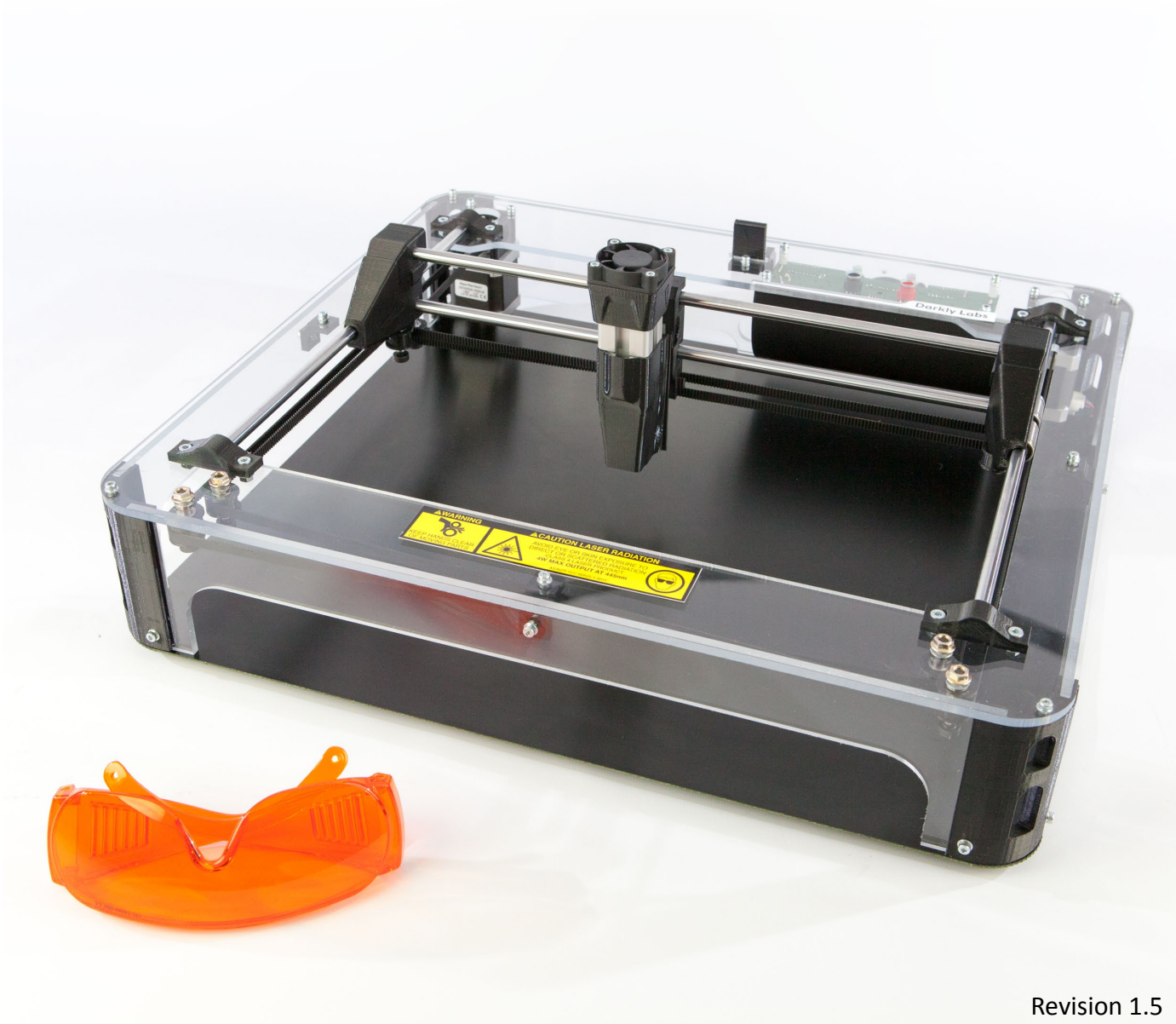
Darkly Labs

Emblaser

-User Manual-



Revision 1.5

IMPORTANT

Read this manual carefully and save it for future reference.

The Emblaser is a cost effective laser cutting and engraving kit for the general hobbyist and maker. The Emblaser is not designed for use in applications such as volume manufacturing.

Danger

Water and electricity are a dangerous combination. Do not use the Emblaser in wet surroundings

Always follow the recommended safety procedures outlined in this manual.

This includes, but is not limited to:

- Always wearing appropriate safety eye-ware when operating the Emblaser.
- Always ensuring your work material is safe to use in the Emblaser.
- Always following the Safety Check List supplied.
- Never use the Emblaser on reflective materials.

Ensure the Emblaser is not used in the vicinity of combustible materials.

Warnings

The Emblaser is not intended to be used by persons (including children) with reduced physical, sensory or mental capabilities, unless they have been given supervision or instruction concerning use of the Emblaser by a person responsible for their safety.

And/or

Children should be supervised to ensure that they do not play with the Emblaser.

The Emblaser is not intended for children under the age of 15 years. Teenagers aged between 15 and 18 years can use the Emblaser with the consent and/or assistance of their parents or persons who have Parental authority over them.

Operation of the Emblaser without the baseplate attached or any other modifications that reduce beam containment or safety interlock functions inherent to the design place the user and bystanders at increased risk of beam exposure and injury.

Damage

Never subject the Emblaser to heavy shocks and do not shake or drop.
Never leave the Emblaser unattended when it is switched on.
Always switch off the Emblaser after use.
Never operate the Emblaser with the base plate removed.

Contents

Welcome to the Emblaser

This Manual is designed to start your journey with the Emblaser.

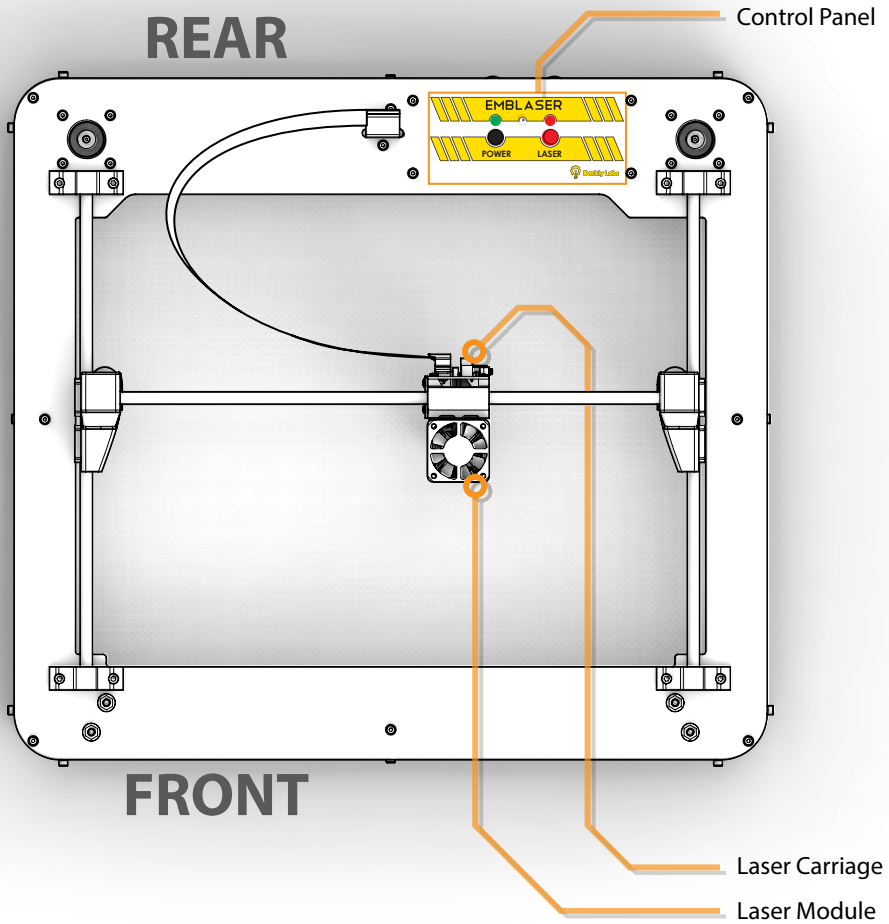
In order to achieve great results you will need to experiment. Taking the time to learn about your new machine by reading this Manual carefully is important.

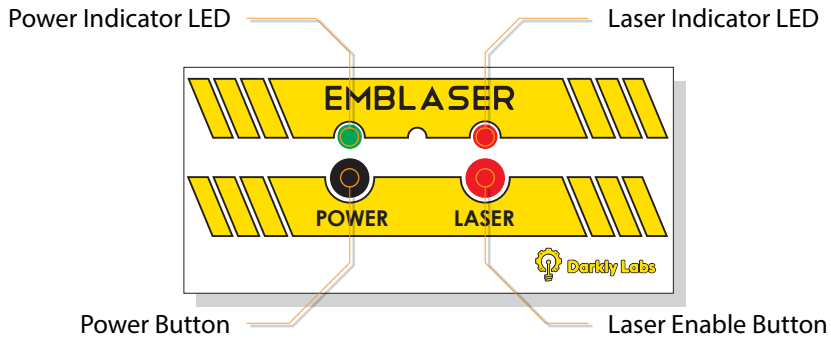
General Specifications

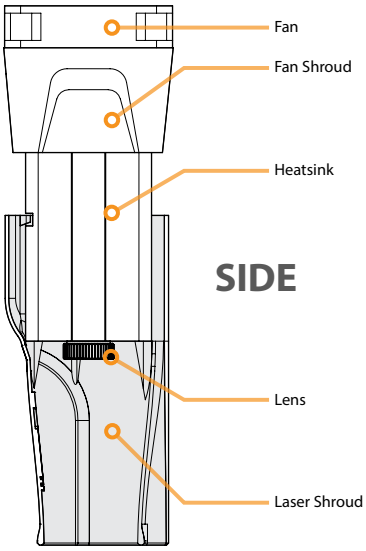
	A4	A3
Physical Dimensions	490mm x 440mm [19.3” x 17.3”]	630mm x 520mm [24.8” x 20.5”]
Working Area	305mm x 210mm [12” x 8.27”]	420mm x 287mm [16.5” x 11.3”]
Max. Material Height	50mm [1.97”]	50mm [1.97”]
Weight	7kg	8kg

Operating Temperature	Ambient Operation	10-32 C [50-90 F]
Electrical	AC input DC output	100-240V, 50-60Hz 12V @ 3amps
Mechanical	Chassis Material Stepper Motors Resolution	Polycarbonate / ABS / PLA 0.9degree step angle 0.08mm / step
Laser	9mm 445 nm laser diode (Class 4) Or 5.6mm 445 nm laser diode (Class 4)	

Layout

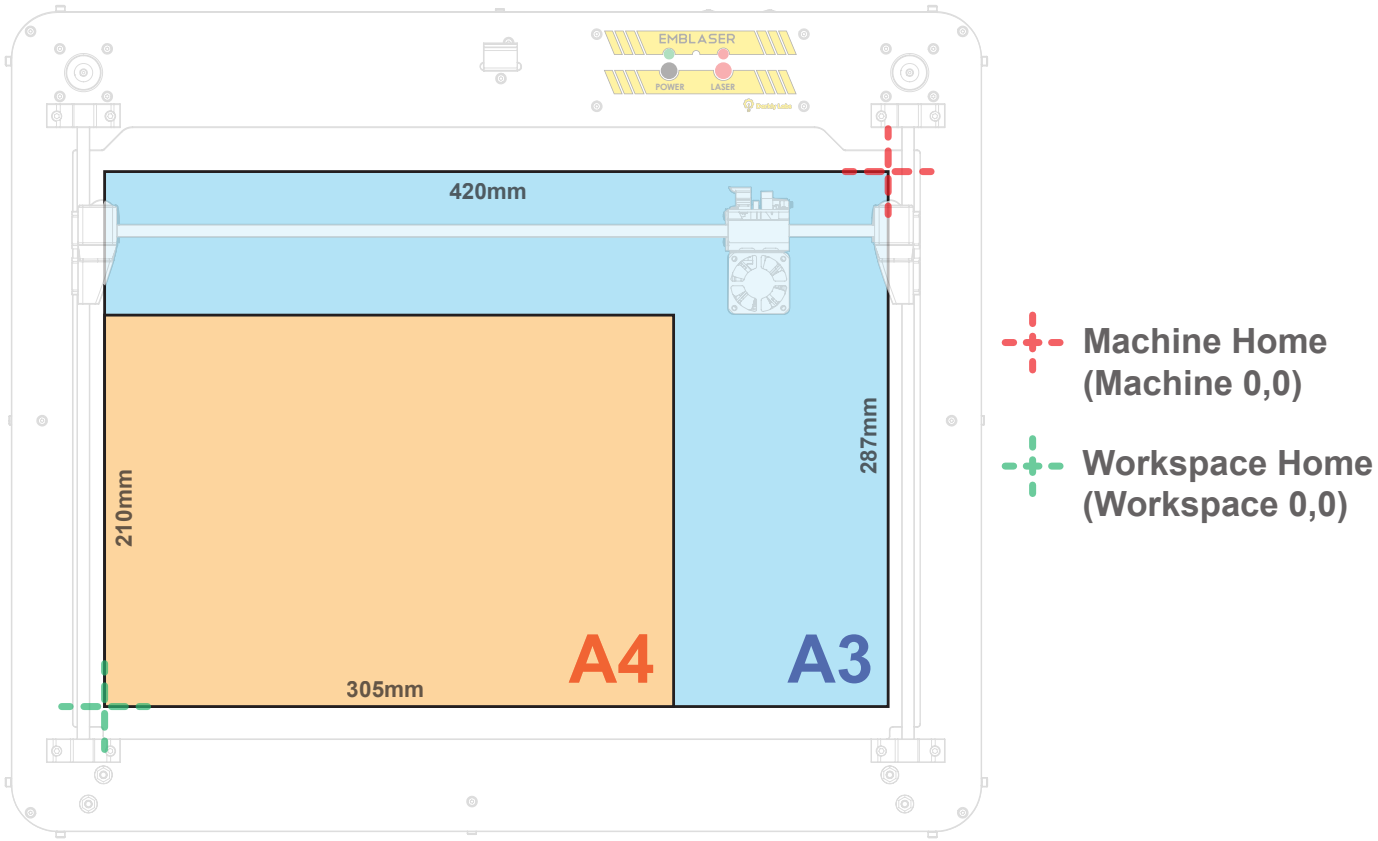

REAR
Control Panel
EMBLASER
POWER
LASER
FRONT
Laser Carriage
Laser Module


Power Indicator LED
Laser Indicator LED
EMBLASER
POWER
LASER
Darkly Labs
Power Button
Laser Enable Button


Fan
Fan Shroud
Heatsink
SIDE
Lens
Laser Shroud

Specifications

Workspace Maximum Travel



Important: Directing the Emblaser to travel beyond these distances will cause it to hit its end stops. This will not damage the machine but will produce an awful noise and require re-homing.

If you do find yourself in this situation, immediately press the power button to turn the machine off. Then proceed with the normal startup procedure.

Safety

Safety Overview

How can a laser injure me?

What Precautions Should I Take?

Important Health Warning Information

Safety Checklist

Safety Overview

The following chapter outlines important safety information.

Please read through all the safety information carefully.

The information outlined in this safety chapter are not intended to replace any existing national or international standards as well as national or local Occupational Health and Safety (OH&S) regulations. These specific responsibilities should be followed. However, in the absence of any specific legislation or regulations, the following constitutes general guidance on responsibilities for the safe use of lasers.

It is crucial that a competant adult is always in charge of the Emblaser and its operation. This individual is responsible for providing laser safety training to users and for ensuring that safe methods of work are always adhered to by users of the Emblaser.

Any potential laser user should ensure that appropriate procedures are followed. This is cannot be reinforced enough, not only to prevent possible irreversible injury to the laser user, but to protect visitors or others who may inadvertently become exposed to any of the hazards of the laser equipment.

Users are encouraged to refer to the references for additional resources and are strongly encouraged to confirm that they are in compliance with all local OH&S requirements.

Watch out for the following symbols to indicate specific laser precautions.

How can a laser injure me?

The Emblaser uses a **Class 4** laser to perform its cutting and engraving tasks. This class of laser can injure or affect the user in three main ways:

1) Thermal Injury

Unlike many light sources that dissipate their power rapidly with distance traveled, lasers produce a collimated (focused) beam that remains concentrated even over long distances.
This concentrated beam of light entering the eye can cause some permanent damage to the retina.

Lasers can also quickly cause thermal injury (burns) to the skin. Continuous exposure to shorter wavelengths, such as ultraviolet, can over time increase the risk of skin cancer.

Important: The danger of retinal injury is always present when working with lasers. This can be from both direct and also indirect (bounced light) beam exposure.

2) Exposure to fumes from laser cutting

The heating which occurs during laser cutting or engraving can cause charring, pyrolysis and even combustion of the material being worked on.

Exposure to the fumes and particulates released during laser engraving or cutting can cause irritation to the airways and potentially be extremely dangerous.

For example, exposure to Isocyanate from thermally degraded polyurethanes has the potential to cause hypersensitivity to develop over time in predisposed individuals, which can lead to subsequent life threatening asthma like reactions on re-exposure to even trace amounts.

Important: See Appendix for information on chemical reactions with various materials during laser cutting and engraving. Always research the material you plan to work with to ensure it is safe to do so.

3) Fire

A laser cutter / engraver works by amplifying light to such a degree as to either melt or burn material while following a designated path. The heat generated during this process could potentially cause combustion (fire) within the material being worked on.

What Precautions Should I Take?

Always wear the correct protective eye-wear

Lasers operate at a specific wavelength. It is important to ensure the protective eye-wear you are using is designed to protect you against these wavelengths.

Emblaser laser diode wavelength:	**445nm**
Protective eye-wear minimum rating:	**Filter the 445nm wavelength** **OD4 (Optical Density)**

- Make it a habit to always wear appropriate protective eye-wear when using the Emblaser.
- Make sure anyone in the vicinity is also wearing appropriate protective eye-wear.
- If you change the laser diode in the Emblaser, ensure you have the correct protective eye-wear for the laser wavelength you will be using.
- Maintain your protective eye-wear and do not use if damaged.

Important: Laser protective eyewear is not necessarily rated for or capable of withstanding continuous exposure to laser radiation. It should only be relied on as a 'last resort' protective measure.

Do not cut or engrave under the following conditions

- When any part of the Emblaser is damaged or not functioning correctly.
- If anyone is standing within 5 meters of the Emblaser without appropriate protective eye-wear.
- When the Emblaser cannot be constantly supervised.
- If children under the age of 15 are present and cannot be constantly supervised by a responsible adult.
- Where flammable solvents or gases are present.
- In wet surroundings.

Do not cut or engrave the following materials

- Do not engrave or cut materials containing chlorine.
- Do not engrave or cut Polyvinyl-chloride (PVC) based materials.
- Do not engrave or cut materials with reflective surfaces such as glass or metal.
- Do not engrave or cut highly flammable materials.
- Do not engrave or cut any material you cannot ascertain is safe to do so.

Avoid cutting or engraving the following materials without adequate ventilation

- Materials containing melamine resins.
- Plastics containing nylon.
- High Density Foam or other material containing polyurethane.
- MDF or other materials containing either urea or phenol-formaldehyde.
- Foam -core board or other materials containing Polystyrene or Styrene foam.

Ensure your Emblaser is setup in a safe location

Where you setup your Emblaser is as important as the materials you will be working on.

- The Emblaser should always be used on a dry, sturdy, flat surface. The surface should be high enough to avoid tampering from young children and pets. There should be no possibility of the Emblaser being bumped or knocked causing it to dislodge or fall.
- The Emblaser should be placed in an area with adequate ventilation.
- The Emblaser should be placed away from any highly flammable materials.
- Ideally, a smoke / fire detector should be installed in the area the Emblaser is being used.
- A fire blanket and smoke extinguisher should always be readily accessible.

Never leave your emblaser unattended

- Do not leave unattended - Always watch your work
- Ensure children and pets are ALWAYS supervised. Never allow children and pets to have access to the Emblaser without parental supervision. The Emblaser is not intended for children under the age of 15 years.
- If you see flame or fire - Immediately stop the machine and extinguish. Not only could a flame grow into a larger fire, its heat will damage the laser guard and possibly the laser optics.

Always follow your local Occupational Health and Safety (OH&S) rules

- Ensure that you comply with local occupational health and safety legislation. Failing to do so could put you in breach of the law. Even if not being used in a business, owners may be in breach of the law if injuries occur, since injury to a member of the general public could conceivably constitute a breach of the owner's OH&S obligation under law, subject to penalties.
- Visit your local government website for OH&S information on laser safety requirements.
- Those operating the Emblaser within an established business should nominate a designated laser safety officer, responsible for the safe use, training, and upkeep of the Emblaser and associated personal protective equipment, administrative controls such as user credentialling and safe operating procedures (SOPs), and engineering controls, such as ventilation

Important Health Warning Information

Color Blindness

The small percentage of the population (0.01%) that have blue-yellow colour blindness (tritanopia) may struggle to see the Emblaser's laser beam at all, and may not realise they are being exposed although permanent damage is occurring. Tritanopic users must therefore be particularly careful.

Hypersensitivity

Isocyanate exposure from thermally degraded polyurethanes has the potential to cause hypersensitivity to develop over time in predisposed individuals, which can lead to subsequent life threatening asthma like reactions on re-exposure to even trace amounts.

Recommendations:

- Those with a history of asthma should avoid laser cutting polyurethanes.
- If a wheeze develops during or after cutting polyurethanes in any user, further polyurethane cutting should cease and medical advice should be sought.
- Isocyanate by products from decomposition of polyurethanes can remain in exhaust ducting and can still cause sensitisation with skin contact.
- If you get a sore throat or eyes while laser cutting polyurethanes, you have developed isocyanate pharyngitis and your precautions are not working effectively.

Airway Irritation

Many of the chemicals liberated by laser cutting and engraving have the potential to cause airway irritation, but few, if any, permanent effects. Some of the chemicals are known carcinogens, but with appropriate local or general exhaust ventilation, exposures are unlikely to add significantly to background environmental exposures (i.e. formaldehyde from MDF furniture, benzene in fuels).

If you are experiencing airway irritation, your ventilation is not adequate.

Safety Check List

- **Are you wearing your safety glasses?**
- **Are there any people in the vicinity and are they wearing safety glasses?**
- **Is the laser guard installed correctly?**
- **Are there any reflective objects within the laser cutting area?**
- **Is there anything that will potentially obstruct the movement of the laser?**
- **Is the material you are planning to cut / engrave safe to do so?**
- **Do you have adequate ventilation?**
- **DO NOT USE THE EMBLASER ON REFLECTIVE MATERIALS**

Be vigilant with safety when using the Emblaser.

Starting Up

Software

Powering Up

Communicating

Homing

Focusing

Installing the Drivers

Windows Installation

Before plugging in your Emblaser, you will need to install a software driver.

Navigate to the following location, download and install the Arduino IDE version that suits your computer and operating system:

http://arduino.cc/en/Main/Software

Run the installer and make sure 'Driver' is selected for install.

OS X Installation

OS X users do not need to install any drivers.

Install the 'Streaming' Software

Your computer talks to the Emblaser via a 'streaming' program, sending it commands instructing it on what to do.

There are many open-source options available for this software. We use a program called 'Ultimate GCode Sender' because it is simple to use and available for most operating systems.

Download and install the latest version of Java:

https://java.com/en/download/index.jsp

Download the latest version of 'Ultimate GCode Sender':

https://github.com/winder/Universal-G-Code-Sender

Run 'Ultimate GCode Sender'

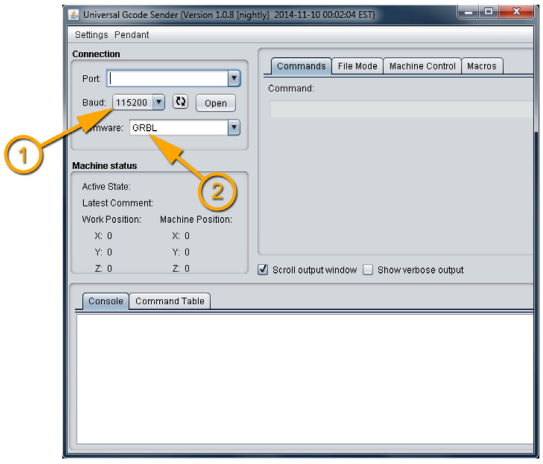
Windows

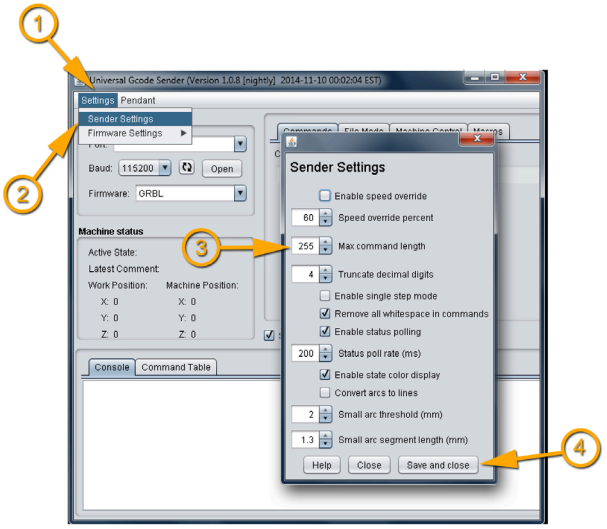
Run 'start-windows.bat'

OS X

Run ` UniversalGcodeSender.jar`

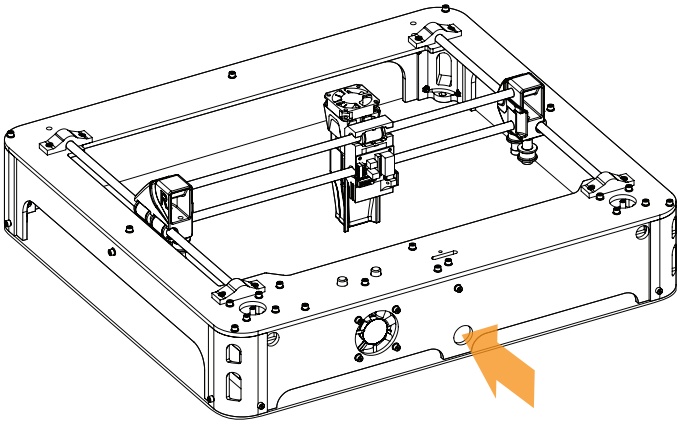
Change the following settings





Powering It Up

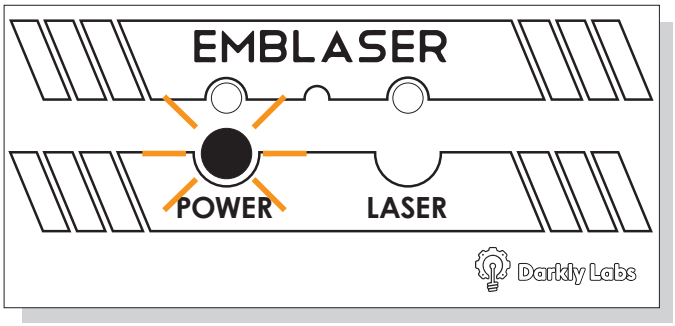
Thread the power and USB cables through the circular opening in the back panel and plug them into the main Emblaser PCB.



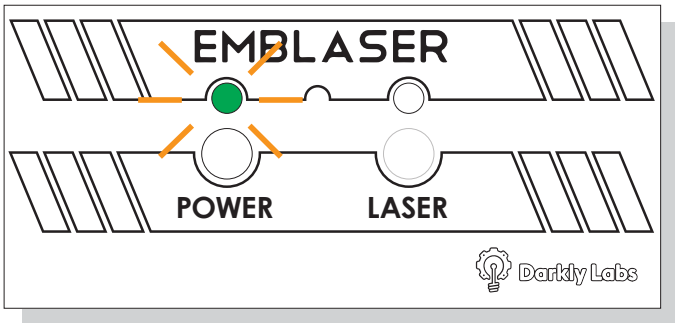
Do not power up your Emblaser yet.

Run through the **Safety Checklist** before proceeding.

Press the ‘Power’ button to turn on the Emblaser.



You will see the LED above the power button turn green and the fan on the laser unit will now be running.



When you first turn on the Emblaser the laser defaults to a ‘disabled’ mode.

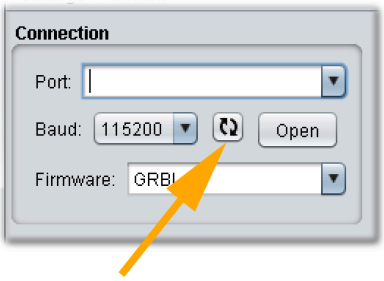
Note: If this is the first time you have connected the Emblaser to your computer, the operating system will detect the USB device and install its required drivers.

Establishing Communication with the Emblaser

When the Emblaser is running, it is constantly listening for instructions on what to do. You communicate with it via the streaming program (Ultimate GCode Sender) you have just installed.

Tip: If your computer is disconnected or goes to sleep the Emblaser will stop operation.

Start 'Ultimate GCode Sender', if not already running from the previous steps.
Press the button to the right of your Baud rate. This refreshes the ports available on your computer.



From the 'Port' pull down list, select your Emblaser port.

Windows

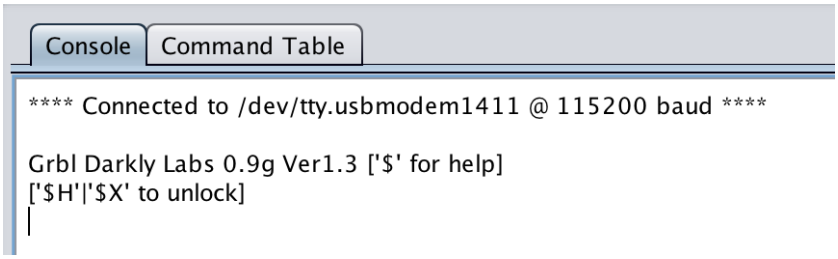
This is likely to be COM3 or higher.
To find out, you can turn off your Emblaser and re-open the menu; the entry that disappears should be the Emblaser port. Turn on the Emblaser and select that serial port.

OS X

This is likely to start with /dev/tty.usbmodem.
To find out, you can turn off your Emblaser and re-open the menu; the entry that disappears should be the Emblaser port. Turn on the Emblaser and select that serial port.

Press 'Open'

You should see the Emblaser respond in the Console window with the following:



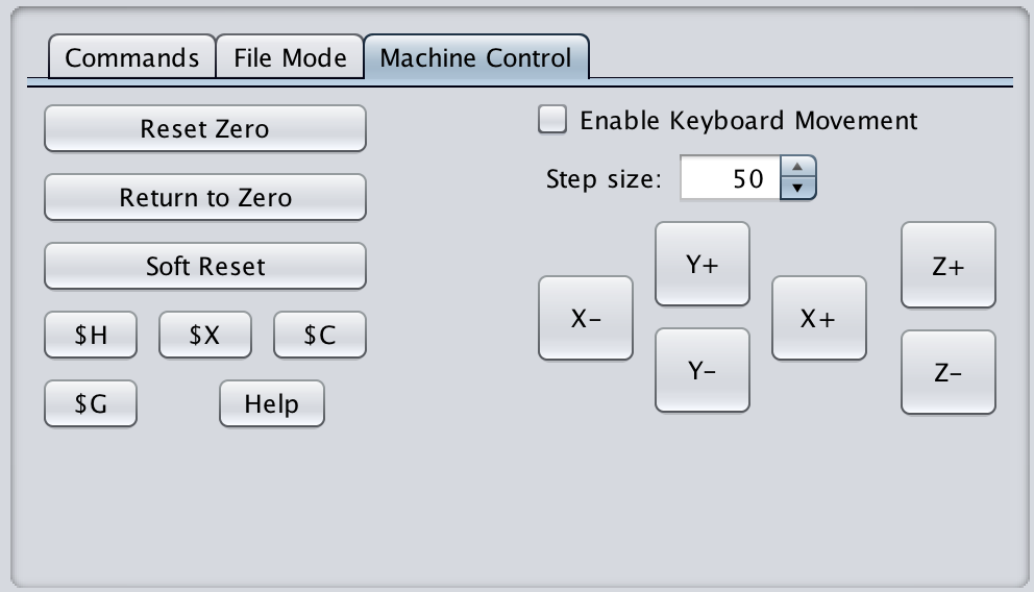
You are now talking directly with the Emblaser and it is awaiting your instructions.

Homing the machine

Whenever you turn on your Emblaser it does not know where the laser is positioned in the workspace. 'Homing' is the process it uses to determine this.

Important: 'Homing' is required whenever the Emblaser is first powered up. It will be in a 'locked' mode and will not accept any commands until this process has been run.

1. Make sure you are communicating with the Emblaser by following the previous instruction steps.
2. In the Universal Gcode Sender, Select the 'Machine Control' tab.



3. Press the Homing Button ($H) indicated above.

The Laser Unit will start to move along the X-Axis until its first limit switch is triggered, then do the same in the Y-Axis.

Once completed the laser unit will sit waiting in the top right corner of the workspace.
The 'Machine Status' window will no longer show a red 'Active State Alarm' message.

Focusing the laser

Laser focusing is the process of creating the narrowest, sharpest focused beam from your laser. This will give you the best cutting and engraving results.
Focusing does not have to be performed very often, but is required the first time you have assembled your kit and if the lens has been changed or moved.

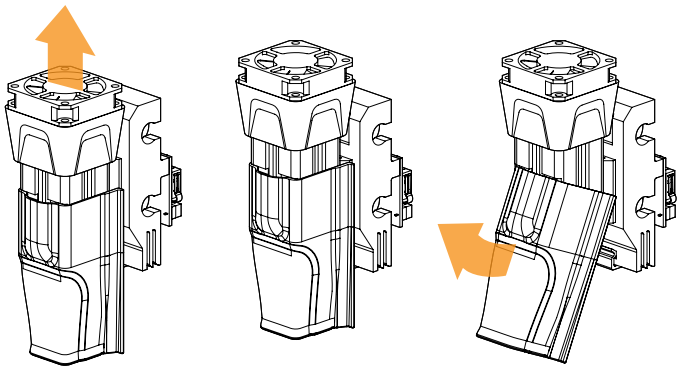
Important: Focusing involves removing the laser guard. Extreme care should be taken to ensure anyone in the vicinity is wearing protective eye-ware. Eye damage will occur if you look at the laser focus spot without protective eye-ware.

How to focus the laser

1.
Put on your safety eye-wear.

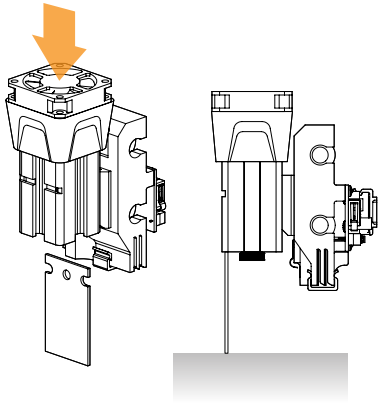
Check for anyone in the vicinity and ensure they are wearing protective eye-wear.

2.
Slide the laser unit up and remove the laser guard.

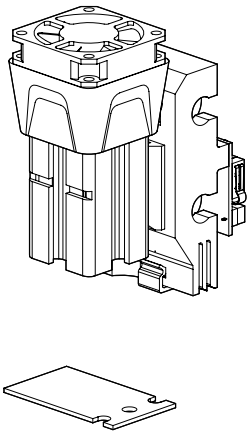


3.
Set the laser unit height with the focus tool.

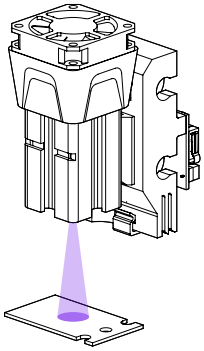
This is done by placing the focus tool vertically onto the machine base and sliding the laser unit down until the heat-sink touches it.

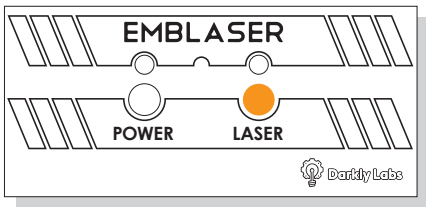


4.
Place the focus tool flat on the work piece under the laser.



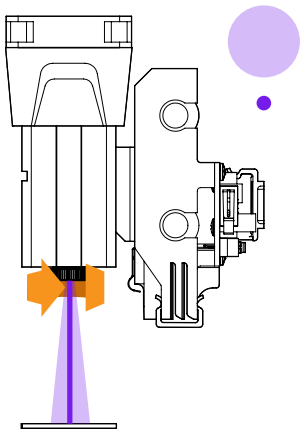
5.
Enter focus mode by holding down the enable button.
The laser will ramp up to 10% power after one second and remain there while focusing is taking place.
Danger: This laser power is enough to cause eye damage. Do not look directly at the focus spot without protective eye-ware. BE CAREFUL.





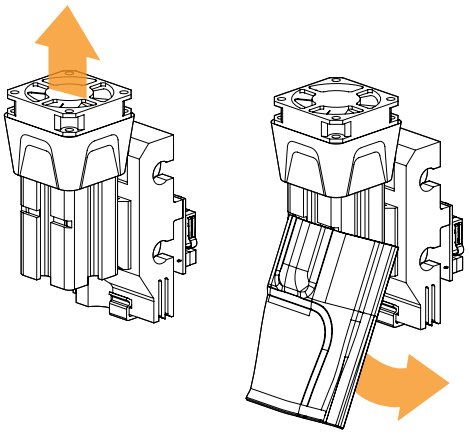
6.
Turn the laser lens until the smallest laser spot is obtained.

Be careful not to unscrew the lens too far or it will come out, along with the focus spring.



7.
Release the enable button.

8.
Slide up the laser unit and re-fit the laser guard.



Running your first job:

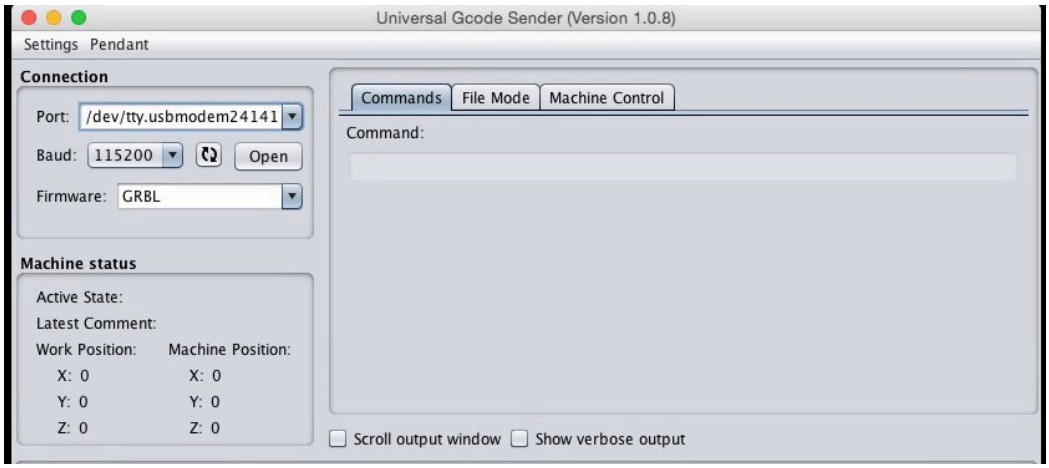
Driving the Emblaser

Setting laser height

Running a cutting job

Driving the Emblaser

It is useful to know how to manually move the laser around.
Start by selecting the 'Commands' tab in Ultimate GCode Sender.
GCode commands can be entered in the 'Command' box highlighted in the image below.



Moving the laser

Standard GCode commands can be used to move the laser around the workspace.
See Appendix for an introduction to GCode

Sample Commands

G0 X150 Y100	Move the laser to position x=150, y=100 at full speed
G1 X0 Y0 F1000	Move the laser to workspace home (bottom left) at 1000 mm/min
G28	Move the laser to machine home (top right corner)

Specifying the laser power

The laser power can be set between values of 0-255, giving you 256 different power levels.
The power can be adjusted via your GCode program and varied on-the-fly as the machine is moving.

Sample Commands

M03 S50	Turn on the laser at a power level of 50 (50/255)
M03 S127	Turn on laser at half power (127/255)
M05	Turn off laser.

Enabling the Laser

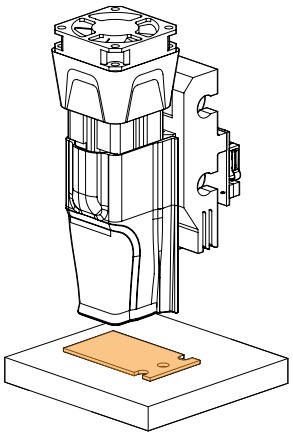
For these commands to turn on the laser the Emblaser must be in 'Enabled' mode.
To do this:
1: Hold down the 'Laser' button down for two (2) seconds until you see a short blink from the red LED above it.
2: Release the 'Laser' button and the LED above it should remain on. The laser is now enabled.

Warning: Running the laser with no workpiece in place can permanently mark your anodized aluminum base plate.

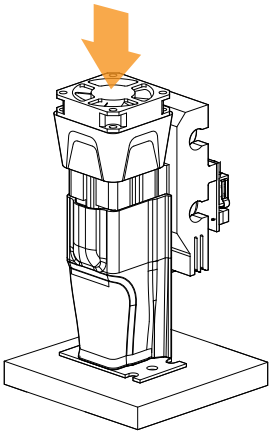
Setting the correct laser height for lasing

Setting the correct height will ensure the laser is focused correctly onto your workpiece. The following process can be used after the laser has been focused.

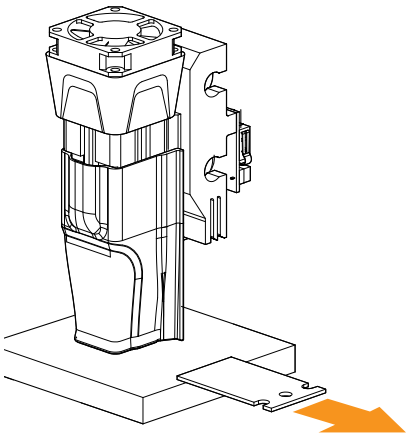
1.
Place the focus tool on top of your work piece.



2.
Carefully slide down the laser unit down until the laser shroud touches the focus tool.



3.
Slide out the focus tool being careful not to move the laser unit's height.

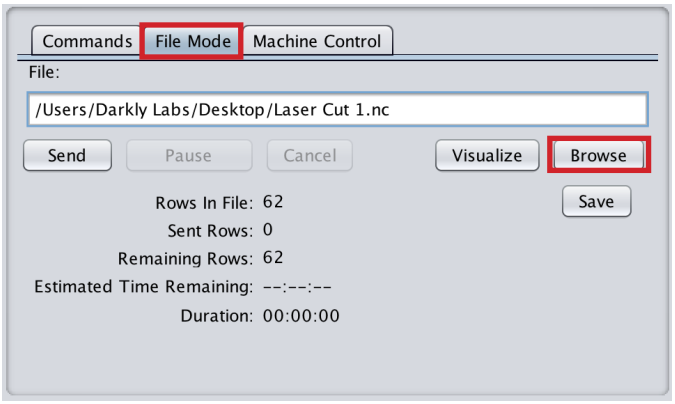


The laser is now correctly focused on your work piece.

Running a cutting job

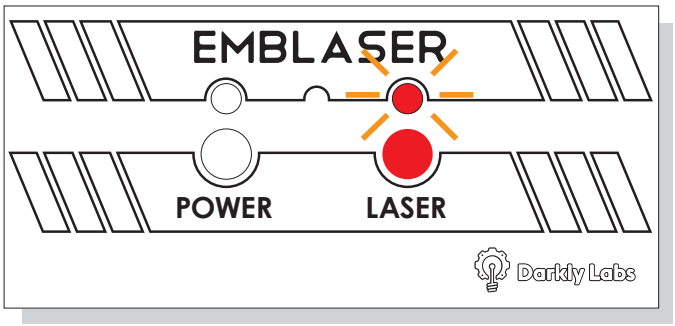
1.
Run through the **Safety Checklist** before proceeding.

2.
Select the ‘File Mode’ tab in Universal G-Code Sender and Browse for your cutting file (*.nc)

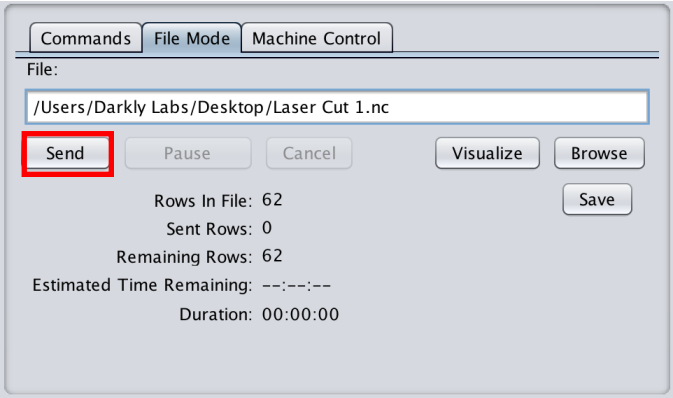


3.
Hold down the ‘Laser’ button for two (2) seconds until you see a short blink from the red LED above it.

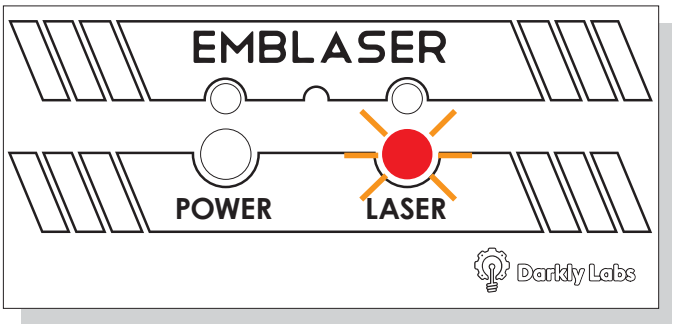
Release the ‘Laser’ button and the LED above it should remain on. The laser is now enabled.



4.
Press the ‘Send’ button to start running your cutting file.



5.
Once your job is completed, disable the laser by pressing the ‘Laser’ button once.



Never leave the Emblaser unattended when it is running a job.

Advanced

Maximum Laser Power Setting

Changing the maximum laser power setting

Updating GRBL and Watchdog microprocessor firmware

Maximum Laser Power Setting

All laser diodes have an ‘ideal’ and ‘maximum’ power level they can be run at. This is controlled by the amount of current being supplied to the diode.

The higher the current, the more laser power is generated along with more heat within the diode. If the current is too high or the diode becomes too hot, its life could be significantly reduced or it may be permanently damaged.

Your Emblaser is preset to supply a ‘safe’ level of current to the default 9mm 445nm laser diode which is part of the standard kit. This current level is determined by the diode manufacturer’s data.

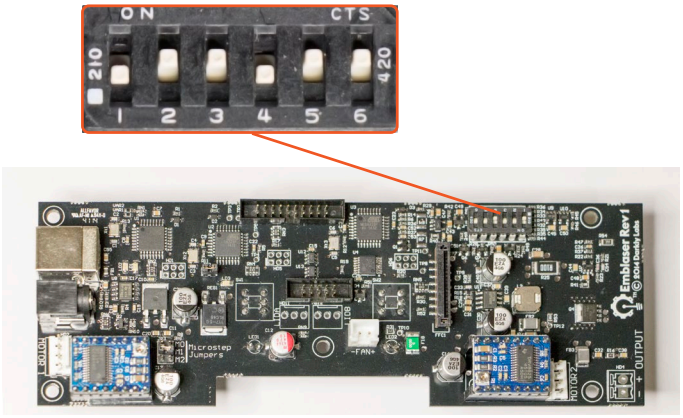
If you are after laser diode longevity we recommend you do not change your maximum power setting.

IMPORTANT: If you change your laser diode to a different variety, you must ensure the correct maximum power level is set. See the following chapter ‘Changing the Maximum Laser Power Setting’ on how to do this. Failure to do so could destroy your laser diode.

Changing the maximum laser power setting

The Emblaser has a unique feature allowing the hard wiring of maximum laser power. This can be used to tailor your system for different laser diodes and also help extend the life of your laser diode.
The laser power is determined by the amount of current allowed to pass through the laser diode. By default, your Emblaser is set to allow no more than 1.8 amps of current to pass through the laser when a maximum laser power of 255 is requested, working well with the 9mm 445nM laser diode.

WARNING: Changing these settings could permanently damage your laser diode.
Extreme care should be taken to ensure the chosen current setting is not above the maximum current your laser diode can support.
Make sure you read the switch numbers in the correct order.



Switch current influence

SW1	SW2	SW3	SW4	SW5	SW6
1000	800	400	200	100	50 mA

0 = OFF
1 = ON

Switches	Current	Switches	Current	Switches	Current
123456	mA	123456	mA	123456	mA
000000	450	010110	1550	101011	2000
000001	500	010111	1600	101100	2050
000010	550	011000	1650	101101	2100
000011	600	011001	1700	101110	2150
000100	650	011010	1750	101111	2200
000101	700	011011	1800	110000	2250
000110	750	011100	1850	110001	2300
000111	800	011101	1900	110010	2350
001000	850	011110	1950	110011	2400
001001	900	011111	2000	110100	2450
001010	950			110101	2500
001011	1000	100000	1450	110110	2550
001100	1050	100001	1500	110111	2600
001101	1100	100010	1550	111000	2650
001110	1150	100011	1600	111001	2700
001111	1200	100100	1650	111010	2750
010000	1250	100101	1700	111011	2800
010001	1300	100110	1750	111100	2850
010010	1350	100111	1800	111101	2900
010011	1400	101000	1850	111110	2950
010100	1450	101001	1900	111111	3000
010101	1500	101010	1950		

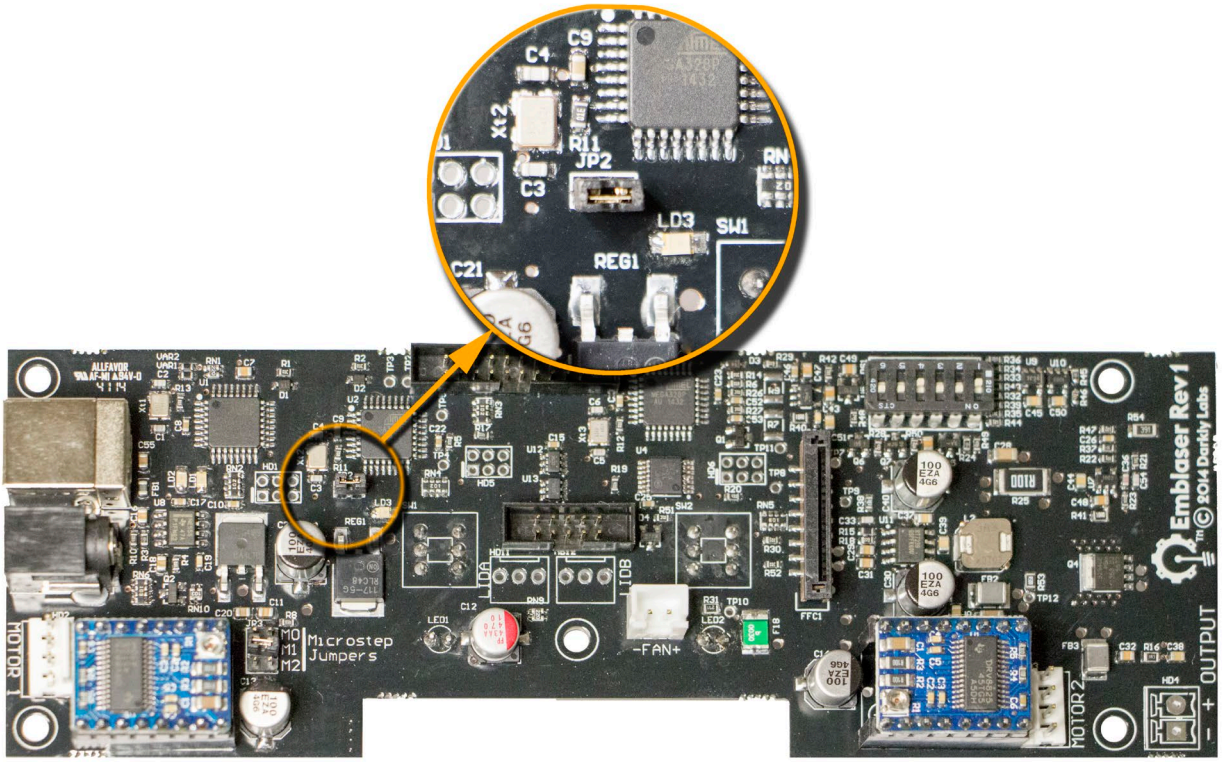
Updating GRBL and Watchdog microprocessor firmware

The Emblaser allows you to update the firmware on the two microprocessors as updates become available. This process can be performed via the USB connection and the update software package supplied by Darkly Labs.

Choosing between the GRBL and Watchdog processors is via a jumper (JP2) on the main PCB.

GRBL MCU = Jumper in place (default)
Watchdog MCU = Jumper removed.

Warning: Incorrectly programming the MCUs can cause the Emblaser to malfunction, be permanently damaged or operate in an unsafe manner. Extreme care should be taken to follow instructions when performing this process.



Process:

- Download update package from Darkly Labs.
- Make sure Emblaser is plugged in to computer USB port.
- Turn off Emblaser.
- Carefully follow instructions supplied with the update.
- Ensure jumper is placed back onto JP2.

TROUBLESHOOTING

Troubleshooting

The Laser won't turn on

Is the laser enabled?
Is the laser shroud in place?

Machine keeps hitting extents and making a horrible noise

Are you asking the machine to move beyond its maximum limits?

See `Workspace` section at the start of this manual for your machine's maximum workspace dimensions.
Re-Home the machine.

Are you moving the laser carriage by hand?

This will cause GRBL to not know where the laser carriage is positioned.
Only move the laser via GCode commands.
Re-home the machine.

Enable light keeps flashing

This is a warning indicating the laser will power up as soon as enabled.
Enter an `M05` command in the UGS command line to ensure laser is off when enabled.

The Emblaser doesn't connect to my computer when I turn it on.

Is the USB cable plugged in correctly?
Is UGS running and holding onto a port?

See 'UGS can't connect to the Emblaser' below.

UGS can't connect to the Emblaser

Sometimes UGS holds onto a port while it is running, preventing the Emblaser from connecting to your computer correctly. If this appears to be the case, follow these steps.
In this order:

Turn off the Emblaser and shutdown UGS.
Restart UGS.
Turn on Emblaser
The Emblaser port should now appear. Connect as usual.

MAINTENANCE

LUBRICATION

LENS CLEANING

Lubrication

Keeping the rails clean and lubricated will ensure your machine maintains its accuracy over time.

After every 50 hours of use:

You will require: Super-Lube Synthetic Grease (supplied with kit)
Lint Free Micro Fiber Cloth

1: Wipe down the rails with a clean lint-free cloth to remove any build up residue or dust.

2: Apply a small amount of the lubricant supplied to each rail.

3: Gently move the gantry and laser unit back and forward to ensure the lubricant works its way into the linear bearings.

Lens Cleaning

The laser lens is a very delicate part of your machine. It is rare that you will need to clean it as the airflow is designed to keep fumes moving away from contaminating its surface.

Cleaning the lens is not recommended unless you feel it is absolutely necessary.

You will require: Isopropyl Alcohol
Lint Free Micro Fiber Cloth

1: Carefully unscrew the lens from the laser module. Be sure to retain the focus spring. Be very careful not to touch the glass part of the lens.

2: Look through your lens and determine whether it looks cloudy or has visible debris on it. If not, reassemble your laser unit and do not proceed with cleaning.

3: If you have determined your lens needs cleaning proceed carefully.
Never touch the glass part of the lens with your fingers or anything other than a lint-free micro fiber cloth. Paper towel, cotton and tissues will scratch the coatings on the lens and leave it permanently damaged..

4: Spray a small amount of Isopropyl Alcohol onto the glass surfaces of the lens and wipe them extremely gently with a micro fiber cloth.

5: Look through your lens once more to determine whether you have removed the debris.

6: Carefully screw the lens back into the laser unit being sure to include the focus spring.

Appendices

Material Properties Table

Laser Modes

Introduction to G-Code

Basic GCode program for Emblaser

Swapping out a Laser Unit

Emblaser PCB specifications

Terms and Conditions

Material Properties Table

Below is a summary of commonly encountered polymers and their thermal breakdown products.

Polymer	Chemical Bonds	Breakdown Products	Effects
Polyolefins:			
Polyethylene	C-H	propane, propene, ethane, ethene, butene, hexene, and butene-1	Flammable
Polypropylene	C-H	pentane, pentene, heptene	Flammable
Polyacrylics:			
polyacrylonitrile (Sail cloths, ABS constituent)	N-H	ammonia, hydrogen cyanide, ketones	Potent airway irritants, toxic at high concentrations
Polyamide polymers:			
wool	O=C-N-H, S-S	carbon disulphide, carbon dioxide, hydrogen cyanide, benzene, toluene, and carbon monoxide	Toxic, irritant
polyurethane	N=C=O	nitrogen oxides, nitriles, isocyanate monomers, liquid polyols	Isocyanate pharyngitis, hypersensitivity and severe asthma in predisposed individuals
nylon	C–N, CO–CH2	Potential for water, carbon oxides, benzene, hydrogen cyanide (HCN), toluene, and benzonitrile, hydrogen and ammonia	Toxic, irritant
Polydienes and rubbers			
Polyisoprene (Synthetic rubber)	Isoprene, potentially other catalysts, crosslinking agents	Isoprene monomers, polymers, thermal cracking products, sulfides if vulcanised	Irritants, toxic
Polybutadiene (component of ABS)	butadiene	Butadiene monomers, cyclic compounds	toxic
Polychloroprene (Neoprene)	Chlorine	hydrogen chloride, polyene	Potent, acidic irritant of mucous membranes, corrosive, toxic

Polymer	Chemical Bonds	Breakdown Products	Effects
Synthetic carbon – oxygen chain polymers			
Polycarbonate (constituent of ABS)	O-CO2	carbon dioxide, bisphenol A, phenol	toxic
polyethylene tetraphthalate (PET)	C-O	acetaldehyde, carbon monoxide, carbon dioxide, compounds with acid and anhydride end groups	Irritant, toxic
Phenolic resins	methylene–benzene	carbon oxides, water, aromatic compounds, methane	Toxic, flammable
Epoxy resins	complex	Varied, mostly phenolic compounds	toxic
Cellulosics			
Wood, paper	Cellulose, lignin	tars	toxic
Halogenated polymers			
PVC	Chlorine	hydrogen chloride gas, polyaromatic hydrocarbons	Potent, acidic irritant of mucous membranes, corrosive, toxic
PTFE	Fluorine	hydrogen fluoride gas, hexafluoro-propene	Potent, acidic irritant of mucous membranes, corrosive, toxic
Related vinyl polymers			
polyvinyl bromide	Bromine	hydrogen bromide	Potent, acidic irritant of mucous membranes, corrosive, toxic
polyvinyl alcohol (PVA)		Water, thermal cracking products	potential irritants
polyvinyl acetate	Acetate	acetic acid	irritant
Styrenics			
Polystyrene (also a component of ABS)	Styrene	Styrene monomers, dimers, trimers, tetramers	Irritant, toxic

Table based on “Thermal Decomposition of Polymers - Craig L. Beyler and Marcelo M. Hirschler”

Laser Modes

Laser can be in any of three modes

Disabled

In this mode, the machine can move normally but the laser will not operate.

Conditions that result in Emblaser disabled mode:
- When first turned on, the Emblaser always defaults to disabled mode.
- The enable button is pressed while laser is enabled.
- The laser shroud is not in place or removed while laser is enabled.
- The stepper motors remain motionless for 60 sec.
- A 'button stuck' condition is detected.

Enabled Mode

In this mode, the machine and laser can be operated normally.

There are two possible results when enabling the laser:
- A non-flashing enable LED indicates the laser will be enabled to a non-lasing low power.
  In this mode, the laser will be visible, but will below the lasing threshold of the laser diode.

- A flashing enable LED indicates the laser may potentially be enabled at a power level above the lasing threshold. This could be the result of a previously set laser power or a currently running cutting job.

How to enter 'Enabled' mode
1. Note whether the enable LED is flashing as discussed above.
   Enter an 'M05' command to ensure the laser is below the lasing threshold when enabled.
2. The laser shroud must be correctly installed.
3. Press and hold down the 'enable' button for 2 seconds, until it blinks. Then release the button.
4. The 'Enabled' light will now remain lit and the laser is enabled.

Focus Mode

The Laser can be enabled into a limited-power mode to assist in lens focusing. This is the only mode in which the laser can be operated without the laser shroud being in place.
Important: Extreme care should be taken in this mode and eye protection is mandatory.

How to enter Focus Mode

1. The user and anyone in the vicinity of the machine must be wearing safety eye-wear.
2. Remove laser shroud.
3. Press and hold down the enable button.
   After 1 sec the laser will ramp up power to a focusing power.
4. Releasing the button will exit focus mode and disable the laser instantly.
   Focus mode will be exited automatically after 1 minute.

Introduction to G-Code

The Emblaser understands a language called G-Code. There are a few commands that are used regularly and will be useful to know.

G0

A `G0` command followed by an x and y location will move the laser to that position at its maximum preset travel speed

G0 X150 Y200
This will move the laser to location 150,200 in the X and Y axes respectively.

G1

A `G1` command is similar to a G0 but gives you the ability to set the speed at which the laser will move to a position.

G0 X150 Y200 F 1000
This will move the laser to position 150,200 at a speed of 1000 mm/min.

Warning: As with the G0 command, entering values beyond the machine's work area will result in it hitting its limits and will require another 'Homing'.

M03 S

The `M03` command will turn on the laser at a power specified by the `S` value.

M03 S120
This will turn on the laser at a power level of 120.
The laser power levels range from 0-255.

M05

The `M05` command will turn off the laser

M05
Laser will turn off.

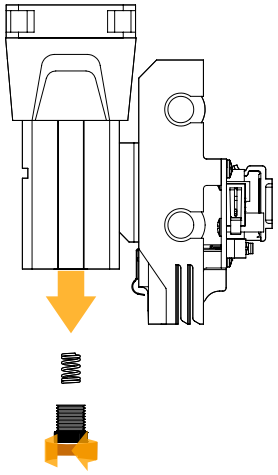
G28

The `G28` returns the laser to its home position (top right of the work space). This is useful for moving the laser out of the way while positioning your work piece.

G28
Laser unit will move to the home position

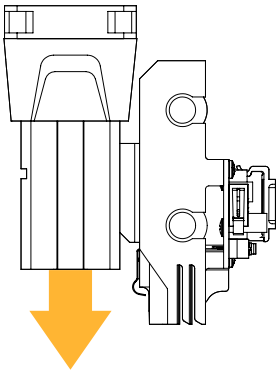
Swapping out a Laser Unit

1. Carefully unscrew the lens and remove along with the focus spring.

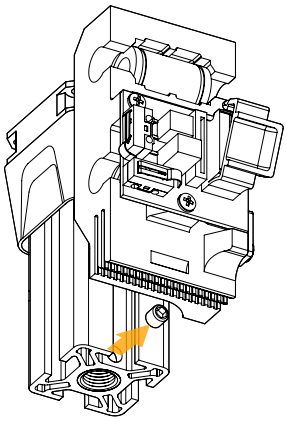


Important: With the lens removed, be careful to keep dust and debris out of the laser diode. A small piece of tape over the opening will help prevent this.

2. Slide the laser unit all the way down to its lowest position.

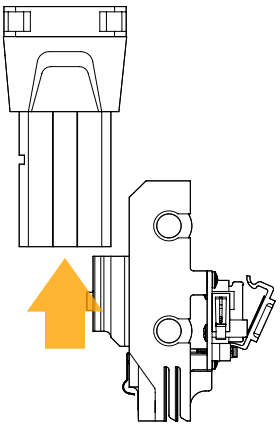


3. Unscrew and remove the set screw holding in the laser diode.

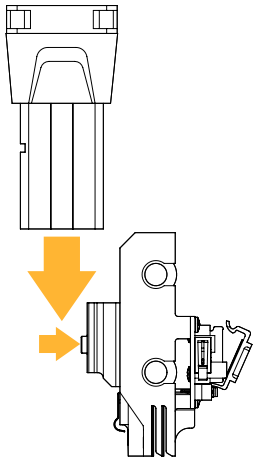


Important: The laser diode will remain inside the heatsink because of friction. Be careful to not dislodge it.

4. Slide the laser unit up and off.

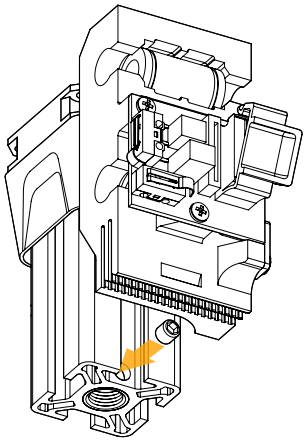


5. Slide on the replacement laser unit. You will need to depress the adjustment pin to allow the unit to slide on.

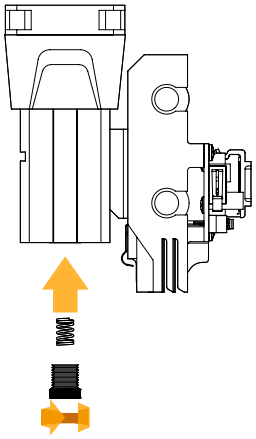


Important: Some force may be needed to depress the adjustment pin. It is a very tight fit.

6. Replace the setscrew to lock the laser diode in place.



7. Carefully insert the focus spring and screw in the lens.



Important

If you have replaced the laser unit for a different type laser diode, you must adjust your maximum laser power settings before turning on your Emblaser.

See the ‘Advanced’ section on how to do this.

Basic GCode program for Emblaser

A cutting file comprises a simple GCode program which instructs the Emblaser on exactly what to do.

Cutting Example
Here is a sample cutting file, which cuts a square shape with 100mm sides.

```
G21                 ( Set the units to mm)
M5                  ( Turn off the laser, just in case it was on from a previous program)
G00 X0.000 Y0.000   (Move the laser unit to WORKSPACE home, bottom left corner)
M3 S127             (Turn on the laser and set its power level to half [127/255])
G1   F800.0         (Set the move mode to 'feed' and set the feed-rate [speed of travel] to 800mm/min)

G1  Y100.000        (Start drawing the outline of the square)
G1 X100.000         (..)
G1  Y0.000          (..)
G1 X0.000           (Finish drawing the outline of the square)

M5                  (Turn off the laser)
G00                 (Set the move mode to 'rapid')
G28                 (Move to MACHINE home position, top right corner)
```

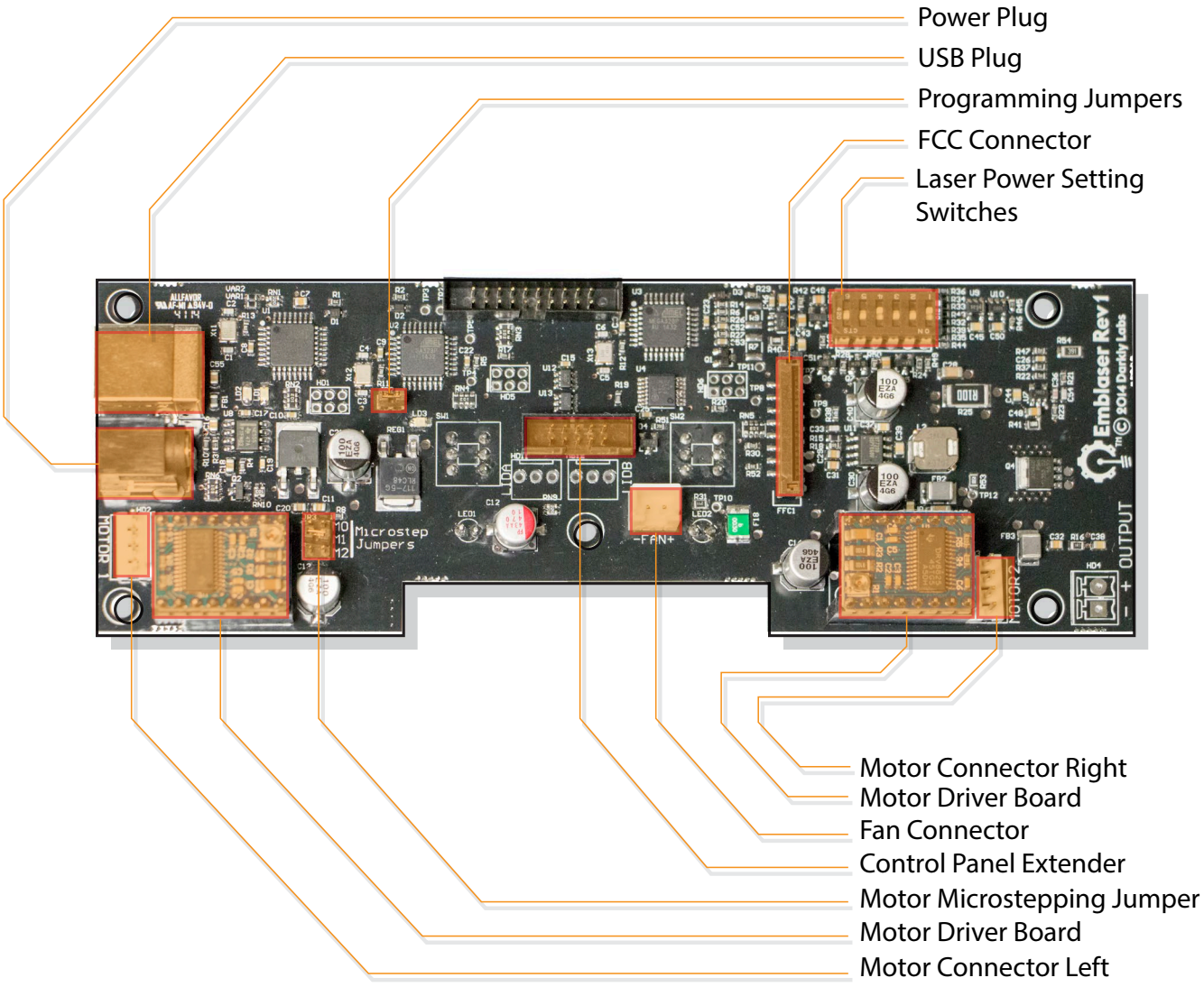
Engraving Example
This is an example of an image engraving file.
Notice the laser power is being adjusted on each line once engraving starts.

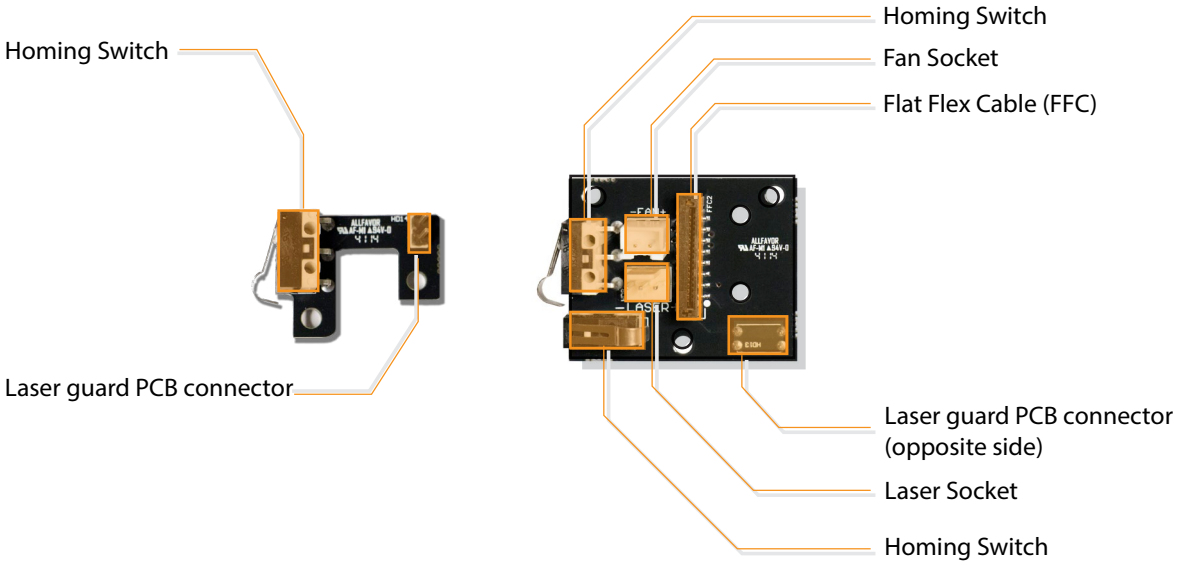
```
G21                 (Set the units to mm)
F1500               (Set the feed-rate [speed of travel] to 1500 mm/min
G01 M05             (Set the move mode to 'feed' turn off the laser)
G01 X0.00 Y0.00     (Move the laser unit to WORKSPACE home, bottom left corner)
M03                 (Turn on the laser)

X0 Y0.254 S162      (Move to the first engraving position and set the laser power to 162/255)
X0 Y0.508 S57       (Move to the second engraving position and set the laser power to 57/255)
..
..
..
X75.692 Y80.01 S5   (Move to the last engraving position and set the laser power to 5/255)

M05                 (Turn off the laser)
G28                 (Move to MACHINE home position, top right corner)
```

EMBLASER PCB SPECIFICATIONS





Terms and Conditions

Terms and Conditions of Use and Purchase

In taking delivery or ownership of the contents of this package (the "Goods") as manufactured by Darkly Digital Pty Ltd trading as Darkly Labs ("Darkly Labs" or "Manufacturer) the end-user acknowledges and accepts or agrees that:

(a) The Goods are intended to provide end-users who are early adopters of a novel technology that is continually being refined and the Goods will require adjustment and maintenance;

(b) While specific training qualifications are not necessary to operate the Goods, they should be willing to learn and to interact with the Manufacturer and the Manufacturer's user community (www.forum.darklylabs.com).

(c) The Goods must be operated in accordance with the instructions provided by the Manufacturer. The end-user must ensure that all safety precautions as recommended by the Manufacturer are followed and that the Goods are not modified so as to circumvent any safety mechanisms that are part of the Goods.

(d) Without limiting the warranties provided under the Australian Consumer Law, the Manufacturer's warranty is on an Acceptable Quality basis and only covers manufacturing defects, including but not limited to failure or faults with electrical components including circuit boards, displays, wiring/connectors and motors that affect the Goods ability to function correctly, as determined by the Manufacturer and parts found to be faulty will be replaced or repaired at the Manufacturer's sole discretion and expense. In the event of a major failure you are entitled to a replacement or refund;

(e) The Manufacturer does not have to repair or replace the Goods if the Goods have been used for a commercial purpose; misused, improperly or inappropriately installed, operated or repaired; abused; damaged or not maintained in accordance with the Manufacturer's instructions. The warranty will become void if repairs are carried out by anyone not authorized by the Manufacturer to carry out such repairs.

(f) The end-user is responsible for the cost of freight to return the Goods to Darkly Labs at the address below, or as amended from time to time. Warranty claims are on a return to base basis. For accepted claims the Manufacturer will cover the cost of repairs and return freight. To ensure the Goods are transported safely we strongly recommend retaining the original packaging materials for reuse as/when service is required. Transport damage is the sole responsibility of the end-user. In the event that repairs or damage is not deemed to be covered under the Manufacturer's warranty the cost of the repair and return freight is the responsibility of the end-user. Payment in full is required prior to the Goods being returned.

(g) As far as the law permits, Darkly Labs will not be liable for any loss or damage caused to property or persons arising from any cause whatsoever. The Goods must be constructed and used in strict adherence to the guidelines and instructions provided by the Manufacturer.

(h) Except as noted above the Manufacturer does not provide any warranty, express or implied, as to the performance of the Goods, their merchantability or fitness for a particular purpose.

(i) The Manufacturer disclaims all liability for claims based on normal wear and tear, misuse or abuse, modification, or damage to the Goods resulting from any negligent or willful act or omission of the end-user, or the use of the Goods with any consumables, supplies, equipment, devices or software not manufactured or supplied by the Manufacturer.

(j) The end-user shall indemnify and hold harmless Darkly Labs against any claim, suit or proceeding arising of or relating to any exclusions noted in (i) above.

(k) The end-user will comply with all applicable laws, rules and regulations with respect to the use of the Goods and abide by all applicable foreign trade/export restrictions or similar rules. In addition the end-user will not transfer, export or re-export the Goods except in full compliance with all applicable export controls administered by the applicable territory.

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