FABTOTUM MANUAL

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SAFETY & WARRANTY GUIDELINES

Before we venture into uncharted territory, let's make sure to cover safety basics of the FABtotum Personal Fabricator. As a general rule, please operate according to the instructions provided by authorized sources only.

Follow the safety instructions below and use common safety practices. Always contact support for advice before modifying or employing the machine in a way that could cause hazards.

FIRST SETUP AND PLACEMENT

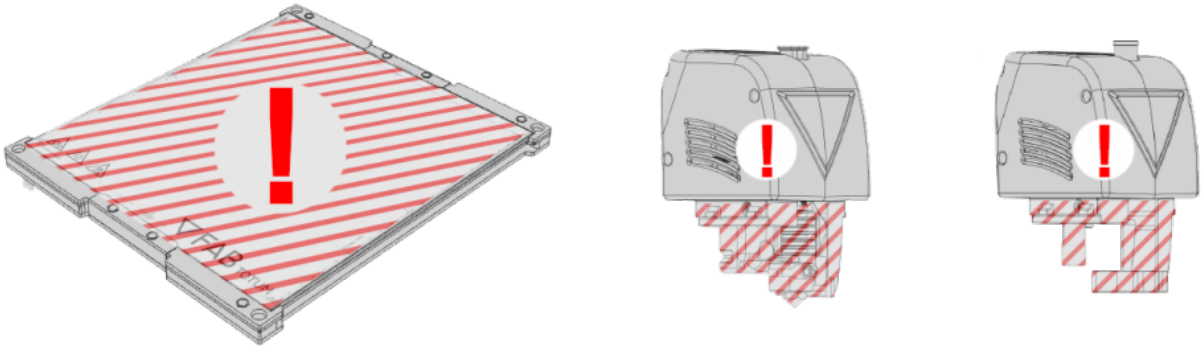
Follow the first setup manual or the complete manual, available at fabtotum.com/support
Place the unit on stable, clean surfaces, away from any obstacles within 30cm / 12″ from the unit.
The unit is intended for indoor use only. Do not use or place outside.
The unit only operates with room temperatures between 15°C and 28°C.
Place unit far from sources of heat, humidity or cold air.
Keep clean dust and clear of any liquid.

IMPORTANT SAFETY NOTES:

Caution: main health risks come from the machine's moving parts and the components that can heat up, such as the plane and the modules.

These parts have warning stickers and status LEDs on them to inform of the dangers related to the use of the FABtotum.

Do not touch the nozzle, the heated bed or any moving part of the unit.



DO NOT touch, move the product or leave it unattended when it's operating or turned on.
DO NOT modify, disassemble or alter the unit and/or its components in any way.
DO NOT touch or bend the flexible connection cable, the connectors and all cables.
DO NOT touch contacts or the metal rods, as hands can ruin contacts and damage the metal protection layer.
DO NOT turn the product off without following the proper shutdown procedure.
DO NOT improperly dispose of the unit.

TECHNICAL SUPPORT

Our support team is always happy to assist you. Many information and solutions can be found at
http://www.fabtotum.com/knowledgebase

3D PRINTERS AND MANUFACTURING: HEALTH MEASURES

Inhalation
Heat may cause the release of irritating vapors. Milling can create and spread dust and other particles.
In case the user inhales them, they should be immediately taken to an aerated place and kept calm.
Always refer to the material datasheet.

For safety reasons some materials can't be used for 3D printing, Milling or Laser engraving.
Check the material proprieties or consult support if unsure. Some materials, when exposed to high temperatures can release dangerous fumes and volatile chemical elements.

Skin
Health risks related to the skin are very uncommon.
If material residue ends up on your epidermis wash the area with plenty of soap and rinse with water.
If skin rashes occur please seek medical attention.

Eyes
Health risks related to the eyes are mainly linked to the use of the laser head and are otherwise uncommon.
For some people dust may be irritating. If that happens rinse your eyes thoroughly with water. In case you are wearing contacts, remove them and start rinsing as described above.
Use proper eye glasses for protection when operating the machine, especially when using the laser head.
Do not look directly inside the unit.

Most common symptoms and effects
Molten material may cause burns and scalds. Cutting tools may cause wounds and injuries.

Disclaimer: Manufacturer gives no warranty of merchantability or of fitness for a particular purpose. Any product

purchased is sold on the assumption the purchaser will make his own tests to determine the quality and suitability of the product. Manufacturer expressly disclaims any and all liability for incidental and/or consequential property damage arising out of the use of this product. No information provided shall be deemed to be a recommendation to use any product in conflict with any existing applicable law. Read the Data Sheet before handling product.

WARRANTY

Warranty will be void if the product is modified or altered in any way as well as it is opened in parts that should be kept closed (i.e. head, rear panel, left side panel, etc ...).
Operating the unit outside its specifications or purposes will also void the warranty.
Using unofficial filaments, accessories, consumables or any third party products as well as following unauthorized maintenance procedures is done at the owner's discretion and risk and may also cause damage to the unit, for which the manufacturer will not be held liable.
The product and its accessories must be kept in reasonable conditions. Do not dispose of the shipping box and packaging material.

The warranty does not cover damages caused by misuse, incorrect use or commands, mishandling or damages elicited by the use of third party accessories.

The warranty does not cover consumables such as: head thermistor, head heating cartridges, milling chuck, SD card, fans, nozzle, 4th axis feeder gear, hot-plate's pogo pins and all removable connectors and PCBs.

Legally applicable warranty period(s)
2 years for natural persons and businesses in the European Union
6 months for natural persons and enterprises in the rest of the World

The Warranty period starts from product's delivery date for online sales or from purchase date for all other acquisitions.
Warranty rights must be exercised before the end of the warranty period and only within 14 days of discovering a factory fault.
Repairs or replacement of the product and its components do not extend warranty period nor renew warranty on the replaced parts.

Software license and warranty
FABUI is an Open Source and all-inclusive software, except where otherwise stated and it is supplied under Creative Commons BY-SA-NC rules (read more here: https://creativecommons.org/licenses/by-nc/3.0/legalcode).
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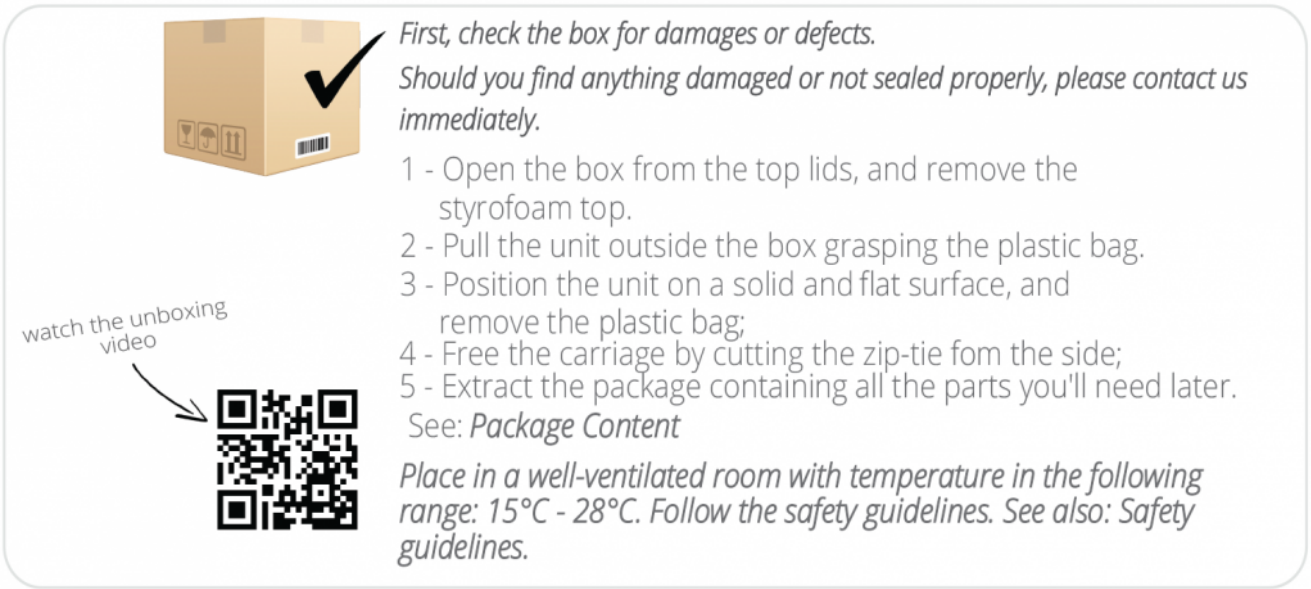
1. GETTING STARTED

UNBOXING THE FABTOTUM PERSONAL FABRICATOR

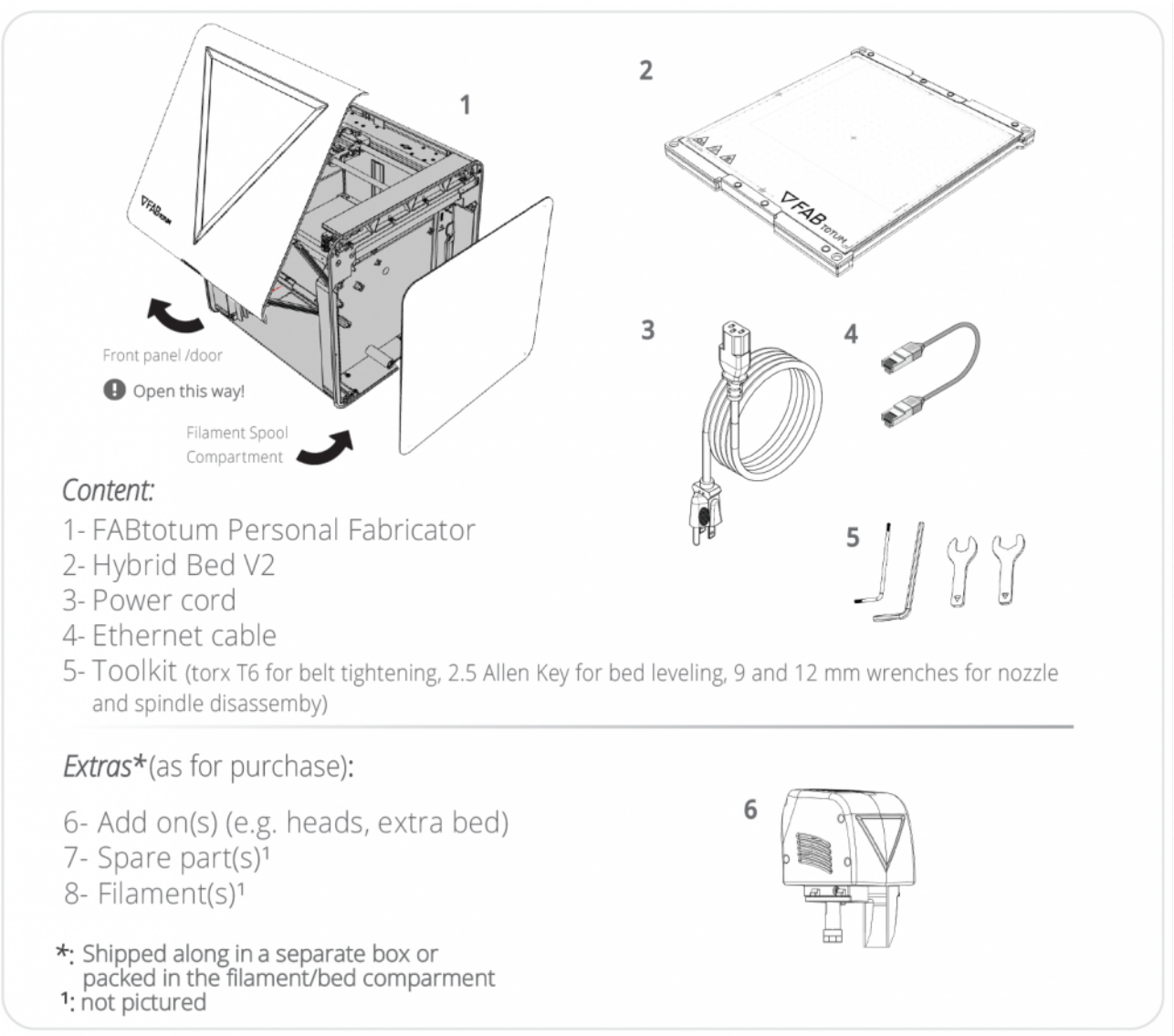
The unboxing procedure is important to prepare the FABtotum before the first setup without damaging the unit. Particular attention must be paid when removing the unit from its box. During unboxing you should also make sure there are no damages that might have occurred during transportation.

NOTICE: Always operate according the Safety and Warranty Guidelines

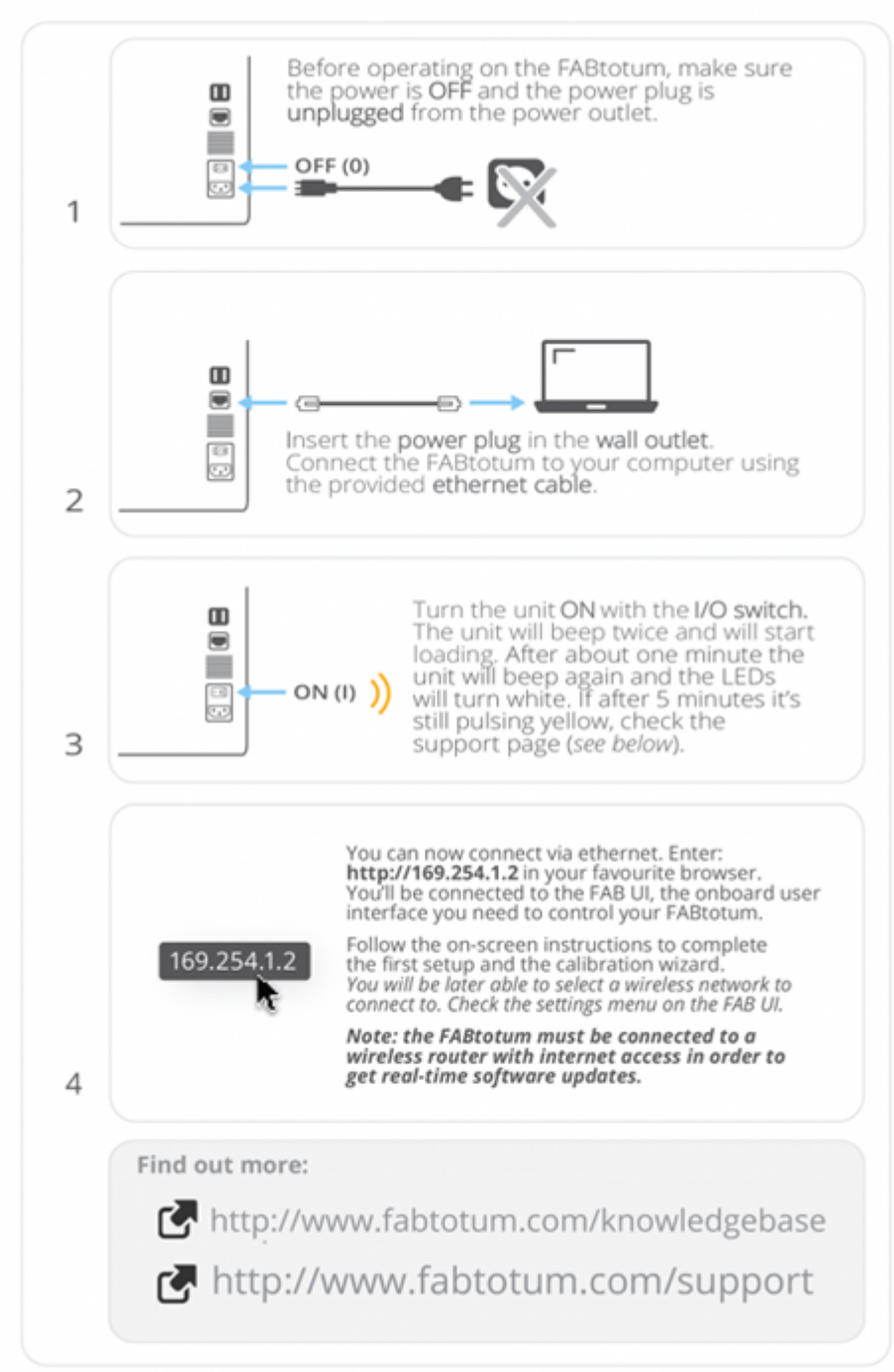
Unboxing the package



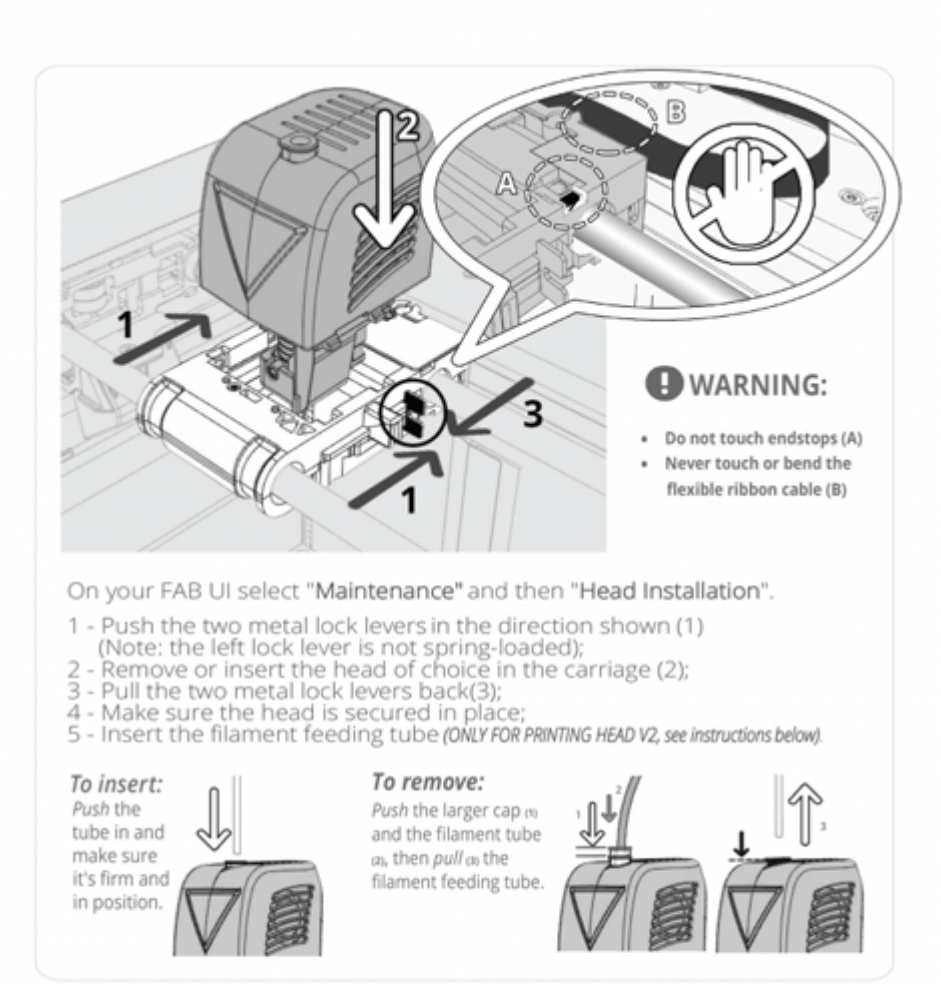
What's in the box

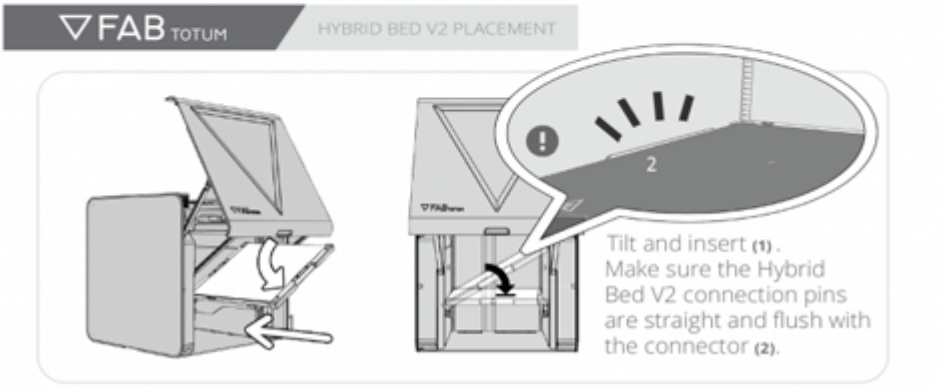


Connecting to the FABtotum



Installing heads and modules





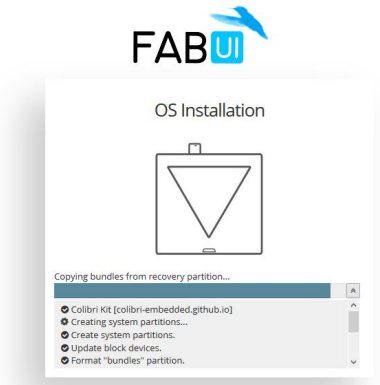
FIRST SETUP

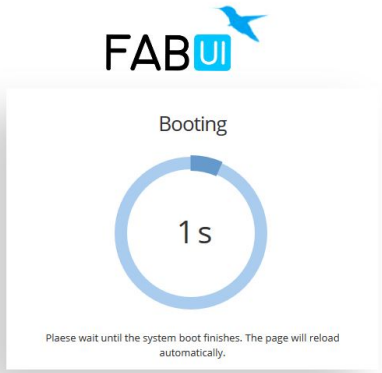
Now it’s time to do the first setup and unit calibration!

The unit Calibration of the FABtotum is a critical step in all future operations. A non-calibrated unit is unable to perform most basic task like printing and milling. Using a non-calibrated hardware could even damage the unit in the long run! After unboxing, setting up the machine and connecting to it with your favourite browser, you’ll be prompted with a setup/configuration wizard.

Once connected to the FABtotum via ethernet cable, you’ll be prompted to initialize the unit operating system (FABUI Colibri) click ok and follow the instructions to proceed.

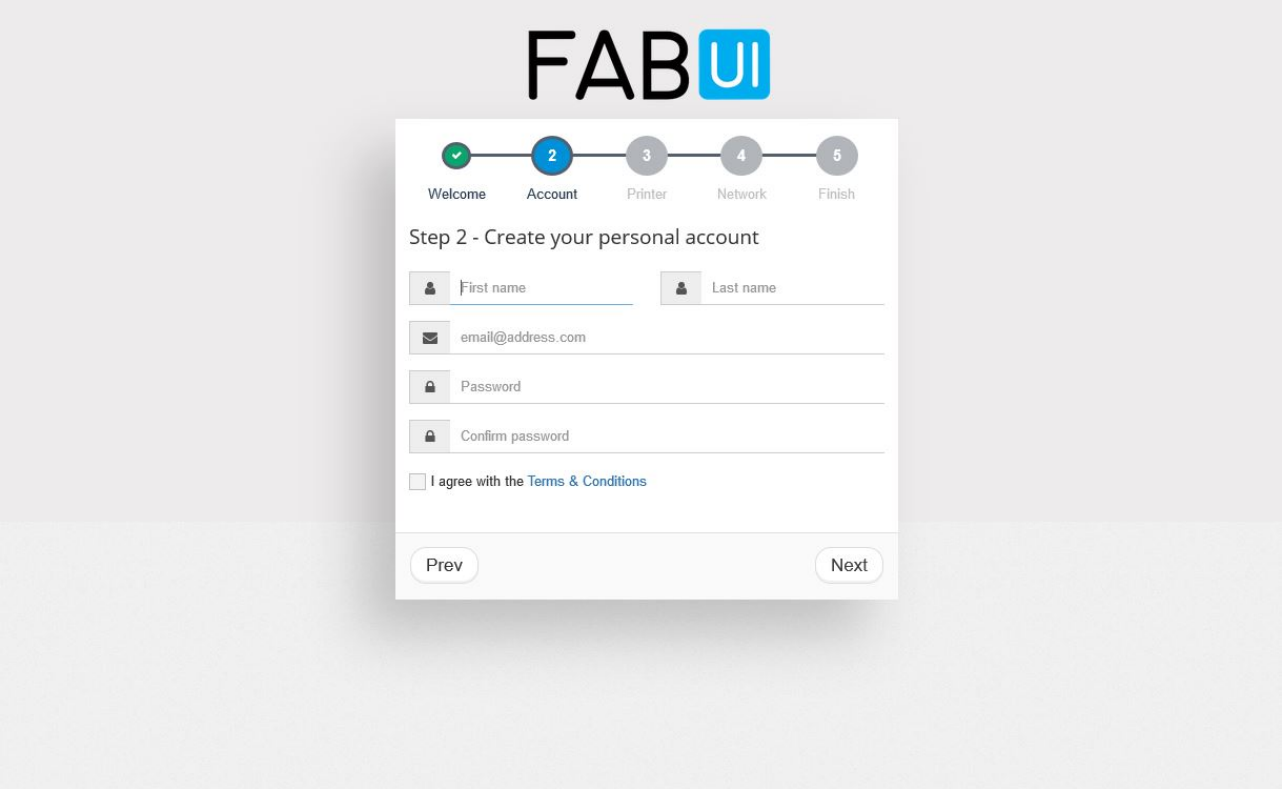
The OS will be installed in a few minutes.





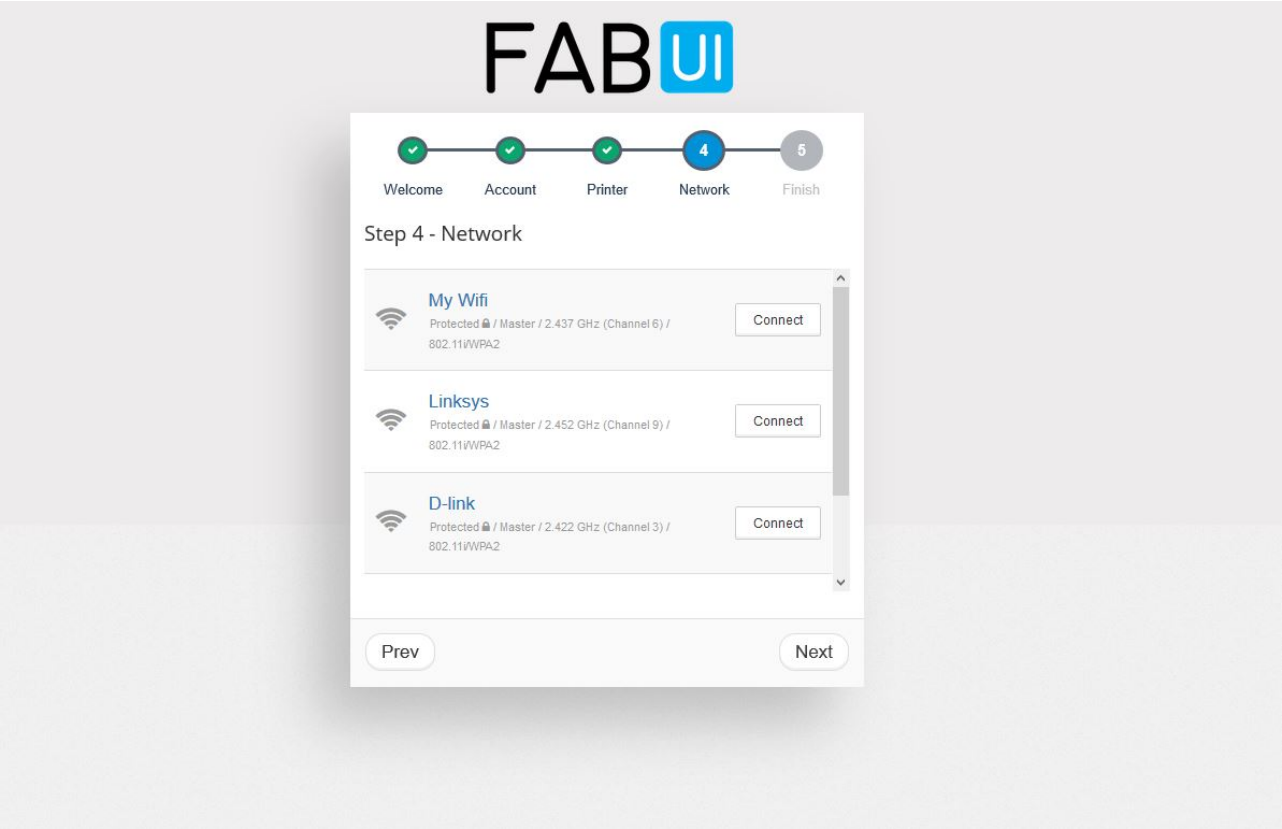
Now it’s time to enter your settings and read carefully all the safety notices, also available on fabtotum.com/knowledgebase.

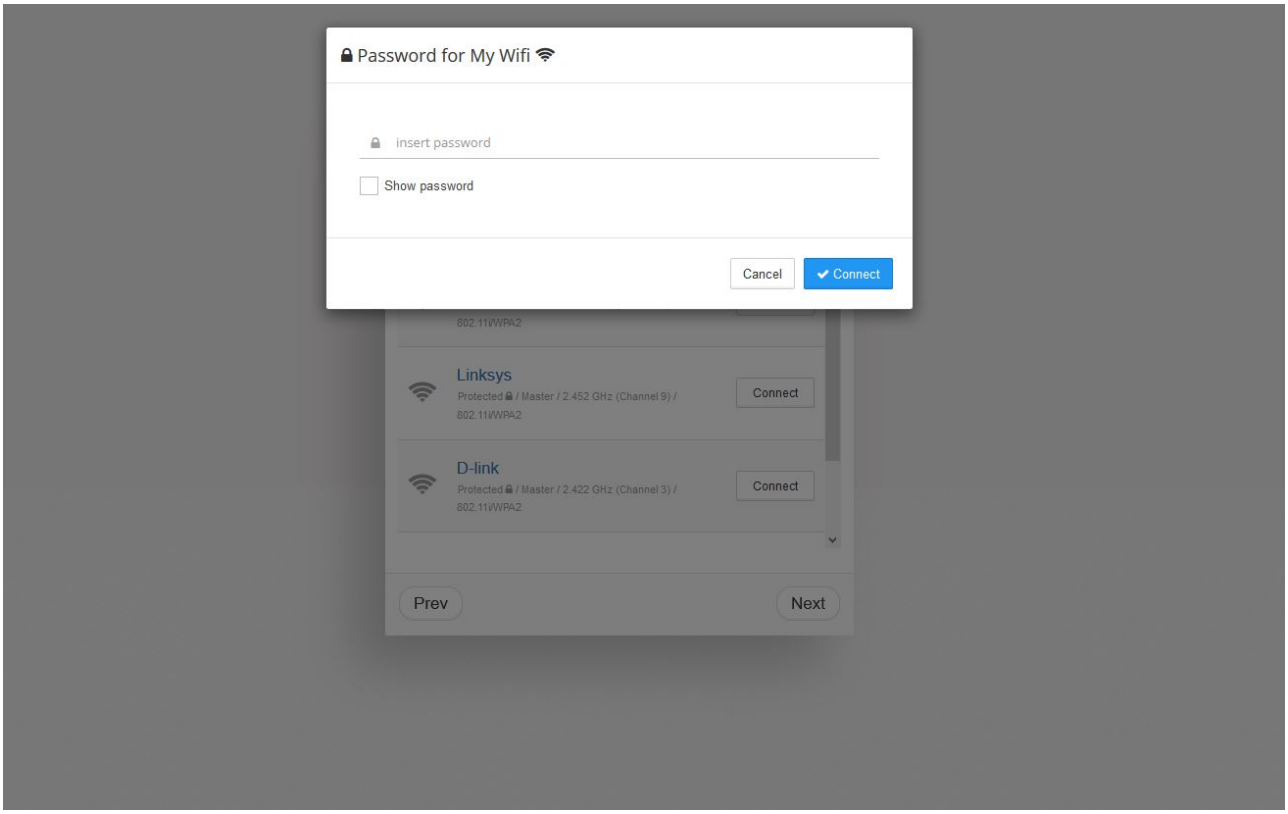
Enter the username (email) Name, Surname and password.
these will be used to access and operate the device.



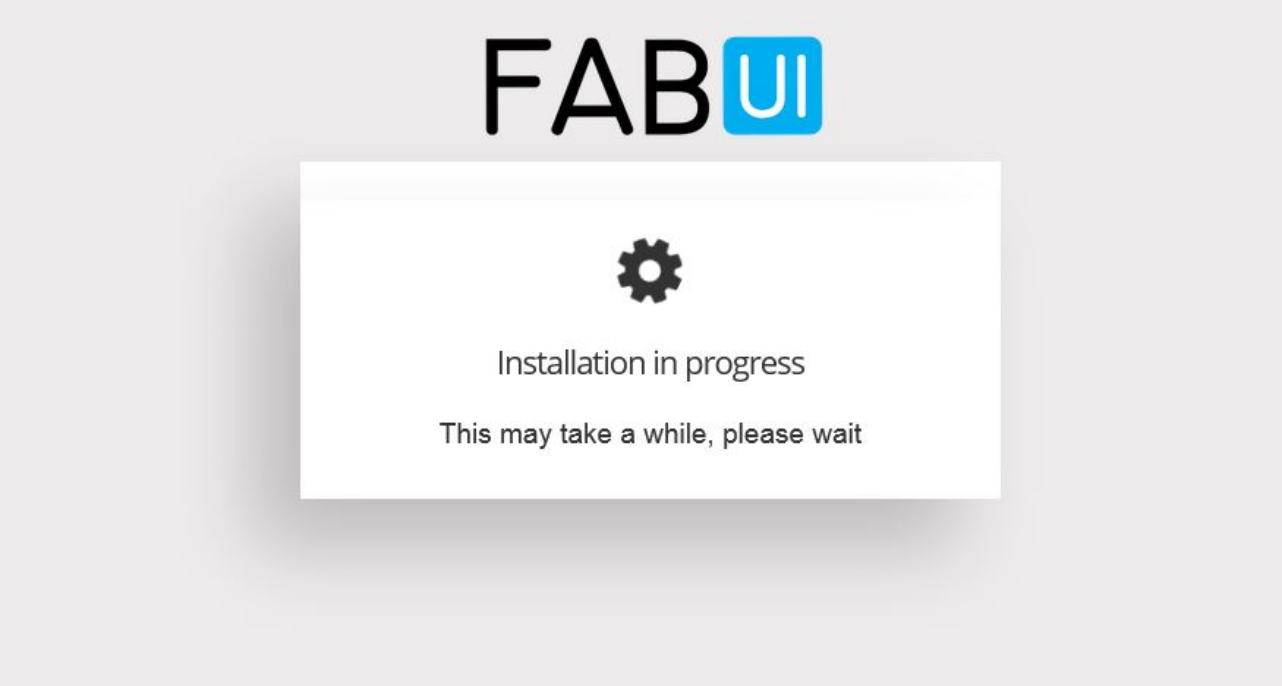
This passage is not mandatory, but you can set up a short name for your unit (a-z 0-9) that will be always accessible in your local Wlan/Lan (in this example http://fab01.local/)

Choose the Wlan you wish your unit will be connected to.



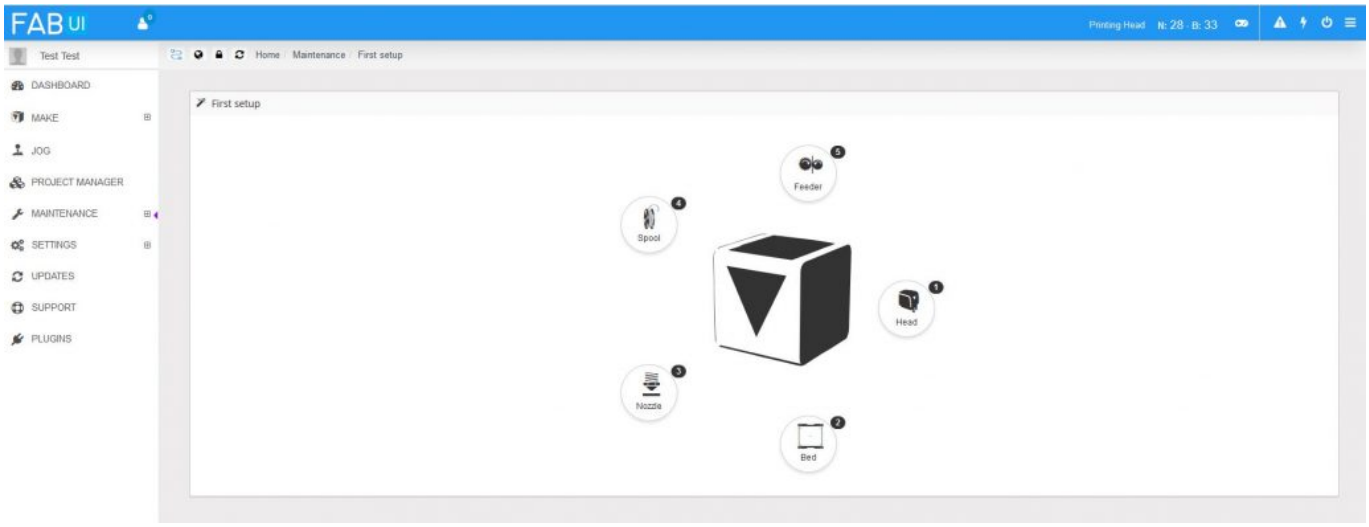


The procedure is finished, the installation will be finalized and you will be redirected to the onboard FABtotum User Interface (FABUI)


FABUI
Installation in progress
This may take a while, please wait

The calibration wizard

After the first setup you'll be able to use the "calibration wizard" (either by clicking on the pop-up alert or going to Maintenance→ first setup).
You can do all the wizard operations later by using the Maintenance menu.



2. SOFTWARE

FABTOTUM FABUI SOFTWARE OVERVIEW

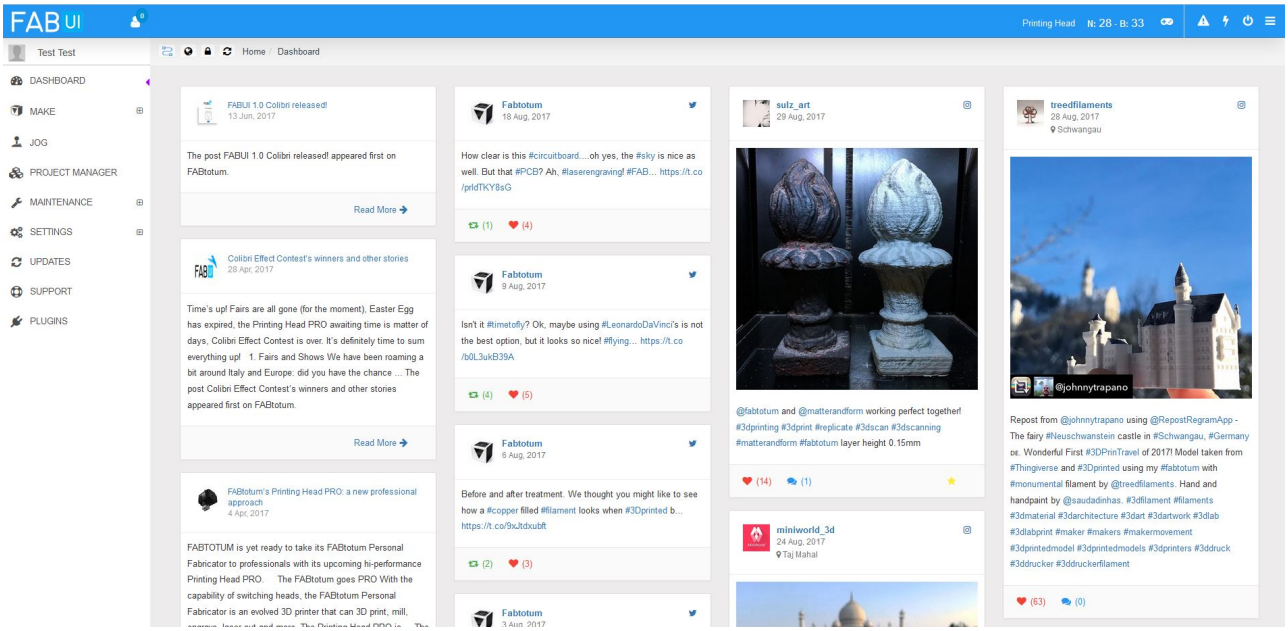
The FABUI is the onboard user interface of the FABtotum Personal Fabricator. It's used to store and launch all the "jobs" like 3D printing, milling, etc.

After having setup the machine, unless otherwise specified, the FABUI will be accessible at http://169.254.1.2 once the FABtotum is switched on and connected directly to your computer via LAN cable.

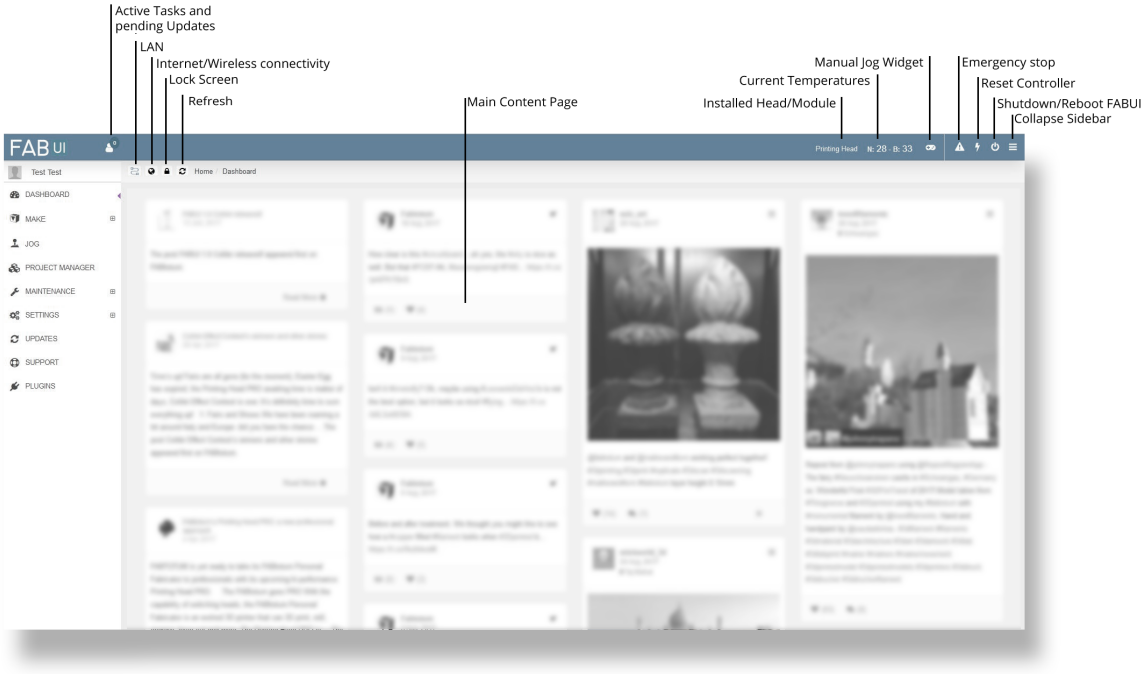
here some of the main features you can access once connected to the FABUI

The login screen allows to secure the session to a single user. Files and projcts will be "locked" or shared between users based on the login.

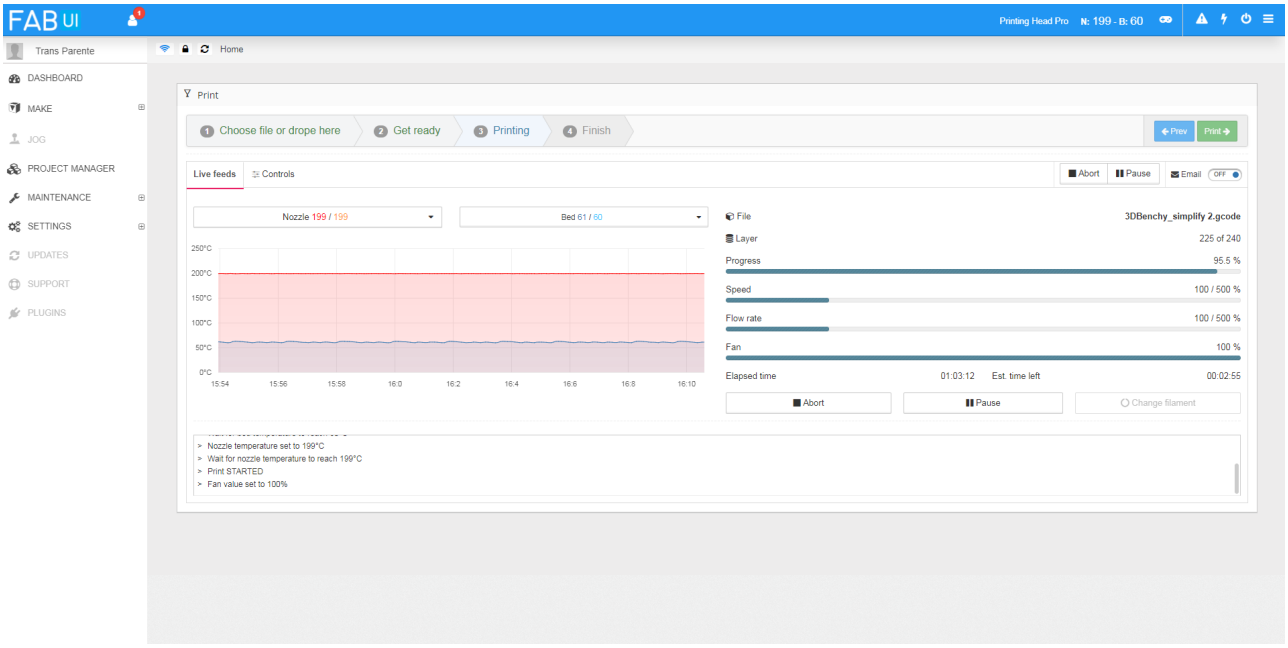
The dashboard is the first page you see once connected and logged in the FABtotum.



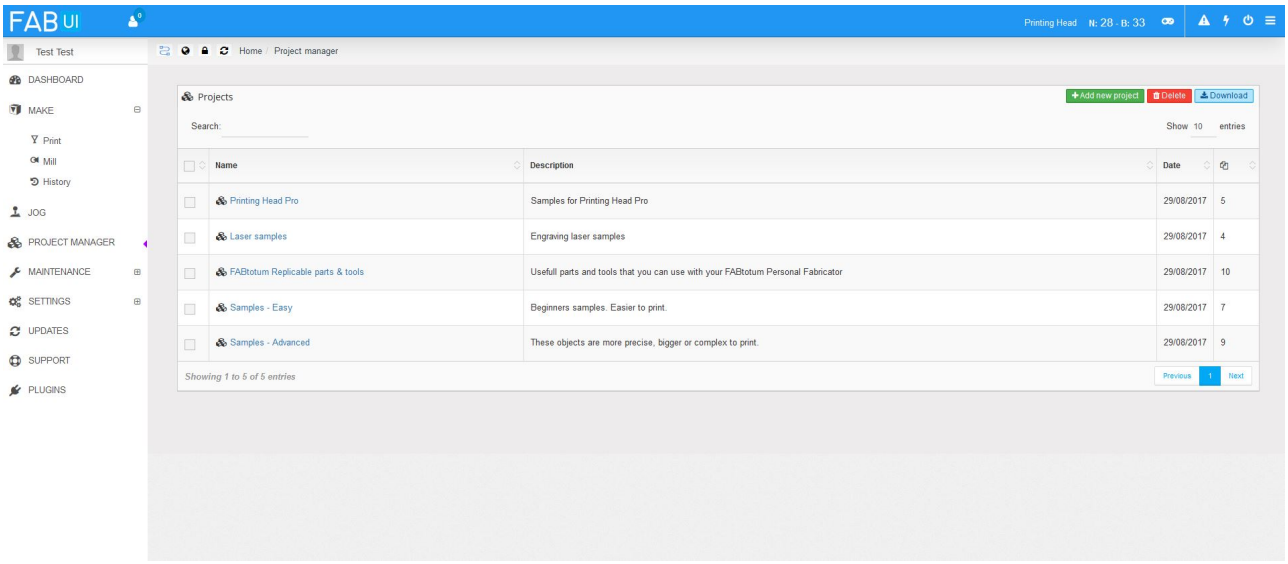
The FABUI controls and menu are locate around the main page, that is dynamically loaded with different contents



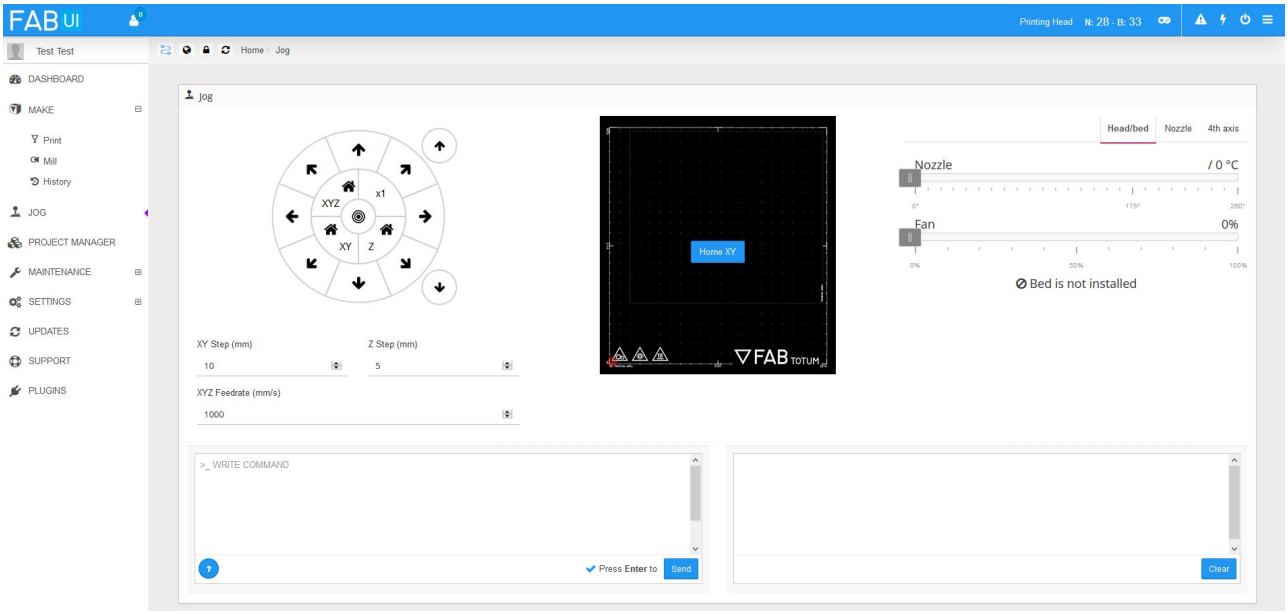
The FABUI allows to monitor , start, pause and stop any manufacturing job and have it run without the need of a connected computer. Il will also send an email notification when the task has been completed.



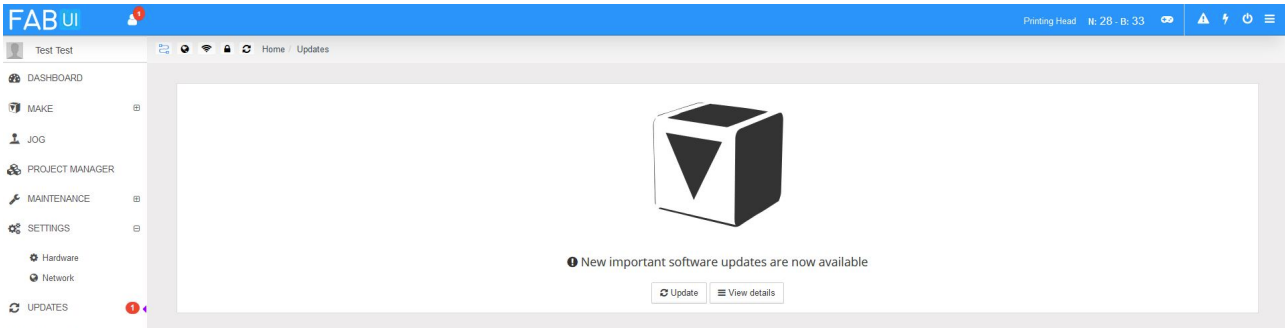
The project Manager is where you can upload and manage files for manufacturing: 3D printing, Milling, Laser engraving etc.



The JOG menu is used to manually move the gantry and enter direct comands (suggested for expert users only)



The Updates Menu allows you to quickly install available updates directly from the internet once they become available.



NETWORK CONFIGURATION GUIDELINES

The connection with the unit happens via PC-to-FABtotum LAN and via Wi-Fi.
While the first direct FABtotum-to-PC LAN connection is mandatory for setup, the unit can be accessed later via wifi only.

A Wi-Fi connection to the internet is always required to download updates. Updates are not mandatory, but are strongly recommended.

You can connect to the internet by linking the FABtotum to a router and editing the LAN settings accordingly.
A suitable IP in the right range,a Gateway (same as the router) and Subnet adresses are required (see your router settings).
You can also connect it to a LAN switch.

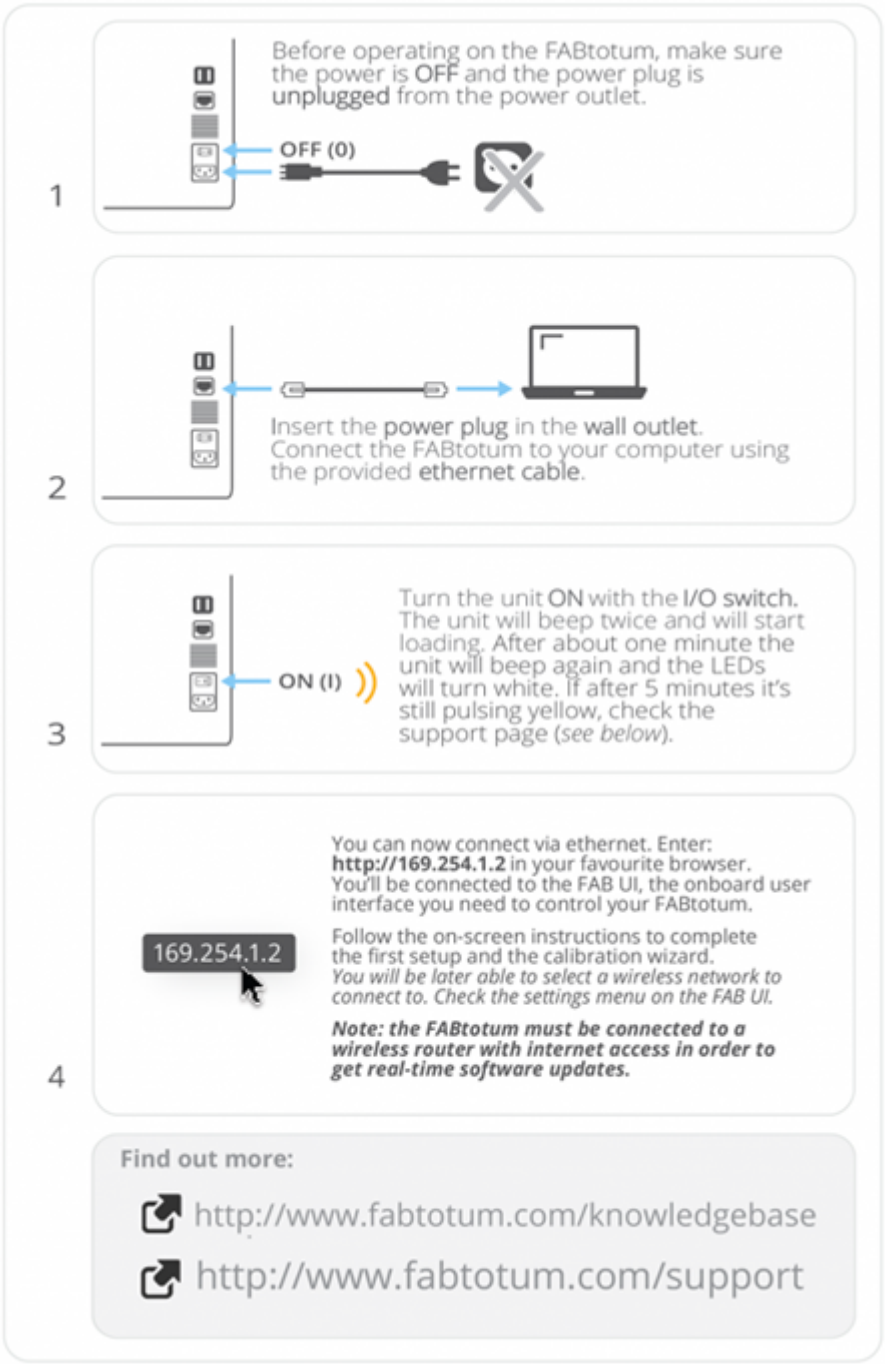
Note: The FABtotum Personal Fabricator will continue a tasks (print, mill etc) even if connection to the computer that started it is lost.

Wi-Fi adapters

Older units have a separate USB Wlan Adapter.
To set up the Wi-Fi connection you need to turn off your FABtotum, plug the USB Wi-Fi dongle in the USB port on the back of the unit and turn it back on. Once connected to the FAB UI, click on “Settings”, then “Network” and then “Wi-Fi”. You will see the list of available Wi-Fi networks, ranked by signal strength.
(NB. Newer machines mount a Rasp Pi 3 which has in-built Wi-Fi, they won’t have to insert any USB Wi-Fi dongle).

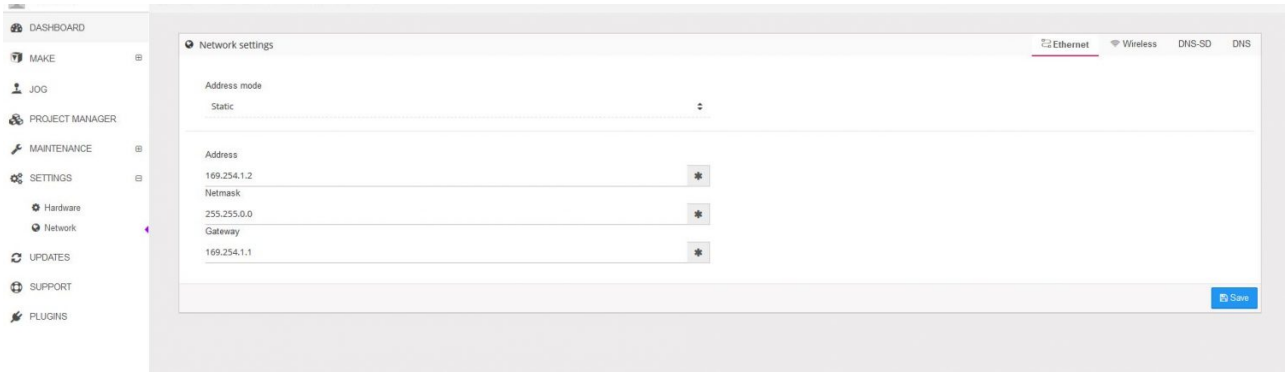
TIP: *The settings of your Network Configuration Panel of your Ethernet Adapter must be set to obtain the IP automatically.*

First time connection

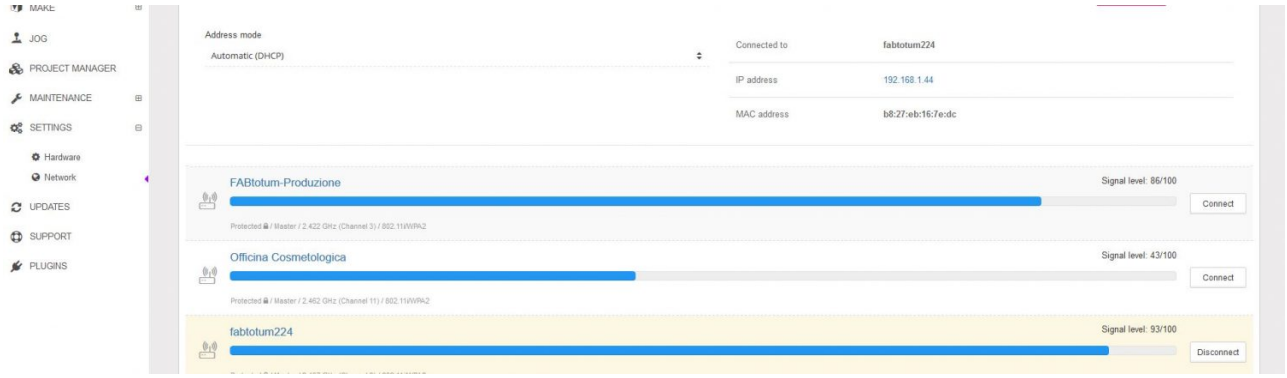


Settings > Network menu overview

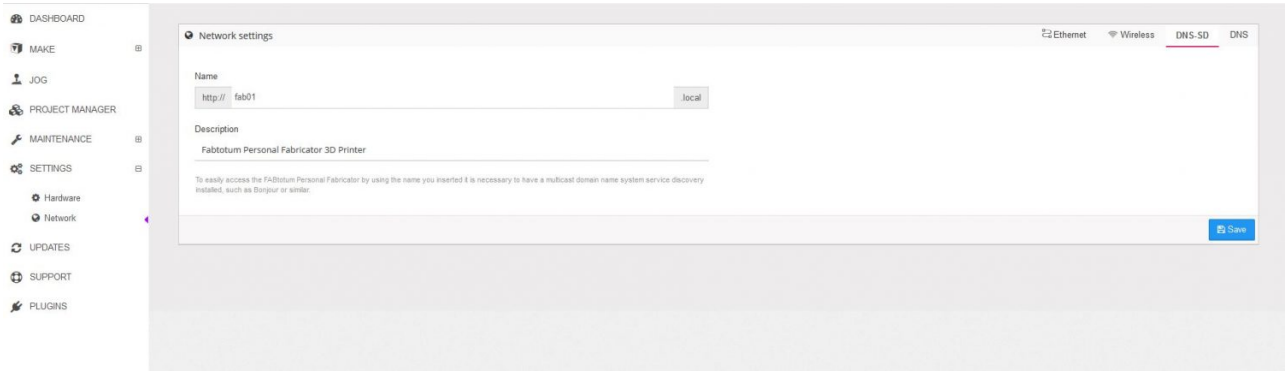
The first Tab of the Settings/Network menu is dedicated to the LAN configuration of the ethernet adapter of your FABtotum Personal Fabricator.
Adress mode can be changed to Dynamic (DHCP) or Access Point.



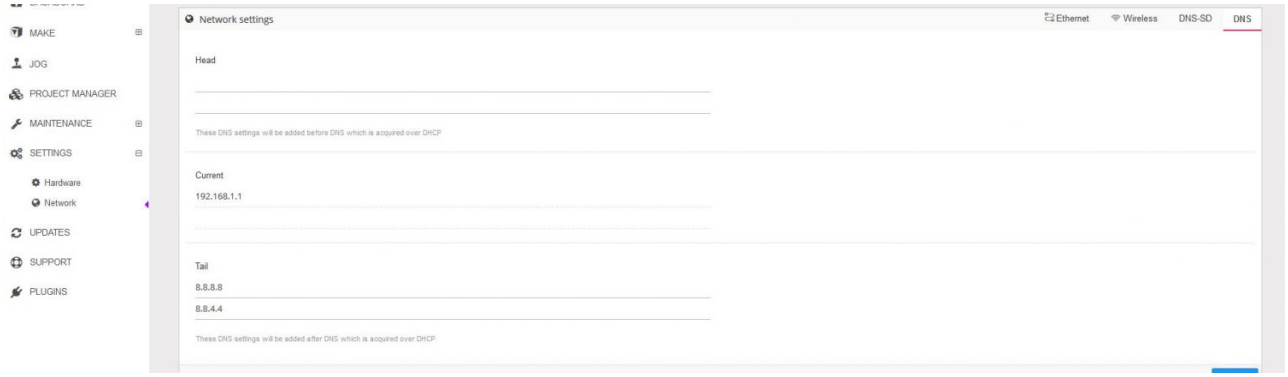
The wireless tab allows to connect to single networks.
Different modes are available: Access Point (AP mode) Available on FABtotum CORE and above.Static and Disabled.



DNS-SD allows to give your unit a Domain name in the format http://NAME.local/ (note the ending “/”).
On windows machines Bonjour service must be installed and running.



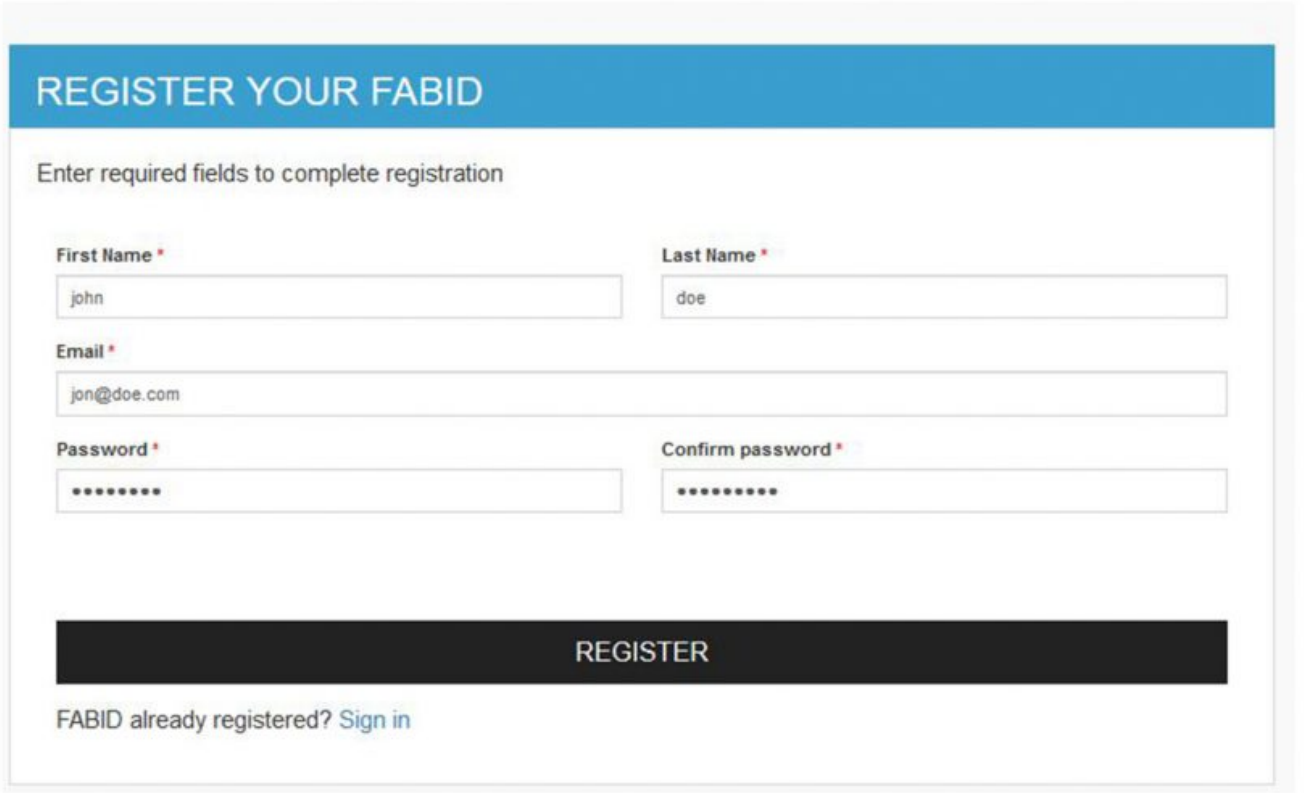
These settings are used on the FABtotum to resolve external domains. Do not change unless it's required by special networking needs.



MY.FABTOTUM: CONNECT OR SHARE YOUR FABTOTUM

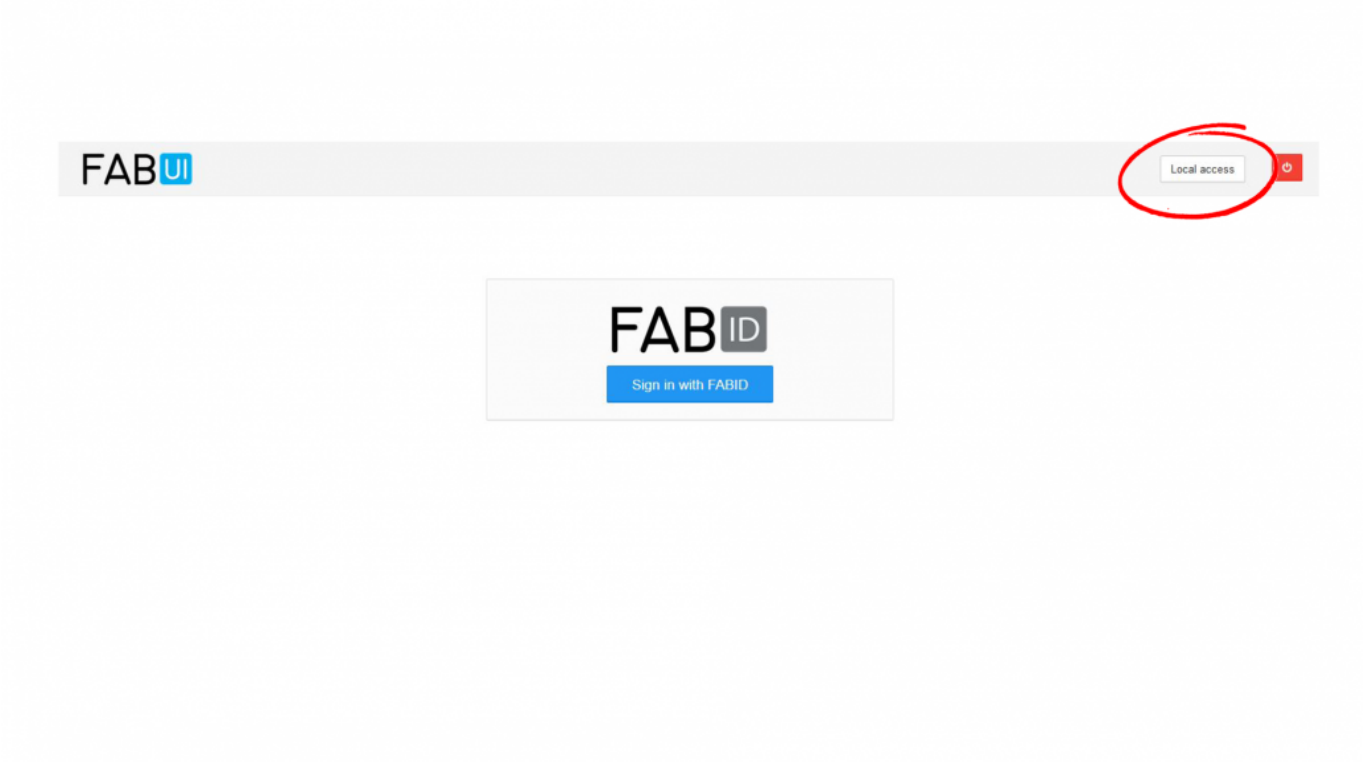
What is MY.FABtotum

MY.FABtotum is a web service that allows all your owned printers/products to be grouped in one place, where you can control them remotely and with ease.
It is also possible to share printers with others using their FABID handle.



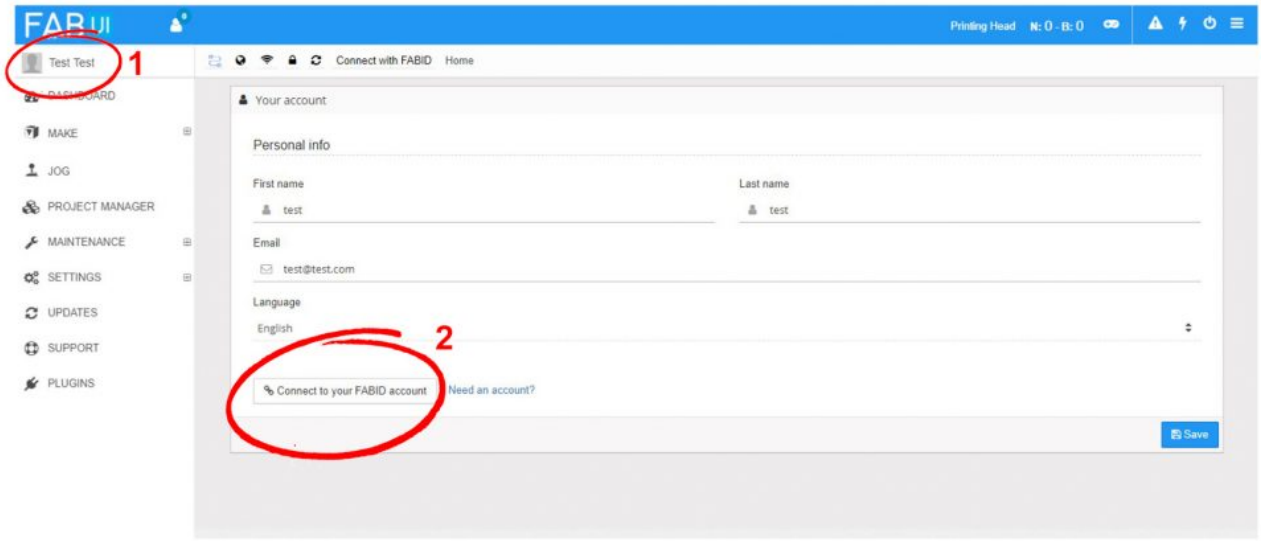
1) Register your FABID

To register to FABID go to the login/registration page.
A confirmation email will be sent afterwards. Use a valid email address.
The FABID login will be the one used for all accesses on all FABtotum services.
For more information check out the FABID page.



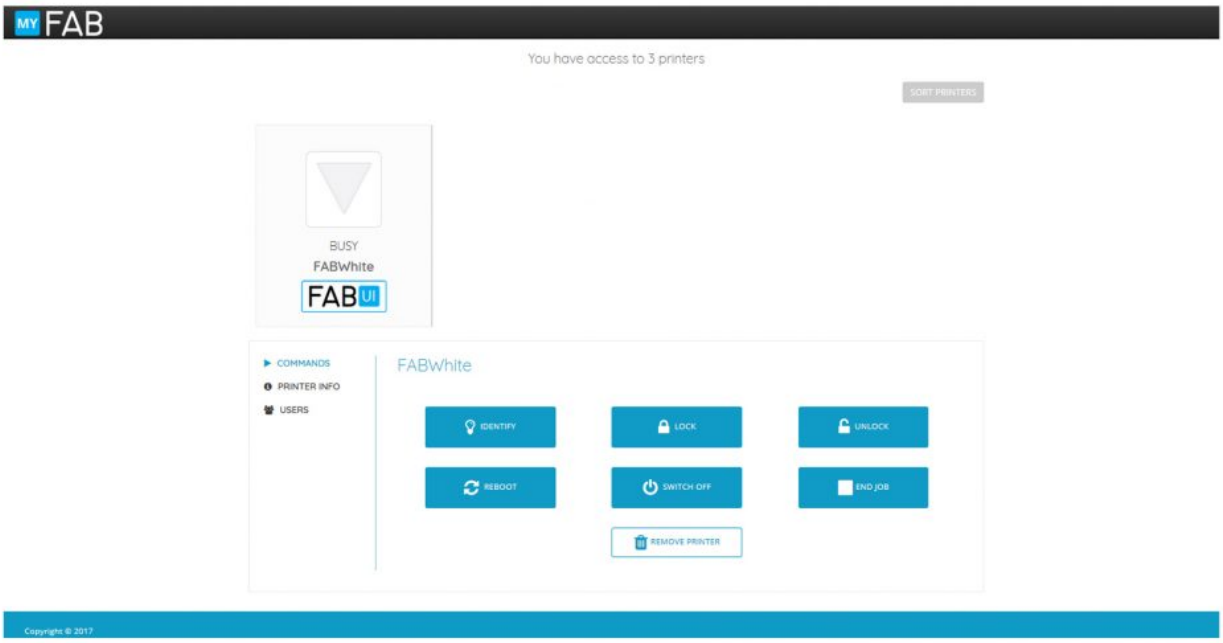
2) Log In the unit FABUI

Log in the FABUI using the Local Access button. This account is the “Owner” of the unit, the one registered during the installation procedure.



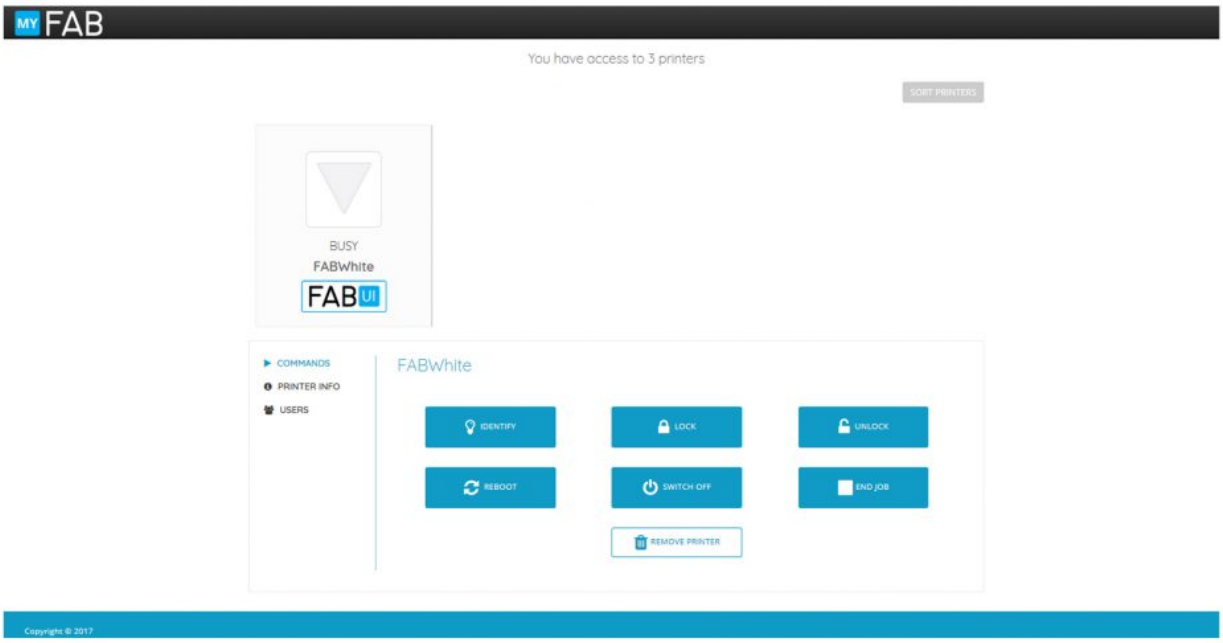
3) Connect to to MY.FABtotum

From the FABUI click on your account name in the top left (1).
Then Click on the *"Connect to your FABID account"* button.
A form will pop up. If you already connected before, it should log you in automatically, otherwise fill the form and log in.



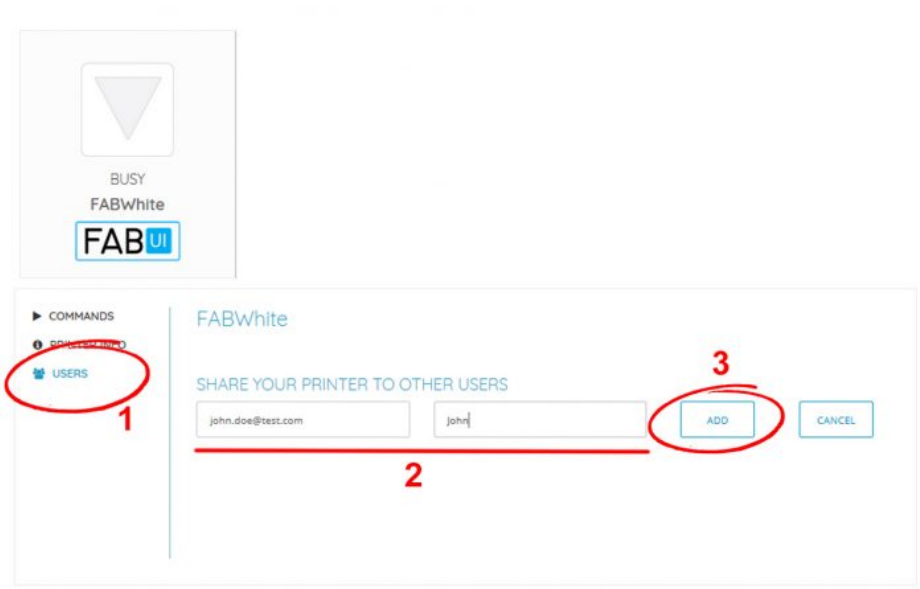
4) Done!

Your printer should shortly appear on your my.fabtotum.com page, where you can see all the printer information, IP address and remote controls.
As owner of this printer you can share it with anyone as well (see below).
From now on you can login to the FABUI with FABID instead of the “Owner” “Local Access” login (the FABUI must be connected to internet).



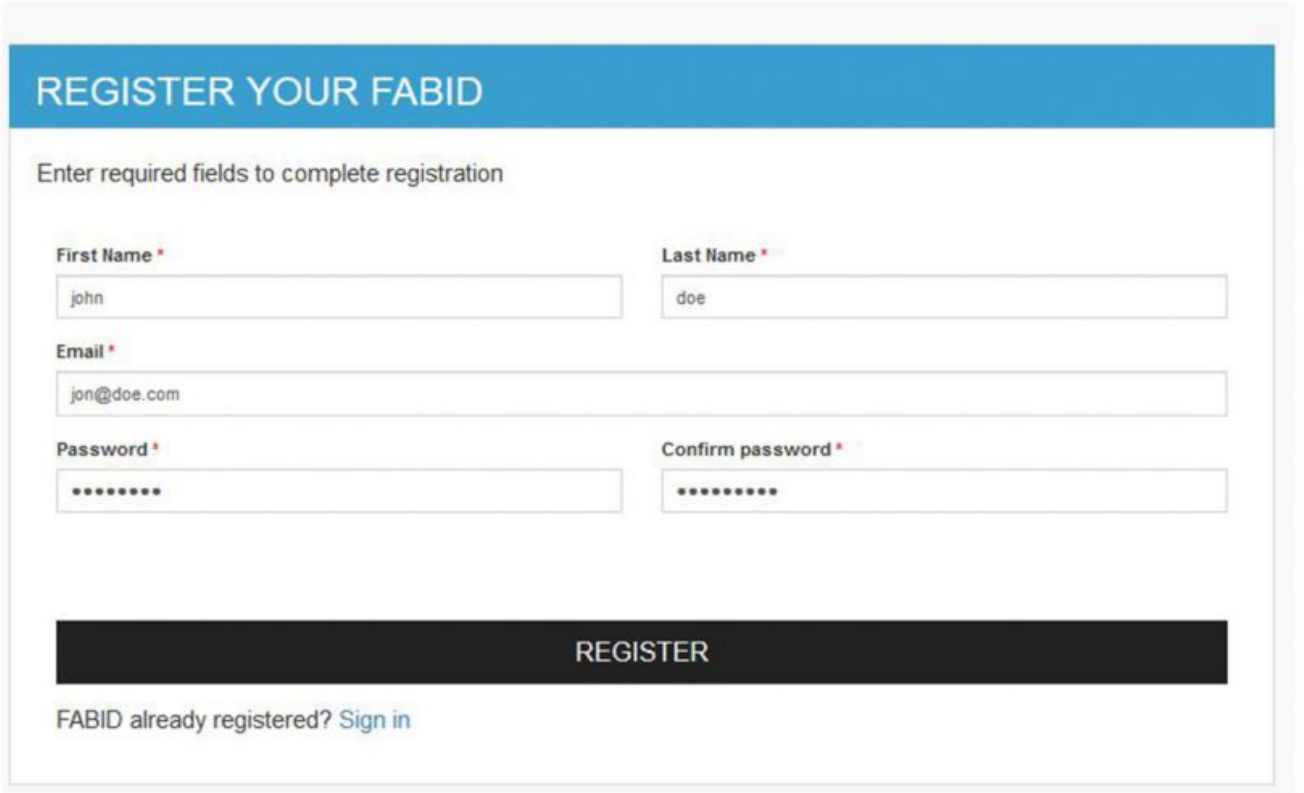
1) Access MY.FABtotum website

This procedure allows to share a printer you own (of which you have local access/you created the first user) that is already connected with FABID to the MY.FABtotum service. If you need to connect your printer first or obtain a valid FABID, see the paragraph above.
During this procedure the printer you want to share can be offline or not powered, but will need to be online and on for the user later.
First log in to your MY.FABtotum page with your valid FABID.



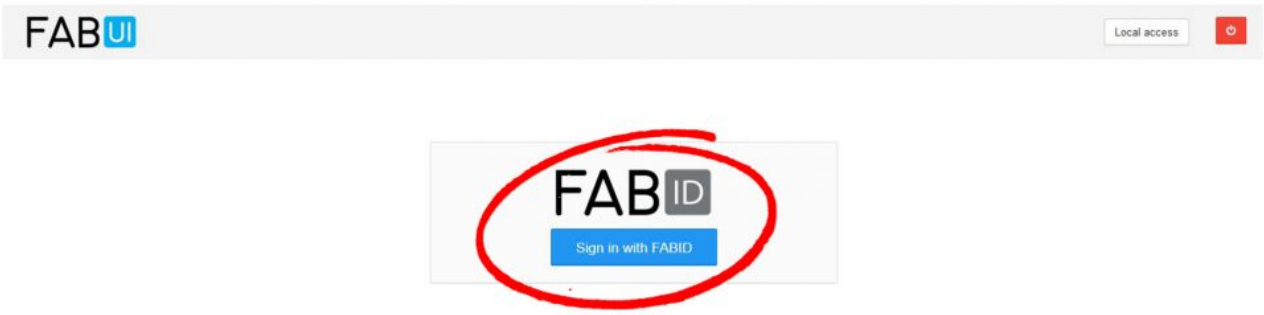
1) Share the access

From the list, click on the icon of the unit you own that you want to share.
From the menu select Users (1) then fill the form (2) with his valid FABID address.
The unit will be shared with this FABID email and this one only.
The Nickname field is just used by the owner (you) as a reminder of the person/department this unit will be shared.
Hit “Add”. An email to his FABID address will be sent shortly after notifying of the new shared unit.
If he does not have a valid FABID he will be able to register it later before being able to interact with the unit.



3) (optional) Register FABID

If the user have no FABID access, he can go to the login/registration page
A confirmation email will be sent afterwards. Use a valid email address.
The FABID login will be the one used for all accesses on all FABtotum services.
For more information check out the FABID page.



1) Done

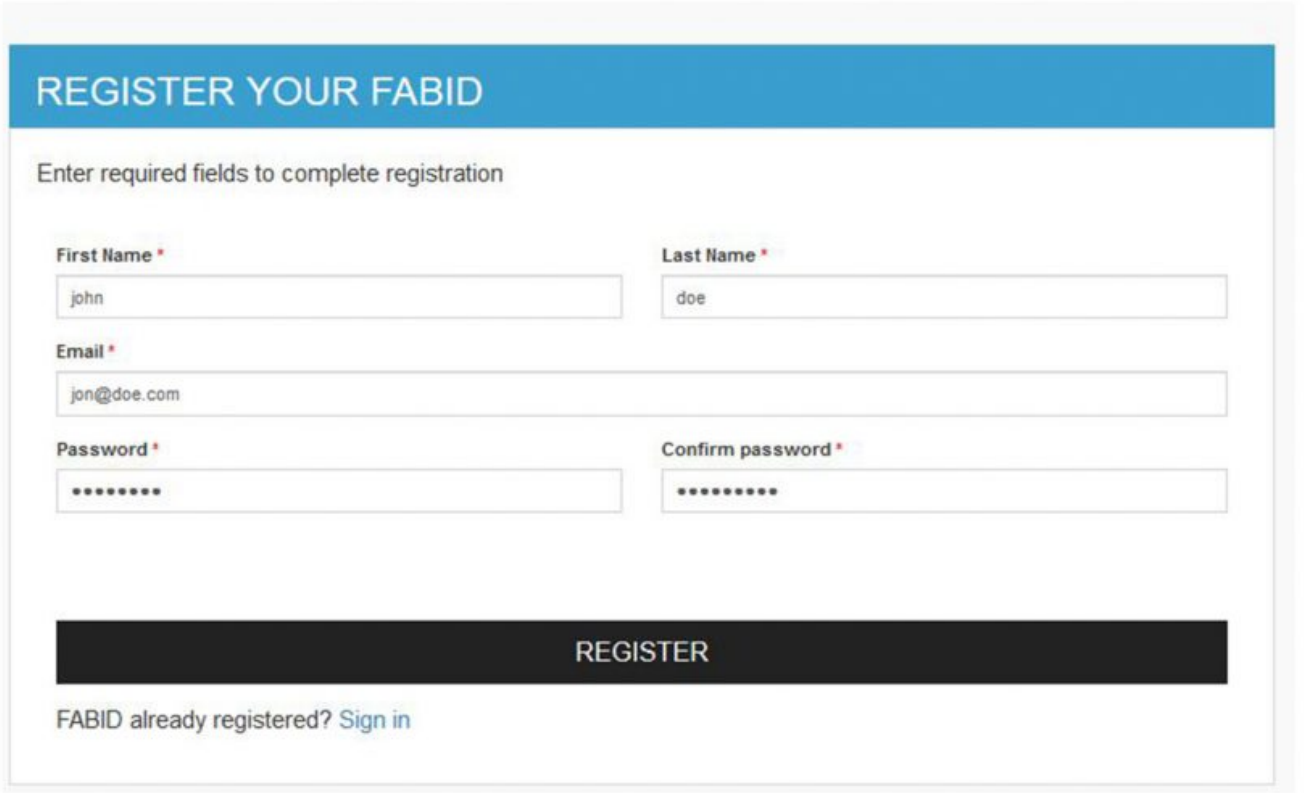
The shared user will now be able to log in on the FABtotum FABUI using his FABID login. He will also be able to see and manage the printer in the MY.FABtotum page.
He will not be able to share the printer with others as he's not the owner.
You can share the same printer with more people by repeating step 2.
The owner can revoke shared access by removing the user from the Users menu of desired device in the MY.FABtotum panel or by disconnecting the printer from FABID.
This last action will remove ALL shared users.

CAM TOOLBOX – ENABLE SUBSCRIPTION

What is CAM Toolbox?

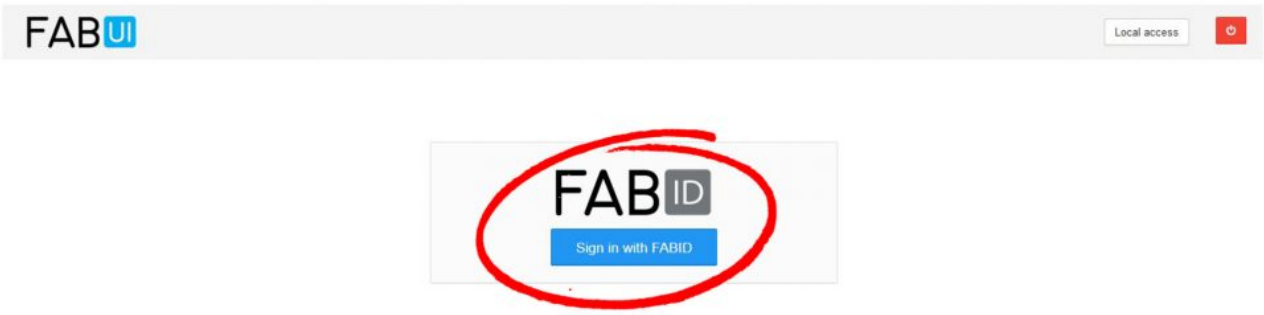
CAM Toolbox is tool for postprocessing images and files for laser engraving.
With CAM Toolbox you can prepare Gcode engravings for the Laser Head directly from your FABtotum FABUI interface and launch the gcode directly from within the FABUI.
You can access CAM toolbox from the latest FABUI version.

Get a Licence



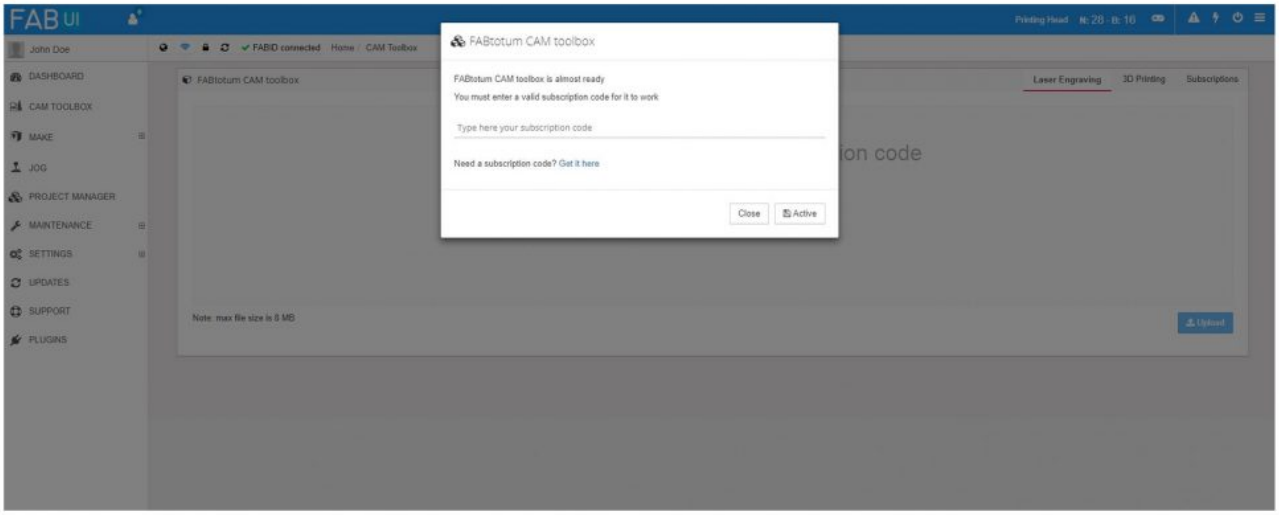
1) Register your FABID and MY.FABtotum

If you don’t have a FABID login, go to the login/registration page
A confirmation email will be sent afterwards. Use a valid email address.
The FABID login will be the one used for all accesses on all FABtotum services and the FABUI.
After the confirmation is completed you also need to add the FABtotum to the MY.FABtotum service. Click Here to learn how to do it.



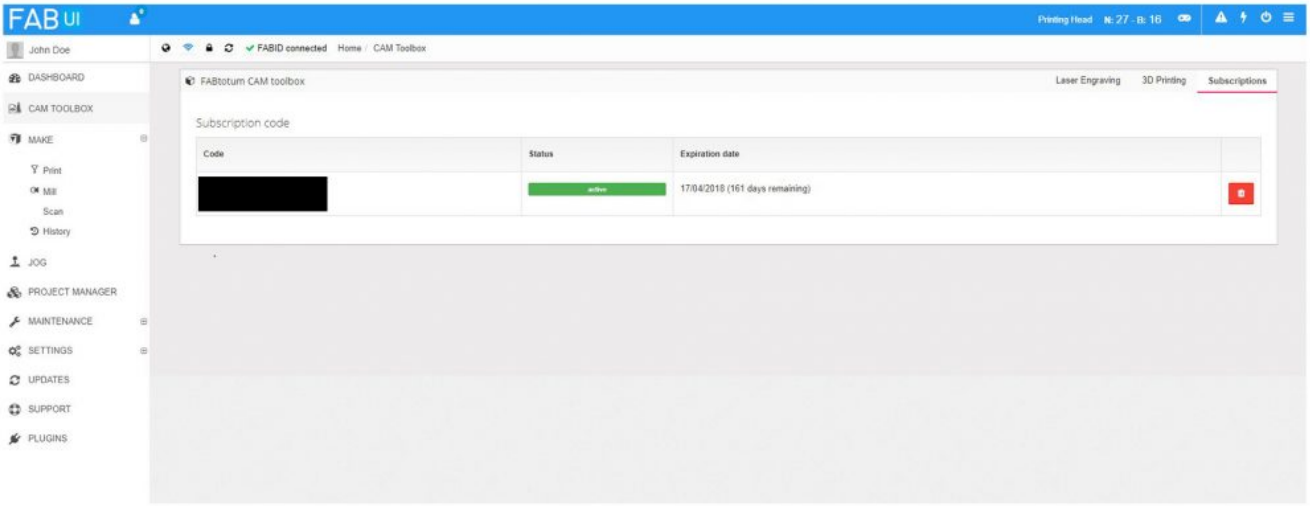
2) Log In the unit FABUI

Log in the FABUI using your FABID connected to the printer. This account is the one that will activate the CAM toolbox subscription.



3) Activate the licence

From the FABUI click on the CAM toolbox menu (left column).
Go to the subscription tab and add your licence code.
If you need a new licence, you can purchase one from the FABtotum Store Subscriptions section



4) Done!

The licence should show up as active.
You can now process the files as usual by going in the desired CAM Toolbox section tab (e.g. Laser).
Consult the laser engraving and cutting software guidelines to get started in laser engraving via the CAM toolbox.

3. 3D PRINTING

YOUR FIRST 3D PRINT

Ok, so you have already calibrated your FABtotum and you are ready to 3D print your first test object.
If you haven't already: go to Maintenance → First Setup for a comprehensive calibration wizard, this is very important!
Learn more about this in calibration.

To start 3D printing you usually need filament. The FABtotum comes with some sample filament, but you may want to load more filament.
If you have already some filament inside the head, hit the Maintenance → Spool Management → Unload Spool procedure first.

First you'll need a file to print. We have already uploaded some 3D printing samples for you in your printer, you can find them in Project Manager – Samples.
You can also upload and print other files, following this procedure, but if you are new to the FABtotum just stick to the samples.
Under the Project Manager, select the object you want to print, then press the "Print" button.

(Please note that you can print something from the Create menu as well!)

Now you are in the folder with the samples, choose your favourite file, for example Marvin key-chain, then Next
Be sure the working plane and the nozzle are clean, close the front cover, then press Continue as instructed.

Choose Simple homing or Auto bed leveling
If your printer is well calibrated, select Simple homing: the print will start quickly.
If you aren't sure about calibration, select Auto bed leveling: the probe will start to measure the bed orientation, then the print will start (it will require few seconds to heat-up).

Starting the print

Wait for the printer to be ready: the carriage will be in the left corner, the Z axis will be homed and bed and nozzle heated (this usually requires around 2 minutes).
Check the printer as soon as it starts printing (you can hear beep) to make sure the bed calibration is ok and that the

nozzle is leaving a good amount of material on the plane so that the first layer (including the skirt/brim) is solid.

- Don’t let any leftover filament get dragged in the print area, cut it if necessary.
- When your FABtotum is printing, you can check all the printing parameters in the Live feed section (nozzle temperature, bed temperature, Z height, etc.)
- While printing you can edit all those parameters in the Controls section.
- Wait for the printer to finish. You can track the progress from the FABUI.

Once the print is completed, the bed will slide and cool down.
Wait for the bed to reach a safe temperature. The bed LEDs will turn off when the temperature is below 50°C.

Retrieving the 3D printed object

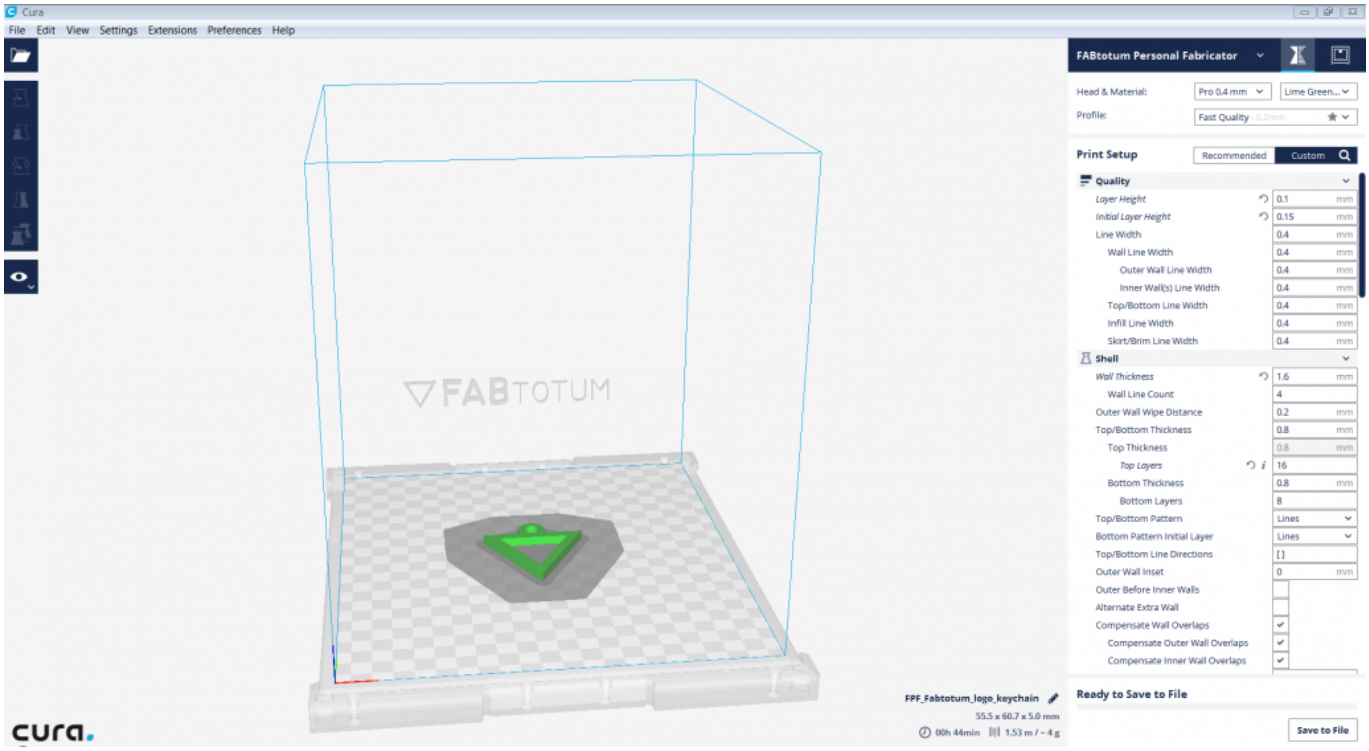
Congratulations! You just finished your first print!
Wait for the bed temperature to go back to safe (the red LEDs will turn off when below 50°C)
When safe, proceed to remove the print by gently pulling it out or twisting the part from the cold glass surface. A steel spatula may help with this task.

Issues?
Please refer to the troubleshooting section if you had problems during printing or your 3D printed object doesn’t satisfy your expectations.

SLICING WITH CURA 2.X & 3.X

Cura is an open source software created and developed by Ultimaker. The FABtotum can work with .gcodes generated with Cura.
To upload one on the FABUI, refer to the FABUI overview.

Note: for legacy Cura 1.5 support, please refer to “Cura 1.5”



Installation

Installing Cura

Download and install version 2.xx / 3.xx of Cura at: https://ultimaker.com/en/products/cura-software
Locate Cura on your computer’s Download folder, install it and then execute it.

Installing with Windows

Double click on the installer located in your download folder.The setup procedure will ask you to choose if you want the program to open other file formats other than .stl (i.e. .obj).

The Wizard will also ask you if you want to install additional drivers to manage your printers. As the FABtotum does not require Arduino drivers for serial connectivity, you can avoid installing those.
Finally, you can click on “Run Cura” and finalize the setup.

Installing with Mac OS

Drag the Cura icon into your Applications folder to start installation.

Setting Up the Machine settings on Cura

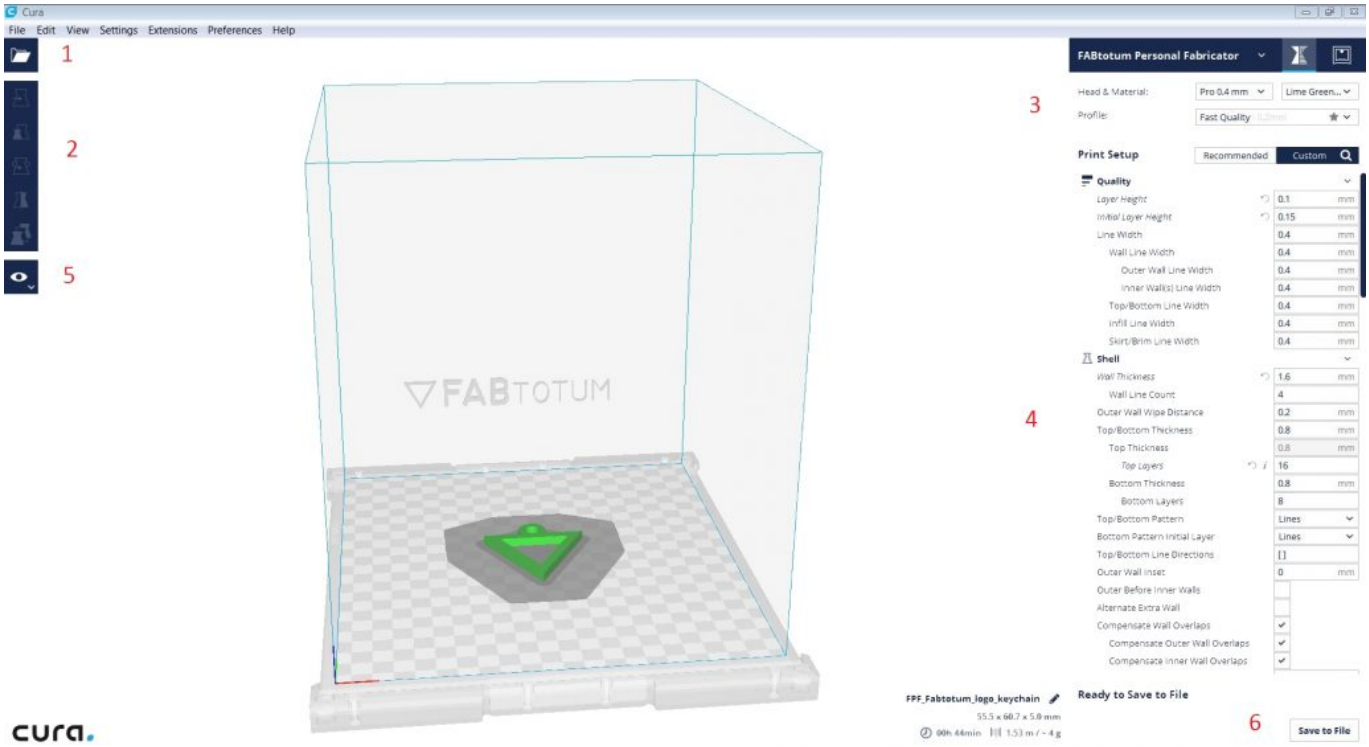
The first time you open Cura you will be asked to choose your machine, select your desired language (English for this guide) etc.
The FABtotum Personal Fabricator is natively supported on versions of Cura higher than 2.6, all other versions of cura will require the user to download and install FABtotum profile packages here: https://github.com/FABtotum/FAB_Configs/

1. Locate the installation path of Cura (eg: C:/Programs/Cura 2.6)
2. Copy the folders contained in the downloaded folder “resources” (definitions, images, materials, settings, meshes, quality, variants) in the “resources” folder of the installation path
   Note: Join the files and not overwrite them, as the software will stop working otherwise
3. Start the application.
4. That’s it, you are ready to slice with Cura.

Note: Profiles are just a starting point and do not constitute a all-in-one solution for all geometries.
Remember that every object is different and has different needs.

FABtotum Profiles

Source: https://github.com/FABtotum/FAB_Configs/archive/master.zip



Slicing an STL model

Once Cura is configured, the correct FABtotum profile is loaded, and you have a model on your computer that you need to prepare for printing, you can proceed with slicing itself.

The task is pretty easy: just drag and drop an .stl or an .obj file to the interface (or select the folder icon “Open file” in the 3D view **(1)**), and the 3D model will load.

You can select it, move it, scale it, rotate it, mirror it and multiply it using the transformation tools **(2)**.

Select the head, the material and the quality profile you want to use to print the model (Eg: Printing head Pro with 0.4mm nozzle in Lime green PLA in fast quality) **(3).**

You can vary the single printing settings **(4)**.

Check how the machine will perform layer by layer (crucial thing to do) by clicking on the view mode icon **(5)**, and save the .gcode by clicking the “Save to File” button on bottom right of the window **(6)**.

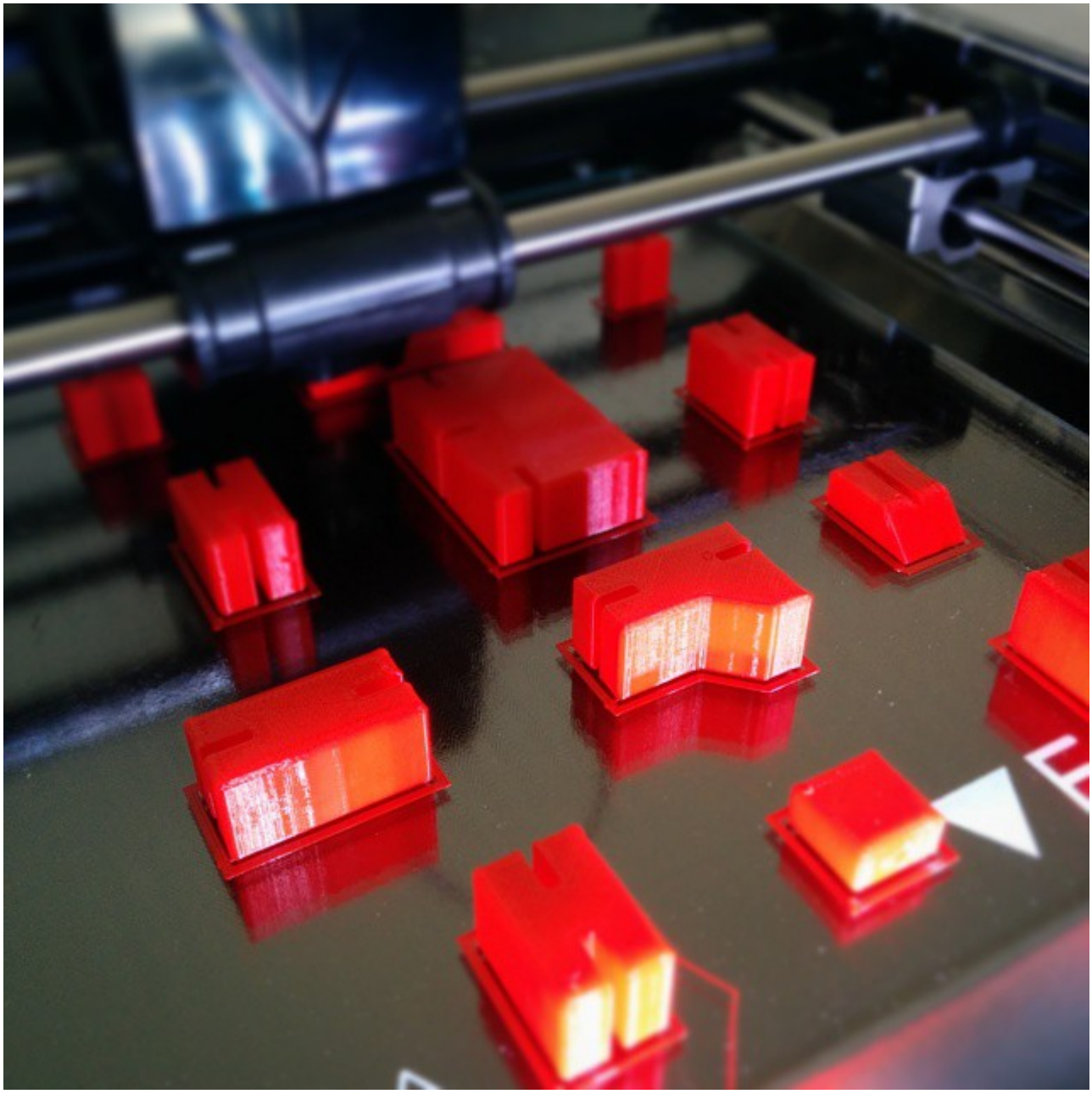
Once you have saved your .gcode file, you must upload it to the FABtotum via the FABUI’s project manager. You can then proceed to print it as usual.

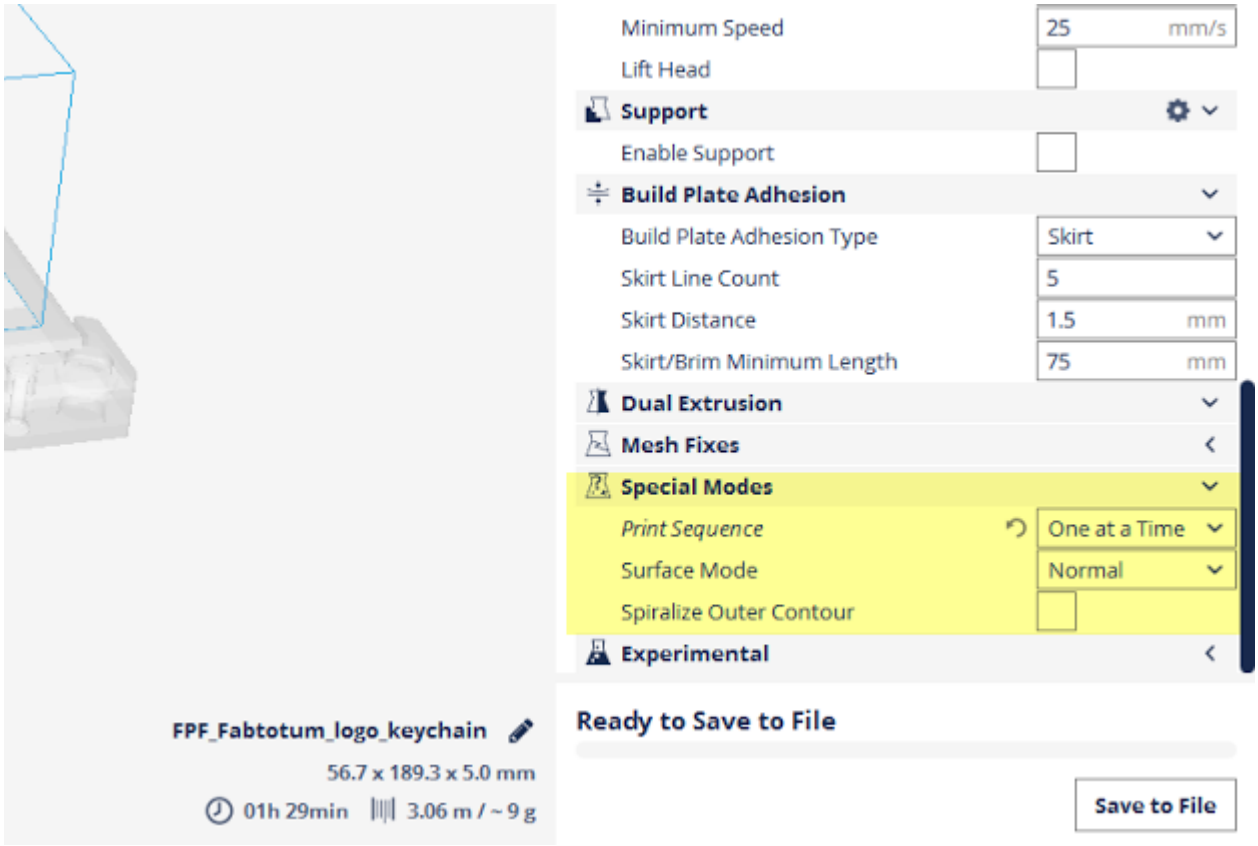
Sequential Batch Printing

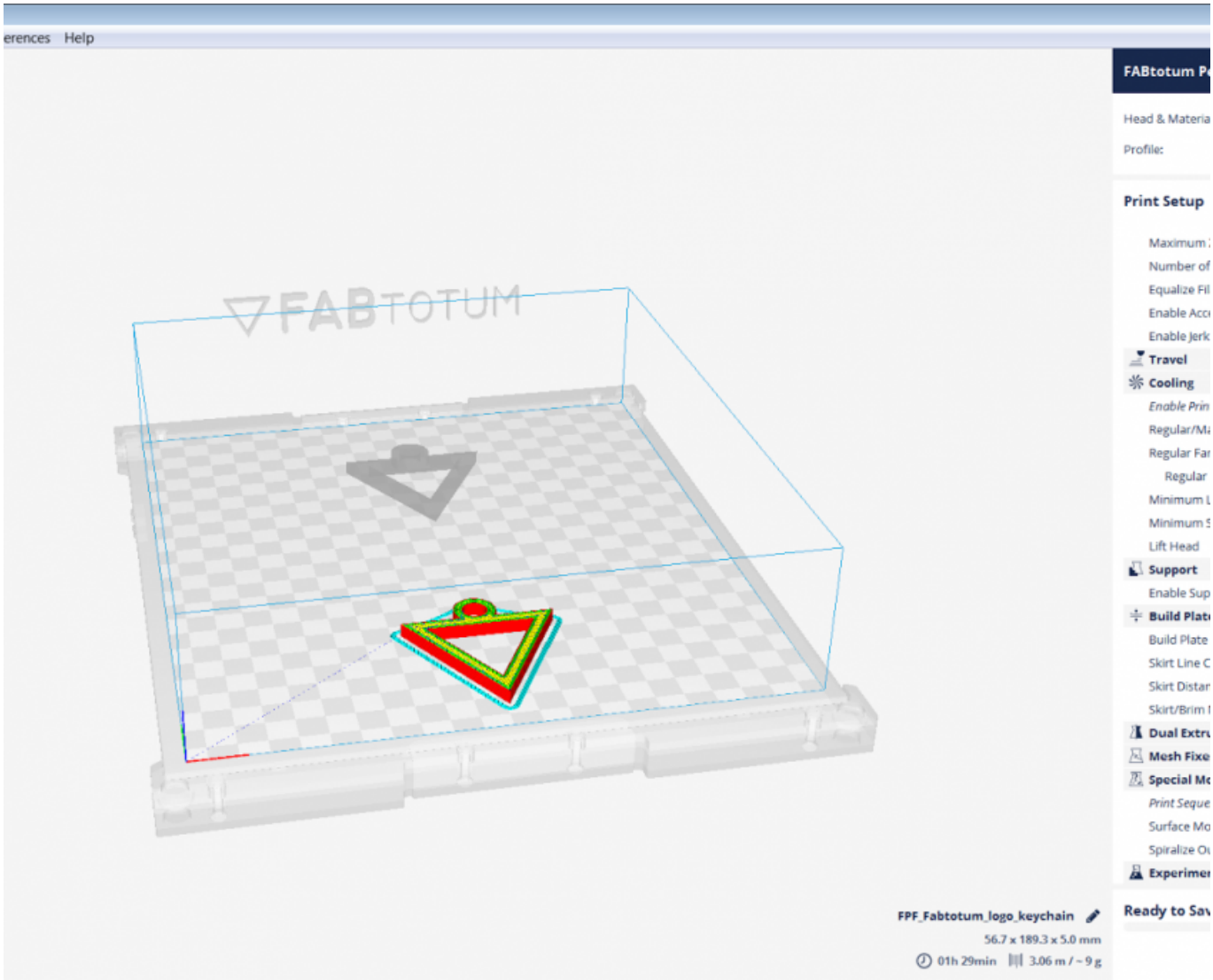
Both Cura 1 and Cura 2 allow to choose the mode of the batch printing: you can print many objects at the same time or one at the time.
This is very useful to reduce printing times and user intervention between multiple prints. It also allows to prepare gcodes of complete projects composed by multiple parts that can be printed in one task.

To switch between one mode to the other one modify the value “Print sequence” from “Special mode” section.

If you select the One at a time mode you will see the the printing volume reduced as size: this for avoid collision between the printed objects (that can have a height < = 17mm) and the carriage.




Minimum Speed
25
mm/s
Lift Head
Support
Enable Support
Build Plate Adhesion
Build Plate Adhesion Type
Skirt
Skirt Line Count
5
Skirt Distance
1.5
mm
Skirt/Brim Minimum Length
75
mm
Dual Extrusion
Mesh Fixes
Special Modes
Print Sequence
One at a Time
Surface Mode
Normal
Spiralize Outer Contour
Experimental
FPF_Fabtotum_logo_keychain
56.7 x 189.3 x 5.0 mm
01h 29min
3.06 m / ~ 9 g
Ready to Save to File
Save to File



Common Slicing Parameters

Once you have tried our profiles you will want to make changes and create your own.
Here are some basic information on slicing.

- **NOZZLE SIZE:** This is the tiny hole from which the material flows, the Hybrid Head has a 0.35mm nozzle, the Printing Head (PRO as well) a 0.4 mm interchangeable one as standard (more are available, their compatibility depends on the Head).
- **LAYER HEIGHT**: This parameter corresponds to the height of each layer. A bigger layer means a less precise, but faster print, a smaller layer means a more precise, but slower print. The maximum layer height is calculated in relation to the size of the nozzle. You should divide the nozzle size by 2, that way you will get a good value to use as a maximum layer height.
  Divide the nozzle size by 3, 4, or 5 to get good values for very high quality prints.
  The minimum layer height is linked to material fluidity, for a standard PLA filament we achieved really nice results

with a 0,05 mm (50 microns, 1/7 Nozzle) layer height. With a 0,03 mm (30 microns, 1/11 nozzle) layer the material started to curl while depositing and the surface finish was worse.

- **SHELL THICKNESS:** With this parameter you can choose how thick the outside shell can be. It refers to the sides of the object. The basic setting foresees you should double the nozzle size (i.e. if using our 0.35 mm nozzle you should set this parameter at 0.7 mm, with our 0.4 mm nozzle, the parameter should be 0.8 mm). However using the basic setting you may see the internal infill of the object from the outside, so this is not appropriate if you want to achieve good surface finish, but you will get a faster print and a lighter object. If you want to create solid sturdy objects, you should increase this as you like.
- **BOTTOM/TOP THICKNESS:** This parameter corresponds to the thickness of the top and bottom shells. These are very important parameters for a high quality print. The higher the value the better the quality, but also the slower the process and the more material is used.
- **FILL DENSITY**: This is the material fill percentage inside the object. Lower infill value means faster printing and lighter but more fragile objects. Higher infill means slower prints, but more resistant objects. Reasonable values range between 10% and 30%. If you are printing PLA, or another low shrinkage material, you can increase infill up to 100% (with ABS you will get a lot of warping).
  There is a big difference between 25% and 24%: that's because up to 24% the filling is in both directions for every layer; from 25%, Cura changes the filling direction at every layer.
- **PRINT SPEED:** This is another parameter that significantly influences print quality. This is the speed at which the machine will print. If you set a very high speed, the mechanical inertia of the machine will start to produce defects on the print. Printing at slower speeds facilitates the machine in following the lines and producing good corners, it also makes it easier for the machine to push filament to the extruder and to cool down the material.
  A good range is between 30mm/s up to 120mm/s, with the most used values being between 50mm/s and 90mm/s.
- **PRINTING TEMPERATURE:** The value to set depends on the material you are using: for PLA a good range is 185°-210°, a good temperature to start is 190°. The material gets more liquid with temperature, so if you want to print at a faster volumetric speed, you will need to increase the temperature of your extruder a little or on the contrary if you are printing slowly you will need to decrease the temperature to avoid melting the material too much. Choose a lower temperature to print files with lots of overhangs.
- **BED TEMPERATURE:** This parameter allows you to choose the temperature of the heated bed. We advise you set this to 40 if using PLA and 60 if using ABS. Max temperature for FABtotum's Hybrid Bed is 100°C.
- **SUPPORT TYPE:** You should use this when printing an object that presents vertical empty spaces. If set to "None" it won't create any support. If set to "Touching build plate" it only creates a support where the support structure should touch the build plane. If set to "Everywhere" it will create a support also on top of the object.
- **PLATFORM ADHESION TYPE:** These are options that you can select to prevent corners from lifting due to warping. "Brim" adds a single layer thick flat area around your object. "Raft" add a thick raster below the object and a thin interface between this and your object. Please note that if you enable either one of the two options, this will disable the "Skirt".
- **FILAMENT DIAMETER:** This corresponds to the diameter of the filament used. Our machine is designed to use 1.75 mm filaments which is the value you should put in Cura. Please always make sure to use our tested and approved high quality filaments when using our FABtotum, you can purchase spools on our store.
- **FILAMENT FLOW:** This is the quantity of material extruded in percentage.
  The ones above are basic parameters, if you're an experienced user you can also work with the advanced settings below.
- **RETRACTION SPEED AND DISTANCE:** The speed is measured in mm per second and corresponds to how fast the filament is retracted while moving from one point to the other. A higher retraction speed works fairly well, but make sure not to set it too high to avoid grinding the filament. The distance is measured in mm and it corresponds to how much filament is retracted, set to 0 for no retraction, we advise you to set to 4 for good quality prints.
- **INITIAL LAYER THICKNESS:** This parameter is used to set how thick you wish your bottom layer to be. Clearly a thicker bottom layer makes sticking to the bed easier. Set to 0.0 if you wish the bottom layer to have the same thickness as all other layers. We advise you to set this parameter to 0.23.
- **INITIAL LAYER LINE WIDTH:** This parameter measured in % is used to improve bed adhesion and provides extra width to the extrusion on the first layer. We advise to set it to 120.

- **CUT OFF OBJECT BOTTOM:** This parameter should be set when printing an object that doesn't have a flat bottom as it sinks the object into the platform. This feature should be used to avoid for the object to detach from the plane.
- **TRAVEL SPEED:** This parameter sets the speed at which the head moves when not printing. Suggested values for this are between 100mm/s, to 200mm/s.
  (500mm/s is the maximum we tried but this causes a lot of noise and may slowly destroy the machine if used for longer periods of time).
- **BOTTOM LAYER SPEED:** It is important that the bottom layer is printed at a slower speed to allow it stick better to the bed, be aware that the bottom layer is the most important layer of all. We advise you set this at 25.
- **INFILL SPEED:** This is the speed at which the infill parts are printed. When set to 0 the machine will use the print speed for the infill. The higher the speed, the faster the print. A faster print will, however, create a lower quality print, but if we consider it's inside, unless you have specific needs, it can be somehow faster.
- **TOP/BOTTOM SPEED:** This is the speed at which the top and bottom layers are printed. When set to 0, the machine will use print speed for them. We suggest you don't print these layers too fast, as printing at a faster pace reduces printing time, but significantly decreases quality.
- **OUTER SHELL SPEED:** This parameter corresponds to the speed in which the outer shell is printed. Printing it at a lower speed will improve the final skin quality, however too much difference between infill speed and outer shell speed can negatively affect printing quality. We advise to set this at 75.
- **INNER SHELL SPEED:** This is the speed at which the inner shell is printed. This should be set at an average speed between the outer shell speed and infill/printing speed. If set to 0, printing speed will be used for the inner shell.
- **MINIMAL LAYER TIME:** This feature sets the minimum time spent for a layer to cool down, before the next layer is put on top. We advise to set it to 6.
- **ENABLE COOLING FAN:** This feature is essential especially during faster prints as it provides extra cooling.
  If you are an expert you can also work with even more advanced settings. This is achieved in Cura by going to → EXPERT → Open EXPERT Settings
- **VOLUMETRIC SPEED (Volumetric Flow Rate):** A good way of understanding your parameters is calculating volumetric speed. This is the number of cubic millimeters the unit is extruding every second.
  You can calculate it as per below:
  LAYER HEIGHT (mm) x NOZZLE SIZE (mm) x PRINT SPEED (mm/s) = VOLUMETRIC SPEED (mm3/s)
  You can change the temperature according to this speed (more volumetric speed, higher temperature) and the maximum volumetric speed of the material you are using.
- **RETRACTION MM AND SPEED:** Our machine is limited to maximum 18 mm/s in retraction speed, so you can stick to this value. As for retraction length, a good value to use it around 6mm (just change at maximum 1-2mm, small changes in this case can be useful).
  Parts with a lot of retraction can damage the filament, till it breaks, so it's better to increase the fill of the part to get the filament to advance more during the print, hence the next retraction will be on a new filament segment.

3D PRINTING FILAMENTS GUIDE

Choosing the right filament

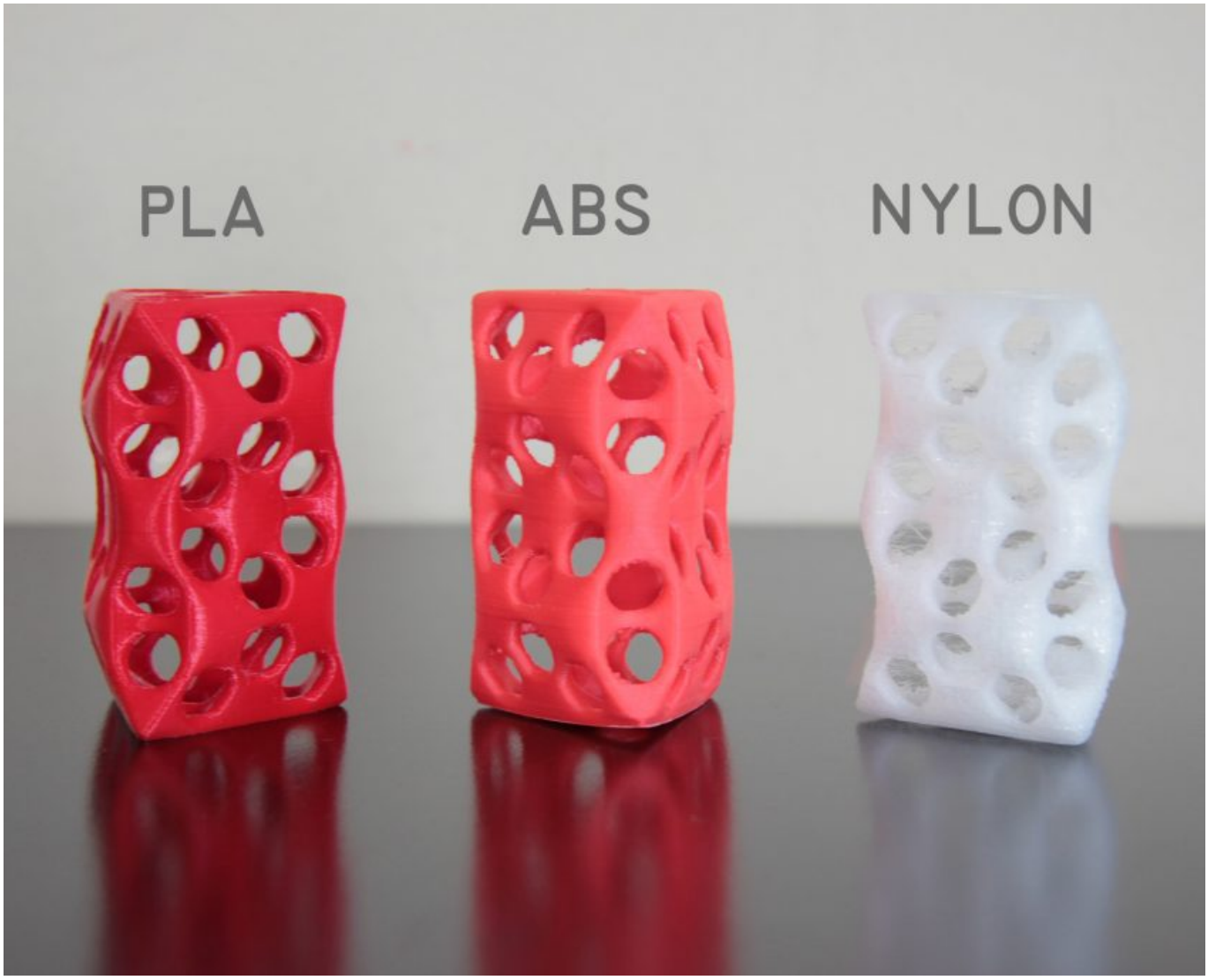
There are several materials that can be 3D printed, each one with different physical proprieties and working temperatures.
The FABtotum can load filament spools up to 210mmx55mm(OD,Thickness), with filament diameter in the range 1.75mm +/- 0.1mm
We strongly suggest using certified official FABtotum brand filaments, as they give more reliable results with our hardware.
You are however free to experiment and use different brands, as long as they use the same material class, diameter and temperature specifications.

See how to load or unload the spools in the load and unload a filament spool article.

Pre-flight check

If you are using a FABtotum filament you should not worry about the material too much, as extensive testing has been done to ensure good performances.
However you may also use third party filaments. In both cases always make sure to keep in mind the following:

- If you are using a Slicing Software profile be aware that it's not meant as a fool-proof solution, and might be tweaked a little to fit each 3D printed object.
  Sometimes a profile will work great regardless, but with the right tuning you might get better results in less time.
- Always store the filament spool in a suitable place, far away from sources of heat, sunlight and humidity.
- Make sure that, if you are using a third party filament, the diameter of the filament is consistent within the tolerance of +/- 0.1mm. Make a few spaced measurement.
- Different filaments use different temperatures. When changing one spool to another which uses a different filament make sure to clean the nozzle at the previous material temperature first, then adjust the temperature, this helps cleaning the melting chamber (hot end) and nozzle.
- Always load and check if the filament is extruding manually (from the JOG menu).
- Make sure the spool is locked in place with the locking lever and it's free to rotate. Have the Feeding tube pass below the back spool roller (under the spool itself) in order to avoid it becoming stuck in the spool once most of the filament has been extruded.



Suggested Temperatures

PLA (Polylactic Acid)

It's one of the most used material in 3D printing: it's a biodegradable polymer that comes from corn.
3D Printing suggested temperature: 200 – 220 °C
Bed temperature: 25 – 65 °C (bed can be at room temperature)

ABS (Acrylonitrile butadiene styrene)

It's a common plastic polymer, it's used to print strong parts. Having an higher glass transition temperature could be used to make parts that are used in hotter environments.
3D Printing suggested temperature: 220 – 260 °C
Bed temperature: 60 – 90 °C

NYLON

One of the stongest material you can find for 3D printing. It can be used for mechanical parts
3D Printing suggested temperature : 245°-255°C
Bed temperature: 90-100°C

Special Filaments:

Combining PLA or ABS with other additives can be possible and will result in different properties.
Charging the polymers with materials like Carbon fibers, wood dust, metallic powder can make stronger materials or with a nice finishing.
Printing settings depends on the polymer used. Refer to the spool manufacturer or , in case of FABtotum Filaments , the Spool label to get the suggested printing settings.

Flexible Filaments

Flexible filaments can be printed only with the Printing Head Pro

Due to the bowden extruder setup it’s -in fact – usually difficult to print flexible filaments like rubber or TPU with the Hybrid Head or the Printing Head V2.
Doing so will result in filament clogging the extruder and subsequent need to clean it.

IMPROVING ADHESION ON THE PLANE

There is a problem that everyone who is using 3D printers will have sooner or later: sticking the printed parts to the build platform.
Adhesion depends on the material used and other environmental factors.

There are different ways to prevent this problem:

- **Calibrating the bed**
  A well calibration will create a constant thickness first layer, the material cools homogeneusly and the printing nozzle will not hit the printed part. With the FABtotum is very easy to calibrate the bed, using the bed calibration guided procedure.
- **Add the brim or the raft to the sliced model**
  All the most used slicing softwares allow to add brim, that is a single layer area around the model, increasing the surface of the object attached to the building plate. Second one builts extra surface under all the object: a better option when thing is not flat.
- **Clean the glass**
  The simpliest way is to clean the glass of the plane properly (when printer is off) with methylated spirits, removing dust, glues and fingerprint.
  To remove hairspray (see below) a little bit of water with a damp cloth will do. Of course, platform must be removed from the printer first. Pay attention and avoid any water to go on electronic parts.
- **Heat**
  Heating the bed (between 40 for PLA and 60°C for ABS) the printer will be able to perfectly work. Very high temperatures may cause other overheating issues such as stringing or clogging of the nozzle.
  When environmental temperatures are above 25°C, slightly lower bed and nozzle temperatures.
- **Hair spray**
  It's one of the easiest and the cheapest solution for stick the 3d printed parts to the bed. It's better to remove the bed from the printer, by removing the bed to his housing, for not damage smooth rods and other precision parts.
  For remove the spray, rub the surface with a paper napkin with a bit of water.
- **Blue tape**
  This is another common method, there are severals types of paper tape, the most used is the Blue Tape you can find on our store.
- **ABS slurry**
  For printing ABS: It is a slurry made with ABS molten in acetone. It's made using ABS scraps and old wrong prints left in a acetone jar for few minutes, until the ABS is completely dissolved. It can be applied using cotton discs or a brush. Warning! Don't smell the vapours after the application.

Other similar solutions:

- Vinyl glue
- Stick glue
- Kapton tape

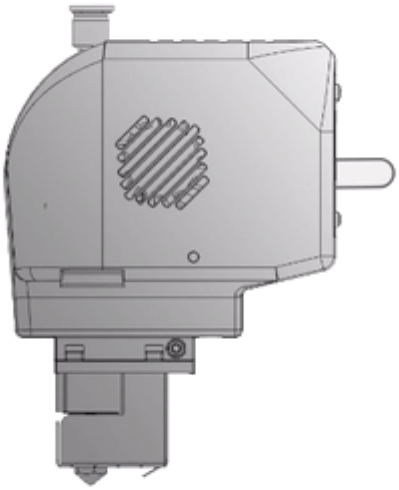
ADVANCED PRINTING HEAD PRO

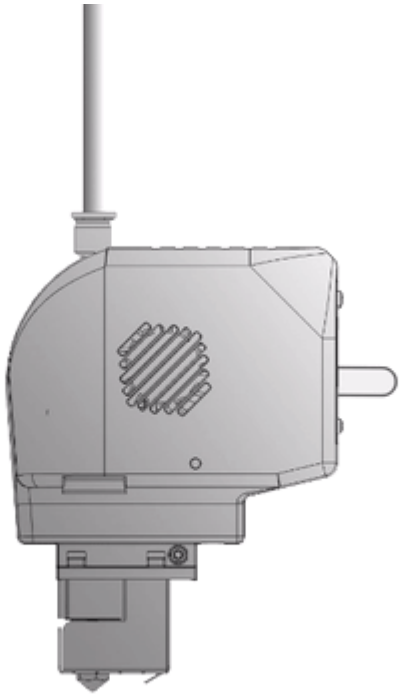
Introduction

The Printing Head PRO is a Head with 1:10 reduction and hi-speed capabilities.
It is important to understand that the main advantage of operating the Printing Head PRO is in its ability to produce more reliable results regardless of the shape of the 3D file being printed, the material and the way the files are arranged on the Hybrid Bed.

In other words with less configuration it is possibile to obtain good results.
Let’s see how to get the best out of the Printing Head PRO by following a few advices.

Filament Management and spool loading/unloading





Depending on the model of the FABtotum (Core, Pro editions) the filament is loaded and unloaded in a different manner.
It’s important to notice that since the Printing Head PRO does not require the feeder mechanism to work, the filament will not be inserted in the feeding mechanism but in a different loading hole.With the Printing Head PRO you can automatically unload or load a spool: from the Maintenance menu, go to Spool.
Such option is also available during a print if the print is paused.
You can also load and unload manually the filament by using the filament release lever on the back of the Printing Head PRO if the nozzle temperature is over 170°C and the unit is not performing any task.
As usual, make sure the filament entering the Head is straight and pointy (cut the tip with scissors at an angle).

FABtotum Core
The Core edition of the FABtotum Personal fabricator have a secondary hole in the spool compartment where to insert the filament if the Printing Head PRO is installed. It is marked by a label in the upper rear corner of the spool compartment. Use this hole to insert the filament up to the Head.

Install the PTFE tube on the Printing Head PRO (1,2) and the back of the FABtotum CORE.
Do not use the onboard feeder mechanism to feed the Printing Head PRO.
Push the filament up until the Printing Head PRO feeding gear, then pull the lever in the back of the Printing Head PRO to complete insertion by pushing the filament further (3).

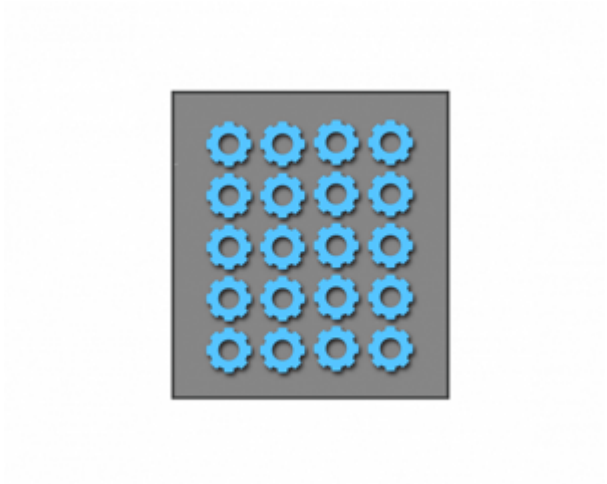
FABtotum Core PRO
The Core PRO edition of the FABtotum Personal Fabricator have a secondary hole in the spool compartment where to insert the filament if the print head pro is installed. It is marked by a label in the upper rear corner of the spool compartment.

Here a filament sensor will sense if the filament is present. Use this hole to insert the filament up to the Head.
Install the PTFE tube on the Printing Head PRO (1,2) and the back of the FABtotum Core.
Push the filament up until the Printing Head PRO feeding gear, then pull the lever in the back pof the Printing Head PRO to complete insertion by pushing the filament further (3).

Core Edition (up until May 2017) & Older Models.
Older units can operate the Printing Head PRO just like any other version above. However no hole in the back panel was present to push the filament, a feature needed unless the spool is kept outside of the unit during print.
Refer to the replicable parts archive to obtain thePrinting Head PRO hole mask to assist you in making a hole in the back of the unit for upgrade.
Notice: if your model does not feature a spool filament control (that pause the print in case of spool depletion) make sure to check that the remaining filament is enought for the print you are about to start or that you pause the print with enought filament remaining to allow a confortable extraction of the filament.
Once you are sure your unit is properly configured and upgraded, follow the instructions to insert and remove the filament from the Core Paragraph.

Filament Extraction/ Spool unloading
Filament extraction on the Printing Head PRO can be done manually or assisted via the spool load/unload procedure available in the Maintenance menu or during a Pause in the print. You can also trigger a pre-programmed pause by introducing a “M0” in the Gode at the desired line.
Once the procedure is completed you can remove the PTFE tube (1) by pushing the push-fit (2). Then pull the filament out of the chamber by pulling up the release lever with the nozzle still hot (3).

Slicing Tips & Tricks for the Printing Head PRO



Nest parts, Avoid Batch Printing

The Printing Head PRO can work on objects with intensive retractions requirements.
It does that with extreme speed and power. Take full advantage of this feature by packing more objects on the Hybrid Bed, the heated bed of any FABtotum, and have them be as close as reasonably possibile and by not using the batch printing feature of your slicing software.

Doing so you will be printing layer by layer all the objects without the need of wasting space.
This is useful for production or pre-production batches of parts that need to produce many pieces without the intervention of the user.

Speed Can be Beneficial, especially at lower temperatures.

With the built-in bowden tube it's common to reduce speed to improve filament grip and surface details.
Instead, with the Printing Head PRO, speed can produce beneficial effects on the print by reducing the time the nozzle is in contact with a particular surface, reducing heat exchanged with the part.
Since the Printing Head PRO can reach higher extrusion volumes, it also means it can print faster even at lower temperatures.
PLA, for instance, can be printed at 5°C less than usual (or even more) without impacting extrusion.
With lower temperatures small details can be obtained more easily.

Customize Slicing Profiles

The Printing Head Pro main advantage is that it can print every 3D object at the first try regardless of the shape.
This does not mean that best result can be obtained from the standard profiles, but that the standard profiles usually are the best in most situations.
Temperature and speed can be tuned, while retracts might depend on the stiffness of the material, in order to reduce artifacts (e.g. on flexible materials).
This way the standard profiles can be tuned for speed or for quality.
All slicing profiles and onboard samples have been tested with FABtotum Official Filaments but may be as well adapted with ease for the respective third party materials.

GENERAL 3D PRINTING TROUBLESHOOTING

When 3D printing with the FABtotum you may encounter difficulties in building certain shapes. As a general rule, always start troubleshooting with this basic set of rules:

The first layer doesn’t stick during printing or the print detaches.

If the filament doesn’t stick during printing, check the following:

- The bed temperature is sufficient for adhesion. Temperatures vary greatly depending on the material and the area covered by the first layer. Don’t turn temperatures too high or the filament, especially PLA, will clog the nozzle.
- There is no debris and the bed is clean of any fingerprint. Skin grease as well as cleaning products can compromise adhesion. Always use denatured alcohol and a clean cloth or paper towel.
- The temperature nozzle is not too hot or too cold.
- The nozzle is sufficiently close to the bed (the first layer should be slightly squished to perfectly stick).
- If everything else fails, try using a surface adhesion product like blue duct tape or regular hair spray.
- Lower the speed to give it more time to stick and cool.
- add raft or brim to expand the contact surface

The nozzle is not extruding filament.

This is a common problem that can have several causes.

Be sure that:

1. Room temperature is between 15°C and 30°C. Too high temperatures will make printing hard, especially if the object presents many retractions.
2. Keep the nozzle and the bed temperature as low as possible. Reduce retraction length as much as possibly while slicing according to the object’s needs.
3. You’re a strictly using top quality 1.75 mm filaments (we recommend to use ours, as the machine is tested with them).
4. Make sure that the the filament can be pushed by the feeding mechanism, to do so:
    - go to Jog;
    - heat up the head to extrusion temperature (PLA 190°C, ABS 230°C, Nylon 250°C);
    - when temperature is reached extract the feeding tube from the printing module by pushing down the push-fit and pulling up the bowden;
    - click on the E+ button and the FABtotum will extrude 10mm, if the filament is not moving, pull it while the motor is running: the filament has been grinded and requires some help to restart extruding;
    - now push the filament and tube back inside the Printing Head and make sure that you can extrude by pressing the E+ button.
5. The nozzle is clean. You can verify this by manually pushing some filament down the printing module when at printing temperature. If extrusion is difficult and you need a fair amount of force, then refer to the maintenance section to unclog a clogged nozzle.

6. Nozzle is too close to the printing surface. In this case the filament won't be able to get out if too close (you can tell it's too close by the fact that the layer is very thin and has a faint tint, almost translucent).

Head or Bed is not heating

Before you operate the machine with the head you just installed, check if the thermistor is correctly working. In the jog menu (or in the top right corner) you will see the current temperature.
If the nozzle is cold and no temperature has been perceived, you should check current room temperature, as the nozzle should be roughly at the same temperature.
Rising the temperature to 50°C (head) or 35°C (bed) should result in the temperature rising.
If this is not the case please check the following:

1. The unit has not entered its safe mode. Safe mode might trigger when an error occurs (unit ambient color is red or solid yellow).
   To get back from safe mode hit the "Alert" button in the top right corner of the FABUI.
2. Check that the head and the bed are correctly inserted and are making proper contact with their connectors.
3. Check that the temperature is at least 180°C. Note that below 175°C the unit will not extrude, triggering a "Cold extrusion prevented" error, this is done to avoid damaging the filament.
4. Check that the flexible flat cable coming from the carriage (flex, in short) is not damaged in any visible part or has bubbles on its surface. This could be caused by a short circuit and requires technical support.
5. As a last check, use a multimeter to check the thermistor and the continuity of the resistor on both the printing head and the hybrid bed. Contact support for detailed instructions.

4. MILLING

CNC Milling: Making a “Make More” Sign

In this guide we are going to take a step-by step approach on how to use the FABtotum for CNC milling, by engraving a sample sign.
We will engrave the “Make More” signon a foam stock block. We’ll use foam because we can avoid damages to the milling bit if something fails.

Files required:

You can download the SVG from which the gcode was created here: Makemore.svg
Download the .nc file (is the numerical control file): Makemore.nc

Preparing the Milling Job

1. Turn upside down the Hybrid Bed so that it shows the milling side.
   Do not mill on glass as it’s dangerous.
2. Place a piece of material that you will mill and fasten it to the bed (Using M4 Bolts and nuts or in this case two-sided duct tape as the material is very light). For this example, the dimensions have to be at least 135x55x20mm (about 5x2x1 inch).
3. Remove the Hybrid Head or the Milling Head and using the provided tools to install the milling bit of your choice.
4. Install the Head on the carriage and on FABUI.
5. Upload the .nc file in “Project Manager”
6. Now go to the Make Menu and start the job for the file you just uploaded to the FABUI.
7. Mark the “Origin Point” with a pen on the stock material. The point mustn’t be exactly on the edge, but 3-4 mm centered. For future reference, the origin point is exactly the same point where the X,Y and Z axis values are 0 in the CAD model.
8. By using the small Jog widget, move the x,y and z axis (move this axis slowly, by reducing the “feedrate” and the “Z step” to not damage the tip of the milling bit).
   The tip has to be few microns from the stock material, to make a fine calibration you can use a piece of paper: position it over the stock material and start to raise the z axis slowly, start to move the paper until it is blocked between the tip and the stock material.
   NOTICE: If the endtops get pressed click on the warning message “OK” and move the head by hand (If they remain pressed, the controls won’t work).
   When the tip is in the correct position, set “Zero” by clicking on the central button, then press “Start” this will “Zero” the position of the tool so it will start according the CAD drawing and more precisely aligned to the stock as the CAM instructions (gcode) expects.

9. When you are done, press start and follow the on-screen instructions. Once the Job has started, the milling motor will power up and the milling process will begin in seconds.
   Take your time to go around in the Control tabs and see the current speed and RPMs.
   You can play around a bit if you are using Foam. Other materials will be way less permissive.
10. Wait for the milling process to end (less than 10 minutes). The milling bit will stop and you will be later be able to retrieve the piece.

Make your own designs

This was a simple introduction on 3D Milling.

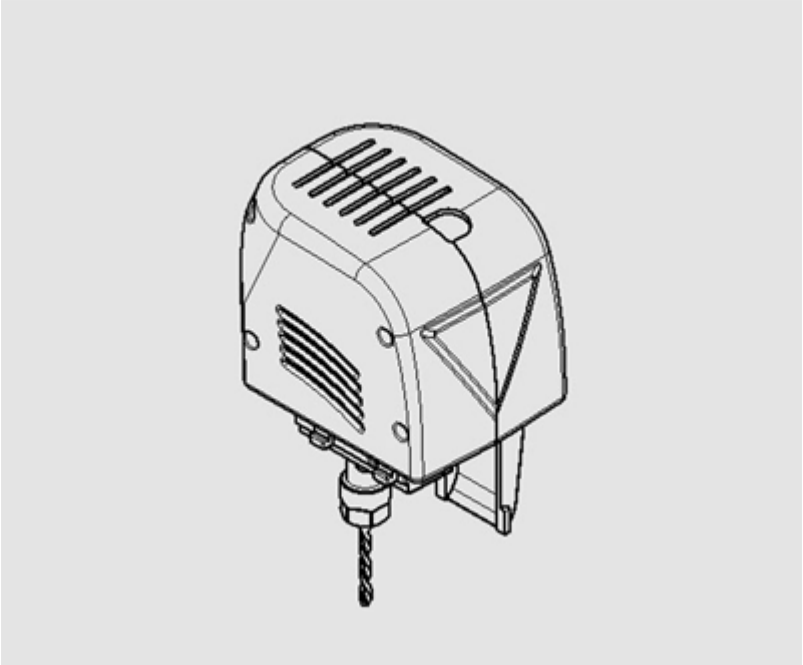
To make more complex designs you can count on a wide array of third party CAD/CAM programs that are widely available and scalable between different sectors.
CAD and CAM design is a wide and deep topic that greatly depends on the software used. If you want to learn how to create your own machining Gcodes starting from your own CAD, look at your CAD/CAM software package and follow the

CAD/CAM guidelines for the FABtotum Personal Fabricator.

You'll be able to generate a gcode file (*.nc, *.gc, *.gcode) with the set of instructions needed to CNC Mill or Engrave your very own CAD design .

In the meantime, check some of the community guides and tutorials on the topic.

INTRODUCTION TO MILLING BITS



The FABtotum Milling Head V2 and Hybrid Head both natively support milling bits with a shank diameter in the range of 3.0 to 3.5mm (0.12 inches or 1/8“)
The above ER8 Collet can be swapped with another compatible one in the ER8 family.
Additional ER8 Collets allow to mount endbits with shank diameter from 1 to 5mm.

Endbits (or Milling cutters) comes in different shapes and sizes, each one for a specific purpose.
Engraving is usually done with fine, point-shaped endbits at higher speeds. Cutting and Roughing of the stock piece are usually done with flat roughing end mills while finishing in 3D milling is done with fine ball nose cutters.

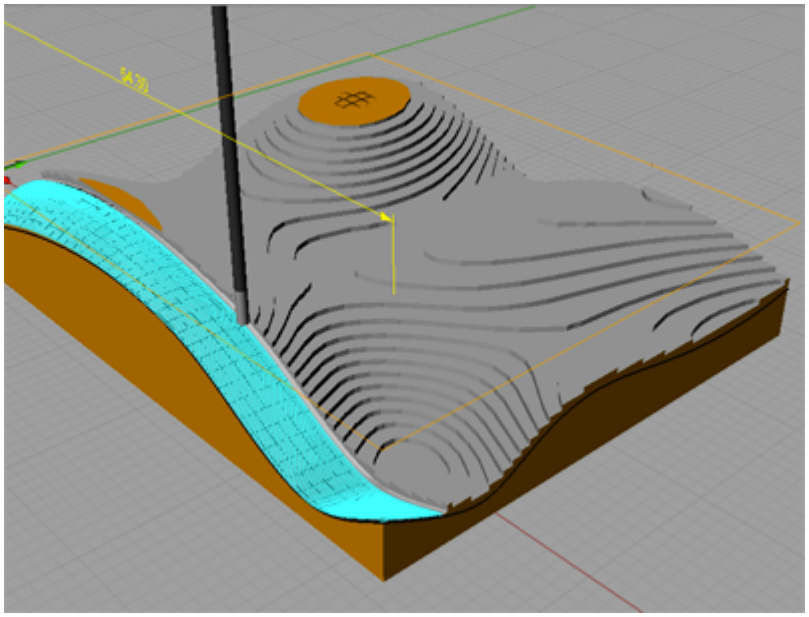
Endbits remove the material by “biting” it away with their flutes while spinning. Each endbit can have a different amount of cutting flutes depending on the diameter and the purpose. The Number of flutes refers to the number of cutting edges that are cut into the body of the tool. More flutes increases the strength of the tool, but reduces space for chip flow. You can cut fast with a single flute tool, but the finish of a three or four flute cutter will be smoother.

Since the number of flutes increases the friction on the tool, which causes the tool to heat up. Some materials, like acrylic or PMMA, require the use of tools with fewer flutes in order to reduce the heat and avoid melting the material. Ideally the tool should never create waste material (chips) that are hotter than room temperature, but that can change very dramatically from material to material.

The speed at which a bit is spun is described in RPM (revolutions per minute).
Every bit has an ideal range of speed or RPMs it needs to operate within.

The ability to change the routers' RPM is essential to good bit life and a good finish.

Vibrations should also be kept at bay. The fewer the flutes, the larger the vibration on the tool, as the load is always localized instead of being distributed among more flutes.



If the tool is going too fast it will heat very quickly, increasing wear and may break. The added stress may ruin the motor spindle.
But how fast is too fast? The concept is better described with the concept of Chip Load.

Chip Load is commonly referred as the amount of material each tool can remove from the stock. Chip Load is dependent upon the feed rate, rotational speed and number of flutes. Each type of material will have a range of optimal chip loads. If the speed at which the tool is proceeding in the material is too much considering the speed at which the tool is removing material then the chip load is too high.

If the chip load is too high noise and vibrations will increase and this usually leads to damages to the endbit.

This leads to the concept of cutting depth. Since you can determine the cutting depth at which the tool operates, a deeper cut will increase the chip load, while a more shallow cut will reduce the chip load. But a shallow cut will stress the tip of the tool more, reducing its capability to plunge effectively in to the material in its lifecycle.

A finishing pass does require more passes to get a smoother surface. flat endmills are usually used only in roughing operations while ball nose cutters are used for finishing contours so you get less of a jagged appearance as shown in the diagram above.

MILLING BITS

Flat End Milling Bit

These ones are very flexible and can be used for many materials, even the hard ones. They are used to carve the material and take the most of it away without a second step. There are single or double fluted bits (actually, there are milling bits with up to eight flutes): the more you have, the harder the material can be. You wouldn't use a single fluted one for metals. The number of flutes increase with the hardness of the material. The FABtotum is able to work on any surface but it might be better to add another pass on the same route rather than going too strong.

Ball End Milling Bit

These are the ones needed to mill details or parts that require a nice and smooth finish. They can be fluted as well and the same idea as above applies.
The Ball End Mill, also known as Ball Nose milling bits, are the best option if the shape is not squared but has curves rounded angles.
They work perfectly with all surfaces but are likely to be chosen when a soft wood, balsa or foam is used. This is not a must but just an idea.
The presence of more flutes can add speed and precision, depending on how they spin: moving clockwise the flutes should take off more material while going backwards they would add a cleaner finish to the object.

V Carve Milling Bit

V carve flutes are used to engrave v-shaped paths and are usually associated with PCB engraving.They are differentiated by the angle of the tip. The bigger the angle the less probable is to break but it will be able to realize only bigger details,

while smaller angles are used for fine details.

5. LASER ENGRAVING

LASER HEAD – SAFETY & HEALTH GUIDELINES

THE LASER HEAD IS A CLASS 3B LASER PRODUCT.
Class 3B lasers are hazardous for eye exposure. They can heat skin and materials but are not considered a burn hazard. For visible-light lasers, this laser's module output power is between 5 and 499 milliwatts at 405 nanometers.

SAFE USE GUIDANCE
The Laser Head is a Class 3B laser product that can reach up to 499 milliwatts. The laser module in this product can emit radiation that causes eye injury if used improperly. Due to the nature of the manufacturing process and the different materials the laser can be shined on, use of laser protective eyewear (provided with this product) is **mandatory** even if class 3B lasers are usually considered safe if reflected from a matte surface. Even mildly refllective surfaces can cause eye damage.

The risk of eye injury is always present: even a brief exposure could cause retinal damage.
Never look directly at the laser beam focusing point unless you are using the provided safety glasses.
Do not use sunglasses or other glasses unless specifically designed to filter out the same power level and wavelenght of this product's laser class.

ONLY ALLOW USE BY A RESPONSIBLE PERSON
This is not a toy. Children should not be permitted to use the FABtotum Personal Fabricator when equipped with a Laser Head.
Any teenager using the Laser Head should be continuously supervised by a responsible adult.

DO NOT USE AS A LASER POINTER
Not designed to work stand-alone and to be easily pointed at targets, the purpose of this product is NOT laser pointing. Use of the unit in this manner is not intended by the manufacturer.
Pointing the unit, reflecting or diverting the beam to another target other than the intended material to be cut or engraved is extremely dangerous and may cause harm or injury.

EYE INJURY HAZARD — DIRECT AND REFLECTED BEAM
Reflections off mirrors, glass, and shiny surfaces can be just as hazardous as the direct beam. Avoid reflected radiation and use of reflective materials.

POTENTIAL EYE INJURY HAZARD – DIFFUSE REFLECTION
Avoid staring at the laser dot at close range, for more than a few seconds even with protective gear. Looking at the laser dot for more than 10 seconds can cause persisting damage.

SKIN INJURY HAZARD
Never interfere with the Laser Head, never place your hand inside the unit at any time.
Do not deliberately attempt to burn skin. This can be very painful, can take long to heal, and can leave a permanent scar.

SMOKE HAZARDS
Airborne particles from laser engraving are dangerous.
Keep in a well ventilated area or use in a segregated room or lab with a fume extractor.
Particulate generated as a result of laser applications is measurable in microns, which means it is small enough to be inhaled. Depending on the material, these particles can cause serious side effects.

IMPORTANT: AVOID DANGEROUS MATERIALS

NEVER USE THE LASER HEAD IN A CLOSED ENVIRONMENT WITHOUT PROPER AIR TREATMENT.
DO NOT USE THE LASER HEAD WITH ANY MATERIAL CAPABLE OF EMITTING SMOKE OR VOLATILE PARTICLES.
DO NOT USE WITH MATERIALS THAT CAN BURN OR SUSTAIN A FLAME.

Never use the Laser Head on materials that may cause dangerous fumes to be emitted and spread. Such fumes can be EXTREMELY dangerous to the health if inhaled or are in contact with skin, eyes and respiratory tract.
While ceramics, glass and wood release microscopic particulate that may cause irritation to the respiratory tract, skin, nose and eyes, metals like steel emit chromium and nickel fumes that are carcinogenic.
Lasered plastics, rubbers and powder coatings produce volatile organic compounds (VOCs). Using a laser system – whether it is cutting, engraving or marking – catalyses VOC gas as it melts the material.Moreover, because these gases are toxic and have the ability to spread quickly, it is important that these fumes are removed immediately.
Synthetic polymers include plastics like polyethylene, polycarbonate, polypropylene, as well as synthetic rubber, polyvinyl chloride (PVC), polyethylene, phosgene and many other materials.
Polyethylene (PET) produces formaldehyde, a noxious VOC and known carcinogen, which means aside from the danger of bringing asthmatic attacks and allergies, it is known to cause cancer.
Rubbers that are exposed to the laser emit benzene, a VOC and recognized carcinogen that may cause death, low white blood cell count, anaemia and cancer.
Polyvinyl chloride (PVC) is a plasticizer that is used to make a multiplicity of products including signage, figurines, flooring and many other products.
PVC emits extremely toxic and corrosive hydrogen chloride acid gas, dioxin, ethylene dichloride and vinyl chloride, which make a very toxic carcinogenic combination.
PVC can cause severe health problems including cancer, neurological damage, as well as reproductive and immune system damage.
Phosgene is an ingredient in most plastics composed of hydrochloric acid. Phosgene destroys lung tissue causing pulmonary edema.

TARGETING AIRCRAFTS AND VEHICLES IS ILLEGAL

Never point, reflect or divert the beam to a moving vehicle or aircraft.

LASER PROTECTIVE EYEWEAR (GLASSES)
The Provided Laser Glasses are mandatory.
Because the eyewear is blocking some or all of the laser's light (for example, a hazardous reflection) you still should use caution even when using laser protective eyewear.
As you use the laser, any other persons in the area should also have the same type of laser protective eyewear as you, or

leave the room if not properly equipped.

DO NOT USE SUNGLASSES FOR LASER PROTECTION
Sunglasses are NOT laser protective eyewear. They are not rated to ensure light-attenuating protection. Most sunglasses will not block enough laser light to significantly reduce hazardous exposures.
use only certified first party equipment or lab-certified equipment rated for class 3B laser products at 405nm.

LASER HEAD PRO – SAFETY & HEALTH GUIDELINES

THE LASER HEAD PRO IS A CLASS 4 LASER PRODUCT.
Class 4 lasers are hazardous for eye exposure. They also can burn skin and materials, especially dark and/or lightweight materials at close range. They should be used with extreme care .this laser's module peak output power is 2000mW @ 405 nanometers wavelenght.

SAFE USE GUIDANCE
The Laser Head PRO is a Class 4 laser product that can reach up to 2000 milliwatts. The laser module in this product can emit radiation that causes eye injury if used improperly. Due to the nature of the manufacturing process and the different materials the laser can be shined on, use of laser protective eyewear (provided with this product) is **mandatory**.
Diffused,reflected or direct radiation exposure can cause skin burns, injury or permanent eye damage.

The risk of eye injury is always present: even a brief exposure could cause retinal damage.
Never look directly at the laser beam focusing point unless you are using the provided safety glasses.
Do not use sunglasses or other glasses unless specifically designed to filter out the same power level and wavelenght of this product's laser class.

SAFE USE IN A WORKING ENVIRONMENT

Due to the nature of the laser emission the workplace/room where the laser head pro is used must be in line with safety regulations depending on your country origin. It's the employer/safety officer or responsible officer duty to take care of personal safety devices and procedures in order to minimize the risk of injury on the workplace.
Access to the room where the laser is being used must be controlled.
All personell should always keep a suitable pair of safety goggles on at any time when in proximity of the device.
Every person in the room must comply with the safety instructions provided by local administrations and the safety instructions.

ONLY ALLOW USE BY A RESPONSIBLE PERSON
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Lasered plastics, rubbers and powder coatings produce volatile organic compounds (VOCs). Using a laser system – whether it is cutting, engraving or marking – catalyses VOC gas as it melts the material.Moreover, because these gases are toxic and have the ability to spread quickly, it is important that these fumes are removed immediately.
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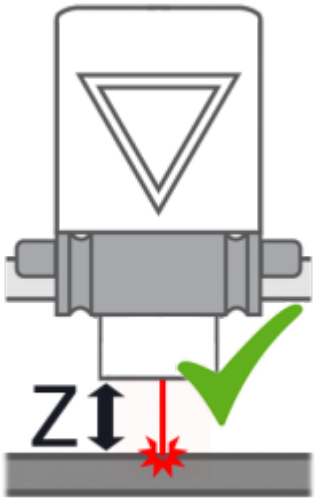
use only certified first party equipment or lab-certified equipment rated for class 4 laser products at 405nm.

CALIBRATING THE LASER HEAD FOCUS DISTANCE



Getting Started

This guide will teach you how to obtain a sharp focusing point with the Laser Head.

BEFORE CALIBRATING: PUT ON THE PROVIDED SAFETY GOGGLES

The Laser Head uses a non-fixed 2-stage lens focusing assembly to obtain a very sharp focusing point.
For the purpose of engraving and limiting health hazards the laser beam has been focused at a fixed range, close to the lower tip of the Laser Head.
Therefore, being the focusing point now fixed, the distance of the Laser Head from the object to engrave or cut must be changed to match the focusing distance.
Usually the focusing point can be found 2 to 4 mm below the tip of the laser head and it can vary during the assembly.

The focusing distance must therefore be determined and saved during this calibration procedure.

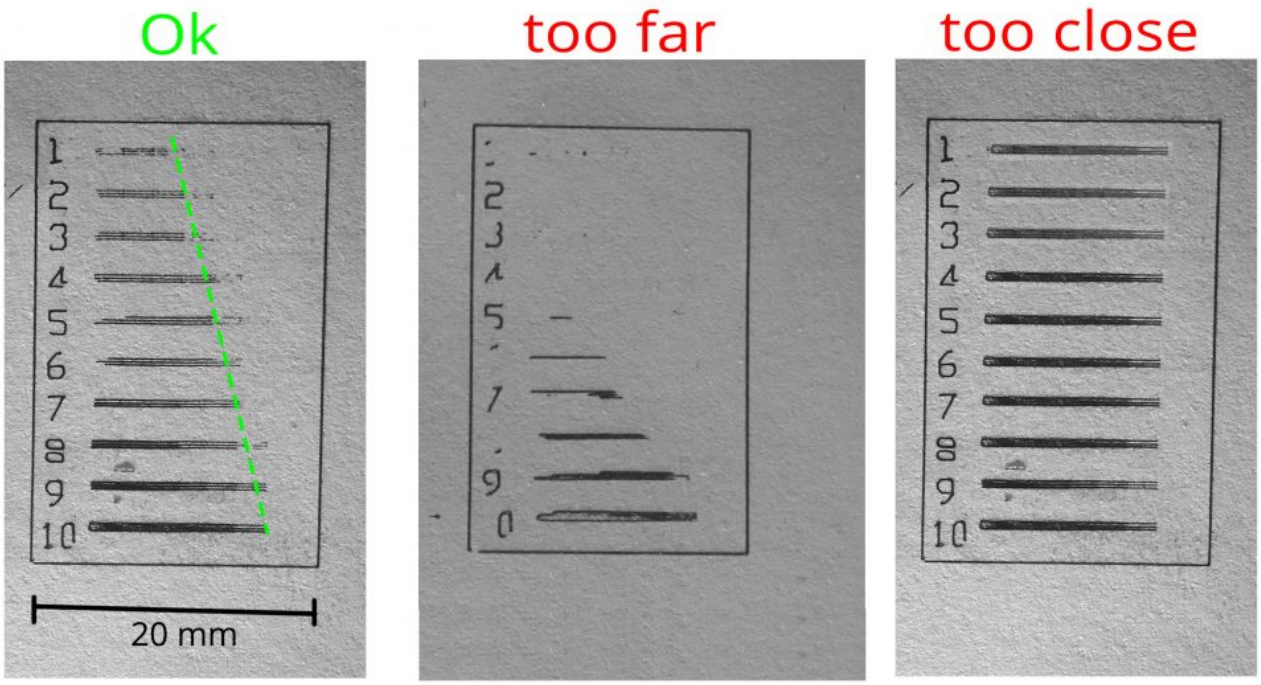
First of all, let’s download the calibration sample Gcode
at http://download.fabtotum.com/gcodes/material_test_pattern.gcode and upload it on your FABUI using the Object Manager.

This is an iterative process. The head will try to engrave different patterns at increasing power that will tell you if you overestimated or underestimated the focusing distance.
This test is also useful to find the right condition to engrave a specific material, as it cycles thru many speed/laser power ratios in order to obtain a good result.

Load the *material_test_pattern.GCODE* gcode file from the Make>Laser menu.
Proceed to put on your safety goggles and take note of the safety warnings and hazards that are listed before starting.
Calibrate the Z using either manual positioning or assisted positioning.

Now get yourself a normal 80gr piece of white printer paper, and place it on the build area (Milling side up).
If you use manual positioning you already know the heigth or perhaps you are using the last known position in a series of laser jobs, all at the same height.In the case of assisted positioning you will be asked to manually move the part you want to laser at around 1 mm from the lower tip of the Laser Head.

Then, after pressing ok , the height will be raised automatically to match the last saved position (3 mm if this is your first time calibrating).
The engraving will start and end within a minute.
Once the process has completed a series of patterns like these should be engraved on the piece of paper.



Find and save the position

What you need to see is:

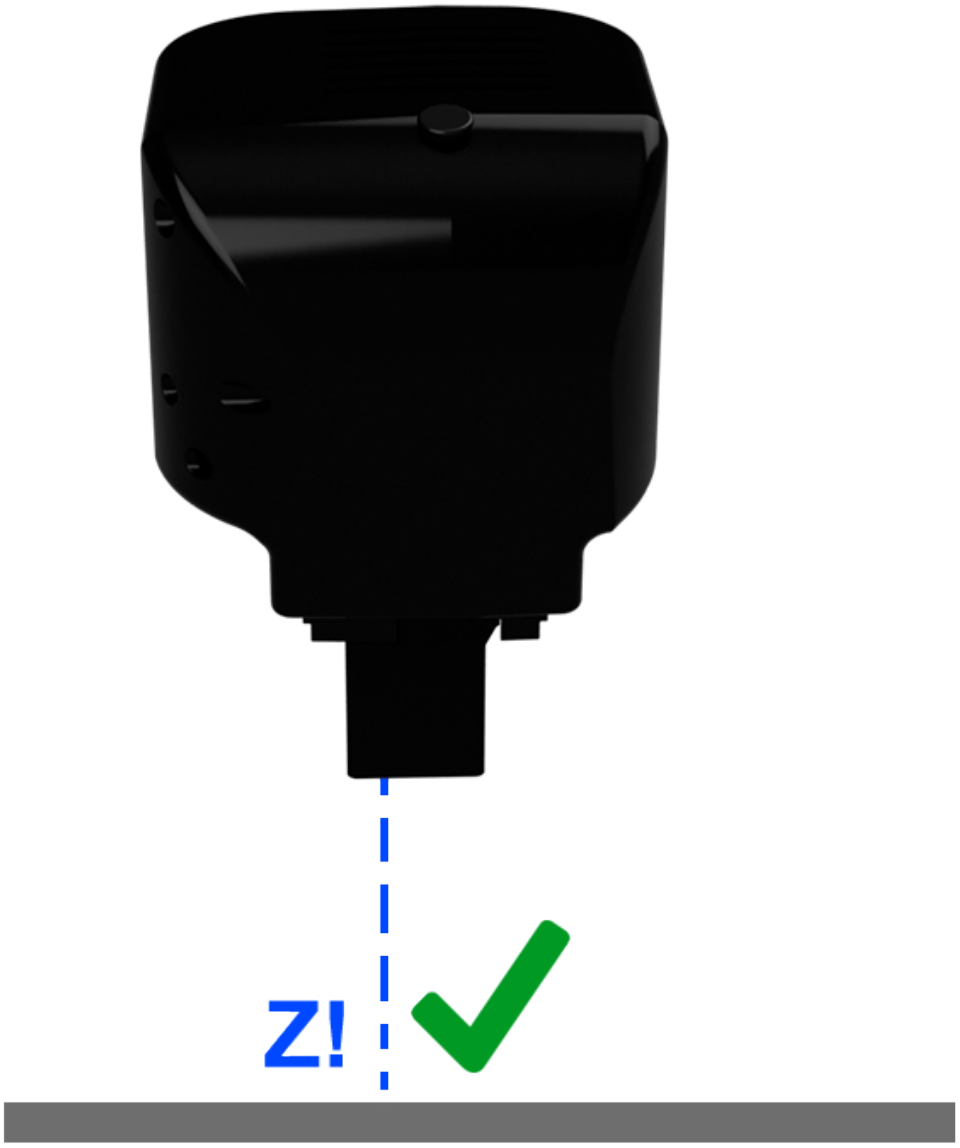
1. A perfect rectangle, almost cut off.
2. A sequence of numbers from 1 to 10
3. A series of “gradient” lines that starts with 50% horizontal fill on the first line (1) and ends with a full black mark -100% fill – on the last line (10)

During the job execution, judge your result and change the Z height accordingly. You can do so by operating on the Z height override button in the command tab.

At the end of each print you will be asked to save the Z height changes.

Change it 1-2 mm each time and test it again, until you get a favorable result.
You can remember the height for later use or start using the Assisted calibration during the laser procedure preparation.
From now on the assisted calibration will return to the position saved each time.

CALIBRATING THE LASER HEAD PRO FOCUS DISTANCE



Getting Started

This guide will teach you how to obtain a sharp focusing point with the Laser Head PRO.

Factory Calibration

Note: The Laser head pro comes pre-calibrated. A factory value is printed on a sticker on the plastic bag.
If you just received a laser head PRO you can quickly set the correct calibration distance by entering this value in the *Z Focusing Distance* Field under Head Proprieties (Select the "gear icon" under *Laser Head PRO* under *Maintenance>head*).
No further steps are required in this case.

Safety First: PUT ON THE PROVIDED SAFETY GOGGLES

For the purpose of engraving and limiting health hazards the laser beam on the laser head PRO has been focused at a fixed range, close to the lower tip of the Laser Head PRO.
Therefore, being the focusing point now fixed, the distance of the Laser Head from the object to engrave or cut must be changed to match the focusing distance.The laser head pro can automatically go to the focusing point after the correct distance is found and saved on the system.
As a rule of thumb, the focusing point can be found 4 to 8 mm below the tip of the laser head PRO.this distance may vary depending on hardware revisions and assembly.

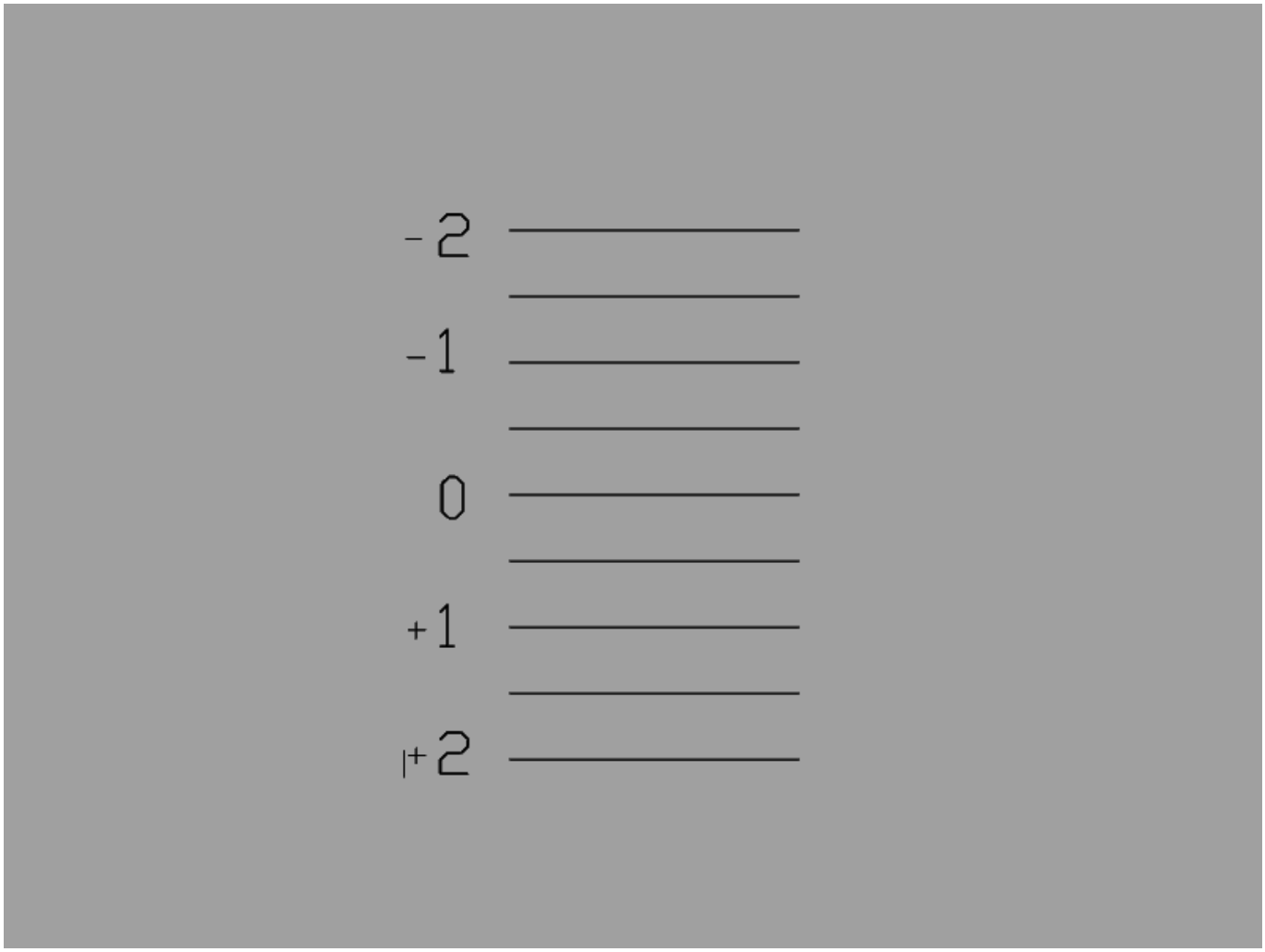
First of all, let's download the calibration sample Gcode
at http://download.fabtotum.com/gcodes/Laser_pro_calibration.gcode and upload it on your FABUI using the Object Manager as usual.

This is an iterative process. The head will try to engrave different patterns at different distances that will tell you how much the focuding point is closer or further.

Load the provided *GCODE* gcode file from the Make>Laser menu.
Proceed to put on your safety goggles and take note of the safety warnings and hazards that are listed before starting.
Calibrate the Z using *automatic focusing*. Automatic focusing is the only procedure that will take advantage of this calibration process.

Now get yourself a normal 80 gr piece of white printer paper, and place it on the build area (Milling side up!).
The laser head should be positioned over the paper sheet.
Save the starting position (with the center button) and proceed.

The engraving will start and end within a minute.
Once the process has completed a series of patterns like these should be engraved on the piece of paper.



Find and save the position

What will happen:

1. A series of numbers from -2 to +2 will be engraved (with the last valid calibration settings).
2. The distance from the piece of paper is automatically increased by 2 mm (the bed is lowered 2mm).
3. Every line from +2 to -2 is engraved 0.5mm closer to the piece of paper.
4. the laser will turn off and the task end, allowing to retrieve the piece of paper.

Observing this series of lines you will have to find the most well engraved line.
Looking the piece of paper against a source of light will greatly help.
Once you identify the best line, see the corresponding value (“-1”, “+1” etc).
Add 0.5 for lines in the middle.

Go to Maintenance>Head on the FABUI. Click on the Gear icon under the Laser Head Pro.
In the “Z focusing Distance” add or subtract the value you just found to the value stored.
For example if you found the best line was at +1.5mm and the stored value was 3.5, then the new value to be saved is 1.5mm+3.5mm=5mm;
Hit save and install.

From now on the automatic calibration will return to the position saved.

LASER HEAD: LASER ENGRAVING AND CUTTING

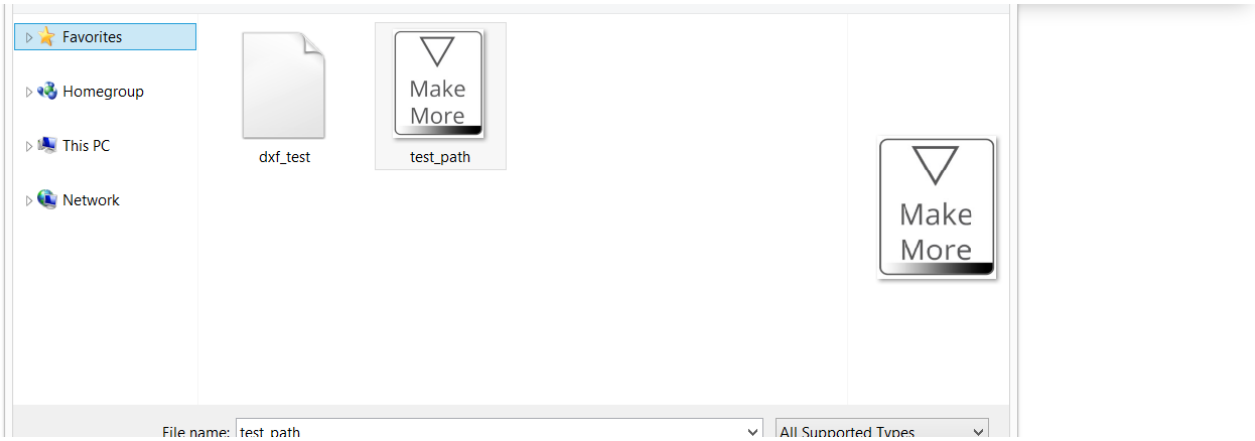
The scope of this tutorial is to illustrate an engraving procedure with a sample raster image.
The procedure is still valid for DXF files, but CAM params will be different when selecting the profiles.
For this tutorial we have chosen the Make More sign on the left.
first of all we'll log in to the Online laser App, in order to generate the Gcode used for laser cutting.

Unique username and password to log on the Laser App tool are to be found on the "First setup guide" sheet provided with the Laser Head.

Let's then follow the instructions provided in the following slideshow.

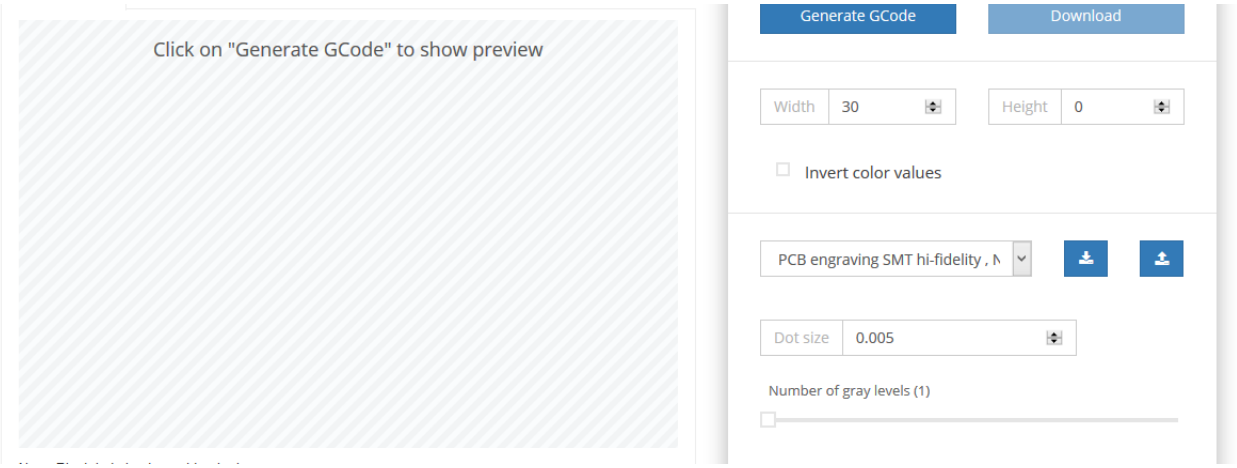
Click or drag and drop to select the desired image.

When using the online application you can Upload *.DXF *.PNG and *.JPG file types. The app will show different options for each one selected. For the purpose of this tutorial we'll use the provided image sample.

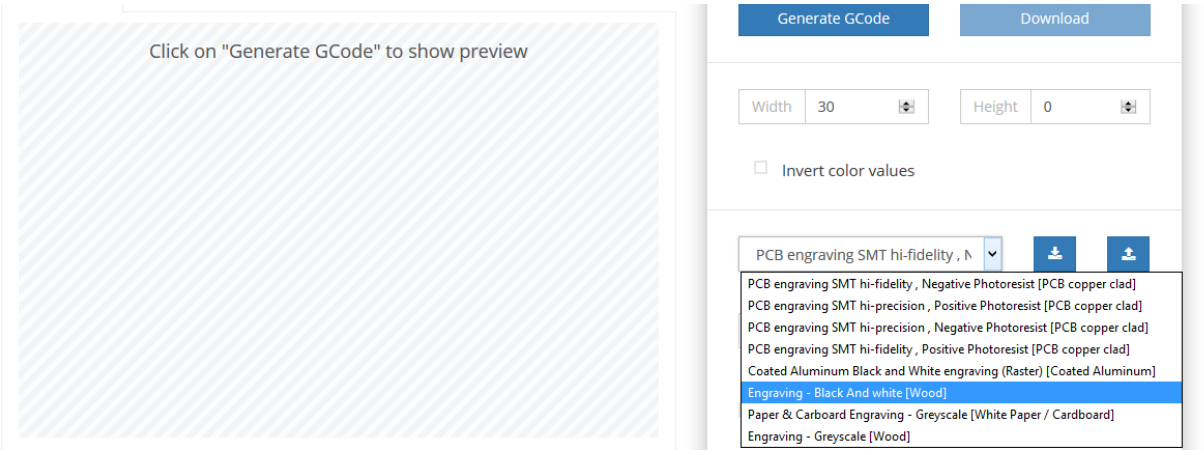


Depending on the file size the upload will take from a few seconds to a full minute.

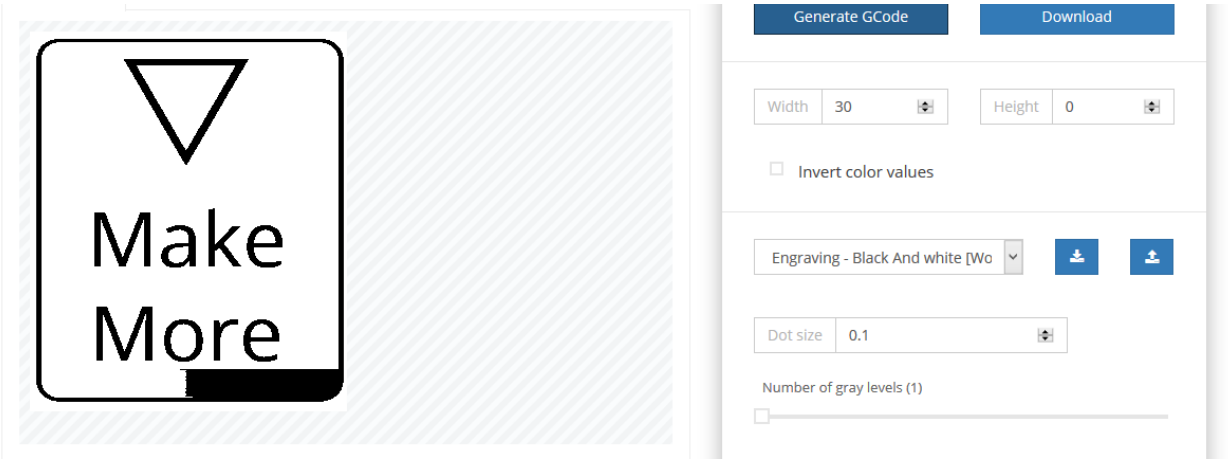
Once the file is loaded, you will be presented with the CAM interface. Notice that at this time you can't see any preview unless the Gcode is Generated.



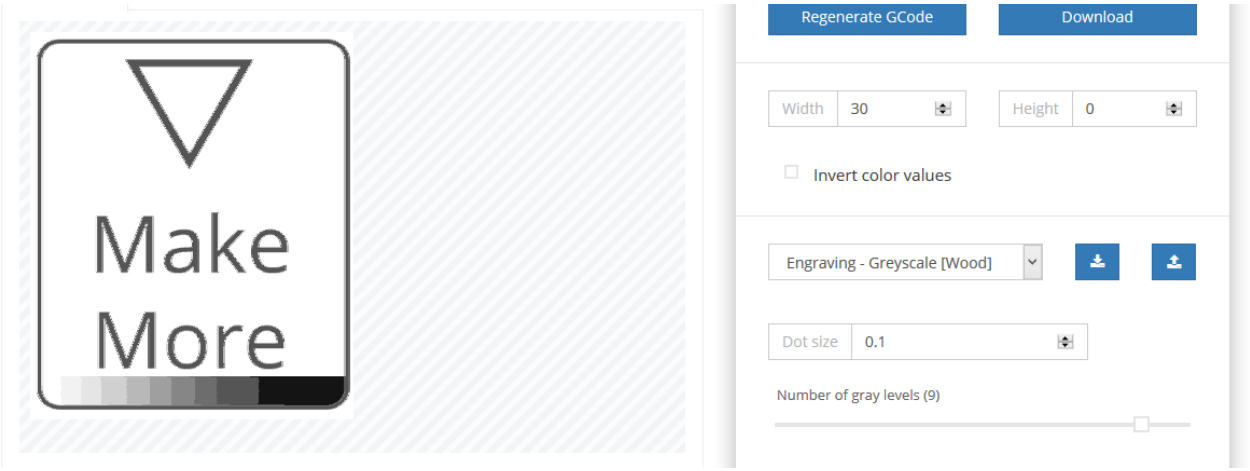
For this job we'll select laser engraving on wood. Press Generate Gcode to see a preview.



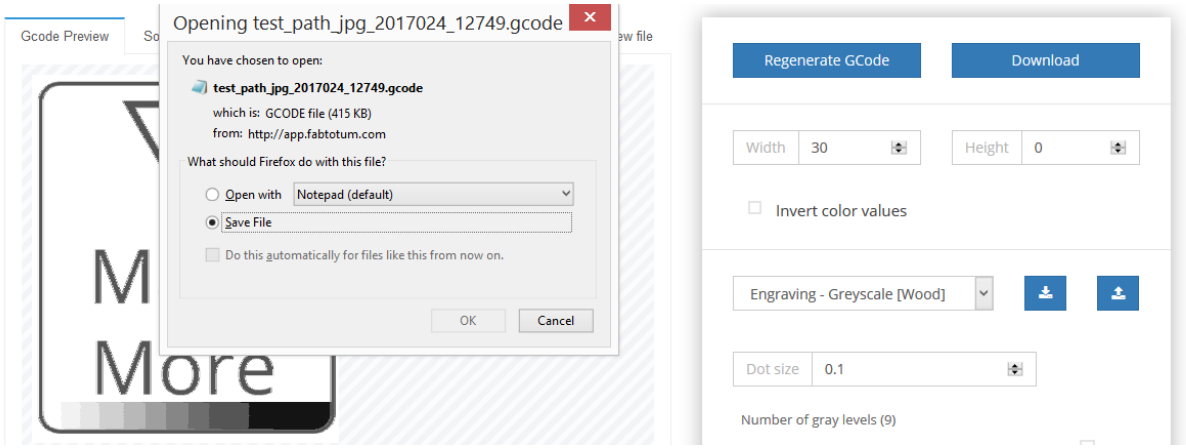
As you can see, the shades are not shown correctly as in the original image, that's because we choose a Black and White profile, that only uses two colors.



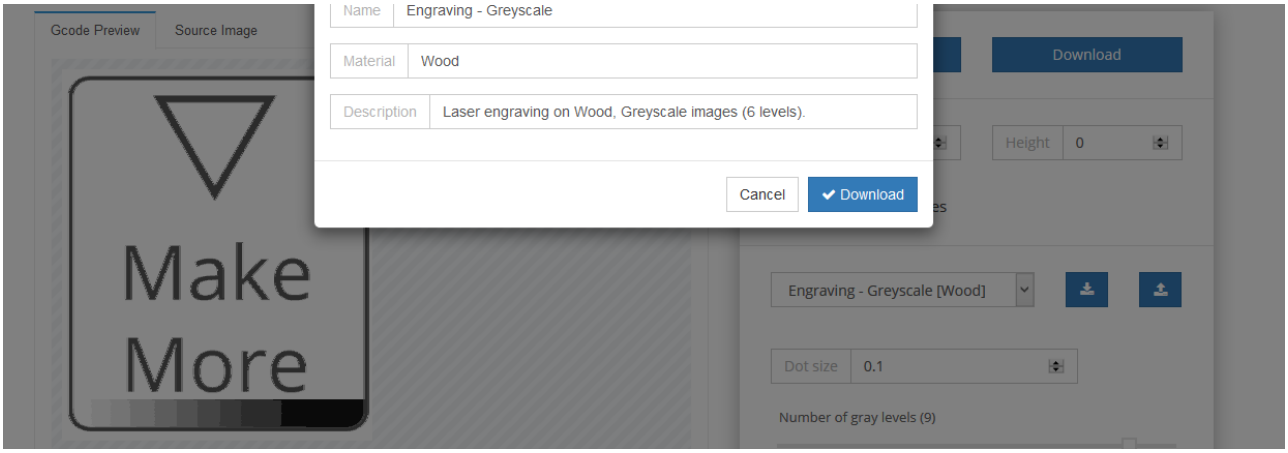
let's change the profile to Engraving -Greyscale (wood) and regenerate the Gcode by pressing the Regenerate Gcode button on the top right side of the page to see how it changes.



Lets download the Gcode by using the Donwload gcode button.
Select the folder where you want it to save it.We'll later upload it in the FABUI Object manager.

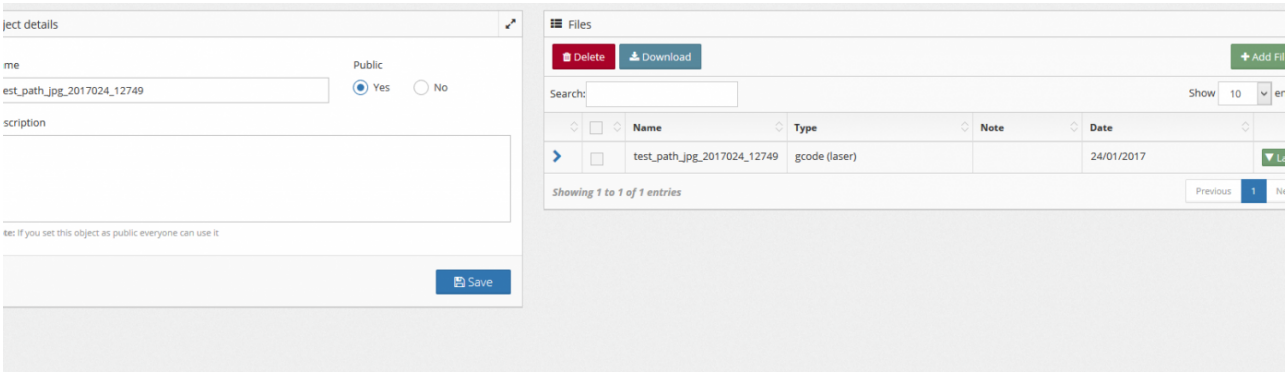


If you made changes to the profile you can download it locally and keep it on your computer.



As usual, go to the FABtotum address on your browser and upload the Gcode to the FABUI object manager page.
Then , from the main Menu run Make>Laser to list all available laser-related files.
Choose the one you want to run and click next.

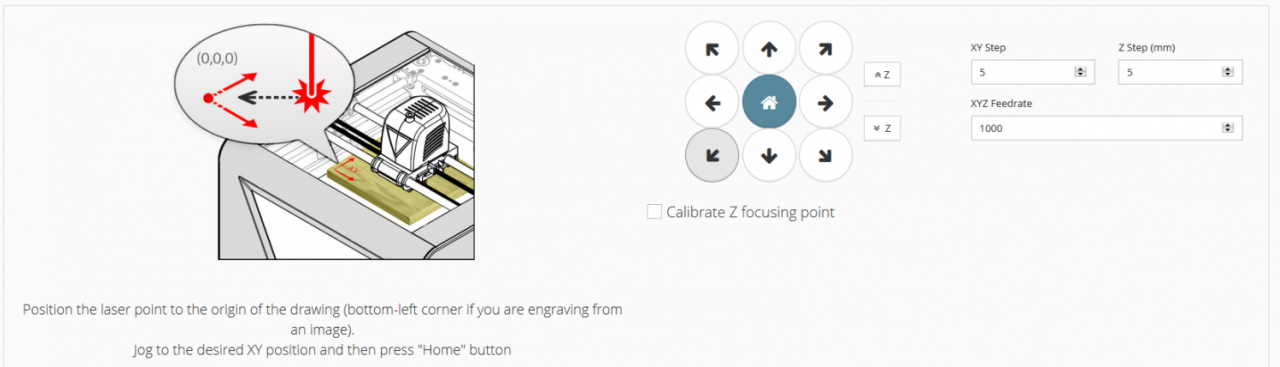
Select the Gcode you previously uploaded and press “Laser”



Safety check: please read carefully what prompted and wear safety goggles as instructed. The Laser Head will be turned on at 5% intensity to allow positioning in the next step.
Proceed when ready.

You can now calibrate the Laser Head to be on the XY origin of the file.
All files are created in the first carthesian quadrant so the 0,0 origin is in the bottom left corner of the drawing.
Jog to the desired position.
Once that is done you can manually or automatically level the Z height accordingly. Read the instructions and choose if you want to be assisted or you keep the current position (good if the Z is already calibrated or if you are doing a second pass).

Press the Home button and ok to proceed.The job will start in a few seconds.



6. 3D SCANNING

3D SCANNING WITH THE FABTOTUM, GETTING STARTED.

(Valid on all FABtotum purchased between 2013 to 2016)

Rotative laser-scanning

Rotative laser scanning is a scanning method that use the red laser line embedded on the FABtotum head and the camera, plus the 4th axis .

It takes two pictures of a rotating object: one with the line projected on the object to scan and one without. Then the post processor installed on the Raspberry makes a subtraction between the two images, obtaining just the line modified on the object's profile. Many lines will compose the point cloud.

1. On the dashboard select the option "**SCAN**", then select the option "**Rotating**"
2. Now select the quality of the scan. A medium quality is enough for most objects.
   * **Quick draft:** 180 pictures
     - **Low:** 360 pictures
     - **Medium:** 720 pictures
     - **High:** 1080 pictures
     - **Ultra:** 1440 pictures
3. Remove the printing bed, now you can see the A axis chuck.
4. Fasten the supplied scanning plate using three scrwes and the supplied allen key.
5. Fasten the object you want to scan. You can use a strong double-side tape or you can download and print and useful mandrel here: https://web.archive.org/web/20160828163341/http://www.thingiverse.com/thing:807381.When you finished, press "**Next**"
6. The scanning process will start in few seconds.
7. When the scanning process is completed, you can choose between "**Make a new scan**" or "**Download**".
   If you choose "download" the browser will download the scan file. It will be a file .asc, which is a comma-separated list of points that you can open and edit with meshlab, netfabb and other software.

Sweep laser-scanning

Sweep laser-scanning is similar to the rotative Lasers-canning procedure. It works on a flat surface instead of rotating the object.
It has lower quality on bigger objects due to the way the camera focus works, but can give good results on medium size objects.

This scanning method produces partial scans as the surface in contact with the bed cannot be seen by the camera and therefore scanned.

Touch Probe Scanning

This scanning method is the most accurate, but the slowest of all methods. It's made to scan very small objects with high detail, like a coin or a relief.
It uses the probe embedded in the FABtotum carriage to measure the geometry of the object.
Special care should be applied as a scan that has not been correctly plannet may result in damages of the touch probe.

It works with objects that have no complex shapes and have gentle curves.
It's also a partial scanning method as it cannot probe the side of the object which is in contact with the hybrid bed platform.

Before starting make sure to secure the object on the hybrid bed. Using the glass side is strongly advised as the probe cannot be get caught in the subtractive side fixtures holes.

1. In the dashboard, select "**Scan**" (eye icon), Insert the name of the new object you are scanning, select the scanning method "**Probing**", then "**next**" to continue the scanning procedure.
2. Now you are setting the scanning parameters. Select the probing area coordinates. You can both select the area on the image, or write the coordinates;
   In this step you can decide the quality of the scan, choose one from:**Draft:** 1 Probe per square millimiters
   Low: 4 Probes per square millimiters
   Medium: 16 Probes per square millimiters
   High: 64 Probes per square millimiters
   Very high: 100 Probes per square millimiters
   Ultra high: 256 Probes per square millimiters
   You can also set the Z jump and Detail treshold, which are advanced settings best explained in the FABUI.
   The Z-Jump is very important as it should be set at least 1.5 times the size of the biggest height difference you expect fromone probe point to the other.
   Setting a Z-jump parameter too small will collid with the object and potentially bend th eprobe.
3. Click "**Next**" to start the scan. Your scan will start after a few moments of calibration.
   The probe will start to softly touch your object and depending on the size of the area and the quality you selected the scan will complete in minutes or hours.
4. After the scanning process the guided procedure will ask you to download an .asc file: it's the point cloud coming from your scan.
   You can process it for have an .stl available for your 3d printer using different programs like Meshlab.

Photogrammetry

This scanning method uses the camera on your FABotum for take photos that will be processed by an external photogrammetry service, such as Autodesk's 123Dcatch or Memento.

Due to the big volume of data and the complex calculations, the post processing will be provided by your pc.

This method work better with objects with a complex texture, not symmetricals, not shiny or transparent (like all kind of 3D scanners on the market).

Procedure

Make a photogrammetry scan with Fabtotum is very easy, following this procedure:

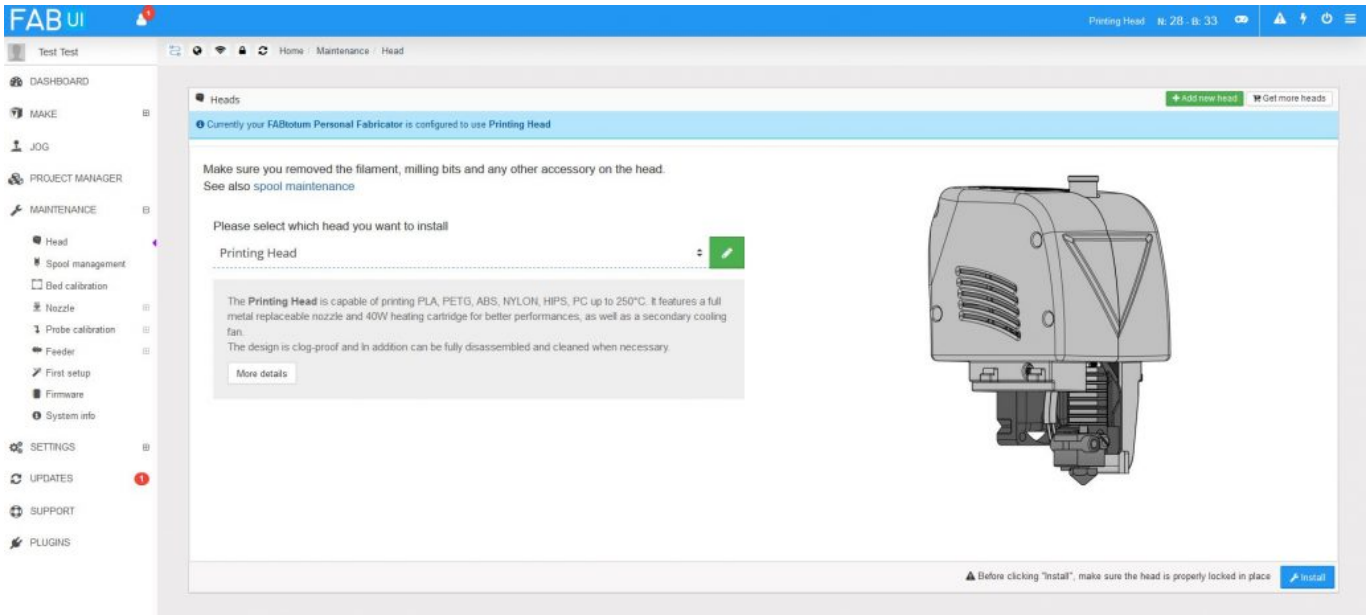
- On the fabui dashboard select "Scan" by clicking on the scanning icon (both are valid)
- On the scanning page choose "Create new object" (1), select "Photogrammetry" method (2), then click "Next" (3). Set the scanning parameters as follows:
    - ISO: 200 (If you have to scan darker objects, increase the value.)
    - Size: 1920×1080
    - Number of slices: 60
- Download the Fabtotum Desktop server clicking "Here" (1)
- (The program is stored into the SD card, it's working with Windows XP or newer, OS X and linux). Test the connection by clicking on the "Check connection" (2), if the connection is working the button will turn in green color, then click on "Next" (3).
- Set and connect the Fabtotum Desktop server.
- Choose the folder where you want to download the photos, by using "Choose folder" (1), "Start server" (2):
- Remove the printing bed, when ready click "Click Here when ready".
- Attach the Chuck using three screws
- Using screws, duct tape or wires attch the object you want to scan and close the FABtotum's door.
- When ready click "Click here when ready".
- The scanning is started! Wait until the FABtotum took the last picture and sent it to your computer using the FABtotum Desktop Server

Post processing a photogrammetry scan.

Please refer to your photogrammetry software manual on how to postprocess the captured images.

7. MAINTENANCE & CALIBRATION

HEAD INSTALLATION



At any given time, you can swap one head for another, provided the unit is not performing any operation.
Swapping heads enable certain options in the FABUI interface itself, so for example you won't be able to launch a subtractive job (e.g. Milling, Laser Engraving) if the head installed does not support that operation.
For Most Heads you are asked to install a new head each time the head is removed physically from the carriage.
This is not true for Custom made heads, Head Development Kits and the Milling head V2.

Regardless of the physical operations to perform on each head, an head must be selected and manually installed on the FABUI user interface.
To do so go to Maintenance > Head.

The current installed head will be showed here with a picture, and will subsequentially be shown in the top menu bar.
On the drop down menu, select the head you wish to install and press **Install**.
The FABUI will set up the machine accordingly.

Profile Management

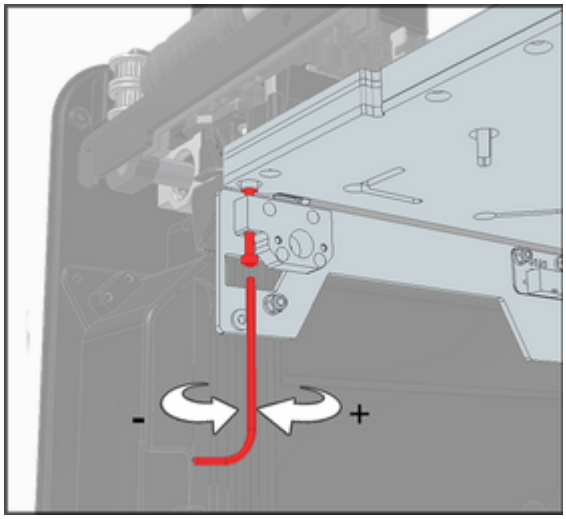
The Head Profile manager, which can be summoned by selecting the Edit button, allows to copy or create and edit profiles for all heads.
You can add custom Gcodes, change steps/unit and much more.
Use this feature only if you know how to operate on these parameters.
Be aware that using custom profiles may disrupt the normal operations of the unit and may cause damage to the head

itself.

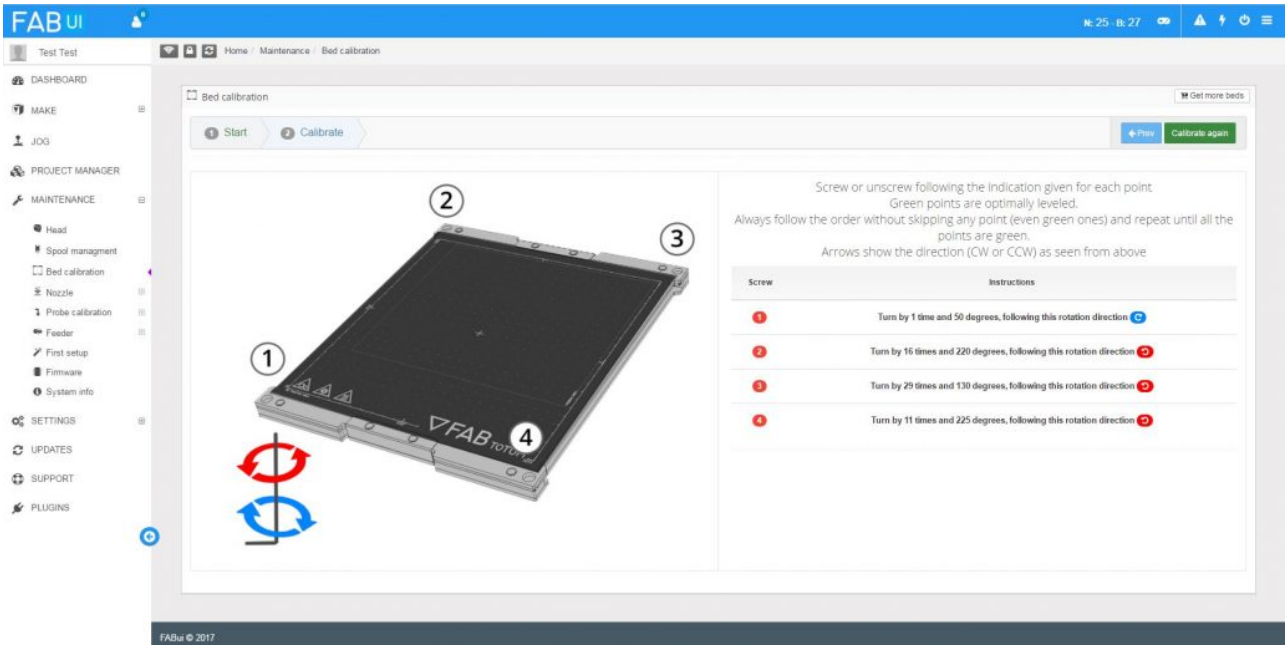
Once saved the profile can be also exported and downloaded.

BED CALIBRATION

It’s very important to have a planar printing bed to make the first printing layer stick perfectly.
With your FABtotum you can easily calibrate it using the guided procedure.
The procedure works only on the 3D printing side of the hybrid bed, unless the fixtures holes are covered on the subtractive side, to avoid any damage to the probe.
You will be tasked to rotate a certain set of screws (located under each corner of the print bed) in order to change the bed orientation.

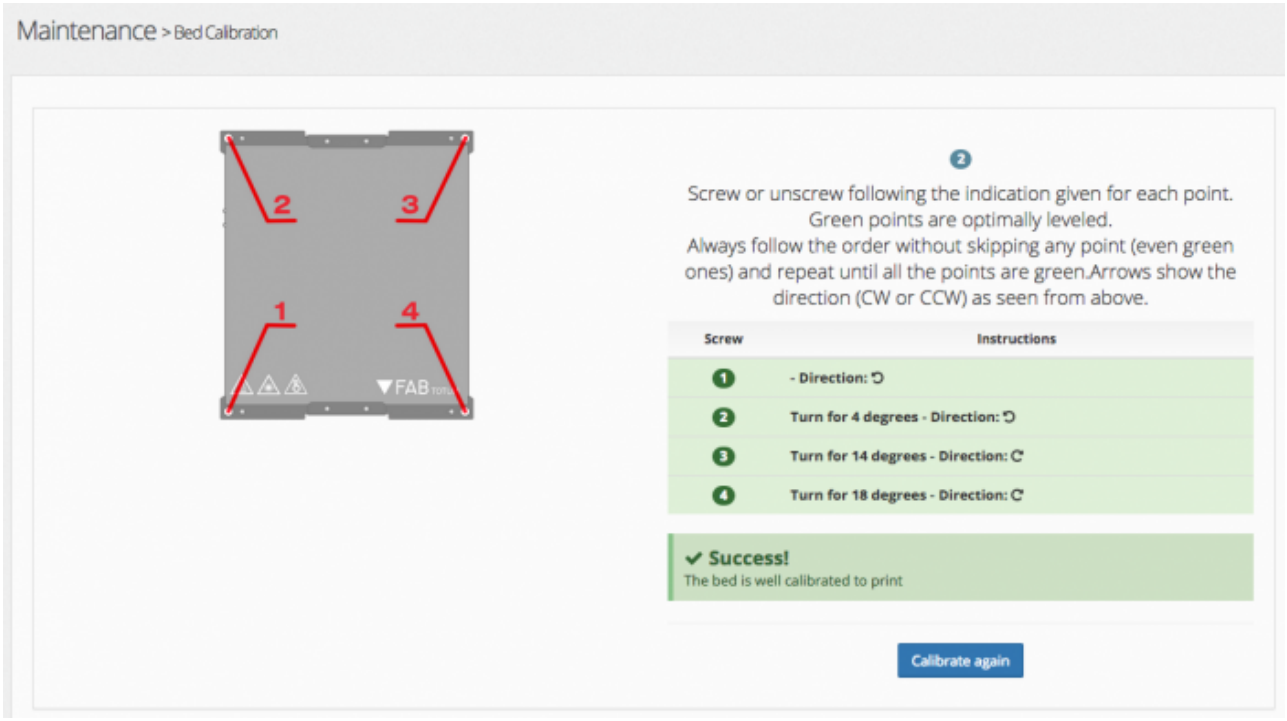


1. In the “Maintenance” select “Bed calibration”
2. You will see the bed calibration wizard. Press Start to start the process.
3. Wait for your printer starts to make the measure of the flatness of the bed in 4 different points. After few minutes you will see a screen like this:



4. By working with the supplied allen key, rotate the screws that sustain the bed as the program tells you.

5. Once all points are done, repeat the measurement. You'll receive new instructions. Repeat until you see that all the points are green:

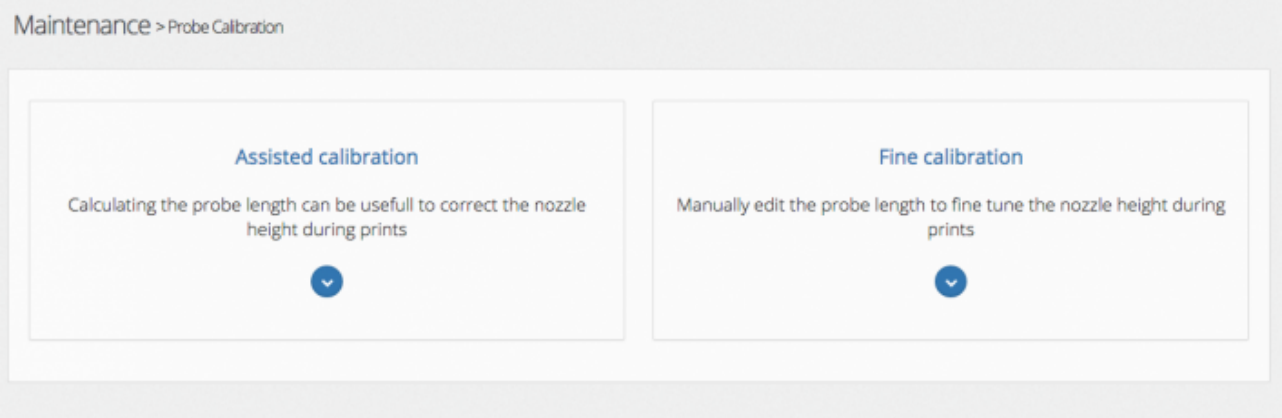


The Hybrid Bed of your FABtotum 3D printer is now calibrated.

NOZZLE HEIGHT CALIBRATION

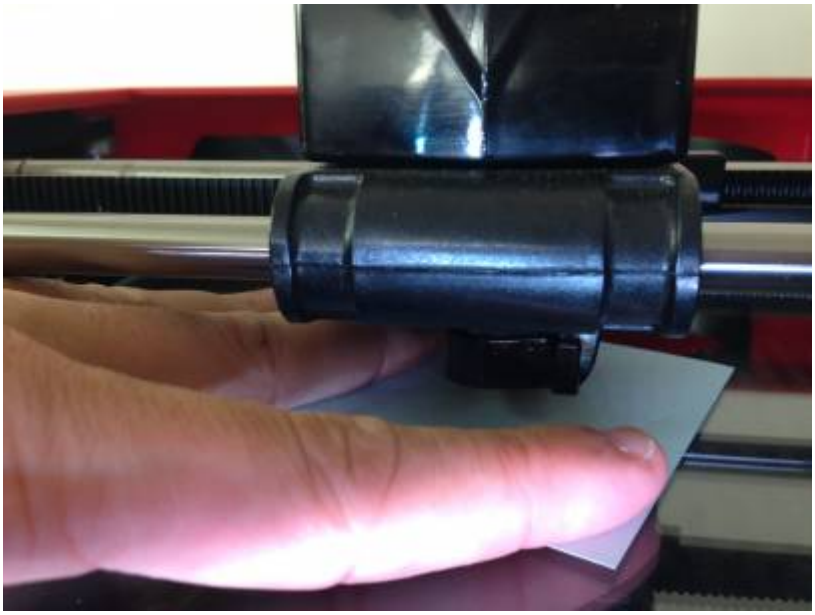
The nozzle height calibration (ex “probe calibration”) sets and stores the value on the FABtotum Personal Fabricator in order to be at the right distance from the bed once the print starts.
Follow these instructions to correctly execute the nozzle height calibration procedure.

1. In the “Maintenance” menu select “Nozzle height calibration”
2. Now you can choose the assisted calibration or fine calibration.
3. Choosing the “Assisted calibration”, will start the assisted calibration.



4. Wait until the nozzle get hot (when it’s hot it’s longer due to thermal expansion).
5. Put a piece of copy paper (80 g/m2). Wait for the probe to exit from its housing.
6. Move the paper adjusting the height by pressing “Z+” or “Z-” until it barely rubs against the nozzle, then press “Calibrate”

7. The unit will set the parameters. The procedure is completed.



Additional advice: “Fine calibration” allows you to enter a precise offset. Do not use this option if you are not sure as a wrong value might damage the unit.

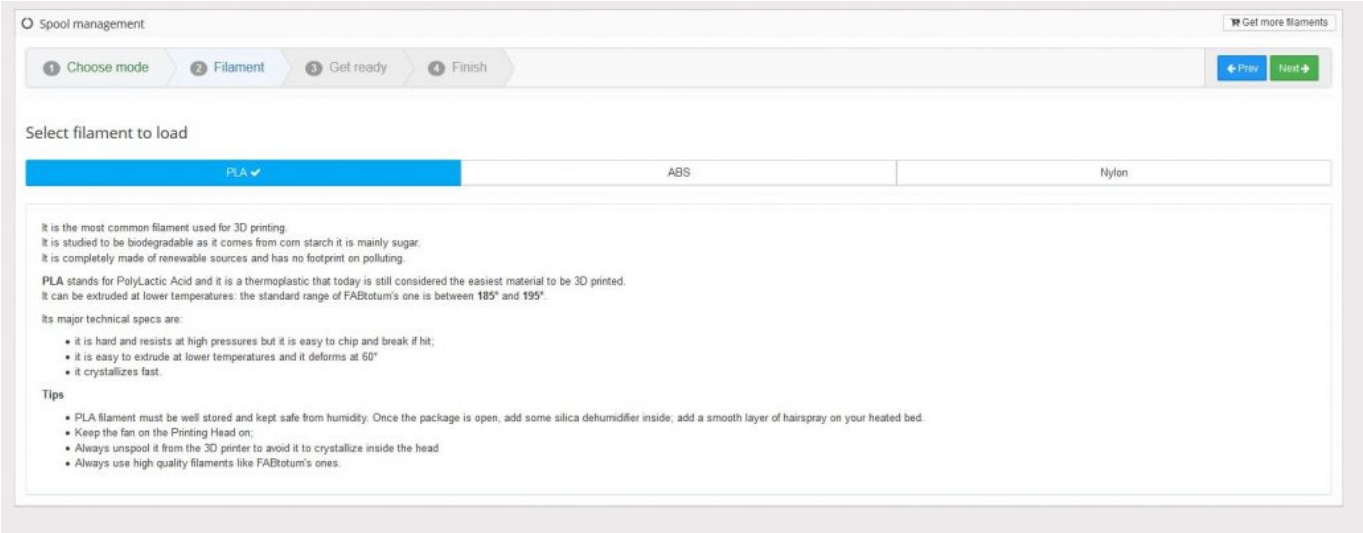
FILAMENT LOADING / UNLOADING

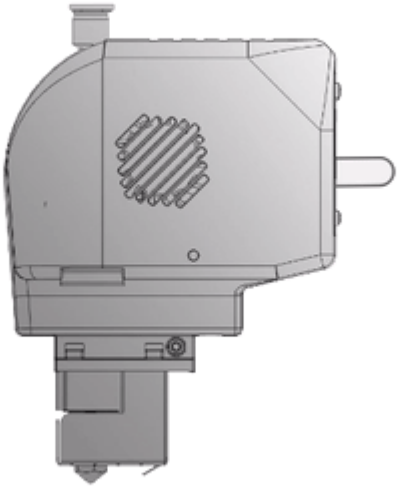
Loading the filament

Loading or changing the filament is an assisted procedure on the FABtotum. The user just need to follow the on-screen instructions and perform a series of tasks to allow the unit to safely insert or remove the filament from the system.
The task is slightly different, depending on the version of the unit and installed Printing Head.
Please refer to the paragraph concerning each Head before proceeding.

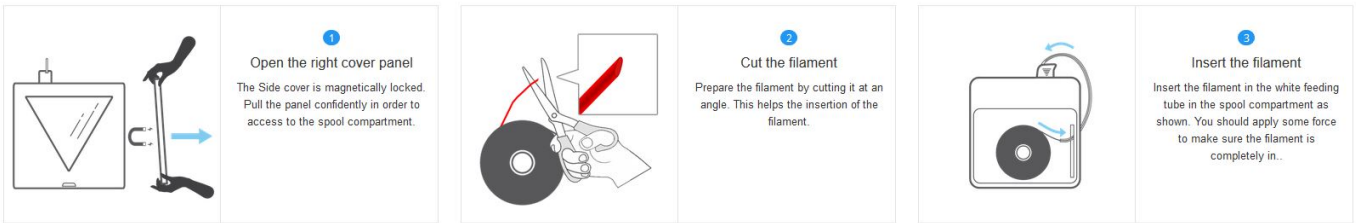
IMPORTANT:
The correct Head must be installed using the FABUI Maintenance > Head Installation procedure before proceeding with loading or unloading a spool.

Printing Head PRO



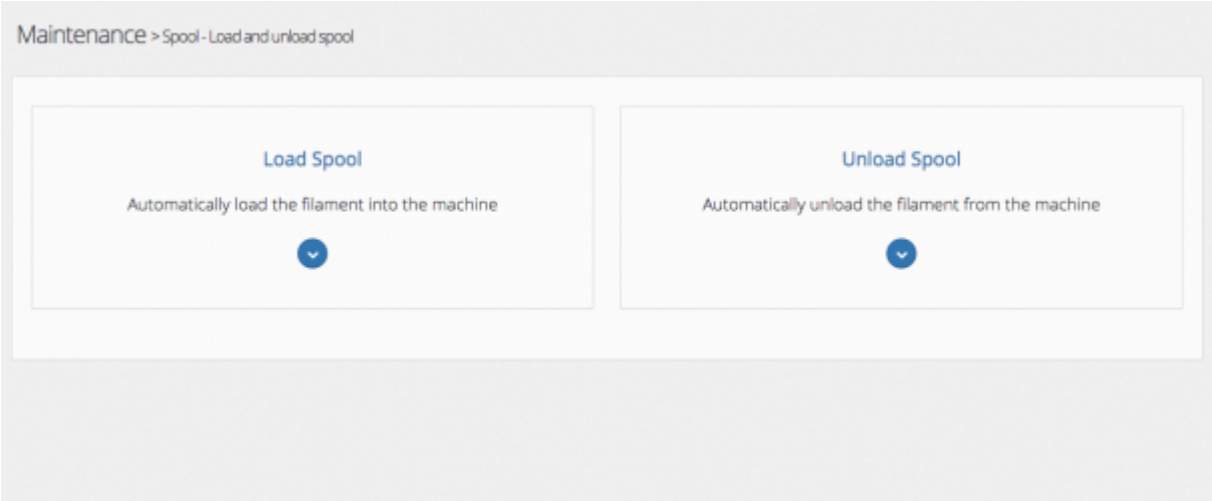


1. Open the compartment on the right of your FABtotum;
2. place the spool as shown;
3. cut the excess filament and sharpen the tip with scissors in order to facilitate entry;
4. insert the filament in the Filament Hole or Filament Tube (according to device version): this is located near the “insert Filament” label in one corner of the comparment.
5. Push the filament all the way up to the Head.
6. Go to “Maintenance” -> “Spool” -> “Load spool” to start the guided procedure.



Printing Head Lite / V2, Hybrid Head

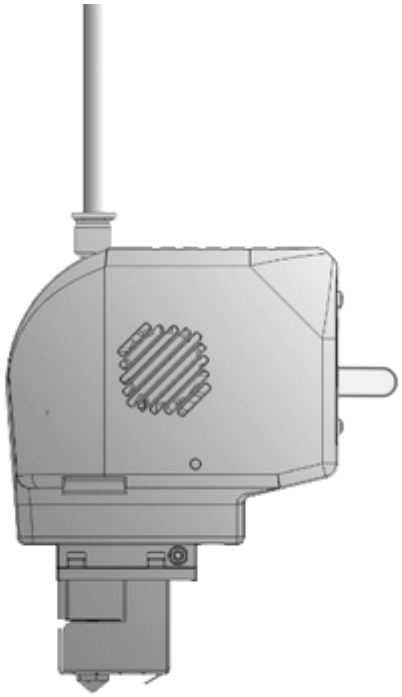
Go to “Maintenance” -> “Spool” -> “Load spool” to start the guided procedure.



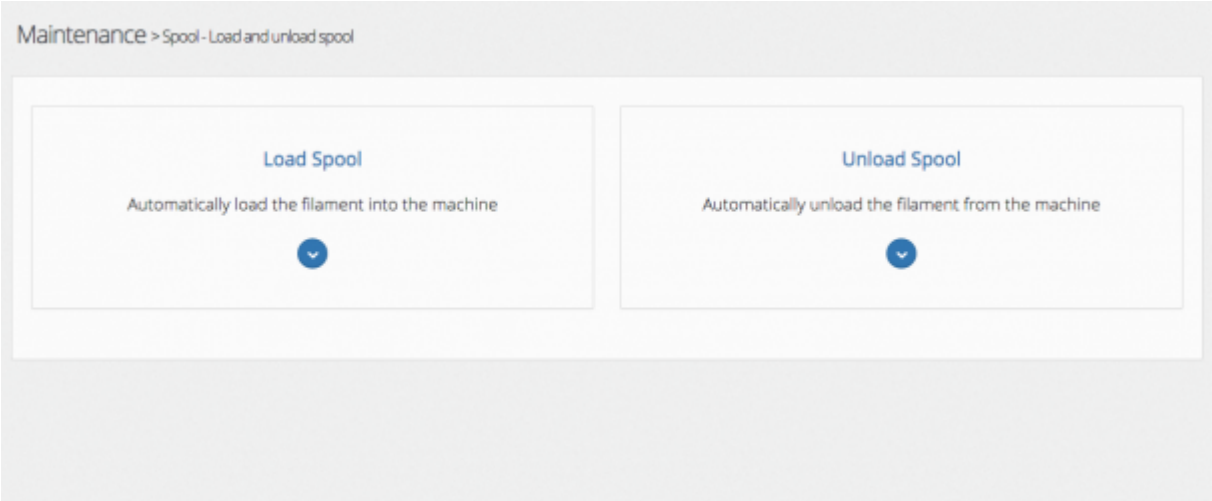
1. Open the compartment on the right of your FABtotum;
2. cut the excess filament and sharpen the tip (a slanting cut will do);
3. insert the filament in the PTFE tube until you reach the feeder (you can feel it: last cm becomes harder and then you cannot push further);
4. help the filament to be loaded and gently pull it when asked by the FABUI;
5. wait until some plastic comes out melted from the nozzle.

Unloading the filament

Printing Head PRO



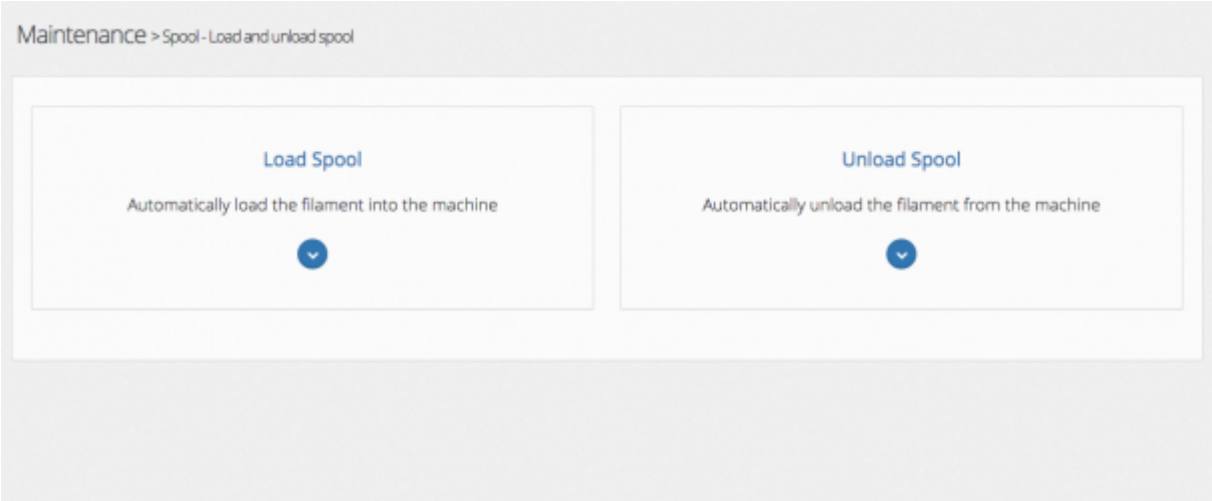
Go to “Maintenance”-> “Spool” -> “Unload spool” to start the guided procedure.



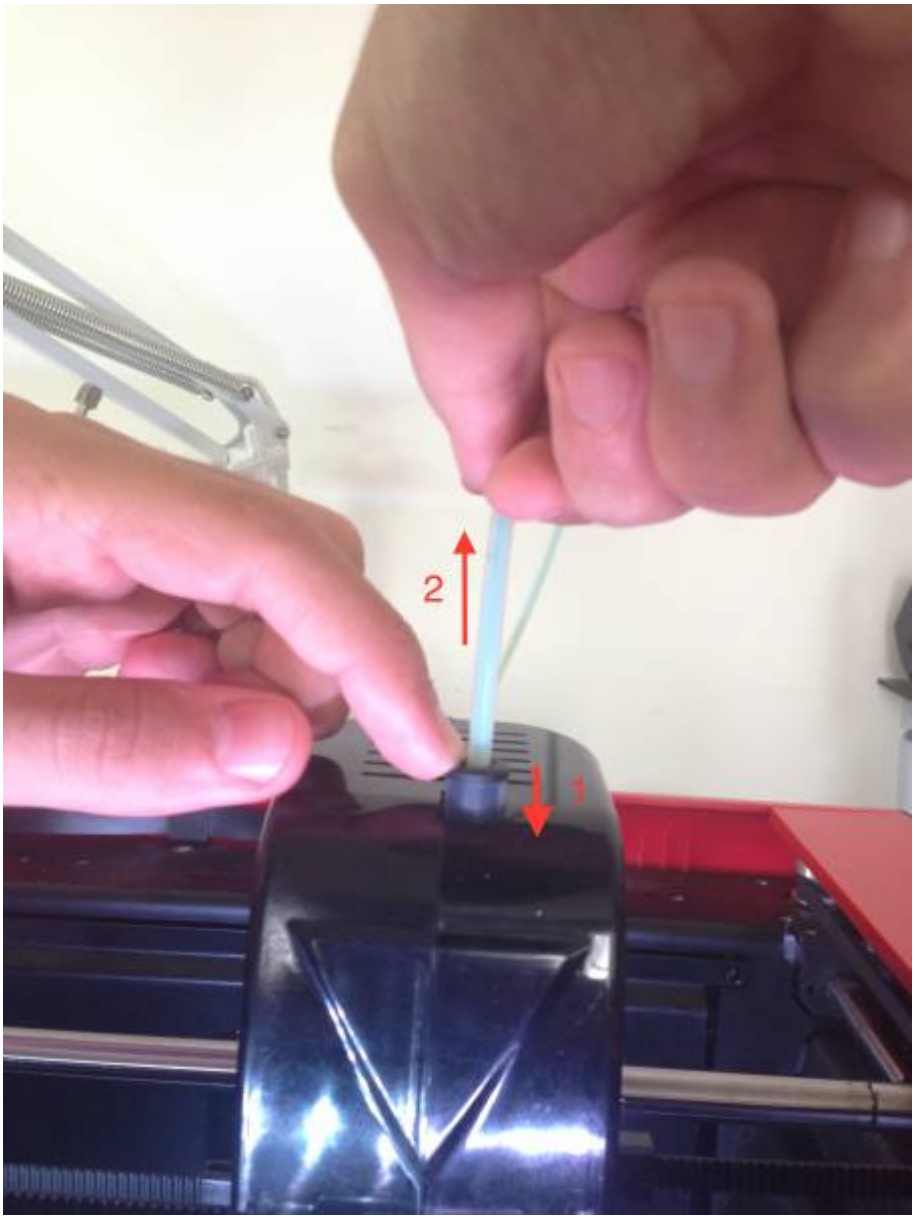
1. Wait for the nozzle to reach melting temperature;
2. when the temperature is reached remove the feeding tube by pushing down the black cap AND pulling the feeding tube up.
3. press “Start” to unload the filament;
4. the filament will be extracted from the bowden tube, assist gently to retrieve the leftover filament.

Printing Head Lite / V2, Hybrid Head

Go to “Maintenance”-> “Spool” -> “Unload spool” to start the guided procedure.



1. Wait for the nozzle to reach melting temperature;
2. when the temperature is reached remove the bowden by pushing on the pushfit and pulling it out;



3. Cut the exceeding molten filament (if you don’t, it can get stuck in the bowden);
4. open the compartment on the right;
5. press “Start” to unload the filament;
6. the filament will be extracted from the bowden tube, assist gently to retrieve the leftover filament.

Notice: we suggest to discard any previously used portion of the filament after it’s processed into the feeder, as it can be compressed and grinded during the extraction.

FEEDER CLEANING ON THE FABTOTUM CORE

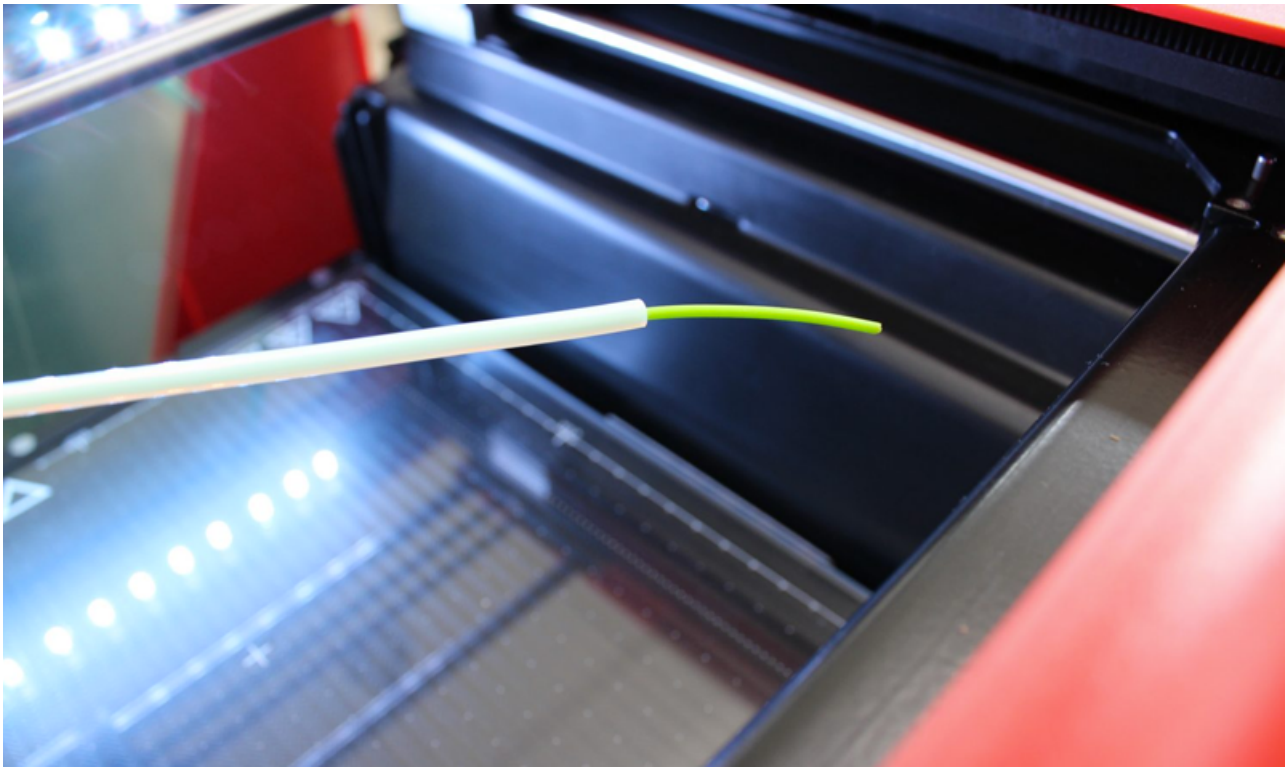
On the FABtotum CORE and CORE PRO the feeder compartment is removeable and can be inspected.
As a result the feeder can be replaced, upgraded and -most importantly- accessed for maintenace cleaning.
Cleaning is a necessary process should the filament be grinded as a result of a problematic print or clogging.
Before attempting a feeder cleaning we suggest to troubleshoot other possible problems on the 3D printing troubleshooting guide.
Symptoms of a messy feeder are filament slipping, feeder clogging or filament stuck in the feeding gear.

This guide will help you cleaning the feeding mechanism from filament residues.

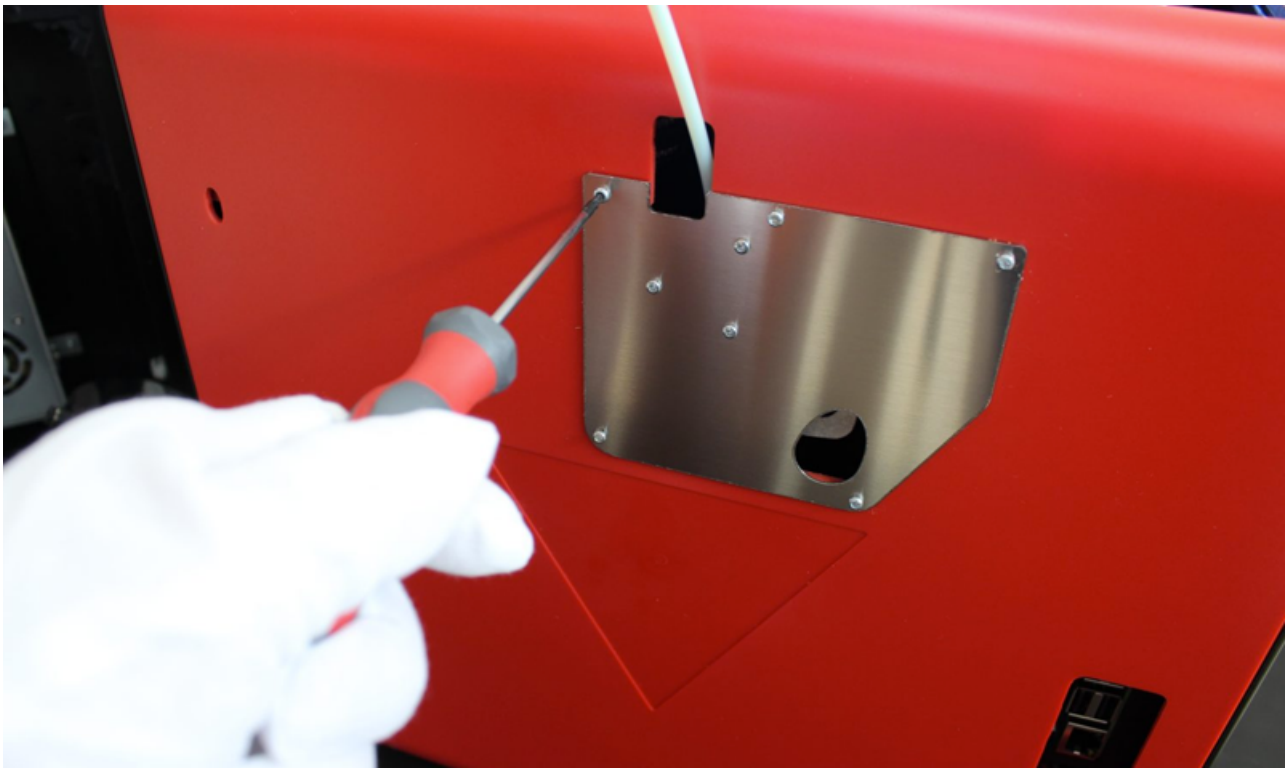
First Thing first: unplug the FABtotum and make sure to follow common safety rules.

We will start by removing the feeder back panel.
This panel keeps the feeder attached to the FABtotum chassis.

make also sure to uninstall and remove the filament from the head… BUT keep a little bit of excess filament sticking out, just like in the picture, in order to help yourself when reintroducing the feeder in the back panel once you are finished with the cleaning process.

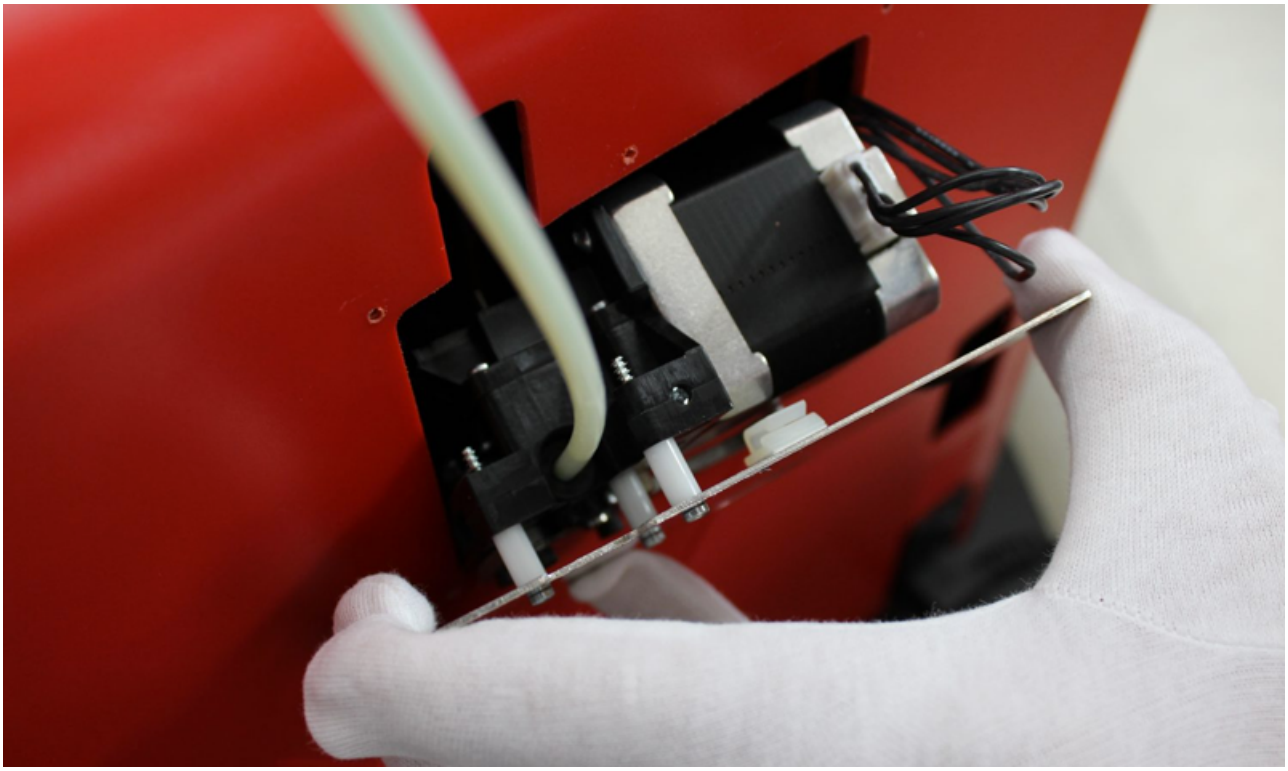


With a T8 screwdriver, unscrew all the external screws. leave the 3 internal untouched for now.



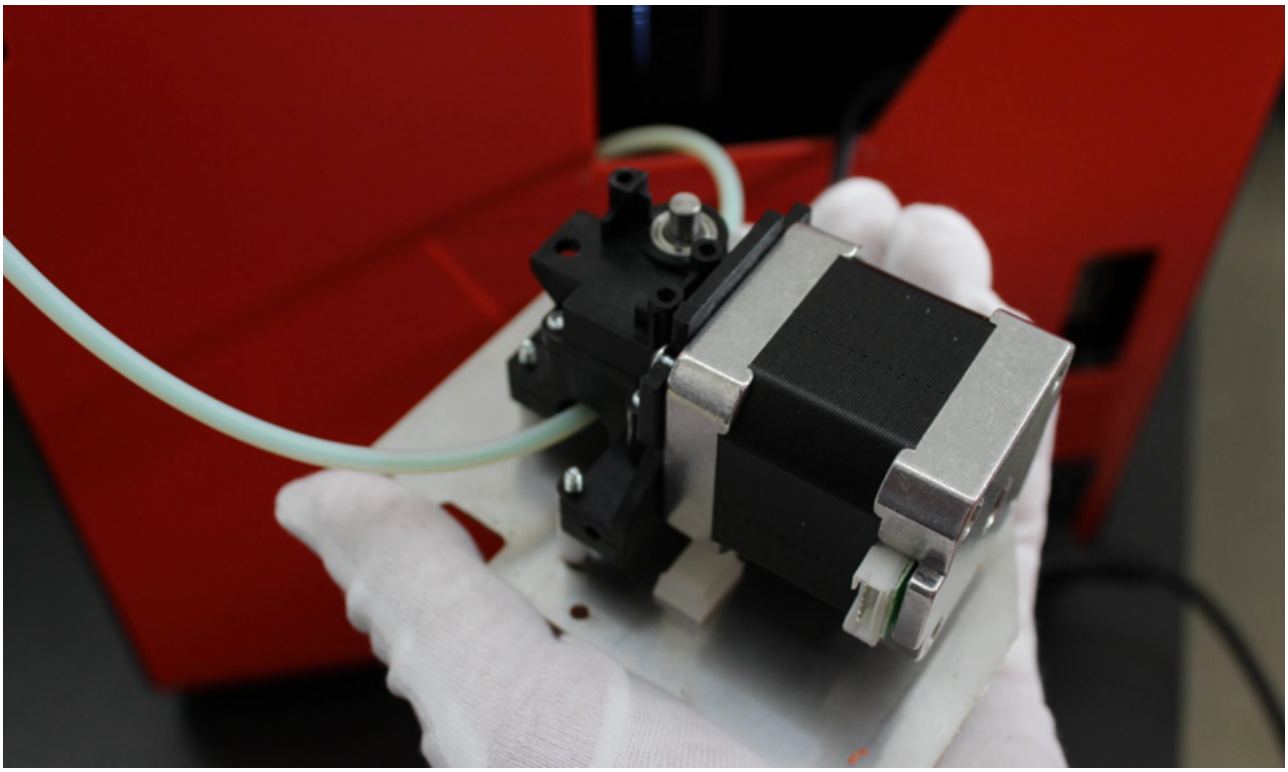
Extract just a few centimeters and take a peek inside, you should see the motor assembly and the motor connector.

With a screwdriver gently disconnect the motor.

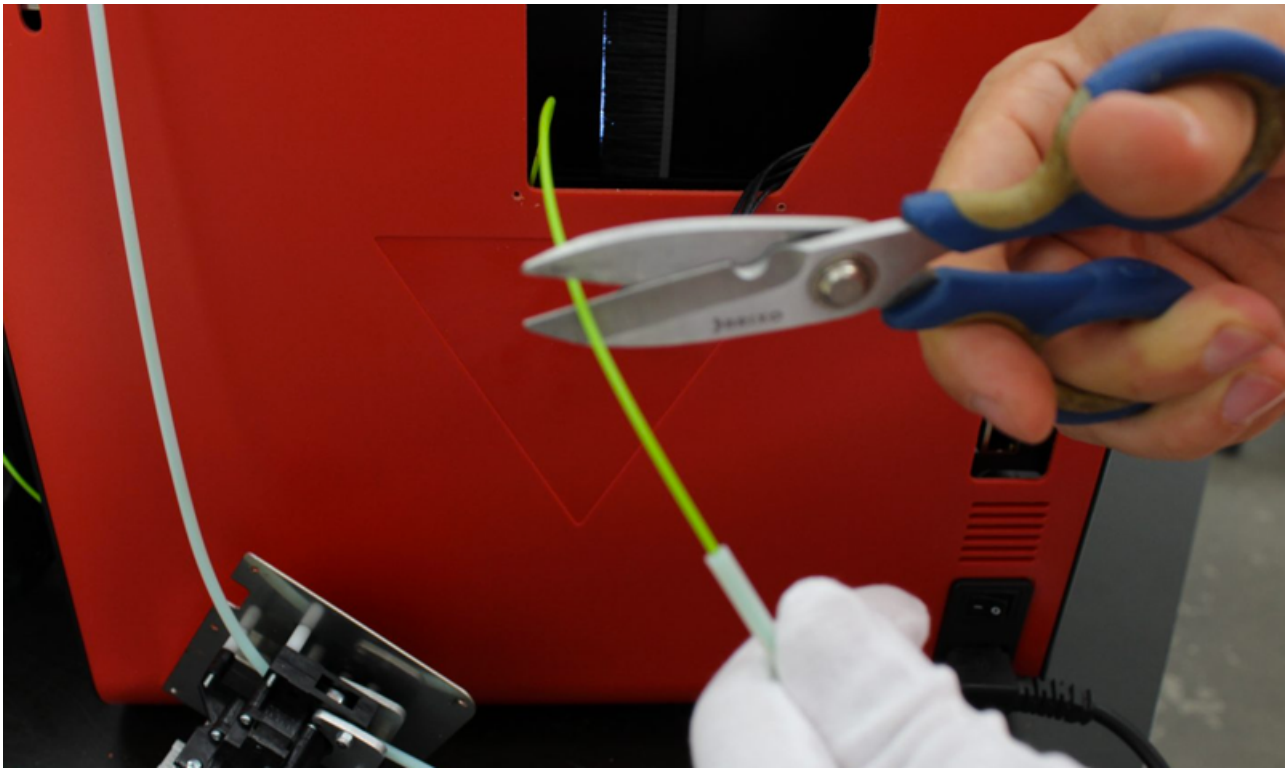


Now pull just a bit the cable in order to avoid to loose it inside the back panel.
Do not pull the cable too much.

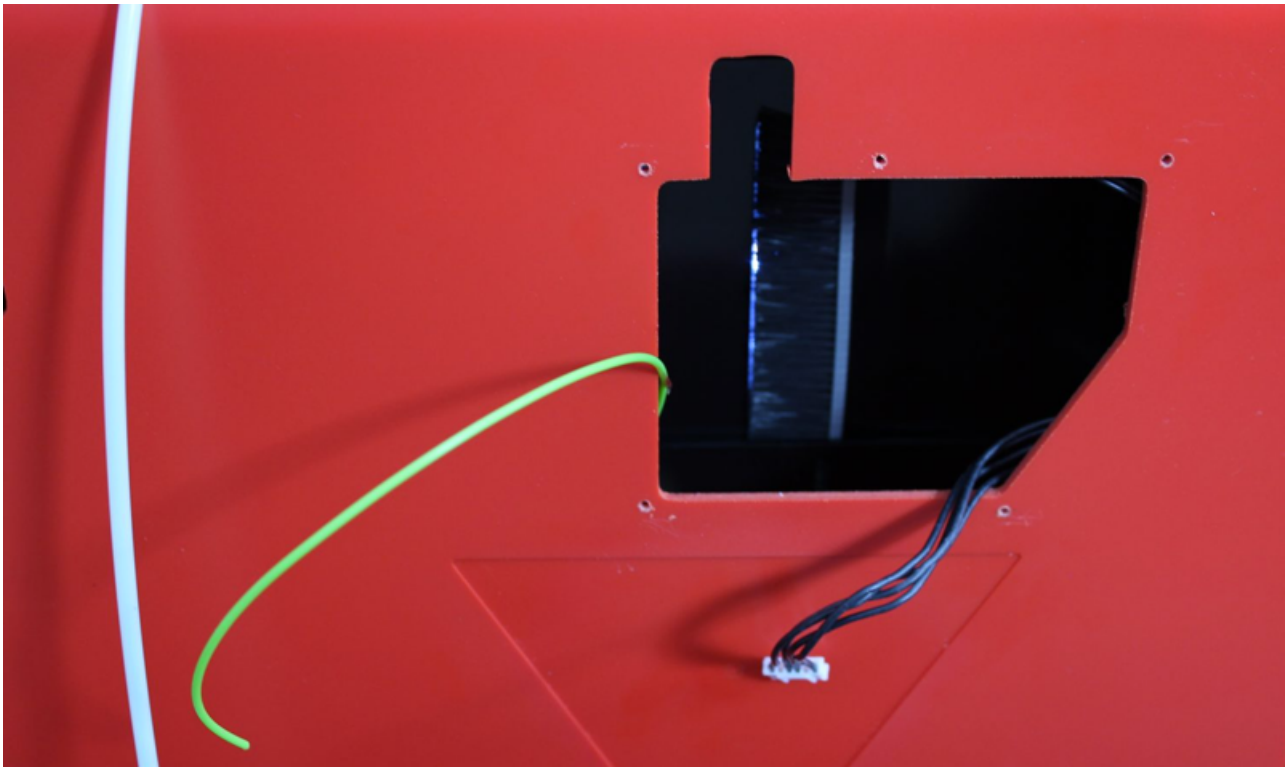
The feeder can now be pulled out.



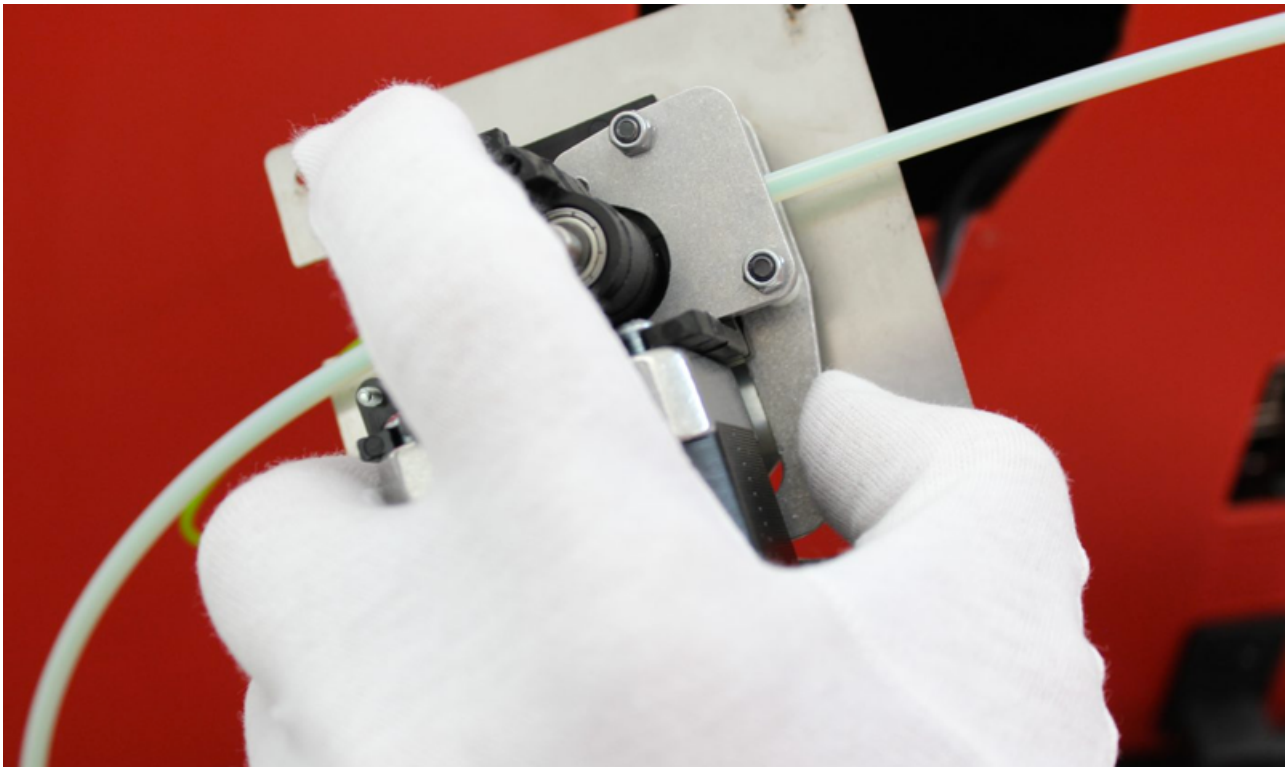
cut the filament inside the feeding tube (leave 10-15cm for later convenience). The filament coming from the spool compartment must not be respooled at this point.



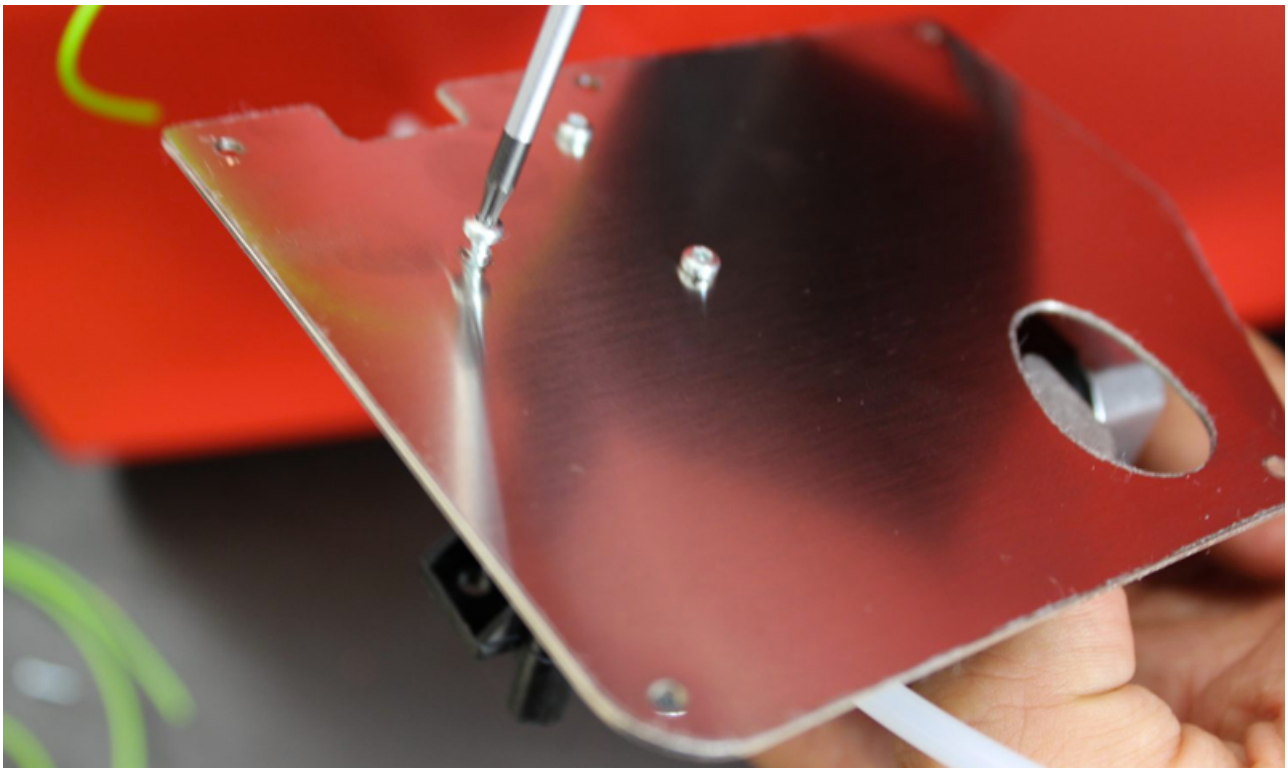
You should end up with a back panel with the motor cable and the excess filament sticking out. Leave it this way for now and make sure those are not moved until further instructions are provided.



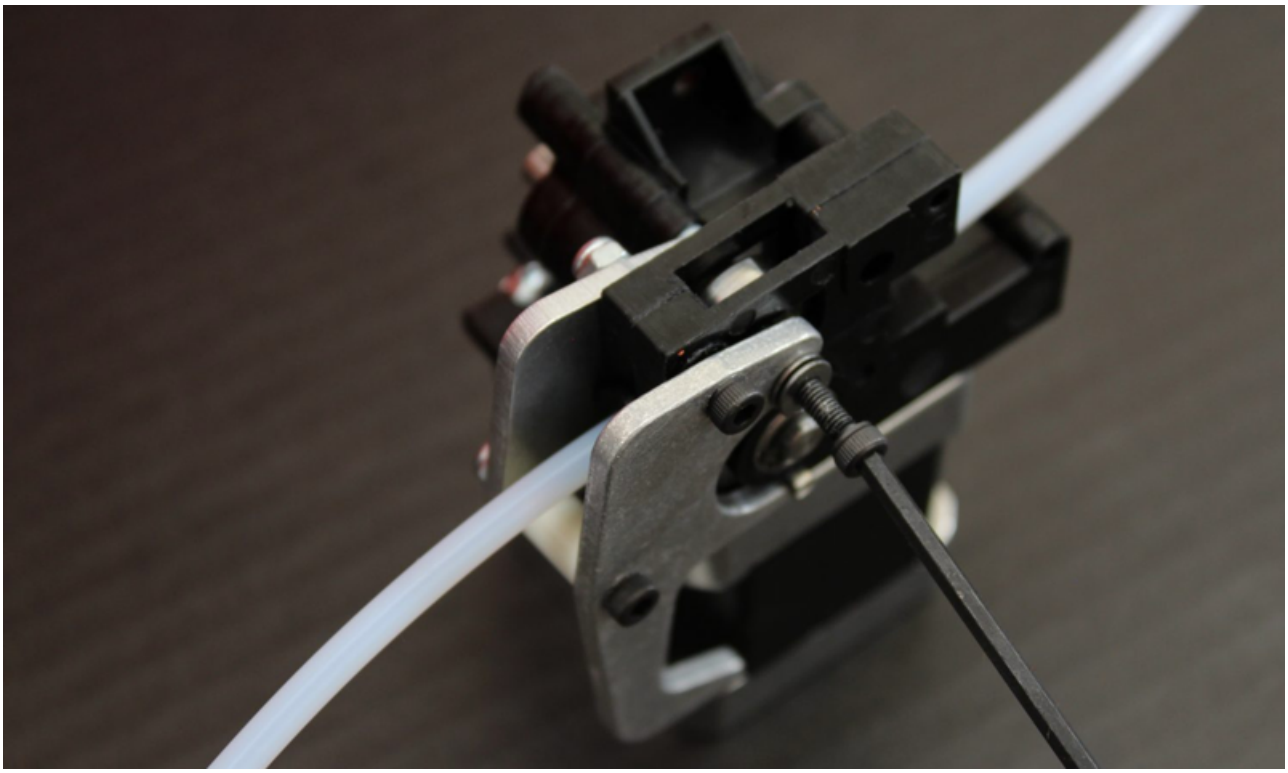
Lets move back to the feeder. Pushing down the feeder release lever (just like in the photo) now we can extract the filament.



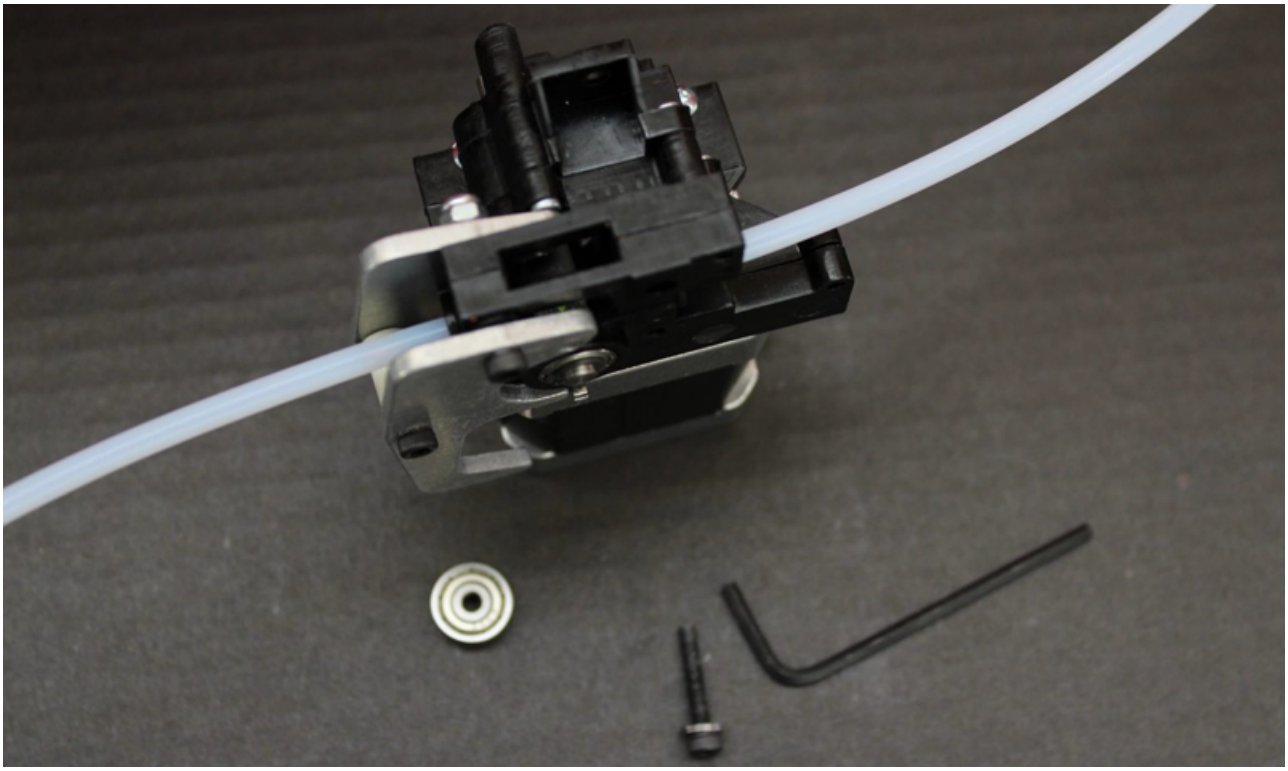
for better access you must remove the feeder plate by unscrewing the 3 screws. Make sure to keep them safe.



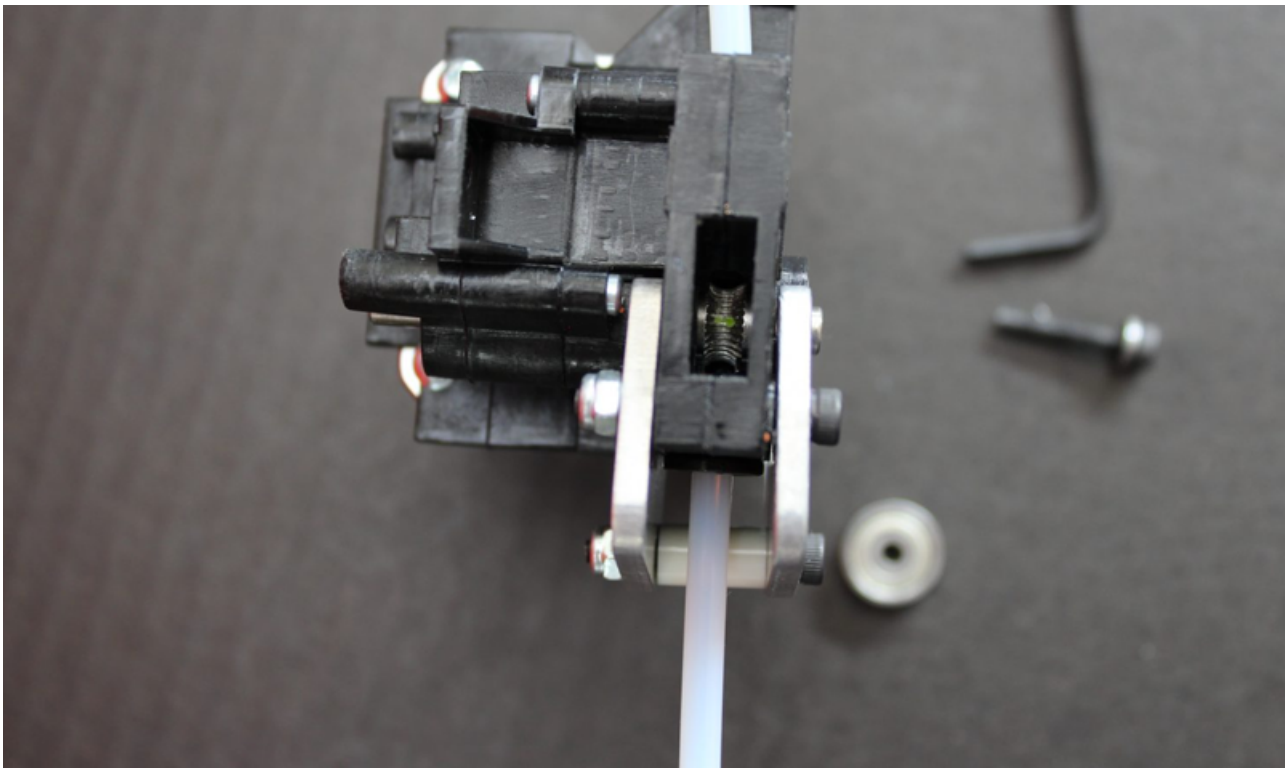
Remove the screw with a HEX driver



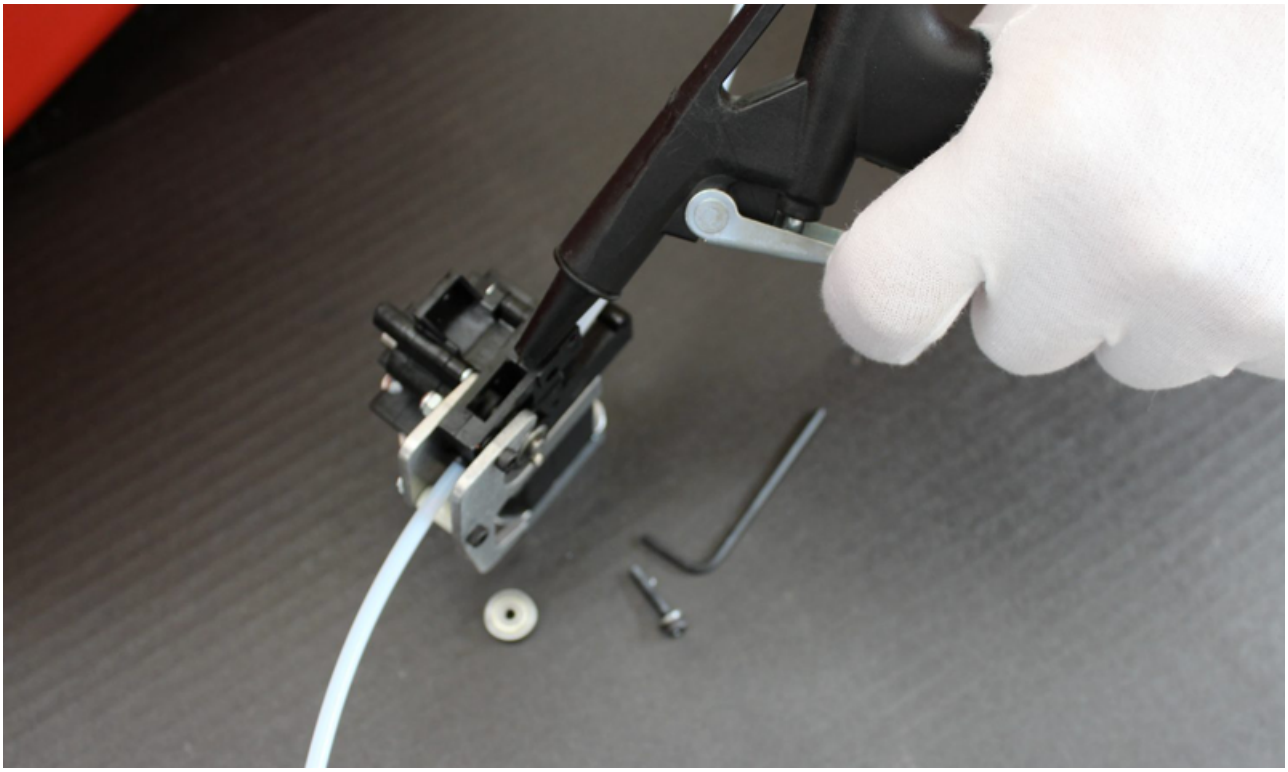
Now you can extract the screw. Look inside and extract the bearing wich was held by this screw.



Inside you can see the feeding gear with some green filament residue.

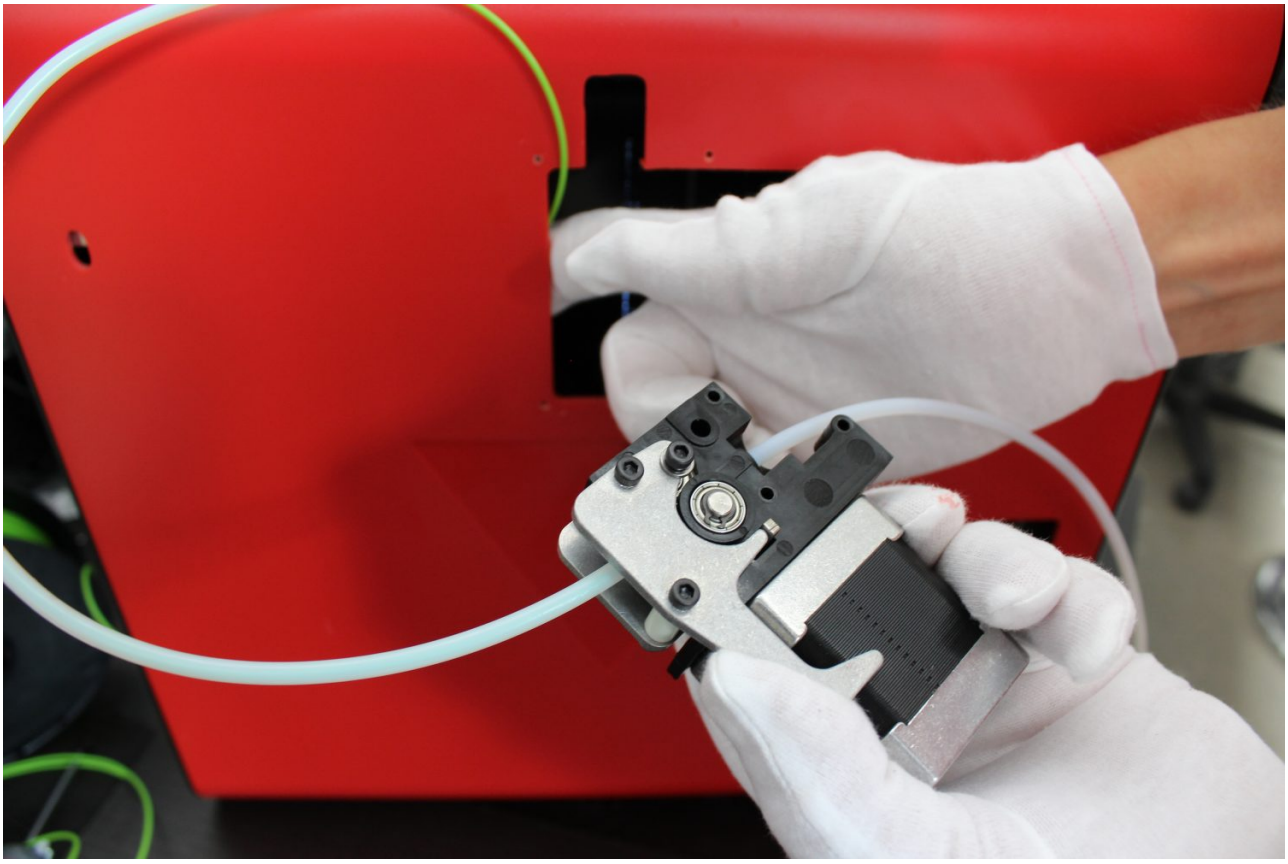


With canned air , a brush or a compressor you can clean the feeding gear.
When you are done, put back the bearing in the feeder and screw it securely but not too tightly.



Before putting everything back clean the filament sticking from the unit as it could have become greasy by touching the librificated leadscrew inside the back of the unit.

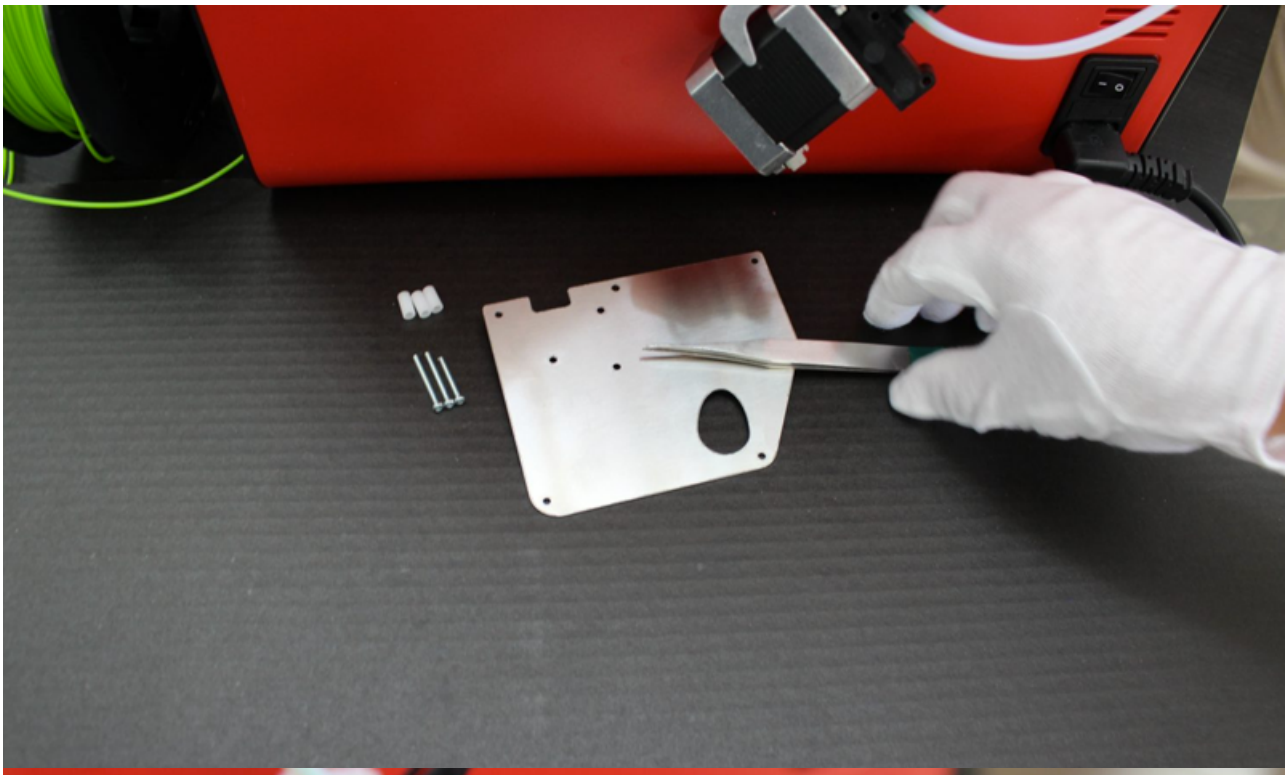
by pushing the release lever on the feeder, you can now insert the filament again up until the feeding gear.

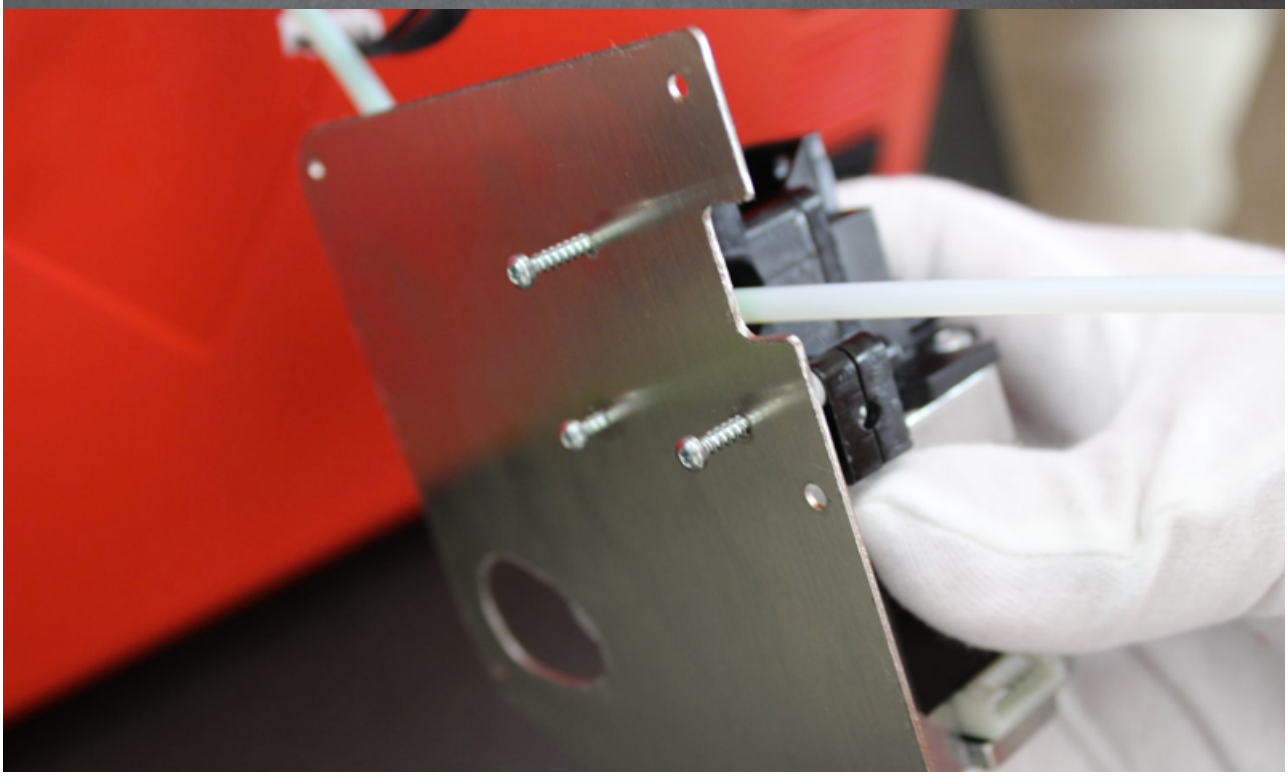


By gently pulling the filament from the filament compartment you can retrieve the feeding tube and have it sticking in the filament compartment as it was originally.

Now screw everything back on the feeder.

the screw indicated by the tweezers is the shortest one of the bunch, in case you wonder.





just like it was before, insert the feeder in the feeder hole in the back of the unit, insert the motor cable connector on the motor and secure the connector on the clip.

Put it back together by screwing the external T8 screws Gently.
Avoid excessive torque as it can eat the plastic away.

REPLACING A NOZZLE : BEFORE STARTING

Nozzles can be swapped in order to change nozzle diameter or material for special filaments or to change an old nozzle with a new one.
Regardless of the reason and the modle of the head the procedure requires the following conditions:

- Remove the filament from the nozzle by unloading the filament
- Remove the head while the unit is idle and the nozzle is cold.

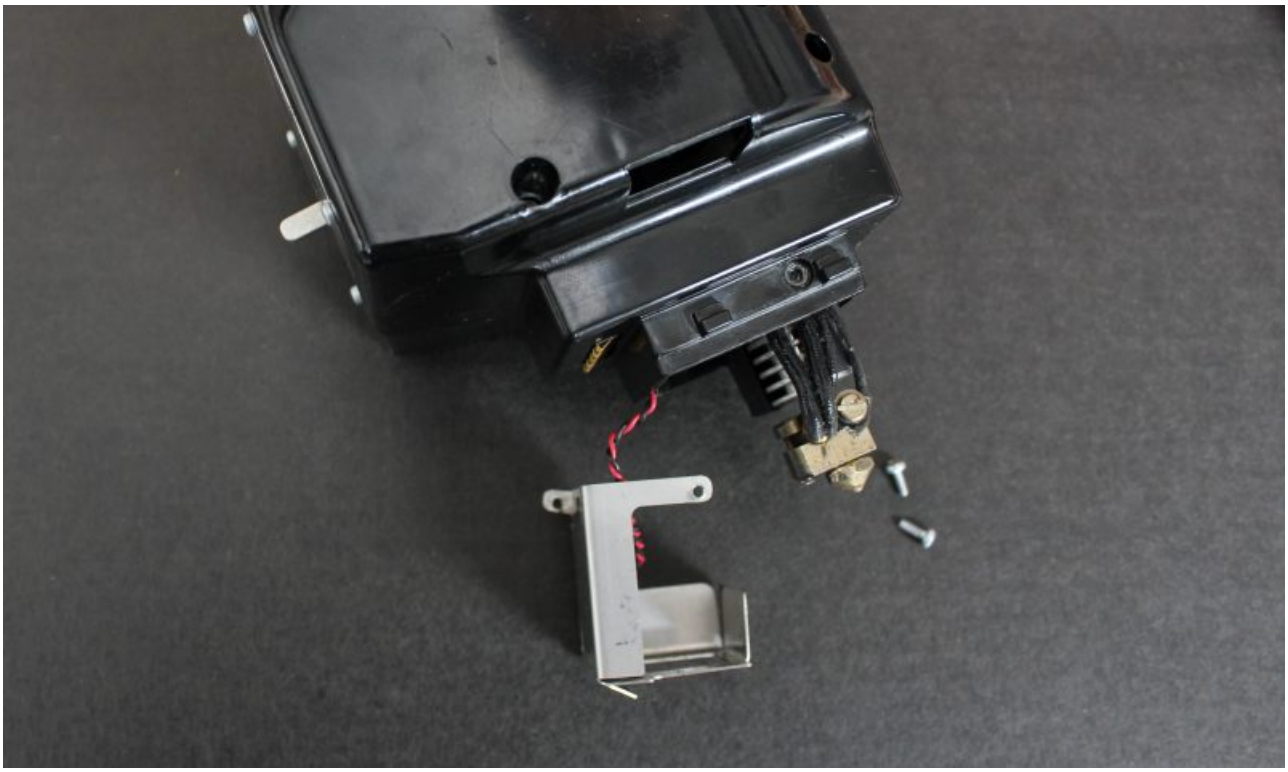
Notice: we suggest to discard any previously used portion of the filament after it’s processed into the feeder, as it can be compressed and grinded during the extraction.

Printing Head PRO

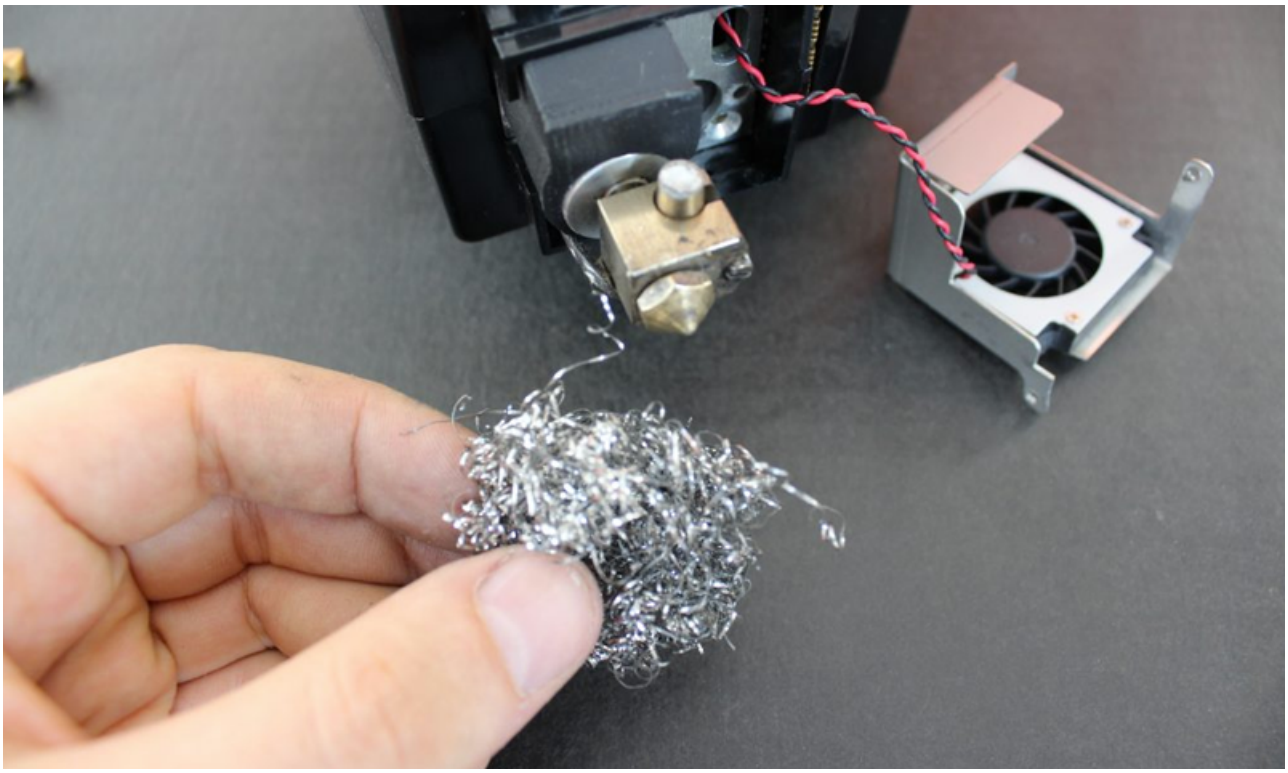
Gather all the parts: the provided monkey wrenches, a T8 screwdriver and the desired nozzle.
Optional: metal sponge for cleaning.

Remove the two screws on the side with a T8 screwdriver.

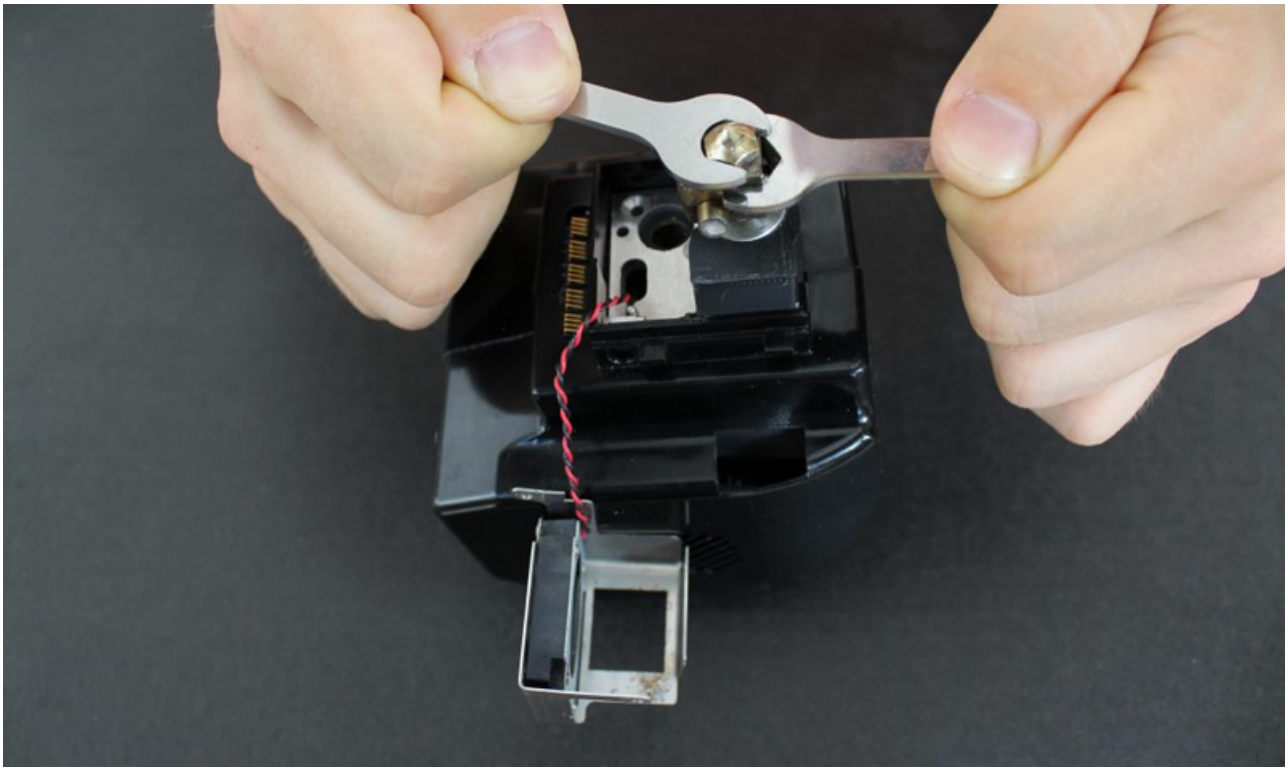
Gently remove the shield. Note that the fan cable must not be pulled at any time.



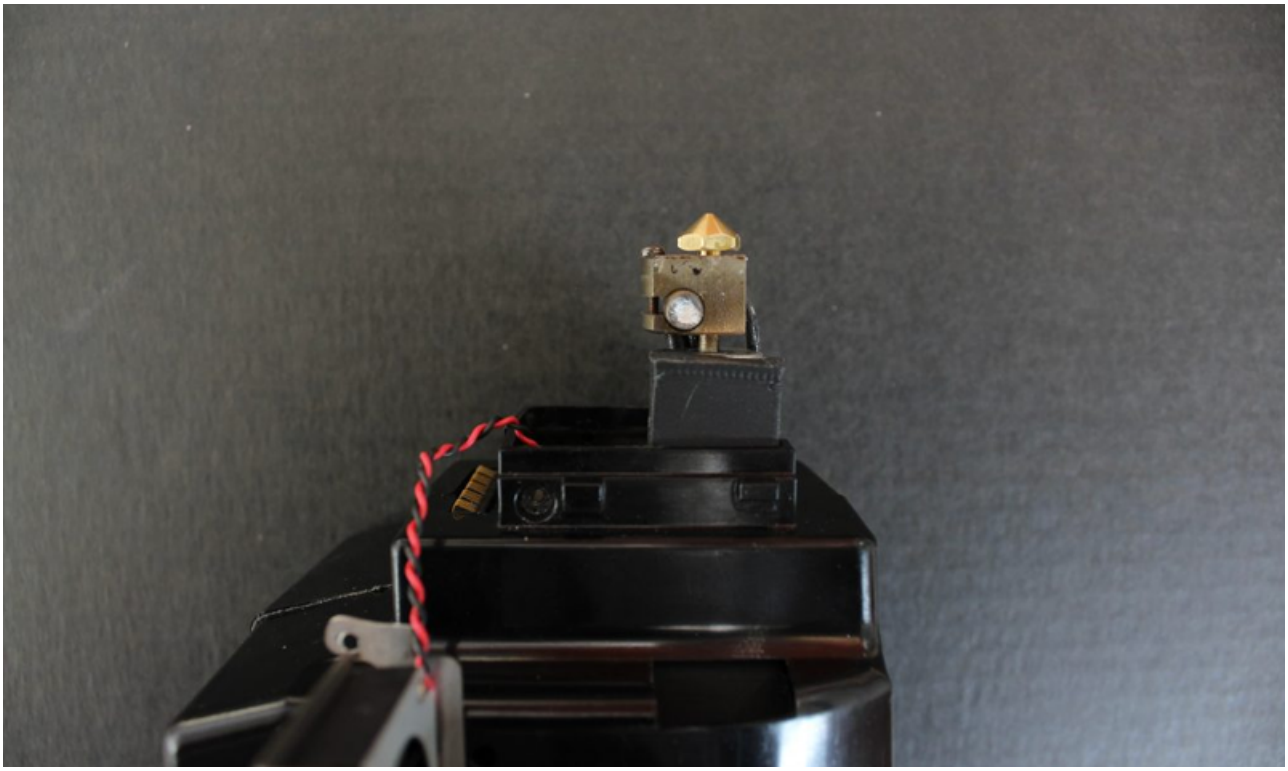
This is a good time to gently clean the hotend from any plastic residue.



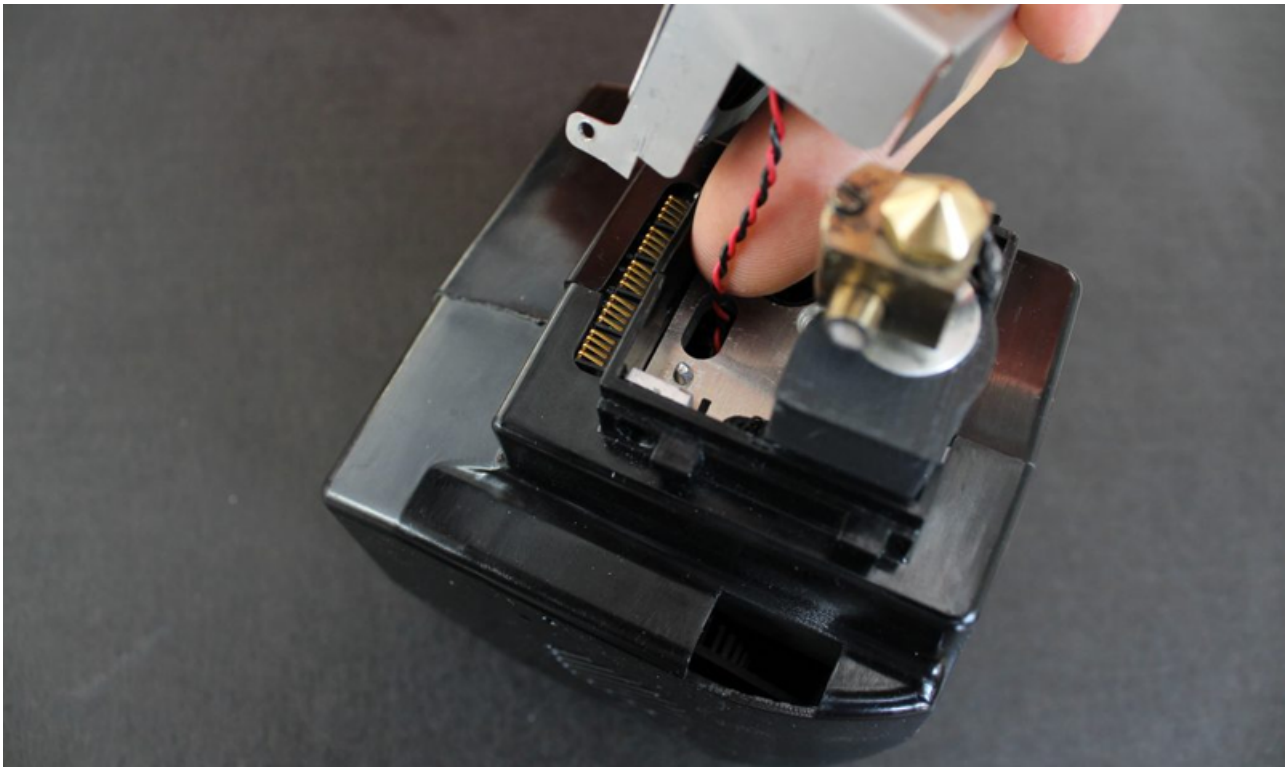
Use the two wrenches to unscrew the nozzle. keep the hotend firm with one wrench and unscrew the nozzle with the other wrench just like you would normally (counterclockwise).
Extreme force is not necessary. Make sure to not hit any cable of part that could break.



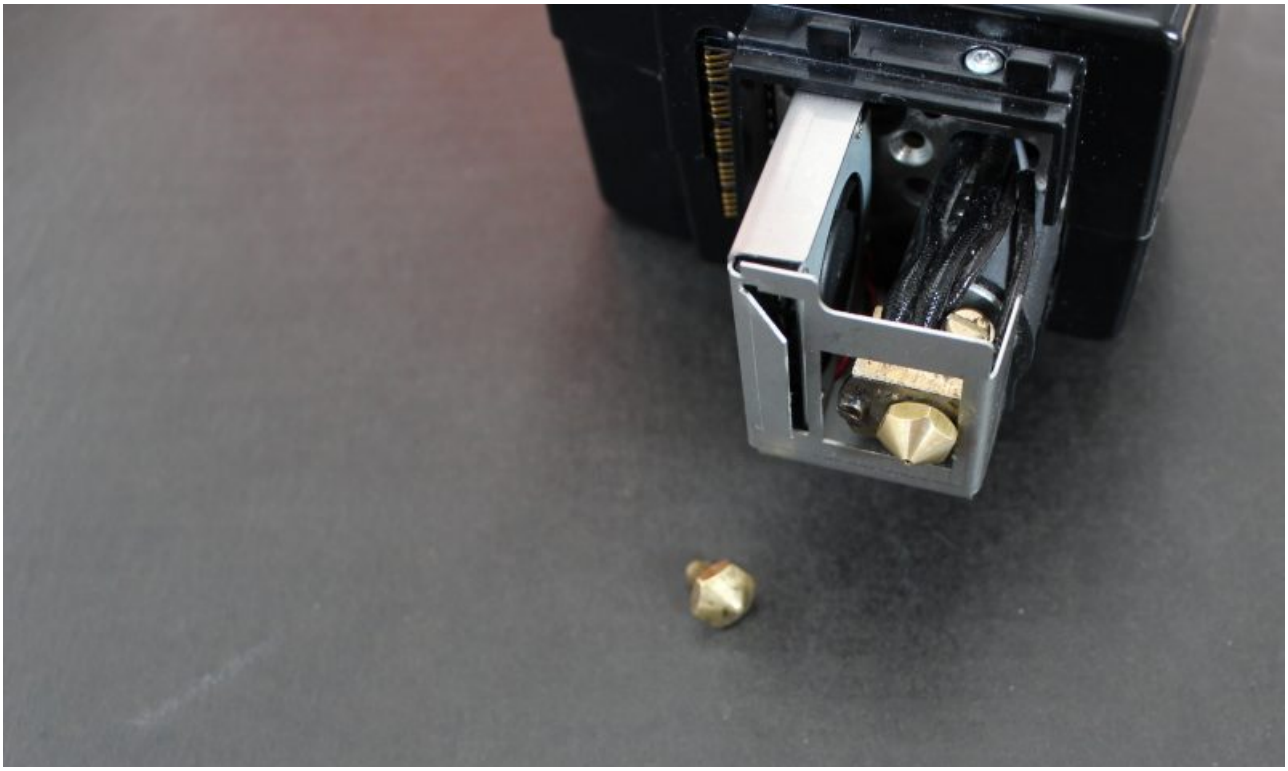
Now screw the new nozzle back in manually and use the wrenches only to fasten it at the end.
As a rule of thumb once you hit resistance the nozzle can still be screwed in for 10-20 angular degrees.
If the nozzle is not tight enought plastic will find a way outside the thread, causing a nozzle failure and a nasty plastic overflow.



The heat shield must be reinstalled. Make sure the wires are not in the way by gently pushing them back in to the respective hole.



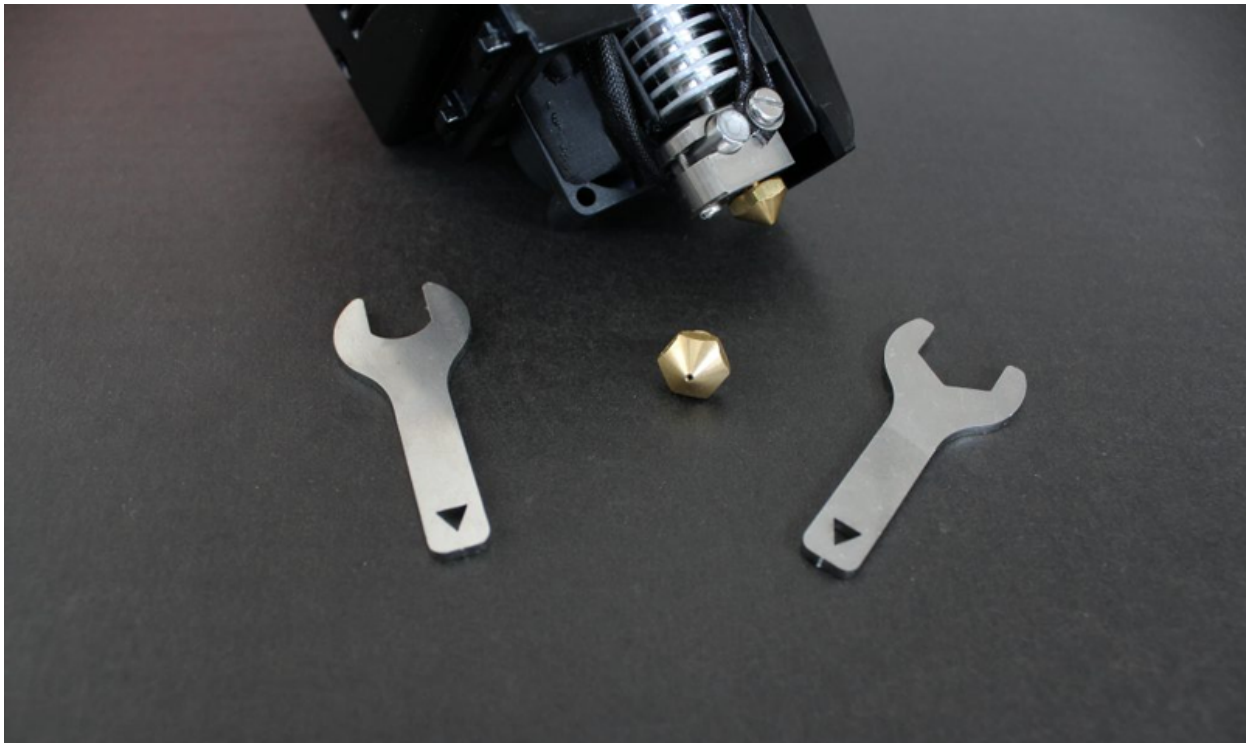
Done! Renstall the head with the FABUI head installation procedure, load the filament and extrude some plastic or run a small print to prime the nozzle.



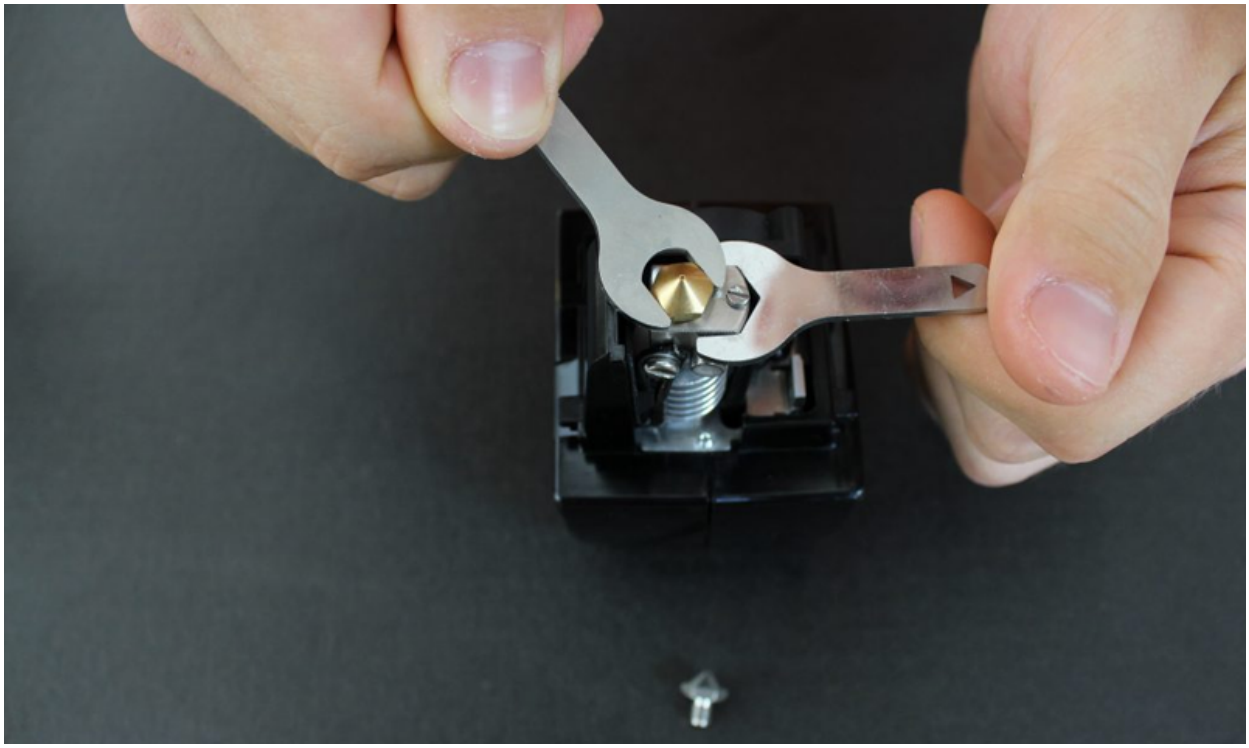
Printing Head Lite / V2, Hybrid Head

To change the nozzle on a Print Head V2 you'll only need the two Wrenches usually provided with the unit.

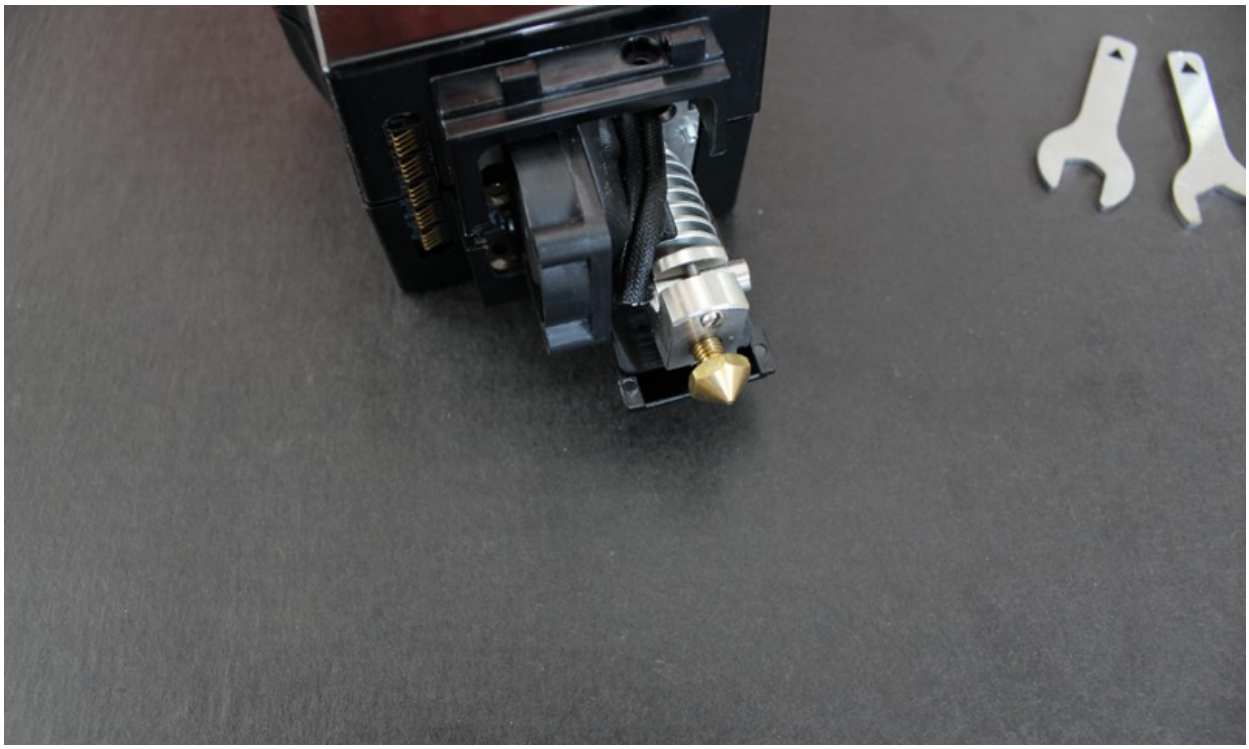
Make sure the nozzle is clean and has no dust or residues in the orifice.



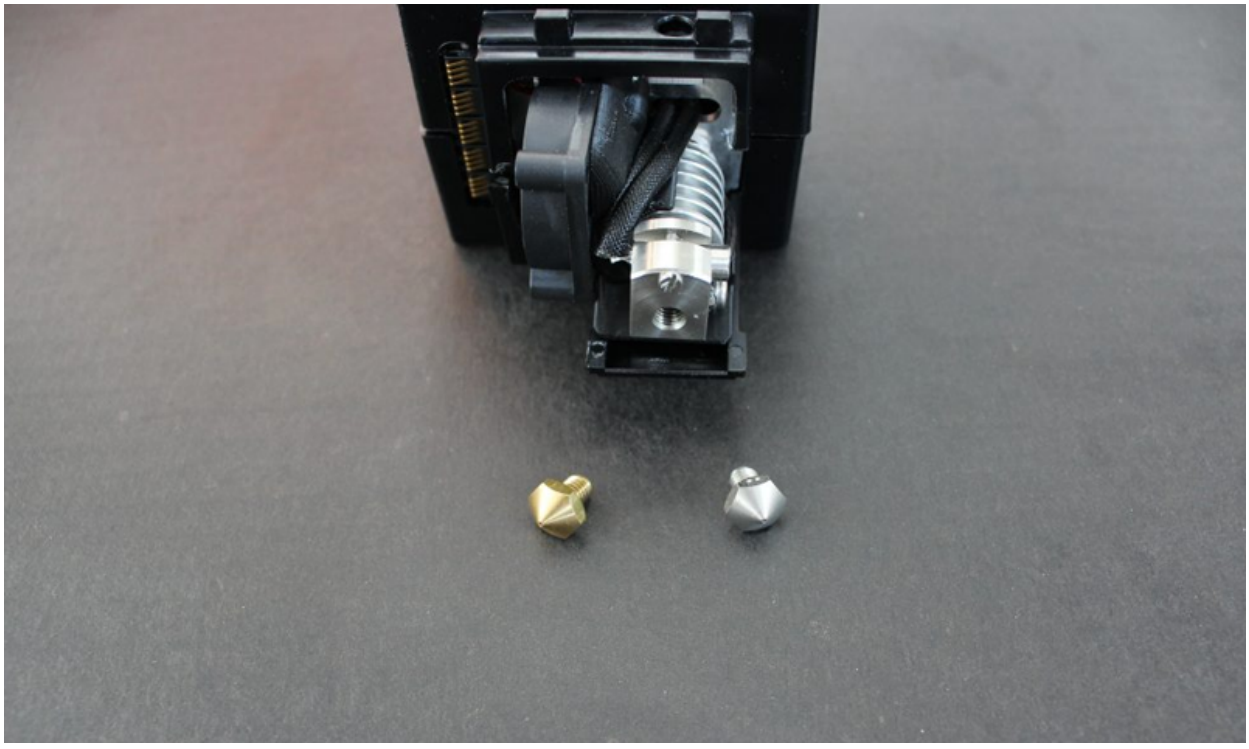
With one wrench keep the hotend still (right wrench in this image), with the other wrench turn the nozzle counterclockwise to unscrew. The nozzle should unscrew fine after a little extra force is applied to fight the initial friction.



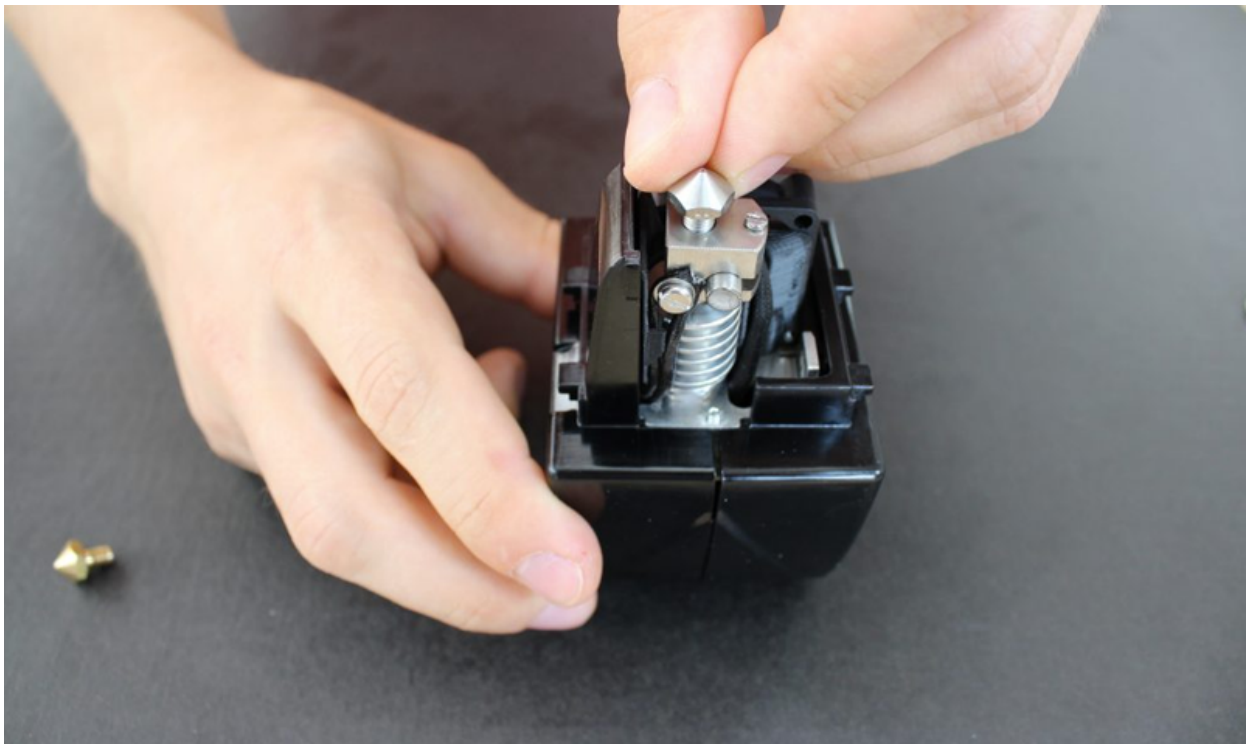
You can unscrew the whole nozzle by hand once the initial friction has been overcome.



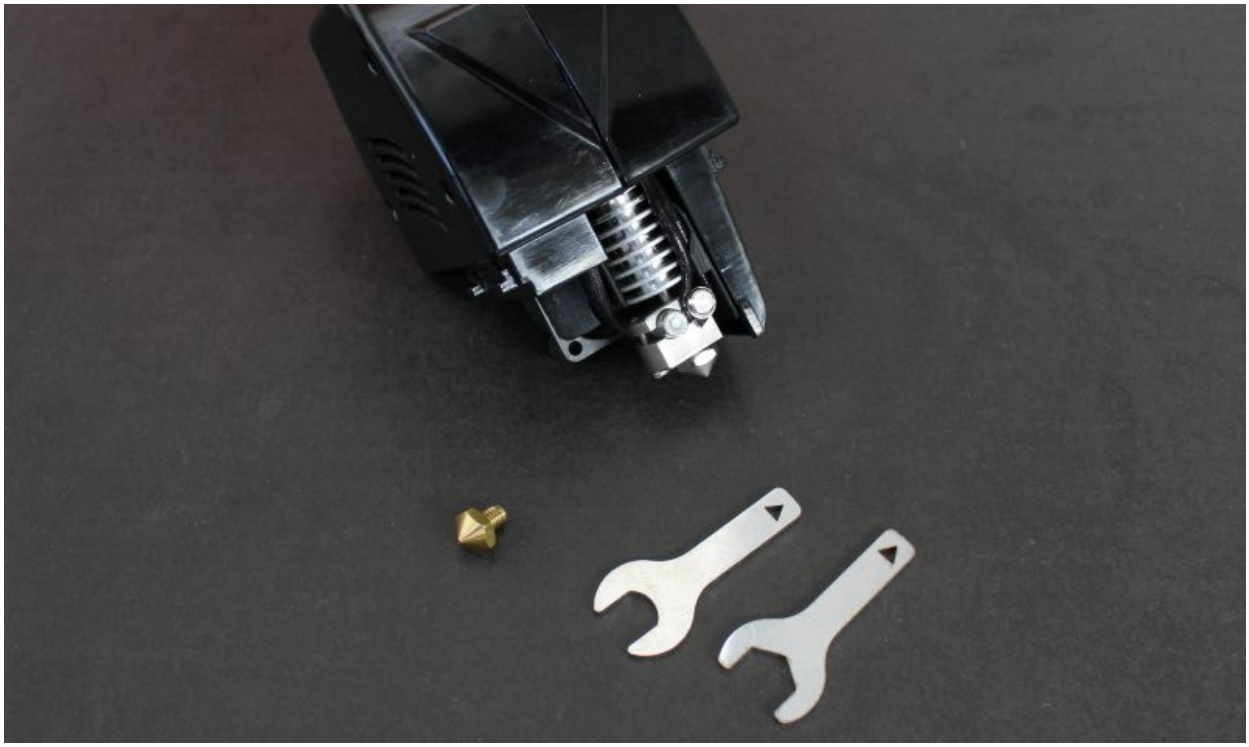
Make sure the final nozzle is clean and void of any dust, epsecially the screw.



Now you can manually and gently screw the nozzle down to around 1 mm distance from the metal base.Use the wrenches to force it screwed in. Once you feel some resistance you can still screw around 10-20 angular degrees more than that.
If the nozzle is not tight enought plastic will find a way outside the thread, causing a nozzle failure and a nasty plastic overflow.



Renstall the head with the FABUI head installation procedure, load the filament and extrude some plastic or run a small print to prime the nozzle.



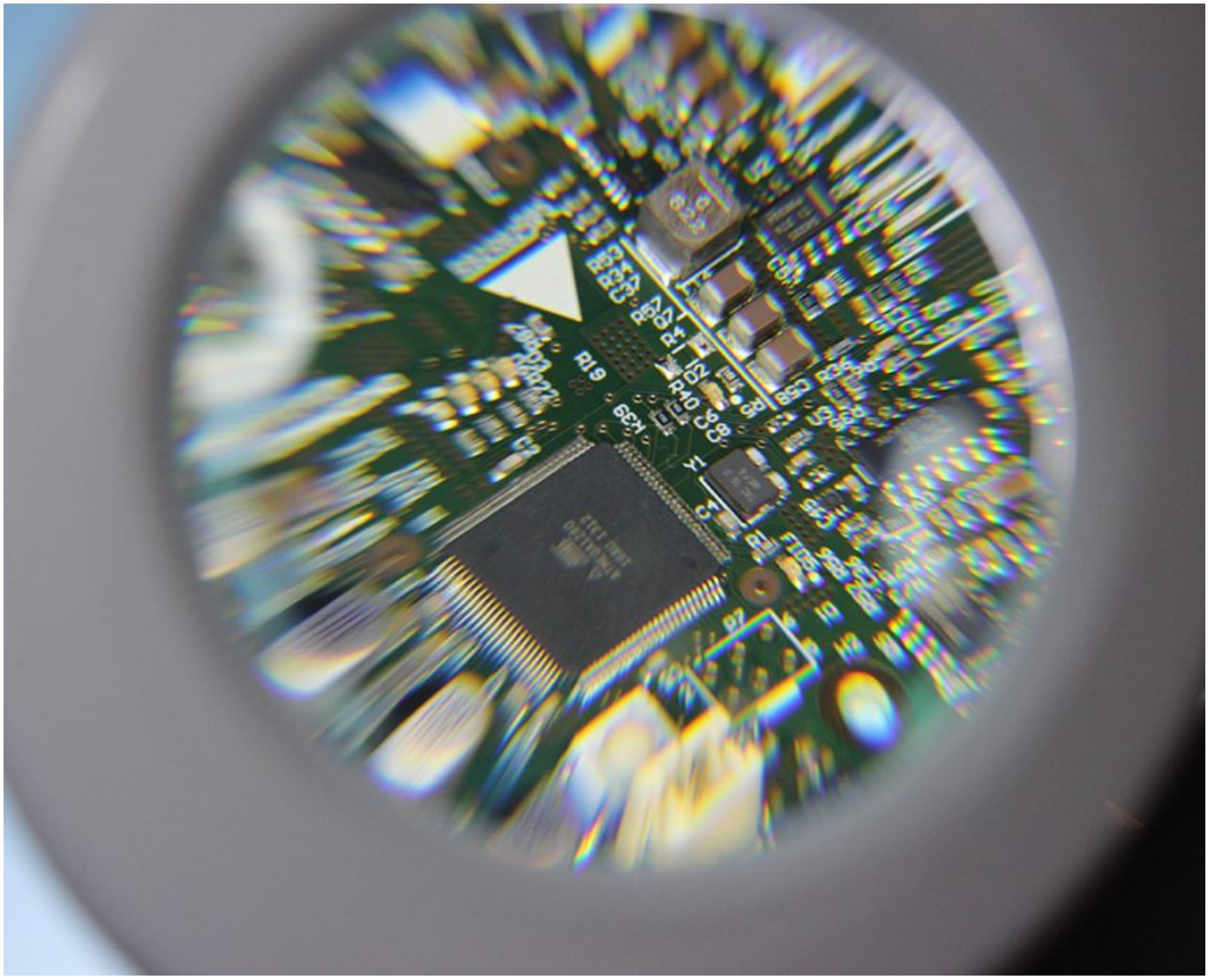
8. RESOURCES & DEVELOPERS

THE TOTUMDUINO BOARD

Totumduino is the name of the FABtotum controller board based on Arduino. Its architecture is based on that of RAMPS 1.4 boards.

Features

- 4th axis connector
- 5th axis on a pole JST connector PH series 2mm connector
- Endstop n1
- Raspi GPIO header connector
- Hotbed connection
- Emergency switch
- Front-door safety switch
- YZ endstops
- 24v power supply
- Interior light output
- Second Extruder temp
- Head connector (this includes: milling motor control, extruder 1 heat control, servo control, servo powering, laser control & power, head light power, probe input, fan control and an I2C bus, X endstops, led controls).
- Board fan power



Firmware Development

The Totumduino firmware is based on the Marlin by Erik Zalm.
Its source code (called FABlin) can be found on GitHub at https://github.com/FABtotum/FABlin.

Communications from the Raspberry Pi to the Totumduino use a custom set of G-codes. Please refer to the Raspberry Pi section for details on how it is done.
The G-code interpreter on the Totumduino translates the commands into appropriate motion control actions.

Firmware development: getting started
FABlin is available at Github, in: https://github.com/FABtotum/FABlin
If you have GitHub installed, you can get the source directly by cloning it: https://github.com/FABtotum/FABlin.git//

This generates a directory with the entire code of the master branch of the repository.
You can also download the source by going to the FABlin GitHub page and using the “Download ZIP” button on the bottom right.

Developing FABlin: version control
If you intend to develop the FABlin or bug fixes, then it is best that you create a GitHub account and use the “Fork” option in the FABlin GitHub page. This creates a copy of the repository under your username. There you can develop anything using the flexibility that GitHub provides and when you have something to share, you can ask for a pull request of your branch.

Developing FABlin: The IDE
A convenient way of developing and compiling the source is to install the Arduino IDE from http://www.arduino.cc/.
It is not the only one, but certainly the most convenient (NB: version 1.06 seems to work, but 1.6.x does not).
Once you have the Arduino IDE installed, you can open the “.ino” file in FABlin to load the source code of the project. Then you can do your edits and compile the code using the “checked” icon on the top left of the Arduino IDE window.

One thing to take into account when using the Arduino IDE is that compiling is detached from saving, you can compile a modified file without saving it. However we prefer using an external editor (Kate, a linux UI editor), while we still use Arduino IDE for compiling.
Before compiling, make sure you have selected the right target chip in the menu. The Totumduino has an ATMEGA 1280. If you compile for another chip it won’t work.

The Arduino IDE generates a file with the same name as the project and extension “.cpp.hex” in the temporary directory. In Linux is in /tmp/buildNNNNNNN/, in windows it is usually in “Windows/Users/me/Appdata/Local/Temp”.

The Arduino IDE generates one of this “build” folders for every execution and does not always clean up afterwards, so always check the date and time of the generated firmware before uploading it or you may be uploading the wrong one (or an old version).

Flashing the firmware
The easiest way to flash a new firmware is to upload it to /var/www/build/Marlin.cpp.hex and use the built-in flasher.

In Linux the procedure is as follows:
scp Marlin.cpp.hex root@fabtotum:/var/www/build

In Windows you should be able to use WinSCP to copy the file Marlin.cpp.hex to the directory /var/www/build/

Make sure the file name is “Marlin.cpp.hex”. Remember that Linux is case sensitive.
After having copied the firmware to the FABtotum, go to: http://[YOUR FABTOTUM IP]/recovery/flash.php and click on Flash Local.
Wait until the web interface completes the operation successfully (it beeps a couple of times in between).

Flashing Firmware from the Raspberry Pi
Upload your firmware to /var/www/build/ and connect to your FABtotum with a ssh terminal (search Putty for Windows or just open the Terminal on Linux/MacOS)

ssh: root@fabtotum
password: fabtotum

cd /var/www/build

/usr/bin/avrdude -D -q -V -p atmega1280 -C /etc/avrdude.conf -c arduino -b 57600 -P /dev/ttyAMA0 -U

flash:w:Marlin.cpp.hex:i

Resources

We want to involve people in the design process as much as possible, and allow them to modify and improve the machine to fit their own needs without needless restrictions.Use of full documentation,drawings and the reproduction of the FABtotum is allowed and encouraged under the Creative Commons Attribution-Noncommercial-Sharealike 3.0 Unported License (CC BY-NC 3.0)

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Mechanical Drawings
FABtotum @ Grabcad (mechanical)
https://grabcad.com/library/fabtotum-2

Electronics
Electronics of the FABtotum personal Fabricator have been released on Github as well, along with the software needed for each microcontroller.
Totumduino v10.4 schematics, draft
http://download.fabtotum.com/TOTUMduino schematics.PDF
Gerbers & BOM of all parts
https://github.com/FABtotum/FAB_Electronics

Firmware & software
The GitHub repository contains both the FAB UI software and the FABlin (a Marlin derivate firmware for multipurpose personal fabrication), as well as ongoing projects like the Colibri-FAB UI. Feel free to get involved in the development: send a pull request for your code.
https://github.com/FABtotum

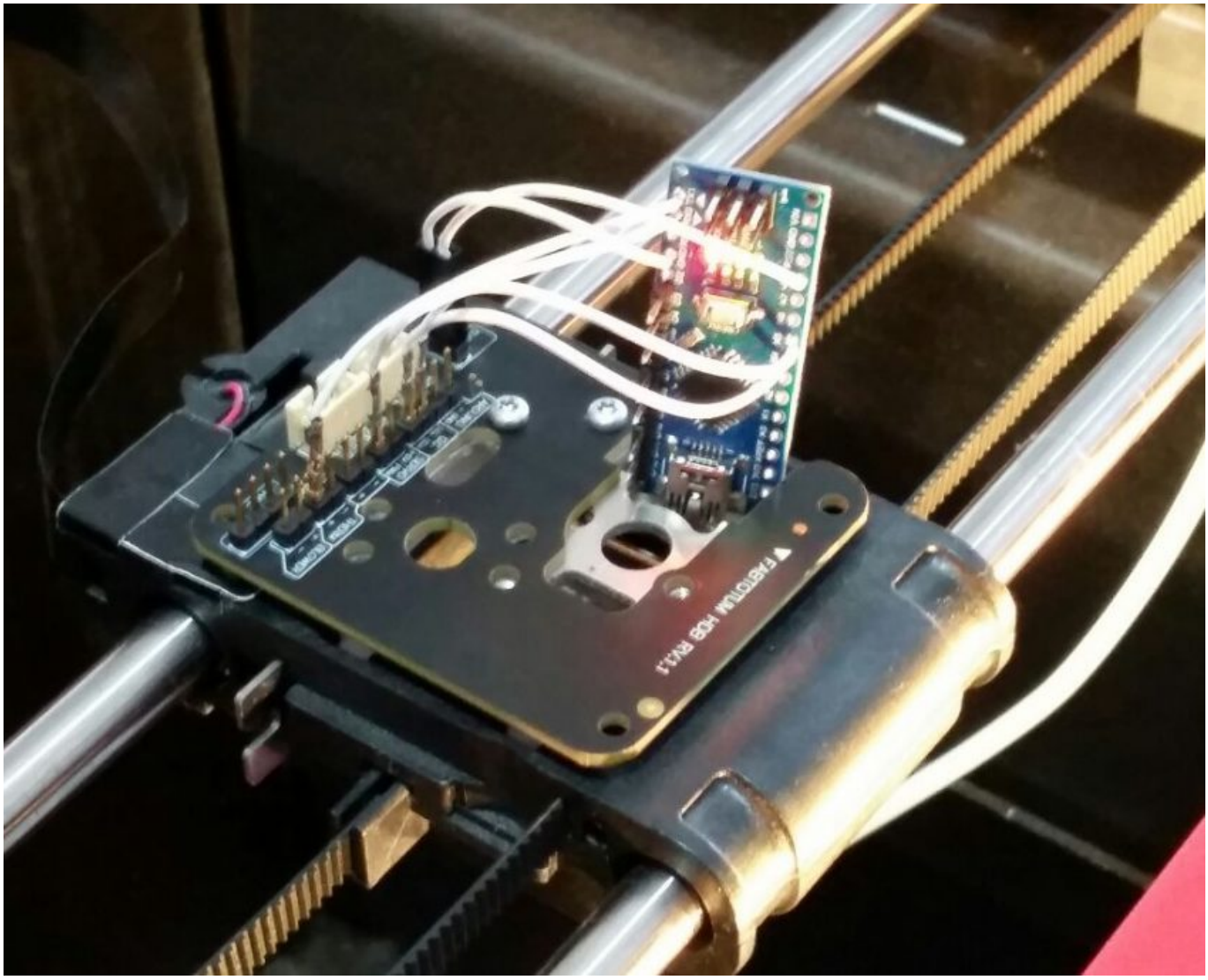
DEVELOPING NEW FUNCTIONS WITH THE HEAD DEVELOPMENT BOARD

Developing a Smart Head for the FABtotum is easy.

For your convenience, we prepared a software development kit containing some Arduino sketches that can be run on a Arduino Nano or similar development boards mounted on the FABtotum Personal Fabricator through a HDB.
This enables to create complex interactions, use actuators and sensors on top of the FABtotum Personal Fabricator.

All sketches require the latest development version of the FABlin. You can compile it yourself
from https://github.com/FABtotum/FABlin/tree/development or flash the precompiled hex file given in this repository.

For general pointers on the Head Development Kit, and the accompanying Head Development Board (HDB), see the link https://github.com/FABtotum/Head-Development-Kit



HEAD DEVELOPMENT GUIDELINES

Intro
Heads can be developed to perform different tasks and sold independently by anyone. Here there are a few guidelines that will help developers design and manufacture new modules.
The FABtotum Personal Fabricator carriage is the platform on which each and every head has to sit.
The carriage provides power, communication and other things through its connector plate. It moves on the X & Y axis.
Power and communication are provided as explained in the electronicl specifications.

A retractable touch-probe, a laser line generator and a LED light are integrated in the carriage and are always available to be used during employment of custom/third-party heads, as long as they don't interfere with each other (i.e.: the probe hitting the lower part of a custom-made head).
Bourns 70AB/Male connectors should be used on a head to work with the printer's carriage. The operating characteristics of this type of modular contact and further information can be found here. The related .stp files for CAD provided by the manufacturer are here.

The five Bourns connectors (also used as a battery connectors for some PDAs) are placed onto the head and make contact with the PCB thanks to the lockdowns. So, when you lock the head in place, its contacts are forced against the PCB.

Head Development Kit
The Head Development Kit has been designed by the FABteam to help DIY enthusiasts who wish to develop new tools for their FABtotum. It features all the I/Os needed to develop new functionalities.

Mechanical Specifications
Each head is locked in place by friction with a locking mechanism built in the carriage.
To disengage and engage it you must push the two levers on the sides of the carriage itself.
The shape of the support plate of a head is crucial, the locking mechanism function is to hold down the head and avoid undesired movements.

Electronic Specifications
The carriage is connected to the Totumduino board and is controlled by the Raspberry Pi.
The pinout is fundamental for all operations and includes spring-loaded contacts positioned on the head mounting plate or PCB (they are called "pogo pins").
Specifications for the contacts can be found here.
The head shape is designed to protect it from dust or accidental movements (see the "Hybrid Head" mounting plate).
The pinout specs of the head should always follow the head connector pinout.

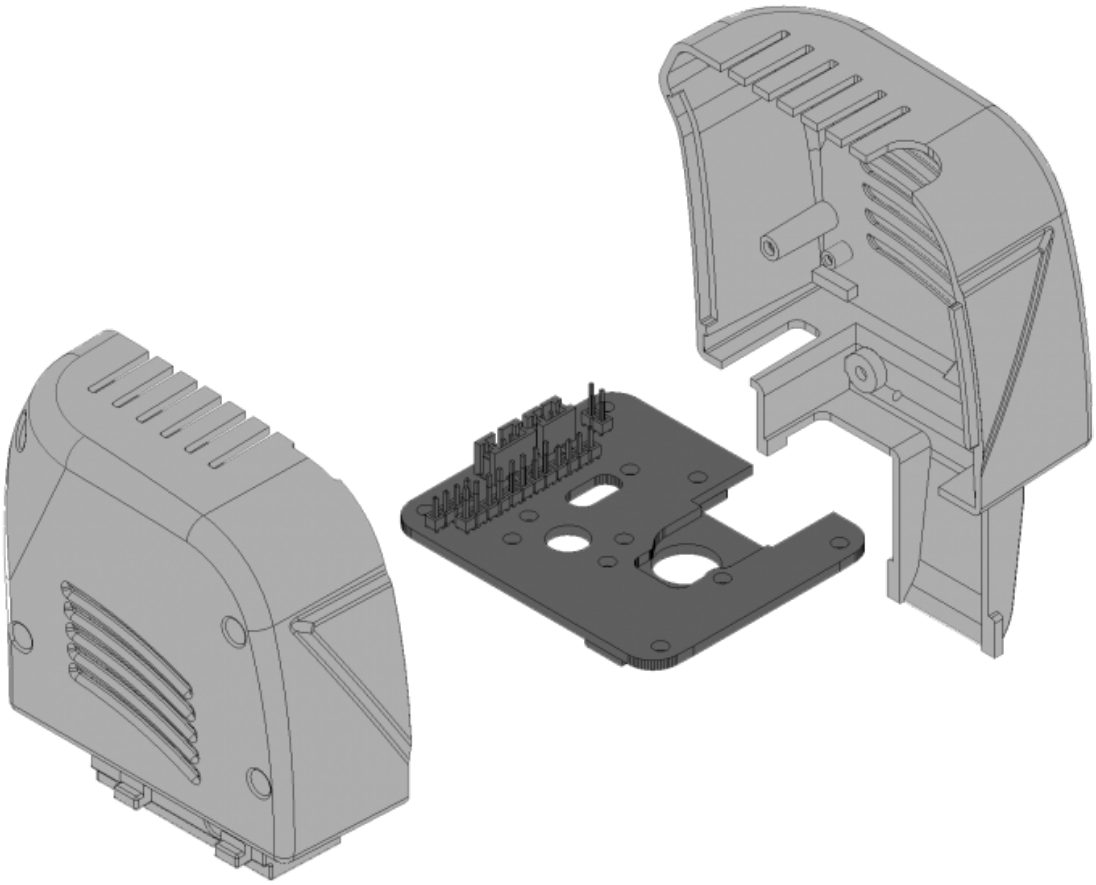
Software Specifications
Each head as well as each optional hardware attached to the FABtotum should comply with these guidelines, safety regulations and related standards imposed by the country in which it is employed. It will also need to be marked accordingly, to ensure that safety and performance specifications are met. Please also note that FABtotum cannot be responsible or liable for use or misuse of third party heads.

Licensing heads
The use of the full documentation, including drawings and the reproduction of the FABtotum Personal Fabricator is allowed and encouraged under the Creative Commons Attribution-Noncommercial-Sharealike 3.0 Unported Licence.
Custom and third-party heads can be reproduced and sold as the creator sees fit, as long as:

- They are not marketed as FABtotum official products;
- They don't use FABtotum logo or graphical assets;

- They don’t harm or put users in direct danger and aren’t used for illegal or questionable activities;
- They comply with the mechanical, electronic, software, safety and licensing standards outlined in this document.

Head Development Kit Resources



You can find the Head Development Kit toolchain on the FABtotum GitHub repo: https://github.com/FABtotum/.