We are Open Source. Collaboration fuels Innovation.
Create, Innovate, and Share.

Note: While every attempt has been made to verify the accuracy of this guide, some illustrations and information may differ from your kit or printed parts. In most instances, the assembly procedure and/or instructions are still valid unless otherwise noted.

Please visit www.maplemakermedia.com for the latest information and releases.

Designed, Illustrated and written by Ryan Adams www.minimadryan.com

Version: 0.3.1 Release: 052415

mapleMaker
ADDITIVE ENGINEERING

GUIDE
1

BUILD GUIDE

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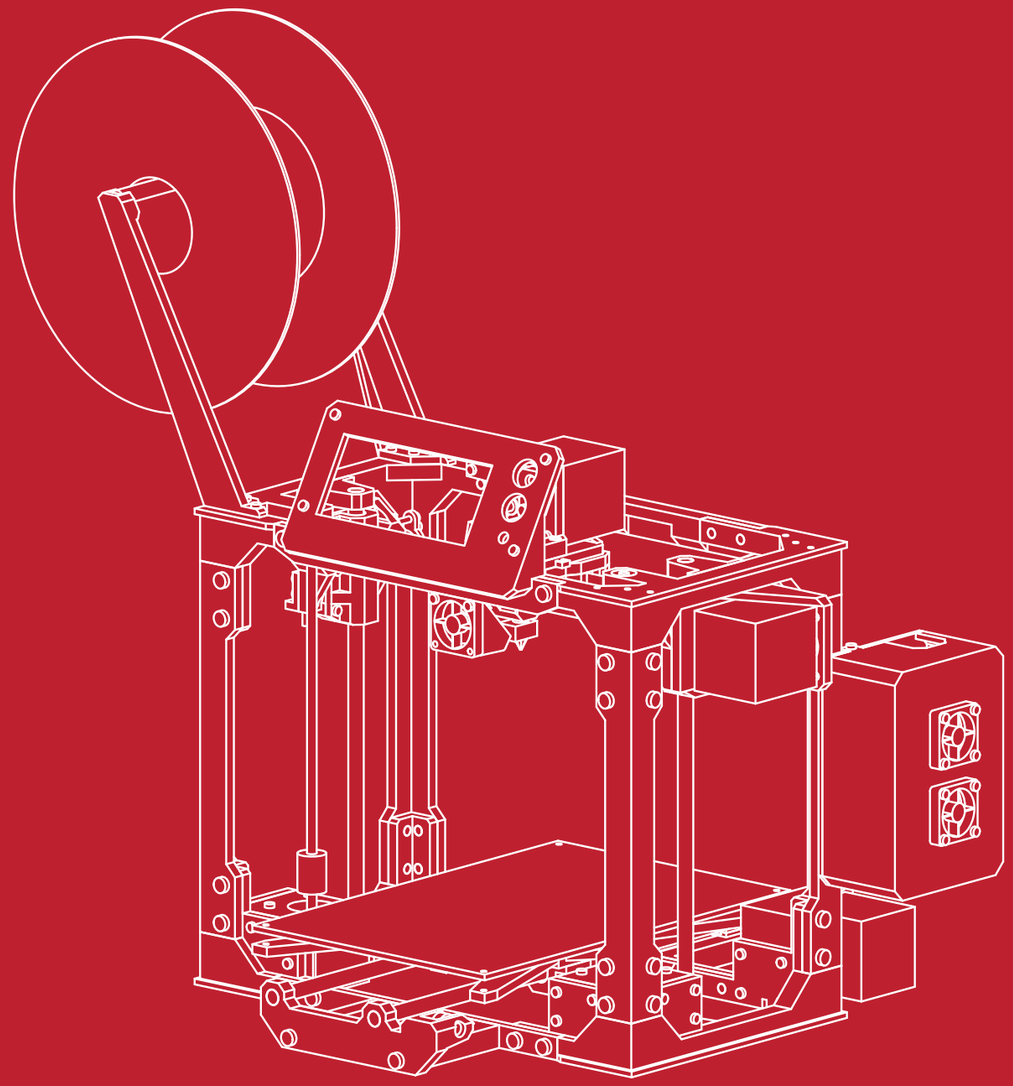
ADDITIVE ENGINEERING

SECTION A



1.1 Introduction

Welcome, and Thank you!

Thank you for your interest in the mapleMaker Mini V2 3D Printer.

The **mapleMaker Mini** introduces you to the world of additive manufacturing and 3D printing. With your own 3D printer, your concepts and design ideas can be translated from computer drawings to physical objects in short period of time.

The goal of this guide is to **introduce you to the parts and pieces** that will be required before you can assemble your printer kit. Most of these items can be sourced both locally and from any number of online retailers.

The aim of this kit was to reduce costs and create an **accessible, hackable, upgradeable, and ultimately, user customizable 3D Printer.** We believe that a 3D printer should evolve with it's users needs and knowledge, and become a platform for any number of future upgrades and additions without the need for costly re-works or additional components.

Ultimately though, we want to empower the next generation of designers, developers, and engineers by giving them the platform and tools to suite their needs for today, tomorrow, and well into the future.

We are Open Source. Collaboration fuels Innovation. Create, Innovate, and Share.

1.2 Table of Contents

This guide is broken into several sections which encompasses the build process of the maplePrint Mini 3D printer. The process begins with the basic frame assembly and finishes with the final wiring and installation.

While we try to maintain the most up to date diagrams and illustrations, there may be slight differences between the illustrations contained within this guide, and the printed parts in your kit. If there are major changes or differences between the instructions contained within and the printed parts, you should have received an updated insert in your kit containing the revised instructions.

1.3 Required Tools

Before we begin the assembly process, it is vital that we have the proper tools to complete the build. Thankfully though, there are only a few tools required for the build. These tools were either included with your kit, or available at any local hardware or tool store.

You will need the following:

#2.5 Allen Key (for use with M3 screws)

#3 Allen Key (for use with M4 screws)

#4 Allen Key (for use with M5 screws)

Ceramic screw driver (for adjusting RAMPS drivers)

Spatula (to remove printed parts from the print bed)

Exacto Knife (for trimming and cleaning parts)

Needle nose or similar pliars

Solder iron and solder

Nylon wire ties or zip ties (for securing wiring looms)

3M Blue painters tape (for printing with PLA)

Hot glue gun (to secure endstops)

Additional information regarding this build guide:

We've attempted to keep this build guide simple and easy to understand. We've broken the assembly into several sections, and each step into individual illustrations to simplify the build process further. Each illustrated step in this guide is also accompanied by a list of parts and hardware required to complete the step. The illustrations of fasteners in these lists are printed to scale and may be used to size the hardware included in your kit. Simply place a fastener on top of or next to the illustration to determine if its the correct one for the job!

1.4 Reseller Information

Below is a list of resellers and manufacturers of the components used in the mapleMaker Mini 3D Printer.

Some components may be sourced from your local home improvement retailers or specialist hobby stores.

Electronics, motors & extruders

Folger Technologies, LLC:	www.folgertech.com
Active Surplus:	www.active123.com
EckerTech Inc:	www.eckertech.com
Misumi	www.us.misumi-ec.com/
Mixshop	www.mixshop.com
Filastruder	www.filastruder.com
SDP/SI CA	www.sdp-si.com/
Skyhunt	www.skyhunt.net
ROBOTDIGG	www.robotdigg.com
Voxel Factory	www.voxelfactory.com

Linear rods & movement

Folger Technologies, LLC:	www.folgertech.com
ROBOTDIGG	www.robotdigg.com
EckerTech Inc:	www.eckertech.com
Mixshop	www.mixshop.com

Fasteners

HD Supply Canada:	www.brafasco.com (minimums may apply)
Fastenal	www.fastenal.com (minimums may apply)

Misc. electronics

Digikey:	www.digikey.ca
McMaster-Carr	www.mcmaster.com (minimums may apply)

1.5 Components

The following list comprises the components required to build your printer. For the purposes of this build, we have used ROBOTDIGG (www.robotdigg.com) to source the majority of the components. ROBOTDIGG offers almost every component required, minus fasteners and threaded rod. The hot end has been sourced through e3D's authorized distributor, Filastruder (www.filastruder.com)

NEMA 17 48oz Stepper Motor
Quantity: 3
URL: http://www.robotdigg.com/product/206/Nema17-48mm-Stepper-Motor
Unit Cost: $9.50

NEMA 17 34oz Stepper Motor
Quantity: 2
URL: http://www.robotdigg.com/product/28/NEMA14-34mm-0.8A-or-1.25A-stepper-motor
Unit Cost: $6.80

Flexible Coupling - 5mm to 5mm
Quantity: 2
URL: http://www.robotdigg.com/product/83/Flexible-Coupling-5mm-Shaft-to-5mm-Screw
Unit Cost: $1.80

20 Tooth GT2 Pulley
Quantity: 2
URL: http://www.robotdigg.com/product/166/2GT-20-Tooth-6.35mm-Bore-Pulley
Unit Cost: $1.85

Open Ended 6mm GT2 Belt (2 meters)
Quantity: 1
URL: http://www.robotdigg.com/product/10/Open-Ended-6mm-Width-GT2-Belt
Unit Cost: $1.80

LMS8UU (Short) 8mm Linear Bearing
Quantity: 12
URL: http://www.robotdigg.com/product/477/LMS8UU+Short+Linear+Bearing
Unit Cost: $0.60

624ZZ Ball Bearing
Quantity: 4
URL: http://www.robotdigg.com/product/11/624ZZ+Ball+Bearing
Unit Cost: $0.35

Poloululu 4988 Stepper Drivers
Quantity: 4
URL: http://www.robotdigg.com/product/120/A4988-stepper-driver
Unit Cost: $3.80

Endstop
Quantity: 3
URL: http://www.robotdigg.com/product/141/Endstop,-Snap-Action-Limit-Switch-SS-5GL
Unit Cost: $0.60

RAMPS 1.4 Controller
Quantity: 1
URL: http://www.robotdigg.com/product/121/Ramps-1.4-Board
Unit Cost: $12.80

Arduino Mega 2560
Quantity: 1
URL: http://www.robotdigg.com/product/123/Arduino-Mega-2560-R3
Unit Cost: $15.80

RAMPS LCD Display
Quantity: 1
URL: http://www.robotdigg.com/product/122/RAMPS-LCD2004-with-SD-Socket
Unit Cost: $12.80

30mm Cooling Fan
Quantity: 4
URL: http://www.robotdigg.com/product/197/12V-3CMHotend-Cooling-Fan
Unit Cost: $1.50

1.5 Components

12V 5A Power Supply

Quantity: 1
URL: http://www.robotdigg.com/product/350/12V-5AAC/DC-Adapter-Power-Supply
Unit Cost: $5.00

Thermistor Cable (1m)

Quantity: 1
URL: http://www.robotdigg.com/product/188/2pin-1MLong-Thermistor-Cables-w/-Dupont-Connector
Unit Cost: $0.40

Endstop Cables (1m)

Quantity: 3
URL: http://www.robotdigg.com/product/189/3pin-1MLong-Endstop-Cables-w/-Dupont-Connector
Unit Cost: $0.60

e3D Lite6 All Metal Hot End

Quantity: 1
URL: http://www.filastruder.com/products/lite6
Unit Cost: $35.00

MK8 Extruder Drive Gear

Quantity: 1
URL: http://www.robotdigg.com/product/242/MK8-Filament-Drive-Gear
Unit Cost: $3.00

Compression Spring (for Extruder & bed)

Quantity: 5
URL: http://www.robotdigg.com/product/71/Compression-Spring-for-Heatbed-and-Extruder
Unit Cost: $2.00

762mm length Linear Rods (Pack of 6)

Quantity: 1
URL: http://www.robotdigg.com/product/113/Rostock-Mini-492mm-Long-8mm-Diameter-Smooth-Rod-Pack
Unit Cost: $24.00

Allen Key Set

Quantity: 1
URL: http://www.robotdigg.com/product/128/1.5,-2,-2.5,-3,-4-size-allen-key-with-ball-head-in-pack
Unit Cost: $2.00

Nylon Cable Ties (100 pack)

Quantity: 1
URL: http://www.www.robotdigg.com/product/127/Nylon-Cable-Ties-2.5*100mm-100pcs-n-3.6*200mm-100pcs-Pack
Unit Cost: $1.80

Ceramic Screwdriver

Quantity: 1
URL: http://www.robotdigg.com/product/181/Ceramicscrewdriver-for-A4988-stepper-driver
Unit Cost: $1.20

4GB SD Card

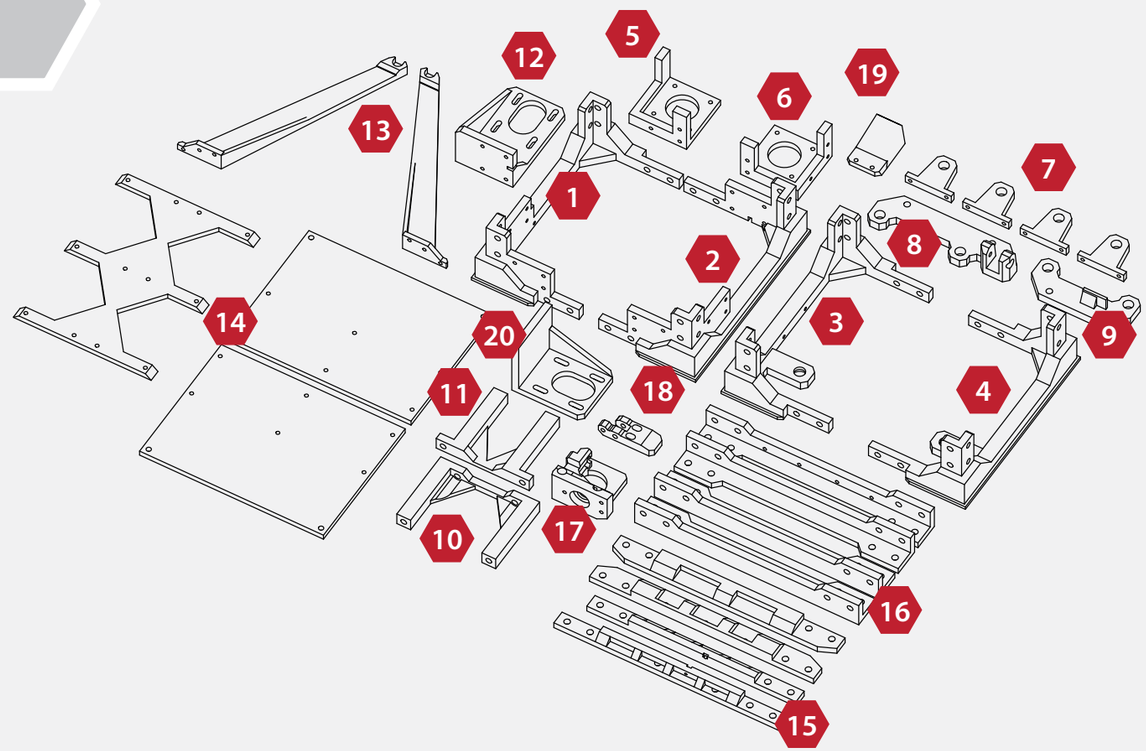
Quantity: 1
URL: http://www.robotdigg.com/product/345/4GB-SDCard-for-3D-Printing
Unit Cost: $4.50

Fasteners & Threaded Rod:

You will also require the following fasteners and threaded rod to complete the build.
These items can be purchased from your local hardware retailer or online. Note that the actual quantities may vary slightly. It is advised that you order extra fasteners to account for differences or lost fasteners.

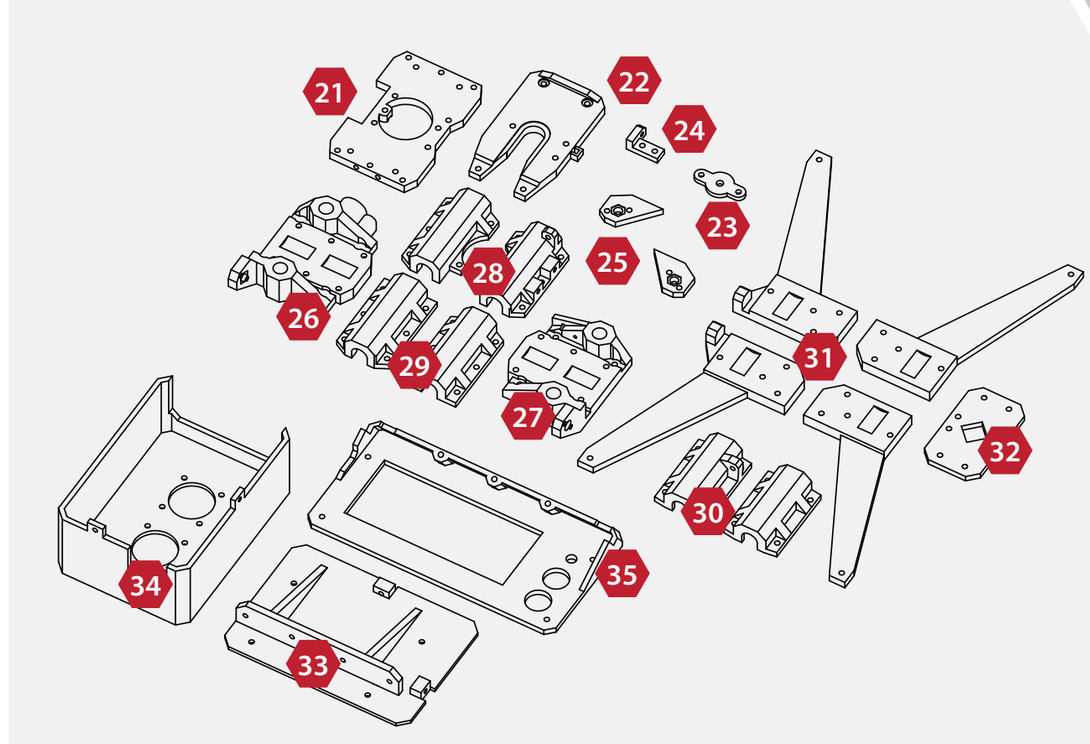
M3X10mm Socket Cap Screw **x150**
M3X20mm Socket Cap Screw **x10**
M3X16mm Socket Cap Screw **x8**
M4X10mm Socket Cap Screw **x1**
M4X16mm Socket Cap Screw **x2**
M5X12mm Socket Cap Screw **x60**
M4X60mm Socket Cap Screw **x2**
4mm - 0.7 Stainless Steel Threaded rod
3mm - 0.7 Flat nut **x6**
4mm - 0.7 Flat nut **x4**

Printed Components



1. Left Lower Frame
2. Right Lower Frame
3. Right Upper Frame
4. Left Upper Frame
5. Left Z Motor Mount
6. Right Z Motor Mount
7. Z Axis Linear rod Mounts
8. Y Axis Carrier (Front)
9. Y Axis Carrier (Rear)
10. Y Axis Mount (Front)
11. Y Axis Mount (Rear)
12. Y Axis Motor Mount
13. Spool Holder Mounts (2)
14. Upper Bed (Printed) (3)
15. Lower/Upper Frame rails (4)
16. Frame Upright Rails (4)
17. Extruder Mount
18. Extruder Idler Arm
19. Print Cooler Duct
20. X Axis Motor Mount

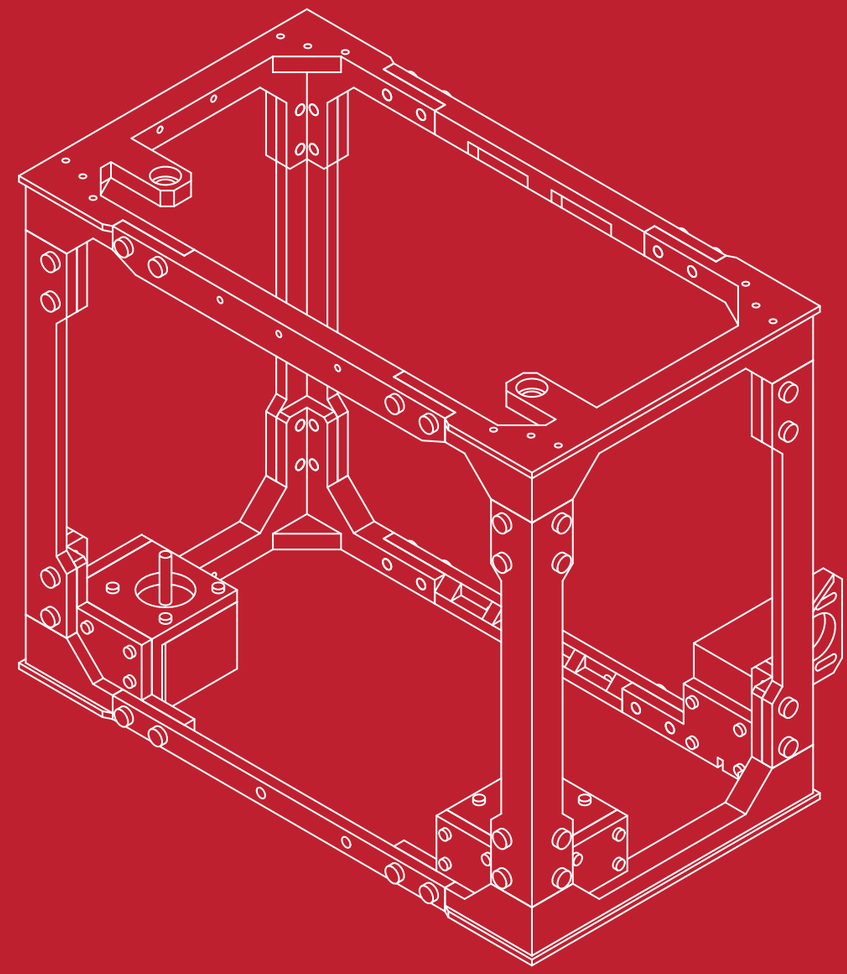
1.5



21. Extruder Base Mount
22. Hot-End Mount
23. X Axis Idler Cover
24. Z Axis Adjustment Mount
25. Z Axis Nut Covers (2)
26. X Axis Assembly (Left)
27. X Axis Assembly (Right)
28. X (Extruder) Bearing Carriers (2)
29. Z Axis Bearing Carriers (2)
30. Y Axis Bearing Carriers (2)
31. Lower Bed Frame (4)
32. Lower Bed Union
33. Electronics Backplate
34. Electronics Enclosure
35. LCD Frame Assembly

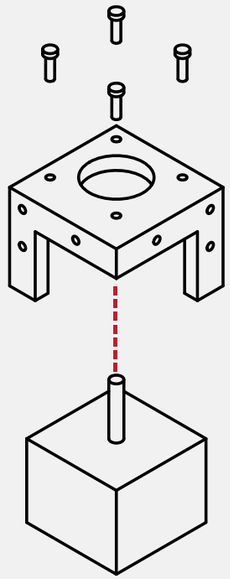
SECTION

B



Z Motor Assembly (Right Front)

1



Locate the Hardware bag marked:
Z-Motor Mounts

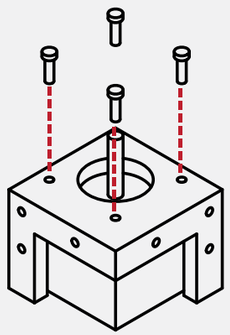
Locate the **Right Front Motor mount**, the upright mounts should face the outside of the frame.

From the Stepper Motor package, select **1** of the **34mm (short) stepper motors.**

From the Fastener package, select:
4 M3x10 cap screws

X 4 — **M3 x 10**

2



Insert the Stepper Motor into the base of the **Right Front Motor Mount**

The threads on the face of the Stepper Motor should align with the 4 holes of the Right Front Motor Mount.

The connector on the motor should face away from the outside corner of the motor mount.

N/A

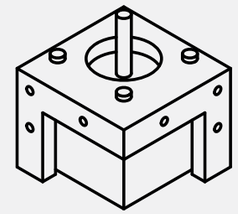
Z Motor Assembly (Right/Left Front)

3

Using the **M3 Hex wrench**, screw the **4 M3 x 10 cap screws** through the **Right Front Motor** mount into the stepper motor.

Note: Take care not to over-tighten the screws, or you may break the motor mount.

Congratulations, the Right Front Z Motor Assembly is complete!



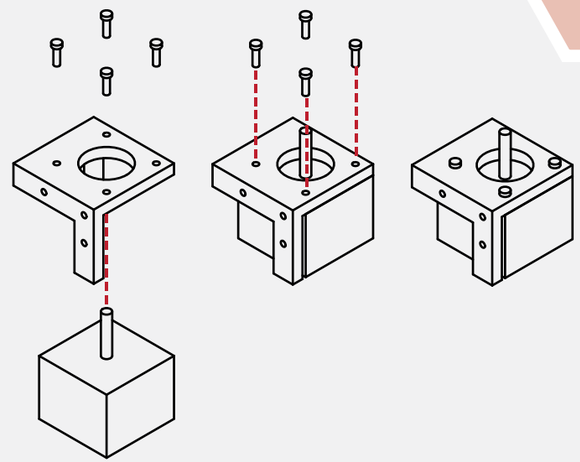
N/A

!

Alert: Left Front Z Motor Assembly

Collect the **Left Front Motor Mount, the second 34mm (short) stepper motor and 4 M3x10 cap screws.**

Repeat Steps 1-3 to complete the **Left Front Z Motor Assembly**

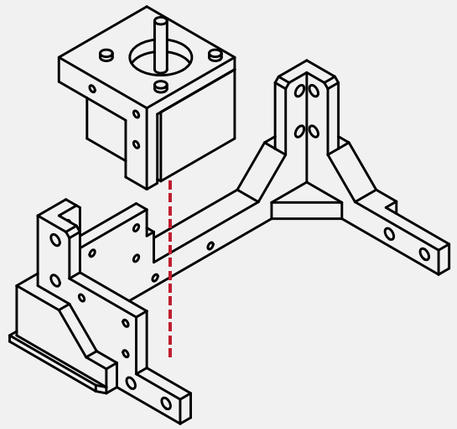


X 4 — **M3 x 10**

Lower Frame Assembly

B 2.2

1



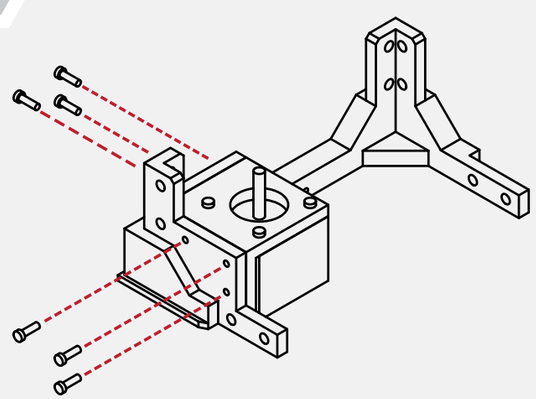
Locate the **lower left side frame**, and collect the left **Z motor assembly** completed in the previous steps.

Place the motor assembly into the lower left frame.

The screw holes on the motor assembly should match the screw holes in the lower left frame assembly.

N/A

2



From the hardware bag, collect **6 M3 X 10** screws.

Using your **M3 Hex wrench,** attach the motor assembly to the lower frame assembly**.**

X 6 **M3 x 10**

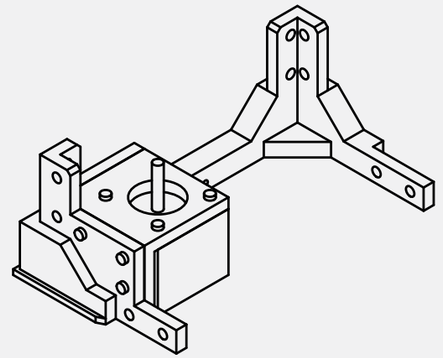
3

Congratulations, you've completed the left lower frame assembly.

Check the fit and ensure that all screws are tight.

Don't over tighten the screws, as this may strip the parts.

N/A



4

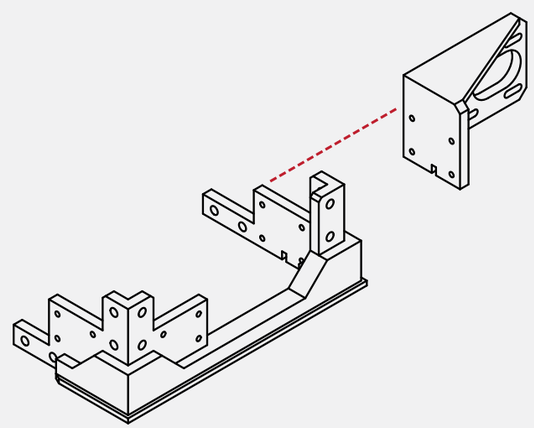
Locate the **Y axis motor mount** from your printed parts kit. This mount is longer than the similar X axis motor mount.

Also from your printed parts, locate the **lower right side frame.**

Check the fitment of both pieces before proceeding to the next step.

Note: The notch in the Y axis motor mount should align with the notch in the frame assembly.

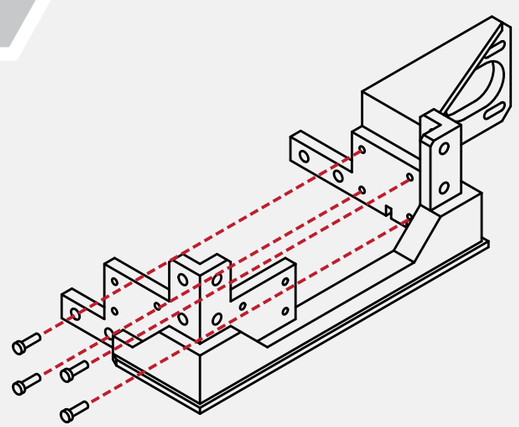
N/A



Lower Frame Assembly

B 2.2

5



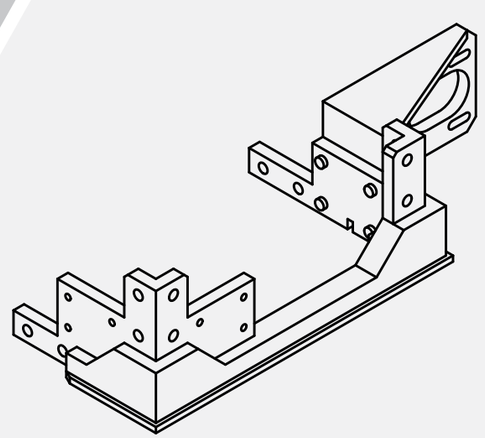
From the hardware bag, select **4 M3 X 10** screws.

Using the screws, attach the **Y axis motor mount** to the lower right side frame.

X 4

M3 x 10

6



The Y axis motor mount is now complete.

Check the fitment of the mount to the lower frame.

Ensure that the mount is tight to the frame and secure.

Do not over-tighten the screws holding the mount in place.

N/A

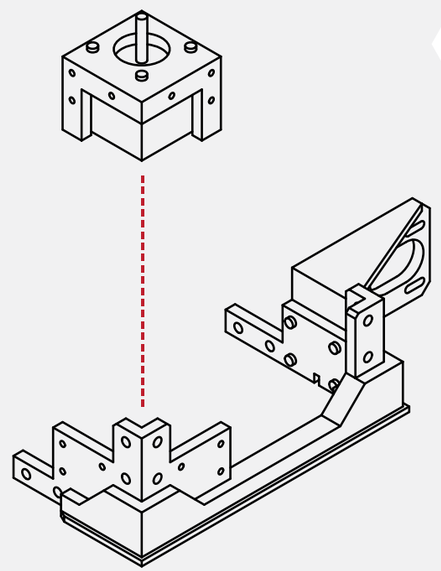
7

Locate the right **Z motor assembly** that was assembled in the previous steps.

Place the motor assembly into the lower right frame.

The screw holes on the motor assembly should match the screw holes in the lower right frame assembly.

N/A



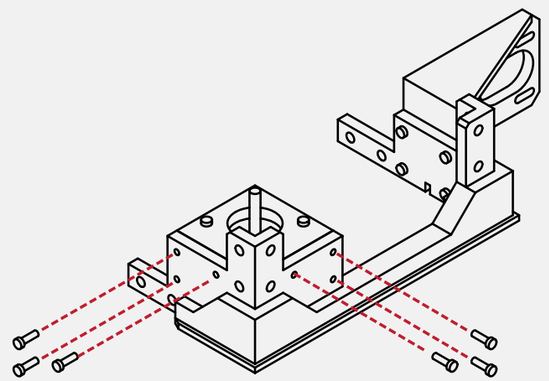
8

From the hardware bag, collect **6 M3 X 10** screws.

Using your **M3 Hex wrench,** attach the motor assembly to the lower frame assembly**.**

X 6

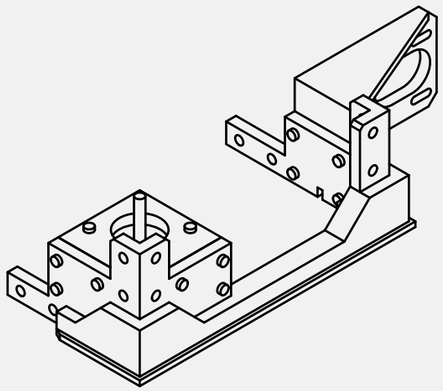
M3 x 10



Lower Frame Assembly

B 2.2

1



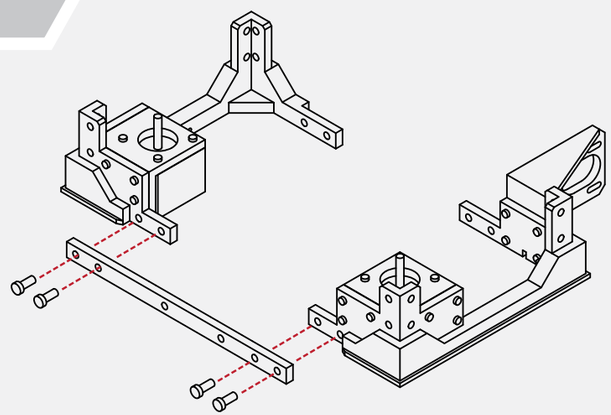
Congratulations, you've completed the right lower frame assembly.

Check the fit and ensure that all screws are tight.

Don't over tighten the screws, as this may strip the parts.

N/A

2



From the printed parts kit, locate the **front lower frame rail.** The front lower frame rail should be longer in length than the rear.

Take the **left and right lower frame assemblies** and match it to the lower front frame rail.

From the hardware bag select **4 M5 X 12** screws and using your **hex wrench** screw them through the lower front rail and into the left and right lower frame assemblies.

Check to make sure the pieces align and there are no gaps.

X 4 **M5 x 12**

3

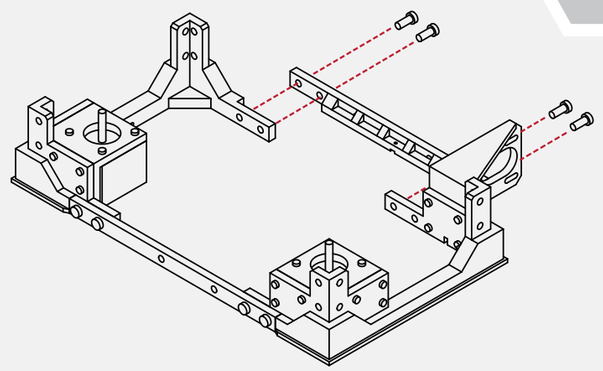
Similar to the previous step, select the **rear lower frame rail** from the parts kit. This rail is longer than the front lower rail.

Select **4 M5 X 12** screws from the hardware bag.

Like the previous step, take the screws and using your **hex wrench** attach the rear frame rail to the lower frame assemblies.

Ensure that the screws are tight and that there are no gaps or alignment issues with the pieces.

X 4 **M5 x 12**

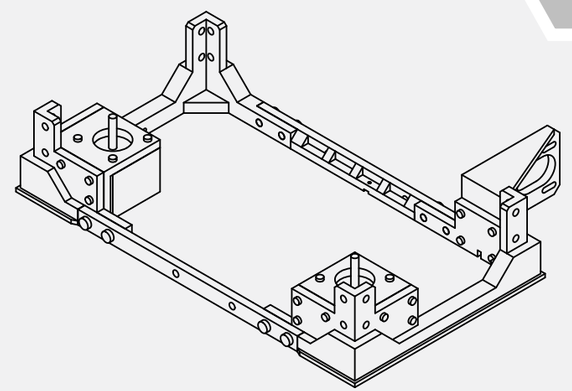


4

Congratulations! You've completed the lower frame assembly!

Take a break and marvel at your accomplishment.

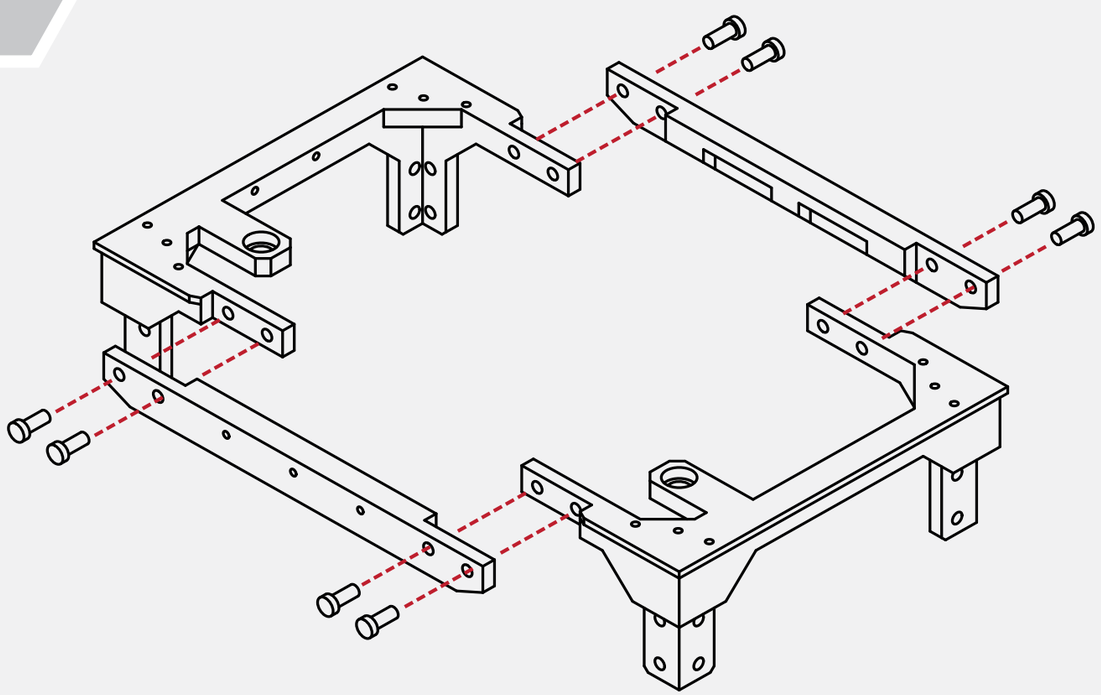
N/A



Upper Frame Assembly

B 2.3

1



The upper frame assembly is similar to the lower frame assembly. You will need to locate the **left and right upper frame assemblies, as well as the front and rear upper frame rails.**

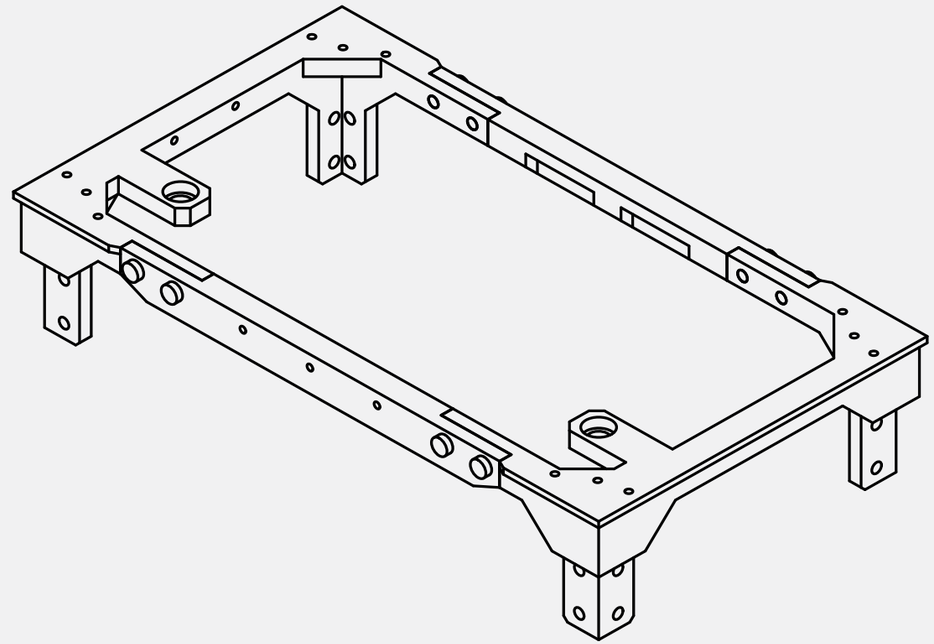
The front frame rail is easily identified by the 3 screw holes for the LCD panel. You will also need to collect **8 M5 X 12 screws** from the hardware bag.

Like the lower assembly, use your hex wrench to secure the upper frame rails to the upper frame assemblies.

X 8

M5 x 12

2



N/A

Congratulations! You've assembled the upper frame assembly! Wasn't that easy?

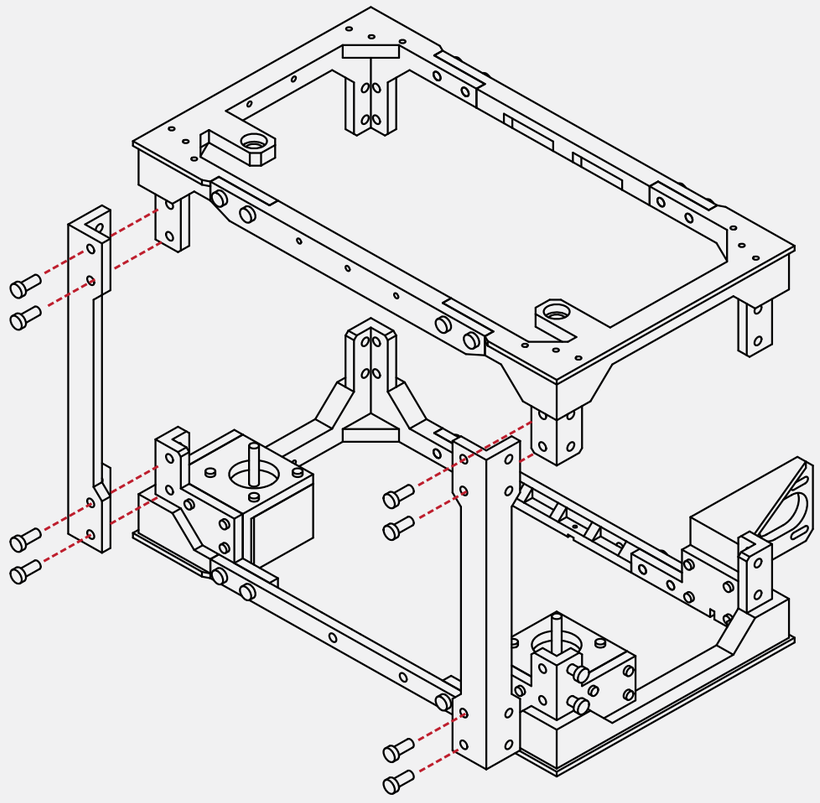
Take a moment to check that the frame appears square and that the frame rails are tight to the frame assemblies.

Ensure that the screws are not over-tightened as well.

Lower & Upper Frame Union

B 2.4

1



From the parts kit, select **2 of the main frame uprights**. These pieces are universal and can be fitted in any position.

Select **8 M5 X 12 screws** from your hardware bag as well.

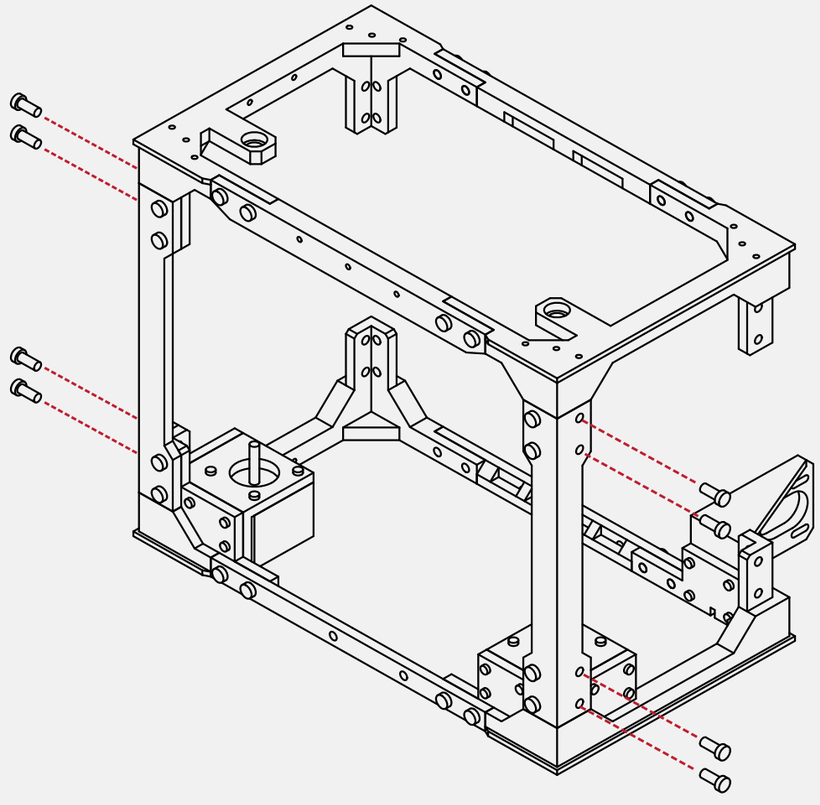
Using your **hex wrench,** install the screws into the frame uprights, and then into the lower and upper frame assembly.

It is best to assemble the lower frame before the upper frame assembly.

X 8

M5 x 12

2



X 8

M5 x 12

With the first uprights installed, from your hardware bag, select **8 additional M5 X 12 screws.**

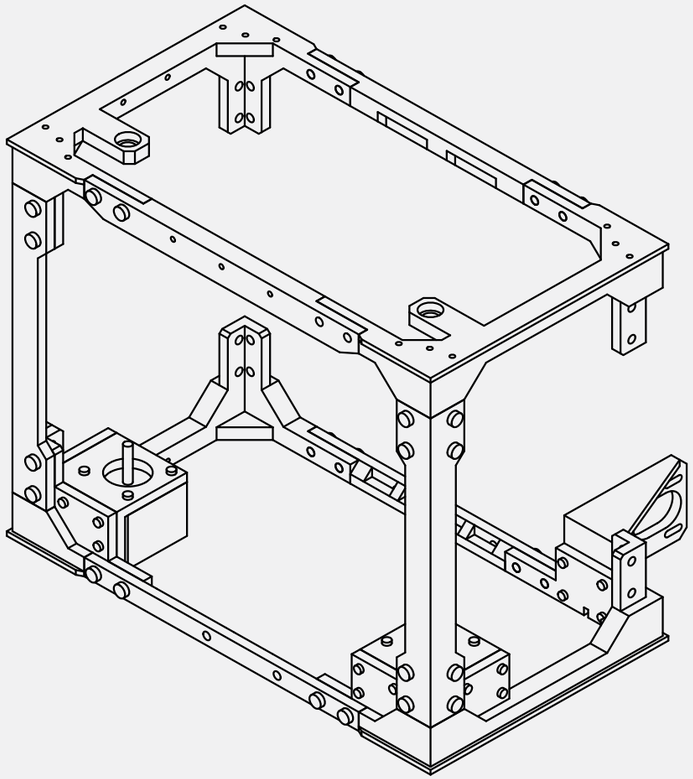
Using your **hex wrench**, install the screws into the uprights.

Ensure that the uprights are tight and aligned to the upper and lower frame assemblies.

Lower & Upper Frame Union

B 2.4

3

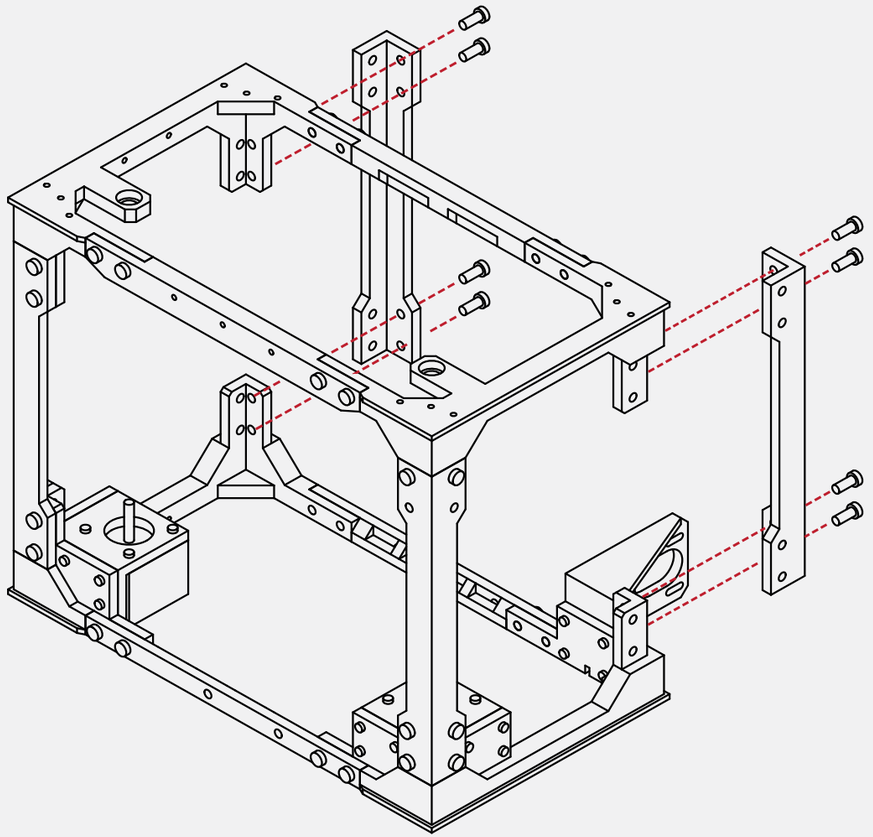


Congratulations! You've installed half of the frame!

We're almost done!

N/A

4



X 8

M5 x 12

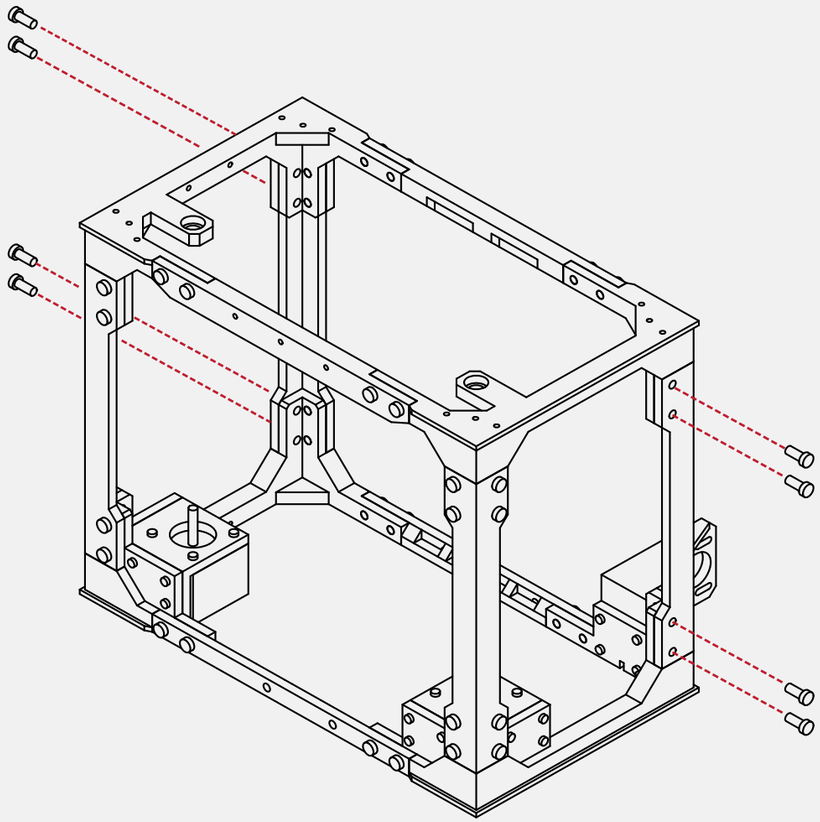
Like our previous step, select the **two remaining frame uprights** and check their fitment to the rest of the frame assembly.

Select **8 M5 X 12** screws from the hardware bag.

Using your **hex wrench**, attach the two uprights to the rear of the frame.

Lower & Upper Frame Union

5



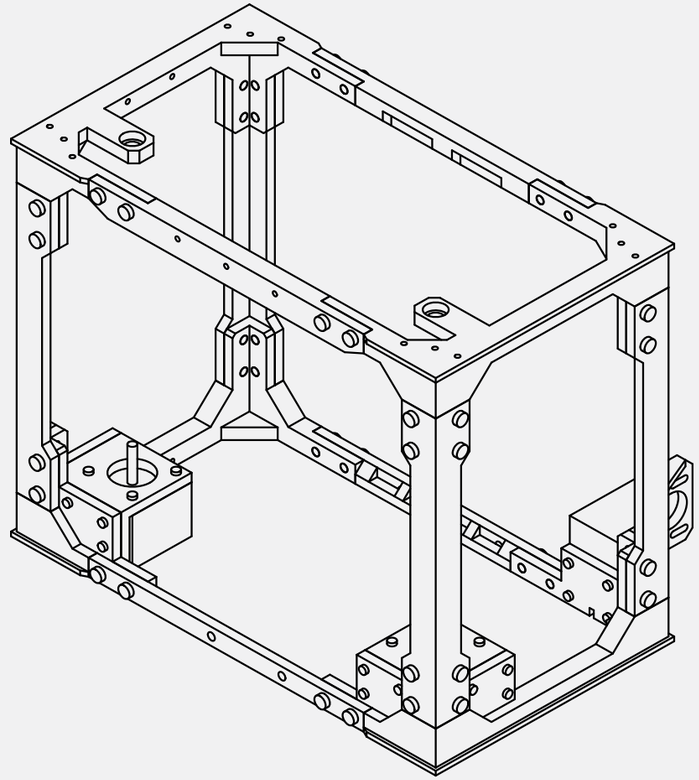
Select **8 additional M5 X12** screws from your hardware bag.

Using your **hex wrench**, install the remaining screws into the uprights and frame assemblies.

X 8

M5 x 12

6



N/A

Congratulations! You've completed the outside frame!

This frame makes up the structural elements of your printer, and is the building block for the remaining elements!

You've done an awesome job, and I'm sure it looks amazing!

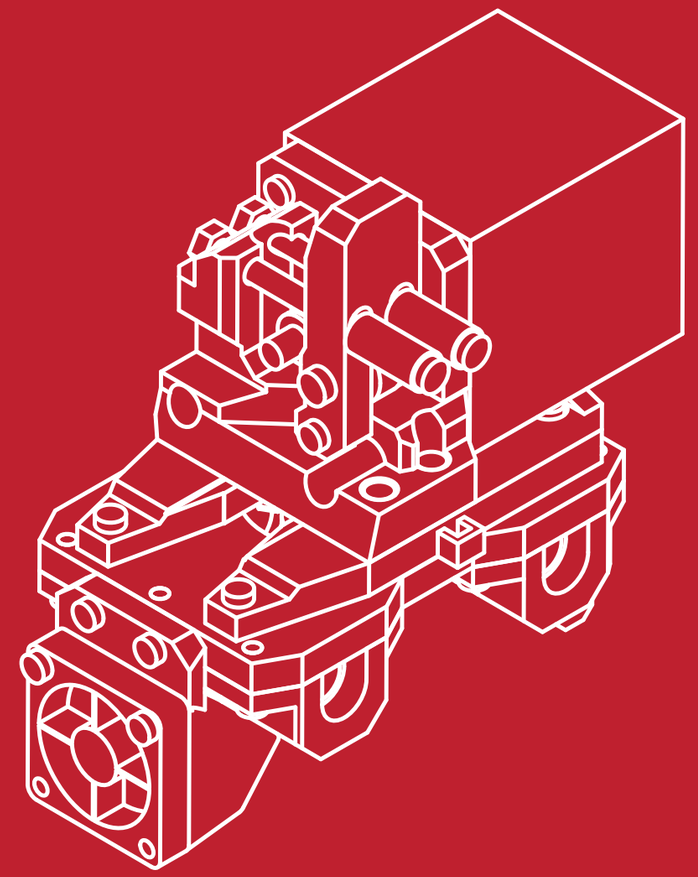
Take a moment to relax and marvel at your feat of engineering, we're going to be kicking it up a notch in the next chapter!

SECTION

C

Note: The extruder design shown here is of the latest revision. Some illustrations shown elsewhere in this manual may depict earlier releases.

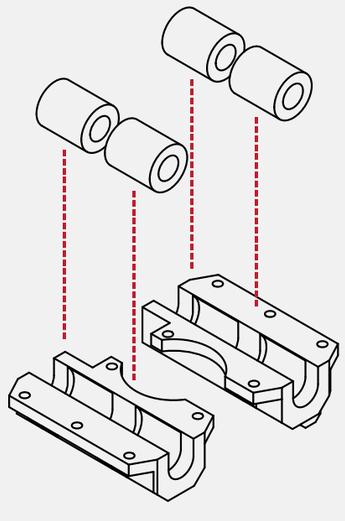
This does not affect the build process.



Extruder Assembly

3.1

1

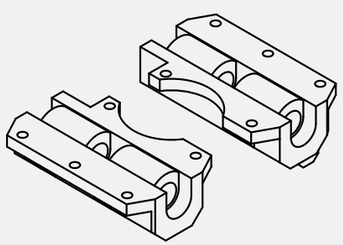


From the hardware kit, locate **4 LMS8UU linear bearings**, and the **2 lower extruder bearing carriers**. These can be identified by their semi circle cut outs.

Insert the bearings into the bearing carriers. Take care not to damage the bearings as they are inserted.

N/A

2

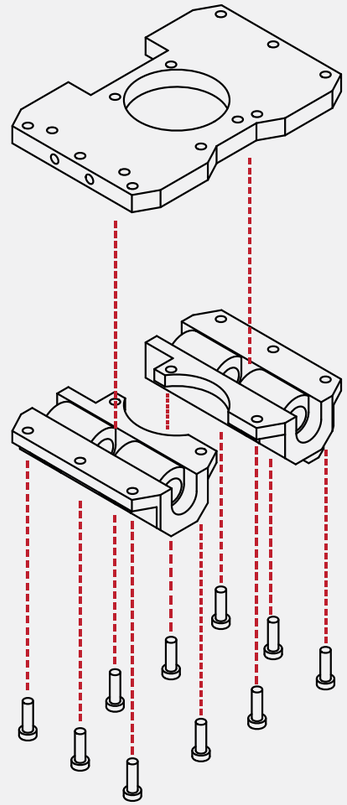


When fully inserted, the bearings shoul protrude slightly fom the carriers.

Ensure that the bearings are aligned, and fully seated before proceeding to the next step.

N/A

3



X 10

M3 x 10

Locate the **lower extruder base** from the hardware kits.

From the hardware bag, select **10 M3 X 10** screws.

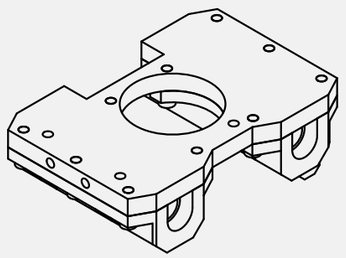
Align the lower bearing carriers with the extruder base. The semi circle cut-outs should align with the opening in the extruder base.

Using your **hex wrench**, install 5 of the screws into each of the bearing carriers, and into the extruder base.

Extruder Assembly

3.1

4

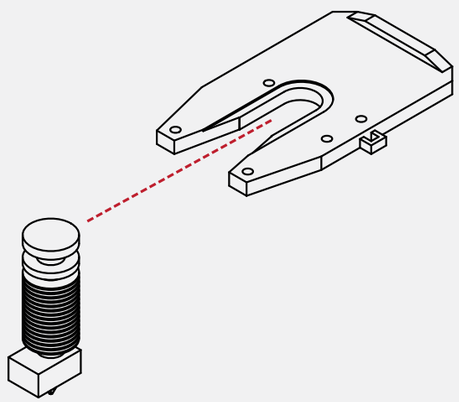


With the carriers mounted to the extruder base, check that the parts fit well and that there are no lose screws.

The bearings should be solidly captured and should not rattle or move once the pieces are assembled.

N/A

5



Locate your **hot-end** from the parts kit. We will be wiring and installing the remainder of its components later in this build.

Locate the **hot-end mounting plate** from your hardware kit as well.

Insert the hot-end into the mount.

The flange on the hot-end should seat snugly up against the lower mount.

N/A

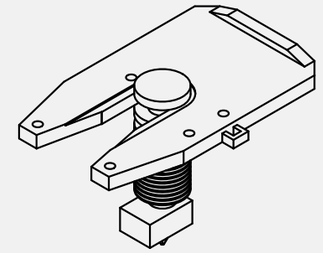
6

Check that there is not any excessive play in the mount.

If there is any play in the mount, use a small piece of tape on the mount to shim the hot-end.

If the play is excessive, contact us for a replacement or solution.

N/A



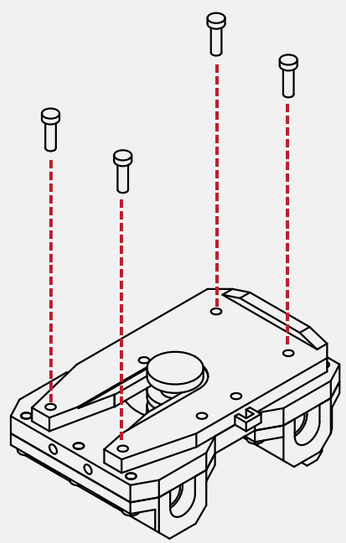
7

Select **4 M3 X 10** screws from your hardware set.

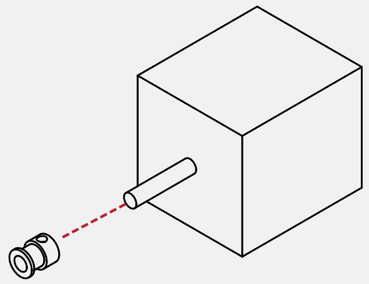
Install the screws into the hot-end mount, and into the extruder base.

Ensure that the mount is securely attached to the lower frame assembly.

X 4 M3 x 10



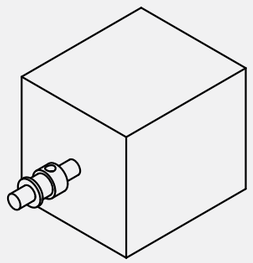
8



From the hardware kit, select one of the remaining **48mm stepper motors,** as well as the **MK8 extruder gear and the included grub screw**.

N/A

9



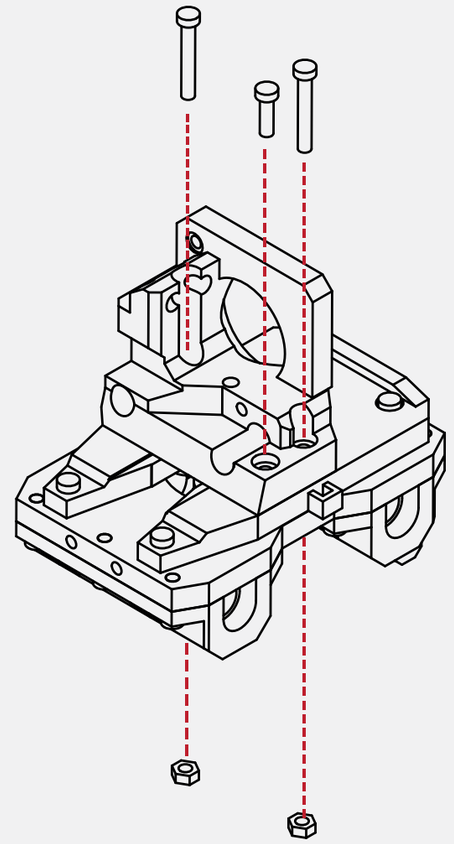
Place the extruder drive gear onto the shaft of the stepper motor.

Use the **small hex wrench** to slightly tighten the grub screw to hold the gear in place.

We will need to fine-tune the gear's location later in this guide, so do not tighten the screw completely.

N/A

9



X 1 — **M3 x 10**

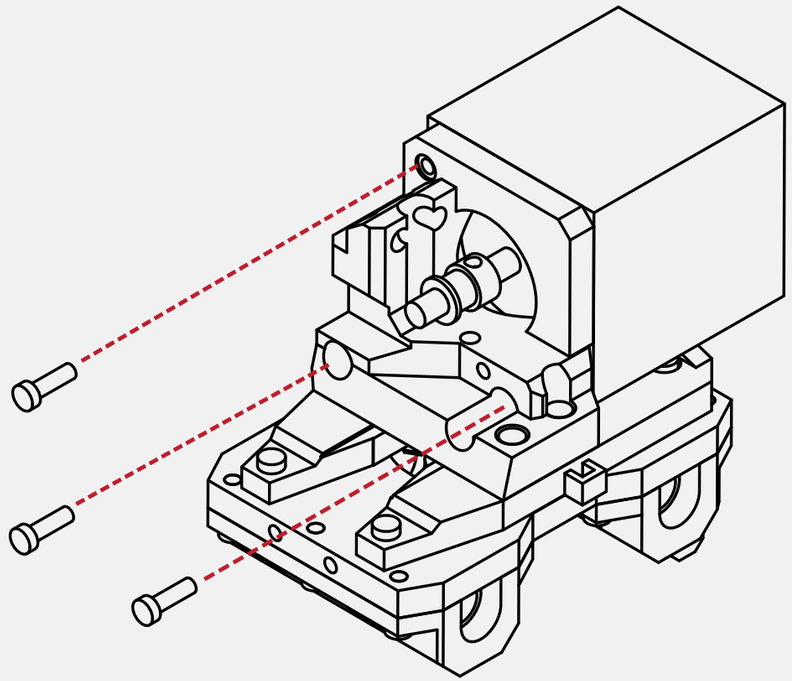
X 2 — **M3 x 20**

Locate the **upper extruder mount** from the hardware kit, **2 M3 X 20 screws, and 1 M3 X10 screw.**

You will also need **2 M3 Flat nuts**.

Attach the **extruder mount to the bas**e using the **2 M3 X 20 screws.** These screws should go all the way through the extruder assembly. Use the **M3 nuts to secure the screws to the underside of the assembly**. Insert the final **M3 X 10 screw** into the top of the extruder assembly.

10



Locate **3 M3 X 10 screws**

Locate the **extruder motor** assembled in the previous steps, as well as the **extruder assembly** assembled previously. **Using 3 M3 X 10 screws**, attach the extruder motor to the extruder assembly.

Ensure that the motor is flush with the assembly.

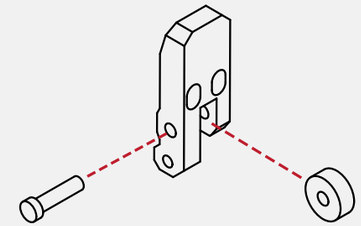
X 3 — **M3 x 10**

11

Locate the **extruder idler** from the printed parts kit as well as one **623ZZ bearing** from the hardware kit.

Insert the bearing into the idler and secure the bearing using 1 M4 X 16 screw.

Ensure that the bearing rotates freely and that there is no binding.



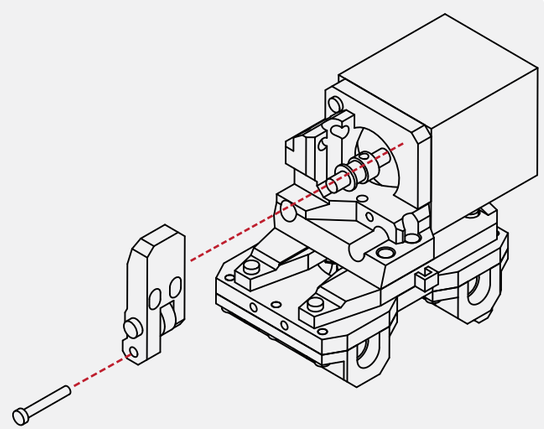
X 1 — **M4 x 16**

12

Gather the **extruder idler** as well as the **extruder assembly** completed earlier.

Using 1 M3 X 20 screw, attach the idler to the extruder assembly.

When attached, the idler should swivel freely on the assembly.

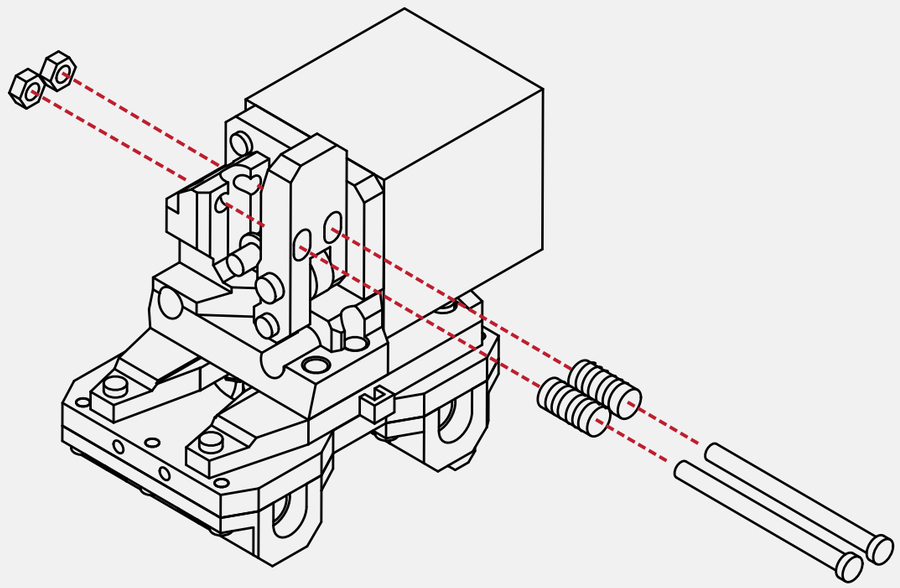


X 1 — **M3 x 20**

Extruder Assembly

3.1

13



Locate **2 M4 X 60 screws, along with 2 compression springs and 2 M4 nuts.**

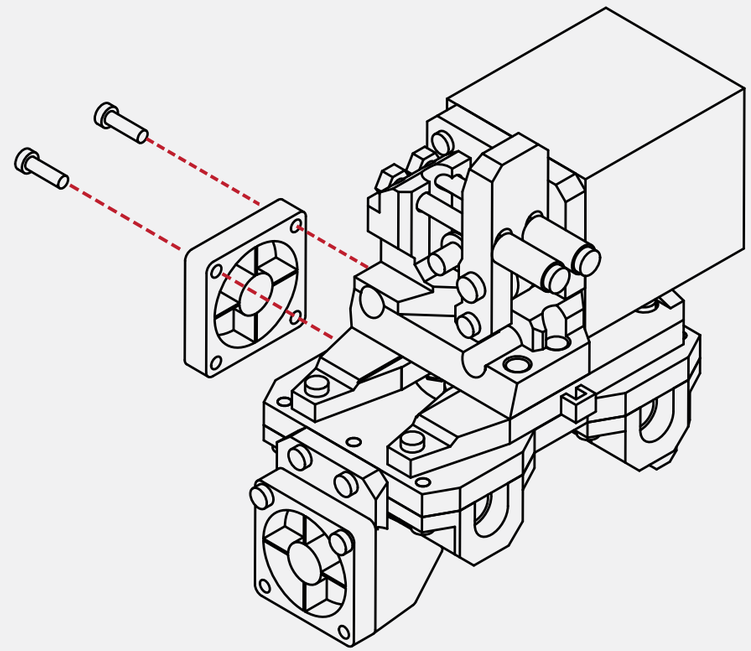
Insert the screws into the compression springs, and then insert these into the 2 openings on the idler.

Thread the screws into the extruder assembly and into the M4 nuts.

Tighten the screws until the springs are compressed, and that the idler is held firmly against the extruder gear.

X 2 — **M4 x 60**

15

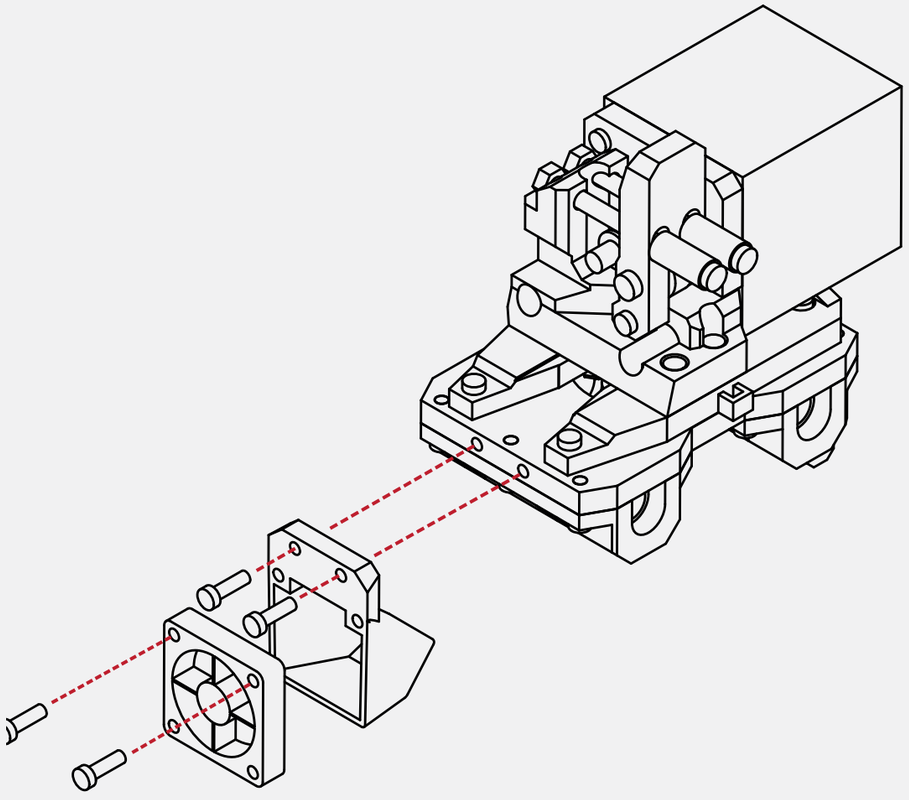


X 2 — **M3 x 16**

Select one of the **30mm cooling fans** from your parts kit, and **2 M3 X 16 screws.**

Using your **hex wrench**, attach the cooling fan to the side of the extruder assembly.

The cooling fan should sit flush with the extruder assembly.



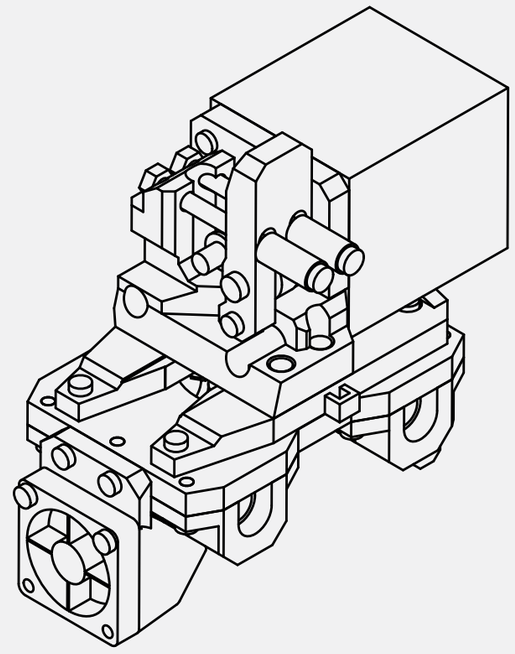
Select one of the **30mm cooling fans, and the fan duct** from your parts kit.

Select **2 M3 X 16 and 2 M3 X 10 screws** from your hardware kit as well.

Attach the cooling fan to the fan duct using the M3 X 16 screws, and attach the fan duct to the extruder assembly using the M3 X 10 screws. Depending on the thickness of your fan, you may need to add an additional washer between the shroud and fan to take up any slack.

X 2 M3 x 10

X 2 M3 x 16



N/A

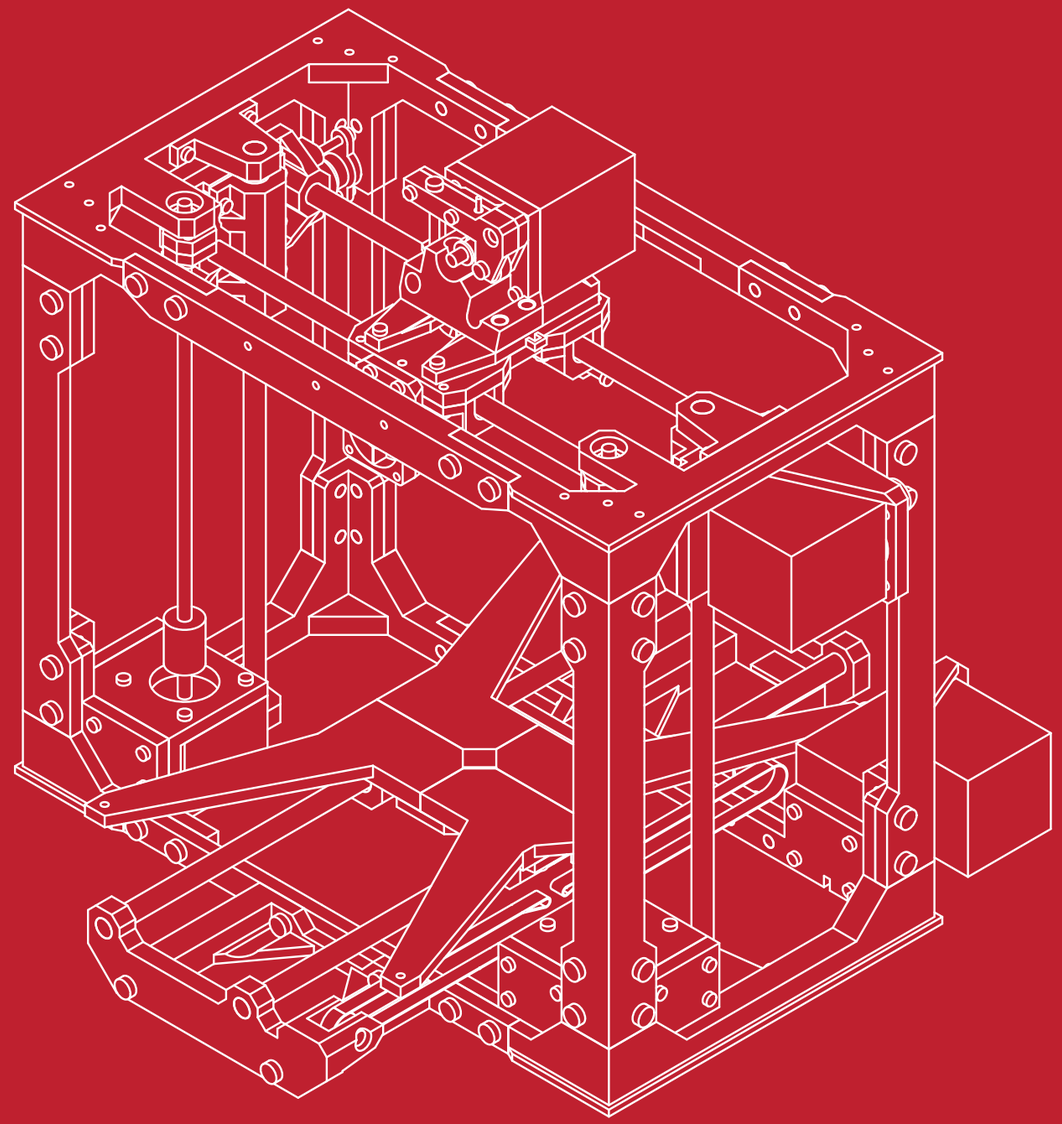
Congratulations, the extruder assembly is completed!

Check that all the components are secure and that the idler provides adequate compression against the extruder gear.

This can be adjusted later in the build process.

SECTION

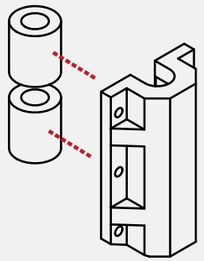
4



X Carriage Assembly

D 4.1

1



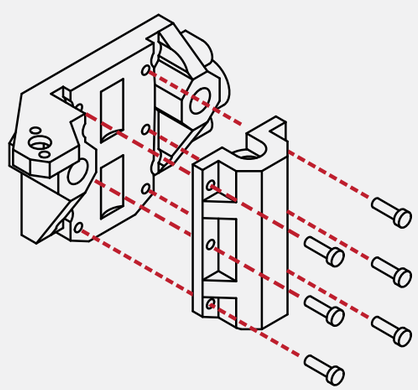
Locate the **Z Axis bearing holders** from your parts kit, and **2 linear bearings** from the hardware kits.

The Z axis bearing holders are identified by their 6 screw holes and slight chamfer on the leading edge.

Press the linear bearings into the bearing carrier and ensure that they are fully seated and aligned.

N/A

2



Fromy your parts kit, locate the **left X axis mount.** The left X axis mount is identifiable by its semi-circle idler mounts on the rear.

Press the bearings and bearing holders into the X axis mount.

Ensure that the bearings and bearing carrier are flush with the mount and insert the **6 M3 X 10 screws** to secure the bearing and holder in place.

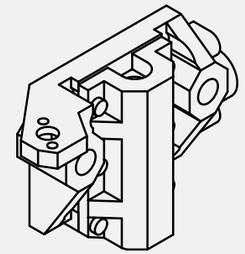
X 6 — **M3 x 10**

The left X axis mount is now complete.

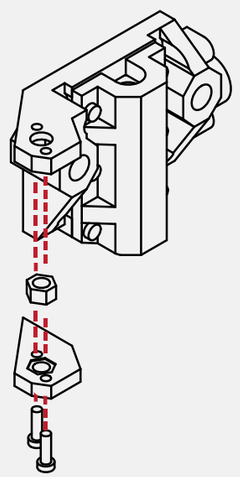
Check that the bearing holder is tight to the X axis mount.

N/A

3



4



Locate one of the **M4 nuts** from the hardware kit along with **2 M3 X 10 screws**, along with the **Z axis capture plate**.

Insert the nut into the X axis carriage.

Using your **hex wrench**, insert the screws into the capture plate, and then attach the plate to the X axis assembly.

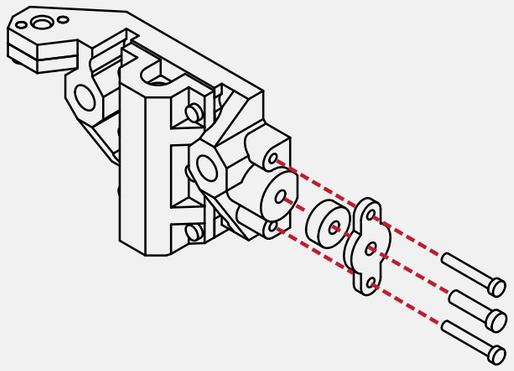
Take care not to damage the X axis mount or over tighten the screws.

X 2 — **M3 x 10**

X Carriage Assembly

D 4.1

5



Take the completed **X axis assembly** and locate the **idler bearing cover plate**, along with **1 idler bearing, 1 M4 X 16 and 2 M3 X 20 screws.**

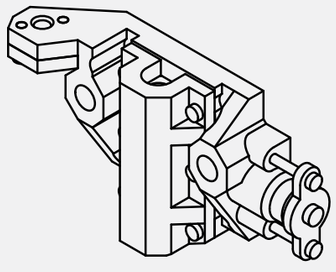
Insert the screws through the cover plate, and place the idler bearing onto the M4 screw.

Using your **hex wrench,** screw the assembly into the X axis assembly.

X 2 — **M3 x 20**

X 1 — **M4 x 16**

6



The left X assembly is now complete. Check that the idler bearing spins freely, and that all screws are tight and secure.

N/A

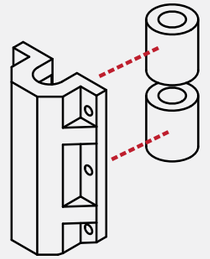
7

Locate the **Z Axis bearing holders** from your parts kit, and **2 linear bearings** from the hardware kits.

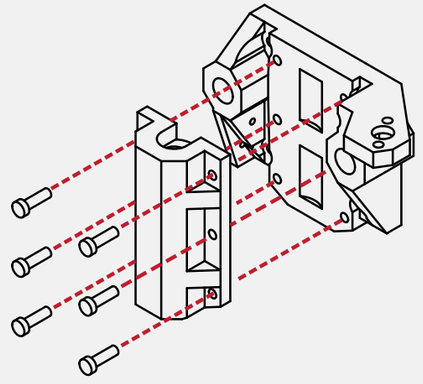
The Z axis bearing holders are identified by their 6 screw holes and slight chamfer on the leading edge.

Press the linear bearings into the bearing carrier and ensure that they are fully seated and aligned.

N/A



8



Fromy your parts kit, locate the **right X axis mount.** Ensure that the bearings and bearing carrier are flush with the mount and insert the **6 M3 X 10 screws** to secure the bearing and holder in place.

Locate one of the **M4 nuts** from the hardware kit along with **2 M3 X 10** screws, along with the **Z axis capture plate**.

Insert the nut into the X axis carriage.

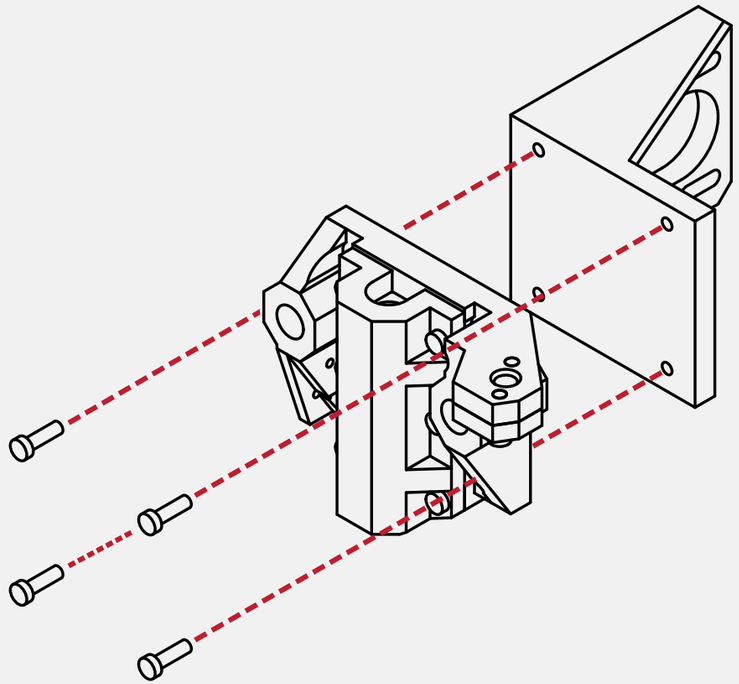
Using your **hex wrench**, insert the screws into the capture plate, and then attach the plate to the X axis assembly.

X 6 — **M3 x 10**

X Carriage Assembly

D 4.1

9



Locate the **X axis motor mount, and right X axis mount**. From your hardware kit, select **4 M3 X 10 screws**.

Align the X axis mount with the motor mount, and using your **hex wrench** install the 4 screws.

Ensure that the motor mount is flush and tight with the X axis mount.

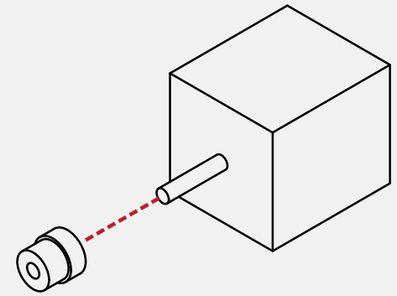
X 4

M3 x 10

10

From the hardware kit, select one of the remaining **48mm stepper motors,** as well as the **GT2 Pulley**.

N/A



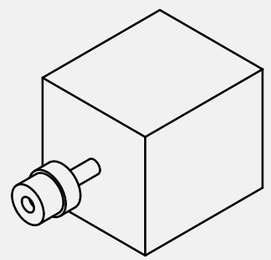
11

Place the **GT2 Pulley** onto the shaft of the stepper motor.

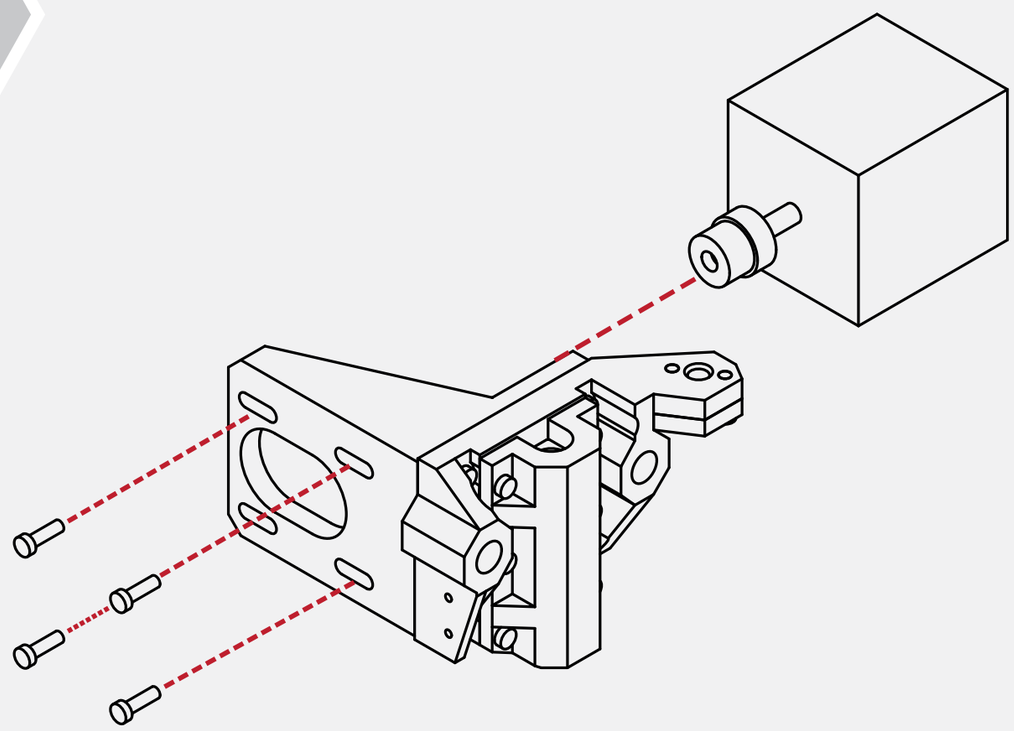
Use the **small hex wrench** to slightly tighten the grub screw to hold the gear in place.

We will need to fine-tune the pulley's location later in this guide, so do not tighten the screw completely.

N/A



12



From your hardeare kit, locate **4 M3 X 10 screws**, and gather the **stepper motor and X axis assembly** from the previous steps.

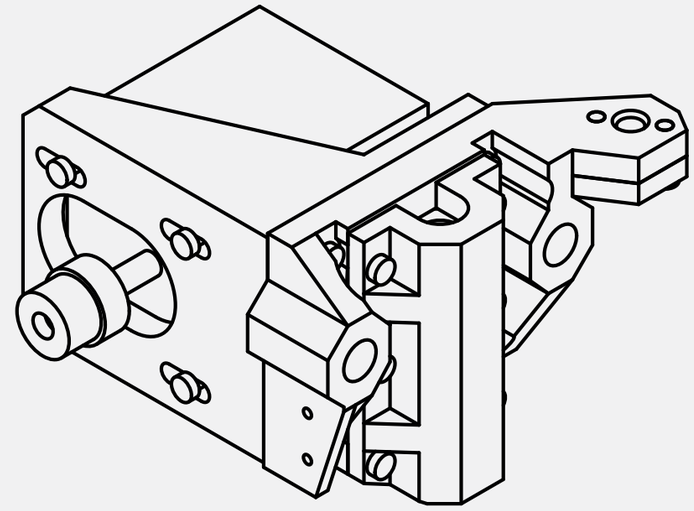
Insert the stepper motor into the motor mount. Ensure that the cable connector on the motor is facing upwards.

Using your **hex wrench**, insert the 4 M3 X 10 screws into the motor mount and into the stepper motor. We will be adjusting the motor tension later in this guide, so there is no need to completely tighten the screws.

X 4

M3 x 10

13



N/A

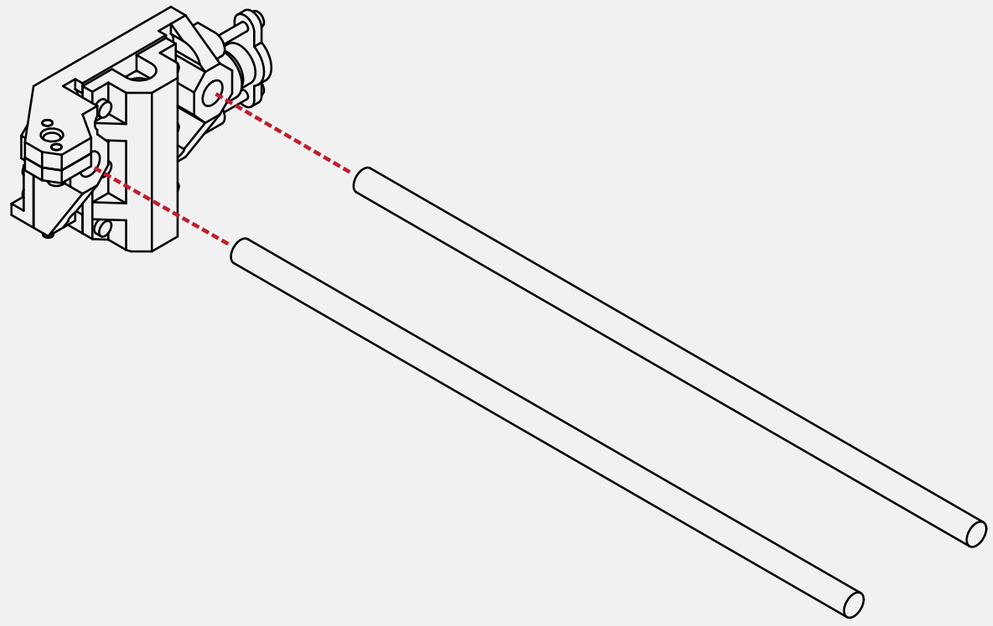
Congratulations! You've completed the X motor assembly.

Take a moment to ensure that all the scews and parts fit correctly and are tight.

X Carriage Assembly

D 4.1

14



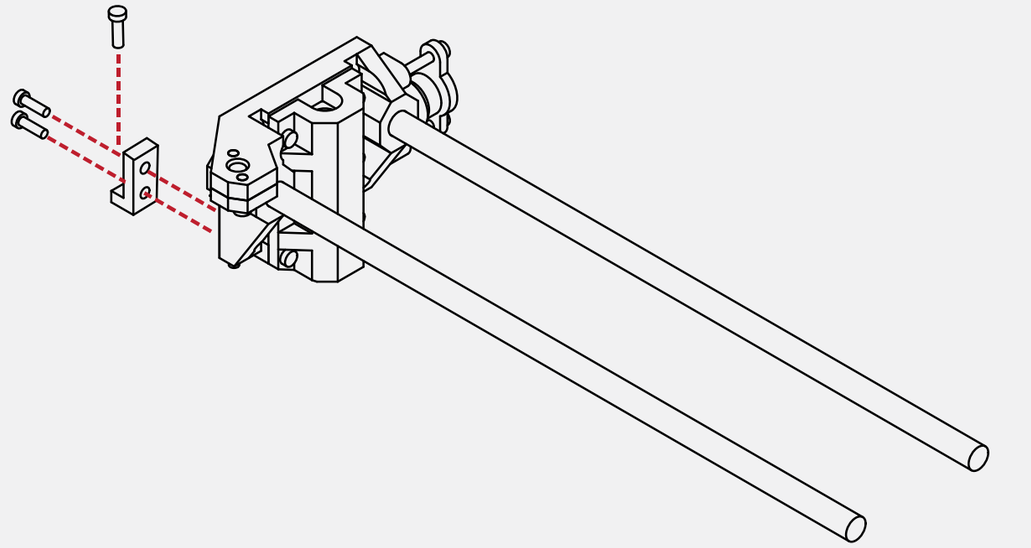
Locate the left **X assembly** from the previous steps as well as **2 250mm linear rod**.

These rods are the same length as the rods used for the Z axis, but shorter than those used for the Y axis. Using a soft mallet, gently drive the rods into the X assembly.

Take care to ensure the rods are inserted square to the assembly and that you do not damage the X axis assembly. When fully inserted, the rods should rest against the small openings on the backside of the X axis assembly.

N/A

15



X 2 — **M3 x 10**

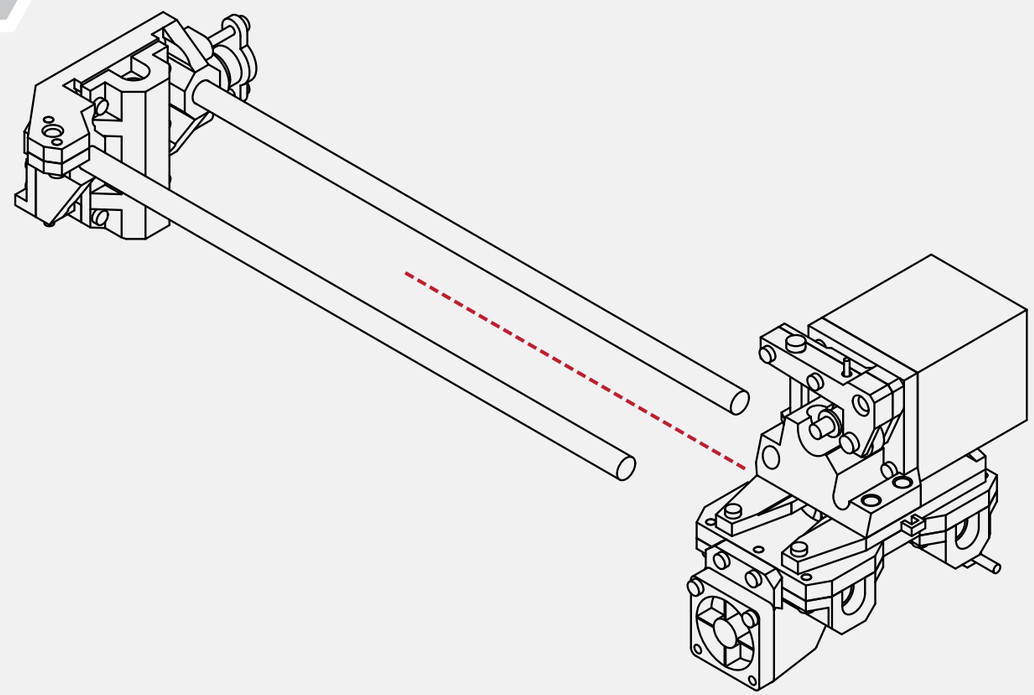
X 1 — **M3 x 20**

Locate the **Z Axis screw mount** from your parts kit, along with **2 M3 X 10**, and **1 M3 X 20 screws**.

Using your **hex wrench**, attach the Z axis screw mount to the outside of the X axis assembly.

Take the remaining **M3 X 20 screw** and screw it partially through the mount. This will be used to level your initial layer height later on.

16



Locate the **Extruder assembly** that we assembled earlier in this guide.

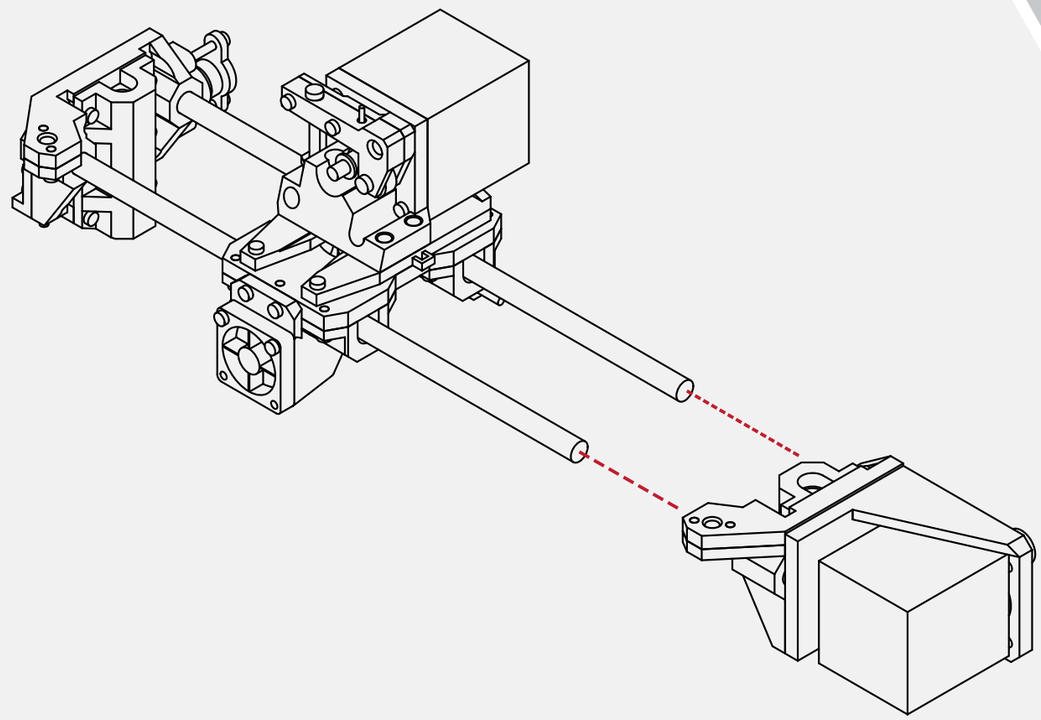
Orientate the extruder so that the hot-end cooling fan is facing the X axis assembly.

Carefully slide the extruder assembly onto the linear rods.

Be careful when doing so, as it is easy to mis-align the rods, and damage the bearings.

N/A

17



N/A

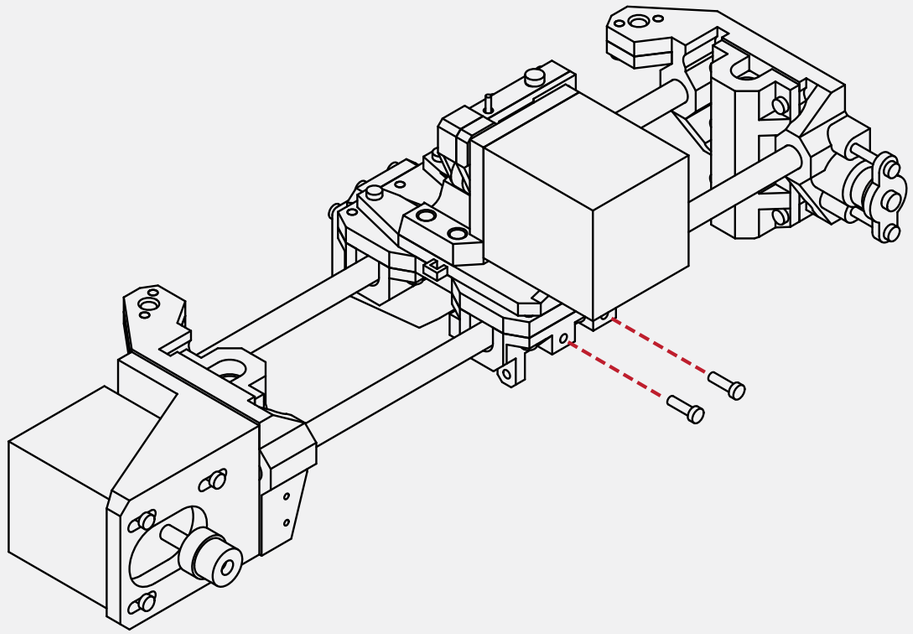
With the extruder assembly in place, collect the right **X axis assembly** that we assembled earlier.

Using a soft mallet, gently insert the X axis assembly onto the linear rods.

Take care not to damage the X assembly or linear rods.

If you find it particularily difficult, you can remove the 4 screws holding the motor assembly, and use the back-side of X axis to hammer against directly. The linear rods should be flush with the backside of the X axis assembly.

18



From your hardware kit, select **2 M3 X 10 screws**.

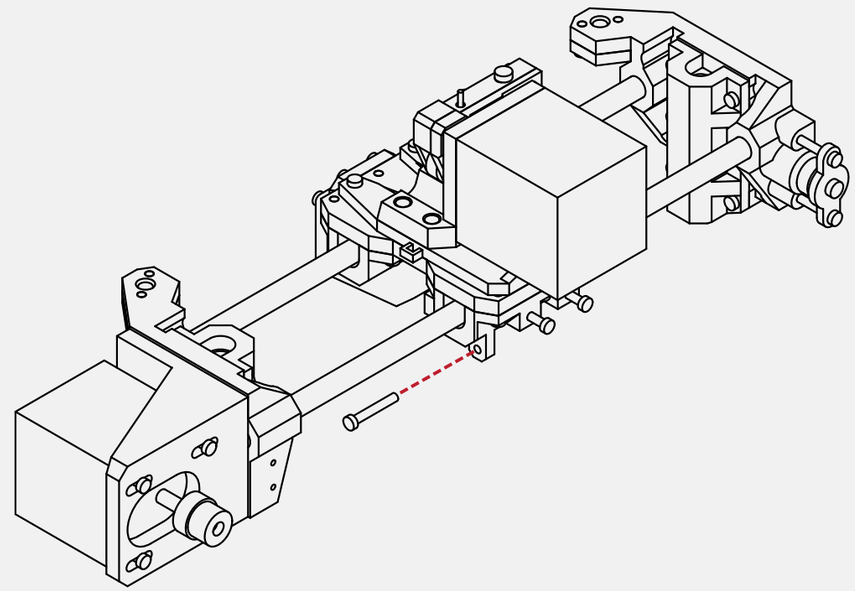
Using your hex **wrench,** insert the screws into the backside of the extruder assembly.

The screws should sit roughly 6mm proud of the extruder assembly. These will be used later in this guide to secure the GT2 belts.

X 2

M3 x 10

19



X 1

M3 x 20

Locate **1 M3 X 20 screw** from your hardware kit.

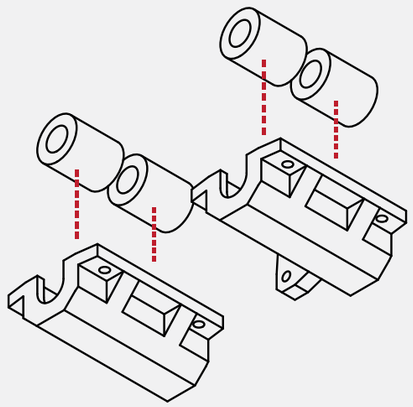
Using your **hex wrench**, insert the screw partially into the extruder assembly.

This screw will be used later to adjust your X axis end-stop.

Y Carriage Assembly

D 4.2

1



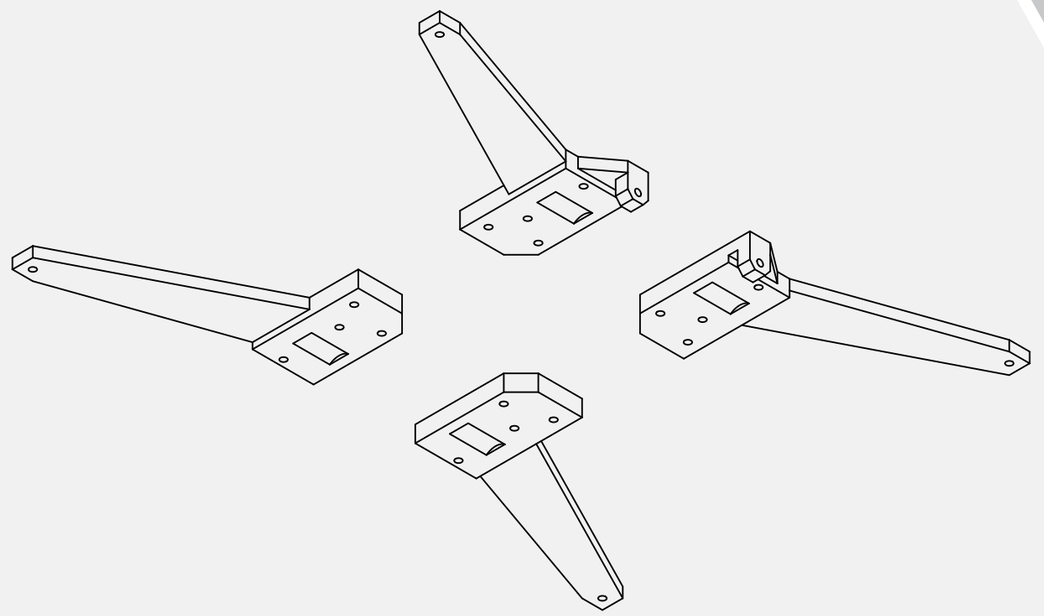
Locate the **lower Y bearing carriers**, and **4 linear bearings** from your parts kit.

Insert the bearings into the bearing carriers.

Ensure that the bearings are fully seated before proceeding.

N/A

2



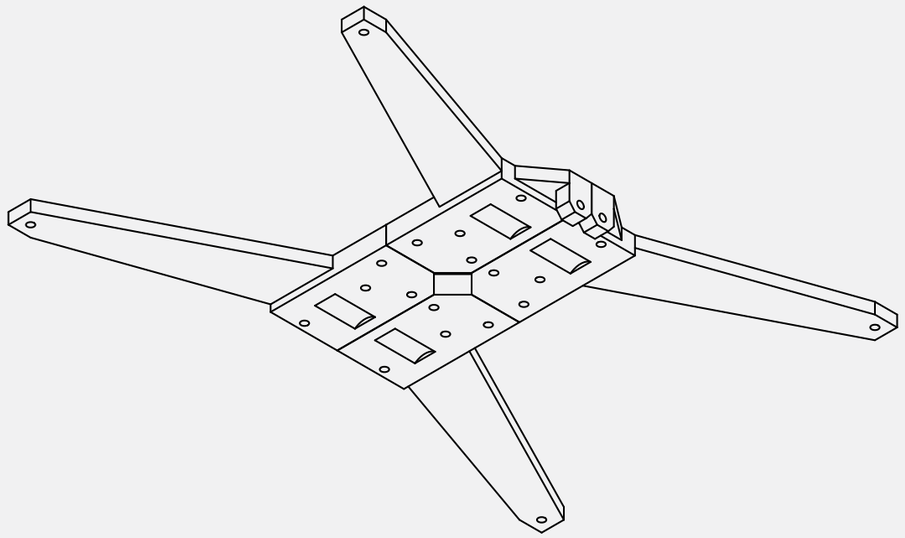
N/A

Gather the **4 lower Y bed** pieces from your parts kit and arrange them like so.

Y Carriage Assembly

D 4.2

3



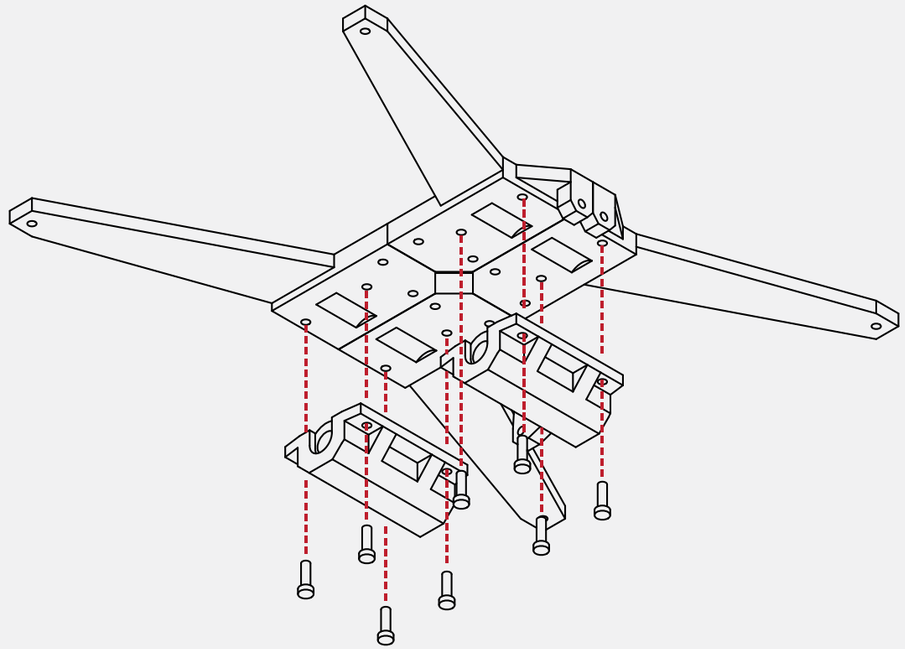
Arrange the lower Y bed pieces such that the indentations for the bearings align.

Ensure that the pieces fit well.

You may use a sharp Exacto-knife or file to trim any parts that do not fit well.

N/A

4



X 8

M3 x 10

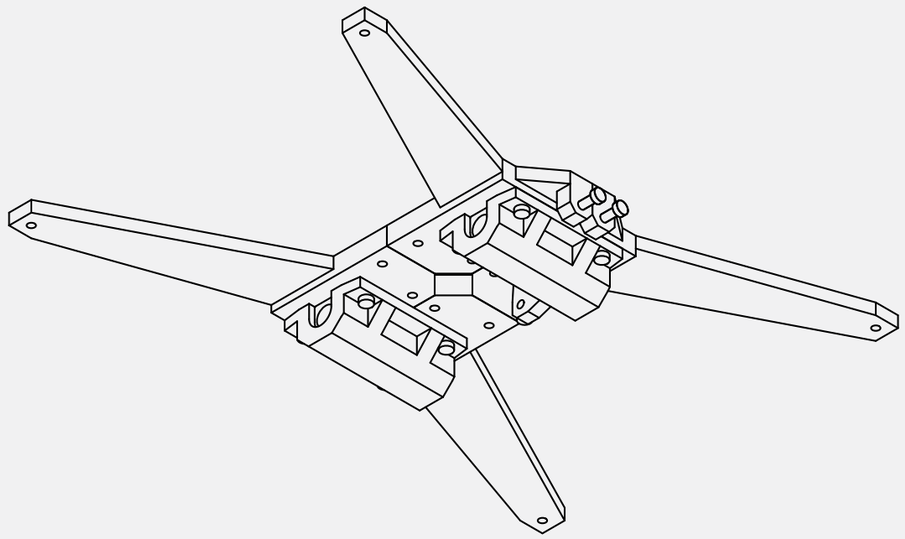
From your hardware kit, locate **8 M3 X 10 screws**. Gather the bearing carriers that were assembled previously.

Using your **hex wrench**, install the 8 screws into the bearing carriers, and then into the Y bed frame components.

Y Carriage Assembly

D 4.2

5

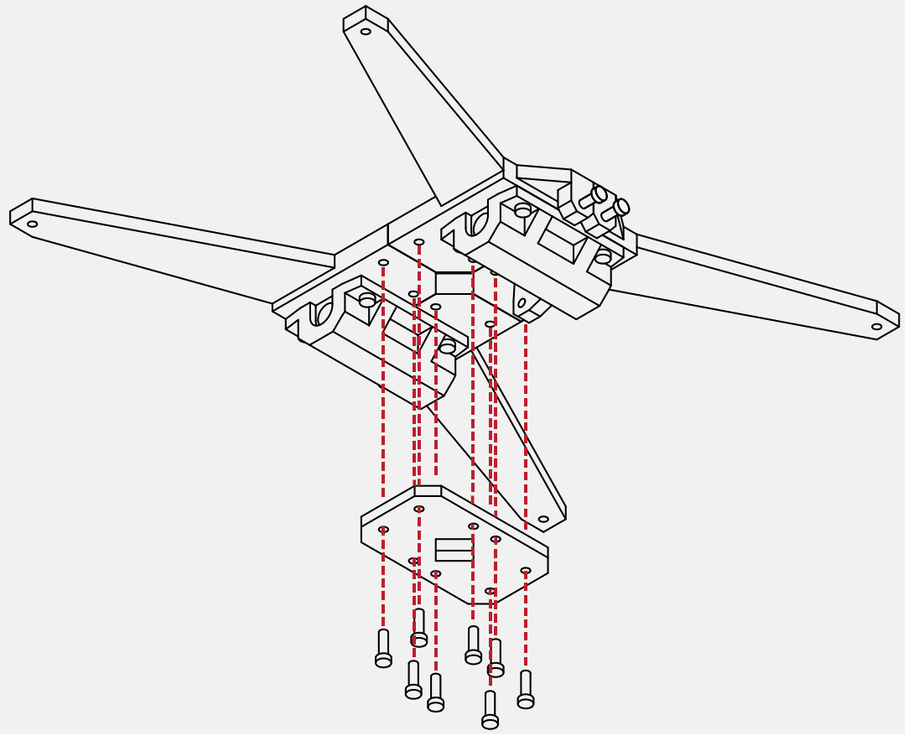


Ensure that all parts fit correctly and that all screws are tight.

The bearings should be firmly captured in their carriers and should have little play in them.

N/A

6



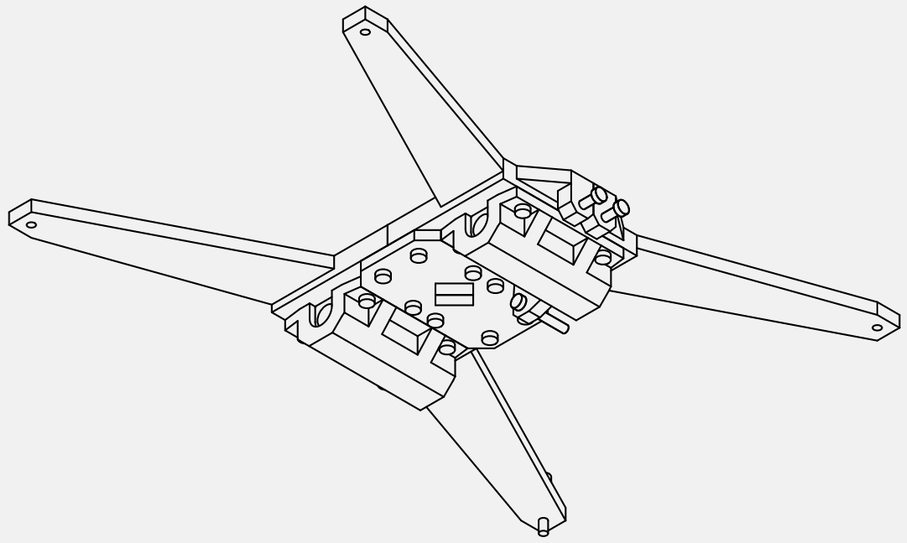
X 8

M3 x 10

Locate the **Y bed cross member** from your parts kit, along with **8 M3 X 10 screws**.

Using your **hex wrench**, install the screws into the cross member, and then into the lower bed assembly.

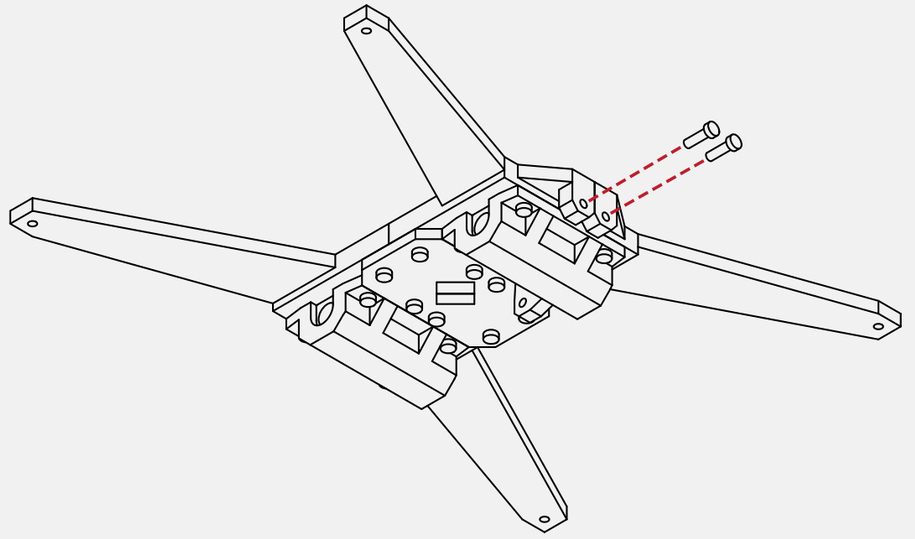
7



With the cross member installed, ensure that all parts fit well and that all screws are tight.

N/A

8



X 2

M3 x 10

Locate **2 M3 X 10 screws** from your hardware kit.

Insert the screws into the 2 mounting points on the side of the lower bed.

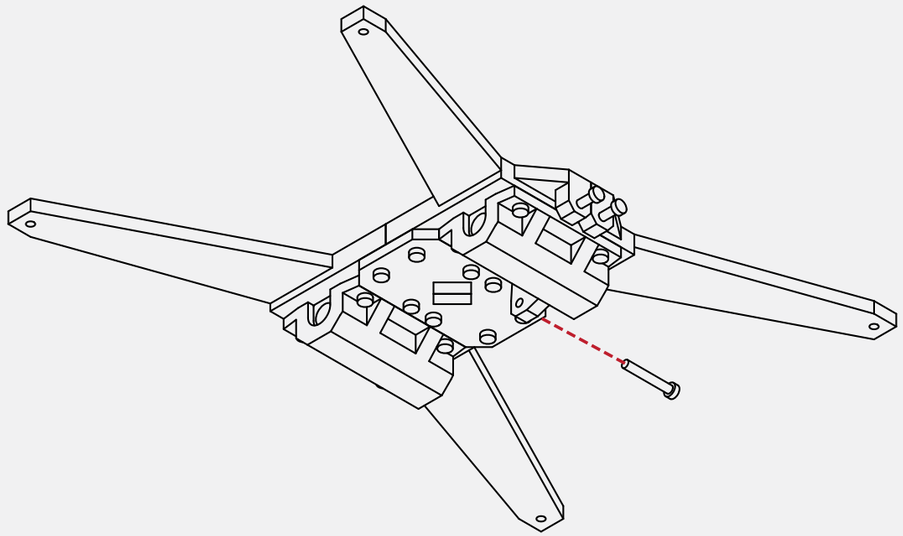
The screws should sit 6mm proud of the mount.

These screws will be used to secure the GT2 belt to later in this guide.

Y Carriage Assembly

D 4.2

7



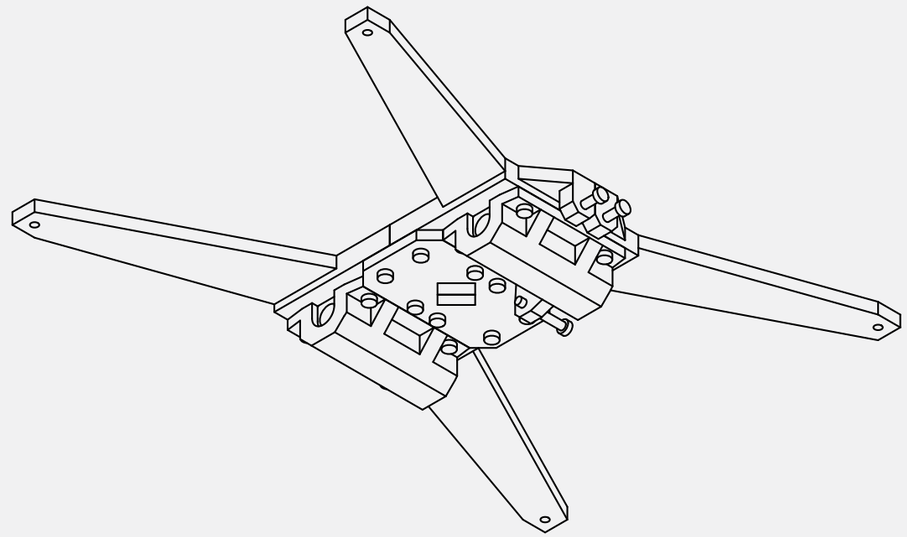
Locate 1 **M3 X 20 screw** from your hardware kit and install it into the screw mount on the rear of the lower bed assembly.

This screw will be used to home the bed later in your configuration.

X 1

M3 x 20

8



N/A

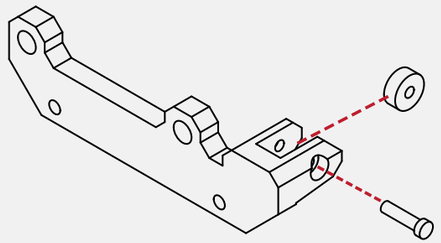
Congratulations! The lower bed assembly is complete!

Double check that all the fasteners are tight and that all the parts are properly aligned.

Y Carriage Assembly

D 4.2

9



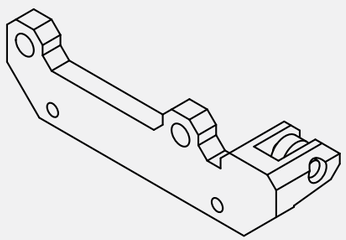
From your parts kit, locate the front Y axis carrier. Locate **1 bearing and 1 M4 X 16 screw** from your hardware kit.

Insert the bearing into the bearing holder, and using youe **hex wrench**, insert the screw into the bearing holder and bearing.

X 1

M4 x 16

10

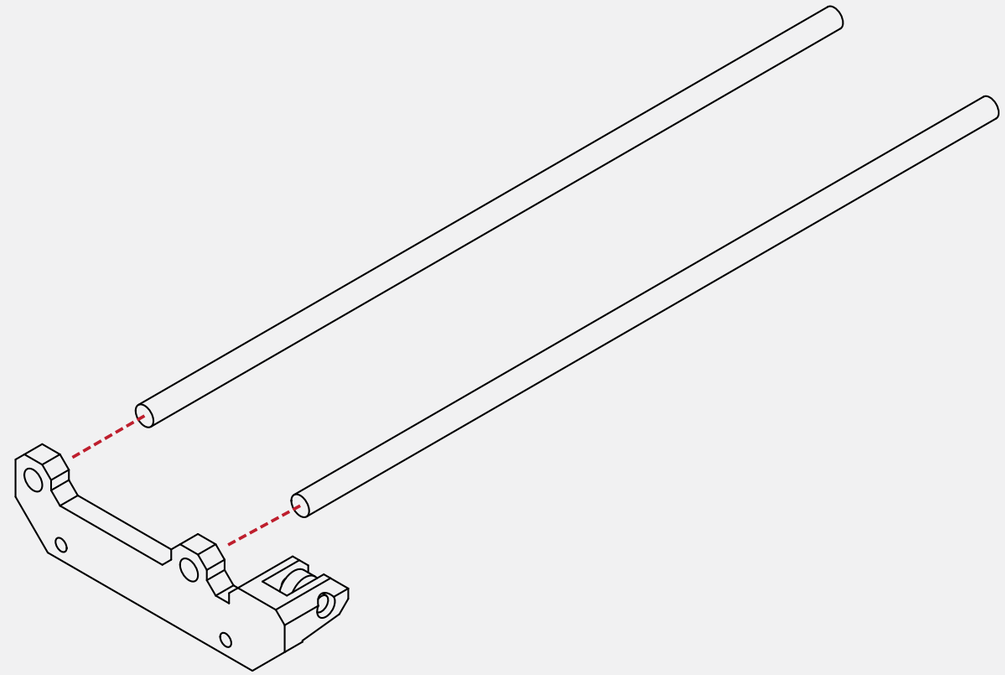


Ensure that the bearing can rotate freely in its holder.

This bearing will act as the idler for the GT2 belt which will be installed later in this guide.

N/A

11



N/A

Locate the **longest linear rods** from your hardware kit.

Using a soft mallet, gently insert the linear rails into the Y axis carrier.

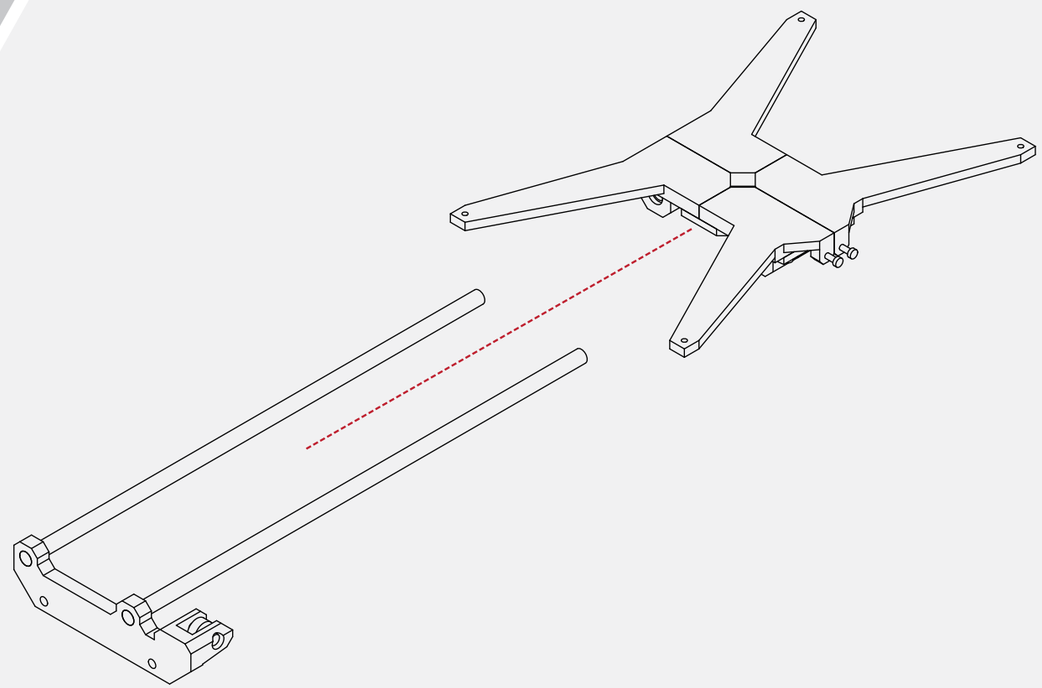
Take care to ensure the rods are square and that the carrier is not damaged.

When fully inserted, the face of the rods should be flush with the face of the carrier.

Y Carriage Assembly

D
4.2

12



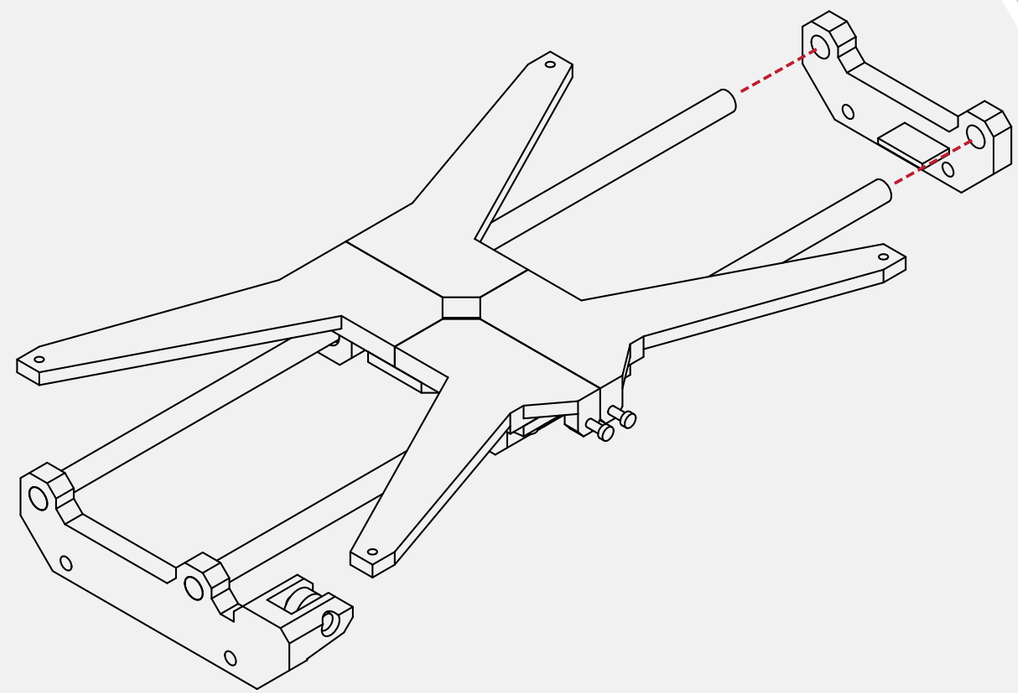
Take the **lower Y bed** from the previous steps and carefully insert the **lower Y carriage** assembly.

Take care when guiding the linear rods through the bearings.

The bearings can easily be damaged if the rods are mis-aligned or excessive force is used when inserting them into the bearings.

N/A

13



N/A

Locate the **rear Y carrier** from your parts kit.

Using a soft mallet, gently insert the carrier onto the existing assembly.

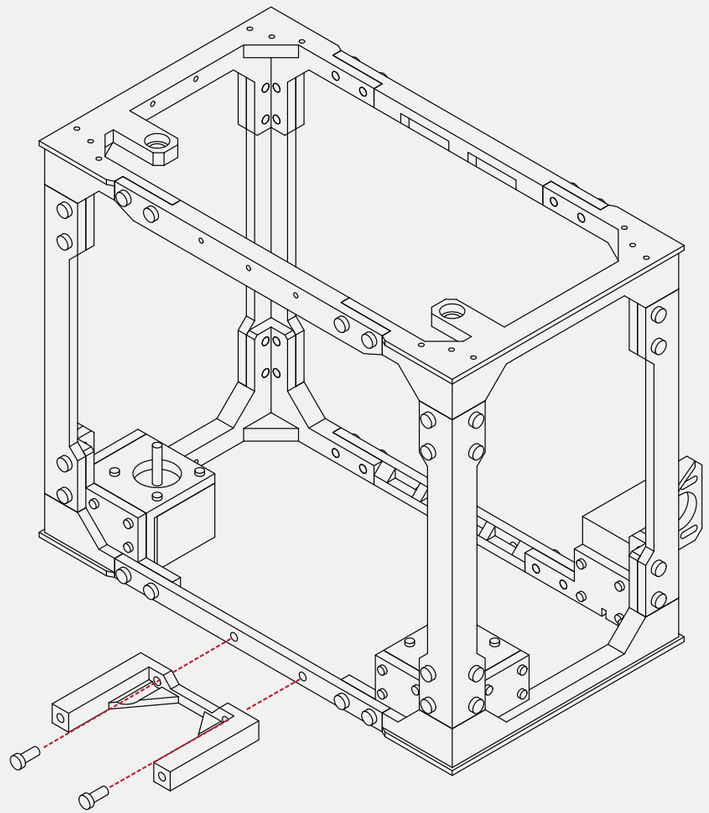
Take care to not damage the rear carrier.

When fully inserted, the faces of the linear rods should be flush with the face of the rear carrier.

Print Bed Installation

D 4.3

1



Take the **front Y axis mount** from your parts kit, and gather **2 M5 X 12 screws**.

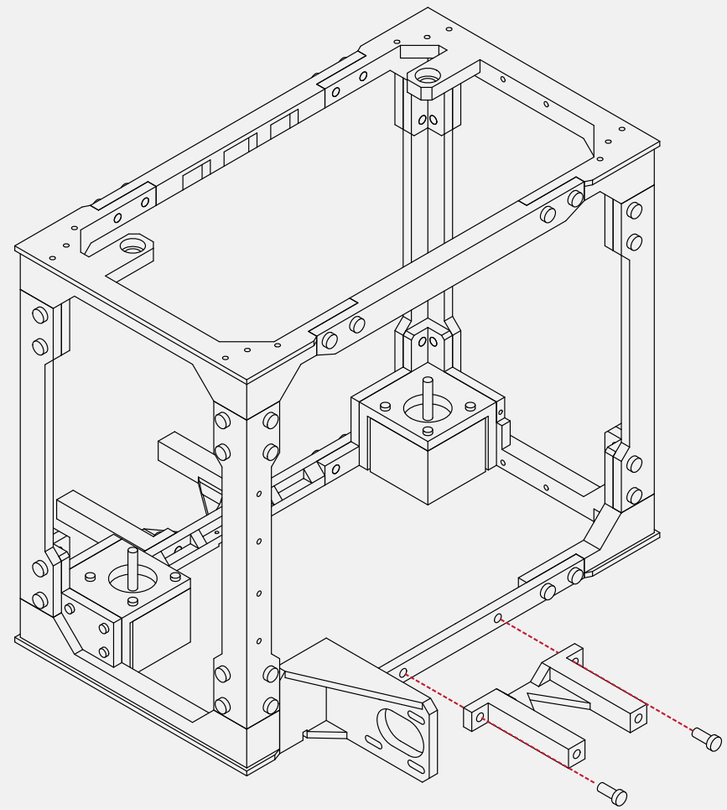
Using your **hex wrench,** attach the Y axis mount to the front frame of the printer.

Ensure that the screws are tight and that the parts fit correctly.

X 2

M5 x 12

2



X 2

M5 x 12

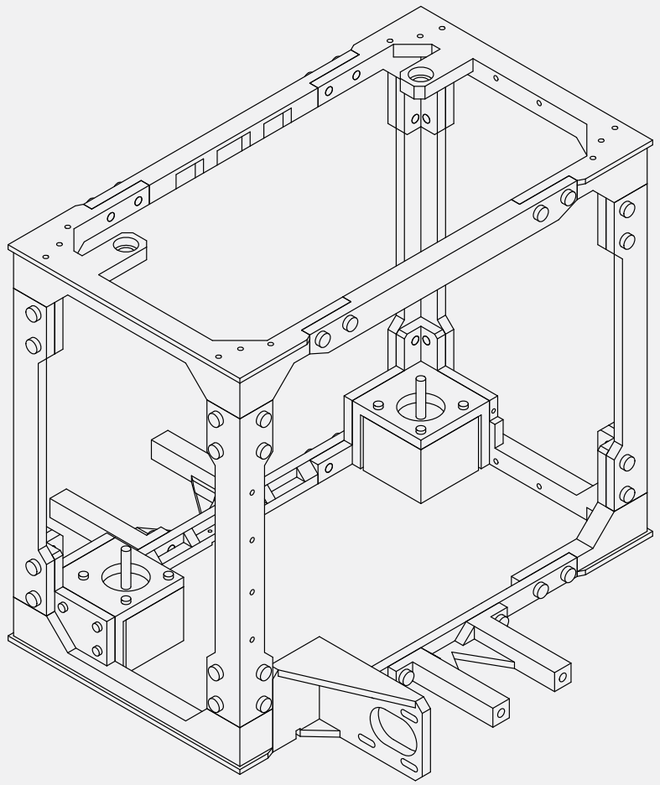
Repeat the same procedure for the rear, using the **rear Y axis mount** and **2 M5 X 12 screws**.

Ensure that the part is tight to the frame and that both screws are tight.

Print Bed Installation

D 4.3

3

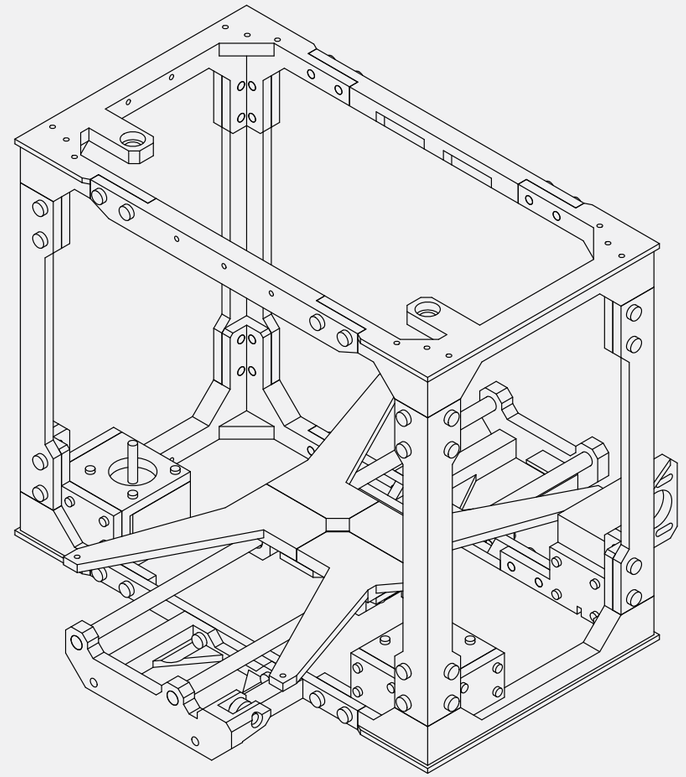


Congratulations, the front and rear Y axis mounts are installed.

Before proceeding, double check that all connections are tight and that the parts fit correctly.

N/A

4



N/A

Locate the **lower bed assembly** that we completed earlier in this guide.

Insert the lower bed assembly into the frame of the printer, and over top of the Y axis mounts.

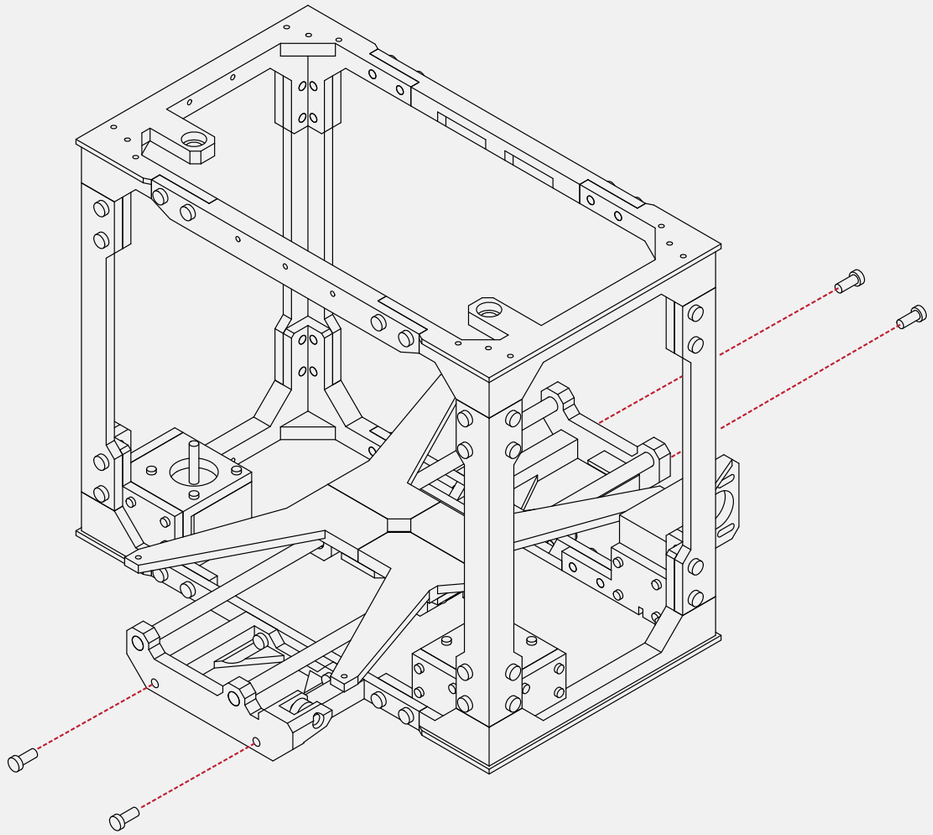
If everything aligns, the lower bed assembly should drop into place on the Y axis mounts.

If the lower bed does not fit, or there is uneccessary force needed to fit it, use a soft mallet on the inside of the Y axis carriers to lengthen them slightly and try again.

Print Bed Installation

D 4.3

5



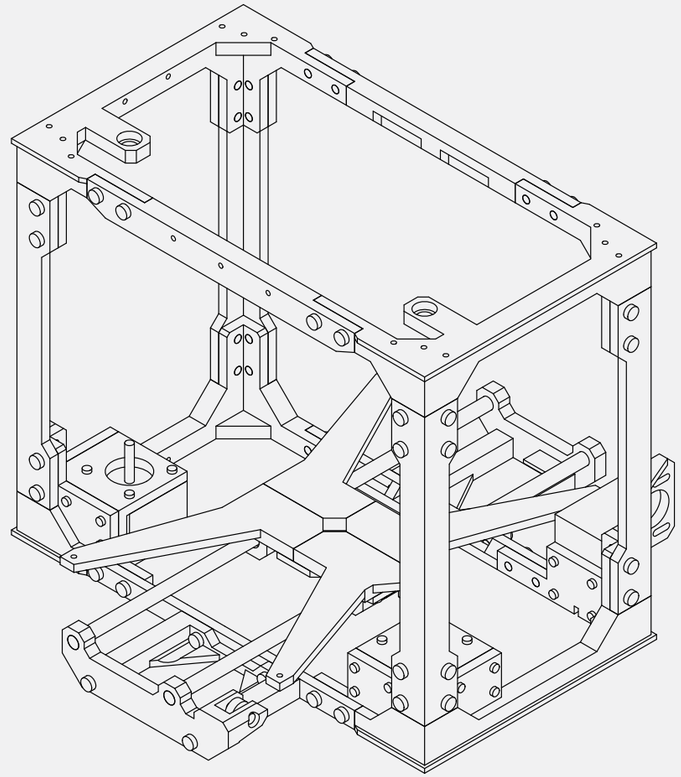
Locate **4 M5 X 12 screws** from your hardware kit.

Using your **hex wrench**, install the screws through the Y axis carriers and into the Y axis mounts.

X 4

M5 x 12

6



N/A

Congratulations! The lower bed installation is complete.

Double check that the screws are secure and that everything aligns properly.

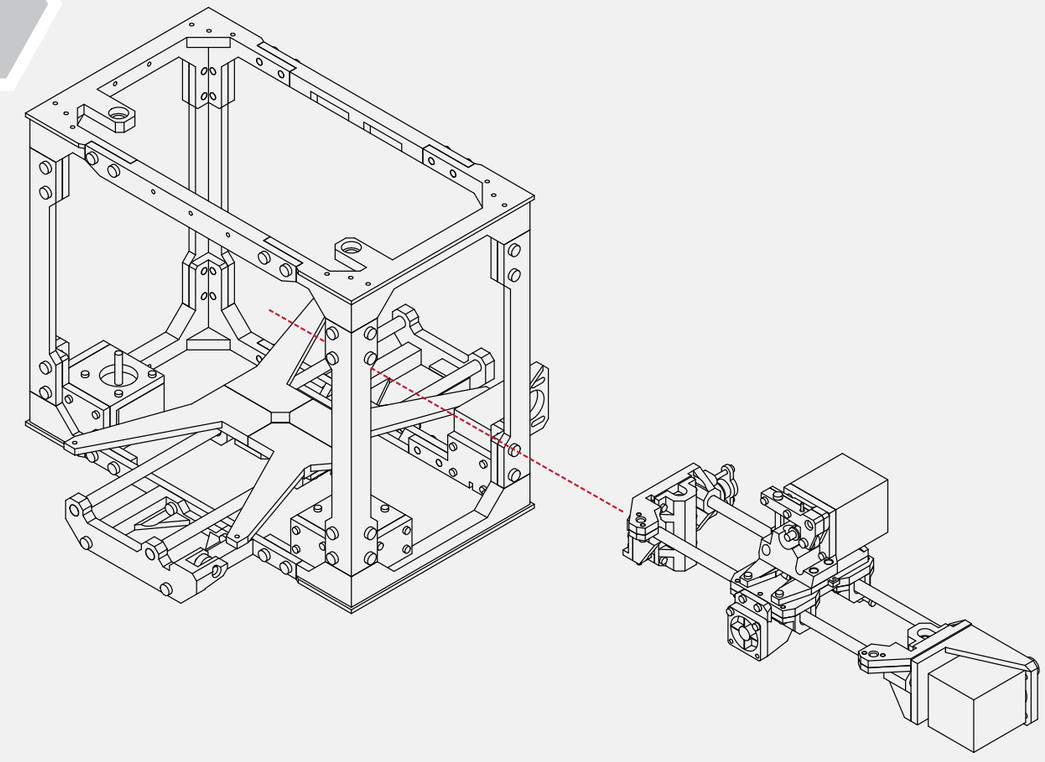
Your printer should sit flat with little or no 'wobble'.

If there is any issues you may readjust the lower Y mount until suitable.

Z Carriage Assembly

D 4.4

1



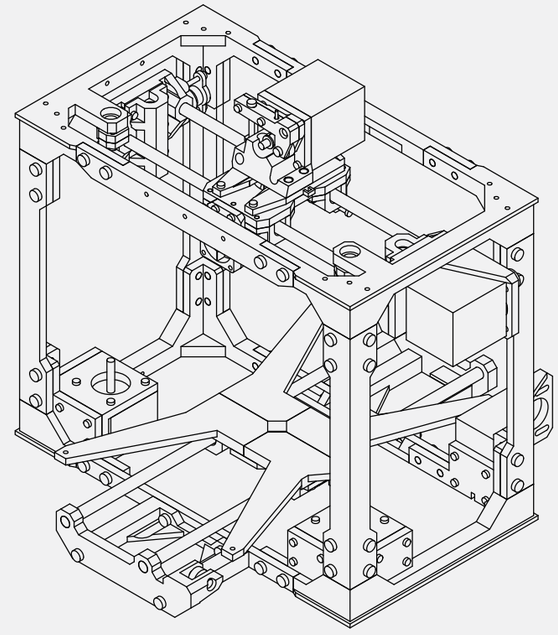
With the lower bed installed, locate the **X axis assembly** completed previously in this guide.

Insert the X axis assembly through the side of the frame.

The front of the extruder should face the front of the frame as well.

N/A

2



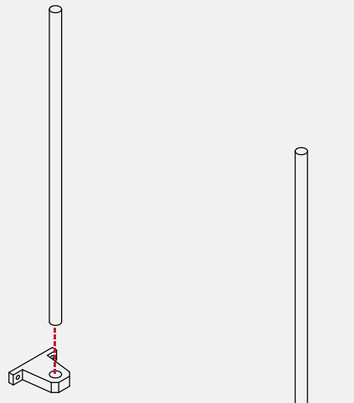
N/A

With the X axis assembly in the frame, it is advised that you temorarily secure the X axis to the top of the frame using cable ties or similar.

Z Carriage Assembly

D 4.4

3



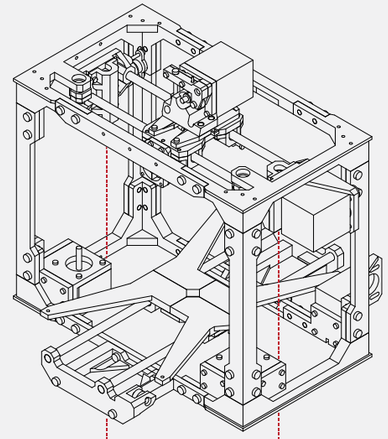
Locate the **Z axis carriers** from your parts kit, along with the remaining **2 linear rods.**

Using a **soft mallet,** insert the linear rods into the carriers.

When fully inserted, the face of the rod should be flush with the face of the carrier.

N/A

4



N/A

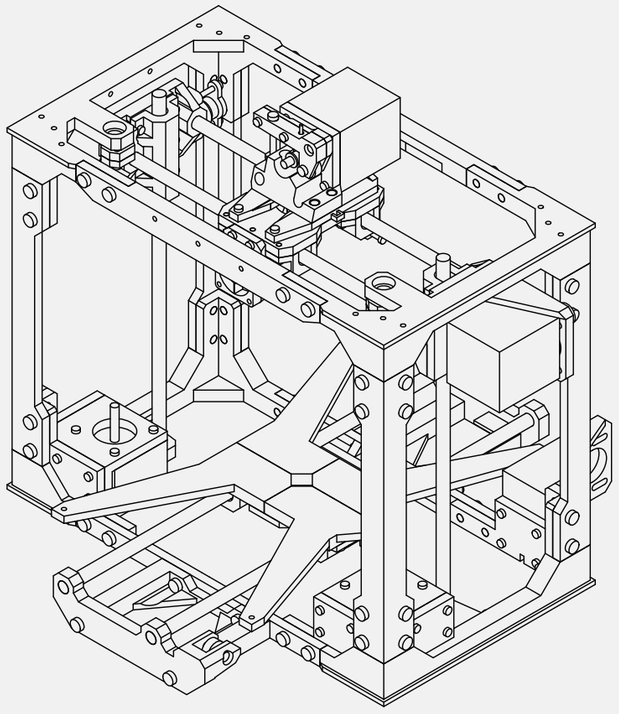
Take the **Z axis rods and carriers** assembled in the previous step and insert them through the bottom of the frame.

Insert the linear rods into the X axis assembly, taking care to not damage the linear bearings.

Z Carriage Assembly

D 4.4

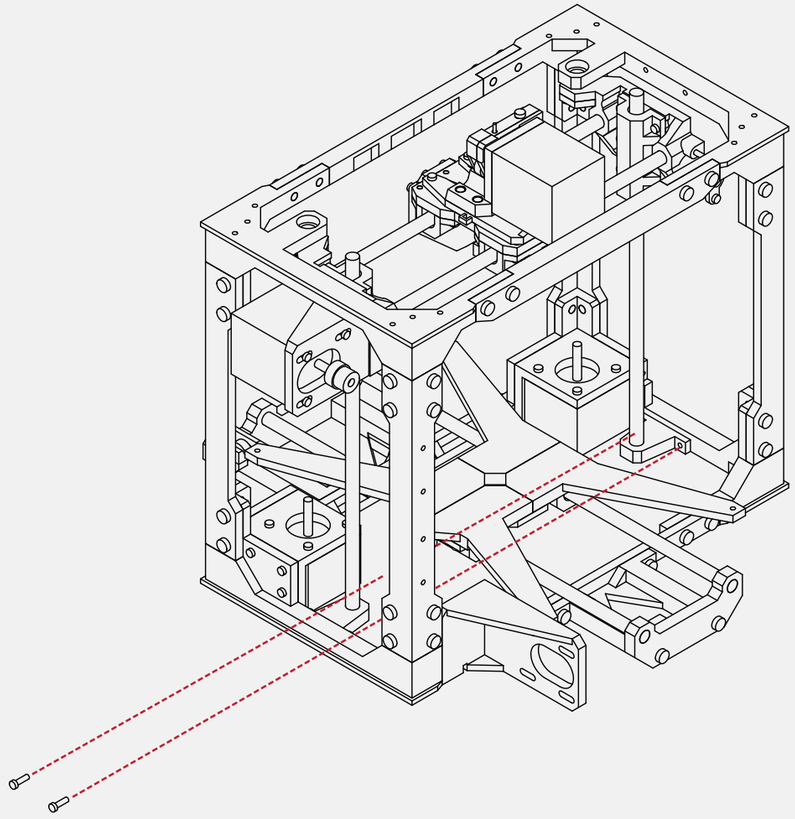
5



With the Z rods in place, check that there is no binding of the X axis and that everything is aligned before proceeding to the next step.

N/A

6



X 2

M3 x 10

Gather **2 M3 X 10 screws** from your hardware kit.

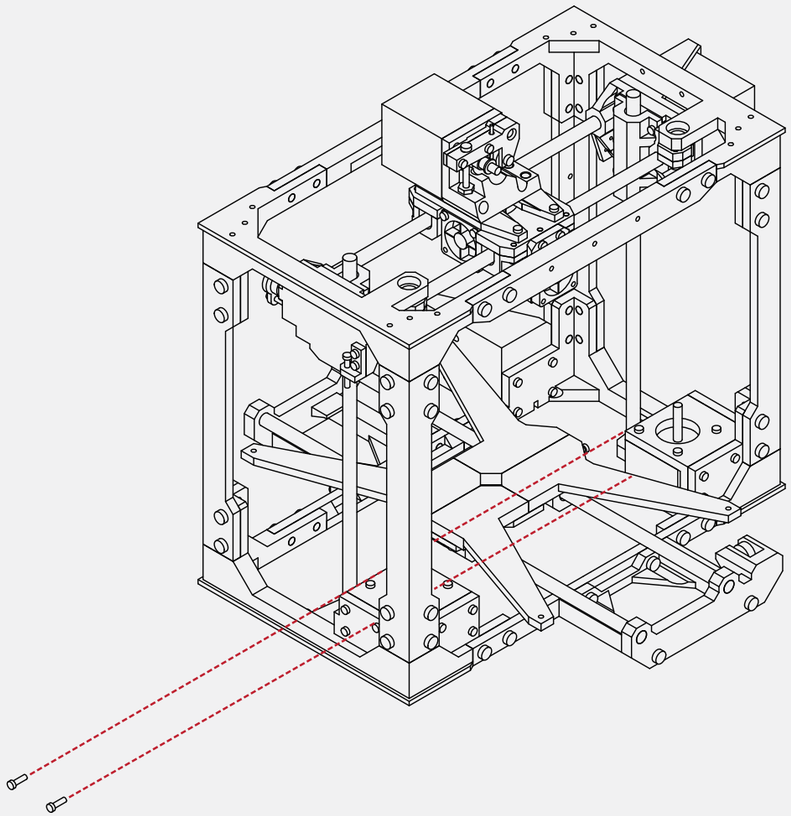
Using your **hex wrench**, install both screws through the ears of the Z axis mount and into the side of the frame.

Take care to ensure that the mount is tight against the frame and that the fasteners are secure.

Z Carriage Assembly

D 4.4

7

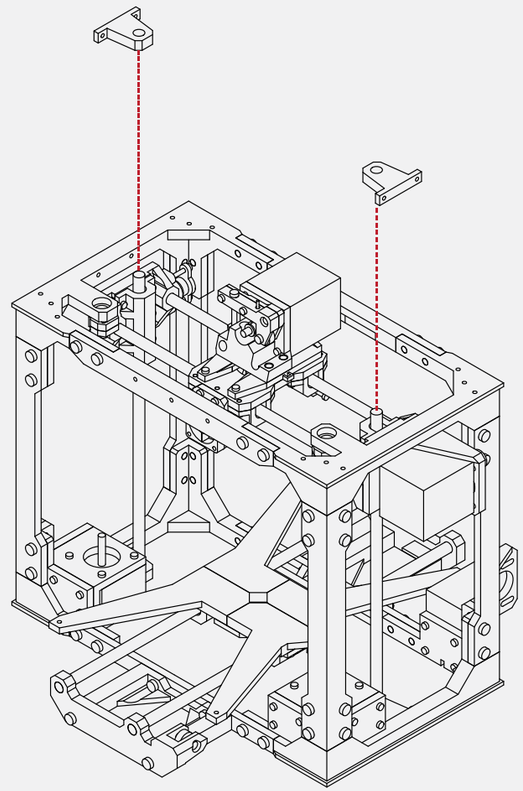


Repeat the same procedure in the last step, securing the opposite Z mount using **2 M3 X 10 screws.**

X 2

M3 x 10

8



N/A

With the lower Z mounts secured to the frame, locate the remaining **2 Z mounts** from your parts kit.

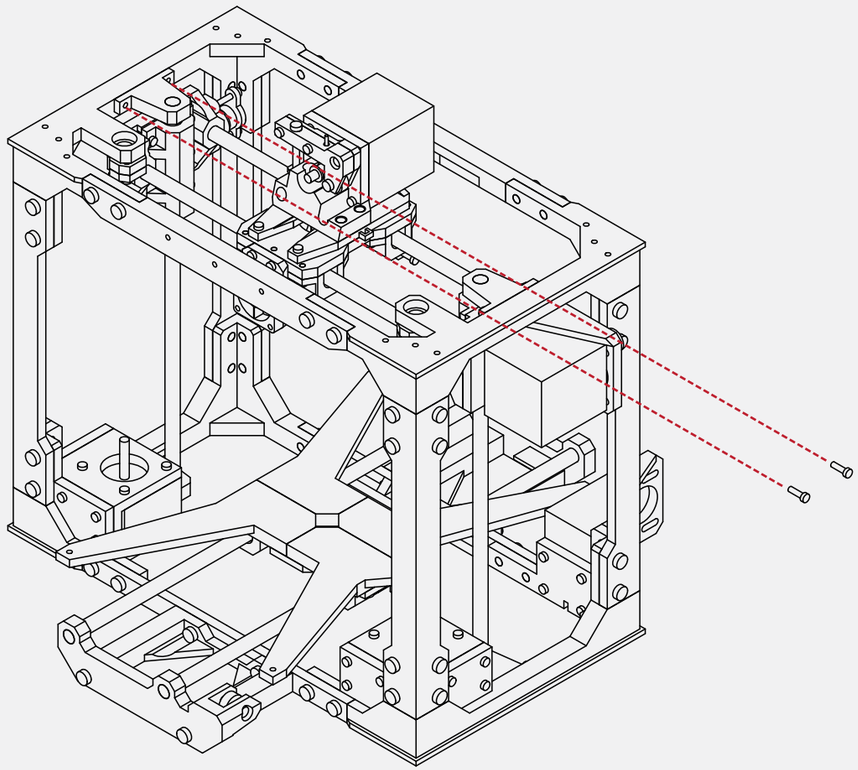
Using a soft mallet, gently install the 2 mounts onto the linear rods.

When properly installed, the face of the Z mounts should be flush with the face of the linear rods.

Z Carriage Assembly

D
4.4

9

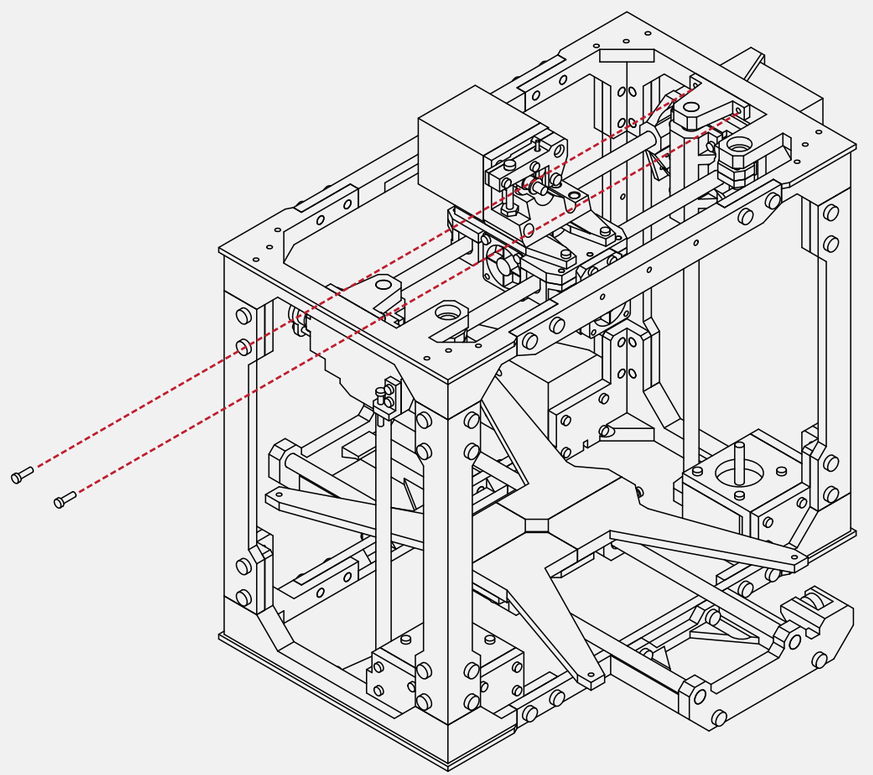


Similar to the previous steps, locate **2 M3 X 10 screws** and secure the top Z mounts. Ensure that the mounts are flush with the frame and that the fasteners are secure.

X 2

M3 x 10

10



X 2

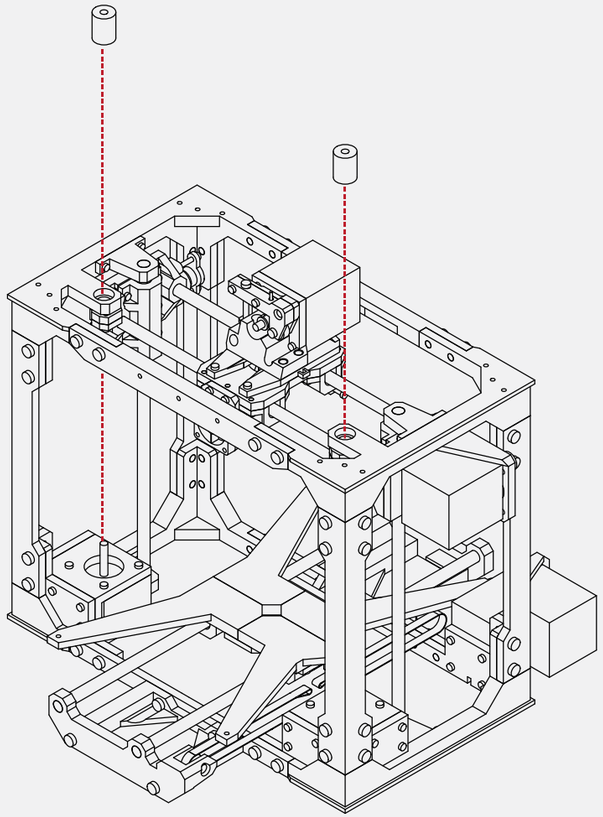
M3 x 10

Repeat the same procedure for the opposite **Z mount.** Ensure that mount is flush with the frame, and that the fasteners are secure.

Z Carriage Assembly

D 4.4

11



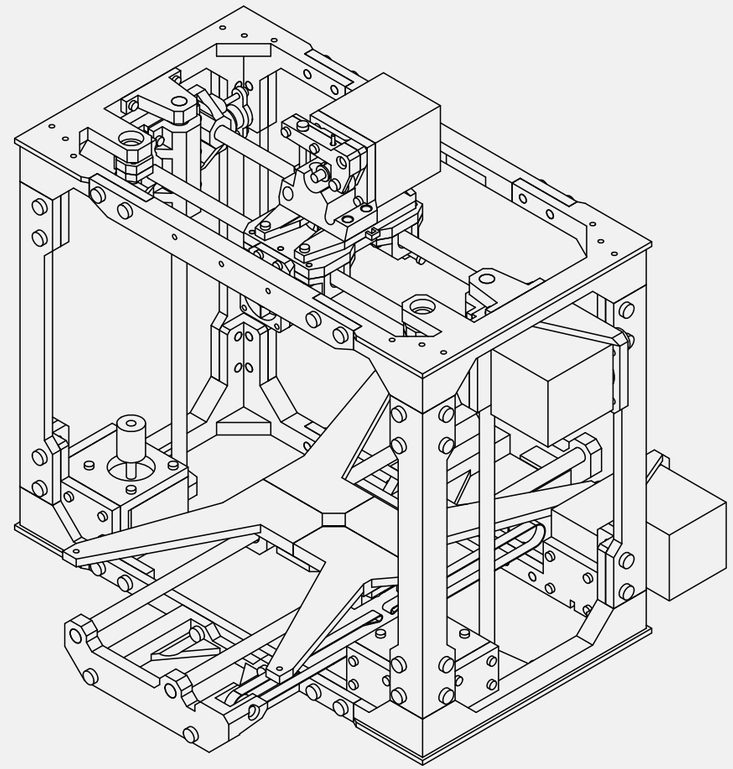
From your parts kit, locate the **Z couplers**.

Slide these couplers onto the shaft of the **Z axis stepper motors.**

Using your **hex wrench**, tighten the set screw on the coupler to secure it to the shaft.

N/A

12



N/A

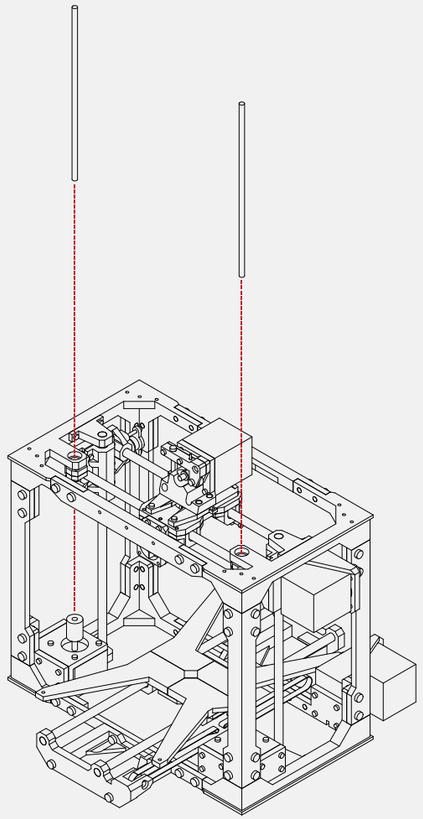
Ensure that the coupler is positioned half way onto the shaft.

The threaded rod will attach to these couplers in the following steps.

Z Carriage Assembly

D
4.4

13



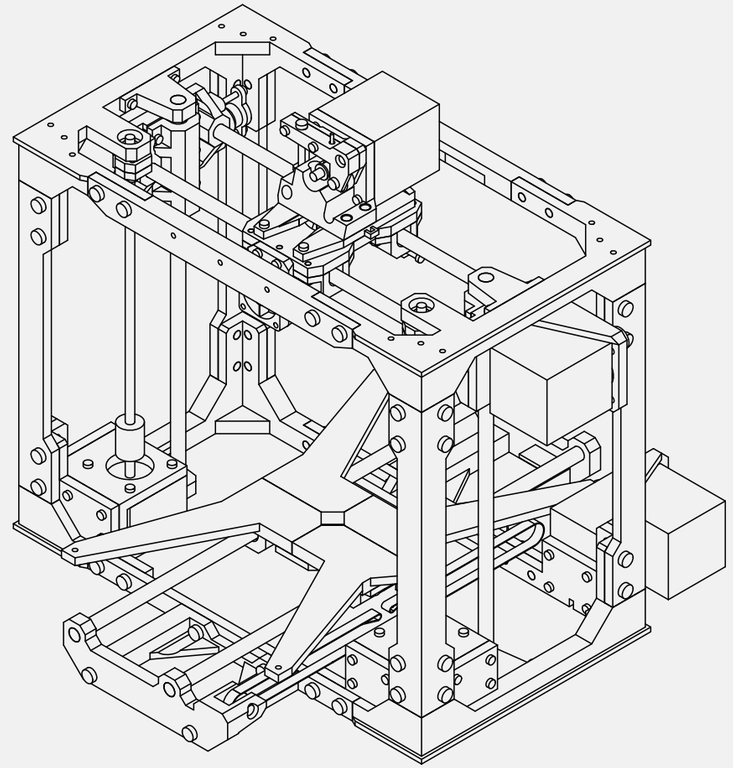
Locate the **threaded rods** from your parts kit.

Insert the rods through the top of the frame and thread the rods through the X axis mounts and into the couplers installed previously.

Using your **hex wrench**, tighten the set screws on the couplers to secure the threaded rod.

N/A

14



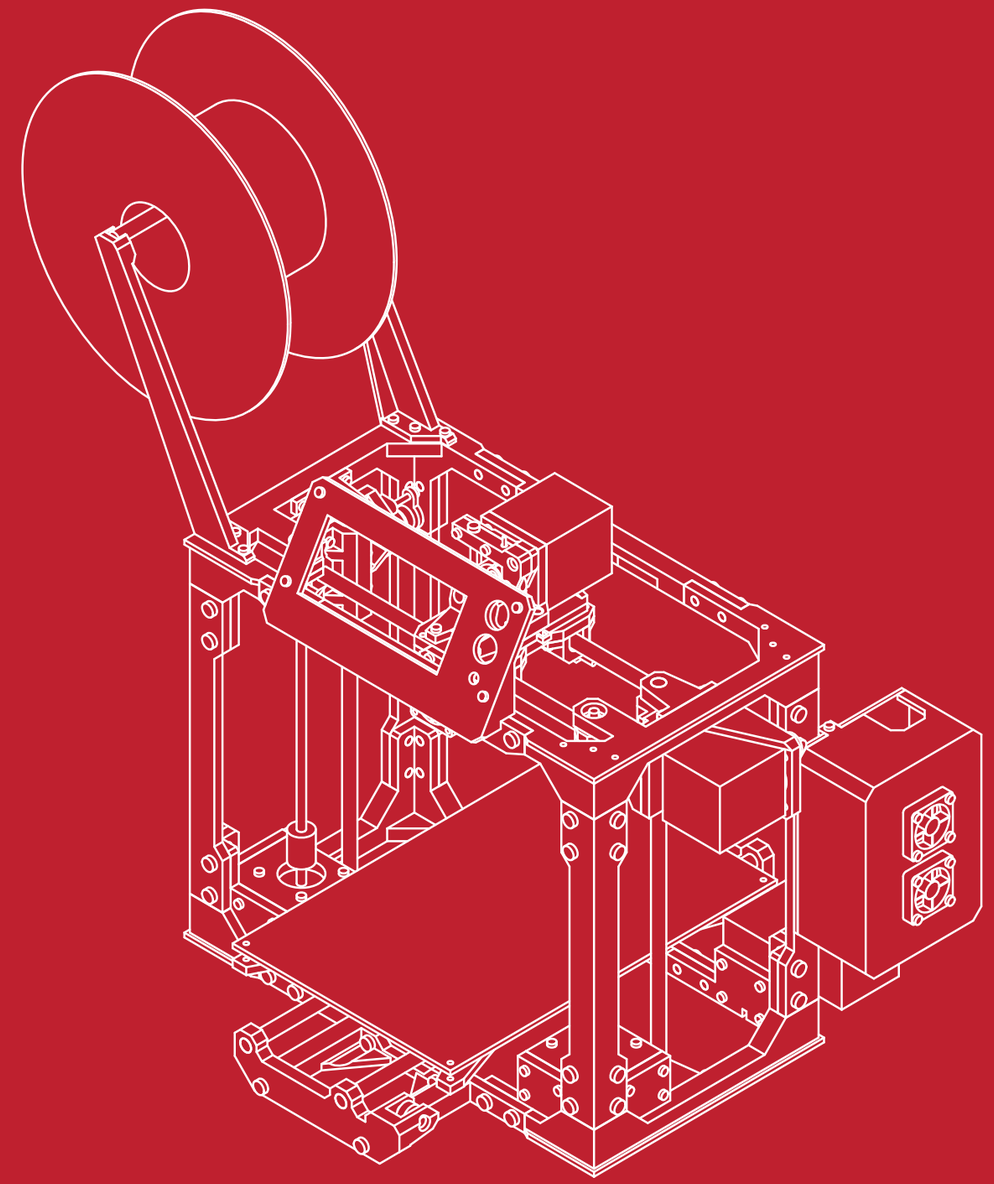
N/A

With both rods secure, check that the X axis is level.

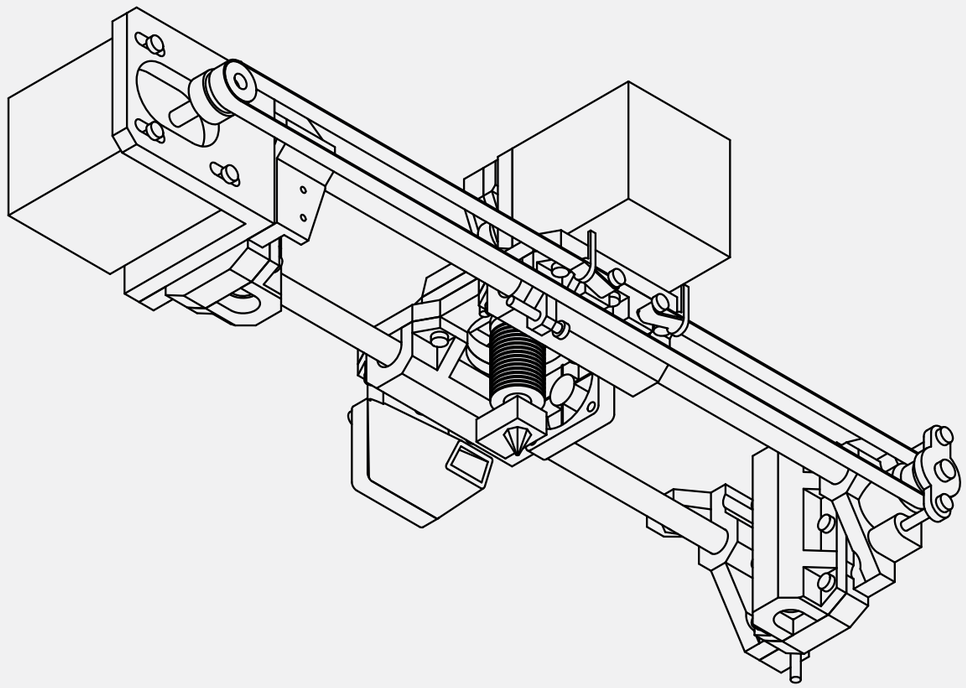
If the X axis is uneven, simply turn either one of the threaded rods to raise or lower the axis until it appears close to level.

SECTION

E



1



From your hardware kit, locate the **GT2 Belts.**

If not already cut, cut the belt to length so that it is long enough to loop around the motor, and opposite idler bearing with some extra length.

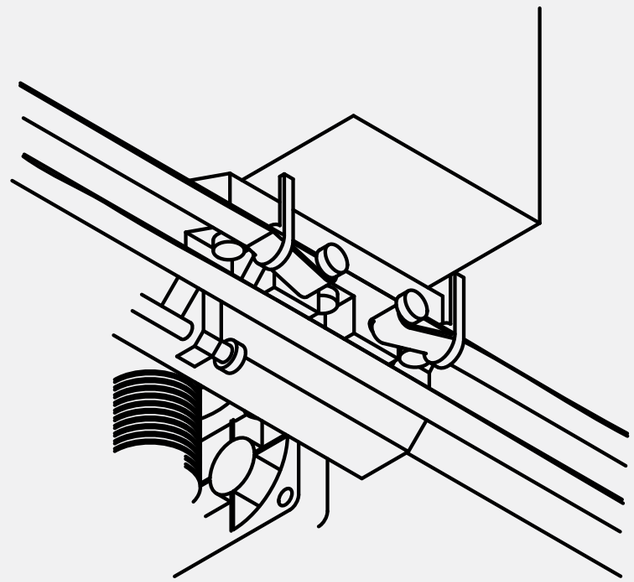
The belt will be mounted with the teeth facing inwards.

Take one end of the belt and loop it around one of the screws on the extruder assembly.

N/A

5.1

2



Secure this using a **cable tie** so that the belt teeth mesh together. Take the belt and loop it around the idler bearing and back around the pulley on the X axis motor.

Your belt should be long enough to reach the remaining screw on the extruder assembly.

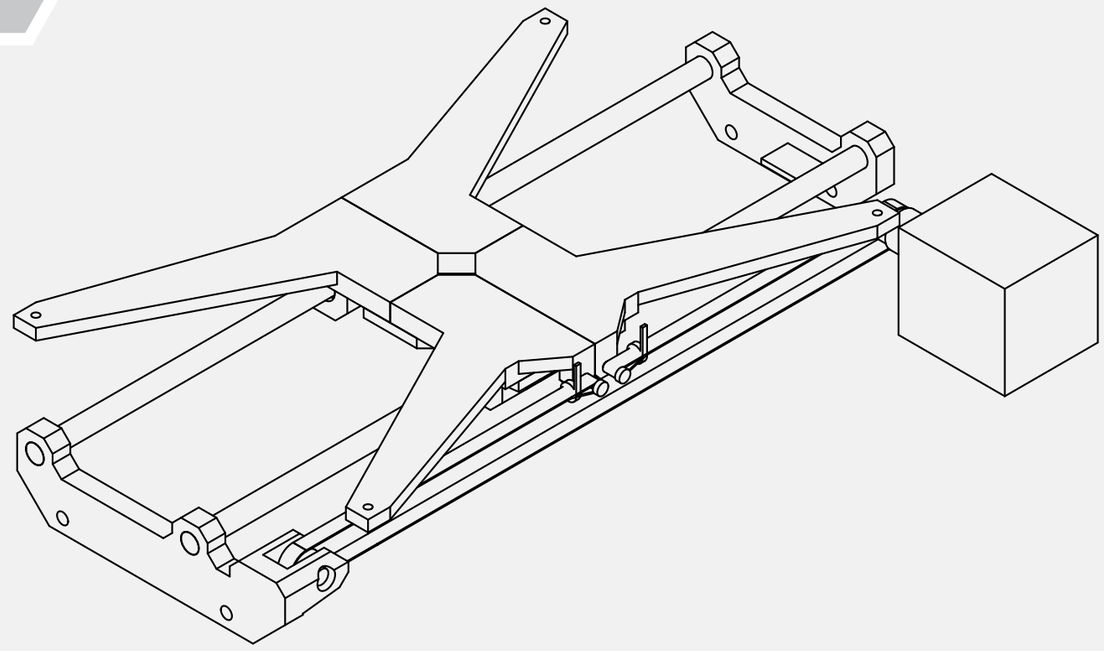
While holding the extruder assembly in place, use a pair of pliers, or a second set of hands to pull the belt as tight as possible to remove any slack.

With the slack removed, secure the belt to the screw using the same method as before.

When complete, the belt should be tensioned and tight. If there is slack, you may loosen the 4 screws holding the motor in place and slide it backwards, away from the frame to tension the belt more.

Remember to tighten the motor mounts when complete.

3



We will now complete the same procedure for the **Y axis.**

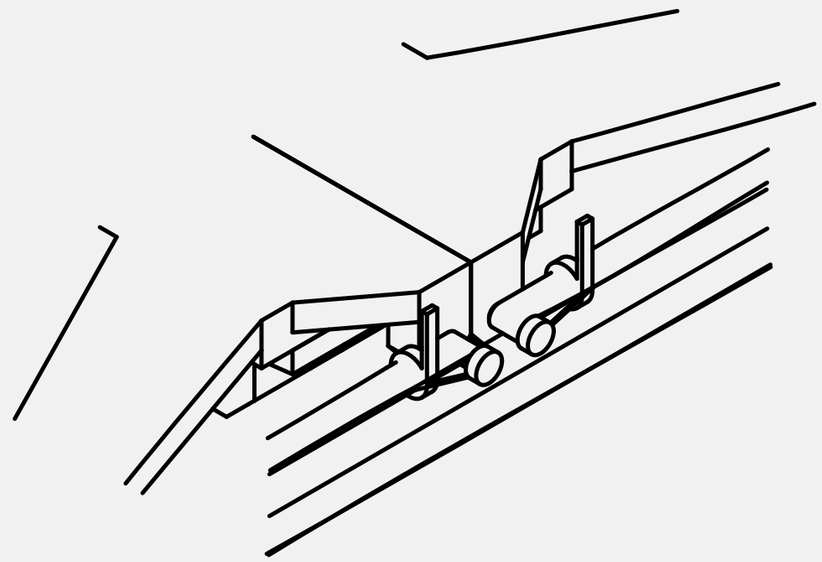
If not already cut, cut the belt to length so that it is long enough to loop around the motor, and opposite idler bearing with some extra length.

The belt will be mounted with the teeth facing inwards.

Take one end of the belt and loop it around one of the screws on the lower bed assembly.

N/A

4



Secure this using a **cable tie** so that the belt teeth mesh together. Take the belt and loop it around the idler bearing and back around the pulley on the Y axis motor.

Your belt should be long enough to reach the remaining screw on the lower bed assembly.

While holding the extruder assembly in place, use a pair of pliers, or a second set of hands to pull the belt as tight as possible to remove any slack.

With the slack removed, secure the belt to the screw using the same method as before.

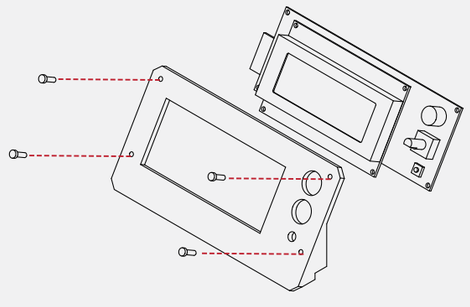
When complete, the belt should be tensioned and tight. If there is slack, you may loosen the 4 screws holding the motor in place and slide it backwards, away from the frame to tension the belt more.

Remember to tighten the motor mounts when complete.

LCD Installation

5.2

1



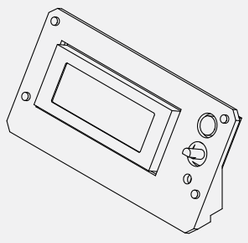
Locate the **LCD display** from your electronics kit, along with **4 M3 X 20 screws,** and the **LCD display mount** from your printed parts kit.

Remove the control nob from the LCD display by pulling straight up on it.

Using your **hex wrench**, insert the 4 screws into the LCD frame, and then into the LCD display.

X 4 — **M3 x 20**

2



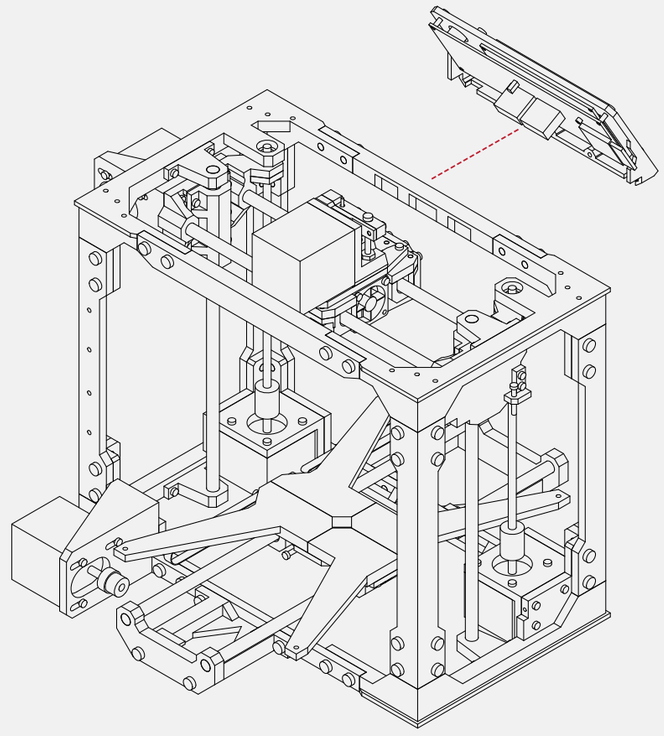
Use **4 M3 nuts** to secure the lcd display to the frame.

Take care to not distort the LCD frame or damage any components when installing the screws.

Re-attach the control nob onto the LCD display.

N/A

3

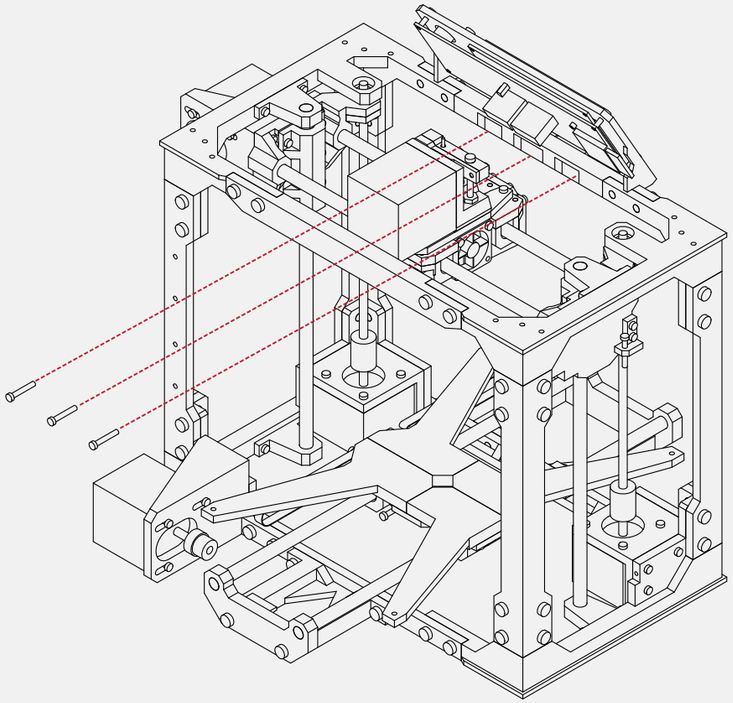


N/A

The LCD frame will affix to the front of the upper frame chassis.

Check to ensure that the frame and LCD panel will fit correctly before proceeding.

4



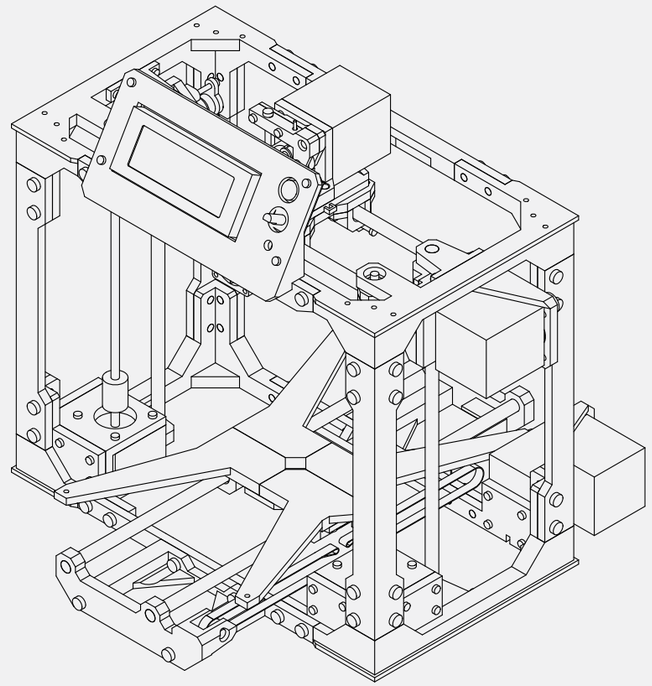
Locate 3 **M3 X 10 screws** from your hardware kit.

With the LCD assembly in place, use your **hex wrench** to insert the screws into the rear of the upper frame, and secure the LCD panel in place.

X 3

M3 x 10

5

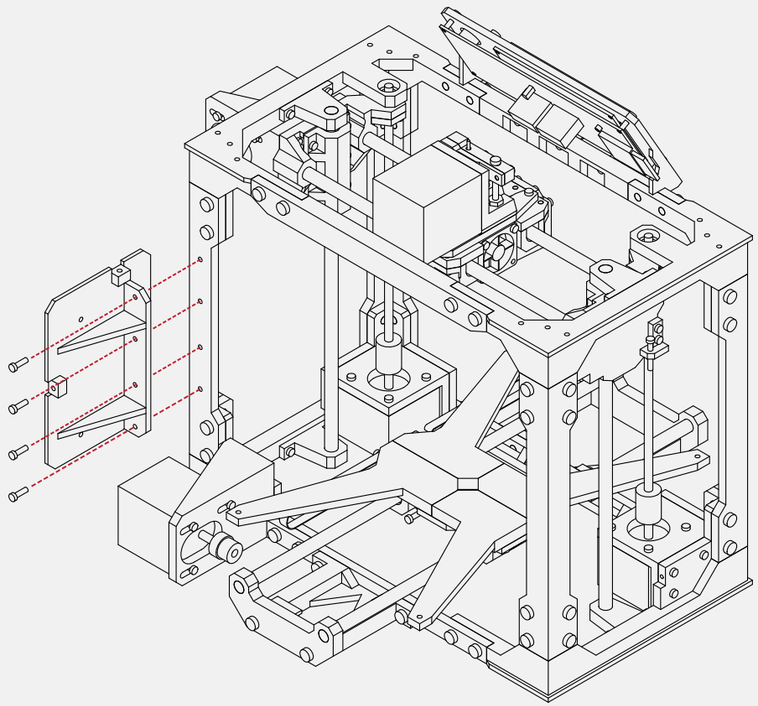


N/A

With the LCD assembly in place, ensure that it is secure and that it fits well.

Ensure all fasteners are tight.

6



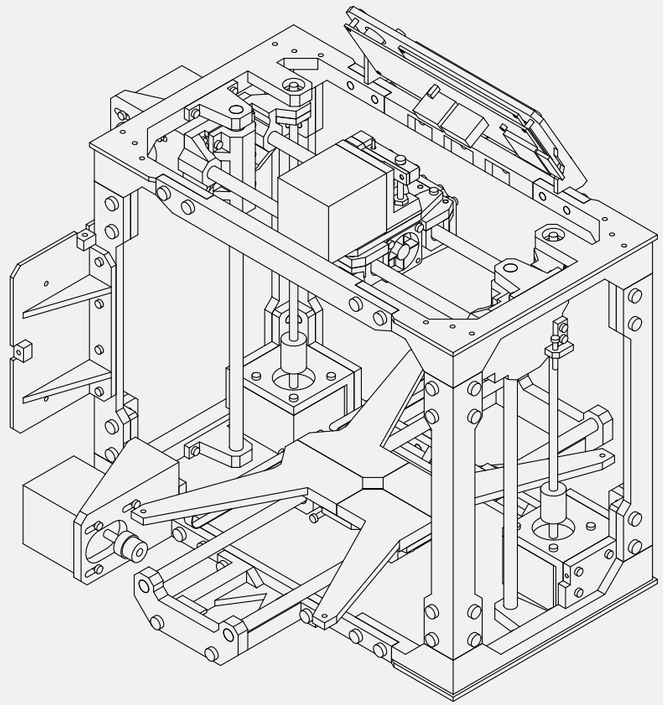
Locate the **Electronics backplate** from your printed parts kit, along with **4 M3 X 10 screws**.

Using your **hex wrench**, insert the screws into the backplate, and then secure the backplate to the rear upright frame.

X 4

M3 x 10

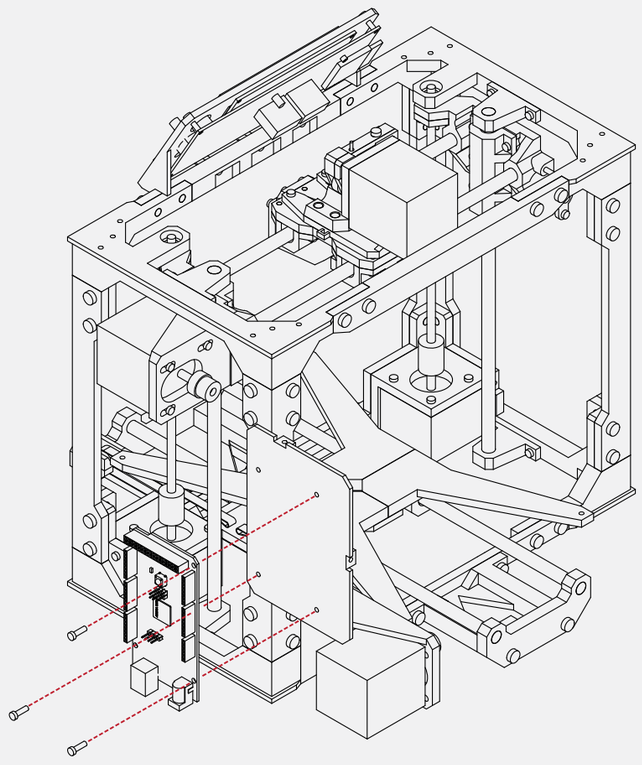
7



N/A

With the backplate in place, ensure that the plate is tight to the frame, and that all fasteners are secure.

8



Locate the **Arduino Mega** from your electronics kit.

This is easily identified by its blue colour board.

Using **3 M3 X 10 screws**, attach the Arduino to the electronics backplate.

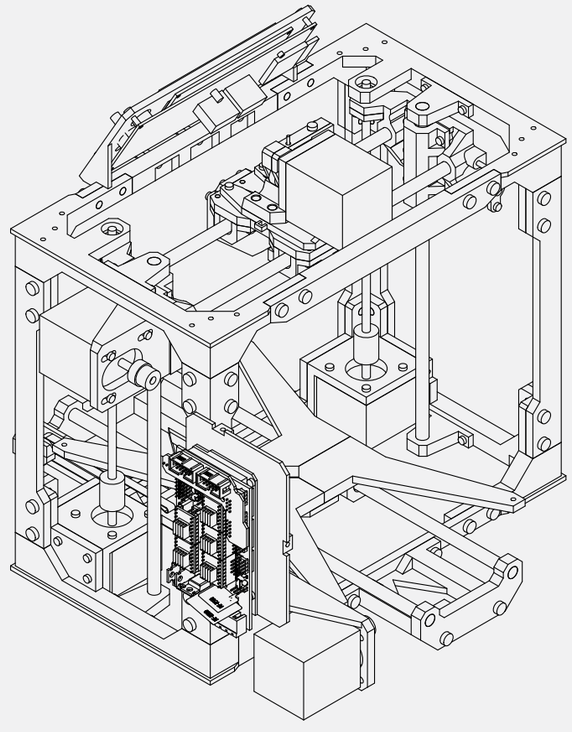
Take care to ensure that the Arduino is not bent or mis-aligned.

The board does not need to be absolutely tight, just secure.

X 3

M3 x 10

9



N/A

Gather the **RAMPS 1.4** electronics board from your hardware kit.

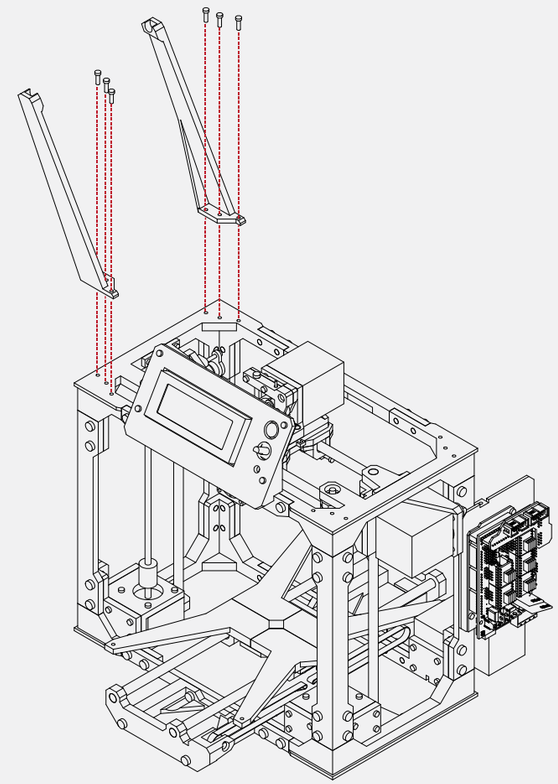
Carefully insert it onto the Arduino board we attached in the previous steps.

Take care to ensure that all of the pins lin up with their respective sockets, and that the board is fully seated.

Filament Spool Installation

5.3

1



Locate the **Spool holder mounts** from your printed parts kit, along with **6 M3 X 10 screws**.

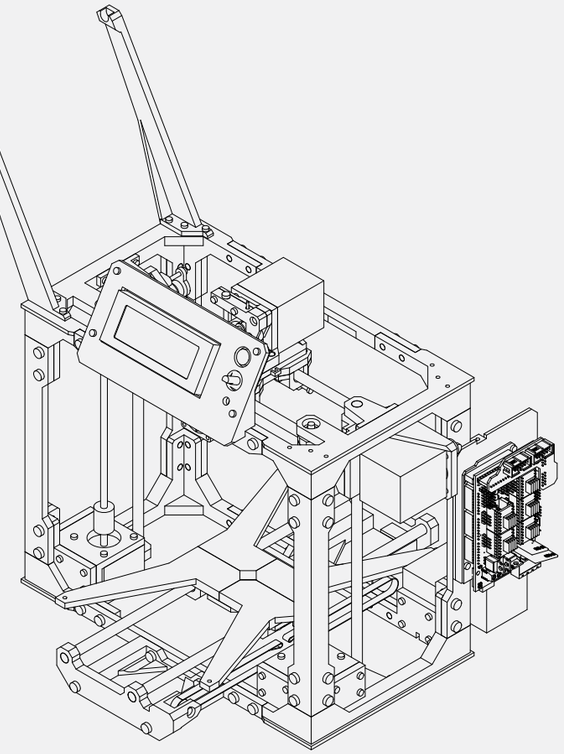
The spool holder can be mounted on either side of the top frame.

Using your hex wrench, insert the screws into the spool holder mounts, and then into the top of frame.

X 6

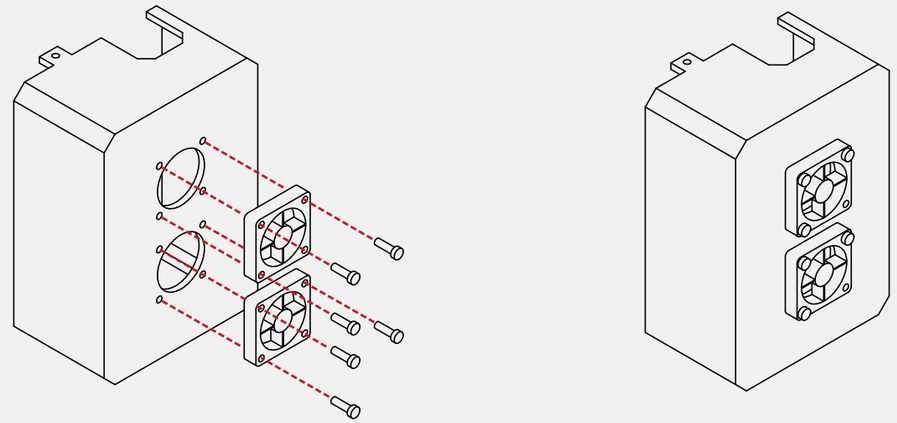
M3 x 10

2



N/A

With the spool holder installed, you can use the remaining short linear rod to hold the filament spool in place.



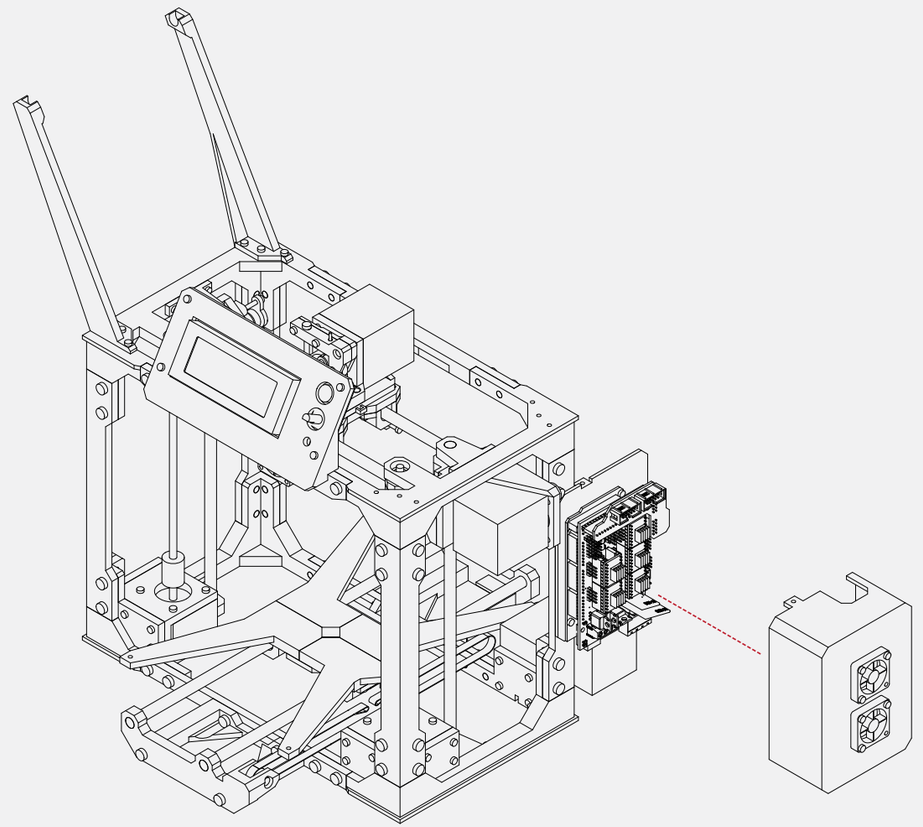
Locate the **Electronics enclosure** from your printed parts kit, along with **2 30mm fans**, and **6 M3 X 16 screws**.

Using your hex wrench, attach the fans to the outside of the enclosure.

Feed the fan wires through the remaining screw hole in the enclosure.

X 6

M3 x 16

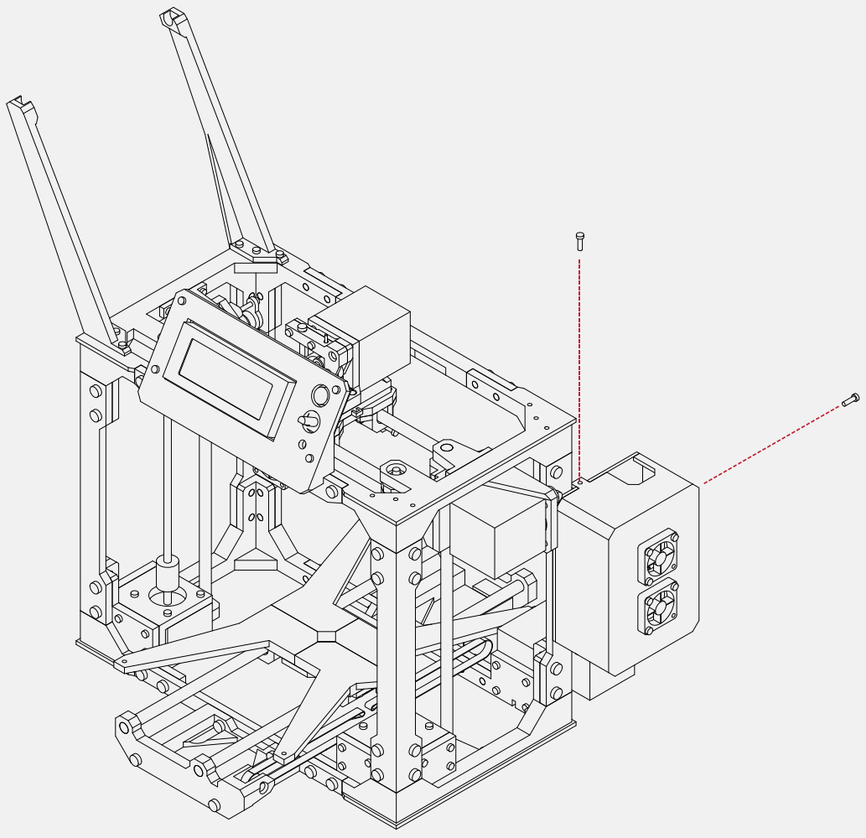


N/A

Check the fitment of the enclosure to the electronics back plate.

The tabs on the enclosure should align and fit with the back plate.

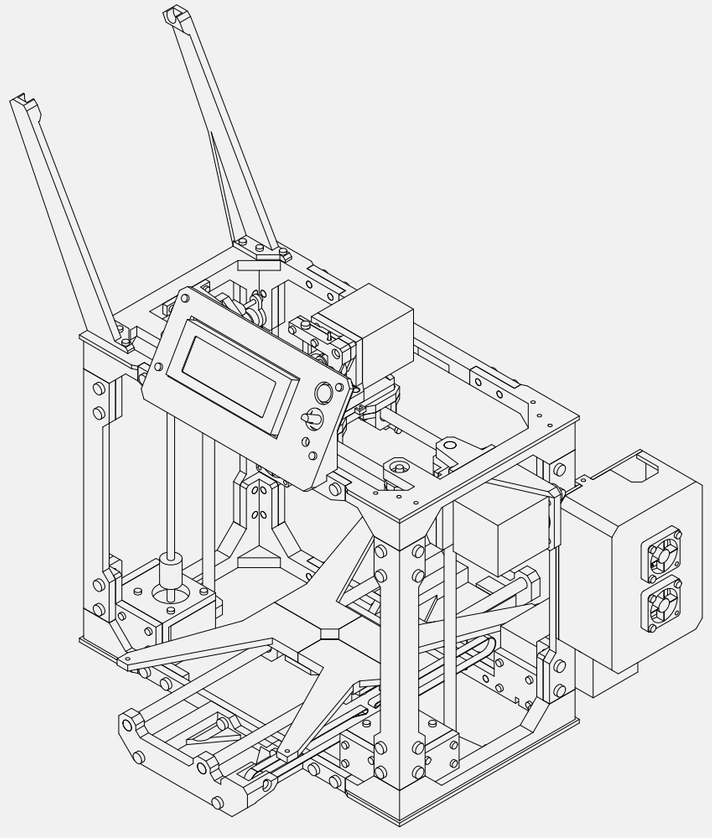
You may need to use a small exacto knife or file to trim the tabs if the enclosure does not fit correctly.



With the enclosure in place, use **2 M3 X 10 screws** to secure the enclosure.

X 2

M3 x 10



N/A

The electronics enclosure is now complete.

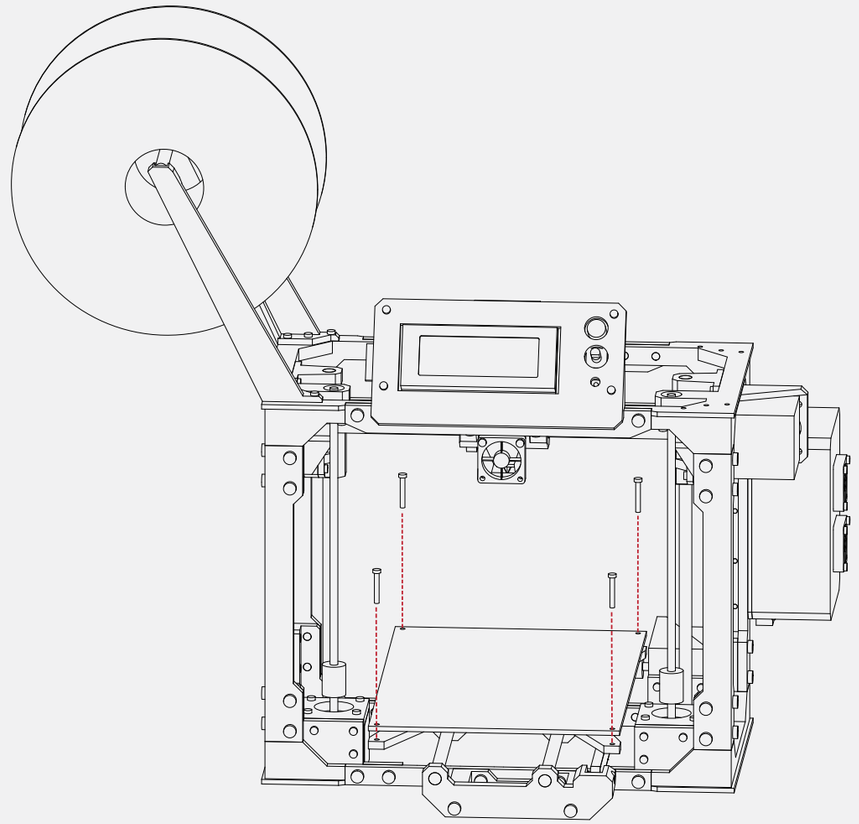
However, for the enxt steps we will need to remove the cover.

Refer to these steps to remove and reinstall the enclosure when completed.

Upper Bed Installation

5.4

1



Locate the **upper bed** from the remaining parts kit, along with **4 compression springs,** and **4 M3 X 20 screws**.

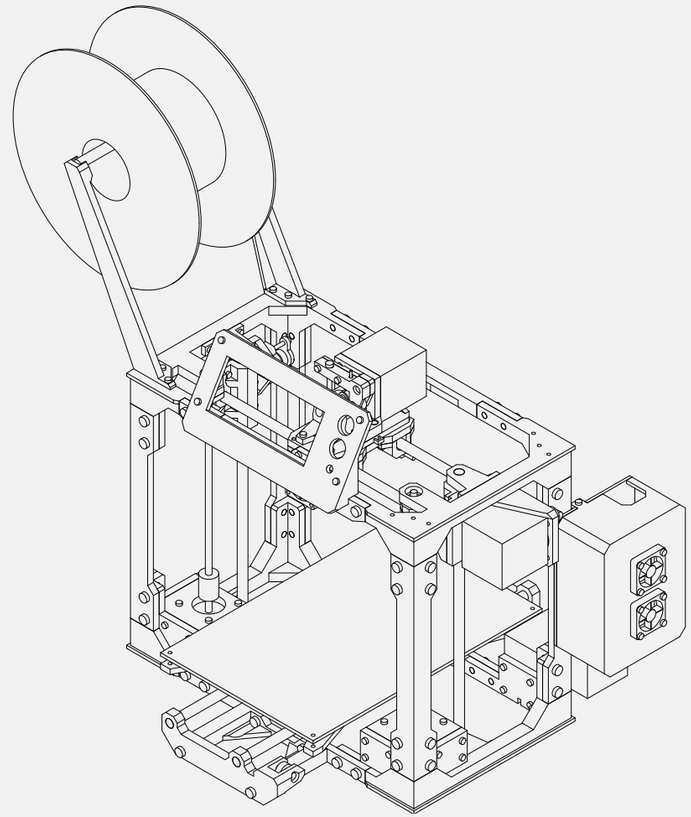
Insert the screws into the upper bed, and place the compression springs onto the screws.

Take the assembly and attach it to the lower bed.

X 4

M3 x 20

2



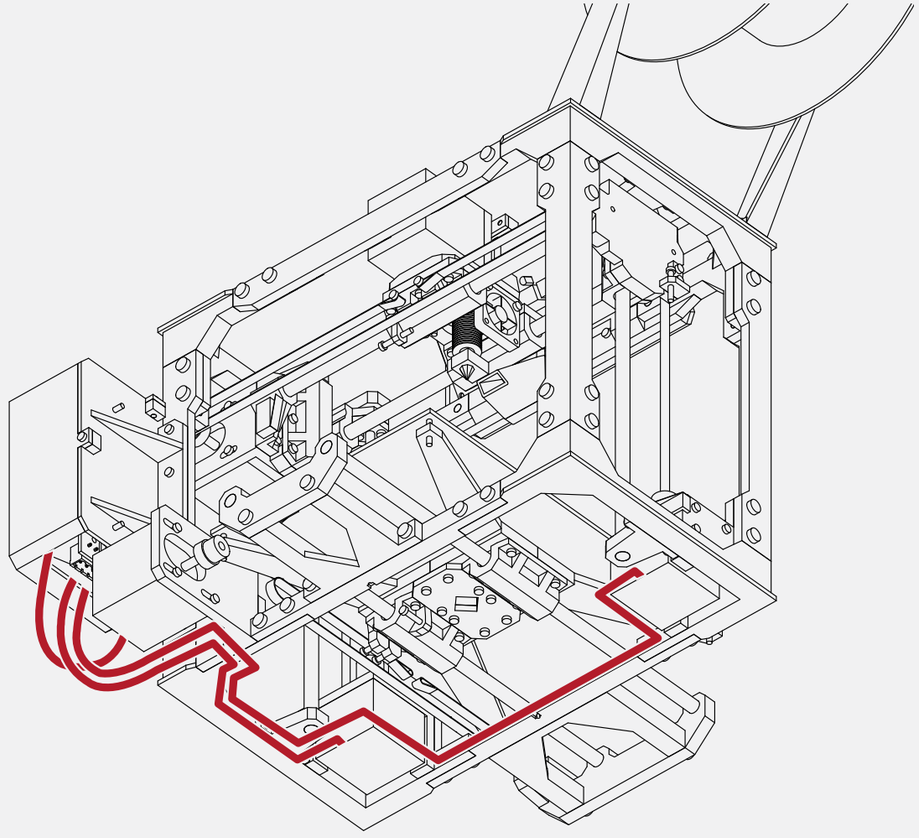
N/A

With the bed in place, the compression springs will allow the bed to be leveled and adjusted.

This is useful for when we set up your printer for its first print.

For now, adjust the screws so that all 4 springs appear equal.

1



From the wiring kit, gather **3 of the wire bundles for the stepper motors.**

Connect the wires to the stepper motors. Take note that the connections are keyed and will only fit in one direction.

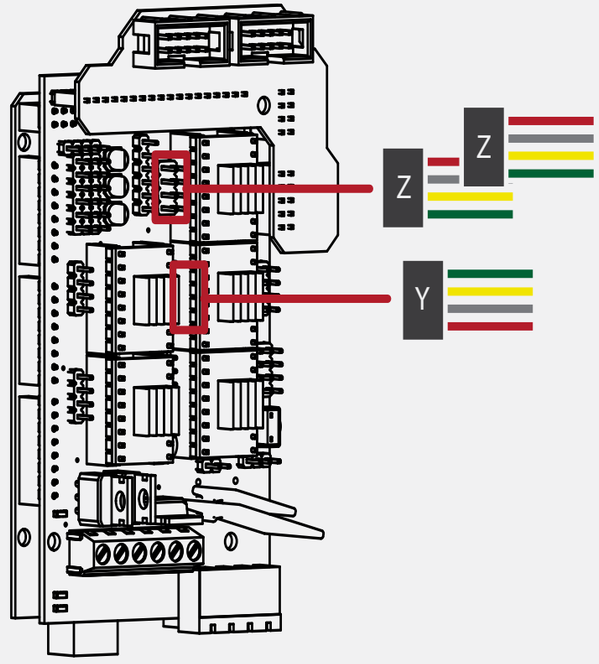
Route the wires similar to the diagram above.

There are several small cut-outs in the frame and areas where you may use a cable tie to secure the wires.

N/A

5.5

2



N/A

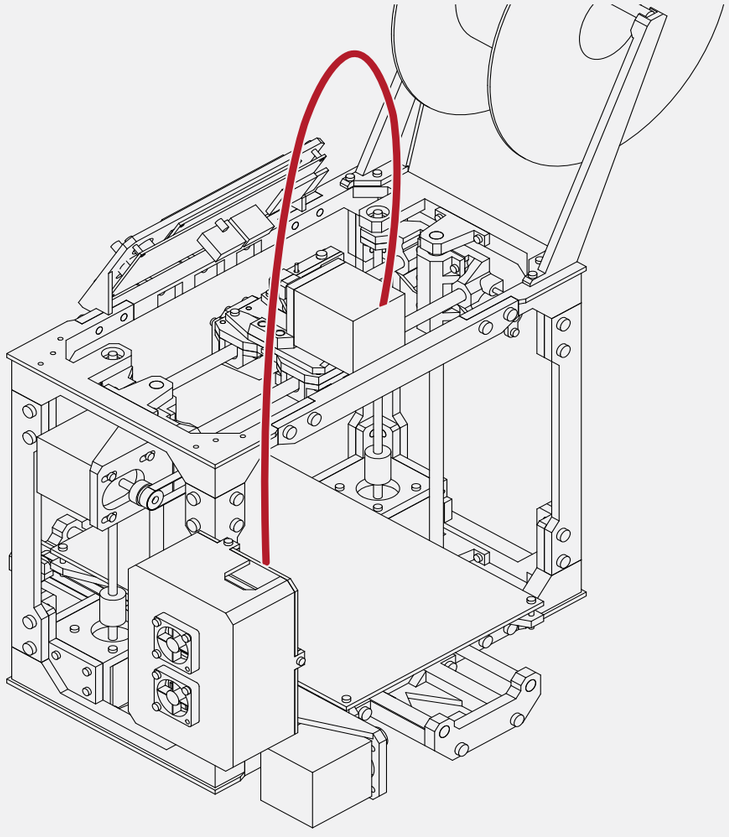
Connecting the stepper motors to the RAMPS is a very simple process.

Take one of the wire leads from the motors and attach it to the driver header pins noted above.

Note the orientation of the wire colours and how they attach to the headers.

While no damage will occur if the wires are backwards, the motor will simply run in reverse of its intended direction.

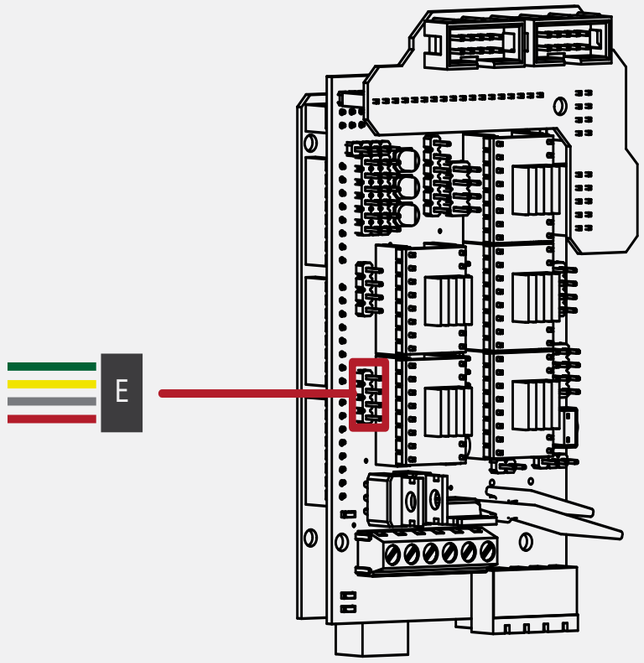
3



Route the stepper wires for the extruder up and over the top of the frame. Give the wire enough slack so that the extruder can freely move to each extent of the frame.

N/A

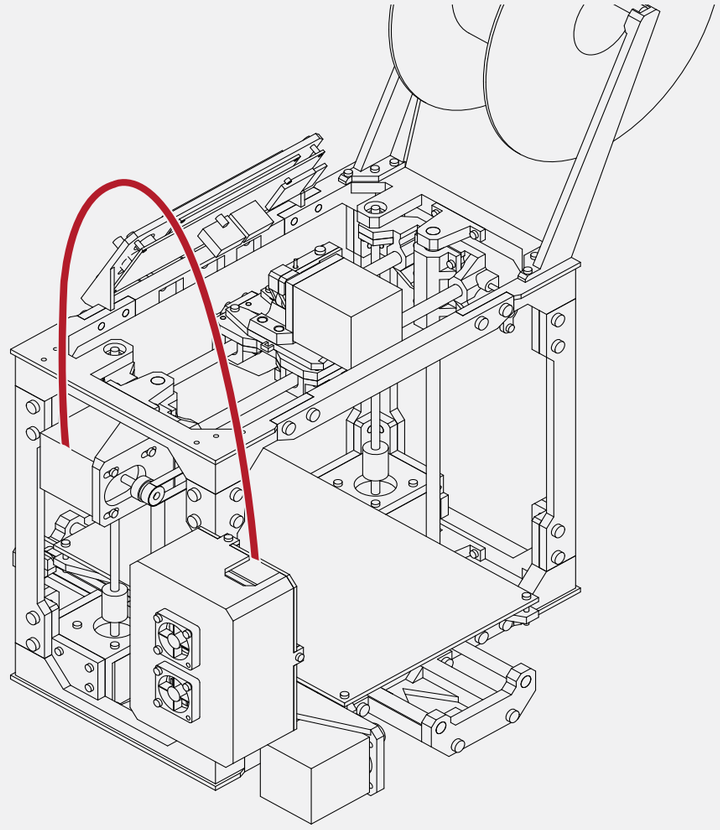
4



N/A

Like the previous step, attach the extruder connector to the header pins outlined above.

5

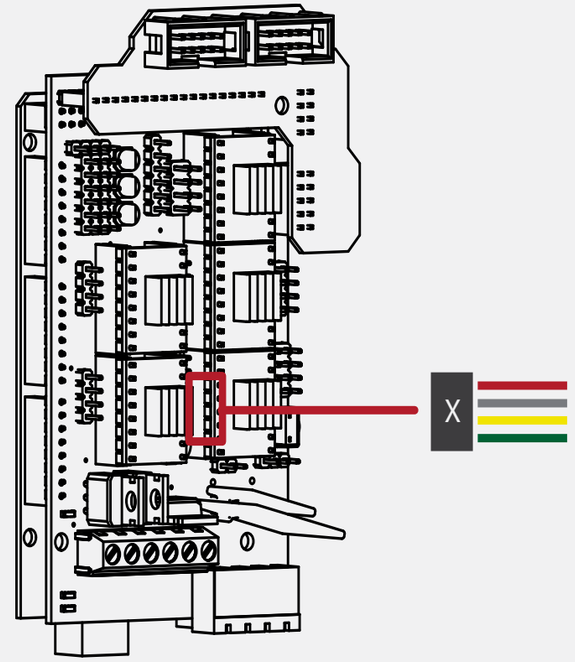


Route the X stepper motor wires over the side of the frame and into the electronics enclosure.

Ensure that there is enough slack in the wires so that the X axis does not bind at either extent.

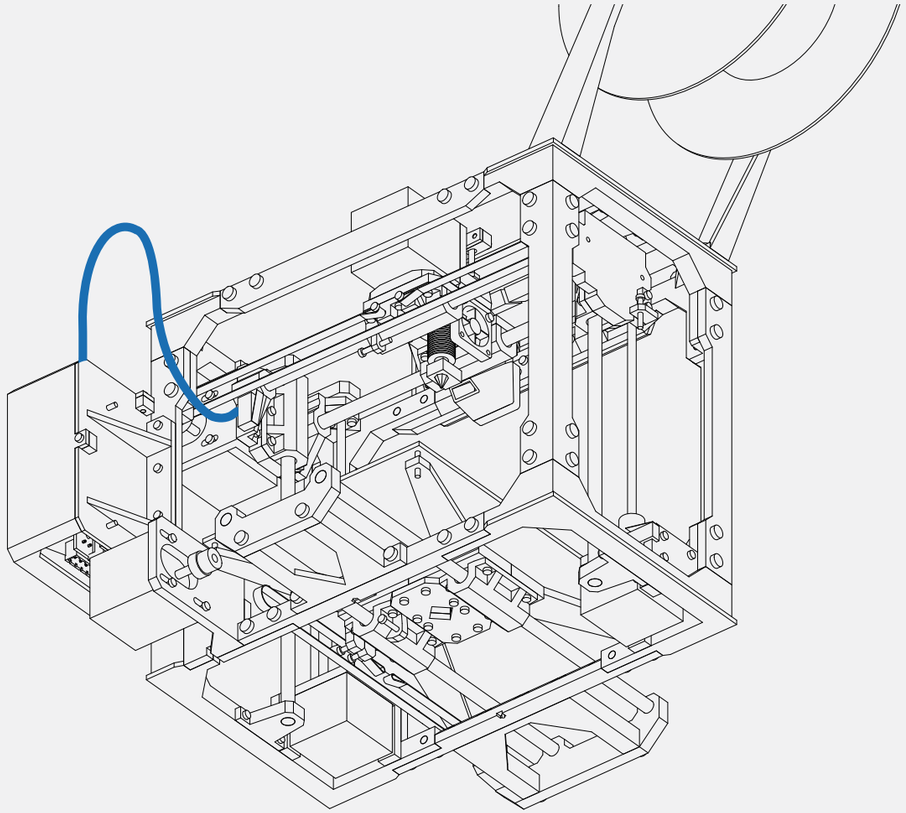
N/A

6



N/A

Connect the X axis stepper wire to the header pin. Note the orientation of the connector.



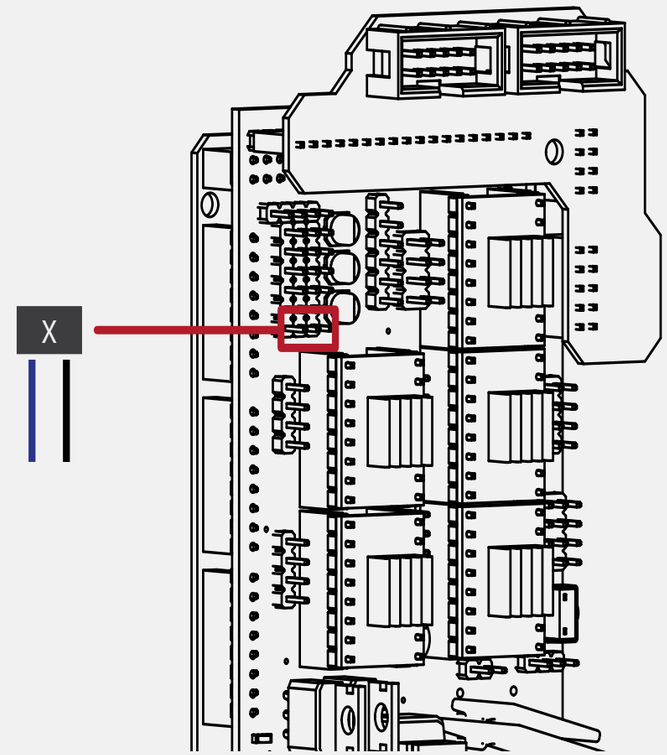
Locate the **End-stops** from your electronics kit.

The X axis end-stop locates the minimum starting position for the extruder assembly.

Using a hot glue gun to secure the ed stop, attach the end stop to the flang on the X axis carrier.

Align it so that trigger is in line with the long end stop screw that we attached to the extruder assembly.

N/A

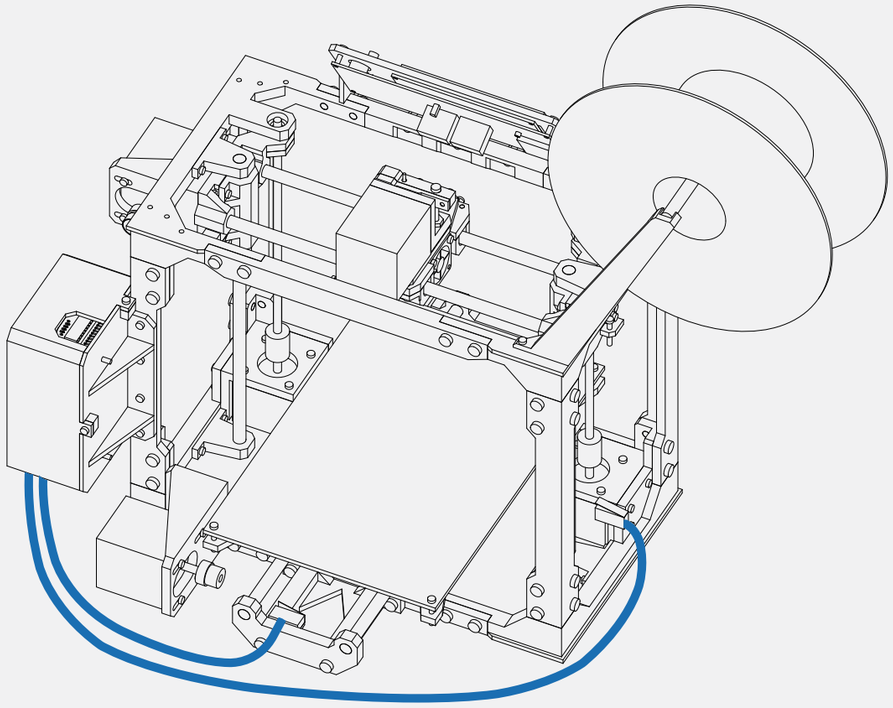


N/A

Connect the X end stop according to the diagram above. The end stop is a 2 wire connector.

The end stop connector, and RAMPS board may have a 3 pin or 4 pin connector, don't worry about this, simply ensure that both wired pins on the end stop connector are attached to pins on the RAMPS board.

7



Locate the **End-stops** from your electronics kit.

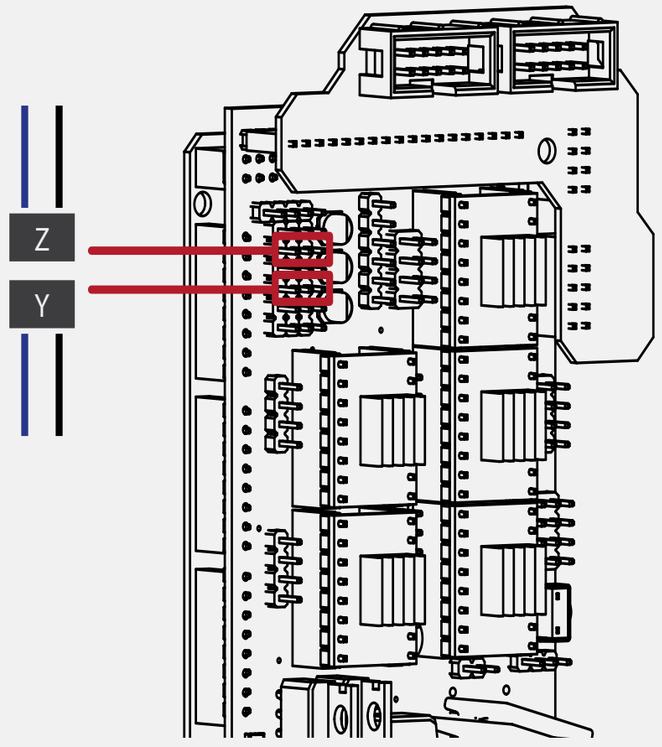
Attach the Y axis end stop to the small shelf at the rear of the Y axis.

Attach the Z end stop to the small shelf on the side of the frame.

In both instances, ensure that the triggers are aligned with the trigger screws on both axis'. We will be fine tuning these screws later in the guide.

N/A

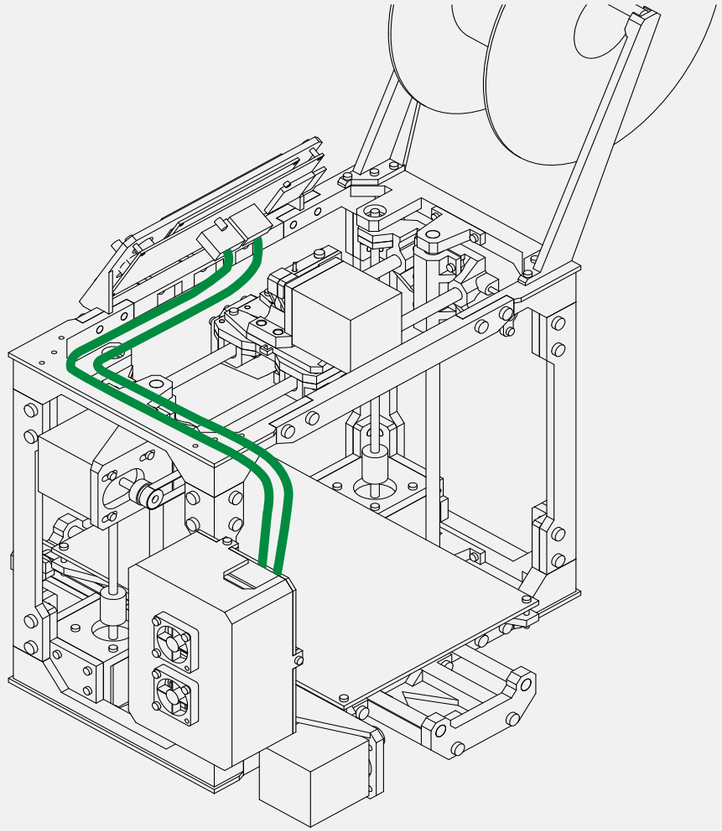
8



N/A

Connect the Y and Z end stop according to the diagram above. The end stop is a 2 wire connector.

The end stop connector, and RAMPS board may have a 3 pin or 4 pin connector, don't worry about this, simply ensure that both wired pins on the end stop connector are attached to pins on the RAMPS board.

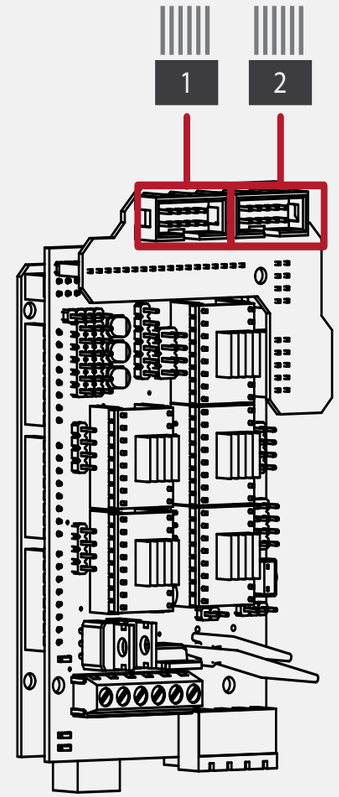


Locate the **LCD ribbon cables** from your electronics kit.

Attach both cables to the rear of the LCD assembly.

Use cable ties to secure the ribbon cables to the frame.

N/A

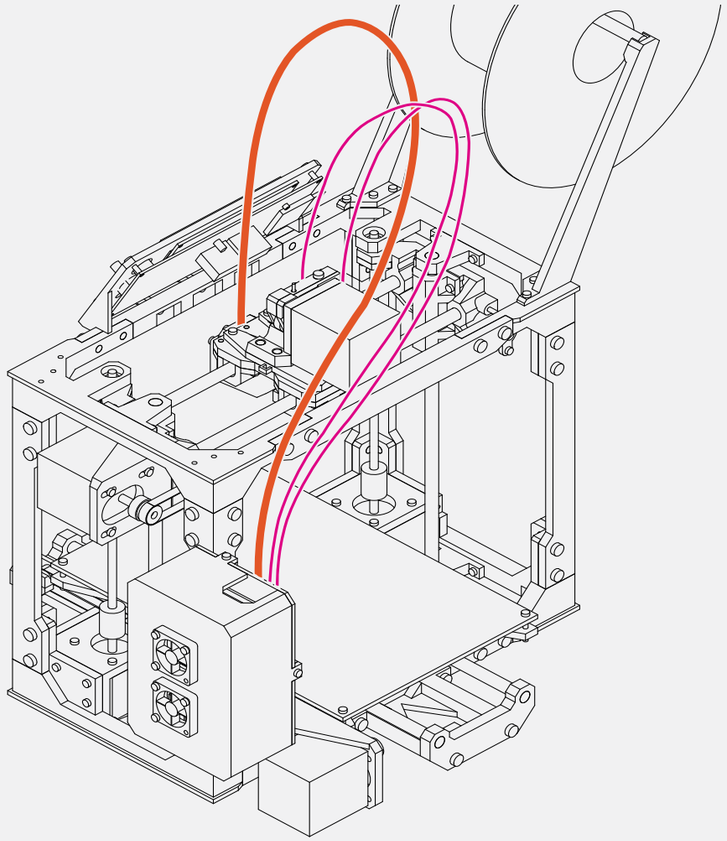


N/A

Attach the LCD ribbon cables to the top of the RAMPS electronics.

The connectors are keyed, and will only connect in a single direction.

11

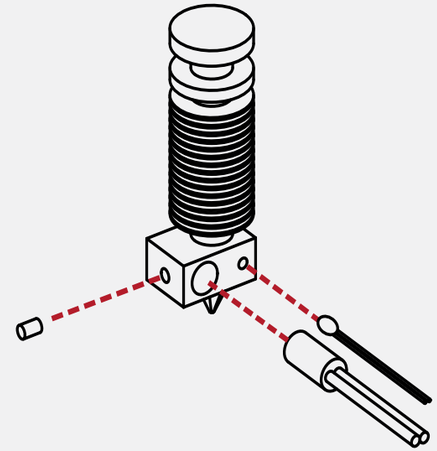


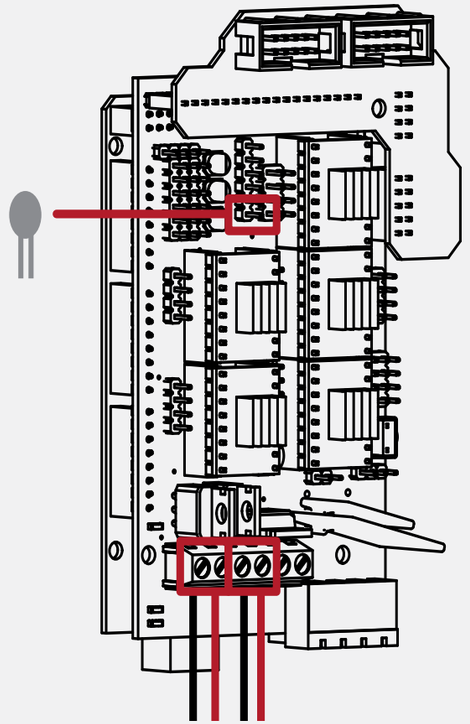
Gather the **hot end heater cartridge** and route it over the top of the frame and into the extruder assembly.

Route the cooling fan and hot end fan wires over the top of the frame and into the electronics enclosure.

N/A

12





Hot End Cooling Fan

Please refer to your hot-end's instructions for correct assembly, however the basics are, insert the heater cartridge into the heater block and secure the cartridge with the small set screw.

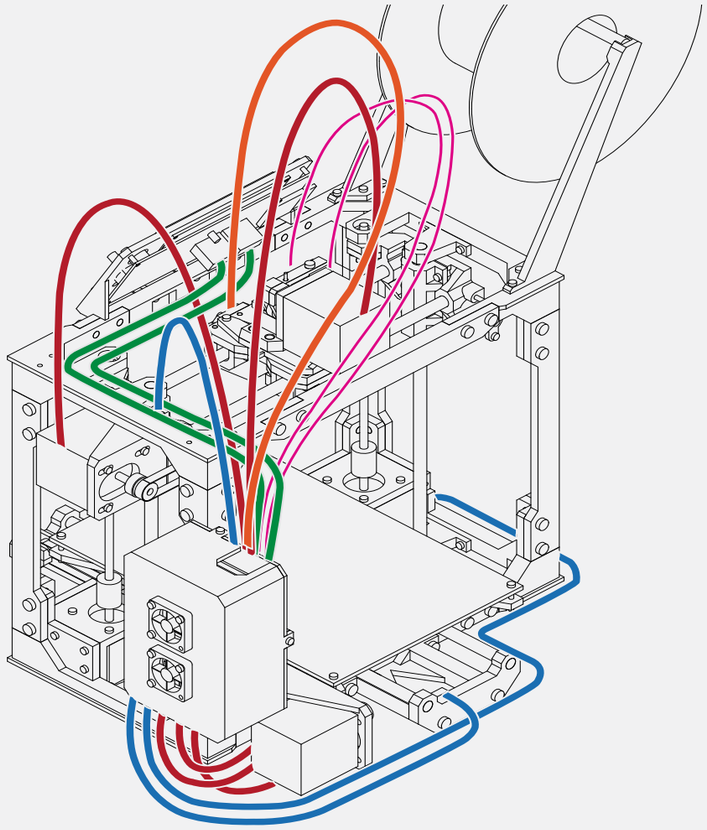
Insert the thermistor into the small opening on the heater block. Use a cable tie to hold both wire sets together.

The connectors used for the hot end and cooling fan are slightly different from the other.

Attach the heater cartridge wiring to the connectors labeled D10. Attach the Print Cooling fan to the D8 connector.

Connect the thermistor to the header pins noted above.

13



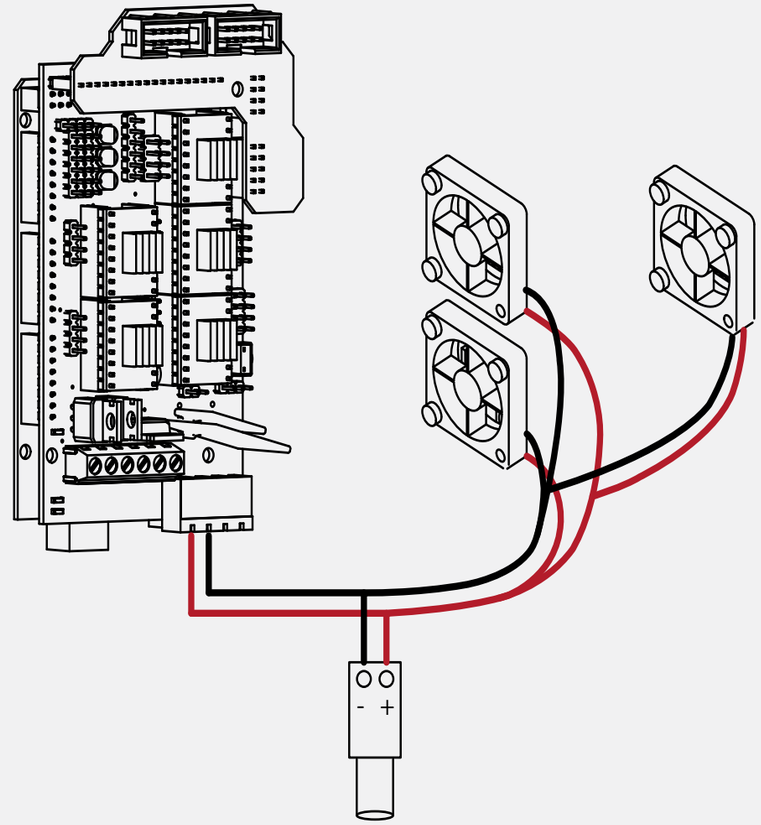
Take the final pair of wires belonging to the Hot End fan and route them over the top of the frame and into the electronics enclosure.

With the wiring mostly complete, use cable ties to neatly secure and bundle the wires.

Ensure that no wires are caught on any portion of the frame , and that all wires are long enough to reach the full extents of the printers motions.

N/A

14



The last connection is to connect the electronics enclosure fans to that of the main power supply.

Wire the fans in parallel to the barrel connector, as well as the Hot end fan.

Connect a pair of wires from the barrel connector to that of the 12V input on the RAMPS board.

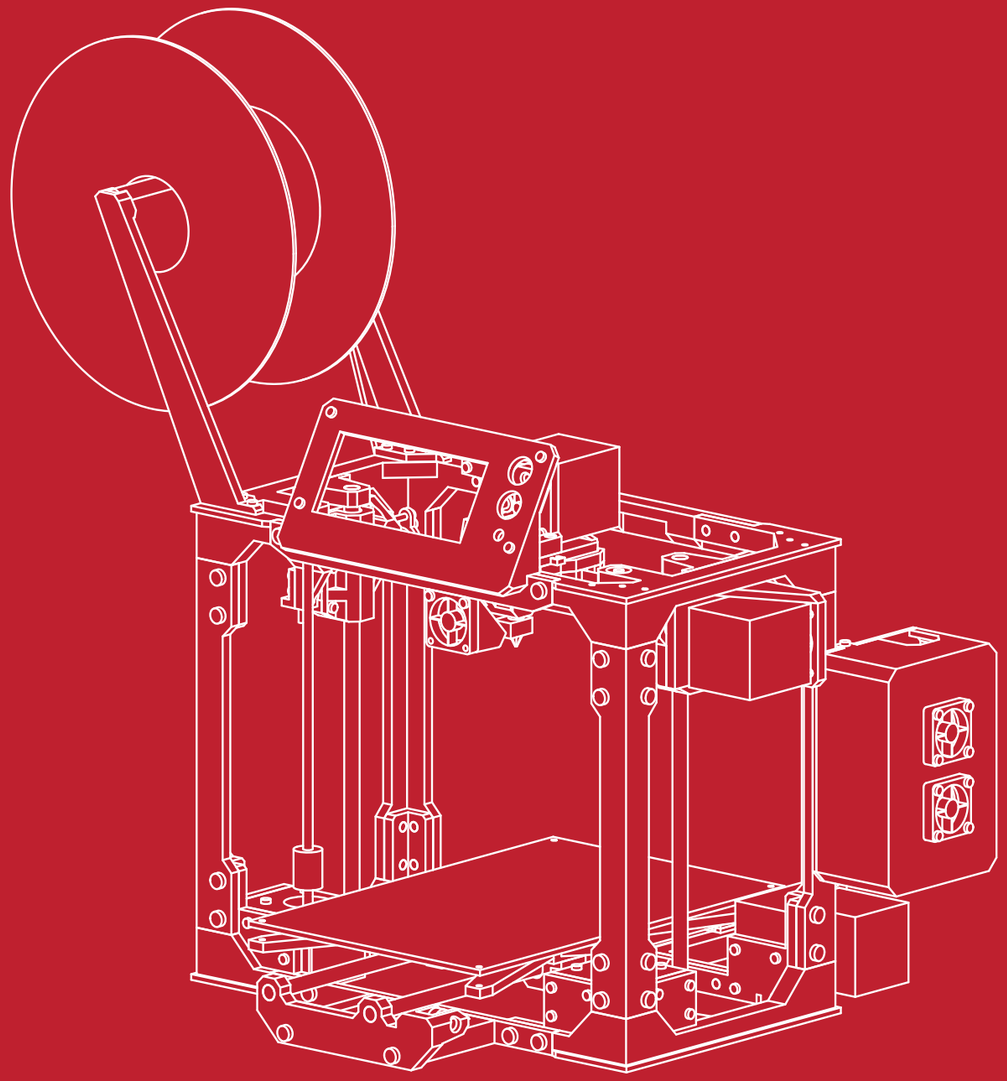
Note the polarity of the wires matches the correct polarity of the barrel connector. With the wiring complete, connect the power supply to the barrel connector and check that there is a green LED on the RAMPS board.

The electronics enclosure fans, and Hot End fan should also be operational.

Once you've verified that everything is functional, re-attach the enclosure. Your printer is now complete.

SECTION

F



Congratulations! You've successfully completed the hardest portion of the build! Pat yourself on the back and marvel at the amazing piece of engineering you've just assembled! We're almost ready to begin printing, but before we do, there's a few more items we will need to cover:

A Note on Self Sourcing Builders:

For those of who wish to source their own components outside of the available kits, we want to clarify a few steps that must be taken.

You will need to cut your linear rods to length, the lengths are as follows. You will need to cut 2 of each:

X Axis: 250mm
Y Axis: 310mm
Z Axis: 250mm
Z Axis Threaded rod: 190mm

You will need to solder the wire connections to the limit switches. These are wired in the normally open (NO) configuration. Refer to the markings on the limit switch for the correct orientation. This is typically the outer pins, with the centre third pin not being used.

Additional information is available through
www.maplemakermedia.com and www.reprap.org

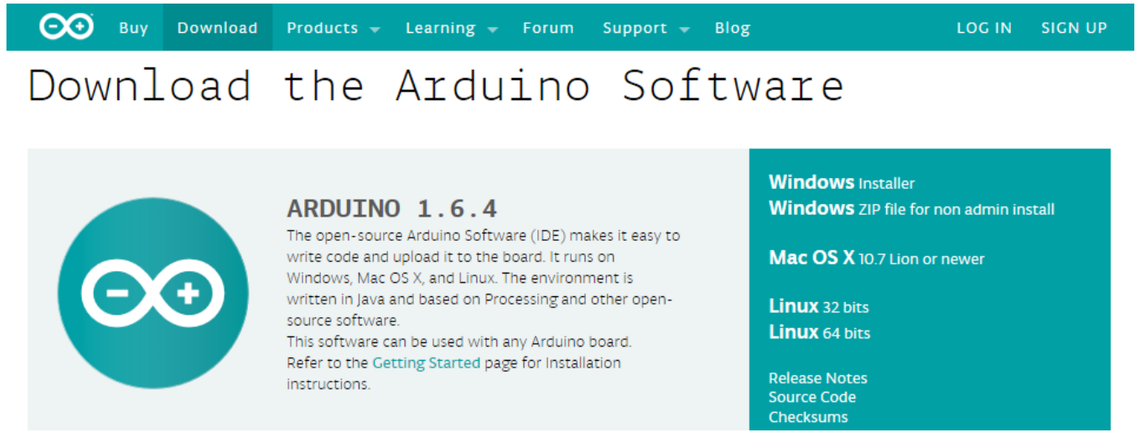
First Power Up & Verification:

Now that we've assembled our printer, our first goal before proceed further is to validate that the printer functions. To do so, connect the power supply to the printer. You should see a row of blocks on the LCD display of the printer, as well as see the Hot-End cooling fan, and electronics cooling fans working. There should be no smoke, flames, or other effects at this time. Congratulations!

A. Installing & configuring the Arduino IDE

Before we begin configuring the firmware, we must first install the appropriate software and drivers to interact with our printer. To begin, we must first install the Arduino IDE.

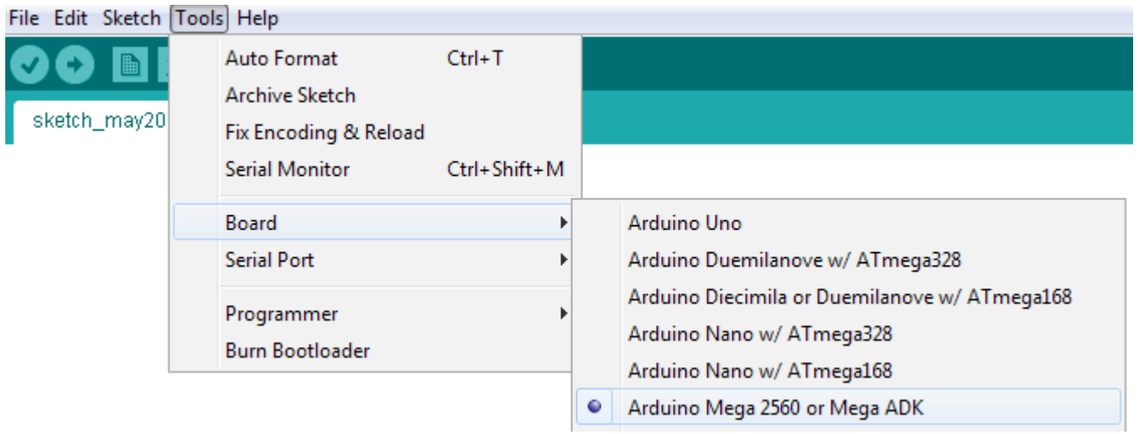
Please visit: http://www.arduino.cc/en/Main/Software and select the latest IDE for your platform.



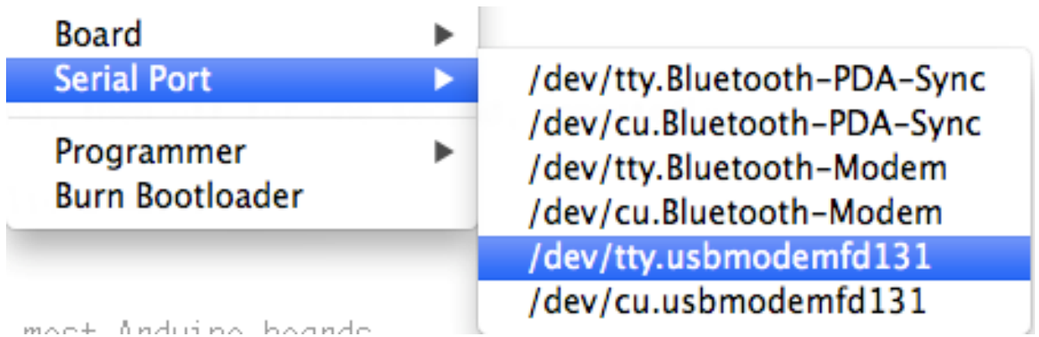
Once you have downloaded the appropriate IDE, run the installer and follow the commands on screen. This installation will also include the driver needed to connect to your printer in later steps.

Once you have installed the Arduino software, you may now connect your printer to the power supply, and connect the USB Type B cable from your computer to the printer.

We must now configure the Arduino software to communicate with our printer, to do so, launch the Arduino IDE. From the Tools Menu, select the Board option, and then the 'Arduino Mega 2560 or Mega ADK'. The Mega 2560 is the core of our printers electronics, and is commonly used in the RAMPS 1.4 configuration.



From the Tools menu again, select the Serial Port. In this drop down you will see several options. The option that we wish to use should begin with '/dev/tty.usbmodem...'. This should be the location of our printer. It is important that you do not have any other Arduino powered devices connected to your PC at this time.



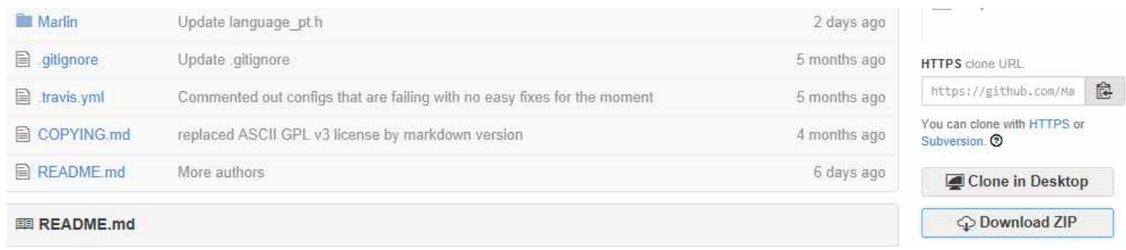
Congratulations, you've installed the Arduino IDE and configured it to talk to your printer. In the next step we will begin modifying the firmware and writing it to our printer.

F 6.1

B. Downloading & configuring the Marlin Firmware

Now that we have the Arduino software configured and connected to our printer, we must obtain the Firmware and make the necessary changes to it in order to suite our printer. The firmware is the 'brains' of the printer, which allows it to interpret gcode, commands, and control motors, extruders and all kinds of accessories. For our purposes we will be using one of the most popular firmwares, MarlinFirmware.

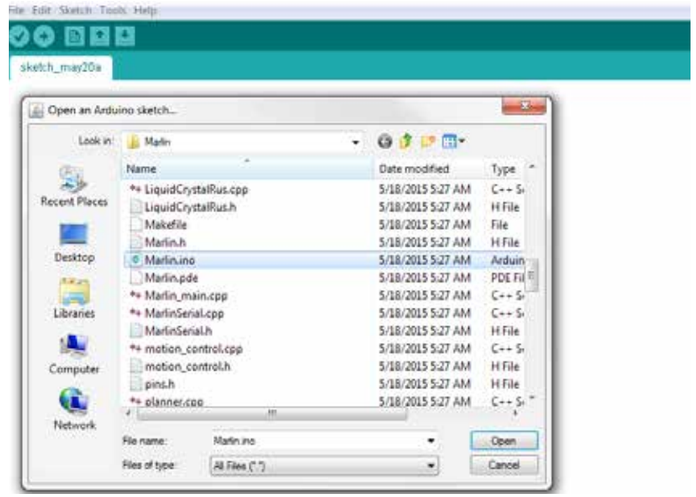
Visit https://github.com/MarlinFirmware/Marlin. On the right hand side of the window, choose the 'Download ZIP' button to download the latest release of the Marlin Firmware.



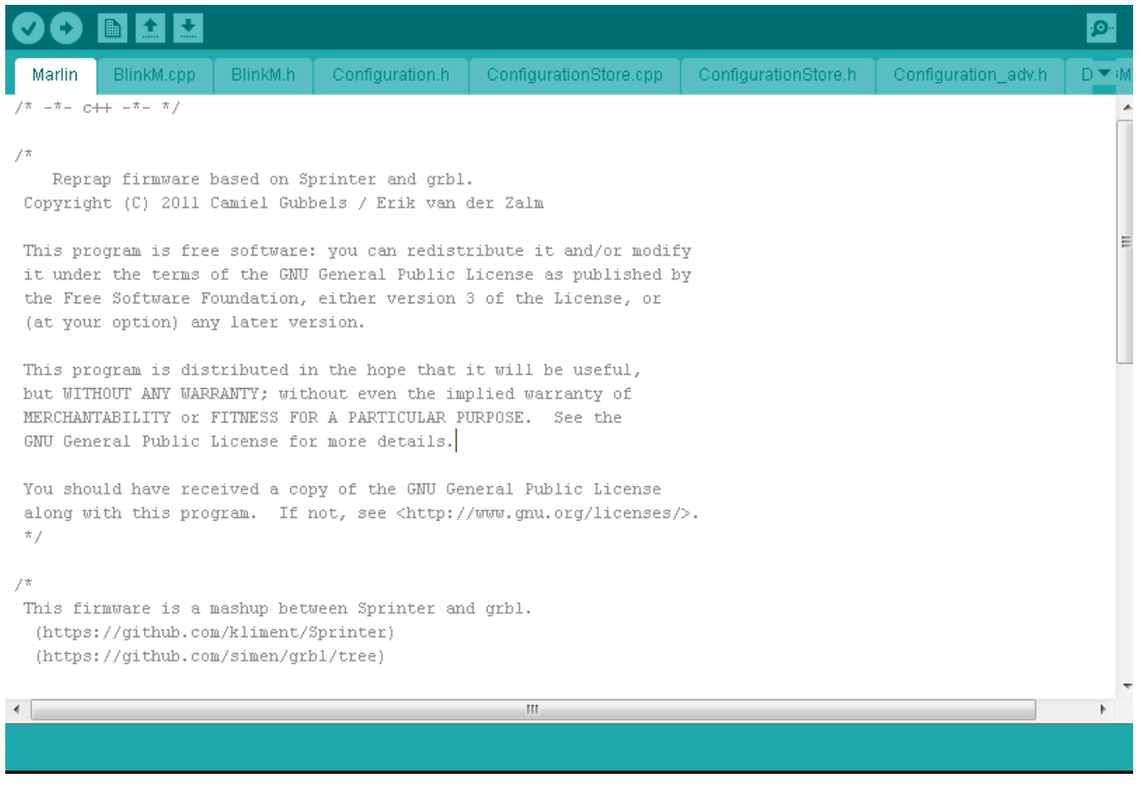
Once the download has completed, extract the Zip folder to a safe location on your computer.

There will be several sub directories and documents contained within the download. For our purposes, we are concerned with the files and configurations located at: Marlin- Release\Marlin-Release\Marlin.

With the Arduino IDE open, select the File > Open option, and then navigate to the directory listed above. In this directory, locate the 'Marlin.ino' file, and click 'Open'.



With the Firmware project files loaded, your IDE should look like this:



In the tabs at the top of the window, locate the tab 'Configuration.h'. This is where we will make all the necessary changes required for our firmware.

The first configuration we must modify is the defined motherboard. In our case, this is located on line 47 of the configuration file. Note: The line number is located in the lower left hand corner of the Arduino IDE.

Change the defined motherboard from #define MOTHERBOARD BOARD_ULTIMAKER to #defineMOTHERBOARD 33. 33 denotes the stock RAMPS 1.4 setup used in our printer.

The second option we must modify is located on line 107. This is the thermistor used in the hot- end. For our purposes, if using an e3D Lite6, this value should be changed from -1 to 5.

Set the values of line 108-110 to 0. Your Thermistor table should look like so:

```
// 10 is 100k RS thermistor 198-961 (4.7k pullup)
// 11 is 100k beta 3950 1% thermistor (4.7k pullup)
// 12 is 100k 0603 SMD Vishay NTCS0603E3104FXT (4.7k pullup) (calibrated for Makibox hot bed)
// 13 is 100k Hisens 3950  1% up to 300°C for hotend "Simple ONE " & "Hotend "All In ONE"
// 20 is the PT100 circuit found in the Ultimainboard V2.x
// 60 is 100k Maker's Tool Works Kapton Bed Thermistor beta=3950
//
//    1k ohm pullup tables - This is not normal, you would have to have changed out your 4.7k for 1k
//                          (but gives greater accuracy and more stable PID)
// 51 is 100k thermistor - EPCOS (1k pullup)
// 52 is 200k thermistor - ATC Semitec 204GT-2 (1k pullup)
// 55 is 100k thermistor - ATC Semitec 104GT-2 (Used in ParCan & J-Head) (1k pullup)
//
// 1047 is Pt1000 with 4k7 pullup
// 1010 is Pt1000 with 1k pullup (non standard)
// 147 is Pt100 with 4k7 pullup
// 110 is Pt100 with 1k pullup (non standard)

#define TEMP_SENSOR_0 5
#define TEMP_SENSOR_1 0
#define TEMP_SENSOR_2 0
#define TEMP_SENSOR_BED 0

// This makes temp sensor 1 a redundant sensor for sensor 0. If the temperatures difference between these sensor
//#define TEMP_SENSOR_1_AS_REDUNDANT
```

We must now configure our maximum extruder temperatures. Because we are using an e3D Lite6, our maximum temperatures cannot exceed 250. Change this value on line 132 like so:

```
// When temperature exceeds max temp, your heater will be switched off.
// This feature exists to protect your hotend from overheating accidentally, but *NOT* from thermistor short/fai
// You should use MINTEMP for thermistor short/failure protection.
#define HEATER_0_MAXTEMP 250
#define HEATER_1_MAXTEMP 250
#define HEATER_2_MAXTEMP 250
#define BED_MAXTEMP 110

// If your bed has low resistance e.g. .6 ohm and throws the fuse you can duty cycle it to reduce the
// average current. The value should be an integer and the heat bed will be turned on for 1 interval of
// HEATER_BED_DUTY_CYCLE_DIVIDER intervals.
//#define HEATER_BED_DUTY_CYCLE_DIVIDER 4
```

Firmware Configuration

F 6.1

Our next configuration is defining the end-stops. Our printer uses end-stops at the minimum positions, and none at the maximum, so we must remove the maximum end-stop configuration from the firmware. In these cases 2 forward slashes like so // will comment out any line of code and render it un-usable to the Arduino. You will need to comment out lines 284, 285, and 286 like so:

```
#ifndef ENDSTOPPULLUPS
  // fine endstop settings: Individual pullups. will be ignored if ENDSTOPPULLUPS is defined
  // #define ENDSTOPPULLUP_XMAX
  // #define ENDSTOPPULLUP_YMAX
  // #define ENDSTOPPULLUP_ZMAX
  // #define ENDSTOPPULLUP_XMIN
  // #define ENDSTOPPULLUP_YMIN
  // #define ENDSTOPPULLUP_ZMIN
#endif

#ifdef ENDSTOPPULLUPS
  //#define ENDSTOPPULLUP_XMAX
  //#define ENDSTOPPULLUP_YMAX
  //#define ENDSTOPPULLUP_ZMAX
  #define ENDSTOPPULLUP_XMIN
  #define ENDSTOPPULLUP_YMIN
  #define ENDSTOPPULLUP_ZMIN
#endif
```

We must also set the end-stop inverting to false. Change the true value to false for lines 293-298 like so:

```
#ifdef ENDSTOPPULLUPS
  //#define ENDSTOPPULLUP_XMAX
  //#define ENDSTOPPULLUP_YMAX
  //#define ENDSTOPPULLUP_ZMAX
  #define ENDSTOPPULLUP_XMIN
  #define ENDSTOPPULLUP_YMIN
  #define ENDSTOPPULLUP_ZMIN
#endif

// The pullups are needed if you directly connect a mechanical endswitch between the signal and ground pins.
const bool X_MIN_ENDSTOP_INVERTING = false; // set to true to invert the logic of the endstop.
const bool Y_MIN_ENDSTOP_INVERTING = false; // set to true to invert the logic of the endstop.
const bool Z_MIN_ENDSTOP_INVERTING = false; // set to true to invert the logic of the endstop.
const bool X_MAX_ENDSTOP_INVERTING = false; // set to true to invert the logic of the endstop.
const bool Y_MAX_ENDSTOP_INVERTING = false; // set to true to invert the logic of the endstop.
const bool Z_MAX_ENDSTOP_INVERTING = false; // set to true to invert the logic of the endstop.
//#define DISABLE_MAX_ENDSTOPS
//#define DISABLE_MIN_ENDSTOPS

// Disable max endstops for compatibility with endstop checking routine
#if defined(COREXY) && !defined(DISABLE_MAX_ENDSTOPS)
  #define DISABLE_MAX_ENDSTOPS
#endif
```


Our most important configuration of the firmware is defining the size of the printer's volume. Defining an area larger than what the printer can physically print is a bad idea, and can cause serious issues, so we must set these values to be equal to or slightly less than the actual physical volume of the printer. The fields that need to be changed are located on lines 337, 339 and 341. In our case, these values should be changed to 140 like so:

```
#define INVERT_E0_DIR false   // for direct drive extruder v9 set to true, for geared extruder set to false
#define INVERT_E1_DIR false    // for direct drive extruder v9 set to true, for geared extruder set to false
#define INVERT_E2_DIR false   // for direct drive extruder v9 set to true, for geared extruder set to false

// ENDSTOP SETTINGS:
// Sets direction of endstops when homing; 1=MAX, -1=MIN
#define X_HOME_DIR -1
#define Y_HOME_DIR -1
#define Z_HOME_DIR -1

#define min_software_endstops true // If true, axis won't move to coordinates less than HOME_POS.
#define max_software_endstops true  // If true, axis won't move to coordinates greater than the defined lengths below.

// Travel limits after homing
#define X_MAX_POS 140
#define X_MIN_POS 0
#define Y_MAX_POS 140
#define Y_MIN_POS 0
#define Z_MAX_POS 140
#define Z_MIN_POS 0

#define X_MAX_LENGTH (X_MAX_POS - X_MIN_POS)
#define Y_MAX_LENGTH (Y_MAX_POS - Y_MIN_POS)
#define Z_MAX_LENGTH (Z_MAX_POS - Z_MIN_POS)
//============================ Bed Auto Leveling ===========================
```

We must now configure our Homing Feedrate. For the purposes of our printer, these should be set to the following values on line 478:

```
//Manual homing switch locations:
// For deltabots this means top and center of the Cartesian print volume.
#define MANUAL_X_HOME_POS 0
#define MANUAL_Y_HOME_POS 0
#define MANUAL_Z_HOME_POS 0
//#define MANUAL_Z_HOME_POS 402 // For delta: Distance between nozzle and print surface after homing.

//// MOVEMENT SETTINGS
#define NUM_AXIS 4 // The axis order in all axis related arrays is X, Y, Z, E
#define HOMING_FEEDRATE {50*60, 50*60, 50, 0}  // set the homing speeds (mm/min)
```

Firmware Configuration

F 6.1

After we have defined our feed rate, we must set our default steps per millimeter. These values indicate how many motor steps are required to travel 1mm. A good baseline for our printers is provided below. Modify these values in your configuration on line 482:

```
// default settings

#define DEFAULT_AXIS_STEPS_PER_UNIT   {80.2, 80.2, 4417, 147}  // default steps per unit for Ultimaker
#define DEFAULT_MAX_FEEDRATE          {500, 500, 5, 25}    // (mm/sec)
#define DEFAULT_MAX_ACCELERATION      {9000,9000,100,10000}    // X, Y, Z, E maximum start speed for a
```

It's also good to modify our max feed rates to the following on line 483:

```
#define DEFAULT_AXIS_STEPS_PER_UNIT   {80.2, 80.2, 4417, 147}  // default steps per unit for Ultimaker
#define DEFAULT_MAX_FEEDRATE          {250, 250, 2, 22}    // (mm/sec)
#define DEFAULT_MAX_ACCELERATION      {9000,9000,100,10000}    // X, Y, Z, E maximum start speed for acc
```

And lastly, set our default max acceleration to the following values on lines 484, 486 and 487

```
#define DEFAULT_AXIS_STEPS_PER_UNIT   {80.2, 80.2, 4417, 147}  // default steps per unit for Ultimaker
#define DEFAULT_MAX_FEEDRATE          {250, 250, 2, 22}    // (mm/sec)
#define DEFAULT_MAX_ACCELERATION      {1000,1000,2,10000}    // X, Y, Z, E maximum start speed for acceler

#define DEFAULT_ACCELERATION          500    // X, Y, Z and E max acceleration in mm/s^2 for printing move
#define DEFAULT_RETRACT_ACCELERATION  500   // X, Y, Z and E max acceleration in mm/s^2 for retracts
```

We've now completed the most crucial parts of the configuration, but we still have a few options remaining.

You will also want to define the EEPROM settings for the configuration, namely enabling them. To do so, uncomment (remove the 2 '//') from lines 519 and 522 like so:

```
// EEPROM
// The microcontroller can store settings in the EEPROM, e.g. max velocity...
// M500 - stores parameters in EEPROM
// M501 - reads parameters from EEPROM (if you need reset them after you changed them temporarily).
// M502 - reverts to the default "factory settings".  You still need to store them in EEPROM afterwards if you want to.
//define this to enable EEPROM support
#define EEPROM_SETTINGS
//to disable EEPROM Serial responses and decrease program space by ~1700 byte: comment this out:
// please keep turned on if you can.
#define EEPROM_CHITCHAT
```


Lastly, we must enable support for the LCD panel on our printer. To do so, uncomment the line 552. This will enable support for the LCD panel included with your printer.

```
// The RepRapDiscount Smart Controller (white PCB)
// http://reprap.org/wiki/RepRapDiscount_Smart_Controller
#define REPRAP_DISCOUNT_SMART_CONTROLLER

// The GADGETS3D G3D LCD/SD Controller (blue PCB)
// http://reprap.org/wiki/RAMPS_1.3/1.4_GADGETS3D_Shield_with_Panel
//#define G3D_PANEL
```

Click File > Save when you are finished.

Congratulations! Your firmware is now complete and ready to be verified. To verify and compile your firmware, click the check icon in the upper left corner of the window. If all goes correctly, in a few moments you should receive a message at the bottom of the screen indicating that the firmware has been compiled like so:

With the firmware compiled, and your printer connected to your PC, you may begin the process of uploading the firmware. To do so, after compiling the firmware, click the arrow button next to the Compile button. The message in the bottom of the window will change to 'Uploading Firmware' and you will see a progress bar appear. When the firmware is flashed correctly, you will see 'Upload finished' appear in the bottom of the window, and you should see your printer information appear on the LCD panel of your printer. Congratulations!

Printer Control Using Cura

F 6.2

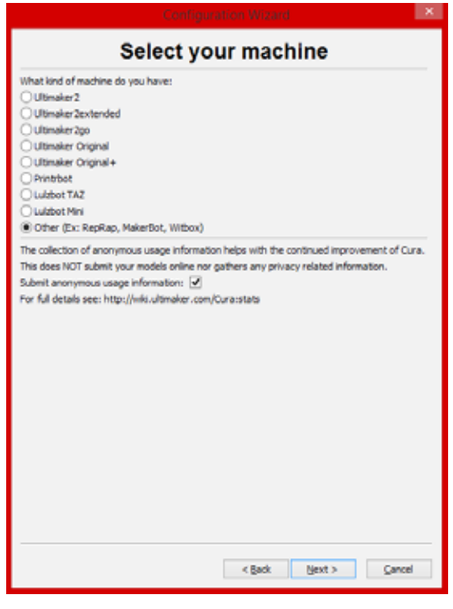
A. Installing and configuring Cura

Now that we have compiled and uploaded the firmware for our printer, we must turn our attention to the software we will use for manipulating the models and creating profiles that allow us to print objects. These is commonly known as a slicer, and there are many options available on the market today. In keeping with our open-source nature, we are using Cura, developed by the amazing team at Ultimaker.

In order to begin, please visit: https://software.ultimaker.com/ and download the latest stable release of Cura for your platform.

Once downloaded, launch the installer and follow the prompts on screen to install Cura. At the end of the installation Cura will automatically launch, and the first run wizard will appear. Click Next to continue.

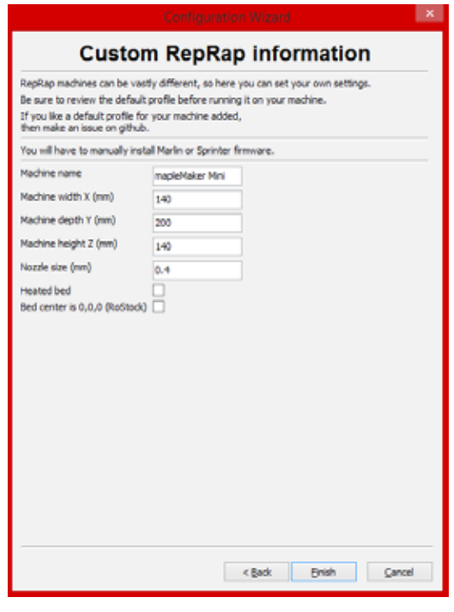
On the next screen you will be asked to select the type of printer that you intend to use. For our purposes, choose the last option, Other, and click Next.



The following screen presents a number of different printer configurations for us to choose from. We will choose the final option, Custom. Click Next to Continue.

We will now need to enter some basic information about our printer. For our printer, these settings are as follows.
Click Finish when you ready.

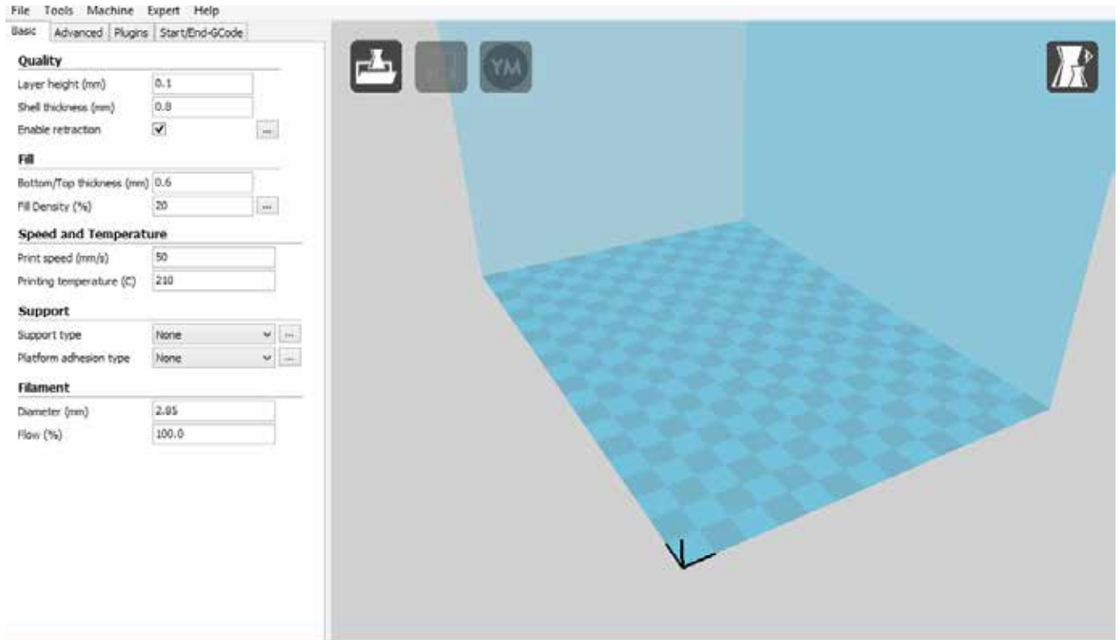
With the basic configuration complete, we will spend a few minutes tweaking our slicing profile to suite our first print.



Printer Control Using Cura

F 6.2

The primary interface of Cura is broken into 2 components. To the right we have the virtual build volume. This where your models are placed. The box on screen represents the build volume of your printer. The second component is the slicing parameters. These are the user controllable options that adjust variables such as the layer height, print speed and support material.



For the purpose of our first prints, lets adjust some of these settings.

Quality

Layer height (mm)	0.1
Shell thickness (mm)	0.8
Enable retraction	☑ ...

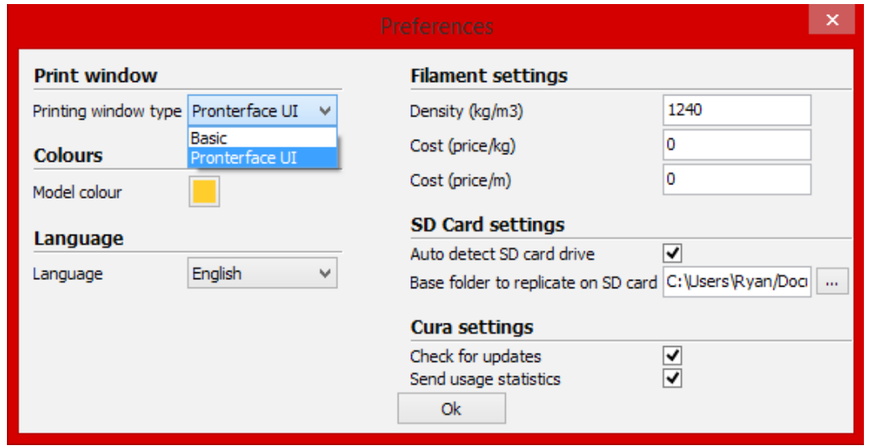
First and foremost, we will adjust the layer height from the stock 0.1 to 0.3. The lower this number, the thinner the layers will be. This will produce a better print, but can also be more challenging and time consuming. 0.3 layer heights are a good compromise between ease of use and quality.

The second option that we must modify is the Filament diameter. This value should be changed to 1.75mm, the diameter of the filament that our printer uses.

Filament

Diameter (mm)	2.85
Flow (%)	100.0

To initially test our printer, we will need to load the advanced UI and Pronterface UI for Cura. To do so, from the File Menu in Cura, choose Preferences. In the Preferences window, change the Printing Window Type to Pronterface UI like below:



For the time being, the rest of the default values will work for our first prints. We will also cover these options in depth later in this guide.

You can also learn more about Cura through Ultimaker's official documentation at:
https://ultimaker.com/en/support/view/248-cura-manual

B. Connecting your printer to Cura

Connecting your printer to Cura couldn't be easier. Simply connect the USB cable from your PC to the printer, ensure that your printer is powered up, and launch Cura. You should see the middle icon in Cura's 3d stage labeled 'Print with USB'.

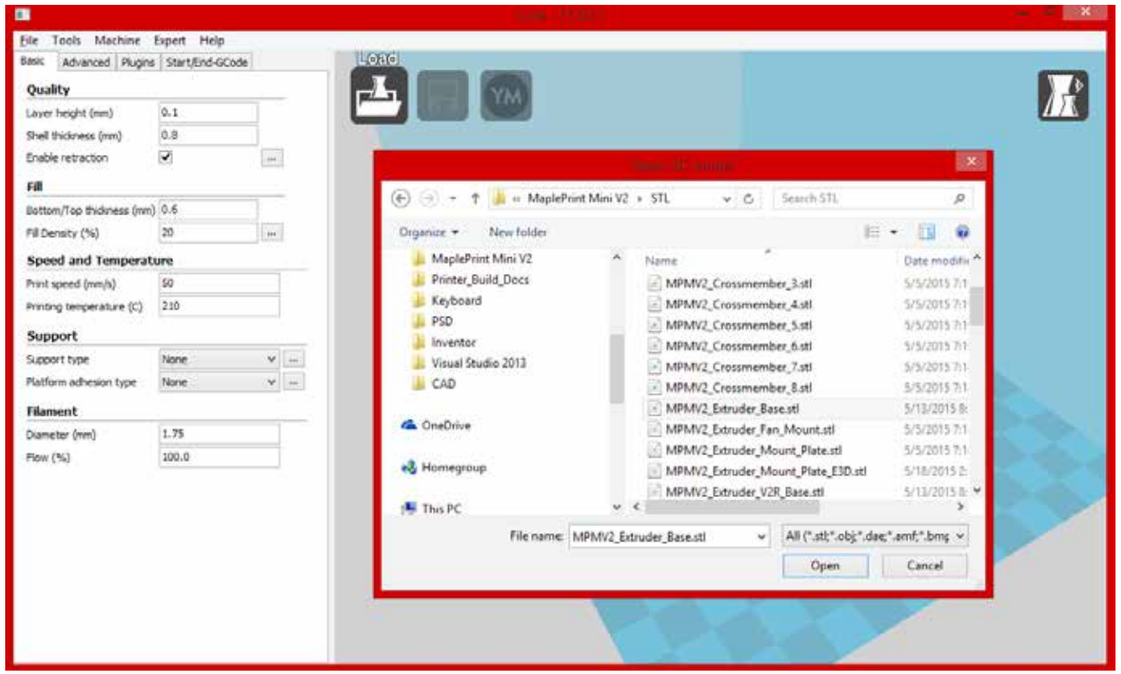
Printer Control Using Cura

F 6.2

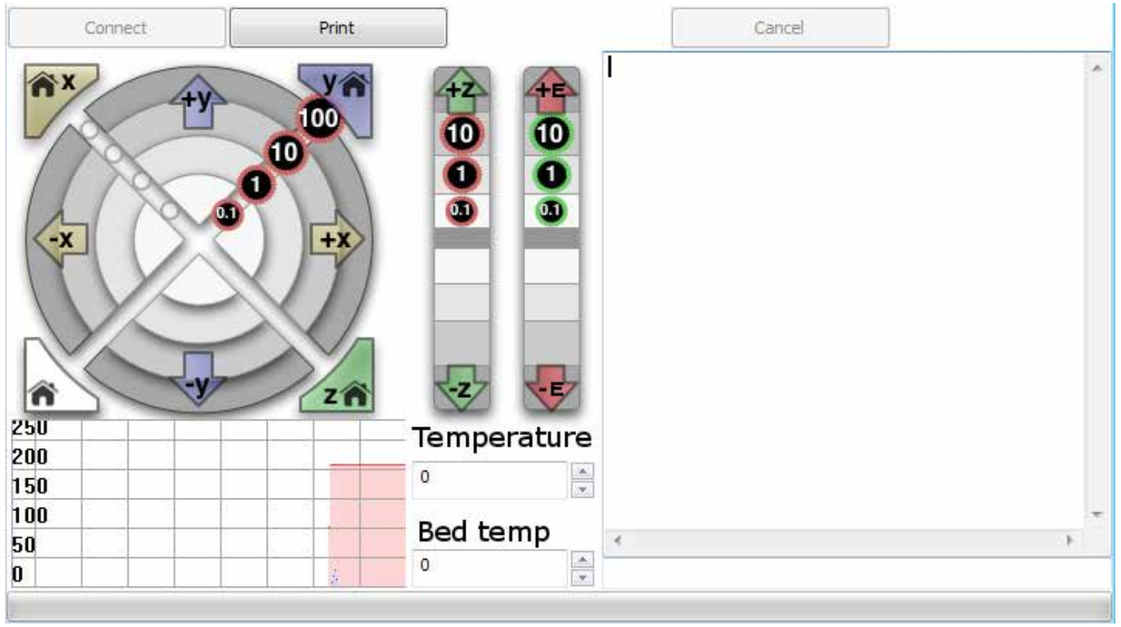
C. Understanding the print controller

For the following guide, we will first need to load a temporary model into the stage of Cura in order to display the printer controller. We will however not be printing at this moment.

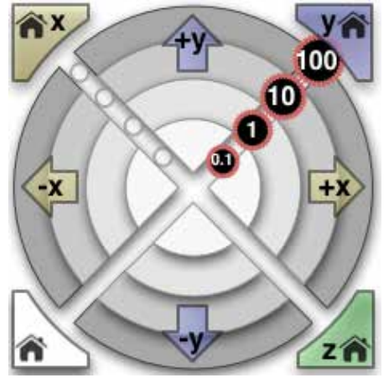
To load a model, click the folder icon on the stage, and select your model. For illustration purposes, we are using a extruder base from the mapleMaker Mini printer.

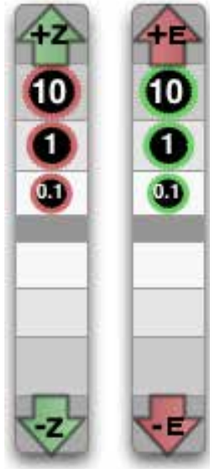


You should now see the object placed in the centre of the stage. When ready, click the Print with USB button. You should now see the Pronterface Interface:



The Pronterface interface is broken into 4 main areas. The first area is the motion controllers for the printer itself. The large cirular dial allows you to control individual axis' of the printer in 0.1, 1, 10 and 100mm increments.



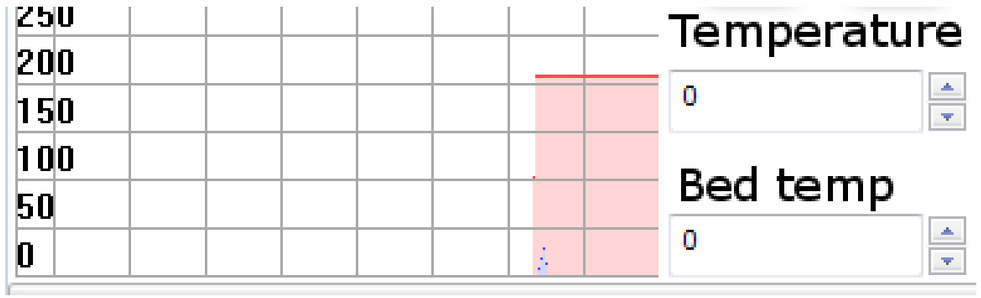


The vertical sliders to the right of the axis controller allows the user to raise or lower the Z axis, as well as extrude filament hrough the extruder. Note: Do not extrude or retract filament unless the hot end is up to temperature. Doing so will damage your printer.

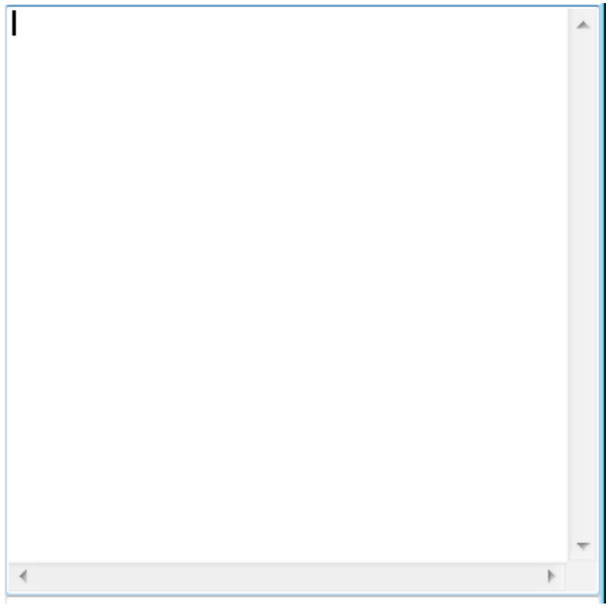
Printer Control Using Cura

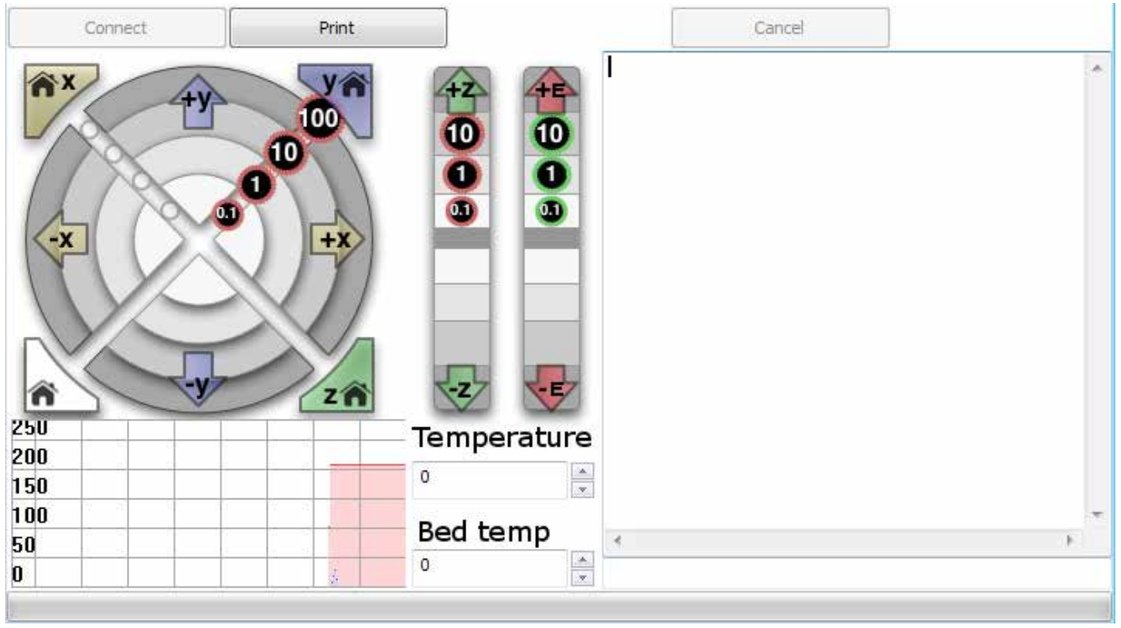
F 6.2

The third area is the temperature control and information. The graph will display the active temperature of the hot end, while the adjoining fields will allow the user to modify the temperature of the extruder.ace:



The last area is the gcode window. This window will display various gcode information such as gcode for your sliced models, as well as error messages and other information. At the bottom of the window is a single line field which will allow the operator to send commands to the printer. We will be using this for our first test runs.





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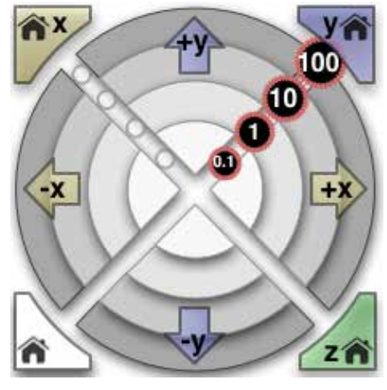

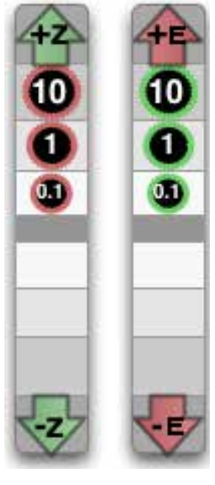

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Printer Control Using Cura

F 6.2

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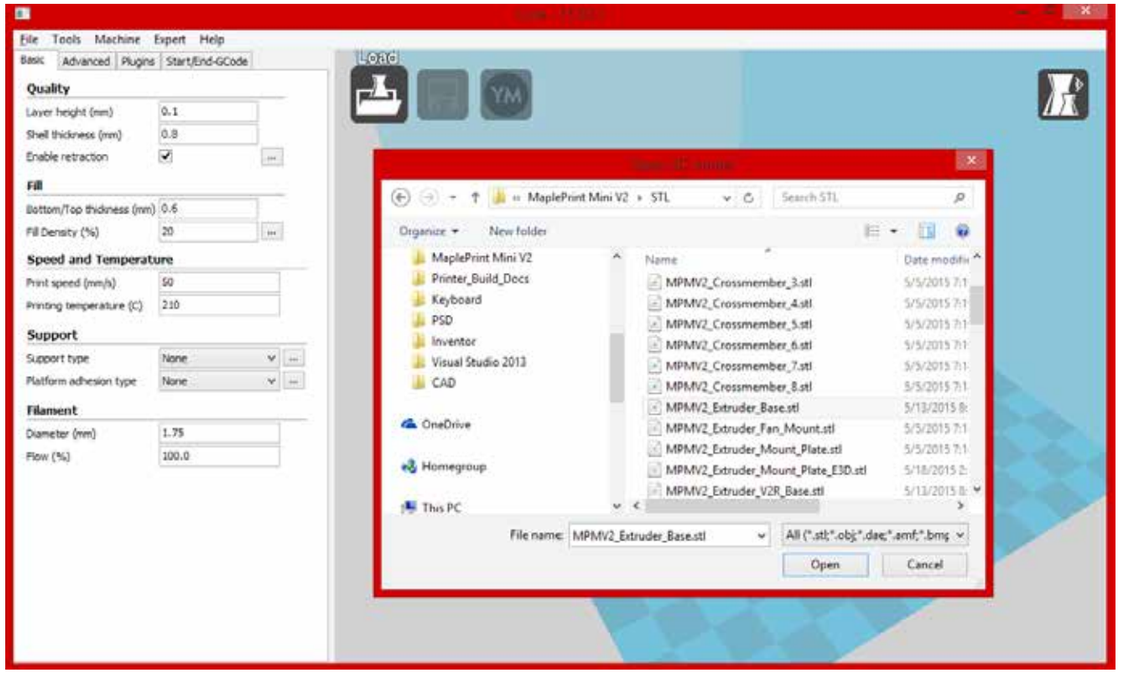
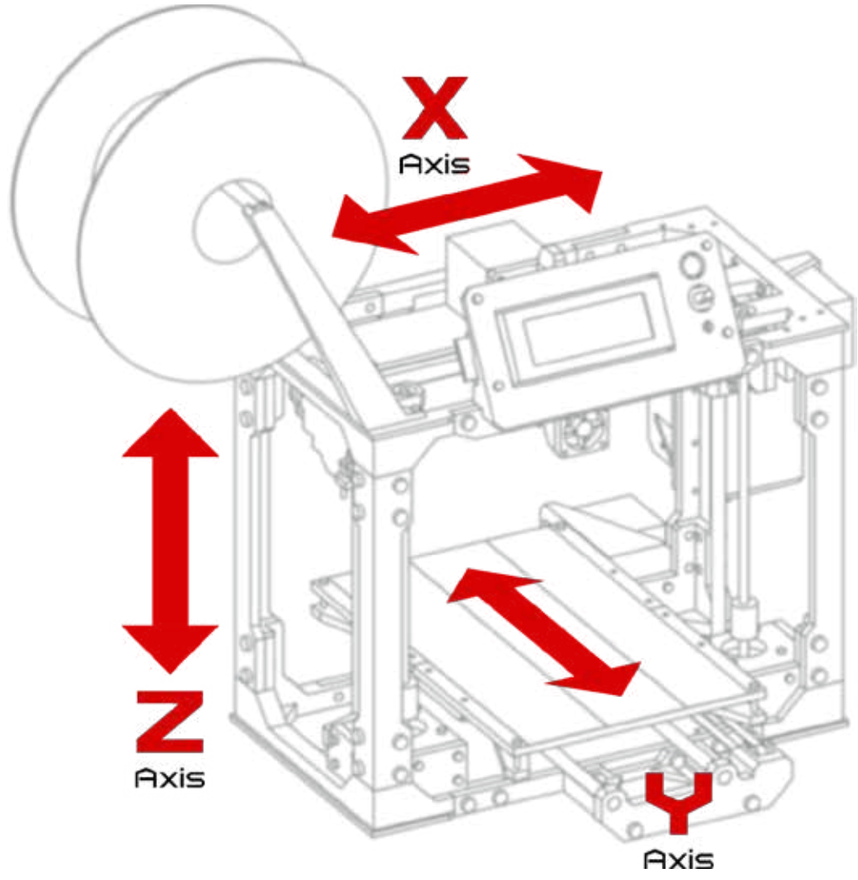


You should now see the object placed in the centre of the stage. When ready, click the Print with USB button.
You should now see the Pronterface Interface:

D. Validating your printer capabilities

i. Axis movements

The most important step in our initial configuration is to ensure that the axis' of the printer move, and move in the correct direction. The axis of the printer is set up in the following:



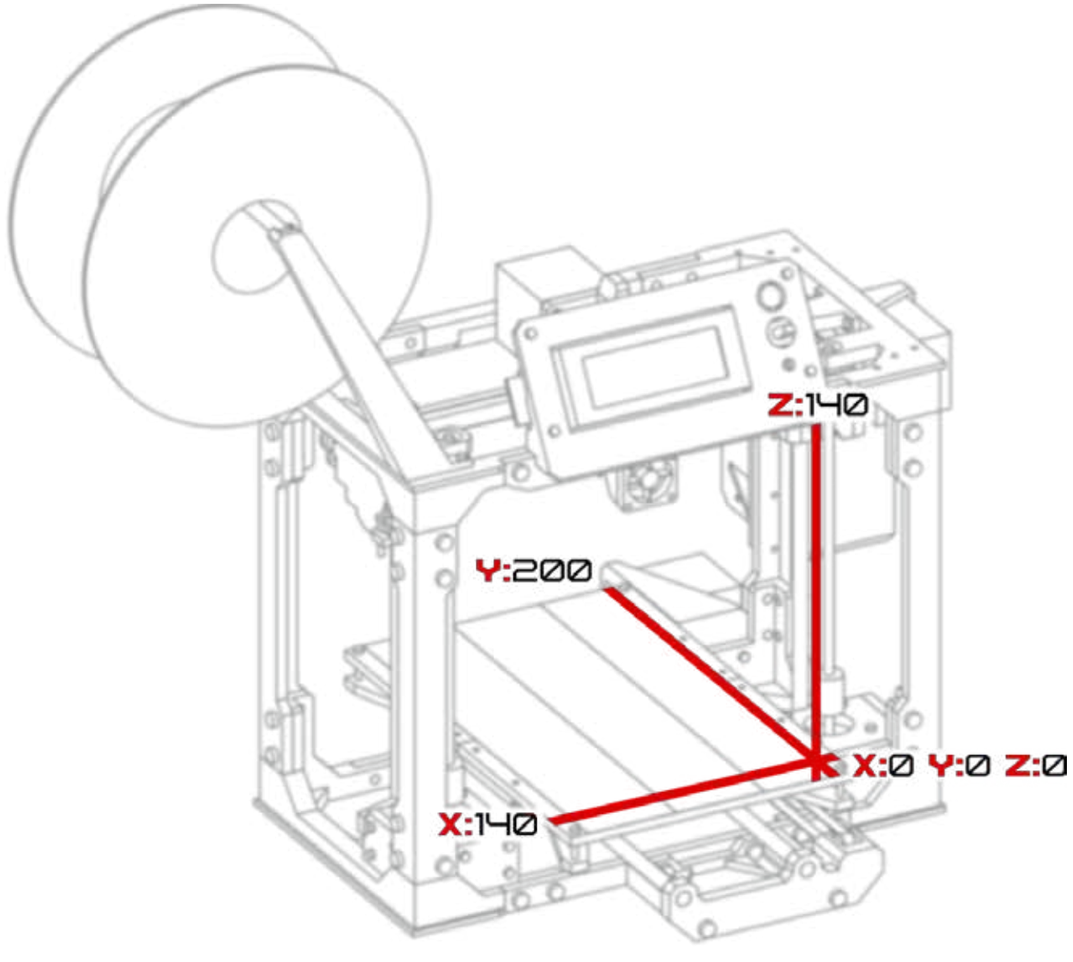
The extruder travels in the X axis, as well as up and down in the Z axis, while the print bed travels only in the Y axis.

Printer Control Using Cura

F 6.2

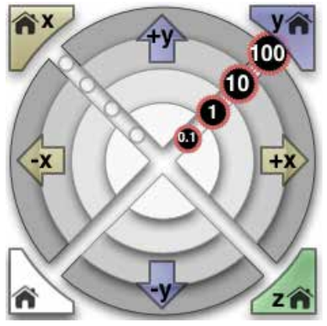
The starting point for the printer, the co-ordinates of 0,0,0 is towards the front right corner of the printer. This means that if we move any one axis in a positive direction, we are moving away from this point, and if we are moving in a negative direction, we are moving towards this location.

This is illustrated in the diagram below. For instance, the maximum travel of the X axis, 140mm would have the extruder all the way to the left side of the print bed, while extending the Y axis to its maximum travel of 200mm would bring it forward.



To test our axis', ensure that each of the axis' are near the middle of their travel and connect your printer to your PC and follow the previous steps to load a temporary model and open the Pronterface UI in Cura.

We will test one axis at a time for the following procedure. To test the X axis, using the Pronterface controller, click on the second inner ring of the right side button (labeled +X). The X axis should move away from our starting point of 0,0,0. Repeat this step in the opposite direction for the X axis. The axis should move back towards our starting point.



Repeat this step for the Y and Z axis as well. Both axis' should move in the correct direction. If for whatever reason they move opposite of the intended direction, disconnect your printer, and unplug the power to the printer. Remove the electronics enclosure cover, and locate the motor driver for the affected axis. Simply unplug the motor cable and reverse itse direction. This will reverse the direction of the motor. Reconnect your power supply and conenct the printer to your PC. Repeat the steps above and validate that the axis' move in their proper direction.

ii. End stop validation

With the correct movement of the axis' verified, we must now verify that our end-stops function as they should. To do so, ensure that none of the axis' are touching the end-stops. From the Pronterface interface, type M119 into the Gcode window and press entered.

If all goes well, you should see the Gcode window dispay several lines of text. These should read as:
X_min: open Y_min: open Z_min: open

Now, using your free hand, depress the X axis end-stop and while depressed, repeat the previous step. Your response should be:
X_min: TRIGGERED Y_min: open Z_min: open

Repeat this procedure for the Y and Z axis. All 3 axis should behave similarly. If any of the end stops behaves differently, disconnect your printer, and verify that the end stop connections on both the end stop and on the RAMPS board are correct. Repeat the procedure to ensure the end stops are working correctly.

Final Printer Configuration

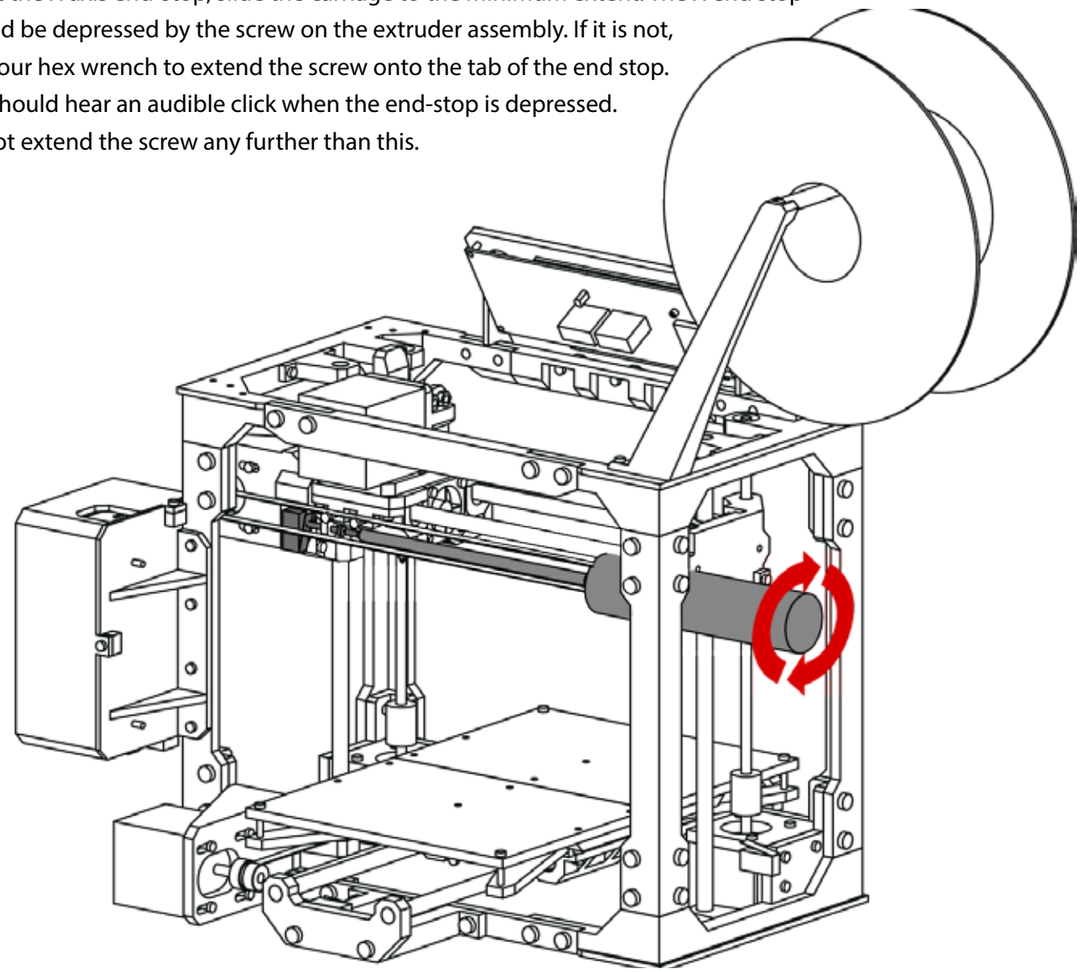
F 6.3

The steps below will help you fine tune the performance of your printer and prepare it for the first print.

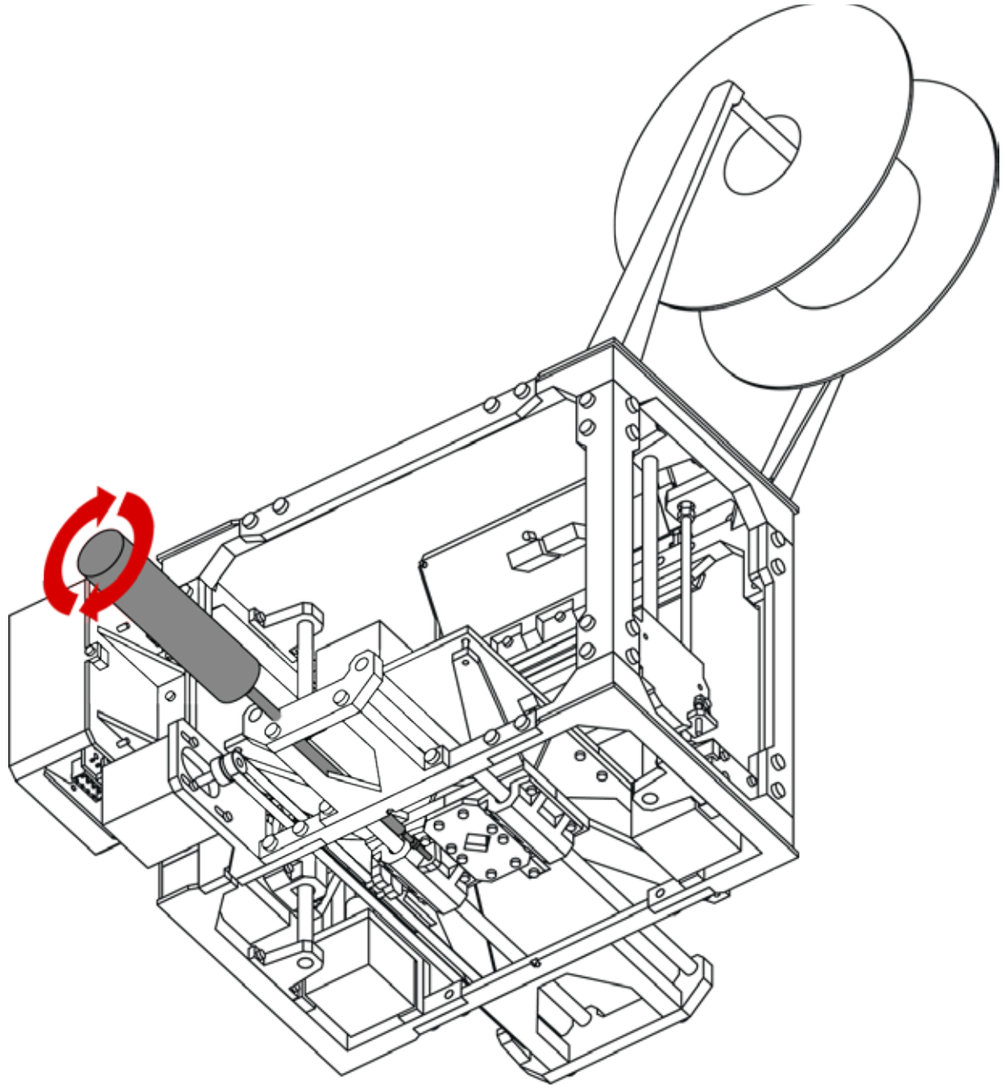
A. Setting your end stops

Setting your end-stop distance is a simple yet important step. To complete this step you will need your M3 hex wrench.

To set the X axis end-stop, slide the carriage to the minimum extent. The X end stop should be depressed by the screw on the extruder assembly. If it is not, use your hex wrench to extend the screw onto the tab of the end stop. You should hear an audible click when the end-stop is depressed. Do not extend the screw any further than this.



The procedure is much the same for the Y axis as well. Extend the Y axis to the minimum of its travel and check to see if the screw on the bottom of the Y axis is contacting the end-stop. If it is not, use your hex wrench to extend the screw until it does. Again, listen for the audible click of the screw depressing the end-stop.



Final Printer Configuration

F 6.3

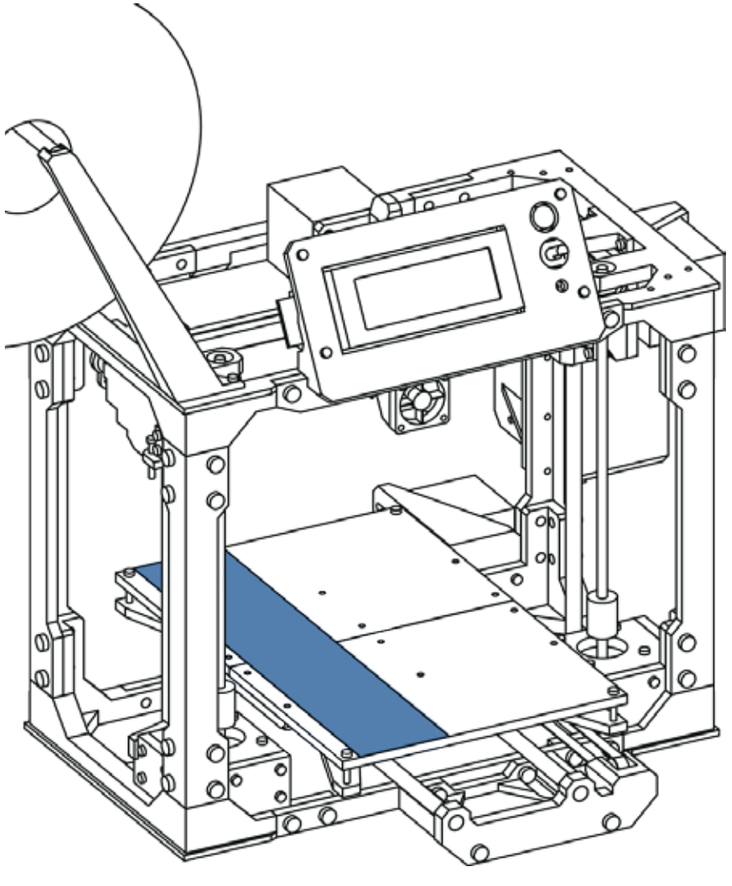
B. Leveling your print bed

Leveling your print bed is perhaps the most crucial step we must take before we print our first object. Thankfully it's a straight forward procedure and one that can be completed easily. You should also periodically re-level your print bed.

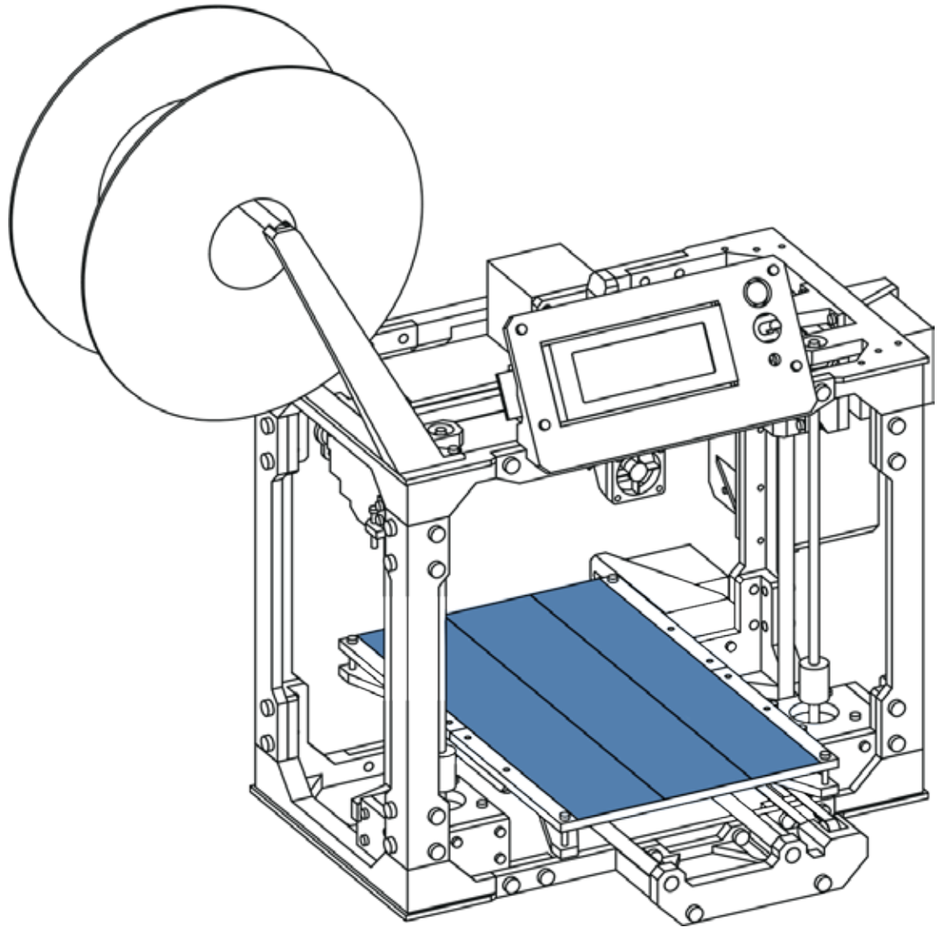
You will need the following:
- Blue painters tape
- A business card or semi-thick sheet of paper
- M3 hex wrench

Before we begin, we must first prepare our print surface. Printing with PLA can be one of the easiest filaments to work with, as well as delivering some of the best results. PLA is also unique in that it does not need a heated bed to print on, and can be printed on a very easy to apply bed, 3M Blue Painters Tape.

Use Blue Painters Tape to cover the print bed completely. Blue Painters tape can usually be found at most hardware stores, in widths ranging from 1 to 2 inches.



It is important that when applying the strips of painters tape, to not overlap the tape. Overlapping the tape will produce a small ridge in your print surface which can affect your print quality and results. It's best to butt each strip up against each other, or leave a very small gap between each strip like so:



With a layer of painters tape applied to the bed, we can now begin to level our print bed.

First we must set the initial height of the Z axis. To do so, we will connect the printer to our PC and launch Cura and the Pronterface interface as illustrated earlier.

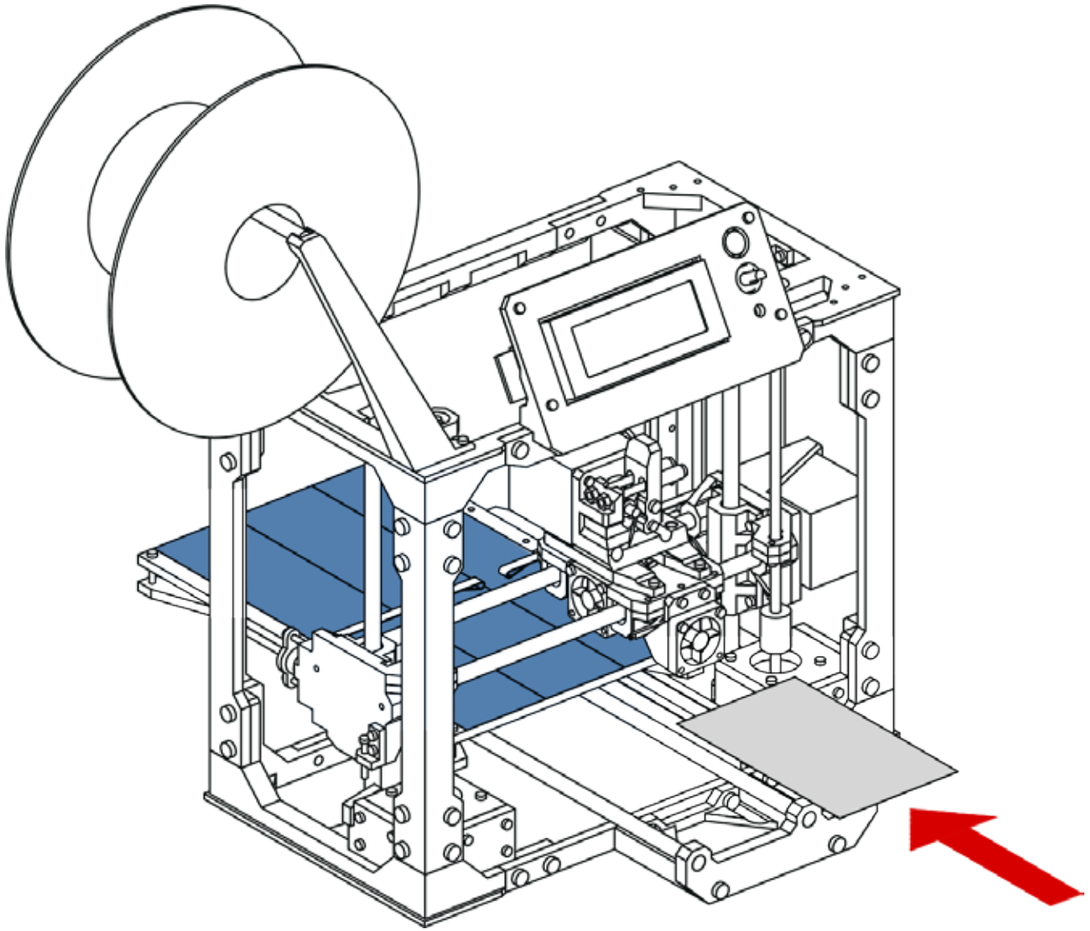
Final Printer Configuration

F 6.3

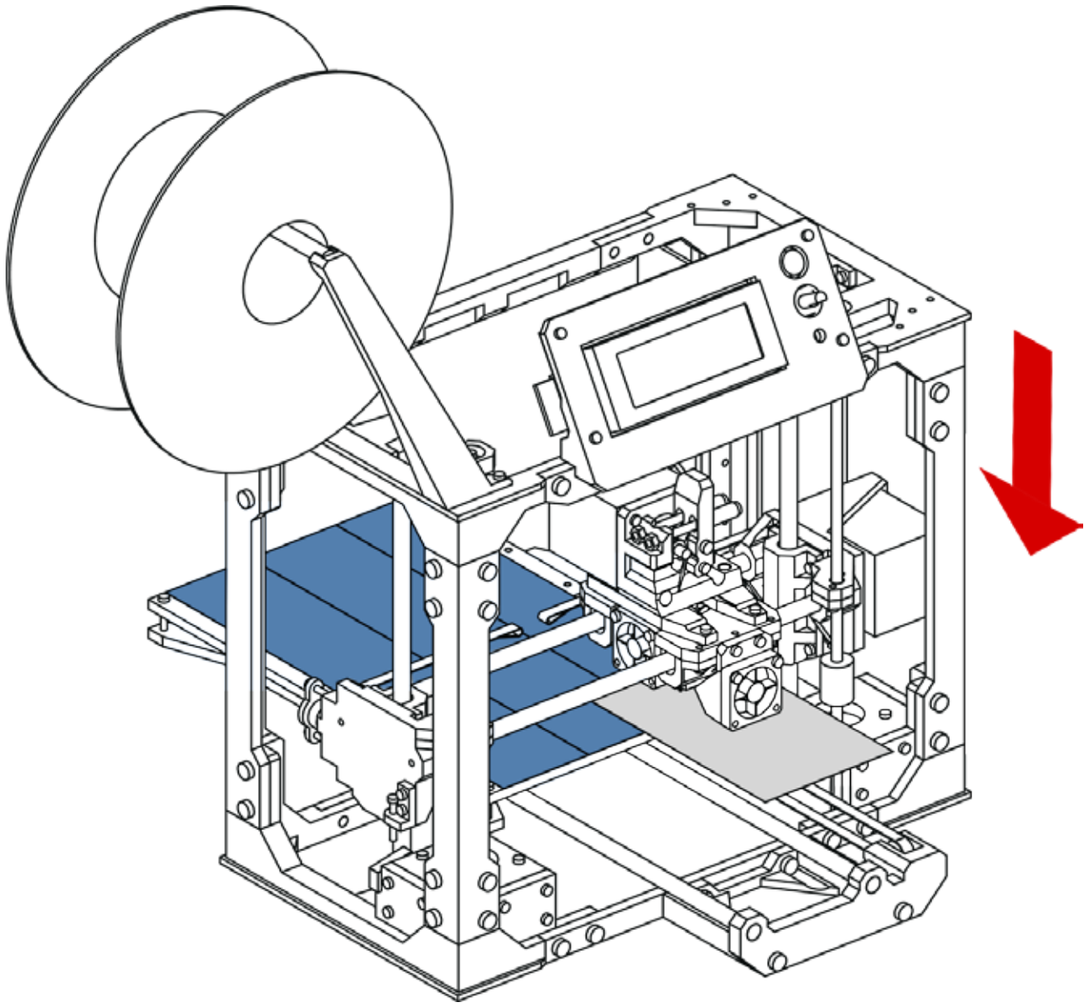
Move the X axis to its minimum position, along with the Y axis. Using the pronterface interface, you can click on the small Home icons in each of the X and Y controllers to home each axis to its minimum positon.

With the X and Y positon at their minimum, begin to lower the Z axis. As you get closer to the print bed, lower your Z axis 1mm at a time.

As the extruder tip reaches the print bed, grab your business card, or semi-thick piece of paper. Slide the paper between the print bed and the extruder. Like so:



Continue to lower the Z axis, this time in 0.1mm increments.

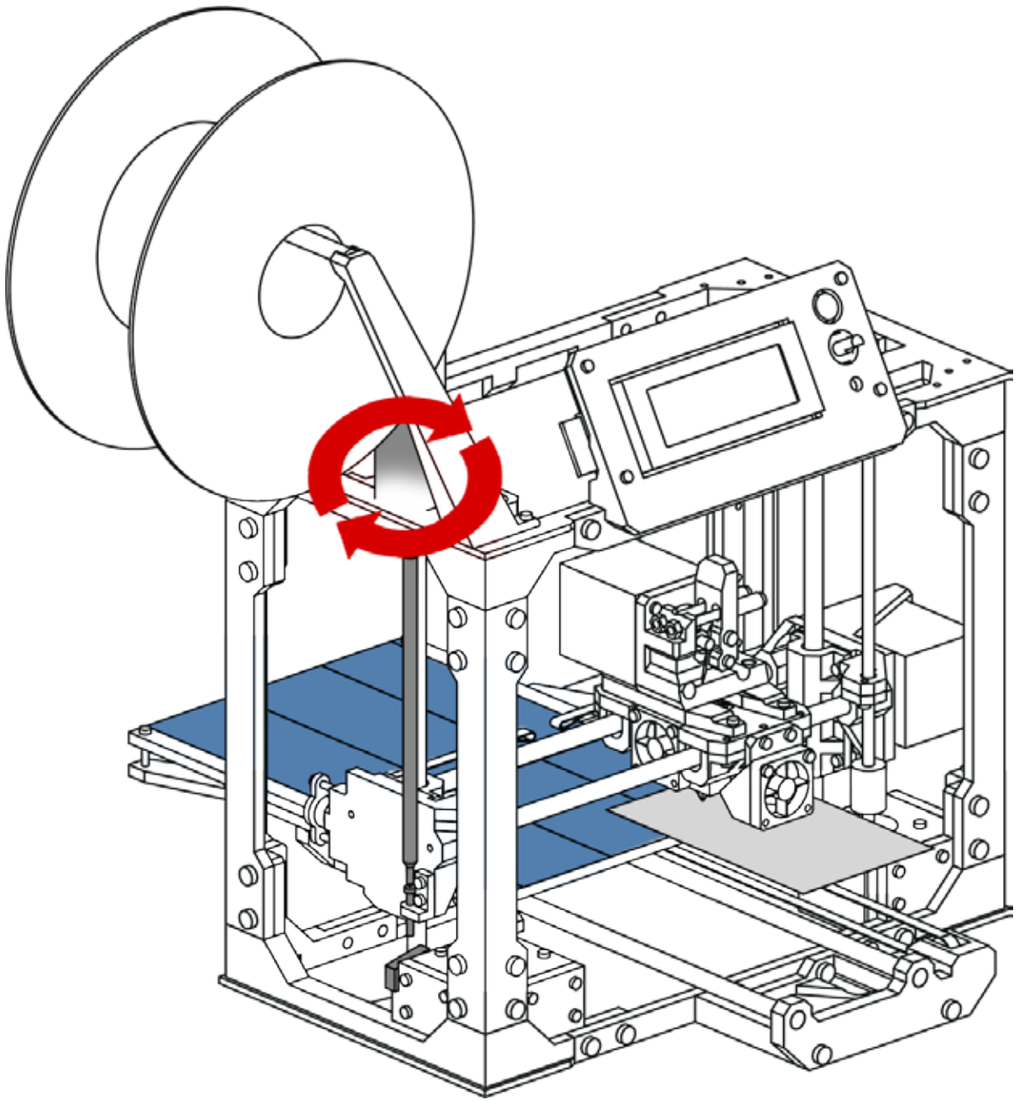


Lower the extruder until you can feel a slight tug when moving the paper between the bed and extruder. We don't want the print head to be crushed into the paper, just slightly snagging it. The thickness of the thick paper represents an ideal first layer height.

Final Printer Configuration

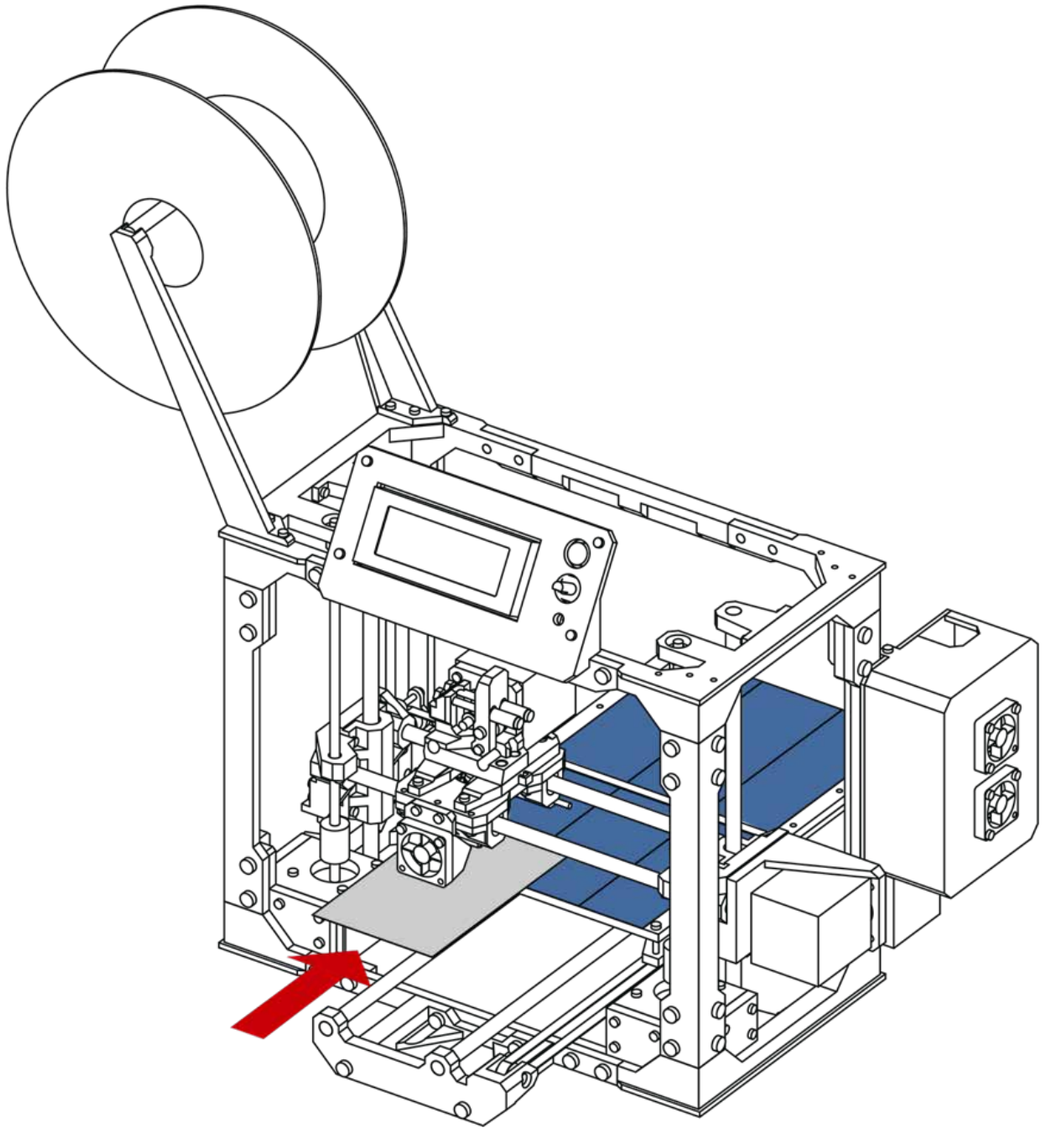
F 6.3

With the initial layer height set, using your M3 hex wrench, extend the Z Axis screw until it contacts the Z end stop. Listen carefully for the audible click of the end-stop, and stop extending the screw when you hear it. You've now set your initial layer height.



We've now set one corner of our print bed as the reference point for the rest of the bed.

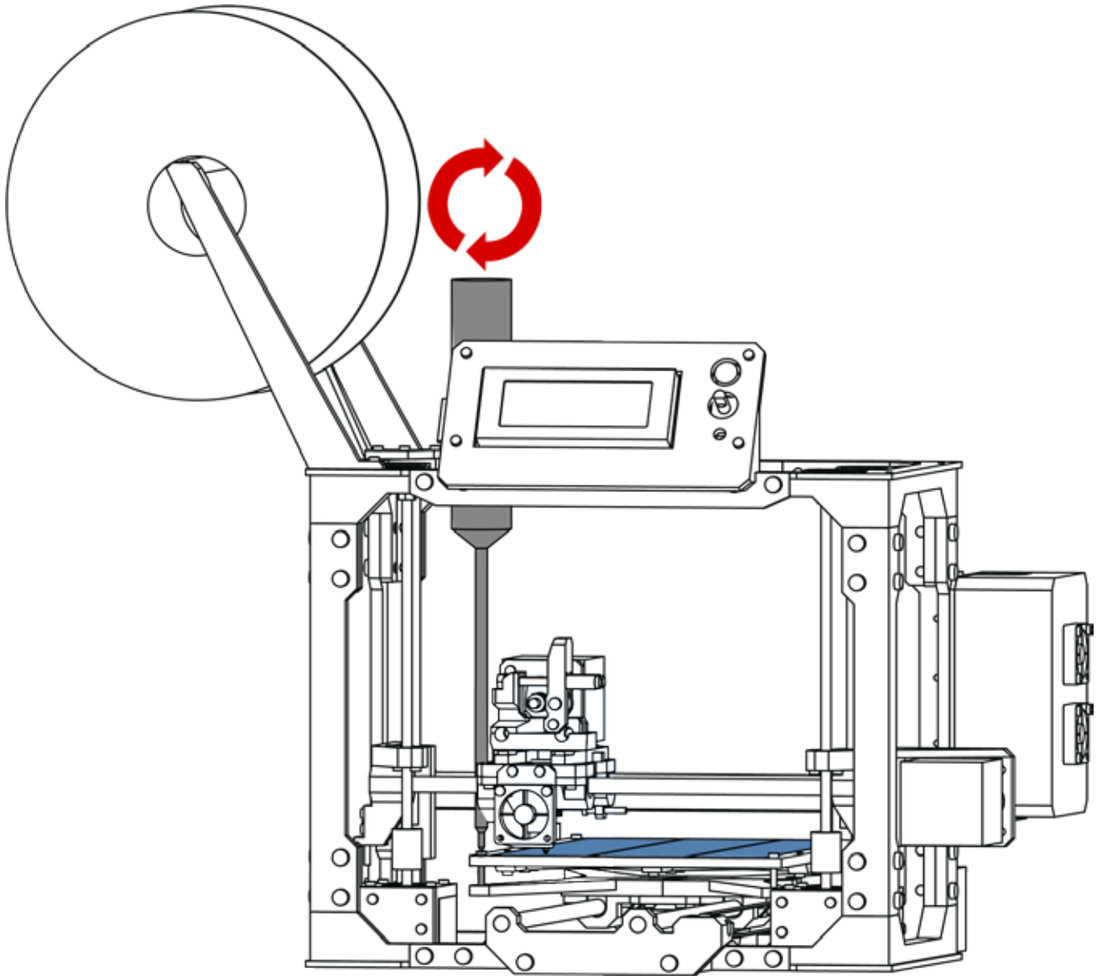
In order to level the remainder of bed, move the extruder to the extent of the X axis (the far left corner)



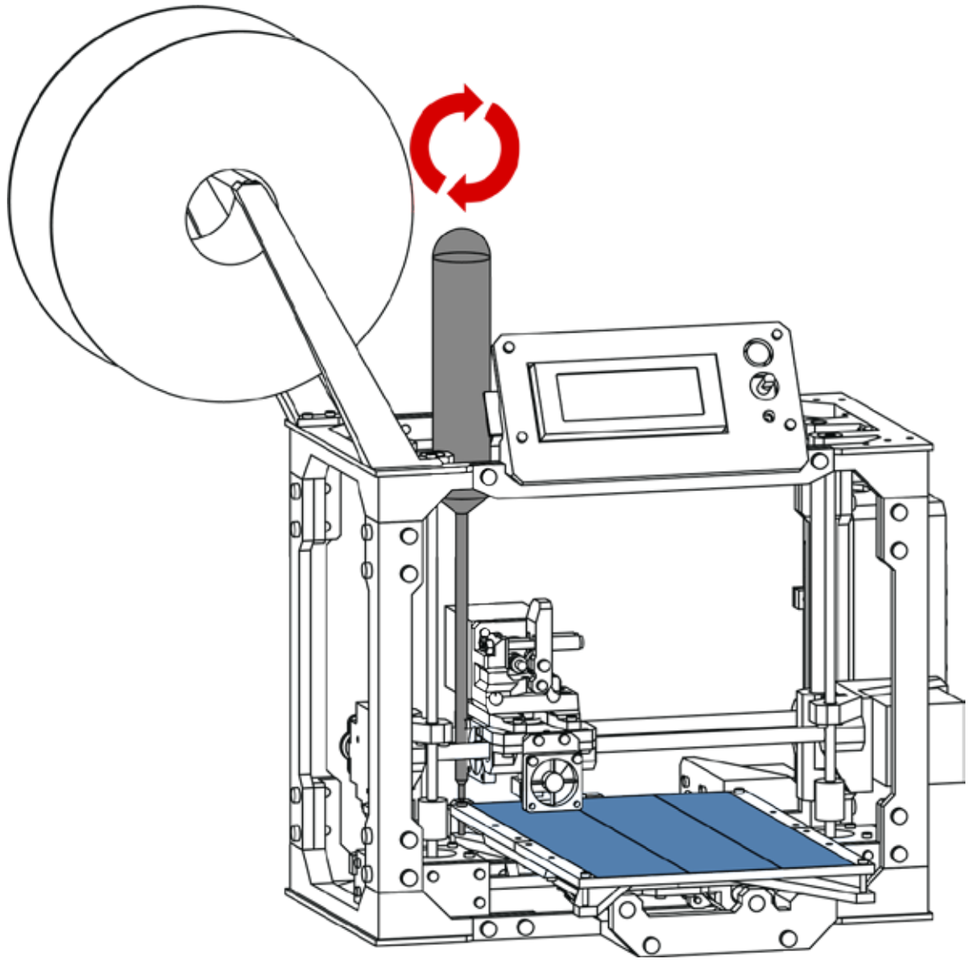
Final Printer Configuration

F 6.3

Using the method before, slide the card between the bed and the extruder. Using your hex wrench, either tighten or loosen the screw in that corner to raise or lower the print bed until the paper drags between the bed and extruder.



Continue this procedure for the left rear and right rear corner of the print bed as well. Using your hex wrench and card to set the height of the print bed.



If all goes well, all four corners of your bed should have the same set distance between the print surface and tip of the extruder. Keep in mind that the print surface should not be level with the surface the printer is sitting on, but be level with the extruder tip at any point of its travel.

Congrats, you're one step closer to your first print!

Final Printer Configuration

F 6.3

C. Loading Filament

Note: Your printer is compatible with 1.75mm diameter materials, and works best with PLA filament.

Before we print our first object, we must load filament into the extruder. To do so, mount a roll of filament onto the filament spool holder and find the end of the filament on the spool. Using a pair of scissors, remove the last few millimeters of filament to ensure that there is a clean cut edge entering the extruder.

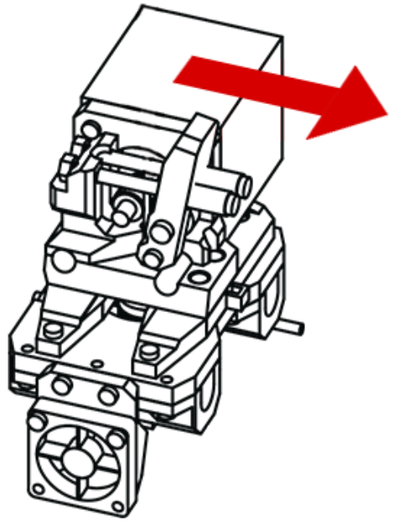
Using your fingers, gently straighten out several inches of filament as best as you can. The filament will have a tendency to curl, and straightening the filament will make it easier to insert into the extruder.

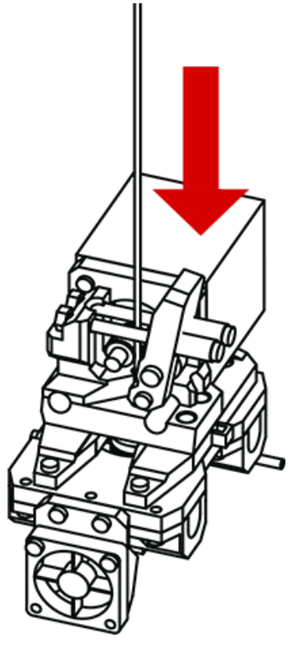
Connect your printer to your PC, and using Cura pre-heat the extruder to 190 degrees. Do not proceed with the next step until your extruder has reached this temperature.

With the filament prepared, pull back on the idler on the extruder like so:

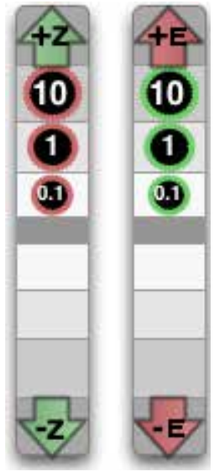
While pulling back on the idler, insert the filament between the drive gear and idler bearing and into the hot-end like so:

You should be able to feel the resistance when the filament enters the hot end. Let go of the idler and check to ensure that the idler bearing is making contact with the filament.





D. Extruding Filament



Now that we have pre-heated our extruder and loaded the filament, we will now prime the extruder and check to see that it is extruding filament correctly.

Open the Pronterface UI from Cura if it is not already open, and check to ensure that the extruder is at its operating temperature of 190 degrees.

From the control panel, locate the extruder panel. This is marked with two arrows labeled 'E' for extruder. Click on the '+10' button to begin extruding. This will extrude 10mm of filament.

You should now see the extruder drawing in the filament. If the extruder is retracting the filament, stop the procedure and disconnect your printer. Open the electronics enclosure and reverse the connection of the extruder motor. Repeat the process above to verify that the motor is operating in the correct direction. Keep extruding 10mm of filament. It will take several attempts before you see any material extruding from the extruder.

It is also important to ensure that the idler is applying adequate pressure to the filament and drive gear. If while extruding you notice the filament slipping or the drive gear not grabbing the filament, tighten the 2 screws on the idler assembly. This will increase the pressure against the extruder drive gear.

You should now begin to see filament extruding from the extruder. Ensure that the filament is extruding in a thin strand and is not building up around the tip of the nozzle. With your extruder primed and ready, we're almost ready to begin your first print.

Note on calibrating your extruder.

In some cases it may be necessary to calibrate your extruder and the amount of filament it extrudes per millimeter. For an excellent introduction to this procedure and a video guide, please visit Thomas Sanladerer's YouTube video here: https://www.youtube.com/watch?v=YUPfBJz3I6Y

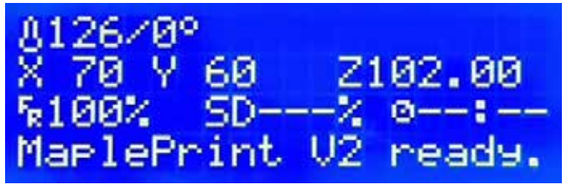
Your default firmware values should provide a decent calibration and good printing results.

Final Printer Configuration

F 6.3

E. Understanding the Printer LCD & SD Card Reader

Your printer is equipped with a LCD display, as well as a built in SD Card Reader. This allows your printer to print untethered without the need for a PC. Printing from an SD card will be covered later in this document. The LCD displays a variety of information during a print.



The primary fields are the following:

The first line displays the real time temperature reading of the hot-end, and the desired set temperature.

The second line contains positional data of each of the axis'.

The last line of the display contains the flow rate. The flow rate is the amount of plastic the printer is extruding. Typically this is set in firmware or slicing profiles. The final two options report back the total percentage of the model that the printer has printed, as well as the elapsed time.

The LCD panel is also equipped with a rotary dial. Pressing this dial will activate the Menu tree and give host to a wide variety of options to control and modify your printer. This menu system is broken into several sections with multiple sub sections:

These menus and the additional SD card slot allow your printer to print without an computer attached.

Top Level:

Watch: This will return you to the main overview screen.

Prepare: This menu contains several sub options for preparing your printer prior to printing

Control: This menu as well as its sub-options allows the user to control aspects of their printer such as temperature, motion and firmware changes (if enabled).

Card Menu: The last option allows you to browse and load any saved .gcode files if an SD card is inserted.

Each of these menus contains a sub-menu with several options as well. Below is a brief review of the sub menus.

Prepare:

Disable Steppers: This will disable the motors and allow the user to move each axis by hand.

AutoHome: This will home all axis to their starting points of 0,0,0.

Preheat PLA: This option will pre-heat the extruder to the specified temperature for PLA

Preheat ABS: This option will pre-heat the extruder to the specified temperature for PLA

Cooldown: Cooldown will disable the heater for the extruder and enable the cooling fan. Handy for after completing a print.

Move Axis: This menu option and sub options will allow the user to move each axis' as well as the extruder, a set distance.

Control:

Temperature: The submenus under Temperature allow the user to define the default settings for extruder temperature, fan speeds, and other settings for both PLA and ABS.

Motion: The motion menu contains the variables used in defining how the printer behaves during movements. This includes options such as acceleration values, jerk settings and retract/extrude values.

Store Memory: This option allows the user to save any changes they have made in any of the previous or sub menus.

Load Memory: This option allows the user to load the configuration that is stored in the EEPROM of the printer.

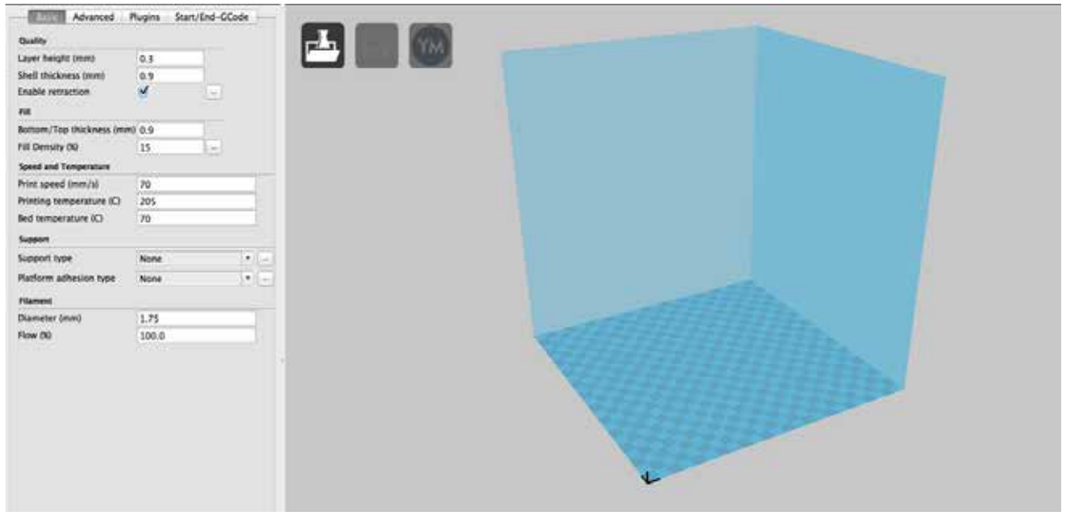
Restore Failsafe: The last option will reset the printer's configuration to the default values that were flashed to the firmware.

Card Menu: Lastly, if one wishes to print directly from the SD card, a user would first save the .gcode file created in their slicing application. After copying the gcode from their PC to the SD card, the user can then load the SD card into the printer. Selecting this menu will display all gcode files present on the card, and selecting any of the gcode files will initiate the print.

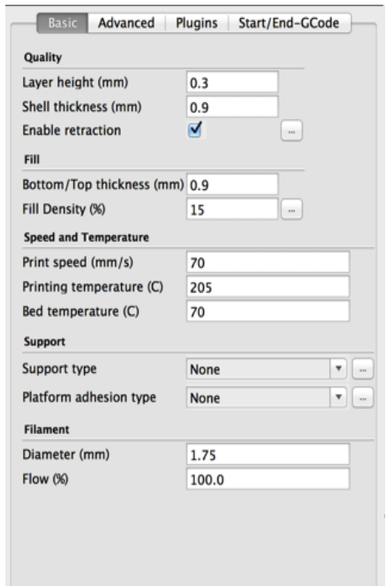
Your First Print

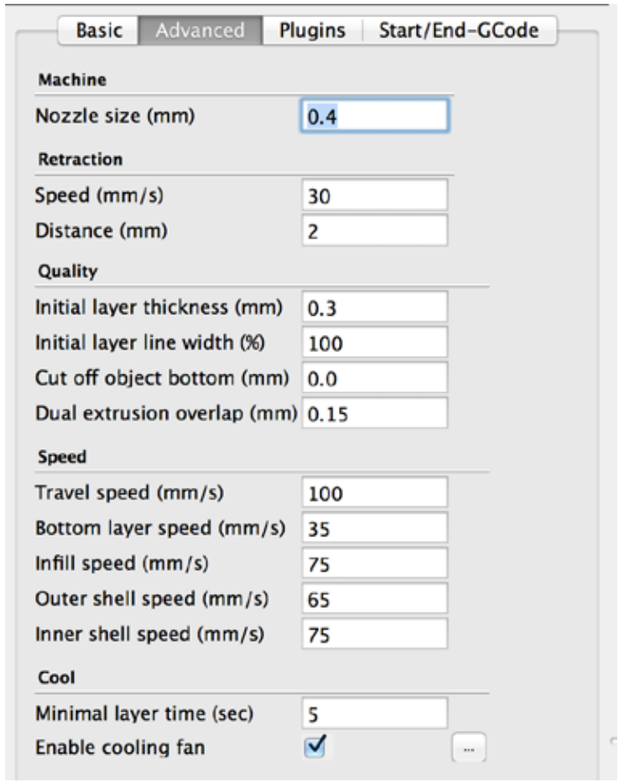
A. Understanding the Cura Interface

Now that we've finally configured our printer, we may begin the process of our first print.



The Cura interface, like discussed earlier is broken into 2 areas, the print settings, and the print stage. The print settings contain variables that can be user adjusted to modify the print quality, speed and other options. Please refer to the settings referenced earlier in the guide. The settings panel also contains additional tabs for more control over the print settings.





Under the advanced tab you may see additional options for controlling items such as the (1) extruder nozzle diameter,(2) filament retraction and retraction speed. Under the Quality heading, the user can adjust settings such as the initial layer thickness, and width. The Speed heading contains all the settings relating to the speed of the machine, including its movements between prints, outer speed and infill speed. Lastly the cooling options allow the user to define how the print is actively cooled with the Cooling fan.

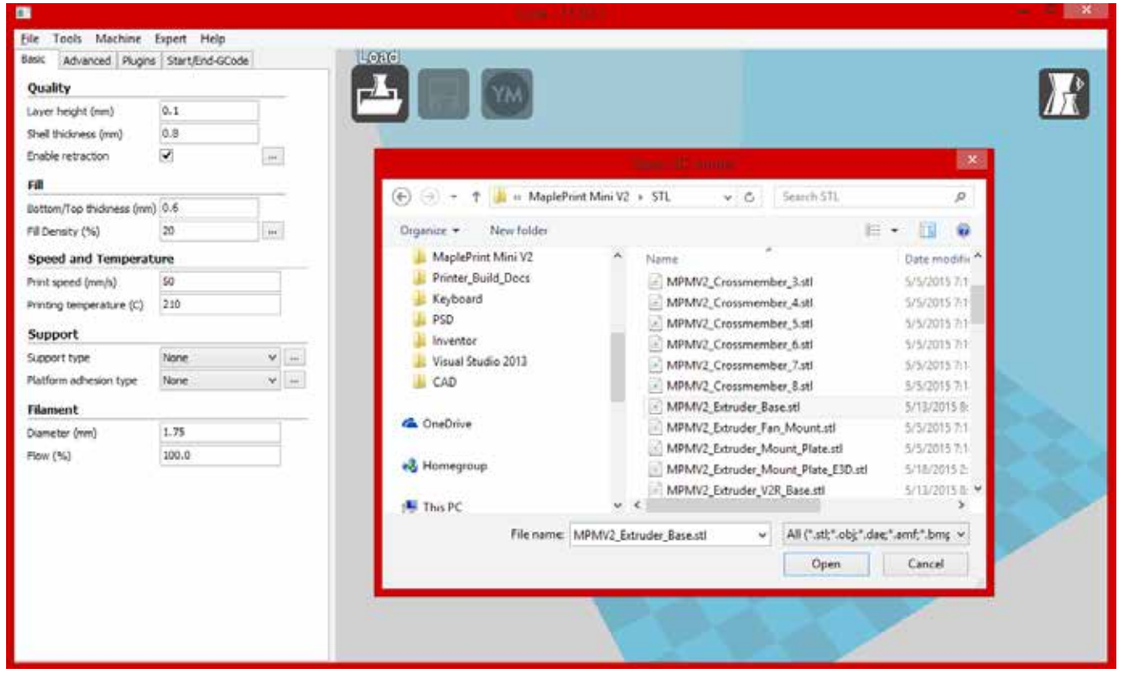
The print stage will display the build volume of your printer, as well as any models or objects that you place on the stage. Use your mouse to pan, rotate and zoom around the stage using their mouse. The stage also allows the user to see several views of their model, ranging from an X-ray view to individual layers of the printed model:

Your First Print

B. Loading and slicing your first model

We're now ready to slice our first model. With Cura open, click the folder icon in the upper left corner of the print stage.

You should now be greeted by a file explorer window. From here select the model you wish to print. For our first print, it is advised that you begin with something simple and quick to print, such as the mapleMaker key fob.



Your model will be automatically sliced and processed once it is loaded. You are now ready to print!

Any changes made to the slicing variables in the right hand window will automatically re-process the model and re-slice the output.

Should you wish to save the gcode and print from the SD card, disconnect your printer from your PC and click the Save icon. Save the .gcode file to your SD card, and then insert it into your printer.

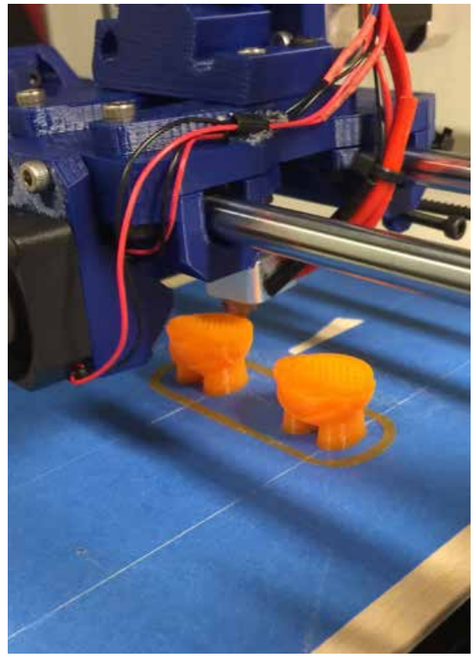
c. Starting & completing a print

Once you've chosen and sliced your object, ensure that your printer is connected to your PC and that it is connected in Cura. Once ready, simply click the 'Print with USB' button in the upper left of the print stage to begin the printing process. Your printer will heat the extruder, and then home each axis.

Once the extruder reaches its temperature, and all the axis's are homed, the printer will begin to print its first layer.

Check to ensure that the filament is feeding correctly, and that the first layer is adhering to the bed. Your first layer should be slightly "squished" and adhere to the blue painters tape. Notice in the image below how the first outside layers are slightly fatter than the rest?

Congratulations! You're now printing! Soon your first test piece will be finished, and you'll be able to pull it off the bed! When it is done, use a small putty knife, or scraper to peel it off the bed. Be careful not to tear the tape, although you can reapply more, and should do so periodically.



Quick Tips

Maintenance Notes

Like any machine, your printer will require some periodic maintenance to ensure that it operates correctly.

- Clean your printer using a light cloth and ensure that the extruder, filament, and print bed are clear of dust or debris
- Check the frame components for loose hardware or worn out parts. If any parts need to be replaced, print a new part and replace the affected pieces.
- Keep the linear rods clean of all debris and periodically add a small amount of machine oil to them to keep them lubricated. Do not oil your hot end or extruder gear.
- Check all connections and wiring for loose connections or broken wires.
- When not using your printer for extended periods of time, store your filament in a cool dry location with as little moisture as possible. If possible store your filament with a small silica gel packet to absorb any present moisture.

Hardware:

Sloppy corners and bad details: If you find your prints corners look more like circles, or that small details in your prints are missing or look less than ideal, check the tension of the belts on your X and Y axis. Sometimes, loose or sagging belts can cause loss of detail and accuracy.

Slipping Filament: Is your filament not extruding correctly, or consistently? Try increasing the compression on the extruder idler by tightening the 2 long screws. This will force the filament into the drive gear and hopefully resolve the slipping. However, if your extruder is working fine, but no plastic is coming out of the hot end, your hot end may be jammed and may require dis- assembly to clean and fix.

Printer not communicating: If you find your printer is not cooperating with your PC, check to ensure that the serial driver is installed correctly. To do so, uninstall Cura and then re-run the Cura installer. The installer includes the required drivers and should fix any issues you are having.

Prints not sticking to the bed: If you find that your prints are not sticking to the bed, check your first layer height. The first layer should go down nice and flat, and be a bit fatter than the other layers. If you see any wavy lines or a very very thin extrusion, then chances are your first layer is too high. After several prints you may also need to remove and re-apply fresh blue painters tape to your bed as well.

Resources:

For more information, tips, and tricks on using your 3D printer, visit some of these awesome sources of information.

3D Printing Resources:

RepRap Wiki: http://reprap.org/
Thomas Sanladerer's 3D Printing Guides: https://www.youtube.com/user/ThomasSanladerer/ E3D Online: http://e3d-online.com/

3D Model Repositories:

YouMagine: www.youmagine.com
GrabCAD: www.grabcad.com
Makerbot Thingiverse: www.thingiverse.com

3D Modeling Software:

Sketchup: http://www.sketchup.com/
Tinkercad: https://tinkercad.com/
Autodesk 123DCatch: http://www.123dapp.com/catch Blender: http://www.blender.org/
Meshlab: http://meshlab.sourceforge.net/
Netfabb: http://www.netfabb.com/basic.php

Disclaimer

While every attempt has been made to ensure the accuracy of the instructions and details contained within this guide. some parts, components or instructions may differ from what is included in your kit. For the latest instructions, guides and information, please visit www.maplemakermedia.com.

It is assumed that the user of this guide and our kit(s) have a basic understanding of how to safely operate and use the tools required to complete this build. If you do not know how to properly operate the required tools, refer to the original guides included with the tools for more information.

We want every experience with our kit to be a postive one. If you are unsure, or notice an error in our documentation, please contact us using the back cover of this document, or online at www.maplemakermedia.com.

While we strive to answer every comment and concern associated with the kit(s), the user must acknowledge and understand that we may not be able to answer every question in a timely manner. Our users are encouraged to use our online resources, as well as the www.RepRap.org resources for additional tips and tricks on building and operating their printer.

And finally, thank you, thank you for believing, and for making this a reality. We are driven by our desire to inspire others, and to expand our users capabilities and horizons. Thank you.