ROBOTS EVERYWHERE

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L-CHEAPO

Laser Cutting and Engraving Module

INTRODUCTION

The L-Cheapo is an inexpensive, easy to install laser cutting and engraving module intended to be added to 3d printers, micro mills, and other consumer grade 3 axis CNC gantries. You can use your new L-Cheapo to cut everything from thin materials like paper and cardstock to wood, plastic, and glass. You can also use it to engrave on these materials, as well as – with some pre-treatment and a high power model – metals.

This manual is intended for someone with at least basic experience maintaining or modifying their gantry. If you are not at this point, please familiarize yourself with the machine you wish to install the L-Cheapo on now. If you require help, Robots Everywhere's support team is happy to assist you, but we are not experts on your particular gantry or installation.

WARNING: LASERS CAN CAUSE BLINDNESS AND SEVERE BURNS. OPERATE LASER ONLY WITH PROPER SAFETY GOGGLES WORN BY ALL PERSONS IN LINE OF SIGHT. DO NOT LOOK DIRECTLY INTO LASER. DO NOT USE LASER ON SKIN. DO NOT POINT LASER AT ANYTHING OTHER THAN WORKPIECE.

INSTALLING YOUR NEW L-CHEAPO

Because the L-Cheapo is designed to support a wide variety of gantries and mounts, hardware to mount your L-Cheapo to your device does not come with the base unit. For most 3d printers, desktop mills, and other small gantries, mounting hardware is 3d printable, and the L-Cheapo housing is attached to the mount securely with two zip-ties.

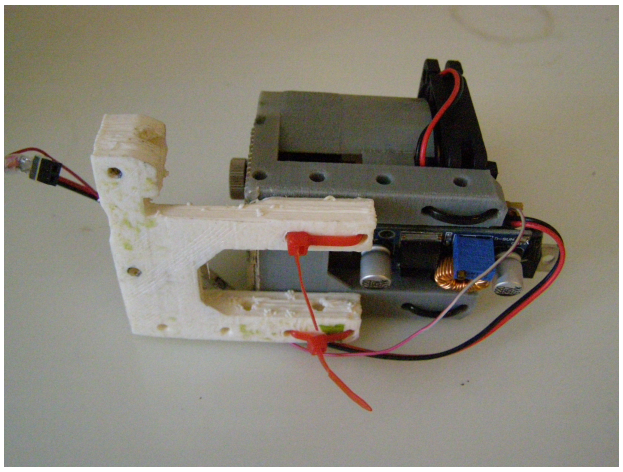
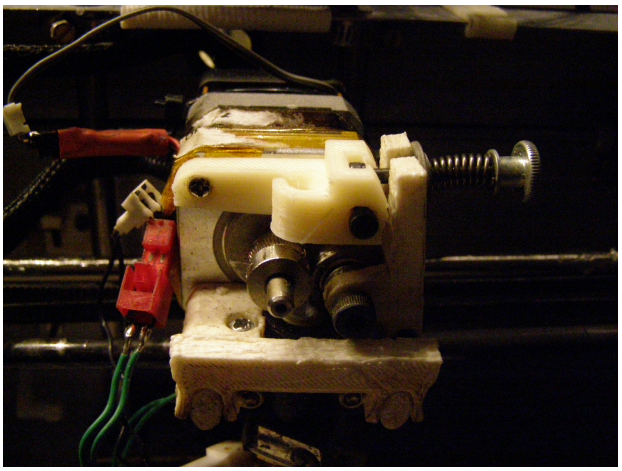
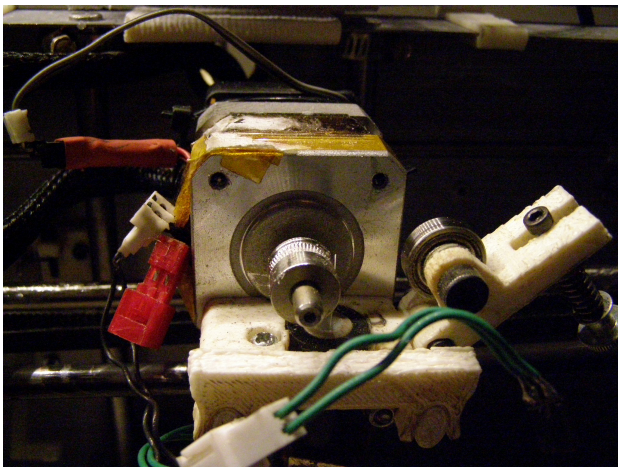


Illustration 1: L-Cheapo Mount Attached

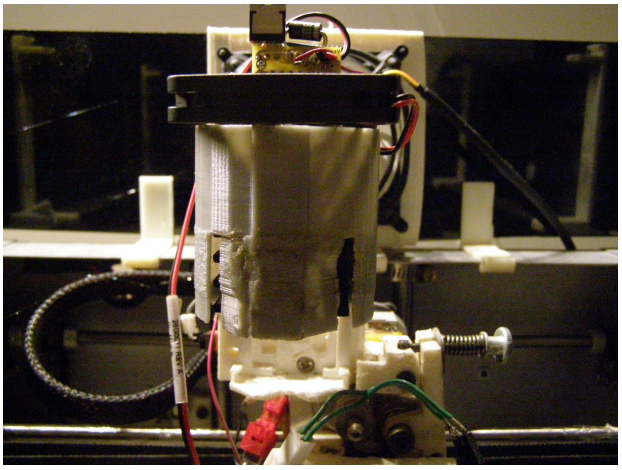
On 3d printers, the mount replaces the filament guide, and still allows for filament to be fed through – the laser does not have to be removed to change back to 3d printing.



Step 1: Remove the Filament Guide

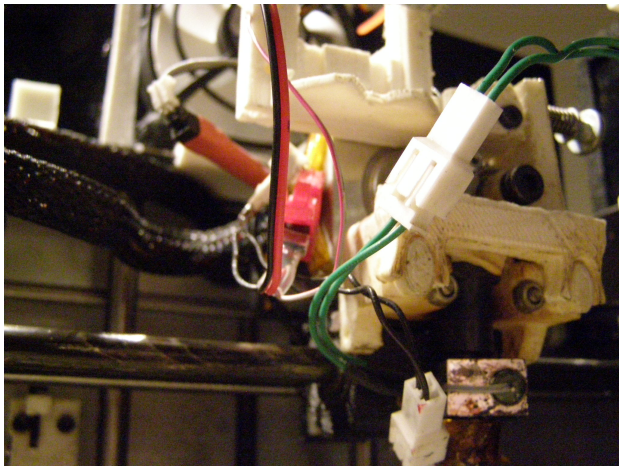


Step 2: Filament Guide Removed



Step 3: L-Cheapo Mounted!

After mounting the L-Cheapo, connect the +V line on the L-Cheapo to +12V or +24V on your gantry. If your gantry has PWM+ and PWM- outputs, connect PWM+ to the PWM (grey) wire on the L-Cheapo, and PWM- to ground. For gantries with no PWM outputs, you may not have control of the laser's power – connect the PWM wire to the +V wire. If you prefer manual control of the laser's power, connect a 100kΩ trim potentiometer between +V and the PWM wire. Note that some control boards, usually those specific for lasers, use analog output, and will have this functionality built in. L-Cheapo is capable of very precise analog control (it can even transmit audio signals) and can be connected to these control boards without any special steps.



Step 4: Plug L-Cheapo In Place of Hot End

Note in the illustration the PWM wire connected to +V.

Input Voltage (V_{in})	12-24V
PWM Voltage	3.3 - V_{in}
Analog Control Voltage	1-2.5V

NOTES ON CONNECTING PWM

By default, the PWM wire on the L-Cheapo (white/yellow) can connect to the PWM+ on the control board, and if the board has a PWM-, connect that to the ground (black) wire on the L-Cheapo (which should also be connected to ground on the board).

If you are using an external power supply for your laser, the same is true. Connect the ground (black) wire to the board's PWM- and the external power supply ground, connect the power (red) wire to the supply's +V, and connect the PWM (yellow or white) wire to PWM+.

In some cases with low end GRBL boards, the above solution will cause the laser to stay on at all times when the board is powered. **ALWAYS DO POWER ON TESTS WITH YOUR GOGGLES ON.** In this case, you have two options. The first is to connect PWM+ directly to pin D11 on the Arduino, used for PWM out on the GRBL board. The second is to use the 4-wire adapter provided by Robots Everywhere. This can be ordered with your laser, or you can special order one by contacting support@robots-everywhere.com.

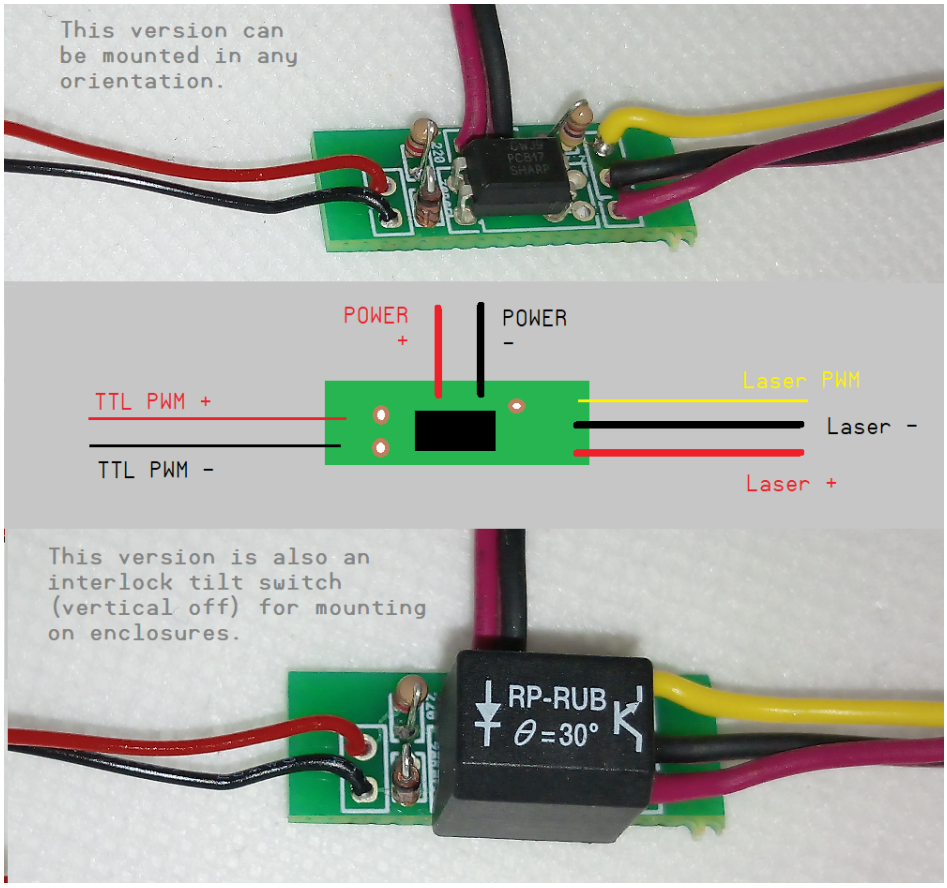


Illustration 2: Installation of 4 Wire Adapter

When installing it, please ensure if you have ordered the tilt-switch version, that the tilt switch is mounted vertically – this is a safety interlock, and without it engaged, the laser will not turn on.

To install the laser with the 4-wire adapter, connect the power(red) wire to the +V (red) wire, ground (black) wire to the ground (black) wire, and the PWM (yellow or white) wire to the PWM wire on the adapter. Connect your power supply to the same +V and GND connectors that the laser is connected to, and connect the small red and small black wires to PWM+ and PWM- on the GRBL board. If there are only 3 wires from the GRBL board to the laser, the missing wire will be PWM-.

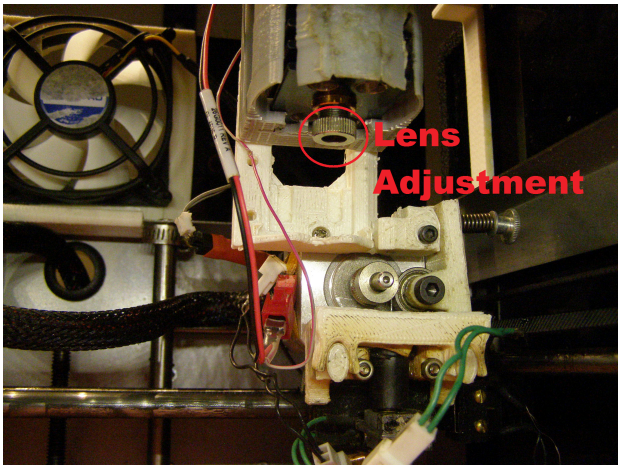
You will then have PWM from your GRBL board, to control the power on your laser.

SETTING THE LASER FOCUS

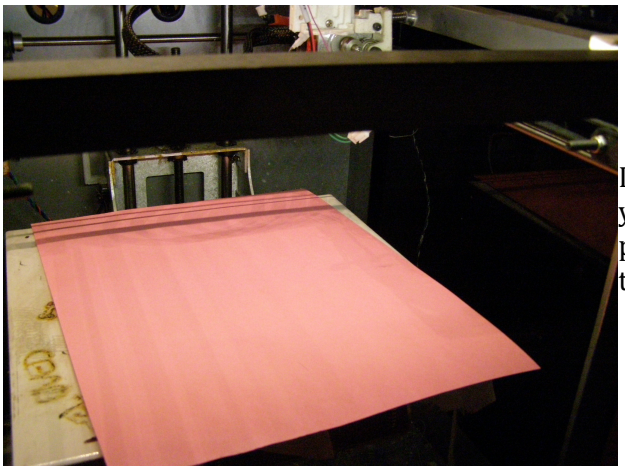
REMINDER: GOGGLES ON!

When the Z axis is at zero, the laser should project the smallest dot possible onto the workpiece. You will want to use a very thin sacrificial piece for this, especially if you are using a 3d printer with a coated or kapton-taped bed – a laser can easily damage these. A ceramic tile cut to the dimensions of your print bed and clamped or taped down makes an excellent safety plate.

Set the laser focus using the lens adjustment wheel at the base of the laser.

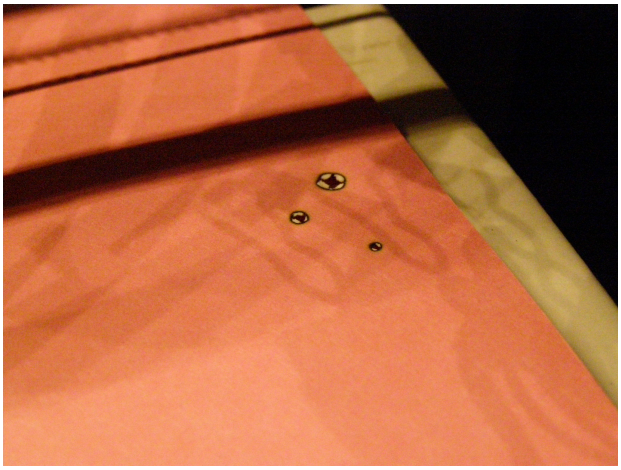


Step 5: Set the Laser Focus with the Wheel

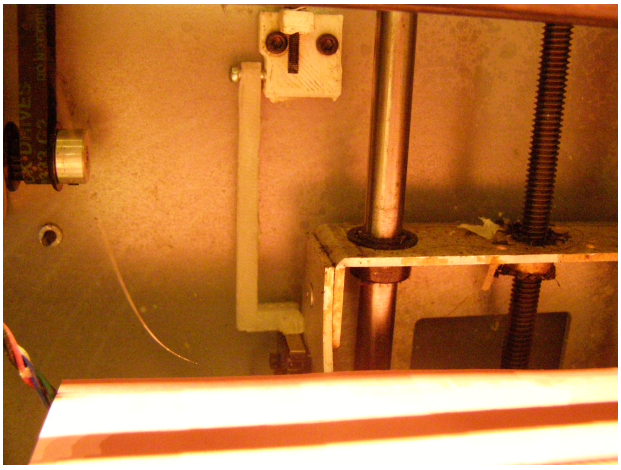


Step 6: Red Cardstock for Focus Testing

Depending on the configuration of your gantry's Z-axis, you may need to increase the Z-axis limit distance (by putting a rod against the Z limit switch, usually attached to the gantry housing).



Step 7: Adjust Focus Until Smallest Pinpoint



Step 8: Add an Attachment to Adjust the Z Limit

OPERATING YOUR L-CHEAPO

The L-Cheapo does not operate any differently than any other tool on the gantry you have connected it to. In general, these CNC tools use gcode, generated by a slicer. Some example slicer tools include Inkscape (with JTech Photonics extension), 3d printing slicers such as Slic3r, Cura, and Skeinforge (which will need to be configured to reverse the Z-axis),

SLICING WITH INKSCAPE

Slicing with Inkscape using the Jtech Photonics Laser Tool is very simple. Simply install the extension to Inkscape, select the path in the SVG you wish to lase, and go to Extensions → Generate Laser Gcode → Jtech Photonics Laser Tool. The tool is available here, with its own documentation.

https://jtechphotonics.com/?page_id=2012

There are other open source Inkscape extensions that support laser cutting and engraving as well, such as GcodeTools.

SLICING WITH SKEINFORGE

The Skeinforge slicer is an older open-source slicer that can be configured easily for multiple pass laser cutter applications. The expected input is an STL negative of the cut; the object being sliced is the material that is going to be lased away.

You will need to adjust the slicer settings. For 3d printing, you are adding material to the print bed, moving the bed away from the nozzle after each pass. Lasers remove material, so you must move the workpiece closer to the laser after each pass. Therefore, the z axis must be reversed.

To begin, create a new profile in Skeinforge for lasing. It should be of profile type “Extrusion” - though you may also be able to use “Cutting/Laser” or “Milling” type profiles, when working with 3d printer gantries we just used a modified Extrusion profile.

The only plugins that should be turned on are Alteration, Carve, Export, Limit, Scale, and Speed. If you are doing an infilled engraving, you will also need to turn on Fill.

Alteration and Laser_Start, Laser_End Files

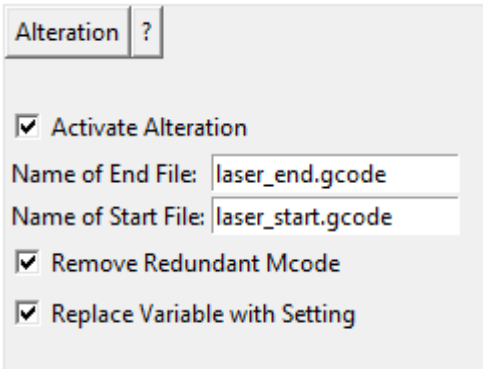


Illustration 3: Alteration Settings

You will need to create 3 files to use Skeinforge for laser cutting and engraving. These may need to be modified for your specific gantry, but as written here work for most of them. Your skeinforge installation will have a specific location for these files – please ensure it can find them.

In Alteration, set the start and end files to the laser_start.gcode and laser_end.gcode files.

laser_start.gcode

M104 S0

G92 X0 Y0 Z0 E0

G21

G28 X0 Y0

M400

M104 S0

G90

G21

M400

M104 S100

laser_end.gcode

G91

M400

M104 S0

G28 X0 Y0

M84

Carve Settings – Layer Height

Carve should be set up as normal, but with the Layer Height setting equal to the single-pass cutting depth for the material you are cutting or engraving and the power and travel speed you intend to use. Experiment with this setting, as it varies from setup to setup. Cutting with slow speed and high power will often allow you 1mm or more – later models of L-Cheapo will allow for even deeper single pass cutting.

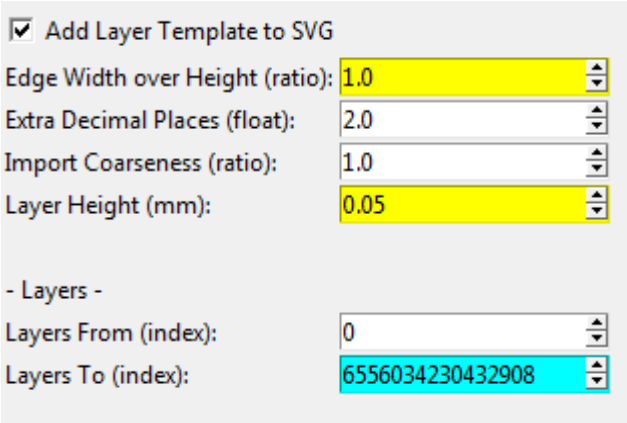


Illustration 4: Carve Settings

Export Settings – Replace.csv

Replace.csv is a search-and-replace file for the gcode output normally designed for printing, in order to change commands for heating to laser on-off.

The following is the replace.csv file. The file should be tab-delimited, but check your version of Skeinforge to be sure.

M104 S100 M400\nM104 S0

M101 M400\nM104 S100

M103 M400\nM104 S0

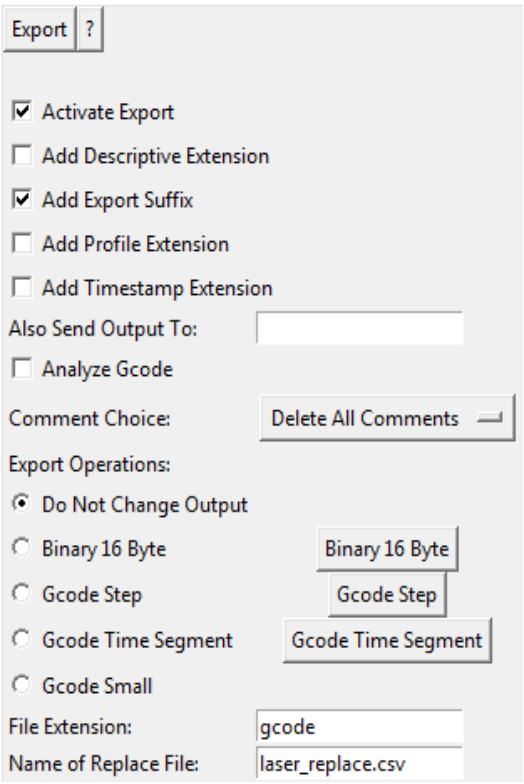


Illustration 5: Export Settings

Limit Settings

Limit should just be the defaults for your gantry. No laser specific changes.

Scale Settings – Negative Z-Axis

In Scale, you need to set the Z-Axis scale to -1.0, as mentioned above. This is because instead of adding material (Extrusion) you are removing it with a laser, so you need to bring the workpiece closer, rather than farther away, to keep the same distance from the tool.

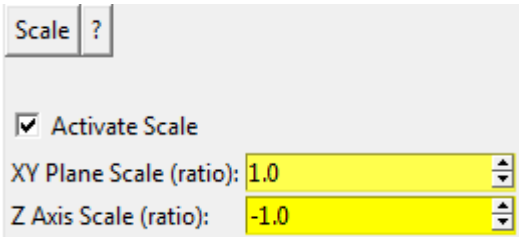


Illustration 6: Scale Settings

Speed Settings

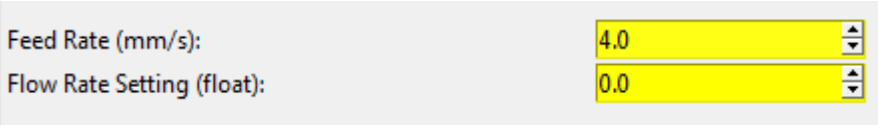


Illustration 7: Speed Settings

The only speed settings that need to be adjusted are the Feed Rate and Flow Rate settings. Feed Rate should be set (in mm/s) to the cutting speed you wish to use. Flow Rate should be set to 0.

Experiment with speeds that suit the material you are cutting. Try 1mm/s as a good default speed. For thin or light materials, or for engraving, you will need to increase this speed significantly.

With all of these settings, you should be ready to slice negatives into laser cutting or engraving gcode using Skeinforge.

SLICING WITH OTHER TOOLS

If you're using a LaserGRBL board, or other dedicated laser cutter, you're already set up for lasing, enjoy the power of L-Cheapo.

Otherwise, use whatever you're comfortable with, using the above information as guidelines for generating gcode.

Cleaning Your L-Cheapo Laser Cutter

To do so, simply wipe the lens clean with a dry microfiber cloth.

When cutting wood, especially without air assist, you may find smoke fouling accumulates on the lens quickly, and it may need to be cleaned every 4-5 hours of operation.

FAQ/Troubleshooting

Q: What kind of power supply does the L-Cheapo need?

A: The L-Cheapo will run off a 12V or 24V supply with at least 6A to run the laser. 3D printer hot-end power will have more than enough peak current. Otherwise, use an external power supply. To run a typical laser engraver gantry with the same power supply as the laser, you will need at least 8A continuous current.

Q: How do I connect PWM?

A: See above notes on connecting PWM. Generally on 3D printers, you will be connecting it to the fan control. If you do not have PWM out on your board, hook it up to +V to run the laser at full power at all times.

Q: Do you track your shipments?

A: Yes. Each laser is individually tested, then when a tracking number is issued, Paypal will automatically forward it.

Q: Did you get my order?

A: Did you get a receipt? If you have an invoice number, we got your order. If not, Paypal did not bill you, so try again or contact Paypal support.

Q: Can it cut [insert material here]?

A: Probably. Check out our youtube channel, or ask support if you are unsure. **BE CAREFUL** with various plastics – many of them emit toxic fumes when laser cut.

A2: If none of those answers were sufficient, feel free to contact support and mail us a sample. We'll make a video of test cutting it for you.

Q: My laser is starting to lose cutting power, is it faulty?

A: Unlikely. You probably just need to clean the lens. To do so, simply wipe the lens clean with a dry microfiber cloth. When cutting wood, especially without air assist, you may find smoke fouling accumulates on the lens quickly, and it may need to be cleaned every 4-5 hours of operation.

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WARRANTY

This product is covered by a **lifetime replacement warranty.** We stand behind our products, which are made in the United States of America.

This warranty covers only express defects of manufacture, and wear and tear until the planned obsolescence of the product as deemed suitable by the manufacturer.

This warranty **does not** cover intentional or accidental damage caused by use or misuse, including overvolting, or destruction in the honorable arena of combat robotics.