Section 3

OPERATION AND PRINTER DRIVER CONTROLS

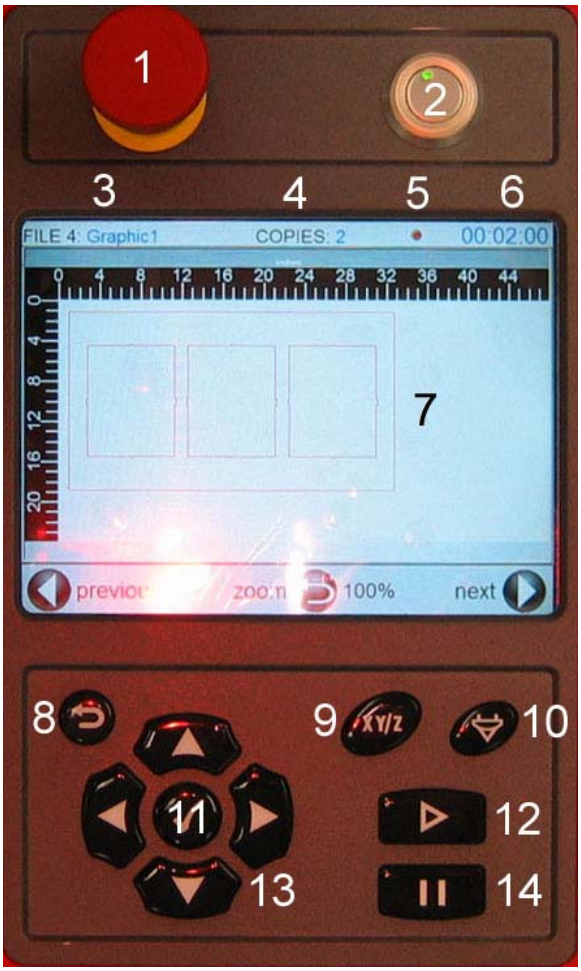
System Operation

Powering On the System

To power on the system, first switch on the main circuit breaker located at the rear of the machine. This turns on the DC power supplies. Then, momentarily press the ON button located on the system control panel.

The Control Panel

The control panel of the laser system provides easy access to all of the controls necessary for cutting and engraving operations.



1. **Emergency Stop**
2. **On / Off**
3. **File Name**
4. **Number of Copies**
5. **Open Interlock Indicator**
6. **Cycle Time**
7. **Display**
8. **Quit / Zoom**
9. **XY/Z Manual Motion**
10. **Camera / Auto Focus**
11. **Select**
12. **Start Mark**
13. **Directional / Scroll Keys**
14. **Pause / Resume**

Control Panel Functions

Emergency Stop
Depressing the Emergency Stop button instantly disconnects all AC power to the system. This button should only be used in case of emergency. To reset the system after executing an E-stop, twist the red button clockwise to release the button. Then, reset the main circuit breaker at the rear of the machine.

On / Off
When the main circuit breaker is switched on, pressing this button will initialize the system and enter the ready state.

File Name
Indicates the file name presently loaded or in the process of being engraved.

Number of Copies
Indicates the number of times the file name displayed has been engraved.

Open Interlock Indicator
A visible RED dot indicates an open interlock (door or panel).

Cycle Time
The amount of time displayed in minutes and seconds to complete one engraving cycle.

Display Screen
The display shows file and system information, provides access to the system controls.

Quit / Zoom
While mark file is visible on display, press to zoom, while in menus, press once will allow you to exit.

XY/Z Manual Motion
The motion button provides access for manual movement of the axes.

Camera / Auto Focus
Pushed once this button will turn on the camera, pushed a second time will allow Auto Focusing of the Z-axis.

Select
Press once to confirm a choice in any menu.

Start Mark
Starts laser processing of the file displayed on the Display Screen.

Direction / Scroll Keys
These keys serve to control manual motion of the axes when used in conjunction with the XY/Z button. They also can be used to scroll through the Display menu.

Pause / Resume
If a file is running, the Pause button halts the file execution and the focus carriage will move back to the home position in the upper right corner of the engraving field. Press Pause a second time will resume the file from the last point processed.

The Menu System

The Viewer Mode

When first powered on, the system will initialize and the display will enter the Viewer Mode. In this mode, the display will automatically show the last file entered into memory. This indicates the system is ready for operation. The file name, the number of cycles executed (copies) and the execution time will be displayed in the Viewer mode.

The system has on-board hard-drive memory, capable of storing up to 100 job files in a print cache. The number of jobs to be stored is adjustable, and can be set by the user in the System Options menu. When the maximum number of files is exceeded, the software will automatically begin deleting the oldest jobs as the new jobs are entered into the cache. The entire cache can also be cleared from this menu.

The left and right scroll keys allow the user to navigate the jobs currently stored in the print cache. When the desired job is displayed in the viewer, the details of that job can be accessed by pressing the Select key (✓) to open the File Editor. In the File Editor, job settings and parameters can be accessed and edited, even during execution of the file. **Changes made to a job in this way will be permanently saved with the job in the print cache!** The file will not revert to the original settings.

File Editor

To use the File Editor, use the Scroll keys to highlight the item to be edited, and then press the Select Key
(✓) to select the item. This will open additional options for editing the selected item.

Color

Select from the list of available colors:

- Black
- Red
- Green
- Yellow
- Blue
- Magenta
- Cyan
- Orange

Mode

Options are Raster, Vector, Raster/Vector and Skip.

Power

Power can be set from 0 to 100%

Speed

Speed can be set from 0 to 100%.

PPI

PPI can be set from 0 to 1000.

Z-Axis

The material thickness can be entered for focusing purposes.

Air / Gas Valve

Gas, Air or Off can be selected.

Air/ Gas Flow
The air or gas flow rate can be set from 10% to 100%, in 10% increments.

Image
The Image Density set in the print driver is displayed, but cannot be edited.

Which Laser
Both / Top / Bottom

Red Dot Pointer
On / Off

Delete This File
Yes / No, used to delete selected file.

System Options Menu

About
SW: Software Version Vx.xx
FW: Firmware Version Vx.xx
HW: Hardware Version Vx.xx

Language
English
Espanol
Francais
Deutsch
Italiano

Units
Inches
Metric

Connection
IP: Fixed IP Address Input.
DHCP: Network Assigned IP Address.

Auto Z
On / Off: Allows Z height to be programmed in the printer driver.

1. Enable the Z Axis in the printer driver.
2. Using the slide scale in the printer driver set material thickness.
3. Press set in the printer driver.
4. Table will lower to the edited Z height before mark starts.

Red Dot Pointer
On / Off: This option is used for test marking, when active the diode pointer is on, laser beam will not be emitted. All doors must be closed before motion will move.

Lens Type
Not selectable, all lens types are detected automatically; all must be calibrated in the Set Lens Focus section of the System Options Menu.

Cutting Table (Optional)

Installed Yes / No: Used for calibration of an optional cutting table.

1. Home Z axis.
2. Press XYZ to enter the motion menu.
3. Press XYZ again until Z axis is highlighted.
4. Press ✓ to accept.
5. SYSTEMS OPTIONS MENU will appear.
6. Scroll down to the CUTTING TABLE INSTALLED.
7. Press ✓ to enter.
8. Press ✓ again to toggle CUTTING TABLE INSTALLED.
9. Press ✓ to accept.
10. Press the DOWN SCROLL ARROW too choose CALIBRATE.
11. Press ✓ to open CALIBRATE MENU, using the focus tool, focus to the top of the cutting table by pressing either the up or down arrow.
12. Press ↩, you will be prompted to save new Z position, choose yes or no.
13. You have now completed focus to the CUTTING TABLE.

Traveling Exhaust (Optional)

On / Off: Activates optional traveling exhaust blower.

Tuning

Used for raster engraving only. Shifts right to left and left to right raster lines for better quality engraving. Set automatically through print driver or manually at display.

Alignment Mode

Used for performing beam alignment and to test for max power.

1. Remove the lens kit from the focus carriage by removing thumb screws.
2. Using masking tape, tape over the beam entrance hole on left side of carriage.
3. Press XYZ then ✓ to access the System Options Menu.
4. Scroll down to Alignment Mode, press ✓ to select.
5. A screen will appear with defaults of 5% power and 2 KHz and Both for laser option.
6. If changes need to be made to the default settings, press XYZ to edit, then using the arrow keys select which setting you wish to edit. Press ✓ to confirm.
7. Press ↩ to return to the previous window.
8. Using the arrow keys, move the carriage to the upper left corner.
9. Press ✓ to fire the laser, press again to stop firing the laser. Fire the laser only long enough to discolor the tape.
10. Using the arrow keys, move the carriage to the lower right corner.
11. Press ✓ to fire the laser, press again to stop firing the laser. Fire the laser only long enough to discolor the tape.
12. Both burns should be overlapping and in the center of the tape.
13. If not, make adjustment to the #2 mirror assembly until 2nd burn covers the 1st.
14. Press ↩ to quit. Motion will return home.

Print Job Cache

System will store up to 100 jobs.
Jobs downloaded to system are permanently stored on the internal hard drive; jobs can be accessed from the main screen (job preview screen).

Clear Cache
Yes / No: Permanently deletes **ALL** stored jobs from system hard drive.

Screen Saver
Sets delay in screen saver on time.

Align Camera (Optional)
Used for calibrating offset from center of focus lens to center of camera.

1. Focus on material.
2. Press XYZ / ✓ / Align Camera /✓.
3. Place material in lower right corner.
4. Press ✓ OK, a cross hair will be engraved. DO NOT MOVE MATERIAL.
5. After cross hair appears scroll down to ALIGN CROSS HAIR, press✓.
6. Wait 5 seconds then move arm by hand. Align cross hair over marked cross hair.
7. Press ✓ to save.
8. Offset will appear.
9. Press ↩ to quit.

Home XY Axis
Homes motion in both the X and Y axis.

Home Z Axis
Homes Z table by lowering table to the bottom sensor.

Detect Collision
No / Yes: When enabled anything protruding above the focal plane will cause collision sensors to stop motion.

Allow Auto Focus
Yes / No: Allows the use of sensor to set focal height.

1. Press ◈ focus mode.
2. Wait 10 seconds.
3. Move carriage over object to be engraved using your hand.
4. Press ◈ focus a 2nd time.
5. You will be asked if you would like to SET FOCUS, press ✓ for yes.

Set Lens Focus
Set Z height for use with Auto Z.

1. Remove all objects from underneath the Z axis table.
2. Scroll down to Home Z Axis, then press✓. Z table will lower to bottom sensor.
3. Press↩ to return to the motion menu, press XYZ again to toggle to Z Axis.
4. Using the arrow keys ✥ focus to the top of the table using the appropriate focus tool.
5. Scroll down to SET LENS FOCUS, choose yes.
6. Z axis will now read 0 on the display.

Diagnostics (This section used for service only)

Manual Motion

When in the Viewer mode, the Manual Motion screen can be accessed by pressing the **XY/Y** button. Once opened, you can toggle between X-Y motion and Z- Motion. The selected axes can then be moved manually using the Direction Keys.

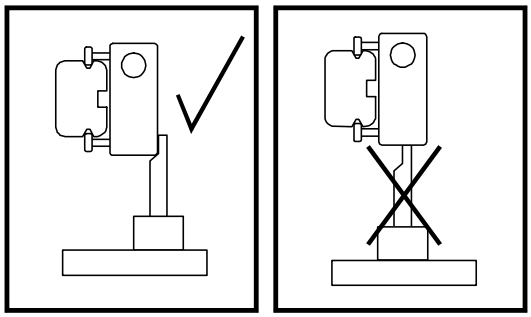
Focusing the Laser

The laser beam passes through the focus lens and converges to a small spot, called the focus point, approximately 2 inches from the bottom of the focus carriage when using a 2.0 lens. In order to engrave or cut properly with the laser beam, the material must be placed exactly at that focus point. To accomplish this, the Z-axis engraving table moves up and down. There are currently 3 methods used to focus the laser beam to the surface of the material: 1) manually by using the focus tool, 2) the Z Position Method using the Auto-Z feature, and 3) Auto Focus Sensor.

Focus Tool Method

First, select *Auto-Z Disabled* in the System Options menu or the print driver. This will insure the Z-table will not move unless intentionally commanded by the operator. Place your material on the engraving or cutting table. Visually make sure that the height of the material will not interfere with the focus carriage when it moves over the material. Select **XY/Z** and use the Motion Control buttons to position the focus carriage. Again using the XY/Z button to select Z, move the Z-axis Table up or down.

Place the focus tool on top of the material and with the focus carriage directly above it, raise or lower the table so that the flat edge the tool rests against the front side of the focus carriage. Slowly raise the table until you observe the tool either tilting or sliding away from the focus carriage. This will occur when the bottom edge of the focus carriage meets with the top of the beveled edge of the focus tool. The objective is to stop moving the table at the point where the tool just starts to move or tilt.



The procedure must be repeated whenever a material of a different thickness is required.

WARNING: To avoid damage to the focus lens, avoid positioning the focus tool underneath the focus carriage.

Sometimes it is desirable to be slightly out of focus when engraving or cutting. It widens the beam at the surface of the material to soften the image or create a wider cut line.

WARNING: DO NOT engrave or cut too far out of focus, as this can be a potential fire hazard. A maximum of .05 inches above or below precise focus should be the absolute limit.

From a physics point of view, there is no difference between raising the Z-axis table a specified distance from the focal point and lowering the table the same distance from the focal point. However, from an applications point of view, we recommend lowering the Z-axis table when intentionally **RASTER ENGRAVING** out of focus and raising the Z-axis table when intentionally **VECTOR CUTTING** out of focus.

Z Position Method and Focus Position Calibration

The Z position method enables the operator to set focus position by entering the thickness of the material in the printer driver.

When using the Z Position method, it is best to first calibrate the Focus position of the focus lens installed. This will insure that the focus position is correct. To do this, open the System Options Menu, and select

Home Z-axis. Make certain that there is nothing under the Z-table that could obstruct the table motion. Select **XY/Z** and use the Motion Control buttons to position the focus carriage to the focus tool. Again using the XY/Z button to select Z, move the Z-axis Table up or down and set the focus position directly on top of the engraving table. Once you are satisfied that the focus height is exactly correct, open the System Options menu and select Set Lens Focus. Set the current calibrated position as the lens focus.

Periodically you should check if the Z POSITION method is calibrated with your focus tool. Since your focus tool is your absolute reference, make sure that you do not lose it. The Set Lens Focus option is used to recalibrate the Z POSITION method.

Once the calibration is set, the focus can be set in the print driver. In the driver, select *Z-axis Auto*. For each color used in the layout it will be necessary to specify the material thickness by either using the z-axis slider, or entering the thickness value directly into the Z-axis text box. When executing the file, the system will automatically compensate for the specified material thickness by positioning the Z-axis accordingly.
See Auto Z / Set Lens Focus.

Auto Focus (Sensor)

Auto Focus will allow you to place your material to be engraved under the focus lens. By pressing the Auto Focus Button on the display the system will focus on to the material using a sensor. **See Allow Auto Focus.**

Printer Driver Controls

Definitions and Terminology

Vector Graphic: An image generated from mathematical descriptions that determine the position, length, and direction in which lines are drawn. Vector graphics are composed of fills and/or outlines.

Fill: A color, bitmap, fountain, or pattern applied to the interior area of a vector graphic.

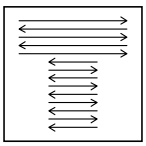
Outline: The line that defines the shape of a vector graphic.

Bitmap: An image composed of grids of pixels or dots.

Motion System: The mechanical/electrical system that delivers the laser beam by moving the focusing lens directly above the application material.

Laser Beam Delivery Method (Mode): Three distinct ways the laser system can deliver the laser beam to the application material called raster engraving, vector marking, and vector cutting.

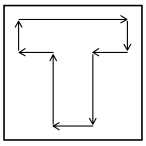
Raster: The process where the laser beam makes a series of bi-directional, horizontal scan lines to produce an image. Fills and Bitmaps are automatically raster engraved by the laser system.



Vector: The process where the laser beam follows the path of the outline (if present) of the graphic.

Marking: Setting the laser power low enough to only penetrate the surface of the material.

Cutting: Setting the laser power high enough to cut all the way through the material (if the material can be cut).



NOTE: When adjusting the printer driver settings, it is highly recommended that you practice engraving or cutting on a scrap portion of that material in case the settings need to be re-adjusted to obtain the desired results.

Laser Settings

Pen Mode

The driver uses the word "PEN" because the laser system works similar to the operation of a pen plotter output device. A pen plotter physically selects a colored pen that matches the same colored objects in your graphic, called "color mapping", and draws the graphic, on paper, in that color. The laser system, however, applies a Mode, % Power, % Speed, PPI, Z Axis and Flow (Air or Gas) setting to the individually colored objects in your graphic. Up to eight (8) sets of user-adjustable parameters, which control laser beam delivery to your application material, can be "mapped" to the respectively colored filled or outlined objects in your graphic.

NOTE: Black and white, grayscale, and color bitmaps are all mapped to the black color's settings.

Clicking the square button toggles through the following laser beam delivery modes for the each of the eight respective pen colors.

- ***RAST/VECT*** (default) rasters fills and vector marks or cuts proper outlines.
- ***RAST*** rasters all fills **AND** outlines regardless of outline thickness.
- ***VECT*** only vector marks or cuts proper outlines. It will skip all fills and will skip all outlines with line weights thicker than a hairline.
- ***SKIP*** ignores all fills and outlines.

Color, Power, Speed, and PPI

To change the % Power, % Speed, and/or PPI of a color, position the mouse arrow on the color name and click once. This will highlight the color's parameters and will allow the changing of the settings by using the scroll bars or by typing in each setting in the appropriate control box. It is possible to click on more than one color to set them to the same setting at the same time.

% Power

Available settings are from 0 to 100%. This setting is directly related to how deep the engraving will be. The higher the setting, the deeper it engraves, marks, or cuts, and vice-versa.

% Speed

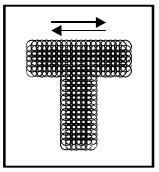
Available settings are from 0 to 100%. **For optimal engraving quality we recommend never exceeding 70% speed.** This setting determines the maximum rate of travel of the motion system. Actual engraving time (throughput) is not only dependent on the % Speed setting, but is also dependent on the size and the placement of the graphic in the engraving field. The motion system will accelerate/decelerate as fast as it can up to the chosen speed. If the motion system cannot achieve the chosen speed based on the size of the graphic or graphical placement in the field it will automatically adjust its speed internally to the maximum speed it can achieve. This is evident when you see the motion system automatically slow down while cutting curves or circles as opposed to straight lines. Automatic proportional pulsing (see PPI) of the laser beam will ensure that there is no difference in the depth of cut from straight lines to curves. Remember that depending on the graphic and your chosen settings, increasing or decreasing the speed setting will not necessarily process the file faster or slower, respectively. We will discuss how to optimize the throughput of the system later in this manual.

% Power and % Speed work together in determining how deep the engraving or cutting will be. Higher power and slower speeds produce deeper results. Lower power and higher speeds produce shallower results.

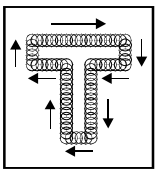
NOTE: 100% raster speed is different than 100% vector speed. Due to the inertia of the X-axis arm, movements in the Y-direction, the speed range is one-third raster speed.

PPI

Available settings are 1 to 1000. The laser beam is always pulsed and never "on" continuously even though it may appear that way. The PPI setting indicates how many laser pulses, per linear inch, the laser cartridge will emit. The pulsing of the laser beam is electronically linked to the motion system. These pulses will always fire, equally spaced, from one to the next, regardless of changes in speed.



In raster mode, the laser pulses are applied in bi-directional, horizontal scan lines just like a dot matrix printer. If you set the PPI to 500 and use the standard focusing lens (2.0") which has a laser spot size of five thousandths of an inch (.005"), pulses will fire every .002 inches (500 PPI), which will produce pulse overlap. Raising the PPI higher, such as 1000, the pulses will overlap more whereas lowering the PPI to something like 150 will spread the pulses out far enough where they may not overlap at all. When raster engraving filled objects, it is advisable to use a PPI setting of 500 or higher. If using less, the image resolution of the engraving is reduced. In some rare cases, using less than 500 PPI may produce better results.



In vector mode, laser pulsing follows the path of the outline of the object. Imagine the laser system working like a sewing machine where the stitching always remains consistent whether you sew fast, slow, or around curves. The setting you use will be application material dependent. Using less than 150 PPI may result in the pulses being spread so far apart that they may or may not touch one another. Perforated paper has this characteristic. Higher PPI settings may cause more of a melting or burning effect on the edges whereas lower PPI settings may reduce the burning, melting, or charring, but may result in a serrated or perforated-looking edge. Increasing or decreasing the PPI setting does not affect engraving speed, only the frequency of the pulses.

Z Axis

By selecting YES, the Z axis will automatically compensate for material thickness. Using calipers, measure the thickness of material to be engraved or cut. Using the slider, set the thickness measured.

Flow (Air / Gas)

All XL Series Engravers come equipped with the air and gas option standard. Simply choose from Air or Gas in the Pen Mode. Using the slider, set the % of pressure desired.

Set Button

After making % Power, % Speed, and PPI adjustments, you must click the Set button to register the change. If you do not click on Set, but click the OK button instead, the settings will revert back to the previous settings.

Image Density

This setting determines how many raster strokes per vertical inch of travel the motion system steps down to produce the engraving. It can also be referred to as the vertical lines per inch or fill spacing. There are six DPI settings to choose from 1000, 500, 333, 250, 200 and DRAFT. In the Windows XP driver it is termed Image Density; there are 6 Image Density choices. Higher Image Density (DPI) settings produce better quality raster images, but reduce productivity by increasing engraving time. Lower Image Density (DPI) settings produce lower quality raster images, but increase productivity by decreasing engraving time.

Image Density (DPI) settings will also have an effect on vector quality and vector speeds when vectoring other than straight horizontal or vertical lines. For example, a circle is made up of very small straight-line

segments linked together at very small angles. If you choose a high quality setting such as 6 (1000 DPI), then these segments are as small as possible and they are high in quantity. The result is the smoothest looking circle but will take longer to vector engrave or cut because the focus carriage must start and stop at the ends of each line segment. Since there are many segments, it will take longer to process, but the quality will be the highest that the machine can produce. If using a low quality setting such as 1 (DRAFT), these segments become longer, but there are less of them resulting in more flat-edged looking curves that will process faster.

By running samples on scrap materials and practicing with different settings, you can find a compromise between throughput and engraving quality.

Settings

A unique feature of the printer driver is the ability to store all of its settings in a file without you having to write them down. These settings files are what we call LAS files.

Save

By clicking Save, the "Save Engraving Setup" dialog box will appear and will allow you to enter in a file name. All settings will be stored in this file that has a ".LAS" extension. DO NOT rename the extension; the driver will not recognize the file as a laser settings file if it does not have the ".LAS" extension name. These files can be stored in any directory on your hard drive or floppy disks and you can have as many setting files as your disks can hold.

Load

To recall printer driver settings that have been previously saved, click on the "Load" button and choose the desired .LAS settings file. The settings that are currently on screen will be replaced by the settings from the .LAS file. You may abort this change by clicking Cancel; clicking OK will approve the change.

Default

This button will reset the driver settings to the originally installed values.

Print Special Effects

In this dropdown list, you can choose from 4 different printing modes, Normal (default), Clipart, 3D, and Rubber Stamp.

Clipart Mode

This control simulates laser printer output and is very useful if using a drawing with many colors, shades of gray, or many outlines. It is recommended to turn this control ON when using DRAWN clipart because there may be some underlying cutting lines hiding behind filled areas. Having this control ON gives a what-you-see-is-what-you-get output very similar to laser printer output. The entire drawing will be raster engraved, including all outlines, and only the Black color setting is used. The driver automatically turns OFF its color-mapping feature and all colors are engraved as different shades of gray, represented by a halftone pattern. The type of halftone pattern is based upon the "Quality" setting of the driver the same way grayscale bitmaps are interpreted. Since clipart images use a wide variety of colors, shades, and outlines, the only effective way of engraving these images is to have this control turned ON. Clipart mode also provides greater compatibility with Windows software that does not work well with vector devices such as the laser system. Do not activate this control when printing photographs or bitmapped images; use it **ONLY** with **DRAWN** clipart.

3D

There are two ways to use this feature. The first method is used produce an engraving that has a contoured depth, giving it a three dimensional feel. It is used in combination with grayscale bitmaps by automatically assigning laser power levels to the shades of gray of the bitmap **WITHOUT** converting the image to a halftone. These power settings are based off the setting you entered for the color black, in the printer driver. The darkest shades of gray (black) will be assigned the value of the setting for the black color. The lightest shade of gray (white) will automatically be assigned a 0%

power. All other shades of gray that fall between black and white will automatically be assigned an appropriate power level that matches the darkness of the color. The engraving will appear "3D" because the depth of the engraving will vary according to the image. Sometimes it takes several passes to create enough relief in the engraving to get the desired results.

Special 3D software is required to produce the type of grayscale images that are compatible with this mode. You cannot simply use ANY grayscale bitmap to produce a "3D" effect. Please contact our Applications Department for the latest 3D software recommendations.

The second way to use the 3D feature is to engrave any photograph, lightly onto the surface of hard materials such as black marble, anodized aluminum, painted brass, micro-surfaced engravers plastic, etc., to produce unbelievable photographic quality. Using the appropriate materials and settings, the end result is an engraving that looks more like a photograph than a halftone or diffusion dithered image does. To use the 3D feature in this method you must first set up a few things.

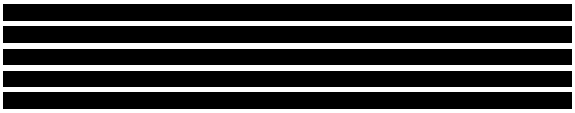
Choose Your Material

The best material to use is one that has the highest contrast such as black anodized aluminum, black marble, or black cored engravers plastic with a white micro surfaced coating. While other materials may work ok, they might not produce the highest quality.

Establishing Nominal Power

Choose your %Speed and you Image Density settings. Set the PPI to 1000 but don't set the %Power setting just yet. The objective is to use the **LOWEST** %Power setting that produces the most contrast such as the whitest (as in black anodized aluminum) or the darkest (as in black cored engravers plastic with a white micro surfaced coating) results. This is what we call the "nominal" power setting. Over-powering the material will produce poor results.

In your graphics software, create a series of 5 rectangles that are about ¼ inch high and 6 inches wide as in the following diagram:



Starting with the top rectangle set the power setting to a value that you know will be too low. For example, engrave the first rectangle at 5% power, increasing the power for each subsequent rectangle 5% finishing the series off at 25% power and note the results. Choose the rectangle that uses the lowest %Power setting to achieve the most contrast. If 25% is not enough power, then engrave the rectangles once again, this time starting at 25% and incrementing by 5% and so on.

In this particular example, we'll say that 20% power looks over-burned but 15% appears under-burned. Since the material may be sensitive to small power changes, you may need to narrow it down a bit further. Engrave a new series of rectangles, but this time start the top rectangle at 15% then add 1% for the next rectangle, and so forth, until you find the best setting between 15% and 20%.

The setting that produces the highest contrast using the least amount of %Power is called the nominal power setting.

Defaults

When you click this button, the ULS 3D Power Calibration screen will appear. Notice that there are 16 slider bars representing the 16 shades of gray of the calibration scale. The 00 and the 15 are not adjustable as they represent white and black. The 14 other ones can be adjusted. The objective is to go back and forth between adjusting the corresponding slider bars and re-engraving the calibration scale until you can duplicate the appearance of the calibration scale as best as you can. As you are progressing **MAKE SURE YOU KEEP SAVING YOUR SETTINGS**

IN AN LAS FILE just in case your computer crashes, etc. This is a lengthy procedure so you do not want to have to do it twice.

Once you have duplicated the Calibration Scale onto your material, calibration is now complete. You only need to do this calibration one time for each material you intend on using to produce photographs.

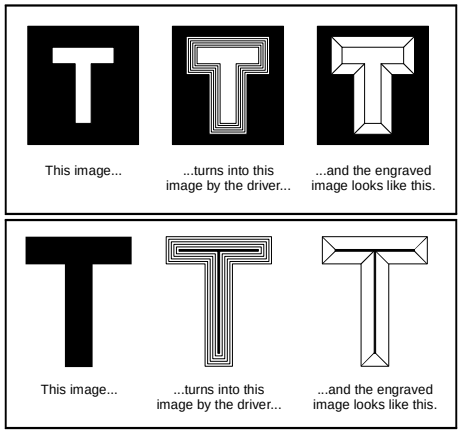
NOTE: If you are using a type of material that becomes lighter when you engrave, such as black marble, you will need to invert the photograph first (make a negative image), in your photo editing software, otherwise when you engrave the image, it will appear like a negative image.

APPLY Button
Click this button to enable the settings that you just set.

CLOSE Button
This closes the 3D Power Calibration settings window and cancels any changes you made to the scale if you didn't click the APPLY button.

DEFAULTS Button
Applies the factory default settings to the 3D Power Calibration settings

Rubber Stamp



This mode causes a "shouldering" effect when raster engraving rubber stamp material or any other material that requires a "shouldered" engraving. The effect looks as if the laser beam engraved the material on an angle, but in actuality it is the precise control of laser power that creates this appearance. This is a "raster only" feature that only works with black colored graphics and uses the power setting of the black color in the printer driver. Vectors are processed normally and can be used for vector engraving or cutting by assigning any of the seven other printer driver colors to the outline desired.

To obtain a "raised" engraving such as a rubber stamp, simply create a "negative" graphic so that the background is black and the text or graphic objects are white. This way, the background engraves and the text or objects remain untouched, producing a "pyramid" effect.

To obtain a "chiseled" or "sunken" engraving, create a "positive" graphic so that the background is white and the text or objects are black. This way, the text or graphic engraves and the background remains untouched, producing a "chiseled" effect.

Defaults

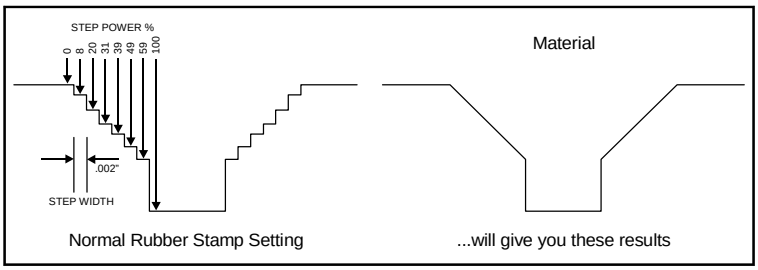
Selecting it brings up a pop-up window so you can choose from the following settings:

Taper Selection
Choose from various types of shoulder angles. Experiment with each setting and note the result.

Invert Page
This converts all black objects into white and all white objects into black for the ENTIRE PAGE. This is very useful for engraving a full sheet of rubber stamps.

Mirror Page
This mirrors the ENTIRE PAGE from left to right (horizontally). It will not mirror individual objects or selections. This is very useful for engraving full sheets rubber stamps because the graphics on screen are non-mirrored and can be proof read easily.

Power
Notice that when you click on different Taper Selections, that the power table changes. This is because the laser applies power in different profiles to produce different styles of taper. You will notice that you cannot adjust the pre-defined Taper, however, if you would like to create a custom taper of your own, first select the Taper Selection that you would like to start with and then click the "NEW" button. This will copy the taper as a "Custom Shoulder" that you can rename by typing a new name in the dialog box and clicking "Rename". You can also adjust the profile however you desire. Each slider bar controls the lasers power for that step. The numbers at the bottom of that slider bar define the width of the step in .001 inches (mils). The square at the top of each slider bar is it activate/deactivate button. Always deactivate the steps you are not using so that it will apply 100% power to that level.



The diagram above is an example of the Normal Rubber Stamp Taper Selection. You can see that there are 8 steps used to create the shoulder. The surface of the material is considered the first step and the bottom of the engraving is considered the last step. You can define as many as 16 steps but the first or the last steps are not definable because they are fixed at a power setting of 0% and 100% respectively. You can only define the parameters for the steps in between the first and last steps in which there are 14 of them. By adjusting the power setting for each step, the width in (.001) inches for each step, and the number of steps, different shoulder profiles can be created. **NOTE:** The maximum shoulder width is .056 inches.

Language
Select from many different languages in this drop down list. Some language changes will not take effect until the printer control panel is closed and then re-opened.

About
Clicking Version will display a pop-up dialog box containing information on the current driver version number as well as the driver's copyright notice. If contacting technical support, it is important to have the version number of your driver available.

Print Direction
Your choices are Down or Up. The default direction is Down which begins engraving at the top of the field and finishes at the bottom. On some materials you may get better results by starting at the bottom and engraving towards the top of the field (Up). This is because the engraving smoke is being drawn towards the top of the field. On some materials engraving Down causes the smoke or debris from the

engraving to be deposited onto the previously engraved surface, possibly damaging the engraved area. Experiment with the different directions using different materials and choose the best method for your application.

NOTE: The Up direction is especially useful when engraving rubber stamps and utilizing the Back Sweep Air Assist option.

Rotary Fixture

This option is available for most models. Please refer to operations manual on how to install and use the Rotary Fixture.

Image Enhancement

These controls allow the user to "fine tune" the image which will enable the laser system to produce the highest quality, highest detailed images at high or low speeds. Image Enhancement may be used at any engraving speed and with any application material.

The following procedure may appear lengthy, but when you actually learn how to use the controls, establishing the correct parameters is easy and quick. Once you have established those parameters you can "SAVE" them in the ULS printer driver as .LAS settings and recall them when needed. Many users choose to name these saved setting according to the application material's name. Before stepping you through the procedure we must first define the parameters.

NOTE: The Image Enhancement settings are designed to work with the BLACK pen color in the printer driver. However, the other 7 pen colors of the printer driver will use the same Image Enhancement settings. Keep in mind that those settings will have a different resulting effect on if the other colors %power, %speed, and PPI are different than the black pen color's setting.

Definitions

CONTRAST: Adjusts the difference between the non engraved and engraved areas in the high density part of the graphic or where there is the most concentration of graphic pixels (in between the dotted lines) as the following diagram illustrates:

Within this effective area, using too little CONTRAST may cause some parts of the letters to appear thin, faint, fuzzy, or even non-existent. Having too much CONTRAST will cause the effective area to appear thick, bold, or over powered.

DEFINITION: Adjusts the difference between low density and the high density part of the graphic. The low density part of the graphic can be considered such as the ascenders and decenders of text, or single pixels that may be horizontally spaced far from other pixels, or the start of the graphic in the direction of the raster stroke. Refer to the following diagram:

Setting this parameter too low may cause the effective part of the graphic to appear thin, faint, fuzzy, or non-existent. Too high of a parameter will cause these objects to appear thicker, bolder, or more powered than the high density areas of the graphic.

DENSITY: Adjusts the difference between the entire non engraved and engraved areas. If the parameter is too high, then the entire engraved image may appear thick, bold or over powered. Too low

of a setting may cause the image to appear thin and pixels or parts of characters may disappear altogether. The opposite effect would occur on inverted images such as white text on a black background.

TUNING: Adjusts the image so that the pixels vertically line up with each other during the left and right, bi-directional raster strokes, will line up properly. A misadjusted TUNING value will cause the image to appear double-imaged or inadvertently bolder than normal. A typical non-Image Enhanced TUNING value can be from -4 up to 0, whereas a typical Image Enhanced TUNING value generally averages around 0. Yes, TUNING will be different if you have Image Enhancements enabled or disabled. Saving the printer driver settings will also save the TUNING value.

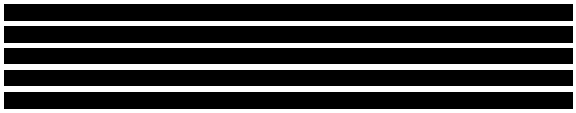
Procedure

The following procedure assumes that you have some experience working with the laser system and you have a general idea of the Power, Speed, PPI, and Image Density settings that you intend to use for the chosen application material.

In the following example, we will be engraving painted brass choosing 100% speed for good throughput, and Image Density 5 for good quality.

Step 1: Establish the nominal power setting.

In your graphics software, create a series of 5 rectangles that are about ¼ inch high and 6 inches wide as in the following diagram:



Starting with the top rectangle set the power setting to a value that you know will be too low. For example, set it to 5% power and the rest of the parameters to 100% speed, 1000 PPI, and Image Density 5. At this time, ensure that Image Enhancement is **NOT** enabled. Engrave the first rectangle at 5% power, increasing the power for each subsequent rectangle 5% finishing the series off at 25% power and note the results. What you are looking for is the **LOWEST** power setting that has the cleanest removal of material. This would be the nominal power setting. While higher than nominal settings may also produce clean engraving, it will overpower the material and may cause highly detailed engraving, unlike these rectangles, to appear too thick, bold or washed-out. If 25% is not enough power, then engrave the rectangles again, this time starting at 25% and incrementing by 5% and so on. In our particular example, we'll say that 20% power looks good but 15% appears underpowered. Since we know that this material happens to be sensitive to small power changes, we'll need to narrow it down a bit further. Engrave the rectangles once again, but this time start the top rectangle at 15% then add 1% for the next rectangle and so on until you reach 20%. The results now indicate that nominal power setting of 17% power looks as if it is the **LOWEST** power setting that produces the cleanest results at 100% Speed, 1000 PPI, and Image Density 5.

Step 2: Using text to set the CONTRAST parameter.

Type in a random line of text, using the Times New Roman font, set at 8 or 10 points in size. Make sure that the text string is at least 6 inches long and that the characters used include punctuation marks, spaces, and lower and upper case as in the following example:

Universal Laser Systems, Inc. produces the "BEST" laser systems in the world!

Engrave it with the settings determined in step one but this time ENABLE Image Enhancement and set CONTRAST to 0, DEFINITION to 0, DENSITY to 100 and the TUNING value to +4. You should expect the results to appear fuzzy, having parts of the characters missing, and overall engraving quality to be not as good as expected. This is normal. Move the line of text, slightly downward in your graphics software so that you will engrave a clean part of the material but keeping it close enough to the previous engraving so that you have something to compare it to. Keep engraving samples and adjusting the CONTRAST upwards in increments of 5 and note the results. The objective is to adjust the CONTRAST just enough to cause the high density areas of the text to be sharp and clear. Ignore the appearance of the ascenders

(like quotation marks or the tops of h's) and decenders (like commas or the bottom of lower case p's) as they will appear faint and unclear. This is to be expected. **DO NOT** adjust the CONTRAST setting to try to force these to appear, we will use the DEFINITION adjustment for those. Right now, **ONLY** concentrate on the high density part of the characters. Setting CONTRAST too high can cause the characters to appear "fat" or "bold". Adjusting the CONTRAST by just one number can make a big difference in appearance so continue adjusting the setting by first incrementing in 5's until you get close, but then fine tune the setting by incrementing or decrementing by 1's until the exact setting is achieved.

***Step 3:* Adjusting DEFINITION to enhance the ascenders and decenders.**
Now, increase the DEFINITION in increments of 5 at a time until the ascenders, decenders, commas, quotation marks and any other low density area characters begin to appear. The objective is to increase the setting just enough to cause these parts of the graphic to match the appearance of the high density areas. Setting the DEFINITION too high will result in ascenders and decenders appearing too "fat" or "bold" compared to the rest of the graphic.

***Step 4:* Reducing DENSITY as needed.**
Once CONTRAST and DEFINITION have been set to the appropriate levels, the graphic may or may not appear to be "fat" or "bold". In most cases, the appearance will look great without making any more adjustments. However, if everything appears overpowered or bold, try reducing the DENSITY down from 100 in increments of 5 and note the results. If the characters begin appear to be "chunky" or appear as if pixels have been eliminated, then you have reduced it too much. Normally you can leave the DENSITY at 100. However, there may be cases where you need to reduce it. Reducing DENSITY can be very useful when the image is inverted such as white text with a black background. In this case, if the engraved area (the background) is overpowering the text (foreground) then reducing the DENSITY may help thicken the text.

TUNING

***Step 5:* Fine tuning the raster strokes.**
At this point, we are finished with Image Enhancements. Make sure that you save your settings. But your graphic may need a little more "fine tuning". The typical TUNING setting is 0 when Image Enhancement is enabled. However, this may or may not be the best setting for your system. To check this setting, you should perform this last test. Engrave the same text, with all your Image Enhancement settings but this time set the TUNING value to 0. Then move the graphic down and engrave it again with TUNING setting +1, then +2 and so forth all the way to +8. Compare each one to the other and find the one that is the sharpest and clearest. Go back and set the TUNING value to the appropriate number and SAVE your settings once again.

The Image Enhancement settings for that material are now complete. If you feel that you can "tweak" it a little more, go back to step 2 and try again, but this time start with your current Image Enhancement settings that you saved. It is not necessary to reset your nominal power setting and we recommend that you leave it the same as the value you determined in step 1.

Setting the Image Enhancement parameters using this procedure will cause all of your graphics, whether big or small, inverted or not, dense or highly detailed, to appear better than ever. We suggest that you run this procedure for all your materials and save your parameters. This may sound like a big job, but the additional productivity and engraving quality that your system is capable of producing is well worth the small amount of time spent.

NOTE: Image Enhancement will cause files to take longer to print. Since most materials do not require the use of Image Enhancement, use this feature only as needed. Also, Image Enhancement and 3D Effects cannot be selected at the same time. The printer driver will automatically notify you if you attempt to do so.

More

Engraving Field

Metric or Inches

Width and Height
The page size that you enter here **MUST** match the page size in your graphics software program **EXACTLY** and it is up to the operator to enter in the correct settings. Select the metric box if metric units are desired.

NOTE: Incorrect use of this feature may cause no graphics, partial graphics, erroneous graphics, or a misaligned graphics output, relative to the application material, to occur. To avoid problems, we recommend that set it to the maximum field size of your laser system (click the Maximum Page Size button) and also set your graphics software programs page size to match.

Maximum Page Size Button
Clicking on this button restores the driver back to the default maximum page size that your model can accept.

Dithering

Dithering settings are used when printing grayscale or color bitmapped images such as TIF, JPG, and BMP formatted images. Since the laser system is essentially a black and white printer (black turns the laser ON and white turns the laser OFF), and if you choose the correct settings, the driver will automatically convert the grayscale or color bitmap into a 1-bit “halftoned” black and white image. This process is very similar to how newspaper photographs as well as laser printer photographs are printed. For a more detailed explanation of the terms “grayscale”, “bitmap”, “halftone”, or “dither”, please refer to the “Graphic Software Setup” section in this manual.

Halftone
This halftone pattern generator converts grayscale bitmaps into a halftoned image based on your Image Density choice in the driver.

IMAGE DENSITY	ANGLE	SHAPE	LINES PER INCH
6	45 DEGREES	ROUND	180
5	45 DEGREES	ROUND	90
4	45 DEGREES	ROUND	60
3	45 DEGREES	ROUND	45
2	45 DEGREES	ROUND	36

Error Diffusion
Unlike halftoning, error diffusion scatters the black pixels in a random pattern to represent shading. It uses the quantity of black dots instead of the size of the black dots to represent the different shades of gray. The pattern created will be dependent on the quality setting that you choose in the driver with the exception that there is no chart to reference. Higher quality settings such as 5 will produce a more densely packed, higher dot quantity pattern whereas lower resolution setting such as 2 will produce a loosely packed, lower quantity dot pattern

NOTE: DO NOT use Error Diffusion when engraving rubber stamps otherwise dots will appear in the background. Choose only Halftone.

Black and White Mode
This mode thresholds the image at 50% black. Each pixel that is greater than 50% black will be converted into white and each pixel that is 50% black or less will be converted into black. This effect is very similar to trying to duplicate a photograph using a photocopier.

Helpful Tip
Engraving grayscale bitmaps using a dithering pattern requires some practice and a bit of trial and error to achieve perfection. It also requires some knowledge of bitmap editing software. These images will visually appear different on one material as opposed to another material even if you use the same driver settings. As a rule of thumb, use an Image Density setting of 5 using halftone or diffusion pattern on harder materials such as marble, anodized aluminum or microsurfaced engraver's plastic. Use an Image Density setting of 3 using the halftone or diffusion pattern for softer materials such as wood or materials that you intend on engraving very deeply.

Vector Optimizer

The four available selections apply to vector output only and have no effect on raster images. Regardless of which of the following selections you choose, vectors are grouped by pen color and will always output in the color order listed in the printer driver.

OFF
Turns off this feature.

ENHANCE ONLY
The printer driver collects all the vectors from the application software and reconstructs them (so to speak) by removing start and stop points within the vector curves so that they run smoother with less jitter. It has no effect on straight, horizontal or vertical, lines

SORT ONLY
The printer driver collects all the vectors from the application software, stores them in temporary memory, sorts them, and the outputs them in the following order:

- All open path vectors are output first (not closed path vectors like circles and squares) beginning with the end point of the vector path that is closest to the current position of the focus carriage. All subsequent open vector paths are output using the same “nearest neighbor” starting point method which eliminates the random “vector hopping” that causes longer processing times.
- Closed paths will follow, beginning with the innermost closed path and ending with the outermost closed path. This is particularly useful in an elevated cutting application to prevent the outer piece from falling first. The beginning point of a closed path is automatically selected by the printer driver by the “nearest neighbor” vector path that has the steepest angle in the Y-axis direction.

ENHANCE AND SORT
This turns on both features simultaneously.

Vector Scaling

This feature allows you to calibrate vector cutting or vector engraving to your particular application. To calibrate the system, as an example, draw a precise, 5” x 5” square in your graphics software. In the printer driver, set the laser power and speed setting to vector mark (do not cut through) this square onto some scrap material. After marking, remove the material and with a precision measuring device such as a caliper, measure the square in both the horizontal (X) and vertical (Y) directions. Let’s say that the measurement was 4.997”x and 4.996”y. Use the formula (desired length/measured length) and enter the result into the X-axis and Y-axis boxes respectively. In this example, the result would be X-axis = 1.0006 to 1.0000 and Y-axis = 1.0008 to 1.0000. The printer driver will scale the images larger for numbers greater than 1.0000 and will scale the image smaller for numbers less than 1.0000. After changing the numbers, repeat the marking procedure and verify that the square is scaled correctly. We used a 5” by 5” square just as an example but you can use any size object that is smaller than the maximum size of the

engraving field. Using the Vector scaling feature with larger images produces more accurate results. Keep in mind that this feature **DOES NOT** scale raster images so if you combine raster and vector images in one file, the raster image may not align with your vectors. You will need to manually position your raster images in their desired position.

CAUTION: Do not attempt to use the vector-scaling feature when your graphic extends out to the absolute edge of the engraving field. You may accidentally cause the driver to attempt to print past the edge of the maximum allowable page size. Unexpected results may occur. If you use this feature, the actual allowable page size decreases by the same amount that you are attempting to offset.

Rotary Rotation

If you have purchased the optional Rotary fixture, you may need to calibrate your fixture if your application requires you to engrave or cut completely around the cylinder precisely 360 degrees. Only use this option if you completely understand and have used the Rotary Fixture in the past. If you are familiar with the operation of the Rotary Fixture and as an application you create a vector line or raster graphic that extends from the top of the page (in your graphic software) all the way to the bottom of the page, you should expect that the Rotary Fixture would rotate a full 360 degrees. If the fixture comes up short or long by a few degrees, you can compensate for this in the driver. If your application comes up short, increase the number past 1.0000 as much as you need to and run your sample again. If your application rotates past 360 degrees, then decrease the number of degrees below 1.0000 to get the ends to line up. You can calculate the exact number (refer to the Vector Scaling technique in the next paragraph) but it may be difficult to measure circumference.