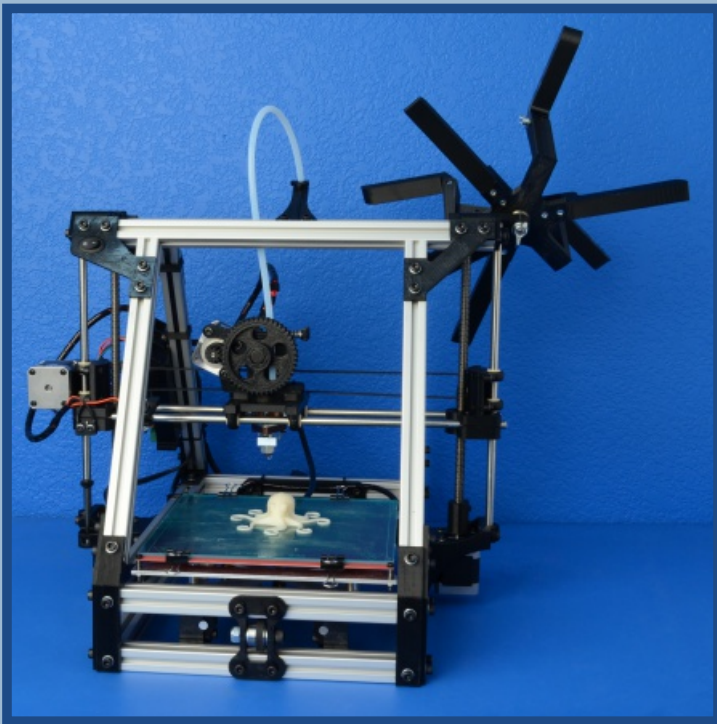


 Aleph Objects, Inc.

Product Manual
AO-100



READ THIS MANUAL COMPLETELY BEFORE UNPACKING AND POWERING UP YOUR PRINTER

This information guide is also available at AlephObjects.com. There you can find more information including images and videos.

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 your self 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 without 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 120°C.

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

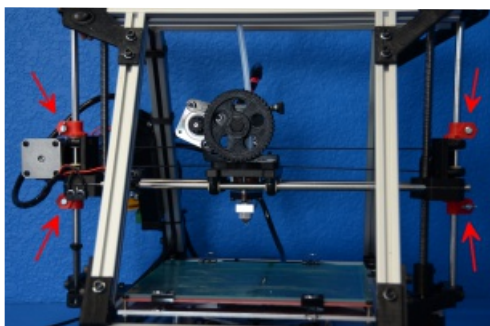
PINCH HAZARD: When the printer is in operation take care to never put your fingers in the moving parts including the belts, pulleys, or gears. Also, tie back long hair or clothing that can get caught in the moving parts of the printer.

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

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 your printer on a stable level surface.
7. Gently unwrap the pink ESD plastic covering the printer. Lightly 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. See image to locate the clamps that need to be removed. 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.



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
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 page ??? to find where the unplugged wire(s) need(s) to be plugged back in.
6. Remove the SDRAMPS module from its bag. Plug in the SDRAMPS module into the 2x4 female plug on the top right of the RAMPS board. The image to the right shows the location and orientation of the SDRAMPS module after being installed on the RAMPS electronics (Fig 2.1).

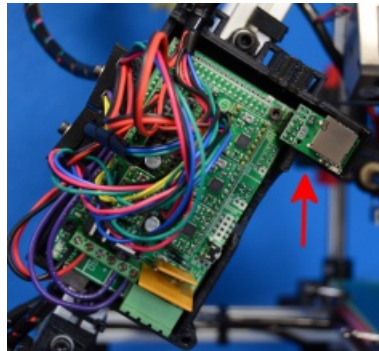


Fig. 2.1

7. 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**
8. Plug the loose black plug coming from the printer into the black plug from the power supply.
9. 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 location.

10. 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.

11. Make sure the printer power switch is turned off (the circle side should be depressed). Plug in the green RAMPS power plug from the power supply into the matching green receptacle in the RAMPS electronics. 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.

12. Locate the plastic filament spool (Fig. 2.2). 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. 2.3). 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. 2.4).



Fig 2.2



Fig 2.3



Fig 2.4

13. 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 left facing the rear of the printer (fig. 2.5). 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 tighten on the wing nut (fig. 2.6). Now turn the filament spool to make sure it turns freely.



Fig. 2.5

13. Locate the filament guide with attached PTFE tube (fig. 2.7). Locate the top most aluminum extrusion that faces the side of the filament spool (fig. 2.8). 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.

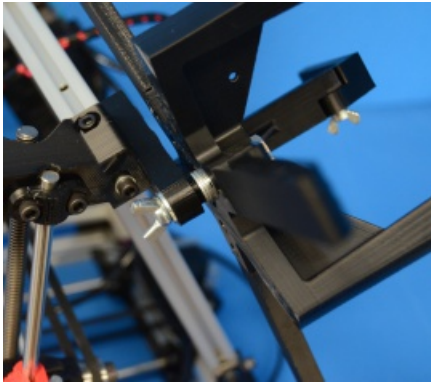


Fig. 2.6



Fig. 2.7

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. 2.9). Once the filament guide is set in place, tighten down the two bolts.

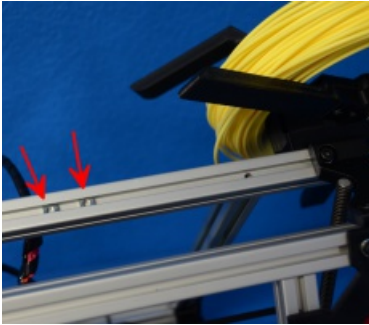


Fig. 2.8

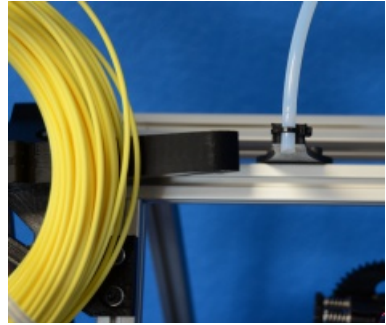


Fig. 2.9

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. Now the twist ties can be removed. Keep the twist ties for future use if you ever need to remove the filament to change to a different filament. Put the twist ties back on the filament coil before pulling off of the spool. Feed the end of the filament through the filament feed tube.

Software

Aleph Objects, Inc. completely supports 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.

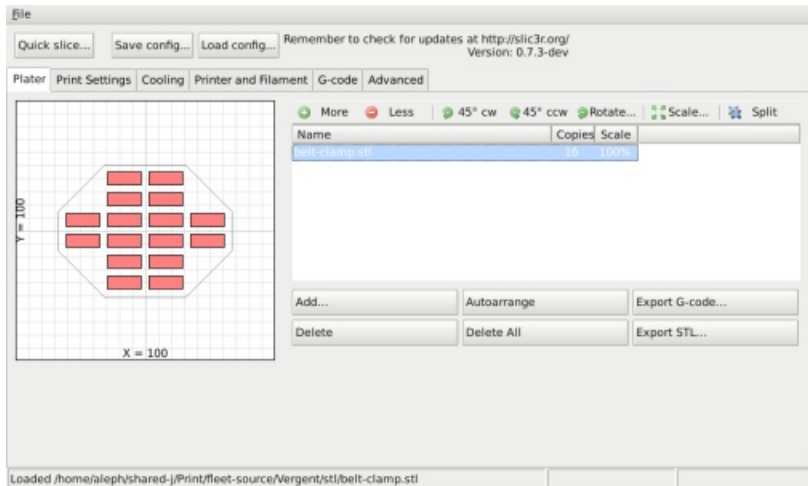
The required software can be found in the Downloads section at www.AlephObjects.com. You will also find there instructions for installing each software on your PC. Make sure to select the software version that corresponds with the AO-100 3D printer and the operating system you are using.

.Gcode Generator: Slic3r

The Slic3r software is the first tool in the chain of 3D printing software. 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.

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 www.AlephObjects.com. Download the configurations to your Slic3r directory.



Slic3r software GUI

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.

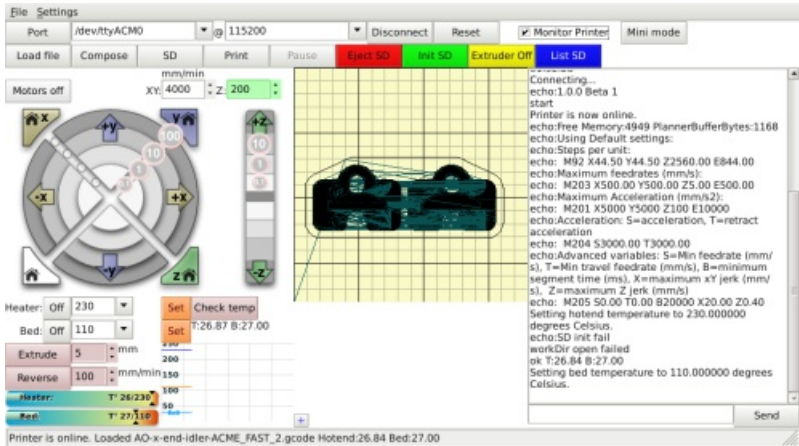
Once you have finished setting your part(s) in Plater you can generate the .gcode by clicking *Export G-Code...* In the file browser navigate to where you would like to save the .gcode file and list a name to save the file as. Click Save and Slic3r will begin generating the .gcode file. When Slicer is 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.

For more information on custom configurations and other Slic3r functions see the Slic3r page in the Downloads section at www.AlephObjects.com.

Host Software: Printron

The host software, Printron, is used to start up and control your 3D printer. 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 Printron, navigate to the Printron directory and launch the `pronterface.py` file. On GNU/Linux operating systems you may need to set the `pronterface.py` file as executable.



Printrun software GUI

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.

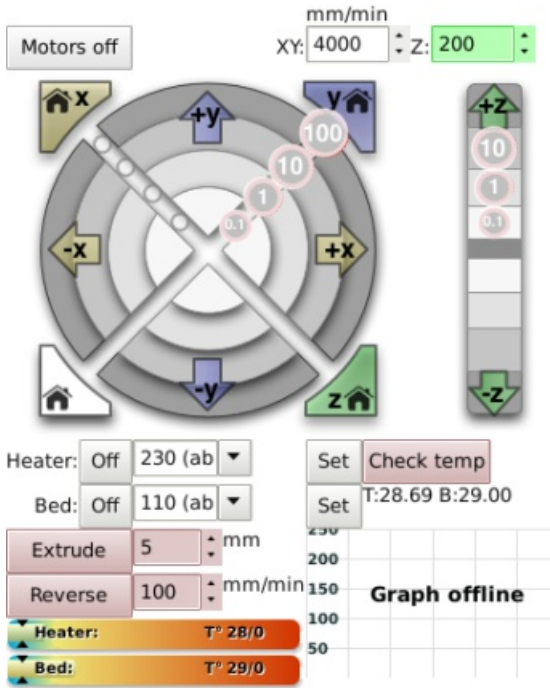
Connecting the Printer

To start up the printer, first you will need to connect to the printer with Printrun. Make sure you 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 successfully 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 Printron interface. To set the hot end and print surface temperature first click the *Monitor Printer* check box on. This will enable the printer temperature 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

Printer controls

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 allow 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 separated 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.

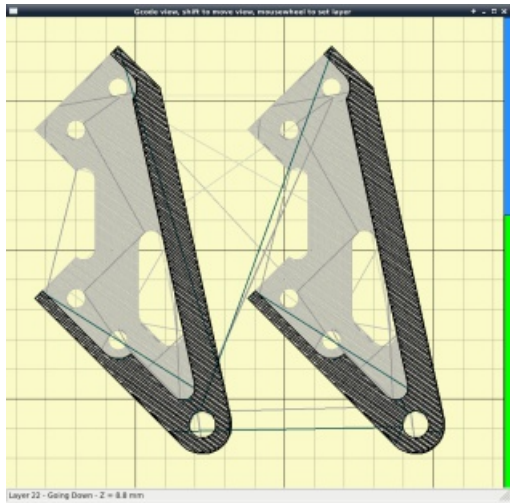
The four triangular buttons around the circular pattern are the axes home buttons. Each home button will move that axis in the negative direction until the end stop is activated. There is a home button for the X, Y, and Z axes. There is also a white home all button that homes all of the axes at once.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



G-Code Viewer

For more information on using Printrun see the Printrun page in the Downloads section at www.AlephObjects.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 Aleph Objects, Inc. 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

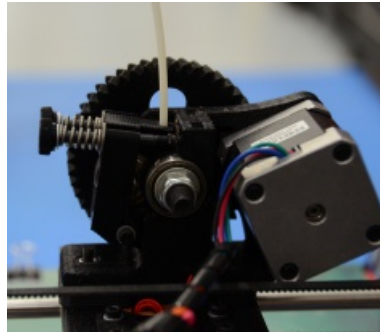
The most widely used Free/Libre 3D modeling software, Blender is well documented with tutorials available on the Blender.org website. Numerous video tutorials can be also found online.

Printing your first print!

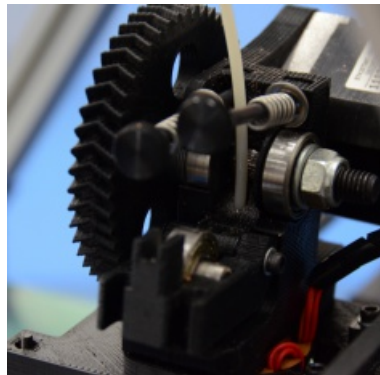
Make sure to first read the instructions for using the Printron software. Connect to the printer. Set the hot end and print surface for ABS plastic and turn both on. If you have not already, make sure the axes end stops are aligned to be triggered when each axis homes. Click the Motors Off button.

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. 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. 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 Printron to test that the extruder is working properly.



Extruder



Filament feed hole

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. 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. 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!



Z End-stop Trigger

Load your first test .gcode file. The .gcode pattern should appear in the Printron 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 the image below as an example of a good first layer height. 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.



First Layer Filament Thickness

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. 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.

Source

The AO-100 3D printer is a free/libre hardware design. All of the source files are available at source.alephobjects.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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