

 **FS LASER**
H-SERIES 20X12 LASER (5TH GEN)

User's Manual

VERSION 2015.01

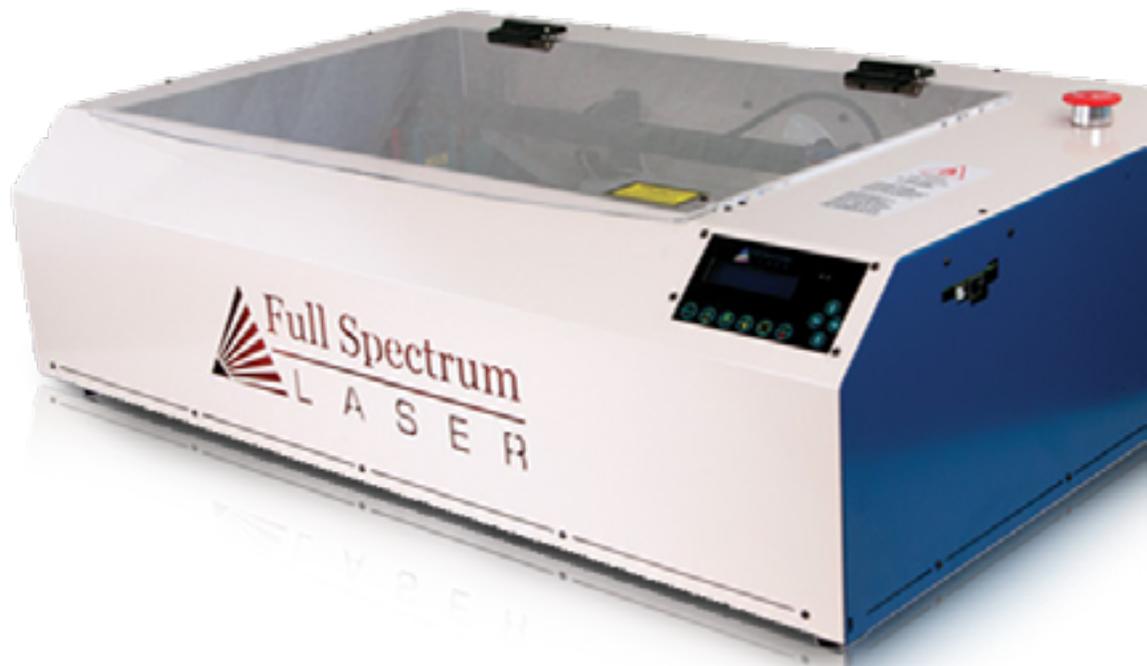


Table of Contents

SAFETY	4
Thank You	5
Laser Safety	6
Electrical Safety	8
Fire Safety	9
Compliance Statement	10
GETTING STARTED	12
Setting Up Your Laser System	13
Parts and Accessories	14
Attaching the Focus Lens Assembly	15
Connecting the Exhaust	16
Exhaust Blower Connection	17
Connecting the Water Pump and Air Assist Compressor	18
Connecting Electrical Power	20
Connecting the Laser to your Computer	21
QUICK START & SETUP	22
Overview	23
Laser Tube Test	25
Mirror Alignment	26

Focusing	30
Laser Head Adjustment	31
Quick Start	33
Troubleshooting	34
Appendix	41
Appendix A: Rotary Attachment Setup and Installation	42
Appendix B: Laser Tube Replacement	47
Appendix C: Power Supply Replacement	52
Appendix D: Belt Installation Instructions	53
Appendix E: Power Supply Connections	55
Appendix F: Warranty Statement	56

Safety

This section explains safety guidelines to use your laser.

Thank You

Thank you for your purchase of a Full Spectrum Laser HL40-5g “Hobby Advanced” Laser System. It is our wish that this product adds value to your business or hobby activities for years to come. Please take time to read this manual in its entirety to safely use your laser to its full potential.

In order to guide you through these documents, we have provided you with these icons:



FIRE WARNING

This fire warning icon calls attention to fire risks that are present while operating the laser.



WARNING & CAUTION

This warning and caution icon are present when special attention to information is required.



USEFUL TIP OR INFORMATION

This icon indicates a useful tip or information that will help you operate more efficiently.



ETHERNET

This icon indicates information related to connecting your laser to your computer using an Ethernet connection.

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. While this device employs the same technology as a handheld laser pointer, it is potentially hazardous if its beam is directed into the eye.

GENERAL OPERATION PRECAUTIONS

The laser operator should observe the following:

- **NEVER** operate the machine with any of the panels removed. Be aware that removal of any portion of the cabinet will expose a Class 4 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).
- **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** use the air assist, especially while vector cutting. Vector cutting movements are relatively slow and apply an extremely large amount of heat to the work piece. This buildup of heat can cause a significant fire risk.
- **DO NOT** disassemble the machine or remove any of its protective covers while the unit is plugged in.
- **DO NOT** defeat the door interlock.
- **DO NOT** look into the beam of the Alignment Laser (visible red diode laser)

- **DO NOT** 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.

**CAUTION**

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

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 Advanced 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

Electrical Safety

The AC input power to the Full Spectrum HL40-5g is potentially lethal and is located on the far right within the cabinet.



- **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.
- **DO NOT** make or break any electrical connections to the system while the unit is turned on.
- **DO NOT** access the electronics area with hands or tools unless the unit is disconnected from power.

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.

Fire Safety



Laser cutting and engraving systems represent 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 easily 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 threaten its surroundings.

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 the laser. Please also be aware that stacking materials (especially organic materials such as paper) can lead to increased risk of flame propagation or work piece ignition.

Please read the following warnings and recommendations and follow them closely at all times!



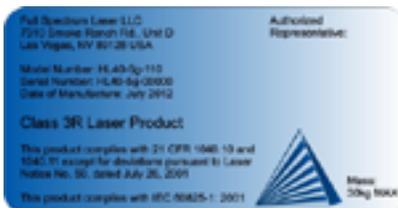
- **NEVER** leave the laser system unattended during operation.
- **KEEP** the area around the machine clean and free of clutter, combustible materials, explosives, or volatile solvents such as acetone, alcohol, or gasoline.
- **ALWAYS** keep a properly maintained and inspected 5lb or larger fire extinguisher on hand. Full Spectrum 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.
- **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.
- **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.

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:



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.

Getting Started

This section guides you to assemble your laser for the first time.

Setting Up Your Laser System

Setup of the Hobby Advanced laser usually takes less than 30 minutes, but there are a few things you will need to take care of before it arrives:

- Purchase distilled water for cooling the laser. Your laser comes with a pump and tubing for circulating the water through the tube and back into a reservoir. *Please make sure to only use distilled water—neither filtered nor deionized water will work and tap water will cause deposits that can destroy your tube and void the warranty.*
- Purchase a container to act as a reservoir for the distilled water. Be sure to check the container regularly to ensure that the water remains clean and deep enough to cover the pump.
- If you did not purchase an exhaust system from Full Spectrum, you will need to purchase and install one. *You may need a contractor to install the exhaust. This must be done **prior** to installation of the laser system.*

Once your laser has arrived, you will need to do the following to set up your machine:

- Remove the laser and accessories from the box
- Connect the exhaust, cooling and air assist systems
- Remove the zip ties (3) that secure the drive belts during shipping
- Remove the zip tie that secures the laser head
- Connect electrical power
- Connect the laser to your computer using an Ethernet cable
- Install the latest version of RetinaEngrave (download information can be found in the shipping box)



NOTE

Please do not throw away the laser's box and packaging, you may need it later.

Parts and Accessories

Your laser shipped with the following included parts and accessories:

	DESCRIPTION	QTY
#1	Laser Engraving Machine	1
#2	Software Download Sheet and Quick Start Guide	1
#3	Water Pump	1
#4	Water Pump Connection Hose	2
#5	Honeycomb Cutting Table	1
#6	Power Cable	1
#7	Ethernet Cable	1
#8	2" Lens Focus Gauge (1.32in)	1
#9	Eccentric Wheel and 4mm Nut Adjustment Tool	2
#10	2mm Hex Key	1
#11	2.5mm Hex Key	1
#12	M3 Thumbscrew	2
#13	M3 Fender Washer	2
#14	M3 Tooth Lock Washer	1
#15	Focus Lens Assembly	1

Attaching the Focus Lens Assembly

The focus lens assembly **(1)** is pre-installed at the factory. It attaches to the focus head using one M3 thumbscrew and two M3 spring washers. Attach the air assist tube to the push-to-connect connector **(2)** once the head has been secured. 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.

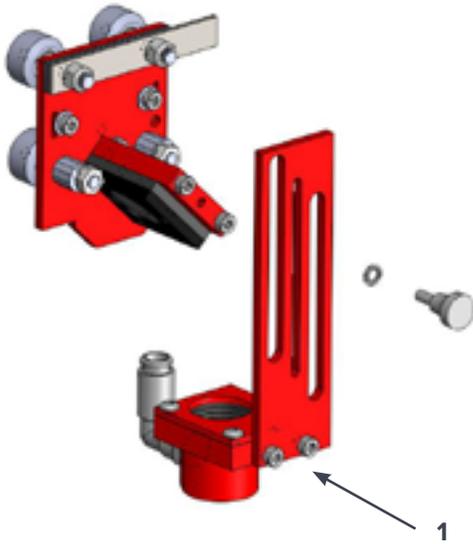


Figure 1 - Focus Lens Attachment

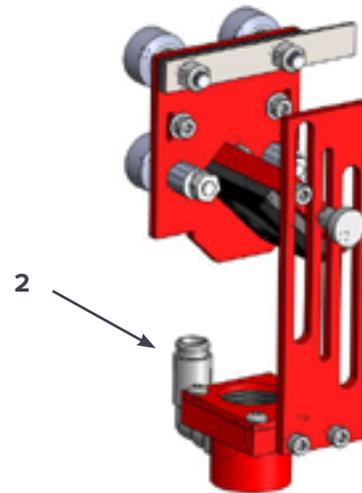


Figure 2 - Air Assist Attachment

Connecting the Exhaust

It is mandatory that an exhaust blower is connected and operating whenever you run a job on your laser. The exhaust blower removes smoke and fumes from the case and exhausts them to the outside of the building. You should never operate your laser without a working exhaust. Full Spectrum recommends exhaust systems capable of 60-100CFM. Keep in mind that exhaust systems with high flow rates may require fixtures for thin materials.



CAUTION

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 be avoided.

In the United States flexible aluminum ducting can be acquired from the following locations:

- Your local hardware store
- McMaster-Carr [HTTP://WWW.MCMASTER.COM/](http://www.mcmaster.com/)

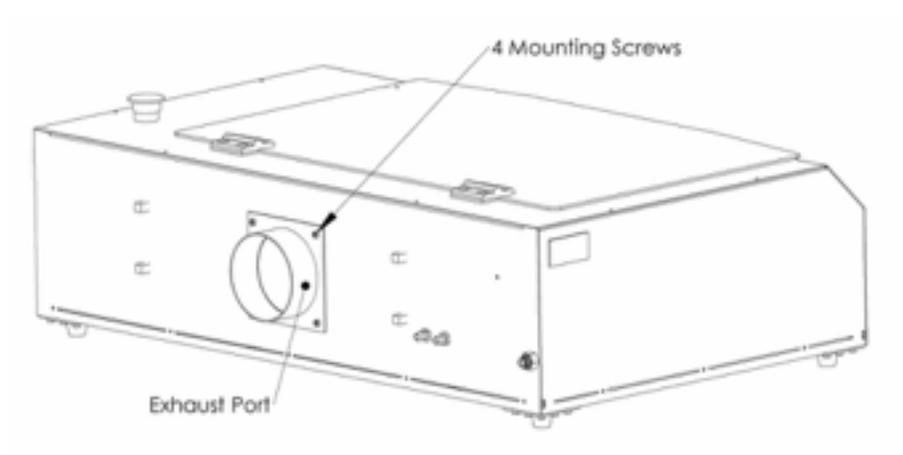
SUPPLIER	SIZE	PART NUMBER	COST
McMaster	4in ID	55335K42	\$7.75/ea (26” compressed, 7’ extended)

Exhaust Blower Connection

You will find a 4" (100mm) exhaust flange with the accessories for your laser. The flange must be attached to the rear of the Hobby Advanced chassis in order to connect an exhaust blower.

Secure the exhaust port using the included screws and nuts.

Once the exhaust flange is installed, use flexible metal tubing to connect the laser system to the exhaust system. Check your system for leaks—most can be remedied with duct tape. Please be aware that the protective housing is not designed to be air-tight; the front grill is designed to allow an exhaust system to draw fresh air through the work area.



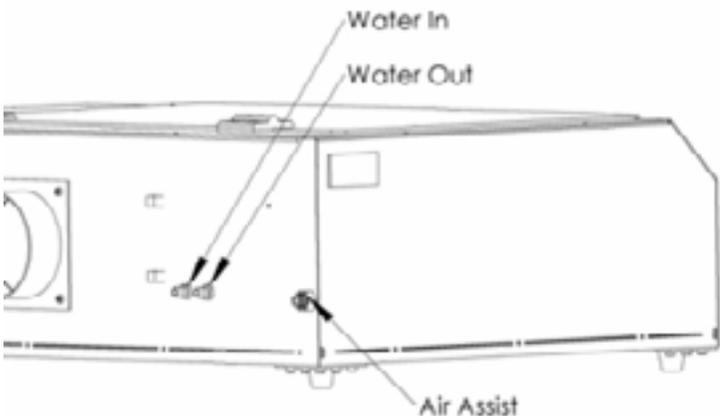
Connecting the Water Pump and Air Assist Compressor

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. A low-flow air compressor for vector cutting gas assist is available as an optional accessory.



CAUTION

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 SEVERLY DEGRADE OR DESTROY YOUR LASER TUBE AND VOID YOUR WARRANTY.



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.

Please make sure that there are no air bubbles inside of the water jacket of the laser tube. Air bubbles can create local hotspots 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.

The tube is cooled by a circulation pump. The pump must be submerged in a container of distilled water (distilled water is available from any grocery chain—most customers use a 5gal paint bucket as the reservoir) with one of the two provided silicone tubes being connected from its output to the Water Inlet fitting. The other tube is connected to the Water Outlet fitting and is left to drain back into the reservoir.

The water inlet and outlet are the two barbed connectors on the rear of the laser to the right of the exhaust flange. The left one is the water inlet and the right is the water outlet.

Air is used as a pressurized gas to assist in cutting and engraving operations. The 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.

On the far right side of the machine is a push-to-connect fitting for the air assist input. Simply push the included ¼" plastic tube into the connector (press on the plastic flange while pulling on the tube to remove it). Make sure that the other end of the tube is connected to the air compressor.



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 30psi. Low-quality compressed air can damage your focus lens.

Connecting 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).

The electrical cord is found among the accessories. The power cord plugs into a C14 power receptacle located on the right side of the machine in the lower rear. The laser system itself draws approximately W of power and can be run off of most circuits without modification. However 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.



NOTES:

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

Connecting the Laser to your Computer

All Full Spectrum Laser Systems are designed to be used with either 32 or 64 bit versions of Windows 7. 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

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.

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 miniSD card, 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 an SD card is not volatile memory, jobs are stored between power cycles.



NOTES:

- 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.

To learn more about how to use the RetinaEngrave 3D print driver and control software, please refer to the [RETINAENGRAVE 3D SOFTWARE MANUAL PDF](#).

Quick Start & Setup

This section is the next step to ensure that your laser is working properly

Overview

Now that you have set up your laser and accessories and have installed the control software, the next step is to ensure that your laser is working properly. The tube test and mirror alignment procedures should take less than 30 minutes and will ensure that your laser is performing optimally. Your laser's main power is controlled by the twist-release switch on the top of the case.

The first thing we are going to verify is that your laser tube did not crack during shipping. This should take less than 2 minutes. The second test will check the mirror alignment and if necessary, adjust the mirrors so they are once again aligned. The laser's mirrors are aligned during assembly at our location, however shipping subjects the laser system to a great deal of vibration which can cause the mirrors to vibrate slightly out of alignment.

These tests require the following tools and materials:

- **Scissors or small wire cutters** (for removing axis zip ties.)
- **Thermal paper** (This is the same paper that receipts are printed on. Used receipts work.)
- **Masking/painters tape** (For taping the thermal paper to mirrors and apertures.)
- **2mm hex key** (For adjusting mirror angles. Included in accessories.)
- **2.5mm hex key** (For adjusting mirror mounts and angles. Included in accessories.)

Before we begin testing the laser, we need to free the motion system from its shipping restraints and remove the accessories from the work area. The accessories are zip-tied to the front beam attenuator—cut the zip tie and remove the accessories. The motion system is restrained by 6 zip ties: one on the X axis drive belt, two on each Y axis drive belt and two securing the head slider. Carefully cut the zip ties, avoiding damage to the drive belts. The focusing sub-assembly is also restrained by zip ties; they must be cut in order to perform alignment.

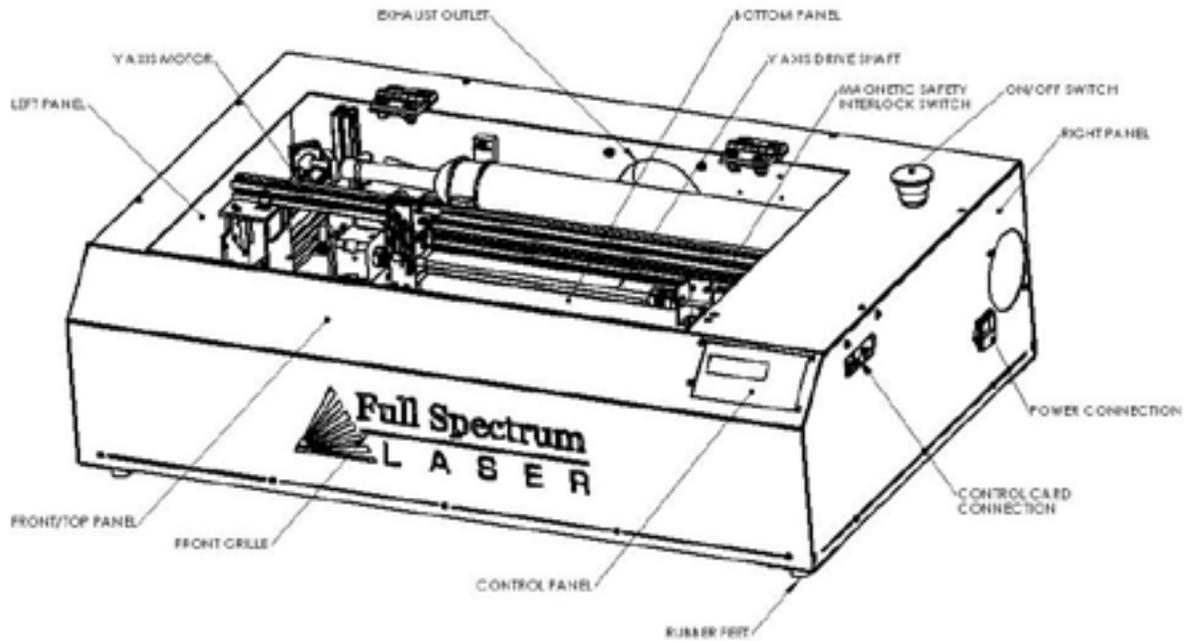


Figure 4 – Exterior Component Description

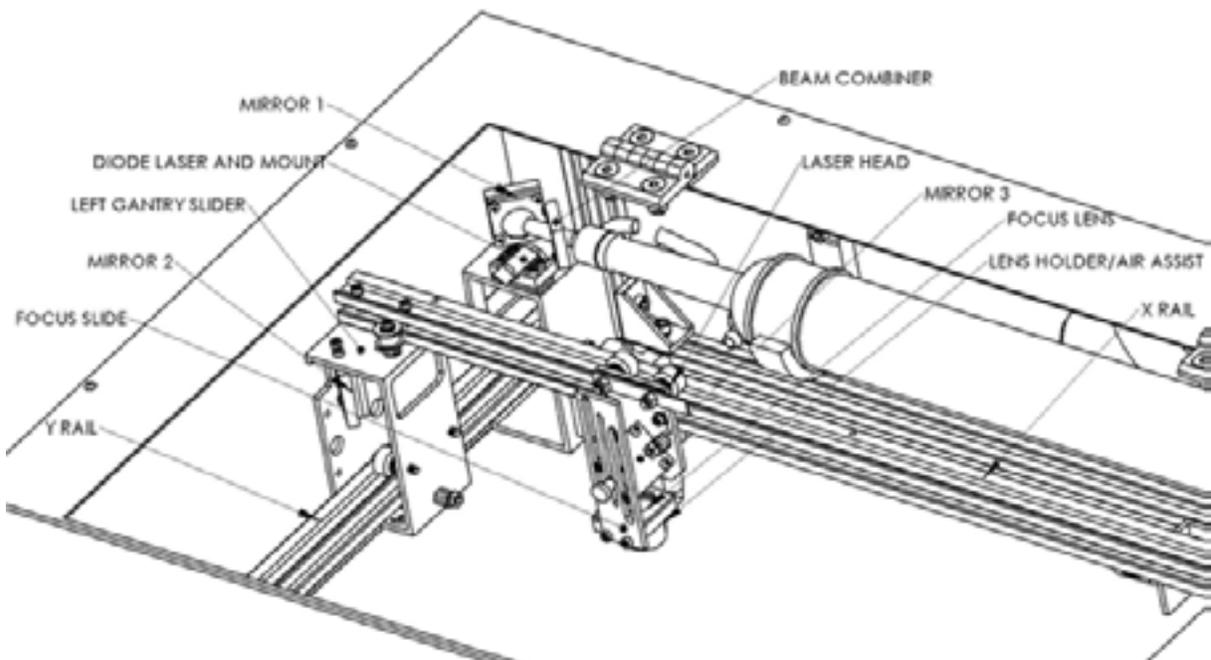


Figure 5 - Optics and Motion Components

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 tube.

1. Make sure that the proper accessories are attached and engaged (water pump)
2. Open the work area cover.
3. Take a piece of thermal paper and tape between the Beam Combiner and mirror 1 with the sensitive (shiny) side facing the laser tube output. Alignment 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 the cover.
5. Place the laser into test fire mode (FS/Z button, toggle until menu reads "Align Mode").
6. Press the Test Fire button.
7. A circular black mark with diffuse 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.

You should hear a 'click' and/or see a plasma arc inside the tube (may require more than one button press). 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. If these solutions do not solve the problem, please contact technical support at support@fullspectrumlaser.com

Mirror Alignment

Your laser was aligned during assembly and test 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

1. Take a piece of thermal paper 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.
2. Jog the laser to the upper left corner.
3. Close the lid and test fire.
4. Observe the location of the mark on the thermal paper.
5. Jog the gantry halfway along the Y axis towards the lower (front) left corner. Test fire and observe the mark.
6. Jog the gantry the remainder of the way along the Y axis and test fire at the lower left corner and observe.
7. The burn mark should be relatively close to the center and should not “walk” after jogging the laser head.

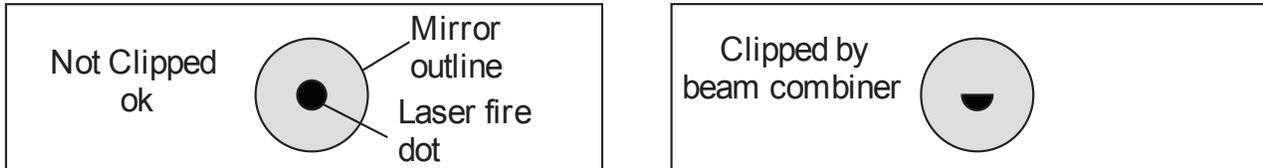
If there was a great deal of variation in the location of the burn marks (more than 2mm of drift) you will need to align your laser. We recommend first aligning the invisible cutting beam with the visible Alignment Beam—this saves a great deal of time lost in opening and closing the lid for safe access while firing the laser. The procedure for this is the following:

ALIGNMENT PROCEDURE

The New 5th Generation 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.

1. Put a piece of thermal paper on mirror #1.
2. Press the UNLOCK button on the laser control panel. In the unlocked state, you can move the laser head around by hand and fire test dots using the TEST FIRE button.
3. Close the lid then press the TEST FIRE button on the laser control panel. A black dot should appear on the mirror. Check that this dot is round and not clipped. You may need to press the test fire button several times

to get a dot. 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. Adjust one of the clamps of the laser tube to move the tube down so it is not clipped by the beam combiner. This should not happen normally unless you changed the tube so contact FSL tech support for more details.



4. Move the X gantry (the long black bar) down to the lowest Y position as shown in the following picture. Put a piece of thermal paper on location #2. Fire a test pulse and observe where the black dot appears on the thermal paper.
5. 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.

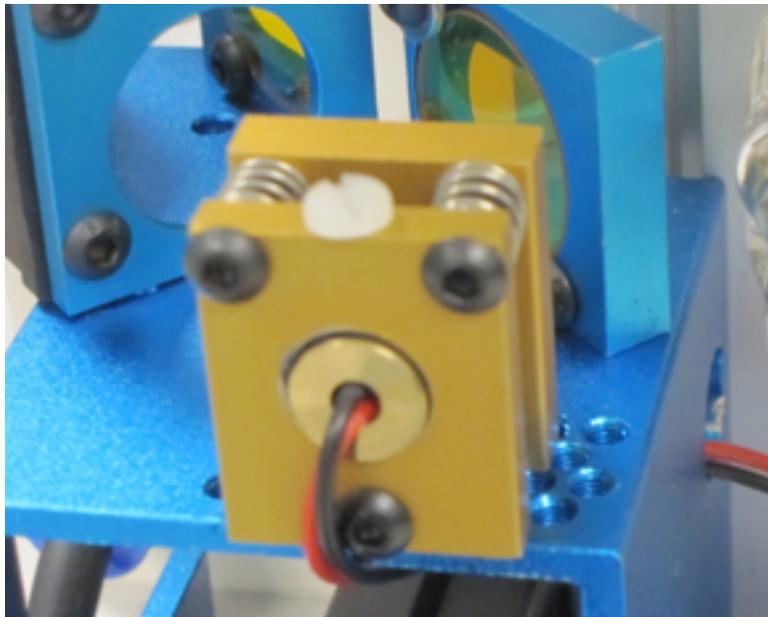
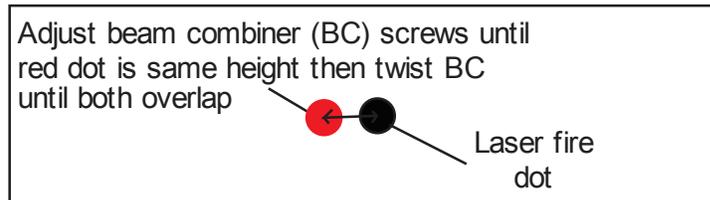
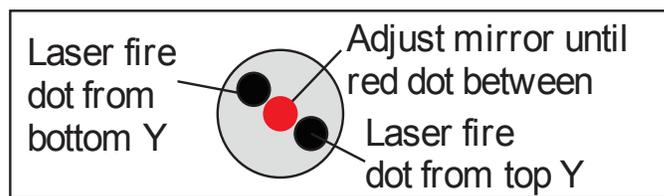


Figure 6 - Revision 2 Diode Mount

6. 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.

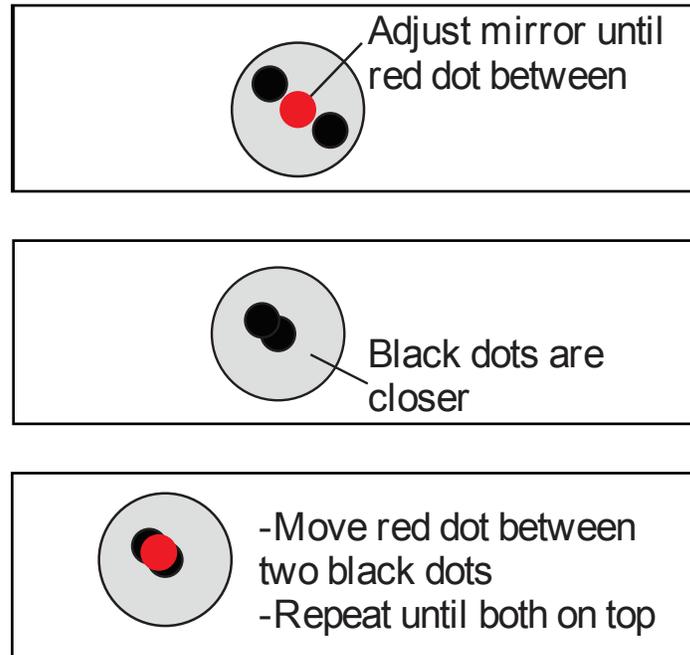


7. Move the X gantry to the top Y position. Fire another black dot onto the thermal paper. You should now have two black dots (one from the upper Y position and one from lower Y position). Move the X gantry up and down and verify that the red dot tracks from one black dot to the other black dot.
8. Move 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.

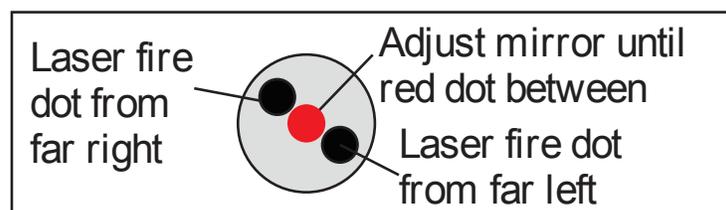


9. Use a fresh piece of thermal paper and fire a test dot with the X gantry still in the lowest Y position. Move the X gantry to the top position and fire another test dot. Now the two black dots should be closer together than in step #6.
10. Move the X gantry back to the lowest Y position. Now adjust the red dot until it moves to the center of the two black dots.
11. 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.

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.** Mirror #1 is now aligned.



12. Once the mirror #1 is aligned, we will 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.
13. Move the laserhead 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.
14. Put on a new piece of thermal paper. Move the laserhead to the far left and fire a black dot. Move the laserhead to the far right and fire a second black dot.
15. 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.
16. Move the laserhead 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.



17. 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.
18. 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.
19. 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.



Congratulations, your laser is now aligned!

Focusing

Focusing the Hobby Advanced Laser is quick and easy. Your laser included a billet sized for the included 2-inch focal length lens. To focus for engraving or cutting, simply place the billet on the top of the engraving plane and then release the locking mechanism on the focus head until the air assist nozzle rests on top of the billet. Then re-tighten the sliding head and remove the billet from the work piece.

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.

ECCENTRIC SPACER ADJUSTMENT INSTRUCTIONS

1. Adjusting the eccentric shafts is done by first loosening 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.
2. With the locking nut loosened, you can use one wrench to turn the eccentric shaft.
 - a. Depending on the initial location of the eccentric, a clockwise turn can either tighten or loosen the wheel.
3. Remember to use the two wrenches to retighten the locking nut after you are happy with the eccentric nut position.



Figure 7 - Eccentric Spacer Adjustment

PROPER WHEEL TENSION INSTRUCTIONS

The proper tension should be tested as follows:

1. Unlock the motors or turn off the machine. 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.
2. Let the laser head go. 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.

3. 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.

Ideally the wheels should be tight enough so if they rotate then 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.

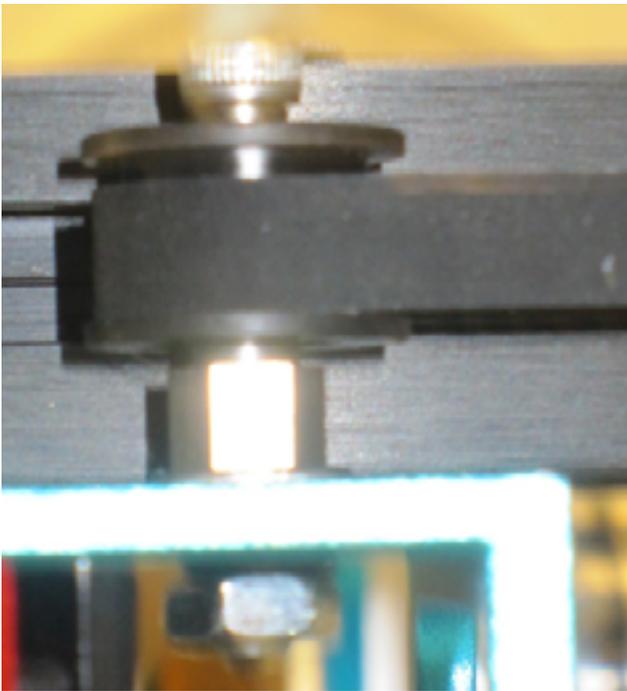


Figure 8 - Detail of X Idler/Tensioner

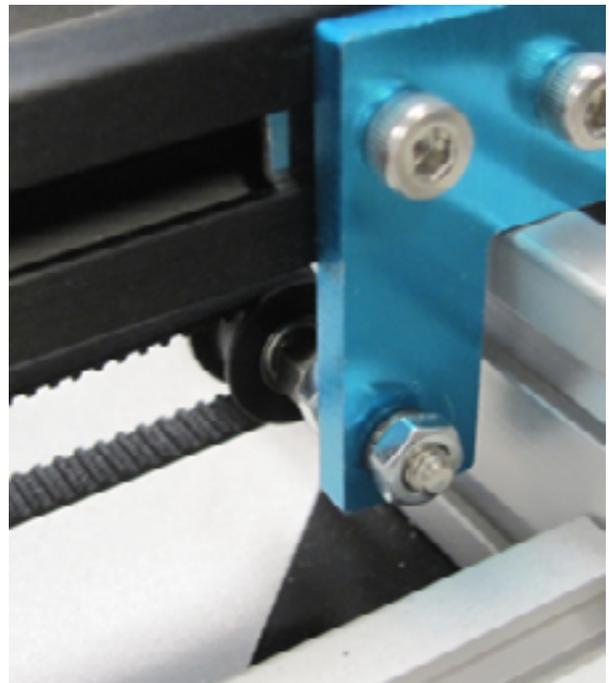


Figure 9 - Detail of Y Idler/Tensioner

Quick Start

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.
7. From CorelDraw, call up the print menu.
8. Select the “Full Spectrum Engineering” Driver.
9. 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.
10. Once the pre-flight check is clear, continue printing to the software.
11. Your design will be loaded and then rendered by RetinaEngrave under the default raster tab.
12. 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.

Troubleshooting

This section contains a list of potential problems and techniques to solve them

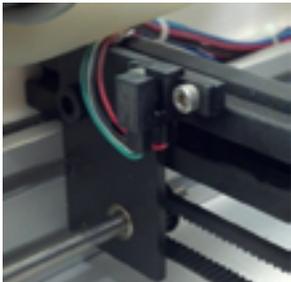
This is a quick troubleshooting reference to assist with common problems. Please contact support if your issue is not mentioned here or if the recommended solution(s) do not solve your problem.

For the purposes of quick and easy troubleshooting, Full Spectrum Laser recommends that customers possess or have access to one of the following in the location they have placed their laser:

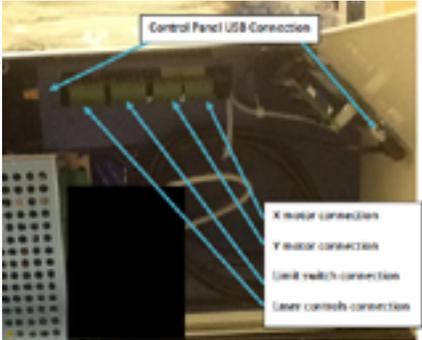
- Digital still camera
- Web camera and videoconferencing software such as skype (internet access required)

These tools are extremely helpful for diagnosing problems, as they allow us to quickly gather important information on the state of your laser.

PROBLEM	POSSIBLE CAUSE	SOLUTION
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.

PROBLEM	POSSIBLE CAUSE	SOLUTION
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.
Laser head skips during raster	This issue is usually caused by over-tightening the adjustment spacers on the lower part of the laser head.	<ol style="list-style-type: none"> 1. 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>Watch laser head adjustment video tutorial</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. <p>Also refer to X-Axis Rail Realignment</p>
Red diode laser OFF	Loose power cords	<ol style="list-style-type: none"> 1. Check that the plugs on the power supply are connected, as it is possible they came loose during shipping.

PROBLEM	POSSIBLE CAUSE	SOLUTION
<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	SOLUTION
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.
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 system to allow connection.
Engraved lines are diffuse; cutting fails even at high power	Laser is not in focus	<ol style="list-style-type: none"> 1. 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.
Motors do not jog	Motors are not connected	<ol style="list-style-type: none"> 1. Verify that the motors are connected to the control card. <div data-bbox="987 1461 1409 1801" style="text-align: center;">  </div>

PROBLEM	POSSIBLE CAUSE	SOLUTION
<p>Vector cut rectangles are out of square (lines are straight, but angles are wrong)</p>	<p>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.</p> 	<p>Steps:</p> <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.
<p>Gantry jams/skips during Y moves</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>Vector cut lines are not straight</p>	<p>This problem is usually caused by a mis-adjusted laser head.</p>	<p>Please follow the instructions in the Laser Head Adjustment section of Part 7 of this manual, or watch the following video tutorial: http://www.youtube.com/watch?v=Pd6eY97JskM&feature=youtu.be</p>

PROBLEM	POSSIBLE CAUSE	SOLUTION
Air hose drags on work piece or coils into beam path	Air line not oriented in correct position	<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 point2. 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

APPENDIX A: ROTARY ATTACHMENT SETUP AND INSTALLATION

OVERVIEW

Thank you for purchasing the Full Spectrum Laser Hobby Advanced Rotary Attachment. 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 5th Generation Hobby Laser (HL40-5g Hobby Advanced). Once you have unpacked your rotary attachment, you will need to connect it to your laser's RetinaEngrave PRO controller before running any jobs.

ROTARY ATTACHMENT INSTALLATION

Once you have unpacked your rotary attachment, begin the installation process by placing it into the work area of your laser (Figure 10 - Rotary Attachment). 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.

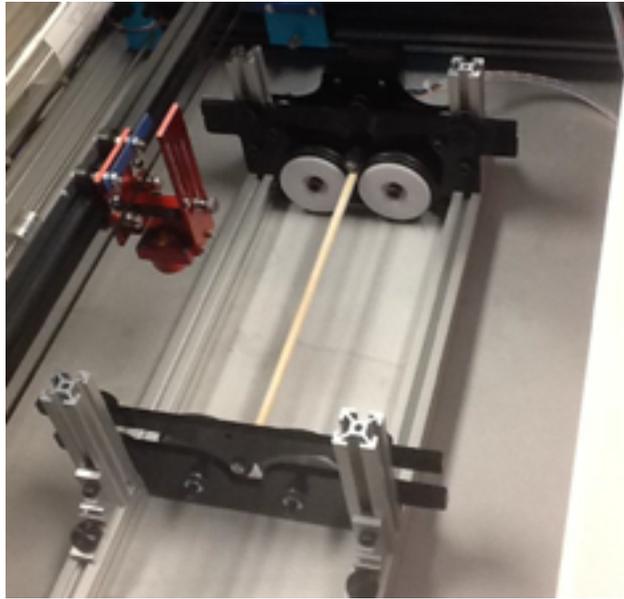


Figure 10 - Rotary Attachment



Because some small objects are very light, the rotary attachment has two hold-down plates to force light objects into contact with the drive wheels.

The rotary attachment works by translating Y motion along a cylindrical surface. With the laser off, place the rotary attachment into your laser's work area, and disconnect the Y motor from the RetinaEngrave PRO control card and connect the rotary attachment motor in its place. Note the orientation of the connector and the wiring (Figure 11 – Rotary Attachment Motor Connection), this orientation should be maintained when connecting the rotary attachment to the control card.

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 work piece. The red dot should be in the same vertical (X-Z) plane as the center axis of the work piece.

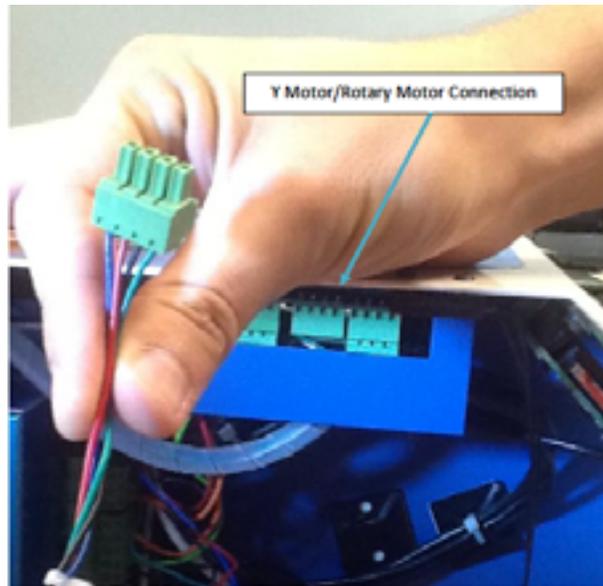


Figure 11 – Rotary Attachment Motor Connection



Keep in mind that Y axis motion is now sent to the rotary, so you may need to unlock the laser head and move the gantry by hand.

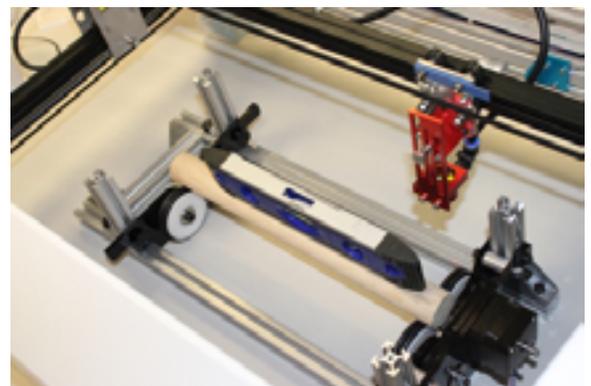
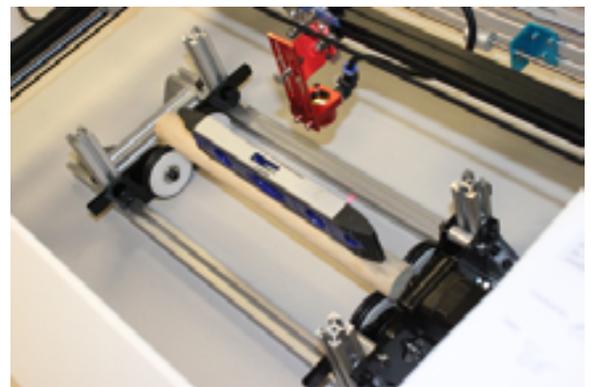
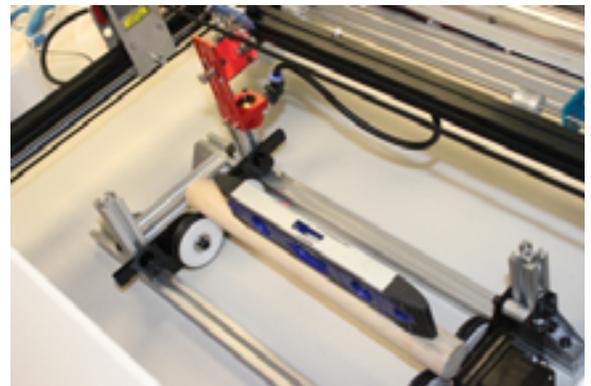
USING THE ROTARY ATTACHMENT

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.

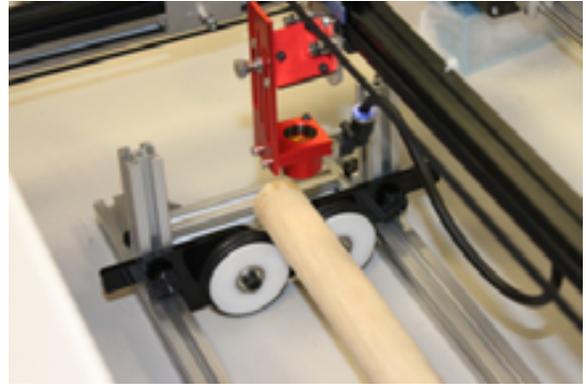
1. A quick procedure to visually align the rotary attachment follows.
2. Focus the laser head onto the rear frame member of the rotary attachment on the far left.
3. Slide the laser head to the right, keeping the red dot in the same relative position on the rotary frame member as you go.



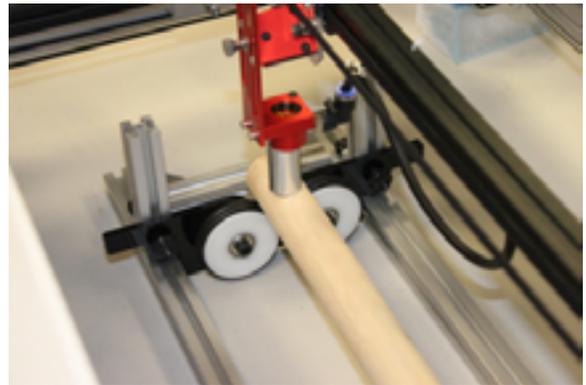
FOCUSING YOUR ROTARY ATTACHMENT AND LEVELING THE WORK PIECE

Rotary engraving should be carried out along the topmost portion of your circular work piece co-planar with the work piece axis. Focus the laser with the included billet. It is important that your work piece be level along its length—a small carpenter's level is very helpful. The following illustrates the steps:

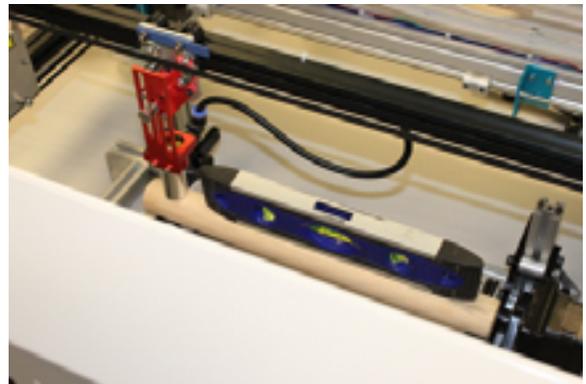
1. Align red dot on work piece.



2. Laser head focused.



3. Laser focused and work piece leveled.



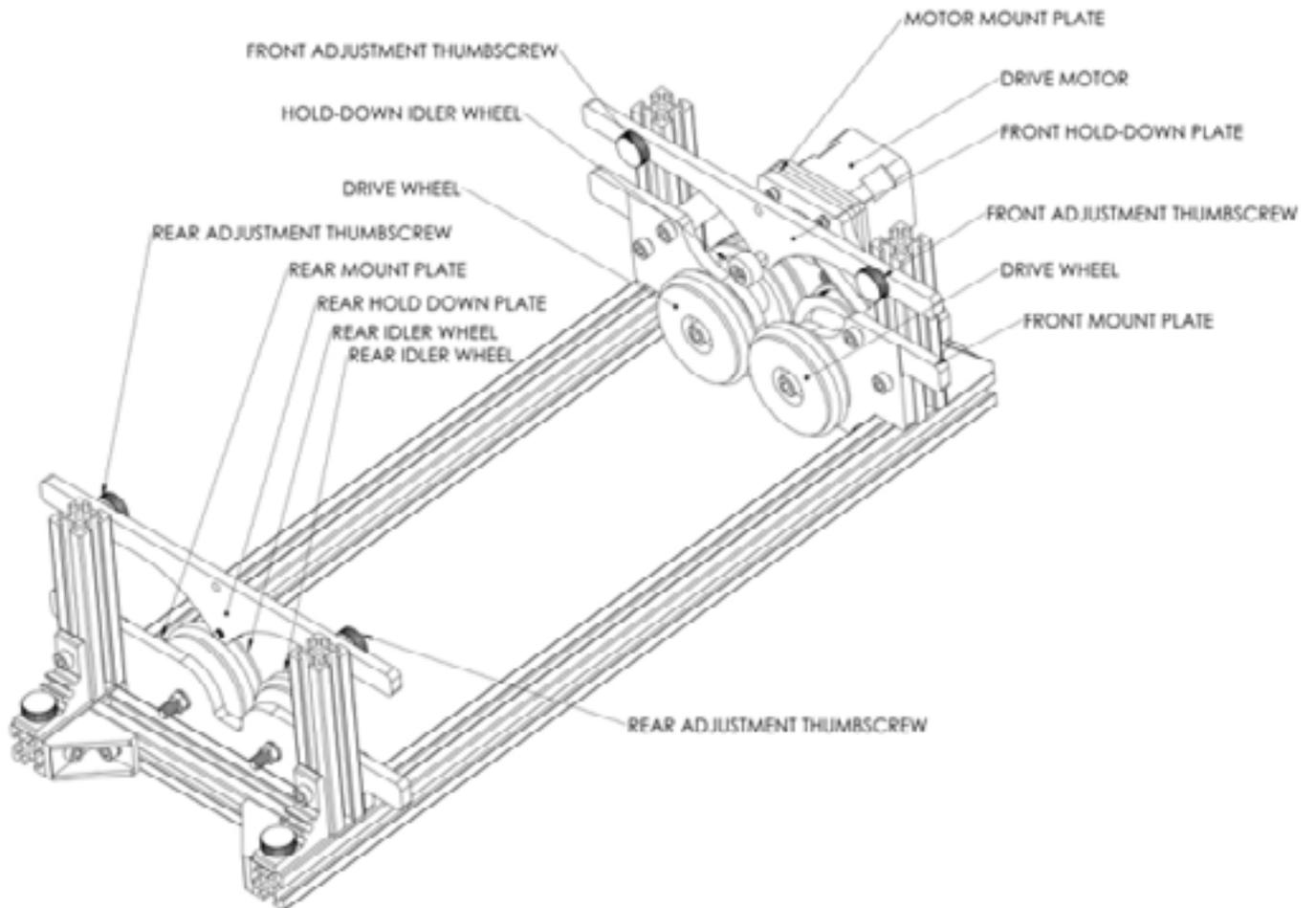


Figure 12 – Rotary Component Description

APPENDIX B: LASER TUBE REPLACEMENT

OVERVIEW

This Appendix provides procedures and a walkthrough to replace the laser tube on your Hobby Advanced 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.

REQUIRED PARTS AND TOOLS:

- FSL 40W replacement tube (Part Number: 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).



CAUTION

- 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.
- 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.

REPLACEMENT PROCEDURE

SWITCHING THE TUBE

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

1. Power off and unplug your unit. Wait at least 1 hour for capacitors to discharge.
2. Disconnect water from rear connectors. Use the small piece of tubing that shipped with your laser to shunt the two water bulkheads together.
3. If necessary, move your laser so that you have at least 1ft of table working space to access the rear of the unit. You will be removing the rear panel to access the tube.
4. Using a wrench, remove the 4 M5 hex nuts from the posts on the rear of the laser
5. Using a 2mm hex key, unscrew the 5 lower M3 6mm button head socket screws and 2 upper M3 6mm button head socket screws.
6. Carefully remove the rear panel and lay flat on your work surface.
7. Carefully remove the silicone sealant and tubing to expose the **BLUE** ground wire (located at the tube aperture).
8. Unwrap the **BLUE** ground wire from the tube terminal.
9. 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. 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. Carefully remove the silicone sealant and tubing to expose the **RED** power wire (located at the rear of the tube).
11. Unwrap the **RED** power wire from the tube terminal.
12. Remove the two water tubes from the inner bulkheads.
13. Remove the water tubes from the laser glass bulkheads—please exercise caution as using too much force can break the bulkheads and prevent a sharp glass hazard (and will also make your tube unusable).
14. Remove the laser tube mounts from the panel. Note the orientation of the tube relative to the holders.
15. Remove the mounting U-bolts from the rubber tube holders.
16. Remove the tube from the rubber holders.
17. Set aside the old tube.
18. Place the new tube into the rubber holders in approximately the same orientation as the old tube.

19. Attach the U-bolts to the rubber holders and place the tube back onto the rear panel.
20. Exercising caution, thread the M5 hex nuts onto the U-bolt posts and make snug (but not yet tight) with the rear panel.
21. Carefully attach the water tubes to the proper laser connection bulkheads. Make sure that the water tube routing and locations match the original configuration

CONNECTING THE TUBE TO THE POWER SUPPLY

1. Straighten the exposed wire on the red lead. Twist the wires together.
2. Slide one piece of silicone tubing onto the red lead .



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



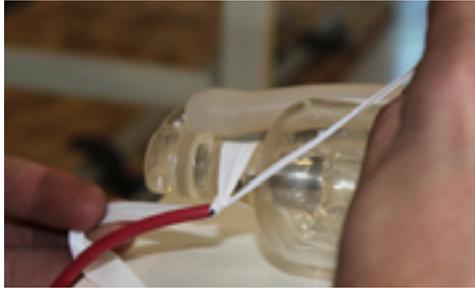
4. Thread Teflon tape around the neck of the laser tube.



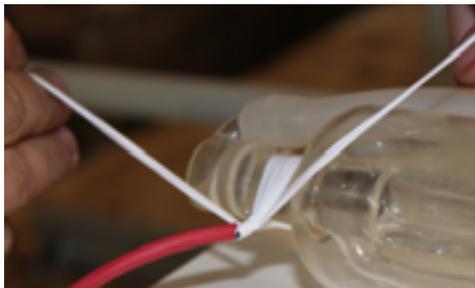
5. Tightly wrap one end of the Teflon tape several times around the electrode.



6. Bring the opposite side of the Teflon tape around the neck of the laser tube and around the inside of the electrode.



7. Wrap the Teflon tape tightly around the electrode.



8. Knot the Teflon tape tightly around the electrode (Figure 66 and Figure 67). Repeat. Trim Teflon tape.



9. Slide the silicone tubing onto the electrode.



10. Fill the silicone tubing with silicone sealant.



11. Allow the silicone to dry.



12. 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.



Figure 13 – Tube Wire Orientation Reference

APPENDIX C: POWER SUPPLY REPLACEMENT

OVERVIEW

This Appendix provides procedures and a walkthrough to replace the Power Supply on your Hobby Advanced 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. This appendix also references procedures found in **APPENDIX B: LASER TUBE REPLACEMENT**.

REQUIRED PARTS AND TOOLS:

- Replacement Power Supply Unit (PSU)
- 3mm hex key (a ball-end 3mm hex driver is very helpful)



CAUTION

- Pulling on the tube wires will break your laser tube at the neck
- 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.

REPLACEMENT PROCEDURE:

1. Disconnect the laser power cord.
2. Wait 1 hour.
3. Disconnect the 3 green PSU board connectors.
4. 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 thread locker and may require some strength to remove.
5. Slide the PSU towards the front of the laser.
6. Disconnect the **RED** wire from the laser tube (refer to **APPENDIX B: LASER TUBE REPLACEMENT**).
7. Remove the old power supply.
8. Place the new power supply into the unit
9. Follow the instructions in **APPENDIX B: LASER TUBE REPLACEMENT** to re-connect the **RED** wire to the tube.
10. Mount the power supply to the frame using the 2x M3-6 socket head cap screws.

APPENDIX D: BELT INSTALLATION INSTRUCTIONS

OVERVIEW

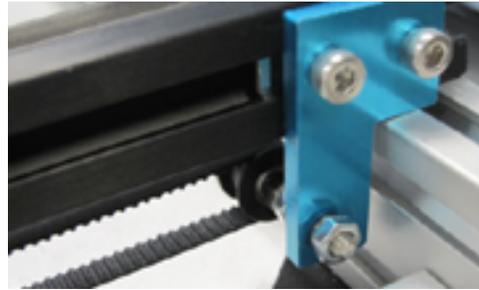
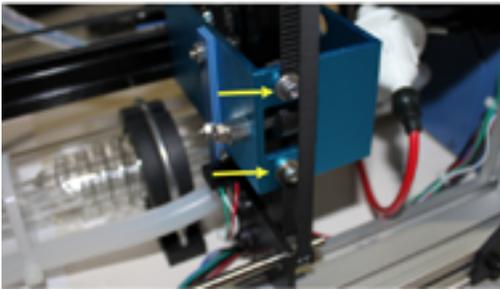
The belts on your laser system are a consumable item and will eventually stretch beyond a usable length or break. You can contact Full Spectrum Laser support for replacements or purchase them from various suppliers. The belts are 6mm wide fiberglass-reinforced neoprene MXL timing belts—1/4in wide MXL 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.

REQUIRED PARTS AND TOOLS:

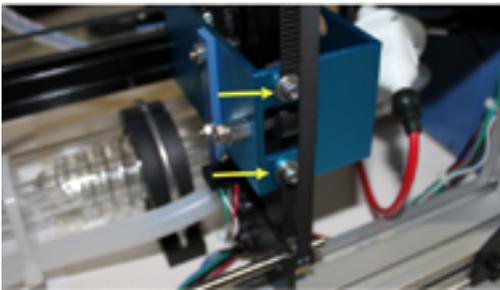
- 2mm Hex key (included with accessories)
- 2.5mm Hex key (included with accessories)
- Scissors

PROCEDURES:

1. 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.
 - A. Make sure that your laser is disconnected from power for at least 1hr prior to the technician's arrival.
 - B. Disconnect water and other connections as the laser will be turned upside down.
2. Loosen or remove the M3 retaining screws and washers so that the old belt can be removed and discarded.
3. Run each end of the new belt through the mounting slot with the teeth on the inside of the closed loop.

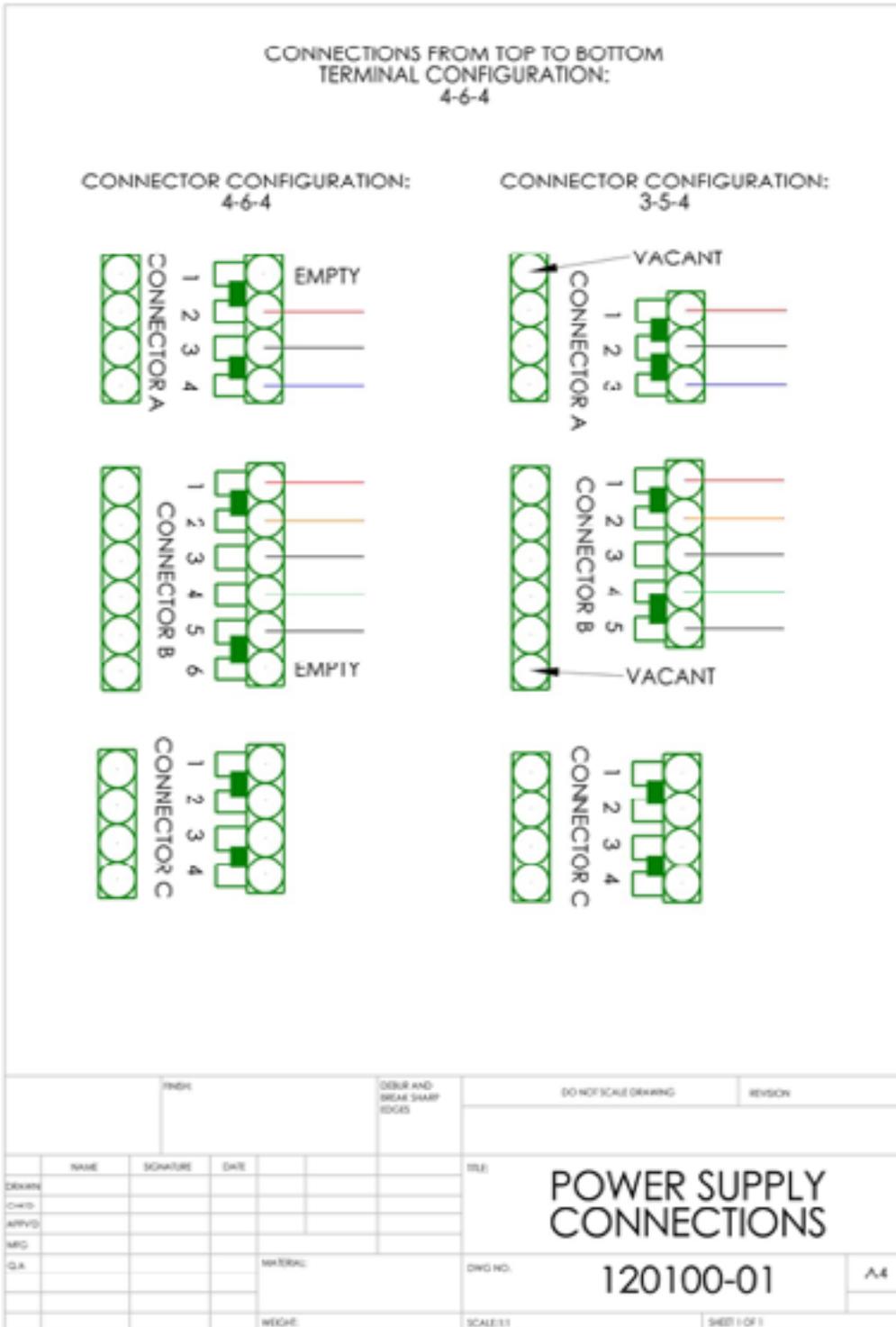


- A. The ends of the belt should protrude by approximately 3 teeth (6mm) through the slot.
 - B. Make sure that the belt forms a flat, closed loop.
4. Tighten the M3 screws to secure and retain the belt. Starting the thread with your fingers can speed the process up.



5. Loosen the idler pulley mount
6. Once the belt has been installed on the riser, loop over the drive and idler pulleys.
7. Tension the belt by pulling on the Y idler pulley mount with your hand. Moderate to strong force is recommended.
8. To re-align the Y gantry, follow the procedures in **TROUBLESHOOTING: Motors do not jug**.

APPENDIX E: POWER SUPPLY CONNECTIONS



APPENDIX F: WARRANTY STATEMENT

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>.



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