RepRapPro Mendel

From RepRapWiki

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Introduction

These pages are the complete instructions for building, commissioning and using the RepRapPro Ltd (http://reprappro.com/) version of RepRap Mendel.

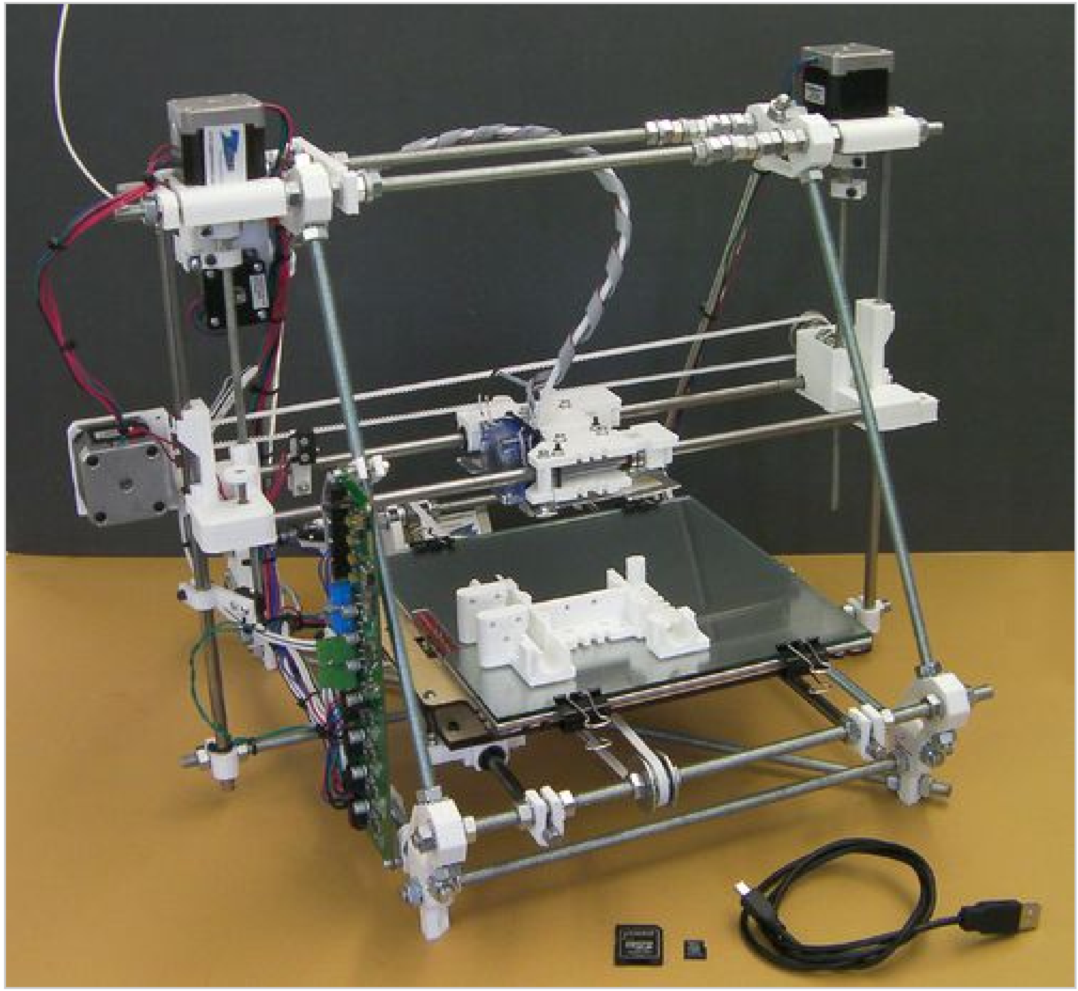
Like all RepRap machines, RepRapPro Mendel (http://reprappro.com/Mendel) is fully open-source. It is licenced under the GPL. All the design files and software are available from the RepRapPro Ltd Github (https://github.com/reprappro) repository; the electronics are here: https://github.com/mosfet/melzi. And it is here in the Thingiverse (http://www.thingiverse.com/thing:20968) .

If you want to print the plastic parts for a RepRapPro Mendel, see this wiki page.

RepRapPro Mendel is based partly on Prusa Mendel with many alterations and additions. It was designed from the start to accommodate multiple extruders to allow colour printing and the printing of single parts with several different materials built into them.

General notes

Give yourself plenty of space and ensure your work area is clean. Dust and dirt are a 3D printer's worst enemy. All printed parts have been printed on various RepRap machines from suppliers within the RepRap community. Despite the fact that these machines are highly tuned RepRap 3D printers, some holes and features may need a little fettling to get the best performance from the RepRapPro Mendel. This is especially true for the Igus bushings used for the Z axis. There is a video how-to on fettling 3D printed parts here on Vimeo



RepRapPro Mendel fitted with Melzi electronics

(http://vimeo.com/14492980) .

Before you start the build, please ensure you have all the components as listed on the packing list included in the kit. If anything is missing, please contact us via email: support@reprappro.com

We understand that people may want to change aspects of the machine's design, and in fact we encourage this as it is one of the benefits of open source development. Before changing anything, please be aware that the RepRapPro Mendel has been designed to maximise the build volume relative to the the machine's footprint, and as such many of its components fit closely to others. So consider your changes carefully before you try to implement them. And when you find improvements, please tell us so that we can include them in future kits, and so that existing owners can upgrade their own machines.

BEFORE YOU ATTEMPT TO ASSEMBLE ANY PART OF THE RepRapPro Mendel 3D PRINTER, PLEASE READ THESE BUILD INSTRUCTIONS FULLY AND ENSURE YOU UNDERSTAND THEM. Although all parts are covered by warranty, this will be invalidated by your not following these build instructions.

The RepRapPro Mendel is a robust RepRap machine once assembled; however it does require a certain amount of care during assembly. If in doubt, force is usually not the answer! There are many ways to get support and advice, see the Get Support section below.

If you can't see clearly from the pictures what's going on click on the picture and open it in a new browser tab. This will take you to a page in this wiki where you can see a high-resolution version of the picture.

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Get support

If you find you need help or advice with assembling, commissioning or using your RepRapPro Mendel 3d printer, you can use the following channels:

- Our Forum (http://www.emakershop.com/forum?vasthtmlaction=vforum&g=1.0) . This is shared with the eMaker and RepRapPro Huxley forum, as the machines are so similar.

- RepRapPro/eMaker channel on freenode irc (http://irc.netsplit.de/channels/?net=freenode&chat=emaker)

- E-mail: reprappro@gmail.com

Tool List

Mechanical

Tools required for the mechanical build of the RepRapPro Mendel 3D printer:

- Drill bits including 2mm, 3mm, 4mm, 6mm, 8mm, 10mm

- Precision screwdriver set

- A set of metric allen keys including:
  - M3 size
  - one that fits inside a M3 set screw (allen key is smaller than M3 size)

- 13mm spanner (M8 nut)
- 10mm spanner (M6 nut)
- 5.5mm spanner (M3 nut)
- 5mm spanner (M2.5 nut)
- 15cm adjustable spanner
- File
- Half round needle file
- Craft knife

- Fine tweezers
- 300mm rule
- Vernier or digital callipers
- Square
- Fine nosed pliers
- Pliers
- Bench vice
- Side cutters
- For the Hot End Assembly you will also need some PTFE plumber's tape and a blowtorch

Electrical

Tools required for the electrical build of the RepRapPro Mendel 3D printer:

- Digital Multimeter
- A fine-tipped soldering iron

- Precision screwdrivers
- Solder (flux is also useful)
- Hair dryer (or other heat source for heating heatshrink wire sleeving; the barrel of a soldering iron works OK)
- Wire strippers/cutters
- Ratchet crimp tool
- Molex crimp tool (such as the 63811-1000, you may also want the extraction tool 11-03-0044, Molexkits.com)
- Scissors

Next step

Frame assembly

Retrieved from "http://www.reprap.org/wiki/RepRapPro_Mendel"
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RepRapPro Mendel frame assembly

From RepRapWiki

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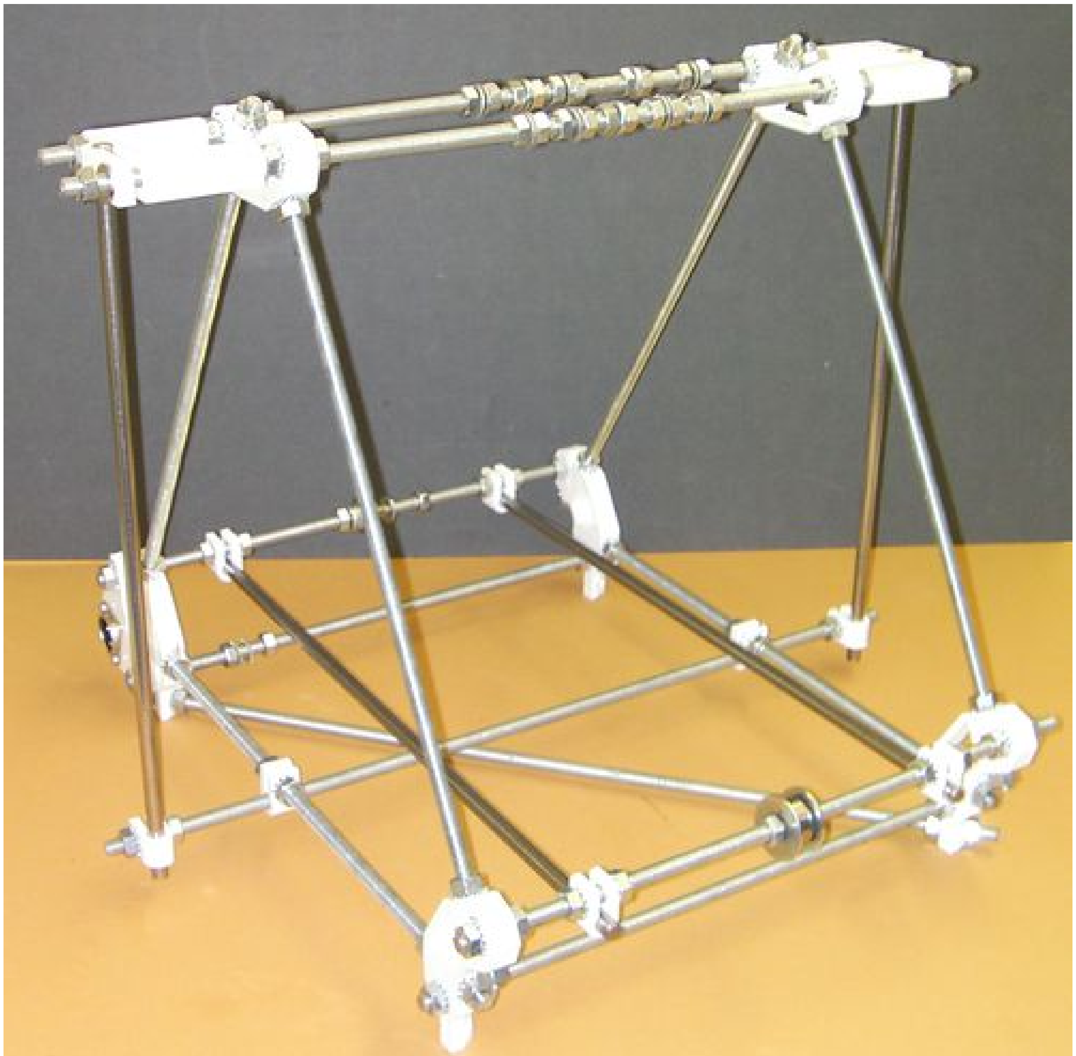
Goal

By the end of this stage, your machine should look like this:

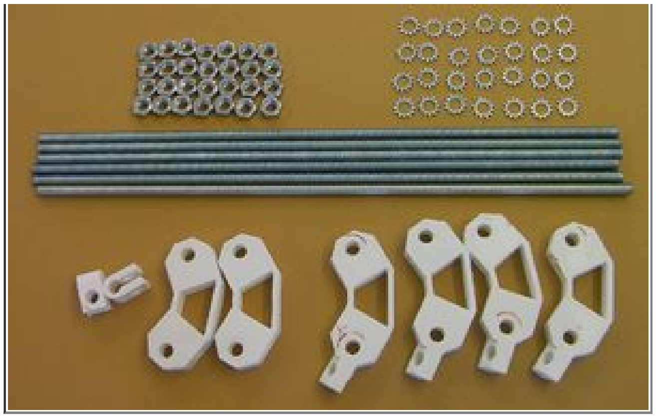


Tools

You will need the following tools

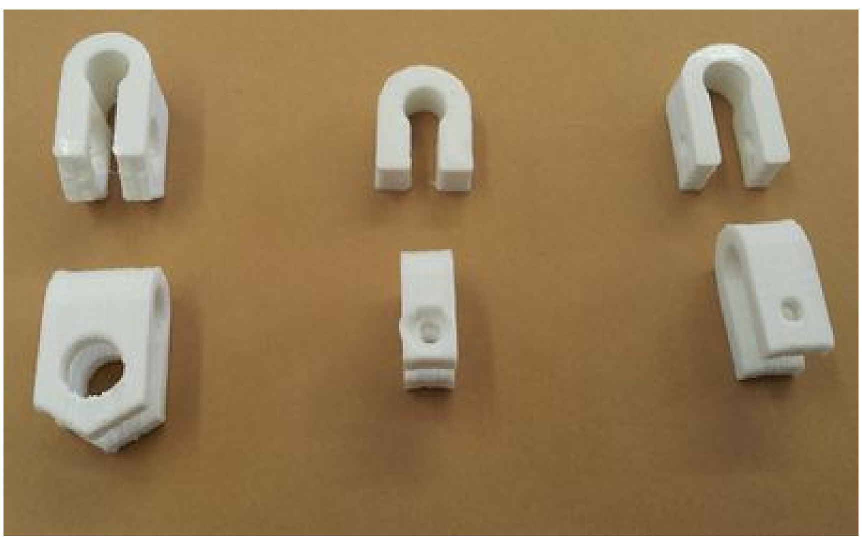
- M8 (13mm) spanner
- Adjustable spanner
- 300mm Rule
- (optional) Spirit level, cotton and Blu-tack

Step 1: Frame triangles



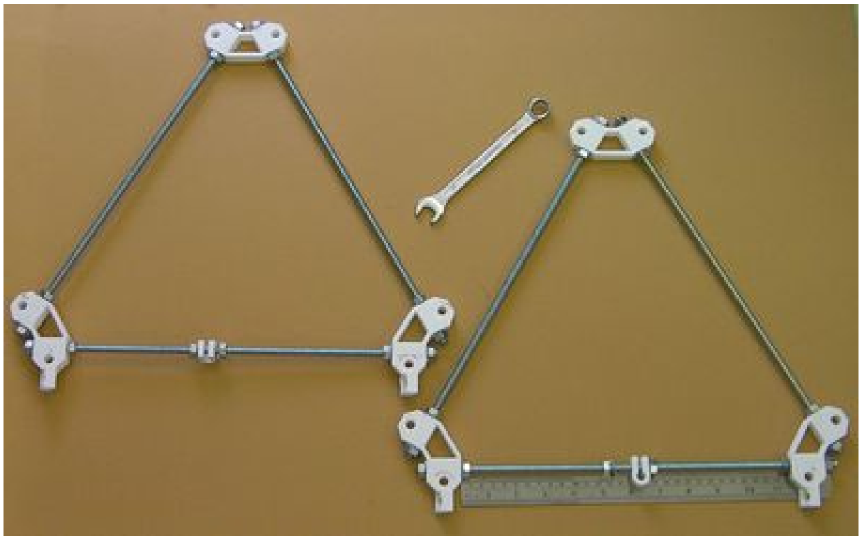
Item	Quantity
370mm M8 rods	6
Printed frame vertex with foot	4
Printed frame vertex	2
Printed U clips	2
M8 nuts	28
M8 lock washers	28

Note that there are three types of printed U clips in your kit:



The ones on the left are the frame clips, the ones in the middle are the Z-drive flexible coupling clips, and the ones on the right are the printed-circuit-board clips. For this step you want the ones on the left.

Split the components into two equal sets, then loosely screw them together into each frame triangle. Make sure you slide a belt clamp along the bottom M6 threaded bars between the frame vertices with feet, with a serrated washer and nut either side. The other nuts should also all have serrated washers under them.



Make the gap between the frame vertices measured face to face next to where the nuts and washers tighten about 290 mm.

Your kit has a template to make it easy to get these measurements right.

Don't tighten anything at this stage.

Step 2: Cross bars

Item	Quantity
330mm M8 rods	4
470mm M8 rods	2
Printed U clips	4
M8 mudguard washers	2
8mm bearings	2
M8 lock washers	10

M8 washers	9 (29)
M8 nuts	26 (46)

The figures in brackets are the numbers if you want to add clamp nuts across the top bars (see below).

Assemble the bars as shown in this picture:

From top to bottom and left to right the sequences are:

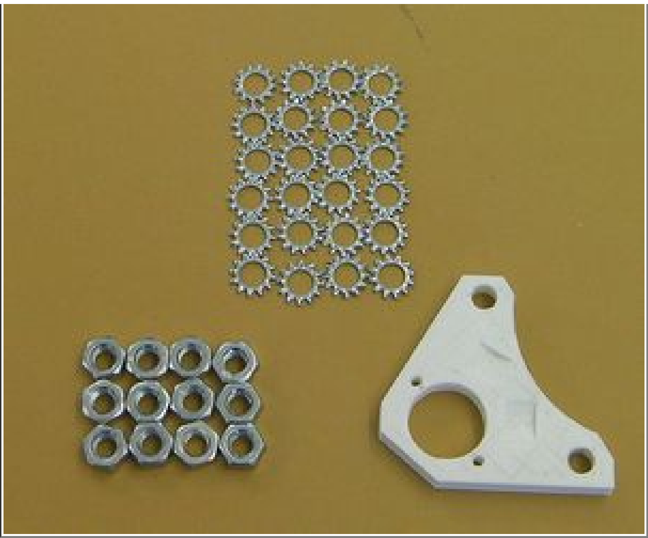
1. Nut, nut.
2. Nut, nut, lock washer, lock washer, nut, nut.
3. Nut, nut, lock washer, U, lock washer, nut, nut, mudguard washer, washer, bearing, washer, mudguard, nut, nut, lock washer, U, lock washer, nut, nut.
4. Nut, nut, lock washer, U, lock washer, nut, nut, lock washer, washer, washer, washer, washer, washer, bearing, washer, lock washer, nut, nut, lock washer, U, lock washer, nut, nut.
5. Nut, 5x(nut, washer, washer, nut), nut
6. Nut, 5x(nut, washer, washer, nut), nut

Take care not to confuse lock washers and ordinary washers. If you don't want the clamp nuts leave out the [5x(nut, washer, washer, nut)]s on the bottom two bars.

What, you are asking, are the clamp nuts for? We have plans to add extra devices that will mount between the top two bars. The clamp nuts are there to retain those yet-to-be-designed devices. In all probability they will not be needed - we will almost certainly design the devices with U clamps that will attach directly without the nuts - but we put the nuts on the prototype just in case we might need them. If you want our recommendation: leave them off.

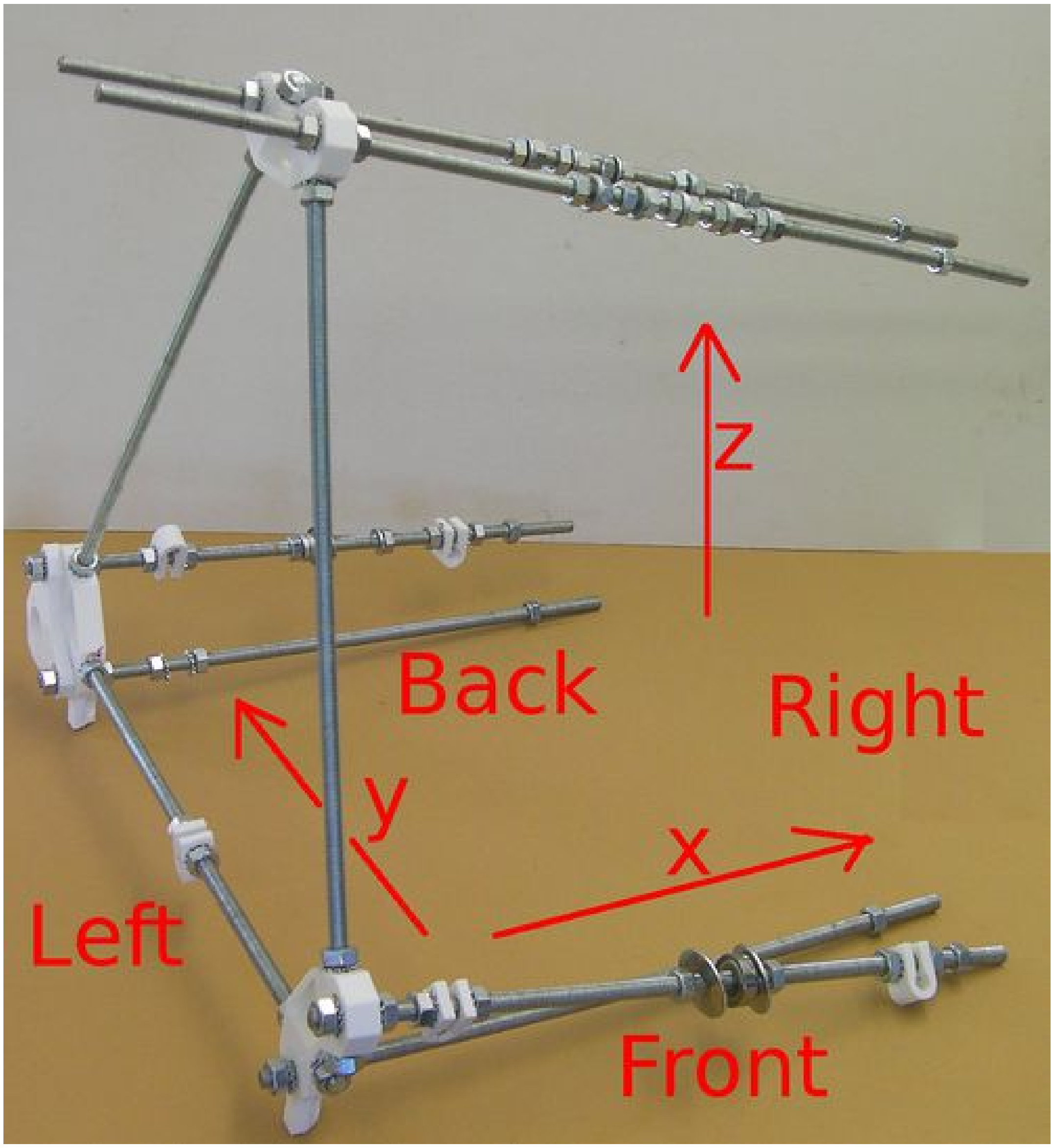
But if you do leave them off put just one of the nuts on and a washer to its left on each of the two bars (this will be used to retain the extruder drive bracket).

Step 3: Put them all together



Item	Quantity
M8 nuts	12
M8 lock washers	24
Printed XLR panel-plug holder	1

Firstly screw the cross bars into one of the triangles as shown:



This is the moment of what embryologists would call gastrulation: the point at which your RepRap acquires a front, back, top, bottom, left and right - as shown. The x, y, and z coordinate directions of the finished machine are also shown. If you like, use sticky tape to attach small labels to the rods while you are building so you can remember which side and which direction is which.

On the bottom, and using the numbers of the rods from Step 2:

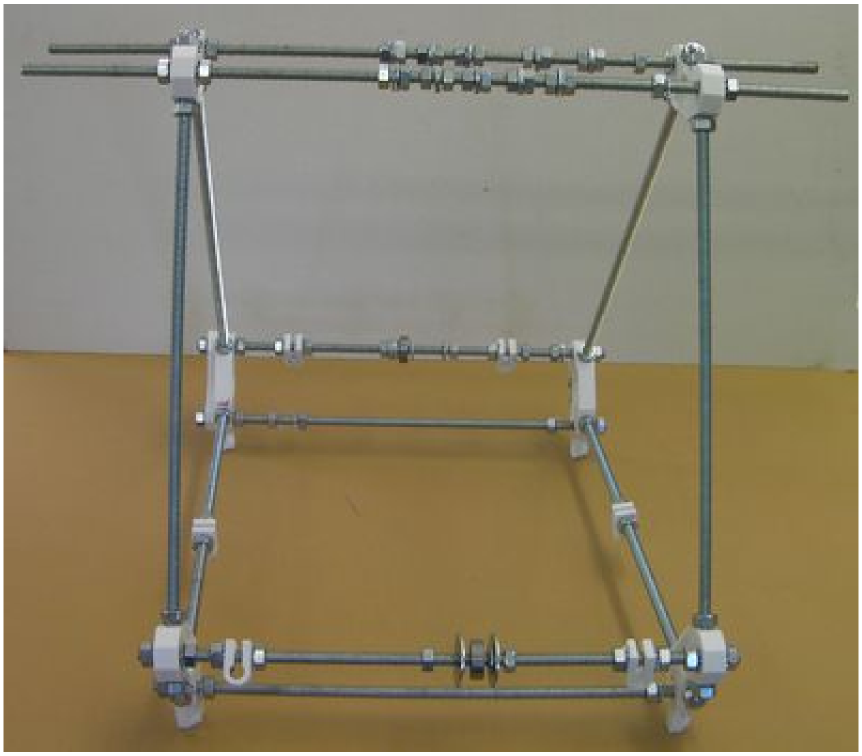
- Back top: Rod 4, with the 5 washers together to the left.
- Back bottom: Rod 2.
- Front top: Rod 3.
- Front bottom (yes - we know this is funny...): Rod 1.

And at the top attach the two long Rods: 5 and 6.

Use two locking washers and a nut on each rod.

The XLR bracket attaches back left. The indentations on it go towards the inside of the machine - they accommodate the washers on the frame.

Next screw the second triangle to the other end of the cross bars:



Now go round the frame tightening everything up using two spanners. Tighten the triangles first, then the six bars in the *x* direction.

Use the template to get the measurements right.

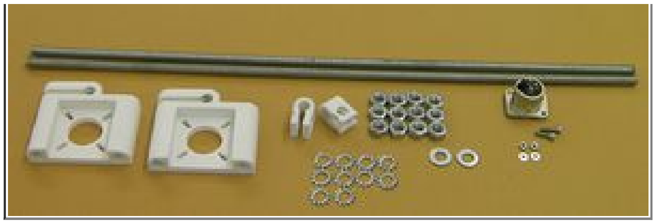
Make the gap between the faces of the vertices on the triangles 290mm, as mentioned above. Make the gap in the *x* direction between the faces of the vertices 273mm.

Get the two top rods even, with an equal amount projecting each side, then move the back one 5mm to the right and the front one 5mm to the left.

Try to get the measurements accurate. But it is more important to get the lengths equal than to get them precise.

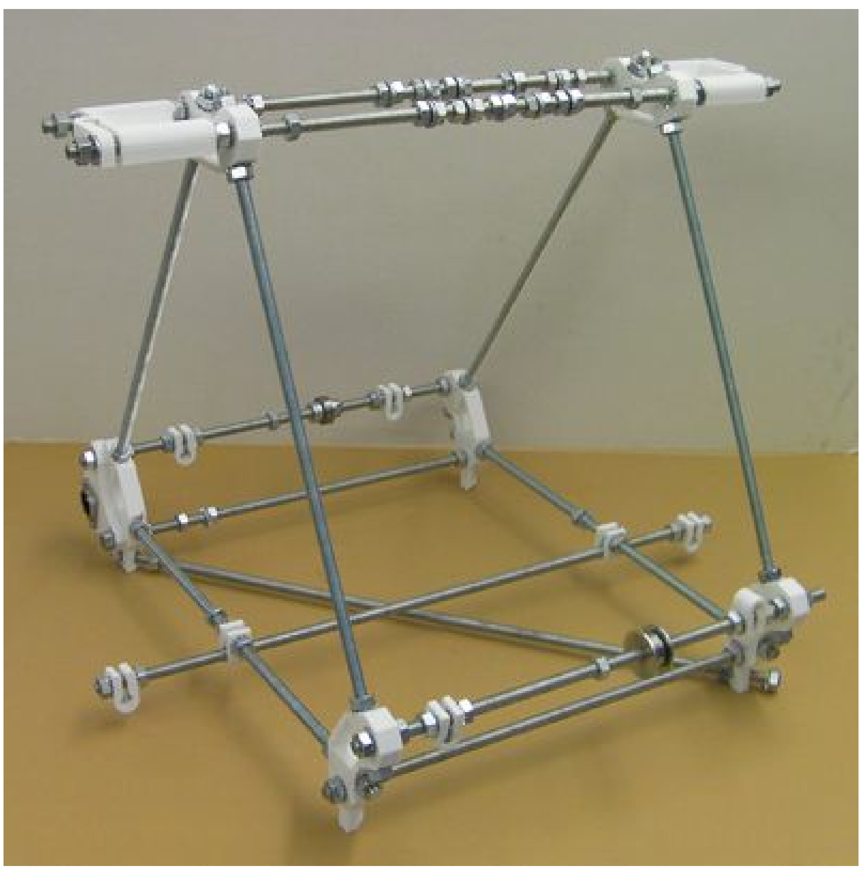
You will find that you can make very fine adjustments when things are almost tight by slightly slackening a nut on one side of a join then tightening the nut on the other side.

Step 4: Z-motor mounts, diagonal, and power connector

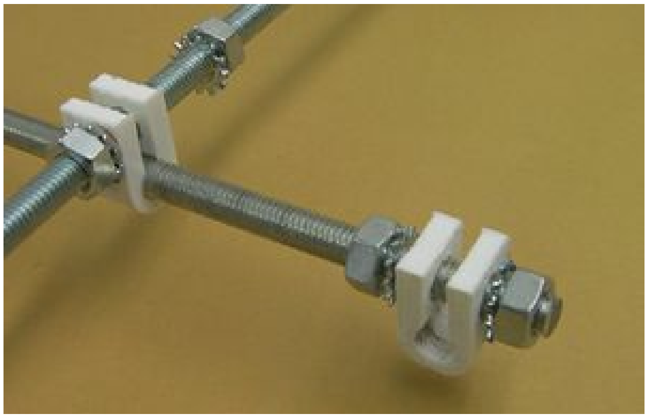


Item	Quantity
470mm M8 rods	2
Printed Z motor holders	2
Printed U clips	2
M8 nuts	12 (14)
M8 lock washers	10
M8 washers	6
XLR panel plug	1
12mm M3 caps	2
M3 washers	2
M3 nuts	2

The two extra nuts are for the optional lock on the Z bar U clips - see below.



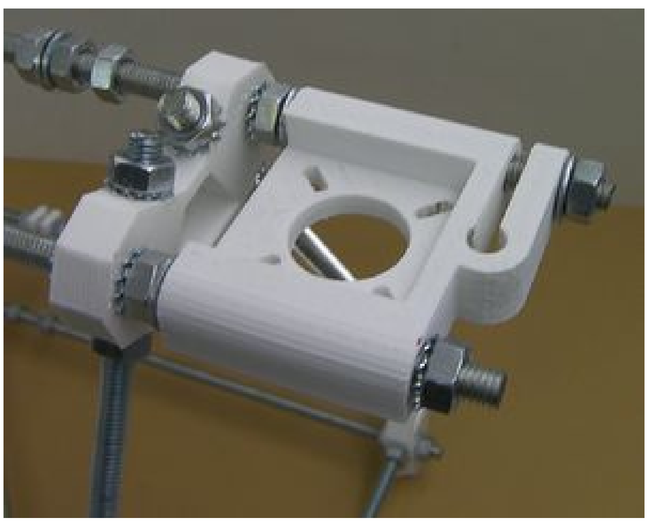
Put the two U clips already on the frame roughly in the middle of their bars, then push one of the 470mm rods through. You may have to twist it, using its thread to move it - it can be quite a snug fit. Use nuts and lock washers to put two more U clips on its ends for the Z smooth rods, as shown. Leave all these lose:



If you want put two extra nuts just inside the ones on the U clips for the Z smooth rods - these will allow you to lock the inside position of the U clips so you can slacken and tighten them later to assemble the machine without losing the vertical adjustment on the Z smooth rods.

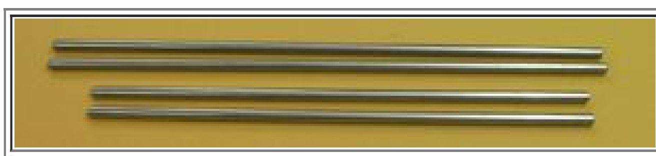
Next thread the base diagonal rod through two of the four feet. Put nuts and lock washers on it both inside and outside each foot, but leave them lose.

Put four smooth washers on the top bars, then put the Z motor mounts on as shown. Secure them with two nuts each, with one smooth washer and one lock washer. The smooth washer goes on the clamp that will hold the Z rods. Tighten the other nuts against their lock washers, but leave the Z-rod-clamp nuts lose:



Fit the XLR plug using the M3 screws, nuts and washers. The washers go under the nuts. Fit the plug so that the triangle formed by its three pins points upwards.

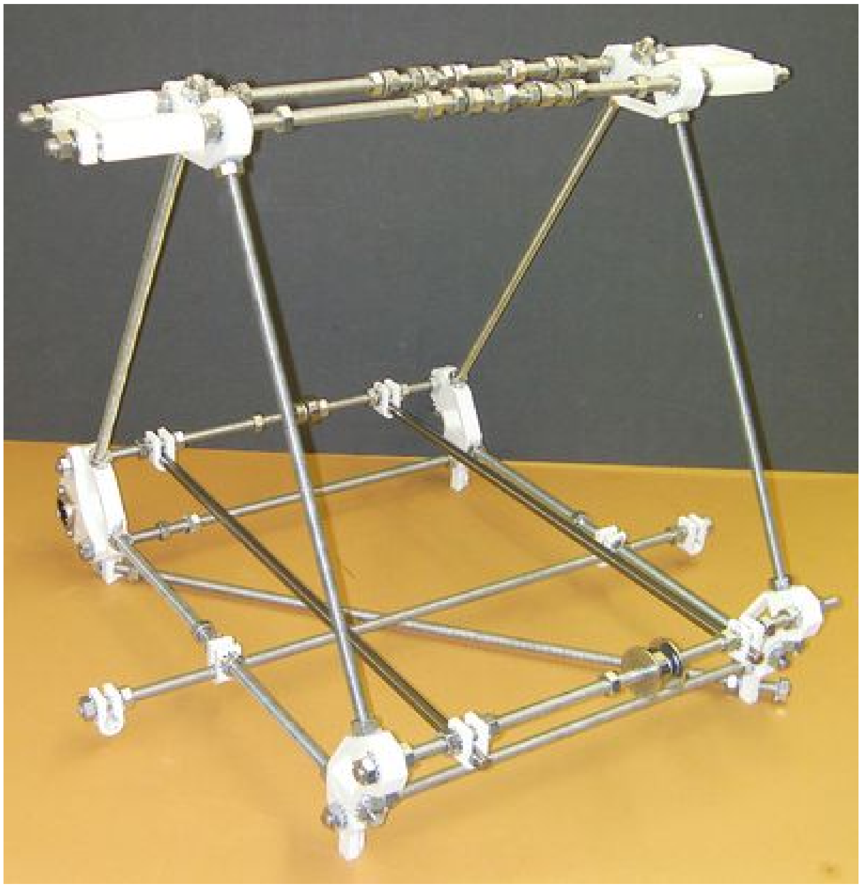
Step 5: Smooth rods



Item	Quantity
400mm smooth rods (Y)	2

350mm smooth rods (Z)	2

Adjust the U clips for the Y rods at the front and back of the frame so that the gaps between their outer nuts and the nuts on the frame vertices are about 20mm. Slide the Y rods through. Don't tighten them:



Next place the frame on a flat surface. Wooden furniture, by and large, is not flat. But thick kitchen worktops are very flat.

Chances are that the frame will rock slightly about one or the other diagonal.

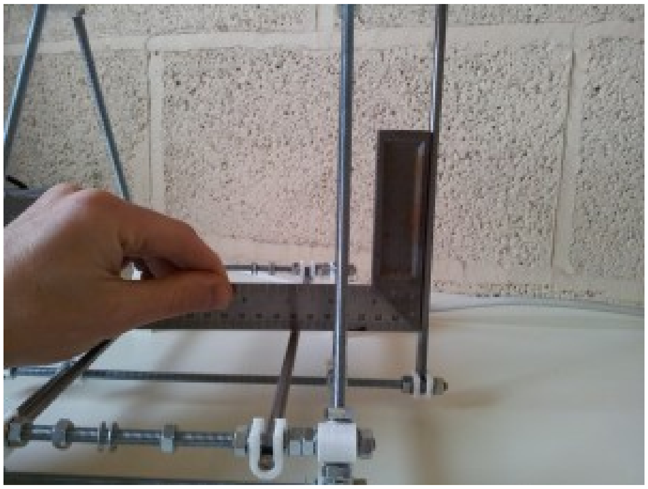
Tighten the diagonal bar in such a way as to stop the rock. If the frame rocks about the bar's diagonal, the gap between its nuts needs to be bigger. If the frame rocks about the opposite diagonal, the gap between the diagonal nuts needs to be smaller.

Adjust the U clamps on the left-hand Y rod so that their nuts are 22mm from the nuts on the left frame triangle, and then adjust the right-hand Y rod U clamps so there is 175mm between the rods. Leave the clamps lose.

Aligning the Z Rods

You can now slide the two Z smooth rods into place. **Do not over-tighten the clamping nuts on the Z motor mounts.** The rods need to be held firm, that is all.

Use a set-square to get the angle of the Z smooth rods correct.



You can now tighten the M8 nuts along the bottom cross bar.

Alternative alignment method

Some people swear by this method, others hate it...

For this you will need the spirit level, two pieces of cotton, and a small blob of Blu-tack.

Build the frame as above, as far as "Aligning the Z Rods".

Place the frame on a **flat** surface (as just mentioned, 40mm-thick Formica-covered kitchen worktops are remarkably flat).

Put the spirit level across the Y smooth bars, and place folded paper shims under the left or right feet until the frame is level left-right. You will discover that a spirit level is an exquisitely sensitive instrument, and that it can easily detect a couple thicknesses of paper.

Rotate the spirit level through a right angle so it rests between the front and back cross bars, and get the frame level front-back too.

Check the frame is level in both directions.

Now thread two lengths of cotton (red arrow) down through the top bracket and the U clamp on the bottom where the Z axis smooth rods will be. Attach it to the Z-axis-smooth-rod holes at the top with Blu-tack such that it is half-way round the inside of the clamp arc.

Put a small blob of Blu-tack on the bottom of each piece of cotton to act as a plumb weight.

Now, in the Y direction adjust the positions of the threaded rod at the bottom and the Z-axis-smooth-rod U clamps so that the cotton falls freely in the middle of the U-clamp holes.

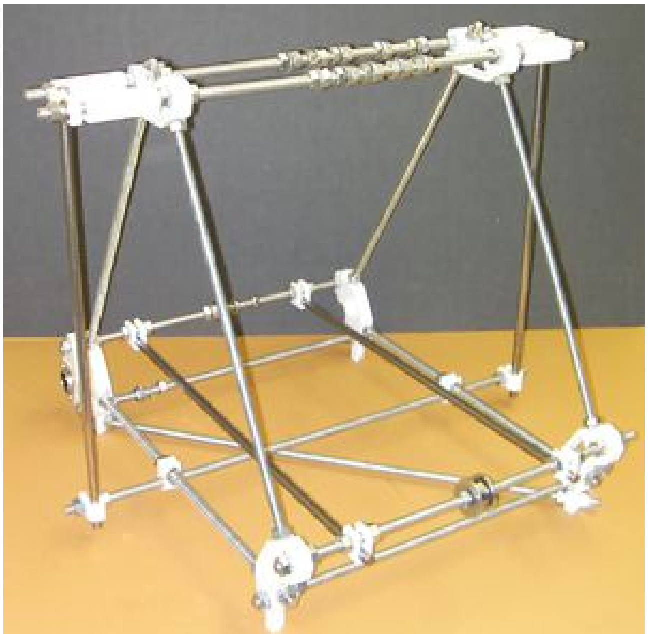
Tighten the nuts on the main frame holding the threaded rod, making sure that the cotton stays in the middle of the holes where it was.

Now tighten the inner nuts to move the U clamps outwards so that the cotton just kisses the edge of the U holes in exactly the same relative position as it is falling through the clamps at the top of the frame.

Slide the Z-axis rods in, tighten the clamps from the outside, and check with a square as in the section above. If you've done everything carefully there should be little or no discrepancy, but it is more important to have a right angle than to have the Z-rods plumb.

Frame finished

You will now have an assembled RepRapPro Mendel frame (though the smooth Y rods and the bearings will still be lose):



Next stage

assemble the Y axis.

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- This page was last modified on 10 July 2012, at 13:31.
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RepRapPro Mendel y axis assembly

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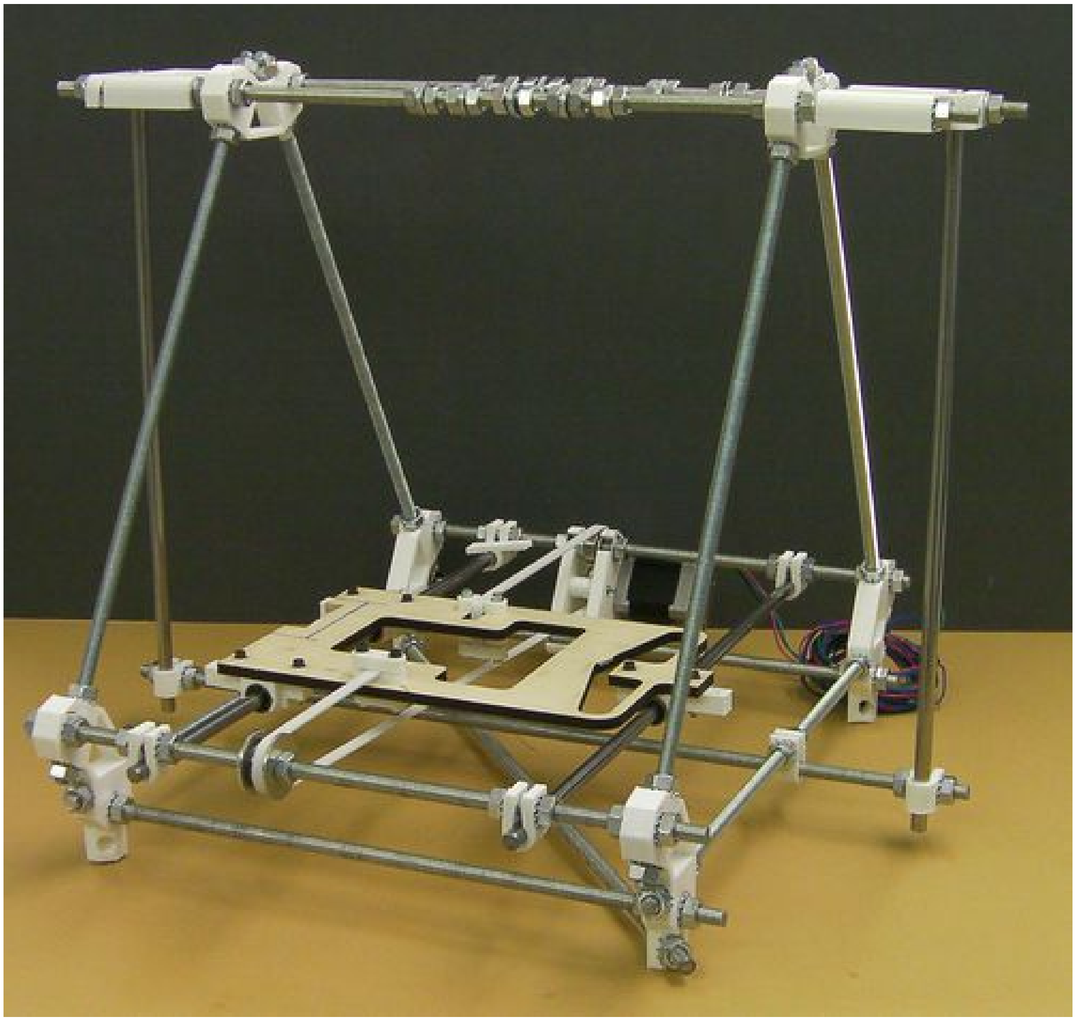
Goal

By the end of this stage, your machine should look like this:

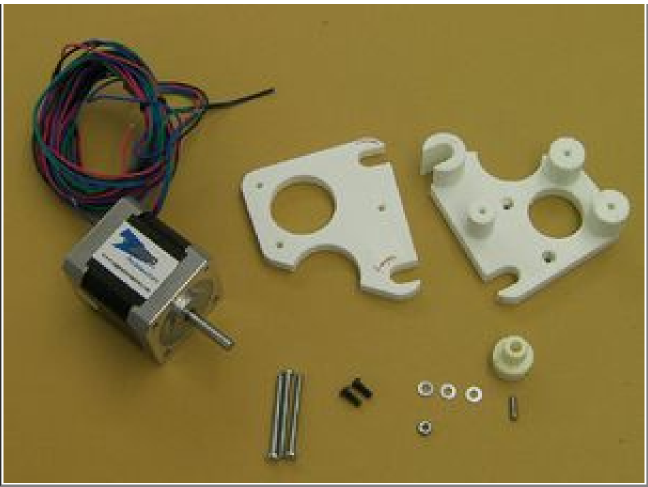


Tools

You will need the following tools

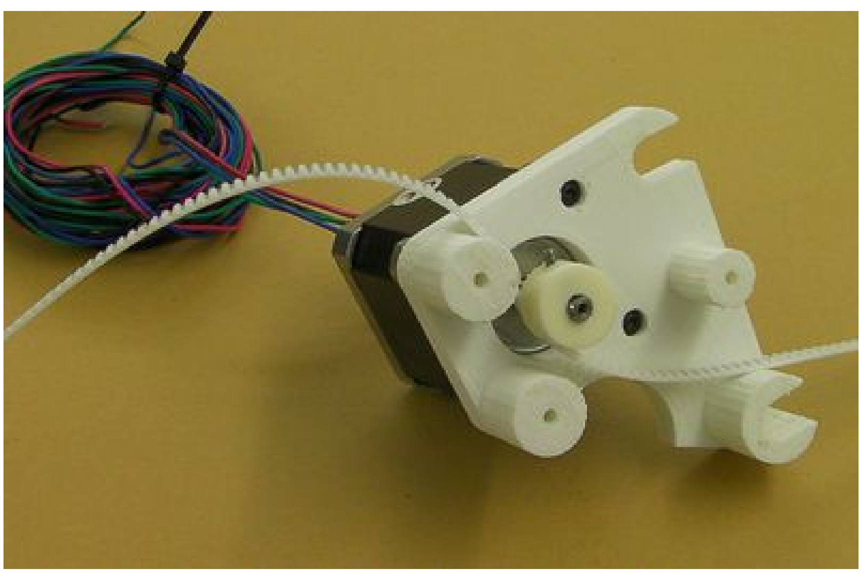
- M8 (13mm) spanner
- Adjustable spanner
- M3 Allen key
- M3 set screw Allen key
- M3 spanner/nut runner
- Long-nosed pliers
- Side cutters

Step 1: Y motor and mount



Item	Quantity
Printed Y motor mount	1
Printed Y motor lid	1
Nema 17 motor	1
M3 x 35mm screws	3
M3 x 10mm set screw	1
M3 nut	1
M3 x 8mm screws	2
M3 washers	3
Moulded toothed pulley	1

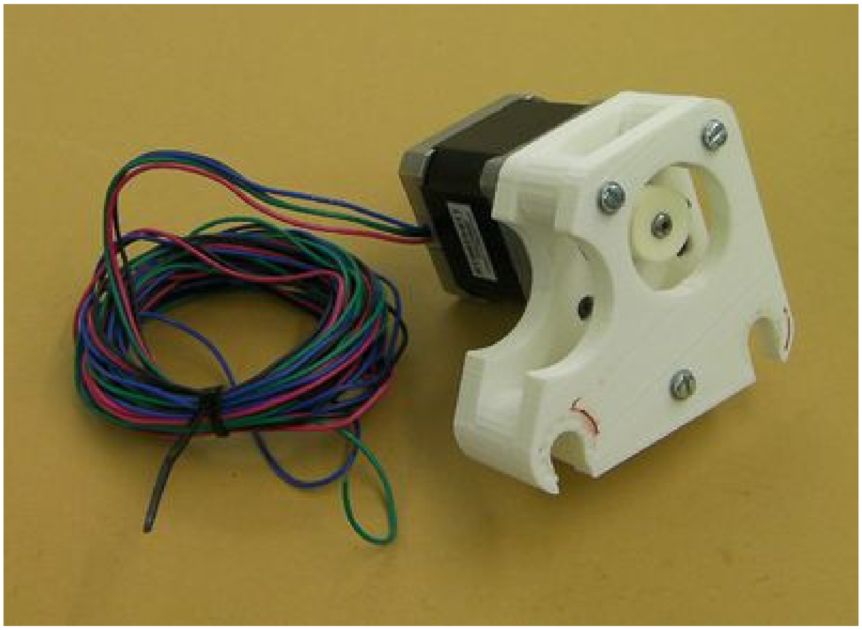
Use the two short screws to attach the motor to the half of its mount with the projections:



The wires come out of the bottom side of the motor in this picture.

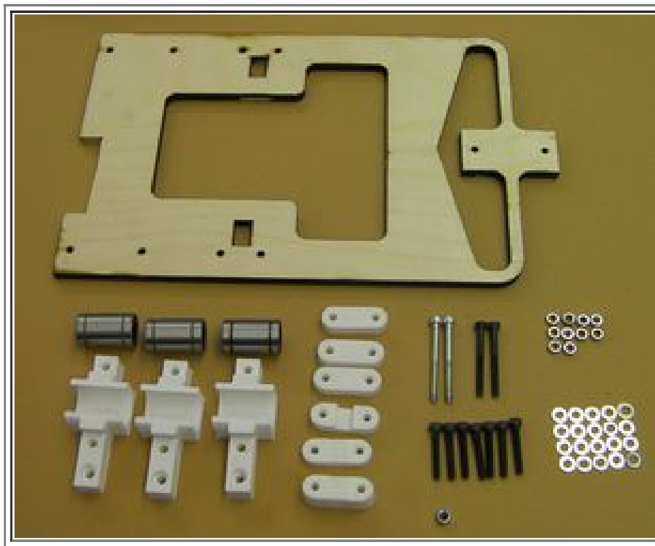
Screw the set screw into the toothed-belt pulley. Take care not to cross the threads - the plastic is not hard. Screw it in far enough to project into the hole down the middle, then back it off so it is no longer projecting. Blow any displaced pieces of plastic from the central hole.

Put the pulley on the motor shaft with its hub outermost, as shown. Use the toothed belt to get it roughly the right distance along the shaft. Align the set screw with the flat on the shaft, and tighten it. **Do not over tighten it -** the pulley has an internal embedded nut, and over tightening will cause this to fracture the pulley.



Use the remaining screws, washers and nut to attach the other half of the mount cage. There is a recess for the nut, which should be a tight fit. Take care when tightening to pull the nut into its recess that the hexagon of the nut is aligned with the hexagonal recess.

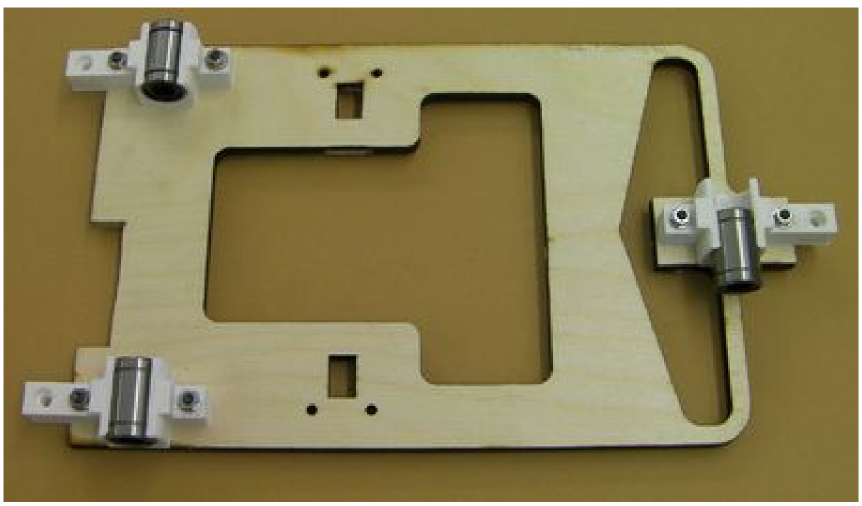
Step: 2 The Y frog



Item	Quantity
Lasercut frog	1
LM8UU bearings	3

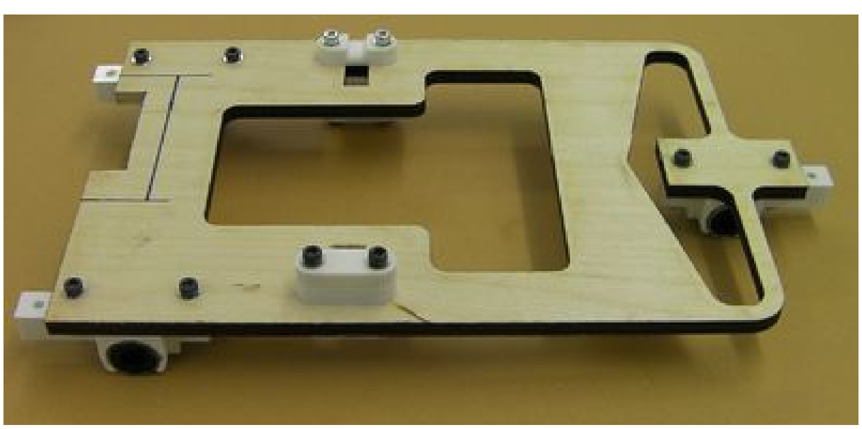
Printed bearing holders	3
Printed 7mm thick belt clamps	3
Printed belt guide	1
Printed 4mm thick ridged belt clamp	1
Printed 12mm thick ridged belt adjuster	1
M3 x 40mm screws	2
M3 x 35mm screws	2
M3 x 20mm screws	7
M3 nylock nut	1
M3 nuts	10
M3 washers	20

Attach the bearing holders to the lasercut part with 20mm screws, nuts and washers. Don't tighten the nuts:



Push the bearings into the bearing holders **from the side** as shown on the right. **Do not try to clip them in from on top.** The bearings should be a snug fit. But if they are a bit lose, simply wrap a little Kapton tape two or three times round the lose bearing. Get it flat without wrinkles or bubbles.

Attach the belt holders:



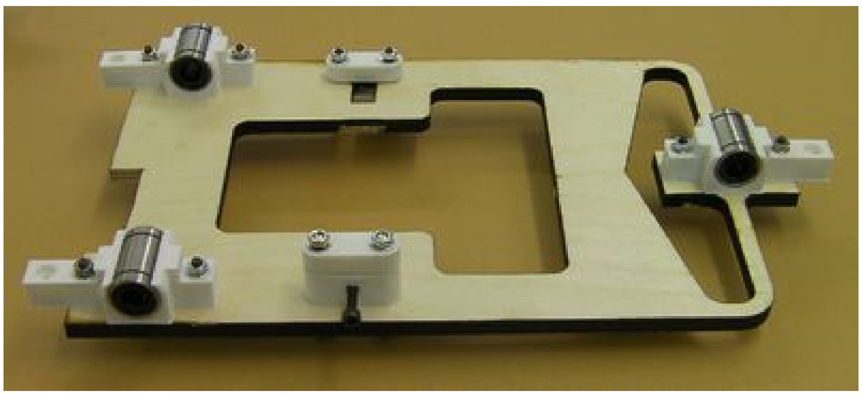
The far one in the picture uses the 40mm screws. From the top the order is:

- Belt guide (curved part towards you in the picture).
- Lasercut frog
- Tensioner (hexagonal cavity towards you in the picture; grip end pattern downwards).
- 7mm thick clamp

The near one in the picture uses the 35mm screws. From the top the order is:

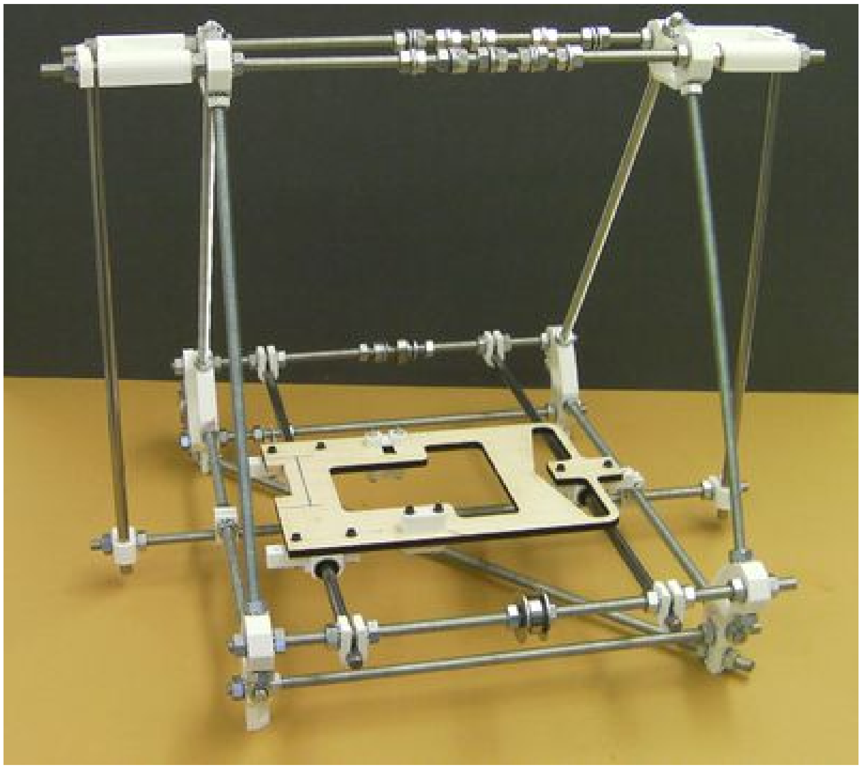
- 7mm thick clamp.
- 4mm thick grip (grip on top).
- Lasercut frog
- 7mm thick clamp (just for load spreading).

Here is a view from underneath to reveal some of the hidden detail:



Fit the nylock nut in the hexagonal hole in the tensioner, and loosely put the remaining screw in it. This screw will tension the belt by pushing on it.

Now to fit the frog to the machine:



With the front of the machine facing you, slacken the **right-hand nuts only** that hold the U clamps with the smooth Y rods. (If you leave the left-hand nuts alone you will be able to re-tighten the rods in exactly the same place - so make sure they don't turn.)

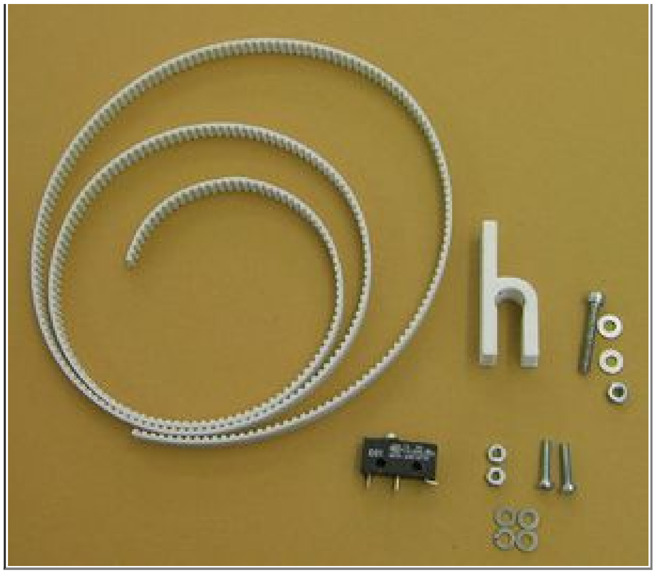
Slide the rods towards the back of the machine. Slide the Y frog over them.

Replace the rods in their U clamps and re-tighten the right-hand nuts on those.

Tighten the M3 screws and nuts that attach the bearing holders to the frog.

Check that the frog slides completely freely back and forth. If it is tight at one end and lose at the other, then the rods aren't parallel. If it is tight at both ends and lose in the middle, then the rods are too close or too far apart. In both cases, measure the rod gap (which should be 175 mm from before - remember the lasercut measuring template) at both ends and in the middle, and get things right by adjusting the **right-hand rod only**.

Step 3: The Y belt

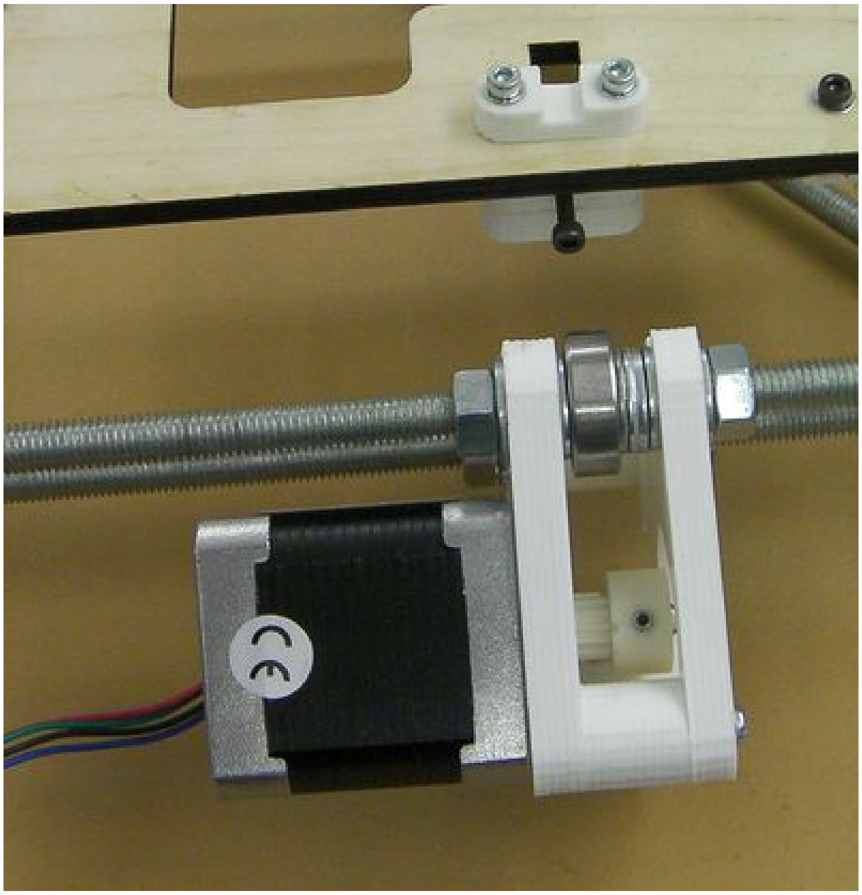


Item	Quantity
Toothed belt	900mm
Printed XY endstop holder	1
microswitch	1
M2.5x16mm screws	2
M2.5 washers	4
M2.5 nuts	2
M3x20mm screw	1
M3 washers	2
M3 nuts	1

Note that the X and Y axis endstop holders are identical, and you want one of those. The Z endstop holder has a longer leg.

Bend the lead on the microswitch as shown in the picture above.

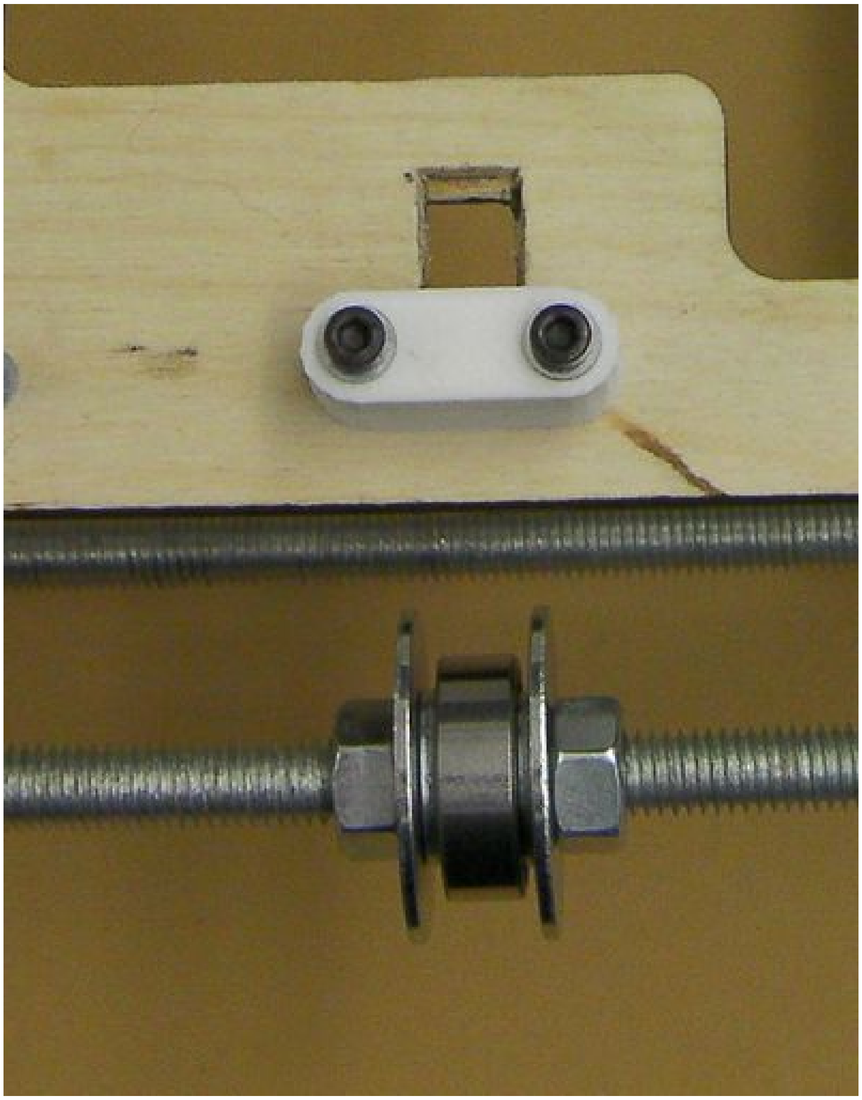
Fit the Y motor and mount:



Adjust its position so that the middle of the bearing is opposite the belt-tensioning screw on the frog.

Tighten the four M8 nuts that hold the Y motor mount, taking care that the distance from the left-hand top and bottom nuts to the corresponding nuts on the frame vertices are the same.

Tighten the Y-belt idler:



Line the bearing up to match the belt clamp on the frog.

If you have done everything right so far, the belt tensioner on the frog should be towards the back of the machine.

Put one end of the belt between the bottom clamp on the tensioner and the tensioner part with the nylock nut in. Have the free length of the belt pointing towards the front of the machine. Position the belt so that its teeth lock with the indentations in the tensioner. You should be able to feel this as you move the belt.

Run the belt up through the hole in the frog, and fold it back in the groove in the belt guide. Get the belt square and central in the guide and clamp, then tighten the M3 screws and nuts that retain it. These need to be tight, but not so tight that they bend the clamp.

Run the belt over the bearing above the motor, round the motor's drive pulley, under the frog to the front of the machine, over the idler pulley, and back to the clamp on the front of the frog.

Thread the belt through the front clamp, get everything square, and pull the belt so there is no slack. It doesn't need to be taught.

Tighten the clamp.

Check the toothed drive pulley on the motor - it needs to be positioned so that the belt runs over the centre of the bearing. Slacken its set screw and move it if need be.

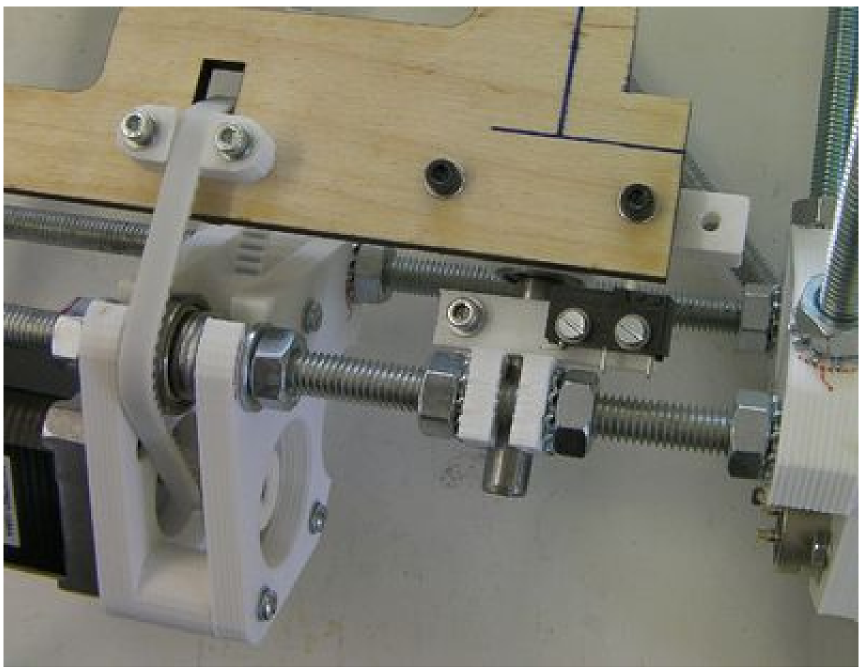
Cut off any spare belt with sidecutters - leave about 20mm free sticking out of the far side of the clamp.

Set the belt tension with the tensioning screw. The belt needs to be taught, but no so taught that it impedes the turning of the motor. Be gentle...

Check that the frog still moves freely front and back in the machine - there should be a certain resistance from the magnets in the motor, that is all.

Also check that the belt runs true. It should not tend to move from side to side more than 1mm or so.

Finally, attach the endstop microswitch to the h-shaped printed bracket with the M2.5 screws, washers and nuts. Attach the bracket to the frame at the back beside the motor:



Use the M3 screw, two washers, and nut to secure it. Before tightening these, make sure that the frog hits the button on the switch at the end of its travel.

Next stage

Assemble the X axis.

Retrieved from "http://www.reprap.org/wiki/RepRapPro_Mendel_y_axis_assembly"
Categories: Build Instructions | RepRapPro | Mendel | Mendel Development

- This page was last modified on 17 June 2012, at 15:13.
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RepRapPro Mendel x axis assembly

From RepRapWiki

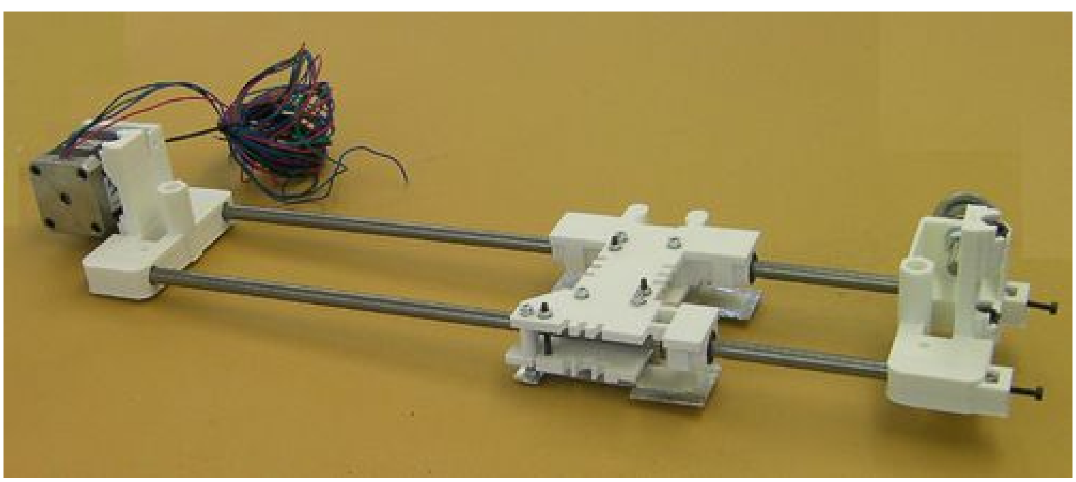
| Introduction | Frame assembly | Y axis assembly | **X axis assembly** | Z axis assembly | Heated bed assembly | Extruder drive assembly |

| Hot end assembly | Power supply | Wiring | Commissioning | Printing | Maintenance | Troubleshooting | Improvements |

Contents

Goal

By the end of this stage, your X-axis should look like this:



Tools

You will need the following tools

- M3 Allen key
- M3 set screw Allen key
- M3 spanner/nut runner
- Long-nosed pliers
- Tweezers
- M8 spanner

Step 1: X carriage assembly

Item	Quantity
Printed X carriage lid	1
Printed X carriage plate	1
Printed X belt clamp	2
Cardboard heatshield*	1
Aluminium cooking foil*	110mm x 135mm
LM8UU bearings	3
M3x20mm screws	5
M3x35mm screws	5
M3x30mm hex-head screws	3
M3 nylock nut	1
M3 nuts	22
M3 washers	27

*Kits supplied from RepRapPro Ltd have the heatshield pre-cut from aluminised card. For those you can skip the next DIY section.

DIY Heatshield

Start by gluing the aluminium foil to the cardboard heatshield. The aluminium needs to go on the underside of the cardboard when the cardboard is the way up shown in the picture above.

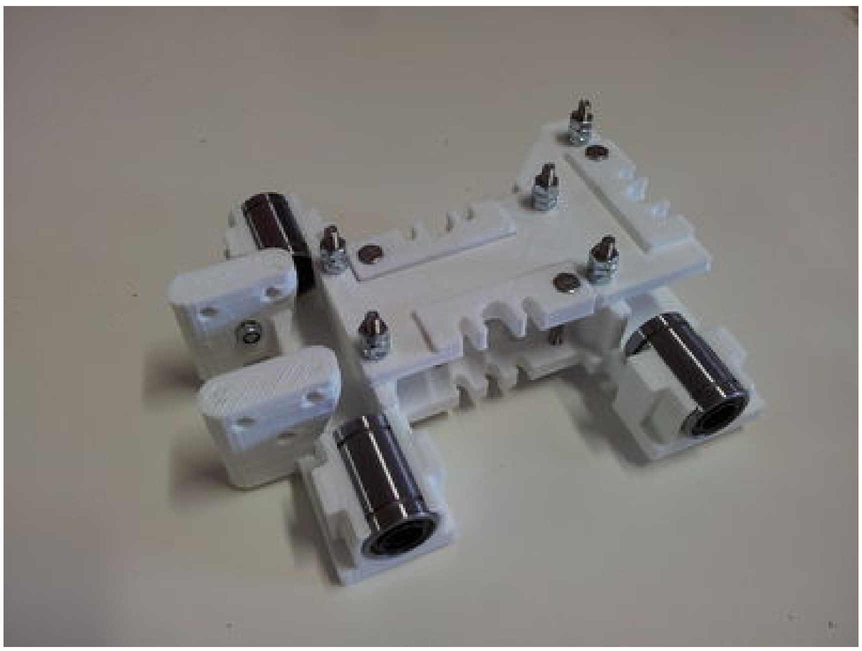
Virtually any glue will do, but aerosol spray glue is easiest. Spray the foil, then drop the cardboard onto it and press it down against a flat surface.

Trim the foil about 5mm out from the edge of the cardboard and fold it over and stick it around the edge on the back. You can make a neat job if you make rectangular cuts of the foil by convex corners, and 45 degree angled cuts in to concave ones.

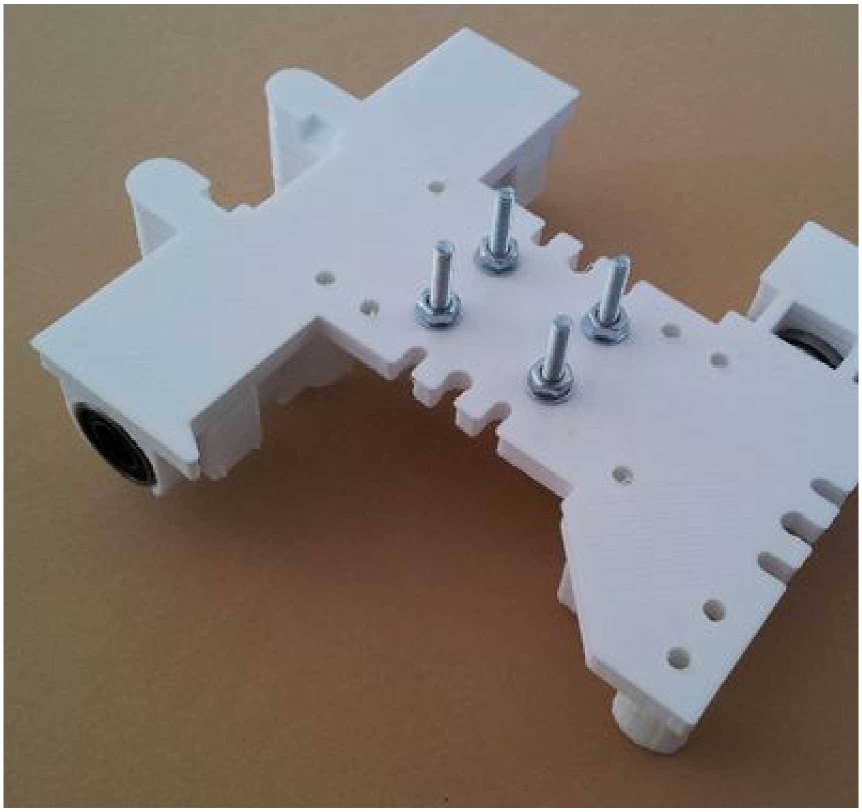
Let the glue set.

The Carriage

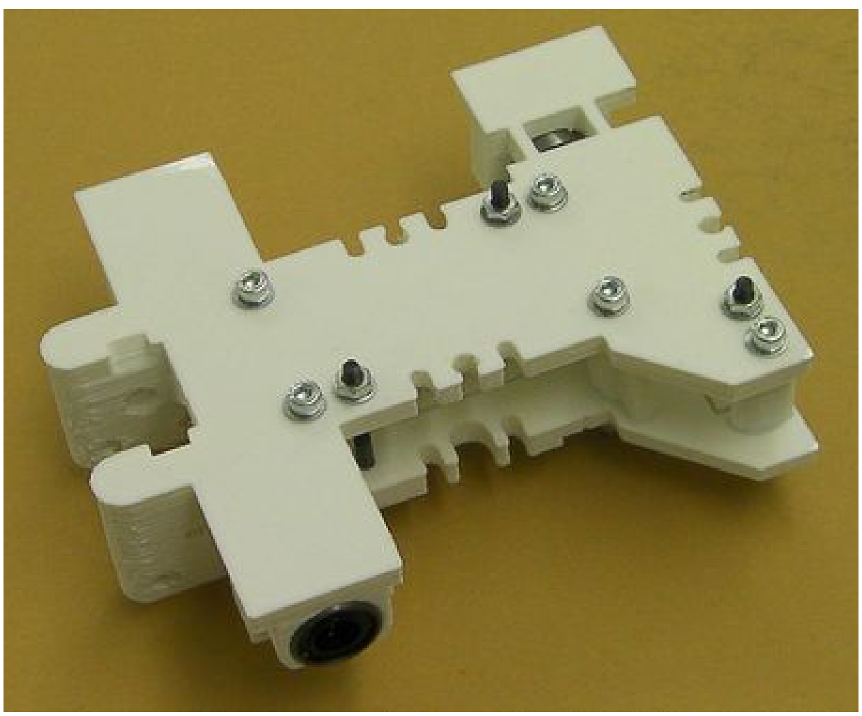
Next with the X carriage upside-down slide the LM8UU bearings into their holders sideways:



Don't try to fit the bearings by clipping them in from above - this will break the carriage. The bearings should be a snug fit. But if they are a bit lose, simply wrap a little Kapton tape two or three times round the lose bearing. Get it flat without wrinkles or bubbles.



Optional: Fit four 16mm M3 cap screws with four washers and nuts (not in the list above) to the carriage as shown. These are not needed at the moment, but will be used in future enhancements. If you fit them now, you will not need to take the carriage apart in the future.



Fit the hex-headed screws in their recesses in the flat plate. You may find it easiest to draw the hex heads into their recesses with a nut and washer on the other side of the plate which you subsequently remove. Make sure the hex head and the hexagonal hole line up before you start applying force.

Use the 35mm screws with nuts and washers to secure the plate to the carriage. Have the ends of the screws projecting as shown in the bearing-fitting picture above. Fit two additional nuts to each screw (making three in total) with two washers between each pair. These act as spacers for the heat shield (to be fitted later).

Put nuts and washers on the ends of the hex-headed screws.

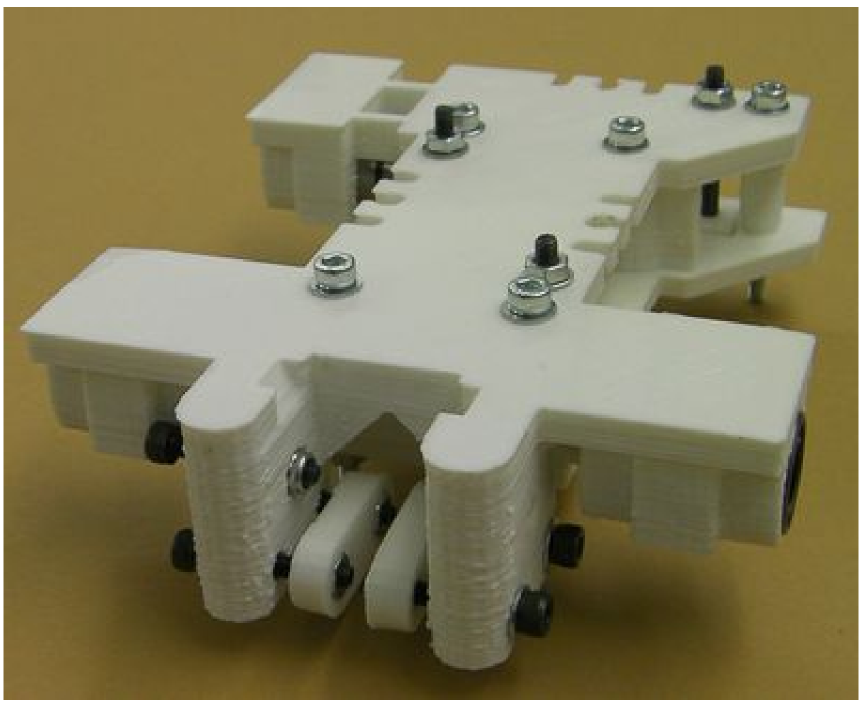
Don't do these up tight. These screws allow you to adjust the relative heights of multiple extruders in the carriage.

Fit the belt clamps with screws nuts and washers.

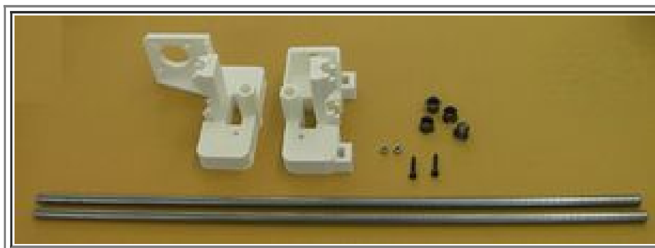
Start by sinking the nuts into their recesses. You can do this most easily by pulling them through with a screw with a washer under its head. Make sure as you tighten the screw that the hexagon of the nut is aligned with its hexagonal hole.

The belt-gripping indentations on the clamps face the vertical pillars.

Fit the tensioning screw using the nylock nut as shown:



Step 2: Main X axis assembly



Item	Quantity
Printed X end (motor)	1
Printed X end (idler)	1

428mm smooth 8mm rods (X)	2
8mm IGUS bearings	4
M3 nylock nuts	2
M3x16 screws	2

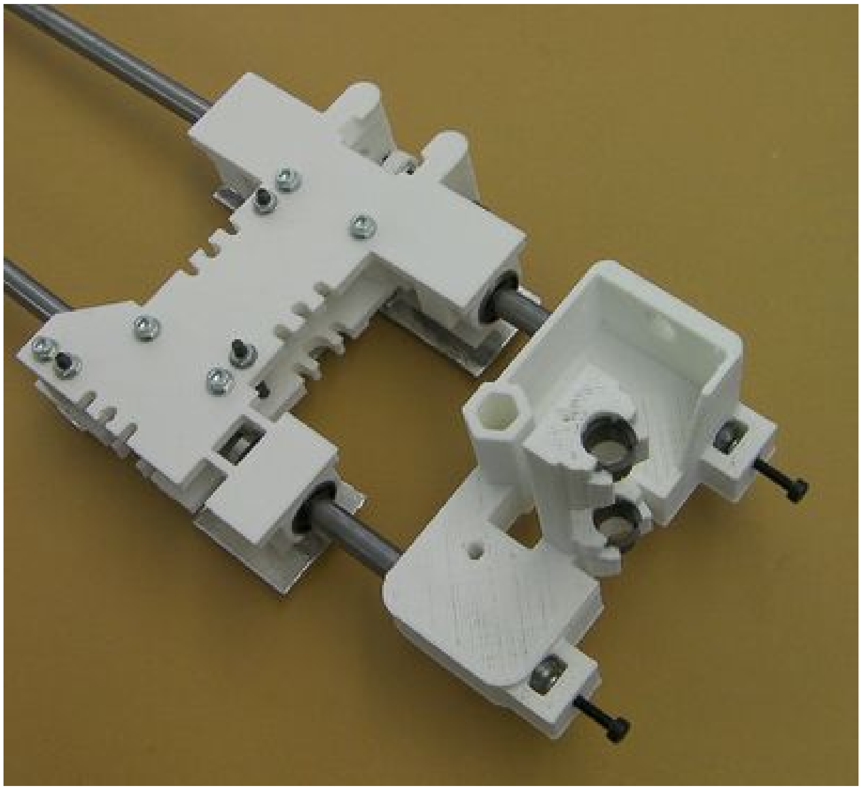
Start by fitting the IGUS bearing inserts to both ends:

You can curl them up so their ends overlap to insert them. Be careful.

Check their internal diameter by running one of the 8mm rods down them. If the rod is too tight (don't force it) put a 9.5mm drill bit shank in a vice, take the bearing inserts out, and slide the printed part over the drill to clean out the hole. Again be careful - you don't want to remove too much material and make a sloppy fit.

Repeat this process until the rod just fits and slides smoothly. It should not wobble from side to side.

With the tweezers fit the nylock nuts into their recesses in the idler end:

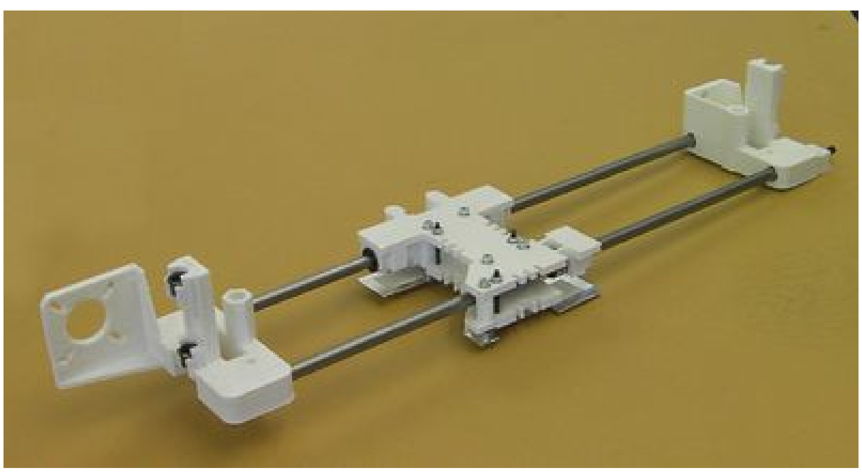


Pull them into their recesses with a screw if needs be.

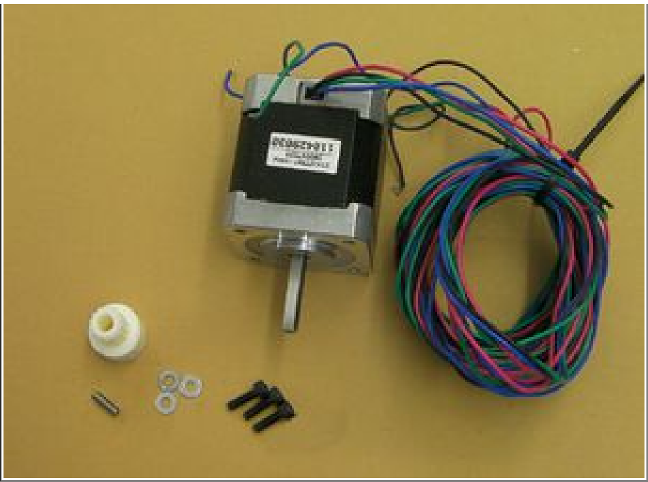
Screw the two screws in by just three or four turns. Slide the smooth rods in so that they abut the screws and nuts.

Put the X carriage on the rods. Make sure to get it the way round shown in the picture.

Put the motor end printed part on the other ends of the rods. Make sure they slide right up to the closed ends of their holes:

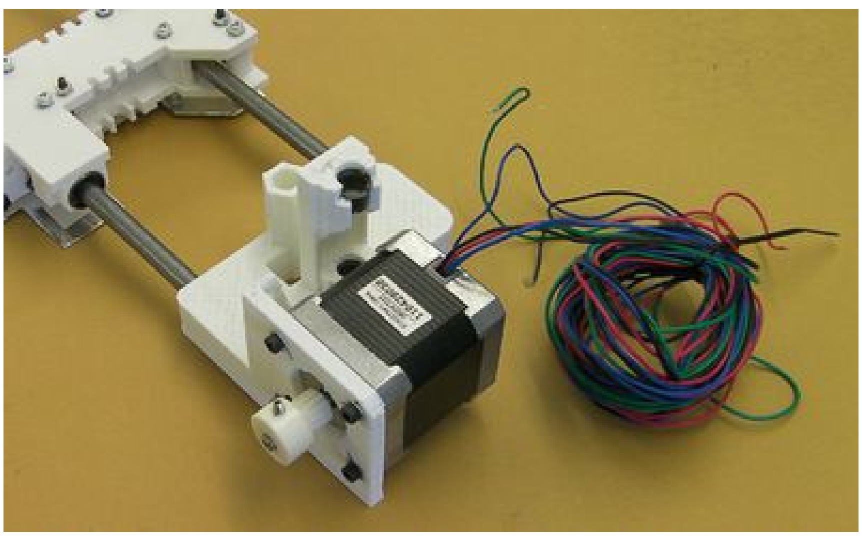


Step 3: Fit the X motor



Item	Quantity
NEMA 17 motor	1
M3x10 screws	3
M3 washers	3
Toothed belt pulley	1
M3 x 10mm set screw	1

Use the screws and washers to mount the motor:



Run the set screw into the toothed pulley until it projects into the central hole. Back it off so it no longer projects. Clean any plastic residue from the hole.

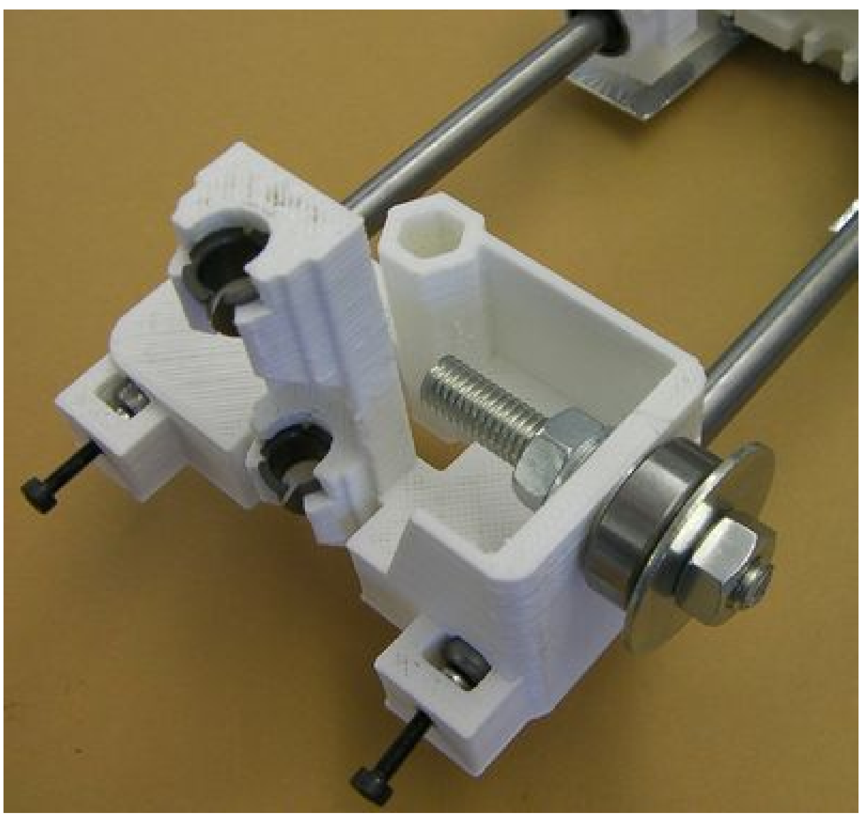
Put the pulley on the motor shaft as shown. Us a toothed belt to position it right - you want the gap between the pulley hub and the printed face where the motor is mounted to be about 1mm bigger than the width of the belt.

Tighten the pulley's set screw against the flat on the motor shaft. Don't do it too tight or you will break the pulley.

Step 4: The X belt idler

Item	Quantity
35mm M8 threaded rod	1
M8 nuts	2
M8 mudguard washer	1
8mm bearing	1
M8 washers	3

Fit the idler:



From the right the sequence goes:

1. Nut
2. Mudguard washer
3. Washer

4. Bearing
5. Washer
6. Printed idler end
7. Washer
8. Nut

Next stage

The Z axis

Categories: Build Instructions | RepRapPro | Mendel | Mendel Development

RepRapPro Mendel z axis assembly

From RepRapWiki

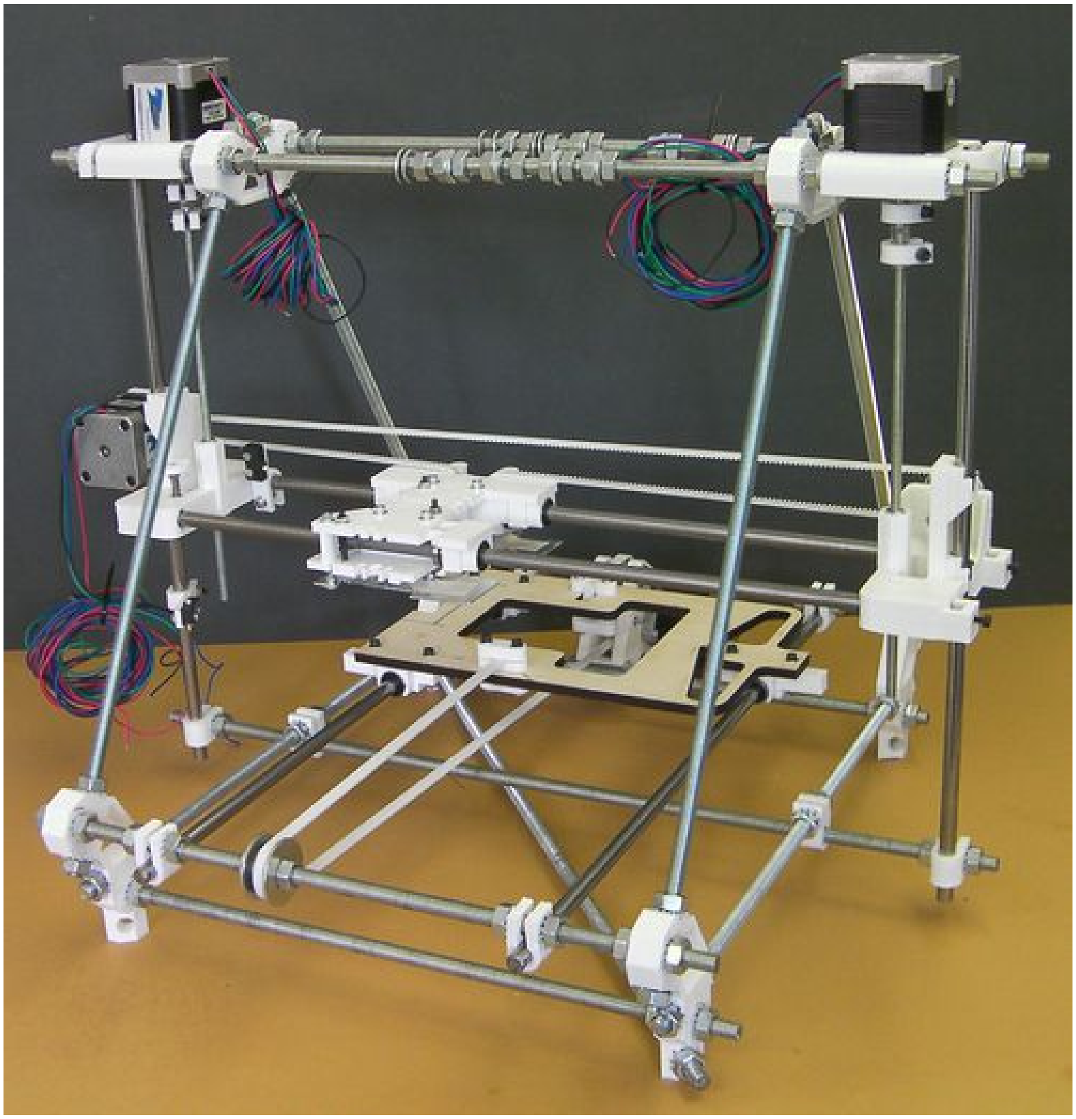
| Introduction | Frame assembly | Y axis assembly | X axis assembly | **Z axis assembly** | Heated bed assembly | Extruder drive assembly |

| Hot end assembly | Power supply | Wiring | Commissioning | Printing | Maintenance | Troubleshooting | Improvements |

Contents

Goal

By the end of this stage, your RepRap should look like this:

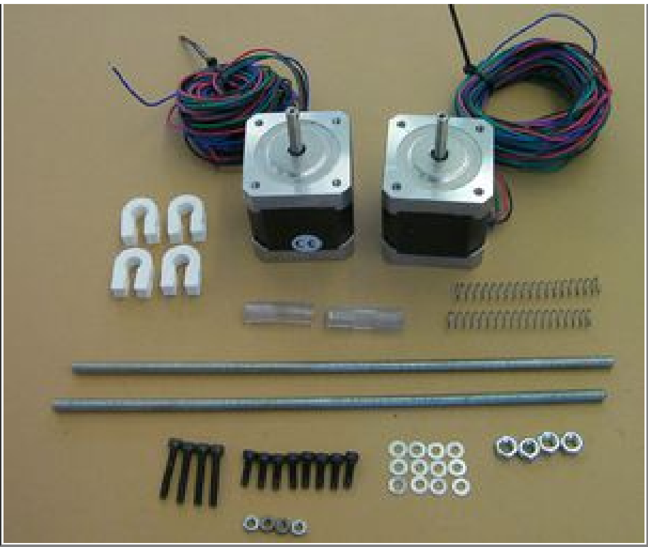


Tools

You will need the following tools

- M3 Allen key
- M3 spanner/nut runner
- Small screwdriver
- M2.5 spanner
- M8 spanner

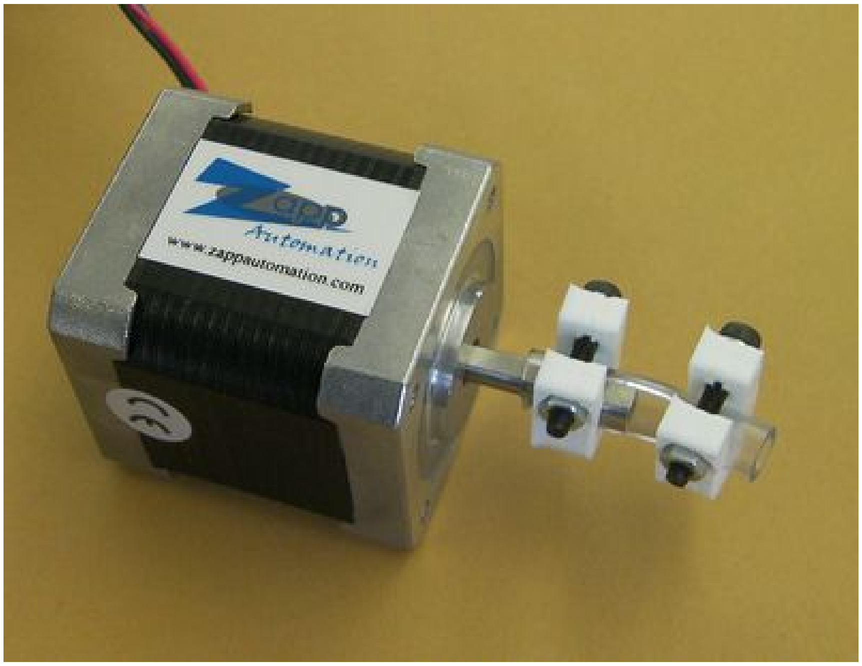
Step 1: Z axis screw drives



Item	Quantity
NEMA 17 motors	2
25 mm springs*	2
215mm M5 studding	2
M5 nuts	4
30mm x 5mm id poly tube	2
Printed U clamps	4
M3 x 20mm screws	4
M3 nuts	4
M3 x 10mm screws	8
M3 washers	12

*The springs shown in the picture are too long; the ones you want are 25mm.

Start by fitting the plastic tubes to the motors using the U clamps. Have the gap in each clamp aligned with the flat on its motor shaft:

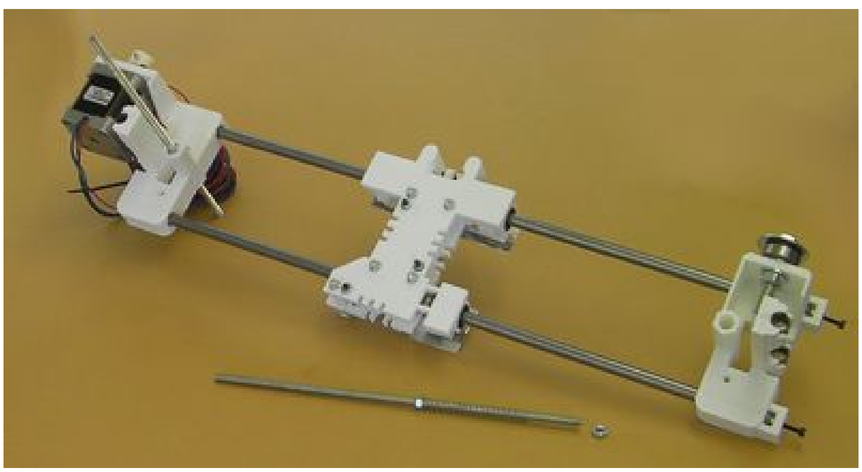


Put both clamps on, but don't tighten them. Have the motor shafts come just under half way through the tubes.

Then use the short screws with washers to fit the Z motors at the top of the frame.

Have the wires point towards the centre of the machine.

Next fit the M5 threaded rods, M5 nuts and springs to the X axis:

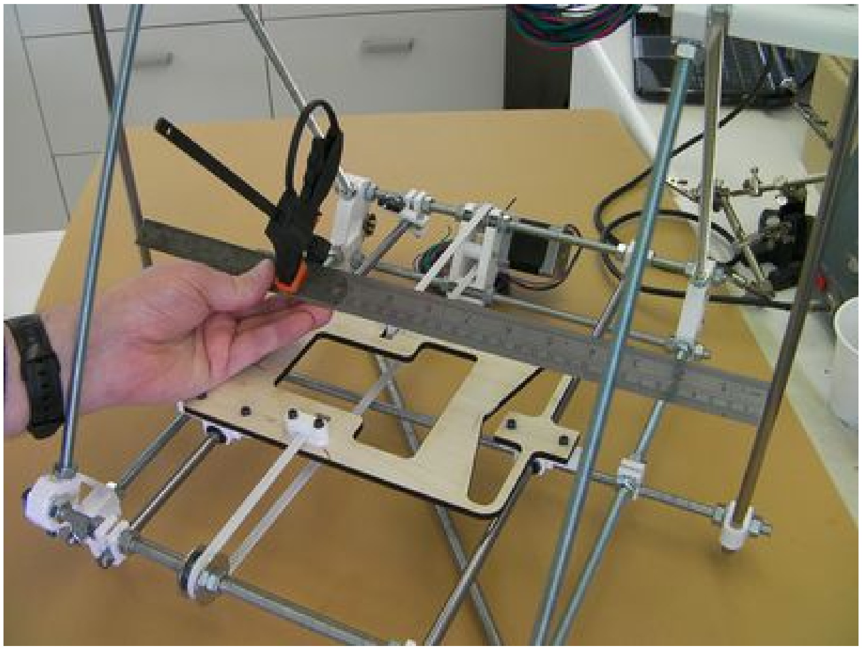


Screw a nut onto a rod and make sure that it fits down the hexagonal holes in the X-axis ends. It should be snug, but move up and down freely. If there are tight spots inside the hexagonal holes scrape them away with a screwdriver blade.

Now fit the nuts and rods. Put a nuts about half way along a bar, put a spring on, and push the spring down the top of a hexagonal hole.

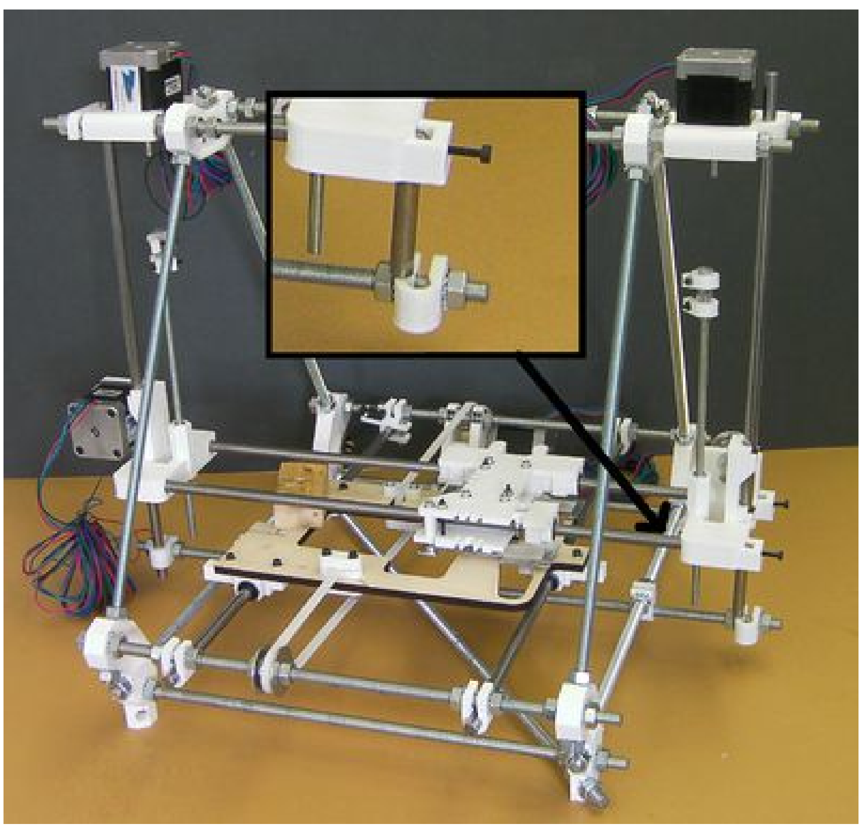
Compress the spring and put another nut on the bottom of the thread. When the spring relaxes it should pull that nut into the hole in the bottom of the hexagonal hole to rest on the constriction about 10mm up inside. Adjust things so that the top nut is about flush with the top of its hole.

Now check that the Z rods are parallel:



A simple way to do this is with two rulers clamped together as shown. Check the gap bottom, middle and top. Make adjustments by slackening and tightening the M8 nuts that clamp the bottoms of the Z rods. **Make the adjustments symmetrically - whatever you do on the left, also do on the right.** You may find it helps to mark the nuts with a felt-tipped pen so you can see how far you turn them.

Step 2: Fit the X axis



(The picture is wrong: the plastic tubes and their U clamps should be on the motors at this stage, not the M5 rods.)

Slacken the nuts on the Z motor mounts that retain the Z rods. Slacken the **outer** nuts on the U clips at the base of the Z rods. Make sure that the inner nuts do not move - then when you re-tighten things everything will go back to the same place.

Slide the Z rods upwards by about half their length. You may need to tighten the top nuts by hand to stop them falling again.

Move the Y frog to the middle of the machine.

Put the X axis on the Y frog. Pack the X axis up with a scrap of wood or similar to get it level and stable.

Push the left-hand Z rod down through the IGUS bearing inserts by the X motor and on down through the U clip at the bottom. Again, take care not to move the inner nut.

Tighten the outer nut on the Z rod, and also tighten the nut at the top on the Z motor mount.

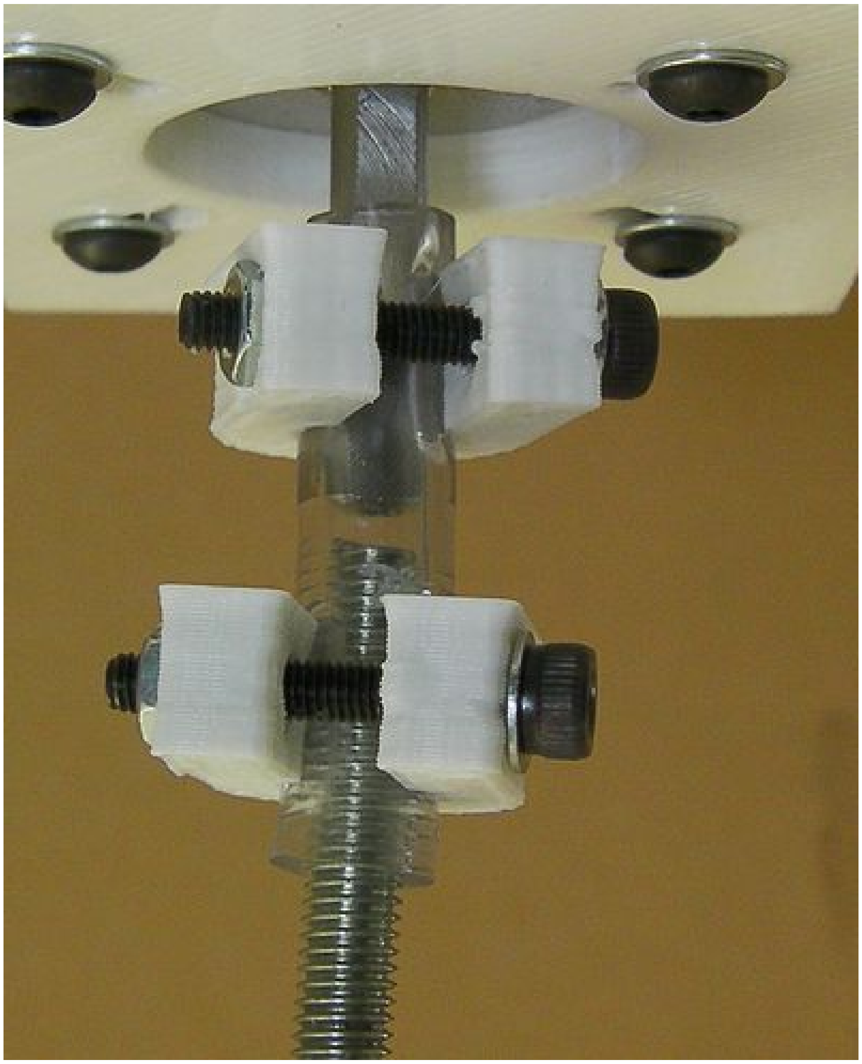
Push the right-hand Z rod down through the X carriage and stop just above its U clip.

The Z rod will be on the inside of the U clip. That is to say, the X axis is (deliberately) too short. (See the inset image.)

With an M3 Allen key, tighten the screws in their nylock nuts on the ends of the X rods. The bottom of the Z rod will move outwards. Adjust it so that it just lines up with the hole down the U clip, then push it on down through the U clip.

Tighten the nuts on the Z motor mount and the outer nut on the bottom U clip to hold the right-hand Z rod firmly.

Finally for this step use a rectangular object to support the X carriage on the Y Frog. Then screw the ends of the M5 rods into the plastic tubes on the motors.

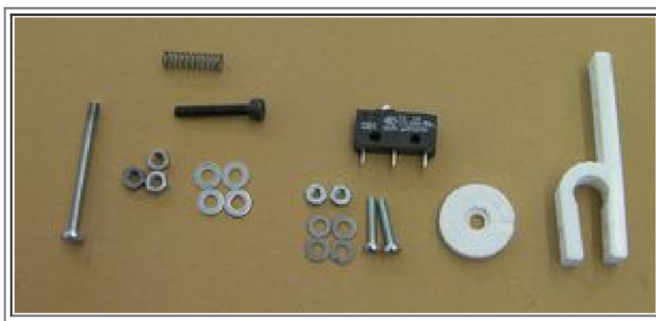


Have gaps of about 2mm to 3mm between the tops of the M5 rods and the bottoms of the motor shafts. (You can see this because the poly tube is transparent.)

Tighten the U clamps on the motor shafts and the M5 rods. Remember to have the flats on the motor shafts aligned with the gaps in the clamps.

Turn the Z motors by hand to get the X axis level. To check this, move the Y frog and the X carriage out of the way, and use digital callipers to measure the gaps between the Y rods and the X rods. These gaps should be the same left and right.

Step 3: The adjustable Z endstop

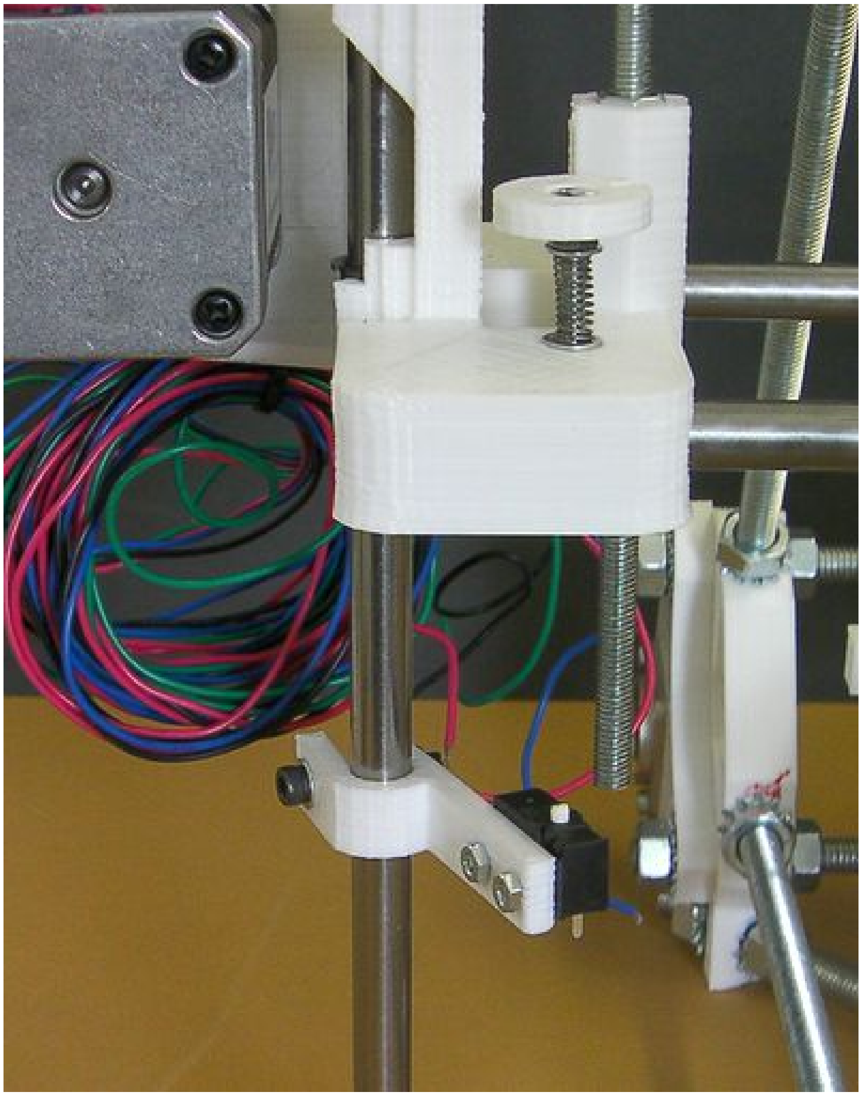


Item	Quantity
M2.5x16mm screws	2
M2.5 washers	4
M2.5 nuts	2
microswitch	1
Printed Z-stop bracket	1
Printed z-adjust wheel	1
M3 x 35mm hex-head screw	1
M3 x 20mm screws	1
M3 nuts	3
M3 washers	4
15mm spring	1

Note that the X and Y axis stop brackets are identical. The Z stop bracket holder has a longer leg; that is the one you want.

Start by using the 35mm hex-head screw together with nuts, washers and the spring to assemble the adjuster:

Then use an M3 nut underneath to fit the adjuster to the motor end of the X carriage:



Pull the nut into its hexagonal recess under the carriage. Make sure the two hexagons line up.

Assemble the switch together with the "h" shaped piece using the M2.5 screws, washers and nuts as shown and fit it to the smooth Z rod.

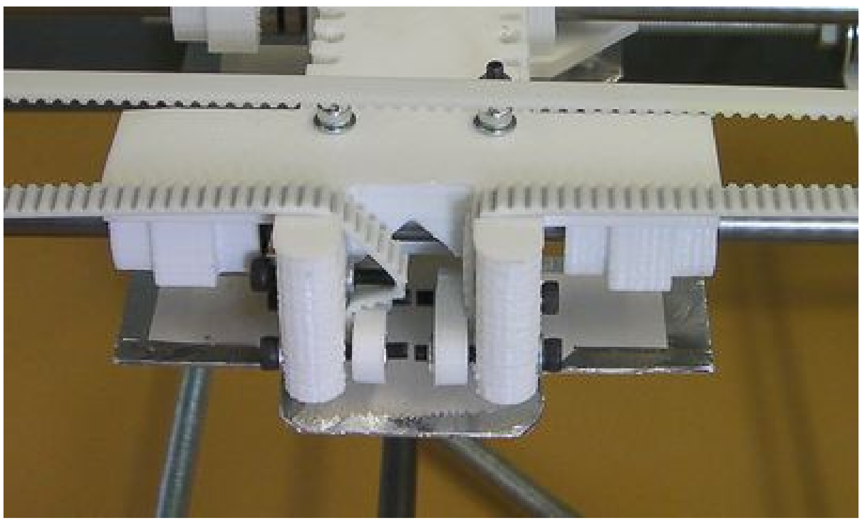
The remaining M3 parts close the h-clamp. Don't do it too tight - it needs to be firm and unmoving, that is all.

The switch button should line up with the end of the adjustment screw.

Step 4: The X belt and endstop

Item	Quantity
Printed XY-stop bracket	1
M2.5x16mm screws	2
M2.5 washers	4
M2.5 nuts	2
microswitch	1
M3 x 20mm screws	1
M3 nuts	1
M3 washers	2
toothed belt	1000mm

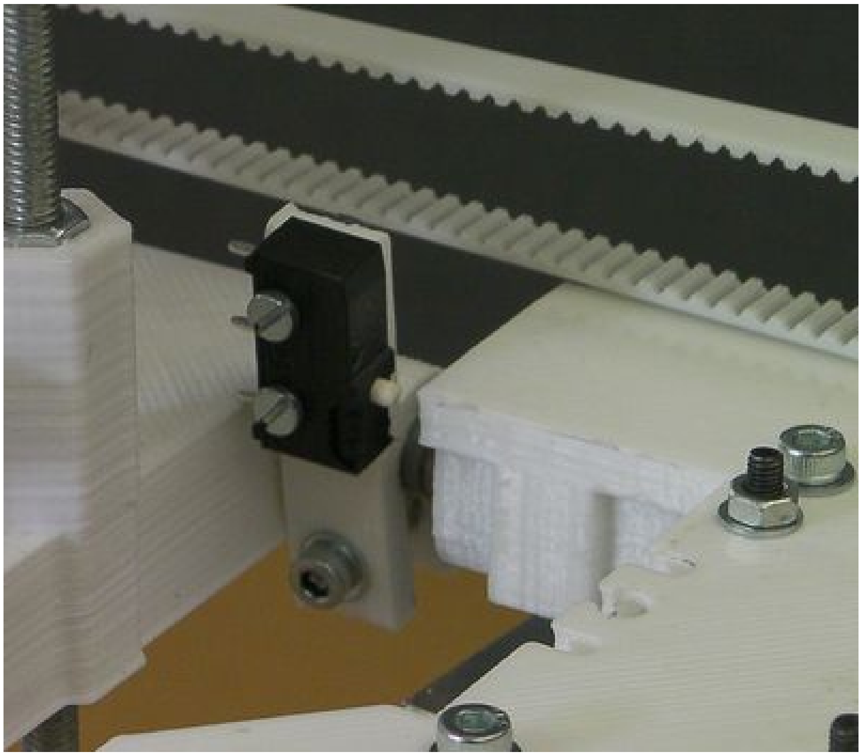
Loop the belt round the X motor pulley, over the X idler bearing at the other end, and attach the ends of the belt to the carriage as shown:



The belt will be a little too long. Pull it so there's no slack, check that the belt teeth are located in the dents for them in the clamps, tighten the clamps, and remove any excess beyond about 10mm with sidecutters.

Use the belt adjusting screw to tension the belt. It needs to be taught, so there's no movement, but don't do it too tight.

Fit the X endstop as shown. It goes on the back of the X carriage at the motor end:



Check that the X carriage hits the switch, but don't do it up tight - you will have to take it off again to wire it up.

Fit the heat-shield under the X carriage, with the aluminium face pointing downwards. Sandwich it between the washers between the nuts that you fitted earlier for this purpose. Fit it as low as you can, with the bottom nuts at the end of their travel.

Next step

Heated bed assembly

RepRapPro Mendel heatbed assembly

From RepRapWiki

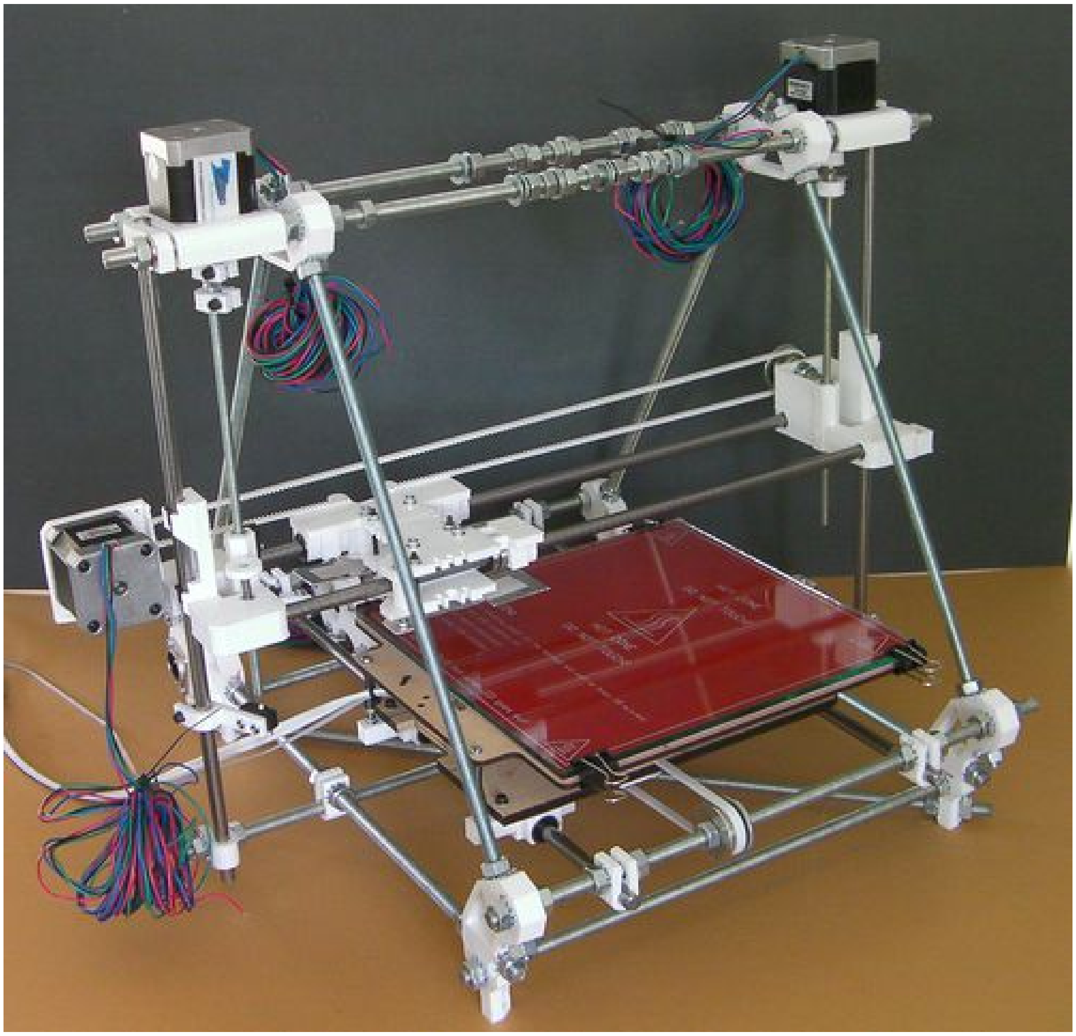
| Introduction | Frame assembly | Y axis assembly | X axis assembly | Z axis assembly | **Heated bed assembly** | Extruder drive assembly |

| Hot end assembly | Power supply | Wiring | Commissioning | Printing | Maintenance | Troubleshooting | Improvements |

Contents

Goal

By the end of this step your RepRap machine should look like this:



And in addition it will have an aluminium plate on top of the red circuit board.

Tools

You will need the following tools:

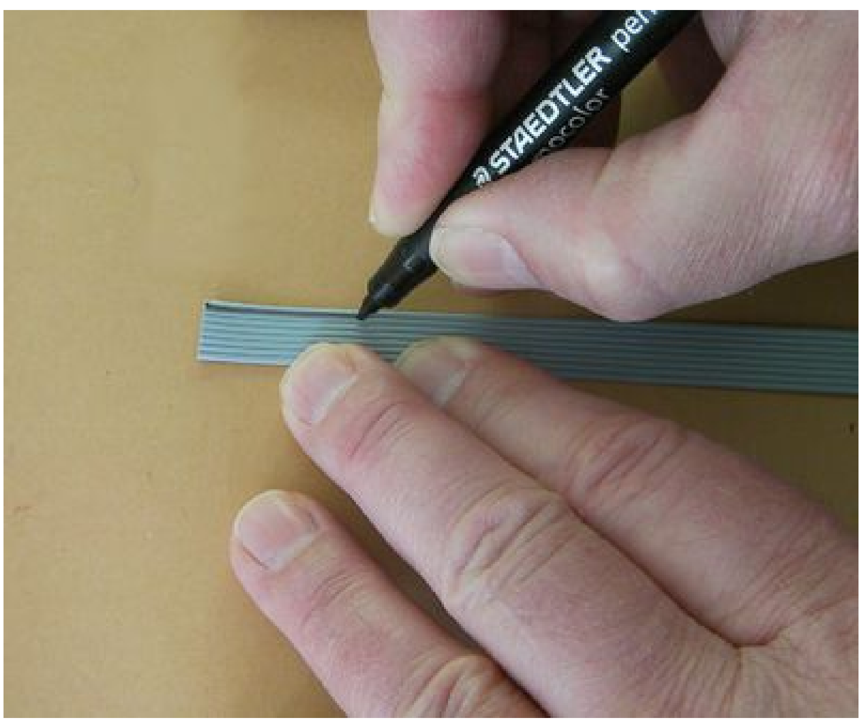
1. M3 Allen key
2. Cross-head screwdriver
3. Multimeter
4. Soldering iron and solder

Parts

Hardware	Quantity	
Lasercut insulator	1	
PCB bed heater	1	
Glass printing plate	1	

Foldback spring clips	4	
M3 x 40mm screws	3	
30mm springs	3	
M3 nuts	13	
M3 washers	16	
10K glass bead thermistor	1	
twin ribbon wire	1.1m	
20A wire	1.1m	
3mm LED	1	
1k resistor	1	
Aluminium heat spreader	1	
M3 x 10mm countersunk screws	4	
1mm dia copper wire	35mm	
Heatshrink	30mm	
Cable tie	1	

Get the twin ribbon wires by stripping them off the 10-way ribbon cable supplied with the kit. If that ribbon cable has a colored stripe down one side, strip the two wires furthest from it. If it has no coloured stripe, strip from one side, then put the remaining 8-way ribbon flat on the bench and run a felt-tipped marker down one side:



This will make the wires in it easier to identify later. Set the 8-way ribbon aside for later use.

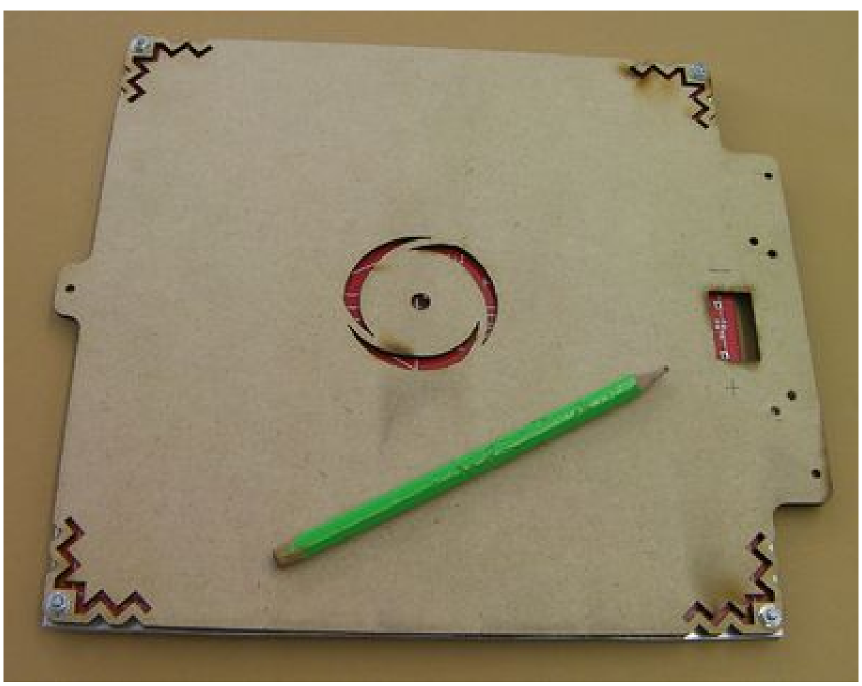
Step 1: Main assembly

Use the countersunk screws together with four nuts and washers to sandwich the heated bed PCB between the aluminium plate and the MDF insulator.

The zig-zag heater track on the PCB faces **up** towards the aluminium plate.

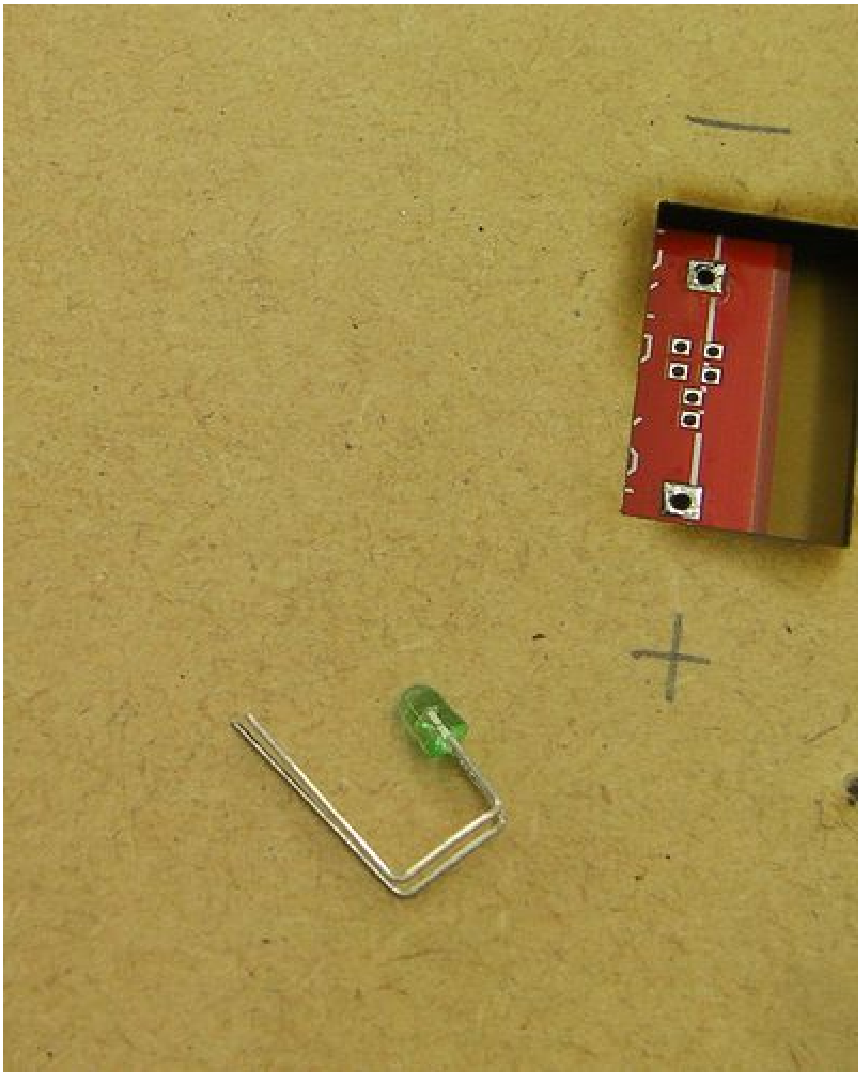
Make sure that the PCB solder terminals, the rectangular cut in the insulator, and the notch out of the aluminium plate all line up.

Take care not to break the lasercut springs in the corner of the insulator. (These are to allow for differential expansion.)

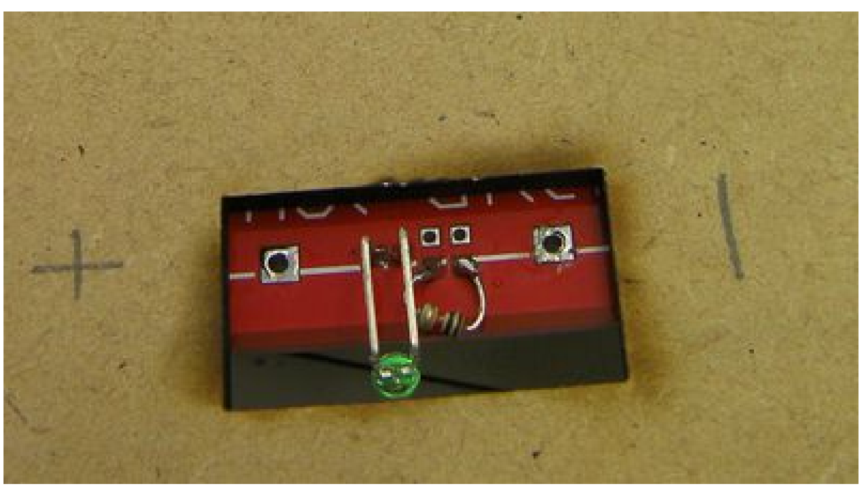


Here is a view of the underside. Use a pencil to mark + and - as shown. This will help with the wiring.

Step 2: Wiring



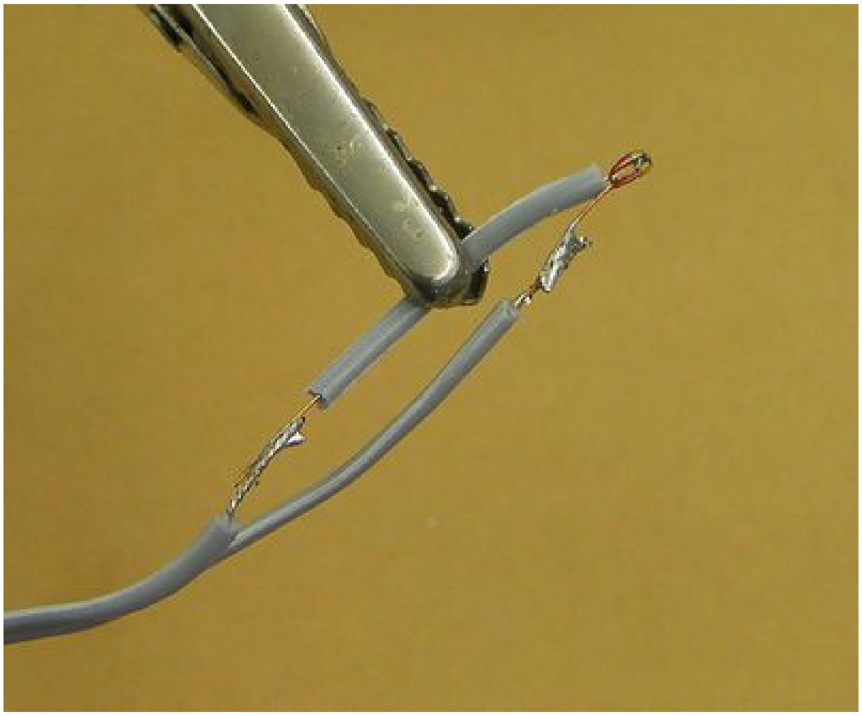
Bend the LED's legs as shown above. The longer leg (+) is underneath in this picture.



Solder the LED and the resistor as shown. You may find this easier if you prop the bed up on something clear of the bench so the wires can poke through.

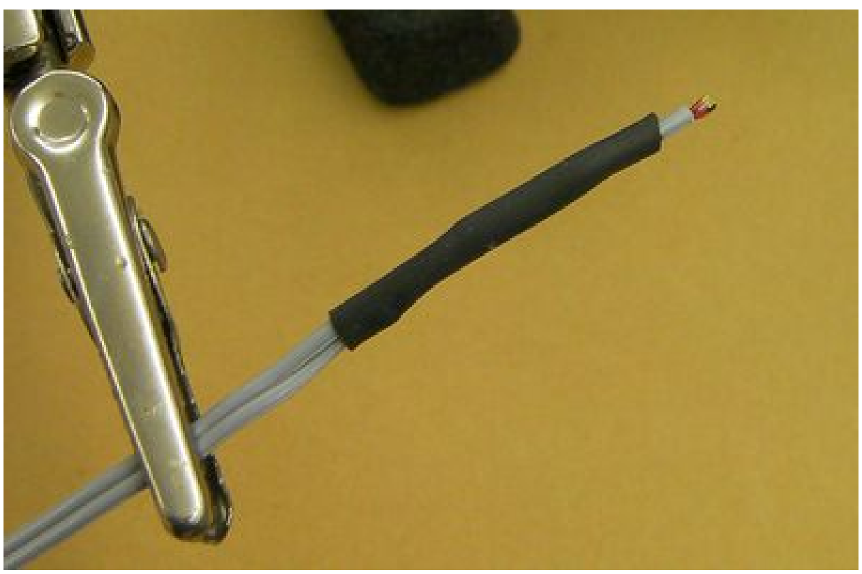
The long leg of the LED goes to the side you marked +. In the picture you are looking at the bottom of the LED.

Solder the wires on both sides of the PCB. Trim the wires flush with the top of the PCB using side cutters.



Solder the twin ribbon wires onto the thermistor as shown above. Stagger the connections. Use the insulation stripped from the short connection to insulate the thermistor wire.

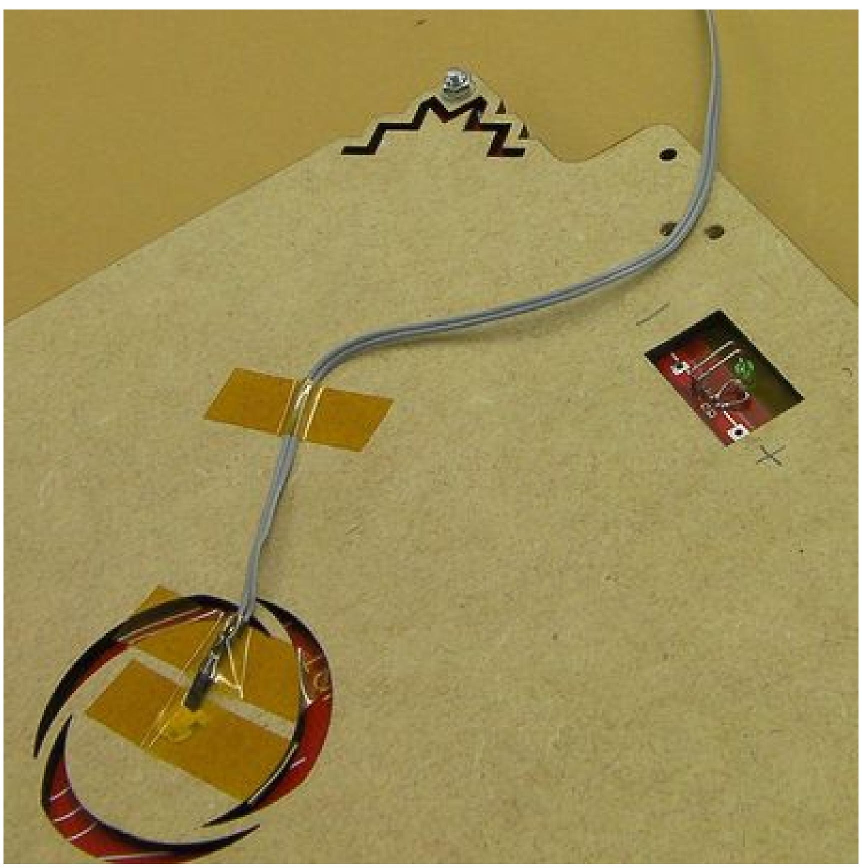
Tin the ends of the wires, then tin the wires on the thermistor, then sweat them together.



Insulate the joins with a length of heatshrink.

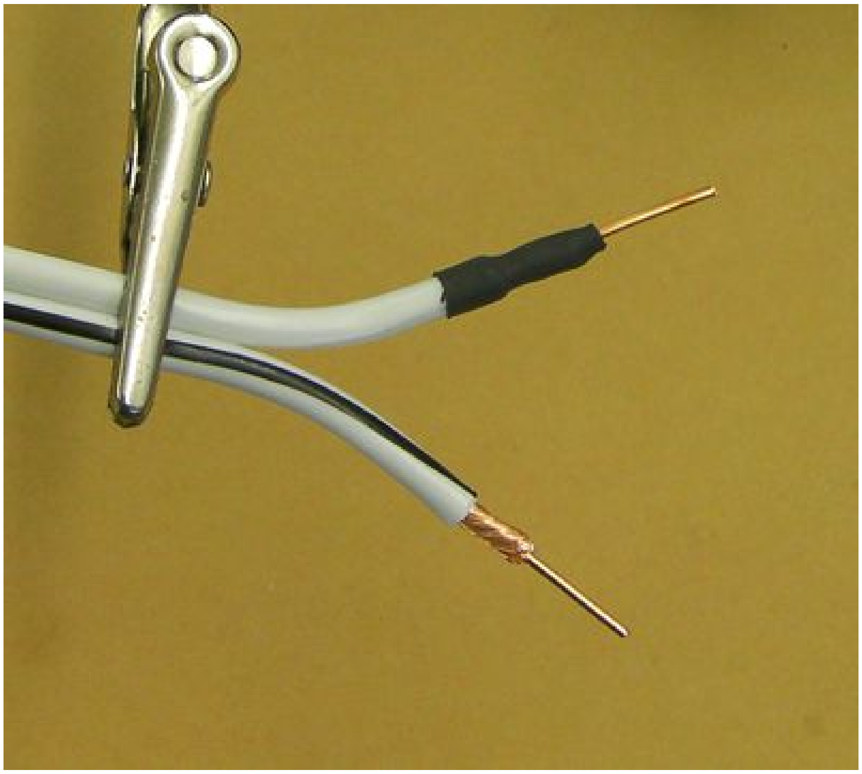
Strip the insulation from the other ends of the wires and use your meter to check the resistance. It should be about 10K ohms, though the exact value will depend on room temperature.

Bend the thermistor at right angles and tape it to the bed. Make sure it goes through the hole in the insulator and the hole in the PCB and touches the aluminium plate. If you like you can add a little heatsink grease to improve the thermal contact between the thermistor and the plate.



Pack the hole in the insulator with something fluffy: cotton wool or a bit of scrunched tissue both work well. Put tape over the hole. (The LED and resistor are the wrong way round in this picture - ignore them.)

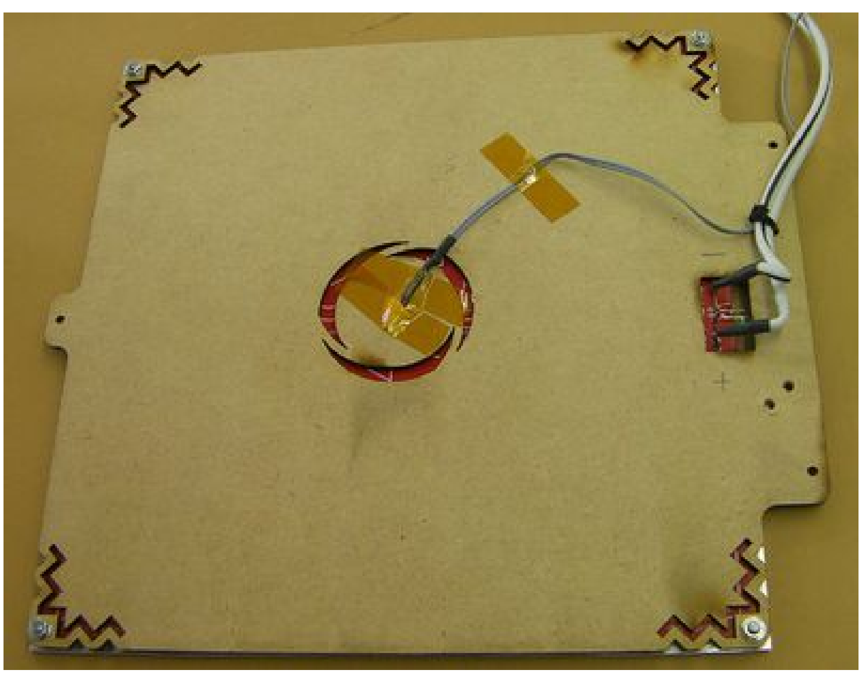
Lead the wires to the edge of the bed where the two cable-grip holes are and tape them down. Use the holes on the side you marked -. Note the strain relief loop; don't run the wires straight.



Cut the single-strand copper wire in half. Bare the ends of the high current wire.

Push the copper into the middle of the wire strands, twist the strands to hold it, and solder the join. Put heatshrink on.

The picture shows one wire complete, the other ready to be soldered.



Solder the wires to the bed. Solder them both sides for strength and trim any excess from the aluminium side.

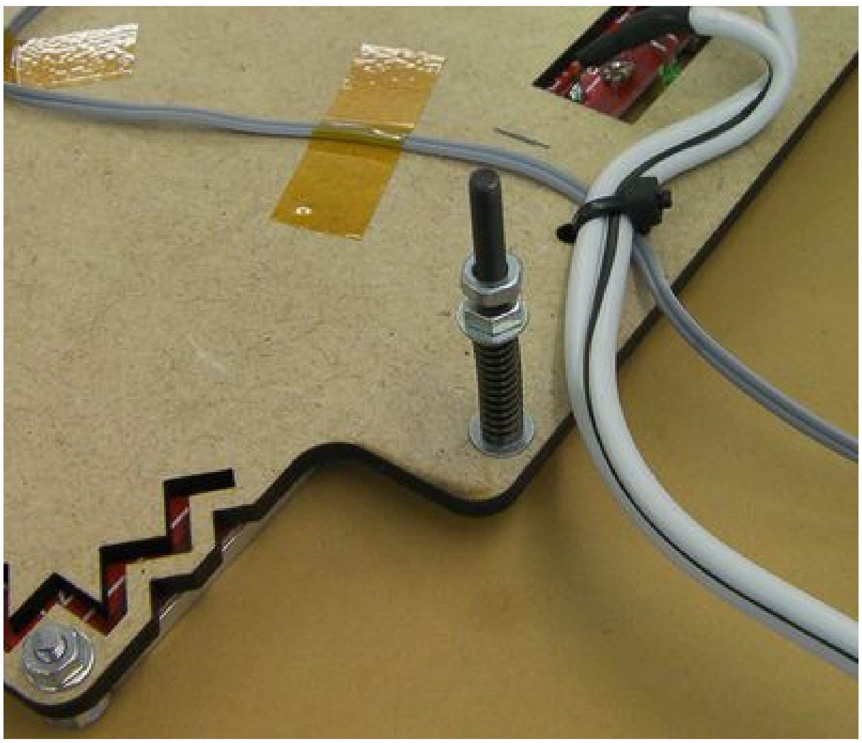
The wire with the black stripe goes to the side you marked -.

Put the glass plate on the aluminium and make sure that none of the wires nor the LED stick out and foul it. If the LED is too high, bend its legs a little to lower it down.

Use the cable tie to attach the high-current wires and the thermistor wires. Again, note that the high-current wires are not pulled taught. They have a strain relief loop. Put the cable tie through the holes on the side you marked -.

Pull the cable tie good and tight (but take care not to break the lasercut insulator), and then clip the excess off it.

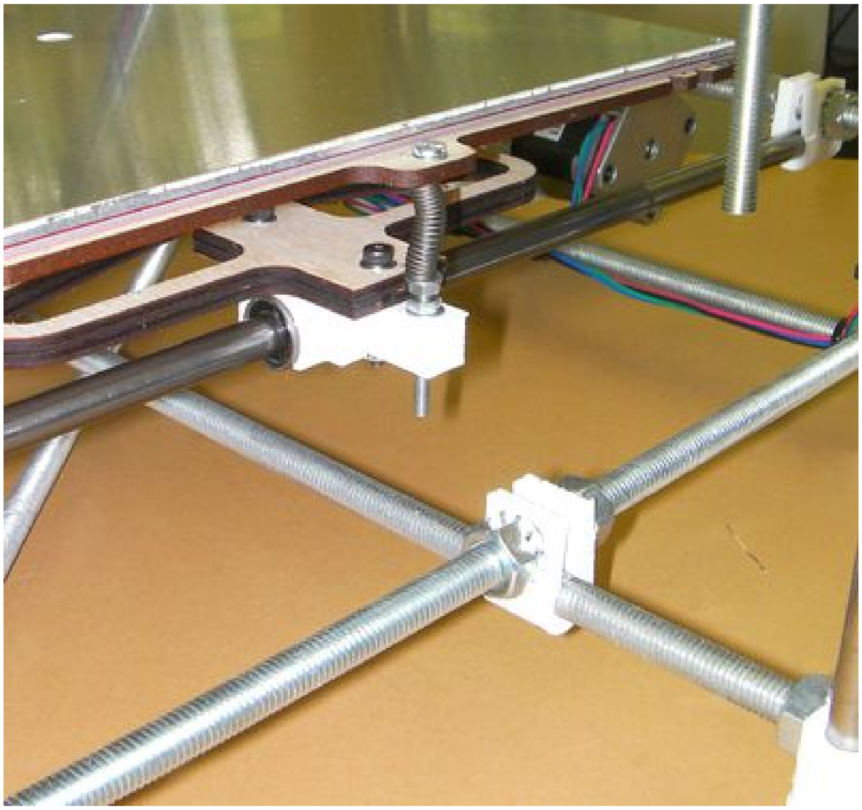
Step 3: Attach to the machine



Put the three long screws through the mounting holes with washers under their heads.

Put the springs on. The sequence from the screw head goes:

1. Screw head
2. Washer
3. MDF insulator
4. Washer
5. Spring
6. Washer
7. Nut
8. Nut



Use the last three nuts and washers to mount the bed on the machine.

If you want a superb machine (of course you do), before you mount the bed put a little superglue on the heads of the screws that hold down the toothed-belt clamps, cut two rectangles of aluminium foil about 20 mm x 30 mm and glue these onto the screw heads. These will act as a heat shield, and will prevent the printed clamps from getting warm.

Pull the nuts into their recesses under the printed parts on the Y carriage with a shorter screw with a washer under its head if needs be.

Adjust the screws to get the bed roughly level (measure the heights of the corners above the Y rods with digital callipers).

Tighten the nuts against the Y carriage to secure the bed.

Adjust the nuts above that set the spring compression so that the bed is held firmly against the screw heads, but can be pushed down with a finger.

Fit the glass plate using the four clips and check that the Y axis moves freely back and forth. Then take the glass off and put it in a safe place - you don't want to break it as you build the rest of the machine...

Next step

The extruder drive

RepRapPro Mendel extruder drive assembly

From RepRapWiki

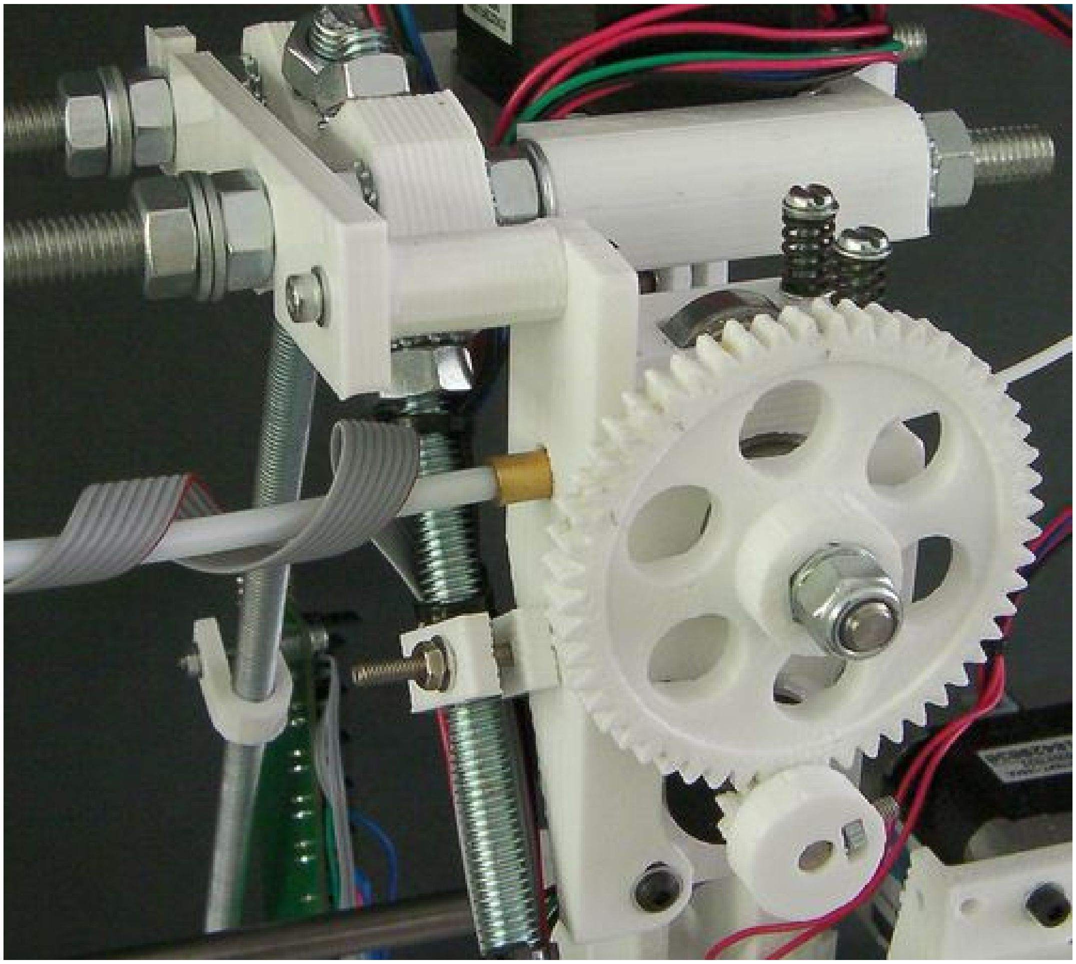
| Introduction | Frame assembly | Y axis assembly | X axis assembly | Z axis assembly | Heated bed assembly | **Extruder drive assembly** |

| Hot end assembly | Power supply | Wiring | Commissioning | Printing | Maintenance | Troubleshooting | Improvements |

Contents

Goal

By the end of this stage your extruder drive will be mounted on the back of your Mendel like this:

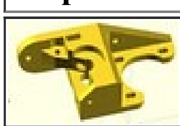


But without all of the wires.

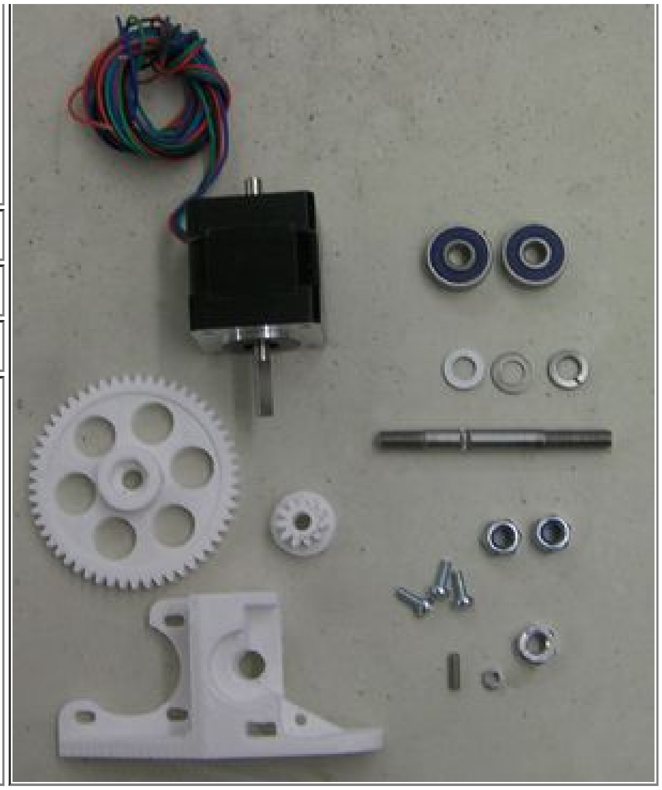
Tools

- 10mm (M6) spanner
- Adjustable spanner
- Allen key
- Phillips screwdriver
- Tweezers
- 2mm drill

Step 1: Motor and hobbed stud assembly

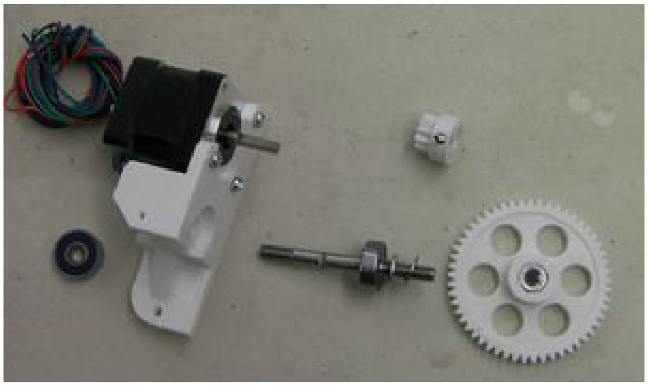
RP parts	Quantity	
	1	
	1	

	1
Hardware	**Quantity**
M6 hobbed stud	1
M6 full nut	1
M6 nyloc nut	2
M6 split washer	1
M6 plain washer	2
626 Bearing	2
NEMA 14 stepper motor	1
M3x10mm socket set screw (Grub)	1
M3 nut	1
M3x8mm screws	3
M3x25mm countersunk screw	1 (Mendel only - not Huxley)



If you are building a Mendel drop the countersunk screw through the mounting hole in angled section on the printed block under where the motor will go - head towards the motor. (Huxley does not need this screw.) You won't be able to fit the screw after you have attached the motor.

Use the 8mm M3 screws to attach the motor to the block. Put it as far from the centre as it will go in its slots. Don't do the screws up tight. The motor wires come out towards the bottom of the picture:



Push the M6 nut (plain, not one of the nylocks) into the hexagonal recess in the big gear.

Put a bearing on the hobbed 6mm stud (note the relative positions of the short and long threads), followed by two plain M6 washers, followed by the gear with its nut. The nut should face away from the bearing.

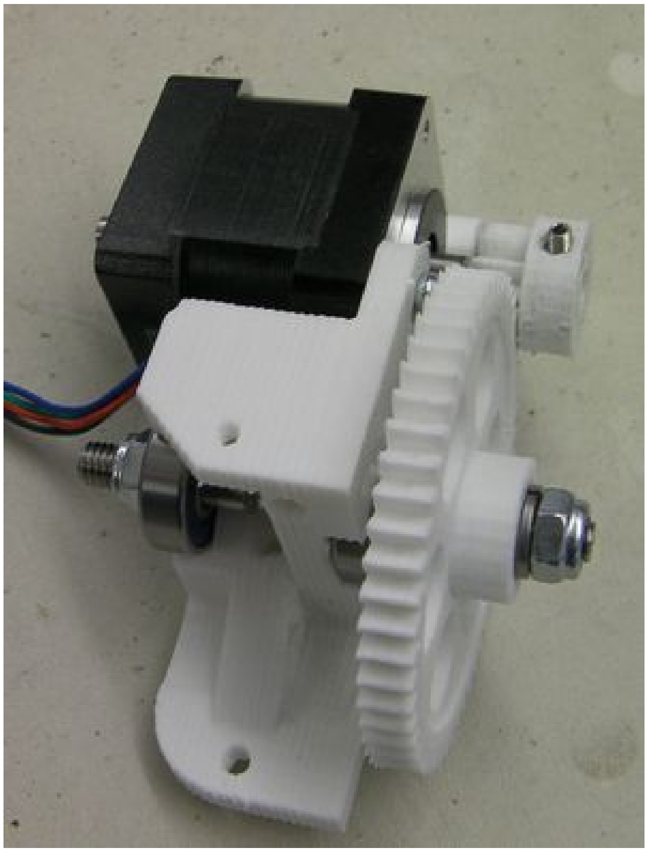
You are going to adjust things so the gears mesh.

Put the M3 nut into the slot in the small gear and run the M3 set screw through it.The small gear may need reaming out by hand with a 5mm bit.

Some motors have a flat on the shaft that runs all the way to the motor case. If yours is one of these, put the small gear on the shaft with its hub towards the motor. Then put the bearing in its hole so the big gear meshes with the small one.

If the flat stops short of the case, put the bearing and the big gear on first, then put the small gear on the other way round (as in the picture below).

Take things apart and put them together again, adjusting the motor's position in its slots, until the gears mesh nicely.



When you are happy tighten all the motor screws, reassemble everything else, and tighten the small-gear set screw. Make sure that the small gear hub is not rubbing on the big gear - there should be about half a millimetre clearance between them.

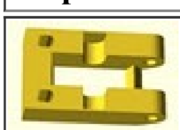
Put the other bearing in on the other side of the block.

Put the split M6 washer on the side with the big gear so it bears on the gear's nut, then put M6 nylock nuts on both ends.

Tighten the nylocks, while checking the hobbing against the 2mm hole down through the block where the filament will run. The hobbing should be centred on this. Undo or do up the big gear with its nut, and the two nylocks until this is so.

Don't tighten the nylocks so far that the gears, stud, and motor can't rotate freely.

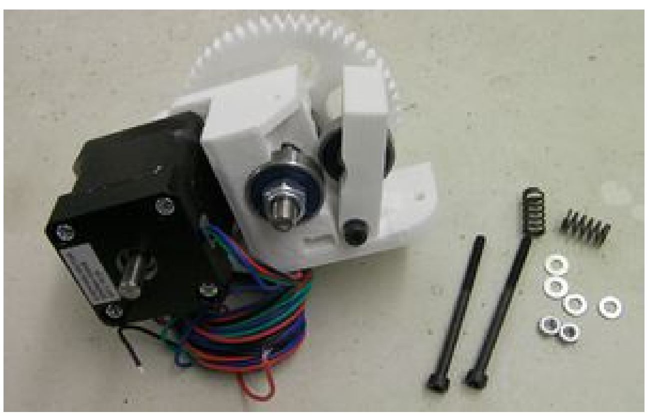
Step 2: Idler

RP parts	**Quantity**	
	1	
Hardware	**Quantity**	
M3x30mm screw	1	
626 bearing	1	

M3x45 screws	2	
M6x20mm socket set screw	1	
M3 washers	6	
M3 full nuts	2	
M3 nylock nut	1	
Springs	2	

Put the bearing on the M6 set screw and drop it into the slot on the printed part. Check that it rotates freely. If it does not, use a blade to remove a little material where it is binding.

Fit the idler to the drive with the 30mm M3 screw, two washers - one each side - and the nylock nut. Don't over-tighten it - it must move freely. The photo below is wrong - you want the head of the screw on the gear side and the nut facing you in the picture. You will find that if you rotate the gear you can get the screw through the holes in it. This makes the idler much easier to remove when it is mounted on the RepRap machine.

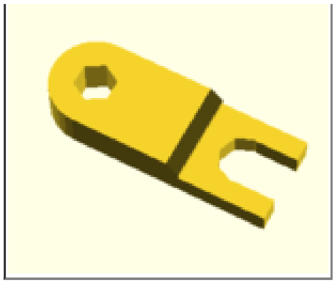


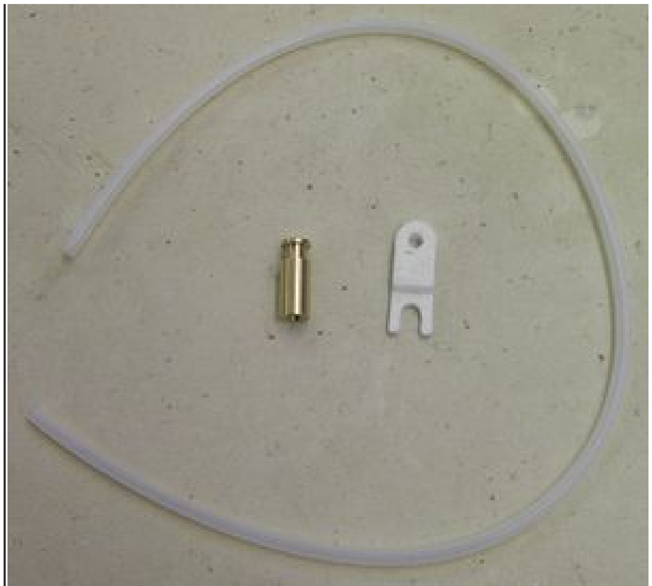
Put the springs on the long screws. Sandwich each spring between a pair of washers.

Put the screws through as shown. If you drop the nuts into their holes with tweezers first, then hold a screwdriver blade over them while you tighten the screws this is less fiddly.

Step 3: The Bowden tube

RP parts	Quantity	

	1
Hardware	**Quantity**
slotted brass retainer	1
PTFE tube	1



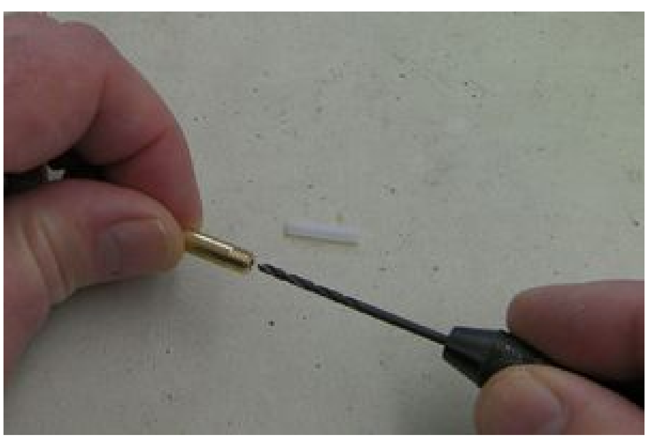
Don't confuse the PTFE tube (shown) with the shorter translucent heatshrink also supplied with the kit.

Use a sharp blade to trim a few millimetres off the end of the tube at right angles to get a clean square end.

If your kit has a 4mm diameter PTFE tube supplied (as opposed to 3mm) then make a small cone on the end with a pencil sharpener. Don't cut too far - PTFE is very soft. The cone makes it easier to start the thread.

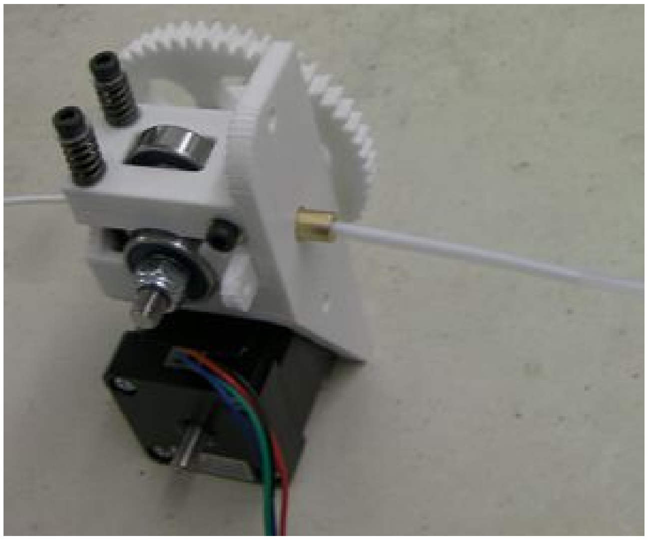
Screw the tube into the brass retainer. Look in the other end (a magnifying glass is useful) to see when it gets to the end of the internal thread, then stop.

Screwing the tube in will have reduced its internal diameter slightly. Gently twist a 2mm drill by hand in the end of the brass to thin the tube where it is inside the screw thread. If you have a small hand-chuck this is made easier. The picture shows this being done for the other brass connector that you will install on the next page. The method is the same:



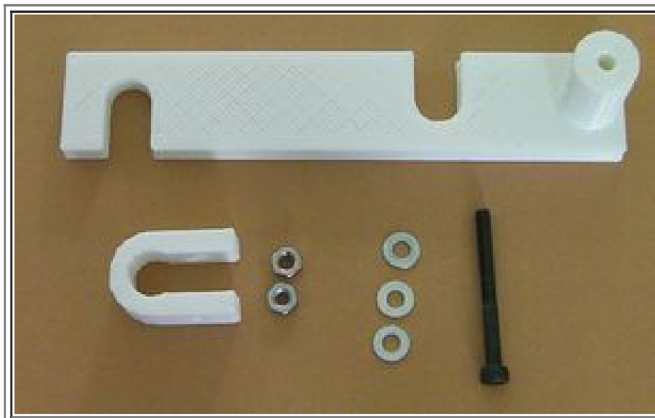
Push a short length of 1.75mm build filament down the tube from its free end to clear out any PTFE swarf.

Push the brass retainer into the drive, and secure it with the printed tongue. The thin end of the tongue goes to the right in this picture:



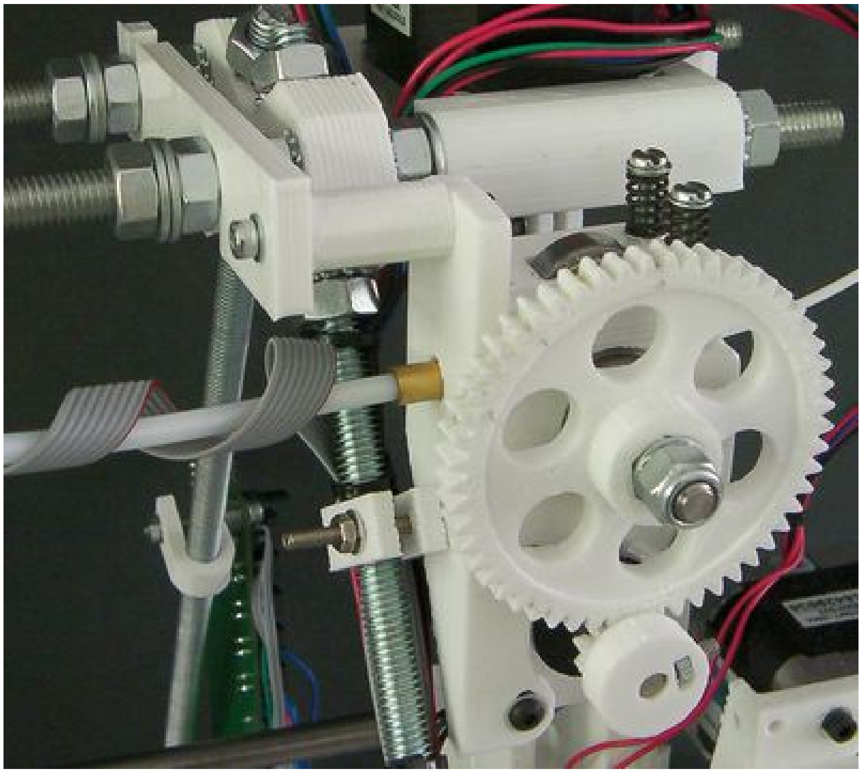
Feed in the short length of 1.75mm filament. The compression screws should be done up just tight enough that when the filament is trapped in the drive you cannot pull it out by hand - no tighter. (Hold the big gear still when you tug to test this.) Turn the device by hand. The filament should feed slowly and smoothly down the tube.

Step 4: Fitting the drive



Item	Quantity
Printed drive bracket	1
Printed U clip	1
M3 washers	3
M3 nuts	2
M3 x 35mm screw	1

Attach the drive bracket to the machine using the nuts on the top bars. It goes on the left of the machine viewed from the front, with the support cylinder at the back.



This view is from the back of the machine.

Use the screw a nut and two washers to attach the drive to the bracket.

Fit the U clip on the frame to match up with the countersunk screw that you fitted to the drive before fitting the motor.

Use a nut and washer to attach the drive to the clip. You will probably find that you have to hold the free end of the screw with long-nosed pliers to tighten the nut - its head is inaccessible, of course.

Finally, use the long-nosed pliers gently to remove the tongue. Take out the PTFE tube and its brass fitting. You will need these separate for the next step...

Next step

Hot end assembly

Categories: Build Instructions | RepRapPro | Mendel | Mendel Development

RepRapPro Mendel hot end assembly

From RepRapWiki

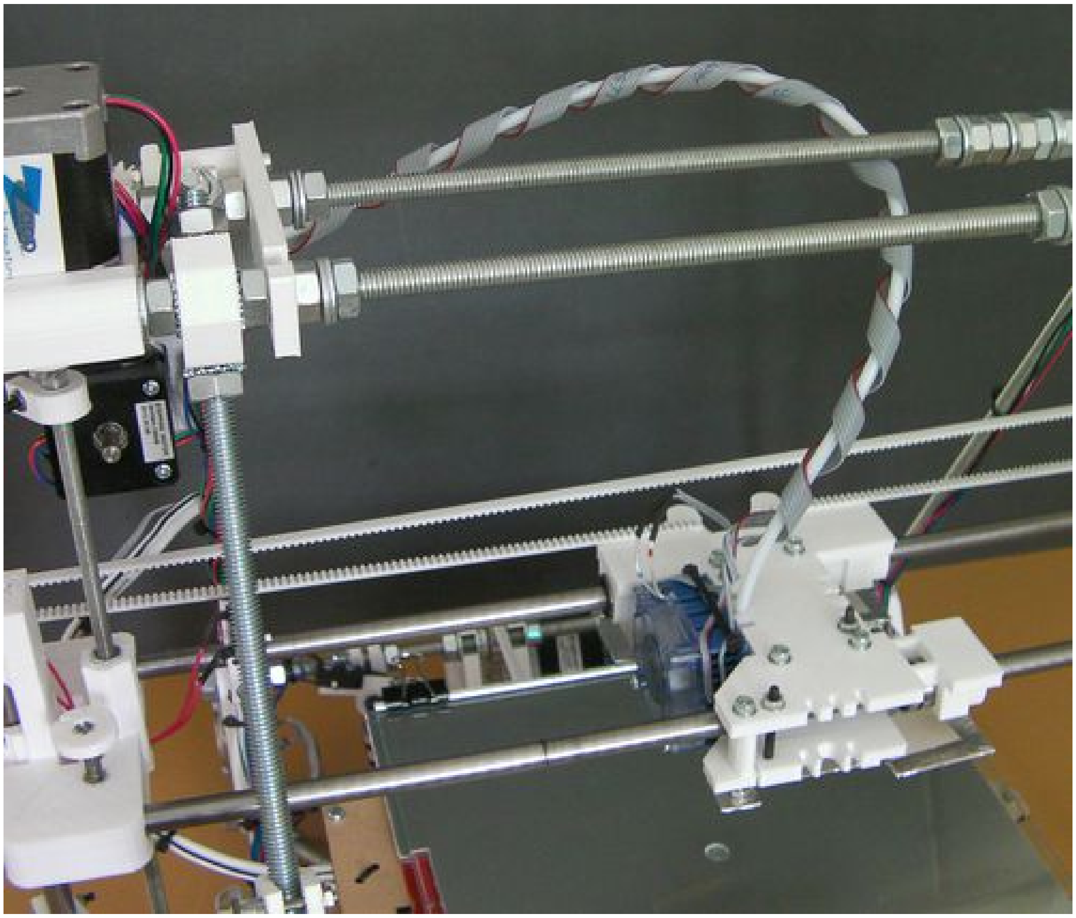
| Introduction | Frame assembly | Y axis assembly | X axis assembly | Z axis assembly | Heated bed assembly | Extruder drive assembly |

| **Hot end assembly** | Power supply | Wiring | Commissioning | Printing | Maintenance | Troubleshooting | Improvements |

Contents

Goal

By the end of this stage you will have finished all the mechanical construction! Your hot end will be fitted to your Mendel like this:



Tools

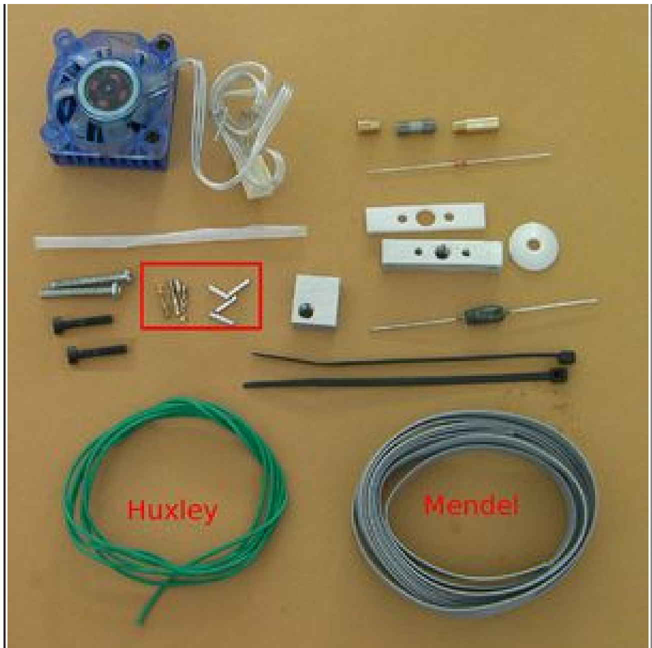
You will need the following tools:

- Allen key
- Small screwdriver
- Pliers
- Adjustable spanner
- Heat sources (small blowtorch plus hairdryer/soldering-iron)
- Bench vice

Parts

Hardware	Quantity	
Fan and heatsink	1	
Aluminium heater block	1	

M3x25 screws	2
M3x16 screws	2
Cable ties	2
Stainless steel barrel	1
Brass union	1
Brass nozzle	1
100K thermistor	1
Heater resistor	1
PTFE insulating cone	1
PTFE spacer	1
Aluminium cooling block	1
Huxley connecting wire	4x300mm lengths
Mendel connecting wire	8-way ribbon cable
crimps	4
PTFE Heatshrink sleeve	1



The heatshrink is easy to confuse with the PTFE

for the extruder Bowden tube. The heatshrink
is the shorter one made from thinner material.

You will see that Mendel and Huxley have different connecting wires. Also the Huxley heating resistor is a 6R8, whereas the Mendel one is 2R7.

There are also alternative crimps for attaching the wiring to the resistor and thermistor (red rectangle). See below.

There are several stages in this construction where you have to trim pieces of PTFE. It is essential to clear any swarf created away and not to let it get into the extruder. PTFE swarf will travel to the nozzle and block it if it is allowed to contaminate the device.

Step 1: The hot part of the hot end

Check that the heater resistor fits in the larger hole in the heater block. The resistors can be a little variable in their diameter. The thermistor should fit in its hole - they are manufactured to a tighter tolerance.

If the resistor is too big, clamp the heater block firmly in a vice and run a 5mm drill down it. Be careful to run it square on. Running the drill up and down will shave a little off the sides of the hole. Repeat this until the resistor fits.

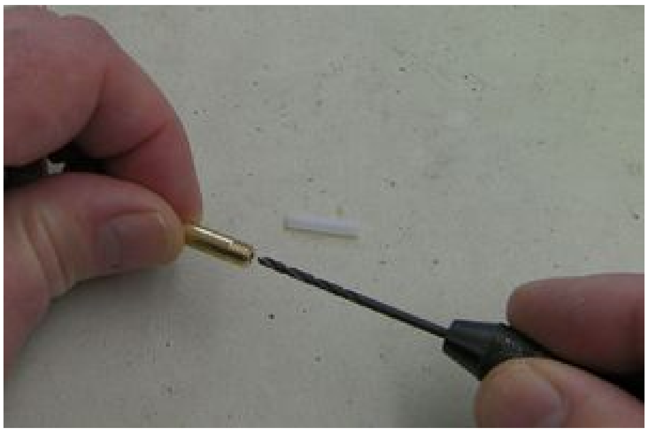
Set the resistor aside for use in a minute.

Take the PTFE tube from the extruder drive that you just made. If you have the 3mm diameter version, cut a short length (about 15mm) from its free end using a sharp blade, taking care to make the cut square on to the axis of the tube. Put the short length aside for use later.

If you have the 4mm diameter version you will also have a short length of 3mm diameter in your kit. In the 4mm diameter tube case, use a pencil sharpener to make a small cone on about 2mm of the free end of the 4mm tube. Take care not to cut too far - PTFE is very soft.

Screw the brass union onto the end of the PTFE tube that you have just cut. By looking down the other end of the brass you will be able to see when the PTFE reaches the end of the thread (a magnifying glass is useful here).

Screwing the tube in will have reduced its internal diameter slightly. Gently twist a 2mm drill by hand in the end of the brass to thin the tube where it is inside the screw thread. If you have a small hand-chuck this is made easier:



Push a length of 1.75mm build filament down the tube from the other end to clear out any PTFE swarf (see the warning above about leaving any behind). Make sure the filament runs freely down the tube and comes out of the far end without impediment.

Wrap plumber's PTFE tape round the shorter thread of the stainless steel barrel **BUT NOT** the nozzle:

Take care that the tape does not cover the holes, and leave the smooth part of the barrel free (or trim the tape away from that with a blade after wrapping). The barrel has a big temperature drop in operation from one end to the other (around 200^{o}C), so it is important that you leave the middle surface free to radiate heat.

Don't put PTFE tape on the nozzle.

Screw the barrel and the nozzle into the heater block so they meet in the middle. The nozzle goes in the side of the aluminium block with the small 2mm through-hole (that will later accommodate the temperature-measuring thermistor).

Offer up the PTFE insulating cone beside the nozzle. The nozzle should stick out of the block a bigger distance than the depth of the cone. The cone will be screwed onto the nozzle later, and the nozzle needs to project out the bottom.

Place the assembly in the corner of a vice, gripping as little of it as is compatible with its being secure. Adjust the adjustable spanner to the flats on the nozzle and have the long-nosed pliers to hand.

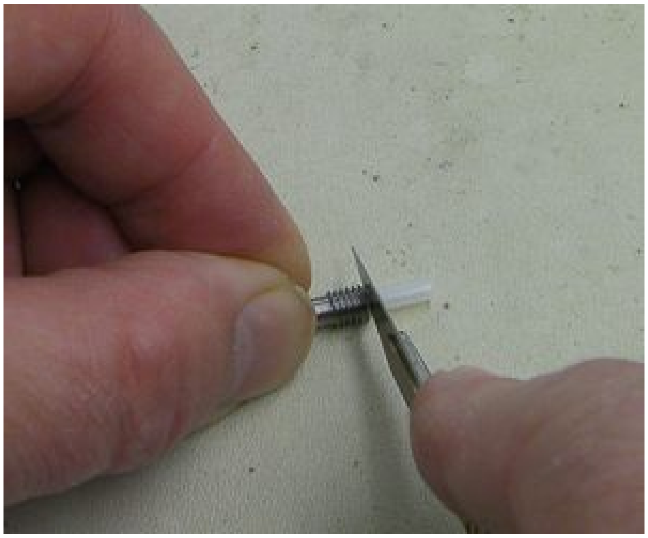
Use the blowtorch to heat the block:

You need to heat the block enough for it to expand by at least the amount it will expand during printing. Neither the brass nozzle nor the stainless steel barrel will expand as much as the aluminium heater block. So, whilst hot, hold the steel coupling with the pliers and tighten the nozzle with the spanner. This will normally take only a very small amount of rotation (say 1 or 2 degress) but will be enough to ensure the nozzle assembly does not leak during printing.

Leave the block in the vice to cool.

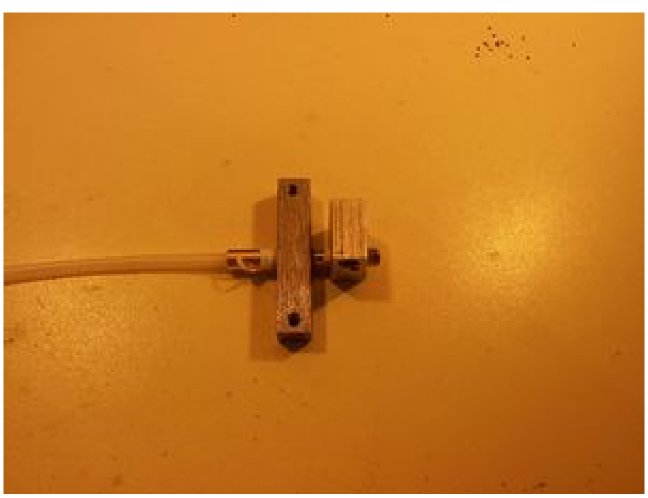
Step 2: The cooling system

Take the short length of PTFE tube you saved and put it in the counterbored hole in the stainless steel barrel. Trim it flush with a sharp blade:



Take a 5mm drill and gently twist it against the end of the PTFE that you have just created to dish it slightly. Make sure you clear all swarf away.

Now screw the brass bowden end piece (with the PTFE bowden tube screwed into it), into the Aluminium heatsink block (the long thin one with five holes in it). Once fully screwed in, screw the free end of the barrel into the M5 hole in the Aluminium heatsink block until it meets the brass piece. Now unscrew the brass piece by 1/4 turn, screw the barrel in to meet it, and finally tighten the brass piece with some pliers. This will result in the barrel and bowden end pieces being locked together inside the heatsink block.



The heater block should be parallel with the heatsink block (and with the power resistor).

Peel the sticky backing off the fan and heatsink. This is quite tough - you may need to pull with pliers. Take care not to put stress on the delicate plastic fan. The easiest way once you have a corner off is to hold that with long-nosed pliers and to roll them over the back face of the heatsink like peeling the lid off a tin of sardines.

If you are building a Huxley, keep the sticky backing - you will need it on the next page. Cover the side that was against the fan with polythene (such as the zip bags that the components come in are made from) and keep the plastic covering on the other side.

You can put a little heatsink grease on the aluminium cooling block if you like. Attach it to the fan with the two longer screws. Put the two shorter screws through the PTFE spacer and screw them a few turns into the block.

You will see that there are slots in the heatsink attached to the fan that blow down on the heater block. Put a piece of sticky tape over those slots.

Step 3: The heater resistor and temperature-measuring thermistor

If the heater resistor is too lose in its hole in the heater block, wrap it in a little PTFE tape.

For Mendel use two adjacent wires from the ribbon cable for each end of the heater resistor - four in all. This is to increase the current capacity. For Huxley, simply connect one wire to each end.

For Mendel the wires across the ribbon cable in order go like this:

1. Wire with the colour stripe: Thermistor
2. Thermistor
3. Fan + volts
4. Fan Ground
5. Heater resistor Wire 1
6. Heater resistor Wire 1
7. Heater resistor Wire 2
8. Heater resistor Wire 2

Resistor wires 1 and 2 are arbitrary - the resistor has no polarity.

You can either use the ferrule crimps (right in the red box in the parts picture) or the connector crimps (left). The connector crimps just plug onto the resistor and thermistor wires, which is simple. The ferrule crimps are a bit more fiddly, and they make a permanent connection.

The advantage of the connector crimps is that you can plug and unplug the wires. The advantage of the ferrules is that they give a better quality (i.e. lower resistance) connection.

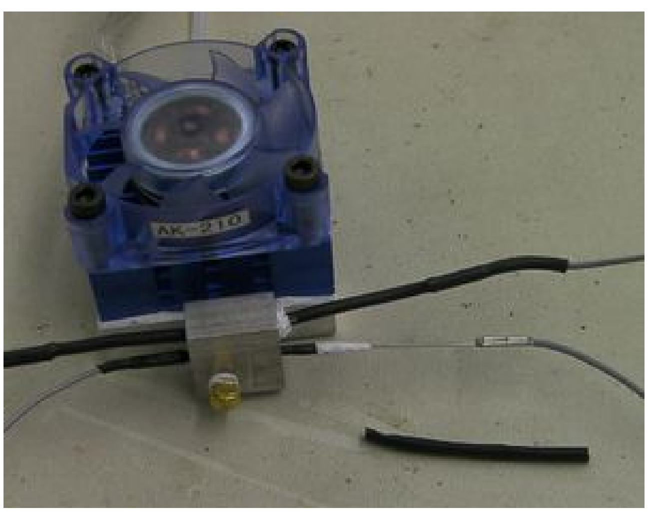
Alternative 1: Ferrule crimps

The pictures show the ferrule crimps and the Huxley single wires.

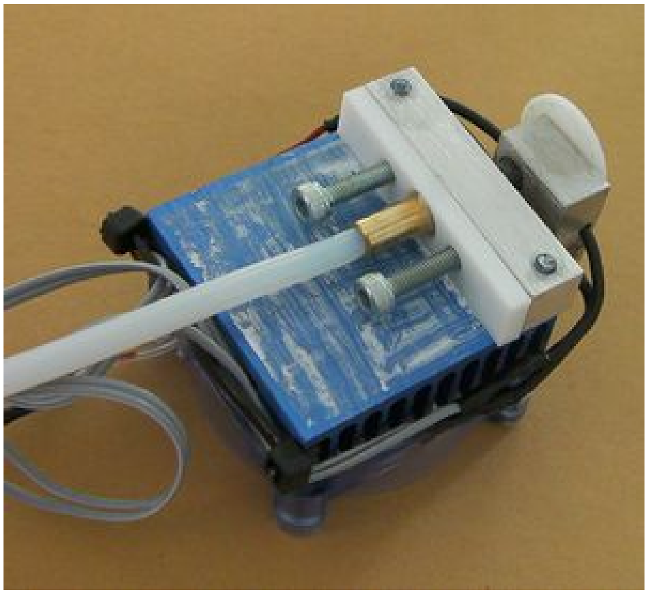
Bare about 10mm on the end of the resistor connector wires and crimp them onto the ends of the resistor's leads. Put heatshrink on and use a soldering iron or hairdryer to shrink it.

The picture shows the left-hand side complete, and the right hand side waiting for the crimp to be slid over the join followed by crimping. It also shows conventional heatshrink. To shrink the PTFE heatshrink you will have to hit it with a flame - a mere soldering iron won't touch it.

The thermistor should fit in its hole - they are manufactured to a tighter tolerance. It will be a little undersized. But the crimps on the thermistor wires won't fit through the hole, so you have to crimp one wire after the thermistor has been pushed through the block.



Put about 20mm of PTFE heatshrink over the thermistor and shrink it on with a flame (try not to scorch things). Put the thermistor in the block - the PTFE should make it a snug fit. Crimp and then heatshrink over the connections to either end. With the ribbon cable for the second thermistor connection, don't forget to slide the heatshrink onto it and away from the join before you make the join - you won't be able to get it on afterwards.



Alternative 2: crimp sockets

Simply crimp the sockets on the ends of the thermistor and heater resistor wires, then shrink black heatshrink over them to insulate them. For Mendel remember that each end of the heater resistor needs two wires - bare them and twist the ends together before fitting the crimp sockets.

Connecting up

Bend the wires up the side of the heat sink. Do not pull them tight - they need a little slack to accommodate movement and expansion. Attach them at the top of the heatsink with two cable ties chained together, one of them running through the top slot in the heatsink.

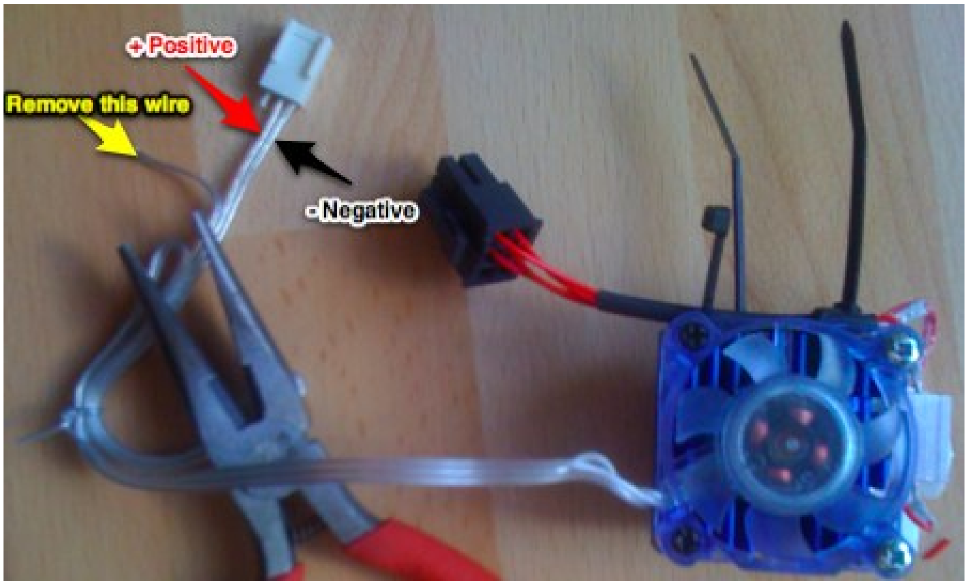
Trim the excess off the cable ties.

Use a meter to check that the resistance between the wires and the aluminium block is infinite and that nothing is shorting.

Also check the resistance of the heater resistor and the thermistor by measuring from the far ends of the wires. The Mendel heater should be just under 3 ohms or the Huxley just under 7 ohms. The thermistor should be about 100K.

Step 4: Fan wires and nozzle insulator

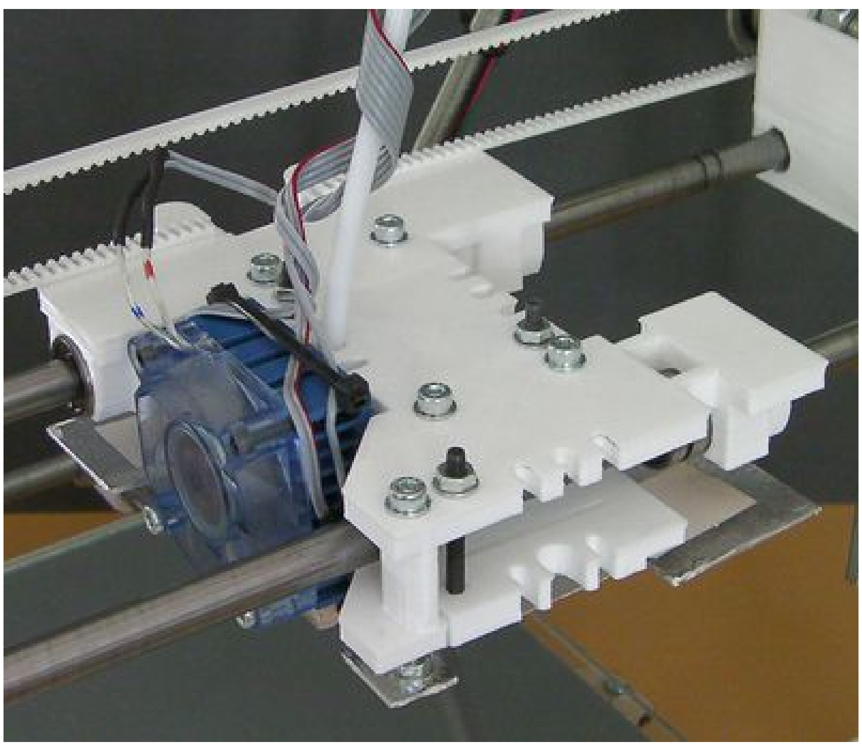
You need to cut one wire off the fan. Looking at the picture below, use a red and a black felt-tipped pen to mark the positive and negative fan wires. Trace them right back to the fan and mark them there.



Cut the socket off (leaving your marks on the fan side of the cut...), then remove the extraneous wire.

Screw the PTFE insulating cone onto the nozzle.

Step 5: Installation



Use the two free screws in the aluminium cooling block to attach the extruder hot end to the X carriage of your Mendel. The PTFE tube clips into the printed vertical channel in the X carriage.

Put the free end of the PTFE tube back in the extruder drive and re-secure it with the tongue that you undid at the end of the previous page.

The tube runs outside the machine. It does not run between the threaded rods.

Twist the ribbon cable **loosely** round the PTFE tube to the top, as shown in the picture at the top of this page. Wrap it 10 turns. Do not pull it tight.

Attach the glass plate to the bed with the four foldback clips.

Screw the Z adjust screw so that about 8mm of it projects below the X motor mount.

Slacken the h bracket that holds the Z endstop switch. Position the Z endstop switch so that when the adjust screw hits it the extruder nozzle is about 1mm above the glass. Tighten the h bracket.

Next step

Power supply

RepRapPro Mendel power supply

From RepRapWiki

| Introduction | Frame assembly | Y axis assembly | X axis assembly | Z axis assembly | Heated bed assembly | Extruder drive assembly |

| Hot end assembly | **Power supply** | Wiring | Commissioning | Printing | Maintenance | Troubleshooting | Improvements |

Contents

Goal

By the end of this step your power supply should look like this:

Safety

RepRapPro Mendel works entirely at low voltage, and there is no danger in putting a finger on any part of the circuitry on the machine itself (though remember some parts are hot).

But the power supply necessarily involves a few mains wires. Mains will kill you if you touch it. So don't.

There are six soldered mains connections in the power supply. If you are not sure about mains wiring, or your soldering is blobby, prone to dry joints, or in any way un-neat, then **get someone who knows what they are doing to help you with the work on this page**.

When doing all wiring make sure that connections have no stray wire filaments that may short on neighbouring parts.

Bare the ends of wires, twist them, check for a neat twist with no strays, and then finally tin them.

This is important on the next page (wiring up the machine), but it is really important for wiring the power supply here. The power supply works with both large voltages and large currents, and so careful, tidy work is essential.

Tools

You will need the following tools:

1. M3 Allen key
2. Cross-head screwdriver
3. Tweezers

4. Multimeter
5. Soldering iron and solder

Parts

Hardware	Quantity
12v Power supply	1
20A wire	1m
Mains cable (not shown)	1
XLR socket	1
Printed cover	1
Mains panel plug	1
LNE mains wires	100mm
M3 washers	8
M3 nuts	3
heatshrink	50mm
M3 x 8mm screws	2
M3 x 20mm screw	1
M3 x 16mm screw	1

Note that sometimes the three mains wires are supplied as a cut length of mains flex. Simply pull the three wires from the outer coating.

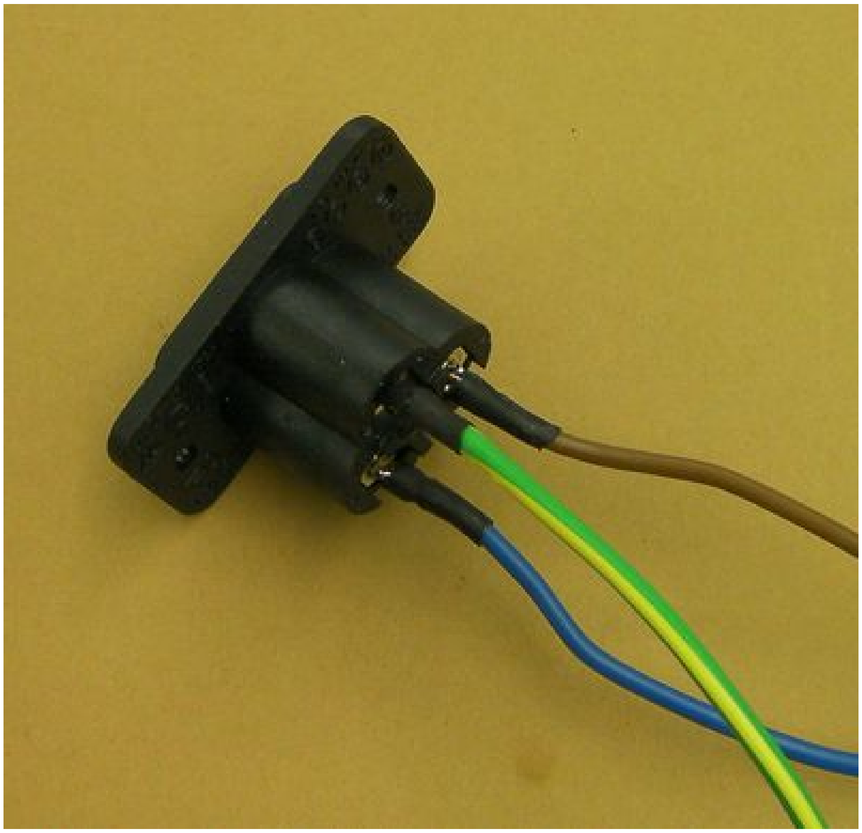
Mains voltage

Set the mains voltage for your country. The switch, shown above, is set to 220 volts when the power supply is shipped. This is the fail-safe setting: if you plug the supply into a lower mains voltage it won't work properly, but it will do no harm.

If your country has mains at 110 volts, flip the switch.

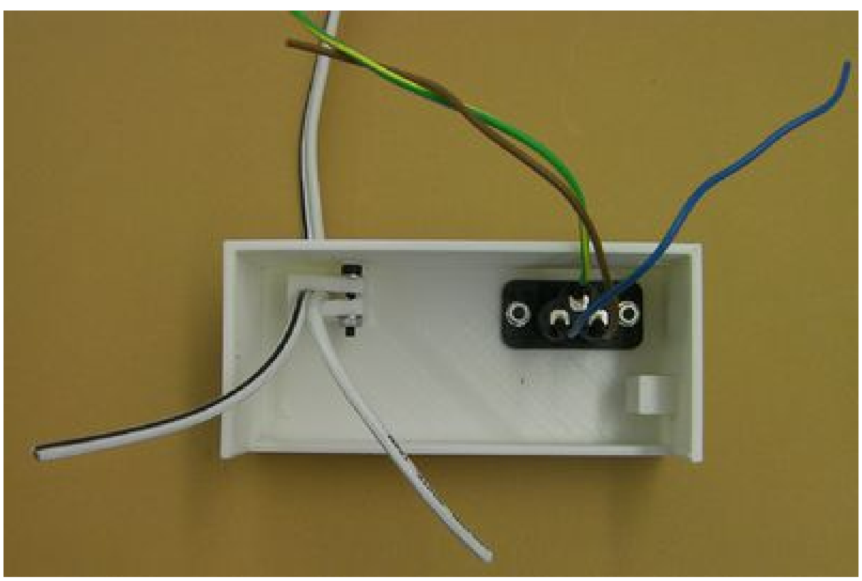
Construction

Step 1: Initial wiring



Start by soldering the mains wires onto the panel-mounting plug. The picture above shows European-convention wiring colours: Brown=Live, Blue=Neutral, and Green-yellow=Ground-Earth. The back of the plug has L, N and the symbol for Ground embossed next to the appropriate connection.

Insulate your joints with short lengths of heatshrink.



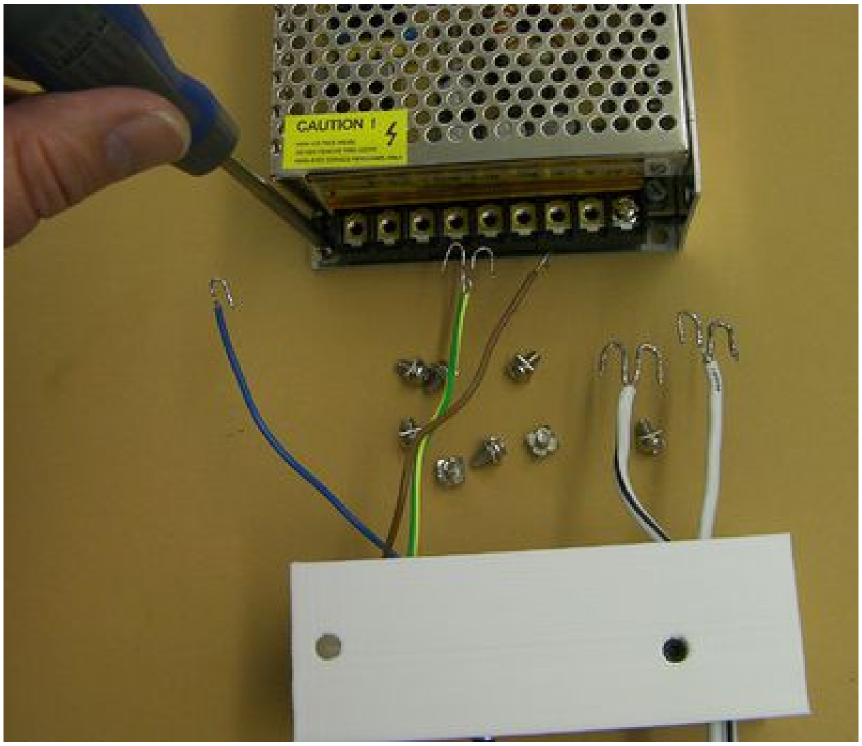
Attach the mains plug to the printed panel with the two short screws, two nuts and four washers. You may find that the holes in the plug are slightly undersized (though the specification says 3mm). This does not matter: screw the screws in and use them to cut threads in the plastic - this will give a more secure construction. Then put the washers and nuts on the back.

Put the thick low-voltage wire through its cable grip so it projects by about 100mm. Secure the grip with the 16mm screw, two washers and a nut. Getting the washer under the screw head in is a bit fiddly - you will probably have to use tweezers.

Don't tighten the grip excessively. Just do the screw up enough to secure the cable so it can't slip.

Split the low-voltage wire into two leads.

Step 2: Connect the power supply



Remove all the contact screws from the power supply except the one on the extreme right in the picture.

Then remove the screw that holds the case together (where the screwdriver in the picture is). Set that aside for use later.

Next, strip, twist and bend the wires. Check lengths and fit before you tin.

For the live and neutral: form the ends into a U that will fit in the connector and be secured by one of the screws.

For the Ground wire and the two fat low-voltage wires, split the filaments of each end into two equal bundles, twist those separately, then form each of them into a U that will fit in the connector and be secured by one of the screws.

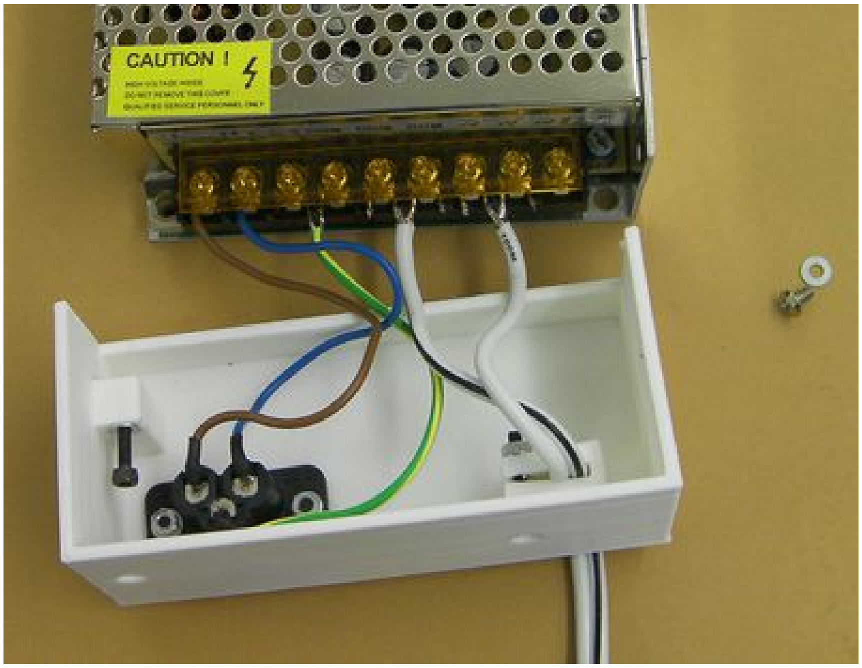
When you are happy that everything fits neatly, tin all the ends.

Screw the Live, Neutral, and one leg of the Ground wire to the labelled connectors.

Screw the other leg of the Ground wire to the COM terminal next to Ground. This is important: it is the connection that earths all the wiring in your machine.

Screw the two Us of the low-voltage wire with the stripe into the two other COM connections.

Screw the two Us of the low-voltage wire with no stripe into the two +V connections.



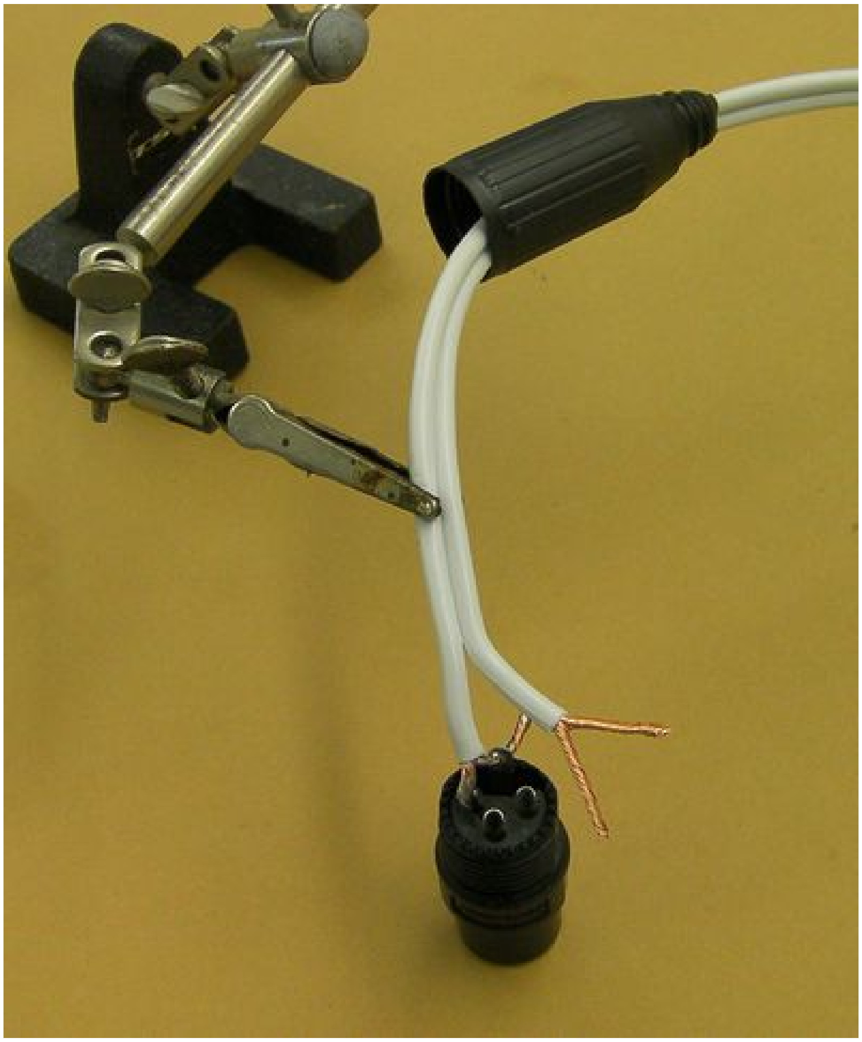
If the tail ends of the Us stick out, trim them with side-cutters. Take care where the cut pieces go - you don't want them shorting out parts of the power supply.

Finally put the 20mm screw with a washer under its head into the hole in the block on the left as shown and attach the cover to the power supply.

Take care to tuck the wires neatly inside. You may have to flatten the mains wires so that they lie in the plane of the back face of the plug.

Use the 20mm screw to secure the cover where you removed the short cover screw before. Use that short cover screw with a washer to secure the other end of the cover to the threded hole in the power supply case.

Step 3: The XLR socket



Put the shell of the XLR connector onto the low-voltage wire.

The picture shows the ground wire connected, and the +12V wires ready to connect.

Separate and strip the ends. Once more divide the ends into two equal bundles, then twist each bundle.

Pin numbers are marked on the back of the socket.

The Ground wire (with the black stripe) goes to Pin 1 of the socket and the tab on the outer case.

The +12V wire (plain white - no stripe) goes to pins 2 and 3.

Push the twisted bundle down the connector (the hole goes quite deep). Give each one a good generous amount of solder.

For the Ground/Tab connection, simply push the wire through and solder it as shown in the picture. Then cut off the excess wire with side cutters.

Screw the shell onto the socket. Hold the wire still so that the turning action doesn't twist it up inside.

Step 4: Testing

Switch your meter to measure resistance.

Plug the mains wire into the power supply **but not into the mains yet**.

Check the resistance between the Ground pin on the mains plug and the metal case of the supply. This should be 0 ohms.

Check the resistance between the Ground pin on the mains plug and Pin 1 of the XLR socket. This should be 0 ohms.

Check the resistances between the case and the Live and Neutral pins of the plug. These should be infinite.

Switch your meter to measure DC voltage.

Put the Ground or Common meter probe in Pin 1 of the XLR socket and the Volts-Ohms-Amps probe into Pin 3.

Plug the mains lead into a socket and switch on the power.

The meter should read +12V plus or minus about 0.3 volts.

Next step

Wiring

Categories: Build Instructions | RepRapPro | Mendel | Mendel Development

RepRapPro Mendel wiring

From RepRapWiki

| Introduction | Frame assembly | Y axis assembly | X axis assembly | Z axis assembly | Heated bed assembly | Extruder drive assembly |

| Hot end assembly | Power supply | **Wiring** | Commissioning | Printing | Maintenance | Troubleshooting | Improvements |

Contents

Goal

By the end of this stage your machine will be ready to commission.

All the wires from electric components in the machine run to the controller electronics.

What you are going to do is to route those wires round the frame from each component to the controller, leaving a generous extra length when the controller is reached **and not at that time connecting the wire to the controller**.

Then, when all the wires have been attached to the frame with cable ties, you will trim them and make the final connections to the controller.

You can route wires and attach them with cable ties as you go. You will then have to clip off those cable ties when a new wire runs on the same route and add a new one holding both wires. This is slightly wasteful, but easy.

Alternatively, hold all the wires temporarily with sticky tape when you route them. Then go round the machine removing the tape and holding the wires with cable ties when all the wires are in place. This is more fiddly, but more parsimonious.

If you click on the pictures below, you will be taken to a high-resolution version. This will help to make details clear.

If you need to identify wires (there are quite a few) then you can use the type of sticky tape called "invisible" tape. This has a surface that you can write on with a felt-tipped pen. Just put a loop of tape round the end of a wire and write "X-endstop" (or whatever) on the tape. You can either remove your labels when everything is connected and tested (neat) or leave them on (convenient if you dismantle the machine later).

Particularly useful is to tape together and label the five sets of four motor wires at their ends furthest from their motors. This helps prevent tangles when you are threading the wires, and you can easily identify them when you come to wire up the controller.

Important: general rules for wiring up

You will do serious damage to your RepRap electronics if the power is connected backwards. Other damaging mistakes are to short out high-current devices like motors and heaters, and to connect high-voltage devices like stepper drivers to signal inputs like temperature sensors.

So - **in the sections below where it tells you to check things - please check them thoroughly**. It is worth taking the time...

Also important for the steps below: when attaching wires to screw connectors, strip about 5mm of insulation off them, twist them between your fingers, and **tin them with solder**. The tinning is needed for good contact, and to ensure that fraying does not cause shorts.

When wires leave a device (like a motor) or arrive at a connection (like the screw connectors on the controller) leave a small slack length (about 20mm long) for strain relief - don't have the wires taut.

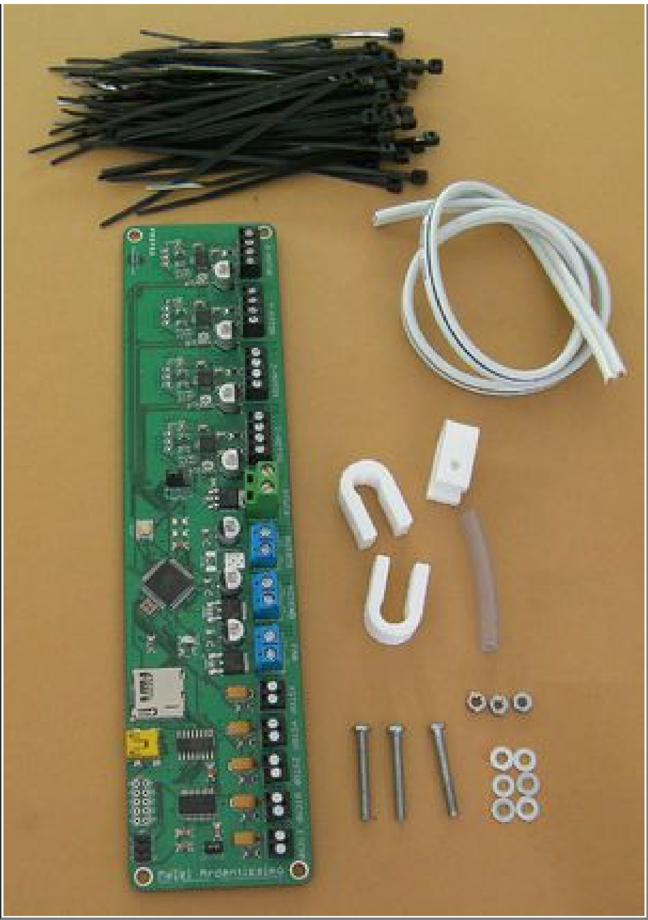
Finally, when making any changes to the wiring or any other electrical aspect of the machine, **first disconnect both the power and the USB**.

Tools

- Wire strippers
- Soldering iron
- Small screwdriver
- Vice

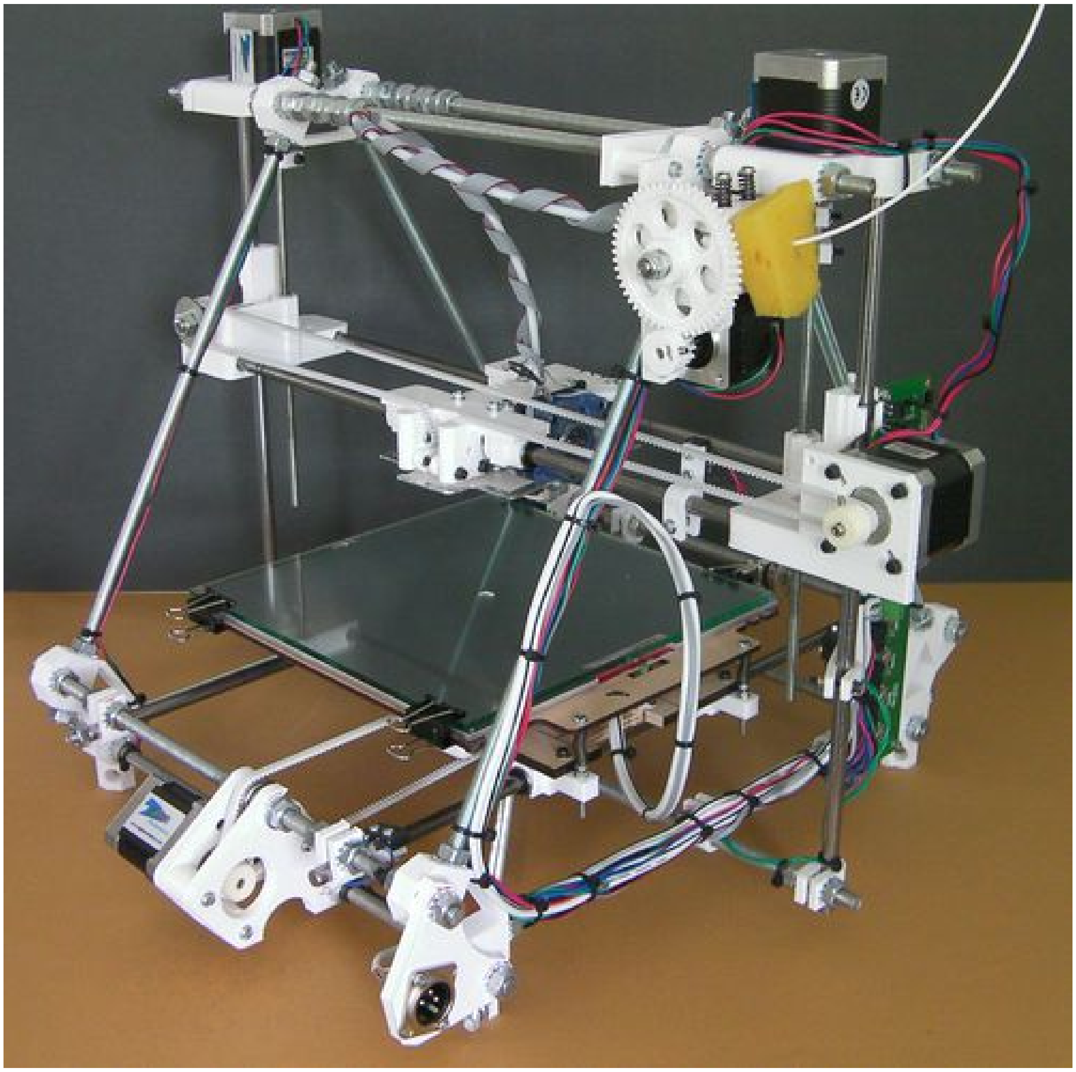
You may also need a reel of "invisible" tape.

Parts



Item	Quantity
Controller board	1
High-current wire	0.5m
Printed U clips	3
M3 x 25mm screws	3
M3 nuts	3
M3 washers	6
3mm i.d. plastic tube	20mm
cable ties	about 60

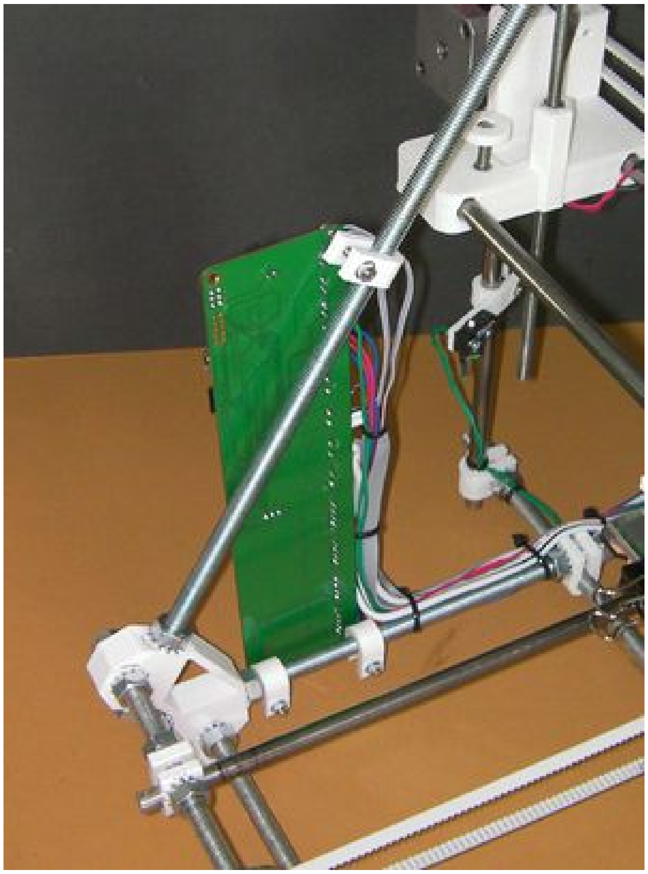
Wire routes



In what follows you will find the routes of the individual connections superimposed on this picture. It is taken from the back of the machine, and the side of the machine on the picture's right is therefore the left side of the machine when it is viewed from the front in its normal working position.

Almost all the wiring runs down the triangle threaded rod to the fore of the picture, and then along the triangle threaded rod at the bottom.

Attaching the control electronics



Attach the three U clips to the frame as shown. The controller board goes on the left hand side of the machine at the front (that is, the end of the frame that is on the same side as the XLR power input connector, but at the other end).

Using a sharp blade cut the 3mm internal-diameter plastic tube into three pieces of equal length of about 7mm. These will form spacers between the printed circuit board (PCB) of the controller and the U clips.

Adjust the positions of the U clips so that they line up with the holes in the PCB and the PCB is vertical.

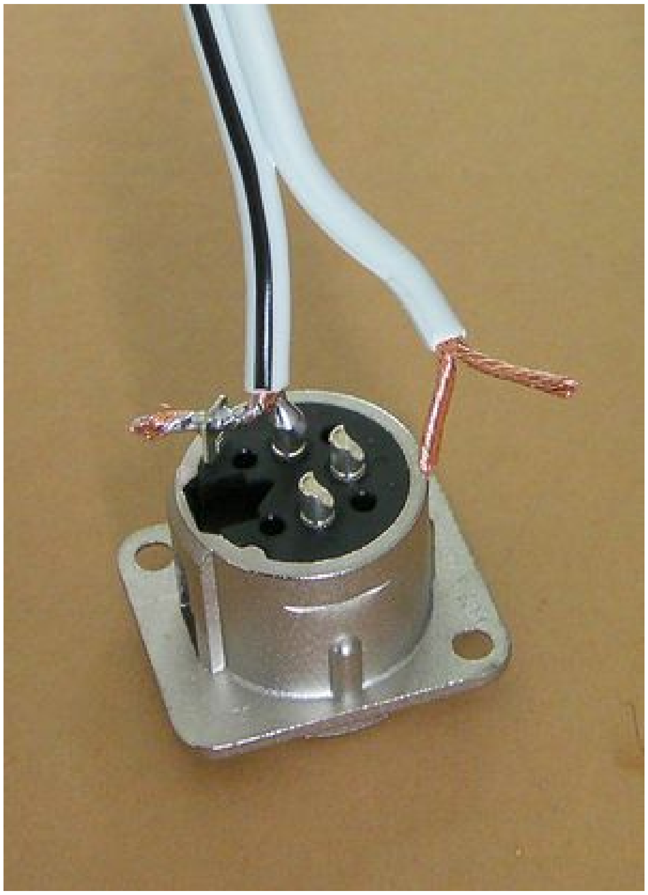
Attach the board to the clips with the screws, washers and nuts. The order goes:

1. screw head
2. washer
3. PCB
4. 7mm plastic tube
5. U clip
6. washer
7. nut

Facing the machine from the front, the components on the PCB should be away from the triangle frame and the USB connector and SD card holder should be at the top of the PCB pointing to the front.

The power supply wire

Detach the XLR plug from the frame vertex at the back.



In what follows take great care that there are NO filaments of wire that are sticking out from twisted bundles. These can cause shorts.

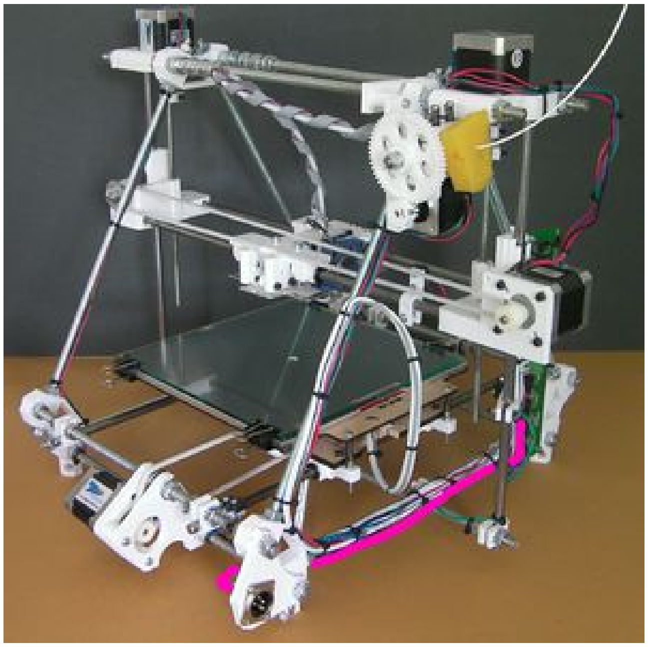
Bare the high-current wire ends, and split each end in two equal halves. Twist those halves separately.

Solder the two from the wire with the black stripe (the Ground - GND wire) to Pin 1 and the plug shell tab.

Solder the two from the plain wire (the +12 volt wire) to Pins 2 and 3.

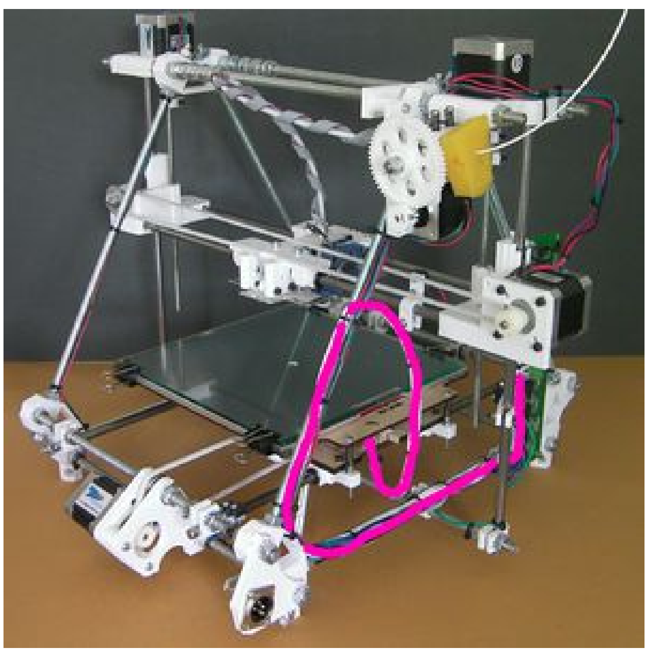
The pin numbers are embossed on the plug. The picture shows the GND connections made, and the +12 volt connections about to be made. The unsoldered fork in the picture going to Pins 2 and 3 is shown a little long; the bared wires need to be about 2/3 the length shown.

Trim the excess wire from the tab with side cutters.



Fit the XLR plug back in the machine. The picture above shows the route of the power wire coloured cerise. Leave a small loop at the XLR plug free for strain relief. Attach it with tape or cable clips to the bottom rung of the triangle, but leave the controller board end free for the moment.

The heated bed wires



Bare the ends of the two thin wires from the bed (the thermistor wires) and use your meter to check the resistance between them. It should be about 10K ohms (though this will depend on room temperature).

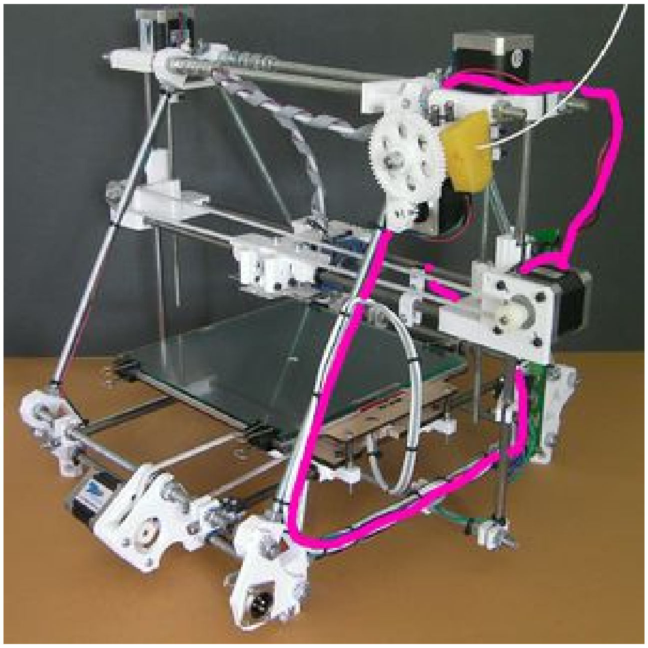
Push the meter probes in the ends of the thick wires (the bed heater PCB). The resistance should be about 1.5 ohms.

Run the power wire and the thermistor signal wire from the heated bed along the route shown. Cable-tie the two together where they loop free in the air. As you can see, the loop joins the frame about half way up.

Check that the bed of the machine can run freely from one Y extreme to the other without the wires pulling taught and without their catching on anything (particularly the M5 screw that drives the Z axis).

Again, don't attach the wires to the controller for the moment.

The X motor wires

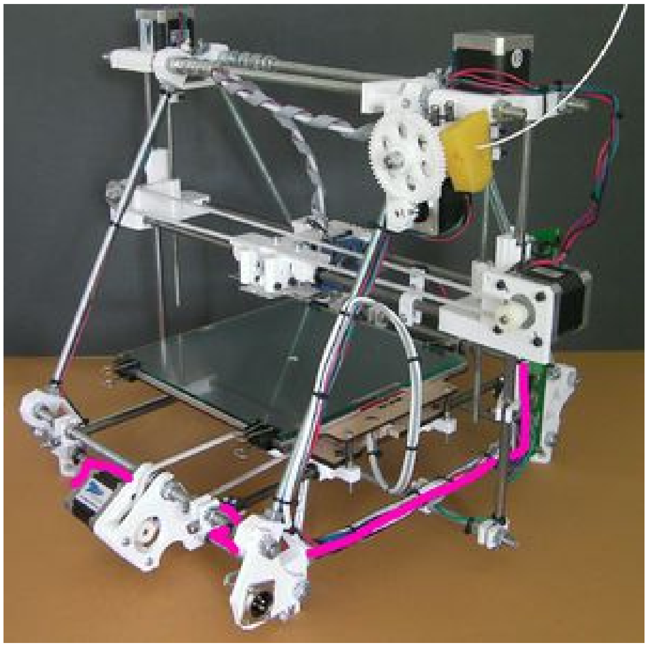


Run the X motor wires along the route shown. (The little bit of cerise colour along the X axis is for the X endstop. That will be done later.)

Leave a generous loop in free air. Remember that the Z axis has to be able to move up and down its full length.

Don't attach the wires to the controller.

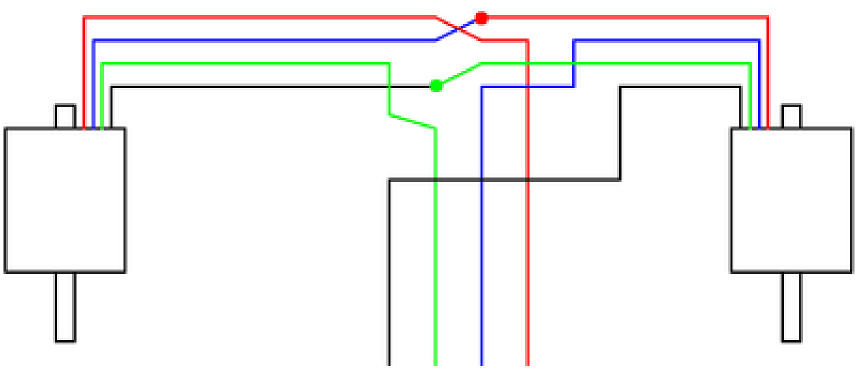
The Y motor wires



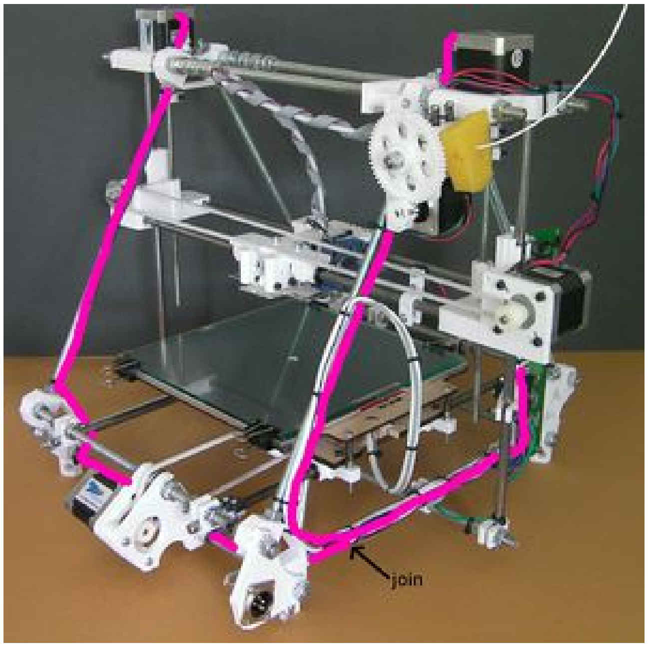
Run the Y motor wires along the route shown. They attach to the bottom threaded rod of the frame at the back. (The little bit of cerise by the Y endstop switch is the wire for that. That will be done in a minute.)

Again, don't attach the wires to the controller.

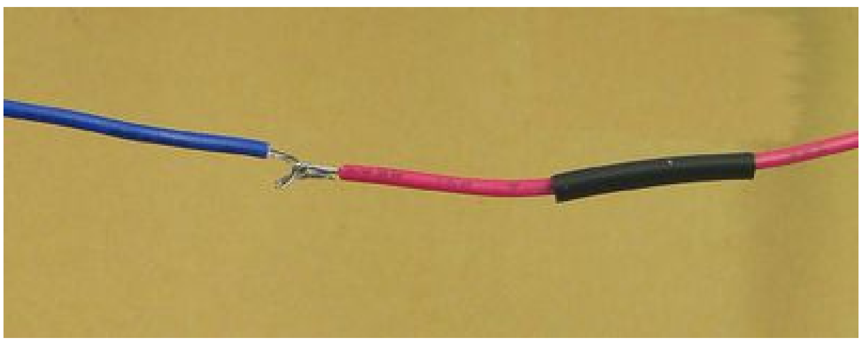
The Z motor wires



The two Z motors are wired in series as shown in the diagram above. It doesn't matter which motor in the diagram is the left one and which the right - the result will be the same.



Run the Z motor wires along the routes shown. Make the joins where indicated.



To make the join bare about 10mm of each wire. Put a short length of heatshrink on one. Form each end into a V (blue wire), hook them together, and then close the Vs (red wire). Solder the join (with the heatshrink further away than shown - you don't want to shrink it prematurely).

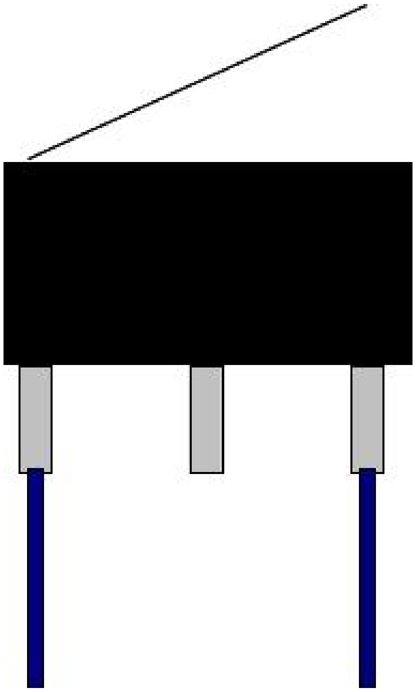
Move the heatshrink over the join and shrink it with the hot barrel of the soldering iron (don't use the tip - that will make a mess of solder on the outside of the heatshrink.)

Don't attach the wires to the controller.

The endstop wires

Cut the ends off the motor wires at the controller board end. Make sure you leave a generous length on each to connect to the controller. If you taped and labelled you motor wires, put new labels just on the motor sides of the cuts before you make them.

Connect your endstops using two wires each. It is a good idea to use a different colour for each axis as this will make it easier to get the endstops connected to the correct input. You should now have plenty of multi-colour wires trimmed from the stepper motors.



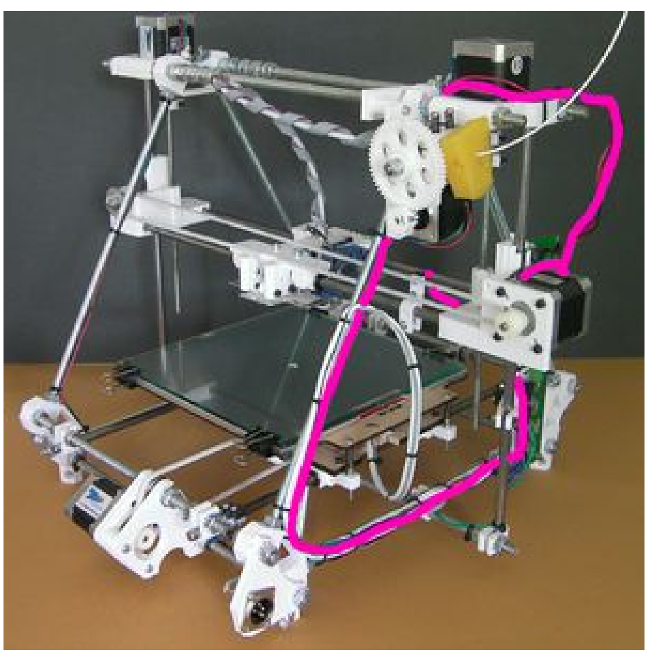
The diagram shows a switch with a lever. RepRapPro Mendel works equally well with levered and un-levered microswitches.

You will probably find it easiest to connect the wires to the endstops with them removed from the machine. Unscrew the three h-shaped clips.

For each endstop switch, crimp or solder a terminal onto the end of the wires, then cover with some heatshrink to insulate the terminal. Connect to the outer pins of the limit switches (the NC = Normally Closed connections; RepRap expects the switch to open when the endstop is hit.)

Put the endstops and their h clips back on the machine.

The X endstop wires



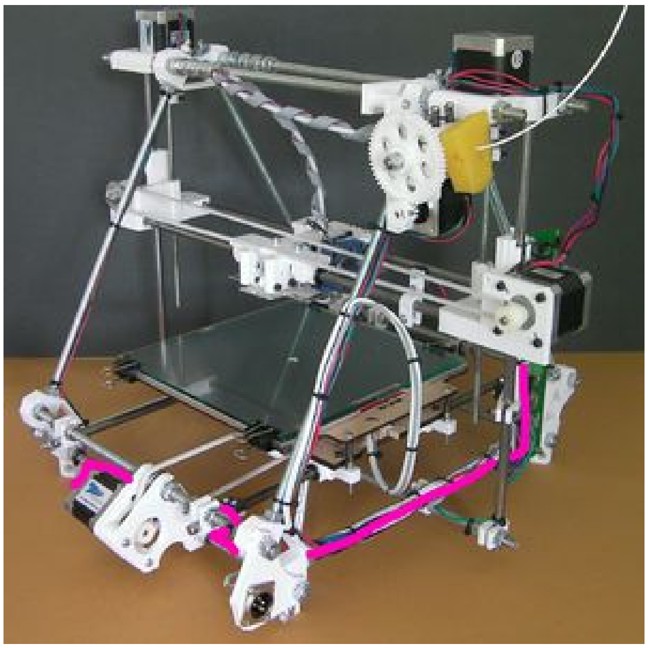
The X endstop wires run along the same path as the X motor wires.

Leave a reasonable loop between the switch and the frame - you may want to adjust the position of the X endstop.

Cable clip all the wires together where they loop free in the air. Get all wires in the loop the same length for neatness (Hint: don't pull the cable ties fully tight. Then you can slide the wires through them to get everything neat before tightening.)

Don't attach the wires to the controller.

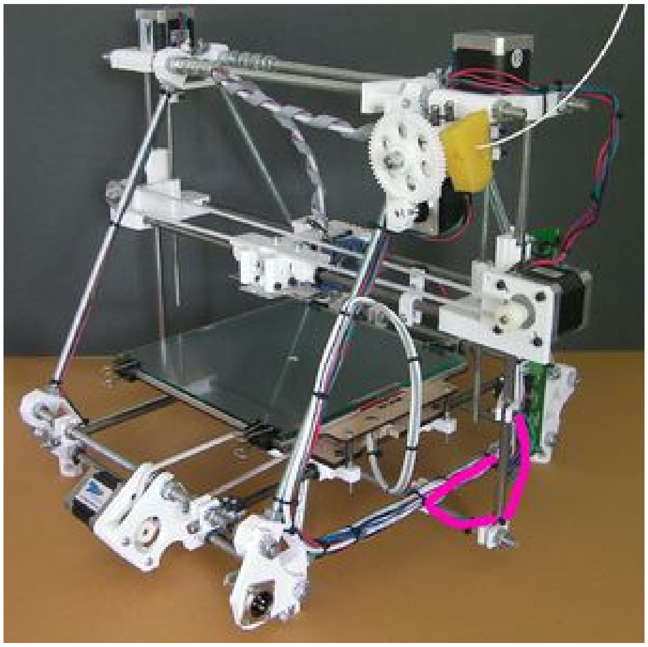
The Y endstop wires



The Y endstop wires run along the last part of the route of the Y motor wires.

Don't attach the wires to the controller.

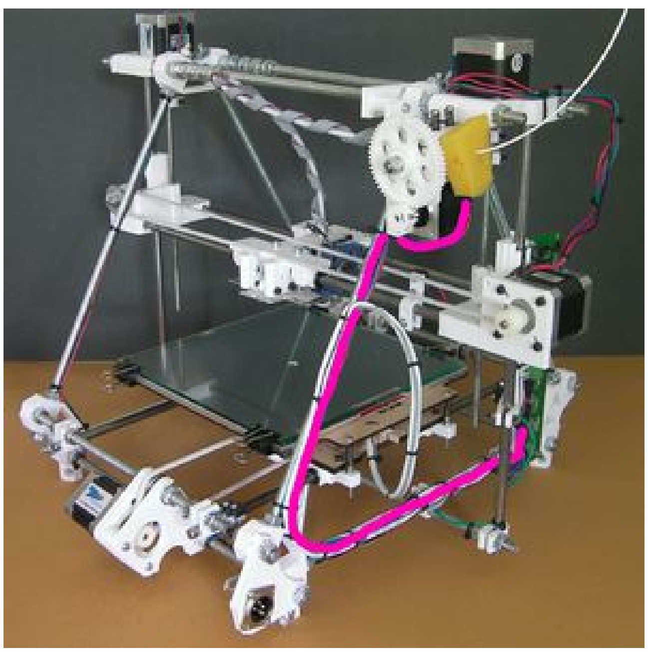
The Z endstop wires



The Z endstop wires run along the route shown. Leave a good loop from the switch to the point where it first connects with the frame. You will need to adjust the height of the switch.

Don't attach the wires to the controller.

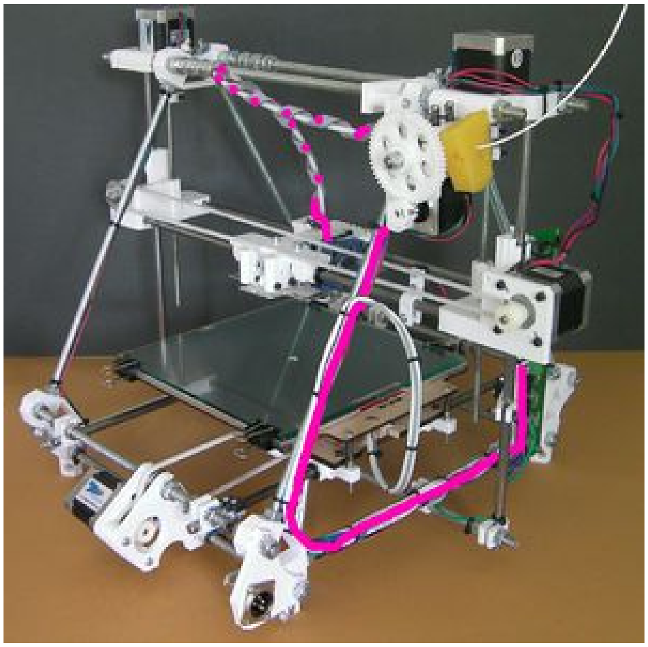
The extruder motor wires



Run the extruder motor wires along the route shown.

Don't attach the wires to the controller.

The hot-end ribbon cable



The hot-end ribbon cable should already be **loosely** wound round the PTFE filament feed tube.

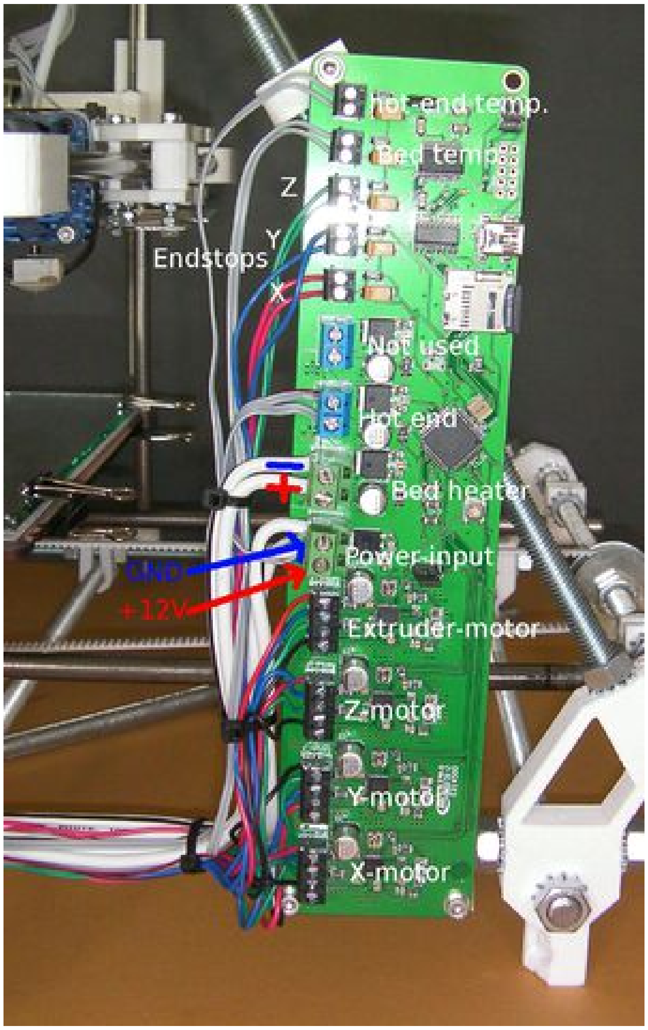
Attach it to the frame along the route shown.

Don't attach the wires to the controller.

Connections to the controller board

First make sure that all the moving parts of the machine can move freely for their full travel without fouling or snagging any of the wiring.

If you have attached all the wires with tape, now is the time to go round the machine cutting off the tape (don't cut the wires...) and attaching the wires permanently with cable ties.



What you are going to do is to trim the wires to length, twist them, tin them, and attach them to the appropriate screw connector. When a wire is in its connector the insulation should abut (but not enter) the metal part of the connector. There should be no bare wire visible.

When you twist and tin the ends of the wires, put them in their connector to check the length. If any are a little long, trim them with side cutters.

When you tighten the screws in the controller board's connectors take care that

1. Your screwdriver doesn't slip and damage the board,
2. You don't put excessive twist stress on the board or push against it too hard - support it with your free hand.

The power wires

Before you connect these, check the wires' polarity. Separate about 30mm of the end of the two power wires (don't get the bed wires by mistake).

Set your meter to read voltage. Connect the power supply into the XLR plug on the frame and plug in the mains cable, but don't turn it on.

Put the COM or Ground probe of your meter on the copper at the end of the wire with the black stripe. Put the Volts-Amps-Ohms probe on the copper in the plain wire.

Turn on the mains. Your meter should read about +12 volts. If it reads 0 or -12 volts, you have made a mistake - find it and fix it.

Turn off and disconnect the power supply.

Cut the wires to length so that they will reach the power connector on the board. The GNG (black stripe) wire goes to the top of the connector and will have to be a little longer.

Bare then ends of the wires and twist them tight. Tin them. Don't use too much solder, or the result will be too fat to fit in the connector.

Screw the wires into the power connector. As mentioned the GND wire with the black stripe goes to the top, the plain wire to the bottom.

Don't do the power connector up tight - you are going to have to connect something else to the same connector in a minute.

This is the single most important electrical connection in the machine. If you get it wrong expensive bad things will happen. Take a moment to double check it.

The bed power wires

These go to the connector just above the power input connector. Again the black stripe is the low voltage one and goes to the top. The plain wire is the +12 volts wire and goes to the bottom.

Connect the wires in exactly the same way as the power wires.

The X motor wires

These go to the bottom connector. From the bottom upwards the sequence is Black, Green, Blue, Red.

The Y motor wires

These go to the connector above the X motor connector. From the bottom upwards the sequence is Red, Blue, Green, Black (that is, the opposite of X).

The Z motor wires

These go to the connector above the Y motor connector. From the bottom upwards the sequence is Black, Green, Blue, Red (that is, the same as X).

The extruder motor wires

These go to the connector above the Z motor connector. From the bottom upwards the sequence is Black, Green, Blue, Red (that is, the same as X).

The hot-end heater resistor wires in the hot-end ribbon cable

A reminder from when you wired the hot end: the wires across the ribbon cable in order go like this:

1. Wire with the colour stripe: Thermistor
2. Thermistor
3. Fan + volts
4. Fan ground
5. Heater resistor wire 1
6. Heater resistor wire 1
7. Heater resistor wire 2
8. Heater resistor wire 2

The hot-end heater resistor wires come in pairs - you will remember that you connected two to each end of the resistor to get a good current carrying capacity.

The hot-end heater resistor wires go to the connector above the bed power wires.

Split them off from the hot-end ribbon cable, bare the ends, twist the pairs together, tin them, and fit them in the connector. The polarity doesn't matter - you can connect them either way round.

Unused connector

The connector above the hot-end heater resistor wire connector is not used.

The X endstop

The X endstop wires connect to the connector above the unused connector. The polarity doesn't matter - you can connect them either way round.

The Y endstop

The Y endstop wires connect to the connector above the X endstop connector. The polarity doesn't matter - you can connect them either way round.

The Z endstop

The Z endstop wires connect to the connector above the Y endstop connector. The polarity doesn't matter - you can connect them either way round.

The bed temperature wires

The wires that run along with the bed power wires connect the bed's temperature-measuring thermistor. They connect to the connector above the Z endstop connector. The polarity doesn't matter - you can connect them either way round.

The hot-end temperature wires

There are two wires from the hot-end ribbon cable that connect the hot-end temperature-measuring thermistor. They connect to the connector above the bed temperature connector. The polarity doesn't matter - you can connect them either way round.

The hot-end fan wires

The hot-end fan wires in the hot-end ribbon cable connect to the power connector - the fan is on all the time. Make sure you get the polarity right. You should have marked the fan's + and - connections when you wired up the fan. Trace them through by counting wires across the ribbon cable.

Slacken the power wire screws and connect the fan wires in parallel with the power.

Tighten these screws firmly - this connector has to carry a large current.

Testing

Set your meter to measure resistance. Short the probe ends. You may find (particularly if your meter is not the most expensive one on the market) that the reading is not quite 0 ohms. Note down what it is - this is your meter's idea of a dead short. Add this number to the low resistances given below.

Put one probe on the casing of the XLR power connector. Put the other on the cover of the SD card socket. The meter should read 0 ohms.

Now the most important check: plug the power supply into your RepRap and put the mains wire on the power supply, but don't connect it to a mains socket. Measure the resistance between the earth pin on the mains plug and the cover of the SD card socket. The meter should read 0 ohms, or at most a small fraction of an ohm. If it doesn't, you have made a mistake. Find it and fix it before you do anything else.

Measure the resistance between the two screws on the power connector. This may start low and then rise. (This is the capacitors in the circuit charging up with the tiny current from the meter.) It should level out at infinity (if anything can be said to *level out* at infinity...).

Measure the resistance between the two screws on the bed power connector. This should be about 1.5 ohms.

Measure the resistance between the two screws on the hot-end heater resistor connector. This should be about 3 ohms.

Make sure all the moving axes are not touching their endstop switches. Check that each resistance on the X, Y and Z endstop connectors is 0 ohms. That is to say the endstop switches should be closed. Press each switch in turn. The corresponding resistance should rise to about 6K ohms (the resistance of the circuit components on the controller board in parallel with the switch).

Check the heated bed temperature sensor connector. The resistance should be about 5 kilohms. This is not just the resistance of the sensor. Other parts of the circuit on the controller board are in parallel with it.

Check the hot-end temperature sensor connector. The resistance should be about 10 kilohms. This is not just the resistance of the sensor. Other parts of the circuit on the controller board are in parallel with it.

Measure the resistance between Pin 3 on the XLR connector and the +12 volts input screw on the controller board. This should be 0 ohms.

Motor currents

This is important.

There are four small potentiometers on the control electronics near to the motor wire connectors. Turn them gently as far as they will go anti-clockwise. Then turn them clockwise by about 30^{o}. This will set the current to the motors quite low. This means that they may not turn reliably, but it is a safe setting. If you need to, you will increase the current later to make the motors reliable.

Next step

Commissioning

Categories: Build Instructions | RepRapPro | Mendel | Mendel Development

- This page was last modified on 17 June 2012, at 16:35.

RepRapPro Mendel commissioning

From RepRapWiki

| Introduction | Frame assembly | Y axis assembly | X axis assembly | Z axis assembly | Heated bed assembly | Extruder drive assembly |

| Hot end assembly | Power supply | Wiring | **Commissioning** | Printing | Maintenance | Troubleshooting | Improvements |

Contents

Goal

By the end of this stage, your machine will be ready for its first print.

Tools

- An object with a measured height (we use a length of 6mm diameter silver steel - the shank of a drill bit works well too).

Step 1: Communication

Before you start trying to talk to your machine, you need Python and the dependencies. Windows users please note that you install the 32-bit versions of all the Python software even if you have a 64-bit machine (that is to say, do exactly what it says on the following link). Go here for instructions:

https://github.com/kliment/Printrun/blob/master/README.md

USB Driver

For Windows, without the main power supply plugged in, set the PWR-SEL jumper on your controller board to USB and plug the controller into a USB port on your computer. Does the computer complain that it has no driver for the USB device? If so, unplug the USB, then install this driver (http://www.ftdichip.com/Drivers/CDM/CDM20814_Setup.exe) . Then, when you plug the controller in, it should register as a COM port on your computer.

Linux systems should recognize the controller straight away with no need for driver installation. The controller will automatically appear as something like `/dev/ttyUSB0` when you plug it in. It is possible that you have to give acess rights to the USB Port e.g. for USB0: sudo chmod 666 /dev/ttyUSB0 (when there is the error message could not open port, permission denied). Or better, on Ubuntu distributions and possibly others, make sure you as a user are a member of group **dialout**.

Mac users should select a driver appropriate to their machine from: http://www.ftdichip.com/Drivers/VCP.htm.

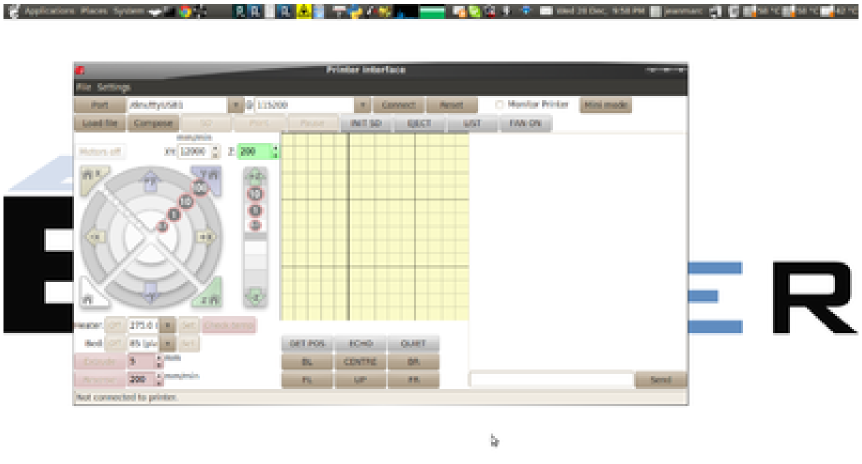
Start talking

The first thing to establish is that you can communicate with your machine. You will need to install and run the RepRappro Pronterface software, which you will find in our github repo here (https://github.com/reprappro/Software) . The button to download a ZIP file is near the upper left.

Connect your RepRap to a USB port on your computer, then run pronterface.py.

The very first time you run Pronterface, select the correct print profile by navigating to the Settings menu, and selecting Slicing Settings. Then select the relevant profile for the material with which you plan to print. For the PLA supplied with RepRap this is **Huxley-PLA-05-03**. Select "Save all" then close the window and return to the printer interface software.

Now select the active serial port in the upper left, choose 250000 for the baud rate. Click Connect, wait a moment, and the software will confirm when the printer is online.



Press the GET POS button, and if the machine returns a position of X0.00 Y0.00 Z0.00 your serial communication is functioning correctly.

NOTE: If your pronterface window does not display the custom buttons (GET TEMP, GET POS, ...), you most likely have another copy of .pronsolerc in your home folder. Delete this file and reload the software. You should now see the extra buttons.

Step 2: Axes

Motor movement

Begin by turning the current-limit potentiometers on the stepper drivers fully counter-clockwise.

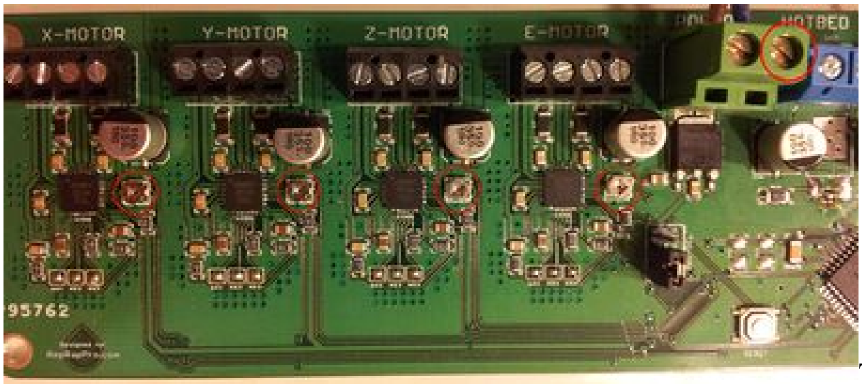
DO NOT CONTINUE WITHOUT CHECKING CURRENT LIMITS!

If limits are not set, the driver boards will most likely be destroyed.

Plug in your power supply. Watch for smoke in case something has gone horribly wrong! Also, make sure that the motors and - more importantly - the four motor driver chips - aren't getting hot. With the current limit all the way down, they should be cold to the touch. Take care with the chips - they have internal temperature shutdowns that kick in around 80^{o}C, a temperature that will burn your finger unless you just touch lightly and briefly.

Melzi adjustment

The current to each motor is controlled by the miniature potentiometer (or trimpots, circled below) beside the stepper-driver chips on the left of the controller board. Use a small screwdriver to turn each one fully anticlockwise (don't force them - they should turn freely). Then turn them clockwise by about 30^{o}.



The rightmost circle at the green terminal block is GND (not a trimpot).

Connect power to your electronics, then using a multimeter, tune the trimpots to provide 1 Amp to each of the stepper motors. The trimpot dial is connected to the REF pin on the A4988 stepper driver ic. The RepRap's stepper motors are rated to 1 Amp, which equates to 0.4v on the REF pin of the A4988 stepper drivers. You can connect the ground probe (usually black) of your multimeter to the GND pin of the power input screw terminal (green, with the GND screw circled in red), and connect the positive probe (usually red) to each of the trimpot dials in turn.

Sanguinololu adjustment

The adjustment of the Pololu stepper drivers that go on the Sanguinololu board is described here on the Pololu site (http://www.pololu.com/catalog/product/1182) . See the section called *Current Limiting*. But ignore the bit on that page about the reference voltage being measured at a via - the easiest place to measure it is on the rotating metal part of the trimpot itself.

Adjust the trimpots to 0.4v by slowing turning clockwise while checking the voltage reading with a multimeter.

Then for both Melzi and Sanguinololu

Now type:

G1 X5 F500

in the field below the log window and click Send. The X-motor should move to 5mm in the positive direction (X5) at 500mm/min (F500).

Now type:

G1 X0 F500

and send. The X-motor should move back to its starting location (X0). If you find that your machine will not move in the negative direction, your endstops are probably not wired correctly. Refer to the Huxley wiring page or the Mendel wiring page to check your wiring.

Repeat the above test for the other three axes. For each axis test, replace the X in the above command with the relevant axis letter (Y,Z,E), but for Z make the feedrate 200 mm/minute:

G1 Z5 F200

You may find that some axes judder, or whine but don't move. This means that their current is set a little too low.

Turn off the power, then rotate the appropriate potentiometer **just a little** clockwise. Put the power back on and repeat the tests above.

Motors going backwards

RepRap works with right-handed Cartesian coordinates. That is to say that looking down on the bed from the front of the machine X runs from left to right, and Y runs from front to back (like a graph). Z runs up towards the top of the machine.

Remember that it is the movement of the printing head that counts: when Y increases, the bed will move towards you.

If you find that an axis is backwards, it is simple to reverse its motor: just power down and then reverse the order of its wires into the controller, so, for example, [black, green, blue, red] goes to [red, blue, green, black]. **Don't forget to turn the power off before disconnecting and connecting wires.**

Endstops

The endstops are only checked during homing. To test them, send a homing command for the X, Y and Z axes in turn, for example

G28 X0

As soon as you press Send and the axis begins to move, activate the relevant limit switch to halt movement of the axis. If activating the switch does not halt your axis, check your wiring (Huxley here or Mendel here).

Homing

You are almost ready to home your machine. Before doing so, ensure the Z endstop is high enough on the Z smooth rod to trigger the switch without the head ploughing into your heatbed.

Press the HOME ALL button and your machine will find its reference position at X0 Y0 Z0.

Step 3: Alignment

Level the X axis

Use digital callipers to measure the height of the X rods above the Y rods (move the carriages out of the way if needs be). Turn the Z motors until the X axis is level.

Level the bed

One of the major differences between the standard pronterface and the eMAKER version is the way the machine is manually controlled. You have five buttons which enable you to position the head above the four corners of the bed and over the centre. The Z axis can be moved in increments of 0.1mm, 1mm and 10mm. The E axis can be moved by the amount specified in the distance spin control. The speed of manual moves can be specified in the spin controls above the manual move buttons.

To level the bed, move the head up such that you have at least the height of your measured object between the head and the bed. Then position the head in the centre and bring it down gradually until it is almost touching the object. Moving the head to each corner, adjust the three M3x30mm cap head screws by which the heatbed is mounted in order to level the bed. The nuts on the M3 screws need to be tight against the spring mounts.

After you have leveled the bed you should add a drop of superglue to the outside of each of the levelling nuts to minimize the shaking as the bed moves. Its actually good if some gets into the threads; you can still adjust be bed height, but it won't creep around by itself.

Set your Z height

With the head at Z0, the tip of the nozzle should be within a paper thickness away from the surface of the bed. To achieve this, follow the sequence:

- HOME ALL
- Send the following command: G1 Zz F200, where z=the height of your measured object.
- CENTRE
- Check that the head is within 0.3mm of your object.
- For Huxley, adjust the height of the Z axis endstop, or for Mendel rotate the adjustment screw, and repeat until your height is set.

Step 4: Heaters

Tick the monitor check box to report the temperatures of your heatbed and nozzle. Ensure that the readings are similar to the ambient temperature of the room.

Heatbed

Command the heatbed to 45C (warm), tick the monitor checkbox and verify that the heatbed temperature reading rises and stabilises around 45C, and that the heatbed is actually warm.

Hot end

Command the nozzle to 100C and watch the temperature rise, overshoot and eventually settle around 100C. Keep an eye on the nozzle during this test. If you see lots of smoke come out of the hot end, turn off the heater. Repeat the test with a target temperature of 200C. The nozzle should reach the target temperature in about 1 minute or less and settle within a couple of degrees of 200C.

The nozzle heater resistor has a lot more power than is necessary, so the the control parameters are set to limit the available power. For the nozzle to reach a target temperature quickly, with minimal overshoot and fast settling time, the integral windup must be tuned for the target temperature. By default, this is set to 80 by the firmware, but the start_PLA.gcode and start_ABS.gcode files should set the appropriate value for that material. This is achieved by the following line:

M301 Ww, where w = 0-255. A higher value means more power available to the nozzle heater.

So, if your nozzle does not reach the target temperature, gradually increase W until the desired performance is reached. W=120 is not uncommon for PLA, and W=180 for ABS.

Once you have tuned this value to your print material, enter it into the relevant start.gcode file. These files are in the directory:

skeinforge/skeinforge_application/alterations/

beneath wherever you have installed **pronterface**.

Step 5: Extruder

Once you have verified the nozzle behaves as expected, you can carry out a test extrusion by hand. Remove the brass bowden start piece from the extruder block and feed some PLA into the tube until it reaches the nozzle (beware of the filament snagging on the short piece of PTFE tube inside the barrel). Command the nozzle to 205C, and once it has reached and settled there, push the filament through and watch it extrude. The extrusion should be maintained with a steady but not excessive force.

Pull out the filament and reassemble the bowden tube for a test of the extruder drive mechanism. This time, click on IDLE or send an M84 command, and rotate the gears whilst feeding some PLA filament in through the extruder drive mechanism. Repeat the extrusion test, this time by manually rotating the large gear.

Finally, try extruding material by commanding the E axis. 200mm/min is a good speed.

Next step

PRINT!

RepRapPro Mendel printing

From RepRapWiki

| Introduction | Frame assembly | Y axis assembly | X axis assembly | Z axis assembly | Heated bed assembly | Extruder drive assembly |

| Hot end assembly | Power supply | Wiring | Commissioning | **Printing** | Maintenance | Troubleshooting | Improvements |

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Mendel Glass Cleaning

The glass bed on Mendel needs to be completely free of all oil and grease (including finger marks), otherwise your prints won't stick to it. We have found that the best stuff for cleaning the glass bed is cheap nail polish remover. Check the ingredients before you buy - the expensive ones have lanolin or other greasy materials in, which would obviously be bad for this application. The cheap ones just have acetone ($(CH_3)_2CO$), a little water, and maybe a tiny amount of glycerine and a compound called bittrex (which is supposed to stop you drinking the stuff...); these work really well. Wipe the glass thoroughly with a clean tissue dampened (but not soaked) in nail varnish remover.

Settings

RepRapPro 3D printers are being sold as a complete printing solution, as such the RepRapPro host software comes with pre-tuned print settings for PLA and ABS filament. We encourage people to play with and put forward improvements to the print settings, but would advise starting with the provided print profiles and working from there.

Warming up

The provided print profiles include a startup routine which will prepare the printer before the print starts. This routine does not include a command to wait for the heatbed to reach the desired temperature, (this is because the heating of the bed can take up to 20mins for ABS printing, and it would be quite disconcerting for the printer to sit there for ages apparently not doing anything and for it to suddenly start after all this time).

So before starting a print, you will need to heat the bed to a suitable temperature for printing:

Huxley: 95C for PLA and 140C for ABS, (bed temperatures are not calibrated on the top surface of the bed, so these values may appear rather high to some people).

Mendel: 55C for PLA and 110C for ABS.

Preparing a file to print

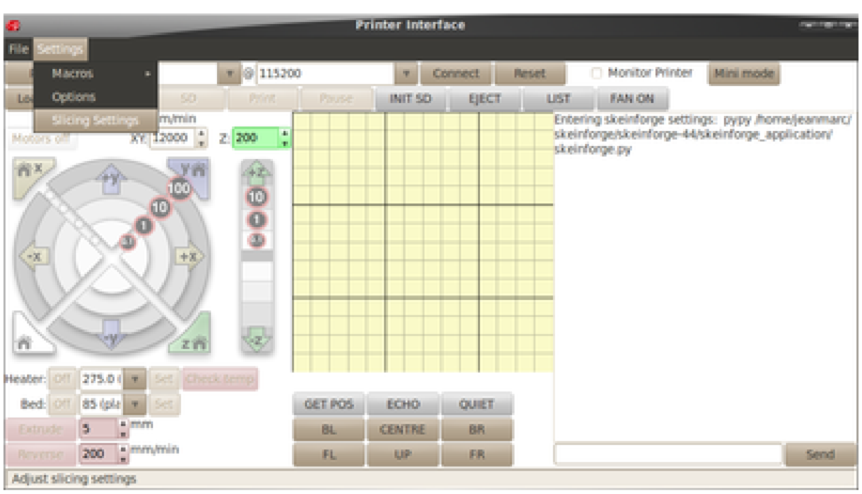
Your 3D model will need to be processed into a format which the printer understands. This is known as a GCode file (print commands are GCodes, see this reference).

Before you can process a 3D model, you may need to tell Pronterface where to find the slicing tool. Click on Settings | Options and check that slicecommand and sliceoptscommand point to the location of your slicing tool. These will normally be:

```
python ./skeinforge/skeinforge_application/skeinforge_utilities/skeinforge_craft.py $s
```

```
python ./skeinforge/skeinforge_application/skeinforge.py
```

respectively. The pronterface software includes a customised copy of skeinforge in the subdirectory called ./skeinforge .



The 3D model will need to be in the STL file format. The software will load either a pre-processed GCode file or an STL 3D model. Click on Load file and select an STL file to process it. You will see progress of this process in the log window.

Once complete, the log will indicate how much filament will be used to print the model. You can then either print direct form USB or copy the file to the MicroSD card in the machine.

If printing from USB, your .gcode file will have been automatically loaded.

It is recommended, however, to print from the MicroSD for a number of reasons. When printing from USB, the print can be adversely affected by the host PC giving the printer a low priority over other running applications, slowing down the stream of commands. Also, the USB connection appears to be quite sensitive to AC noise on the power cable to the host PC.

To print from the SD card, copy the file to the card (which can be done through the printer interface with the SD card still in the machine, but it is much quicker to insert the card into the host PC and copy the file. Just make sure you INIT SD once the card is re-inserted).

Starting a print

To begin a print, you need to select the file you wish to print. Either from the Load file button to print direct from USB, or from the SD Print button.

Once the print starts, the machine will go through the following startup routine:

1. The printer moves all 3 motion axes in a negative direction to find X, Y, and Z zero.

2. The nozzle is heated to the relevant extrusion temperature.

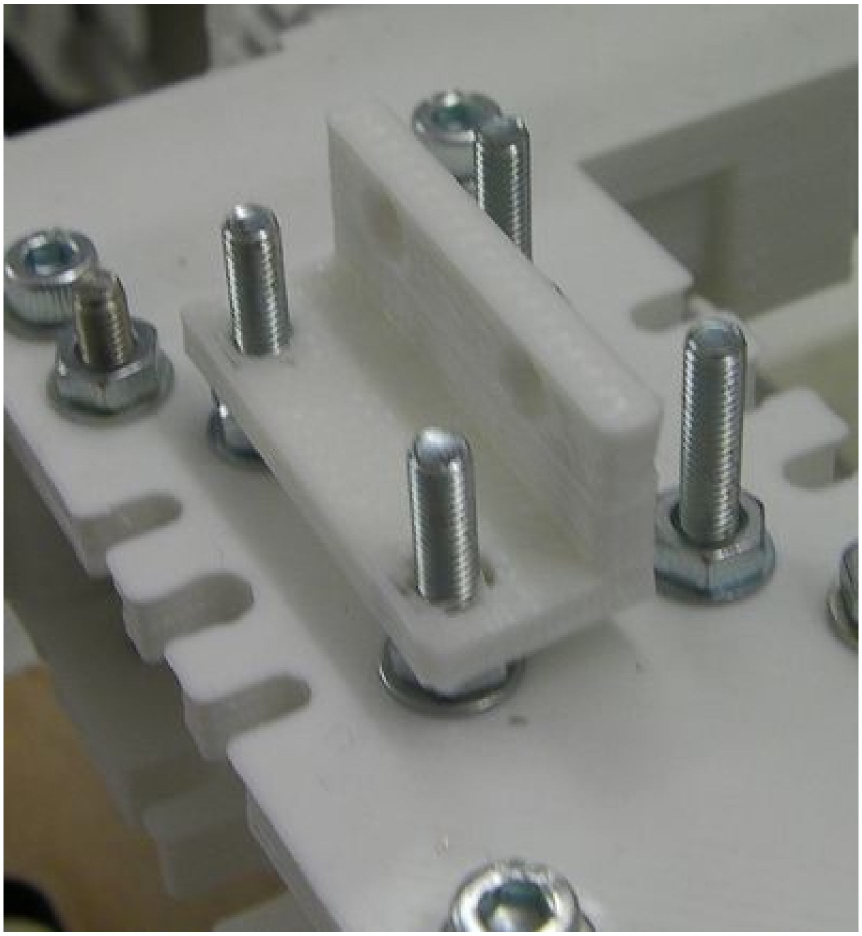
3. Once extrusion temperature has been reached, the machine will print an outline before printing the component(s) to ensure the melt chamber behind the nozzle is primed.

When not required to move, the Z motors are de-activated. This can be a useful feature as it allows the Z height to be tweaked and the X axis to be levelled whilst the outline is being printed. Simply rotate the Z couplings by hand to get a good first layer (filament slightly squished). If you have moved the two couplings in unison to adjust the Z height, you will need to adjust the Z offset in the firmware before the next print, otherwise you will end up having to tweak the Z height manually at the start of each print.

To adjust the Z height in firmware, use the command **M203 Z<value>** where <value> is the amount in millimeters by which you wish to adjust the Z height. If the first layer is too close to the bed, you need to effectively move the bed down, so <value> will be negative. If the nozzle is too far from the bed during the first layer, <value> should be positive to raise the bed. The maximum adjustment is +/-1.27mm. Note that the Z height adjustment is stored in non-volatile memory on the printer so your printer will remember this setting even if you remove power.

Your first print

The first thing to print is the x-carriage expansion clip for your own machine:



This is not needed for the machine at the present, but will be used for future enhancements.

The file for this is on the RepRapPro Github repository here (right mouse click and select "Save link as"): https://raw.github.com/reprappro/Mendel/master/Print-mendel/Individual-STLs/hot-end-pcb-bracket-1off.stl. (The source OpenSCAD (http://openscad.org) model is here if you want that: https://raw.github.com/reprappro/Mendel/master/Openscad/hot-end-pcb-bracket-1off.scad.)

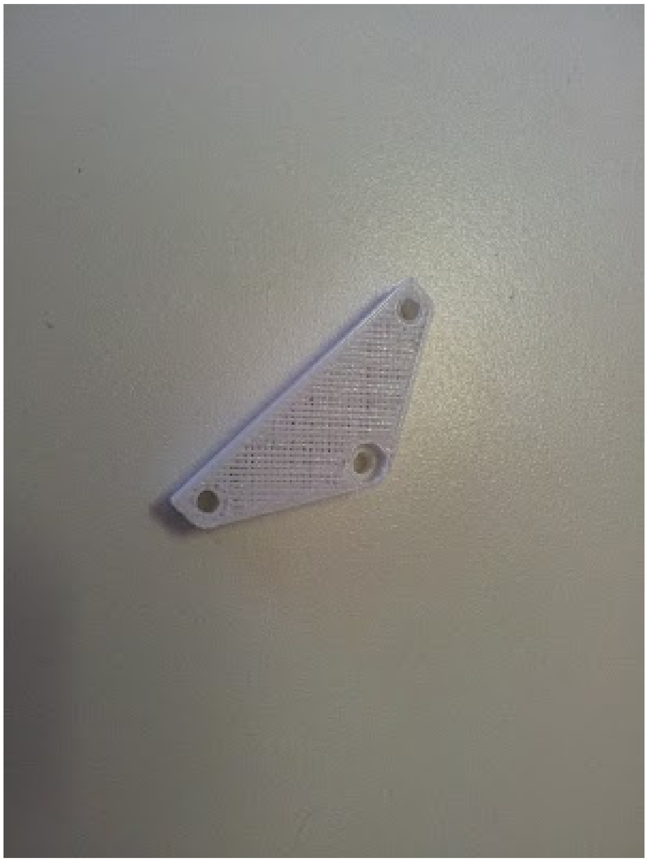
Save the .stl file, load it up and print it!

Tuning your printer

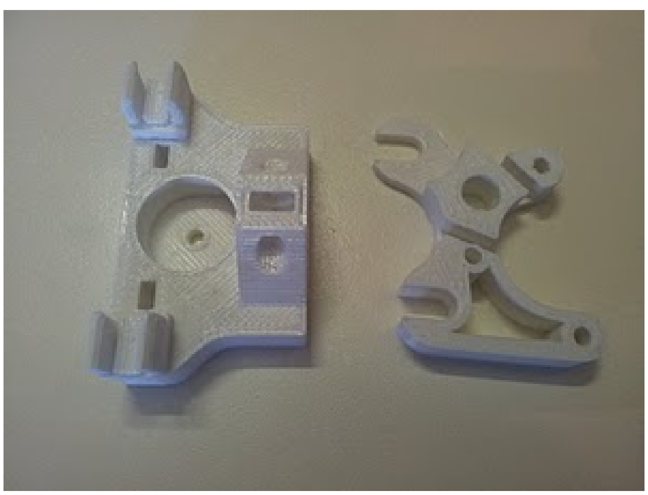
The skeinforge print profiles are tuned based on an assumption as to how much plastic is fed into the extruder for a given number of steps of the extruder drive motor. A critical parameter affecting the quality of the prints is how accurately skeinforge knows the volume of plastic it is feeding into the extruder. In practice, this will vary slightly between machines. This is due primarily to the actual filament diameter, and to variations in the effective diameter of the hobbed stud.

The filament diameter should be measured and the value entered in skeinforge's Dimension plugin.

The E steps/mm setting can be adjusted without uploading new firmware, using M92 Ee, where e is the new E steps/mm value. By default the firmware has this set to 980. When this value is tuned, the top surface fill will have virtually no gaps between lines of filament, and no extra plastic at the ends of the lines.



If the E steps/mm is set too low, a gap will separate the fill lines



A good test piece for this exercise is a 3mm high 30x30mm square.

Once you are happy with your E steps/mm value, you can edit your firmware as per these instructions. Please update your firmware even if you don't need to change this setting; new versions come out regularly for fixing bugs (like the bug where an unplugged/failed thermistor means the heater goes to full power)!

Print another RepRap

So can I print more RepRaps in my RepRap?

Yes!

Your RepRapPro printer has been designed to replicate - that's what the **Rep** stands for. Indeed, RepRaps are humanity's first self-replicating manufacturing machines.

Replicating the plastic parts for another RepRapPro is easy. You can then use them to make a new RepRap (maybe with your own experimental design changes). Or you could make the RepRap plastic parts for a friend. Or you could sell sets of RepRap plastic parts to other reprappers on eMakerShop (http://www.emakershop.com/) or eBay (http://www.ebay.com/sch/i.html?_from=R40&_trksid=p5197.m570.l1313&_nkw=reprap&_sacat=See-All-Categories) .

RepRap's free GPL Licence means that you are completely at liberty to do all of these things.

Go to this wiki page to find out how to print a complete set of RepRapPro Huxley plastic parts.

Go to this wiki page to find out how to print a complete set of RepRapPro Mendel plastic parts.

Profiles

Printing with different plastic may require modified print profiles. Have a look at this page for details, and if your plastic isn't listed, please add to the table once you have worked out the best settings.

Changing Filament

1. Heat nozzle to operating temperature.
2. Reverse filament until it comes out of the extruder drive (about 380mm). You can do this at 600mm/min.
3. Command M84 to turn the motors off. Feed the new filament in by hand.
4. Drive/feed the filament to just before the hot end.
5. Command the filament at 200mm/min until it squirts out of the nozzle. You may need to hold the bowden tube straight for the filament to go down into the hot end easily.

Retrieved from "http://www.reprap.org/wiki/RepRapPro_Mendel_printing"
Categories: Build Instructions | RepRapPro | Mendel | Mendel Development

- This page was last modified on 17 June 2012, at 16:56.

RepRapPro Mendel maintenance

From RepRapWiki

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Uploading new firmware

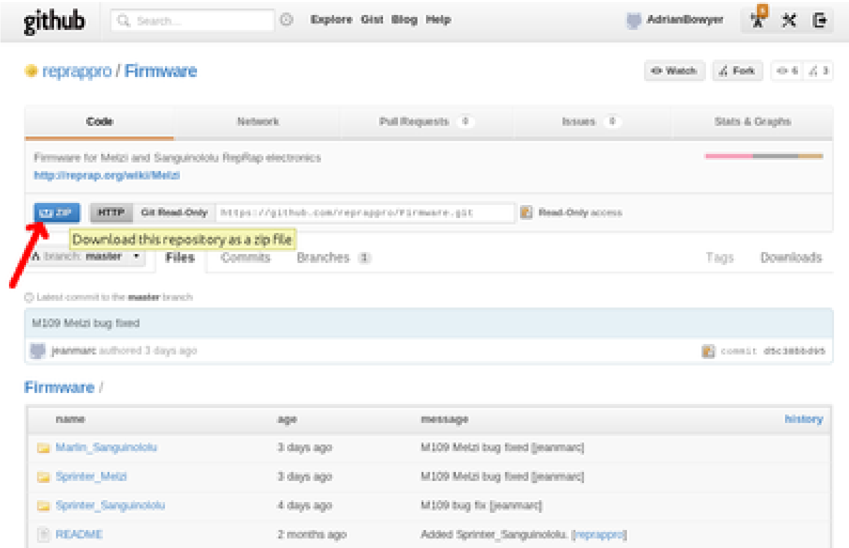
The firmware is the computer program that resides in the microcontroller chip on the controller printed circuit board.

Required software

Downloading from Github

Most of the data you need for RepRapPro hardware and software is on Github. Navigate to the appropriate page.

Then download your software with the button on the left to get it as a .ZIP file:



Arduino and Sanguino

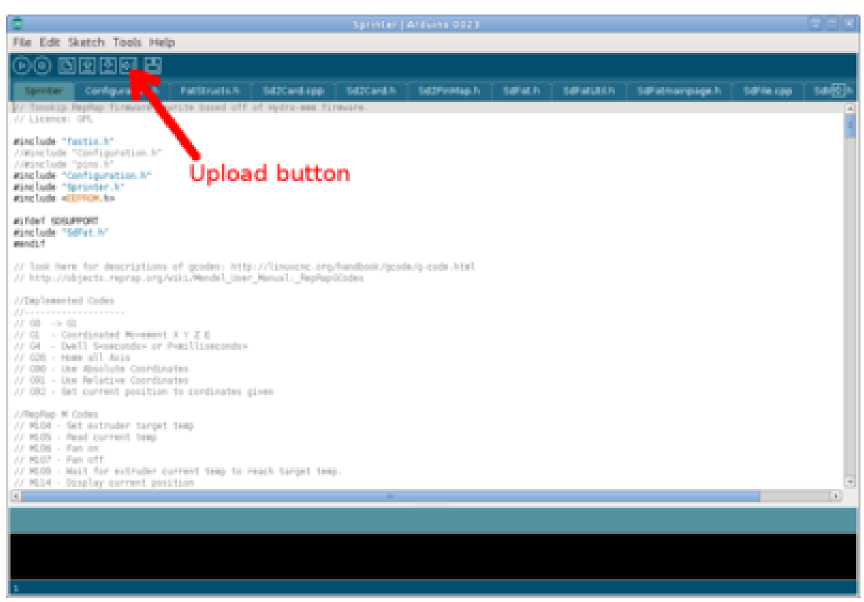
Get the Arduino IDE from the Arduino website here (http://arduino.cc/en/Main/Software) . It's probably best to use Version 0023 until Arduino 1.0 settles down.

Add the Sanguino files (https://github.com/jmgiacalone/sanguino1284p) to your Arduino hardware folder. See the README file in that Github repository for instructions.

Git repository

Firmware source code is stored in the RepRapPro git repository (https://github.com/reprappro/Firmware) . Download the zip file as shown above and then extract the main folder to your drive. Copy this into your ~/sketchbook folder to make it visible within the Arduino IDE. The Arduino software is much easier to use when it knows where you keep the RepRapPro files, so use File/Preferences to set your preferred location.

Uploading



Launch the Arduino IDE, and use the File | Sketchbook menu to open one of the two main firmware projects (depending on your electronics board): Sprinter_Melzi or Sprinter_Sanguinololu. (The third option, the Marlin_Sanguinololu project, will only work if your board has the ATmega1284P chip since it requires more memory.)

Select the Sanguino board from the Tools | Board menu. Check your processor type (look at the number on the big chip on the controller board). You will either need to select "Sanguino W/ATmega644P" or "Sanguino W/ATmega1284p 16 mhz", as appropriate. (If you can't see the Sanguino boards you will need to check that you have downloaded the right files and moved them to the correct folder - see above).

Ensure the serial port is ticked from the Tools | Serial port menu (the RepRap controller board must be physically connected to your computer with the USB cable at this stage, and the auto-reset jumper must be fitted to the board).

Select the tab for the file **Configuration.h**. At the top are the following lines:

```
// Uncomment ONE of the next three lines - the one for your RepRap machine
//#define REPRAPPRO_HUXLEY
//#define REPRAPPRO_MENDEL
//#define REPRAPPRO_WALLACE
```

Uncomment (i.e. remove the two // characters) from the line corresponding to your machine.

About 20 lines further on you will see the following section:

```
//// Calibration variables
// X, Y, Z, E steps per unit - Metric Prusa Mendel with Wade extruder:
float axis_steps_per_unit[] = {91.4286, 91.4286, 4000, 910};
```

These four values allow you to store accurate settings for your printer. Once you have calibrated your printer, particularly the fourth value for Extruder steps, you can edit this line.

To upload your firmware, click the Play button (the first button) to verify that the code compiles correctly, then click Upload (the sixth button) to send the firmware to your processor.

Dismantling the hot end

With care you can completely to dismantle the hot end:

1. Cut the PLA filament so that you have about 300 mm sticking out of the feed side of the drive.
2. Loosen the spring screws on the drive (or remove them) so that the filament is not being gripped at all.
3. Pull the tongue out of the drive to release the brass coupling. Pull the filament through the drive so the PTFE tube and filament are free.
4. Run the hot end up to temperature, and wait for about 30 seconds.
5. Push the filament through by hand so that it extrudes slowly. Push about 100mm of filament through to get fresh material right through the hot bit.
6. Turn the heat off, and watch the temperature as it cools. Clean any extruded filament away from the end of the nozzle.
7. When it gets down to 100 C, pull the free end of the filament gently but firmly. At that temperature the plastic should be soft enough to come out of the heater assembly, stretching a bit. But it should be coherent enough to hold together; it should all come out, right down to the nozzle, leaving the filament path completely empty.
8. Disconnect the power and wait for everything to get to room temperature.

9. Disconnect the hot end wires from the controller board, and slacken the two screws that hold the hot end to the X carriage. Take the hot end off the machine.
10. Cut the cable ties on the fan heatsink that retain the wires.
11. Unscrew the fan and heatsink and set them aside.
12. Unscrew the PTFE cone at the bottom of the nozzle, and set that aside. For the next three steps, take care not to damage the wiring as you unscrew things. Take your time and hold the wires out of the way.
13. With long-nosed pliers unscrew the brass end of the PTFE tube from the long block. Set the PTFE tube aside.
14. Unscrew the long block from the short double-threaded stainless steel tube. Set the long block aside.
15. Retrieve the short length of PTFE from within the counterbored recess in the stainless tube. Set it aside.
16. Carefully remove the crimps from one end of the thermistor wire and the heater resistor wires.
17. Pull the heater resistor and the thermistor out from the other end of the aluminium block.
18. Gently hold the aluminium block in a vice, and use an adjustable spanner on the flats of the brass nozzle to unscrew that.
19. Unscrew the stainless steel tube, taking care not to damage its threads if you have to grip it.
20. Clean all residues of PTFE tape from the components.

To reassemble the hot end, follow the instructions on the hot end assembly page for Huxley here and for Mendel here.

Categories: Build Instructions | RepRapPro | Mendel | Mendel Development

RepRapPro Mendel troubleshooting

From RepRapWiki

| Introduction | Frame assembly | Y axis assembly | X axis assembly | Z axis assembly | Heated bed assembly | Extruder drive assembly |

| Hot end assembly | Power supply | Wiring | Commissioning | Printing | Maintenance | **Troubleshooting** | Improvements |

Contents

Parts warp

Problem

If the first layer does not adhere well enough to the heatbed, there is a chance the component(s) will warp during printing.

Solutions

1. Cleanliness of build surface

Set the heatbed to atemperature of 45C and wait for it to settle there. Clean the surface with nail polish remover (containing acetone, glycerine, and as few other igredients as possible, and definitely **not** lanolin or any other oil or grease) using a lint free cloth. Set your heatbed to your print temperature ready for printing.

2. Setting Z zero

Follow the instructions laid out in Huxley commissioning or Mendel commissioning

3. Reduce bed temp

The default 95C maybe too hot, try a lower setting of 50-60C.

Machine stops extruding

Problem

This could be due to a number of reasons:

- Bowden tube has popped out of the pneumatic fitting.
- Extruder motor does not move much but makes a squeaking noise.
- Extruder motor rotates. but the gears do not.
- Extruder drive motor and gears rotate, but the filament does not feed.

Solutions

1. The most likely reason for the bowden tube popping out of its fittings is due to contamination inside the melt chamber. To ensure the melt chamber is free from contamination, follow these steps:

(i) Heat nozzle to around the ABS extrusion temperature and feed (by hand) some filament into the nozzle.

(ii) Set the nozzle temperature to 78C and wait for the temperature to settle there.

(iii) Reverse the extruder, pulling out the filament from the melt chamber, along with any contamination.

(iv) Cut the contaminated end from the filament.

2. If the extruder motor does not move as expected, but makes a squeaking noise, it means it does not have enough torque to drive the extrude3r feed mechanism. Ensure Vref on the stepper driver is set to 0.4v,as described in the Huxley commissioning instructions or the Mendel commissioning instructions.

3. If the gears are not rotating with the motor, tighten the M3x10mm socket set screw which anchors the small gear to the motor shaft.

4. This could be due to a number of reasons. It is possible for the M6 lock nut to come a little loose after much printing, alowing for some play in the hobbed stud. This can result in the filament wandering from the hobbed section of the stud during a print. Once the filament is on the smooth part of the stud, it will no longer feed.

If the filament is still over the hobb, and has stopped feeding, there is most likely a section worn away from the side of the filament. This could be due to a nozzle jam. To resolve this, follow the instructions as per solution 1 above.

Stepped layers

Problem

Midway through printing a part the next layer appears to have slipped by a millimetre or two causing a step which should not be there.

A step in the printed object results from a stepper motor skipping steps. This is a result of the motor not having enough torque to move the axis (temporarily, since the print continues at the new position). This can be caused by many things, including:

- Stepper driver overheats and temporarily shuts down
- Motor overheats and therefore loses power
- Print head snags on something, usually a curling print due to the previous layers not having cooled enough when the next is put down. This curling eventually solidifies and creates an obstruction for the head. This failure is usually pretty final though.
- Axis snags on something. This can either be the belt wandering and snagging on the printed parts, or wiring catching/getting in the way of movement.

There are probably other ways a step in the print can happen, but the above are the most common ones.

Solution

Depending on the cause:

1. Use secondary cooling fan to cool the electronics.

2. Check that the motors are being supplied with sufficient current to meet the demand. The test pads on each stepper motor driver should read 0.4V, relative to ground.

3. Check that the nozzle is not dragging through plastic as it travels.

4. Check all wires, cogs and belts whilst printing and reposition/realign anything impeding the smooth movement on all axes.

RepRapPro Mendel improvements

From RepRapWiki

| Introduction | Frame assembly | Y axis assembly | X axis assembly | Z axis assembly | Heated bed assembly | Extruder drive assembly |

| Hot end assembly | Power supply | Wiring | Commissioning | Printing | Maintenance | Troubleshooting | **Improvements** |

This is the place to describe improvements to RepRapPro Mendel

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