed 10 amp fuse with a fuse of a higher rating. This will void your warranty and the electronics will not be adequately protected from surges or short circuits.

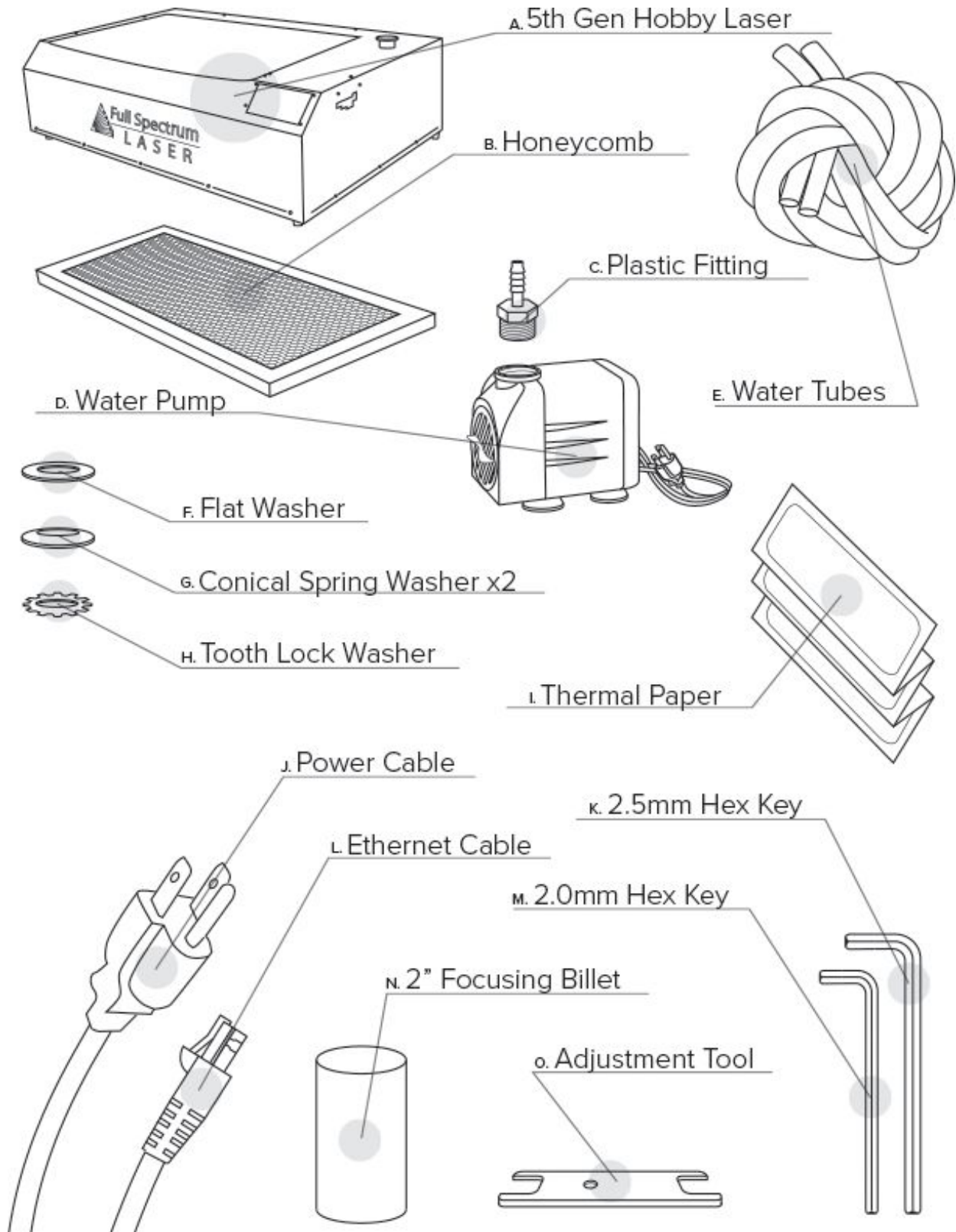
POWER ON/OFF is controlled by the large red button (e-stop) located on the top of the case in the far right. This is a normally-open twist to release button. To power the laser down, simply press the button down until it locks. To power the laser up, twist the button clockwise according to the indicating arrows on the surface of the button.

IN CASE OF A BLOWN FUSE determine the cause of the overload before replacement to protect the machine from damage.

Safety Stickers

- 1. CERTIFICATION/IDENTIFICATION LABEL.** This sticker is located on the rear of the machine. Any updates to the information (date of manufacture and manufacturer address) are added as adhesive overlays.
- 2. WARNING LABEL.** This label is located on the rear of the machine, above the certification label.
- 3. EXPLANATORY LABEL.** This label identifies the classification of the HL40-5g in accordance with IEC 60825-1. It is located on the rear of the machine, next to the Warning Label.
- 4. NON-INTERLOCKED PROTECTIVE HOUSING SAFETY LABELS (5).** Two exterior labels located on left and bottom panels. Two interior labels located on the bottom of the power supply and the side optics riser #1 so that the labels are visible when the covers have been removed. One label located on the right tube access panel.
- 5. DEFEATABLY-INTERLOCKED PROTECTIVE HOUSING SAFETY LABEL.** This label is located on the machine's cabinet door, in the lower right-hand corner.
- 6. APERTURE SAFETY LABEL (2).** This label is located on the left slider of the Y gantry and on the main aperture of the laser tube.
- 7. ELECTRICAL SAFETY LABEL.** This label is located on the right panel of the machine.
- 8. FIRE WARNING LABEL.** This fire hazard label is located on the right side of the top panel of your laser system.
- 9. FAN WARNING LABEL.** This label warns to keep fingers away from fan and to not tamper with fan cover.

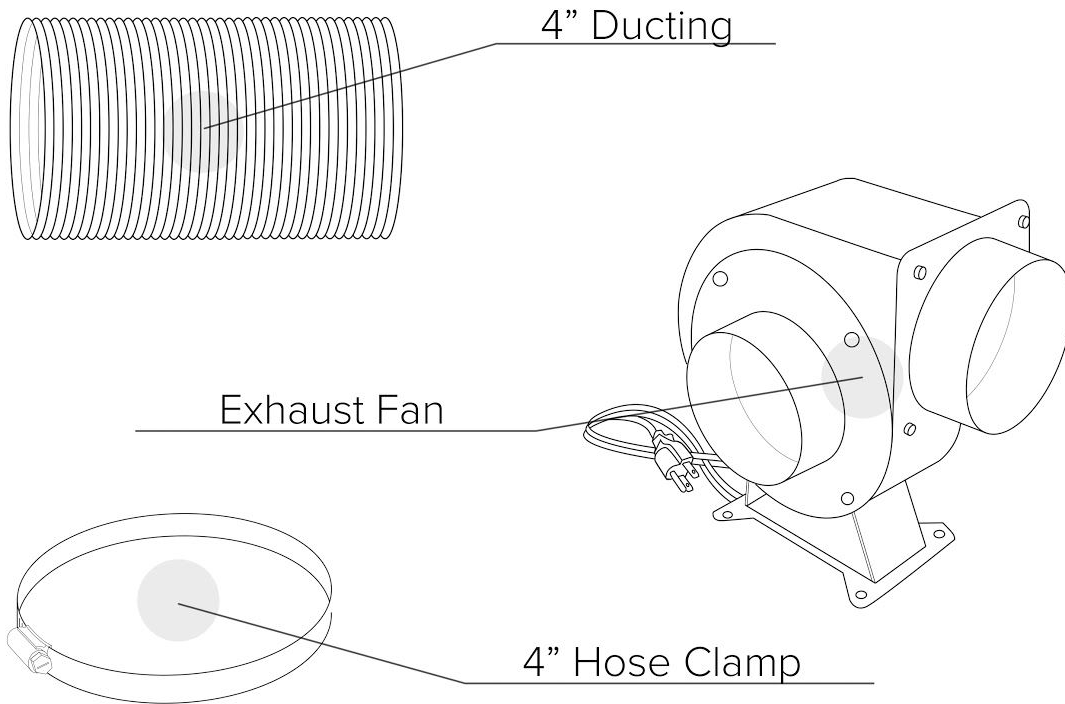
UNBOXING



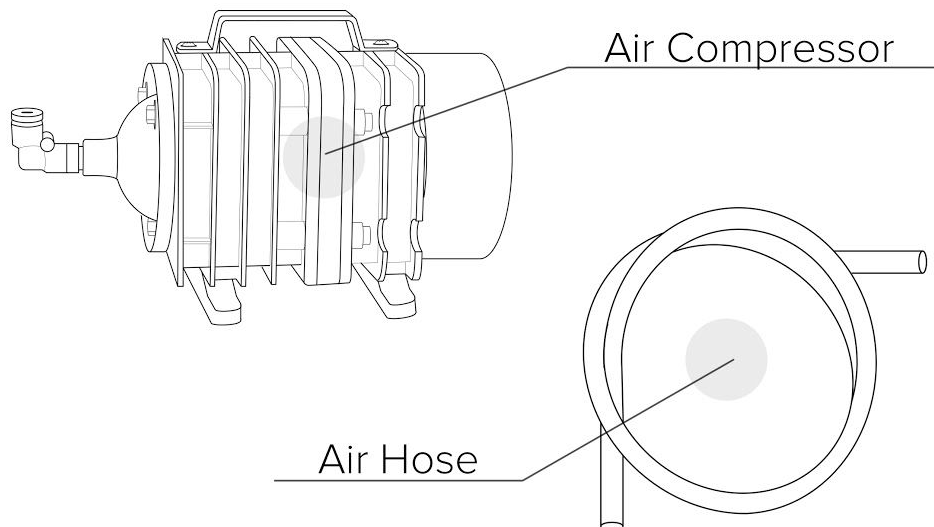
Optional Accessories

These items will only be included if they were purchased in addition to the standard Hobby Laser kit

Exhaust Fan Upgrade



Air Compressor Upgrade



H-Series Hobby Laser Parts List

Your laser shipped with the following included parts and accessories:

DESCRIPTION (QTY)

- A. Laser Engraving Machine (1)
- B. Honeycomb Cutting Table (1)
- C. Plastic Fitting (1)
- D. Water Pump (1)
- E. Water Tubes (2)
- F. Flat Washer (1)
- G. Conical Spring Washers (2)
- H. Tooth Lock Washer (1)
- I. Thermal Paper (1 sheet)
- J. Power Cable (1)
- K. 2.5 mm Hex Key (1)
- L. Ethernet Cable (1)
- M. 2.0 mm Hex Key (1)
- N. 2" Focusing Bilit (1)
- O. Adjustment Tool (1)

Optional Accessories (not included but recommended):

- P. 4" Ducting (1)
- Q. Exhaust Fan (1)
- R. 4" Hose Clamp (1)
- S. Air Compressor (1)
- T. Air Hose (2)

Additional Recommended Tools

3-5 gallons of distilled water

A five gallon bucket

Small scissors

Aluminum Tape

Ducting Tube

Exhaust Fan (recommended)

Unboxing Your H-Series Hobby Laser

When your H-Series (5th Gen) Hobby Laser arrives, it will require careful unboxing and examination of parts. Follow these instructions for best results.



FRAGILE PARTS! Be gentle in removing the foam packaging and accessories. Never pull or force the packaging loose from the laser cutter. Be particularly aware that the water inlet and outlet nodes protrude from the tube and are extremely fragile when unboxing your laser tube.

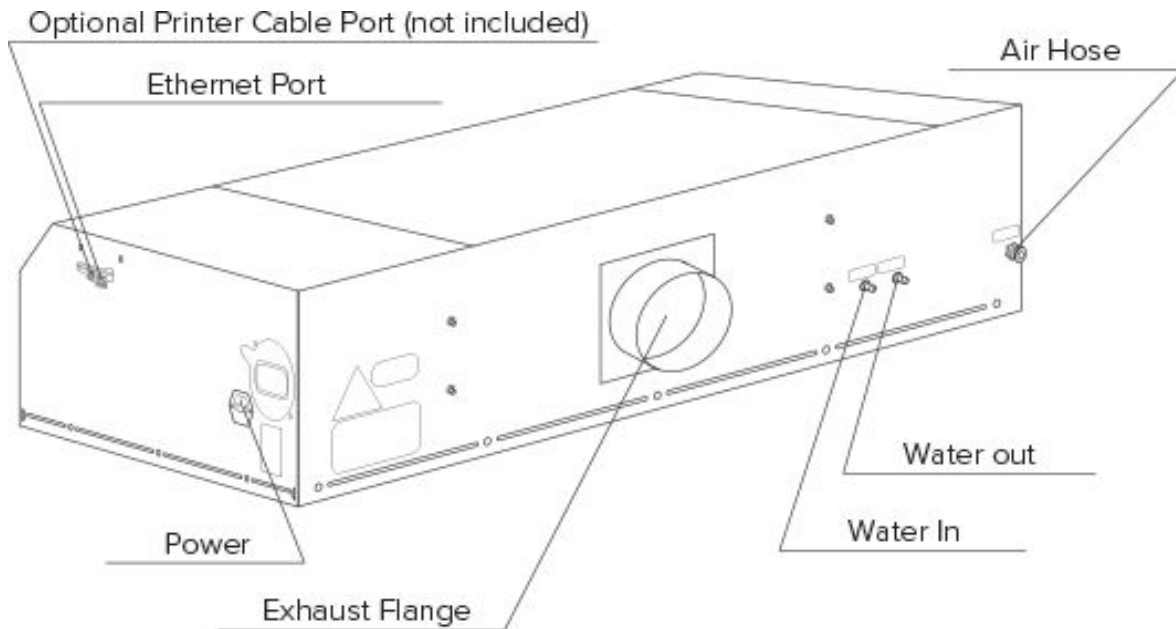
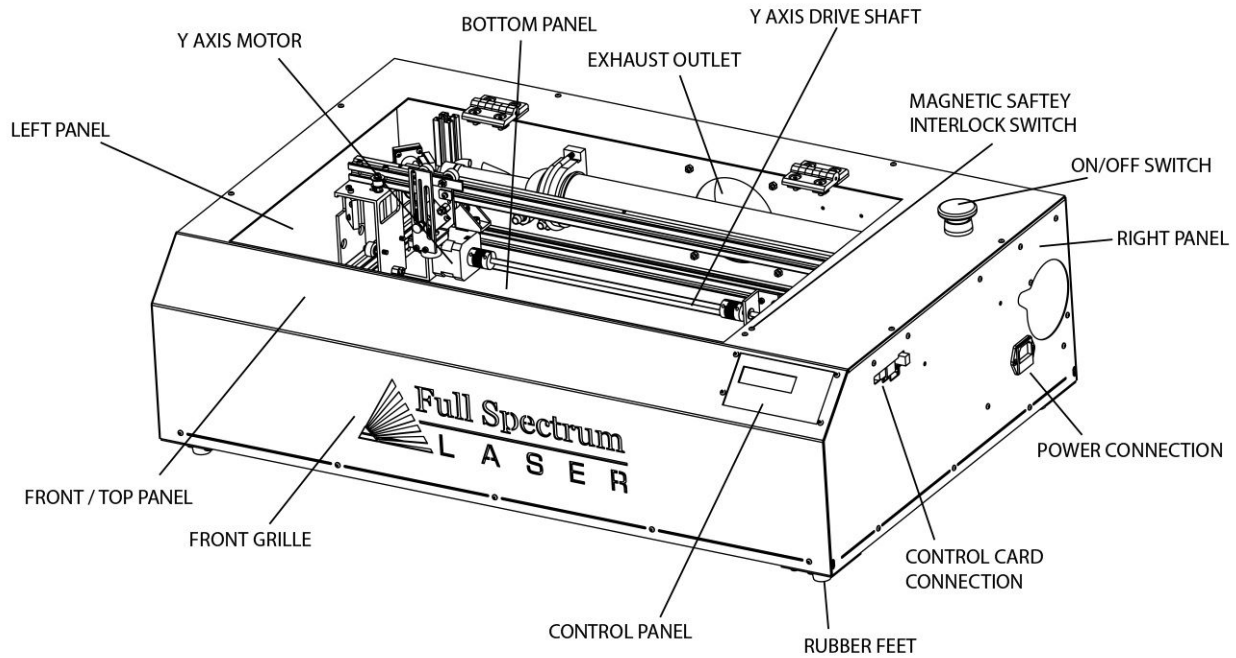
UNBOXING STEPS

- 1. Create a work space.** You will need an open, level work space to place your laser cutter. A solid table with adequate room (the machine's dimensions are 32" x 20" x 8.25") for the machine is recommended. Be sure the workspace is free of fire hazards and is well ventilated. Always have a fire extinguisher handy in case of emergency.
- 2. Carefully open the top of the box.** Set the box on a flat space near where you will place the machine. Open the box carefully from the top. If you use a cutting tool to open the box, be careful not to allow the cutting edge to touch the machine or any packed accessories. Always use all tools with caution and only as specified by the manufacturer.
- 3. Remove "honeycomb" cutting table.** Remove the honeycomb plate (B) from the box and then remove the bubble wrap surrounding it. Set the honeycomb plate aside for now. Once we have removed the packed accessories we will insert it into the base of the machine.
- 4. Remove the Machine from the box.** With the foam packaging intact, gently lift the machine out of the box and place on a clean flat surface such as the table you plan on keeping it. Be aware that the machine weighs 55 lbs. Find someone to help you lift it if this is a strain for you. Next slide off the foam packaging. The machine should now be flat on your work surface.
- 5. Remove protective sheet from lid.** With the foam supports and the honeycomb removed, you will now see the lid of the laser cutter. To protect the lid during shipping there is a protective film material covering it. Carefully peel off this film from the plexiglass lid and dispose it in a proper waste container.
- 6. Remove Accessories.** Nestled in packing foam, inside the interior of the machine, are the following parts and accessories: a plastic bag with cords and small accessories, the water pump and perhaps the air compressor (sold separately). Inspect these parts to insure they are accounted for and intact.

7. **Insert the Honeycomb.** Place the honeycomb into the laser cutter machine body and lay flat. Be careful not to hit other machine components during this procedure.

8. **Inspect the machine.** Examine your laser cutter for defects and breakage. If you find any defects or breakage, contact your sales representative immediately. Have pictures of the damage ready to share. Your machine is now unboxed.

INSTALLATION AND ASSEMBLY



With your laser cutter unboxed and placed in its permanent work space we can now assemble it. This is a simple process that should take less than half an hour to complete. The following stages will be described in detail.

Assembly Stages:

1. Remove the Zip Ties
2. Connect the Exhaust
3. Assemble the Water Pump
4. Assemble the Air Compressor (Recommended)
5. Connect Power
6. Connect the Ethernet Cable
7. Install RetinaEngrave Software

In addition, you will need the following tools and accessories (not included with your machine purchase):

1. 3-5 gallons of distilled water
2. A five gallon bucket
3. Small scissors
4. Aluminum Tape
5. Ducting Tube
6. Exhaust Fan (recommended)
7. Internet connection (to download software)

Assembly Stage One: Remove Zip Ties

To secure the machine during shipping, zip ties are used to hold the X belt, the Y belts and the laser head. These must be removed before operating your laser cutter for the first time.

REMOVE ZIP TIE STEPS:

1. **Locate Zip Ties.** There are a total of four (4) zip ties that need to be cut and removed. One is located on the laser head, one is located on the X belt and the last two are located on the left and right Y belts.
2. **Cut and Remove Four (4) Zip Ties.** Using a small pair of scissors (nail cutters work remarkably well), carefully cut and remove all four (4) zip ties listed above. DO NOT cut the zip ties on the laser tube itself. Be aware that the glass laser tube is extremely fragile. Be careful NOT to damage any part of the machine during this process.

Assembly Stage Two: Connect the Exhaust

It is mandatory that an exhaust blower is connected and operating whenever you run a job on your laser. A properly installed exhaust blower removes smoke and fumes from the case and exhausts them to the outside of the building.



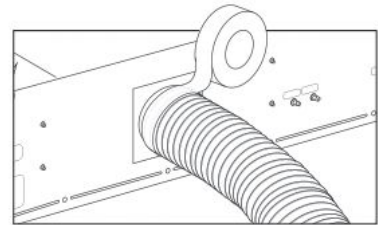
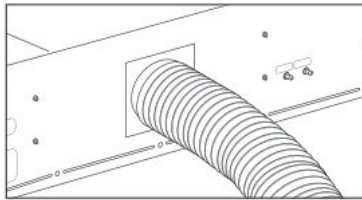
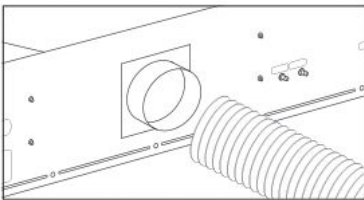
CAUTION! You should never operate your laser without a working exhaust. Full Spectrum recommends exhaust systems capable of 232 CFM. Keep in mind that exhaust systems with high flow rates may require fixtures for thin materials.



FIRE WARNING! It is important that either rigid or flexible metal ducting be used in the exhaust system. Any type of “soft” ducting is potentially flammable and should not be used under any circumstance.

CONNECTING THE EXHAUST STEPS:

1. **Position Ducting.** Place your 4” ducting (not included) over the installed Exhaust Port located at the back of the machine and hold.
2. **Secure with Aluminum Tape.** Evenly tape, secure and seal the ducting to the Exhaust Port using aluminum tape (not included).



3. **Attach Exhaust Fan (recommended).** We recommend using an exhaust fan to ensure maximum air exhaust. Secure the other end of the ducting connected to the machine to a Exhaust Fan (not included). Now repeat the ducting and taping process on the other side of the Exhaust fan creating a sequence of machine to ducting to exhaust fan to second ducting.
4. **Ventilate Outside.** Set the open end outside of a window or an installed ventilation outlet. Check your system for leaks—most can be remedied with duct tape. Please be aware that the protective housing is not designed to be airtight; the front grill is designed to allow an exhaust system to draw fresh air through the work area.

Assembly Stage Three: Connect the Water Pump

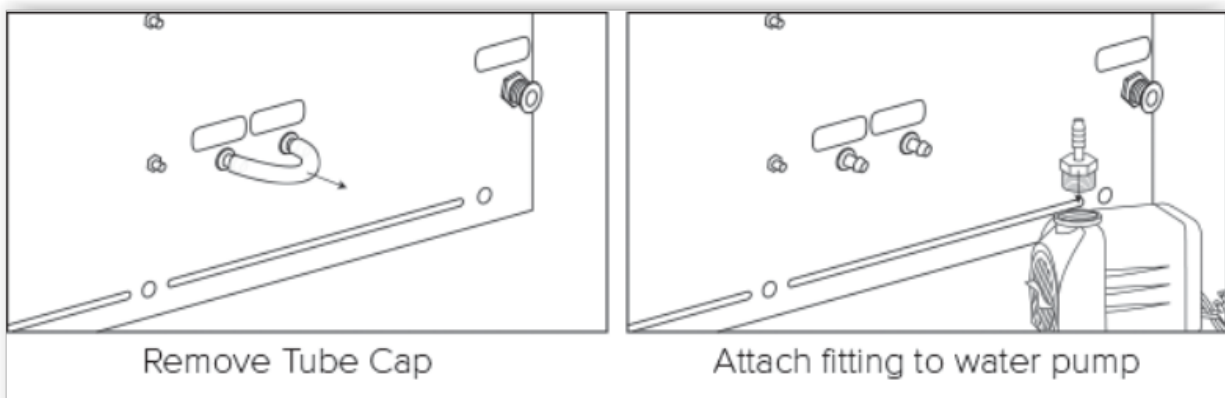
Your HL40-5g laser uses a water-cooled continuous beam CO2 laser tube. The tube requires a flow of room temperature water to regulate the temperature of the resonance chamber. Your purchase includes a water pump for cooling the laser tube.



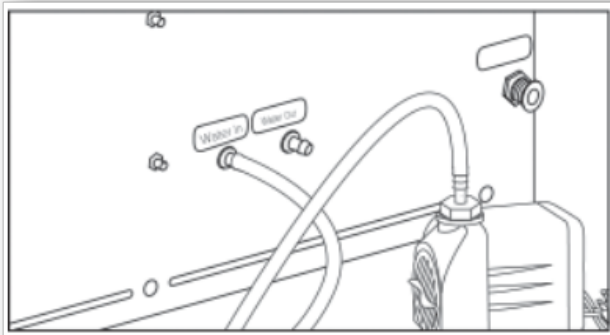
NEVER FIRE THE LASER WITHOUT A CORRECTLY CONNECTED AND POWERED WATER PUMP. FIRING THE LASER WITHOUT TURNING THE PUMP ON OR, WORSE, WITH NO WATER IN THE SYSTEM, WILL SEVERELY DEGRADE OR DESTROY YOUR LASER TUBE AND VOID YOUR WARRANTY.

CONNECTING THE WATER PUMP STEPS:

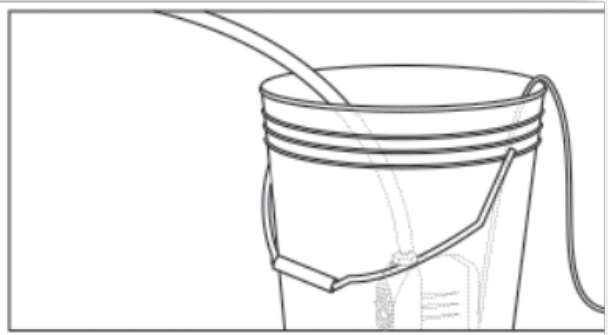
1. **Remove Capping On Water inlet/Outlet.** Remove the short silicone tubing capping the water inlet and outlet on the back of the machine.
2. **Attach Water Pump Fitting.** Remove the water pump (D) from its packaging. Attach the white plastic fitting (C) to the water pump by gently screwing it on.



3. **Prep Water Bucket.** Fill a clean 5 gallon bucket (not included) with 3 - 4 gallons of distilled water (not included). ALWAYS use only distilled water and replace often.
4. **Attach Inlet Water Tubing.** Push one end of one of the two (2) silicone water tubes (E) onto the water pump fitting (C). Now attach the other end of that tubing to the "water inlet" located at the back of machine. Completely submerge the assembled water pump in the bucket of distilled water.

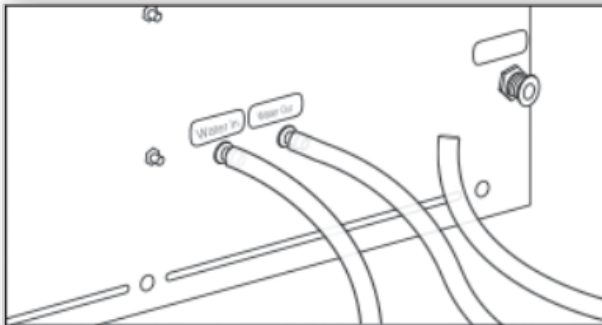


Connect water pump to "Water In"



Place pump into distilled water

- 5. Attach Outlet Water Tubing.** Push one end of the other silicone water tubing (E) onto the "water outlet". Place the other end of the water tubing into bucket of distilled water.



Connect the second tube to "Water Out"



Place open end in bucket



PRO TIP! We recommend that you attach the laser and water pump to a power strip and use that to control the mains power to the unit—this ensures that the water pump is always on when the laser is powered.



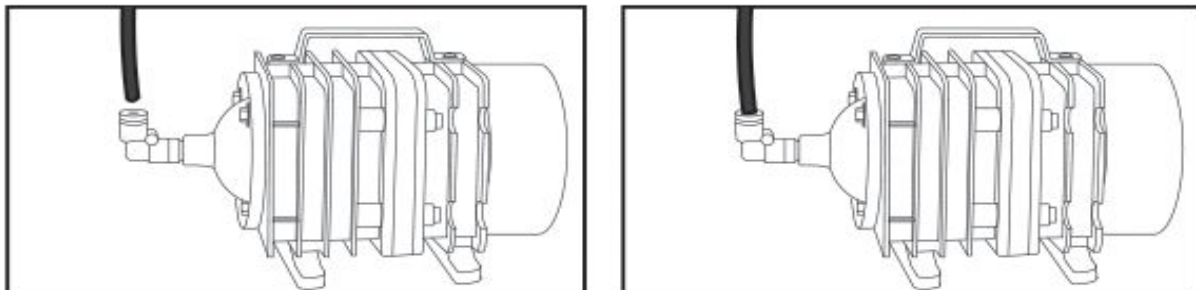
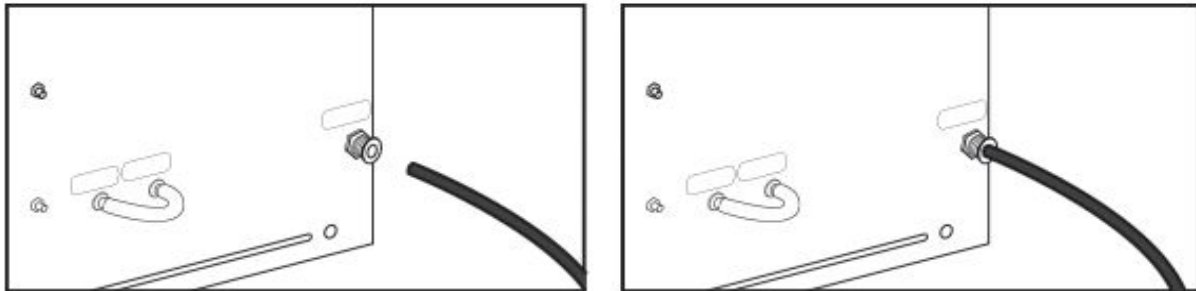
CAUTION! Make sure that there are no air bubbles inside of the water jacket of the laser tube. Air bubbles can create local hot spots in the lasing chamber and reduce the lifetime of your tube. If present, water bubbles typically migrate to the electrodes on either end of the tube. You should visually inspect the laser tube to make sure that bubbles are not present; slightly tilting the laser while powering on the circulation pump is usually sufficient to remove bubbles.

Assembly Stage Four: Assemble the Air Compressor (Recommended)

Air is used as a pressurized gas to assist in cutting and engraving operations. This pressurized air is critical to safe and efficient cutting operations as it not only helps cut through material more quickly, but also helps prevent the formation of flames. A low-flow air compressor for vector cutting gas assist is available as an optional accessory at <http://fslaser.com/Product/HobbyCompressor>.

ASSEMBLING THE AIR COMPRESSOR STEPS:

1. **Attach Push Fitting (Recommended).** Remove the air compressor from its packaging. Gently screw on the push fitting to air compressor.
2. **Attach Air Hose to Air Compressor (Recommended).** Push one end of the black air inlet hose into the air compressor push fitting until it is snug.



3. **Attach Air Hose to Laser Cutter (Recommended).** Insert other end of the black air inlet hose into the “air inlet” slot in the back of laser cutter (A) via the blue push fitting.



THIRD-PARTY AIR ASSIST SYSTEMS. If you choose to attach your laser to a 3rd party air compressor, make sure to use at least one stage of air drying and air cleaning (5 micron filter recommended) and limit the input pressure to no more than 30 psi. Low-quality compressed air can damage your focus lens.

Assembly Stage Five: Connect Electrical Power

The Full Spectrum Hobby Advanced Laser System and available accessories are configured to accept 110VAC at 60Hz. 220VAC units connect to power through an included converter (single-phase 220VAC).

CONNECTING ELECTRICAL POWER STEPS:

1. **Prepare Power Cord.** Remove the electrical cord (J) from its packaging.
2. **Plug in Power Cord To Laser Cutter.** The power cord plugs into a “C14” power receptacle located on the right side of the machine.
3. **Plug in Power Cord to Outlet.** Finally, plug the power cord into any proper outlet socket in your workspace.



PRO TIP! Please be aware that the accessories will increase the circuit load; the most significant power draw usually comes from the blower/exhaust system. Consult the manufacturer’s information and manual for the operating parameters of your exhaust system.



POWER ON/OFF: the laser’s power is controlled by the large red button (e-stop) located on the top of the case in the far right. This is an open twist to release button. To power the laser down, simply press the button down until it locks. To power the laser up, twist the button clockwise according to the indicating arrows on the surface of the button.



IN CASE OF A BLOWN FUSE: determine the cause of the overload before replacement to protect the machine from damage. The laser system is equipped with a fuse on the power inlet to protect the machine from surges or short circuits. The fuse is user-changeable (machine ships with 10A fuse installed). If problem persists, contact customer support.



CAUTION! do not replace the installed 10 amp fuse with a fuse of a higher rating. This will void your warranty and the electronics will not be adequately protected from surges or short circuits.

Assembly Stage Six: Connect the Ethernet Cable

All Full Spectrum 5th Gen Laser Systems are designed to be used with either 32 or 64 bit versions of Windows 7 or later. Full Spectrum Laser recommends a system with the following minimum specifications:

Intel® Core™ or AMD Athlon™ II processor
Microsoft® Windows® 7 64-bit with Service Pack 1
6GB of RAM

CONNECTING ETHERNET CABLE STEPS:

1. **Identify the Ethernet Cable.** Locate and remove the included Ethernet cable (L) from its packaging.
2. **Plug Ethernet Cable into Laser Cutter.** Plug in the Ethernet cable into the Ethernet slot on the H-Series Hobby Laser.
3. **Plug Ethernet Cable into Computer.** Connect Via Router (Recommended). Router connectivity is more reliable than directly connecting via Ethernet and should be the primary way of connecting. Direct connect from laser to computer should be a secondary choice, if possible. If direct connecting to router is not available (i.e. due to location of router) then we recommend using an Ethernet to WiFi adapter that is connected to the router. If both of those are not possible then direct connection to computer can be utilized via the Ethernet cable.



PRO TIP! The Hobby Advanced can connect to your computer via either Ethernet or USB (but not both simultaneously). Full Spectrum includes an Ethernet cable in the laser accessories and recommends the use of Ethernet cables as USB is more prone to electrical interference.



ATTENTION! Your laser must be connected to your computer in order to download jobs. The laser can store jobs in its onboard memory while powered, however loss of power will cause stored jobs to be lost. If you purchase and install a USB device, you can download jobs to your laser and run them without a computer attached (however you will not be able to alter the job settings from the laser control panel). Because a USB device is not volatile memory, jobs are stored between power cycles.



PRO TIP! If your laser is located more than 6ft from your computer, you will need to use the Ethernet connection. Connecting via Ethernet while the power is on requires you to power cycle your machine in order to obtain an IP address.

Assembly Stage Seven: Install RetinaEngrave Software

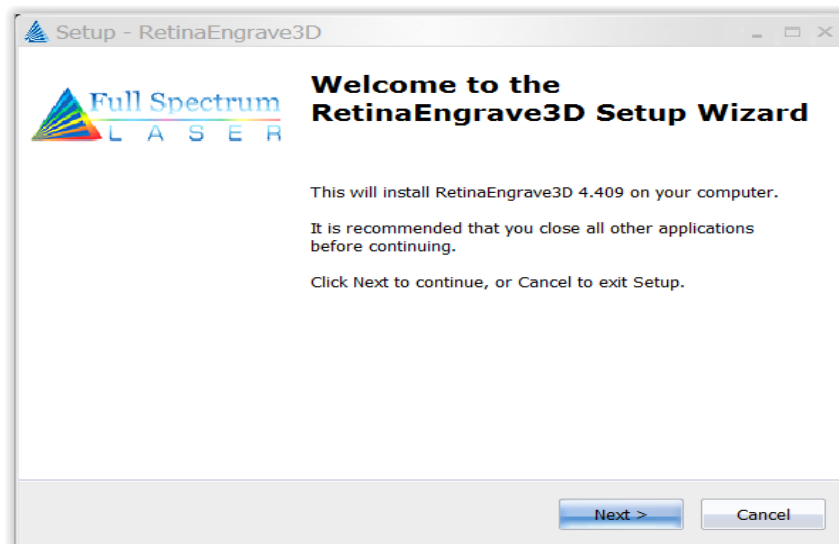
RetinaEngrave v4.420 is a combination of a print driver and control software that communicates with, downloads jobs to, and controls the laser system. It is available on the Full Spectrum software page (<http://fslaser.com/Software>)



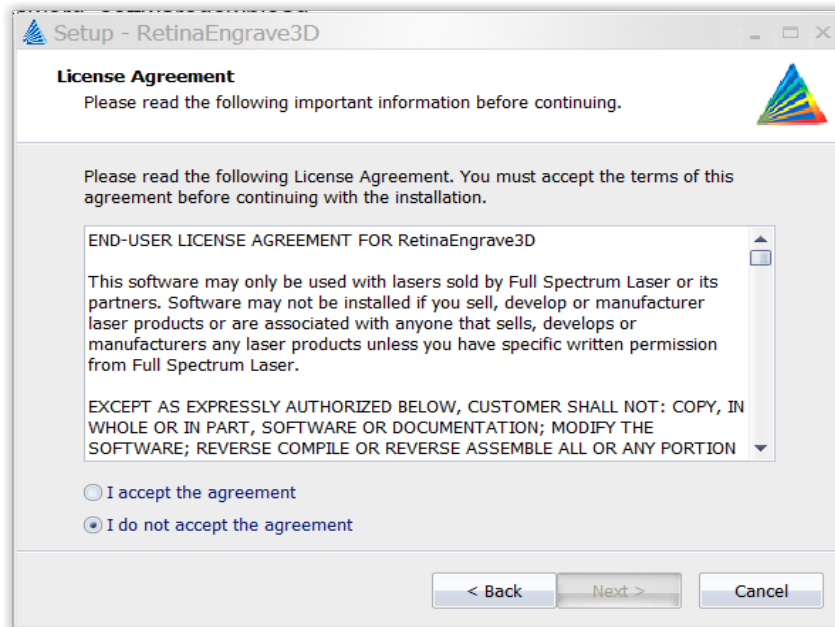
ATTENTION! The laser must be powered on when operating the software or when connecting the laser via the Ethernet cable. You will need uninterrupted Internet access for this process.

INSTALLING RETINAENGRAVE SOFTWARE STEPS:

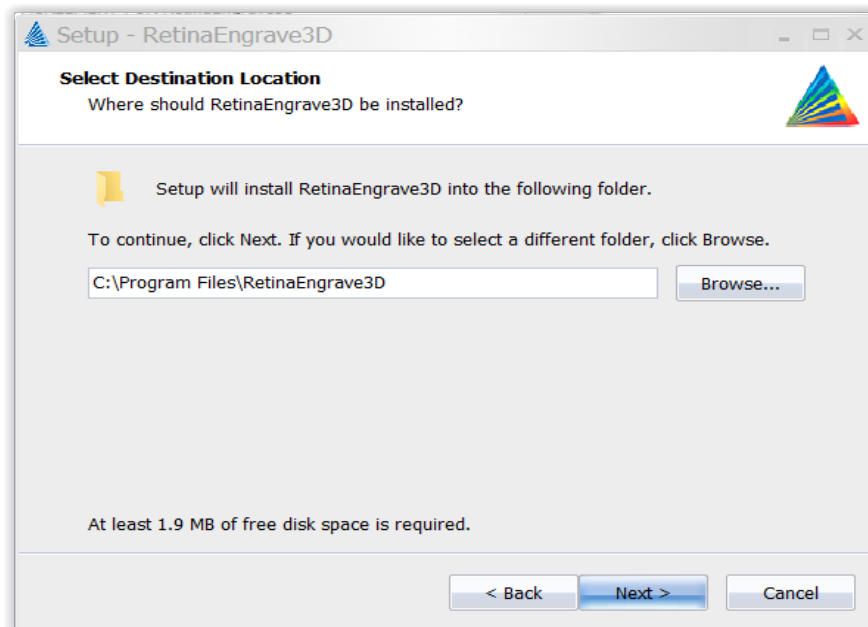
1. **Go to Download Page.** Turn on your computer or laptop, now connected to your laser cutter via the Ethernet Cable (J) or a router as demonstrated in Stage Six (above). In your favorite browser (Google Chrome, Firefox, etc) go to <http://fslaser.com/RetinaEngrave>.
2. **Download Installer.** You will need to download the RetinaEngrave installer first. Click Download RetinaEngrave Installer to begin the process.
3. **Run Installer.** Once the Installer is downloaded click **Run**. Approve any security warnings. The software will not harm your computer.
4. **Run Setup.** You will be welcomed by the setup wizard. Click **Next**.



5. **Accept the License Agreement.** Read and understand the terms of the license agreement and click the button labeled “I accept the agreement”. Then click **Next**.

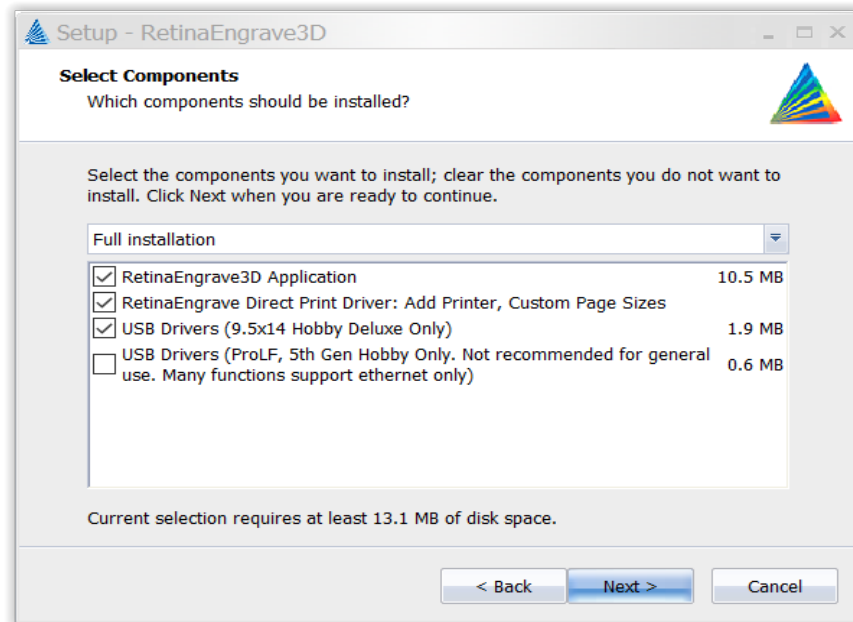


6. **Select Destination.** This is an optional step where you can place the installed software where you wish on your computer. The default destination is your C drive. If this is acceptable, Click **Next**.

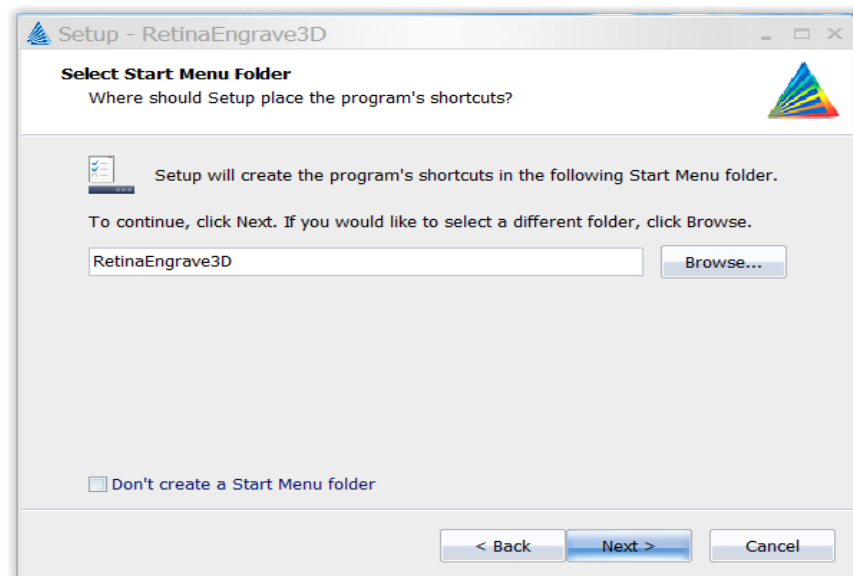


7. **Select Components.** This is another optional step allowing you to choose what components you want to add with your install. You can selectively click any component on

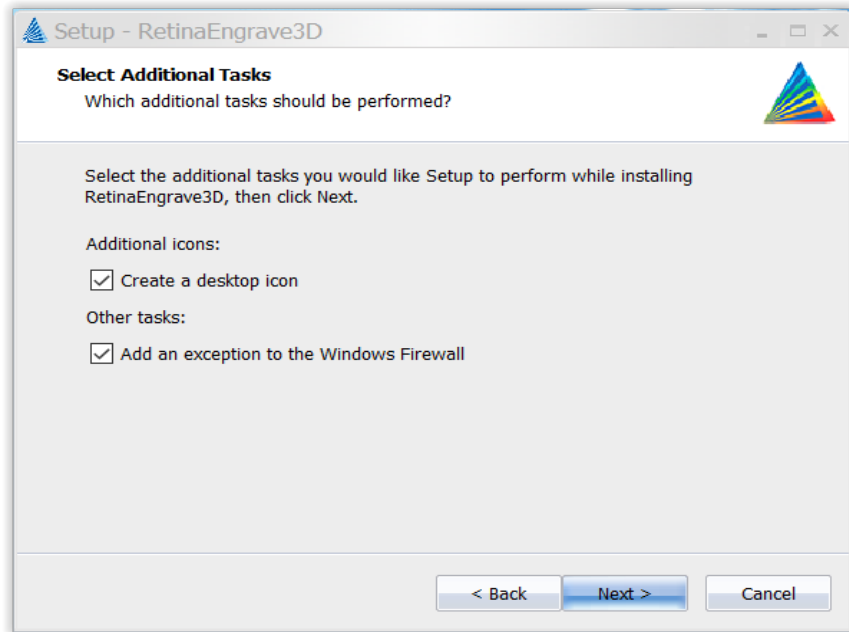
or off by adding or removing a checkmark next to each one. Or you can choose the default components. After you have made your selections, Click **Next**.



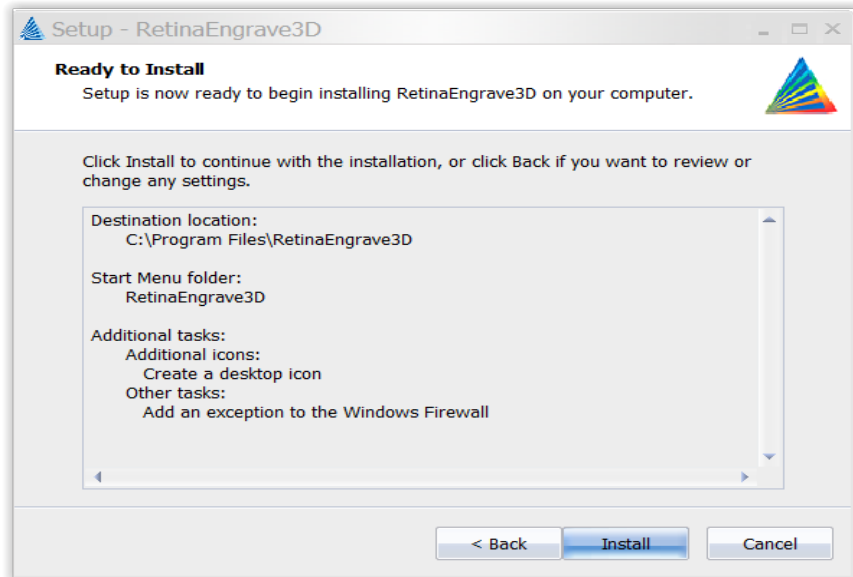
8. **Select Start Menu Folder.** This will name your folder and create a shortcut in your Start Menu folder. It is recommended that you use the default name. Click **Next**.



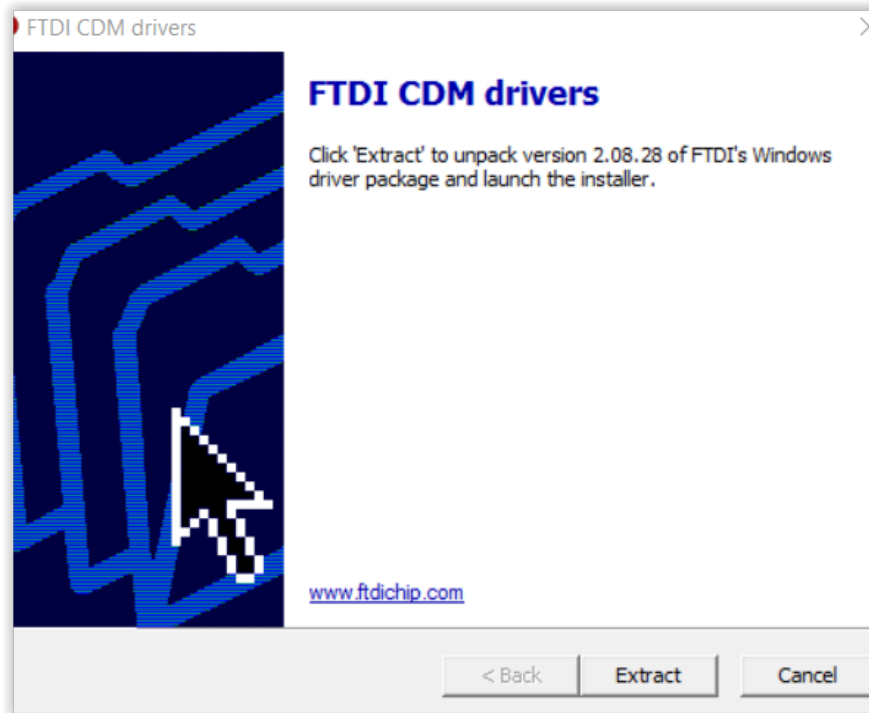
9. **Select Additional Tasks.** This window allows the options to create a shortcut desktop icon and tell your computer not to firewall (block) running the program. Both are the default options and are recommended. Click **Next**.



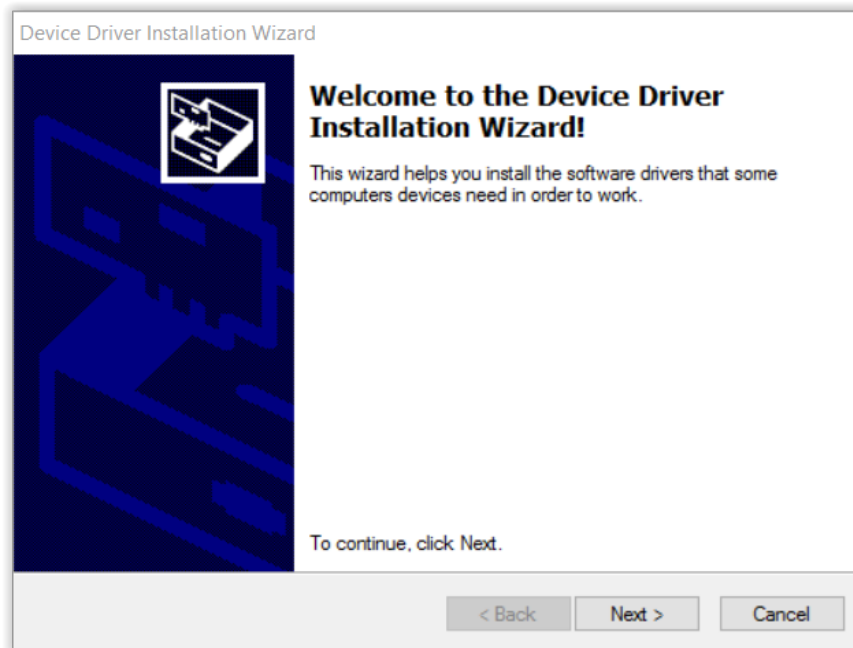
10. Install RetinaEngrave Software. The RetinaEngrave software is ready to install. Click **Install** and allow the computer time to run to the next step.



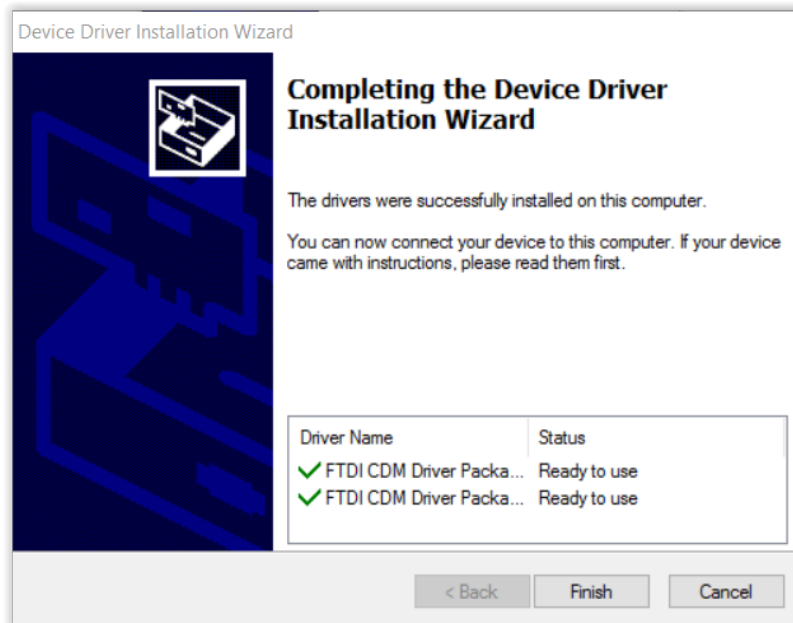
11. Extract Files. Click **Extract** to unpack the files and launch the install process.



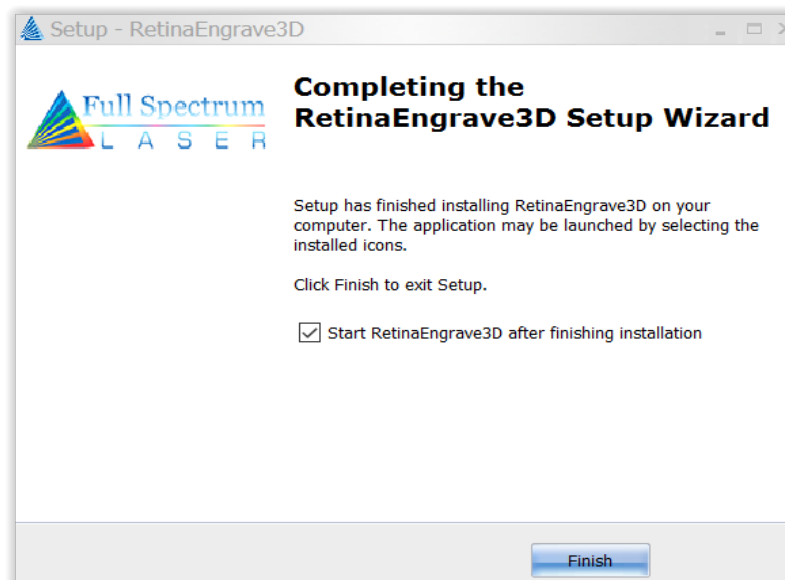
12. **Driver Installation.** This is another necessary step in downloading the software. Click **Next.**



- 13. Finish.** You will now see a window telling you the drivers are successfully installed. Click **Finish**.



- 14. Open RetinaEngrave Software.** You are ready to launch the program. You can go directly to the software by Clicking **Finish**. You can also launch the program through your start menu or by clicking the desktop shortcut icon.





ATTENTION! If the laser system does not find a DHCP server while booting, it will assign itself an IP address. This address is displayed on the screen after boot—the self-assigned IP does not change between power cycles.

- The panel uses capacitive sensing which requires contact with skin to operate.

- The panel is quite sensitive and can often sense changes through thin fabrics (a cotton shirt). Please take note of this and avoid leaning on the panel during maintenance.

- The control panel interface is mode-based, meaning that each button's function depends on the currently-selected mode.

TESTS AND ADJUSTMENTS

It is important that your laser is tested and adjusted (if needed) for proper use before you start your first job. The following will be on our list of tests and adjustments:

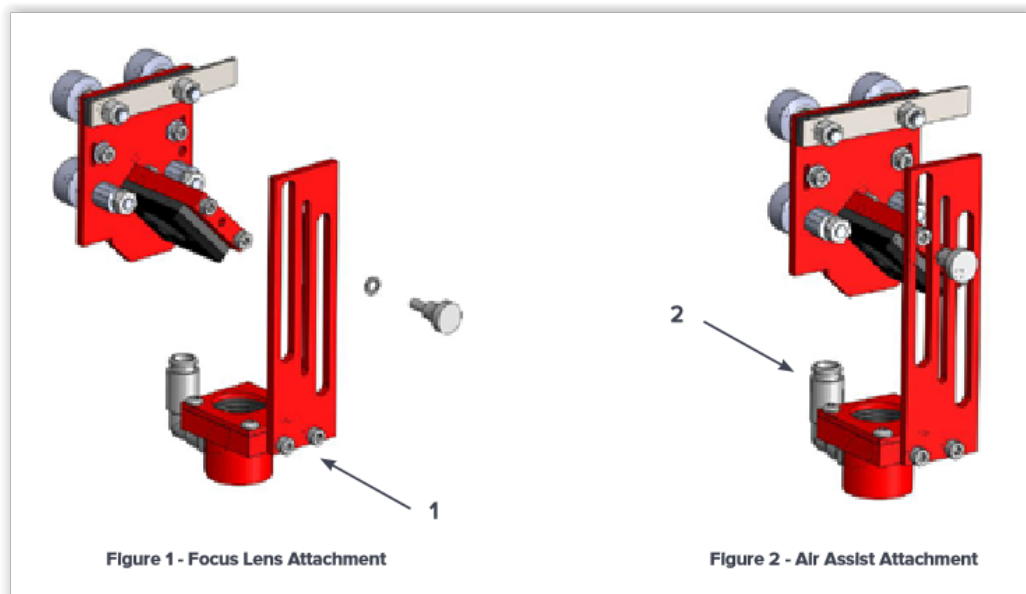
1. Focus Lens Adjustment
2. Laser Tube Test
3. Mirror Alignment
4. Focusing
5. Laser Head Adjustment
6. Belt Tension

Focus Lens Adjustment

The focus lens assembly is pre-installed at the factory, however it can sometimes become loose or out of adjustment during the shipping process.

FOCUS LENS ADJUSTMENT STEPS:

1. **Adjust Focus Lens.** The Focus Lens attaches to the focus head using one (1) M3 thumbscrew and two (2) M3 spring washers (G). Be sure all screws and washers are accounted for and properly placed and tightened (Figure 1).
2. **Check the Air Assist.** Be sure the air assist tube is attached to the push-to-connect connector once the head has been secured (Figure 2).



3. **Check for Interference.** Run a job with the laser OFF to verify the air tube will not interfere with the beam path or rub against the X rail while engraving. Alternatively, this can be done manually by physically moving the laser head with your hand in a rectangular pattern within

the work area. The laser will need to be “Unlocked” to proceed with a manual test. Use the touch screen and press the lock icon to toggle from “Locked” to “Unlocked”.

Laser Tube Test

In this test we are going to tape a piece of thermal paper between the laser tube aperture and the beam combiner aperture and then test fire the laser to ensure the laser is aligned.

LASER TUBE TEST STEPS:

- 1. Check Assembly.** Before you get started with the tube test, be sure the machine is properly assembled with the water pump and air compressor working. This will be a live firing of the laser.
- 2. Open Safety Lid.** You will need to access the interior of the machine.
- 3. Place Thermal Paper.** Take a piece of thermal paper (1) and tape it between the Beam Combiner and Mirror #1 with the thermal sensitive side facing the laser tube output. Alignment of the thermal paper is not critical, but make sure that there is a large enough white space that can capture the beam output; the beam is approximately 5mm in diameter and will exit from the center of the tube.
- 4. Close Safety Lid.** Safety measures should make it impossible to fire the laser with the safety lid open. Regardless, never attempt to fire the laser with safety lid open.
- 5. Set Laser To Test Mode.** This step will require using the Touch Screen Interface. This manual has a section fully describing the Touch Screen features, but for now we can complete this process with minimum introduction. Place the laser into test fire mode by pressing the “FS/Z button”, toggle until menu reads “Align Mode”.
- 6. Test Fire the Laser.** Press the Test Fire Button on the Touch Screen once (see User Interfaces section for complete guide to touch screen functions). You should hear a ‘click’ and/or see a plasma arc inside the tube (if not, press the Test Fire Button again). The click is from the power supply switching rapidly on then off for the test pulse. If you observe either of these actions but no mark on the thermal paper, the paper was most likely reversed or incorrectly placed. If you do not mark the paper and are not observing a noise during a test fire attempt, it is possible that the cover interlock was not properly engaged; try shifting the cover or magnet closer to the sensor.
- 7. Check Results.** A circular black mark with diffused edges should appear on the thermal paper. If there is interference, the mark will be occluded and/or have a very sharp edge. If this is the case, your tube is working but has come out of alignment.

Mirror Alignment

Your laser was aligned during assembly and testing in Las Vegas—the CO2 beam and Alignment Laser beams were matched to follow the same path through the mirrors and fire down the center of the focusing head. However, shipping is a high-vibration environment and it is sometimes necessary to re-align mirrors. Before we go through a full re-alignment process, let's check and see what the current alignment is:

ALIGNMENT TEST

STEPS:

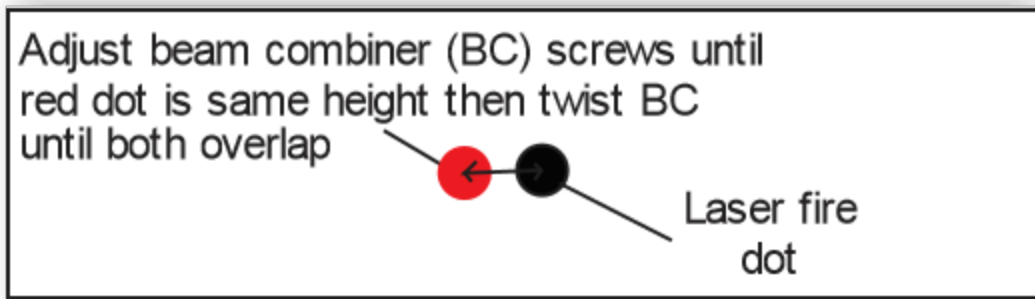
1. **Open Safety Lid.** You will need to access the interior of the machine.
2. **Place Thermal Paper.** Take a piece of thermal paper (1) and place it above the lens on the focusing head, covering the aperture. Tape two edges so that the paper will stay relatively taut over the hole. Press your finger firmly along the edge of the aperture to make a mark on the thermal paper to show the aperture's outline.
3. **Position the Laser for Testing.** Using the Touch Screen Interface, push the arrow keys to position the laser in the uppermost left corner.
4. **Close Safety Lid.** Safety measures should make it impossible to fire the laser with the safety lid open. Regardless, never attempt to fire the laser with safety lid open.
5. **Test Fire the Laser.** Press the Test Fire Button on the Touch Screen.
6. **Check Results.** Observe and note the location of the mark on the thermal paper.
7. **Reposition Laser.** Using the Touch Screen Interface arrow keys, position the laser halfway along the Y axis towards the lower (front) left corner.
8. **Test Fire the Laser.** Press the Test Fire Button on the Touch Screen.
9. **Check Results.** Observe and note the location of the new mark on the thermal paper.
10. **Last Repositioning.** Once again, using the Touch Screen arrow keys, move the laser the remainder of the way along the Y axis.
11. **Test Fire the Laser.** Press the Test Fire Button on the Touch Screen.
12. **Final Results.** Observe and note the location of the final mark on the thermal paper. The burn marks should all be relatively close to the center and should not alter after repositioning the laser head. If there was a great deal of variation in the location of the burn marks (more than 2mm of drift) you will need to align your laser (see below).

The H-Series Hobby laser has an integrated beam combiner which greatly simplifies beam alignment. The general procedure is to first align the red beam with the invisible beam then use the red beam as the primary indicator for alignment. We recommend first aligning the invisible cutting beam with the visible Alignment Beam—this saves a great deal of time lost in opening and closing the lid for safe access while firing the laser. Follow this procedure:

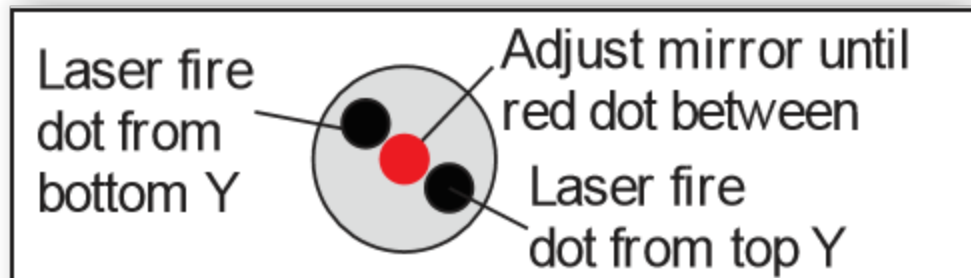
RE-ALIGNMENT PROCEDURE (Mirror #1)

STEPS:

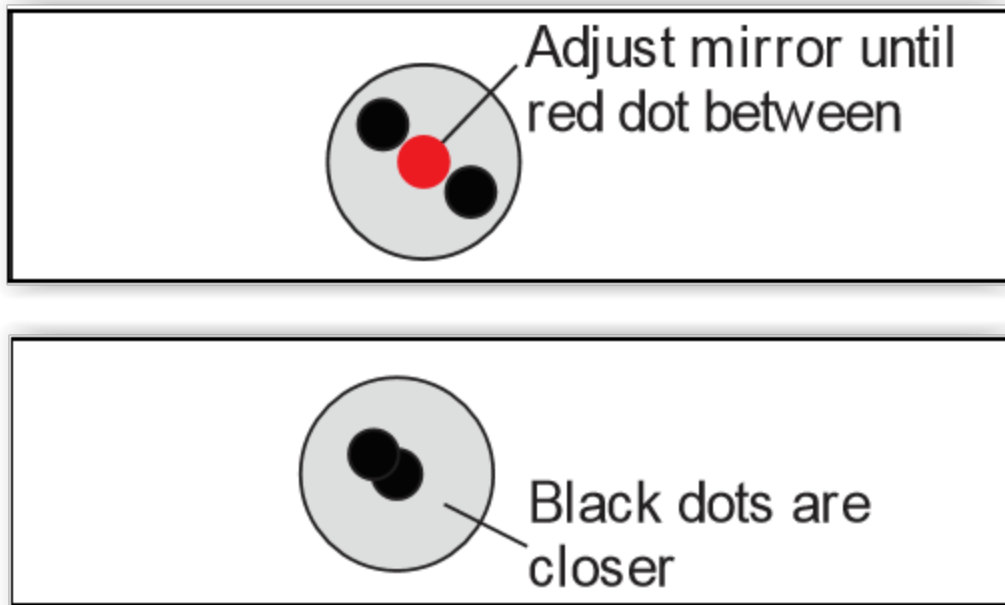
- 1. Open Safety Lid.** You will need to access the interior of the machine.
- 2. Place Thermal Paper.** Take a piece of thermal paper and place it over Mirror 1 in the same matter as in the Alignment Test.
- 3. Unlock Laser to Manual Control.** Pressing the Lock/Unlock button on the Touch Screen Interface locks or unlocks the drive motors. System cannot jog or test fire while unlocked, but laser head can be positioned by hand, which is what we want to do next.
- 4. Close Safety Lid.** Safety measures should make it impossible to fire the laser with the safety lid open. Regardless, never intentionally fire the laser with safety lid open.
- 5. Test Fire the Laser.** Press the Test Fire Button on the Touch Screen. Observe and note the location of the new mark on the thermal paper. You may need to hit Test Fire more than once to create a visible black dot on the thermal paper.
- 6. Check Results.** A black dot should appear on the thermal paper. Check that this dot is round and not clipped on the left or right. In the unlikely case the dot is still clipped after multiple test fires, the tube may be sitting at an angle causing it to hit the beam combiner. This will need to be adjusted.
- 7. Adjust Mirror #1.** Adjust one of the clamps of the laser tube to move tube left or right so it is not clipped by the beam combiner. This should not happen normally unless you changed the tub. Contact Full Spectrum Laser tech support for more details.
- 8. Move and Retest Fire.** Move the X gantry (the long black bar) down to the lowest Y position. Put a piece of thermal paper on location #2. Fire a test pulse and observe where the black dot appears on the thermal paper.
- 9. Adjust Pointer.** Without moving the gantry and without touching any of the mirrors, adjust the red dot pointer so that the red dot overlaps with the black dot. Do this by adjusting the screws that hold the red laser in place. Once the red dot overlaps with the black dot, the red is travelling along the same path as the invisible laser beam and can be used to align the rest of the laser instead of relying on the invisible black dot.



- 10. Retest Fire.** Move the X gantry to the top Y position. Fire another black dot onto the thermal paper. You should now have two black dots (one from the upper Y position and one from lower Y position). Move the X gantry up and down and verify that the red dot tracks from one black dot to the other black dot.
- 11. Adjust Mirror #1.** Move the X gantry to the lowest Y position. The red dot should now overlap with one of the black dots. Adjust mirror #1 until the red dot is in the middle of the two black dots.



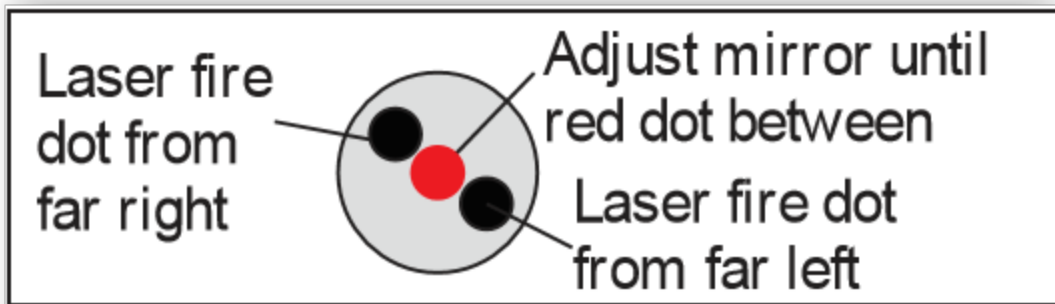
- 12. Retestfire.** Use a fresh piece of thermal paper and fire a test dot with the X gantry still in the lowest Y position. Move the X gantry to the top position and fire another test dot. Now the two black dots should be closer together.
- 13. Adjust.** Move the X gantry back to the lowest Y position. Now adjust the red dot until it moves to the center of the two black dots.
- 14. Repeat Until Aligned.** Repeat the process of firing two black dots on the top and on the bottom Y positions and adjusting mirror #1 to move the red dot to the center of the two black dots until the two black dots from the top and bottom Y positions are centered on top of each other.



RE-ALIGNMENT PROCEDURE (Mirror #2)

- 15. Adjust Mirror #1.** With mirror #1 aligned, we will now adjust mirror #2. Put a piece of thermal paper on mirror #3. Using the red dot, adjust the mirror until the red laser is somewhere on the mirror.
- 16. Fire and Adjust.** Move the laser head to the far right position. Fire a test dot here producing a black dot. The red and black dot may be off slightly because the distance travelled by the laser beams is longer so any small errors are amplified. Without touching any of the mirrors, adjust the red dot to overlap with the black dot through the screws on the red laser diode mount or twisting the red laser diode mount.
- 17. Second Test Fire.** Put on a new piece of thermal paper. Move the laser head to the far left and fire a black dot. Move the laser head to the far right and fire a second black dot.
- 18. Track and Verify.** Now you should have two black dots on the thermal paper and the red dot. Verify as you move from the left side to the right side that the red pointer tracks between the two black dots.
- 19. Adjust Mirror #2.** Move the laser head to the far right. The red laser dot should overlap with one of the black dots. Adjusting only mirror #2, move the red dot between the two

black dots.



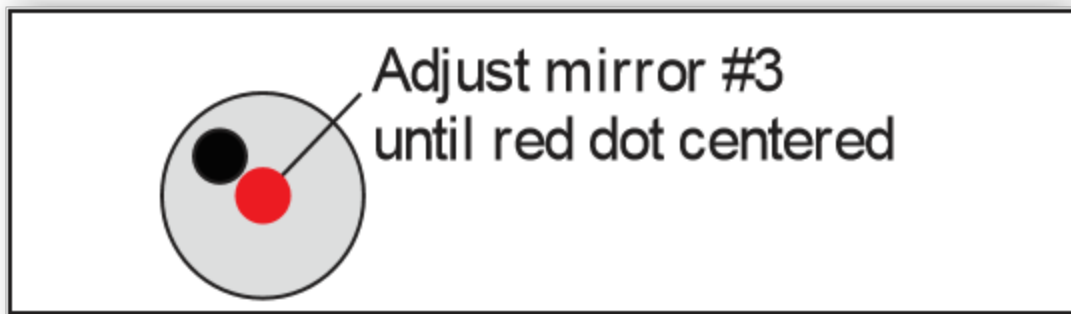
- 20. Test Fire and Adjust.** Replace with a new piece of thermal paper and fire dots in the far left and far right positions. Again move to the far right position then adjust the red dot between the two black dots. Repeat until the two black dots are exactly on top of each other. Mirror #2 is now aligned.



PRO TIP! The idea is that when the laser is not aligned, you will have two black dots from the test fires in the top and bottom positions. The red laser pointer is aligned with the invisible laser pointer so gives you immediate feedback on the mirror adjustment. By adjusting it into the middle of the two black dots, you are splitting the error difference. Usually after 1 or 2 iterations, the black dots will be exactly on top and this axis is aligned. The goal is to have the two black dots overlap exactly. **IT IS NOT NECESSARY THAT THE DOTS BE IN THE CENTER OF THE MIRROR BUT THEY SHOULD BE SOMEWHERE ON THE MIRROR.**

RE-ALIGNMENT PROCEDURE (Mirror #3)

- 21. Adjust Mirror #3.** Once mirror #2 is aligned, put a piece of thermal paper on top of the lens. Adjust the screws on mirror #3 until the red dot is in the center of the lens. Fire a black dot into the thermal paper.
- 22. Fire and Adjust.** Move the laser head around and verify the red dot does not move away from the black dot anywhere on the laser bed. The closer you get the dots stationary, the better aligned the laser will be. You can fire black dots at the 4 corners of the laser bed and verify none of them are more than 2mm away from each other. Adjust mirror #3 until red dot centered.



For a video tutorial on the Mirror Alignment Procedure, goto <https://www.youtube.com/watch?v=qLJs-f2cvkE>.

Focusing

Focusing the Hobby Advanced Laser is quick and easy. Your laser included a billet sized for the included 2-inch focal length lens.

STEPS:

1. **Place Billet.** Place the billet on the top of the engraving plane.
2. **Release Locking Mechanism.** Release the locking mechanism on the focus head until the air assist nozzle rests on top of the billet.
3. **Retighten.** Retighten the sliding head and remove the billet from the workpiece.

Laser Head Adjustment

Proper laser head adjustment is critical for high accuracy. The two upper wheels of the laser head have fixed axles and the two bottom wheels are mounted through eccentric spacers. When the eccentric spacers are turned, they tighten the bottom wheels against the underside of the black X axis rail. Too much tension and the wheels can bind up when doing high speed raster or rapid moves. Too little tension and you can see some slop in the cutting. Two special wrenches are included to adjust the wheels.

ECENTRIC SPACER ADJUSTMENT PROCEDURE

STEPS:

1. **Adjust the Eccentric Shafts.** First loosen the locking nut which is pressed against the spring washer and the eccentric shaft. Use one of the included adjustment wrenches to hold the eccentric spacer in place while using the second to loosen the nut. With the locking nut loosened, you can use one wrench to turn the eccentric shaft.
2. **Position.** Depending on the initial location of the eccentric, a clockwise turn can either tighten or loosen the wheel.

3. **Resecure.** Use the two wrenches to again tighten the locking nut after you are happy with the eccentric nut position.

PROPER WHEEL TENSION PROCEDURE

STEPS:

1. **Prep.** Unlock the motors or turn off the machine's power for at least an hour.
2. **Assess Tightness.** Grip the laser head with one hand. You should be able to turn each of the wheels relatively freely with the other hand even with the laser head held in one place. If you can't turn each wheel without moving the laser head, likely the tension is too high and one or both eccentric wheels need to be loosened.
3. **Test Laser Head Tension.** Turn each of the wheels and the laser head should move. If the wheels are freewheeling then the tension is too low and the eccentrics should be tightened.
4. **Assess For Further Adjustment.** Check if there is any front to back tolerance in the laser head assembly. This can be tested by gently twisting the laser head about the Z and X axes of the machine. There should be minimal wobble to ensure the laser head doesn't move when the laser head rapidly changes direction. A small amount of looseness on the head is required for proper operation.



PRO TIP! Ideally the wheels should be tight enough so if they rotate, they move the head but not tight enough that they introduce too much friction. The above wheel test is an excellent test of balance between these two.

Belt Tension

The belts of your laser should be relatively tight and have no sag; you should be able to pluck any of the belts and it should vibrate back to stiffness. Ideal belt tension is achieved by applying moderate to high pressure with one's hands to the idler pulley—no extra leverage is needed. The X idler pulley is held in place with an M4 hex nut and can be adjusted with the included eccentric adjustment key. The Y idlers are mounted on two L-shaped brackets and held with two M4 cap screws. The M4 cap screws require a 3mm hex key to adjust. See Belt Installation section in this manual for more detail.

USER INTERFACES

H-Series Hobby Laser Touchscreen Interface

The LCD touch panel allows you to control the basic functions of your laser without needing to connect to a computer. This is very convenient during alignment and testing procedures.

DISPLAY PANEL

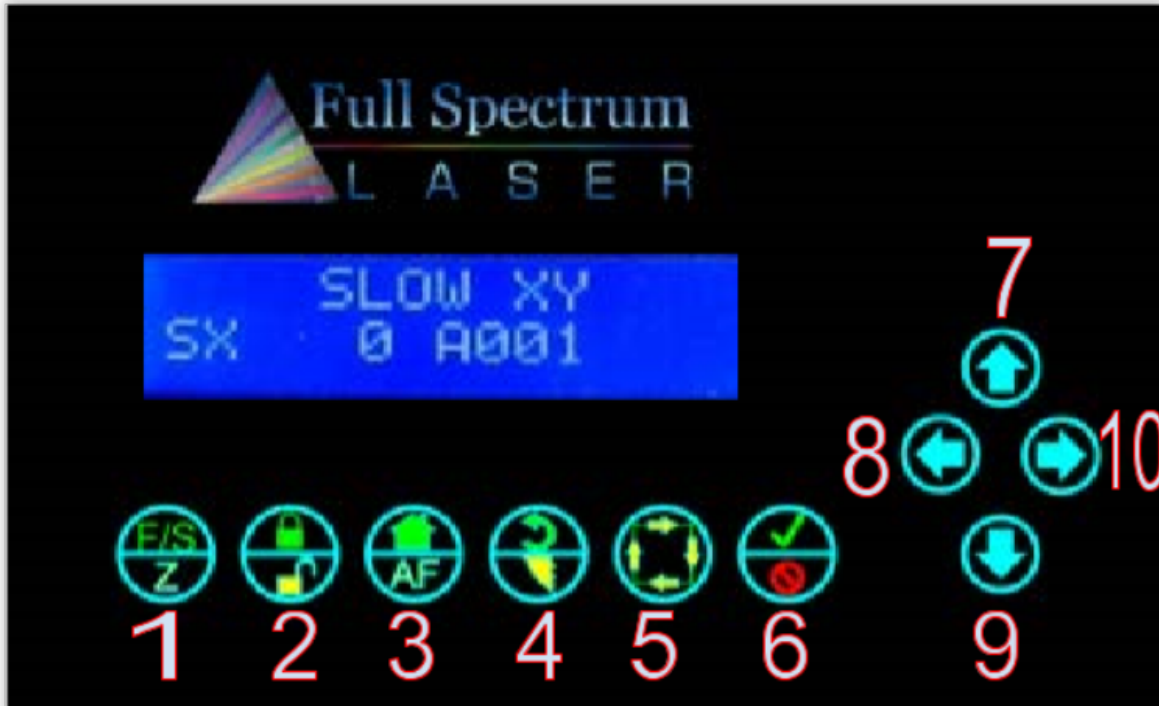


The LCD screen has two lines and gives operations information in four fields:

1. **Selection Field.** Located on the top line, this field gives information on the current operation mode of the laser.
2. **Mode Field.** Located on the far left of the lower line, this field tells the operator the current mode.
3. **Power Field.** Displays the laser power on a scale of 0-255. During a job you can adjust from 0-255 on the fly using the up and down arrows. It is located to the right of the MODE field. Note that if the power is increased above the default power setting (180), the laser tube life will deteriorate more rapidly.

4. **Address Field.** Displays the last 3 digits of the IP address with a character prefix. A prefix of A means that the laser did not find a DHCP server on its network and self-assigned an IP address. The D prefix means the laser found a DHCP server.

BUTTON FUNCTIONS



Panel function buttons are numbered 1 through 6 starting from the left. Jog buttons (arrow pad) continue the numbering from 7 starting at 12 o'clock and counting up counterclockwise. Typically the icons on the top line are active during Fast XY Jog (Mode 0). The icons on the bottom are typically active during Alignment (Mode 2).

1. **FS/Z (MODE SELECT).** Toggles between modes:
 - a. **Fast XY Jog (Mode 0)**
 - b. **Slow XY Jog (Mode 1)**
 - c. **Alignment (Mode 2)**
 - d. **Factory Reset (Mode 3)**
2. **LOCK/UNLOCK.** Locks or unlocks the drive motors. System cannot jog or test fire while unlocked, but laser head can be positioned by hand.
 - a. **Locked**
 - b. **Unlocked**
3. **HOME.** If in Fast XY (Mode 0) or Slow XY (Mode 1) pressing this button will cause the laser head to seek the home position. After homing, the laser will know the position of the head. Unlocking the motion system causes the unit to forget position (it must be re-homed).
4. **RETURN/TEST FIRE.**

- a. In **Fast XY (Mode 0)** or **Slow XY (Mode 1)** the laser will move to the previously saved job start position.
 - b. In **Alignment (Mode 2)** this button fires a short-duration pulse designed to mark thermal paper.
- 5. RUN PERIMETER**
- a. In **Fast XY (Mode 0)** the bounding perimeter of the job will be shown quickly (RetinaEngrave software must be started/loaded with a job for this function to be active).
 - b. In **Slow XY (Mode 1)** the bounding perimeter of the job will be shown slowly.
- 6. START/CANCEL.** In any menu mode (File Select or Factory Reset) this button will select the option displayed in the SELECTION field.
- a. Cancels a move operation (homing, autofocus or a running job).
 - b. In **Fast/Slow XY**, with the laser **UNLOCKED**, this fires a higher-power test pulse.
 - c. In **Fast XY**, pressing this button after the laser homes will rapidly move the head to the upper left corner of the workspace.
 - d. In **Slow XY**, pressing this button after running a job will allow you to re-run the same job.
- 7-10. JOG BUTTONS.** Four green arrow keys pointing UP (7), DOWN (9), LEFT (8), and RIGHT (10).
- a. In **Fast or Slow XY (Modes 0 and 1)**, the buttons move the laser head left/right and front/back.
 - b. In **File Select (Mode 3)** the up and down buttons scroll through the loaded jobs.

PRO TIP! During a job only the **LOCK/UNLOCK, CANCEL** and **UP/DOWN JOG** buttons function. All other function buttons are disabled.



- **LOCK/UNLOCK** pauses/resumes the job.
- **CANCEL** cancels the job.
- **UP/DOWN JOG BUTTONS** allow you to adjust the job power on the fly. Scale is from 0 (no power) to 255 (full power). We don't recommend going over 180 with Hobby system lasers, due to that they go over 180 the tube rated life will decrease.

MODES

FAST XY JOG (MODE 0) AND SLOW XY JOG (MODE 1). Use the jog buttons to move the laser head. Press the home button to index the laser head.

ALIGNMENT (MODE 2). Use this mode during tube testing and mirror alignment. The test fire button fires a short-duration laser pulse that will mark thermal paper. Use the jog buttons while the motors are locked to jog the head. Unlock the motors to move the head by hand. The test fire

function is enabled while the motors are unlocked. The test pulse will not fire with the magnetic safety interlock open.

FILE SELECT (MODE 3). Navigate through .bin job files that are loaded on a microSD card (not included). Use the up and down jog buttons to scroll through the list and press the Start button to load the job. Press the Start button a second time to run the job.

FACTORY RESET MODE (MODE 4). Use this mode to reset the laser's IP address settings to the factory defaults. Useful if you assign a static IP but can no longer connect.



Attention! The Hobby Laser controller has 2 hard stops and 2 soft stops on the limits of the axes. Soft stops prevent the motion system from attempting to move beyond its mechanical limits, but require a reference in order to work: the laser must be homed in order for the soft stops to function properly.

Validating Control Card

RetinaEngrave 3d control cards are preinstalled in all Hobby Laser models. If you are a new customer, your laser's control card is shipped with an 80-hour temporary usage authorization. If you are an existing customer, this information will apply if you update your software—after the update you will have 80 hours to activate your card. The 80 hours are only counted while the laser is ON. During the temporary usage period you must connect your laser to your PC while it is connected to the internet and validate your card. Control card activation is a one-time process. This section will walk you through the validation process

VALIDATION OF CONTROL CARD (New Customers Only)

STEPS:

- 1. Connect Your Laser to Your Computer.** Either directly or over the network. You will need a working Internet connection to continue. Note that activation cannot be done via USB.
- 2. Turn On Your Laser.** Your machine must be ON to continue this process.
- 3. Start RetinaEngrave.** RetinaEngrave will automatically attempt to connect to your laser. Alternately, you can manually select or enter its IP address. Once the laser has successfully connected to RetinaEngrave a popup will appear informing you that your card is temporarily activated, the amount of hours remaining and will ask you to validate your card.
- 4. Click “Continue →”.** This will advance you to the validation information screen.
- 5. Fill Information Fields.** Fill in the requested information. This information should match the information you supplied with your initial order. If they do not match, we may contact you for

clarification or updated information. Remember spaces with an asterisk (*) require input of valid information. The information requested is the following:

- a. **Purchase Order Number (Optional).** This will be either a three (3) digit number or a nine (9) digit number that was emailed to you from GoogleCheckout at the time you purchased your machine.
 - b. **Contact Person/Company (Required).** Enter a first and last name.
 - c. **Contact Email (Required).** Use an active email account that you regularly check.
 - d. **Comments(Optional).** Comments can include any information that you want to be added to your customer account file.
6. **Click Send.** Once all the required fields are filled in (and any optional fields you chose) click **“Send”**. The information will be sent to us for comparison against your order information. Once the information has been received by us, you will see a pop-up confirmation message. From there we will quickly verify your information and validate your authorization. The next time you launch RetinaEngrave software your control card should be validated and activated under your account.

VALIDATION FOR EXISTING CUSTOMERS (SOFTWARE UPGRADE)

1. **Follow Download Instructions.** Download the latest version of RetinaEngrave and extract the .zip archive to a location on your computer. You may or may not be required to update your laser’s firmware.
2. **Open the extracted folder.** Read any documents (Text, PDF, Word) found there for installation information. Follow those instructions first (load firmwares using your current version of RE3D).
3. **Run Installer.** Run the RetinaEngrave executable installer. Follow the steps in the previous section: VALIDATION OF CONTROL CARD.

OFFLINE VALIDATION

If you are unable to connect to your laser and the internet at the same time you will need to perform the following steps to activate your unit.

1. **Ethernet Connection.** Connect your computer to your laser cutter via the Ethernet cable that came with your machine.
2. **Launch RetinaEngrave Software.** Start the RetinaEngrave program to ensure that you have a connection with your unit.
3. **Select “Create Profile Offline”.** Navigate to the Help menu, and select “Create Profile Offline”.
4. **Select “Save Profile to File”.** Again, navigate to the Help menu, and select “Save Profile to File”.

5. **Save Profile.** Choose a location on your computer and save your laser's profile.
6. **Log In.** Connect your computer to the internet and log in to your email account you registered your purchase with (or the email you used to validate your control card).
7. **Send Profile to Full Spectrum Laser.** Attach the laser profile file to a new email and send to activation@fullspectrumlaser.com. We will verify that your information matches the purchase, or send you an email if we need more information. Once your profile has been verified, we will email you an activated profile. When you receive this email continue to the final steps below.
8. **Download the Activated Profile.** This file will be attached to the email you received.
9. **Start RetinaEngrave.** You can drag the activated profile into the workspace, or use the Help menu → "Open Profile From File". Your laser is now activated.

Using RetinaEngrave Software

RetinaEngrave is the combination control software, electronics and print driver that allows you to create jobs and download them to your laser system. The full control package for your laser has four parts:

- **RETINAENGRAVE PRINT DRIVER**
- **RETINAENGRAVE JOB SOFTWARE**
- **FSL LCD CAPACITIVE TOUCH CONTROL PANEL**
- **RETINAENGRAVE PRO LASER CONTROLLER**

QUICK START CHECKLIST

A typical job starts with the creation of a design in your favored software. You can also find designs online. Once you are satisfied with your design, follow these steps:

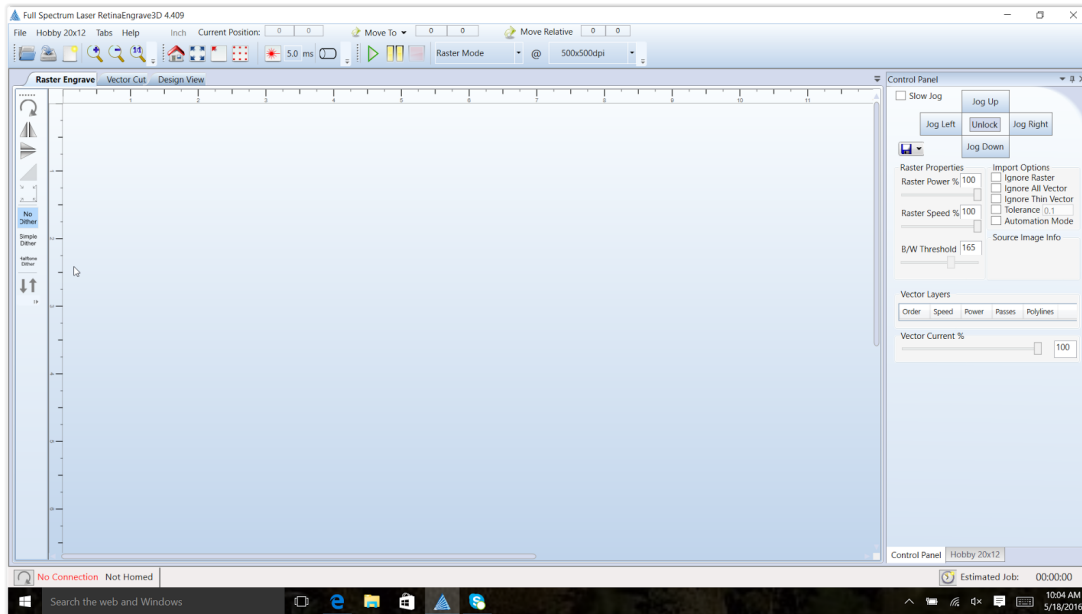
1. **Open RetinaEngrave.** Double-Click the RetinaEngrave icon on the desktop of your computer. The program must be open at the time of printing from your design software in order to capture the print stream. You can also print to an XPS print file while RetinaEngrave is not running and open this XPS file at a later time to print.
2. **Select Print Driver.** Select the “Full Spectrum Engineering Print Driver”. Make sure that the “Preflight Check” tab is not giving any warnings.
3. **Print.** Click the “Print” button. Your job is parsed by RetinaEngrave and will appear in the RetinaEngrave software under the currently selected mode tab. Now you are able to review your design, make adjustments and choose the laser settings for running the job.
4. **Options.** You can start the job immediately or download the job to the onboard memory of the RetinaEngrave controller. To run a downloaded job, there is an additional step of loading the job in the controller’s memory before pressing “Start”. This is done using the LCD touch panel.



ATTENTION! The first time that you open RetinaEngrave, you will be asked to select your laser from a popup menu. It is extremely important that you choose the correct laser, for example, **Generation 5 Hobby 20x12**. Choosing the wrong laser will cause communication errors and the laser tube will fire continuously. If you select the wrong laser, use the Laser menu and select “Change Laser” to select the proper unit. If the connection dialog (lower left of RetinaEngrave) shows the laser as disconnected, make sure the Ethernet cable is plugged in and power cycle the laser. If there is still a connection issue, go to the laser menu and manually enter the IP Address displayed on the control panel after boot.

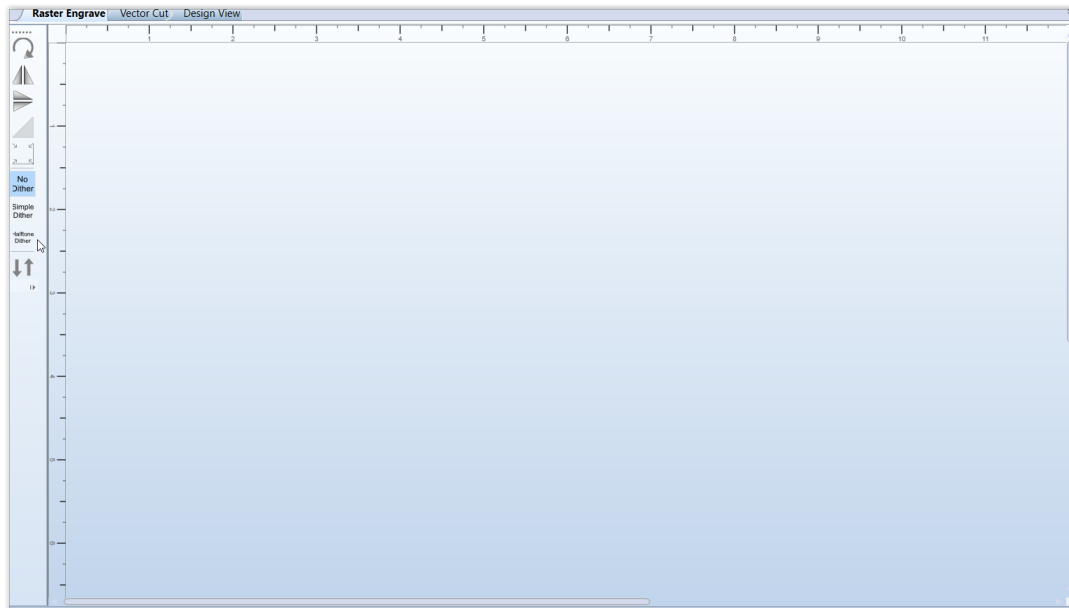
RetinaEngrave Interface

In this section you will be introduced to the major interface features of RetinaEngrave.



WORK SPACE

The workspace window shows a preview of your current job.



TOP LINE MENUS (LEFT SIDE)



FILE

The File menu allows the user to open up files to engrave. RetinaEngrave supports drag and drop of .xps files for vector cutting and standard image file types (.bmp, .jpg, .png, .tiff) for raster engraving. Other file types must be printed to the Full Spectrum Engineering Driver or saved as .xps documents. The file menu also allows a user to load or save a project and settings.

File sub-menus

- Save Project
- Open Project Settings Only
- Options
- Clear Workspace

The File sub-menu allows you to save your workspace window setup, set the PC to audibly alert when a job is completed, enable or disable the keyboard shortcuts, load the last-saved project on startup or log output for troubleshooting. Note that adjustments made to the designs scale or stroke color while in RE cannot be saved. Designs need to be at the desired scale and stroke color before being brought into RE.

LASER

The Laser menu provides options related to the laser unit configuration and communications. It will allow you to select the type of laser you are connected to, manually reconnect to the laser or manually set the connection IP address.

Laser sub-menus:

- Change Laser Profile
- Firmware (Update)
- RetinaEngrave Card Commands
- Configure Static IP Address
- Specify IP Address for Connection
- Save Job as Binary File
- Send Binary to USB
- Save and Send Current Job to USB
- Material and Focus Tests

The Laser sub-menu allows you to save the current job and settings as a .bin file onto a USB device (when the device is loaded onto the laser).



CAUTION! The “RetinaEngrave Card Commands sub-menu option should only be accessed under supervision of Full Spectrum Laser support staff.

TABS

The tabs menu allows you to show the 3D Engrave Tab or the Control Panel.

Tabs sub-menus:

- Show 3D Engrave Tab
- Show Control Panel

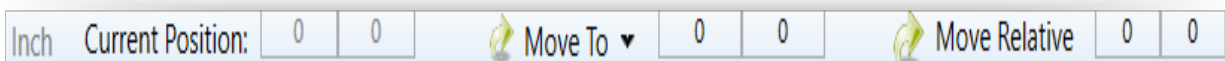
HELP

The help menu offers options to inform you about the version of RetinaEngrave you are using, an Activation menu (future functionality), and Troubleshooting and Update fields which will open the FSL website in your default browser.

Help sub-menus:

- Offline Activation
- Software Updates
- About

TOP LINE MENUS (RIGHT SIDE)



INCH/CM

This tabs switches measurements from inches to the metric system.

CURRENT POSITION

Shows the laser's current absolute position from the origin (home; upper right), it is reset to 0,0 when the laser is homed. The right field is the X coordinate, the left field the Y coordinate.

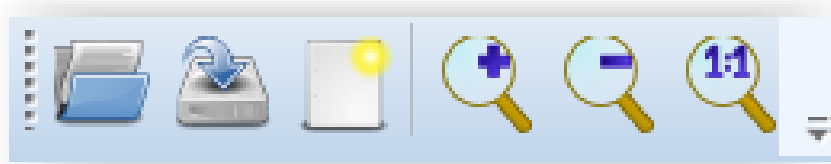
MOVE TO

The text fields show the saved position read from the controller. The fields are editable, allowing you to move to a manually entered location. Pressing the Move To button will first move the laser head to the home switches for reference then rapidly move to the position in the text boxes. Press the Home button to move the laser head to the origin. The laser will measure the distance it takes to reach the limit switches and enter the X and Y values into the Move To fields. It will then set the Current Position boxes to 0,0.

MOVE RELATIVE

These fields command a move by the specified amounts along X and Y using the current position as the origin. Combine with the Home button to move to, or between, fixture points.

LINE TWO MENUS (LEFT)



OPEN FILE [CTRL+O]

Open compatible file types (.xps, .bmp, .set, .bin).

SAVE PROJECT [CTRL+S]

Save your current project and settings as a .set file.

CLEAR WORKSPACE

Clear the workspace of the current job. This feature only exists in prior versions of the software.

ZOOM IN [+], ZOOM OUT [-], 1:1 ZOOM

The zoom buttons control the workspace view of the Engrave and Cut tabs. The 1:1 Zoom button restores the default zoom level.

LINE TWO MENUS (MIDDLE)



HOME [H]

Move the laser head to the origin (upper right of the work area). The laser should be homed after startup or RetinaEngrave will present a bounds alarm when you attempt to run a job.

RetinaEngrave has a built-in bounds checker to make sure that your design fits within the workspace.

PERIMETER [J]

The perimeter function will run the laser head in a box that bounds the limits of your design.

PERIMETER STEPS [P]

Each button press steps through one side of the perimeter bounding box.

LASER HEAD POSITIONING (BETA)

The default job origin is located at the upper left of your design (0,0 in the workspace) and referenced from the current location of the laser head in the work envelope. The Laser Head Positioning button opens a dialog box that allows you to change the default job origin between the

center of the job or the upper left (2 radio buttons in top menu division). The lower division of the Laser Head Positioning dialog box contains 9 radio buttons that allow you to preview job perimeter positions (you cannot set them as work origins). Keep in mind that the job origin setting is reset to default when RetinaEngrave is closed.

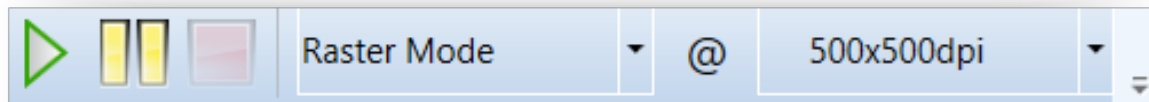
TEST FIRE [F] AND TEST FIRE DURATION FIELD

Pressing this button causes the tube to fire for the amount of time (in milliseconds) listed in the duration field. Default value is 5.0ms—this works well for marking thermal paper without burning through. Remember to close the lid or the tube will not fire.

ROTARY ENGRAVE TAB

The rotary tool, when selected, allows you to enable a rotary attachment, if installed, which allows the proper steps to be sent to the rotary to turn the item properly. See Appendix B: Rotary Attachment Installation for more information on the rotary attachment.

LINE TWO MENUS (RIGHT)



START JOB [G]

Press the Start button to start the job with the current settings. The job origin is, by default, located at the upper left of your design and is indexed from the current location of the laser head. For example, if you are vector cutting a 3 inch square, the laser will fire and move 3 inches to the right, then 3 inches forward (down), then 3 inches left and finally 3 inches up back to the starting position of the laser head. The Start button will be grayed out and not selectable whenever the laser is disconnected.

PAUSE [SPACEBAR]

Pressing the space key will pause and unpauses the in-progress job.

CANCEL

Immediately ends the in-progress job and returns to the job origin.

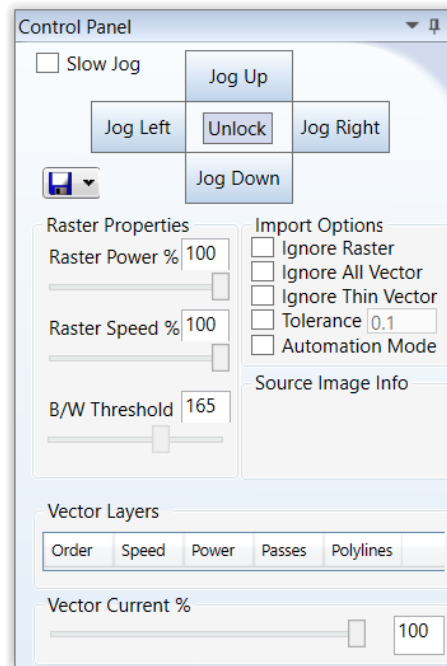
MODE-SELECT MENU

This drop-down menu allows you to select between several modes: Raster and Vector modes open their respective tabs, “Raster then Vector” mode will first run the job in the raster tab (black pixels) and then run the job in the vector tab. The Simulate Vector modes create a red-dot overlay in the workspace that follows the path of your vector lines at some multiple of the currently selected speed (for example, 100% speed at 0.5x runs at equivalent of 50% speed).

RESOLUTION MENU

Drop-down menu where you can select the dpi of the current job. Only used in Raster mode.

CONTROL PANEL



JOG

“Jogging” allows you to move the laser head using either the buttons or the keyboard arrow keys. Selecting the slow jog checkbox jogs the motion system at half of normal speed. The Lock/Unlock button allows you to unlock the motors to move the laser head by hand—the motors must be locked in order to run a job or jog.

RASTER PROPERTIES

The Raster Properties section allows you to set the power and speed of a raster job, as well as the B/W threshold for a grayscale image (see Operations section for more information).

IMPORT OPTIONS

Import Options allow you to set conditions under which the print stream from Windows is captured. Ignoring raster data is useful if you are working with large or complex files and only causes RetinaEngrave to only render outlines of filled sections. Ignoring vector data is useful when engraving images. Ignoring thin vectors will ignore small lines within a factor set by the tolerance field.

VECTOR LAYERS.

The Vector Layers section controls the layer order, speed, power and number of repeats for each layer. As discussed in the General Usage sub-section, vector layers are based on one of 7 colors. The Contained Objects First checkbox determines the order of cutting within a particular layer.

CUSTOMIZING THE INTERFACE



The user interface for RetinaEngrave is built around several tabs relating to functionality (Raster Engrave, Vector Cut, etc). These tabs can be dragged to change their order or location in the program window. You can organize your workspace using the auto-size function or leave the tab dialog window floating. The auto-size function will snap the dragged tab to a preset location in the program window. The default tab location is reached by dragging to the center of the auto-size overlay. Keep in mind that the Start button will always start a job using the data in the active tab.

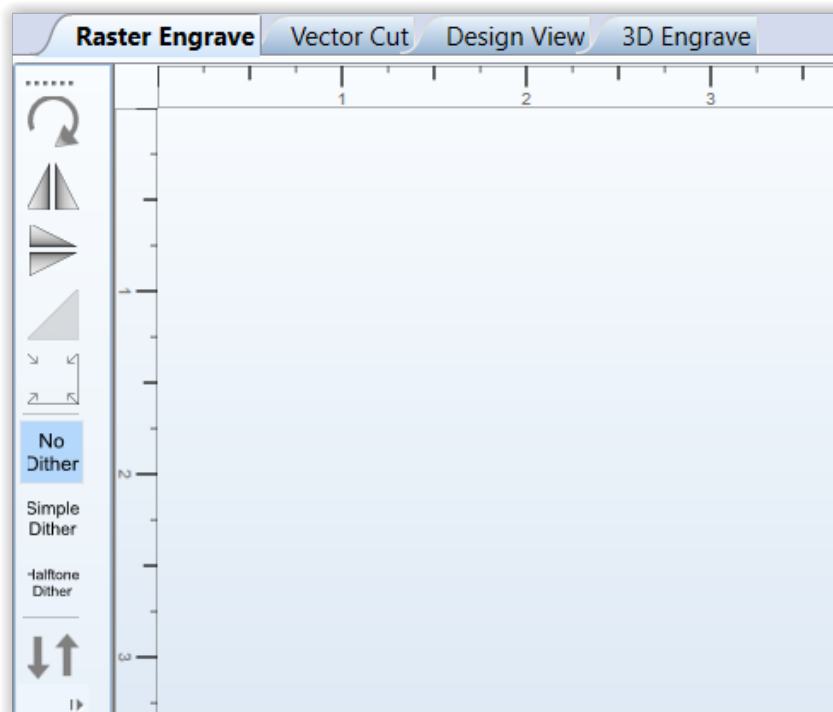
OPERATIONS

Engraving

Your H-Series Hobby Laser System has several advanced functions that make it easy to bring your designs from your computer into the real world. Engraving is the process by which complex designs are etched into a work piece or a work piece is marked using an additive coating such as Therman™. Engraving can range from a simple surface mark all the way through deep material removal. Engraving is differentiated from cutting in that cutting is the process of burning a closed contour completely through a workpiece. The most common type of engraving is known as “Raster Engraving” or “Rastering”, because the laser fires individual pulses corresponding to pixels in an image. When the laser is operating in raster mode the head moves rapidly from left to right and slowly top to bottom, engraving your image pixel by pixel and line by line. You can also engrave images in vector mode by setting the power such that you score the workpiece without cutting through.

Engraving works with both vector and pixel-based source files, allowing you to engrave anything from a simple block logo all the way to high-resolution photographs. The proceeding sections will introduce you to engraving with RetinaEngrave.

RASTER ENGRAVE TAB (LEFT BUTTON PANEL - TOP TO BOTTOM)



ROTATE IMAGE 90 DEGREES

Each button press will rotate the image 90 degree clockwise.

MIRROR IMAGE VERTICALLY

Mirrors the current image about a vertical centerline.

MIRROR IMAGE HORIZONTALLY

Mirrors the current image about a vertical centerline.

INVERT IMAGE

Reverses the black and white pixels of the image. Useful for engraving on coated materials.

SCALE

Scales the image larger or smaller..

NO DITHER

When No Dither is selected, RetinaEngrave will use the threshold slider value to compute a grayscale cutoff. Any grays below the threshold will be black and any above will be white.

SIMPLE DITHER

Dithering a color or grayscale image will produce a pattern of black pixels that approximates the original gradients. Dithering applies a computed dot density of on/off pixels to the image to create a grayscale effect. The quality of the dithered image preview in the workspace often looks poor—however, the actual output engrave quality will be much higher. Dithered images simulate true grayscale by averaging pixel density to achieve an optical effect closely approximating the original image. Selecting this button has no effect on images that are 1-bit or black/white already.

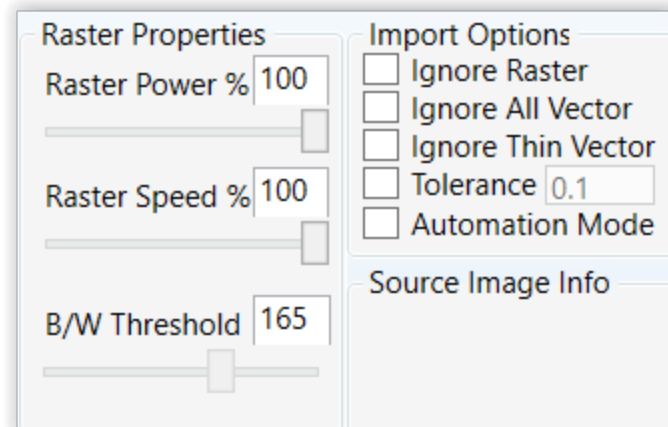
HALFTONE DITHER

Like the Simple Dither button, this button dithers the image in the workspace but uses a different algorithm. Certain images and work materials will often respond better to one algorithm or another.

REVERSE RASTER

Selecting this feature will allow the job to begin from the bottom of the image and engraver bottom to top instead of top to bottom as standard. This requires the laser head to be jogged down the Y axis in the work area to start the raster job from the bottom left of the image instead of the top left..

RASTER PROPERTIES (CONTROL PANEL)



RASTER POWER %

This field and slider allow you to set the firing current as a percentage of the maximum as set in the configuration file. Laser tubes have a minimum activation current; setting this value too low (below 10%) could result in the laser not firing as this is under the minimum activation current. Keep in mind that when setting the power below 10%, the tube may no longer fire as it has reached the minimum activation current.

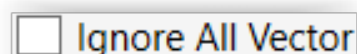
RASTER SPEED %

Set the engraving speed as a percentage of the maximum. Maximum speed is set in the config.xml file. The raster routine in v4 is optimized so it only rasters non-whitespace and minimizes the acceleration distance. If you set the speed % very low such as 1% then the laser head does not need much acceleration distance. Total time to engrave = (acceleration time + raster time). Since acceleration time is also lower the total time is not linearly related to the speed %. However, the energy/heat applied to the material is linear according to the speed %. For deeper engraving use a slower speed.

BLACK/WHITE THRESHOLD

Adjust this slider to fade in or fade out portions of any image that is not black/white. Your computer graphics card must be fast enough to use the slider in real-time to see the updates. This has no effect on 1-bit bitmaps or black and white images. If you have a computer with a slow graphics card, set the threshold using the text box and enter the values manually.

IGNORE ALL VECTOR



Checking this box will only import raster data and ignore vector data. When processing a print job, RetinaEngrave attempts to sort all the vectors for the fastest cut times. A drawing containing millions of points or vectors will take up a large amount of memory and CPU which can cause a

major slowdown in performance. Ignoring the vector data will also allow faster print jobs if only raster is required.

DPI SELECTION



Full Spectrum Laser recommends default settings of 500x500dpi for most applications; text as small as 4pt can be engraved at 500 dpi with excellent readability. Typically, 1000 dpi is only used special cases. The dpi setting also affects the delivered power density, as higher dpi settings correspond to a higher number of pulses per square inch. It is also important to note that due to the focused beam spot size (0.002-0.005 inches) there will be pixel overlap at higher dpi settings. This leads to a blending effect in the overlapped areas, which will lead to a darker engrave result on particular materials, such as wood.

The dpi settings affect the print processing resolution. The maximum printing resolution is set in the configuration file and displayed in the control panel in the Source Image Info box. The final resolution is set to the maximum of the configuration file setting and the dpi selected from the dropdown menu. The default setting is 250 dpi. By selecting 1000 dpi before printing, the laser will import at 250 dpi then upscale the image using a bi-cubic interpolation to 1000 dpi.

RetinaEngrave stores the source image in memory and converts it to grayscale before dithering. Due to the large number of pixels in a 1000 dpi image (1 million pixels per square inch) your computer may run out of memory. Computers with less available memory should select 250 dpi before printing because even at an input resolution of 500 dpi the memory requirements can be high.

POSITIONING WHEN RASTER ENGRAVING



When you raster an image, the laser head accelerates to the desired speed over some at the default job origin—if you are using a changed origin, such as a center origin, the laser head will still move to the upper left corner before beginning the job. Because of the acceleration and deceleration distances, some jobs will require a one (1) inch buffer on the left and right sides to avoid crashing the laser head.

PRO TIPS! Getting Better Raster Results

A laser has two states: on and off. Every black pixel or “laser dot” is the result of the laser turning on and firing at a particular location. This location is controlled by the input image, which can be thought of as a “map” of on and off pixels. The question is how do we give RetinaEngrave the best “map” of these laser dots to accurately represent the original image?

Your source image is processed several times between sending it to the Windows XPS Image Writer (printer) and final laser processing of the workpiece. The first alteration of the source image occurs when the image is sent from the print stream into RetinaEngrave. If the printer DPI is set differently from the software DPI, the source image must be up-sampled to the native DPI of the laser; up-sampling is necessary to keep the output image dimensions (in inches) the same as the source image dimensions. This process generates new pixels; unfortunately there are mathematical constraints on the sampling process so it is imperfect.

In order to avoid introduction of error through up-sampling, the source image must be a 1-bit image. 1-bit images are an exact “map”; all pixels are either on (black) or off (white). The best results are achieved by creating/converting a source image in a dedicated editing program with DPI settings that match the native DPI of the laser (1000 dpi).

In the case of non 1-bit .bmp images (grayscale/color), dimensions are set on import using the page size in the print driver dialog box. Changing the DPI setting results in a different number of pixels in the same space, without changing the dimensions of the image. This procedure results in lower output quality that is not true to the source image. Multi-bit images that are not evenly divisible by the native laser DPI (250/500/1000) should always be direct printed instead of dragged and dropped, and should be rastered at the same resolution as they were printed. The case study in the following section examines the results of various import methods.

SOURCE TYPE	IMPORT METHOD	BEST PRACTICE
1bit BMP	Drag and Drop, File-Ope	Pixels are divided by laser dpi (1000 for hobby). 1000=1 inch. DPI box changes DIMENSIONS of output by skipping lines. Output is always true to source. It is not recommended to Direct Print 1-bit images
Color/Grayscale BMP	Direct Print	Always Direct Print non 1bit images as they are sampled at a rate proportional to laser output resolution, resulting in better quality output. For best output, Raster at the same DPI as the source image
XPS file containing image	Drag and Drop, File-Open, Direct Print	For best output, Raster at the import DPI

Cutting

In Vector Cut mode, RetinaEngrave receives information from the print stream and interprets it as a series of paths for the laser head to follow. In order for the print stream to have vector information, the file being printed must be a vector file. RetinaEngrave is capable of following complex contour paths created in any vector drawing program, however certain programs and formats are more reliable than others.

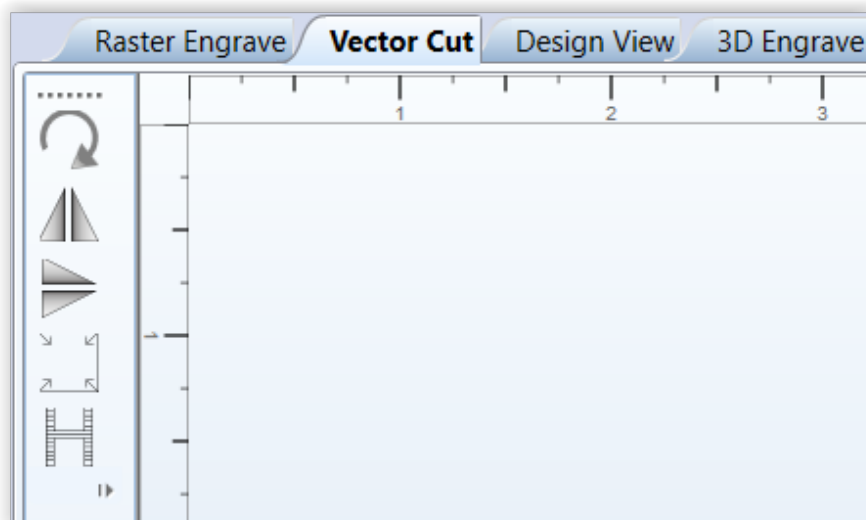
Full Spectrum Laser carries out unit testing using CorelDraw X7 and recommends that Hobby Laser owners use this program. If you use different design software and run into a problem with the print interface, we recommend printing to the XPS Document Image Writer or saving as a PDF. PDF files save vector information and are the best way to carry artwork from a non-compatible operating system (Mac or Linux) onto your Windows PC.

Limited testing has been carried out with CorelDraw X6 and it appears to be a good choice, as well. Other popular packages include Adobe Illustrator, Inkscape and Google's free online vector drawing application. Additionally, most CAD packages are able to output drawings in a vector format for printing; Autodesk 123D is particularly interesting for its cost (free) and built-in 3D slicing capabilities.



PRO TIP! The Microsoft XPS Document Writer creates images so that they will print exactly as they appear on your screen. Any program that is vector based will have its information embedded as vector paths (CorelDraw, MS Word, CAD programs, etc) and should work with the Vector Cut functionality of RetinaEngrave3D.

VECTOR CUT TAB (LEFT BUTTON PANEL - TOP TO BOTTOM)



ROTATE VECTOR 90 DEGREES

Each button press will rotate the design 90 degree clockwise.

MIRROR VECTOR VERTICALLY

Mirrors the current vector drawing about a vertical centerline.

MIRROR VECTOR HORIZONTALLY

Mirrors the current design about a horizontal centerline.

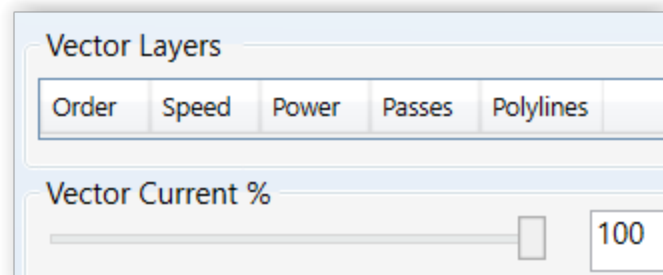
RESIZE VECTOR ACCORDING TO INPUT VALUES

This button will bring up a dialog box allowing you to change the size of the vector image in the workspace by setting specific X and Y dimensions. It does not preserve scale.

HORIZONTAL VECTOR HATCHING

This button and corresponding parameter box automatically fill closed contours with a horizontal hatch pattern, with the gap between horizontal scan lines (in inches) determined by the input in the parameter box. This is a useful function for engraving deeply into an object—with the proper settings it will remove material much more quickly than in Engraving mode. Be aware that due to the scan gap being non-zero the bottom surface might not be smooth.

VECTOR LAYERS, VECTOR CURRENT %



VECTOR LAYERS

RetinaEngrave automatically separates vector drawings into layers by color. Each layer can specify different properties. The Reset Layer Properties button will reset the Vector Layers table to the default values.

Order. Layers are cut in order from one (1) to seven (7).

Speed. Sets the speed of the layer as a percentage of the maximum value.

Power %. Sets the PWM frequency. PWM power control is very fine. Setting it to 0.5% will mark but not cut through paper.

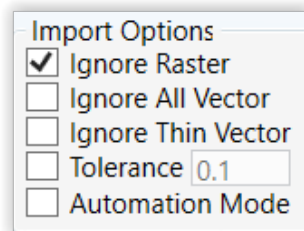
Passes. Number of repetitions.

Polylines. Number of polylines associated with a layer.

VECTOR CURRENT %

Total power is determined by a combination of delivered current and voltage to the laser tube. The current is directly regulated while voltage is controlled by PWM (Pulse Width Modulation). PWM is a technique whereby an average voltage is delivered in a series of pulses per unit time. In Vector mode you can control both the PWM frequency (power) as well as the delivered current (Vector Current %). In Raster mode, the output is pulsed based on the speed and pixel pattern, so only current control is available (Raster Power %).

VECTOR IMPORT OPTIONS



IGNORE RASTER

Select this option to speed up processing of large vector files on computers with limited memory. Raster data is memory intensive for large drawings at the highest resolutions and is unneeded if only vector cutting is required.

IGNORE ALL VECTOR

The existing documents in the Vector Cut is not replaced when loading new documents.

IGNORE THIN VECTOR

Disables vectorable content from Raster Tab and non-vectorable content from Vector Tab. Vectorable is defined as having line-width set to hairline. All other objects, including images, are non-vectorable. This option is useful when importing projects with the intention of "Raster then Vector" (Combined Mode).

TOLERANCE

Override the Config File Import Tolerance Setting. This is used to determine the amount of points generated for objects on Vector Import.

AUTOMATIC MODE

Start jobs as soon as they are printed using default settings.

Designating Layers

Designating a color to objects/ layers you want to vector cut enables you to take advantage of RetinaEngrave's ability to specify cutting order, cut speed, laser power and number of repeats for each layer.

RetinaEngrave supports up to seven standard color layers for maximum program compatibility: Black, Blue, Red, Magenta, Green, Cyan, and Yellow from the RGB color palette.



PRO TIP! RetinaEngrave uses a “best guess color round off routine” when a color is not a standard RGB color. Avoid using black whenever possible because black is the default color RetinaEngrave uses whenever it cannot figure out what color it should be. By avoiding black, you will have more control.

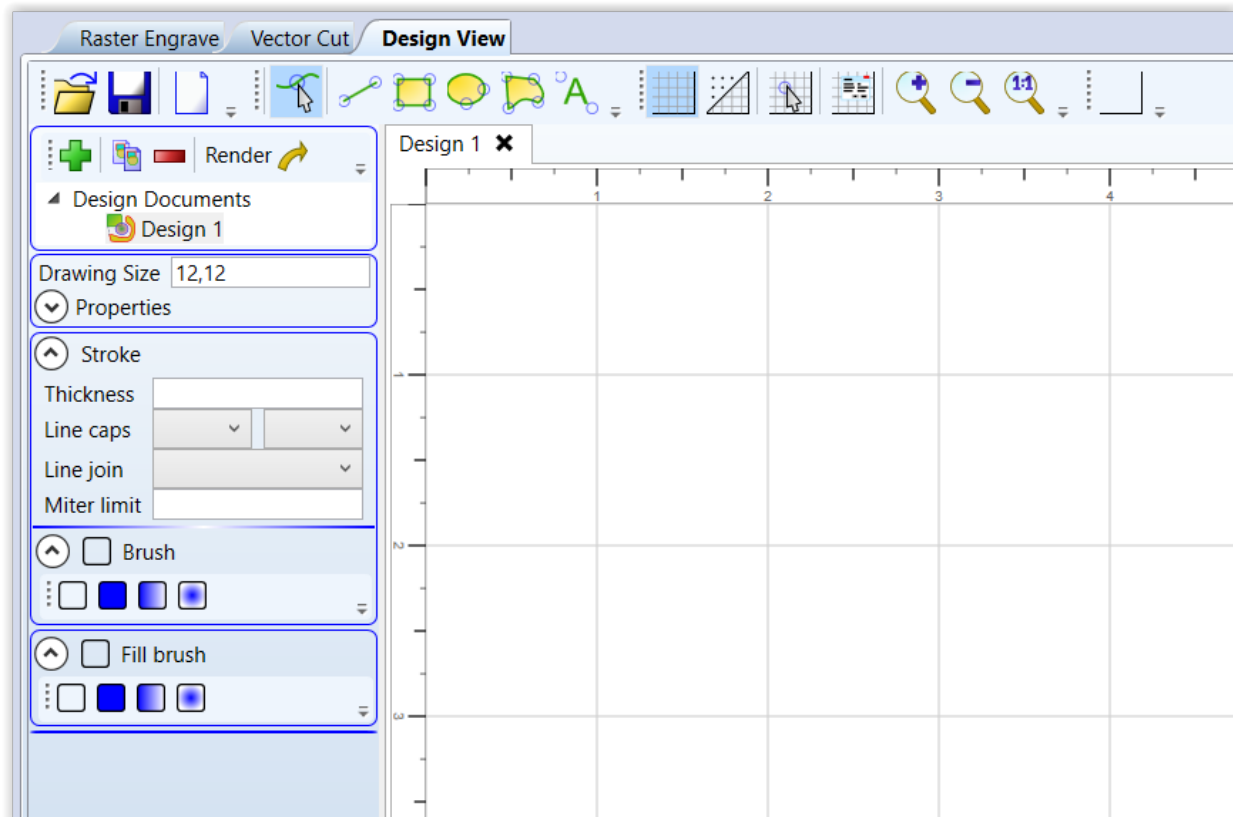
Design Tab

The Design Tab provides basic drawing tools for creating simple designs within RetinaEngrave. The tools allow you to draw open or closed contours, complex paths, shapes and text with a variety of fill options. The Design Tab is project based, with each project having one or more designs. Once you have a design, you select it and render it to one of the mode tabs.

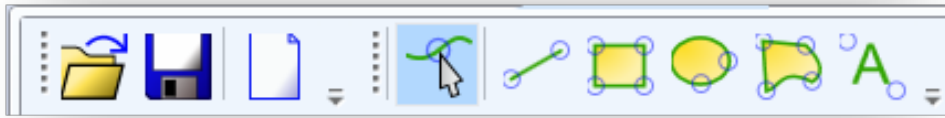


Attention! The Design Tab is not meant to replace a dedicated drawing/design package—it exists as an internal tool for quick tests and is released “as is”. If you are having a problem with the output of the design tab, please use a standard program such as CorelDraw to create your work and report any software issues to support@fslaser.com.

DESIGN VIEW



DESIGN VIEW TOP LINE BUTTONS (LEFT SIDE)



OPEN

Open a new project. Opening a new project removes any unsaved data in the document design window.

SAVE

Save your current project.

NEW PROJECT BUTTONS

Opens a new project.

EDIT SHAPE

Select shapes or points and edit their information (color, thickness, fill, etc).

NEW LINE

Add a new point to point line. Drag the end handles to change length or use the Shape Properties box (bottom of Shape Properties Panel) to set start and end points.

NEW RECTANGLE

Draw a rectangle. Use the handles to change proportions or the properties panel to adjust width and height (units are inches) as well as corner radii. Use the Stroke properties to adjust corner joint type.

NEW ELLIPSE

Draw an ellipse. Use the properties panel to change the X and Y radii (units are pixels).

NEW PATH

Create a new spline path. Select one of the endpoints to bring up the Shape Properties box and add/remove points and adjust line tangency.

NEW TEXT

Place text in the design area.

DESIGN VIEW TOP LINE BUTTONS (LEFT SIDE)



TOGGLE GRID

Changes the visibility of the drawing grid in the design area.

TOGGLE POINTS

Changes the grid format from lines to points.

TOGGLE SNAP-TO-GRID

Enable or disable snap functionality with drawing points.

GRID OPTIONS

This popup menu controls grid display and parameters. The Grid Width and Snap Grid Width fields can be altered to suit your preferences; units are in inches.

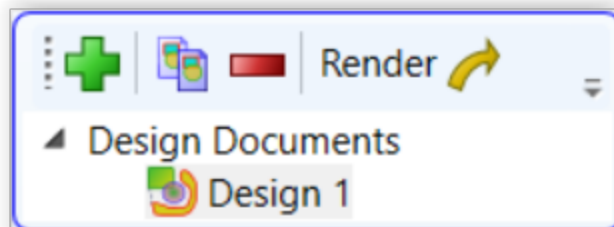
ZOOM BUTTONS

Adjust the zoom level of the design area.

BOUNDING OPTION

Print bounding box around work area perimeter.

PROPERTIES PANEL (TOP)



NEW DRAWING

Create a new drawing.

COPY DRAWING

Copy current drawing

DELETE DRAWING

Delete current drawing

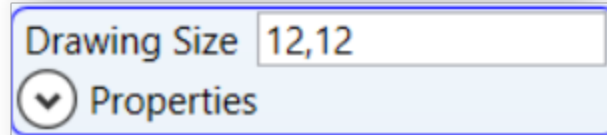
RENDER

Output drawing to Vector/Raster tabs

DESIGN SELECTION MENU

This drop-down list allows you to select which drawing to make active via a left double-click. You can also select the tab of the drawing you would like to work on in the design area.

DRAWING PROPERTIES



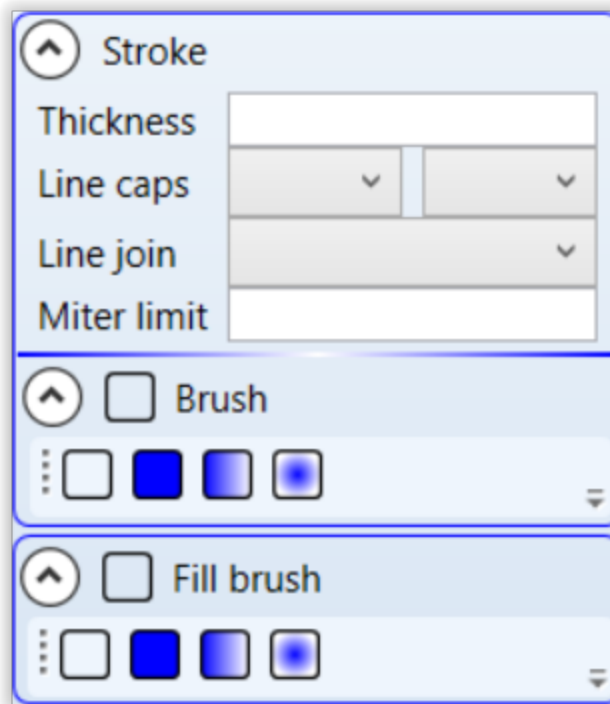
DRAWING SIZE

Set the total work area drawing size units in inches.

DESIGN PROPERTIES

This drop-down list allows you to select which drawing to make active via a left double-click. You can also select the tab of the drawing you would like to work on in the design area.

SHAPE PROPERTIES



STROKE

Control the stroke thickness (pixels), endpoint shape, joint behavior and miter behavior.

BRUSH

Control the color and fill style of the brush. Allows you to create and specify gradients.

FILL BRUSH

Specify the properties of a closed shape

Workspace Tools

Use the drag handles located on the edges of your design to resize the image. The extension lines display the width and height of the bounding box that encloses the image. Dragging the square handle will preserve the design's scale. The small field located on along the height extension line gives the current X and Y workspace coordinates of the mouse.



Hovering the mouse over a vector object (polyline) will cause it to highlight. You can right-click the mouse to disable that object in the current job and right-click again to re-enable. Clicking on a poly line will bring up the workspace editor. You can move, scale or disable it; assign it to a layer using the colored buttons; reverse the direction of the path; or close small gaps between the ends of an unclosed polyline (for advanced users).

HARDWARE & MAINTENANCE

With a little care and maintenance, your H-Series Hobby Laser Cutter will remain clean and continue to run at top efficiency for years to come. Be aware of all safety and maintenance issues with your machine by following all the safety instructions in this manual.

Replacing the Laser Tube

This section provides procedures and a walkthrough to replace the laser tube on your Hobby Laser. Please carefully read all instructions before beginning the replacement procedure as there are several critical steps which must be properly followed to avoid breaking the laser tube. The included pictures show how to properly connect wires to the tube's electrodes and secure the connections.



FRAGILE GLASS! Pulling on the tube wires will break your laser tube at the neck. The water connections are very fragile, **DO NOT** pull or force the connection tubes— gently work the tubes off of the connectors.



SHOCK WARNING! The capacitors in the power supply retain power even after turning the laser off. To ensure your safety, turn off the laser, remove the power cord and wait at least 1 hour before accessing the power supply.

REQUIRED PARTS AND TOOLS:

FSL 40W replacement tube ([Part #420153-01](#))

Wrench (for M5 hex nuts)

Scissors/wire cutters

Large zip ties

2mm hex key for removing back panel of laser (included with accessories)

6.5mm ID silicone tubing (included with FSL replacement tube)

RTV Silicone Adhesive Sealant (available at your local hardware store)

Teflon/PTFE tape (at least 2 10in lengths). Also called plumber's tape; blue PTFE tape is ideal (available at your local hardware store).

REPLACING TUBE STEPS

- 1. Power Off Machine.** Power off and unplug your unit. Wait at least 1 hour for capacitors to discharge.
- 2. Disconnect Water.** Detach the tubes from the rear connectors. Use the small piece of tubing that shipped with your laser to shunt the two water bulkheads together.

3. **Create Workspace (optional).** If necessary, move your laser so that you have at least one (1) foot of table working space to access the rear of the unit. You will be removing the rear panel to access the tube.
4. **Remove Hex Nuts.** Using a wrench, remove the 4 M5 hex nuts from the posts on the rear of the laser.
5. **Remove Button Head Socket Screws.** Using a 2mm hex key, unscrew the five (5) lower M3 6mm button head socket screws and two (2) upper M3 6mm button head socket screws.
6. **Remove Rear Panel.** Carefully remove the rear panel and lay flat on your work surface.
7. **Expose Blue Ground Wire.** Carefully remove the silicone sealant and tug to expose the **BLUE** ground wire (located at the tube aperture).
8. **Unwrap Blue Ground Wire.** Unwrap **BLUE** ground wire from the tube terminal.
9. **Test For Residual Voltage.** Hold the **BLUE** ground wire about 8 inches from the exposed end. Move the exposed end to the **RED POWER** terminal. If there is any residual voltage in the capacitors, there will be a spark as it grounds to the **BLUE** wire.



SHOCK WARNING! DO NOT hold the BLUE wire near the exposed end while doing this. NEVER perform this procedure while the laser's power cord is connected. The waiting period should have dissipated any residual charge, but take extreme care during this procedure.

10. **Remove Tubing.** Carefully remove the silicone sealant and tubing to expose the **RED** power wire (located at the rear of the tube).
11. **Unwrap RED power wire.** Unwrap the **RED** power wire from the tube terminal.
12. **Remove Water Tubes (Step One).** Remove the two (2) water tubes from the inner bulkheads.
13. **Remove Water Tubes (Step Two).** GENTLY remove the water tubes from the laser glass bulkhead.



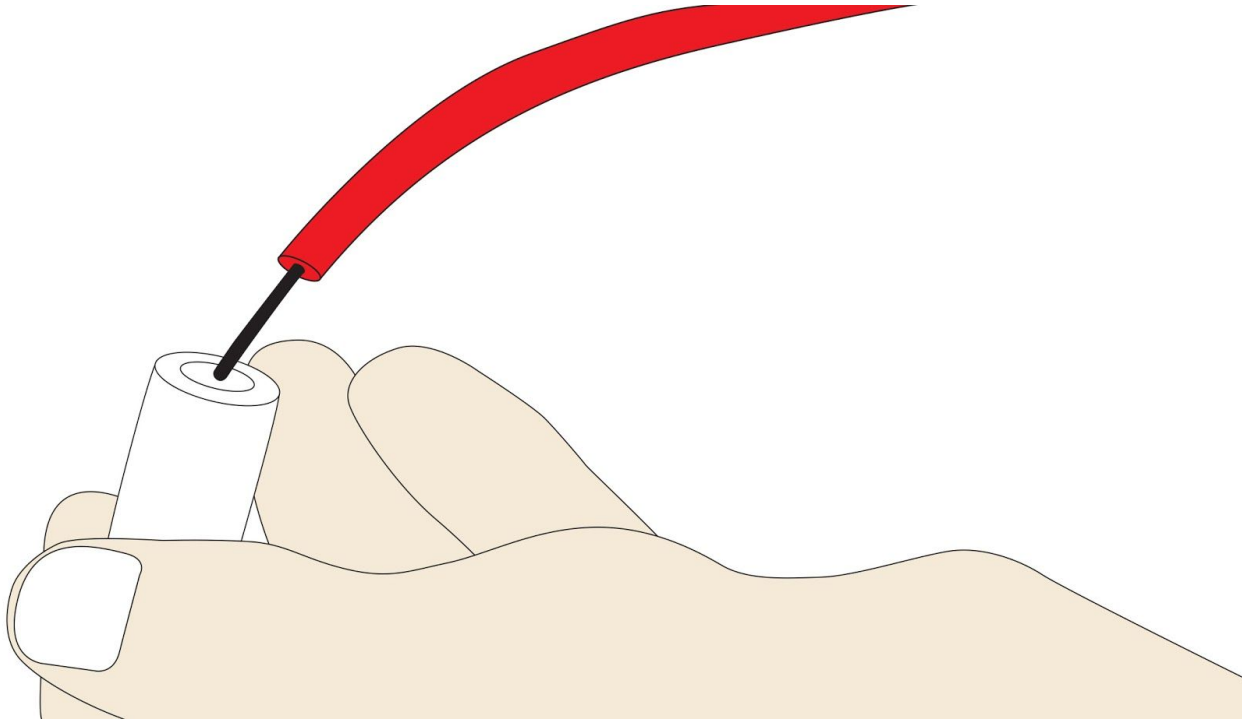
FRAGILE GLASS! Exercise extreme CAUTION during this step as using too much force can break the fragile bulkheads and create a sharp glass hazard (it will also make your tube unusable).

- 14. Remove Tube Mounts.** Remove the laser tube mounts from the panel. Note the orientation of the tube relative to the holders. The glass coils should always be oriented to the **LEFT** when facing the back of the machine.
- 15. Remove U-Bolts.** Remove the mounting U-bolts from the rubber tube holders.
- 16. Remove Old Laser Tube.** Remove the tube from the rubber holders and carefully set it aside for later disposal.
- 17. Place New Laser Tube.** Place the new tube into the rubber holders in the same orientation as the old tube was in when it was removed (with the glass coils oriented to the **LEFT** when facing the back of the machine).
- 18. Re-Attach U-Bolts.** Attach the U-bolts to the rubber holders and place the tube back onto the rear panel.
- 19. Re-Thread Hex Nuts.** CAREFULLY re-thread the M5 hex nuts onto the U-bolt posts and make snug (but not yet tight) with the rear panel.
- 20. Re-Attach Water Tubes.** Carefully re-attach the water tubes to the proper laser connection bulkheads. Make sure that the water tube routing and locations match the original configuration.

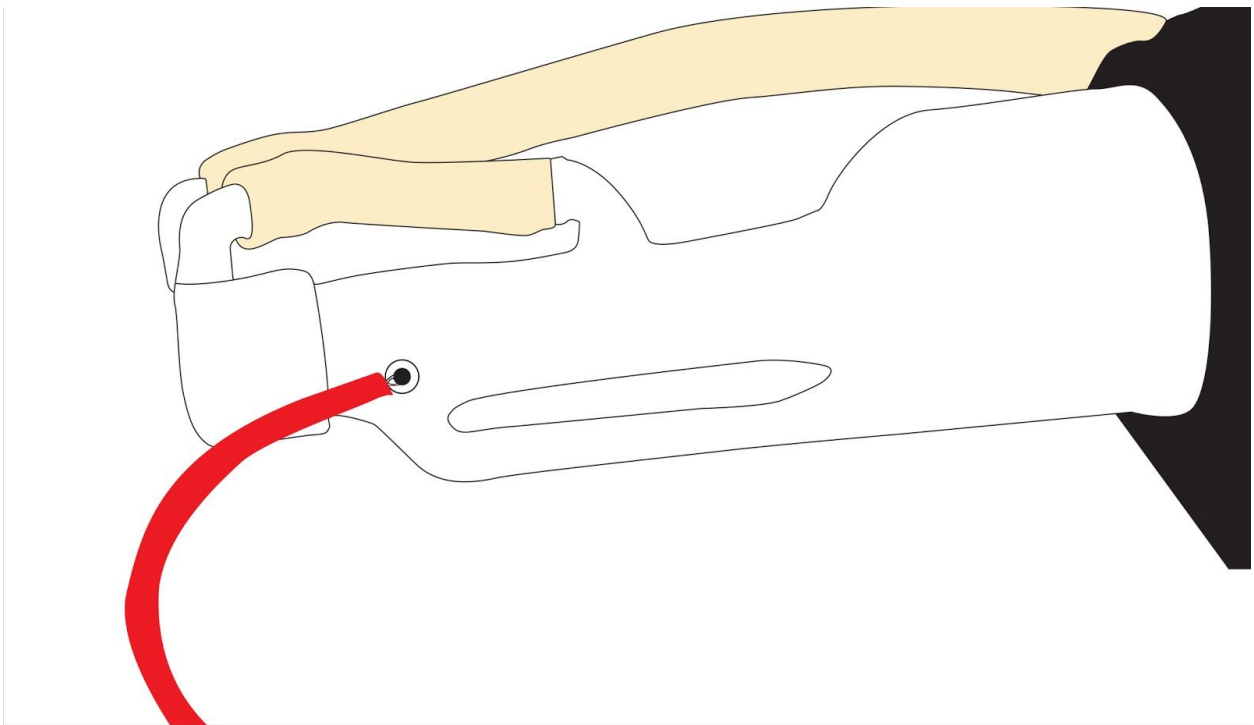
We have now switched the old laser tube for the new laser tube. The next, and more difficult, steps will be to connect the new laser tube back to the power supply.

CONNECTING POWER TO TUBE STEPS

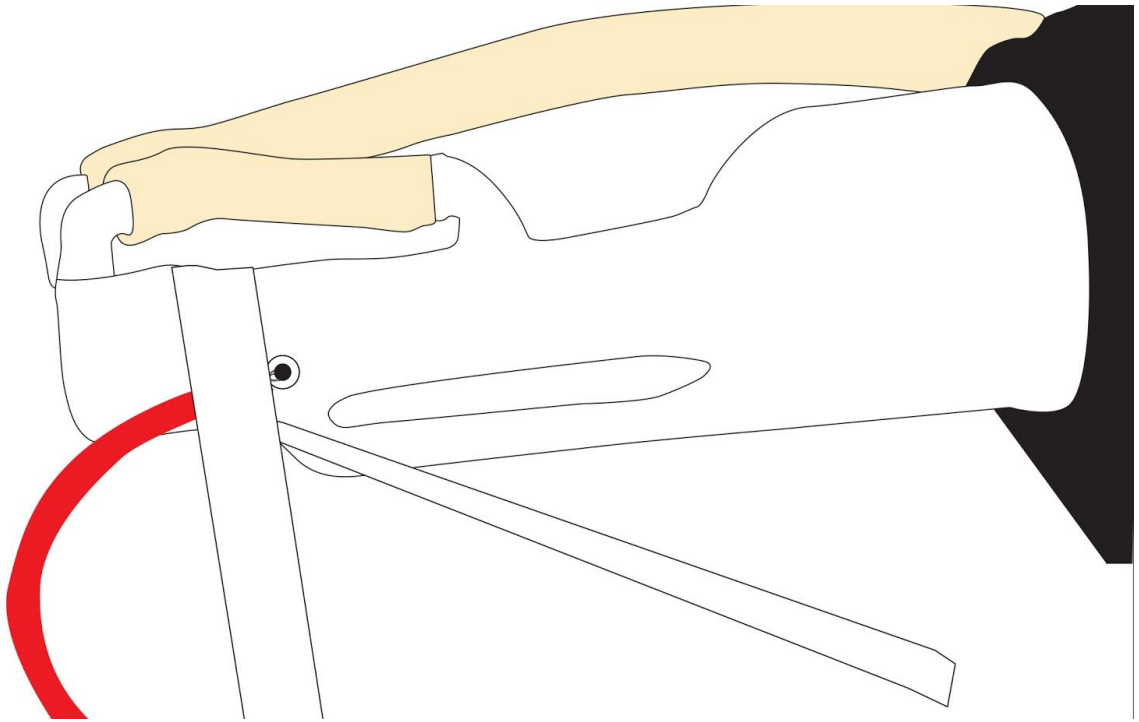
- 1. Prepare Wire.** Straighten the exposed wire on the red lead. Twist the wires together.
- 2. Place Silicone Tubing.** Slide one piece of silicone tubing onto the red lead.



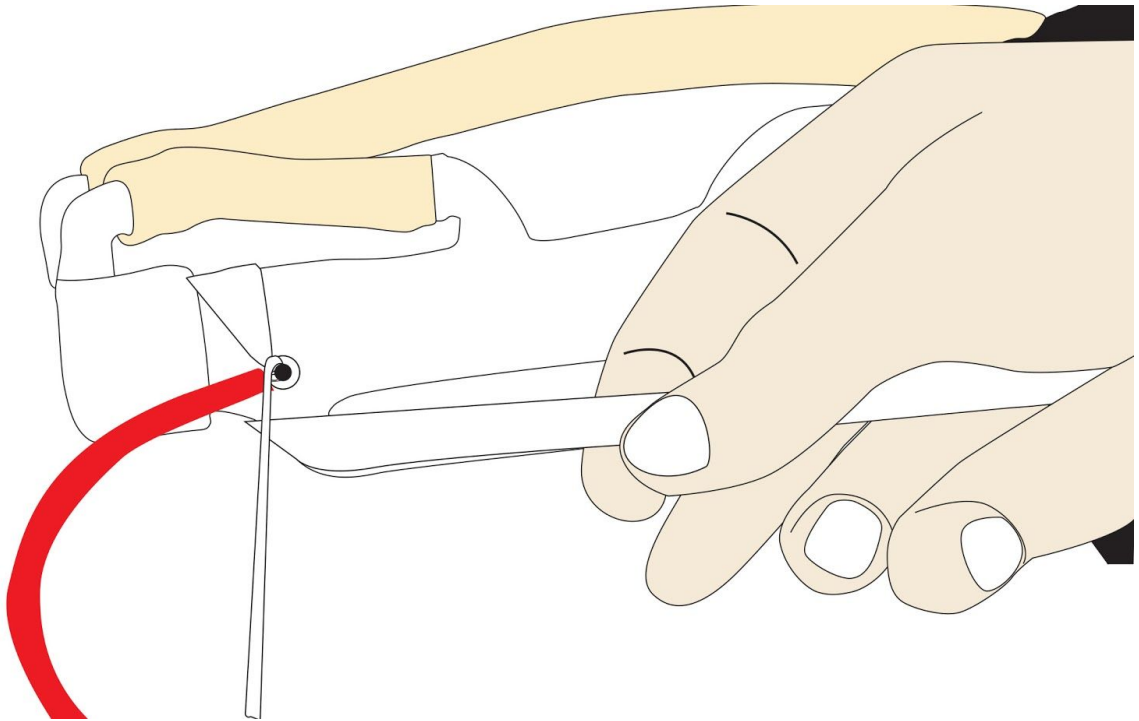
3. **Wrap RED Lead.** Wrap the exposed portion of the **RED** lead tightly and securely around the positive electrode—reflector end, opposite of the aperture.



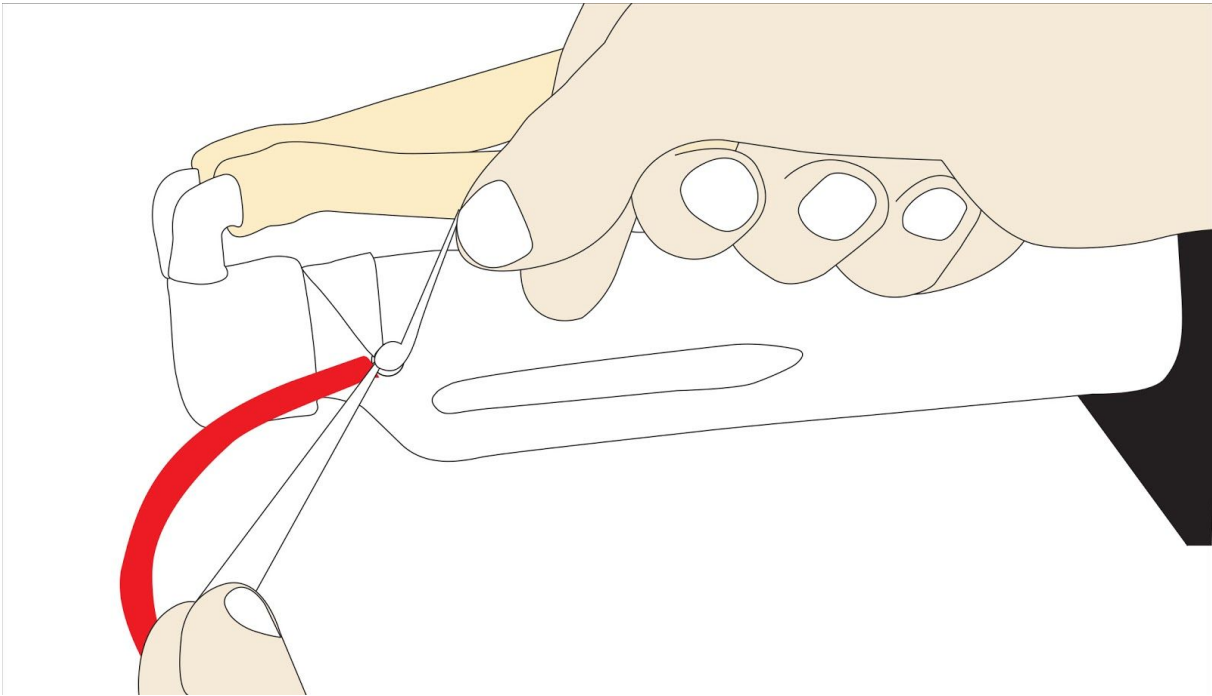
- 4. Thread Tube Neck.** Thread Teflon tape around the neck of the laser tube.



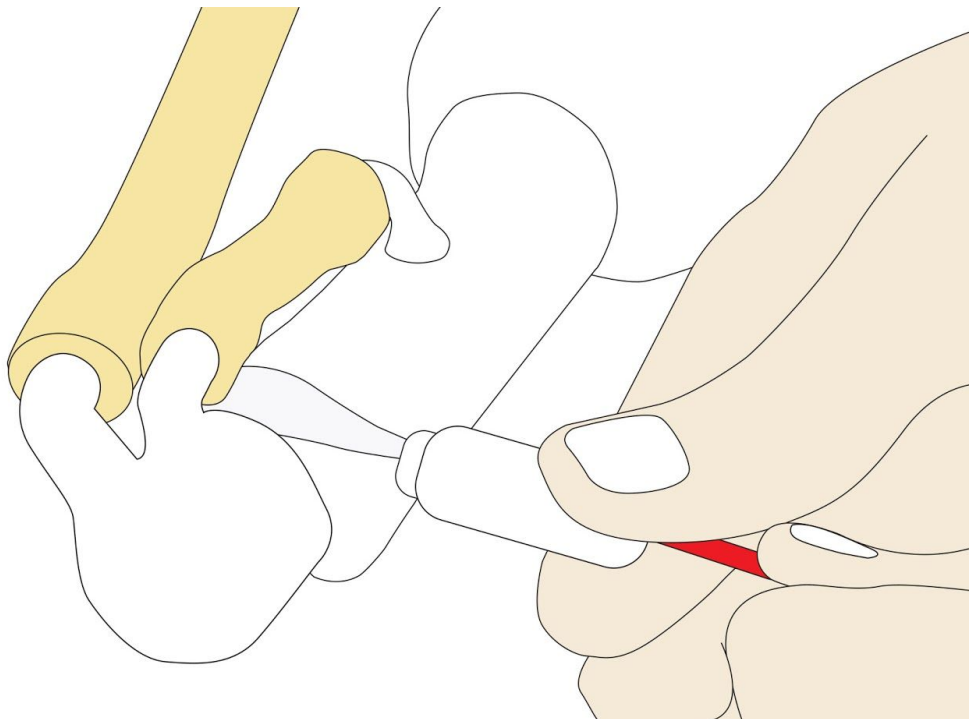
- 5. Wrap Electrode.** Tightly wrap one end of the Teflon tape several times around the electrode.



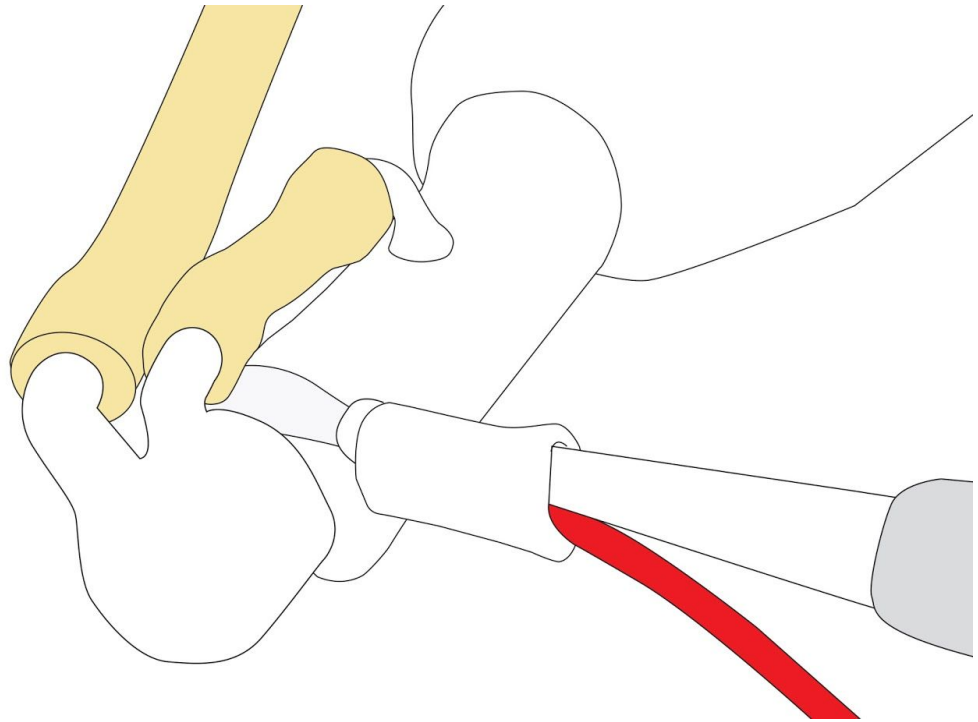
6. **Wrap Tube Neck.** Bring the opposite side of the Teflon tape around the neck of the laser tube and around the inside of the electrode. Knot the Teflon tape tightly around the electrode. Trim Teflon tape.



7. **Slide Silicone Tubing.** Slide the silicone tubing onto the electrode.



- 8. Fill with Sealant.** Fill the silicone tubing with silicone sealant.



- 9. Let Dry.** Allow the silicone to dry completely. This could take up to 24 hours depending on your environment.
- 10. Repeat steps for BLUE Ground Wire.** Repeat steps 1 through 8 for the **BLUE** ground wire that attaches to the electrode nearest the tube aperture; it is not necessary to insulate the ground wire with silicone tubing or sealant.

Replacing the Power Supply

Please carefully read all instructions before beginning the replacement procedure as there are several critical steps which must be properly followed to avoid breaking the laser tube.



FRAGILE GLASS! Pulling on the tube wires will break your laser tube at the neck. The water connections are very fragile, **DO NOT** pull or force the connection tubes— gently work the tubes off of the connectors.



SHOCK WARNING! The capacitors in the power supply retain power even after turning the laser off. To ensure your safety, turn off the laser, remove the power cord and wait at least 1 hour before accessing the power supply.

REQUIRED PARTS AND TOOLS:

Replacement Power Supply Unit (PSU)

3mm hex key (a ball-end 3mm hex driver is very helpful)

STEPS

- 1. Power Off Machine.** Power off and unplug your unit. Wait at least 1 hour for capacitors to discharge.
- 2. Disconnect PSU connectors.** Disconnect the three (3) **GREEN** PSU board connectors.
- 3. Remove PSU screws.** Using the 3mm hex key, remove the 2x M3-6 socket head cap screws that secure the PSU to the frame. These screws are secured with threadlocker and may require some strength to remove.
- 4. Position PSU.** Slide the PSU towards the front of the laser.
- 5. Disconnect Red Wire.** Disconnect the **RED** wire from the laser tube (refer to Replacing the Laser Tube section in this user manual).
- 6. Remove Old PSU.** Remove the old power supply.
- 7. Position New PSU.** Place the new power supply into the unit.
- 8. Re-connect Red Wire.** Again, follow the instructions in the Replacing the Laser Tube section in this user manual to re-connect the **RED** wire to the tube.
- 9. Secure PSU.** Mount the power supply to the frame using the 2x M3-6 socket head cap screws.

Belt Installation

The belts on your laser system are a consumable item and will eventually stretch beyond a usable length or break. You can contact Full Spectrum Laser support for replacements or purchase them from various suppliers. The belts are 6mm wide fiberglass-reinforced neoprene MXL timing belts—1/4in wide MXL timing belts will also work. SDP-SI (<https://sdp-si.com/eStore/>) sells open-ended 1/4in wide MXL belts by the foot (PN: A 6Z16-C025). The Y belts are approximately 34in in length, and the X belt is approximately 49in in length.



ATTENTION! The M3 retaining screws on the gantry can be difficult to access without removing the bottom of the laser casing. For this reason, you should contact a trained technician to perform Y belt replacements.



SHOCK WARNING! The capacitors in the power supply retain power even after turning the laser off. To ensure your safety, turn off the laser, remove the power cord and wait at least 1 hour before accessing the power supply.



WATER WARNING! You will be disconnecting the water system and working with the laser upside down. Be sure the machine is dry before proceeding with this process.

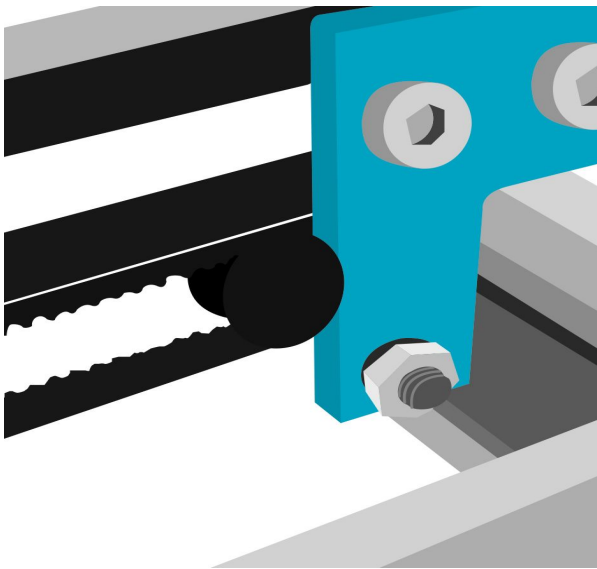
REQUIRED PARTS AND TOOLS:

2mm Hex key (included with accessories)
2.5mm Hex key (included with accessories)
Scissors

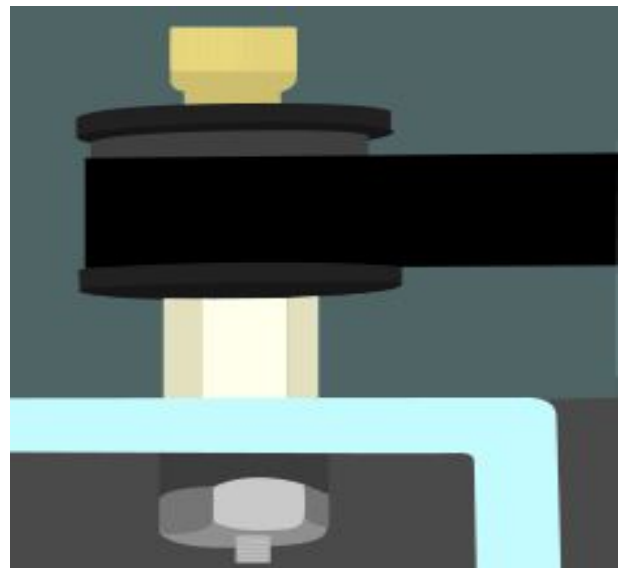
STEPS:

- 1. Power Off Machine.** Power off and unplug your unit. Wait at least 1 hour for capacitors to discharge.
- 2. Disconnect Water.** Detach the tubes from the rear connectors. Use the small piece of tubing that shipped with your laser to shunt the two water bulkheads together.
- 3. Loosen Retaining Screws.** Loosen or remove the M3 retaining screws and washers so that the old belt can be removed and discarded.
- 4. Mount Belt.** Run each end of the new belt through the mounting slot with the teeth on the inside of the closed loop. The ends of the belt should protrude by approximately 3 teeth (6mm) through the slot. Make sure that the belt forms a flat, closed loop.

5. **Tighten Retaining Screws.** Tighten the M3 retaining screws to secure and retain the belt. Starting the thread with your fingers can speed the process up.
6. **Loosen the idler pulley mount.** Once the belt has been installed on the riser, loop over the drive and idler pulleys.
7. **Tension the belt.** Pull on the Y idler pulley mount with your hand. Moderate to strong force is recommended. If the motors do not jog, verify that the motors are connected to the control card.



Detail of X Idler/Tensioner



Detail of Y Idler/Tensioner

Appendix A: Troubleshooting

Problem	Possible Cause	Solutions
Front Panel does not turn on.	<ol style="list-style-type: none"> 1. USB Disconnected. 2. Control card is not receiving power. 3. Laser is not ON. 4. Loose connections. 	<ol style="list-style-type: none"> 1. Check that the internal USB connection between the Control Card and the Control Panel is in place. 2. If the USB cable is connected, check that the Control Card is receiving power. The green LED on the Ethernet port will be lit if the Card has Power. 3. If the Ethernet LED is not lit, verify that the laser is plugged in and the power is ON (E-stop is unlocked). If the laser is plugged in and power switch (E-stop) is ON, check that the power supply is receiving power (green LED on main board is lit). 4. If power supply LED is receiving power, check connections between laser and power supply. If connections are good (no loose connectors or wires) and foregoing tests passed, please contact support.
Laser does not fire.	<ol style="list-style-type: none"> 1. Laser cover is open or magnet wires are disconnected. 2. Water is flowing in the wrong direction or water sensor is not working. 	<ol style="list-style-type: none"> 1. Make sure that the cover of your laser is closed during jobs or test fires. Check that the magnet wires are connected to the terminals on the power supply. 2. Be sure that water is flowing from right to left through the laser tube. If confirmed and issue persists contact support.

Problem	Possible Cause	Solutions
<p>Laser head skips during raster.</p>	<p>This issue is usually caused by over-tightening the adjustment spacers on the lower part of the laser head.</p>	<p>This issue is usually caused by over-tightening the adjustment spacers on the lower part of the laser head. Try loosening the cams and testing a raster job at 0% power. The adjustment spacers should be tight enough to restrict the laser head from moving more than a very small amount but the laser head should be movable without too much effort by hand (test this with the laser off or motors unlocked).</p>
<p>Laser unable to HOME.</p> <p>The laser attempts to home but crashes before tripping the optical interrupt. Usually along the Y axis.</p>	<p>This problem is caused by the Y axis interrupter “flag” and optical limit switch “interrupt” moving from the nominal mounting positions.</p> <p>X rail came out of alignment during shipping and flag cannot reach far enough to access sensor.</p>	<ol style="list-style-type: none"> 1. Using a business card or small piece of paper, home the laser and interrupt the problem axis. Motion along that axis should cease. If it continues to move, the problem is likely electrical—please contact support. 2. If the axis stops moving, the issue is mechanical. 3. Loosen the 2 M3 screws that secure the optical interrupt and slide it towards the front of the laser. You can also loosen the two M4 nuts that hold the flag in place and slide the flag towards the interrupt. Be sure that you do not unscrew the wheel axles.

Problem	Possible Cause	Solutions
<p>Laser pauses during a job.</p> <p>Random Pausing or other button pushes (panel led lights green randomly).</p> <p>The laser stops movement during a job and displays a “Paused” message on the touch panel and/or the Pause button in RetinaEngrave is grayed out, without the user having commanded a pause.</p>	<p>This occurs due to the sensitivity of the front capacitive touch panel combined with ElectroMagnetic Interference (EMI) caused by a poor connection to the tube electrodes.</p>	<p>Tests:</p> <ol style="list-style-type: none"> 1. Unplug the short USB cable going to the panel— this should fix the issue and the job should complete normally. You can run any job as normal with the panel disconnected using the computer to control the laser. 2. Reconnect the panel and open the lid and run the job. The laser will not fire with the lid open. The job should complete normally without ever pausing. This indicates a bad ground connection; ground is located on the left side of the laser tube (nearest the emission aperture). <p>Resolution:</p> <ol style="list-style-type: none"> 1. Clean the electrode and rewrap the ground wire on the laser tube (see Appendix F – Tube replacement) 2. Shifting of the connection during shipping can sometimes cause a loose connection to the ground wire. The voltage on this wire is less than 0.1V and it must make tight contact with the electrode or else there can be unpredictable EMI behavior. Remove the wire, sand the surface of the electrode and rewrap the wire on the post. We recommend a few layers of teflon tape to hold down the wire to the post. The post is very delicate and we do not recommend attempting to solder to it as solder doesn’t hold and we also don’t recommend crimping to it to prevent breakage of the surrounding glass. Wrapping the wire + wrapping with teflon tape to hold it down is the best way to install it. 3. It is not necessary to insulate this low voltage wire. Previously, tubes were wrapped and insulated on both sides but only the Red high voltage wire MUST be insulated.

Problem	Possible Cause	Solutions
Laser head crashes during a job	This issue is only apparent on jobs that take up the full work area or are run close to the edge.	<ol style="list-style-type: none"> 1. In either Raster or Vector mode, the laser must first be Homed for the soft limits to work properly 2. In Raster mode, the laser requires an acceleration and deceleration distance that varies with the Speed %; lower speeds require a shorter acceleration/deceleration distance. As a general rule of thumb, at 100% Raster speed, jobs need 1" clearance on the left and right.
PC does not connect to Laser	<p>Internet connection is not properly configured.</p> <p>Third-party antivirus or firewalls blocking RE from establishing connection.</p>	<ol style="list-style-type: none"> 1. Verify that your internet connection is properly configured for DHCP. You must reset the laser after connecting the Ethernet cable. On some PCs it is not possible to browse the internet over WiFi and connect to the laser via Ethernet at the same time. 2. Temporarily disable windows firewall and third party antivirus software to allow connection.
Engraved lines are diffuse; cutting fails even at high power.	Laser is not in focus.	Check that your laser is in focus. Rest the included focus billet on top of your work piece. Loosen the lens slide so the output nozzle rests on the focus billet. Retighten the slide.
Red diode laser OFF.	Loose power cords.	Check that the plugs on the power supply are connected, as it is possible they came loose during shipping.

Problem	Possible Cause	Solutions
Motors do not jog.	Motors are not connected.	Verify that the motors are connected to the control card.
Vector cut rectangles are out of square (lines are straight, but angles are wrong).	This problem is usually caused by a loose rear coupler or an uneven belt (after a Y-axis crash or skip). Re-squaring the Y axis is not difficult, but it is very helpful to have an extra pair of hands.	<ol style="list-style-type: none"> 1. Using the 2mm hex key, loosen the motor flex coupling (2 screws). 2. Make sure that the middle flex coupling is tight (avoid putting pressure on the Y shafts). 3. Take two known-length standards of equal size (1-2-3 blocks work well) and place them at the front of the machine on either Y-rail, flush with the interior wall of the top panel. 4. Slide the gantry forward so that both left and right risers are in contact with the blocks. 5. Maintaining forward pressure on both sides of the gantry, re-tighten the motor flex coupling.
Vector cut lines are not straight	This problem is usually caused by a mis-adjusted laser head.	<p>Return to the instructions for Laser Head Adjustment (Stage Five in the Installation & Assembly Section).</p> <p>See Appendix D: H-Series Support Videos.</p>

Problem	Possible Cause	Solutions
<p>Gantry jams/skips during Y move.</p>	<p>This is usually caused by the Y axis eccentric cams being over-tightened. The normal motion along the Y axis should be smooth and not require too much force when the laser is off or unlocked.</p>	<p>Slowly move the Y axis from the rear of the laser to the front. If you feel bumps or sticking points, the eccentric cams are over-tightened. Loosen the cams until the Y motion is smooth.</p> <p>The wheels of risers 2 (left slider) and 3 (right slider) should be contacting the Y rails in the following manner:</p> <ul style="list-style-type: none"> • Eccentric wheels should have good contact with bottom channel • One of the upper, fixed wheels on each side should have good contact with the upper channel • One of the upper, fixed wheels on each side will be free-wheeling or have low-contact with the upper channel.
<p>Air hose drags on work piece or coils into beam path.</p>	<p>Air line not oriented in correct position.</p>	<ol style="list-style-type: none"> 1. Slide the laser head to the far right of the work area and drop the focus slide to its lowest point. 2. Remove the air hose from the connector on the laser head. 3. Make sure the air hose is straight and free from kinks or bends. 4. Replace the air hose into the connector, giving it a slight counter-clockwise twist so the hose is suspended in the air behind the laser head. 5. Slide the head from right to left and make sure that the hose does not interfere with the beam path or work piece.

Appendix B: Rotary Attachment Installation

The Full Spectrum Laser Hobby Advanced Rotary Attachment is an accessory to the H-Series Hobby Laser and is not included with the base purchase. You can order the rotary attachment from the Full Spectrum Laser website at <http://fslaser.com/Products/LaserAccessories>. The rotary attachment is capable of engraving on objects from 0.25in diameter. This Appendix explains the typical install method of the rotary attachment into a H-Series Hobby Laser (HL40-5g Hobby Advanced). Once you have unpacked your rotary attachment, you will need to connect it to your laser's RetinaEngrave controller before running any jobs.

ROTARY ATTACHMENT INSTALLATION

The rotary attachment is a friction-wheel type—objects rest on two driven and two idling wheels and are turned to engrave an image onto the surface of a cylindrical object. The rotary attachment works by translating Y motion along a cylindrical surface.

STEPS

1. **Power Off Machine.** Power off and unplug your unit. Wait at least 1 hour for capacitors to discharge.
2. **Position Rotary.** Place the rotary attachment into your laser's work area.
3. **Disconnect Y Motor.** Disconnect the Y motor from the RetinaEngrave PRO control card. Note the orientation of the connector as you do, you will connect the rotary with this same orientation.
4. **Connect Rotary.** Connect the rotary attachment motor in its place keeping the same orientation of the connector and the wiring as the disconnected Y motor.



PRO TIP! Once you have connected your rotary attachment, you can activate your laser and move the rotary attachment and laser head into a position to engrave on your workpiece. The red dot should be in the same vertical (X-Z) plane as the center axis of the workpiece.

USING THE ROTARY ATTACHMENT

The rotary attachment is designed to be used within the laser case, however its maximum engraving diameter can be increased by modifying your laser system's bottom panel. Please be aware that any system modifications must be performed by an authorized technician and in accordance with all applicable state and federal laws.

ALIGNING YOUR ROTARY ATTACHMENT

The best way to align your rotary attachment with the laser head is to build a jig that uses the frame as a reference. This is a very quick process.

1. **Starting Position.** Focus the laser head onto the rear frame of the rotary attachment on the far left when facing the machine from the front.
2. **Slide.** With the red dot visible, slowly slide the laser head to the right.
3. **Align.** Adjust the positioning of the rotary until the red dot tracks back and forth evenly down the center. Note that the rotary is not assembled to the body of the machine but is freestanding. You may need to re-align your rotary each time you use it.



Rotary engraving is best performed along the topmost area of the project. It is crucial that the rotary level. Use a small carpenter's level to be sure your rotary is flat within the interior of the laser cutter.

Appendix C: Quick Start Steps

Your Full Spectrum Laser system is ready to use if you have read the manual to this point and followed all of the foregoing instructions. Please remember to use caution while operating the laser and make sure that all accessories are functioning properly before running any job. The following instructions provide a general workflow for taking an original design and turning it into a laser cut part:

1. **Create your artwork/design in the software program of your choice (e.g. CorelDraw) or use the Design View tab of RetinaEngrave.**
2. **Turn on the machine and accessories and wait for it to find an IP.**
3. **Once the machine has an IP (approx. 30s), launch RetinaEngrave.**
4. **Place your piece of sample material on the honeycomb.**
5. **Focus the laser head onto the sample piece.**
6. **Close the cover. 6. From CorelDraw, call up the print menu.**
7. **Select the “Full Spectrum Engineering” Driver.**
8. **If the “Pre-flight check” fails, check that both your document page size and printer page size match the size of the work area, and that no artwork is outside the boundaries of the page.**
9. **Once the pre-flight check is clear, continue printing to the software.**
10. **Your design will be loaded and then rendered by RetinaEngrave under the default raster tab.**
11. **Once you have set the power levels and layer ordering to your liking, you can run the job. If you plan to run it often, you can save the project file to a location on your hard drive.**

Appendix D: H-Series Support Videos

In addition to this user manual, we have created a series of videos to provide additional assistance for the more complicated procedures. <http://fslaser.com/Support/Hobby> will take you to a page on the Full Spectrum Laser website where you can access the following help videos:

Hobby Laser Unboxing

Hobby Laser Setup

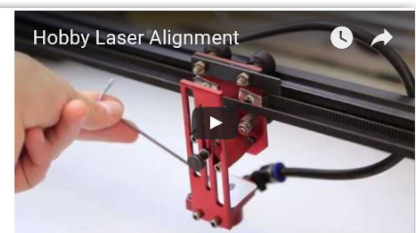
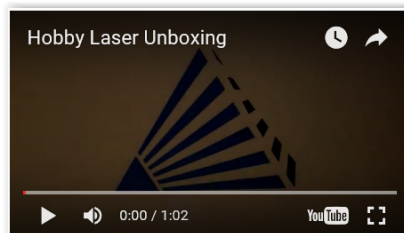
Hobby Laser Alignment

Hobby Laser Bottom Panel Removal

Hobby Laser Lens Replacement

Laser Tube Replacement

Proper Wheel Alignment



Appendix E: Warranty Information

Within the first 30 days, Full Spectrum Laser will replace or repair any defective parts free of charge and pay for ground shipping of parts. Overnight shipping is available at extra charge.

Outside the first 30 days, Full Spectrum Laser will replace or repair any defective part within the warranty period free of charge but shipping charges are the responsibility of the customer. The warranty includes parts and labor only. Shipping of defective and replacement components is excluded by the warranty. The customer may arrange their own shipping or drop parts off to exchange parts at our warehouse free of charge. Typically Full Spectrum Laser has most replacement parts on hand for immediate shipment of under warranty parts.

All defective parts must be returned to Full Spectrum Laser postage paid for evaluation before replacements are issued unless otherwise authorized. The warranty is valid for normal use only and excludes Acts of God, user error and use outside of normal parameters. Parts damaged by fires are considered user error if the machine is left unattended. Just like operating a household gas stove, always stand next to the machine with a fire extinguisher and be ready to turn it off in case of a fire and never operate the machine unattended.

Prior to 8/7/2012, the extended warranty was charged separately and the Hobby Lasers had a 60 day base warranty on all items excluding shipping unless an extended warranty was purchased.

After 8/7/2012, the Hobby lasers have a 60 day warranty on all items and a free extended limited 1 year warranty which excludes consumable items/shipping included in their price. The limited warranty excludes shipping and consumables and other normal wear and tear items. All electronic items (control cards, power supplies, motors) and most mechanical items are covered under the extended warranty unless damaged by abuse/fires. Consumables not covered include, but are not limited to, rubber parts such as tubing, belts, plastic wheels, lenses, mirrors, other optics, and laser tubes.

Within the first 30 days the original purchaser may transfer the balance of your warranty to anyone else free of charge provided you notify us in writing. Outside of the first 30 days, we will only provide warranty and tech support services to the original purchaser unless a warranty transfer fee is paid as there is a cost involved with initial tech support of new users and accounting fees. If you sell your machine, the warranty remains valid but the buyer must arrange with the original purchaser to request RMAs and send in the machine for repairs unless a warranty transfer fee is paid.



Please note that the most current warranty agreement can be found at <http://fslaser.com/service-and-support>.

Join the Full Spectrum Laser Community (Social Media)

Full Spectrum Laser invites you to join our community of hobby makers and professional manufacturers through our social media channels (Facebook, Twitter, Tumblr, etc.). We always have something positive to say about hobby maker culture or the industry we work in. You can follow us as we cross the country going to conventions and maker events or just check out all the awesome stuff we make. Best of all, we offer all those designs for all those projects we make with our laser cutters and 3D printers for FREE. Join our community and see what all the excitement is about.



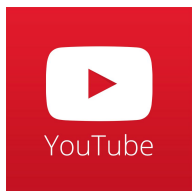
www.facebook.com/fslaser



twitter.com/fullspeclaser



www.instagram.com/fullspectrum



www.youtube.com/user/FullSpectrumLasers

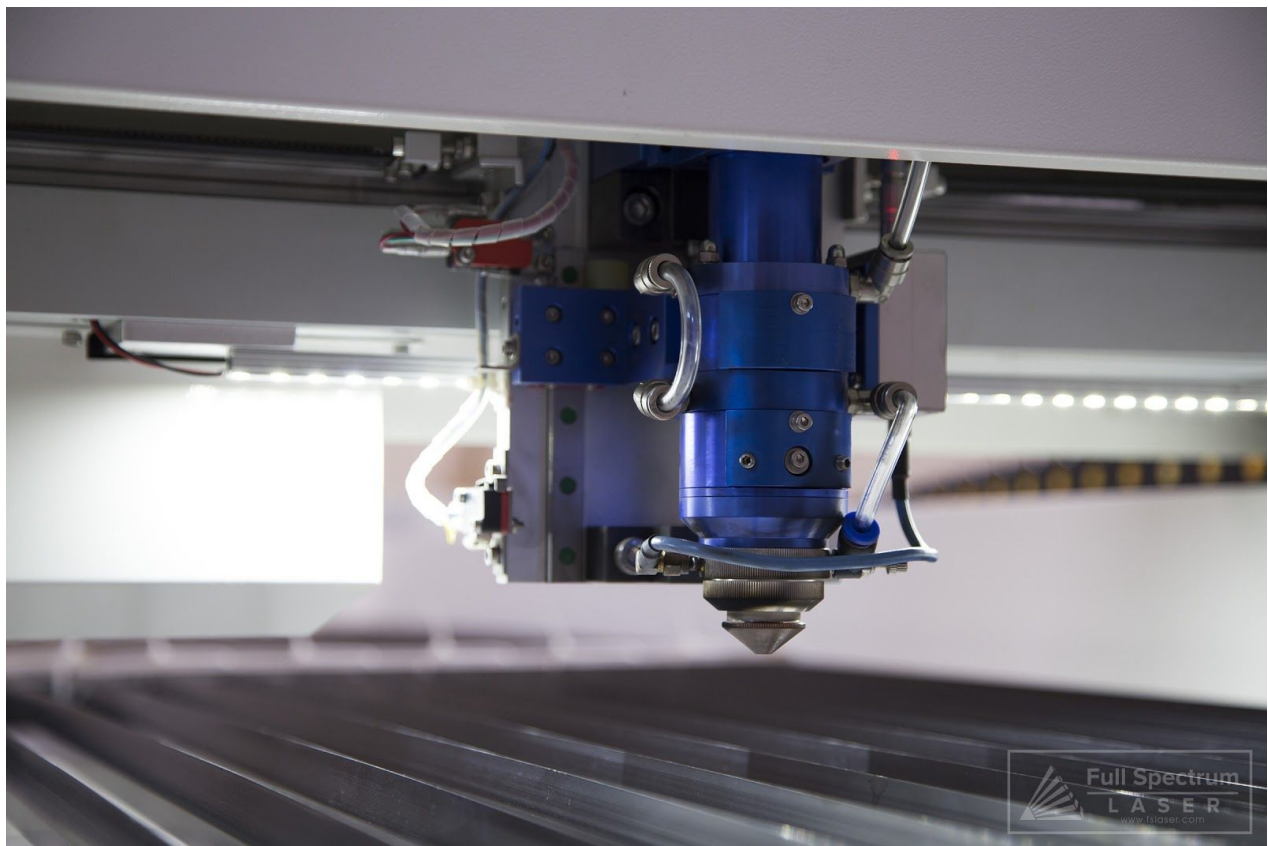


www.tumblr.com/blog/fslblog

Ready To Go Professional?

Have you gotten the most out of your hobby laser? Have you hit the limits of your output quotas and want to see how the professionals do it? Step up to Professional Grade with the Pro-Series by Full Spectrum Laser.

Our P-Series Professional C02 Laser cutters take your production to the next level. Industrial grade components give you faster movement, better precision and increased laser power. All P-Series Lasers come with our RetinaEngrave 3D ethernet controller, motorized z-stage, autofocus, knife edge and honeycomb trays and all necessary accessories included standard.



Go to <http://fslaser.com/Products/Lasers> for a complete catalog of the Full Spectrum Laser Pro-Series laser cutters.

Technical Support is available from 8:00 am (PST) to 5:00 pm (PST) Monday through Friday at support@fslaser.com.