



LASERCUTTER NOTES

2016 - 2020 Robotseed

OVERVIEW

The purpose of this document is to describe the different specs of converting a Chinese laser cutter to Smoothieboard. The intent is to create a checklist so that the converter can make sure to have all of the necessary equipment with him while installing the machine.

GOALS

1. List all steps required for installing, transforming and securing the machine
2. For each step list the required equipment

TODO

- Make a pre-installation kit with pre-wired smoothieboard and all other wiring. Document it.
- Explore the automatically blurring of the window
- Explore positive pressure lens protection [Positive Pressure Protection]
- In PPP chambers, have pressure detection hardware to detect when laser becomes mis-aligned
- Use a thermocouple for misalignment detection
- Use temperature reactive material to help with alignment (color changing / thermochromic)
- Design and print 3D printed magnet handles
- Thin plate of acrylic in front of opening for last mirror so that users can detect mirror mis-alignment
- Do <http://bit.ly/2ZCvxvH>
- Add this tool to the kit for users to measure plate thickness: <https://fr.aliexpress.com/item/32981327732.html> or even better <https://fr.aliexpress.com/item/32692320145.html>

- Use BLTouch for bed levelling
- Fablab key system
- Work area scanning with <http://bit.ly/33jSOQr>
- Cat whiskers sensor
- Kaizen foam cnc milling service with online tool
- Add front facing USB host / multi-sd card port
- Add low-profile drawer with kaizen foam for all accessories
- Replace entire front door with single sheet of acrylic (make rig to fold)
- Do calibration Gcode files
- Do <http://bit.ly/2ZEaAQY>
- Laser glasses must become part of the standard package
- Add velcro to the tablet as standard
- Set up WEEE
- Solder joints for vacuum system drawer being broken in La Rochelle and Guyana
- Use genetics to fine tune magicATC
- Use OpenCV and the cameras to auto-detect fires starting visually and stop fires with air or something.
- <https://play.google.com/store/apps/details?id=com.procoit.kioskbrowser&hl=en>
- Add in user kit : funnel, longer cable for cooler for easier placement
- Todo : checklist for pre-installation for things like demineralized water, wifi etc
- Add to documentation : don't move the machine, be careful depending on pavement type under the wheels
- Add Teflon/PTFE pieces of plastic to the main door to make sure it doesn't lock up. Test this on one of the new machines from the coming batch, or at UBO OpenFactory.
- AUTO DOOR OPENING ON OUR MACHINE
- Thicker window sheets/plates
- Try out <http://bit.ly/2yKQVTr> (laser lenses of different provider)
- The water protect/detect must have a connector on the machine side, not just the chiller side
- Add temperature reading sensor to the tube so the temperature graph is useful
- Create a script that connects over SSH, and replaces the right files to configure a machine
- <https://hackaday.com/2020/06/23/an-open-source-tool-to-document-your-wiring/> Use this for wiring diagrams, including in the Smoothie documentation
- Use <https://github.com/formatc1702/WireViz>
- Test and use the collimated air flow, also for CNC mills: <https://hackaday.com/2020/11/25/cleaner-laser-cutting-with-a-3d-printed-nozzle/>
- Test measuring the output of the laser using a photoresistor. Integrate this into the actual machine to test power putput at every startup.

- Alternative USB camera for top-down view: <https://www.uctronics.com/arducam-16mp-imx298-usb-camera-w/-autofocus-lens-1.html>
-

STEP BY STEP

Below each step of a laser cutter smoothification, and for each step the necessary equipment

BEFORE ARRIVAL

- Ask about network, need an ethernet and a wifi access on the same network
- Ask for the ground to be clean, or for a tarp/carpet as the technician will be on the ground a lot
- Check the machine can pass through all entries/doors/hallways
- Ask for at least 5 liters of demineralized water

ARRIVAL

- Ask where the restroom is
- Ask where the first-aid kit is
- Ask where the fire extinguisher is
- Ask for a garbage bag if you don't have one

UNPACKING

The machine should be unpacked by the customer. However, it's possible some packages might need opening.

- Cutter
- Scissors

Put aside the packaging so we can re-use it later when re-packaging the machine.



MACHINE OPENING

Some parts of the machine might require being opened. They are generally closed by screws :

- Modular screwdriver with full “bit” set
- Electric screwdriver

WINDOW INSTALLATION

- Modular screwdriver with full “bit” set (nut is 8mm)
- Powered screwdriver (ideally)
- Multi-purpose pliers

Steps :

- Remove protective sheet.
- Place window in it's place.
- Add window holder.
- Screw the bolts in.



DOOR HANDLE INSTALLATION

- Modular screwdriver with full “bit” set

Screw the door handle to the main door.



ADDITIONAL WINDOW

An acrylic window will be added to the door where the air intake is located, so that children can not look at the beam

- Hex spacers
- Acrylic sheet / pre-cut window



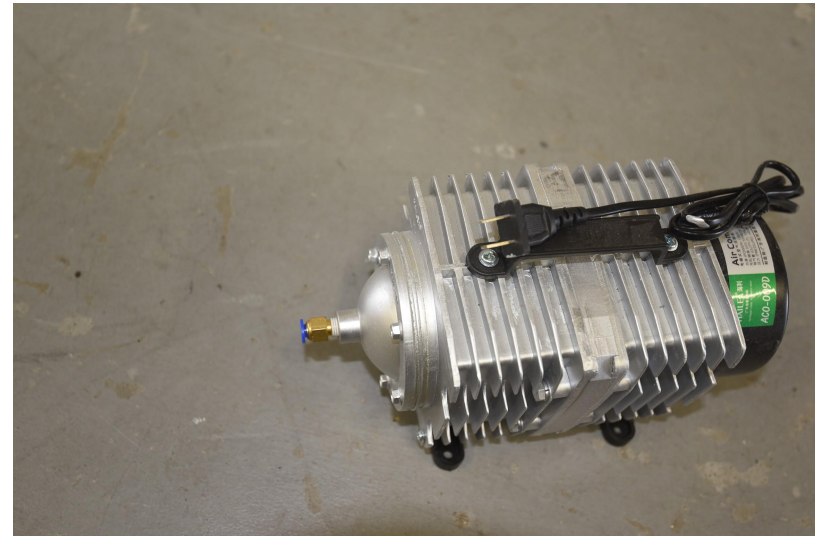
AIR PUMP INSTALLATION

The air pump is connected to power, and to the air input :

- Zip ties
- 220V power plug in case the provided one is incorrect

Steps .

- Insert and tighten push-fit connector
- Connect tube to pump and machine
- Plug into power



POWER SUPPLY TO ALL ELEMENTS

We need a main power supply for the entire machine :

- Power strip of adequate power

5V POWER SUPPLY TO ALL ELEMENTS

- 5V 6A Power supply

FUME EXTRACTOR INSTALLATION

The fume extractor needs several items in order to be installed :

- Additional tubing for extraction
- Screw-tightened metal collets
- 220V power plug in case the provided one is incorrect
- Hammer to rectify any bent metal
- Strong tape (multiple rolls)

AUTOMATED WINDOW

Add to the main window, an automatically blurring window that is triggered by the laser powering.

- Automated window
- 48V power supply

LENS CLEANUP

Before testing, we need to clean the lenses up :

- Glasses cleaning wipes

LASER TUBE INSTALLATION

The laser tube is delivered un-installed, to make sure it doesn't get destroyed during transport.

We need to install it when we get it. This requires :

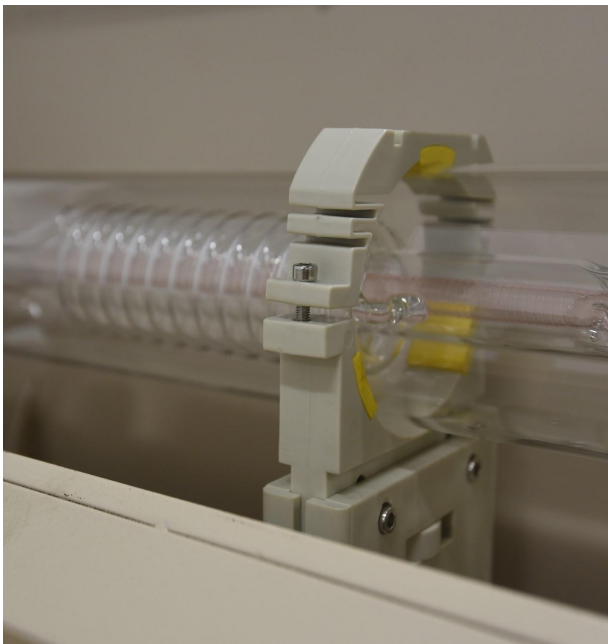
- Zip ties
- Crimps to attach the electrodes

Steps :

- Unbox tube
- Remove screws of laser door
- Unscrew tube holders
- Install tube. DO NOT overtighten
- Re-screw tube holders
- Attach anode
- Attach cathode
- Install protecting cap
- Attach water input, ziptie



- Attach water output, ziptie





WATER CHILLER INSTALLATION

The water chiller needs to be connected to the machine (power) and the tubes attached :

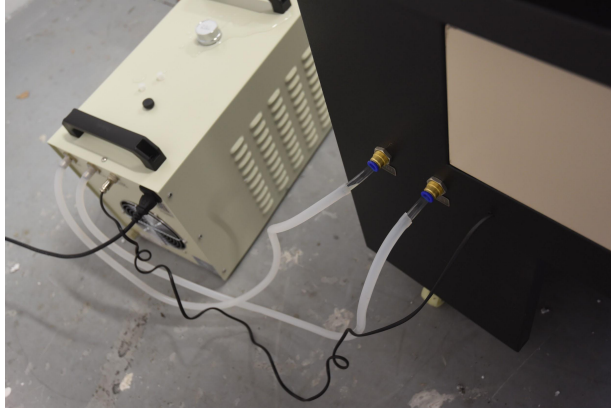
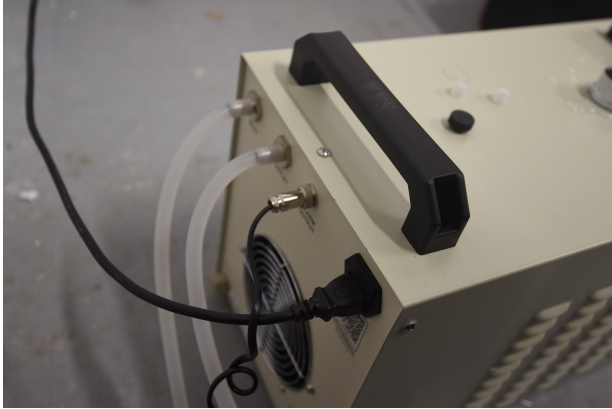
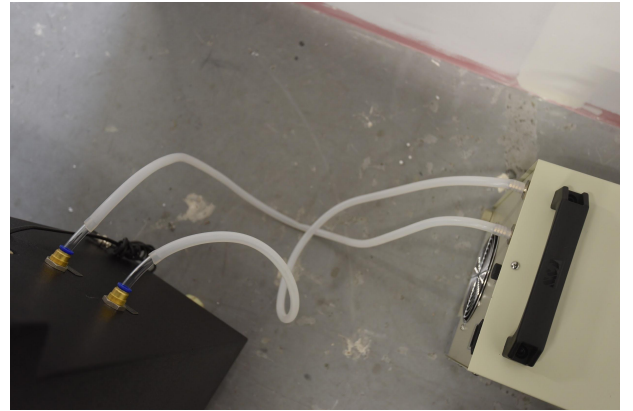
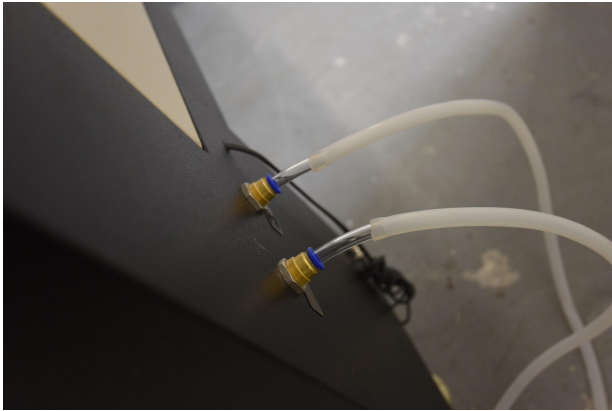
- Zip ties
- Distilled water, 10 liters
- 220V power plug in case the provided one is incorrect
- Funnel

Steps :

- Unpack chiller
- Insert tubes into machine
- Insert tubes into chiller (outlet to inlet, inlet to outlet)
- Insert distilled water
- Close chiller reservoir with cap
- Connect alarm signal
- Power up chiller
- Check water flow
- Close laser tube door with bolts

If the alarm sounds when first starting the chiller, give it at least 10 minutes to get out of alarm by itself, it's possible the water is simply too hot and it needs to cool it.





LASER BEAM TESTING AND ALIGNMENT

We need to test the laser beam before actually aligning it. We do this by burning sheets of paper, we need :

- Toilet paper
- A4 sheet paper
- “Painter’s” tape
- Laser safety glasses

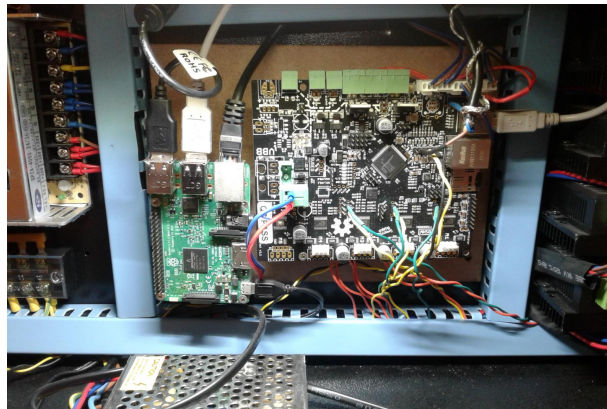
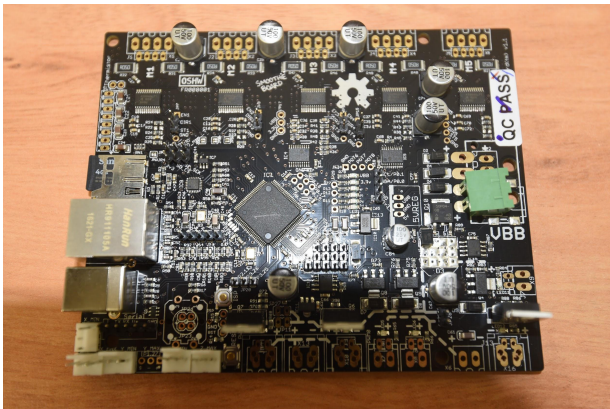
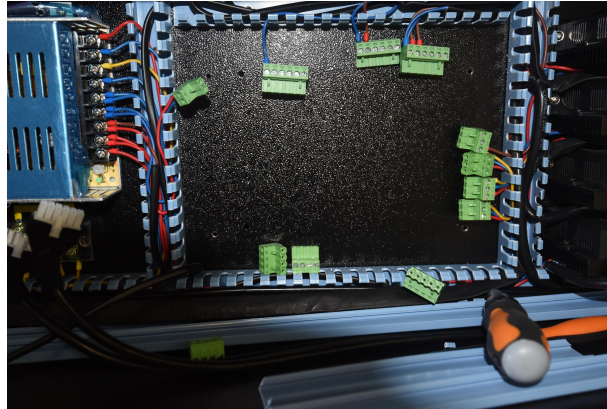
SMOOTHIEBOARD FIXATION AND SOLDERING

We need to attach the Smoothieboard to the rest of the hardware.

- Epoxy two-components glue
- M3 20mm spacers
- M3 nuts
- M3 bolts
- Pre-cut 10mm delrin plate (TODO : Cut)
- Small stickers on wires for labelling
- Sharpie for labelling

Steps :

- Disconnect original electronics
- Remove original electronics
- Sè



Note : a plenty of pictures should be taken before undertaking re-wiring. Let's not make our life more complicated than it needs to be.

SMOOTHIEBOARD WIRING TO THE SYSTEM

We now need to wire the Smoothieboard to the rest of the system. This is done mostly by doing « Y » connections between the peripheral, original DSP, and the Smoothieboard. This can be done by rewiring and re-crimping everything, or by using “parasitic” T-connectors.

- Smoothieboard 4XC

- Smoothieboard connector packs
- Crimps of various side
- Logic-size wires in many colors
- Parasitic T-connectors
- Smoothieboard-side 2.54mm connectors of various sizes
- Soldering equipment
- Rainbow-style pre-crimped female-female and male-to-female 2.54mm ribbon cable
- 4-pin green terminals for pre-installation kit making

Steps :

- Wire stepper motor step/dir/5v wire and modify them to have 2.54mm (breadboard) connectors. Blue is step, yellow is dir, red is 5v
- Add ferrites to stepper driver wires
- Connect to smoothieboard for each axis
- Make 5V 3-way fork and connect
- Add connectors to endstop connectors. Polarity is irrelevant
- Connect endstop connectors
- Add ferrites to endstop wires
- Upgrade firmware and add standard configuration file
- Test movement and homing
- Remove original DSP screen and cables
- Cut and remove original usb/ethernet connectors and cables
- Add power strip for raspi and network adapter
- Cut and wire to mains the power cable of the power strip

LASER POWER SUPPLY CONNECTION DETAILS

Old version : <https://docs.google.com/document/d/1-s8svvenaMxiSMuMnzBvdHAXPbQrbAyGf05y4LrxG9Q/edit>

We connect the Smoothieboard's control pins, to the laser power supply, using an Ethernet cable (without the connectors).

The old method used open-drain to provide 5v but the new method uses direct 3.3v control by adjusting the potentiometer on the laser power supply to enable 3.3v pwm control.

Laser power supply pins :

- H : The laser won't power on unless this pin is tied high (to 3v+).
- L : The laser won't power unless this in is tied low (to GND).
- P : Water protect, the power supply turns off unless this is connected to GND
- G : Ground
- IN : PWM or DAC (0-5V normal, 0-3.3V with potentiometer adjustment) laser power input.
- 5V : 5V output.

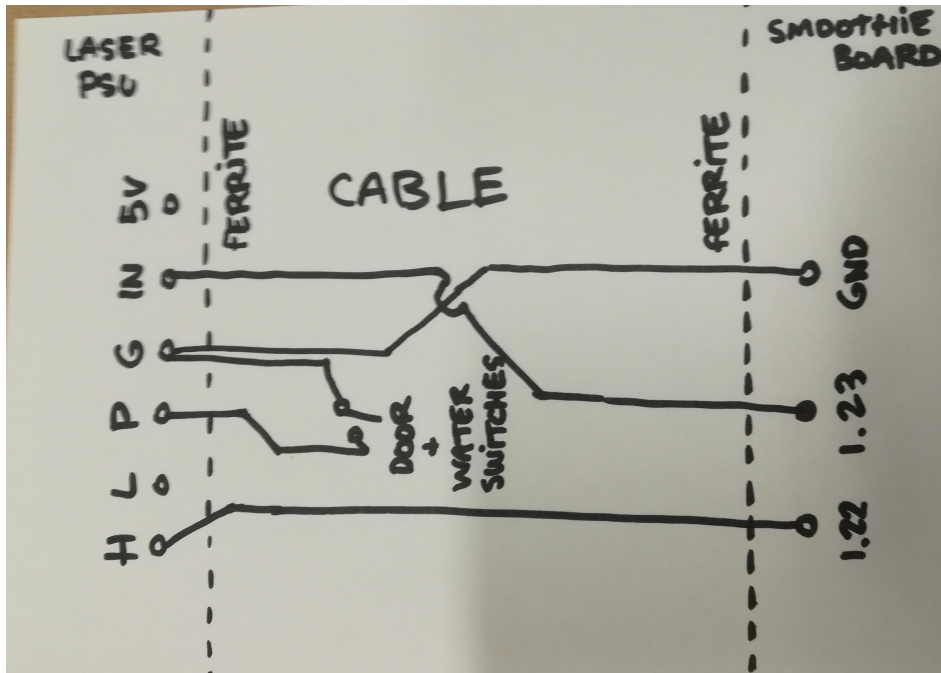
The Smoothieboard pins (see <http://smoothieware.org/pinout>) :

- P1.22 : TTL pin, used to turn the whole power supply on and off at the beginning and end of moves
- P1.23 : PWM pin, used to modulate the laser power
- GND : Used as the switching reference

The connections of the ethernet cable at each end :

- Orange/White and Green/White as a pair : PWM GND and TTL GND. Connects on the Smoothieboard to GND. Connects on the power supply to GND / G.
- Orange : PWM Signal. Connects on the Smoothieboard to 1.23. Connects on the power supply to IN.
- Green : TTL Signal. Connects on the Smoothieboard to P1.22. Connects on the power supply to H

Smoothieboard side	Cable color	Original cable color	Three cable color	New signtech	Power supply side	Numbered cable
GND		Brown/Red	Black	Brown	G(ND)	1
						
1.22v		Yellow	Red	Yellow+Green	H	2
1.23v		Blue	Green	Blue	IN	3



SMOOTHIEBOARD FIRMWARE AND CONFIG INSTALLATION

- Micro-SD card USB reader

Take the SD card out of the Smoothieboard and access it using the SD card reader.

Drag and drop the firmware and the configuration file.

The firmware file is firmware-cnc.bin at <https://github.com/Smoothieware/Smoothieware/tree/edge/FirmwareBin> (download and rename to “firmware.bin”)

The config file is <https://pastebin.com/cFMHLtEs> (history/old: <https://pastebin.com/77JmXb7F>) (click “Download” and rename to “config”, no file extension)

Properly “eject” the SD card from the OS (“unmount”), and remove it physically.

Insert the SD card back into the Smoothieboard, power the machine on and wait for the firmware to flash (you will see the LEDs do a little dance)

RASPBERRY PI FLASHING

Take a new SD card, minimum size 8GB

Insert it into the USB SD card reader.

Download octopi at <https://octopi.octoprint.org/>

Unzip the zip file, you want the .img file

Follow the flashing instructions at <https://www.raspberrypi.org/documentation/installation/installing-images/README.md> as follows :

Download the “Etcher” program : <https://etcher.io/>

Run Etcher

Select Octopi image, select SD card, flash.

Insert SD card into Raspberry Pi.

RASPBERRY PI INSTALLATION

- Flash raspi per above section
- Power up raspi
- Connect smoothieboard to raspi
- Power up
- Check raspi and smoothieboard operation

LASER ALIGNMENT

See user manual

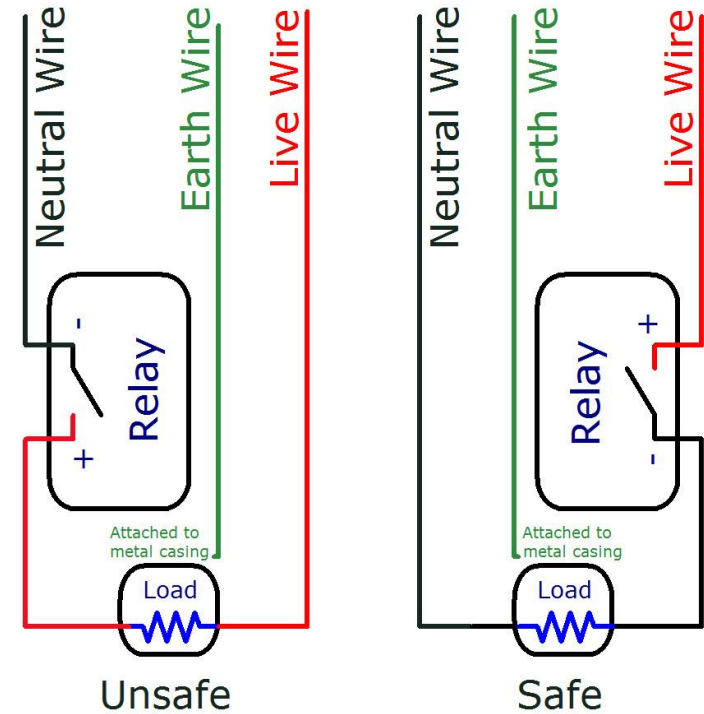
SSR SWITCHING WIRING

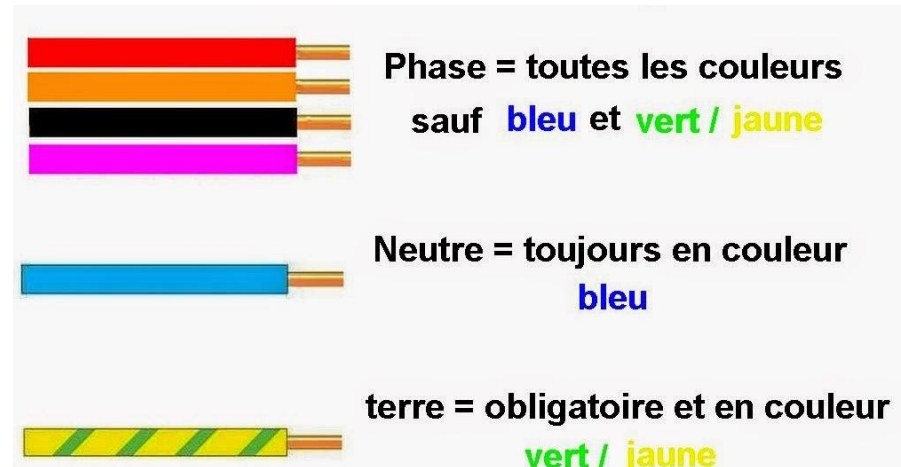
Users can use Gcode to switch a power strip on and off, allowing them to turn fans and pumps only when strictly needed.

- SSR ([Datasheet](#))
- Power strip
- Additional wiring
- M3 and M5 drill bit
- M3 or M4 screws and nuts and spacers

Steps :

- Cut power cord of power strip
- Stick power strip to machine's back
- Pass power cord to inside of electronics system
- Attach SSR to inside of machine [300 × 300](#)





TABLET INSTALLATION AND WIRING

Need :

- Tablet
- Velcro
- 5V connection cable (**USB to +/-, not USB to USB**)

Steps :

- Unpack tablet
- Make hole big enough for usb micro connector
- Add joint to close hole (todo : not currently doing so)

- Glue tablet to machine (or use velcro)
- Connect machine to power

INTERFACING VIA ETHERNET

The board should be able to connect to the local network via Ethernet. It should get a static IP address.

- Ethernet cable, short
- Ethernet cable, long
- Ethernet extension port (female to female)
- Ethernet port extension (female to male, wall-mounted)

INTERFACING VIA USB

The board should be able to connect to a nearby computer via USB.

- USB cable, short. Shielded with ferrite
- USB cable, long, Shielded with ferrite
- USB extension cable, wall-mounted

PROTECTING AGAINST EMI

EMI can be hell on large machines. We want to make sure we don't have those bugging us.

- Ferrite beads of various sizes

HARDWARE FOR SOFTWARE

In order to test the machine, we need to interface with it and use it.

- Ethernet router
- Ethernet cable (x2)
- Portable computer
- Mouse
- My own keyboard

DOOR PROTECTION

If the laser does not come with a door protection system, we need to add it.

- Magnetic switch
- Magnet
- Endstop-type switch
- Wiring

Steps :

- Drill holes for screws
- Drill hole for cables
- Drill hole for cables in PSU case
- Connect cable to switch

- Pass cable from switch to PSU
- Attach switch and magnet
- Connect to PSU circuit

Todo :

- Move to double (redundant) switches.
- Document if it's NO or NC to wire

DEBUGGING ELECTRONICS

If something goes wrong, we need ways to figure out what it is.

- Multi-meter
- Logic analyzer (with probes)
- Portable oscilloscope (with probes)
- FTDI cable
- JTAG adapter
- SD card reader
- USB hub
- Spare SD cards

DEBUGGING HARDWARE

Sometimes what goes wrong is mechanical, then we need things to gather information

- Measuring ruler

ADD STICKERS TO THE MACHINE ONCE COMPLETE

- Laser safety warning on the door
- Electricity safety warning on the cabinet doors

Stickers todo

180 x 250 mm :

- Large red text on yellow safety instruction sticker with slanted dotted line on borders (see signtech original picture)

142 x 42 mm :

- Robotseed logo, URL and email contact sticker

33 x 16.5 mm :

- «Laser power»
- «Ampmeter»
- «Light switch»
- «Stop switch»
- «Main power»
- «PC Connect»
- «Ethernet connect»
- «Inlet»
- «Outlet»
- «Power in»

- «Air inlet»
- «Chiller/Air pump»

85 x 55 mm :

- « Signtech / Made in china / Model number / Specs »

40 x 500 mm :

- « Ne pas fixer le point de combustion, lumière visible intense »

Undefined :

- « Faisceau laser invisible (rayon infrarouge de découpe) et extrêmement dangereux si cette porte est ouverte. Regarder le faisceau ou ses reflections est dangereux. »
- « Faisceau laser visible (point rouge de positionnement) et dangereux si cette porte est ouverte. Regarder le faisceau directement est dangereux. »
- « Faisceau laser invisible (rayon infrarouge de découpe) et extrêmement dangereux si cette porte est ouverte et l'interrupteur de sécurité est défectueux. Regarder le faisceau ou ses reflections est dangereux. »
- Icône danger laser
- « Débranchez la machine avant d'ouvrir ce panneau »
- « Point de sortie du laser »
- « Laser infrarouge (10.6 μm) d'une puissance de ___ W. Laser de classe ___ »
- « Laser visible (650 nm) d'une puissance de ___ mW. Laser de classe ___ »
- Icône danger électrique
- « Attention haut voltage derrière cette porte, danger de mort, toujours éteindre la machine avant d'ouvrir »
- Icône danger incendie

- « Attention danger d'incendie, ne jamais opérer la machine sans supervision. Toujours garder un extincteur en état de fonctionnement à proximité de la machine. Nettoyez la machine régulièrement pour éviter l'accumulation de débris et de suies inflammables. Merci de lire le manuel d'utilisation. »
- Icône livre. « Utilisation interdite sans avoir suivi une formation adéquate et une lecture complète du manuel d'utilisation »c
- « Merci de ne pas utiliser la découpeuse laser pour fabriquer une découpeuse laser »

Normes :

- 21 CFR 1040 et IEC 60825-1 : Identification des sources laser, de leur type, de leur classe et de leur puissance.

TEST PROCEDURE FOR MACHINE BEFORE SHIPPING

PREPARING MACHINE FOR SHIPPING

MAINTENANCE HARDWARE

There is some maintenance that is usually done after some usage time, but that needs to be done at reception times on some machines. For example :

- 3-in-1 grease
- Cleaning supplies (water, soap, wiping paper)
- Acetone

GIVE TO THE CUSTOMER

A box with :

- Laser glasses
- Cleaning supplies
- Full manual
- Replacement lenses
- Magnets for honeycomb bed (with rubber around them)
- Calibration tabs of the correct height.
- Hex key for red dot pointer adjustment

VERIFICATIONS

- Check bed level without honeycomb. If incorrect, fix.

WHEN MACHINE IS INSTALLED

Get customer to sign :

- Document certifying he was taught how to use the machine
- Document certifying the machine was delivered and is working

Throw the garbage bag out.

Clean up around the machine.

NORMS AND REGULATIONS

Directive 98/37/EEC pour machines Annexe IIA

Article 89/336/EEC EMC et amendment 92/31/EEC

Directive 73/23/EEC pour les basses tensions

EN 60335-1 Sécurité des appareils électrodomestiques et analogues

EN 55014/1993 Compatibilité électromagnétique

EN 60825-1/2001 Sécurité des équipements laser

EN 60950/A1+A2 Sécurité des équipements électriques et des équipements informatiques, y compris le matériel électrique de bureau

EN 55022/94 et EN 50082-2/95 Compatibilité électromagnétique

EN 55014/1995

EN 60204-1 Sécurité des machines

KITTING BILLS OF MATERIALS

There are 3 different kits to source and stock in the context of laser cutter installation :

- Transformation kit : All the tools and bits necessary to transform a machine

- Installation kit : All the tools and bits necessary to install a machine at the customer's
- Customer kit : All the tools and bits left with the customer once the machine is delivered

TRANSFORMATION KIT BOM

One-time use

Quantity	Item	Source
1	5V/5A Power supply	Taobao
1	Raspberry Pi 4	Raspberry Pi 3 or 4
1	8+GB MicroSD card, flashed with our version of Octoprint	Not from ali or taobao
1	MicroUSB power supply (just for the cable to cut) with 1.5 meter cable	Taobao (to update with longer cable)
1	5V/signal extension red/black cable	Taobao
1	Short USB-B cable	Taobao (30cm) . Better if available : With ferrite , aliexpress
1	Android tablet, 10.1" Asus	Amazon or Carrefour
1	Velcro tape	Carrefour
1	720p Logitech Webcam Trouver un modèle	Carrefour
1	Printed webcam magnetic support	Robotseed, To print
1	Smoothieboard v1.1 4XC with step/dir terminals soldered	Internal
1	Laser cutter wiring kit	Internal (to externalize)
1	Custom CNC machined delrin plate	Internal (to externalize)
1	Double sided tape	Brico Depot
1	Magnetic door switch	Gotronic
1	Solid state relay (OMRON)	Gotronic

1	Power strip	Brico depot
	5V crimps	
	220V crimps	
	220V wiring	
	Cable-to-cable crimp	
1	Printed set of stickers	Internal, custom
1	France power plug (replacement)	Brico depot
1	Strong tape roll	Brico depot
	Zip ties	
1	2-component Epoxy glue	Brico depo
4	M3 20mm hex spacer	Bricovis
4	M2.5 8mm hex spacer	Bricovis
4	M3 bolt 10mm	Bricovis
4	M2.5 bolt 10mm	Bricovis
4	M3 nut	Bricovis
4	M2.5 nut	Bricovis
1	Ethernet cable, long (5M)	Carrefour or Taobao
1	Ferrite beads of various sizes	Taobao

Tools and re-usables

Quantity	Item	Source
1	Cutter	Brico depot

1	Cutter blades	Brico depot
1	Scissors	Brico depot or Carrefour
1	Multi-bit screwdriver set	Brico depot
1	Powered screwdriver	Brico depot
1	Multi-purpose pliers	Brico depot
1	Hammer	Brico depot
1	MicroSD USB reader	Carrefour
1	M3 and M5 drill bit	Brico depot
1	USB cable, long, with ferrite	Taobao
1	Ethernet router in case they don't have a network yet	Carrefour
1	Portable computer with Visicut and Etcher	Internal
1	Volt-meter	Brico-depot
1	Ruler	Brico-depot

INSTALLATION KIT BOM

Quantity	Item	Source
1	100mm aluminium tubing	Brico depot

3	Tubing tightening collets	Brico depot
1	Set of laser alignment MDF targets	Internal (TODO)

CUSTOMER KIT BOM

Quantity	Item	Source
1	Box of “vu” glasses cleaner	Carrefour
1	IR Laser safety glasses	TODO
1	Set of laser alignment MDF targets	Internal (TODO)
1	3-in-1 grease spray	Brico-depot
1	Small IPA bottle	TODO
1	Full manual	Internal
1	Replacement lens	Comes with the machine
1	Laser box	TODO
1	Neodymium magnets	Supermagnete
1	Set of allen wrenches	Taobao

LASER WIRING KIT FABRICATION

STEPPER MOTOR STEP/DIRECTION WIRING HARNESS

Instructions :

Cut wires to length :

- **3** x step wires, yellow, 500mm
- **3** x dir wires, green, 500mm
- **6** x 5V wires, red, 500mm
- **1** x Z jumping step wire, yellow, 80mm
- **1** x Z jumping dir wire, green, 80mm
- **2** x Z jumping red wires, red, 80mm

Strip all wires at each end.

Install ferrules on stepper driver side of the wires :

- **4** x 500mm red wires get one red ferrule
- **2** x 500 mm yellow wires get one yellow ferrule
- **2** x 500 mm green wires get one green ferrule
- **2** x 500 mm red wires get one 80mm red wire attached, then one red ferrule on the junction and one red ferrule on the end of the 80 mm wire
- **1** x 500 mm yellow wires get one 80mm yellow wire attached, then one yellow ferrule on the junction and one yellow ferrule on the end of the 80 mm wire
- **1** x 500 mm green wires get one 80mm red wire attached, then one green ferrule on the junction and one green ferrule on the end of the 80 mm wire

Pull each of the ferrules and replace any ferrule that would fall off due to a crimping problem.

Install 2.54mm pin connectors (single, the ones for the thermistors on Smoothieboard) on each remaining end of cables that yet doesn't have a connector.

Add heat shrink to each crimp for isolation.

Take red/green and red/yellow pairs of wires and twist them together using a power tool.

Confirm continuity on each of the cables using a multimeter on each end (in sound mode).

5V POWER SUPPLY TO SMOOTHIEBOARD

Instructions :

Cut a 20cm length of red/black power cable.

Strip each end of each cable in the pair.

Add red ferrules to each end of the red cable, and black ferrules to each end of the black cable.

Confirm continuity on each of the cables using a multimeter on each end (in sound mode).

SIGNAL CABLE TO SSR SWITCH

Instructions :

Cut a 400mm length of black cable and a 400mm length of yellow cable.

Strip each end of each cable.

Install 2.54mm pin connectors (single, the ones for the thermistors on Smoothieboard) on one end of each cable.

Add heatshrink to each crimp for isolation.

Strip the other end 25mm on each cable.

Take a high power claw connector and wrap the cable around it then back inside.

Crimp the claw connector.

Twist the two wires together.

Confirm continuity on each of the cables using a multimeter on each end (in sound mode).

ENDSTOP CABLES

Instructions :

Cut 3 x 300 mm lengths of brown cable and 3 x 300 mm of blue cable

Strip each end of each cable.

Add an endstop crimp to one end of each cable

Insert crimps into the right-most side of an endstop connector (3-pin)

Confirm continuity on each of the cables using a multimeter on each end (in sound mode).

LASER CONTROL CABLE

Instructions :

Take a CAT5 or CAT6 ethernet cable of length :

- 2 meters for 6040
- 3 meters for 1060
- 4 meters for 1610

Cut the ethernet connector at each end of the cable.

Strip the cable 70mm at each end.

Remove the blue and brown pairs, keep the orange and green pairs, at both ends.

Separate each pair.

Strip all of the wires.

Strip and twist the two white-color wires together.

Crimp each of the 3 cables with 2.54mm crimps (the thermistor kind for Smoothieboard)

Add heat-shrink to each of the crimps for isolation.

Confirm continuity on each of the cables using a multimeter on each end (in sound mode).

5V JUNCTION TREE

Instructions :

Cut 8 x 50 mm lengths of red cable.

Strip each end about 8mm

Do a 1-to-3 tree junction and twist it together.

Use a cable-to-cable crimp to fix the junction.

Add heat-shrink to the junction for isolation.

Do this twice (two tree junctions total).

Joint both trees into a single 1-to-2-to-3 three (1-to-6), with the single end being a 2.54mm thermistor-type crimp.

Add heat-shrink for isolation to the single-end.

Add male crimps to each of the remaining crimp-less ends.

Add heat-shrink for isolation.

Confirm continuity on each of the cables using a multimeter on each end (in sound mode).

CALIBRATION GCODE FILES

METHODOLOGY

The templates (text and other engraving) for the calibration files are generated as OpenSCAD files, then exported to DXF, and finally converted into laser-cutting files (G-code) using Visicut.

The calibration routines themselves are generated by scripts and then added to those templates to create the final calibration G-code file.

TOOLS

These fonts are used to have single-line engraving in Cambam

TYPES

These files are used to calibrate different things in the machine :

- Laser alignment and bed levelling, by doing 9 engravings in a 3x3 grid covering all of the work area, allowing for detection of inconsistencies.
- Detection of focus point and calibration of ideal focus for a given material by doing grids different heights
- Detection of ideal speeds and powers for a given material by doing grids of both
- Engraving calibration by doing series of lines at all power values
- Calibrate number of passes versus engraving at various speeds and powers

```
dimension_x = 550;  
dimension_y = 350;  
step       = 10;
```

```

steps_x      = floor(dimension_x / step );
steps_y      = floor(dimension_y / step );

// Ruler for X axis
for(i = [ 0: 1: steps_x]){
    translate([10 + i * step, 5]) {
        rotate(a=[0,0,90]){
            text(str(i), font = "Liberation Sans", size=6);
        }
    }
}

// Ruler for Y axis
for(i = [ 0: 1: steps_y]){
    translate([-5, -(10 + i * step)]) {
        rotate(a=[0,0,0]){
            text(str(i), font = "Liberation Sans", size=6, halign = "right");
        }
    }
}

// Document title
translate([0,20]) {
    rotate(a=[0,0,0]){
        text("Robotseed laser cutting calibration test template", font = "Liberation Sans", size=6);
    }
}

// X axis label

```

```

translate([dimension_x + step, 20]) {
  rotate(a=[0,0,0]){
    text("<-- X axis: laser power -->", font = "Liberation Sans", size=6, halign = "right");
  }
}

// X axis label
translate([-20, -(dimension_y + step)]) {
  rotate(a=[0,0,90]){
    text("<-- Y axis : Cutting speed -->", font = "Liberation Sans", size=6, halign = "left");
  }
}

```

ORIGINAL ELECTRONICS WIRING REFERENCE

6.LASER

1. DC5V - Nothing
2. WP - Brown(WP) -
3. PWM - White/1(laser)/Yellow -> laser in (IN)
4. TTL - White/3(laser)/Blue -> laser L (L)
5. GND - Blue(WP)+White/2(laser)/Brown -> laser gnd (G)

7.AXIS/X

1. DC5V - Red (driver5V)
2. PUL - Blue (DriverPUL)
3. DIR - Yellow (DriverDIR)

7.AXIS/Y

1. DC5V - Red (driver5V)
2. PUL - Blue (DriverPUL)
3. DIR - Yellow (DriverDIR)

7.AXIS/Z

1. DC5V - Red (driver5V)
2. PUL - Blue (DriverPUL)
3. DIR - Yellow (DriverDIR)

7.AXIS/U

1. DC5V - White(Laserpointer?)
- 2.
- 3.

24V

1. GND
2. 24V

11. IN

6. GND

8. XY LIM

- 1.
- 2.
- 3.
4. ELY- - Brown (Xmin)
5. ELX- - Brown (Ymin)
6. GND - Blue (X+Y gnd)

9. ZU LIM

- 1.
- 2.
- 3.
- 4.
5. ELZ- - Brown (ZMin)
6. GND - Blue (Z gnd)

LASER

HLPG

1. H
2. L - White(3)/Blue -
3. P - Blue jumper
4. G - Blue jumper + White(2)/Brown
5. IN - White(1)/Yellow
6. 5V

