

# Control Panel Interface

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This section will guide you through the basic functions of your laser

# Overview

Your Laser system is powered by our advanced 3D PRO controller, which can perform basic functions (alignment and test) without requiring a PC connection. Installation of a microSD card will allow you to permanently store jobs created in our RetinaEngrave software on your laser and thus free up your PC for more important tasks (like surfing the internet).

Once you have prepared a job in RetinaEngrave, you can start the job immediately or download the job to the onboard memory of the laser. To run a downloaded job, there is an additional step of loading the job in the controller's memory before pressing "go". This is done using the LCD touch panel:

1. Press the **Mode Select** button (**FS/Z**) until the MODE field reads "FF".
2. The SELECTION field should read "filename.bin", where "filename" is the name of the job file you loaded.
3. Press the Start/Cancel button (button 6) to load the job.
4. Press the Start/Cancel button again to run the job.

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



## NOTES

- 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.

# Panel and Display

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

- The SELECTION field is located on the top line and gives information on the current operation mode of the laser
- The MODE field is located on the far left of the lower line and tells the operator the current mode
- The 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.
- The 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.
- The POWER field displays the laser current in mA, or “LOff” for current less than 1mA. Sometimes this field will display 1.1mA even when the tube is off; in general, anything less than 2mA is considered off.



Figure 1 – Control Panel

# Button Functions

Panel function buttons are numbered 1-6 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).

- The SELECTION field is located on the top line and gives information on the current operation mode of the laser
- The MODE field is located on the far left of the lower line and tells the operator the current mode
- The 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.
- The 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.
- The POWER field displays the laser current in mA, or "LOff" for current less than 1mA. Sometimes this field will display 1.1mA even when the tube is off; in general, anything less than 2mA is considered off.

## DURING SETUP

### 1. FS/Z (MODE SELECT)

- Toggles between modes
- Fast XY Jog (Mode 0) -> Slow XY Jog (Mode 1) -> Alignment (Mode 2) -> File Select (Mode 3) -> Factory Reset (Mode 4)

### 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.

### 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

- a. In any menu mode (File Select or Factory Reset) this button will select the option displayed in the SELECTION field.
- b. Cancels a move operation (homing, autofocus or a running job).
- c. In Fast/Slow XY, with the laser UNLOCKED, this fires a higher-power test pulse.
- d. In Fast XY, pressing this button after the laser homes will rapidly move the head to the upper left corner of the workspace.
- e. In Slow XY, pressing this button after running a job will allow you to re-run the same job.

#### 7. JOG BUTTONS (4)

- 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.

### DURING A JOB

1. Only the **LOCK/UNLOCK** and **CANCEL** buttons function. All other function buttons are disabled.
  - a. **LOCK/UNLOCK** pauses/resumes the job.
  - b. **CANCEL** cancels the job.
2. **UP/DOWN JOG BUTTONS** allow you to adjust the job power on the fly. Scale is from 0 (no power) to 255 (full power).

## 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.



#### **NOTES**

- 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.

# Software Interface

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This section will guide you through using the software

# Overview

**RetinaEngrave3D** 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:

- **RETINAENGRAVE3D PRINT DRIVER**
- **RETINAENGRAVE3D JOB SOFTWARE**
- **FSL LCD CAPACITIVE TOUCH CONTROL PANEL**
- **RETINAENGRAVE3D PRO LASER CONTROLLER**

A typical job starts with the creation of a design in your favored software. Once you are satisfied with your work, open RetinaEngrave3D then your design program's print dialog. Select the "Full Spectrum Engineering Print Driver", make sure that the "Preflight Check" tab is not giving any warnings then click on 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. You can start the job immediately or download the job to the onboard memory of the RetinaEngrave controller (if you have installed a microSD card). To run a downloaded job, there is an additional step of loading the job in the controller's memory before pressing "go". This is done using the LCD touch panel.

**RetinaEngrave3D** is a powerful program with an easy to use interface. It features standard keyboard shortcuts, which come in especially handy if you have a wireless micro-keyboard.



## NOTES

- The software instructions in this manual are current for Version 4.339
- Hovering the pointer over any button will give you its name and shortcut key.
- RetinaEngrave, like the laser itself, is mode-based. Please note the type of job you wish to run (Engraving, Cutting, Design, etc) is determined by the currently-selected tab above the Job View.
- The control panel determines important job settings and allows you to move the laser head. Keep in mind that each section of the control panel only applies to its corresponding Job View tab (eg Vector Properties only affect the job in the Vector Cut tab).



# Using RetinaEngrave

## GENERAL USAGE

### **OPEN RETINAENGRAVE BY DOUBLE-CLICKING THE DESKTOP ICON OR SELECTING IT FROM THE PROGRAM MENU.**

The program must be open at the time of printing from your design software in order to capture the print stream. Alternately, you can print to an XPS print file while RetinaEngrave is not running and open this XPS file at a later time to print.

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.

### **PRINT FROM ANY APPLICATION AND SELECT THE "FULL SPECTRUM ENGINEERING DRIVER" AS THE PRINTER**

Vector mode will only capture Vector output. Vector mode has been tested with many different vector programs such as CorelDraw X5, AutoCad 2011, Inkscape, Adobe Illustrator, Draftsight and more as shown in our demo videos. However, if you have problems vector printing to RetinaEngrave, use CorelDraw X5. Read the tips on our forums for how to import most file types such as DXF files into CorelDraw. Raster mode should print from any program.

### **SELECT THE MODE TAB – VECTOR CUT OR RASTER ENGRAVE**

Click on the mode tab that corresponds to the type of job you would like to perform. For engraving, keep in mind that engraved areas should be black. For cutting, colors (Blk, Red, Grn, Blue, Magenta, Cyan, Yellow) correspond to individual paths and settings. Use the Control Panel to adjust to power and speed of the job.

### **PRESS THE "GO" BUTTON TO START CUTTING**

This downloads the job to the laser's temporary memory and starts it. The cutting happens in the background. While every effort is made to efficiently multi-thread the process, avoid memory-intensive tasks while cutting because the trajectories are calculated on the fly by the software. Also monitor the progress of the cut on the lower right hand corner.

## VECTOR MODE

RetinaEngrave generates vector information from .xps files directly. RetinaEngrave is capable of recognizing up to 7 layers of vector information based on line color; Cut+Engrave operations reserve Black for engraving. All other file types must be opened in their native application or CorelDraw and sent through the Windows print dialog. Alternatively, print to the “XPS Document Writer” and open the resulting .xps within RetinaEngrave.

## RASTER MODE

RetinaEngrave can open .xps files and various image formats to generate Raster images for engraving. However, RetinaEngrave handles 1-bit bitmaps differently from other formats as it does not rescale a 1-bit bitmap. In 1-bit mode, 1 pixel = 1/1000 of an inch or 1/500 or 1/250 depending on the selected output resolution. If the pixel is black it will fire the laser, otherwise it does not fire. 1-bit bitmaps produce the most predictable output. Other image formats are opened with best-effort conversion and up-scaling. You can generate your own 1-bit dithered images for grayscale effects. There is a tutorial on using Adobe Photoshop to generate 1-bit bitmaps on the Full Spectrum Laser forums.

## ADJUST THE THRESHOLD TO INCLUDE OR EXCLUDE PORTIONS OF THE DRAWING IN RASTER MODE

When working with a grayscale image, adjust the threshold up or down to alter which portions of the image you wish to engrave.

## RASTER RESOLUTION

DPI (Dots Per Inch) is a measure of the pixel density of an engrave. For example, 1000x1000 DPI corresponds to 1000 left to right sweeps per vertical inch of an image. Higher DPI settings will engrave more deeply as the average laser on time per unit area is higher. Engraving at 250dpi will be 4x faster than 1000dpi. We have found that 250DPI works well for most block/vector engravings and 500DPI works well for image engraving.



### NOTES

- The job origin in RetinaEngrave is the upper-left of your design.
- RetinaEngrave does not use a fixed index system: the job origin is the current position of the laser head, wherever it happens to be. Make sure to position the head such that your job fits into the workspace and onto your work piece.

# Automatic White Space Cropping

RetinaEngrave automatically crops white space from the page. This allows the use of programs like MS Word where you cannot set the exact position of the output easily on the page. To prevent cropping, draw a colored rectangle (yellow recommended) around your objects at the desired output size. In Raster Mode, use the Threshold button to fade brightly colored lines. In Vector Mode, set the Repeats of the yellow layer to 0 to ignore this line. In Figure 3, there is a yellow box drawn around the items. When this image is printed, it is cropped to the yellow box outline and the size is 6.71"x3.48". In Figure 4, the yellow box is omitted. The image is cropped to the extents of the non-zero pixels and produces an image that is 4.77"x1.22".

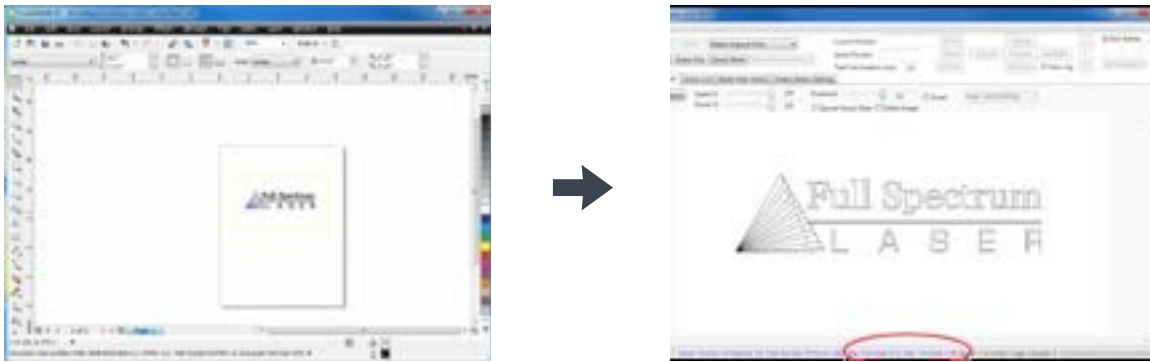


Figure 3 - Outline Cropping

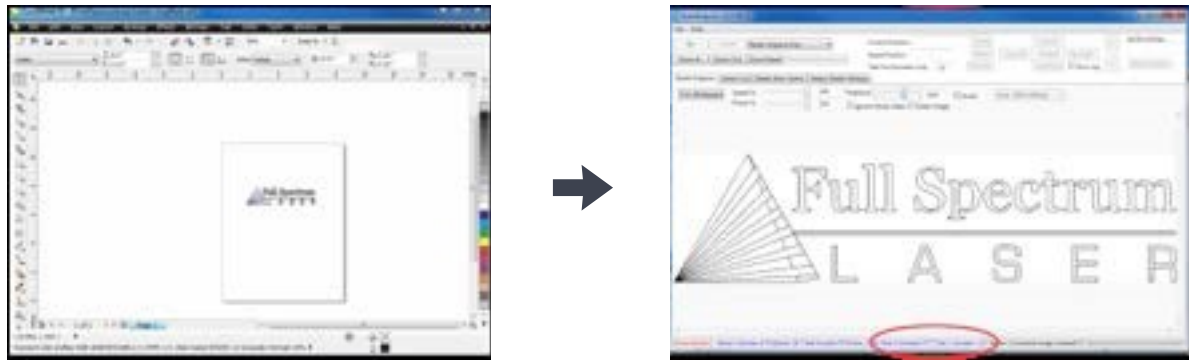


Figure 4 - Standard Cropping

This feature is particularly useful when trying to align the drawing on existing material. For example, if you have a 4"x6" wood plaque that you want to engrave, measure the size of the plaque then draw a 4"x6" yellow box this size in your drawing. Put the text inside this box. Set the position of the laser to the top left hand corner of the wood plaque and press Start and it will raster the same size and location on the plaque as you have laid out in the drawing.

# Printing Size

The paper size within the printing options must match the work area of the laser you are printing to. This is done at time of printing and is independent of the software you are printing from. RetinaEngrave automatically crops all whitespace from the image so the first non-white pixel is at position (0,0) in the top left.

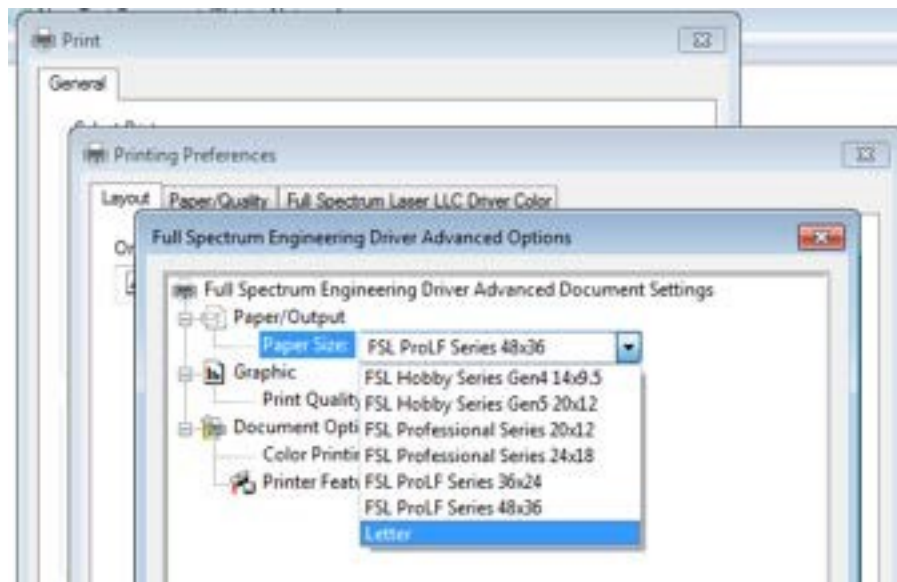


Figure 5 - FSL Printer Driver Work Area Selection

## TO CHANGE THE PAPER SIZE:

- Select Preferences → Advanced and change the paper size.

# Description of Major Interface Features

Please note that certain advanced features require attachment upgrades to the laser (notably Z axis, autofocus and rotary functions).

In this section you will be introduced to the major interface features of RetinaEngrave. We will go through the interface one line at a time from left to right and start at the top (Figure 21). Shortcut keys are bracketed [].

## THE WORKSPACE

The workspace is a preview of your current job.

## LINE 1

### FILE MENU

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.

The options 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.

### LASER MENU

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.

The Laser menu also allows you to save the current job and settings as a .bin file onto a MicroSD card (when the card is loaded onto the laser).

The laser Card Commands sub-menu should only be accessed by direct request and under supervision of Full Spectrum Laser support staff.

## TABS MENU

The tabs menu allows you to show the 3D engrave tab or Control Panel.

## HELP MENU

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 MENU

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 fixture points or between fixture points.

## LINE 2

### 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.

### 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.

### 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 (ADVANCED USERS)

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.

## ESTIMATE JOB TIME

This button calculates the job time based on the current speed settings. The resulting estimate can be found in the lower right hand corner of RetinaEngrave.

## 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

Displays the 3D engrave tab.

## 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 3in square, the laser will fire and move 3in to the right, then 3in forward (down), then 3in left and finally 3in 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 up-pause 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 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 (eg 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

The control panel contains 5 sections: **Jog, Raster Properties, Import Options, Source Image Info and Vector Layers.**

The Jog section 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.

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.

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.

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.

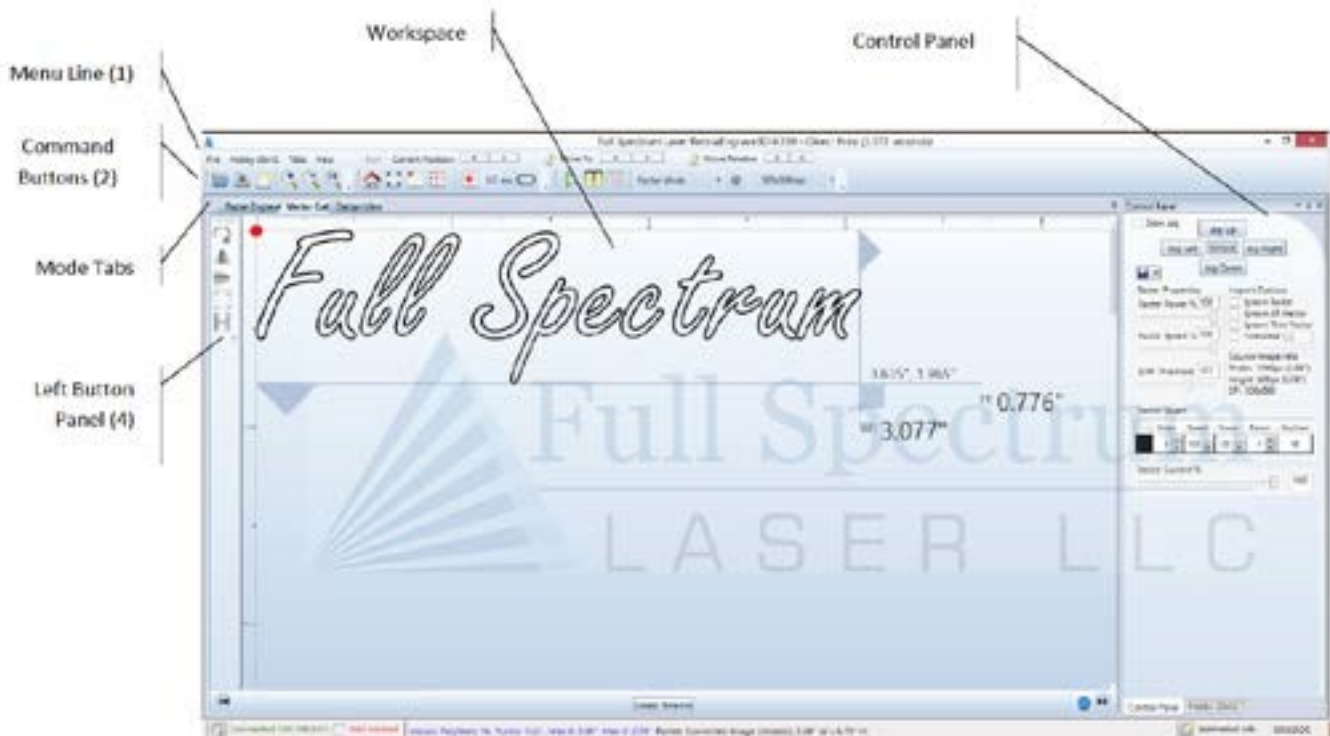


Figure 6 - RetinaEngrave3D Interface

## CUSTOMIZING THE INTERFACE

The user interface for RetinaEngrave3D 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 (Figure 7) 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.

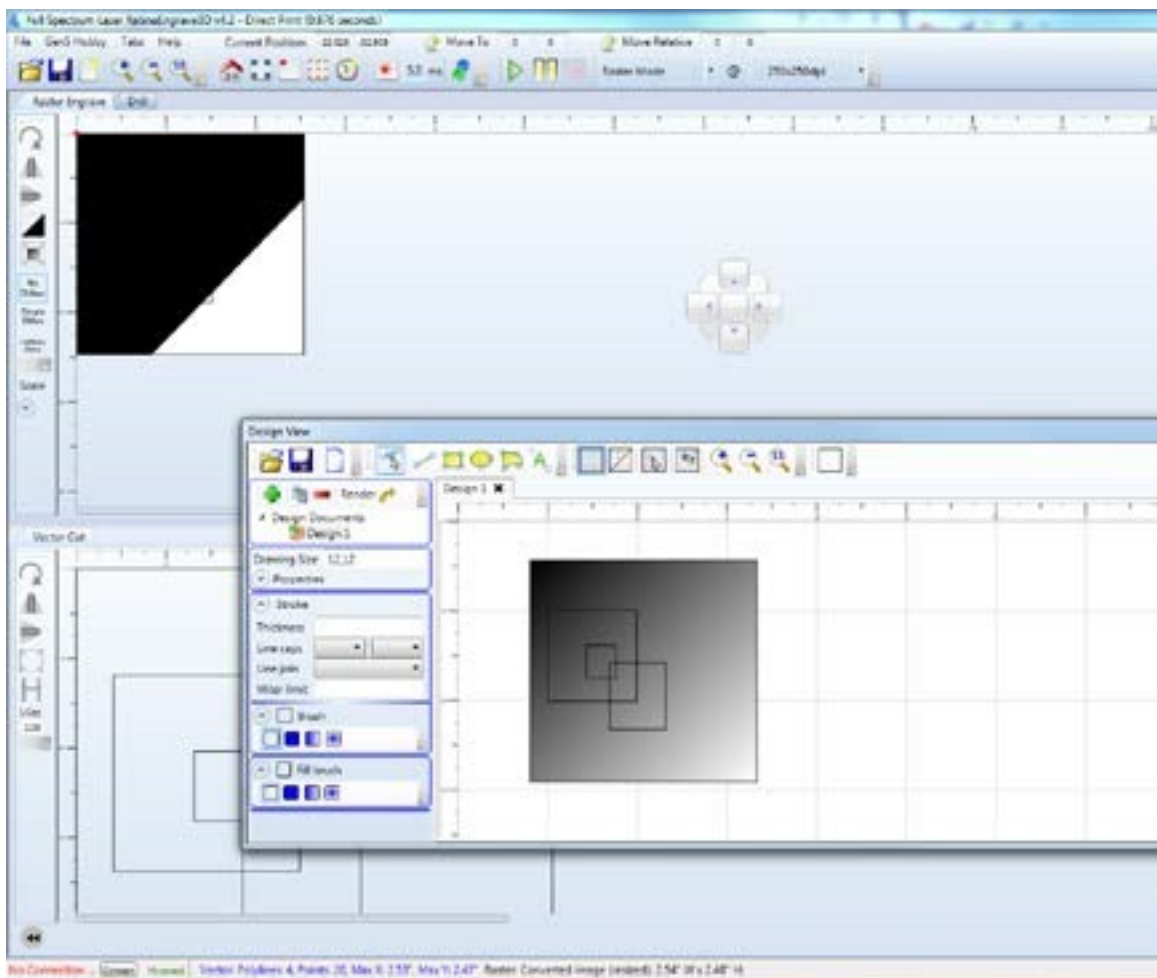


Figure 7 - Customizing the RetinaEngrave3D Interface

# Engraving

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The proceeding sections will introduce you to engraving with RetinaEngrave3D

# Overview

Your Full Spectrum Laser Hobby Advanced Laser System has several advanced functions that make it easy to bring your designs from your PC 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 Thermark™. 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 work piece. 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 (Part 9), by setting the power such that you score the work piece 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 through high-resolution photographs. The proceeding sections will introduce you to engraving with RetinaEngrave3D.

## Raster Engrave Tab

Select this tab before hitting the Start button to Raster Engrave only. If your image looks cut off or cropped, be sure to read Part 7: Working with Projects Larger than 8.5”x11” to learn how to change the paper size in your program. Please refer to Figure 21 for a visual representation of the Raster Engrave interface.

### 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.

**TRIM WHITESPACE**

Use this button to automatically remove additional whitespace in the image after using the Threshold slider. Usage of this button is not recommended; instead, adjust your design in its native drawing software to remove items you don't want to show up on the output before printing. RetinaEngrave automatically removes whitespace for all non-zero pixels.

**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.

**SCALE IMAGE**

The Scale dropdown allows you to scale a design before engraving. Set the scale factor in the field and apply it using the set scale button.

## RASTER PROPERTIES AND IMPORT OPTIONS (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 will result in the laser not firing. Keep this in mind when setting power below 10%.

### 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 settings of 250x250dpi for most applications; text as small as 4pt can be engraved at 500dpi with excellent readability. Typically, 1000dpi 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 (0.002-0.005in) 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 (woods).

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 250dpi. By selecting 1000dpi before printing, the laser will import at 250dpi then upscale the image using a bi-cubic interpolation to 1000dpi.

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



## **IMPORTANT NOTE: 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, for example 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 1in buffer on the left and right sides to avoid crashing the laser head..

# 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 work piece. 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 (1000dpi).

In the case of non 1-bit .bmp images (greyscale/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.



## Summary of Best Practices for Image Formats

SOURCE TYPE	IMPORT METHOD	NOTES
1bit BMP	Drag and Drop, File-Open	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/Greyscale 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 images	Drag and Drop, File-Open, Direct Print	For best output, Raster at the import DPI

## Case Study: The Effects of Up-scaling Following Direct Print

We have generated a small 50x50 pixel box. In the following illustration, the center box is the original size. This is direct printed using “Half Page” format from Windows Picture Viewer. Figure 8 is the actual size of what is generated from Direct Print. Figure 9 is the result of a Direct Print at 250dpi. Observe the rounded edges due to the drastic increase in size.

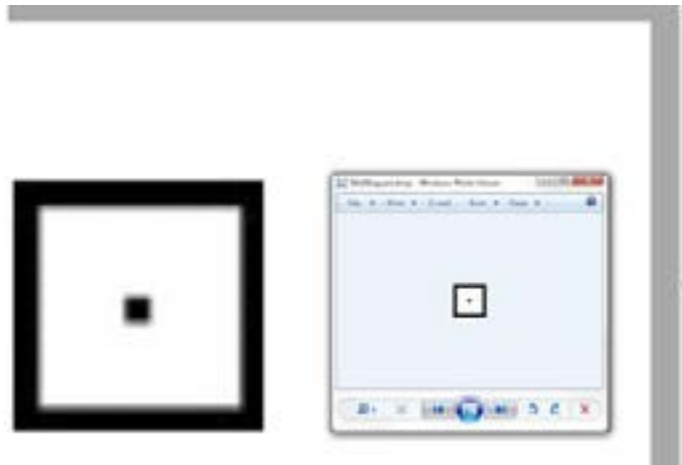
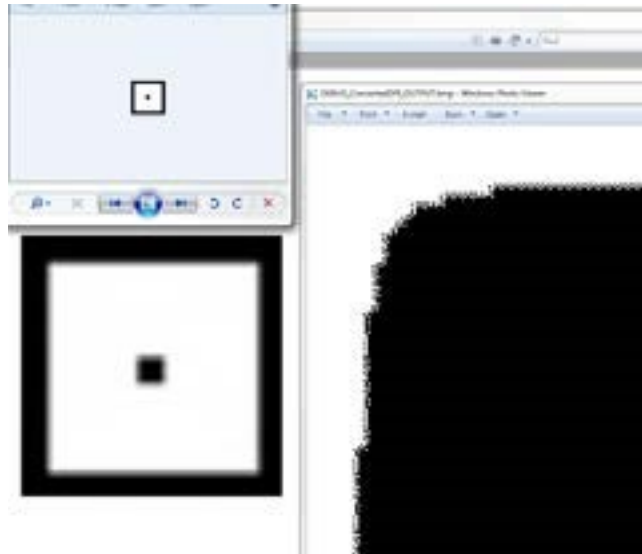


Figure 8 - Direct Print Source



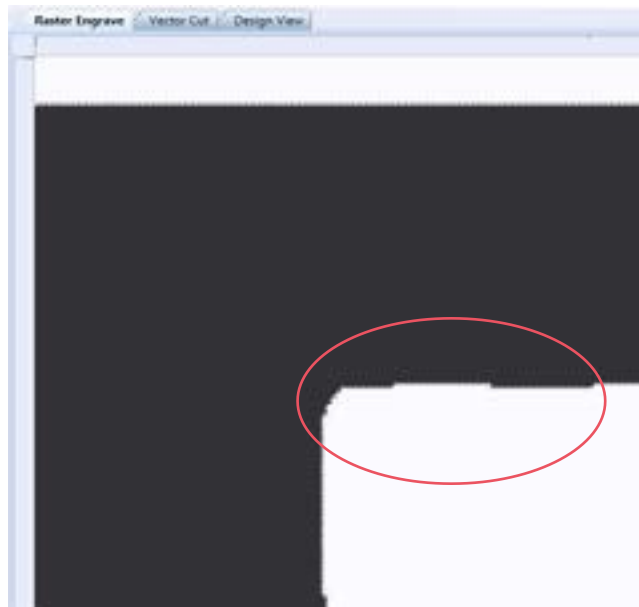
Figure 9 - Direct Print at 250dpi

If we select 1000dpi within RetinaEngrave and then Raster, we get surprising results. The right image in Figure 10 is the actual output that is sent to the laser, including the anomalies along the edge. This is the result of direct printing from a small source to a large output and rastering at a much higher DPI than the project was direct printed at (1000 vs 250).



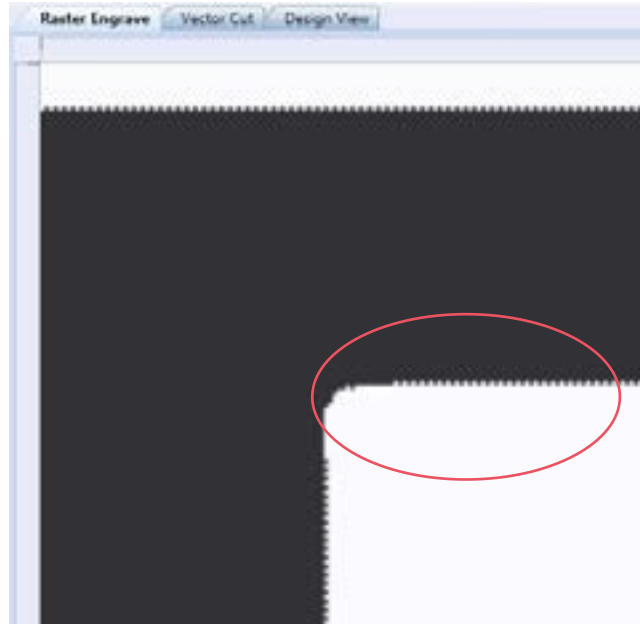
**Figure 10 – 1000dpi Output from 250dpi Print**

In Figure 11 we take the corner of the same project and output it at 500dpi instead of 1000. The effects are still visible although not as severe as using a 1000dpi output.



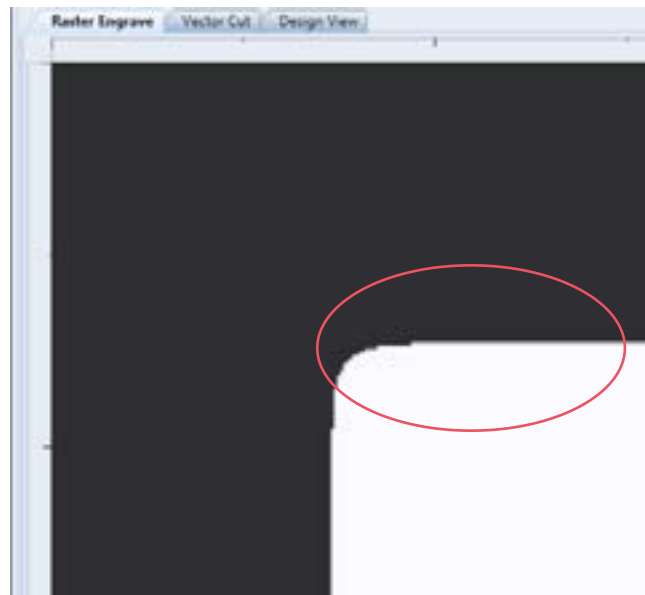
**Figure 11 – 500dpi Output from 250dpi Source**

Figure 12 shows a Direct Print at 500dpi with output at 250dpi.



**Figure 12 – 250dpi Output from 500dpi Source**

When we print at 250dpi and output at 250dpi, we find the best results because import and output DPI are identical (Figure 13). The software must up-sample to 1000dpi in order to lase, resulting in an image  $\frac{1}{4}$  the size of the original. In order to output at the same dimensions as the source, the software skips 4 lines for every line of output on the Y-Axis. In this way, no scaling is required and no anomalies are introduced as pixels need not be generated before output.



**Figure 13 – 250dpi Output from 250dpi Source**

# Cutting

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The proceeding sections will introduce you to cutting with RetinaEngrave3D

# Overview

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 X5 and recommends that Hobby Advanced 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 7 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.

**NOTE:**

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

Select this tab before hitting the **Start** button to cut the paths displayed in the work area. If your image looks cut off or cropped, be sure to read Part 7: Working with Projects Larger than 8.5"x11" to learn how to change the paper size in your program.

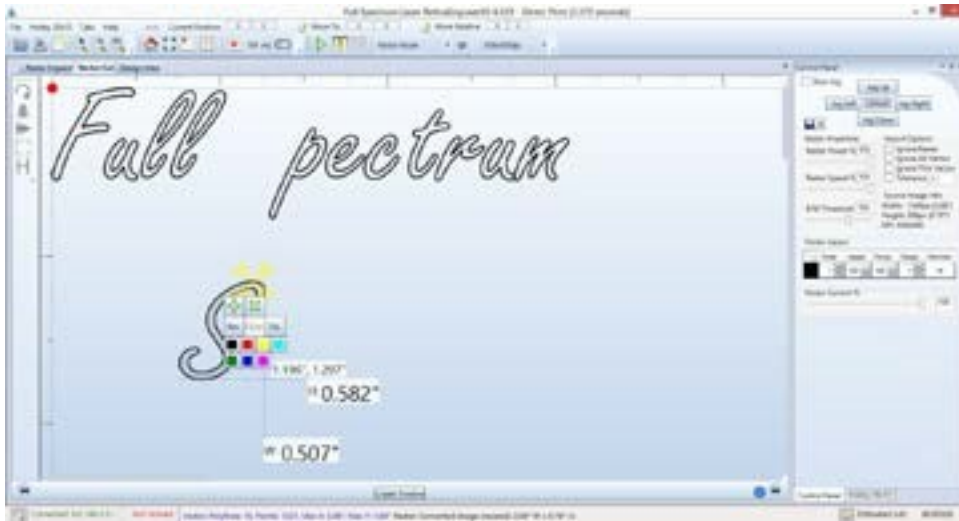


Figure 14 – Vector Engrave Interface

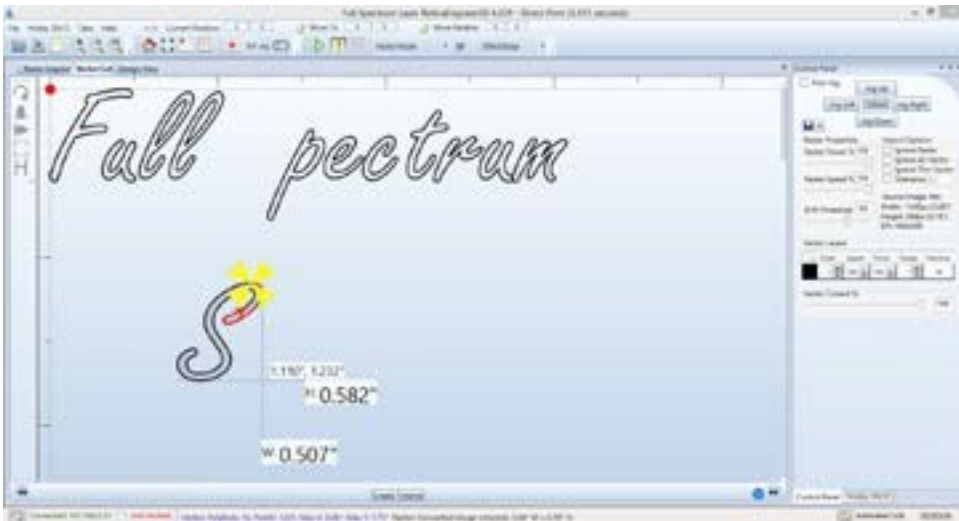


Figure 15 - Vector Cut Path Selection

## 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 % AND 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.

### 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 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.

- Layer: The designated color of the layer
- Order: Layers are cut in order from 1 to 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.
- Repeat: Set the number of repeats of the layer at the chosen power and speed settings. Set to 0 to ignore the layer.

# Designating Layers

Designating a color to objects/ layers you want to vector cut enables you to take advantage of RetinaEngrave3D's ability to specify cutting order, cut speed, laser power and number of repeats for each layer.

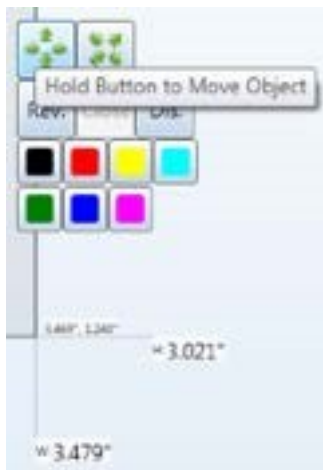
RetinaEngrave supports up to seven standard color layers for maximum program compatibility: **Black**, **Blue**, **Red**, **Magenta**, **Green**, **Cyan**, and **Yellow** from the RGB color palette.

RetinaEngrave uses a best guess color round off routine when a color is not a standard RGB color. Avoid **Black** whenever possible because this is the default color RetinaEngrave uses whenever it cannot figure out what color it should be. By avoiding Black, you will have more control.

## 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 (poly line) 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 un-closed poly line (for advanced users).

# Advanced Functions

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This section introduces you to the advanced capabilities of RetinaEngrave3D

# Overview

The following sections introduce you to the advanced capabilities of RetinaEngrave3D. Some of these capabilities are only possible with the purchase of extra attachments (rotary engraving). Please make sure that you are familiar with the previous sections of this manual before working with the advanced functions.

- Combined Engraving and Cutting allows you to set up a job to engrave a design and then cut a pattern
- The Rotary Engraving tab is the interface for setting up a raster job to be engraved on the outside of a cylindrical object (requires rotary attachment)
- The 3D Engraving tab allows you to take a grayscale image and set up a job that will convert it into an automatic series of layers to achieve a 3D effect

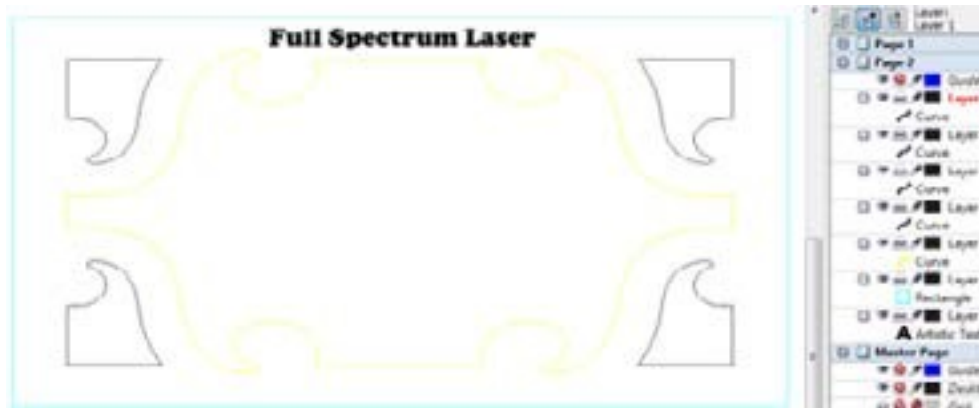
## Engrave then Cut

RetinaEngrave3D supports engraving and cutting in the same job. In this section we describe the process of using CorelDraw X5 to properly prepare your image before direct printing to RetinaEngrave

1. Designate either yellow or cyan to the layers you want to vector and designate black to the layers you want to raster.
2. In our example image we want to
  - a. Engrave the text and the four corner objects in raster mode by changing them to black.
  - b. Cut the middle object and the outside border in vector mode by changing them to yellow or cyan.



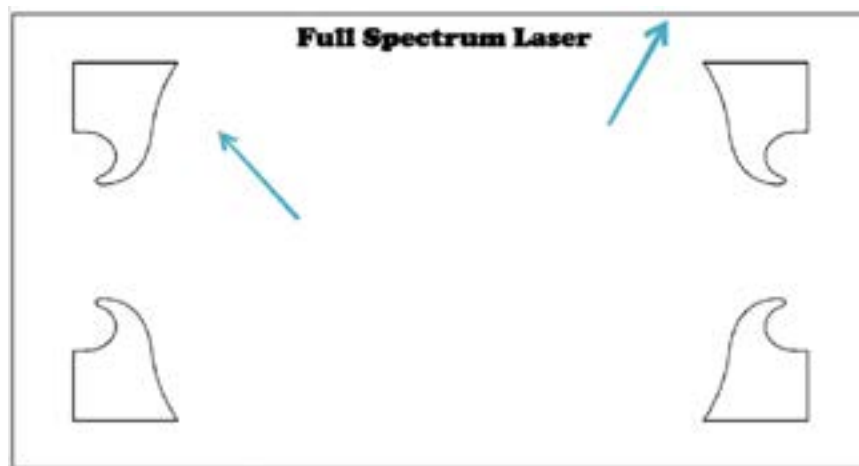
Figure 16 - Engrave/Cut Example Source



**Figure 17 - Engrave/Cut Ready for Direct Printing**

Make sure that any text that is “Artistic Text” in CorelDraw X5 has a Hairline outline applied.

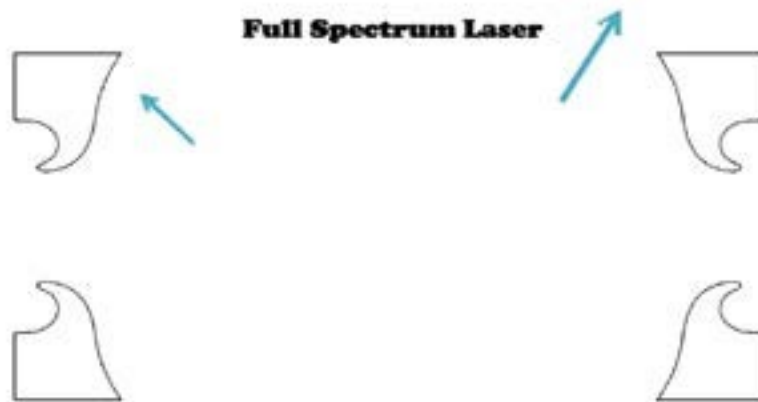
1. Verify that RetinaEngrave is running in the background.
2. File → Print using the Direct Print Driver.
3. Switch the current program view to RetinaEngrave.
4. Use the mode select drop-down menu to choose Raster then Vector mode.
5. Adjust the slider on the the threshold setting to fade out/in objects. RetinaEngrave will only raster what is visible on the screen. Adjusting the slider to the left will fade out objects, while sliding to the right will fade in objects. You can also adjust the threshold by manually typing a value into the box next to the threshold slider between 0.000 and 1 and then left clicking on the image. The maximum threshold value of 1 will make the



**Figure 18 - Yellow Layer After Threshold**

image solid black and should not be used. For optimal results first adjust the threshold almost all the way to the right to a value of 0.999.

6. Slowly adjust the threshold setting to the left until the vector objects that you previously designated yellow and/or cyan in CorelDraw X5 completely fade out, leaving only the black raster objects visible. In our example image we found that a threshold setting of 0.96 made the center yellow vector object completely fade out. The cyan vector border has not faded out and further threshold adjustment is needed.
7. Further adjustment of the threshold to the left to a value of 0.9 makes the cyan vector border completely fade out. The threshold for our example image is now properly adjusted leaving only the black objects that we want to raster engrave visible. The end goal when adjusting threshold value is to adjust the threshold to the left just enough to make the yellow/cyan objects fade out while leaving the black raster objects highly visible for optimal detail raster engravings. Threshold settings for your particular image could vary from our example image settings.



8. Adjust the Speed % and DPI to your desired settings.
9. Left Click on the Start button to engrave your material.

When the raster engrave process is complete DO NOT move your material inside the laser cabinet. Both Raster Engrave mode and Vector Cut mode use the same job origin. As long as the material has not been moved between the raster engrave process and vector cut process the image will line up correctly on your material after finishing the vector cutting process.

# The Design Tab

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This section provides basic drawing tools for creating simple designs with RetinaEngrave

# Overview

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.

## **Please note:**

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](mailto:support@fslaser.com)

# Design Tab Functionality

## LINE 1

### **OPEN, SAVE AND NEW PROJECT BUTTONS**

These buttons allow you to load a saved project, save your current project or open a new project. Opening a new project removes any unsaved data in the document design window

### **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 end points to bring up the Shape Properties box and add/remove points and adjust line tangency.

**NEW TEXT**

Place text in the design area.

**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.

**SHAPE PROPERTIES PANEL (LEFT SIDE)****NEW DRAWING, COPY DRAWING AND DELETE DRAWING**

These buttons allow you to create a new drawing, delete a drawing or copy the current drawing.

**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**

Set the total work area drawing size units in inches).

## STROKE PROPERTIES

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

## BRUSH PROPERTIES

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

## FILL PROPERTIES

Specify the properties of a closed shape

## SHAPE PROPERTIES

Control the properties of the currently selected shape. Set exact size of features.

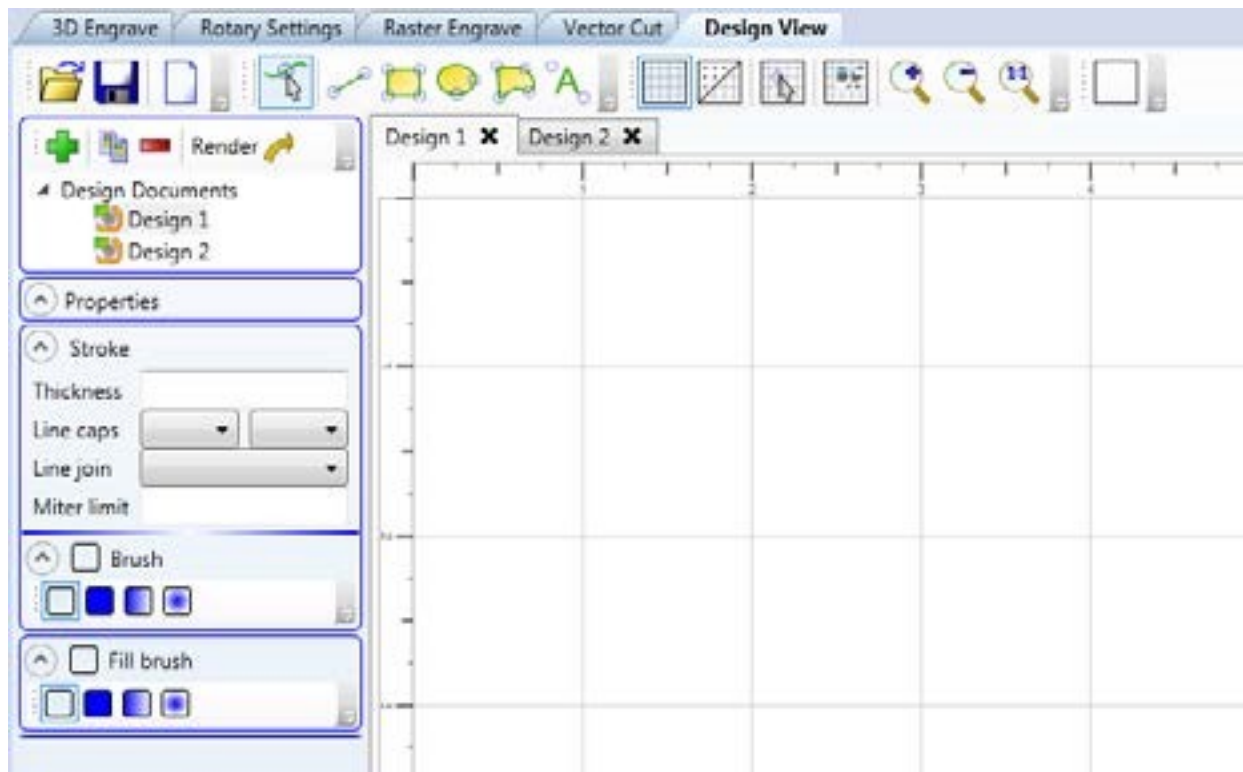


Figure 22 - Design Tab Interface