READ THIS MANUAL COMPLETELY BEFORE UNPACKING AND POWERING UP YOUR PRINTER

This information guide is also available at LulzBot.com. There you can find more information including images, videos, and updated versions of this manual.

Hazards and Warnings

WARNING before you unpackage or use your printer: This 3D printer is a machine with motorized and heated parts. When the printer is in operation always be aware of possible hazards.

ELECTRIC SHOCK HAZARD: Never touch the electronics board when the printer is powered. Always power down the printer and completely turn off and unplug the power supply before touching or removing any wires from the electronics board. NEVER touch the screw terminals on the power supply when the AC plug is plugged into a power socket.

STATIC CHARGE: Make sure to ground yourself before touching the printer, especially the electronics. Electrostatic charge can burn up electronic components. To ground yourself touch a grounded source. An easy way to ground your self is to rinse your hands in the sink.

BURN HAZARD: Never touch the extruder nozzle or heater block with out first turning off the extruder heat and allowing it to completely cool down. Also, never touch recently extruded plastic. The plastic can stick to your skin and cause burns. Also beware of the heated bed which can reach up to temperatures 120C.

FIRE HAZARD: Never place flammable materials or liquids on or near the printer when powered or in operation.

PINCH HAZARD: When the printer is in operation take care to never put your fingers in the moving parts including the belts, pulleys, or gears. Also, tie back long hair or clothing that can get caught in the moving parts of the printer.

AGE WARNING: For users under the age of 18, adult supervision is recommended. Beware of choking hazards around small children.

Table of Contents

Unpacking Instructions

1. Remove the plastic bag containing instructions, cords, and small parts
2. Remove the top foam padding
3. Slowly remove the two smaller foam pads. One of these pads will contain the plastic filament spool.
4. Remove the bubble wrapped power supply.
5. Grab the top of the wrapped printer on the top center where you will feel two lengths of square aluminum tubing. Holding the top two tubes, SLOWLY pull the printer upwards out of the box. The two large side foam pads should fall off when the printer is out of the box.
6. Set you printer on a stable level surface.
7. Gently unwrap the pink ESD plastic covering the printer. Gently lift the printer to slide the plastic wrapping from under the printer.
8. Using scissors or wire cutters, cut and remove the two ORANGE plastic straps. One strap is located on the bottom front of the printer on the print bed. The other strap is around the extruder carriage and X axis. Make sure to not cut any of the surrounding wires or belts.
9. Find the item list attached to the plastic bag of parts. Before you move on to setting up your printer make sure all of the items on the list are in your package.
10. Remove the four clamps above and below the x-end motor mount and idler (Fig. 1-1). Loosen and remove the wing nut and screw on each of the four clamps. Remove each of the four clamps by popping them off of the smooth rod. Keep the clamps and hardware for future use if you need to ship or transport your printer.
11. Remove the blue tape from the print surface. Make sure to not remove the green PET film on the glass print surface. The PET film helps keep the print attached to the print surface during printing.

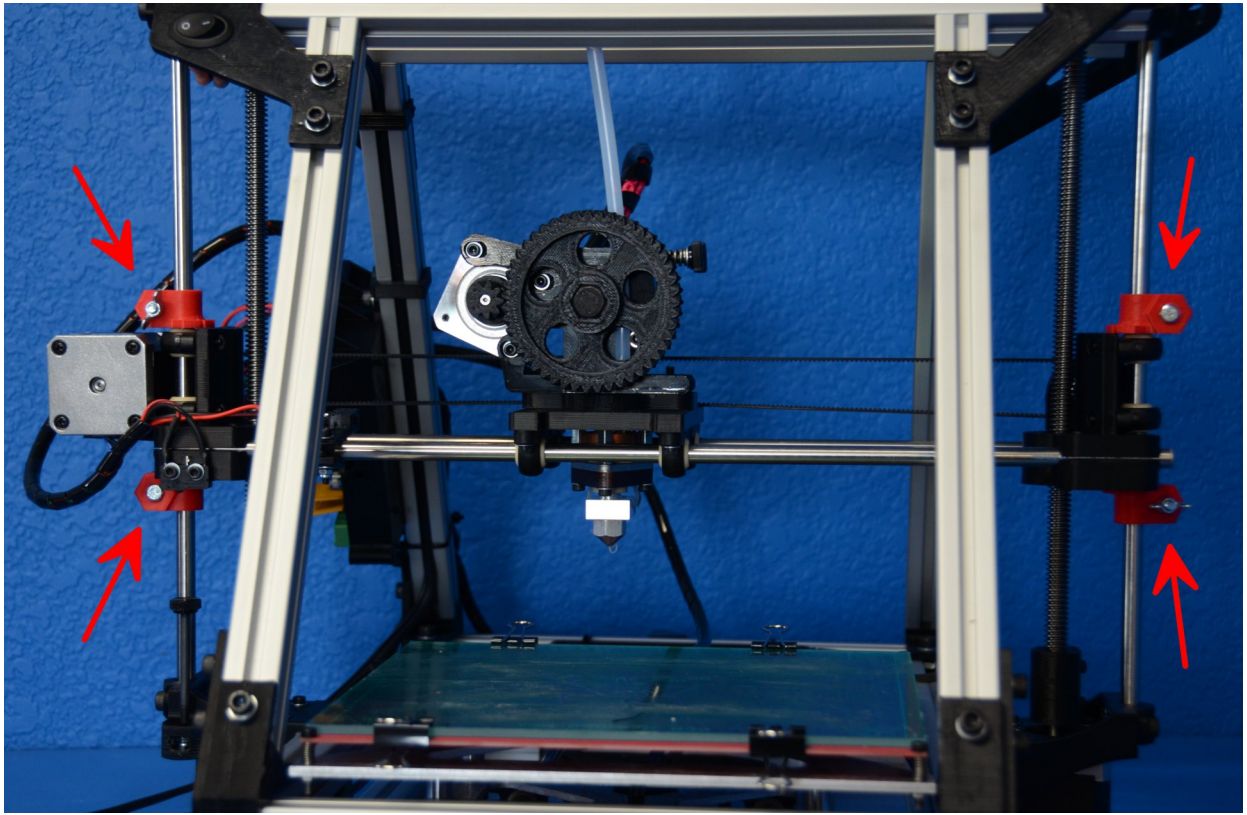


Fig 1-1. Remove shipping clamps noted by arrows

Setup

1. Your printer has been pre-calibrated and tested; however, after unpacking you will need to double check that everything is in order before you print.
2. You should set your printer on a stable, flat, and level surface large enough for extra space around the printer. Make sure your printer work space is clear of anything that could obstruct the movement of the printer. Make sure there are no flammable fabrics or liquids near the printer space. It is also best to not put your printer near a drafty window or air conditioner vent.
3. Check that the three mechanical end-stops are aligned to contact with the respective ends. The mechanical end-stops are small switches located at the home point of each axis. (Fig. 2-1, 2-2, and 2-3)
5. Make sure none of the wires have come unplugged from the RAMPS electronics board. If any wires have come unplugged in shipping or unpacking please see the reference image on the support page at LulzBot.com to find where the unplugged wire(s) need(s) to be plugged back in.
6. Unwrap the power supply, USB cable, and sample plastic filament.
MAKE SURE THE POWER SUPPLY IS COMPLETELY UNPLUGGED BEFORE MOVING ON TO THE NEXT STEP
7. Plug the loose black plug coming from the printer into the black plug from the power supply (Fig. 2-4).
8. Set the AC power setting on the side of the power supply. You will need to set it to 110V or 220V depending on your regional location.
9. Plug in the USB cable, B plug (square plug) side, into the USB receptacle on the printer electronics. Plug the other end of the USB cable, A plug side, into your computer.
10. Make sure the printer power switch is turned off (the circle side should be depressed). Plug in the black RAMPS power plug from the power supply into the matching black receptacle in the RAMPS electronics (Fig. 2.5). Make sure the screw terminals on the plug are facing out from the printer. Now you can plug in the AC power plug from the power supply into an AC power outlet.
11. Locate the plastic filament spool (Fig. 2-6). Locate and loosen the three wingnuts on the upper arms. Completely loosen and remove the

three wingnuts and washers. Slide each of the three arms off of the screws (Fig. 2-7). Turn each arm 90 degrees outwards from the spool until the arm is parallel with the lower arms. Replace the washers and wingnuts and tighten (Fig. 2-8).
12. Remove the large wing nut from the back of the spool. Take off one washer leaving the other three on the spool mounting bolt. Now locate the spool mount arm on the top right facing the rear of the printer (Fig. 2-9). Slide the spool mounting bolt through the hole in the spool mount arm. From the back of the spool mount arm slide the one washer on to the spool mounting bolt and turn on the wing nut (Fig. 2-10). Use an M8 wrench to hold the spool mount bolt head and pliers to turn and tighten down the wing nut. Tighten the wing nut tight enough to put pressure on the spool hub bearing.
13. Locate the filament guide with attached PTFE tube (Fig. 2-11). Locate the top most horizontal aluminum extrusion closest to the filament spool (Fig. 2-12). In the extrusion you will find two loose t-slot nuts. The filament guide attaches to the printer by screwing in the two bolts through the filament guide into the t-slot nuts. First thread the two bolts into the t-slot nuts. Leave the bolts loose enough so the filament guide can slide back and forth across the extrusion. Set the filament guide 1.5-2cm away from the end of the lower arms of the filament spool (Fig. 2-13). Once the filament guide is set in place, tighten down the two bolts.

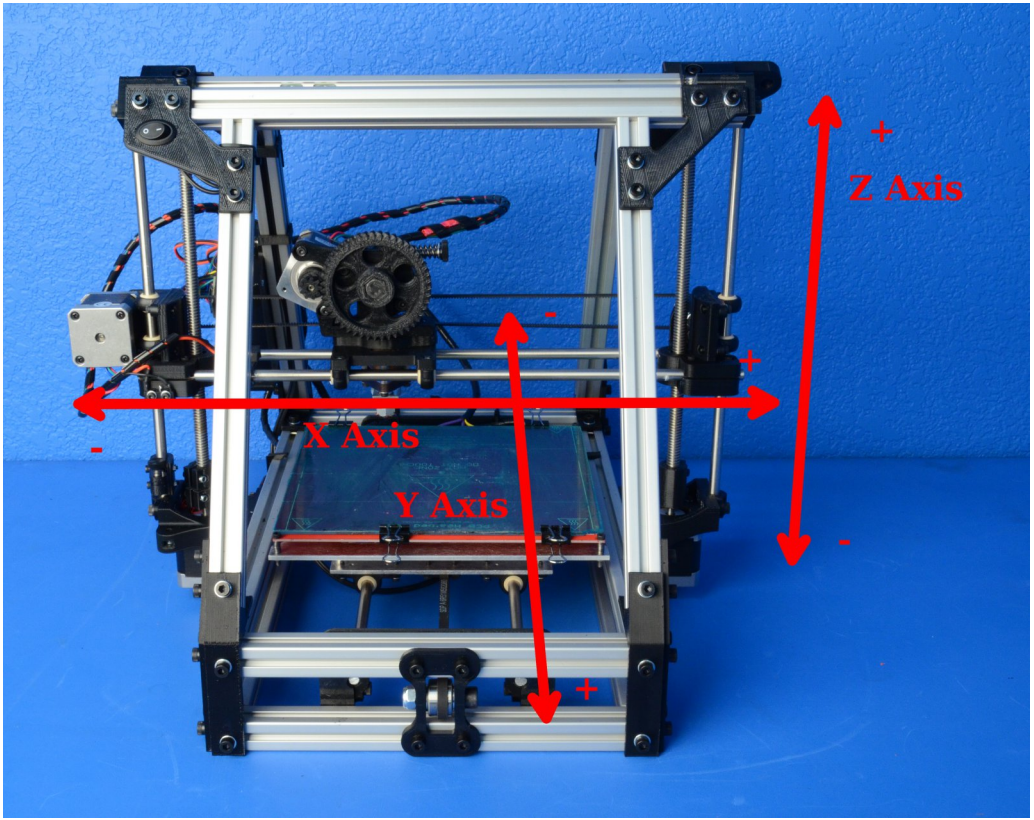


Fig. 2-1. Axes movement directions

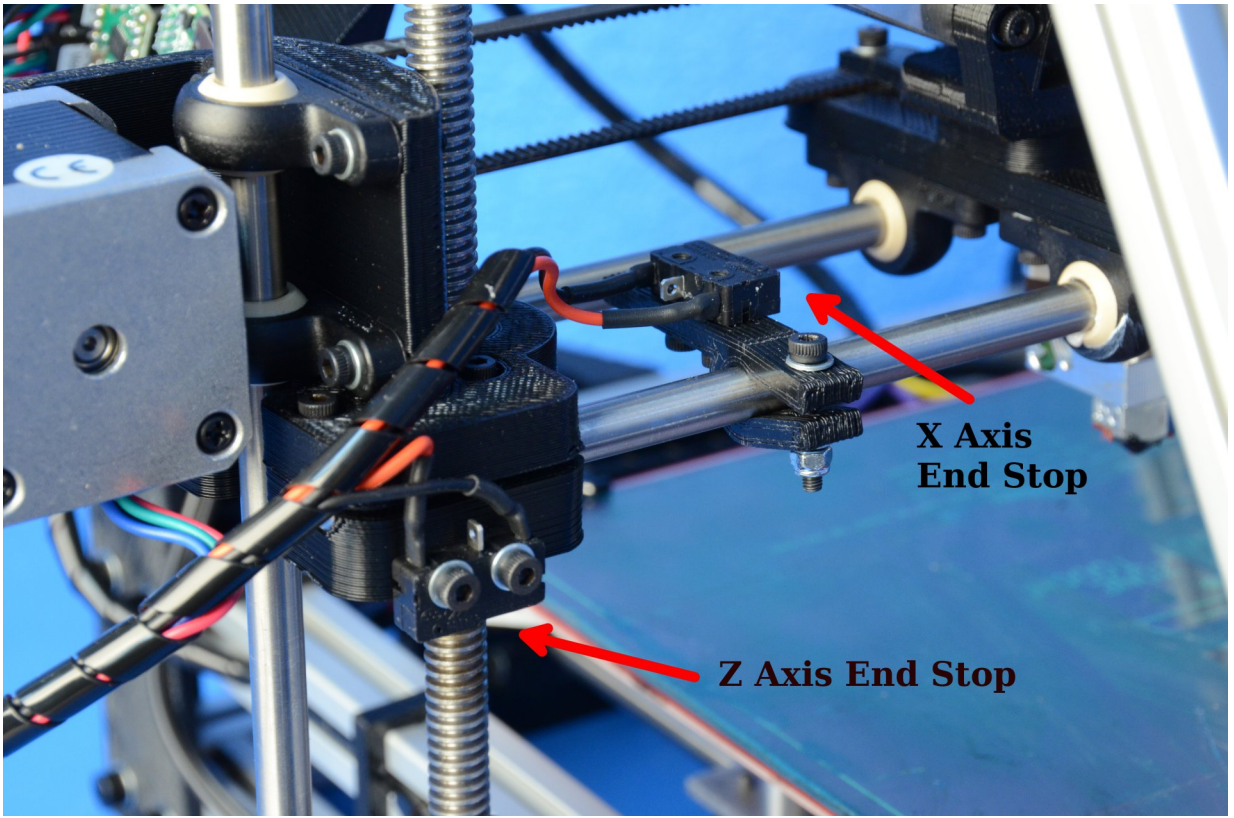


Fig. 2-2. X and Z axis end stop locations

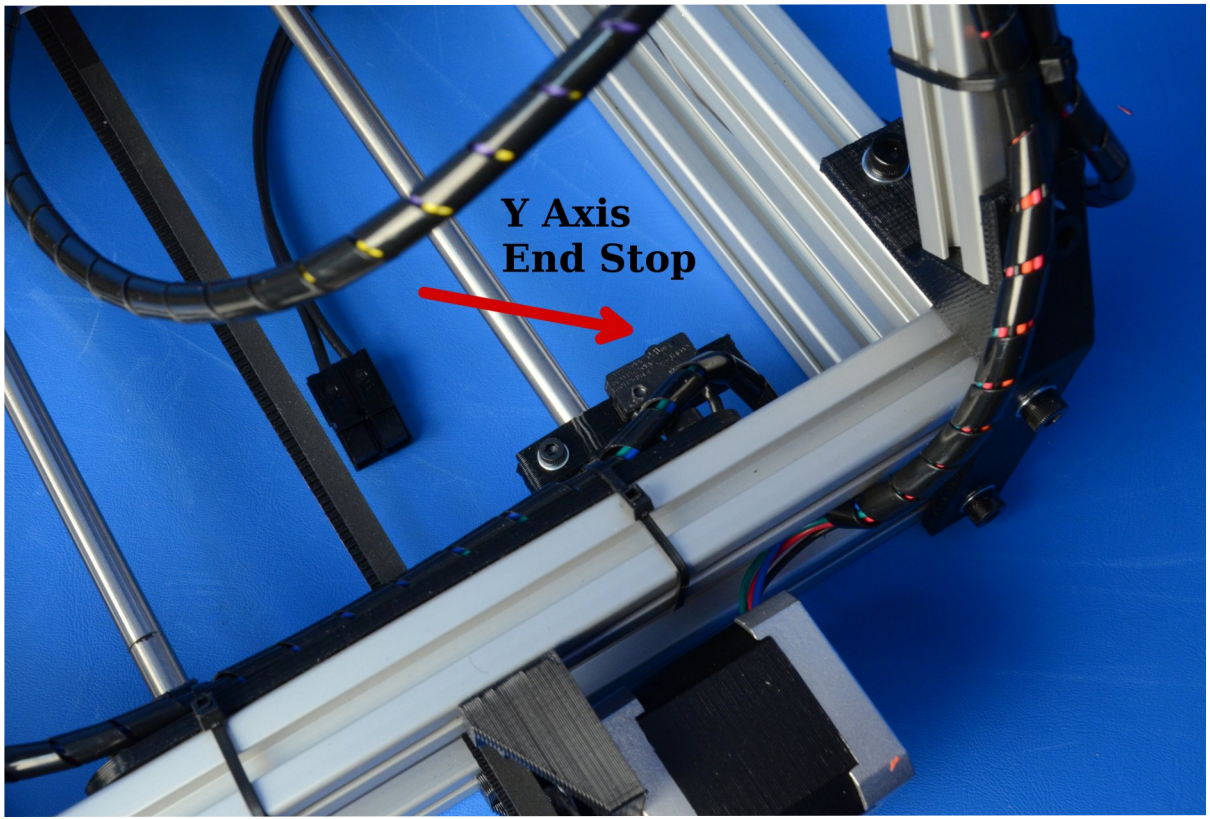


Fig. 2-3. Y axis end stop location

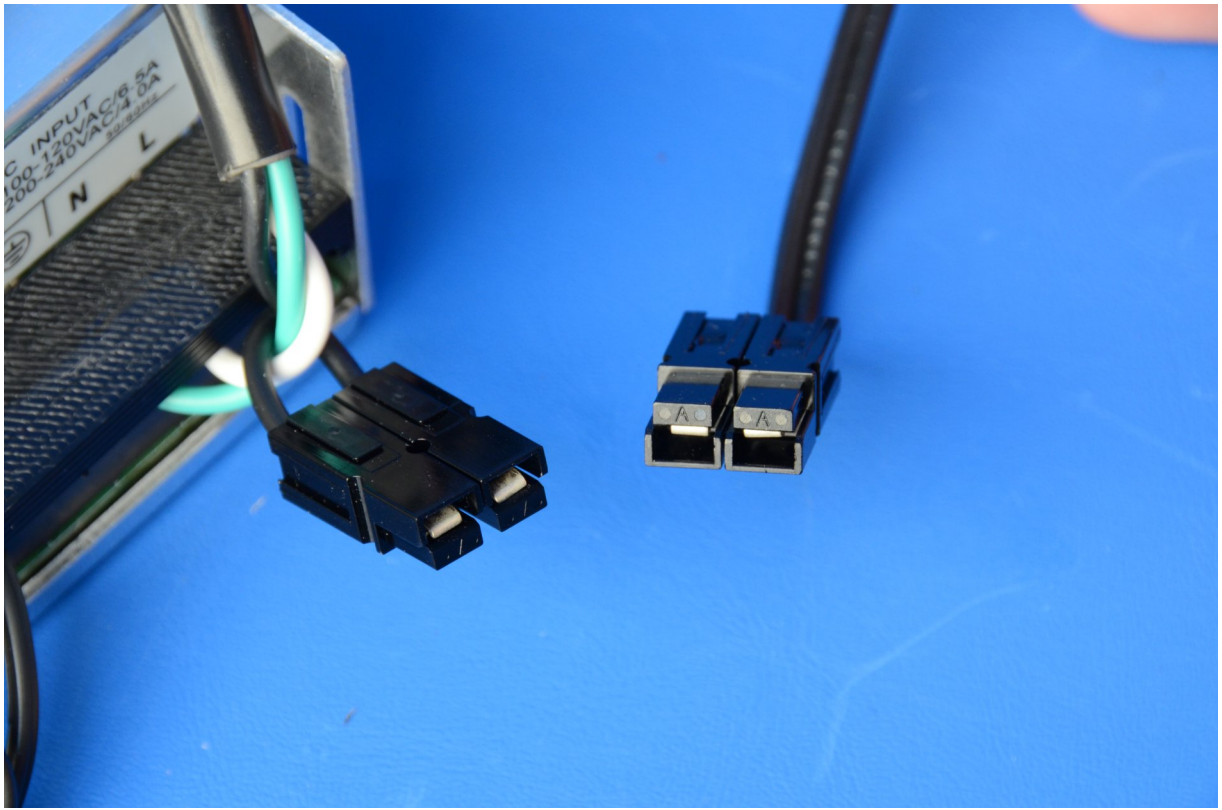


Fig. 2-4. Power supply plugs

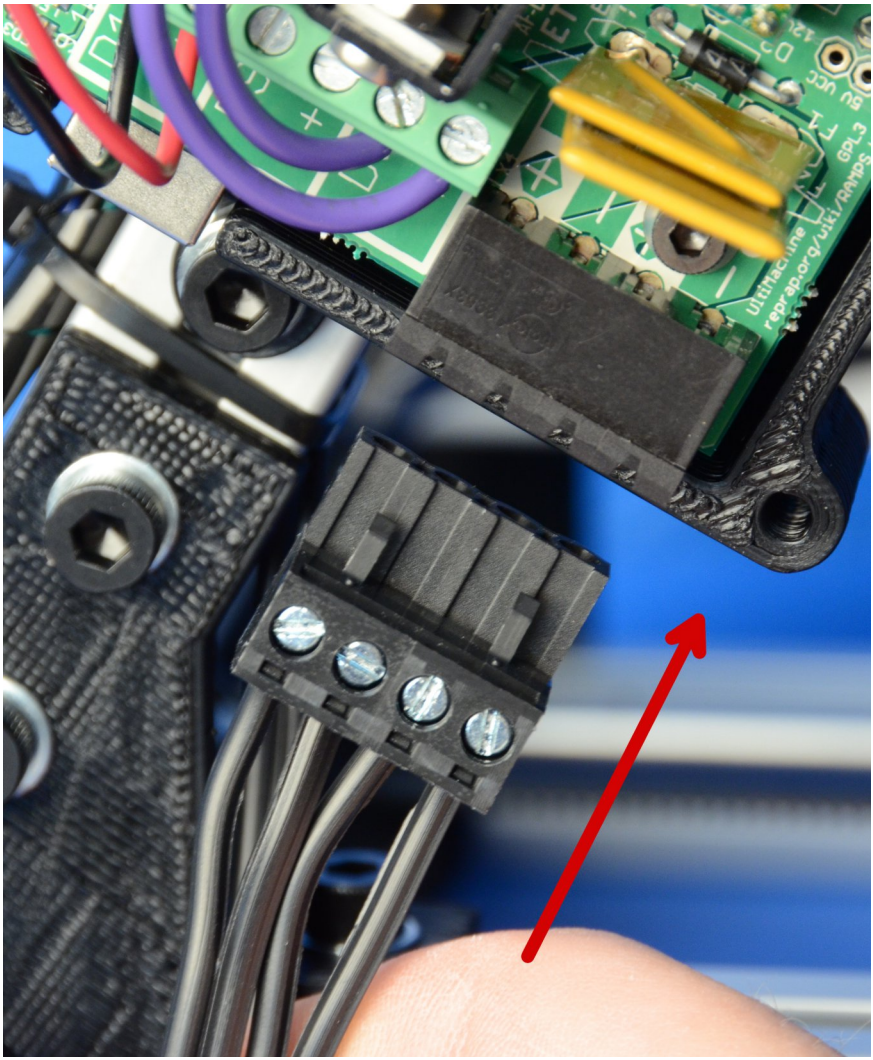


Fig. 2-5. RAMPS plug and receptacle

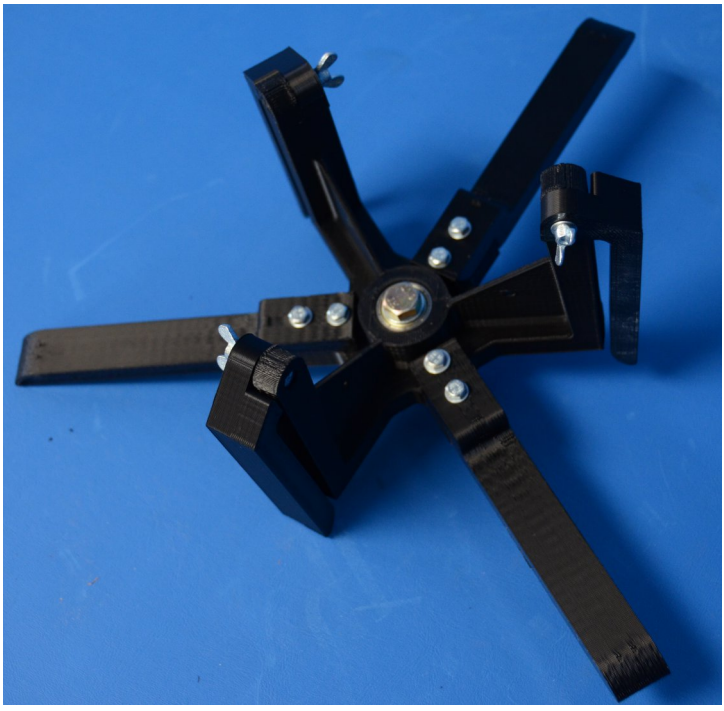


Fig. 2-6

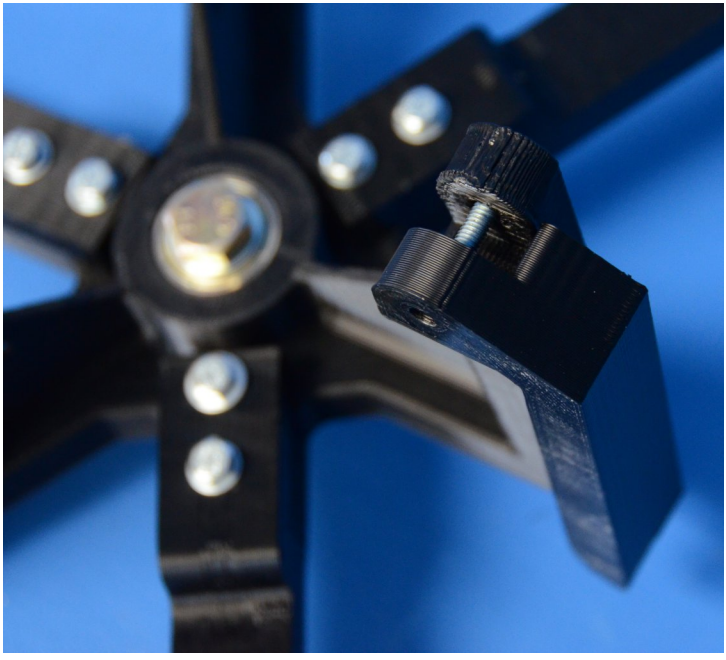


Fig. 2-7

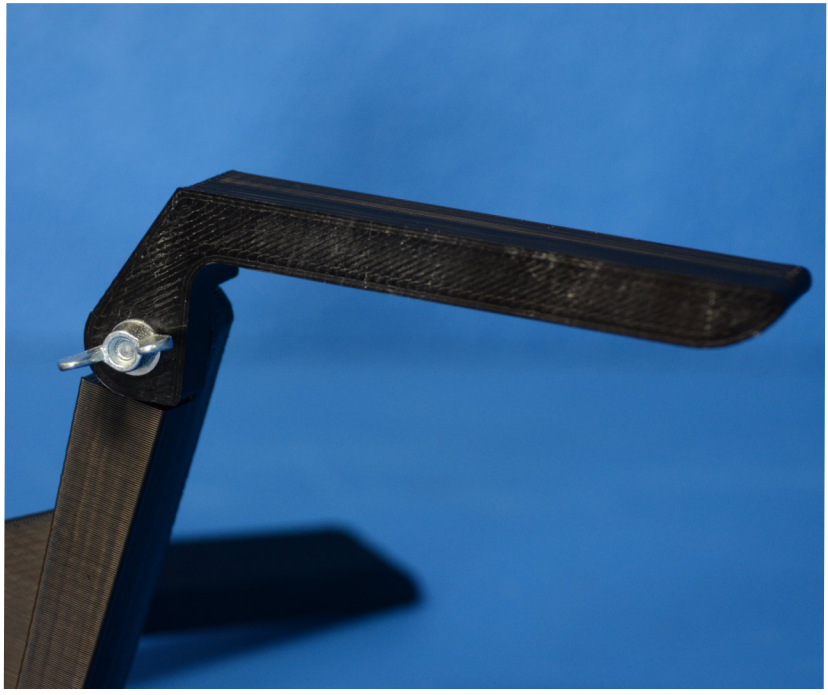


Fig. 2-8

Fig. 2-9

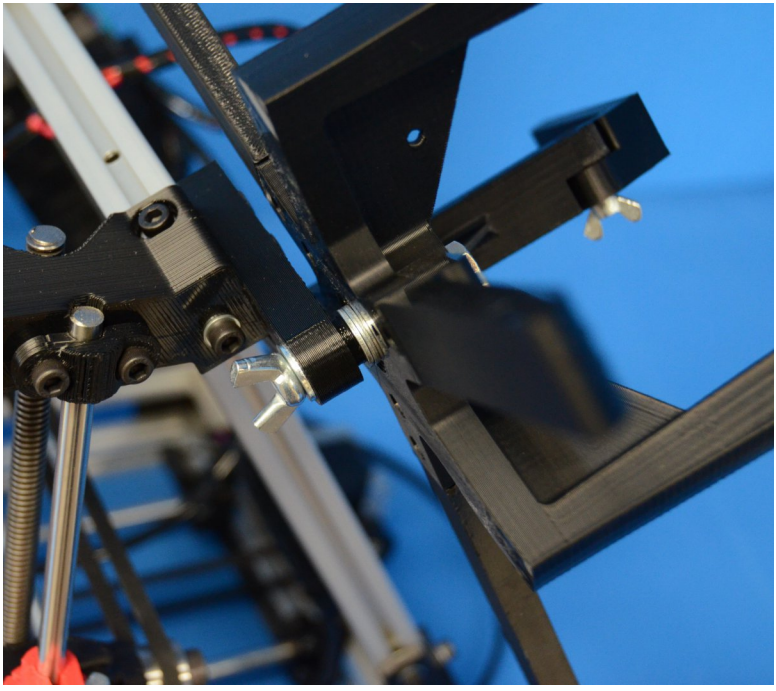


Fig. 2-10

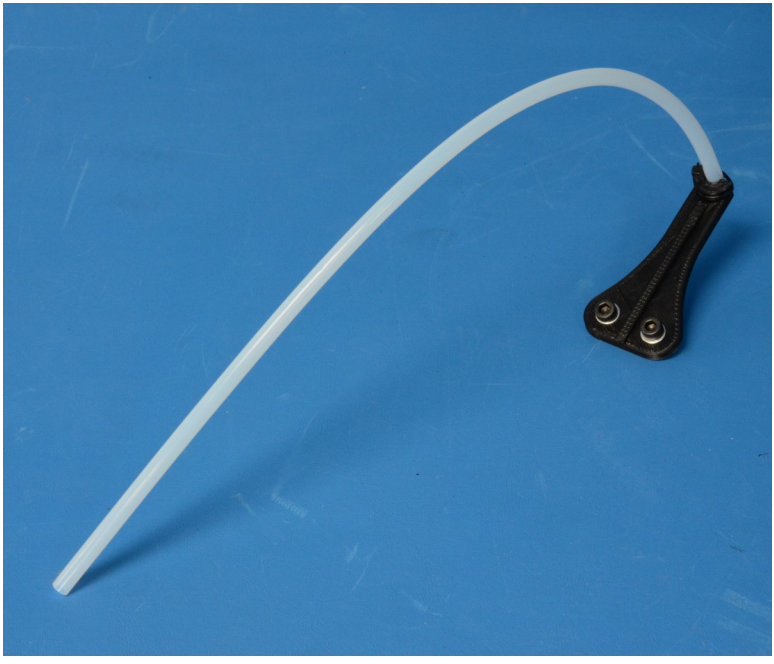


Fig. 2-11

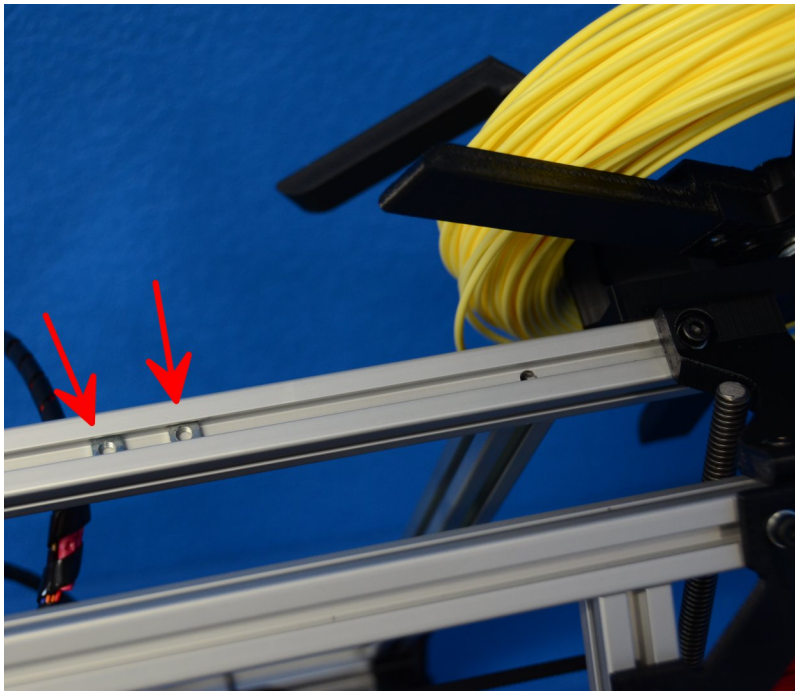


Fig. 2-12

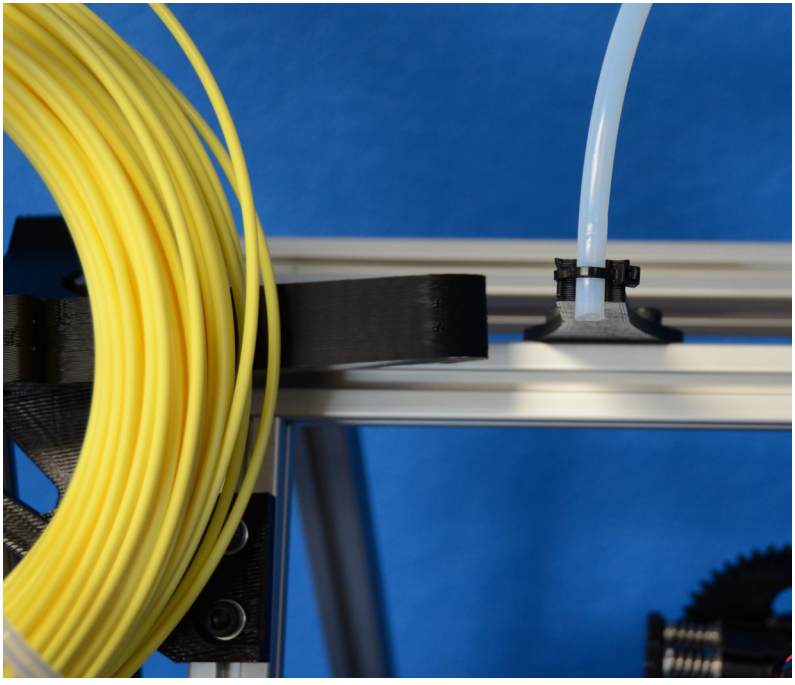


Fig. 2-13

Software

Aleph Objects, Inc. and LulzBot completely support free/libre hardware and software. Along with the AO-100 being a free/libre hardware design, it has been tested to work with free/libre software.

To operate your desktop 3D printer you will need to install a few software packages onto your PC. You will need a 3D printer host, an .stl to .gcode generator, and optional CAD or 3D modeling software.

All of the following free/libre software is available for GNU/Linux, Windows, and Mac. However, we highly recommend using these softwares on GNU/Linux. Many of the major updates and development is completed first for use on GNU/Linux and then later built for Windows and Mac.

The required software can be found in the Downloads section at www.LulzBot.com. You will also find there instructions for installing each software on your PC. Make sure to select the software version that corresponds with the AO-100 3D printer and the operating system you are using.

.Gcode Generator: Slic3r

The Slic3r software is the first tool in the chain of 3D printing software (Fig. 3-1). Slic3r uses commonly used .STL (Stereolithography) files to create .gcode files. Gcode files contain instructions for the 3D printer on where, when, and how fast to make movements. However, .gcode programming is not very suitable for CAD and 3D design. This is where Slic3r and the .STL file comes into use. The .STL file is a 3D model file that can be exported by all common CAD and 3D modeling software. The Slic3r software then slices the .STL 3D model in to layers and print paths to create a 3D printable .gcode file.To launch Slic3r navigate to the Slic3r directory and launch the slic3r.pl file. On GNU/Linux operating systems you may need to set the slic3r.pl file as executable.

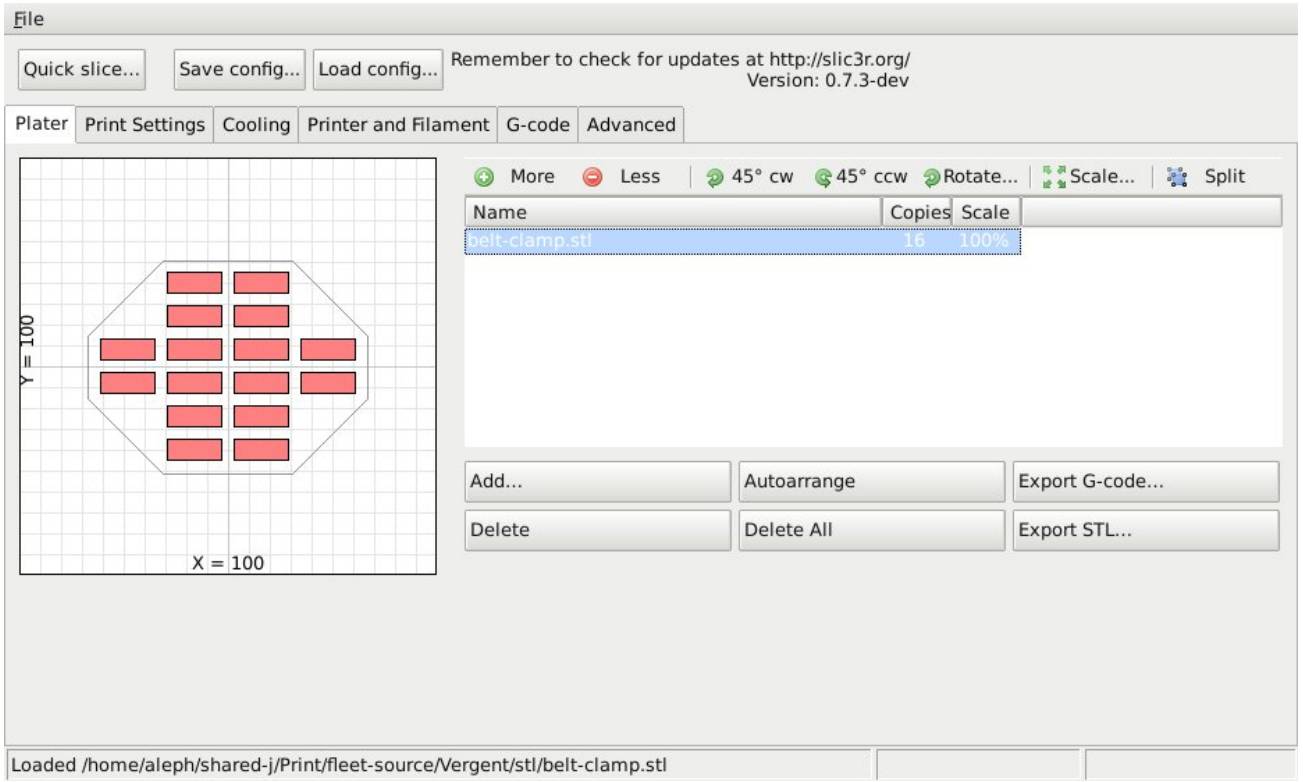


Fig. 3-1. Slic3r software GUI

Slic3r includes very simple settings that allow you to easily refine prints. You can create multiple configurations for changing printer setups including nozzle sizes and desired print resolution. For ease of use we have pre-defined Slic3r configurations available in the Downloads section at download.lulzbot.com. Download the configurations to your Slic3r directory.

To load configurations press the Load Config... button. In the file browser that opens, locate the downloaded configuration files. Select the configuration file that matches the nozzle size currently installed on the printer (0.5mm nozzle is installed with printer shipment). Press Open and the pre-defined configuration will load into Slic3r. You can also save custom configurations for your self by pressing the Save Config... button. A file browser will open that allows you to define a name and save your custom configuration.

To load an .STL 3D model file into Slic3r, activate the Plater tab and click the Add... button. In the file browser navigate to the .STL you wish to load and click Open. The silhouette of the model will appear in the Plater diagram. To print more than one copy of the model at a time select the model name from the list and click the More button. With each press of the More button an additional copy of the model will be added to Plater. To remove a copy of the model select the model name again and click Less. To completely remove the model from Plater select the model name and click Delete.

Once you have finished setting your part(s) in Plater you can generate the .gcode by clicking Export G-Code... In the file browser navigate to where you would like to save the .gcode file and list a name to save the file as. Click Save and Slic3r will begin generating the .gcode file. When Slicer is finished you will receive a prompt. If you have created a plate with multiple model designs you can also use the Export STL... function to save an .STL file for quickly reproducing the same plate of models.

Host Software: Printrun

The host software, Printrun, is used to start up and control your 3D printer (Fig. 3-1). The host controls include: setting the extruder and print surface temperatures, manual control of each axis, and manual extrusion. The host is also where you will push print files (.gcode) to the 3D printer or load print files from the SD card for printing out model designs.

To launch Printrun, navigate to the Printrun directory and launch the pronterface.py file. On GNU/Linux operating systems you may need to set the pronterface.py file as executable.

Connecting the Printer

To start up the printer, first you will need to connect to the printer with Printrun. Make sure have connected the USB cable from your PC to the printer before launching Printrun. If not, close Printrun, connect the USB cable, and relaunch Printrun. In the top left Port pull down menu select the correct port for the printer (generally ACM# or USB#). If you only have one printer connected there will only be one port available to select. Make sure the port baud rate is set to 115200 in the pull down menu to the right of the port selection.

Now, to connect to the printer click the Connect button. In the text output window you will see multiple return lines. If you see Printer is now online you have succesfully connected to the printer. The printer control buttons on the left will also darken and become clickable after connecting. When you need to disconnect the printer simply press the Disconnect button.

Printer Controls

All of the printer controls can be found on the left side of the Printrun interface (Fig. 3-3). To set the hot end and print surface temperature first click the Monitor Printer check box on. This

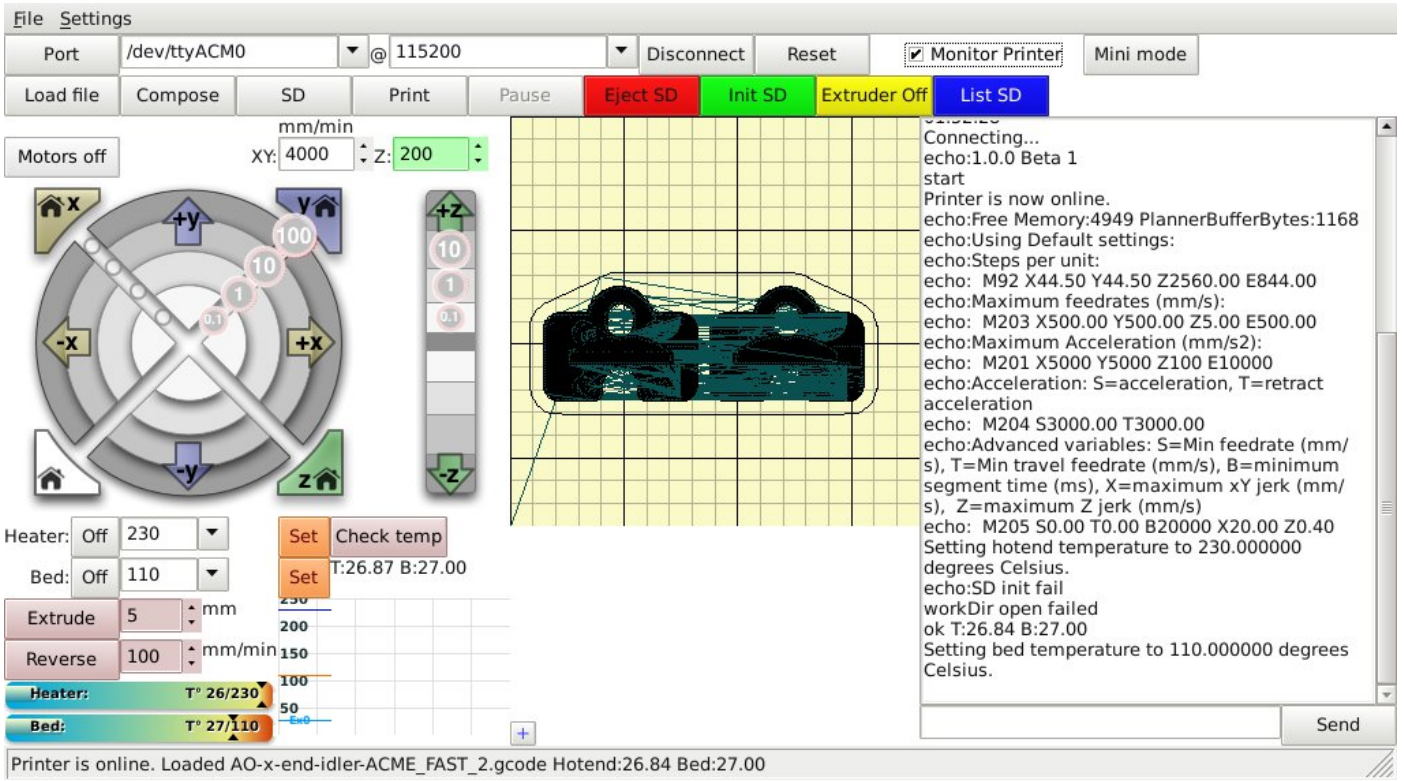


Fig. 3-2. Printrun Software GUI

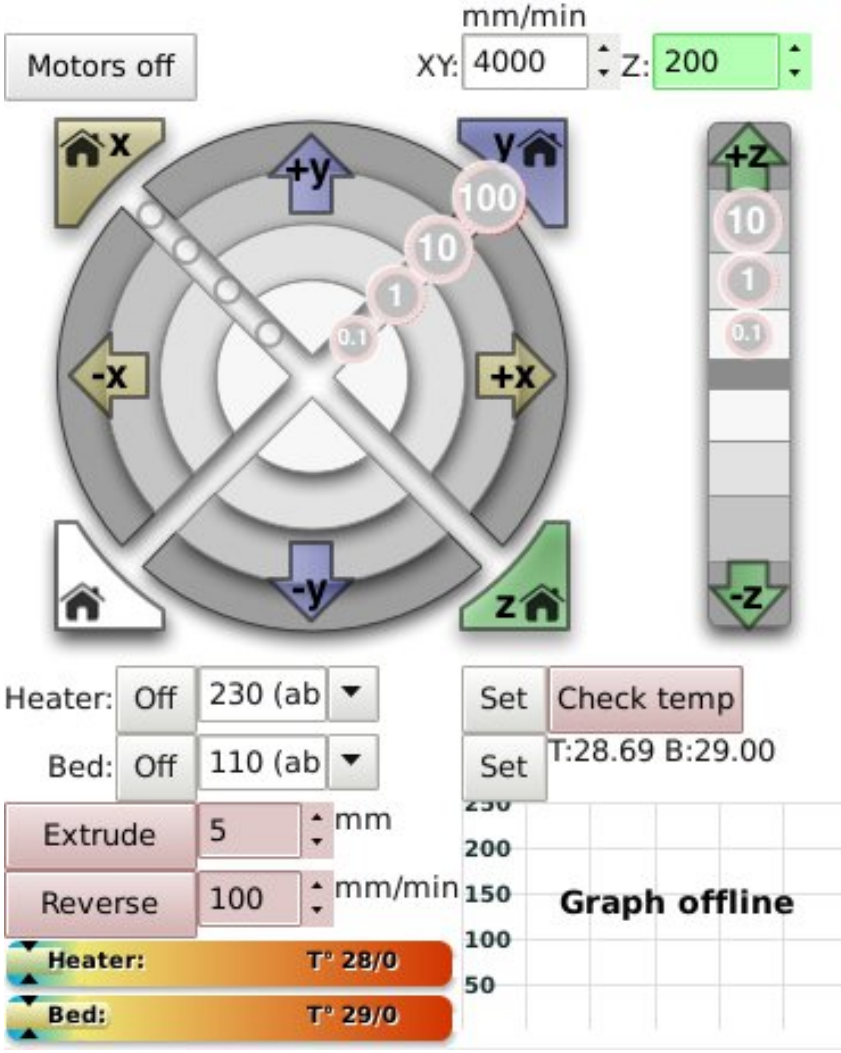


Fig. 3-3. Printer Controls

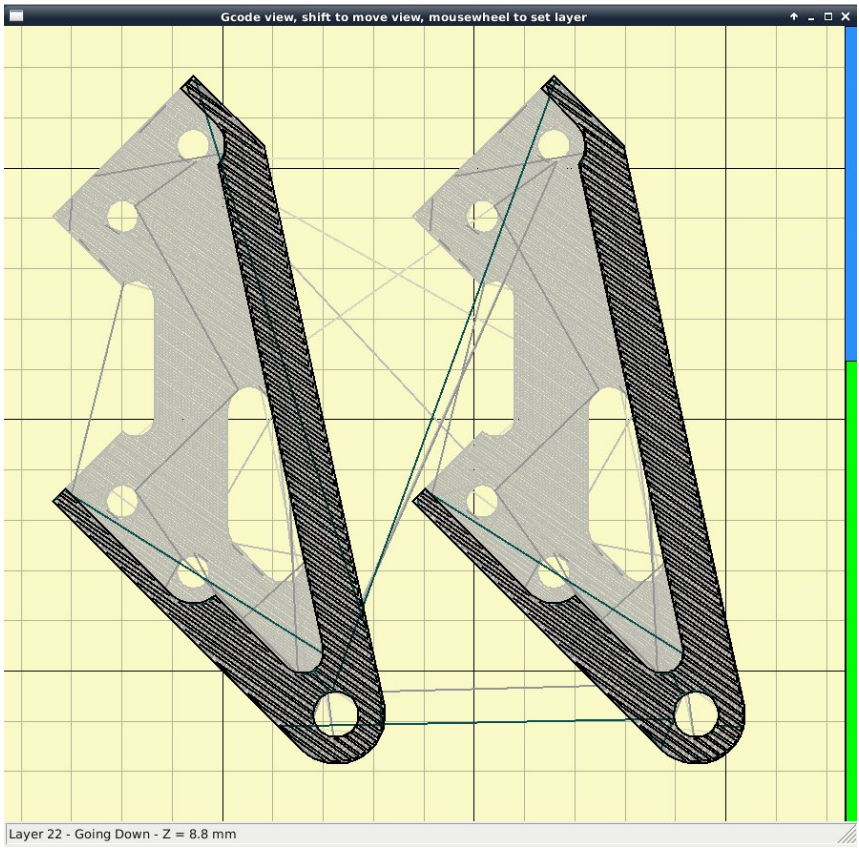


Fig. 3-4. Printer Controls

will enable the printer temparature bars and graph. The hot end and print surface controls are labeled Heater and Bed. Select the temperature setting by using the pull down menu for pre-defined temperature settings. You can also set custom temperature settings by typing into the temperature box.

To turn on the hot end and/or printer surface click the respective Set button. The Set button will highlight Orange when the temperature is set to on for that component. When the hot end or print surface is set to on you will see the the temperature bar and graph display the set temperature and the current temperature. When both components have reached the correct temperature the printer is ready for printing. Clicking the Off button will turn off that component and highlight the Off button blue.

Below the temperature controls are the manual extrusion controls. There you can manually extrude plastic through the hot end and retract the plastic filament from the hot end. The Extrude button will feed the amount of plastic, set to the right in mm, through the hot end. The rate at which the plastic is fed is set below the extrusion length (mm/min). The Reverse button will perform the opposite of Extrude, pulling the plastic filament back out of the hot end.

The large pattern of buttons above the temperature controls are the axes manual controls. These functions allows you to manually move each of the three axes of the printer. The circular pattern of four quadrants controls the X and Y axes. The top and bottom quadrants move the Y axis; the top in the positive direction (forward) and the bottom in the negative direction (back). The left and right quadrants move the X axis; the left in the negative direction (left) and the right in the positive direction (right).

Each quadrant is split into four sections that control the length of movement of 0.1mm, 1mm, 10mm, or 100mm. The innermost section moves the axis 0.1mm with each section outwards a larger movement with the outside section moving the axis 100mm.

The linear control bar to the right controls the Z axis. The Z axis is also seperated into multiple movement lengths; 0.1mm, 1mm, and 10mm. The upper three buttons move the Z axis up and away from the printer surface; the three lower buttons move the Z axis closer to the print surface.

The four triangular buttons around the circular pattern are the axes home buttons. Each home button will move that axis in the negative direction until the end stop is activated. There is a home button for the X,Y, and Z axes. There is also a white home all button that homes all of the axes at once. The Motors off button will deactivate all motors allowing all of the axes to be moved by hand.

Caution: when homing, the axis will continue to move in the negative direction until the end stop switch is activated. If the printer is ever transported make sure the end stop switches are in the correct position before printing. The end stops should be aligned so they will be activated by the axes.

Loading Print Files

To load a .gcode file into Printrun click the Load file button. Navigate to the .gcode file in the file browser and click Open. You will now see a 2D images of the first layer of your model design in the G-code viewer (Fig. 3-4). Click the G-code viewer window to see a more detailed version of the sliced model. In the pop-out G-code viewer you can zoom in using the mouse scroll wheel and flip through layers with the up and down arrow keys.The lines shown in the G-code viewer represent the path the extrusion nozzle will follow to print the model.

For more information on using Printrun see the Printrun page in the Downloads section at www.LulzBot.com. Instructions for running a print can be found in the Starting the First Print section in this manual.

CAD and 3D Modeling Software

Currently LulzBot is not distributing a CAD or 3D modeling software package. However, there are multiple free/libre software packages available. Other common non-free CAD and 3D modeling software would also be capable of exporting the required .STL files.

CAD Software

FreeCAD: free-cad.sourceforge.net
Although still in development, FreeCAD is a great free/libre CAD software. Containing a full GUI for building CAD models, FreeCAD is capable of creating simple to complex designs. STL files can also easily be exported for use with 3D printing. FreeCAD is available for GNU/Linux, Windows, and Mac

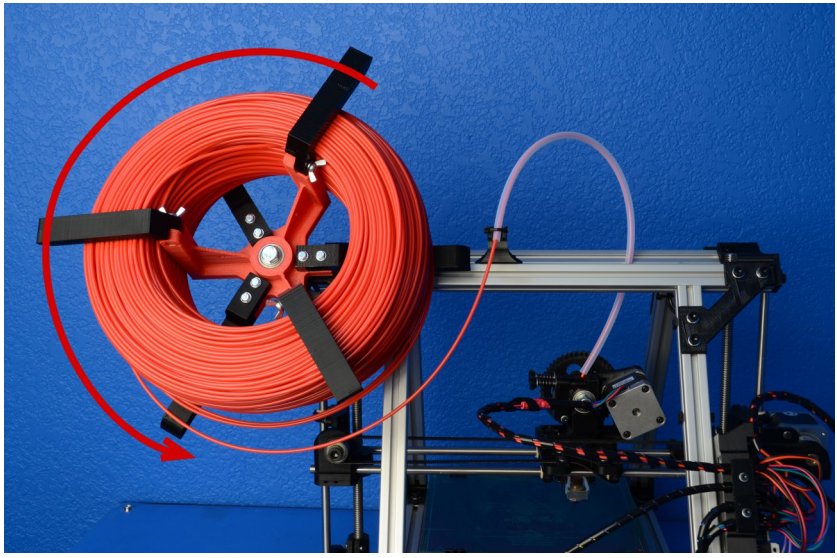
3D Modeling Software

Blender: blender.org

The most widely used Free/Libre 3D modeling software, Blender is well documented with tutorials available on the Blender.org website. Numerous video tutorials can be also found online.

Loading Filament

Loosen the three wing nuts on the upper arms of the filament spool. Turn the upper arms 90 degrees upwards away from the printer. Remove a 5lb coil of filament from the plastic packaging, leaving the twist ties on. Slide the coil over the spool upper arms. Lower the three upper arms and re-tighten the wing nuts. The twist ties can now be removed. Keep the twist ties for future use if you ever need to remove the filament to change to a different filament. Feed the end of the filament through the filament feed tube. Slide the end of the filament through one of the holes in hub of the filament spool. This will keep the filament from unwinding from the spool.



Printing your first print!

Make sure to first read the instructions for using the Printrun software. Connect to the printer. Set the hot end and print surface for ABS plastic and turn both on. If you have not already, make sure the axes end stops are aligned to be triggered when each axis homes. Click the Motors Off button.

Once the hotend is heated to the correct temperature you will now need to load the plastic filament into the extruder. Loosen the two idler bolts (turn the black plastic knobs by hand) to take pressure off of the idler springs (Fig. 4-1). Pull both idler screws upwards to release the idler. The idler can be turned downwards allowing access to the hobbed bolt and filament feed hole. Feed the end of the plastic filament into the filament feed hole (Fig. 4-2). Now you can push the filament through the extruder by slowly pushing the filament down into the hot end.

Once the filament extrudes a small amount out of the nozzle raise the idler back into place. Slide the two idler bolts and springs back into place. Tighten the two idler bolts so that the spring coils are around 2mm apart. Now use the Extrude button in Printrun to test that the extruder is working properly.

Use the home buttons to home the X axis and then the Y axis. Next home the Z axis. When the Z axis is at home the nozzle tip should be sitting right against the glass (Fig. 4-3). The nozzle should not be pushing down on the print surface. To lower or raise the Z home height adjust the Z end stop trigger. The end stop trigger is on the far left of the printer near the print surface (Fig. 4-4). The end stop trigger can be lowered by turning clockwise and raised by turning counter-clockwise. Once you have homed the axes and the hotend and bed have reached the correct temperature it is time to print!

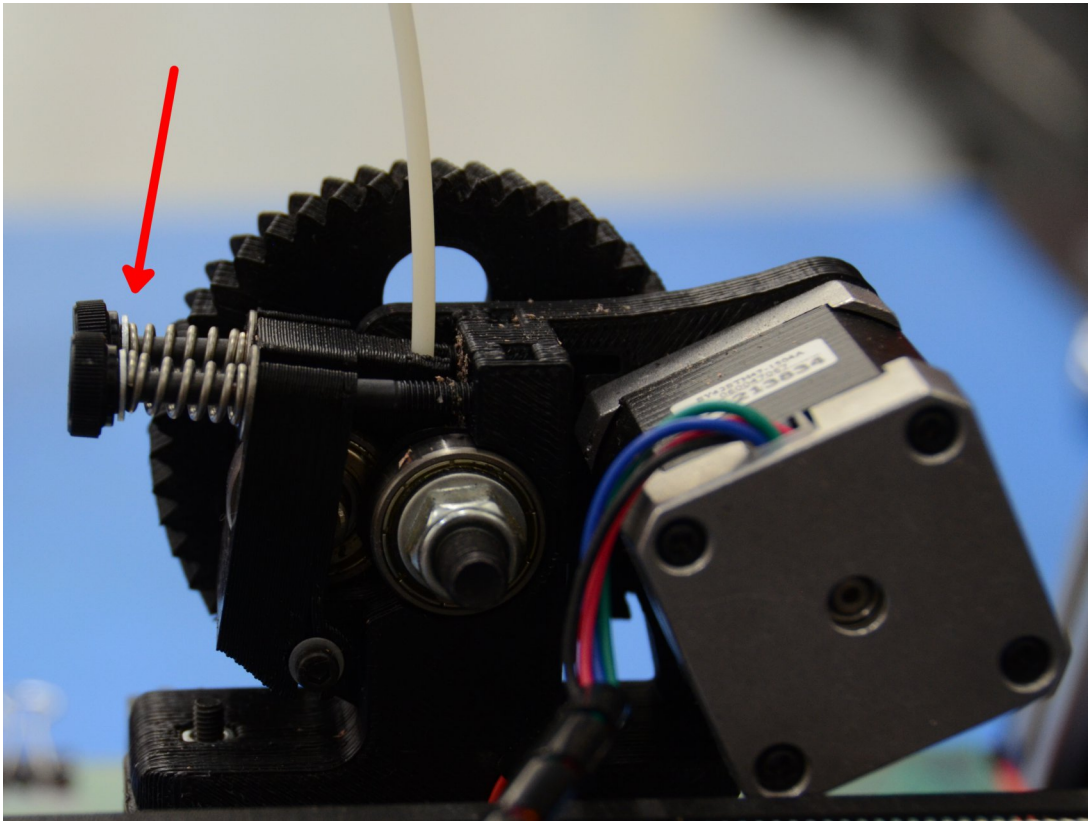


Fig. 4-1. Extruder and idler tension bolts

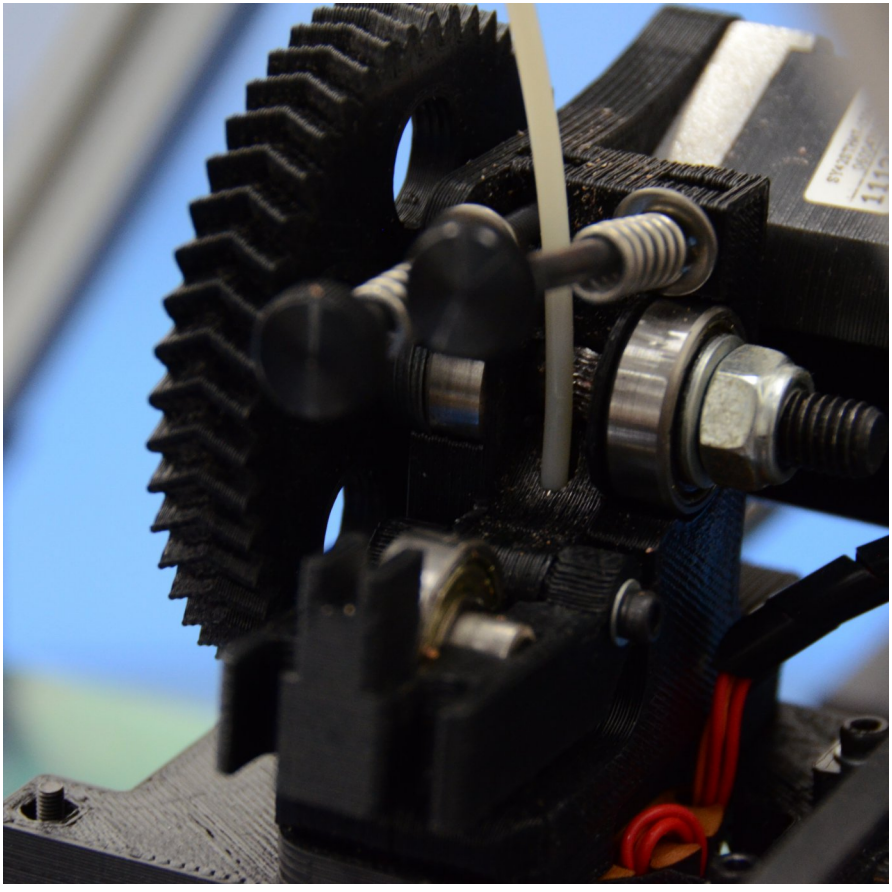


Fig. 4-2. Extruder Feed Hole

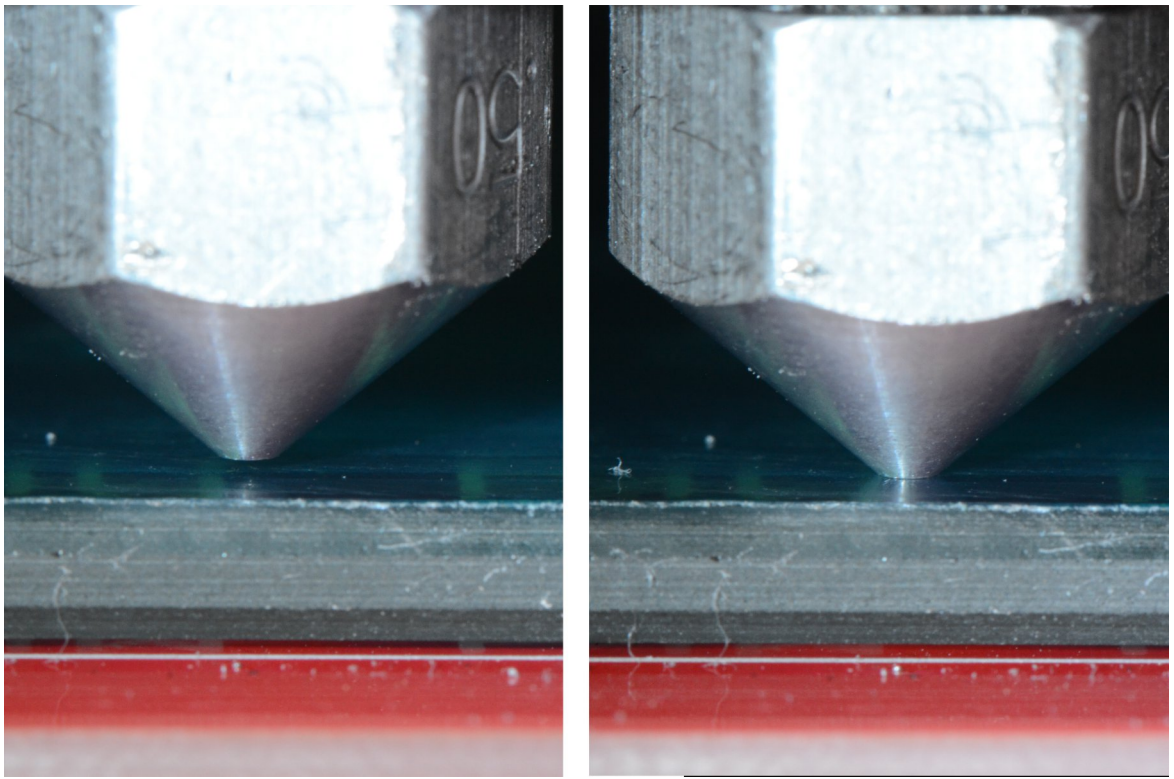


Fig. 4-3. Home nozzle height. Left: Too high, Right: Correct

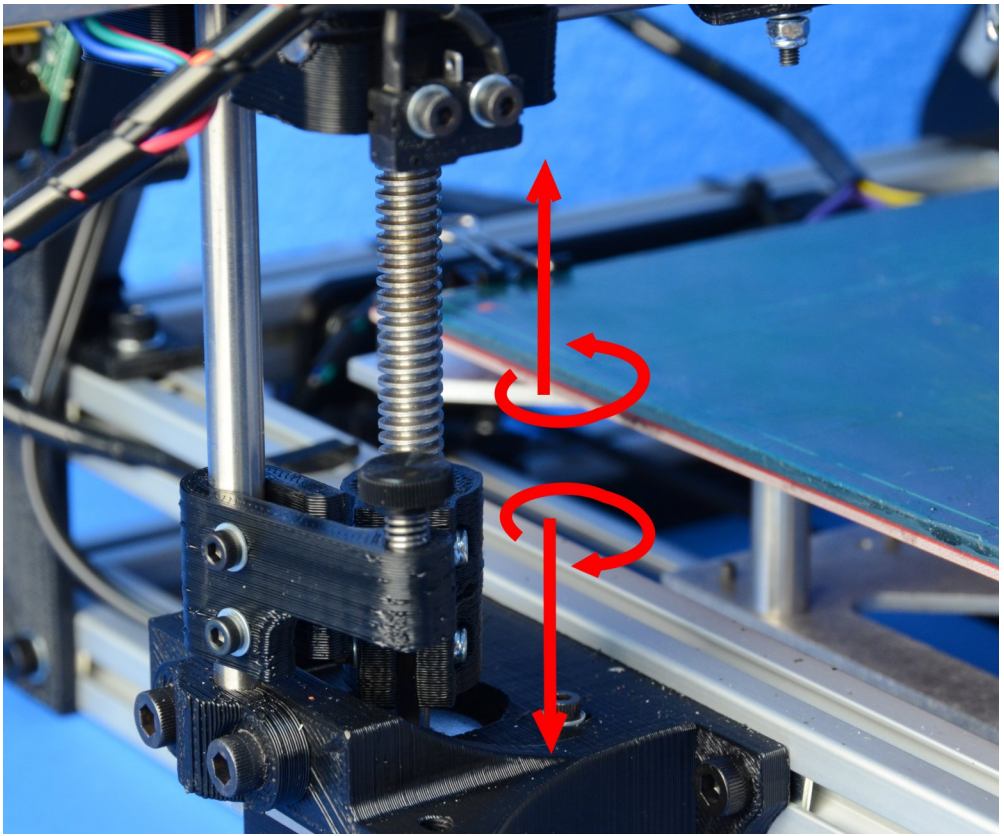


Fig. 4-4. Z home trigger height adjustment

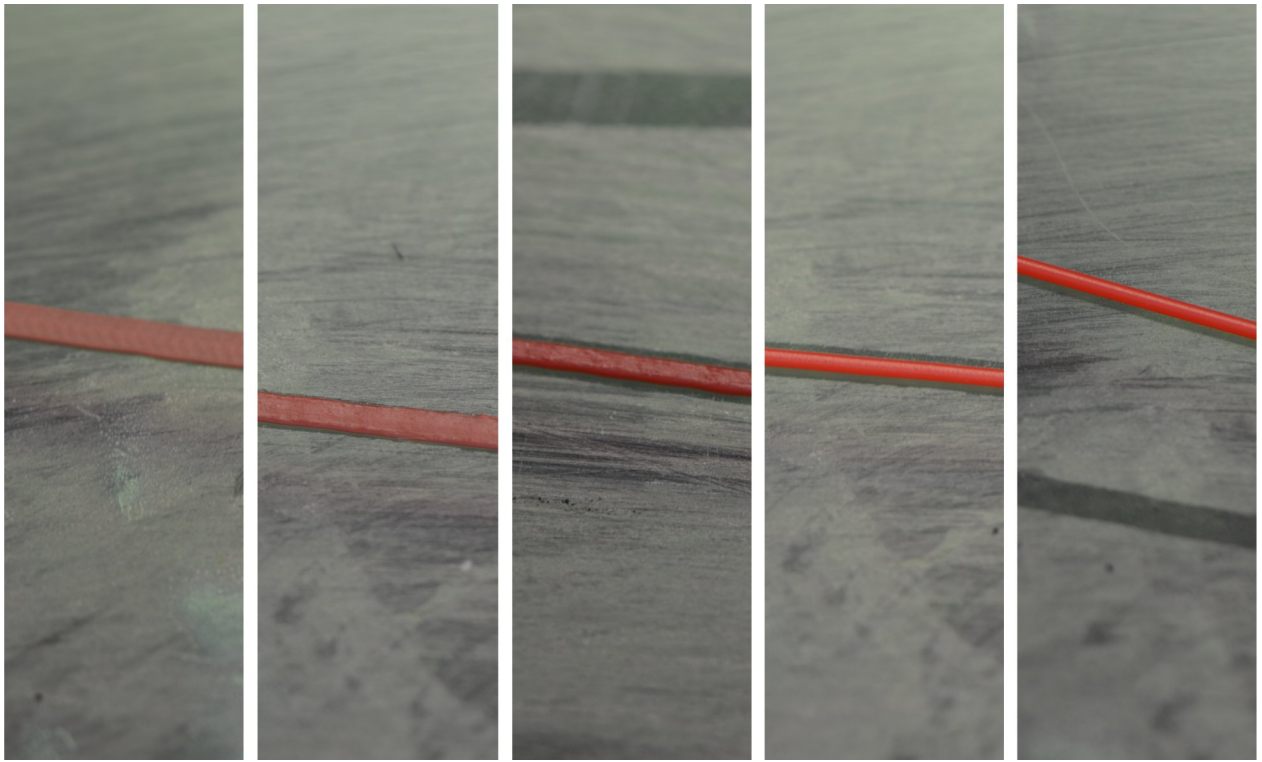


Fig. 4-5. Correct first layer adhesion

Load your first test .gcode file. The .gcode pattern should appear in the Printrun G-Code viewer. Press the Print button to begin the print. When the print starts make sure the first layer is not printing too close or too far from the print bed. Note Figure 4-5 as an example of a good first layer adhesion. If the first layer is too high or low you can pause the print by pressing the Pause button. Adjust the Z end stop trigger. After making adjustments you can home the axes and press Restart to restart the print.

After the part is finished printing, the heated bed will automatically cool down to 60C. If you are printing PLA you will need to turn the heated bed off. Once the bed cools you can you pop the finished part off of the printed surface. To remove the printed part, use the knife included in your printer kit. Using the side of the knife blade pry up one side of the printed part. If your part is large you may need to pry at multiple points to pop the part off of the print surface. Make sure to reset the heated bed to the correct temperature and allow it to heat up to the needed temperature before starting the next print.

Tips

Changing nozzles

To achieve higher resolution parts you can change to a smaller sized nozzle, included in the printer kit. Using the 0.25mm or 0.35mm nozzles you can print at smaller layer heights to create smoother parts.

In most cases the nozzle is best changed when the hot end is completely cool. Note that in some cases you will have to slightly heat the hot end to remove the nozzle. NEVER try to remove the nozzle when the hot end is at extrusion temperature. At higher temperatures the threaded extension expands in the nozzle causing the nozzle to bind if turned.

To change the nozzle you will need the 18mm and 13mm wrench from the printer tool kit. Slide the 18mm wrench onto the rectangular aluminum heater block.

Using the 13mm wrench turn the nozzle counter clock-wise. Make sure the nozzle is turning off of the threaded aluminum extension that runs up through the heater block. Do not allow the heater block to turn. This can put strain on and possibly damage the wiring. If the threaded aluminum extension is turning with the nozzle, retighten the nozzle until it touches against the heater block again.

To loosen a stuck nozzle off of the threaded extension, heat the hot end to 90-100C. This will soften the plastic inside the hot end and allow the nozzle to be turned off of the threaded extension. Take care when removing the nozzle while the hot end is hot. Wear leather gloves or use a towel to turn the nozzle off of the hot end.

Once you have removed the nozzle you can then thread on the other nozzle size you would like to use. Make sure the nozzle has threaded correctly onto the threaded extension before trying to turn it with the wrench. Turn the nozzle clock-wise until it tightens against the heater block.

After installing the new nozzle you may need to adust your Z home trigger setting before printing again. Refer to the Printing Your First Print section for calibrating the Z home trigger setting.

If you will be changing nozzles frequently we suggest reapplying a small amount of high temperate anti-seize to the inside threads of the nozzles. You will need an anti-seize capable of temperature of at least 250C.

First layer print adhesion

In some regions and during Winter months you may find that during printing, printed parts lift off of the print surface on the corners. If you are seeing this problem you can make an acetone/ABS solution to apply to the print surface. Using the HDPE acetone safe bottle included in the printer kit, fill the bottle 3/4 full. Now cut eight, four inch lengths, of ABS filament and put them in the bottle with the acetone. Allow the ABS filament to disolve over night.

To apply the acetone/ABS mixture put a small amount onto a paper towel. Now, rub the towel onto the PET print surface to apply a thin layer of ABS. Generally only one thin layer of the acetone/ABS solution is needed. However, if needed you can apply multiple layers.

Acetone can cause skin irration when prolonged skin contact occurs. It is recommended to use a acetone safe glove when applying the acetone/ABS mixture. It is also recommended to use the acetone/ABS mixture in a well ventilated space. Leave the mixture bottle closed except when applying a small amount to the wiping towel.

Maintenance

There is very little maintenance needed in keeping your AO-100 3D printer running. Depending on your rate of use you will want to perform a quick check of your printer every 2-4 weeks. The following maintenance guide lines will keep your printer printing quality parts.

Wipe the smooth steel rods with a clean rag or paper towel. The linear bushings leave a solid lubricant that builds up over time. If you begin hearing squeking noises while the printer is printing, this is likely a sign that the smooth rods need to be cleaned. NOTE: never apply any lubricant to the smooth rods.

After multiple weeks of use the PET film print surface will begin to wear. To replace the PET print surface remove the glass sheet from the printer. Peel the strips of PET film from the glass sheet. If there is any glue or plastic residue left on the glass surface clean with acetone or alcohol based glass cleaner. Using the roll of PET film from the printer kit lay down four strips of PET film onto the glass sheet. Use a credit card or driver's license to smooth down and push out any trapped bubbles under the film.

Source

The AO-100 3D printer is a free/libre hardware design. All of the source files are available at download.lulzbot.com including: 3D models and print files for all of the printed parts, design files for all electronics and machined parts, and a bill of materials including every part needed to build the printer.

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