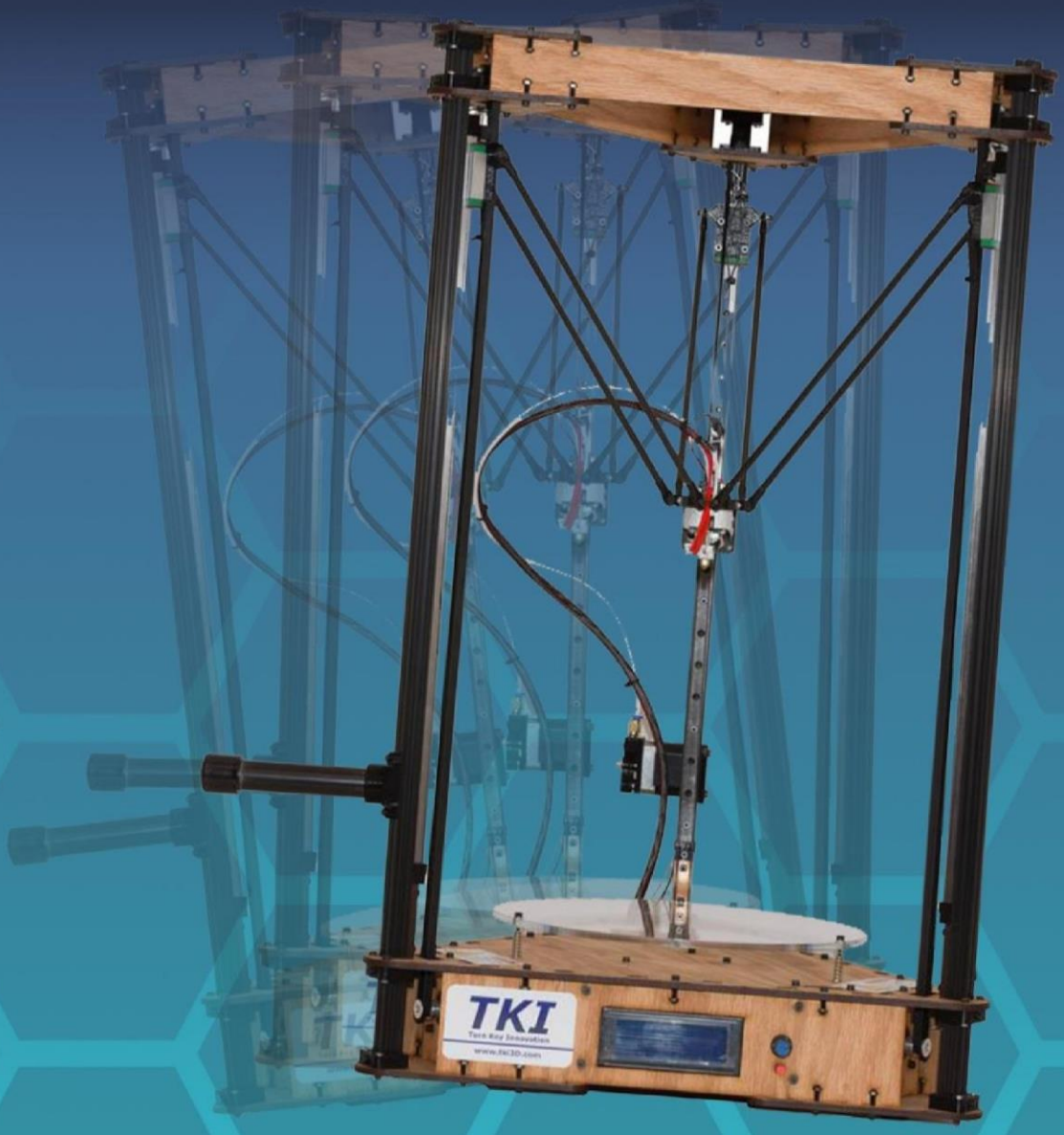
KOSSEL MODEL A

USER'S GUIDE



TKI

TurnKey Innovations

Table of Contents

CONTENTS

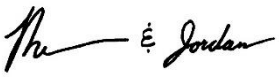
INTRODUCTION

Congratulations! If you are looking over this manual it means that you are the proud owner of a TKI Kossel Model A 3D printer, which is a powerful tool that can help you unleash your creative spirt.

We know the frustrating, non-existent support that typically comes with a 3D printer. Turn Key Innovations, or TKI, was created with the idea that everyone should have access to 3D printing and be fully supported in making ideas come to life. This User Manual was assembled to provide guidance in understanding common procedures while using our 3D printer. It covers everything from the basic setup you'll need to get started to the maintenance required to keep your printer performing like new.

We look forward to helping you succeed in the exciting world of 3D printing and giving you everything you need to unlock your innovation.

Reliably yours,



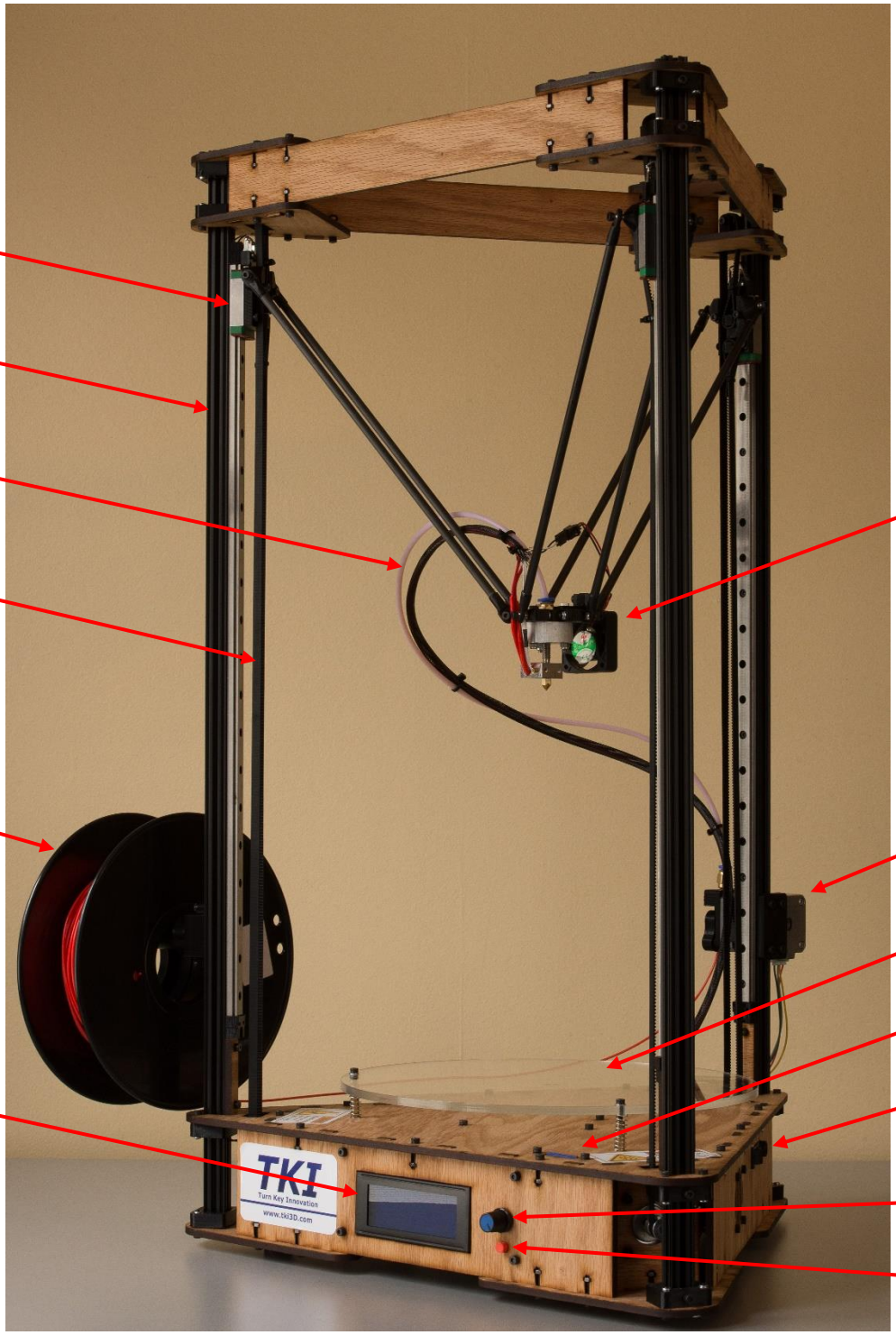
Rob and Jordan

CONTACT TKI

We understand that manual only covers the basics of your TKI printer, so if at any time you need more assistance, visit our support page at**www.tki3d.com/support** to send us a message or give us a call at **305-928-5433** and we will be happy to address your question or concern.

PRINTER FEATURES & DEFINITIONS

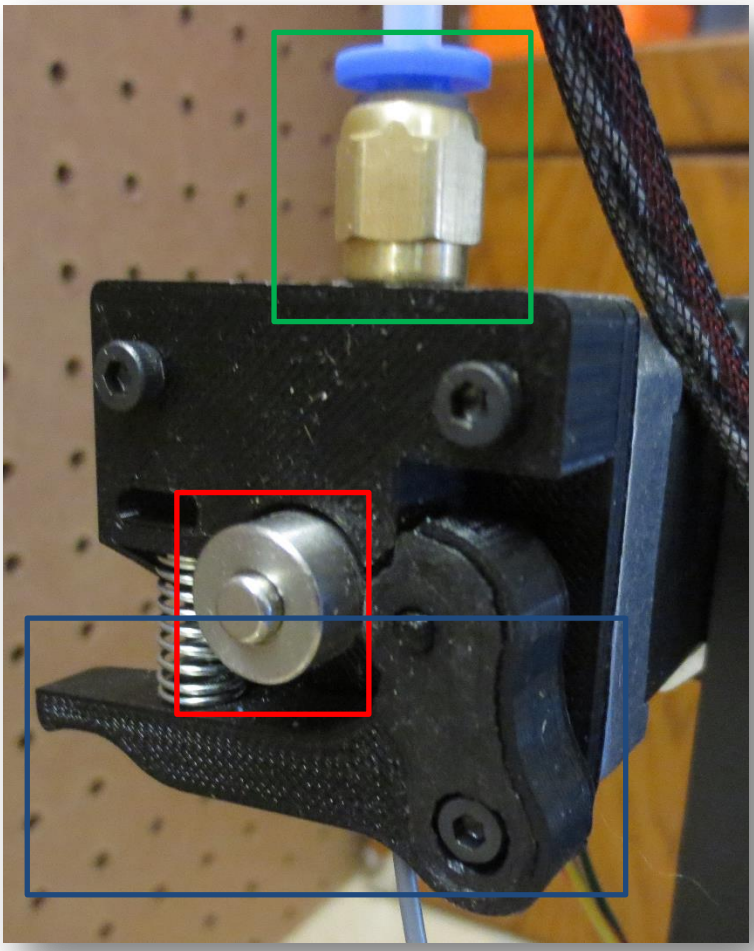
The figure below shows the features of the TKI Kossel Model A printer. You can reference this graphic for clarification of printer parts mentioned in this manual.



Extruder

The extruder pushes the filament from the spool into the hotend of the gantry. Components of the extruder:

- Drive Gear (Red), feeds the filament to the hotend
- Extruder Lever (Blue), applies force so the drive gear can grip the filament
- Bowden Tube quick disconnect (Green), attaches the Bowden Tube to the Extruder.



Bowden Tube

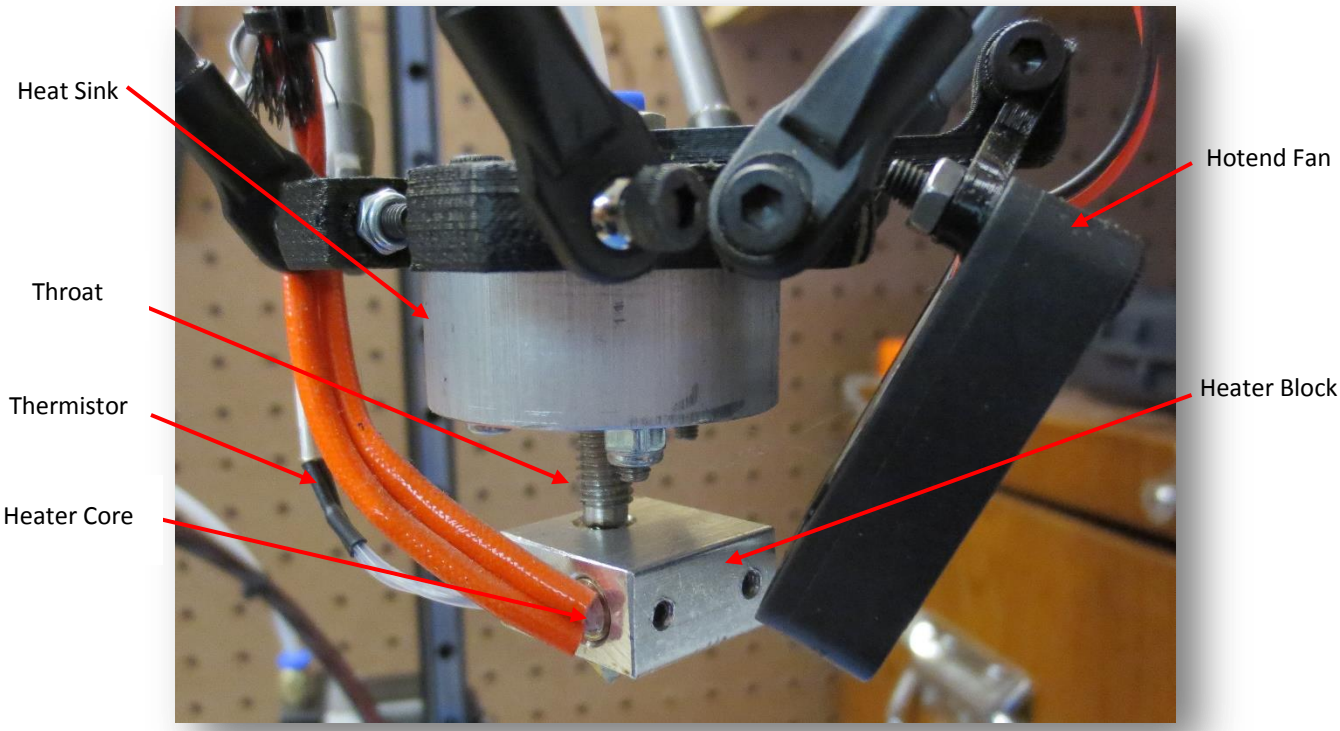
The Bowden Tube is the small tube that runs from the extruder to the hotend.

Nozzle

The nozzle is the brass fitting below the heater block that the plastic extrudes from.

Hotend

The hotend melts the filament as it gets pushed through the Bowden Tube by the Extruder. It is comprised of the following parts:



SD Card Slot

The SD card slot at the front of the printer allows you to insert an SD card to run the machine code and print without connecting to a computer.

X, Y, Z Towers

Looking at the front of the printer (facing the LCD screen), the left tower is the X, the right tower is the Y, and the back tower is the Z. These designations are used when leveling the bed and during troubleshooting procedures.

Carriage

There is a carriage located on each linear rail which is attached to each tower. The cumulative position of each of the three carriages determines the position of the gantry. Attached to the carriage are the connection rods that support the gantry.

Gantry

The gantry is the hotend and its components. It is connected to the three carriages by the connection rods.

Power Switch

The power switch controls the power of the printer and is located on the right side of the machine. If the printer is connected to a computer, then the LCD screen will be on, but the stepper motors and hotend will be off unless you use the power switch.

Power Jack

The power jack is where the power supply plugs into on the right side of the printer.

LCD Screen

The LCD screen is the user interface that controls the printer. To the right of the LCD screen is a speaker (top), control knob (center), and emergency stop button (bottom). Press in the control knob to select a function or rotate it to scroll through the menu options. If the stop button is pressed the machine must be power cycled for functionality to return.

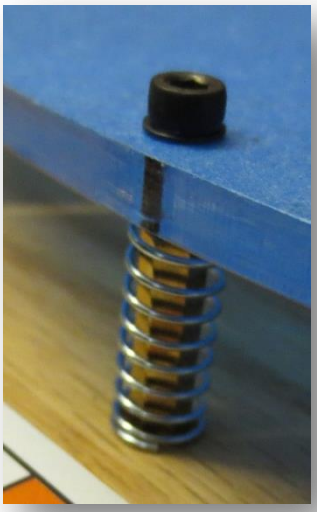
- **Info Screen**: The info screen is the home screen display for the LCD screen.

- **Main Menu**: Press in on the control knob from the info screen to navigate to the Main Menu.
  - Info Screen – Returns to the home screen
  - Prepare – Option to setup a print (preheat hotend, auto home, cool down, etc)
  - Control – Change printer firmware settings (temperature, motion, and restore failsafe)
  - Print From SD – Select a file to be printed

- **Prepare**: You can reach this from the Main Menu. The two common features that will be used on this screen are:
  Auto Home – Zeros the machine and returns the gantry to the home position
  Preheat PLA – Sets the hotend temperature to 200 °C

Bed Leveling Screws

The bed leveling screws are used to level the printer bed. The three bed leveling screws are located near the bottom of each tower.



SOFTWARE PARAMETER SETUP

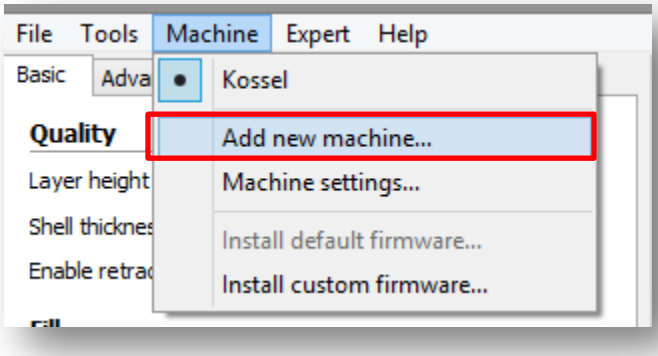
TKI recommends using Cura Software as the G-code generation software. G-code is a commonly used numerical control programing language used to control the position, speed, and path of the 3D printer. A link to the Cura software and other resources are found at our website at www.tki3d.com/resources.

Note: *While TKI recommends using Cura for slicing and G-code generation, other slicing software can be used. The printer parameters detailed below are a recommended for optimum performance of a TKI printer, which can be used for other software.*

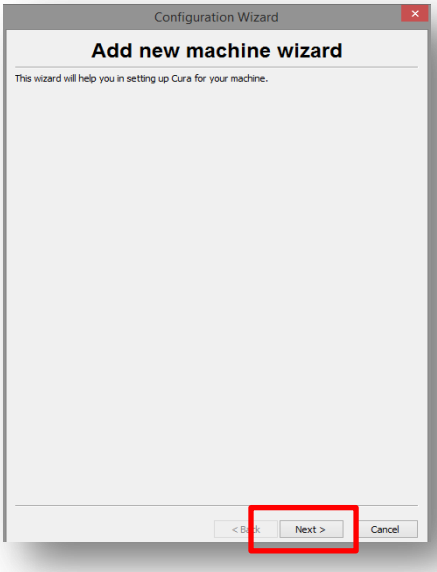
The printer setup for Cura will only need to be completed once.

SETTING UP A PRINTER PROFILE IN CURA

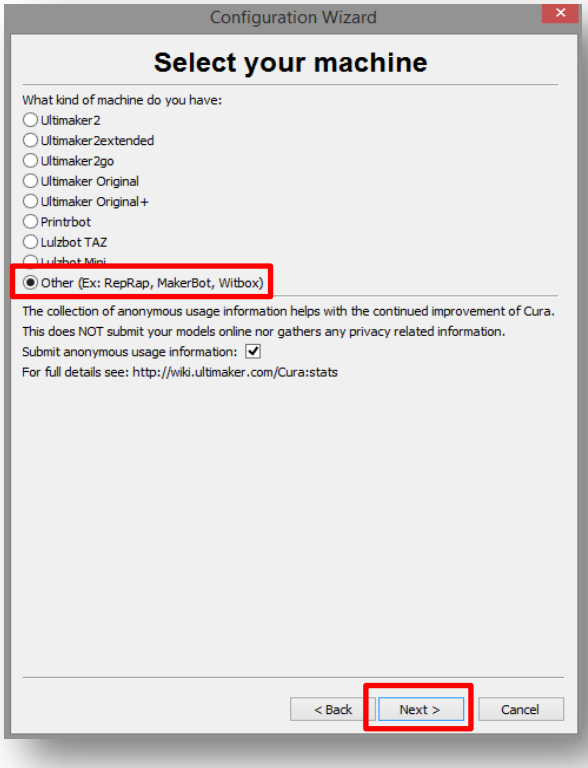
1. Download and install Cura at https://software.ultimaker.com/
2. Launch the Cura program from your computer's start menu or desktop icon
3. To setup your printer, select **Machine > Add new Machine**



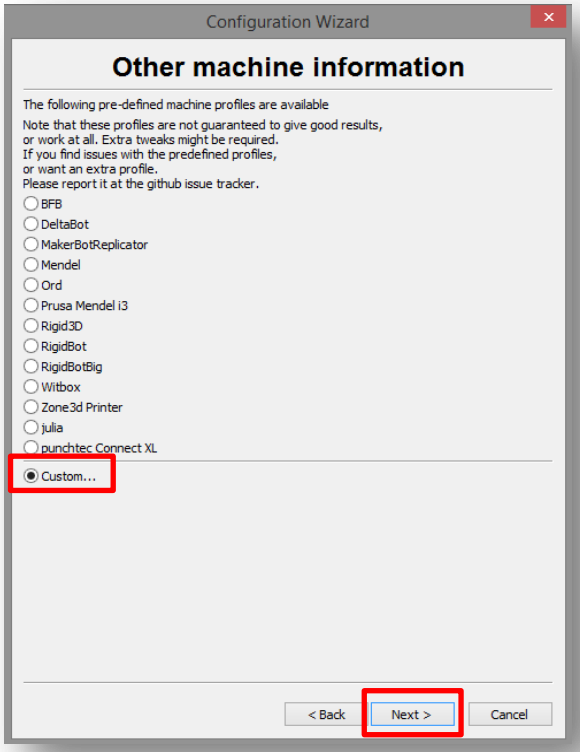
4. Click **Next** on the Configuration Wizard.



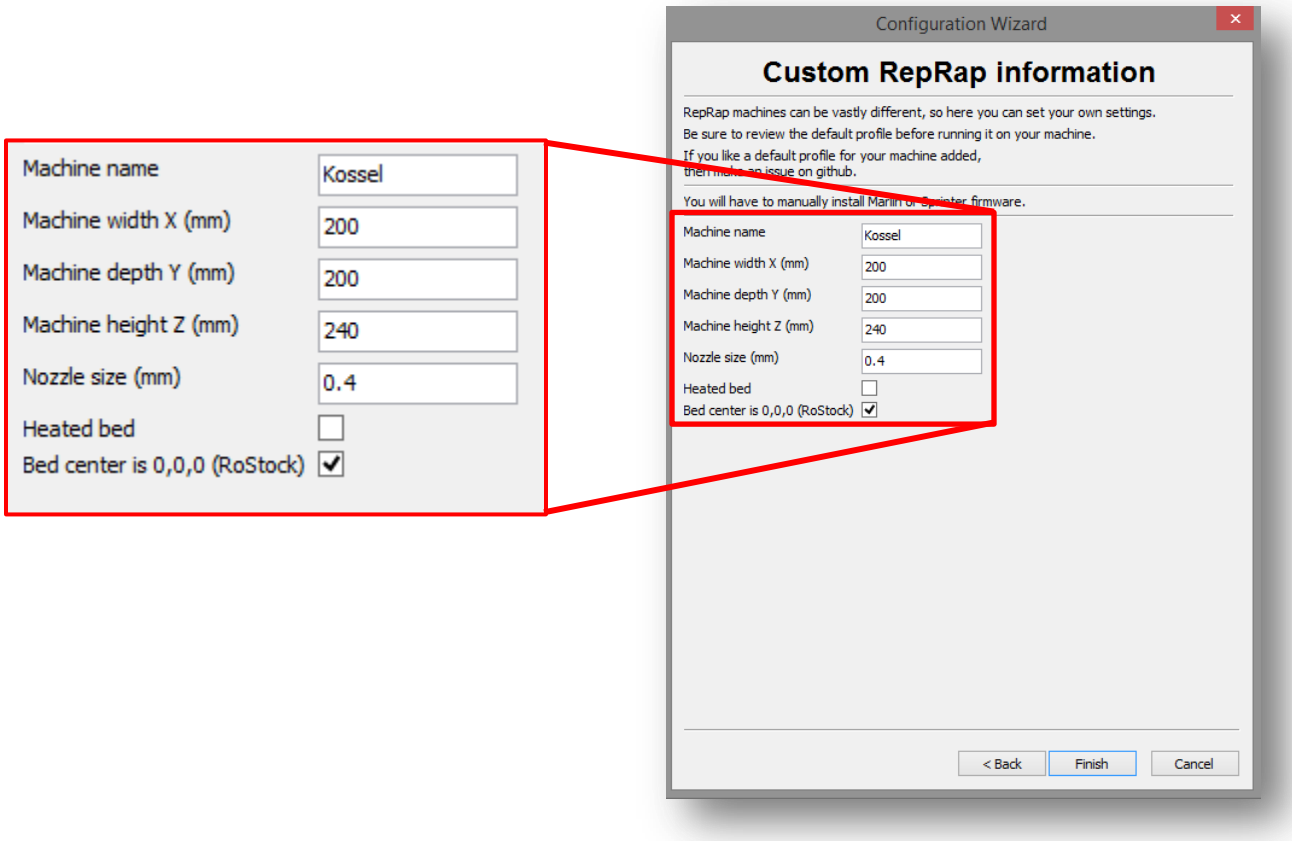
5. Under "Select your machine," choose **Other (Ex: RepRap, MakerBot, Witbox)**. Then click **Next.**



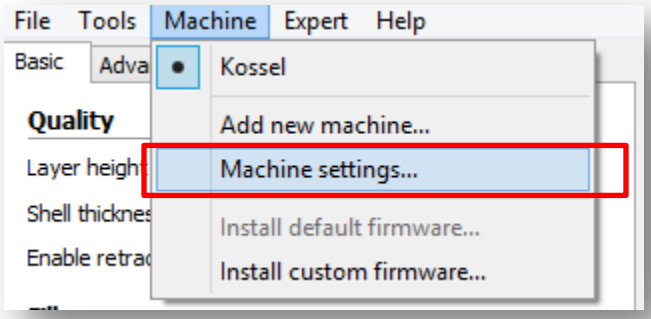
6. Under “Other machine information,” select **Custom** and click **Next.**



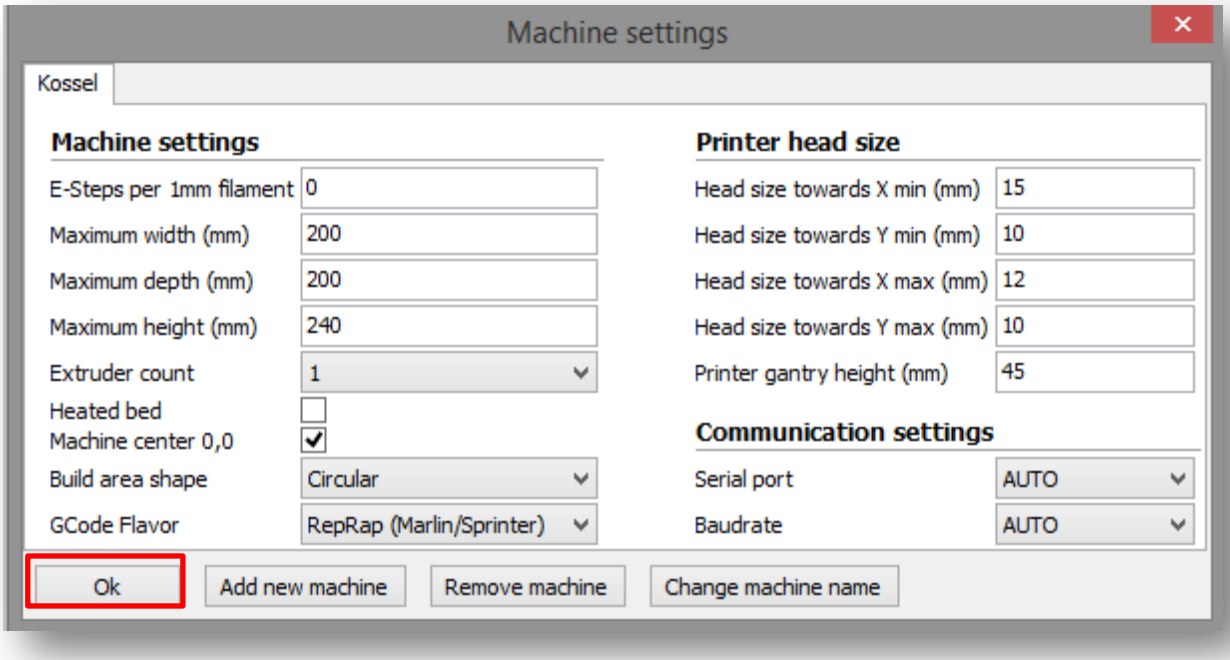
7. Input the following values into the RepRap custom settings.



8. Go to **Machine > Machine Setting**



9. Verify the following values in the table under Machine settings and click **Ok**.



Your TKI printer profile has now successfully been added to Cura.

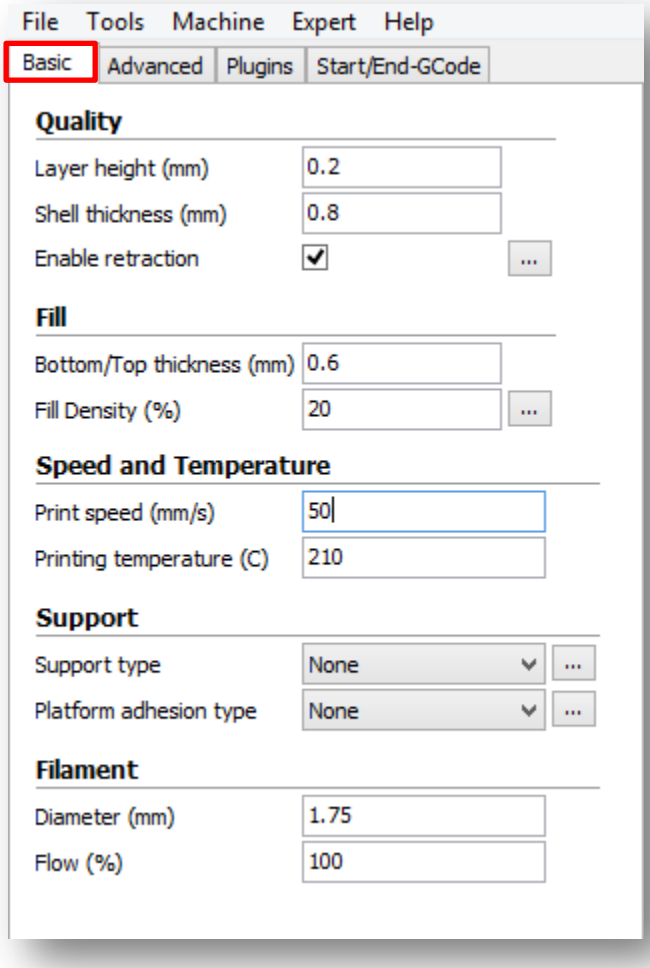
PRINTING SETTINGS

Printing settings determine the characteristics for an individual print. These settings include: print speed, fill density, shell thickness, layer height, and other advanced settings. This section should be used as a guide to the different settings that may need to be changed, and which settings should remain constant depending on your desired results.

PRINTING SETTING DEFINITIONS

Basic Settings

The parameters that are frequently adjusted to obtain the desire results for an individual part are found under the Basic Setting tab in Cura. The figure below shows the typical Basic tab settings for most prints. A detailed explanation of each parameter can be found below in the figure.

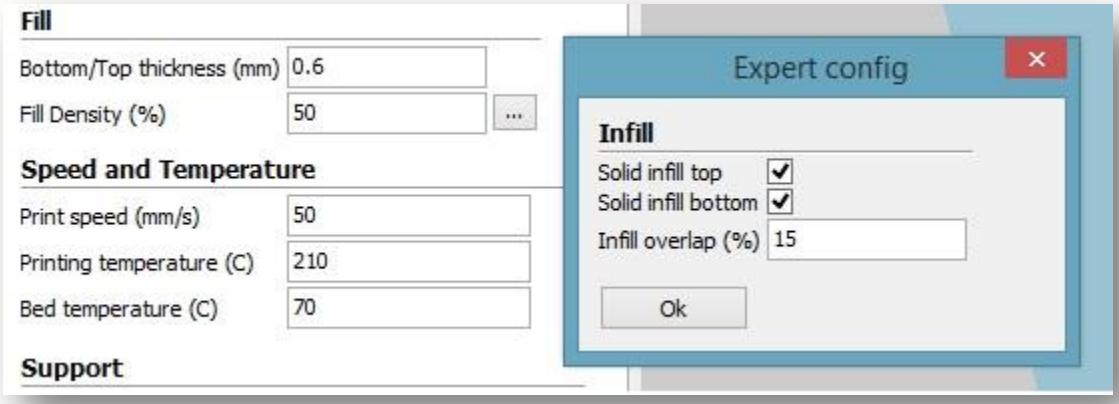


Quality

- **Layer Height (mm):** This describes the Z distance between each layer. For a 0.4 mm nozzle, the average quality can be achieved with a layer height of 0.2 mm. Average quality is sufficient for most prints except for items with fine details. If a higher resolution is desired, the layer height setting can be changed to 0.15 mm or 0.1 mm.
- **Shell Thickness (mm):** This describes the thickness of the outer shell of a printed part. This value must be a multiple of the nozzle size. For example, when using a 0.4 mm nozzle a 0.8 mm shell thickness is two nozzle widths.
- **Enable Retraction:** This setting allows the extruder to retract the filament when it is traveling between points during a print. Retracting the filament will prevent the nozzle from leaving a residue as it travels.

Fill

- **Bottom/Top Thickness (mm):** This describes the thickness of the solid bottom and top layers of a part. This value must be a multiple of the layer height. For example, a part with a layer height of 0.2 mm will have 3 solid bottom and top layers when the input is 0.6 mm for this parameter.
- **Fill Density (%):** This describes the amount of infill that will be printed in a part. Typically, an infill of 20% is sufficient internal support to make a strong part. Increasing the infill to 70% will make an almost solid part. Click on the **"…"** button to show the Expert config window. In this window, the top and bottom layers can be turned off. For example, a vase can be made by turning the solid infill top to off and setting the fill density to 0%.

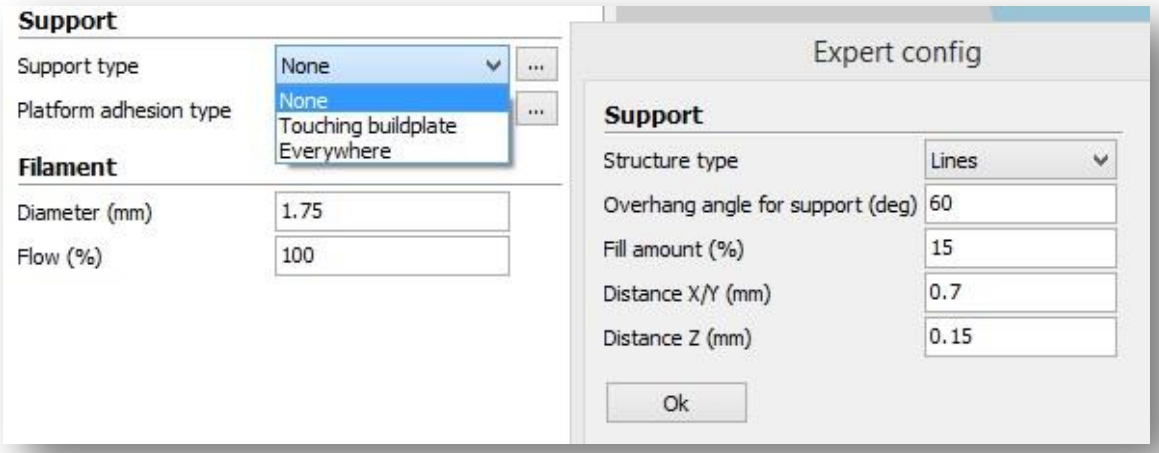


Speed and Temperature

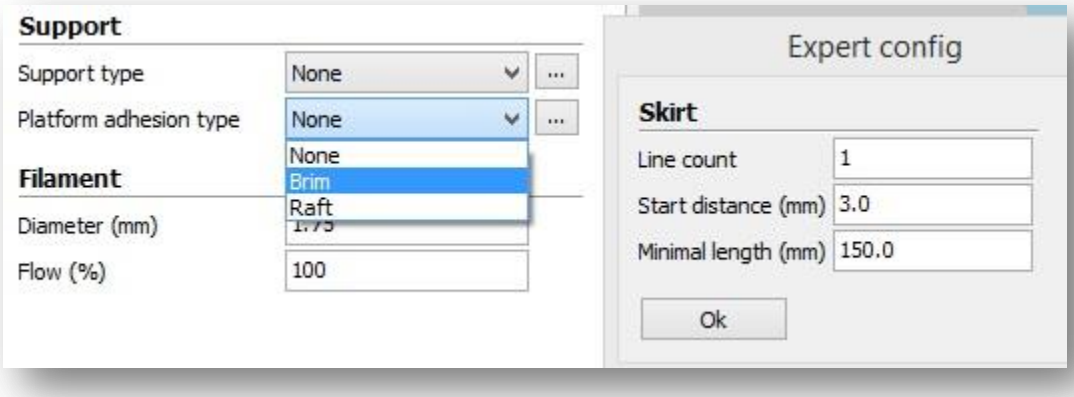
- **Printing speed (mm/s):** This describes the nozzle speed while printing.
- **Printing temperature (°C):** This describes the temperature of the hotend while printing. This value can be adjusted depending on the material being used. PLA should be set between 200 °C - 210 °C.
- **Bed Temperature (°C):** The TKI Kossel Model A does not have a heated bed. This value can be ignored for the TKI firmware.

Support

- **Support type:** Support material is used when a model's geometry exceeds 60 degrees from the vertical for a part feature. There are three support type options: **1) None,** which should be used when there are no features that exceed 60 degrees, **2) Touching buildplate**, which will add support material everywhere that a feature exceeds the 60 degree requirement as long as the structure overhangs the printer bed and not another section of the part, and **3) Everywhere**, which will add support material to all features that exceed the 60 degree requirement, including overhangs that are over another section of the part. Clicking on the **"…"** button will bring up the Expert config window where additional features can be edited.



- **Platform adhesion type:** The platform adhesion setting is used to prevent the part from warping or peeling off the printer bed. If the printer bed is properly prepared using blue painters tape, the platform adhesion parameter should not be needed using PLA filament. There are two types of platform adhesion: **1) Brim**, which is a flat single layer that extends past the footprint of the part to extend the adhesion area, and **2) Raft**, which is a support structure under a print that helps secure it to the bed. A **skirt** is the initial pass that outlines a part to prepare the hotend for printing.

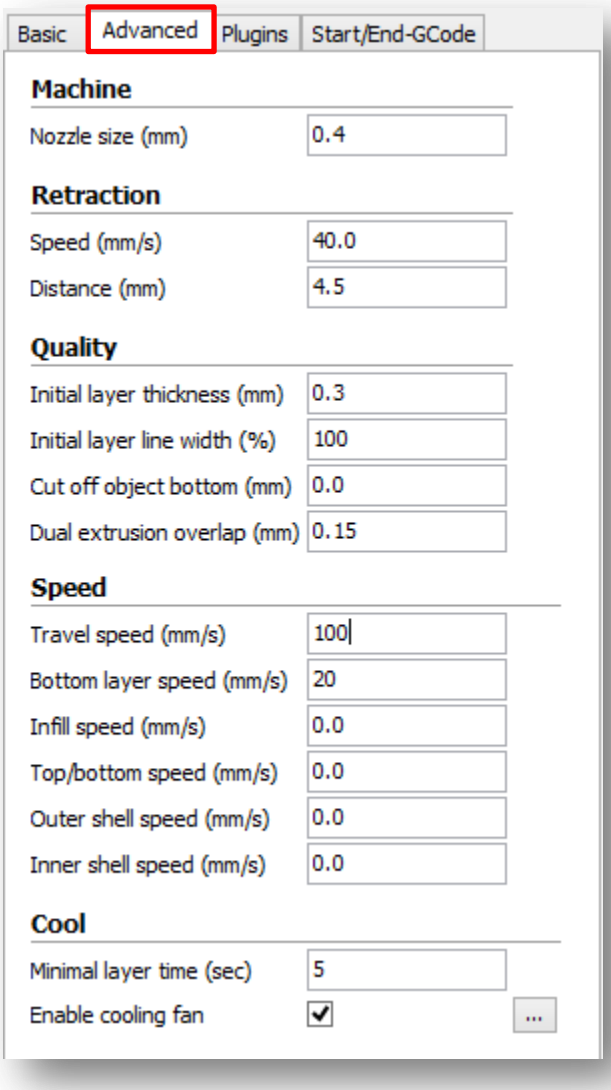


Filament

- **Diameter (mm):** This describes the diameter of the filament being used. This value should be adjusted to the standard TKI filament of 1.75 mm.
- **Flow (%):** This describes the amount of filament being pushed through the nozzle. This value can be adjusted to optimize the quality of the print. A typical value is between 90-100 % for your TKI printer. If excessive plastic is being extruded, reduce this value by 5%.

Advanced Settings Defined

The Advanced tab parameters are printer specific and most will only need to be adjusted once. The figure below shows the typical advanced tab settings for your TKI printer. A detailed explanation of each parameter can be found below in the figure.



Machine

- **Nozzle size:** The size of the nozzle being used.

Retraction

- **Speed (mm/s):** The speed at which the filament is retracted.
- **Distance (mm):** The distance the filament is retracted. This value can be raised if there is excessive residue during printing.

Quality (Only applicable parameters discussed)

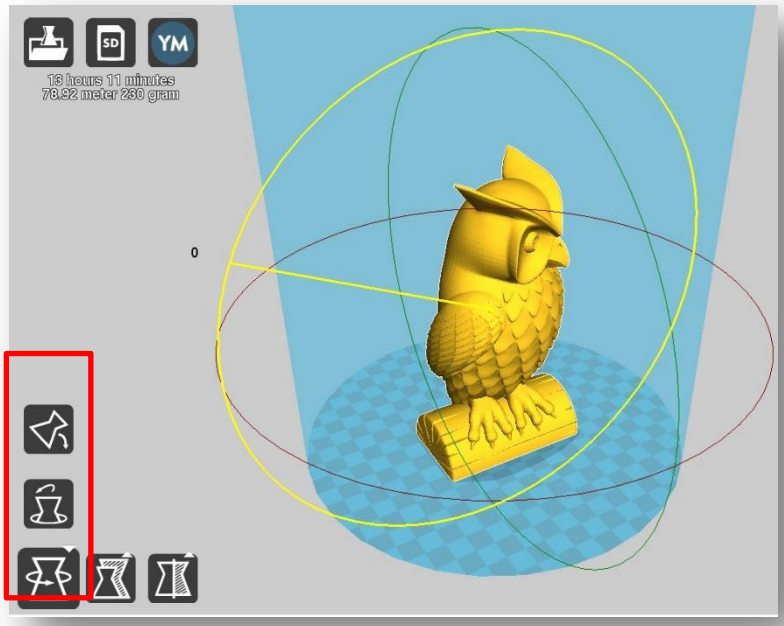
- **Initial layer thickness (mm):** The distance between the printer bed and the nozzle for the initial printed layer.

Speed (Only applicable parameters discussed)

- **Travel speed (mm/s):** The speed at which the hotend moves when it's not extruding filament.
- **Bottom layer speed (mm/s):** The speed at which the hotend moves when printing the first layer. This value is typically set lower than the normal print speed to ensure adhesion of the first layer.

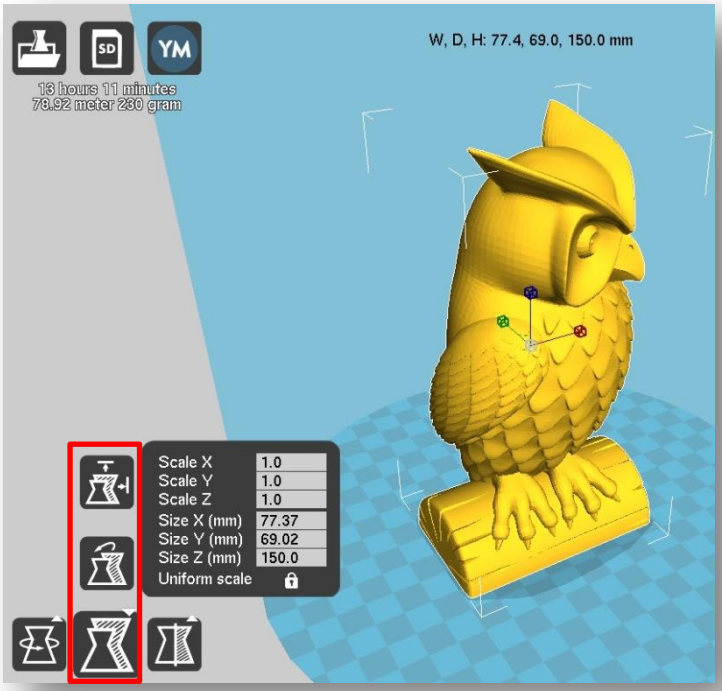
Individual Part Settings (located at the lower right of the printer window)

- **Rotate -** This function allows the part to be rotated inside the printer's workable volume. To rotate a model, click on the rotate function in the lower left corner. Select the axis of rotation by selecting and holding the desired circle around the part. Drag the circle to change the orientation of the part.

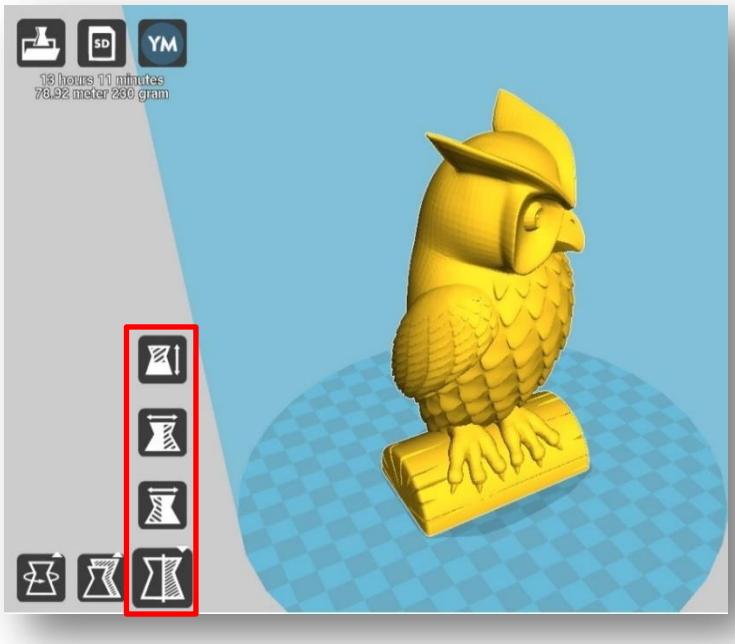


- **Scale –** The scale function adjusts the dimensions of the part. Click on the scale icon in the lower left corner. The scale can be adjusted by a percentage or a dimension.

  Note: Cura interprets all dimensions in millimeters. If the model was made using inches it will appear very small in the Cura window. Simply select the part and uniformly scale it by 25.4 to restore the part to its correct size.



- **Mirror –** This function allows you to mirror the part about an axis. Click on the mirror icon in the lower left corner to activate this function. Select the desired axis to mirror part about.

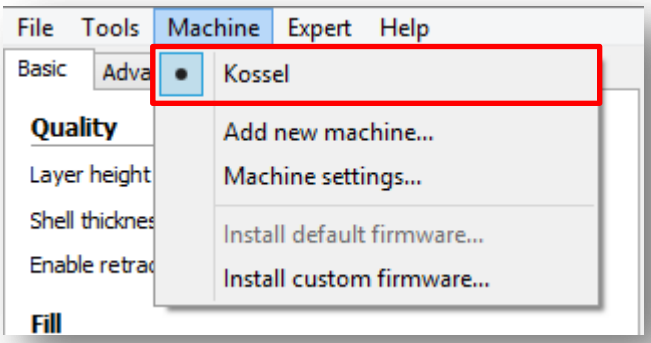


GENERATING G-CODE USING CURA

This section details the baseline parameters to use for generating G-code in the Cura software. G-code is the machine language that the control the printer motors and heater. Individual objects may require changing some of the parameters discussed in the previous sections to obtain the desired quality and speed.

STEP-BY-STEP PROCESS

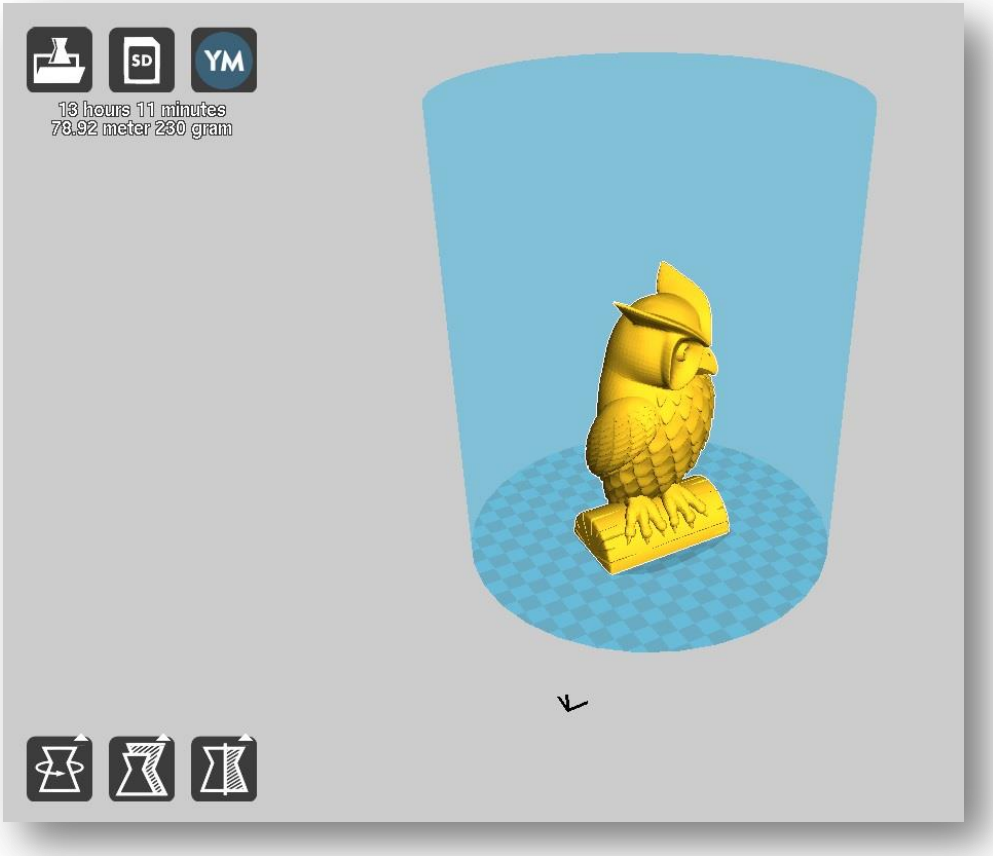
1. Verify that Kossel is selected under the Machine tab.



2. Load the desired model file (the file must be in an STL format) by clicking on the Load icon in the top left of the print window.

3. Once the model has loaded, reposition the part to the desired location and orientation on the printer bed. To reposition the model, click, hold, and drag it to the desired location in the printer's volume, identified by the shaded blue area.

   Note: the orientation will determine if support structure is required. Reference the Printing Settings Definitions section for help manipulating the part.



4. Verify and adjust any of the Basic and Advanced printing settings. See the Printer Settings Definitions section for more detailed information on these settings.

   Note: Hovering the mouse over a setting will bring up a description of how the setting will affect the print.

5. Insert the SD card into your computer. Click the SD card icon in the top left of the print window to save your files to the SD card.

Your files are now loaded onto the SD card, and you are now ready to print. The next section will detail the steps to print directly from your SD card.

PRINTING FROM AN SD CARD

The Kossel Model A can read the G-code of your print file directly from an SD card. This allows the machine to run without being connected to a computer.

STEP-BY-STEP PROCESS

1. Insert the SD card into the printer. The SD card slot is located next to the print bed, and to the right of the LCD screen.
2. Turn on the printer or restart if required. When an SD card is installed the machine must be restarted to recognize the card.
3. Press the control knob once to reach the Main Menu.
4. Scroll down to “Print from SD” and press the control knob again to select this function.
5. Use the control knob to scroll to the desired print file. Newly added files will usually appear at the bottom of the file list.
6. Press the control knob to select the file you want to print. The printer will heat the hotend to operating temperature and auto home the gantry.
7. Watch the first layer being printed to ensure that the bed is at the correct height and properly leveled. If the bed appears to be at the wrong level stop the printing process and relevel the bed. Once printing is completed the gantry will return to the home position.
8. Allow the hotend to reach room temperature. Then remove your finished masterpiece.

PRINTER OPERATION

This section details several processes that periodically will need to be performed to keep your printer running like new.

CHANGING FILAMENT

This section will guide you through the process of changing filament to allow you to replace fully consumed filament spools or change colors between prints. To change the filament you must first completely remove the current filament and then install the next filament spool.

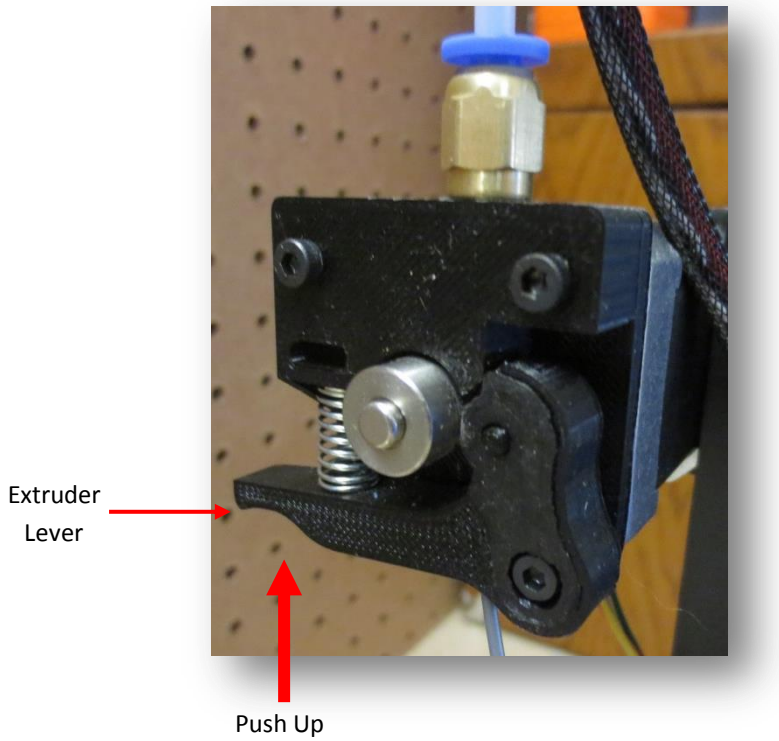
CAUTION: The hotend will be heated to operating temperatures and can cause injury.

Removal

1. Turn on the printer and preheat the hotend to the operating temperature (210 °C for PLA).
2. Push up on the extruder lever and slightly push in on the filament until it comes out of the tip of the nozzle. The figure below shows the extruder lever and direction to push.
3. Gently pull the filament completely out of the Bowden Tube while continuing to push up on the extruder lever.

Installation

1. Prep the end of the new filament by clipping it at a 45 degree angle, and straighten 2 to 4 inches of the clipped end, which will be inserted into the extruder.
2. Push up on the extruder lever and insert the filament into the extruder.
3. Continue to feed the filament through the extruder and the Bowden Tube until it flushes out the old filament from the nozzle.
4. Release the extruder lever and you are now ready to get back to printing!

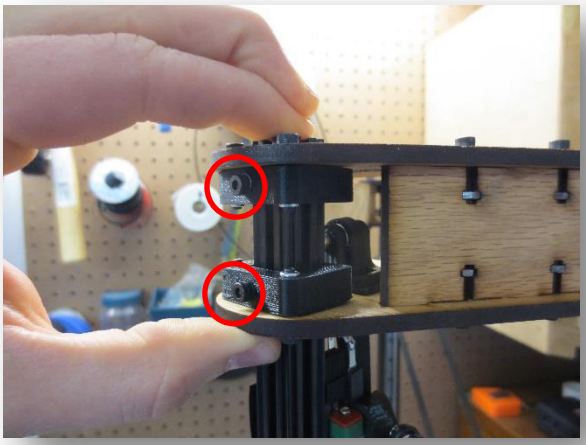


BELT TENSIONING

The printer belts will occasionally need to be tightened to ensure optimum performance from your printer. The belts on each tower should be tight enough to pluck gently, similar to a guitar string. If the belts are too tight, the stepper motors will stall, but if the belts are too loose they could skip a tooth on the pulley. Follow the steps listed below for easy belt tensioning.

Note: Only tighten one belt at a time to prevent the top support from dropping.

1. Loosen the two screws on the top side of the tower that holds the belt that needs adjusting.

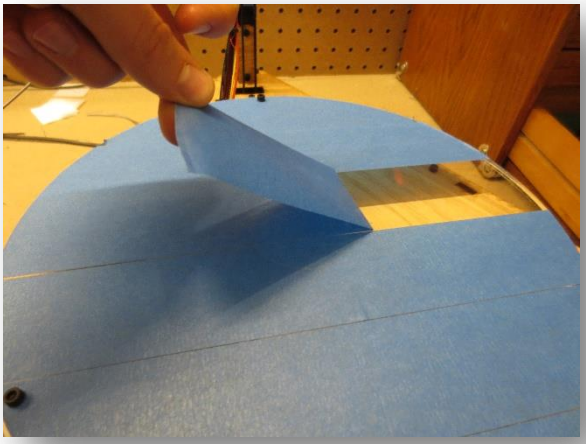


2. Place your thumb under the lower screw and your pointer finger on the top of the rail. Push up with the thumb until the belt is to the desired tension. Tighten the two screws to secure the new position.

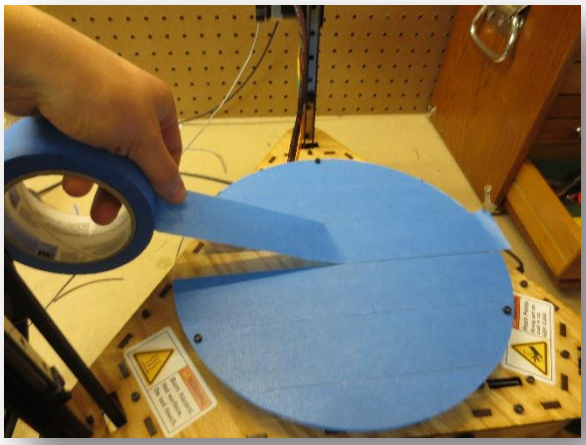
BED PREPARATION

The bed preparation process ensures that the filament will stick to the printer bed. This process requires 3M Scotch Blue Painters Tape and a razor blade (optional).

1. Remove any old tape that needs to be replaced.



2. Apply the new Scotch Blue painters tape to the bed to replace the tape that was removed.



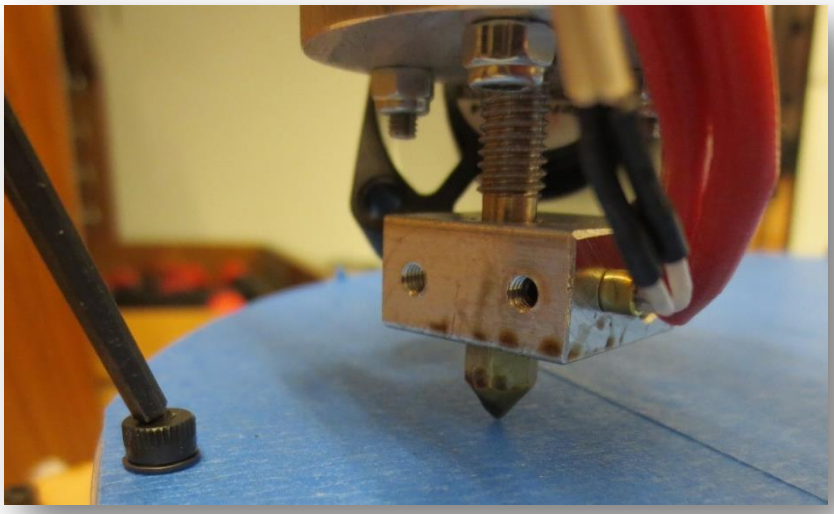
3. Gently press down on the new tape to smooth out the edges. Ensure there are no bubbles in the tape. Use a razor blade to trim the edges of the tape to the dimensions of the bed (optional).

BED LEVELING

Bed leveling ensures that the printer bed is perpendicular to the nozzle. An unleveled bed will result in poor adhesion to the bed and poor print quality. The bed is leveled by adjusting the three bed leveling screws which allows for adjustment of the bed during printing of the first layer, if required.

The goal during the bed leveling process is to have the nozzle 0.1 mm above the bed when it prints the first layer of your part. To simplify the bed leveling process, we have created a G-code program that will aid you in completing the leveling process in less than 5 minutes. This bed leveling program can be downloaded at **www.tki3d.com/program/bedlevel**. This program moves the nozzle adjacent to each tower and brings it to the zero position just above the bed. The nozzle will hold this positon for 20 seconds to allow the user to adjust the level of the bed at each tower. The LCD screen will display a countdown timer to prompt you when the nozzle is going to move to the next tower location.

1. Download the bed leveling G-code onto an SD card **www.tki3d.com/program/bedlevel**.
2. Ensure the nozzle is at room temperature and disconnect the power to the hotend fan by disconnecting the connector before beginning the bed leveling process.



3. Use the control knob to navigate to the bed leveling program on the SD card (Bedlevel.gcode) and select run.
4. Adjust the bed leveling screw next to the first tower when the nozzle is adjacent to the first tower to the point that the nozzle is almost touching the printer bed. A good way to check for clearance between the bed and the nozzle is by inserting a piece of paper between the bed and the nozzle. If there is a slight drag on the paper then the nozzle is in the correct position.
5. Repeat step 4 as the program moves the nozzle to the remaining two towers.

> **Note:** For the first print after the bed leveling process, it is important to watch the first layer to ensure it adheres to the bed correctly. You may have to adjust the bed leveling screws during this first layer to optimize the bed position.

MAINTENANCE

Regular maintenance is important for accurate worry free printing. Perform these simple steps to optimize your printing experience.

CHECK BELT TENSION

Every few weeks it is important to make sure the belts are the correct tension, as they may stretch out during use. Follow the instructions in the Belt Tension section if you suspect a belt need to be tighten. The belts should be checked every few weeks for casual use and every week if the printer is used daily. Checking the belt tension regularly will help prevent print failures and/or damage to the printer.

CHECK PRINTER BED LEVEL

Verify the bed is level every 5-6 prints. In addition, the bed should be leveled after replacing the Scotch Blue Painter's Tape on the bed or if during removal of a part you feel the bed may have shifted. Check the bed level by running the bed leveling program (See Bed Leveling section).

TROUBLESHOOTING

The table below shows some of the most common problems experienced with 3D printer use and solutions to resolve them. For more troubleshooting help visit our FAQ page **www.tki3d.com/resources**. If you still can't find the answer to your question, please contact us by visiting **www.tki3d.com/support** or call **305-928-5433**. We are happy to assist you with any problem you might be having.

Symptom	Solution
Layers are shifting towards a tower	Check and tighten the belt on the tower that the layers are shifting towards.
Belt skipped	Check and tighten the belts per the belt tensioning procedure.
SD Card is not recognized by the printer	Restart the printer. If the SD card is still not recognized, remove and reset the SD card.
Initial Layer is not sticking	First try replacing the Scotch Blue Painter's Tape. Next, check the bed level. Finally, a thin layer of Elmer's glue (glue stick only) can be applied for maximum adhesion.
Plastic is not extruding from the nozzle.	Ensure the filament is feeding correctly and being pushed into the nozzle from the extruder. Next, verify the nozzle temperature is correctly set between 195-210 °C.