

VLS Desktop User Guide ***VLS3.60ES***

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Universal's laser systems are protected under one or more of U.S. Patents: 5,661,746; 5,754,575; 5,867,517; 5,881,087; 5,894,493; 5,901,167; 5,982,803; 6,181,719; 6,313,433; 6,342,687; 6,423,925; 6,424,670; 6,983,001; 7,060,934; 7,415,051; 7,469,000; 7,715,454; 7,723,638; 7,947,919. Other U.S. and international patents pending.

Thank you for choosing Universal Laser Systems®. We appreciate innovative customers like you who have made Universal Laser Systems an integral part of their business.

Universal Laser Systems is committed to providing the highest level of customer satisfaction and support. To ensure your satisfaction, we urge you to read the documentation provided with your equipment.

Since 1988, Universal Laser Systems has been committed to continually improving our technology and customer-driven laser solutions. Your satisfaction is very important to us and we welcome your feedback. Tell us about your experience with Universal Laser Systems and our systems at moreinfo@ulsinc.com.

Should you have any questions, please contact Universal Laser Systems' Customer Service Team at 480-609-0297 (USA), +43 1 402 22 50 (Austria), +81 (45) 224-2270 (Japan) or e-mail us at support@ulsinc.com.

Again, thank you for choosing Universal Laser Systems.

Your Universal Laser Systems Team

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Software

Software and other documentation can be downloaded at www.ulsinc.com/support/technical-downloads

Warranty

Warranty documents pertaining to your purchase were included with the laser system when it shipped from the factory. Should you require a copy of the warranty, please contact ULS at 480-609-0297 or email support@ulsinc.com.

Parts

To order parts for your Universal laser system, contact ULS at 480-609-0297 or support@ulsinc.com.

Chapter 1 - Specifications

VLS3.60ES		
Operating Environment	Well-ventilated office (recommended) or clean, light-duty manufacturing	
Operating Temperature	50°F (10°C) to 95°F (35° C) capable 73°F (22°C) to 77°F (25° C) for best performance	
Storage Temperature	50°F (10°C) to 95°F (35° C)	
Operating Humidity	Non-condensing	
Electrical Power	Single Phase 110/240V AC, 10/5 Amp, 50/60 Hz Grounded (earthed) and stable (surge and spike protected)	
Particulate/Odor Outside Ventilated Exhaust System	High-pressure vacuum blower capable of:	
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 5px;">150 CFM (cubic feet per minute) @ 6 inches static pressure (255m³/hr at 1.5kPa)</td> <td style="width: 50%; padding: 5px;">250 CFM (cubic feet per minute) @ 6 inches static pressure (425m³/hr at 1.5kPa)</td> </tr> </table>	150 CFM (cubic feet per minute) @ 6 inches static pressure (255m ³ /hr at 1.5kPa)
150 CFM (cubic feet per minute) @ 6 inches static pressure (255m ³ /hr at 1.5kPa)	250 CFM (cubic feet per minute) @ 6 inches static pressure (425m ³ /hr at 1.5kPa)	
Computer Requirements (See the Installation & Set-up Guide for more information)	Requires dedicated PC with Windows® 10/11 32/64 bit or Mac with OS10 or higher and one available USB port (2.0 or higher)	
Laser Safety	CO ₂ Laser, Interlocked Safety Enclosure = Class 1 Red Diode Pointer = Class 2	

SPECIFICATIONS*	VLS3.60ES
Material Processing Area (W x H)	24 x 12 in. (610 x 305 mm)
Maximum Part Size (W x H x D)	26.75 x 14.6 x 4 in. (679 x 370 x 102 mm)
System External Dimensions (W x H x D)	34 x 14 x 25 in. (864 x 356 x 635 mm)
Rotary Capacity	Max. Diameter 5 in. (127 mm); Min. Diameter 0.5 in. (12.7 mm)
Motorized Z-Axis Lifting Capacity	20 lbs. (9 kg)
Available Focus Lenses**	2.0 in. (50 mm) / 3.0 in (75 mm) / HPDFO™ (High Power Density Focusing Optics)
Control Software	Laser System Manager (LSM) control software
Laser Platform User Interface	Five button keypad
Optics Protection	Integrated with included gas assist
Laser Options	10.6 μm CO ₂ : 10, 30, 40, 50 and 60 watts 9.3 μm CO ₂ : 10, 30 and 50 watts
Safety Features	Over Temperature Detection, Emergency-Stop Switch, plumbed for optional fire suppression module
Camera Vision System	Door mounted camera for visual alignment of design files
Approximate Weight	95 lbs. (43 kg)
Power Requirements	110V/10A; 220V-240V/5A
Exhaust Connection	One 3 in. (76 mm) port; 250 CFM @ 6 in. static pressure (425 m ³ /hr. at 1.5 kPa).

*Specifications are based on the 2.0 in. (50 mm) focus lens. Full specifications are available on the ULS website and are subject to change.

**Consult ULS for 1.5 in. (38 mm) and 4.0 in. (101 mm) focus lenses.

Chapter 2 - Safety

Description of Appropriate Use

This device is designed for laser cutting and engraving in an office, laboratory, workshop or light duty manufacturing environment. Materials to be processed must fit completely inside the system for proper operation.

CAUTION: This device is not designed, tested, intended or authorized for use in any medical applications, surgical applications, medical device manufacturing or any similar procedure or process requiring approval, testing or certification by the United States Food and Drug Administration or other similar governmental entities.

General Safety

Use of the equipment in a manner other than described in this manual or failure to follow the operational requirements and safety guidelines listed in this manual can result in injury to yourself and others and may cause damage to the equipment and your facility.



EXPOSURE TO THE LASER BEAM MAY CAUSE PHYSICAL BURNS AND CAN CAUSE SEVERE EYE DAMAGE. Proper use and care of this system are essential to safe operation. Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.



NEVER OPERATE THE LASER SYSTEM WITHOUT CONSTANT SUPERVISION OF THE CUTTING AND ENGRAVING PROCESS. Exposure to the laser beam may cause ignition of combustible materials which can lead to a fire. A properly maintained fire extinguisher should be kept on hand at all times.



NEVER LEAVE MATERIALS IN THE LASER SYSTEM AFTER LASER PROCESSING HAS FINISHED. Always remove all material including scrap material from the machine after use. Scrap material left in the laser system including materials that collect in the removable cutting table can be a fire hazard. It is also recommended you allow scrap materials to cool prior to leaving the work area. A properly maintained fire extinguisher should be kept on hand at all times.

A PROPERLY CONFIGURED, INSTALLED, MAINTAINED AND OPERATIONAL PARTICULATE AND FUME EXHAUST SYSTEM IS MANDATORY WHEN OPERATING THE LASER SYSTEM. Fumes and smoke from the engraving process must be extracted from the laser system and filtered or exhausted outside.



SOME MATERIALS, WHEN ENGRAVED OR CUT WITH A LASER, CAN PRODUCE TOXIC AND CORROSIVE FUMES. We recommend that you obtain the Material Safety Data Sheet (MSDS) from the manufacturer of every material you intend to process in the laser system. The MSDS discloses all of the hazards when handling or processing a particular material. **DISCONTINUE** processing any material that causes chemical deterioration of the laser system such as rust, metal etching or pitting, peeling paint, etc. Damage to the laser system from corrosive fumes is **NOT** covered under warranty.



DO NOT ATTEMPT TO MOVE OR LIFT THIS SYSTEM ALONE. Obtain the assistance of additional people when lifting or carrying (secure motion system and doors before lifting). Injury may occur if improper lifting techniques are used or the system is dropped.

DANGEROUS VOLTAGES ARE PRESENT WITHIN THE ELECTRONICS ENCLOSURES OF THIS SYSTEM. Access to these areas is not necessary during normal operation. If it becomes necessary to open one of these enclosures for service reasons, please remember to disconnect the power cord from your electrical supply.



NEVER REMOVE THE GROUND LEAD TO THE ELECTRICAL CORD AND PLUG THE SYSTEM INTO A NON-GROUNDED OUTLET. A laser system that is not properly grounded is hazardous and has the potential to cause severe or fatal electrical shock. Without proper grounding, the laser system may exhibit sporadic or unpredictable behavior. Always plug the system into a properly grounded (earthed) outlet.

THE POWER SUPPLY CORD IS THE MAINS DISCONNECT DEVICE; THE EQUIPMENT SHOULD BE LOCATED CLOSE TO AN EASILY ACCESSIBLE POWER OUTLET. To disconnect the equipment from the supply mains, the power cord should be unplugged from the power outlet or main power inlet (appliance coupler) of the unit.

THE LASER SYSTEM IS DESIGNED AS A CLASS I, GROUP A, PLUGGABLE DEVICE. It is also designed for connection to IT power systems which provide the most flexibility to the user.

THIS DEVICE IS SPECIFICALLY DESIGNED TO COMPLY WITH CDRH PERFORMANCE REQUIREMENTS UNDER 21 CFR 1040.10 AND 1040.11 AND TO COMPLY WITH EUROPEAN LASER SAFETY REGULATIONS UNDER EN60825-1. CDRH is the Center for the Devices of Radiological Health division of the Food and Drug Administration (FDA) in the USA. No guarantees of suitability or safety are provided for any use other than those specified by Universal Laser Systems, Inc.

CO₂ Laser Safety

ULS Laser systems are designed to support a sealed carbon dioxide (CO₂) laser cartridge that produces intense invisible laser radiation at a wavelength of 10.6 microns in the infrared spectrum. For your protection, the laser is contained within a Class 1* enclosure designed to completely contain the CO₂ laser beam. CAUTION: Use of controls or adjustments or performance of procedures other than those specified herein may result in exposure to hazardous levels of invisible laser radiation.

- Laminated safety glass is employed in the viewing window to block 10.6 micron laser radiation from CO₂ lasers. This viewing window will block transmission of CO₂ laser radiation allowing safe observation of laser processing. Do not operate the laser system if the view port is damaged, with any of the doors removed or if any of the safety interlocks are defeated.
- The intense light that appears during the engraving or cutting process is the product of material combustion or vaporization. **DO NOT STARE AT THIS INTENSE LIGHT FOR LONG PERIODS OF TIME OR VIEW DIRECTLY WITH OPTICAL INSTRUMENTS SUCH AS BINOCULARS OR MICROSCOPES.**
- This device contains a visible Red Diode Pointer (Class 2) to aid in positioning material to be cut or engraved. **DO NOT LOOK DIRECTLY INTO THE RED LASER BEAM OR USE A REFLECTIVE SURFACE TO REDIRECT OR VIEW THE RED LASER BEAM. NEVER ATTEMPT TO VIEW THE RED LASER BEAM USING OPTICAL INSTRUMENTS SUCH AS BINOCULARS OR MICROSCOPES.**
- The user door(s) are safety interlocked which will prevent the CO₂ laser beam from firing when the user door(s) are opened. The Red Diode Pointer is **NOT** safety interlocked and can be automatically activated with the door(s) either open or closed.
- **DO NOT OPERATE THE LASER SYSTEM IF ANY SAFETY FEATURES HAVE BEEN**

MODIFIED, DISABLED OR REMOVED. This may lead to accidental exposure to invisible CO₂ laser radiation which may cause severe eye damage and/or severe burns to your skin.

- Always use caution when operating a laser system.

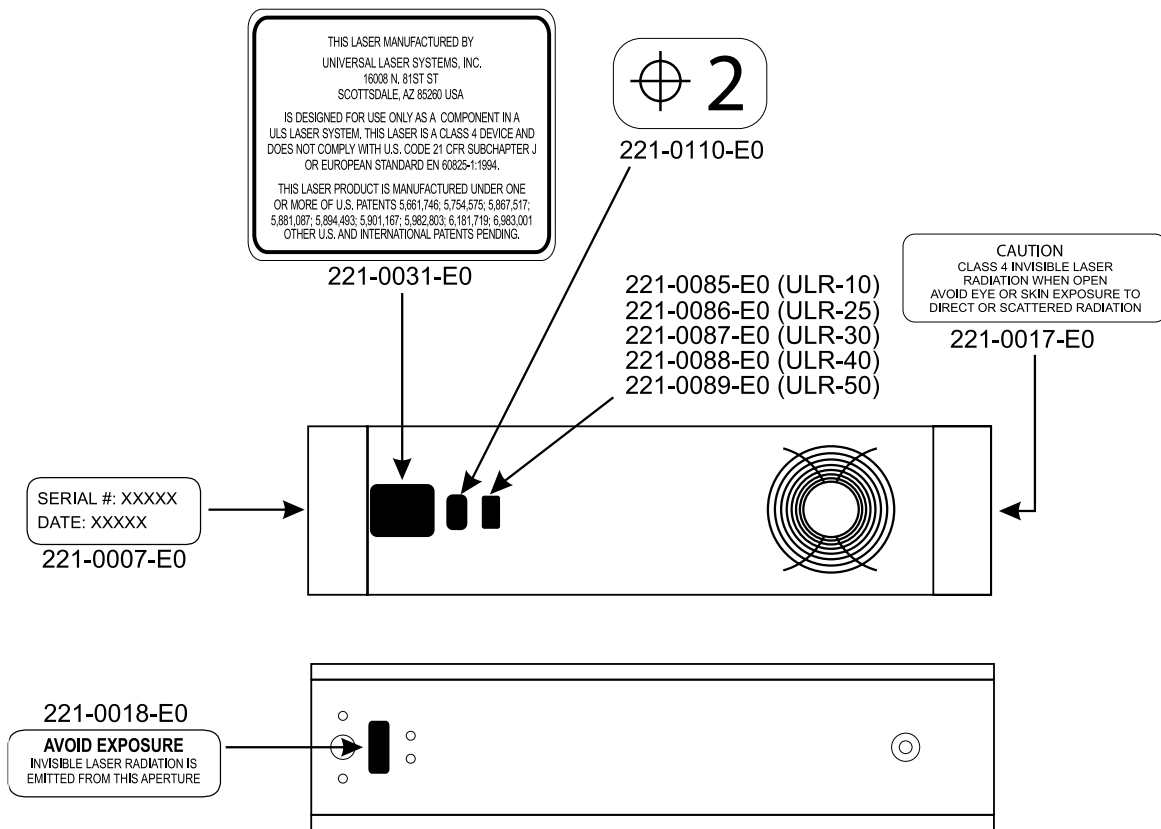
*An enclosure which does not permit human access to laser radiation in excess of the accessible emission limits of Class 1 for the applicable wavelength and emission duration.

Tamper Proof Labels

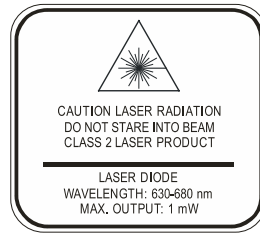
All laser cartridges are equipped with tamper proof labels. There are NO field serviceable parts inside a Universal Laser System, Inc. (ULS) laser cartridge. If your laser cartridge needs service, please contact the Customer Service Team at 480-609-0297 (USA), +43-1-402-22-50 (Austria), +81(45)224-2270 (Japan) or e-mail us at support@ulsinc.com.

Safety Labels

CDRH and CE regulations require that all laser manufacturers affix warning labels in specific locations throughout the equipment. The following warning labels are placed on the laser system for your safety. Do not remove these labels for any reason. If the labels become damaged or have been removed for any reason, do not operate the laser system and immediately contact Universal Laser Systems, Inc. at 480-609-0297 (USA), +43 1 402 22 50 (Austria), +81 (45) 224-2270 (Japan) or e-mail us at support@ulsinc.com for a free replacement.

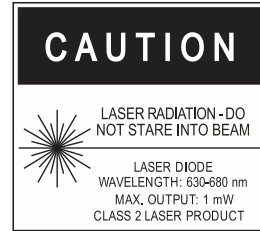


ULS CO₂ Laser Cartridge Labels



221-0115-E0 (INTERNATIONAL)

or



221-0116-E0 (DOMESTIC)

CAUTION
CLASS 4 INVISIBLE LASER RADIATION
WHEN OPEN AND INTERLOCK FAILED OR
DEFEATED AVOID EYE OR SKIN EXPOSURE
TO DIRECT OR SCATTERED RADIATION

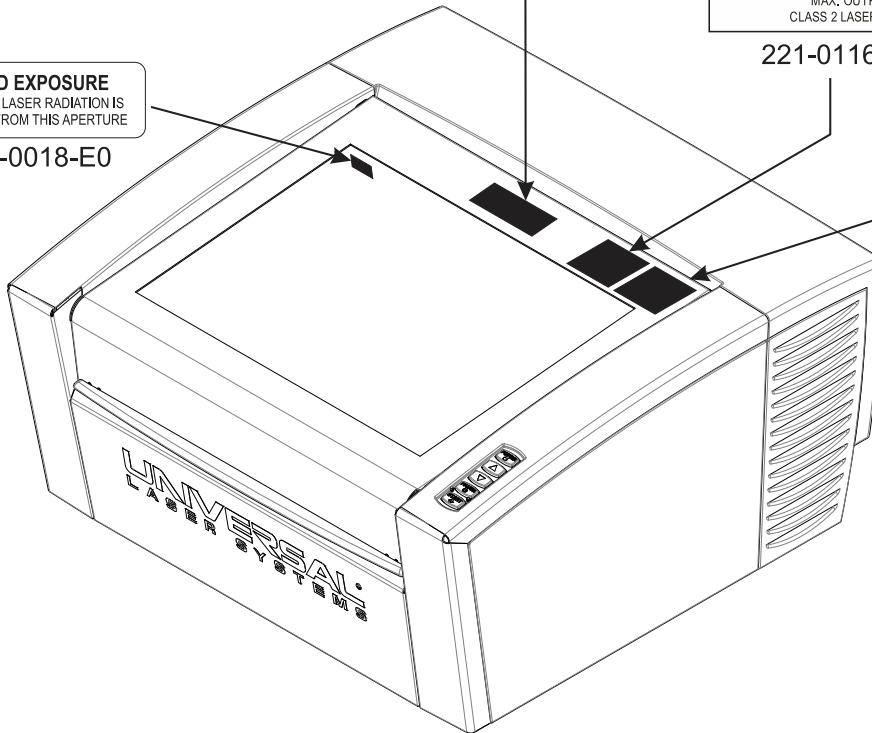
221-0016-E0

AVOID EXPOSURE
INVISIBLE LASER RADIATION IS
EMITTED FROM THIS APERTURE

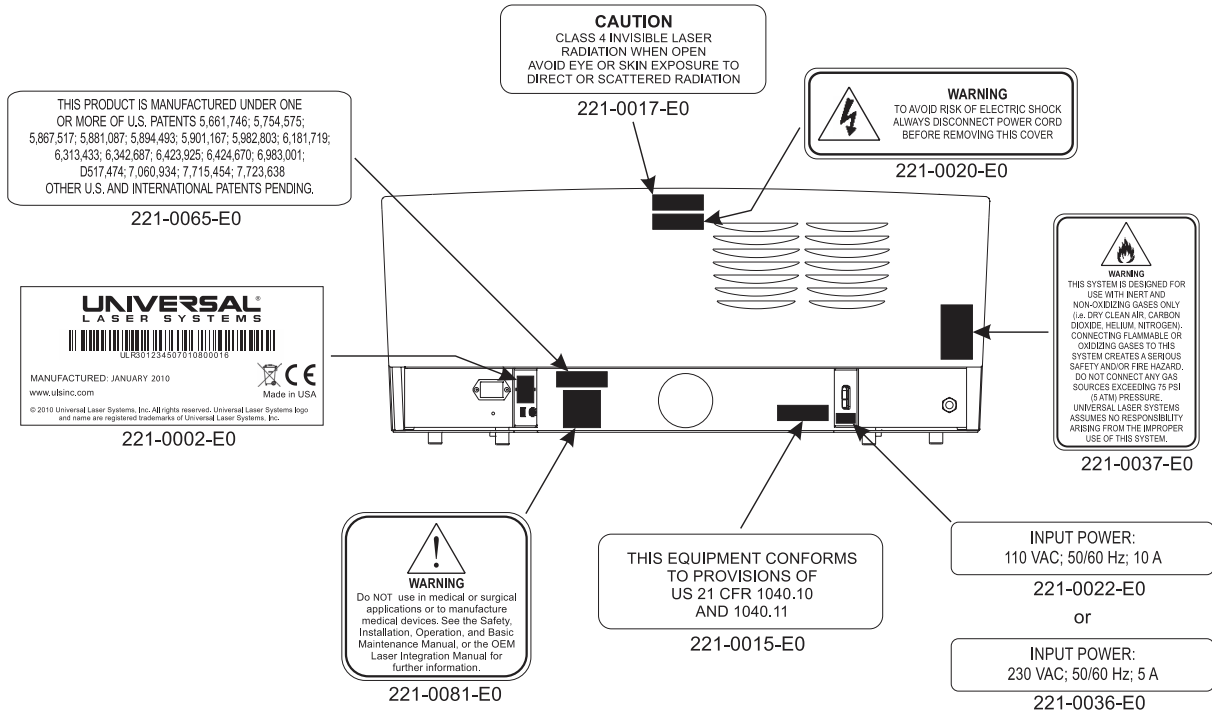
221-0018-E0



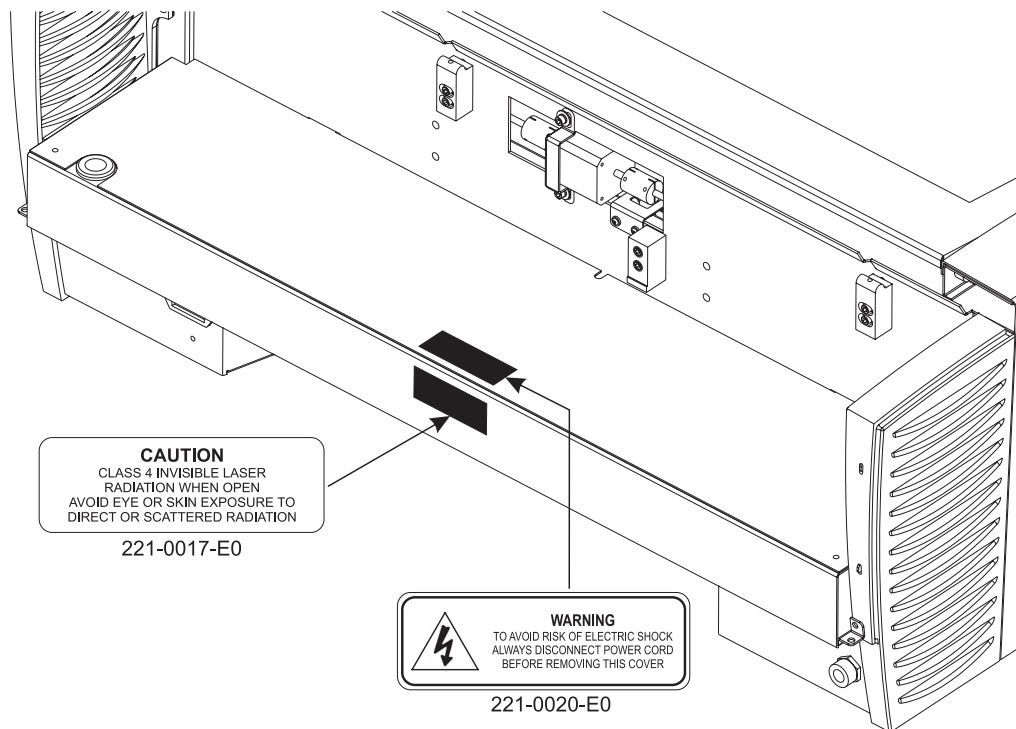
221-0012-E0



Front View



Back View



Back view with laser cover removed

EU Declaration of Conformity

UNIVERSAL[®]
LASER SYSTEMS

Product Identification: All ULS Laser Systems

Manufacturer:

Universal Laser Systems, Inc.
16008 N. 81st St.
Scottsdale, AZ 85260
USA

European Office:

Universal Laser Systems GmbH
Lerchenfelder Guertel 43
A-1160 Vienna/Austria

The manufacturer hereby declares that the equipment specified below is in conformity with the following directives:

2004/108/EEC (EMC Directive)
2006/95/EEC (Low Voltage Directive)
2006/42/EEC (Machinery Directive)
2002/95/EEC (ROHS Directive)
2002/96/ECC (WEEE Directive)

based on the standards listed.

Standards Used:

Safety:

EN 60950: 2002
EN 60825-1: 2007 (Class 2)

EMC:

EN 55024 1998 (Class A)
EN 55022: 2003 (Class A)
EN 61000-3-2: 2001 (class A)
EN 61000-3-3: 2002
EN 61000-4-2: 2001 (4kV CD, 8kV AD)
EN 61000-4-3: 2003 (3 or 10 V/m)
EN 61000-4-4: 2002 (1 or 2 kV power line)
EN 61000-4-5: 2001 (class 3)
EN 61000-4-6: (3 or 10Vrms)
EN 61000-4-8
EN 61000-4-11

Note: This is not a declaration of conformity. The importer of this equipment supplies the declaration of conformity.

Warning: This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

FCC Compliance

This ULS laser system has been tested and found to comply with Federal Communication Commission (FCC) directives regarding Electromagnetic Compatibility (EMC). In accordance with these directives, ULS is required to provide the following information to its customers.

FCC Compliance Statement and Warnings

This device complied with FCC Rules Part 15. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class A digital device as set forth in Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with manufacturer's instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his or her own expense.

Users should be aware that changes or modifications to this equipment not expressly approved by the manufacturer could void the user's authority to operate the equipment.

This equipment has been type tested and found to comply within the limits for a Computing Device per FCC part 15, using shielded cables. Shielded cables must be used in order to ensure compliance with FCC regulations.

Recycling



By placing the above symbol on our products and accessories, Universal Laser Systems is indicating that we are committed to helping reduce the amount of waste electronics ending up in municipal landfills. Therefore, Universal Laser Systems urges consumers to recycle this product and its accessories. Universal Laser Systems is equipped to recycle any of its electronic products and accessories and will assist our customers with their recycling options. To arrange for recycling of your ULS product or accessory, please contact Universal Laser Systems for more information at 480-609-0297 (USA), +43 1 402 22 50 (Austria), +81 (45) 224-2270 (Japan) or e-mail us at support@ulsinc.com.

Chapter 3 - Installation

This section provides step-by-step instructions for site preparation, computer/software setup and laser system assembly and connection. Follow the instructions in the order shown.

1. Site Preparation
2. Operating System Requirements and Software Installation
3. Assembling and Connecting Your Laser System

Note: Make sure to complete step 2 (software installation) prior to plugging the laser system into a USB port on your PC.

CAUTION: Damage to the laser system due to inadequate or improper installation or operation is not covered under the Universal Laser Systems (ULS) Warranty. See the ULS Warranty for additional information. A ULS Warranty document is supplied with your laser system. Should you require a copy of the Warranty, please contact the ULS Customer Service Team at 480-609-0297 (USA), +43 1 402 22 50 (Austria), +81 (45) 224-2270 (Japan) or e-mail us at support@ulsinc.com.



Please refer to the Safety section before operating your laser system.

Step 1: Site Preparation

Operating Environment (User Supplied)

1. The laser system must be installed in an office, laboratory, workshop or light duty manufacturing environment.
2. Dusty or dirty environments can damage the laser system. Keep the laser system isolated from any processes that produce airborne particles such as sandblasting, sanding, machining, etc. Also, keep the laser system isolated from any equipment requiring mists of oil or water for lubrication. Airborne dust and liquids can coat and damage optics and motion system components.
3. Avoid small, enclosed, non-ventilated areas. Some materials, after laser engraving or cutting, continue emitting fumes for several minutes after processing. Having these materials present in a confined, unventilated room can create a health hazard.
4. For best results, since the laser cartridges are air-cooled, we recommend operating the laser system between the ambient temperatures of 70°F (21°C) and 78°F (25°C).
5. Avoid storing the laser system outside the temperatures of 50°F (10°C) and 95°F (35°C) as excessively cold or hot temperatures can damage the laser cartridge or reduce its lifetime.
6. Ambient humidity levels must be non-condensing to protect optics.
7. The laser system should be at least 1 foot (300 mm) away from any wall or obstruction to allow for access and proper ventilation.

Electrical Power Source (User Supplied)

1. For your system's electrical requirements, please refer to the "INPUT POWER" label near the power inlet.
2. **CAUTION:** Never remove the ground lead to the electrical cord and plug the laser system into a non-grounded outlet. A laser system that is not properly grounded is hazardous and has the potential to cause severe or fatal electrical shock. Without proper grounding, the laser system may exhibit sporadic or unpredictable behavior. Always plug the system into a properly grounded (earthed) outlet.
3. Noisy or unstable electricity and voltage spikes may cause interference and possible damage to the electronics of the laser system. If electrical power fluctuations, brown outs or constant power outages are a problem in your area, please contact your local Electrician to supply a power isolation and regulation module. Electrically noisy equipment, such as equipment with large motors, can also cause

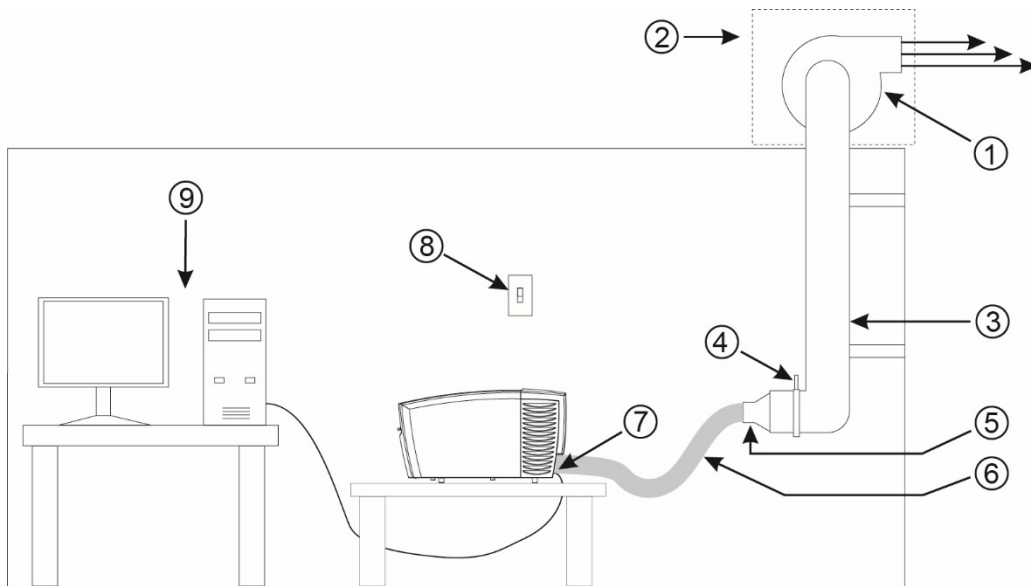
interference if plugged into the same outlet. It may be necessary to attach the laser system to a dedicated electrical line to resolve the problem.

4. The laser system is designed as a Class I, Group A, pluggable device. It is also designed for connection to IT Power systems which provide the most flexibility to the user.

Exhaust System (User Supplied if not using optional Exhaust Air Filtration Unit)

1. We recommend you consult with a licensed contractor to meet local safety and building code requirements.
2. The exhaust system must be capable of supplying a minimum of **250 CFM (cubic feet per minute)** of airflow while under a load of 6 inches of static pressure (425m³/hr at 1.5kPa).
3. Do not install forward incline, backward incline, in-line or ventilator fans because these types of air handlers are inadequate and inappropriate for this type of installation. A high-pressure blower must be used to meet minimum airflow requirements.
4. For personal safety and noise control, we recommend that the exhaust blower be mounted outside the building.
5. Rigid tubing should be used for the majority of the connection between the blower and the laser system. The tubing should be smooth-walled and have as few 90-degree bends as possible.
6. Install an exhaust gate to adjust airflow and to close off the exhaust when the laser is not in use. Place this gate near the laser system within 5 to 10 feet (1.50 to 3.00 meters).
7. Use a short piece of industrial grade, wire-reinforced rubber tubing to connect the laser system's exhaust port to the exhaust gate and secure with a hose clamp. This will provide some mobility for your laser system and will isolate exhaust blower vibrations from your laser system.
8. Wire the exhaust blower electrically to a wall switch in the same room for easy ON/OFF control.

Note: The following diagram shows a typical exhaust system layout. Use this as a guideline for proper exhaust system installation. Although this diagram serves as an example, we recommend you consult with a licensed contractor to meet local safety, environmental and building code requirements and to also calculate the correct size blower required for your particular installation. Length of exhaust pipe, exhaust pipe diameter, number of 90-degree angles and other restrictions must be calculated when determining the correct exhaust blower unit. Installing an undersized or oversized blower is not only unsafe, but can also lead to excessive wear and tear to the laser system and premature failure.



1. Exhaust blower mounted outside* (User Supplied)
2. Weatherproof shield (User Supplied)
3. Rigid ducting matching the diameter of the blower inlet (User Supplied)
4. Shut-off or air-flow gate (User Supplied)
5. Adapter to the hose reduces from 4" to 3" (User Supplied)
6. Flexible, wire-reinforced, industrial grade rubber hose (User Supplied)
7. Connection to laser system
8. Exhaust On/Off switch (User Supplied)
9. Computer (User Supplied)

*Exhaust blower illustration may differ according to your region.

Step 2: Computer Requirements and Software Installation

Your computer is a critical component in the operation of your laser system. In fact, you cannot operate the laser system if it is not connected to your computer and running the Laser System Manager (LSM) software.

You can only run one laser system per computer. You will need to purchase a separate computer for each laser system you own. You must operate the laser system using the computer that is directly attached to it via the provided 6 ft (2 meters) USB cable. USB cables longer than 6 feet (2 meters) may cause the laser system to malfunction.

Note: Your laser system will work best when attached to a USB 3.0 (USB SuperSpeed) port.

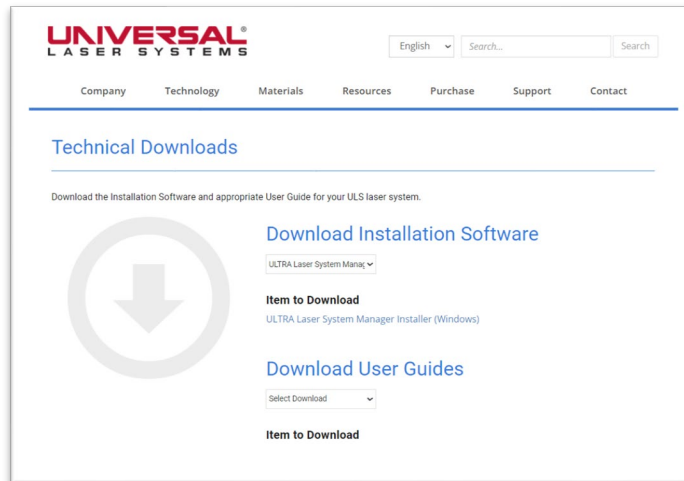
Computer Power Management

Power management settings on your computer can interfere with proper operation of the laser system by putting the PC in standby or sleep mode while the laser system is processing material. The settings can be controlled through the power options in the Windows control panel on your PC. Make sure to change your setting to never allow the computer attached to the laser system to go to sleep.

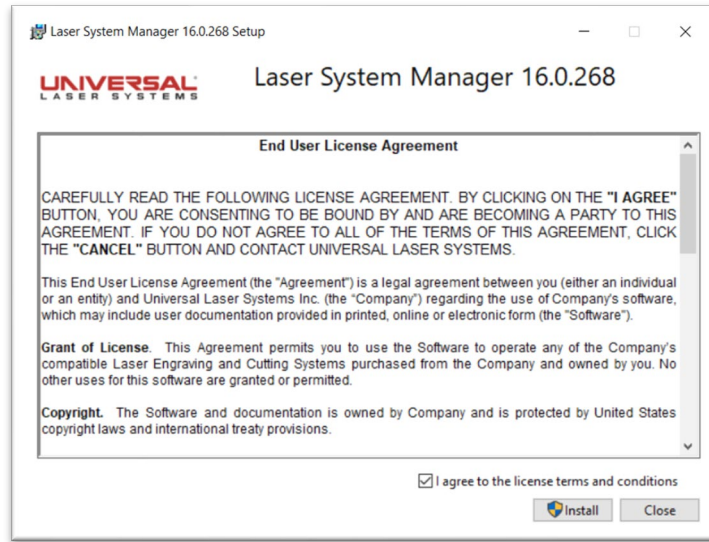
Software Installation

At this point you need to install the Laser System Manager (LSM) software. Please note that in order to install the software, you need to have administrative privileges on the computer before starting installation.

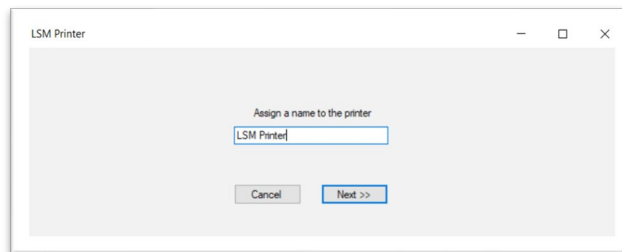
1. Download the latest LSM software package from the website <https://www.ulsinc.com/support/technical-downloads> by selecting “Laser System Manager installer” from the “Download Installation Software” drop down menu and then pressing the link under the “Item to Download” heading. Please note, you can also download the manual for your VLS desktop laser system here as well.



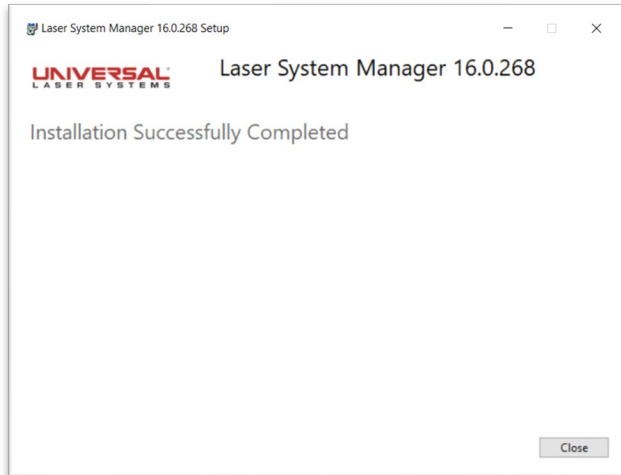
2. Once the installation package has been successfully downloaded, launch the LSM software installer and agree to the licensing terms to start the installation.



3. At some point during the installation process, the installer will offer to install the LSM printer driver. The printer driver enables printing design files to the LSM software for laser material processing. This is a convenient way to create laser material processing tasks for the VLS desktop laser system. However, you can also import design files into the LSM, so the printer driver is not required. If you want to print to the LSM, change the printer driver name as desired and press next, otherwise, press cancel. You can always load the printer driver later, by running the installation package again.



4. When installation is complete, you will be prompted to close the installer.



Step 3: Assembling and Connecting Your Laser System



Familiarize yourself with the instructions before getting started.

The final step in installation is to assemble your laser system, install the laser cartridge, make final connections and perform a beam alignment check. Do not power up your laser system until the final step, "Checking Beam Alignment."

Exhaust Air Filtration Unit Assembly (Optional)

1. Unpack the air filtration unit and place it on a level surface.
2. Push down on the tabs of the locking casters so that the cart does not roll.



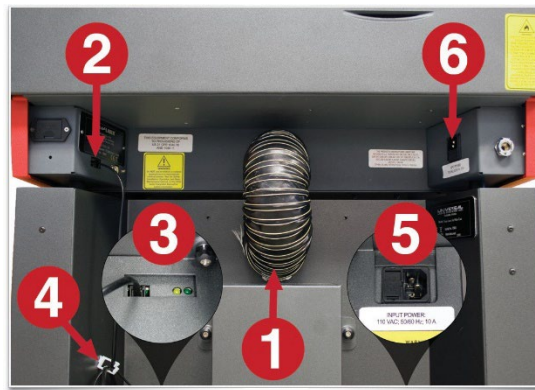
3. Unpack the laser system.



4. With the assistance of another person, lift the laser system and place it on top of the air filtration unit so that the feet of the laser system rest within the four depressions on top of the air filtration unit.



5. Bend and connect the short exhaust hose (1) provided with the air filtration unit to the exhaust port on the back of the laser system and secure it with the provided hose clamps. Once the hose is attached, install the provided sheet metal cover over the exhaust hose.
6. Attach a power cord to the air filtration unit's power inlet (5), but do not plug into power outlet at this point.
7. Connect the provided 3 ft. communications cable between one of the two Serial ports (2) of the laser system and the Serial port connector on the air filtration unit (3). Secure the Serial cable using the retainer clips (4).
8. Attach a power cord to the laser system's power inlet (6), but do not plug into power outlet at this point.



9. Continue to next section

Laser System Assembly

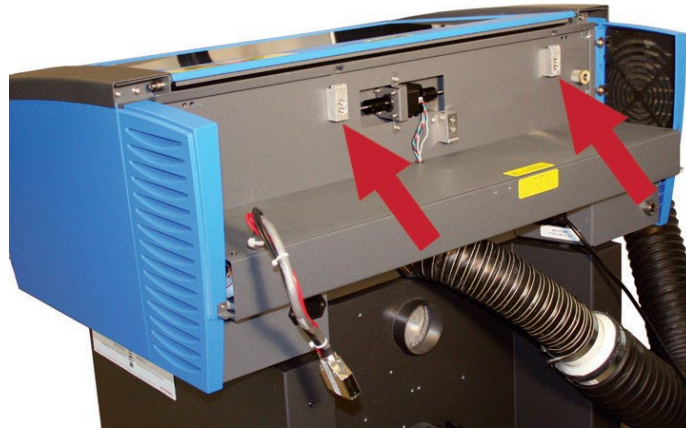
1. Unpack the laser system, place it on the table or desktop where you intend to operate it (if not using the optional exhaust air filtration unit), open the top door and remove any packing materials from inside the machine.
2. Gently move the X-Axis arm (1) back and forth. It should slide freely, if all packing material has been removed.



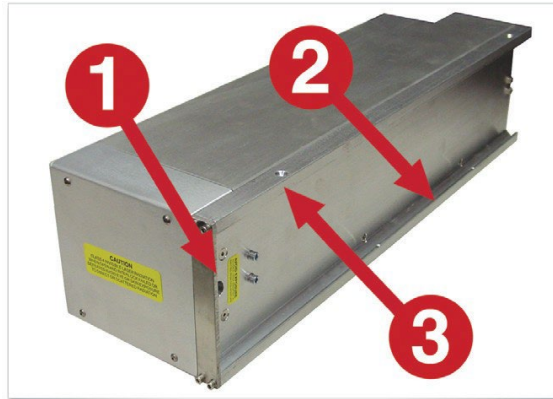
3. The laser cartridge for your laser system may be shipped separately. If the laser cartridge is not already installed in the VLS laser system, locate the laser and follow these instructions to install it, otherwise skip to the next numbered step.
 - a. Remove the back cover from the laser system by removing the two screws on the left and right side of the cover.



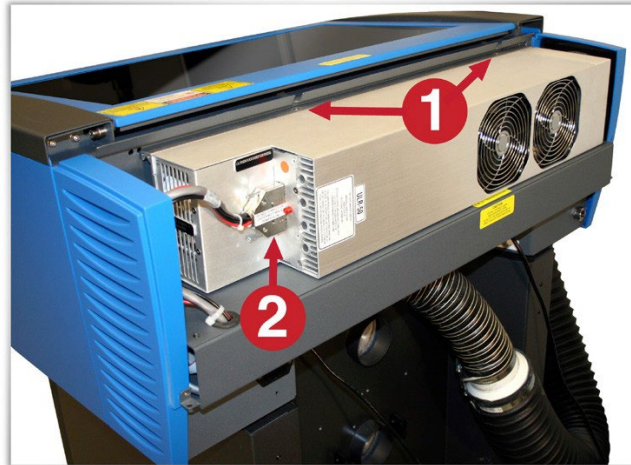
- b. Locate the two mounting blocks shown with arrows below and the laser connector on the left side of the laser compartment.



- c. Locate the “V” grooves along the upper (3) and lower (2) part of the laser cartridge base plate and the alignment plate (1) at the end of the base plate.



- d. Pick up the laser cartridge by the ends and mount the cartridge onto the mounting blocks shown in step b by placing the upper “V” groove on top of the mounting blocks. Slide the cartridge to the right or left as necessary until the mounting holes (1) in the top of the laser line up with the mounting holes in the top of the laser mounting blocks.

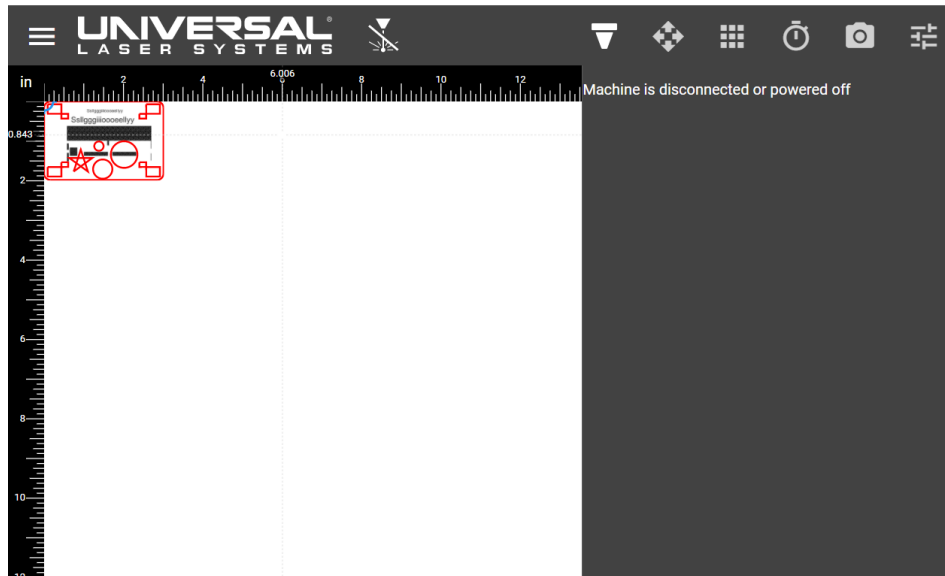


- e. Install the two supplied mounting screws in the mounting holes (1) and connect the laser connector (2) to the laser as shown.
 - f. Replace the back cover.
4. Plug the laser system and optional exhaust air filtration unit, if present, into appropriate power outlets.
 5. Connect the USB cable provided with the laser system between a USB port of the computer and the USB port on the back of the laser system.

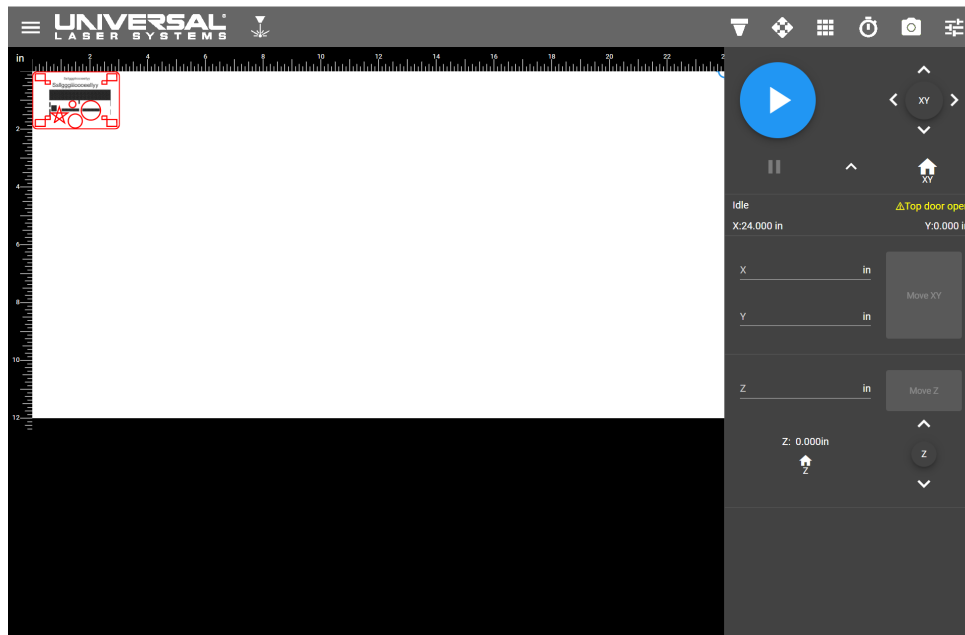
CAUTION: The laser system is USB 2.0 Hi-Speed and must be attached to a USB 2.0 or preferably a USB 3.0 port. The laser system comes equipped with a high quality, 6-ft (2.0 meter) USB 2.0 certified cable. We recommend you use this provided cable. Please note that longer USB cables or USB extension cables may induce sporadic behavior.



- After connecting the USB cable, launch the LSM software. The LSM will launch and indicate that the laser system is disconnected or powered off.



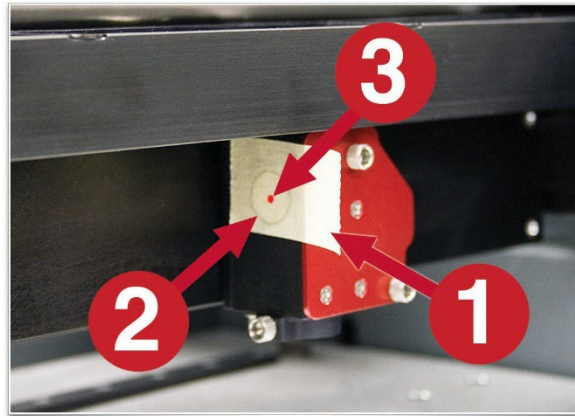
- Press the Power button on the VLS desktop laser system to turn the laser system on. The laser system should connect to the LSM software and after initializing and homing the motion system, the laser system should be ready to operate and the LSM should look like this. If the laser system does not initialize, check all connections and try to power on the laser system again. Contact ULS support if the laser system fails to power on and connect to the LSM.



Checking Beam Alignment

As a final step in the installation process, you need to check your beam alignment. You do this using the red alignment pointer built into the laser cartridge.

1. Launch the LSM software, if it is not already running, and turn the laser system on by pressing the power button on the keypad.
2. Open the top door and the red alignment pointer should automatically turn on.
3. Place a small piece of masking tape across the 3/4" (19 mm) hole in the focus carriage (1). Gently rub the tape around the edge of the hole so that you can see the outline of the hole through the tape (2).
4. Observe the red alignment pointer on the masking tape (3). The red pointer should appear centered to within 1/8 inch (3 mm) or better of the center of the hole in the carriage. If not, turn off the laser system, remove and re-install the laser cartridge and try again. If the red dot still does not appear centered, please contact the ULS Customer Support Team at 480-609-0297 (USA), +43 1 402 22 50 (Austria), +81 (45) 224-2270 (Japan) or e-mail us at support@ulsinc.com.
5. Once you have completed laser beam alignment verification, make sure to remove the masking tape.



Focus Carriage Beam Alignment

Accessories

Your laser system may include various accessories such as a cutting table for laser cutting applications, rotary fixture for cylindrical objects and a ULS Computer Controlled Compressed Air Unit along with coaxial and lateral gas assist attachments for gas assisted material processing. The accessories section of the manual details how to install and use these accessories.

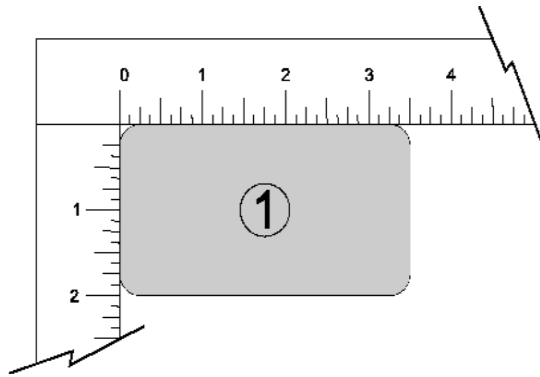
Running Your First Control File

This example will walk you through the process of engraving an image on a 2 x 3.5 inch (50 x 89 mm), 0.020 inch (0.5 mm) thick anodized aluminum test card supplied with your laser system. For additional test cards please contact Universal Laser Systems' Customer Service Team at 480-609-0297 (USA), +43 1 402 22 50 (Austria), +81 (45) 224-2270 (Japan) or e-mail us at support@ulsinc.com.

Note: This example uses a design file which can be downloaded from the same website where you downloaded the LSM installation package <https://www.ulsinc.com/support/technical-downloads> by selecting *LSM test file* from the "Download Installation Software" drop down menu and then pressing the link under the "Item to Download" heading.

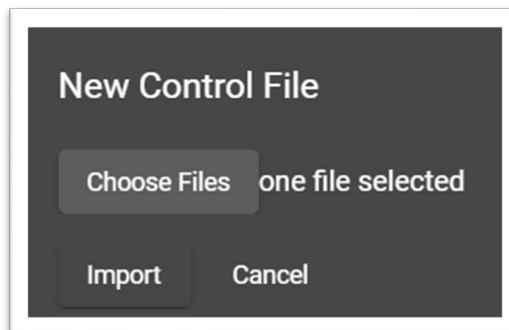
Step 1 – Loading and Positioning the Material

Position the piece of anodized aluminum (1) in the upper left corner of the table, against the rulers.

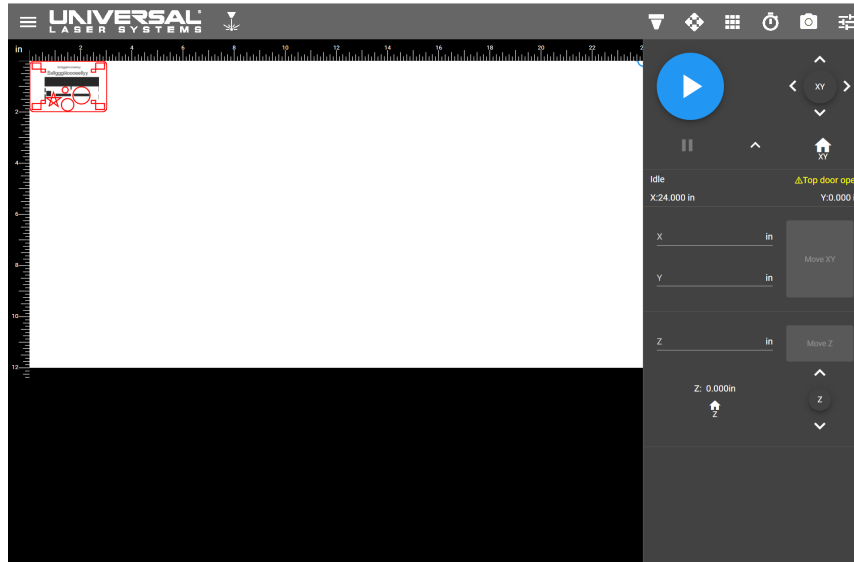



Step 2 – Importing the test file

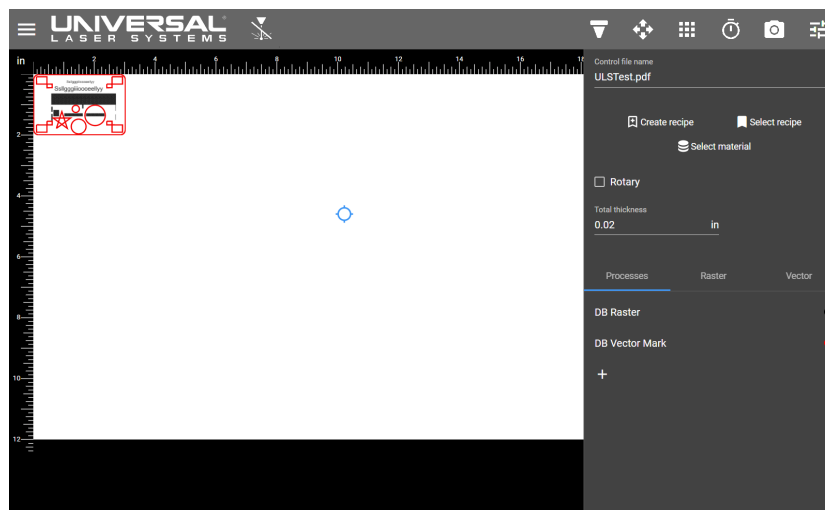
1. Select Control Files from the menu bar in the upper left corner of the LSM
2. Press the + sign in the lower right corner of the control files page of the LSM to launch the import dialogue.
3. Select *Choose Files* and locate the ULSTest.uls file you downloaded from the website in the note above to import the test file into the LSM.



- The test file should import and appear in the upper left corner of the system operation page of the LSM as shown.



- Measure the thickness of the material (a digital calipers is recommended for this task).
- Press the process settings button  in the upper right corner of the system processing page to view the process settings for the control file you imported into the LSM. Enter the thickness you measured in the previous step in the total thickness field. This value will be used by the laser system to position the top surface of the anodized aluminum card at the focal plan of the installed focus lens. Note the two processes already set up for this control file: DB Raster and DB Vector Mark. The DB Raster process will use intelligent database settings to raster mark the black parts of the artwork and the DB Vector Mark process will use intelligent database settings to vector mark the red parts of the artwork.



Step 4 – Starting the Process

1. Turn on the exhaust and laser system if not already on.
Note: Laser system cooling fans are variable speed and may speed up and slow down during operation as needed to cool the lasers.
2. Make sure the material is positioned correctly within the engraving area.
3. Close the top door.
4. Press the Start button on the keypad of the laser system to begin laser processing.

CAUTION: Observe that the laser system is functioning properly. If everything is working properly, an image should appear on the test card as the laser system runs the control file. If no image appears, check focus manually as described in the User Guide and adjust if necessary. If you cannot resolve the issue, please contact your distributor or the ULS Customer Service Department. Never leave the laser system unattended while laser processing.

Step 5 – Material Removal and Reloading

Once the laser system has completed processing the material, the focus carriage will move to the home position in the upper right hand corner of the processing field.

Before opening the top door, wait a few seconds to allow any remaining fumes that are left from laser processing to evacuate through the exhaust system.

Congratulations! You have just completed your first laser processing control file. Below is an image of the sample test card as it should look after laser processing. If your results are not satisfactory, please contact the Customer Service Department at 480-609-0297 (USA), +43 1 402 22 50 (Austria), +81 (45) 224-2270 (Japan) or e-mail us at support@ulsinc.com.

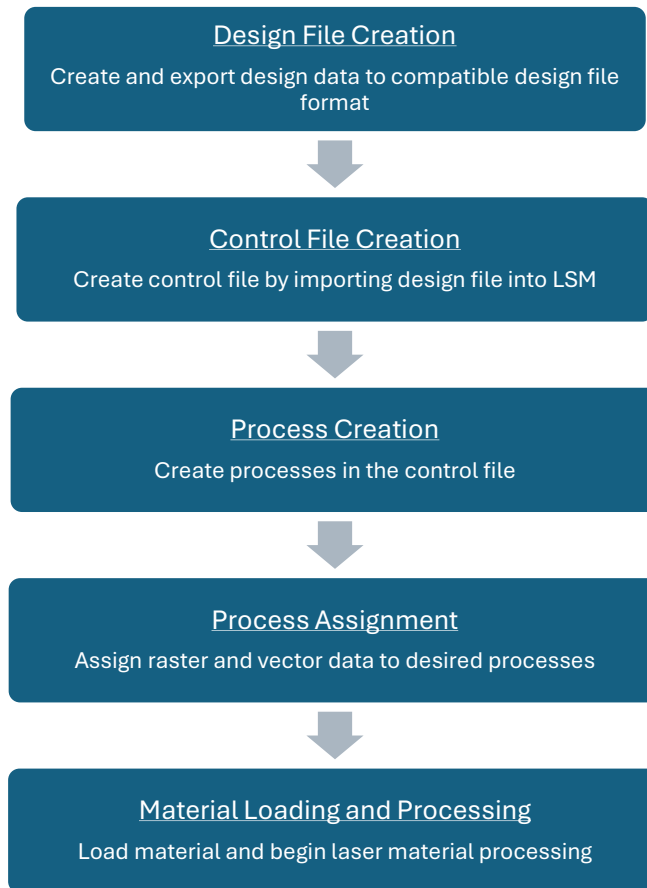


Chapter 4 - Operation

Important Laser Material Processing Workflow Overview

CAUTION: Please refer to the Safety section before operating the laser system.

Processing materials on the VLS desktop laser system is a simple five-step procedure outlined in the diagram below. This section details each step including term definition, procedures, and best practices.



Laser Material Processing Workflow

1. Design File Creation

Laser System Manager (LSM)

The software that runs the VLS desktop laser system is the Laser System Manager (LSM). It handles all aspects of importing, planning, arranging, organizing, and running design files to completion.

Design Files

A design file contains the design information (shapes, lines, images, etc.) that will be used to create a control file for laser material processing. A design file can be created using any software capable of outputting or exporting raster and/or vector data to an appropriate file format. Supported file types include PDF, DXF, SVG, BMP, JPG, TIFF, GIF or G-code,. There are two methods for turning design files into control files: Importing and Printing.

Importing a Design File

Importing a supported file type is accomplished by pressing the large plus symbol in the control file page within the LSM. A remote connection to the VLS desktop LSM via a browser provides users with this same capability. This is the preferred method of transferring design files to the VLS desktop laser

system since it does not require installing additional software and works on any OS that supports a modern browser.

Printing a Design File

To print a design file, a printer driver must be installed on the computer on which the design file is generated. Once a printer driver is loaded on a PC, the VLS desktop laser system acts as a network printer and can receive design files by simply using the design software's *print dialog*. Once printed, the design file will be sent to the LSM, and a control file is generated from the design file.

Elements of a Design File

The LSM interprets elements of a design file as either raster or vector data. The VLS desktop laser system uses these raster and vector elements to modify materials using either of two modes: a raster mode or a vector mode.

Raster Mode of Operation

The raster mode of operation is used primarily for surface modification. In this mode, images or shapes from a design file are reproduced on the surface of a material by moving (scanning) the carriage of the beam delivery system back and forth on the X Axis arm while stepping the Y Axis arm in small increments. As the carriage scans across the material surface, laser energy is applied in a grid of discrete pulses at resolutions up to 2000 dpi. Material is either removed or modified in some way (annealed, oxidized, etc.) depending on the kind of material being processed and the amount of laser energy being deposited. Raster image data must be present in the user's design file to employ this mode of laser material processing. Raster image data can either be in the form of color or greyscale bitmap images, or solid filled areas.

Vector Mode of Operation

The vector mode of operation is used for both cutting and marking materials. In this mode, vector shapes or outlines from design files are used to simultaneously direct the X and Y Axes of the beam delivery system to follow a vector path, while applying controlled amounts of laser energy to partially or completely cut through a material. This mode can also be used to create thin marks on the surfaces of some materials without penetrating the surface. Vector path data must be present in the user's design file to use this mode of laser material processing.

2. Control File Creation

Control Files

To begin modifying materials with VLS desktop laser system, a control file must first be created in the LSM. A control file contains the collection of raster image and vector path data in addition to the laser material processing parameters needed for a particular laser material processing application.

Importing design files

Control files are created by importing design files into the LSM using the import or printer processes discussed above. During the import process, the import engine maps each vector and raster data element from its original color to one of sixteen colors supported by the LSM based on a color matching algorithm. The black value has a special use -- to condition multicolor or greyscale data for raster processing. This is achieved by dithering the laser power to recreate the features of the original design file.

3. Process Creation

Once a control file is created in the LSM by importing a design file, a process must be defined for each task (i.e. laser cutting, laser marking, laser engraving, laser surface modification, etc.).

Default processes

When a new design file is imported into the LSM, the material thickness and type must be selected from the ULS Intelligent Material Database. Each material in the database contains up to three predefined default processes; a raster process, a vector cutting process, and a vector marking process (non-supported processes will not appear for certain materials). These default processes can be used as-is or modified as needed. The default processes are called database processes and use the Intelligent Materials Database to calculate optimal settings for each process type for the current system configuration.

4. Process Assignment

After processes have been established for each laser material processing task, each element of the imported raster and vector data must be assigned to a process. Raster and vector data is assigned to a process based on the color of the raster or vector element. Although the LSM supports up to 16 different colors for process assignment, only the colors present in the control file will be displayed. Additionally, if a color does not contain compatible data, it will not be displayed for assignment within a process. For example, if a color does not contain vector data, it will not be available for assignment to a vector process.

5. Material Loading and Processing

Alignment of material and design file data

Once the processes have been set up for each color and colors assigned to each process, laser material processing can begin. Material must be placed on the Material Support Structure and positioned to align with the raster and vector data in the control file. Corresponding rulers in the preview window of the LSM and on the table can be used for rough alignment. For more precise alignment, the red target pointer can be used to relocate design file data to the material or vice versa using the relocation tools in the LSM. If the system is equipped with a door mounted camera vision system, the built in cameras can be used to visually align design files with materials.

Setting up the Cutting Table

The optional cutting table can be used for cutting processes. The honeycomb support surface on the cutting table efficiently exhausts smoke and fumes when cutting through materials. If some of the laser processes are cutting processes, it is recommended to install the cutting table prior to processing.

Focusing

The laser system must be properly focused on the top surface of the material for optimal results. The VLS desktop laser system automatically focuses the system on the surface of the material if the total material thickness is entered into the process settings for the control file being run. Alternatively, the manual focus tool can be used to manually focus on the surface of the material before processing.

Setting up gas/air assist

The VLS desktop laser system controls and directs a source of compressed gas/air onto the material which can aid in material processing for certain materials and applications. Two attachments are available for directing the gas/air to the material; a coaxial gas/air assist attachment that directs gas/air down onto the material coaxially with the focused laser energy and a lateral gas/air assist attachment that directs air along the material's surface, perpendicular to the focused laser energy. Coaxial gas/air assist works best for certain vector processing tasks and lateral gas/air assist works best for certain raster processing tasks. Gas or air assisted laser

processing can be selected independently for each process set up in a control file. Gas/air flow levels can also be programmed per process.

Initiating processing

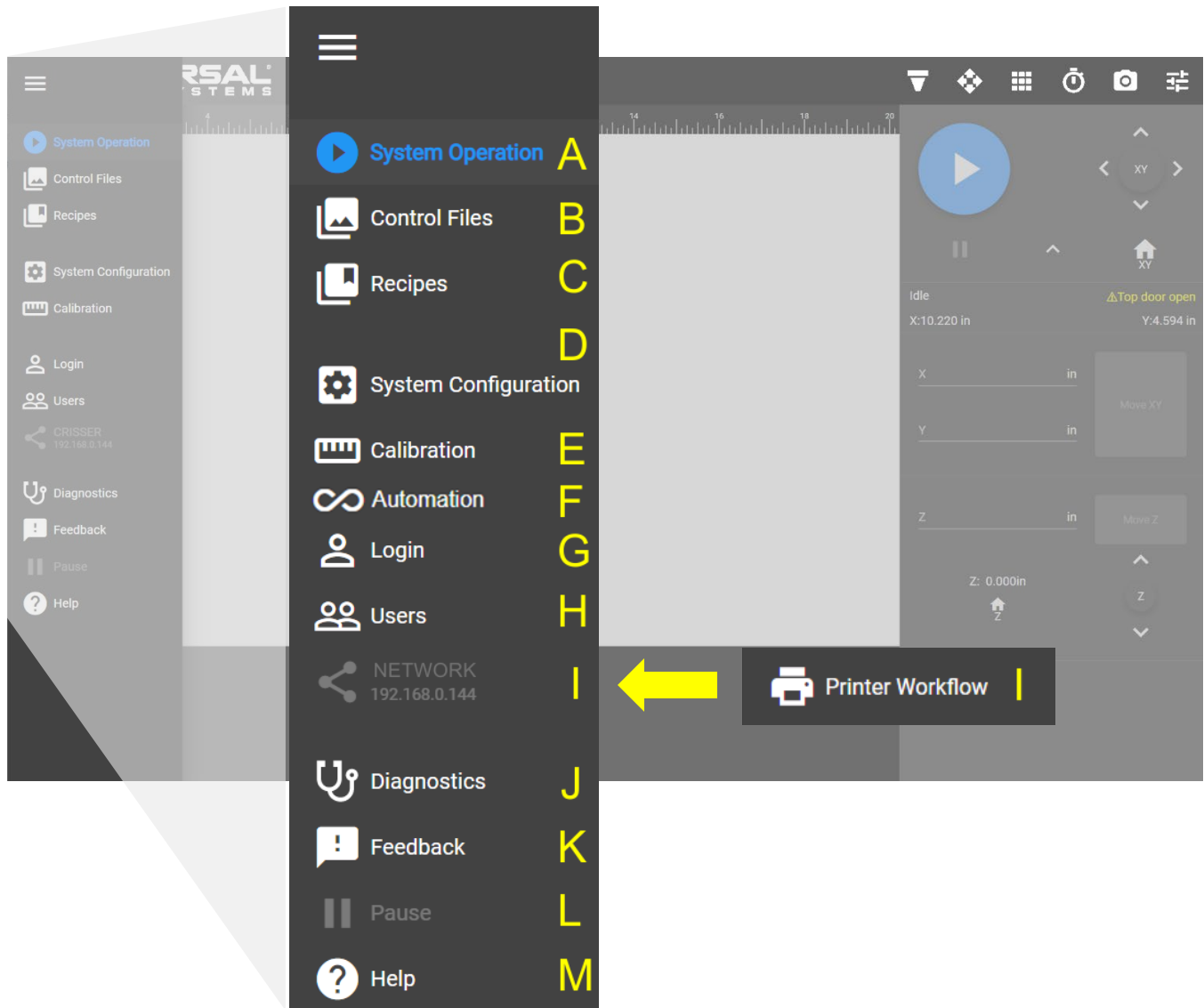
Once the control file is properly set up and material is loaded and aligned with the control file data, processing is initiated by pressing the process start button in the LSM. Once processing is initiated it can be paused, if necessary, then resumed or restarted as desired. Laser processing tasks occur in the order processes are listed in the control file and by the order of the colors assigned within each process. Within a process colors are run from left to right in the order they were added to the process but can be reordered by dragging.

Laser System Manager Overview

The LSM (Laser System Manager) is the software interface used to control the VLS desktop laser system, manage control files, setup processes, etc. The following Quick Reference Guide provides a brief overview of the functionality of the LSM.

Main Menu

The Main Menu of the LSM is accessible by pressing the *Main Menu Button*, three horizontal lines in the upper left-hand corner of the LSM. It provides quick access to a wide variety of software features. Most of the items accessible from this menu open a new page of the LSM software.



A- System Operation

Opens the System Operation Page to control the laser system, setup control files, adjust settings, etc. This page is the default page for the LSM unless no control files exist in which case the Control File Page will appear.

B- Control Files

Opens the Control Files Page to manage the control files stored in the LSM and to import new files.

C- Recipes

Opens the Recipes Page to access a list of all of the recipes currently stored on the system. Recipes are saved collections of laser processing settings that can be applied to design files.

D- System Configuration

Opens the System Configuration Page to adjust general system and software settings such as the laser diode behavior, the LSM units, and the Z Axis speed setting.

E- Calibration

Opens the Calibration Page to access a series of wizards and dialogs to aid in system calibration.

F- Automation (if optional automation accessory is installed)

Opens the Automation Page to configure the automation ports. See the accessory section on the automation accessory for more details.

G- Login/User Detail

A login screen will be presented if no users are logged into the LSM. The Login screen will ask for the username and password. At least one user account must be created to use this feature. If a user is already logged into the LSM a User Details Page will be presented where the currently logged in user may change their passwords and view their operational permissions.

H- Users

Opens the Users Management Page where users may be added, removed, and configured.

I- Network Information

Displays the IP address of the computer directly connected to the VLS desktop laser system through USB. This IP address is displayed so it can be used to log into the LSM remotely on any other device on the local network by typing the IP address into any internet browser.

I- Printer Workflow (if connected remotely to the laser system)

When viewed from a remote computer, this option replaces the Network Information on the Main Menu. Select this option to initiate the download of a Printer Driver which, once installed, will enable a user to print their design files directly to the system over the network.

J- Diagnostics

Opens the Diagnostics Page where users can access diagnostics tools for various components of the laser system and accessories to aid in troubleshooting problems.

K- Feedback

Opens the Feedback dialog where users can submit reports of software errors directly to ULS for review (requires an internet connection).

L- Pause

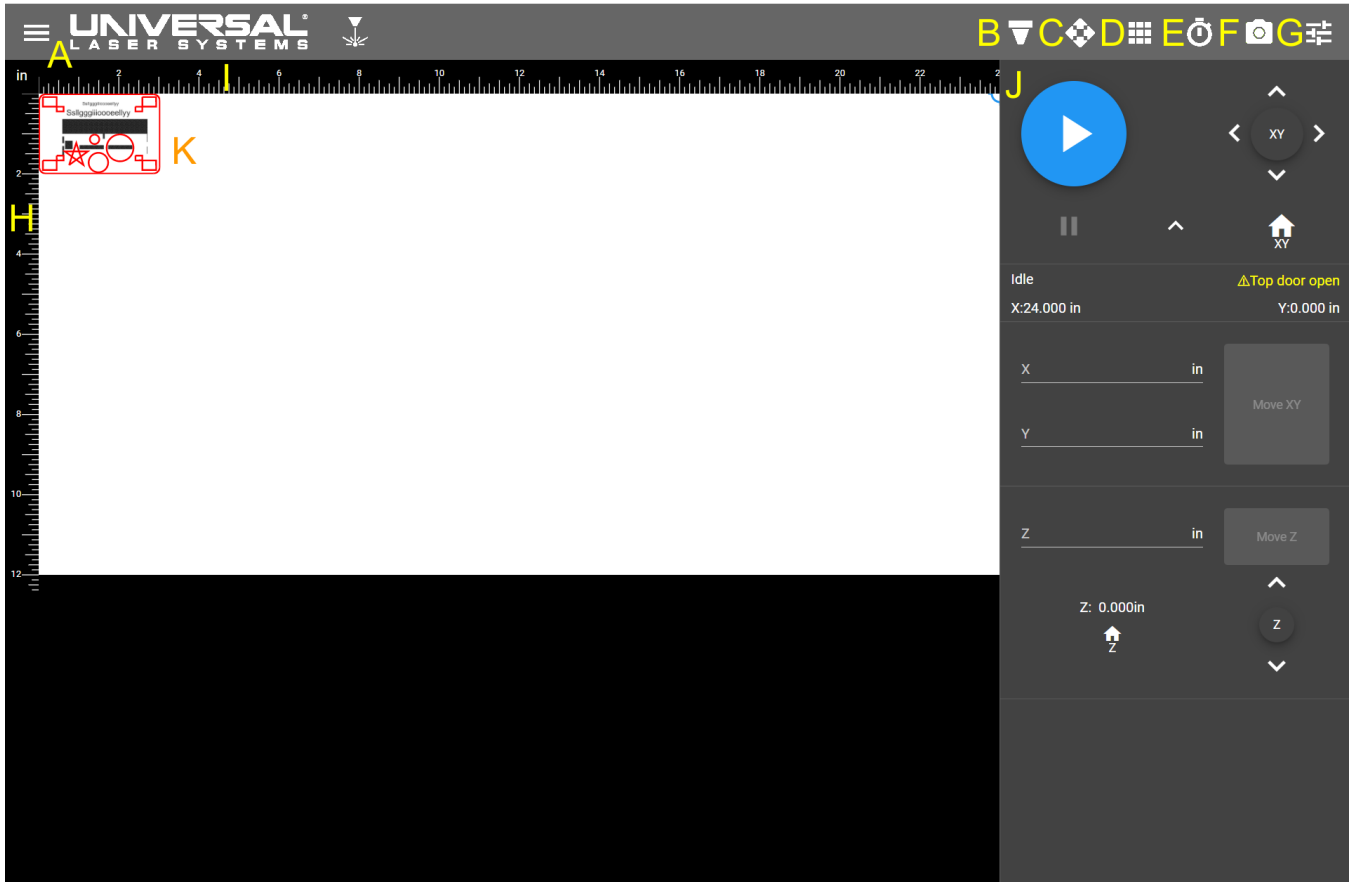
Pauses the laser system for both convenience and safety. This pause control is needed for safety if the user becomes logged out of the system while the system is processing material.

M- Help

Opens the Help Page, which contains information regarding the system's state, provides access to Remote Diagnostics, and enables the user to update the LSM software.

System Operation Page

The primary location for laser system controls is the *System Operation Page*. The system may be positioned, set up, and run from this page. This default page is the most used in the LSM.



The System Operation Page

A- Menu Button

Opens the Main Menu on the left-hand side of the LSM. While opened, no other buttons will be enabled. For further details, refer to the Main Menu section of this manual.

B- Focus View

Opens the Focus View as the current sidebar on the right-hand side of the LSM. For further details, refer to the Focus View Controls section of this manual.

C- Relocation View

Opens the Relocation View as the current sidebar on the right-hand side of the LSM. For further details, refer to the Relocation View Controls section of this manual.

D- Duplication View

Opens the Duplication View as the current sidebar on the right-hand side of the LSM. For further details, refer to the Duplication View Controls section of this manual.

E- Estimation View

Opens the Estimation View as the current sidebar on the right-hand side of the LSM.

F- Camera View

Opens the Camera View as the current sidebar on the right-hand side of the LSM. For further details, refer to the Camera View Controls section of this manual.

G- Settings View

Opens the Settings View as the current sidebar on the right-hand side of the LSM. For further details refer to the Settings View Controls section of this manual.

H- Vertical Rule

Provides a vertical position reference in the processing area for the Design File Preview. Units are adjustable in the Systems Configuration Page.

I- Horizontal Rule

Provides a horizontal position reference in the processing area for the Design File Preview. Units are adjustable in the Systems Configuration Page.

J- Focus View Controls

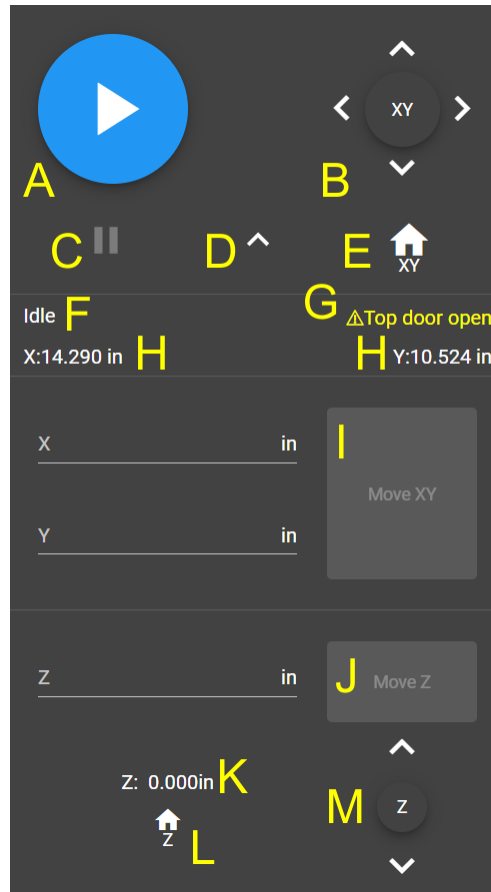
Contains the controls associated with locating and moving the motion system. For further details, refer to the Focus View Controls section in this manual, below.

K- Design File Preview

Shows a preview of the design file and its current location in the processing area. This area is interactive and performs different functions depending on the menu displayed on the right of the preview.

Focus View Controls

These controls are primarily used to position and locate the motion system across each axis, and for positioning the material to be laser processed. Several of these controls are duplicated in other views. When in this view pointing at a position in the preview area with a mouse will move the beam delivery motion system to that location.



System controls.

A- Begin Processing Button

Initiates laser material processing, during which time, the button will be disabled.

B- XY Axis Joystick

Moves the system along the X and Y Axes simultaneously. Touch and drag the central button to manually adjust the system position. Tapping on any of the four arrows will generate incremental movements in the associated direction (Up, Down, Left, and Right). The size of these movements is determined by the Tap Sensitivity Adjustment Button (D).

C- Pause, Resume and Stop Process Buttons

The Pause button causes the system to pause during processing. When paused, the Pause button will be replaced by a Resume and a Stop button. The Resume button will cause the system to resume processing where it was paused. The Stop button will clear the paused state.

D- Tap Sensitivity Adjustment Button

Adjusts the sensitivity of movement of the arrow buttons between Low, Medium, and High on each joystick. The current sensitivity level is indicated by the number of chevrons on the button. More chevrons indicate larger movement distances.

E- Home XY Button

Simultaneously performs the homing routine on the X and Y Axes, causing the system to move towards the upper right-hand corner of the processing area and reestablish the home position.

F- System Status Indicator

Displays a brief written description of the system's status. The text will change as the system state is modified and will turn yellow if warnings are associated with the current state.

G-Warning State indicator

Displays a brief written description of warnings about the state of the system that might prevent laser processing from occurring such as interlocked doors being open to the laser processing area.

H- System Location Indicators

Provides the exact location of the carriage in the X and Y Axes. Units are adjustable in the System Configuration Page.

I- Move XY Axes Form & Button

Enables manual entry of the X and Y Axes locations. Entering a value into each text field followed by depressing the Move XY Button will cause the carriage to move to the specified location. Units are adjustable in the System Configuration Page.

J- Move Z Axis Form & Button

Enables manual entry of the Z Axis location. Entering a value into the text field followed by depressing the Move Z Button will cause the material support structure to move to the specified location. Units are adjustable in the System Configuration Page.

K- Z Axis Location Indicator

Provides the exact location of the material support structure (Z Axis). Units are adjustable in the System Configuration Page.

L- Home Z Axis Button

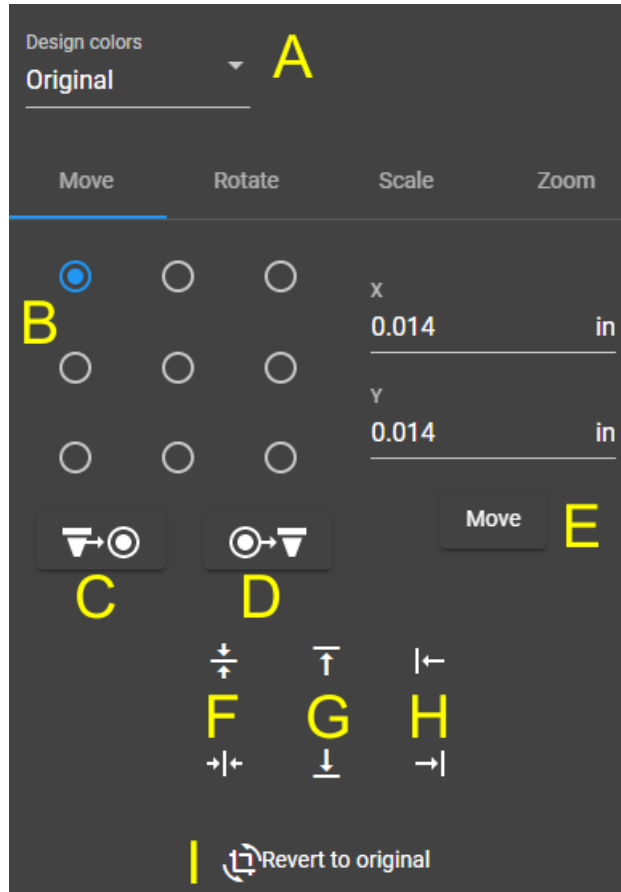
Performs the homing routine on the Z Axis. This will cause the material support structure (Z Axis) to move downwards and reestablish the home position. Note that this procedure may take up to one minute to complete.

M- Z Axis Joystick

Moves the material support structure (Z Axis) up and down. Touch and drag the central button to manually adjust the Z Axis position. Tap the Up and Down arrows to generate incremental movements. The size of these movements is determined by the Tap Sensitivity Adjustment Button (D).

Relocation View Controls

This set of controls manages the location, rotation angle and scale of the design file within the Design Preview Area. Design files may be manipulated by dragging the control handles around the design itself in the preview area, or by using the controls provided in the right-hand sidebar. Each type of manipulation (location, rotation, and scale) has its own set of controls selectable as tabs on the sidebar.



Move Tab

A- Design Colors

Improves ability to see design files when superimposed on materials of different colors by temporarily switching the preview of the design to one selectable bright color.

B- Relocation Anchors

Acts as both indicators and selectors for the nine anchor points on the design file. Select an anchor point to make it active. The anchors shown in the Design Preview Area are synchronized with these anchors and serve the same function.

C- Carriage to Anchor Button

Moves the carriage to the current location of the active anchor on the design file.

D- Anchor to Carriage Button

Moves the active anchor on the design file to the current location of the carriage.

E- Anchor to Location Form & Button

Displays the current location of the selected anchor and allows that location to be moved. To move the selected anchor overwrite the current X and Y positions with desired X and Y positions and press Move. Units are adjustable in the System Configuration Page.

F- Center Design File Buttons

Centers the design file in either the vertical or horizontal direction.

G- Vertical Min-Max Placement Buttons

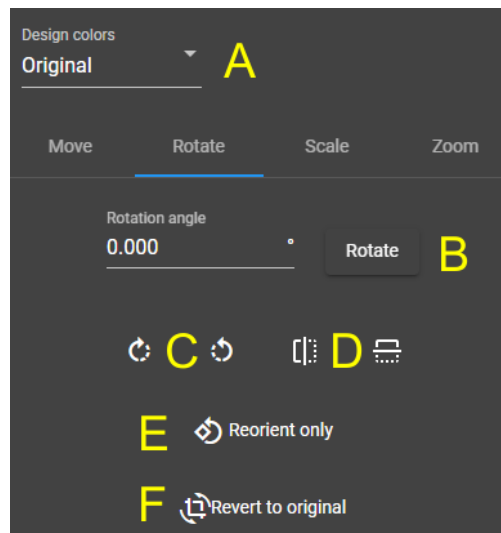
Moves the design file to the top or bottom of the processing area. The X Axis location of the design file remains unchanged.

H- Horizontal Min-Max Placement Buttons

Moves the design file to the far right or far left of the processing area. The Y Axis location of the design file remains unchanged.

I- Revert to Original Button

Reverts all changes (location, rotation, and scale) to that of the original design file.



Rotate Tab

A- Design Colors

Improves ability to see design files when superimposed on materials of different colors by temporarily switching the preview of the design to one selectable bright color.

B- Rotate Form and Button

Rotates the design file to the specified angle.

C- Quick Rotation Buttons

Rotate the design file in 90 degree increments in the specified direction, clockwise or counterclockwise.

D- Mirror Buttons

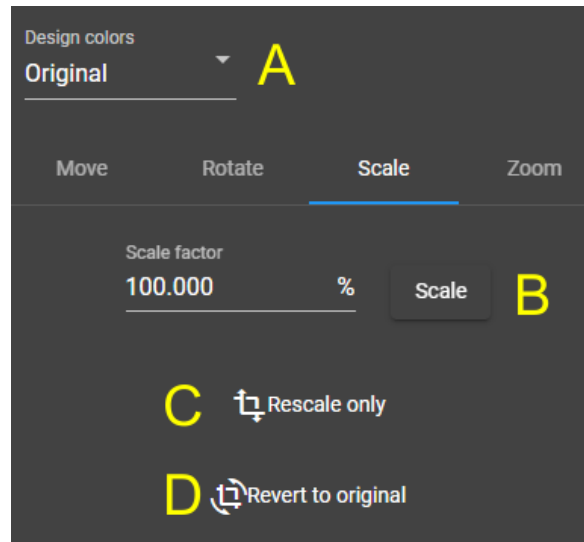
Mirrors the design file about the horizontal or vertical axis.

D- Reorient Only Button

Reverts to the original rotation angle of the design file but preserves location, scale and mirroring changes.

E- Revert to Original Button

Reverts all changes (location, rotation, and scale) to that of the original design file.



Scale Tab

A- Design Colors

Improves ability to see design files when superimposed on materials of different colors by temporarily switching the preview of the design to one selectable bright color.

B- Scale Form and Button

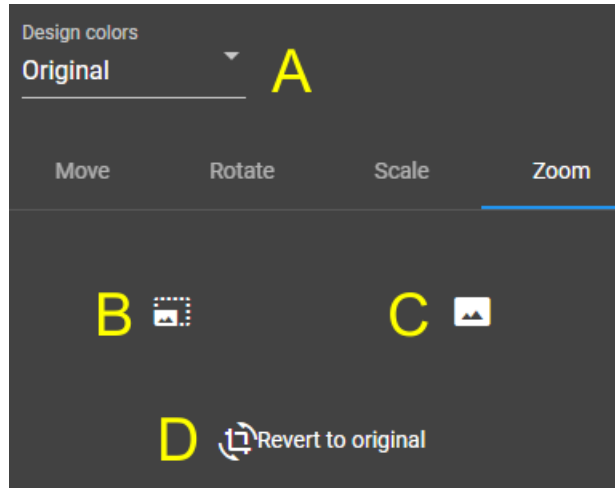
Scales the design file by the specified percentage.

C- Rescale Only Button

Reverts to the original scale of the design file but preserves location and rotation changes.

D- Revert to Original Button

Reverts all changes (location, rotation, and scale) to that of the original design file.



Zoom Tab

A- Design Colors

Improves ability to see design files when superimposed on materials of different colors by temporarily switching the preview of the design to one selectable bright color.

B- Zoom Full Field Button

Shows the full extent of the processing area in the Design Preview Area.

C- Zoom to Design File Button

Shows only the region occupied by the design file in the Design Preview Area.

D- Revert to Original Button

Reverts all changes (location, rotation, and scale) to that of the original design file.

Duplication View Controls

These controls relate to duplication of a design file within the *Design Preview Area*. They provide a convenient method to create multiple impressions of a single design file within the LSM.

The image shows a control panel for duplicating design files. It includes a 'Duplicate to Fill' button (A), a 'Remove Duplicates' button (B), and a form (C) for specifying the number of columns and rows. Below the form are input fields for X and Y pitch (D) and X and Y gap (E), all with units in inches.

A- Duplicate to Fill Button

Generates duplications to fill the field rightwards and downwards from the location of the original design file. To maximize the number of instances, place the original design file in the upper left-hand corner of the processing area before duplication.

B- Remove Duplicates Button

Removes all duplicate design files and returns the Row and Column counts to a value of one.

C- Row & Column Count Form

Provides fields to indicate the number of Columns and Rows desired for duplication of the current design file. Duplicates will be placed to the right and below the location of the current design file. To maximize the number of instances, place the original design file in the upper left-hand corner of the processing area before duplication.

D- Duplication Pitch Form

Provides fields to adjust the design file duplication pitch in both the X and Y directions. The pitch is the total spacing from edge to edge of each duplication instance. Changing either the pitch or gap will override any previous pitch and gap settings. Units are adjustable in the Systems Configuration Page.

E- Duplication Gap Form

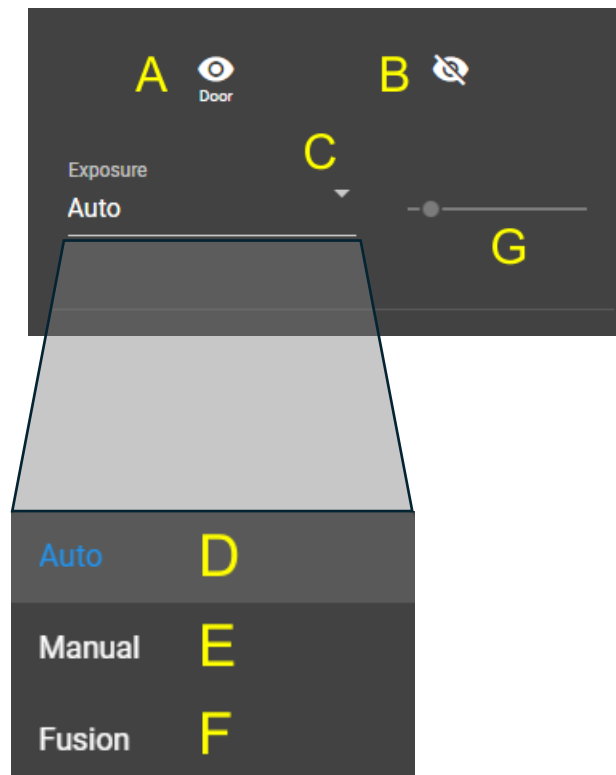
Provides fields for adjustment of the design file duplication gap in both the X and Y directions. The gap is the space between the outermost extents of the design file. Changing either the pitch or gap will override any previous pitch or gap settings. Units are adjustable in the Systems Configuration Page.

Special Note:

Specific Cells in the duplicate array can be skipped when laser processing by long pressing on the cell in the control file preview area. Deactivated cells will be grayed out. Long pressing again will re-activate the cell.

Camera View Controls

If the door mounted camera vision option is installed, this menu provides controls for interacting with the camera. The camera is installed on the top door of the laser system and provides a panoramic view of the laser processing area and allows for manual alignment of design files with materials placed in the processing area.



A- Image Capture Button

Captures an image of the material processing support surface from the door mounted camera and displays the image in the background of the design file preview window.

B- Remove Image Button

Clears any camera images from the background of the design file preview window.

C- Camera Exposure

Selects an exposure method for the camera. Ambient lighting affects the quality of the image captured by the camera. Different methods of controlling the exposure settings for the camera can be selected to optimize the image. Each is explained below.

D- Auto Exposure

Allows the camera to set the exposure level. This method works well when there are no direct overhead lights which can cause bright reflections on the material support surface, or highly reflective materials placed on the support surface.

E- Manual Exposure

Allows the user to set the exposure level using the slider control to the right of the exposure selection control. This method can compensate for bright reflections from overhead lighting, but may leave some areas of the image too dark if reflections are too bright

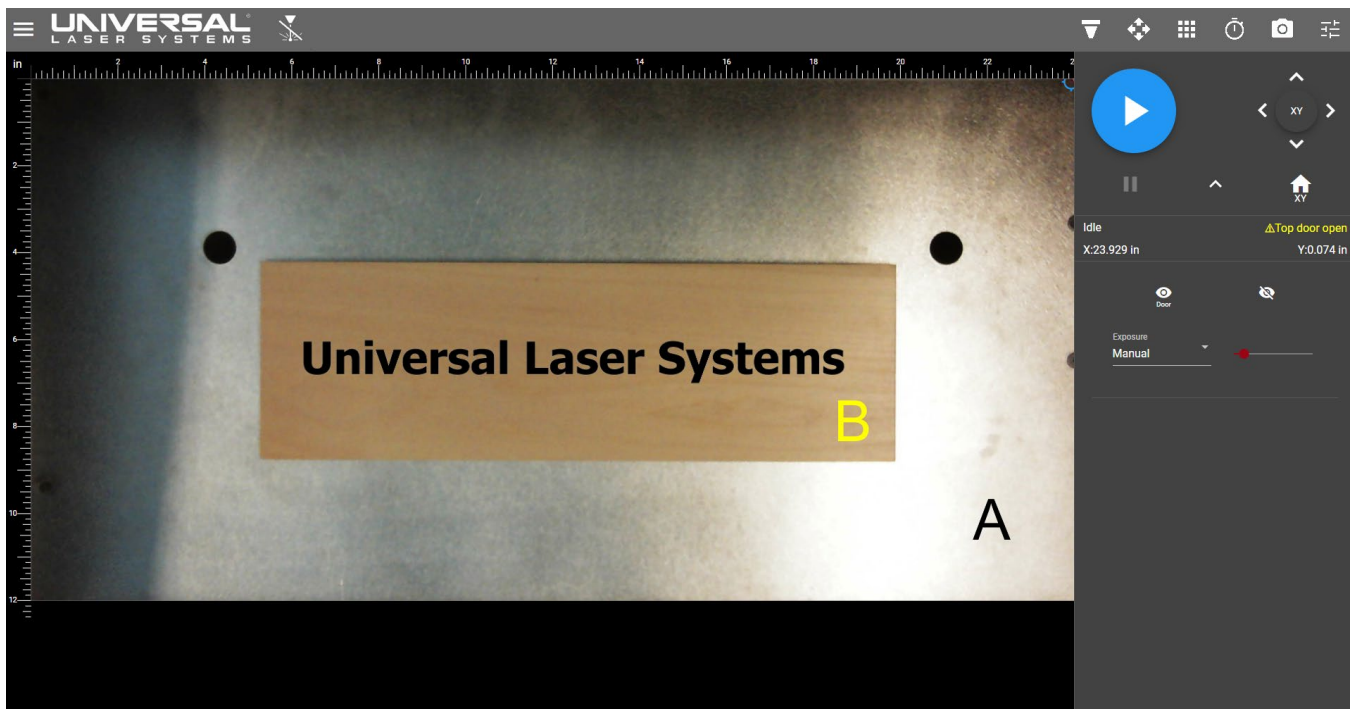
F- Fusion Exposure

This method automatically takes multiple pictures at different exposure levels and combines the images to produce a composite image that flattens out the effects of different lighting conditions in different areas of the material processing area. This method produces the best image but takes a few seconds to generate.

G- Manual Exposure Slider

This slider adjusts the manual exposure level when manual exposure is selected. When Auto or Fusion Exposure is selected, this slider is grayed out.

Camera Preview Results



A- Camera image

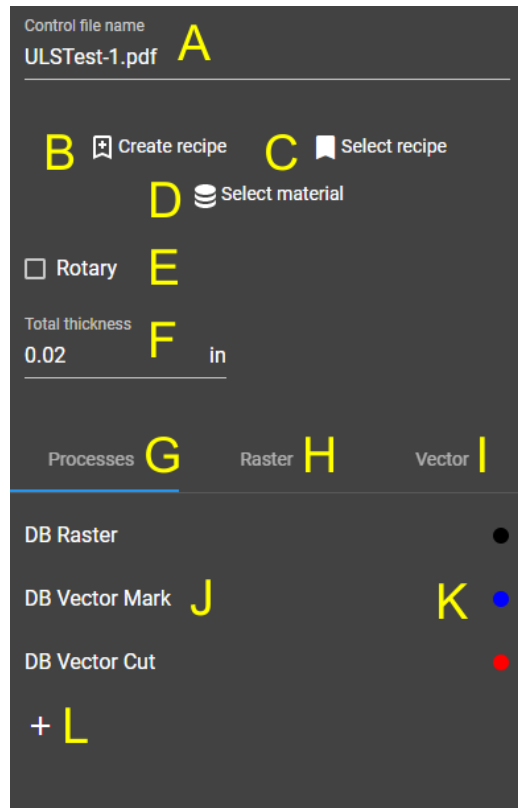
Image of material support surface with material placed on the support for laser processing as captured by the door mounted camera using the manual exposure method. A new image can be captured at any time by pressing the door camera button.

B- Superimposed Design File

The design file, in this case the text "Universal Laser Systems" is superimposed on the camera image to allow visual alignment of designs with materials placed on the material support surface using the relocation tools to reposition, rotate and scale the design as needed before laser processing begins.

Settings View Controls

The *Settings View* is the primary location used for setup, ordering, and configuration of the various processes that are possible on the VLS desktop laser system. Individual processes are assigned a set of colors that correspond to graphical elements within the design file.



A- Control File Name

Displays the name of the control file. When importing a new design file, this field is automatically populated with the newly imported file's name. Tap in this field to edit the name of the control file.

B- Create Recipe Button

Opens the Create a New Recipe Wizard, enabling the creation of a recipe from the current processing settings. These settings can be later recalled and applied to another control file. A recipe is a copy of all of the current process settings for the selected control file.

C- Select Recipe Button

Selects a recipe from saved recipes and applies the recipe to the current control file.

D- Select Material Button

Selects a material from the materials database and applies its default recipe to the current control file. If there are existing intelligent database processes in the control file all processes will be recalculated for the new material. If the new material does not support cutting, any database cut processes will be removed.

E- Rotary Selector

Selects the rotary axis module to process round materials. When selected, a yellow horizontal line will be displayed in the preview area showing the rotational axis. If a control file with rotary selected is started and the rotary fixture is not installed and an error message will be displayed indicating that the rotary fixture must be installed.

F- Total Thickness

Enter the thickness of the material to be processed and this value will be used to position the top surface of the material at the focal plane of the installed final focus lens (the installed lens is chosen in the System Configuration page) if the focus mode in a process is set to "Focus on Surface."

G- Processes Settings Tab

Lists all of the processes, assigned colors, and the processing order in the selected file. This is the main tab used for editing laser processing settings.

H- Raster Settings Tab

Contains the specific settings for the raster elements of a design file. For more detail, refer to the Raster Settings Tab section of this manual.

I- Vector Settings Tab

Contains the specific settings for the vector elements of a design file. For more detail, refer to the Vector Settings Tab section of this manual.

J- Process List

Lists all processes with their assigned colors. Processes will be executed from top to bottom. Colors within the same process will be executed from left to right. To Edit a process, select that process and the process editing form will pop up. The settings displayed in the process editing form will differ depending on the process type selected. Process editing forms for each process are described below.

K- Colors Assignments

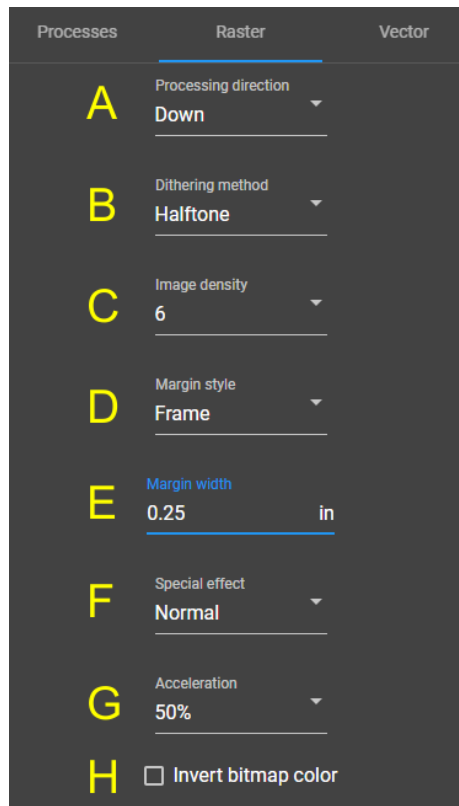
Indicates what colors in the design file have been assigned to a process. All colors assigned to a process will have those process settings assigned to them for laser processing.

L- Add New Process Button

Creates a new process. Press this button to open the New Process Dialog where process type, settings, and color assignments can be made.

Raster Settings Tab

Contains settings common to all raster elements of a design file.



A- Processing Direction

Determines the direction the raster motion will progress throughout the control file. Down will start at the top of the control file and make its way downward. Up will start near the bottom of the control file and progress upward.

B- Dithering Method

Uses the rasterization dithering method to adjust the appearance of color and grayscale image data in the design file. In addition to traditional halftone and error diffusion dither patterns, there are three specialty modes for photo marking/engraving: coarse, medium and fine. When marking/engraving photos, choose the method that provides the best results on the particular material being processed. Fine is usually best for hard materials and coarse for soft.

C- Image Density

Selects image density. Higher numbers will result in more raster passes per unit distance while lower numbers will increase throughput. Selecting the lowest number that meets the quality requirements will result in optimal processing results.

D- Margin Style

Indicates the type of margin to be used for the raster process. Tight will reduce the overall processing time by moving only the required amount in the X direction for each raster stroke. Frame will make each raster stroke the same length over the entire process – the length of the widest single raster line.

E- Margin Width

Specifies the amount of additional motion system travel beyond the right and left edge of raster image data when raster processing. Adding a non-zero margin may be necessary on some materials to produce even and consistent marking at the right and left edges of a raster marked or engraved process.

F- Special Effect

Enables selection of special raster modes used in 3D Engraving and Rubber Stamp production as well as a reduction mode that is useful for reducing overmarking which is similar to ink bleeding and can prevent 2D/3D barcodes from reading properly.

G- Raster Acceleration

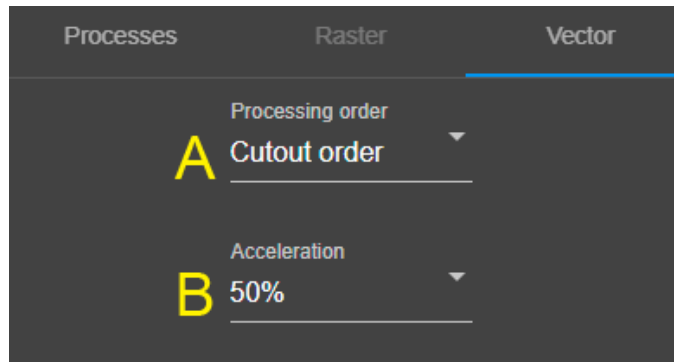
This value corresponds to the amount of acceleration the system will undergo during raster processing. Higher percentages will yield faster completion times. Lower percentages will yield higher quality results.

H- Invert Bitmap Color

This switch will invert the colors in a raster image. This is especially useful for engraving bitmaps onto material where the surface color is dark and the raster marked color is light or for processing rubber stamps where the background needs to be removed to leave the stamp text and graphics raised.

Vector Settings Tab

Contains settings common to all Vector Processes set up in the *Processes Tab* (Database and Custom).



A- Processing Order Settings

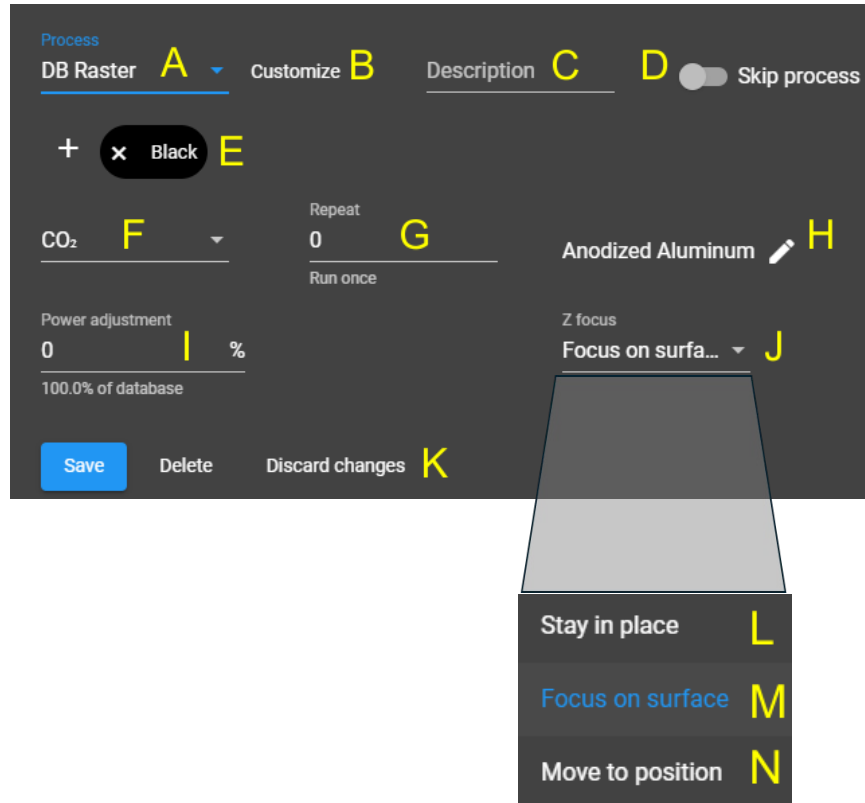
Determines the processing order of the vector graphical element. “As designed” will process vectors in the order they were created in the design software. “Cutout order” will process vectors from innermost to outermost closed shape, which is useful when material is elevated to avoid back reflection when being cut and parts fall out as they are cut. “Minimum time” processes vectors in an order that tries to minimize completion time.

B- Vector Acceleration

This value corresponds to the amount of acceleration the system will undergo during vector processing. Higher percentages will yield faster completion times. Lower percentages will yield higher quality results.

DATABASE RASTER AND DATABASE VECTOR MARK SETTINGS

Uses the Intelligent Materials Database to generate laser processing settings for a Raster Marking Process.



A- Process Type Selector

Indicates the process type. The interface above shows the Intelligent Database Raster settings. If changed, the available settings will change to reflect the new process type. When using intelligent database settings, the LSM will use the rated power of the installed laser and its wavelength to calculate the appropriate settings for the selected process on the selected material type (and thickness for cutting processes). If the material or laser is changed, the database will automatically adjust the settings for the new laser or material selection

B- Customize

This button will retrieve the database settings for the currently installed laser and selected material and convert those settings to a custom raster or vector process. Once the process has been converted to a custom process using the customize button, the process is decoupled from the intelligent database and will not be automatically adjusted if the laser or material is changed. Customization is useful for developing new settings for new materials by using a similar material as a starting point or for developing new non-standard processes for an existing material by providing a starting point from the intelligent material database and adjusting the settings as needed.

C- Process Description

Provides a field to enter a description of the process. In addition to the text box shown above, this description will appear in the Process Settings Tab along with any recipe information that may be saved.

D- Skip Process Toggle Button

Provides an easy way to store the process settings while enabling the user to quickly disable a process. If toggled on, the process will be greyed out in the Process Settings Tab, indicating that it will currently be skipped when the laser system processes the selected file.

E- Associated Colors

Displays the design file colors assigned to the selected process. Colors may be removed by selecting the X next to the color's name or added by selecting the + sign. Only colors found in the design file will be available to add to each process. If multiple colors are assigned to a process, colors will be processed left to right. The order in which the colors will be processed can be changed by dragging the color in front or behind other colors as desired.

F- Laser Type

This control indicates the type of laser that should be used during the selected process.

G- Repeat Count

The number of times to repeat the selected process.

H- Material Selection

Indicates the currently selected material for the current database process. The Pencil button launches the database's Material Selection Dialog that categorically lists all materials in the Intelligent Materials Database compatible with the current system setup. Changing material for a specific process will not change the material selection for the other database processes. This is useful for setting up processes for layered composite materials when processing a specific layer or if processing multiple materials at once. To change the material selection for all processes in a control file, use the material selection tool at the top of the Settings View Controls instead.

I- Power Adjustment

The Intelligent Materials Database determines the appropriate laser power based on the material type, thickness, and selected laser type. Power adjustment enables fine-tuning of this value to accommodate deviations in material thickness or chemical formulations.

J- Focus Mode

Determines focus mode used before the process is started. (See below for a description of the available focus modes.)

K- Save / Delete / Discard Changes Buttons

Select one of these three options: Save the new/changed process settings, Delete entire process and move the assigned colors to the unassigned category (the delete key will not be present when creating new processes), or Discard changes and return to the System Operations Page (If the process is new, Discard Changes will Delete the entire process).

L- Focus Mode – Stay in Place

This mode will not move the Z axis before processing. The Z axis will remain in the position it was in when the process started.

M- Focus Mode – Focus on Surface

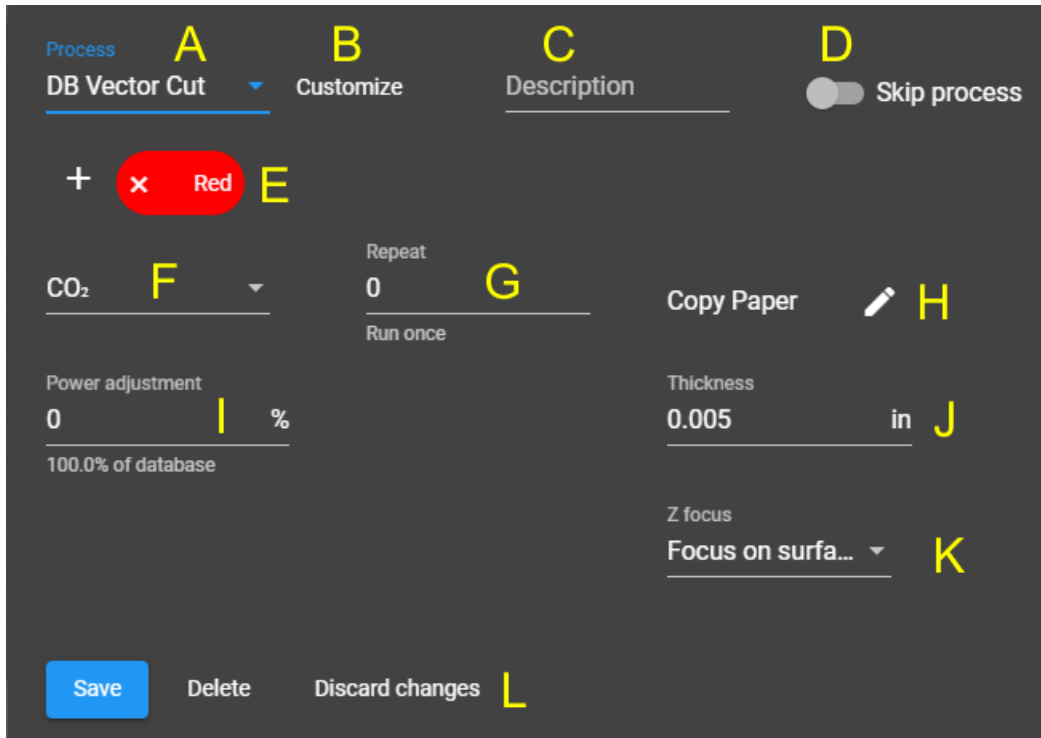
This mode will move the Z axis to the position that puts the top surface of the material at the focal plane of the selected lens by moving the Z axis down from the calibrated focal plane by the thickness specified in the Total Thickness setting at the top of the process settings menu. For most efficient operation, the focus on surface mode should be selected for the first process and all subsequent processes can be set to Stay in Place.

N- Focus Mode – Move to Position

When this mode is selected, a control will appear to enter a specific Z position. The system will move the Z axis to this position before processing.

DATABASE VECTOR CUT SETTINGS

Uses the Intelligent Materials Database to generate laser processing settings for a Vector Cutting process.



A- Process Type Selector

Indicates the process type. The interface above shows the Intelligent Database Vector Cut settings. If changed, the available settings will change to reflect the new process type. When using intelligent database settings, the LSM will use the rated power level of the installed laser and its wavelength to calculate the appropriate settings for the selected process on the selected material type (and thickness for cutting processes). If the material or laser is changed, the database will automatically adjust the settings for the new laser or material selection

B- Customize

This button will retrieve the database settings for the currently installed laser and selected material and convert those settings to a custom raster or vector process. Once the process has been converted to a custom process using the customize button, the process is decoupled from the intelligent database and will not be automatically adjusted if the laser or material is changed. Customization is useful for developing new settings for new materials by using a similar material as a starting point or for developing new non-standard processes for an existing material by providing a starting point from the intelligent material database and adjusting the settings as needed.

C- Process Description

Provides a field to enter a description of the process. In addition to the text box shown above, this description will appear in the Process Settings Tab along with any recipe information that may be saved.

D- Skip Process Toggle Button

Provides an easy way to store the process settings while enabling the user to quickly disable a process. If toggled on, the process will be greyed out in the Process Settings Tab, indicating that it will currently be skipped when the laser system processes the selected file.

E- Associated Colors

Displays the design file colors assigned to the selected process. Colors may be removed by selecting the X next to the color's name or added by selecting the + sign. Only colors found in the design file will be available to add to each process. If multiple colors are assigned to a process, colors will be processed left to right. The order in which the colors will be processed can be changed by dragging the color in front or behind other colors as desired.

F- Laser Type

This control indicates the type of laser installed.

G- Repeat Count

The number of times to repeat the selected process.

H- Material Selection

Indicates the currently selected material for the current database process. The Pencil button launches the database's Material Selection Dialog that categorically lists all materials in the Intelligent Materials Database compatible with the current system setup. Changing material for a specific process will not change the material selection for the other database processes. This is useful for setting up processes for layered composite materials when processing a specific layer or if processing multiple materials at once. To change the material selection for all processes in a control file, use the material selection tool at the top of the processes page instead.

I- Power Adjustment

The Intelligent Materials Database determines the appropriate laser power based on the material type, thickness, and selected laser type. Power adjustment enables fine-tuning of this value to accommodate deviations in material thickness or chemical formulations.

J- Thickness

The thickness entered here is used by the intelligent materials database to calculate the appropriate settings to cut through the selected material using the installed laser. Please note that this thickness is not used for focusing when focus on surface is selected. The total thickness entered in the control at the top of the process menu is used for focusing. Typically, the total thickness and process thickness will be the same value, but they are separate controls to allow for process thickness to be varied from total thickness for cutting layers of multilayer materials.

K- Focus Mode

Determines focus mode used before the process is started. (See Database Raster and Database Vector Mark Settings section above for a description of the available focus modes.)

L- Save / Delete / Discard Changes Buttons

Select one of these three options: Save the new/changed process settings, Delete entire process and move the assigned colors to the unassigned category (the delete key will not be present when creating new processes), or Discard changes and return to the System Operations Page (If the process is new, Discard Changes will Delete the entire process).

CUSTOM VECTOR SETTINGS

This screen contains the controls needed to configure a Custom Vector Process. This process could be used to cut a material that is not found in the Intelligent Materials Database.

A- Process Type Selector

Indicates the process type. The interface above shows the Custom Vector settings. If changed, the available settings will change to reflect the new process type. When using intelligent database settings, the LSM will use the rated power of the installed laser and its wavelength to calculate the appropriate settings for the selected process on the selected material type (and thickness for cutting processes). If the material or laser is changed, the database will automatically adjust the settings for the new laser or material selection

B- Process Description

Provides a field to enter a description of the process. In addition to the text box shown above, this description will appear in the Process Settings Tab along with any recipe information that may be saved.

C- Skip Process Toggle Button

Provides an easy way to store the process settings while enabling the user to quickly disable a process. If toggled on, the process will be greyed out in the Process Settings Tab, indicating that it will currently be skipped when the laser system processes the selected file.

D- Associated Colors

Displays the design file colors assigned to the selected process. Colors may be removed by selecting the X next to the color's name or added by selecting the + sign. Only colors found in the design file will be available to add to each process. If multiple colors are assigned to a process, colors will be processed left to right. The order in which the colors will be processed can be changed by dragging the color in front or behind other colors as desired.

E- Power Setting

Displays the power percentage to be used for the laser. This setting will modulate the laser to reduce average power applied to the material to the selected percentage of the rated power of the laser.

F- Pulses Per Inch

Displays the number of laser pulses per inch for the selected process.

G- Speed Setting

Displays the percentage of process speed applied to all colors in the process.

H- Repeat Count

The number of times to repeat the selected process.

I- Focus Mode

Determines focus mode used before the process is started. (See Database Raster and Database Vector Mark Settings section above for a description of the available focus modes.)

J- Save / Delete / Discard Changes Buttons

Select one of these three options: Save the new/changed process settings, Delete entire process and move the assigned colors to the unassigned category (the delete key will not be present when creating new processes), or Discard changes and return to the System Operations Page (If the process is new, Discard Changes will Delete the entire process).

CUSTOM RASTER SETTINGS

This screen contains the controls needed to configure a Custom Raster Process. This process could be used to mark or engrave materials that are not found in the Intelligent Materials Database.

The screenshot shows the 'Custom Raster Settings' interface. It features a dark background with several labeled components: **A** is a dropdown menu for 'Process' currently set to 'Custom Raster'. **B** is a text input field for 'Description'. **C** is a toggle switch for 'Skip process'. **D** is a color selection area showing a red color with an 'X' to remove it and a '+' to add it. **E** is a slider for 'Laser power' set to 0%. **F** is a slider for 'Repeat' set to 0, with 'Run once' below it. **G** is a slider for 'Speed' set to 100%. **H** is a dropdown menu for 'Z focus' set to 'Focus on surfa...'. At the bottom are 'Save', 'Delete', and 'Discard changes' buttons.

A- Process Type Selector

Indicates the process type. The interface above shows the Custom Raster settings. If changed, the available settings will change to reflect the new process type. When using intelligent database settings, the LSM will use the rated power of the installed laser and its wavelength to calculate the appropriate settings for the selected process on the selected material type (and thickness for cutting processes). If the material or laser is changed, the database will automatically adjust the settings for the new laser or material selection

B- Process Description

Provides a field to enter a description of the process. In addition to the text box shown above, this description will appear in the Process Settings Tab along with any recipe information that may be saved.

C- Skip Process Toggle Button

Provides an easy way to store the process settings while enabling the user to quickly disable a process. If toggled on, the process will be greyed out in the Process Settings Tab, indicating that it will currently be skipped when the laser system processes the selected file.

D- Associated Colors

Displays the design file colors assigned to the selected process. Colors may be removed by selecting the X next to the color's name or added by selecting the + sign. Only colors found in the design file will be available to add to each process. If multiple colors are assigned to a process, colors will be processed left to right. The order in which the colors will be processed can be changed by dragging the color in front or behind other colors as desired.

E- Power Setting

Displays the power percentage to be used for the laser. This setting will modulate the laser to reduce average power applied to the material to the selected percentage of the rated power of the laser.

F- Repeat Count

The number of times to repeat the selected process.

G- Speed Setting

Displays the percentage of process speed applied to all colors in the process.

H- Focus Mode

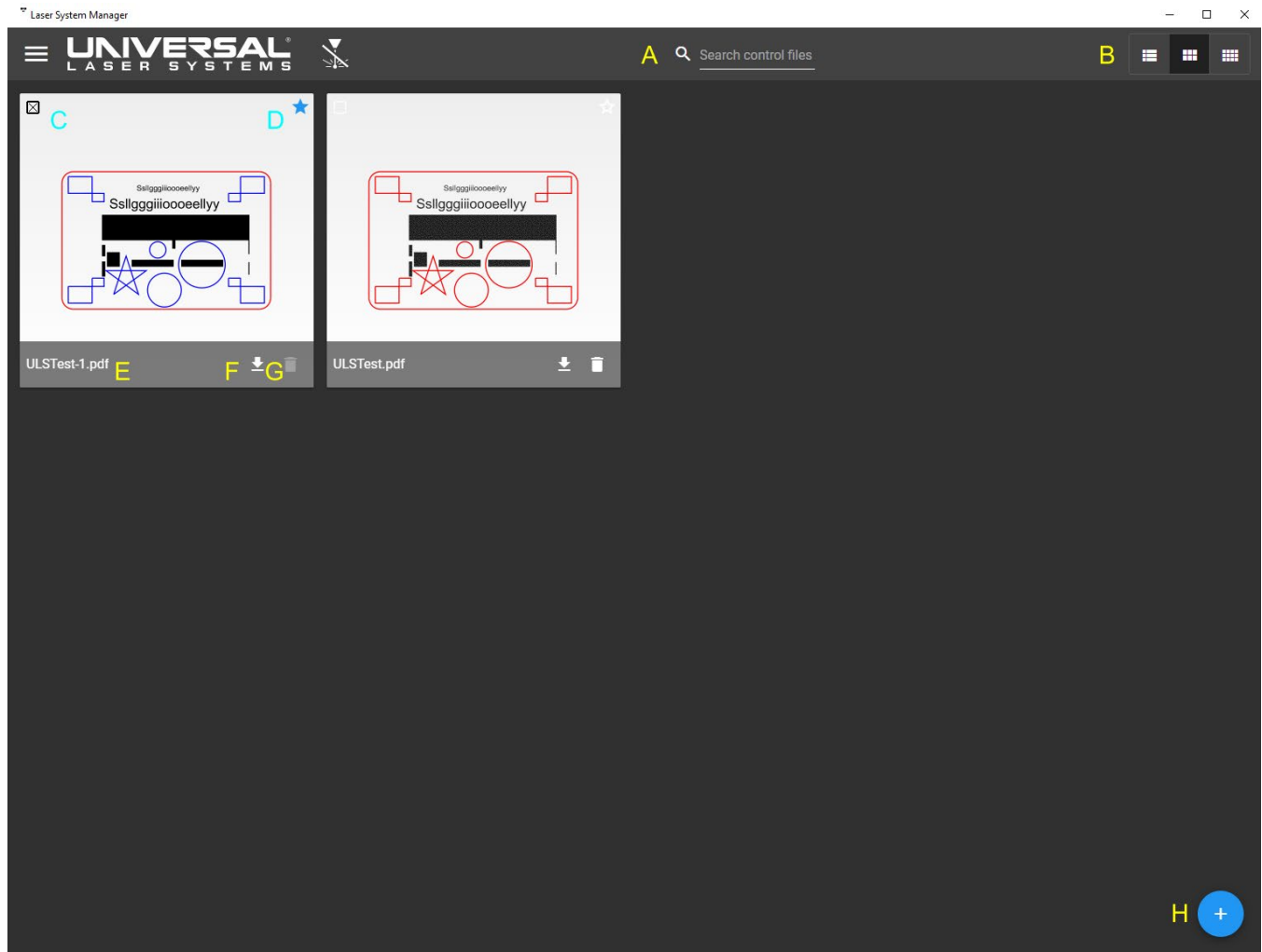
Determines focus mode used before the process is started. (See Database Raster and Database Vector Mark Settings section above for a description of the available focus modes.)

I- Save / Delete / Discard Changes Buttons

Select one of these three options: Save the new/changed process settings, Delete entire process and move the assigned colors to the unassigned category (the delete key will not be present when creating new processes), or Discard changes and return to the System Operations Page (If the process is new, Discard Changes will Delete the entire process).

Control Files Page

The collection of Control Files stored on the system is managed and selected through this page. To select a control file for processing press the thumbnail or name of the control file and the view will automatically switch to the System Operation Page showing a preview of the selected control file.



A- Control File Search Box

Control File Search Box can be used to search for specific control files in the queue. The search supports partial matches and fuzzy matches.

B- Control File Display Settings

Control File Display Settings can be used to select between a large thumbnail view, a small thumbnail view and a list view.

C- Multi-Selector for Control Files

This checkbox can be used to select more than one file for deletion.

D- Star Button

This button flags a file as permanent. These files can not be deleted until the star button is deactivated. This prevents accidental deletion of important control files.

E- Control File Name

Displays the name of the control file.

F- Export Control File Button

The export Control File Button can be used to export a control file for backup or to import to another ULS laser system.

G- Delete Control File Button

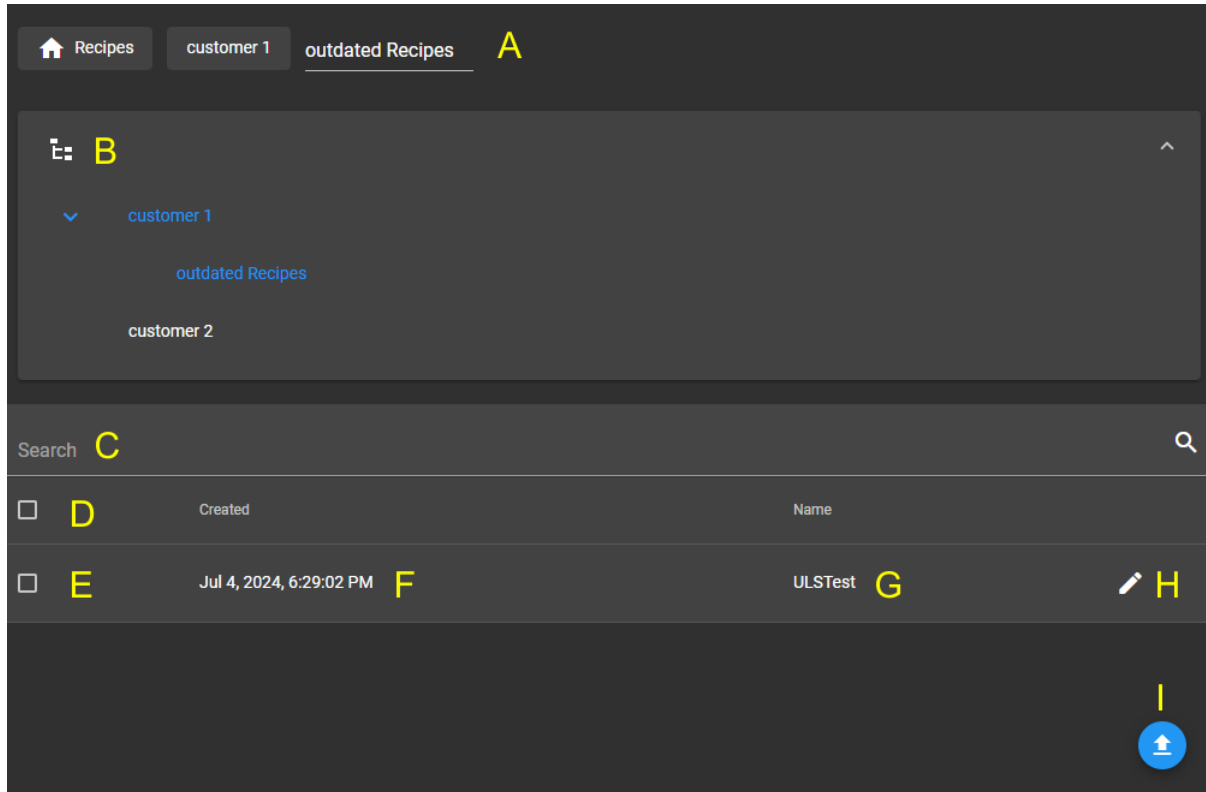
The delete Control File Button can be used to delete a control file. To delete multiple control files, use the multi-selector check box.

H- Import Control File Button

The import Control File Button can be used to import new control files. The LSM can import multiple file formats including PDF, DXF, SVG, BMP, JPG, TIFF, GIF, and G-Code files. Control files from other laser systems running the LSM can also be imported.

Recipes Page

Recipes are copies of all of the laser processing settings from a particular control file. They provide a convenient method to store and apply process settings for commonly used setups and materials to new control files making setup more efficient. They can also be exported for transfer to other laser systems controlled by LSM software. Recipes can be organized in folder structures to make it easier to manage and find a particular recipe.



A- Recipe Folder Location

Displays the current path within the recipe folder storage structure where the listed recipes in the recipe list at the bottom of the page are found. Selecting a portion of the folder path allows navigation to parent folders in the path. The current folder name can also be edited by typing over the folder name with a new name.

B- Recipe Folder Structure

Displays the entire recipe folder storage structure created to store and organize the recipes on a particular computer. Selecting any folder in the structure will cause the LSM to navigate to that folder. By default, a new LSM installation will have only one root folder called Recipes. This folder name cannot be changed. All recipes created will be stored in that root folder unless subfolders are created. New folders and subfolders can be created as needed and recipes can be moved to those new folders and subfolders at any time.

C- Recipe Search Tool

A tool for searching recipes. The search tool can accommodate incomplete or fuzzy name search and can also search by recipe creation dates.

D- Recipe List

Lists the recipes stored in the selected folder.

E- Multi-selector for Recipes

This checkbox can be used to select multiple recipes to move, delete or export. When one or more recipes in the list is selected, tools will appear in the upper left corner of the page to move, delete or export the selected recipes.

F- Recipe Creation Date

Lists the creation date of each recipe in the list.

G- Recipe Name

Lists the name of each recipe in the list.

H- Recipe Name Edit

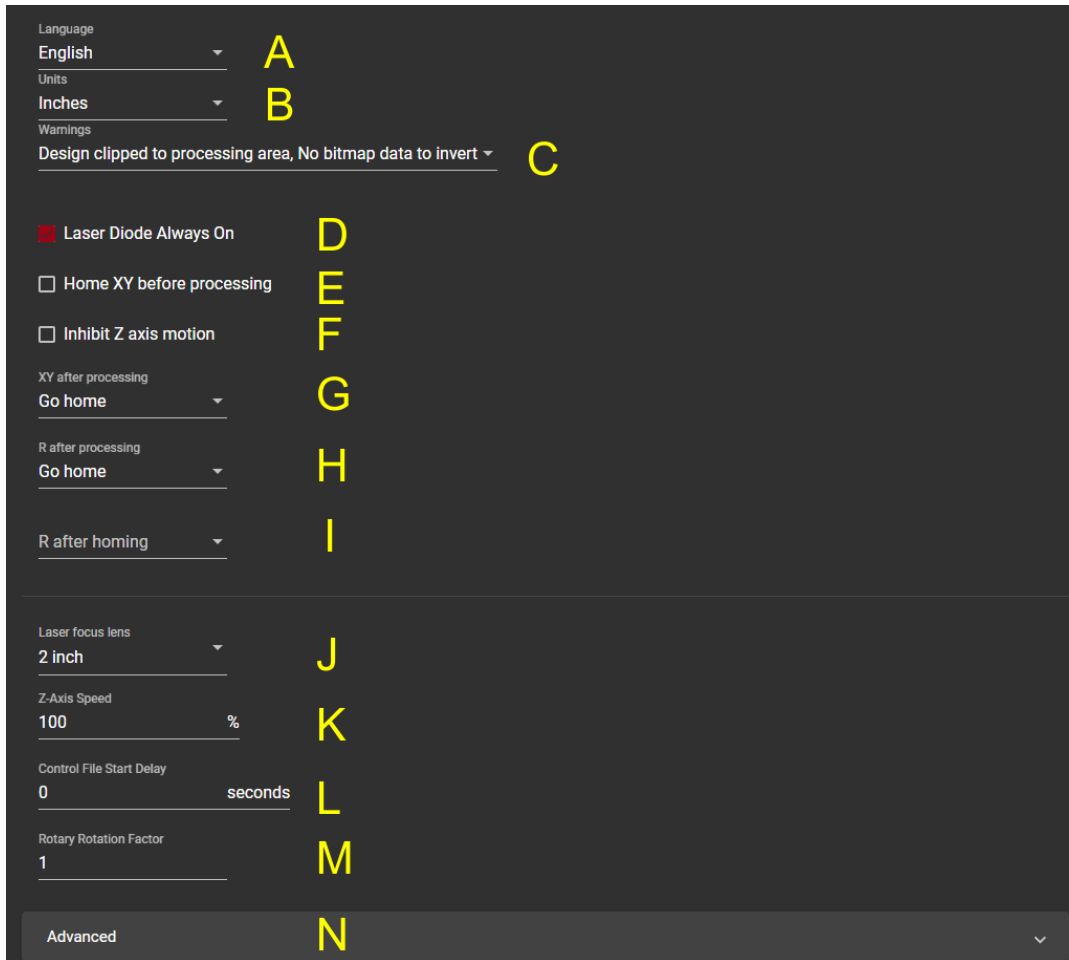
Select this button to edit a recipe name.

I- Recipe Import

Press this button to import recipe(s) from other laser systems.

System Configuration Page

This page provides access to system-wide configuration options.



A- Language Selection

Select desired Language for the LSM.

B- Units Selection

Select desired unit of measure: Inches or Millimeters.

C- Warning Silencer

Lists Several warnings that can be silenced if desired. The warnings are defaulted to on with new installations but can be silenced.

D- Laser Diode Always On Checkbox

Laser Diode Always on Checkbox will force the laser diode to be on at all times. The default behavior when this switch is off is for the diode to be on only when the top door is open.

E- Home XY Before Processing Checkbox

The Home XY Before Processing Checkbox forces the LSM to rehome the laser system each time a control file is run. This can improve repeatability for very high accuracy applications but adds time to processing a control file.

F- Inhibit Z Motion Checkbox

The Inhibit Z Motion Checkbox is used to globally inhibit Z motion during laser processing regardless of the Z motion focus mode selected in each process in the control files.

G- XY After Processing Behavior

The XY After Processing behavior selector can be used to specify the desired behavior for the beam delivery motion system after processing a control file. The options are: Go Home which moves the beam delivery motion system to the home position, Stay in Place which leaves the beam delivery motion system at the last position it moved to during laser processing of the control file, and Go to Position which allows the user to enter the X and Y coordinates of a desired location for the beam delivery motion system to move to after processing a control file.

H- R After Processing Behavior

The R After Processing behavior selector can be used to specify the desired behavior for the rotary axis after processing a control file. The options are: Go Home which moves the rotary axis to the home position, Stay in Place which leaves the rotary axis at the last position it moved to during laser processing of the control file, and Go to Position which allows the user to enter the R position of a desired location for the rotary axis to move to after processing a control file.

I- R After Homing Behavior

The R After Homing behavior selector can be used to specify the desired behavior for the rotary axis after homing or rehomeing the rotary axis. The options are: Remain in Place which keeps the Rotary axis with location of the middle of the processing field facing straight up and Go to Position which allows the user to enter the R position of a desired location for the rotary axis to move to after homing or rehomeing.

J- Laser Focus Lens

This selector is used to inform the LSM of the final focus lens that is currently installed in the laser system. This information is used to establish the focal plane for that lens during lens calibration and use that focal plane to put material surfaces at that focal plane during processing when focus on Surface is selected. A separate focal plane position is stored for each lens available on the VLS desktop laser system. Rotary fixture rotation axis and cutting table focal planes are also stored based on the currently installed lens.

K- Z- Axis Speed

Set the Z axis max speed. This is defaulted to 100% on new installations but can be reduced if desired. This can be helpful when positioning heavy loads.

L- Control File Start Delay

Can be used to add a delay before processing. This can be useful for automated processes to wait for certain events to occur before processing begins.

M- Rotary Rotation Factor

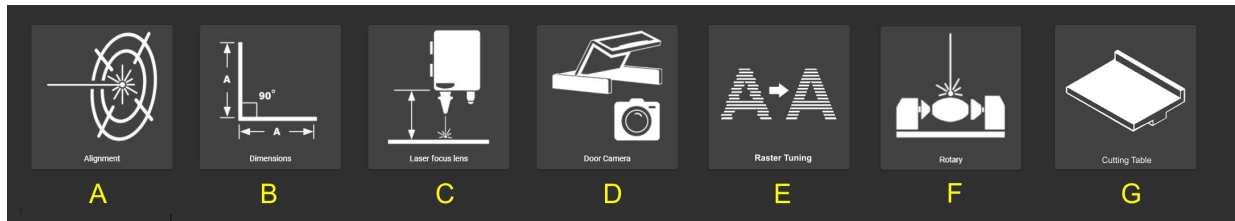
Can be used to compress or expand artwork to prevent or force a small amount of overlap

N- Advanced Configuration

Advanced Configurations settings. Only use upon recommendation of ULS support staff.

Calibration Page

The VLS desktop laser system provides a series of *Wizards* and *Dialogs* to aid in system calibration. All system calibration is performed first at the factory, then again during system installation. It is atypical to require use of these options frequently.



A- Alignment Calibration

Launches the Laser Alignment Calibration dialog. This dialog provides tools for checking the alignment of the laser with the beam positioning system. The beam positioning system can be quickly moved between the corners of the laser processing field and the pointer can be turned on and off and CO₂ laser pulsed in short bursts to burn marks on masking tape placed over the carriage aperture to check laser alignment.

B- Dimensions Calibration

Launches the Dimensional Calibration dialog. This dialogue can be used to draw a pattern of a certain size which can then be measured, and the measurements entered into the dialogue so the LSM can compensate for inaccuracies in scale and skew.

C- Lens Calibration

Launches the Lens Calibration Wizard

D- Door Camera Calibration

Launches the Door Camera Calibration Wizard. This Wizard will walk the user through the calibration process for the door camera so that the door camera image is accurately aligned with the laser processing area and lens distortion in the camera is properly compensated.

E- Raster Tuning Calibration

Launches the Raster Tuning calibration wizard. This wizard will walk the user through calibration of bidirectional raster strokes so that images are properly aligned.

F- Rotary Calibration

Launches the Rotary Calibration Dialog if a rotary axis module is installed. This dialogue sets the Y and Z positions of the rotary axis.

G- Cutting Table Calibration

Launches the Cutting Table Dialogue if the cutting table module is installed. This dialogue sets the Z position of the surface of the cutting table.

User Login Page

When the laser system is configured to require login on startup or to access the VLS desktop laser system from a remote location, this screen will appear. A valid *Username* and *Password* will be required to operate the laser system. For safety, remote users will have reduced permissions not allowing laser system operation even if they have permission to operate the laser system allowed in their user account unless the user logged in remotely is the same user logged in locally.



A- Laser Emission Indicator

Depicts the current Emission Status of the laser system. If a laser source could potentially start firing, the indicator is shown as it is above. If any of the interlocks are opened (for example if the top or front doors are open) a diagonal slash will appear through the indicator.

B- Username Field

The Username of the account. Users may be added, removed, and configured in the User Management Page.

C- Password Field

The Password of the account. Passwords may be managed in the User Management Page.

D- Hide Password Button

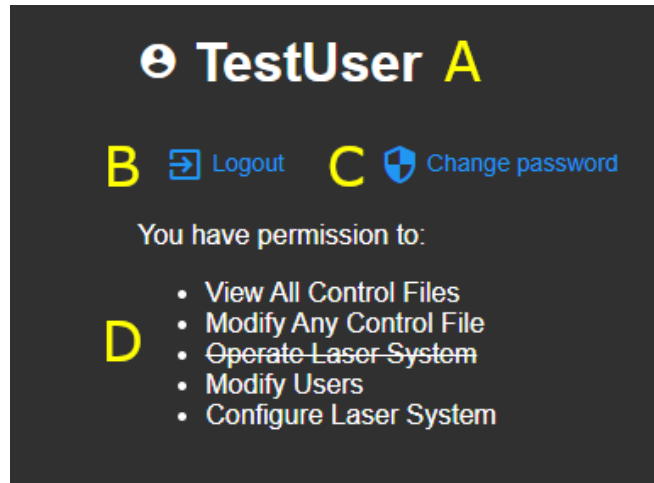
Toggles between showing and hiding the password as it is typed into the Password Field.

Note:

There is a password recovery mechanism available if needed, by pressing the ? button in the lower left corner of the login page and following the instructions.

User Details Page

A currently logged in user can access a summary of their permissions, log out, or change their password in the *User Details Page*.



A- User Name

Indicates the currently logged in user.

B- Logout Button

Logs the current user out of the system.

C- Change Password Button

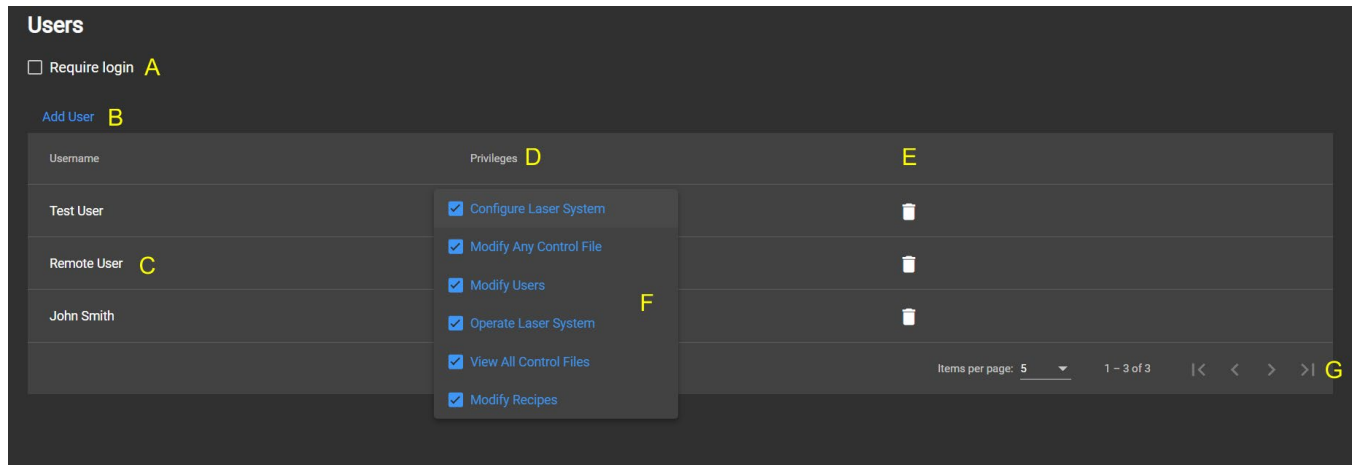
Enables the current user to change the password associated with their account.

D- Current User Permissions List

Lists the available permissions for the currently logged in user. Can be modified by a user with the Modify Users permissions in the User Management Page. Operate Laser System will always be disabled for remote users even if they have this permission allowed in their account unless the same user is logged in locally. This is indicated in the figure above by the fact that the Operate Laser System permission is listed by crossed out.

Users Management Page

Select this page to manage the users who have access to the laser system, and to indicate various permissions and capabilities specific to each one. At least one user account must be created in order to access the laser system remotely. Remote access from other computers on the network is possible though an internet browser by entering the IP address of the computer connected to the laser system as the web address.



A- Require Login

This control effects behavior on the computer directly attached to the VLS desktop laser system and overrides the default behavior of allowing anonymous laser system interaction by anyone present at the laser system. When enabled, the LSM requires local users to login prior to interacting with the laser system. Note that LSM always requires login for remote users, even when this option is disabled.

B- Add User Button

Creates a new user.

C- User Names

Lists users who are authorized to interact with the laser system.

D- User Privileges Drop-Down

Displays the permissions each user has been granted.

E- Delete User Button

Deletes the selected user.

F- User Privileges Selection

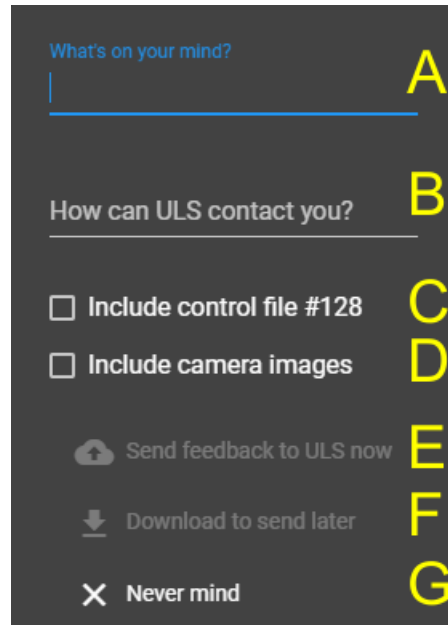
Provides a checklist to grant or revoke specific privileges for each user. Privileges may be modified by checking or unchecking each option.

G- User Page Controls

Provides buttons and drop-down menus to navigate between pages of users should the number of names exceed the maximum entries viewable on a single page.

Feedback Dialog

This dialog allows users to submit comments or software error reports directly to ULS for review. Error reports include the laser system log files for error diagnostics, but they do not include user's personal information or control/design files by default to protect privacy. Users can elect to include the currently selected design file which is often very useful in resolving issues as well as the camera images generated and used during camera calibration which are very useful for diagnosing camera related issues.



The screenshot shows a dark-themed feedback dialog box. At the top, it asks "What's on your mind?" with a text input field labeled 'A'. Below that, it asks "How can ULS contact you?" with a text input field labeled 'B'. There are two checkboxes: "Include control file #128" labeled 'C' and "Include camera images" labeled 'D'. At the bottom, there are three buttons: "Send feedback to ULS now" labeled 'E', "Download to send later" labeled 'F', and "Never mind" labeled 'G'.

A- Feedback Message Field

Provides a field for the user to enter a message to be left in the log file.

B- Contact Information

Provides a field for the user to enter contact information so ULS staff can contact the user to resolve issues.

C- Include currently active control file

Permits the system to send the currently active control file information with the error report. This is often very helpful for error resolution. If submitting an error related to a specific control file, make that file the active control file before submitting the report.

C- Include Camera Images

Permits the system to send the camera images generated and used during camera calibration which are very useful for diagnosing camera related issues

D- Send Feedback Button

Submits the error report to ULS and exits the Feedback request dialogue. The laser system must be connected to the internet.

F- Download Button

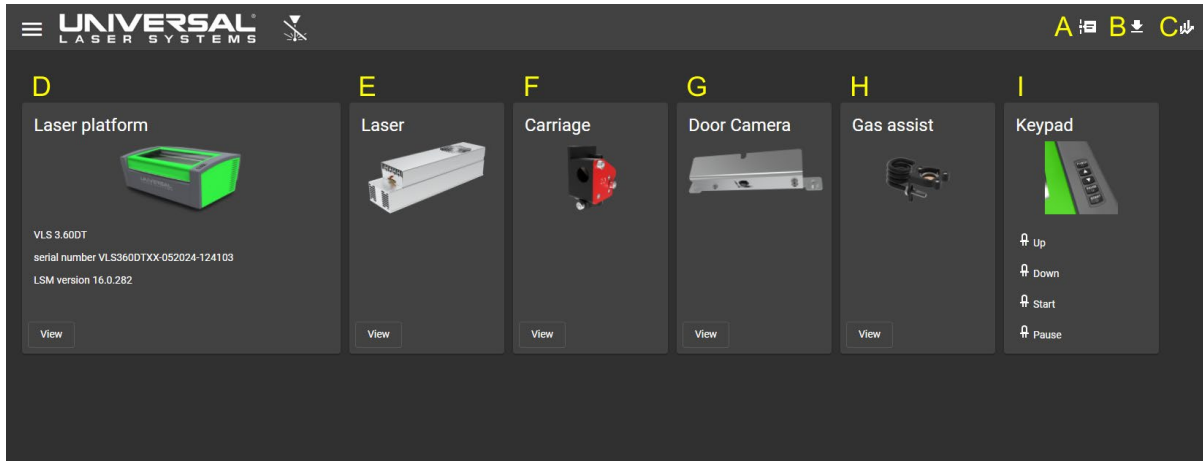
Creates a zip file of all of the diagnostics data which can be copied to the computer or a thumb drive and sent to ULS support staff later. This is useful for submitting diagnostics files to ULS support staff if the computer controlling the laser system is not connected to the internet.

G- Never Mind Button

Exits the Feedback dialog without sending any information to ULS or downloading any data.

Diagnostics Page

The Diagnostics Page provides information and diagnostics tools for the various subsystems of the laser system the LSM attached to. Some information is provided on the diagnostics buttons and further information and diagnostics tools for each subsystem can be accessed by selecting each diagnostics button.



A- Log File Storage Location

This button opens a file explorer window to the location where the log files are kept for the current installation of the LSM. This can be useful for viewing the diagnostic logs on the computer running the LSM.

B- Diagnostics Download

This button will create a zip file with all of the diagnostics data for the system. This zip file can be emailed or sent to ULS support staff upon request for help with troubleshooting issues. This diagnostics zip file is the same one that is automatically generated and sent to ULS when a Feedback Request is submitted using the Feedback function in the LSM. The Feedback function requires a connection to the internet to work so this button can be used to manually generate and copy a diagnostics zip file to a thumb drive so it can be sent to ULS from another computer if the computer running the VLS desktop laser system is not connected to the internet.

C- Usage log

This button will create a comma separated data file of the usage log of the laser system during a specified data range. This CSV file can be imported into spreadsheet software such as Excel for viewing and manipulation. The log will contain a list of all control files run during the specified time period including a time stamp of when the control file was started, who was logged into the LSM at the time, the duration of laser processing and whether the control file went to completion or was stopped or paused before completion.

D- Laser Platform

This card shows the type of laser system the LSM is connected to, the serial number of the laser system and the version of the LSM software that is currently running. Pressing on the View button provides access to the various firmware versions running the laser system CPU.

E- Laser

This View button provides access to information on the currently installed laser source. Information includes the laser's rated power and wavelength and the version of firmware running in the laser. This button also provides access to tools to turn the laser diode on and pulse the laser source for checking function of the laser and alignment with the beam positioning system. Additionally, information on the status of the interlocks is displayed.

F- Carriage

This View button provides access to the final focus lens installed in the carriage and the Z position of the focal plane for that lens. The installed lens is not automatically sensed so for proper operation the user is responsible for selecting the currently installed lens on the System Configuration Page.

G- Door Camera

This View button provides access to a live view of the door mounted camera. The user can select the exposure method for the live view if trying to diagnose lighting condition issues. Additional information is provided on whether the camera is calibrated or not and provides access to the images captured and used during the last calibration. These images can be very valuable for diagnosing camera calibration issues. These calibration images will also be sent to ULS when Feedback is submitted if the user gives permission to include them.

H- Gas Assist

This View button provides access to tools to test the ULS compressed air unit, if installed, along with a plumbing diagram of the gas assist system.









I- Keypad

This button shows the status of the buttons on the keypad on the VLS desktop laser system. When each button is pressed on the keypad, the corresponding LED will light up if the keypress was successful. This is useful for testing the keypad if there is a suspicion that a button is not working or is stuck in the pressed state.

Help Page

This page provides information useful for addressing system problems should they arise.

The screenshot displays a dark-themed user interface for a laser system. It features a vertical navigation menu on the left with yellow letters A through J. The main content area is divided into several sections:

- A Alarms**: Shows 'None'.
- B Computer**: Shows a checkmark icon and a dropdown arrow.
- C Version**: Shows '16.0.282' and a dropdown arrow.
- D Communication**: Shows '0 transmission failures' and a dropdown arrow.
- E Tasks**: Shows '0 in progress'.
- F**: A button labeled 'Delete all control files'.
- G**: A button labeled 'Download backup'.
- H**: A button labeled 'Download diagnostics'.
- I**: A button labeled 'Download installer for remote diagnostics'.
- J Diagnostics**: A section containing:
 - Laser platform**: VLS 3.60DT, serial number VLS360DTXX-052024-124103
 - Keypad**: Up , Down , Start , Pause 
 - Laser**: 
 - Carriage**: 
 - Door camera**: 
 - Gas assist**: 

A- Alarms

This section lists any current faults with the laser system connected to the LSM.

B- Computer

This section lists details about the computer the LSM is running on that might be useful for diagnosing issues. It will also indicate any computer specifications that are considered marginal for running the LSM.

C- Version

This section lists the version of the LSM that is currently running and provides tools for downloading new versions. See the software update section below for more details.

D- Communication

This section lists any communications errors that have occurred between the LSM and any of the various subsystems and how many have occurred. The counts can be reset to determine how quickly and often any errors are occurring. This information is helpful for diagnosing issues with communications.

E- Tasks

This section lists any background tasks that may be running. Background tasks are launched whenever a new design file is imported into the LSM or when any changes are made to any control file settings of an existing control file that require re-rendering of the design file to accommodate new settings.

F- Delete All Control Files

This button purges the LSM of all control files. Backups of control files should be made before using this function if any control files need to be saved. Individual or select groups of control files can be exported using the export function in the Control Files Page, or the Download Backup button on the Help page can be used to backup all control files and recipes at once.

G- Download Backup

This button creates a backup file of all control files, which can be imported to restore the backed up control files. It also creates a backup file of all recipes.

H- Download Diagnostics

This button creates diagnostic zip file that can be saved to the computer or a thumb drive. This diagnostic zip file is that same file that is created and transmitted to ULS support staff when using the feedback request function.

I- Download Installer for Remote Diagnostics

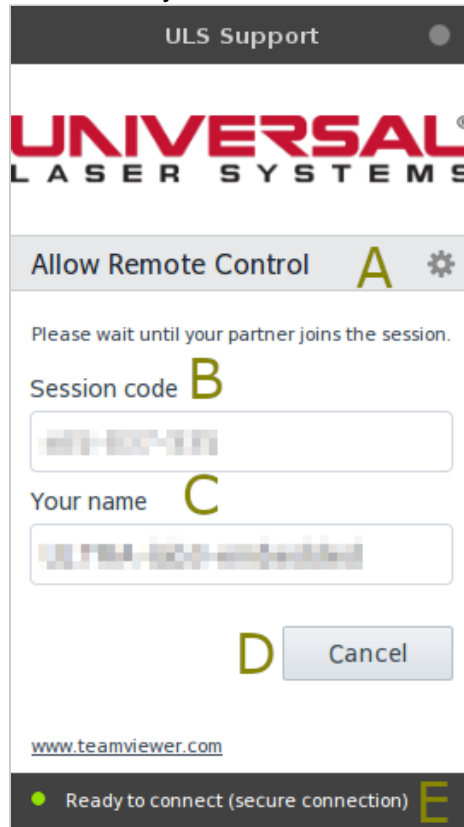
This button downloads the installer for the TeamViewer remote diagnostic tool that can enable ULS support staff to remotely connect to the computer and help diagnose issues with the LSM or VLS desktop laser system. Download and install this software in order to launch a remote diagnostic session with a member of the ULS support team. Permission will have to be given to allow the connection. See Remote Diagnostics section below for more details on setting up and allowing a remote diagnostic session.

J-Diagnostics

This section provides links to the same diagnostics information and tools as the diagnostic section of the LSM. The information accessed in these sections is identical.

Remote Diagnostics

Remote Diagnostics enables a user to initiate a remote session with ULS Support to aid in system troubleshooting. During a remote session, the system must maintain a robust connection to the internet.



A- Remote Access Controls

Enables a user to initiate a session that gives a ULS Service Technician remote access to the laser system for troubleshooting purposes.

B- Session Code

Grants remote access of a user's laser system to a ULS Service Technician.

C- Your Name

Displays the name of the local party operating the system. This will appear in any chat dialogs which are opened while the system is being remotely controlled.

D- Cancel

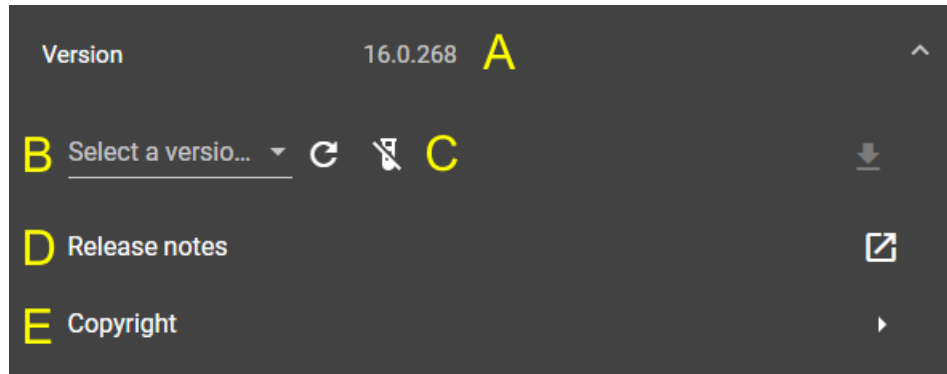
Cancels the remote systems and returns the user to the LSM.

E- Connection Status

Displays the current connection status.

Software Update

Software updates are routinely released to continuously improve the Laser System Manager (LSM) and laser system operation as well as add new features and laser material processing parameters to the Intelligent Materials Database. Software updates can be downloaded from this section of the help menu.



A- Currently Installed Software Version

Displays the current software version installed on the system.

B- Available Software Versions

Displays a list of the currently available software versions old and new. This list is pulled from ULS Servers and therefore requires an internet connection to operate properly.

C- Hide Pre-Release Versions Button

Beta versions of software that contain experimental or early-release features are sometimes made available for customer testing and feedback. This button shows or hides these prerelease version as desired.

D- Release Notes

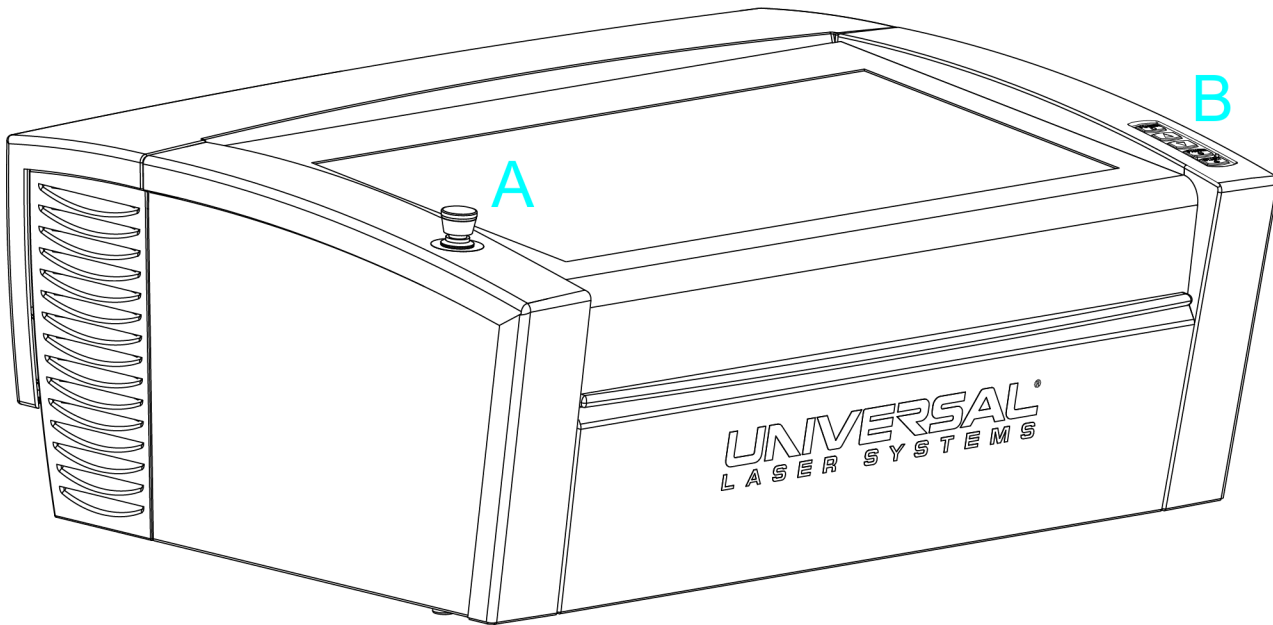
This button downloads the latest software release notes for LSM. The release notes include information on new features added and bugs fixed in each version. An internet connection is required in order to access the release notes.

E- Copyright

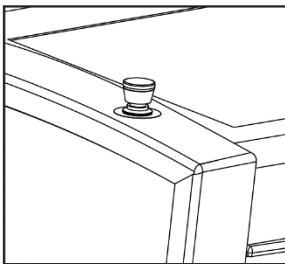
This button provides access to the copyright notice for the LSM software. This is the copyright notice that was agreed to when the software was installed.

Control Panel

The control panel on your laser system provides the functions necessary to manually focus and initiate laser processing on your laser system.



A- Emergency Stop Button



This switch can be depressed in an emergency to cut power to the laser system, instantly stopping laser processing. If this switch is depressed, power can be restored by twisting the E-STOP to reset it. For safety, the system will not power on immediately. The Power button must be depressed to restart the laser system.

B- Keypad

Safety Interlock Status

A Red LED on the keypad provides an indication of the status of the interlock system.

Indication	Condition
On	The top door to the laser system is closed. If laser processing is initiated in this state, the CO ₂ laser will fire.
Flashing	The top door to the laser system is open and the safety interlock system has disabled the CO ₂ laser. If laser processing is initiated in this state, the CO ₂ laser will not fire and the red target pointer will be on instead.

A Green LED indicates whether the machine is powered on or not.

Keys



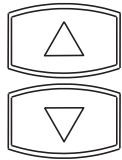
Power: This button turns the Laser system ON and OFF, but only if the Laser system is connected to a computer with the LSM installed on it. The Laser system cannot power ON and function independently of the computer and LSM software. To power the Laser system OFF, the power switch must be held down for about five seconds.



START: Initiates processing of the laser control file currently selected and visible in the preview screen of the LSM.



PAUSE: If a control file is running, the Pause button stops laser processing and moves the focus carriage to its home position in the upper right corner of the engraving area. If the Pause button is pressed again, laser processing will resume at the point where the motion system was paused. If the Start button is pressed while the machine is in a paused state, it will restart processing at the beginning of the control file.



UP/DOWN: These buttons move the engraving table up and down for loading material into the laser system and manually focusing. Pressing a button once will move the table .010" (.254mm) in the indicated direction. Holding a button down will move the table continuously in the indicated direction until the button is released.

Loading and Processing Materials

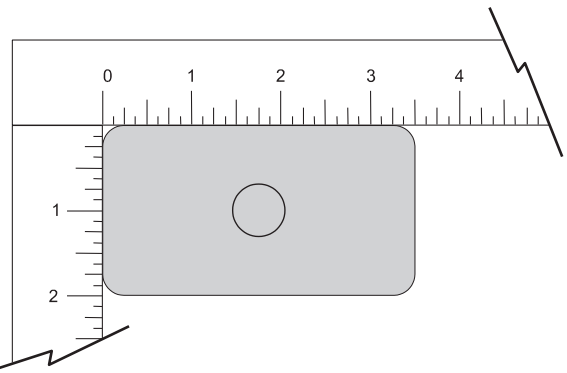
Before laser processing material, you will need to load material into the laser system and then focus the laser system onto the top surface of the material.

Loading Material

Open the top door to the laser system and place material to be laser processed onto the material support table. You may need to manually move the support table down to allow clearance to fit thicker materials into the machine. If you are cutting, you can also use the cutting table (use of this accessory is described in the accessories section of the manual).

CAUTION: Material to be laser processed must fit completely within the machine so that the top door to the laser system can be closed. The access door is safety interlocked and will not allow the laser to operate if the access door is not fully closed.

Position the material so that it is aligned with the design to be engraved, cut or marked. There are a few methods that can be used to accomplish this. One method is to use the rulers on the laser system processing table and the corresponding rulers in the system operation page of the LSM to align your material with the design in your laser control file. It is often useful to push the material up against the rulers and position your graphics accordingly before printing. A second method is to use the relocation feature in the LSM to move your design to your material. The red target laser can be used for locating on the material and then snapping a corner or center of the design to that location using the LSM. If the laser system has the camera option installed, a snapshot of the material on the material support surface can be taken. The snapshot will appear as the background of the design file preview on the system operation page of the LSM with the design in the control file overlaid on top. The LSM relocation features can then be used to visually align, rotate and scale the design to fit your material. A third method is to use fixturing to position your material. This is especially useful for odd shaped materials. The laser system can even be used to create the fixturing. For example, fixturing can be made out of acrylic by placing a piece of acrylic against the rulers in the laser system and cutting the shape of the material to be laser processed out of the acrylic. You can then place the material in the cut out to position it accurately.



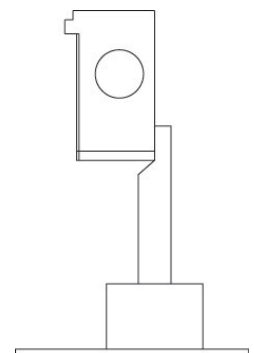
Focusing

Once you have positioned the material, you will need to focus the laser system by adjusting the Z axis up or down until the top surface of the material to be laser processed is at the focal plane of the lens installed in the laser system. This can be done in one of two ways.

The first focusing method is to use the calibrated focus tool provided with the lens kit. Every lens kit is provided with a calibrated focus tool so make sure to use the one provided with the lens being used.

Manual focusing steps:

1. Move the focus carriage out over the material to be laser processed by using the jog controls in the LSM or pointing and clicking on a location on the control file preview in the LSM.
2. Move the engraving table manually up or down in the Z axis as necessary until the base of the focus tool can be placed on the top surface of the material to be laser processed and the wedge shaped notch at the top of the focus tool can be placed as shown with the edge of the carriage fitting in the corner of the notch.
Laser processing results are very sensitive to focus so pay close attention to the fit of the focus tool.
3. Remove the focus tool from the material processing area.



The second focusing method is to measure the thickness of the material (use a calipers for accuracy) to be laser processed; enter the material thickness into the “total thickness” control in the process settings of the control file you plan to run; select the “focus on surface” method within each process in the control file. The Z axis will move up or down to the appropriate height when you press the start button to initiate laser processing of the selected control file.

Important Note: Make sure the lens specified in the system configuration of the LSM matches the lens installed in the laser system when using this feature and that Inhibit Z Axis Motion is disabled in the System Configuration Page.

CAUTION: In order for this method to work correctly, the Z axis must be properly homed and calibrated to the lens being used. To verify this, with no material on the material support surface, move the Z axis position currently listed as the focus plan position for the installed lens in the focus lens calibration section of the LSM calibration page. While at this Z height the manual focus tool can be used to check if the material support surface is at the focal plane for the lens installed. If necessary, re-home the Z axis using the home Z command in the LSM system operation page and re-check. If you are still having trouble, recalibrate the lens using the lens calibrate function in the calibration section of the LSM.

Initiating laser processing

Once the material is placed and focused, you are ready to initiate laser processing of the selected control file. If you need to use air assist for the material to be processed, make sure you have a coaxial or lateral air assist attachment installed on the carriage and the ULS Computer Controlled Compressed Air Unit is properly connected (see the accessories section for details). Also ensure that your air filtration unit is plugged in to a power outlet and properly connected to the laser system. Then start the control file by pressing the start button on the control panel or in the LSM.

CAUTION: Make sure the air filtration unit activates and proper exhaust flow is present in the laser system during laser processing. If proper exhaust flow is not present, damage to optics and other laser system components can occur very quickly.

Third-Party Graphic Software Configuration

The LSM supports importing a wide variety of graphic interchange formats as well as a Windows printer driver for printing design files to LSM. Every effort has been made to make the printing process as seamless as possible, however, to get the best results when printing through the LSM Windows Printer Driver, you should be aware of a few general guidelines for all software as well as some specific notes regarding some of the more popular Windows software for printing to the laser system.

General Software Guidelines

Use the following GENERAL guidelines when configuring Windows software applications to print to the LSM Windows Printer Driver.

Page Setup

To properly position graphics in the laser system processing field, most graphics software will permit the customization of the page size and orientation. As a rule of thumb try to set the page orientation in your software of choice to Landscape and the page size to 24 x 12 in to match the VLS3.60ES desktop laser system processing area. This should result in the upper left corner of the page aligning with the upper left corner or zero-zero of the laser system processing field.

Some graphics software will provide on-screen rulers. If this is the case, it is often possible to configure the rulers so they match those in the laser system. This can also help with positioning of graphics in the processing field of the laser system.

Power Control through Color Selection

As mentioned earlier your laser system uses colors to assign laser settings to different elements of the graphics you are printing.

Vector Output for Vector Cutting and Marking

The printer driver distinguishes between raster objects (raster engraving) and vector objects (vector cutting and marking) by the types of elements contained in the graphic being printed. All graphics, other than outlines of very thin line widths will be interpreted as raster objects and the raster mode will be used for laser processing. Not all software is capable of printing vector output. If you want to create a control file for vector cutting, make sure your graphic software of choice allows creation of vector lines and that the line width can be 0.001" (0.0254 mm) or less. The printer driver will interpret these objects as vectors.

Overlapping Raster Objects

If the artwork created has raster objects that overlap, the driver will automatically filter out the portion of the object that is not visible so that only the visible part of the underlying filled area will be engraved to prevent the overlapped area from being engraved twice. This allows the color white to be used as an effective drawing tool. Since the laser system will not engrave the color white (this is the background color), it can be used to block out the undesired engraving areas of raster objects. However, you cannot use a white fill to cover a vector outline, the outline will vector cut even though you cannot see it on screen.

Overlapping Vector Objects

The driver does not filter vector objects that overlap each other. If you place one thin vector outline on top of another, both outlines will be cut by the laser system. This can be useful for making multiple cutting passes in one laser control file for thicker materials.

Bitmapped Scanned Images

When printing raster objects such as photographs which are grayscale or color bitmaps, keep in mind that the printer driver uses a dither pattern filter screen to reduce the images to black and white (monochrome images) for laser processing using variable spacing between the dots to create the illusion of shades of gray. These dither patterns are relatively coarse so it is not necessary to use high resolution bitmaps. Grayscale or color photos should be reduced to 300 to 600 dpi for purposes of laser processing and scanned images should be scanned into the computer at 300 to 600 dpi.

AutoCAD and AutoCAD LT

Vector output

Line widths for printing from AutoCAD products are controlled by plot styles. Make sure you set the first eight pens in the plot style you use to .001" (.0254 mm) or less in order to ensure vector objects are output.

Placement of Graphics

The easiest way to control placement of graphics in the processing field when using AutoCAD is to create a non-printing rectangle with a width and height equal to the processing field in the VLS desktop laser system: 24 x 12 in. Then print using the Print Window feature and use the Pick Tool to pick the upper left and lower right corners of the rectangle as the print window. You can then treat the upper left corner of the rectangle as the zero-zero point in the processing field and lay out your graphics inside the rectangle as desired.

Make sure you print with a 1:1 scale and make the plotter margins zero in the print setup screen. Also make sure plotter offsets are set to zero.

CorelDRAW (All versions)

CorelDRAW products have a color matching feature which interferes with the proper mapping of colors in graphics being printed with colors in the printer driver. Make sure to turn color matching feature off when using CorelDraw.

Solidworks

When using 3D solid modeling software such as Solidworks, you must keep in mind that the laser system is a 2D device, so you must create a 2D drawing view of the object you want to laser process. You cannot print 3D parts and assemblies directly to the laser system.

To dictate placement of your control file on the processing table in the laser system, use a custom page size and make it the same size as your laser system's material processing area. Make sure to remove any drawing templates and borders from the page or they will print also and be part of your laser control file. Once your page size is set, match the material processing area in the laser system. Treat the upper left corner of the page as equivalent to the zero-zero point in the processing field of the laser system. Solidworks does not give you the ability to precisely position sketch elements on the page, so you can use the relocate feature in the LSM to more precisely position your control file once you have printed them.

Set the thickness for the thin line font in document properties to .001" (.0254 mm) or less to force thin lines to be output as vector objects. Then assign all line segments in the drawing view the thin line font and change colors as necessary to later assign to desired processes.

Chapter 5 – Accessories

Air/Gas Assist System

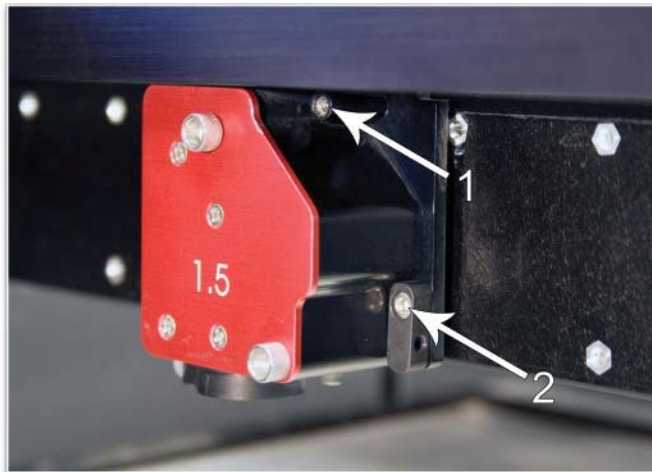
Air/Gas assist is employed with a coaxial or lateral gas assist attachment to direct air flow onto the material being processed during laser material processing. This feature also provides compressed air to the optics (mirrors and lenses) in the system, reducing contamination. Air assist aids in removing smoke and debris from the laser processing area and directing it to the exhaust. It also helps reduce the heat affected zone in the material being processed and helps to prevent flame up when processing certain materials. Use of this system requires a supply of 50 PSI max pressure and 2.0 cfm free air flow (3.2 bar and 3.2 cubic meters/hour), clean, dry oil free compressed air or gas. Air can be provided by the ULS Computer Controlled Compressed Air Unit. The Air Assist System consists of a lateral or a coaxial fitting and a ULS Computer Controlled Compressed Air Unit. The lateral fitting is geared more toward engraving applications and the coaxial is geared more toward cutting applications.

Air/Gas Assist Lateral Attachment

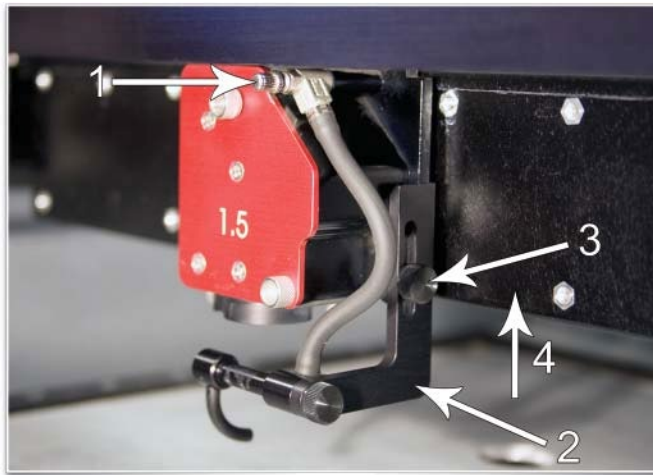
The Lateral Air Assist attachment directs debris and smoke away from cutting or engraving processes toward the exhaust at the back of the laser system. When using this attachment, you can adjust the angle of the air jet coming from the attachment as necessary to optimize the effect of the air assist.

Installation

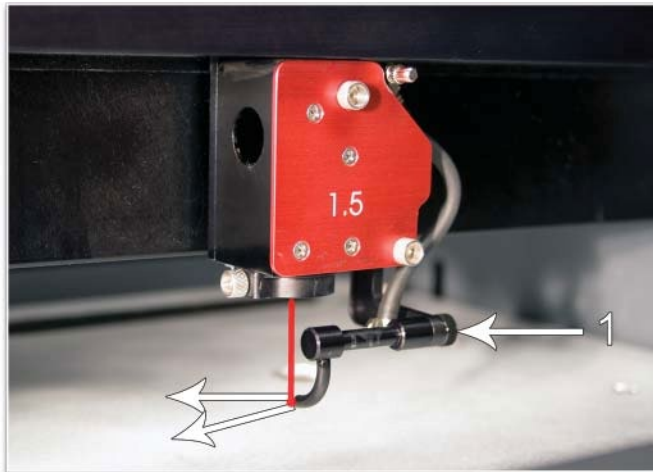
1. Remove (if present) the plug screw (1) with a flat bladed screwdriver. Attach the mounting block (2), if not already attached, with the provided mounting screw using a 3/32 Allen wrench (once the mounting block is installed, it can be left in place).



2. Using the provided 3/16 nut driver, attach the needle valve (1) to the port from which you removed the plug. Be careful not to cross-thread the small fitting when installing and do not over tighten it (the needle valve will be left permanently installed on the carriage from this point forward). Attach the air assist lateral attachment(2) to the mounting block using the thumbscrew (3) and adjust it up or down (4) as necessary. Tighten the thumbscrew once it is at the desired height.



- Adjust the angle of the nozzle as necessary by loosening the thumbscrew (1), rotating the bracket and re-tightening the thumbscrew. A convenient way to align the air flow is to focus on the material to be processed and then align the nozzle using the angle and height adjustments toward the red target laser which is on when the laser system is powered on and the top door is open.



Air Flow adjustment

The needle valve can be used to adjust air flow for different applications. It is best to start with the needle valve at maximum flow (turn the needle valve counterclockwise until it seats), then adjust as necessary.

Removal

Remove the height adjustment thumbscrew and detach the air assist lateral attachment from the mount. You can re-attach the thumbscrew to the mount so as not to lose it. Detach the hose from the needle valve by using a small wrench or needle nose pliers to loosen the nut that attaches the hose to the needle valve and unthreading the nut from the needle valve. The needle valve will stay with the carriage.

Air Assist Coaxial Attachment

The Coaxial fitting attaches to the base of the Focus Carriage and will force air directly onto the surface of your material. It also helps to protect the lens from contamination.

CAUTION: Do not install the coaxial attachment unless you plan on using Air Assist and never use this attachment without proper airflow. Leaving this attachment in place and running the laser system without airflow will cause smoke from laser processing to be drawn up into the attachment and rapidly damage the focus lens.

Installation

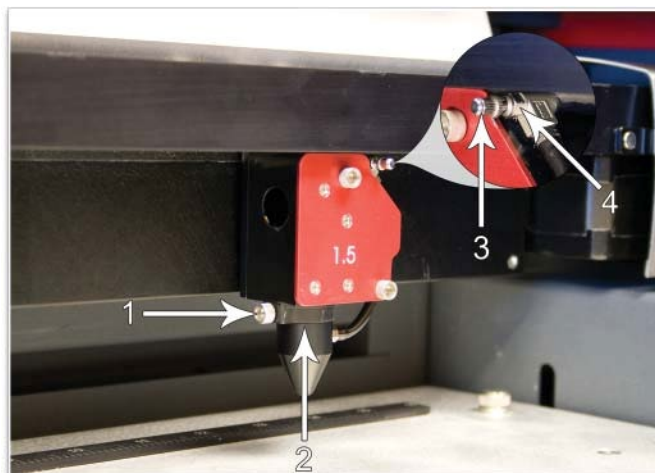
1. Remove (if present) the plug screw with a flat bladed screwdriver.



2. Using the provided 3/16 nut driver, attach the needle valve to the port from which you removed the plug. Be careful not to cross-thread the small fitting when installing and do not over tighten it (the needle valve will be left permanently installed on the carriage from this point forward).



3. Loosen the thumbscrew (1) on the side of the Focus Carriage (if already attached). Insert the coaxial attachment (2) into the circular opening in the base of the Focus Carriage until it bottoms out and gently tighten the thumbscrew.



Air Flow adjustment

The needle valve can be used to adjust air flow for different applications. It is best to start with the needle valve at maximum flow (turn the needle valve counterclockwise until it seats), then adjust as necessary.

Removal

Loosen the thumbscrew and pull the attachment downwards. Leave the thumbscrew attached to the Focus Carriage by re-tightening. Detach the hose from the needle valve by using a small wrench or needle nose pliers to loosen the nut that attaches the hose to the needle valve and unthreading the nut from the needle valve. The needle valve will stay with the carriage.

ULS Computer Controlled Compressed Air Unit

The ULS Computer Controlled Compressed Air Unit provides a 50 PSI max pressure and 2.0 cfm free air flow (3.2 bar and 3.2 cubic meters/hour) source of clean, dry, oil free compressed air for air assisted laser material processing. It can be used in conjunction with either the coaxial or lateral air/gas assist accessories. It also supplies compressed air for optics protection. It contains a sound insulated air compressor,

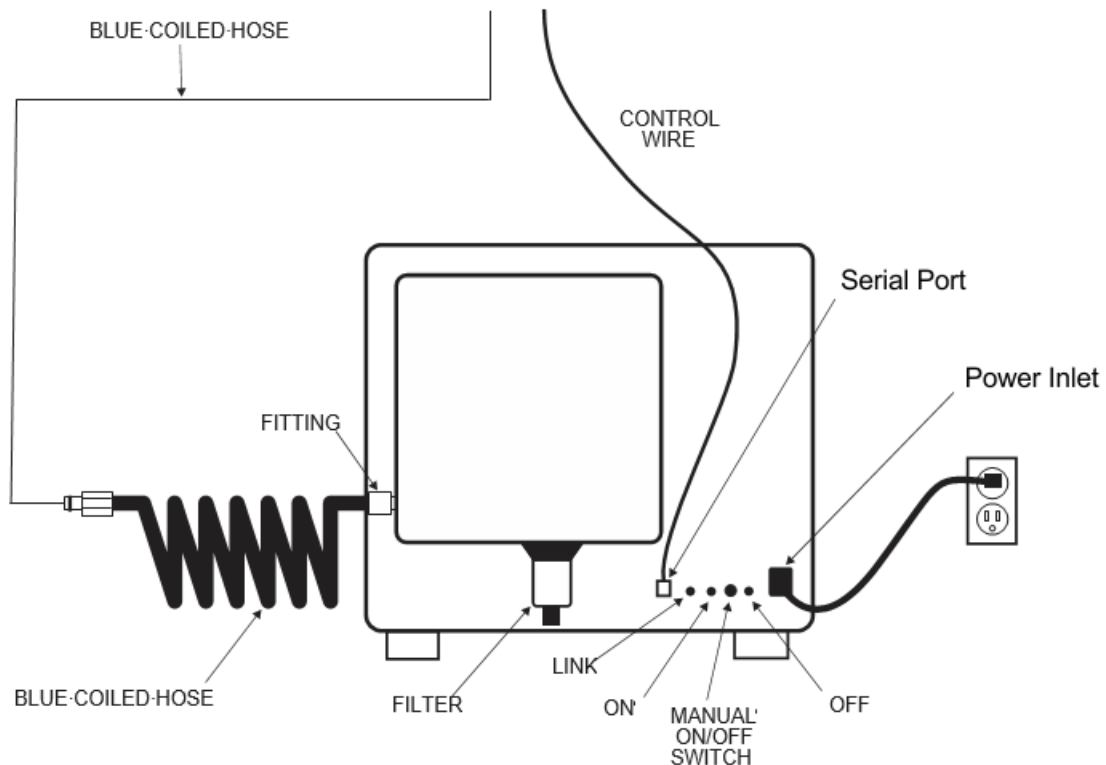
CAUTION: Air Assist can decrease frequency of cleaning for the optics but will not decrease the need for maintenance as a whole.

Installation

1. Insert one end of the provided blue coil hose into the air supply fitting on the back of the laser system.



2. Then connect the other end of the blue coil hose to the ULS Computer Controlled Compressed Air Unit.
3. Connect a power cord to the power inlet and then connect the power cord to a grounded electrical outlet.



4. Connect the provided communications cable between one of the laser system Serial ports and the Serial port on the ULS compressed air unit.

Controls

The ULS Computer Controlled Compressed Air Unit functions automatically when connected to the laser system and no operator intervention is necessary. Controls and indicators on the unit are for diagnostics and provide the following information:

Link light – blinks to indicate good communications link with the laser system

ON and OFF lights – indicate the state of the compressor. If the ON light is illuminated the compressor should be running and supplying compressed air. If the OFF light is illuminated the compressor should be off and no compressed air is being supplied.

Manual ON/OFF switch – turns compressor on or off manually to verify operation.

Operation

Operation of the compressor is automatic if all of the connections are properly made, and the unit has power. The ULS Computer Controlled Compressed Air Unit will automatically power on when the laser system starts processing a control file, and then power off automatically when the control file is finished processing.

Maintenance

The particle filter should be inspected every 8 to 16 hours of use. Clean out the filter as necessary. The filter can be inspected by unscrewing the lower bell shaped portion of the filter housing (1/8 turn) and removing the red foam filter found inside. If it needs cleaning, wash it in water, dry it thoroughly and reassemble.

Exhaust Air Filtration Unit

The exhaust air filtration unit provides exhaust flow to remove the smoke and fumes generated during laser processing of materials. It also contains a three stage filtration system to clean the exhaust air removed from the laser system. The three stage filtration system consists of a pre-filter to remove coarse particulates, a HEPA filter to remove fine particulate and an activated charcoal filter to remove fumes and odors. A high-pressure vacuum motor is employed to provide the air flow. The filtration unit also serves as a base for the laser system.

To reduce noise and prolong filter life, the filtration unit only operates while the laser system is running a control file.

The filtration unit has sensors to monitor the pre and HEPA filters and a consumption meter to monitor consumption of the carbon filter. The LSM provides warnings when it is time to change each filter.

Note: Always keep a spare set of filters on hand to reduce downtime.

Filter replacement

The Carbon filter is housed in the bottom drawer of the filter unit and the Pre and HEPA filters are housed in the top drawer. To replace any of the filters, open the drawer and remove the drawer lid. Remove the filter and replace it with a new one. The HEPA filter is underneath the pre filter so you will have to remove the pre filter to gain access to it.

Maintenance

The area around the pre filter and the chamber above the HEPA filter may become dirty over time. It is a good idea to take an opportunity to clean these areas with a vacuum cleaner and/or a wipe down with a mild soap solution when replacing these filters.

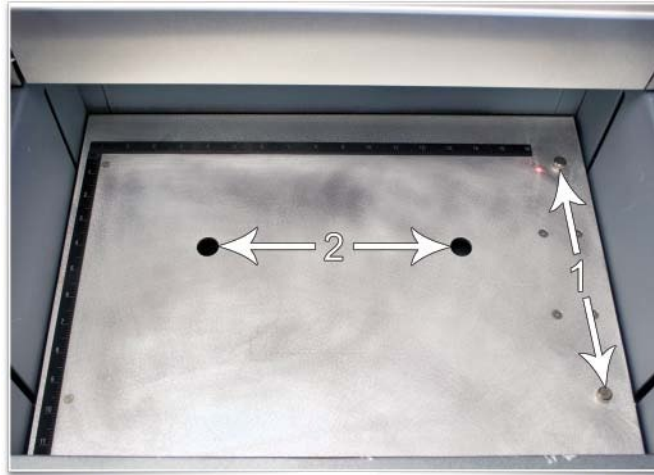


Cutting Table

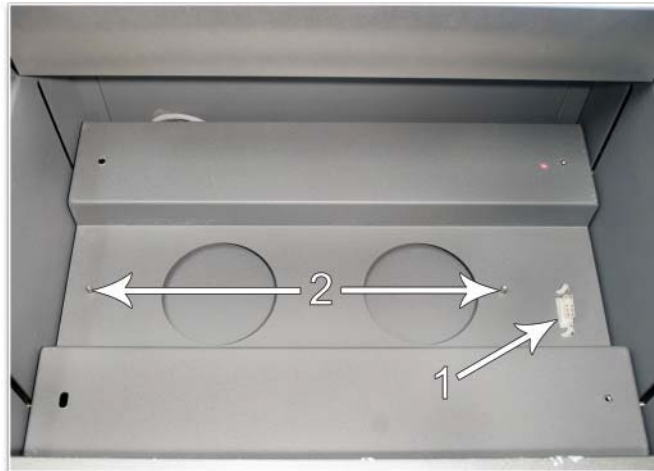
The cutting table is used to support material when cutting so that exhaust flow is redirected both above and below the material for clean cuts. Without it, smoke and debris can build up underneath the material causing the surface of the material to be damaged. The cutting table also helps to reduce damage to the surface of the material from laser back reflection which can occur when the laser reflects off of the table supporting the material if you attempt to cut without the cutting table.

Installation

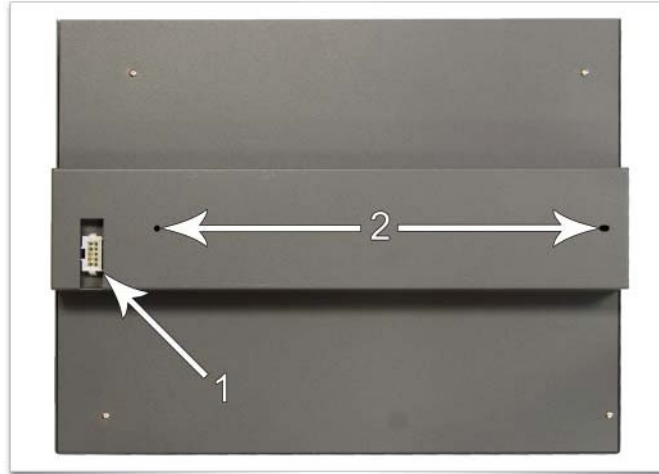
1. Turn on your laser system.
2. Lower the engraving table to the bottom of its travel.
3. Remove the engraving table by loosening the two captive thumbscrews (1). Then, using the finger holes (2), carefully lift the table out of the laser system.



4. The table support platform underneath contains a self-aligning electrical connector (1) and the two alignment pins (2).

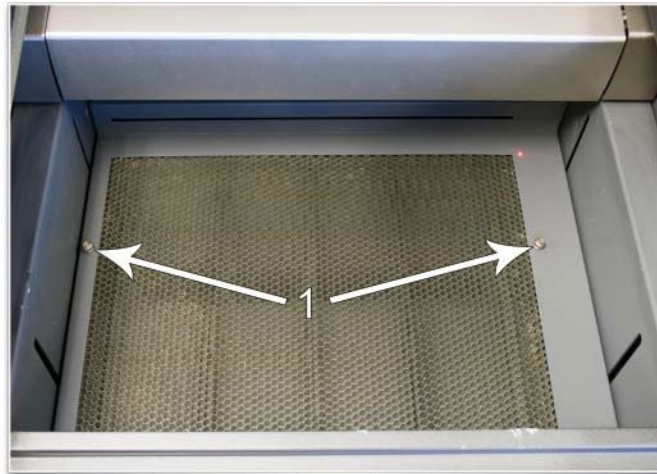


5. Locate the self-aligning electrical connector (1) and two alignment holes (2) on the underside of the cutting table.



6. Using the thumbscrews as handles (1), install the cutting table into the machine (the cutting table is hot swappable so it is not necessary to turn power off to switch between table and cutting table) and adjust it until it engages the connector and alignment pins. The cutting table will be detected automatically and Z axis zero position will be adjusted automatically to the top surface of the cutting table.

CAUTION: The cutting table must be calibrated to the laser system in order to function properly. Calibration is performed at the factory, however, if the zero position does not appear to be correct you may need to recalibrate the table. See the calibration instructions below.



Cutting Table Focus Lens Calibration

To properly use the cutting table with the focus on surface feature in the LSM, the cutting table must be calibrated to the lens you are using. This is done at the factory when the laser system ships. You can recalibrate the table height by selecting the cutting table Calibrate button in the calibration section of the LSM and following the instructions.

Maintenance

As you use the cutting table, material from the cutting process may fall through the honeycomb surface and collect in the bottom of the cutting table. Periodically check this area and remove any material that has collected there.

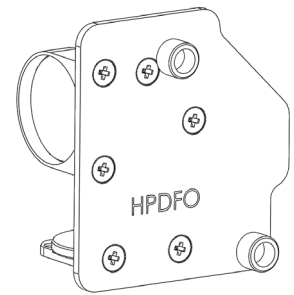
CAUTION: If left to build up in the bottom of the cutting table, this scrap material can be a fire hazard.

The honeycomb material that makes up the support surface for materials being cut will wear out over time and can easily be replaced. New honeycomb can be purchased from the Customer Service Team at ULS. To replace the material, remove the back panel of the cutting table. Remove the old honeycomb and replace it with a new one. Reinstall the back panel.

HPDFO

High Power Density Focusing Optics (HPDFO) has a smaller focal spot size than a standard 2.0" inch lens. Depending on the type of material being processed, the effective spot size produced by the HPDFO can be as small as 1/4th the size of a standard 2.0" focusing lens.

With a smaller spot size (higher power density), depending on your material, you can engrave smaller text, produce sharper graphics and photographs and vector mark and cut thinner lines with the same laser power. With the HPDFO it is also possible to scribe and/or etch some uncoated metals, such as stainless steel, directly without the assistance of chemicals or coatings.



The HPDFO replaces the standard lens kit in the carriage and comes with its own calibrated focus tool which should always be used when focusing with the HPDFO.

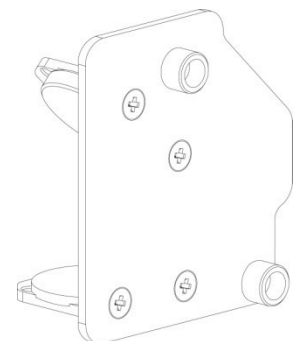
Installation

1. Turn off the laser system.
2. Rotate the X axis arm cover up and out of the way.
3. Remove the two thumbscrews that hold the lens kit in place and slide the lens kit out.
4. Replace the standard lens kit with the HPDFO lens kit.
5. Before running a file, select HPDFO from the installed lens list on the LSM System Configuration page.

Lens Kits

There are two Focus Lens Kits available for your laser system; 2.0 and 1.5, along with the High Power Density Focusing Optics (HPDFO). Included with each kit is its own calibrated focus tool.

Different lenses produce different spot sizes and have different focal ranges. For example, the 1.5 lens produces a spot size of 0.003" (0.076 mm) and has an effective focal range of +/- 0.075" (1.91 mm). This lens can engrave very fine detail, but can only be used on very flat materials. The 2.0 lens has a spot size of 0.007" (1.77 mm), but has an effective focal range of +/- 0.140" (3.5 mm) making it much less sensitive to flatness of material and accuracy of focus, but with the trade off of a larger spot size. Contact Universal Laser Systems customer support for help in choosing the right lens for your application.



Automation Kit

The Automation Kit provides six inputs to initiate various laser system functions using signals from external devices, such as PLCs and provides two outputs for polling laser system status. The automation kit is automatically detected upon power-up and is configured from the Automation page in the LSM. If the automation kit is not present, the controls for the automation kit in the LSM will not be visible.

CAUTION: ULS does not authorize or support third party safety devices via the Automation Kit. Outputs are intended to be used for informational purposes such as to indicate error conditions; they are not intended to drive external devices.

Installation

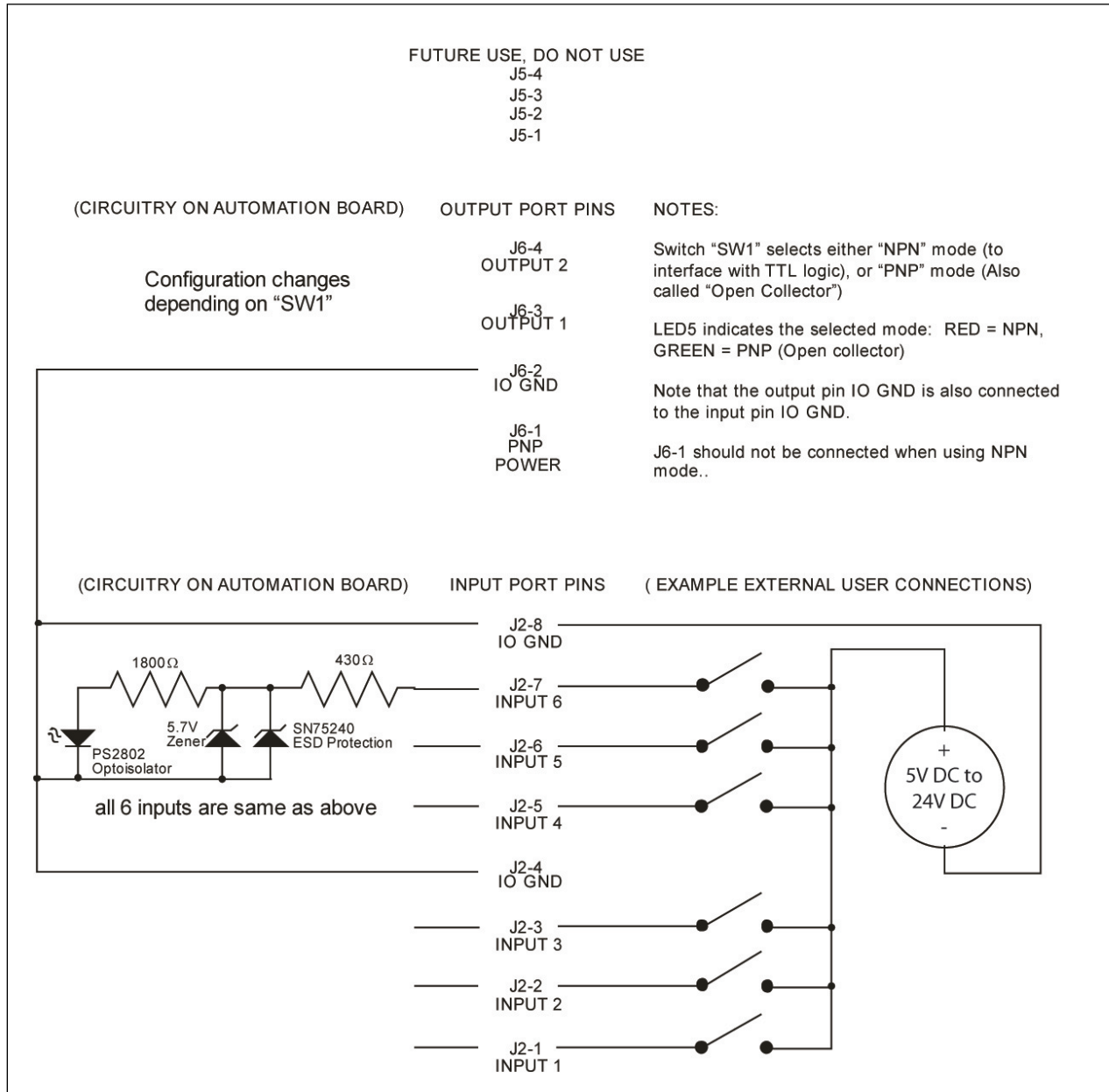
1. Ensure power is off to the engraver and any accessories such as the compressor.
2. Using the supplied patch cable, plug into either one of the laser system accessory ports shown below.



3. Then connect the other end of the patch cable to the PWR/COM IN RJ9 connector at top of Automation Kit.
4. (Optional) If you are using an ULS Computer Controlled Compressed Air Unit for air assisted laser processing, use the included RJ9-to-RJ9 cable to connect the compressor to the unused RJ9 PWR/COM OUT jack on the automation kit.

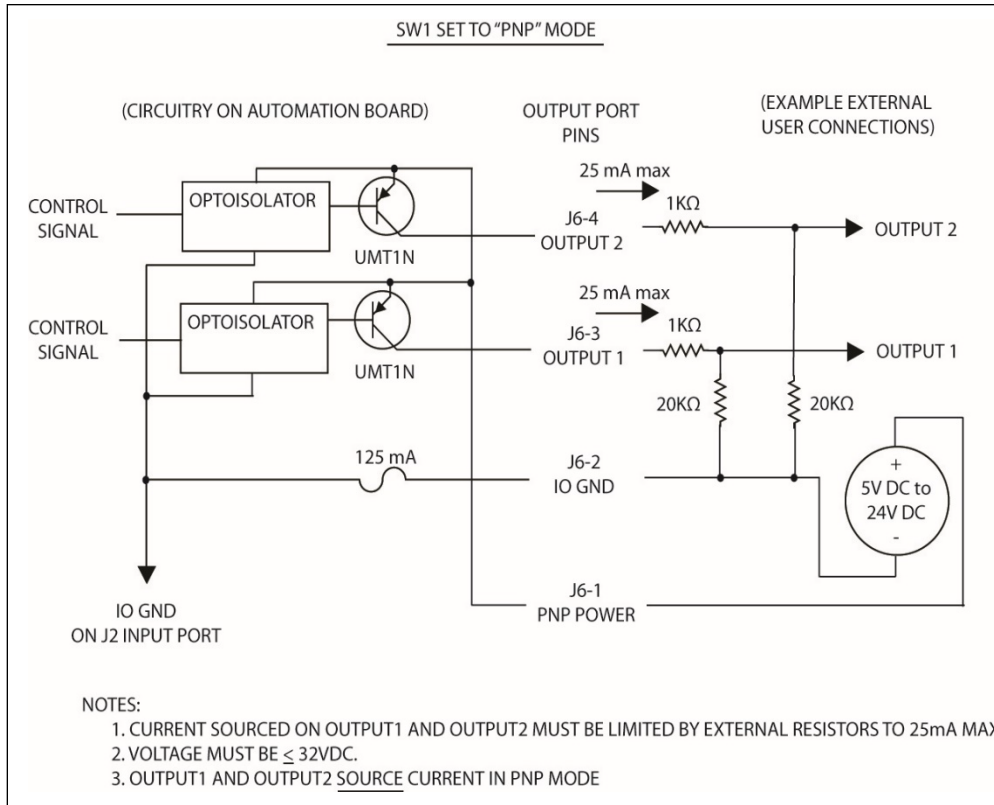
External Wiring

The automation kit connector J2 is used to wire external signals to six programmable inputs which can initiate various laser functions. To trigger a function, supply between 5V DC to 24V DC to one of the input pins as shown below. It is not necessary to limit current with a resistor to the input pins. The pulse on the input pins should be held high longer than 5mS in order to register.

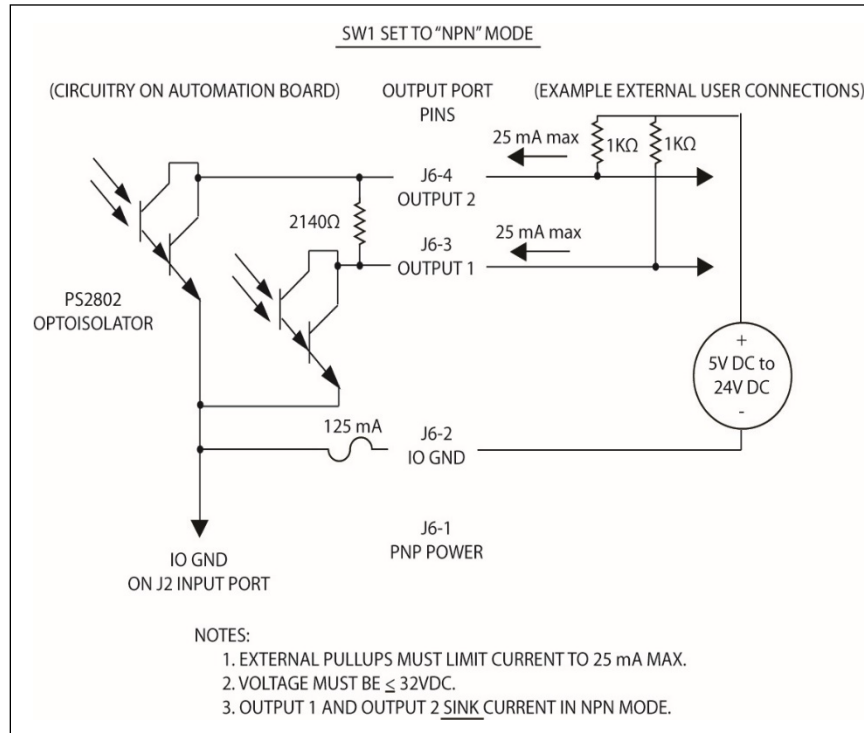


Automation Kit I/O Connections

The automation kit connector J6 is used to poll the two programmable status outputs. It can be used in two modes, selectable by the "PNP/NPN" switch on the top of the board. LED 5 indicates the position of this switch, lighting up green for PNP or red for NPN mode. Two example diagrams are shown below to indicate the difference between the modes. PNP (also known by the name "open-collector") mode is recommended in most cases. In both modes, the user must supply correct value resistors to limit the current to 25mA or less. The voltage used should not exceed 32V DC.



Example Connection for PNP mode



Example Connection for NPN mode

Automation Page

This page is used to configure the Optional Automation Interface to communicate with other equipment through the optional automation module. This module must be installed to see this page.

The screenshot shows the 'Automation Page' configuration interface for Universal Laser Systems. At the top, the 'UNIVERSAL LASER SYSTEMS' logo is visible. The interface is divided into several sections:

- A Input Pin:** A table with 6 rows. Each row has a pin number (1-6), an action dropdown menu, and a delay field set to '0 seconds'. The actions are: 1. Start, 2. Resume, 3. Start, 4. Ignore, 5. Ignore, 6. Ignore.
- B Action:** The dropdown menus for the actions in the Input Pin section.
- C Delay:** The delay fields for the actions in the Input Pin section.
- D Control File:** A field containing a file icon and the text 'Uls Top-to-Bottom DesignFile.pdf'.
- E Output Pin:** A table with 2 rows. Each row has a pin number (1-2), a trigger dropdown menu, and a delay field set to '0 seconds'. The triggers are: 1. On Completed, 2. On Aborted.
- F Trigger:** The dropdown menus for the triggers in the Output Pin section.
- G Delay:** The delay fields for the triggers in the Output Pin section.

A- Input Pin

Displays the pin number corresponding to the input wiring connection on the optional automation module. Connections may be accessed under the top laser cover on the back of the laser system.

B- Input Action

Defines the action that will be performed by the laser system when this input is triggered. The actions available are: Start laser processing, Pause laser processing, Resume laser processing.

C- Delay

Provides a field to specify a delay time before performing the selected action after receiving a signal on the input.

D- Control File

Allows the user to specify the control file that will be used if the Start action is triggered.

E- Output Pin

Displays the pin number corresponding to the output wiring connection on the optional automation module. Connections may be accessed under the top laser cover on the back of the laser system.

F- Trigger

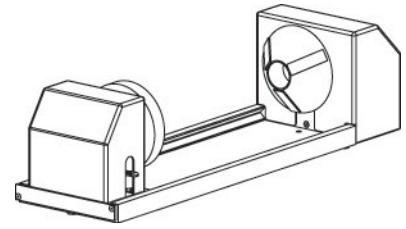
Defines the trigger event that will cause the output to assert closing the output relay connected to the corresponding pin. Trigger events available are: On completion of laser processing, On Running and On abort.

G- Delay

Provides a field to specify a delay time after the selected trigger event occurs before the output is asserted.

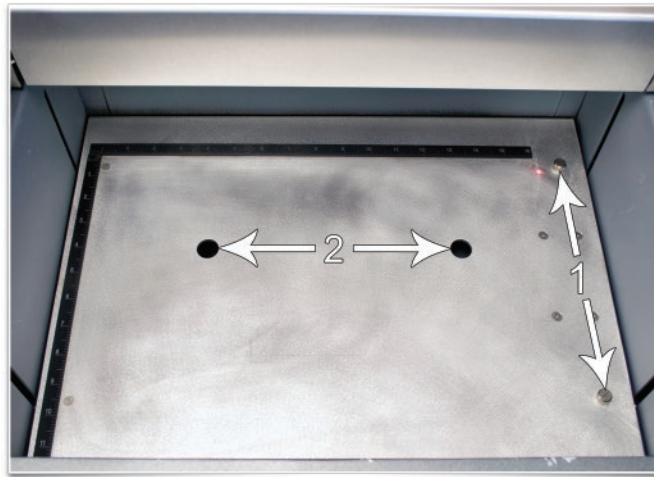
Rotary Fixture

The Rotary Fixture allows the laser system to engrave and mark on cylindrical objects. The Rotary fixture is equipped with an external cone shaped fixture mounted to the fixed, motorized end and an internal cone shaped fixture attached to the adjustable end allowing the fixture to hold a variety of objects such as wine glasses, mugs, cups, etc. Additional internal and external cone fixtures can be purchased by contacting the ULS Customer Service Team at 480-609-0297 (USA), +43 1 402 22 50 (Austria), +81 (45) 224-2270 (Japan) or e-mail us at support@ulsinc.com.

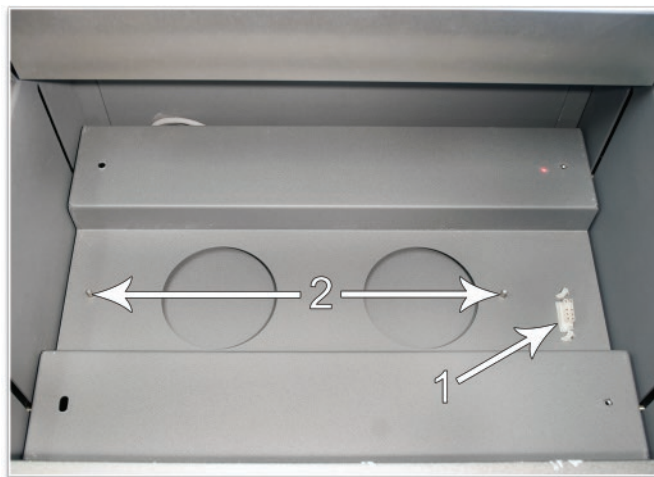


Installation

1. Remove the engraving table by loosening the two captive thumbscrews (1) and using finger holes (2) lift the table out of the laser system.

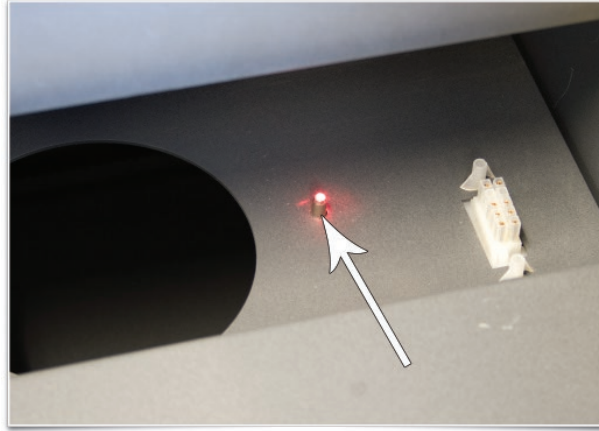


2. Underneath the engraving table you will find a large recessed slot with a self-aligning rotary connector to the right side (1) and the two alignment pins (2). If you are using the rotary for the first time or replaced the laser system's CPU, rotary position calibration may be needed, if so proceed to Rotary Position Calibration below. If rotary calibration is not needed proceed to step 3



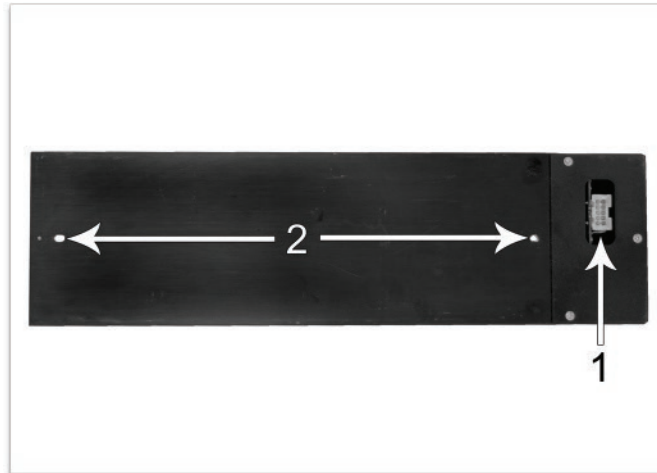
Rotary Position Calibration

- a. Raise the Z-Axis platform to the top of its travel (engraving table should be removed first).
- b. In the LSM calibration, select rotary calibration, use the joystick controls to move the carriage manually and center red alignment pointer on the right side rotary alignment pin show below.

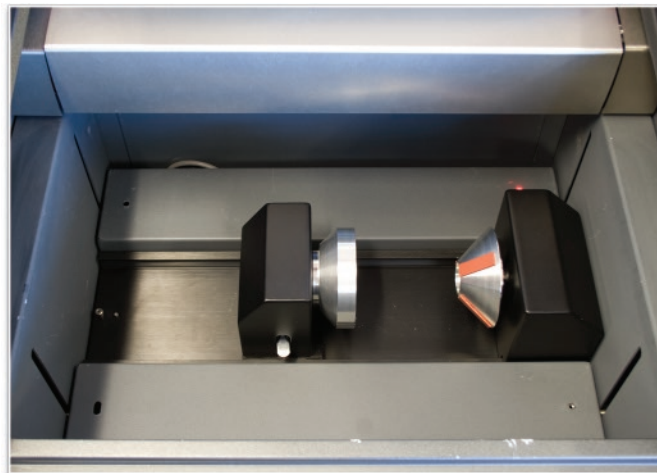


- c. Next, press the Y position SAVE button while the red alignment laser is still located on the right alignment pin to save the Y location of the rotary axis.

3. Lower the laser system engraving table enough to install the rotary fixture. Make sure the motion system will clear the top of the rotary fixture.
4. On the underside of the Rotary Fixture locate the self-aligning electrical connector (1) and two alignment holes (2).



5. Turn off laser system. (Important – you risk damaging the electronics in the VLS laser system if you install the rotary fixture into the VLS with the power on.)
6. Insert the Rotary Fixture into the recessed slot and adjust until the connector engages, the alignment pins protrude through the alignment holes in the base of the rotary fixture and the rotary is sitting flat. The rotary will indicate that it is installed properly by automatically rotating its cone slightly. If you are using the rotary for the first time or replaced the laser system's CPU, rotary focus calibration may also be needed, if so proceed Rotary Focus Calibration below. If rotary focus calibration is not needed the rotary is ready for use.



Rotary Focus Calibration

- a) In the LSM calibration page select rotary calibration. Using the joystick controls in the LSM move the carriage manually and center red alignment pointer over the top of the internal cone fixture. Use the focus tool and manually focus on top of the internal cone fixture as shown.



- b) Next, Press the Z position SAVE button ONLY to save the Z position of the rotation axis of the rotary fixture.

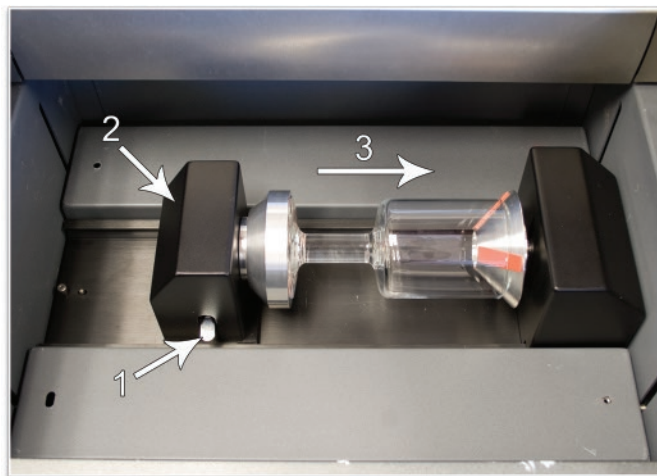
Loading Material

Before loading material into the fixture, measure the diameter (1) of the material in the area where the engraving or marking is to be located, by using a caliper or similar measuring device. A wine glass is used for illustrative purposes here.



1. Place the open end of the material (4) on the fixed end of the rotary fixture. Lift the lever (2) on the adjustable end of the fixture and slide it up against the base of the material so the material rests firmly centered inside of the inverted cone. Push the adjustable end of the fixture (3) to the right firmly against the bottom of the material. Lower the lever on the end of the fixture to lock the material in place. The rubber pads should keep the material from slipping.

Note: If the material does not have an open end you can purchase an additional internal cone fixture to hold the material. If the material has two open ends you can purchase an additional external cone fixture to hold the material. To change out fixtures, loosen the setscrew that holds the fixture to the rotary shaft, remove the un-needed fixture and replace with the new fixture.

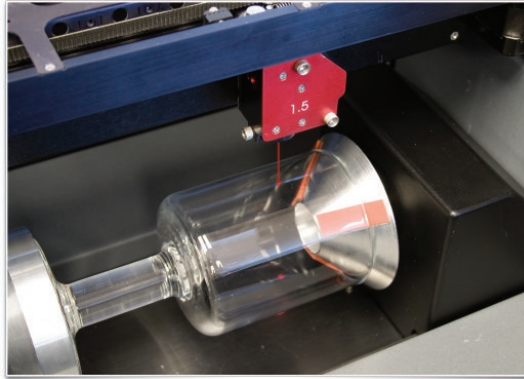


2. Power ON the laser system.

Determining Graphic Placement

The next step is to align the graphics to be printed with the material inserted in the rotary fixture. Again, a wine glass is used for illustration. You can use the X axis ruler or to be more precise use the Red alignment Laser and the X-Y coordinate display in the LSM to position the graphics in the X axis.

1. Using the joystick controls in the LSM, position the Focus Carriage above the material.
2. Move the carriage left or right until the red alignment laser is located where you would like the top of the graphic to start on the material as indicated in the picture below.



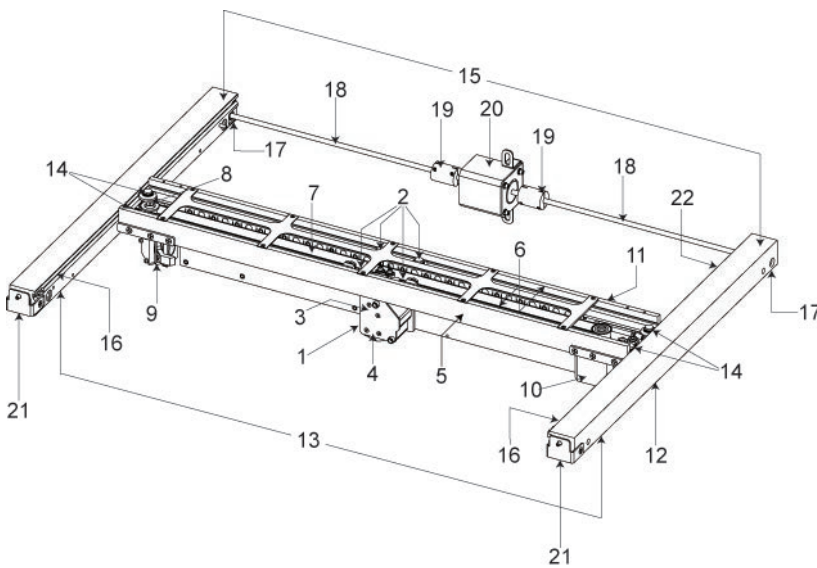
3. Select the control file in the LSM that you want to use for laser processing with the rotary fixture. In the process settings select the rotary switch to indicate the control file can only be used with the rotary fixture, and enter the diameter of the material to be processed. The preview window will change so that the vertical height of the processing area is equal to the circumference of the material and a red horizontal line will appear centered vertically indicating the position that is top center of the material.
4. Use the relocation function to position the design in the control file vertically (usually centered vertically) and horizontally so that top of the design is aligned with the pointer you positioned in step 2.
5. Finally rotate the material by hand until the position you want to be the vertical center of your design is facing directly up. Keep in mind that the rotary fixture does not have a home location in the rotational axis so the topmost part of the material (the part facing straight up) is always the center of the graphic when processing with the rotary fixture using LSM.

Chapter 6 - Maintenance

Overview

Accumulation of dirt and debris on the motion system components will cause uneven or rough engraving, loss of engraving position and premature failure. Accumulation of smoke or dirt on optics can result in loss of laser power and premature failure. It is important to keep your laser system as clean as possible to ensure trouble free operation and best results from laser processing. Always turn the laser engraving system OFF and unplug it before performing any cleaning procedures.

Motion System Components Diagram



1. Focus carriage
2. X-Axis bearing (4)
3. #3 mirror (inside cover plate)
4. Focus lens (inside cover plate)
5. X-Axis rail (arm)
6. X-Axis bearing track (2)
7. X-Axis belt
8. X-Axis idler pulley
9. #2 mirror and holder
10. X-Axis motor and drive gear
11. X-home sensor board
12. Y-home sensor board
13. Y-Axis belt (2)
14. Y-Axis bearing (4) (2 on right side Y-Axis rail, 2 on left side Y-Axis rail)
15. Y-Axis rail (2)(one right side and one left side)
16. Y-Axis rail bearing track (2) (one on right side, one on left side)
17. Y-Axis drive gear (2) (one on right side, one on left side)
18. Y-Axis shaft (2) (one on right side, one on left side)
19. Y-Axis shaft flex coupler (one on right side, one on left side)
20. Y-Axis motor
21. Y-Axis idler pulley (2) (one on right side, one on left side)
22. Y-Axis home sensor magnet

Note: #2 Mirror Cover and X-Axis rail cover have been removed for visibility

Cleaning and Maintenance Supplies

- ⤴ Mild soap solution mixture of 1 tablespoon (14.78 ml) liquid soap and 1 quart (liter) of water in a spray bottle
- ⤴ Window cleaner
- ⤴ Paper towels
- ⤴ Cotton cloth
- ⤴ Denatured alcohol (do not use on any painted surface, plastic or the Top Window)
- ⤴ Acetone (can be used on the engraving table, but nowhere else)

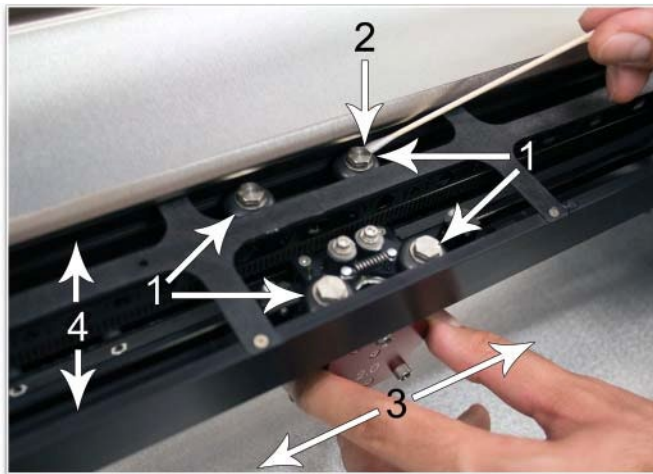
CAUTION: When using acetone or denatured alcohol, please follow the instructions on the printed label of these materials for safe handling procedures.

- ⤴ Cotton swabs (supplied)
- ⤴ Lens cleaner (supplied)
- ⤴ Vacuum cleaner
- ⤴ Set of Allen wrenches sized from 0.050 to 3/16 inch

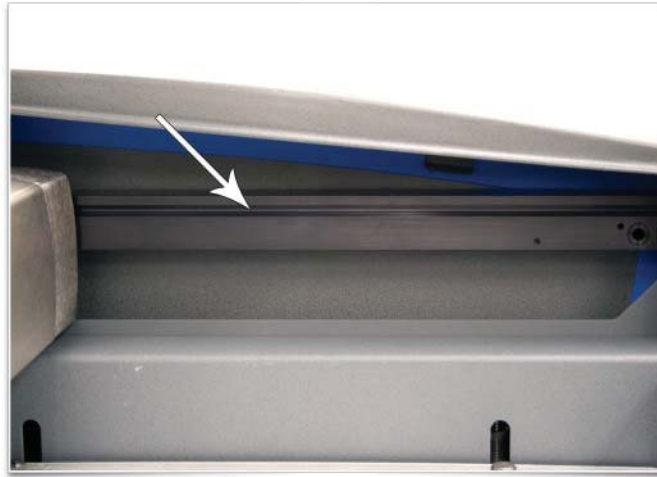
System Cleaning and Maintenance

Motion System

- ⤴ Vacuum all loose dirt and debris from the inside of the device.
- ⤴ Clean the processing table surface with either a soap solution, or alcohol, and a cloth or paper towels (acetone can be used in extreme cases to remove gummy deposits, but should be handled carefully as it will melt plastic components of the laser system). Never pour or spray any solution directly into the laser system. Always dampen your paper towel or cloth with the cleaning solution outside of the laser system and then wipe down the parts you are cleaning with the dampened cloth.
- ⤴ Locate the four X-Axis Bearings (1). Dampen a cotton swab with a soap solution. Place and hold the dampened swab against each in turn bearing as shown (2), grasp the focus carriage (3), move the focus carriage left and right holding the swab on each bearing to roll the bearing against the swab. Also use a dampened swab to clean the length of the x-axis v-grooves (4).



- ⤴ Dampen a cotton swab or cotton cloth with soap solution and clean the Y axis v-groove shown below. Slide the X-Axis Arm toward the front or rear of the device as necessary to gain access to the entire length of the Y-axis v-groove.



Main Enclosure

- ⤴ Clean the glass Top/Front door with a non-abrasive cotton cloth, paper towel or facial tissue and window cleaner. The top window is made out of glass; therefore, do not use abrasive cleaning clothes because they will scratch the glass. Also, do not use abrasive chemicals that will damage the glass.
- ⤴ Use a soft cloth dampened with the soap solution to clean the enclosure. Do not use alcohol, acetone or any other harsh chemical as these will damage the paint.

Optics

A visual inspection of the #2 and #3 mirrors, beam window and focus lens should be performed at least once a day.

CAUTION: Do not clean an optic that appears clean. Excessive cleaning can damage the optical coatings. To prevent contamination, wash your hands thoroughly before handling and cleaning any optic. Try not to touch the optical surfaces with your fingers, handle optics only by the edge or optical housing. Fingerprints can damage the optical coatings.

Never clean any optic right after engraving or cutting because the optic may be hot and the cool lens cleaning solution may thermally shock the optic and crack it.

#2 Mirror

To gain access to the #2 mirror rotate the X axis rail cover up and out of the way. Locate the #2 Mirror Holder handle on the left end of the rail (red) and gently slide it out of the holder. It is held in place by magnets so you may feel a slight resistance as you are sliding it out.

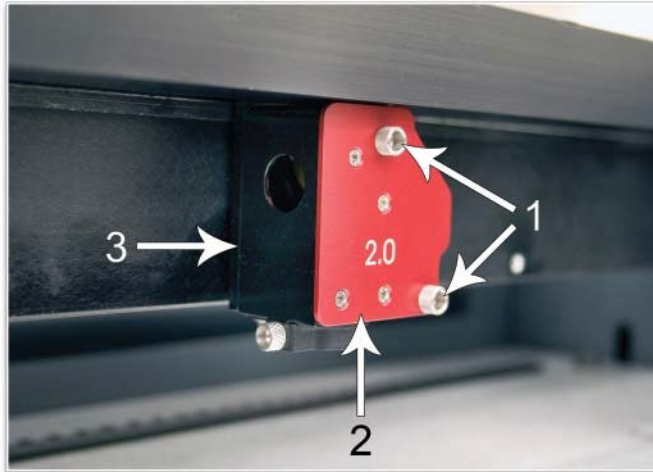


Inspect the #2 mirror and clean it only if there is debris present. To clean the #2 mirror with a cotton swab, moisten the cotton swab with the lens cleaning solution supplied with the laser system. Do not use other types of cleaners or solutions. Gently roll the cotton swab across the mirror once. Do not drag the swab or roll it back and forth as this can scratch the mirror. If the mirror did not come clean, use a fresh cotton swab and repeat the procedure. Reinstall the mirror by sliding it back into its holder until seated.

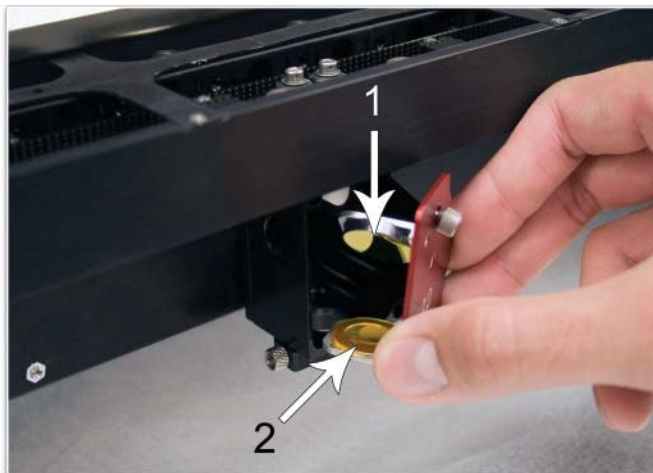
CAUTION: When reinstalling the mirror make sure not to install it backwards.

#3 Mirror and Focus Lens

Loosen the two thumbscrews (1). They are held captive by retaining clips so they should remain with the cover. Grasp the Front Cover Plate (2). Gently slide it forward and out of the Focus Carriage (3).

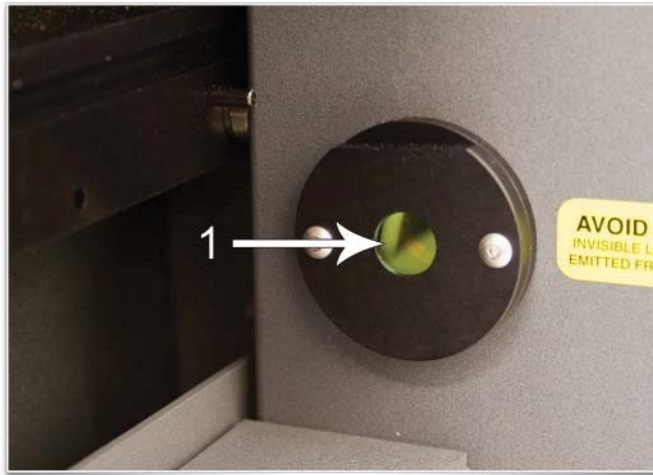


Inspect the #3 Mirror (1) and Focus Lens (2) and clean as necessary. Be sure to inspect both the top and bottom of the Focus Lens. Use the same cleaning method described for the #2 mirror to clean #3 mirror and lens. Make sure to use a fresh swab for each pass.



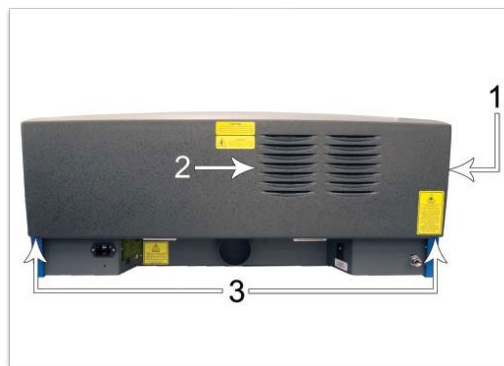
Beam Window

The Beam Window (1) is located where the laser beam enters into the processing area. It is located in the upper left hand corner of the engraving area against the back wall and is yellow in color. It is only necessary to clean the front side of the beam window. Do not remove the optic to clean it; simply clean it in the same manner as the #2 mirror.



Cooling Fan Filters

The side (1) and rear (2) cooling fan filters are located inside the Rear Cover. To access them, remove the two mounting screws (3) underneath the rear of the system. Lift the cover straight up and off. Locate the filters on the inside of the rear cover and on the inside of the side vent panel. Remove the plastic retainers and the filter media. Rinse the filter media with soap and water. Allow them dry before re-installing.



Exhaust Plenum

The exhaust plenum should be routinely inspected and cleaned to ensure good exhaust flow. To access the inside of the exhaust plenum, lower the engraving table to the bottom of its travel and then remove the table by loosening the thumbscrews on the right side and lifting the table out. You can then remove the exhaust plenum cover on the inside back wall of the machine by gently pulling on it. It is held in place by snap fasteners. Clean the inside of the plenum with a mild soap solution and then reinstall everything in the reverse order.

Adjustments and Lubrication

Periodic adjustments are not normally required. The bearings in the motion system will self-adjust to take up any clearances as they begin to wear. The belts are fiber-reinforced and will not stretch under normal use so periodic tension adjustment is not necessary. All bearings in the system are sealed and do not require lubrication. Do not lubricate the tracks that the bearings ride in.

Maintenance Schedule

We recommend the following schedule:

As necessary

- ⤴ Clean engraving table
- ⤴ Clean main enclosure
- ⤴ Clean top door window

Every 8 hours of engraving

- ⤴ Clean X-Axis and Y-Axis bearings
- ⤴ Clean X-Axis and Y-Axis rails and bearing tracks
- ⤴ Clean X-Axis belt
- ⤴ Check beam window, #2 mirror, #3 mirror and Focus lens for debris. Clean ONLY if dirty.

Every month

- ⤴ Clean cooling fan filters
- ⤴ Clean Z-Axis lead screws with white lithium grease
- ⤴ Check for X-Axis and Y-Axis belt wear. Replace as necessary.
- ⤴ Check and/or clean X-Axis and Y-Axis drive gears
- ⤴ Check for X-Axis and Y-Axis bearing wear. Replace as necessary.
- ⤴ Inspect system for loose screws and mechanical parts. Tighten as necessary.

Every 6 months

- ⤴ Clean exhaust plenum

Note: If you have any questions about maintaining the laser system, please contact the ULS Customer Service Team.

