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Before you start your build

Jul - 23 | By: jmgiacalone | no comments.
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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 eMAKER Huxley. This is especially true for the Igus bushings used for the Z axis.

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: info@emakershop.com

We understand that people may want to change aspects of the machines 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 eMAKER Huxley has been designed to maximise the build volume relative to the the machine's footprint, and as such many of it's 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 eMAKER HUXLEY 3D PRINTER, PLEASE READ THE BUILD INSTRUCTIONS FULLY AND ENSURE YOU UNDERSTAND THEM. Although all parts are covered by warranty, this will be invalidated by not following the build instructions.

The eMAKER Huxley 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.

Table of Contents

All images shown in these instructions can be found on our Picasa web albums:

- eMAKER Huxley 4
- Frame
- Y axis
- X axis
- Z axis
- Bed thermistor and nichrome
- Heated bed
- Extruder drive (cold end)
- Hot end

Get support

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

- Our Forum

- emaker channel on freenode irc

- Email info@emakershop.com

Tool List

Mechanical

id=”attachment_406″ align=”aligncenter” width=”300″ caption=”Tools required for the mechanical build of the eMAKER Huxley RepRap 3D printer”[1]

- Drill bits
- Precision screwdriver set
- Allen keys, 1.5mm and 2.5mm
- 10mm Spanner
- 6″ adjustable spanner
- File
- Half round needle file
- Craft knife

- Fine tweezers
- 6″ rule
- Vernier calipers
- Square
- Fine nosed pliers
- Pliers
- For the Hot End Assembly you will also need some PTFE plumber's tape

Electrical

id=”attachment_408″ align=”aligncenter” width=”225″ caption=”Tools required for the electrical build of the eMAKER Huxley RepRap 3D printer”

[2]

- Digital Multimeter

- Soldering station (temperature controlled soldering iron)
- Precision screwdrivers
- Solder (flux is also useful for soldering the FTDI chip)
- Lighter (or other heat source for heating heatshrink wire sleeving)
- 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 (primarily for cutting Kapton Tape)

Next step

Frame assembly

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Frame assembly

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Goal

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

id=”attachment_437″ align=”aligncenter” width=”300″ caption=”eMAKER Huxley assembled frame”

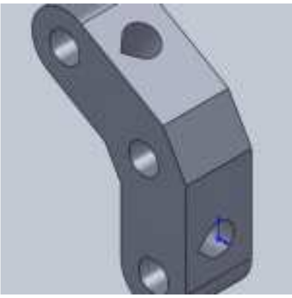
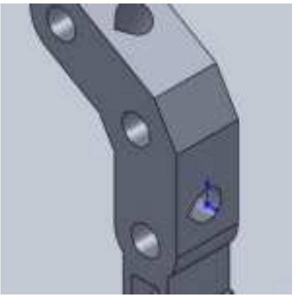
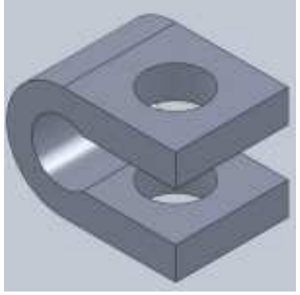
[1]

Tools

You will need the following tools

- M6 combination spanner
- 300mm Rule

Step 1: Frame triangles

RP parts	Quantity
	2
	4
	2

Hardware	Quantity
M6 threaded bar x 250mm	6
M6 nuts	28
M6 serrated washers	28

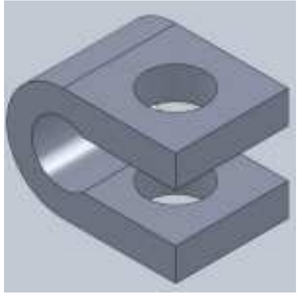
Split the above components into two equal sets, then loosely screw them together into each frame triangle. Make sure you slide a belt clamp along the bottom M6 threaded bars, with a serrated washer and nut either side.

Place a serrated washer between the RP parts and each M6 nut. You frame triangles should now look like this

Before moving on to the next step, we need to tighten the nuts on both frame triangles. For each frame, measure the distance between the vertices on all 3 sides. The distance you should be aiming for is **207mm**. The main thing is to make them all the same. The better aligned your frame is, the better your prints will be when printing large and/or tall objects.

Tighten all the M6 nuts ensuring the distance between vertices of 207mm is maintained.

Step2: Cross bars

RP parts	Quantity
	4

Hardware	Quantity
M6 threaded bar x 185mm	4
M6 nuts	20
M6 serrated washer	20
626 Bearing	2

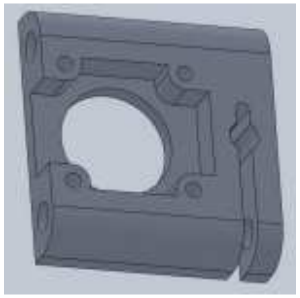
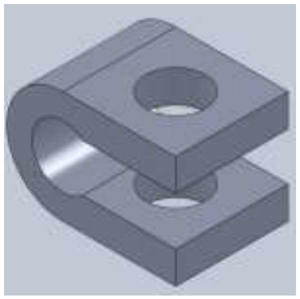
Again split the above components into 2 equal sets. You will assemble 2 top bars (identical), and 2 bottom bars (identical). Each of the cross bars is symmetrical.

So for the top bars, you will need (starting from the middle of the M6 threaded bar): serrated washer, 2 M6 nuts, serrated washer, bar-clamp, serrated washer, 2 M6 nuts, serrated washer, (and repeat in the other direction).

And for the bottom bars: 1 x 626 bearing, M6 nut, serrated washer, (and repeat in the other direction, except for the bearing).

Your cross bars will now look like this

Step3: Put them all together

RP parts	Quantity
	2
	2

Hardware	Quantity
M6 threaded bar x 285mm	3
M6 smooth rods x 235mm	2
M6 nuts	20
M6 serrated washer	20

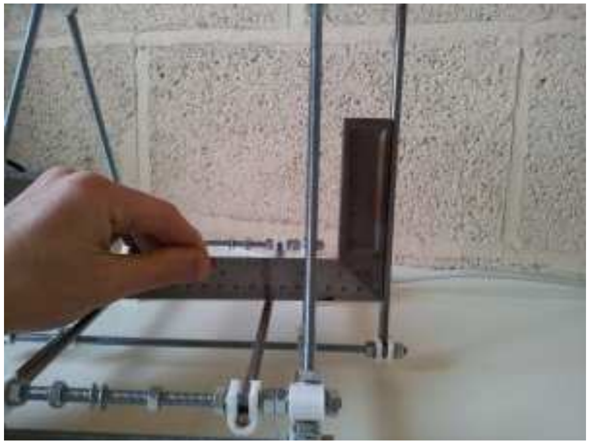
Firstly screw the cross bars into one of the triangles, then screw the second triangle to the other end of the cross bars

Now we need to slide the two top bars through the top frame vertices. Slide each bar through one vertex, then fit one serrated washer, 2 M6 nuts and another serrated washer before sliding the bar through the opposite vertex. Next, slide a Z motor mount onto each ends of the top bars. This may need a little force as the holes through the z motor mounts tend to be quite a tight fit on the M6 threaded bars (it's usually a good idea to make sure you can push a spare length of M6 threaded bar into each of the z motor mount holes before trying to fit them to your frame).

Before tightening the M6 nuts on the top bars, slide the bottom cross bar through the 2 bottom bar clamps. You do not need M6 nuts or washers either side of these bar clamps. At each end of this bottom cross bar, fit an M6 nut, a serrated washer, a bar clamp, a serrated washer, and another M6 nut. You can now slide the 2 Z smooth rods (those of 235mm) into place.

At this stage, the frame should be quite loose, so just jiggle everything around until it all the angles look about right. Once you are happy with this step, you can tighten the nuts on the cross bars. The distance between the frame vertices along the cross bars should be **143mm**. When tightening the M6 nuts on the top cross bars, please note that you do not need to tighten the nuts which clamp against the Z smooth rods too much, only enough to stop the smooth rod from sliding down. If you slip two washers into the groove on the Z-motor mount (with the threaded rod run through their holes) you will be able to clamp your frame solidly <u>and</u> grip the Z-rods without over stressing the plastic. Your kit doesn't come with these washers. 1/4″ washers work well for this.

Before tightening the bar clamps on the bottom cross bar, slide the Y axis smooth rods (270mm) into place and use a set square to get the angle of the Z smooth rods correct. Make sure you get the right smooth rod for the Y-axis; if you swap them you will have to go back and take things apart again.



You can now tighten the M6 nuts along the bottom cross bar.

And you will now have an assembled eMAKER Huxley frame

id=”attachment_437″ align=”aligncenter” width=”300″ caption=”eMAKER Huxley assembled frame”

[2]

The next stage is to assemble the Y axis.

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Y axis assembly

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Goal

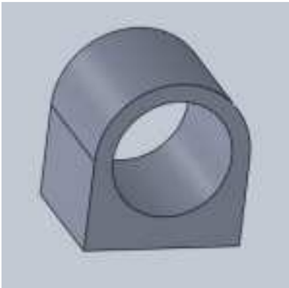
By the end of this stage, your machine will look like this

Tools

You will need the following tools

- Phillips screwdriver
- Adjustable spanner

Step 1: Sled assembly

RP parts	Quantity
	4
Hardware	**Quantity**
Frog	1
LM6UU Linear bearings	4
#4×3/8″ self tapping screw	6
M3 washers	6

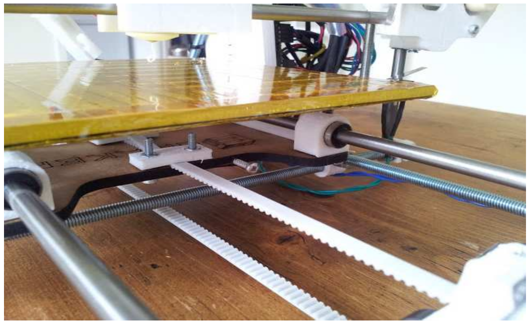
Begin by inserting a linear bearing into each bearing holder. The bearing will be an interference fit in the RP part, so may need some persuasion to go in. A good trick is to warm the printed part with a hot air gun, then put the linear bearing on a flat sturdy surface and push the printed part over it. If you need to apply more force, use the adjustable spanner (set to a diameter just larger than the linear bearing outer diameter) and push down on the printed part.

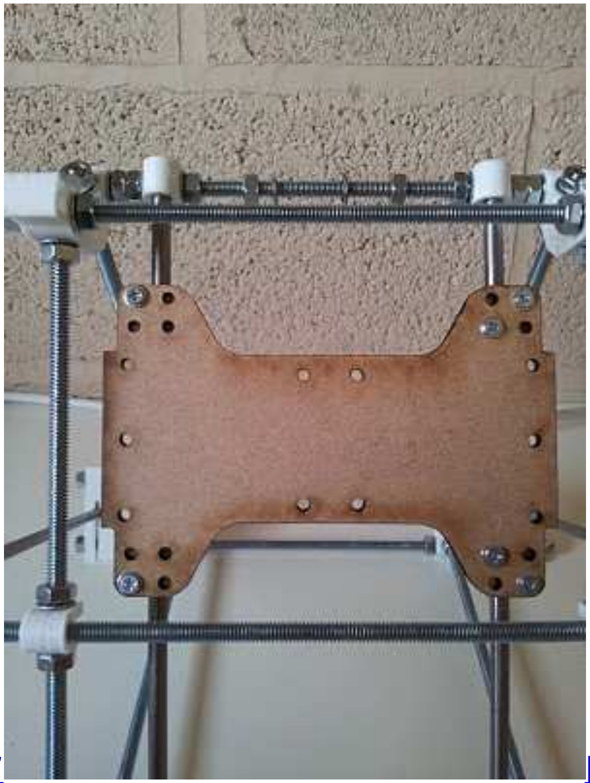
When correctly fitted, the linear bearing should protrude by the same amount from each end of the bearing holder.

Slide 2 linear bearings onto each 270mm long smooth rod. Ensure the linear bearings slide freely along the smooth rods. If the bearings are a little tight, insert the smooth rod into a power drill, then spin the rod for a few seconds whilst holding a scouring pad over it. Clean the rod with a cloth, then try the bearing fit again.

Now slide the smooth rods into the bar clamps. Using a vernier caliper, measure between the smooth rods. Ensure the distance between the rods is the same at both ends.

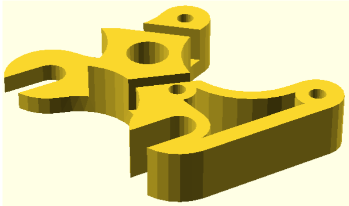
You can now fit the laser cut Frog. Before you tighten everything, you should pre-drill a hole in the frog for the Y-axis end stop adjustment screw and install this screw; its really difficult to install later. You can locate this screw by temporarily placing the frog and shafts in place; the correct hole location is in line with the end stop switch mounting hole, moving paralell to the smooth rods.



The frog is attached to the four bearing holders using at least one #4×3/8″ self tapping screw (and M3 washer) per bearing holder. Begin by attaching the frog to the 2 bearing holders on one side, ensuring the linear bearings slide freely. From the underside, the fitted frog should now look like this id=”" align=”aligncenter” width=”300″ caption=”fitted Frog”[1]

It is important that the above assembly slides freely on the smooth rods. Take your time to get this step right as it will help you when commissioning the machine. If the Y axis is too tight, the motor will struggle to accelerate the axis as it should, resulting in missed steps and failed prints.

Step 2: Y motor and idler brackets

RP parts	**Quantity**
	1
	1
	1
	1

id=”" align=”aligncenter” width=”300″ caption=”Y axis motor fitted”

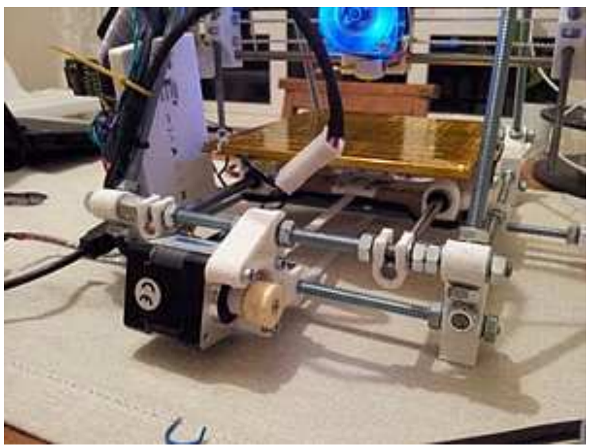
Hardware	**Quantity**
626 bearing	1
623 bearing	1
M5 washer	1
M3 x 16mm screw	4
M3 washer	1
M3 nut	1
NEMA 14 stepper motor	1

The next stage is to fit the Y axis idler and motor assemblies. Each end is made up of 2 printed parts and some hardware. Each end is in 2 parts to enable printing these components without the need for support material.

Motor end

Fit the 14 tooth pulley to the Y axis stepper motor. This should slide over the front shaft (the one with a flat), and is fixed to the shaft by tightening the M3x10mm socket set screw (Note: the gear has an encapsulated nut, insert the screw and tighten it all the way until it breaks out into the centre hole. Clear out the plastic and then fit it onto the motor). **Don't** tighten the screw too much with the pulley mounted otherwise you could break the pulley apart.
Ensure the teeth face in towards the motor (the Y axis belt will not fit with the pulley the other way around).
Screw the motor to the Y motor bracket using the 3 M3x16mm screws, then fit the parts for the Y motor bracket either side of the 626 bearing, and between the serrated washers on the top cross bar.

The Y axis motor end will now look like this



[2]

Note the orientation of the stepper motor, with the wires pointing in towards the machine and the motor on the left of the bracket when looking at the machine from this end.

Idler end

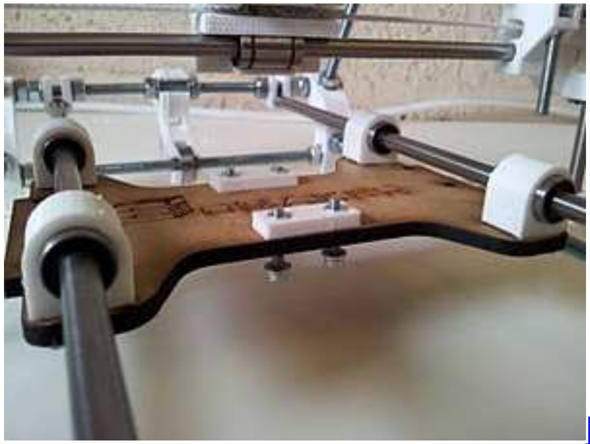
The Y axis idler end is also constructed from 2 printed parts. Fit an M5 washer on the boss printed on the inside of the thicker part of the idler bracket. Before screwing the two printed parts together with the M3 screw, slide the screw through the Y-idler-split-1 printed part, slide the 623 bearing onto the screw and pass the toothed belt around the bearing. Ensure this can move freely over the bearing. If the printed part restricts the belt's movement, remove the belt and file/cut some material away form the offending section of the printed part. Once happy with this, place an M3 washer over the bearing, then the y-idler-split-2 printed part onto the M3 screw, and tighten with the M3 nut. Fit this assembly onto the cross bars in a similar fashion to the Y axis motor end.

Step 3: Y axis belt

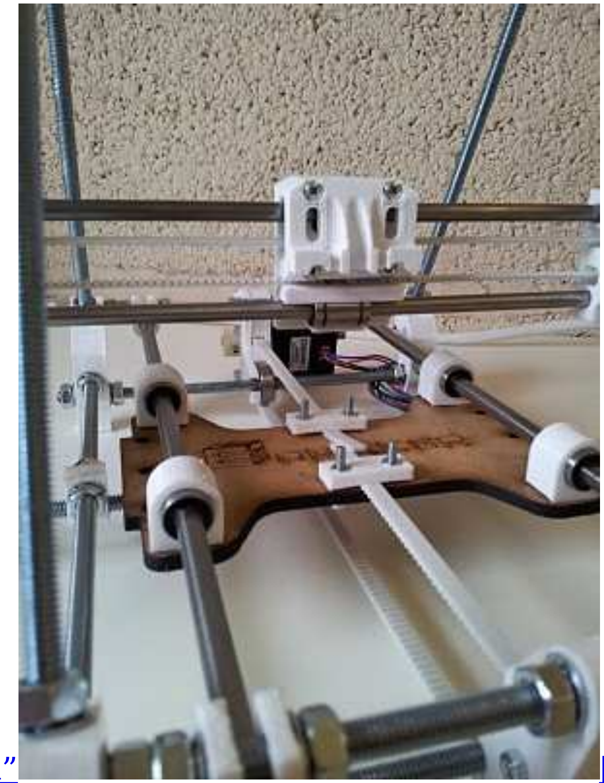
RP parts	Quantity
	2
Hardware	**Quantity**
T2.5 PU Belt 600mm	1
M3x16mm screw	4
M3 nut	4
M3 washers	4

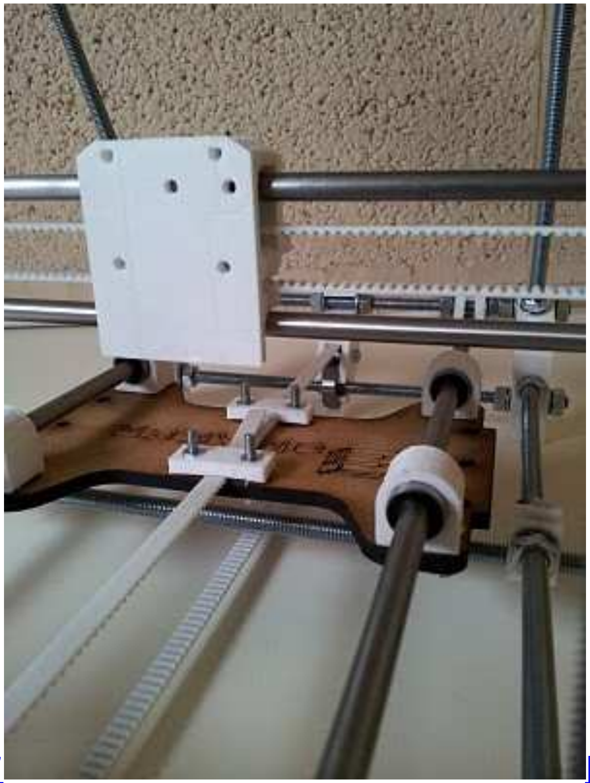
Loosely fit the belt clamps to the top face of the Frog using the M3x16mm screws, fitting a washer beneath the head of each screw.

[id=”" align=”aligncenter” width=”300″ caption=”Loosely fitted belt clamps”]

[3]

Now slide the belt under one of the belt clamps and tighten the latter ensuring the belt in centred. Route the belt through each Y axis motor end, around the 14 tooth pulley, under the two 626 bearings, around the 623 bearing in the Y axis idler end and back under the other belt clamp. Do not pull the belt too tightly at this stage, but nip up the belt clamp enough to enable you to slide the Frog to either end of the smooth rods without the belt escaping.

id=”" align=”aligncenter” width=”300″ caption=”Y axis belt fitted”  [4]

id=”" align=”aligncenter” width=”300″ caption=”Y axis belt fitted”[5]

Slide the Frog to the motor end of its travel, then line up the Y motor bracket so the belt runs freely though its run. Repeat for the idler end. You can now loosen one of the belt clamps, pull the belt tight and fully tighten both belt clamps. The final stage is to manually slide the Frog from end to end, at different speeds, ensuring you have smooth movement. If the belt snags at any point, adjust the belt runs. For example, if the belt tends to one side of the idler bearings, tip the idler bracket over a little so the belt maintains its position centrally over the bearings as the Frog is moved from end to end.

Next step

X axis assembly

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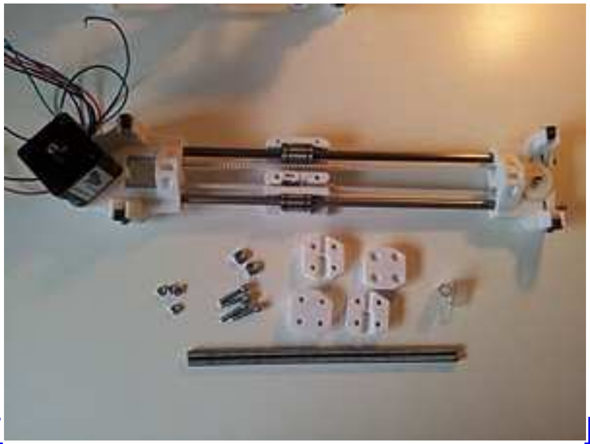
Goal

By the end of this stage, your X axis will look like this

id="" align="aligncenter" width="300″ caption="X axis assembled"  [1]

Tools

You will need the following tools

- Phillips screwdriver
- Pliers

- Half round needle file

Step 1: X axis rails

RP parts	Quantity
	1
	1
	1
	1
	1

id=”" align=”aligncenter” width=”300″ caption=”x axis parts 1″

[2]

Hardware	Quantity
265mm Smooth Rod	2
LM6UU Linear bearings	2
#4×3/8″ self tapping screw	4
M3 nut	1
M3 washers	4

M3 socket set screw	1
Igus bushings	4

We will start by fitting the Igus bushings into the x ends.
These bushings need to allow the Z smooth rods to slide easily, without much slack. In order to achieve this, you will need to fit an Igus bushing into position and slide a smooth rod through it.

id=”" align=”aligncenter” width=”300″ caption=”Igus bushing trial fit”  [3]

If the fit is too tight, remove the igus bushing, then remove a small amount of material from the X end, (using the half round file), and try the smooth rod through the bushing again. Repeat this procedure for all 4 bushing positions, then use the self tapping screws (with an M3 washer on each) to secure the bushings in place, (but do not over tighten the screws, the bushings should remain free).

The holes for the smooth rods are very deep and tend to be very tight fitting; you should ream these out before assembly.

NOTE: the screw holes may need to be drilled out a little deeper using a 2.5mm diameter drill bit. **DO NOT force the screw in or you could damage the printed parts.** The holes are long enough for #4×3/8″ screws, but will need to be drilled a little deeper for #4×1/2″ screws.

id=”" align=”aligncenter” width=”300″ caption=”Igus bushings in position”
[4]

Now slide a smooth rod through each pair of bushings to ensure it slides easily, but without too much slack. If the smooth rod is stiff, you have either over-tightened the self tapping screws, or you need to remove a little more material from the X ends.

Run a 5.5 mm drill through both Z-axis threaded rod holes; these holes must allow the threaded rod to slide through easily.

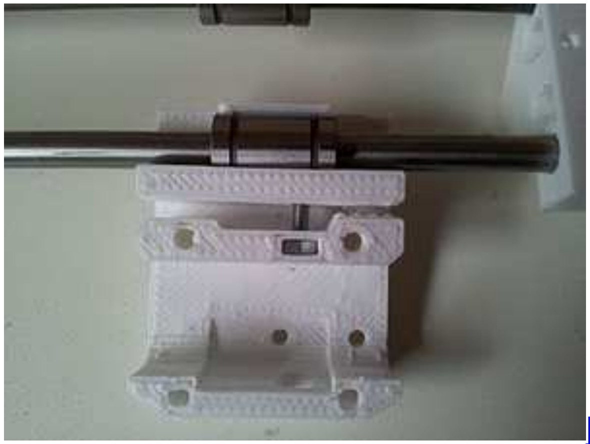
You can now insert the smooth rods into the X motor end, and slide a linear bearing onto each rod, (you may need to de-burr the end of the rods with a file to get the bearings on). The smooth rods go a LONG way into the motor mount; make sure they are both fully inserted before you go further. As with the Y axis smooth rods, if the linear bearings are a little tight, place the smooth rod into an electric drill, then spin the rod whilst rubbing it with a scouring pad. The linear bearing should slide freely along the rod, but without too much play.

Add the X idler end, at which point your X axis assembly will look like this id=”" align=”aligncenter” width=”300″ caption=”x axis parts 2″[5]

You can now click the X carriage onto the linear bearing on the lower smooth (it should be quite a tight fit, so may need some force to get it into place), then you can fit the M3 nut and socket set screw.

id=”" align=”aligncenter” width=”300″ caption=”Fitting the X carriage socket set screw”
[6]

id=”" align=”aligncenter” width=”300″ caption=”X carriage socket set screw fitted”

[7]

NOTE: The socket set screw is not there to retain the linear bearing, but is used later to pull the X belt tight. DO NOT screw the set screw so far into the X carriage to cause delamination of the printed part!

id=”" align=”aligncenter” width=”300″ caption=”X carriage in place” [8]

Step 2: X belt

RP parts	Quantity
	1

Hardware	Quantity
T2.5 toothed belt	1
Galvanised wire	1
NEMA14 stepper motor	1
M3x16mm screw	7
14 tooth T2.5 pulley	1
623 bearing	1
M3x10 socket set screw	1
M3 washer	1
M3 nut	3

id=”" align=”aligncenter” width=”300″ caption=”x axis parts 3″

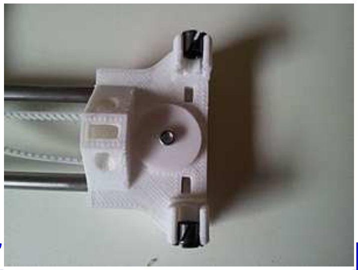

[9]

Insert one end of the toothed belt into the 3 teeth printed into the X carriage, then route the belt through the X motor end, back through the top half of the X carriage, through the X idler end and back to the X carriage.

Assemble the idler bearing assembly by sliding the idler cover, the 623 bearing and M3 washer over the M3x16mm screw, then fit this to the X idler end.

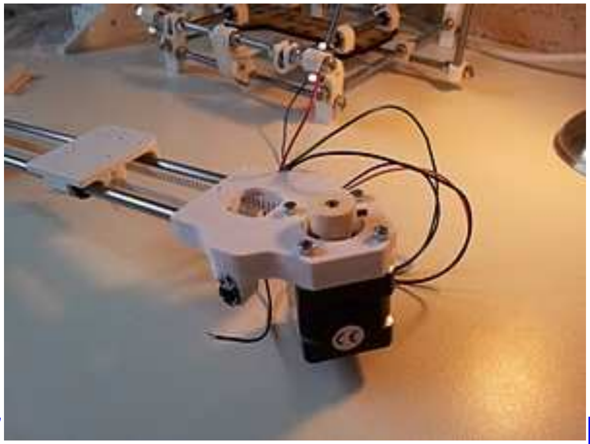
id=”" align=”aligncenter” width=”180″ caption=”X idler bearing

id=”" align=”aligncenter” width=”180″ caption=”X idler

id=”" align=”aligncenter” width=”180″ caption=”X idler M3 assembly”[10] fitted”[11] nut fitted”[12]

Now fit the 14 tooth pulley to the motor shaft with the flat on it, and use the M3x10mm socket set screw to secure the pulley to the shaft. As with the Y axis motor, ensure the pulley teeth are facing towards the motor body. You can then screw the motor to the X motor end using the 4 M3x16mm screws.

NOTE: It is common for the corner of the X axis motor housing to foul against the Z smooth rod, causing the Z axis to bind. Please assume this will happen and file before installing the motor! To resolve this, file the corner of the motor body facing the Z-rod (and don’t be shy, you can remove a couple of mm without damaging the motor) until it clears the Z smooth rod.

id=”" align=”aligncenter” width=”300″ caption=”X axis motor fitted”[13]

Loop the galvanised wire under the M3x10mm socket set screw fitted to the X carriage, then count 17 teeth from the loose end of the toothed belt and fold it over on itself so the end reaches the 17th tooth and slide it into the X carriage with the wire through the belt loop.

id=”" align=”aligncenter” width=”150″ caption=”X tensioning wire”[14]

id=”" align=”aligncenter” width=”150″ caption=”X belt fitted”[15]

NOTE: Do not tighten the belt at this stage. This will be done when the X axis assembly is fitted to the Z smooth rods.

Step 3: Set X axis length

Before moving on to assemble the Z axis, ensure the distance between the Igus bushings is within 1mm of the distance between the Z smooth rods (which will already be installed on the frame assembly at this point). To do this, insert the two M3x16 screws on the idler side of the X axis along with 2xM3 nuts in the rectangular slots (if you can see the rods in these slots then use a flat headed screwdriver to nudge them back a little). These are used to push on the ends of the smooth rods to make adjustments to the distance. Measure the distance between the Z smooth rods at the top, then adjust the X axis assembly to suit.

Next step

Z axis assembly

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Heatbed assembly

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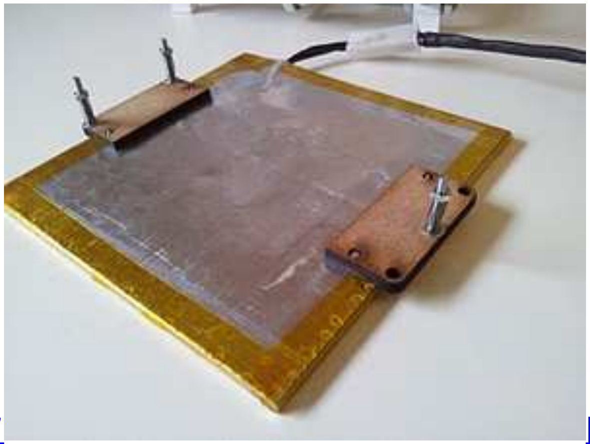
Goal

By the end of this stage, your heatbed will look like this (Viewing Bottom / Heat-bed is shown upside-down)

id=”" align=”aligncenter” width=”300″ caption=”Assembled heatbed”  [1]

Tools

- Wire strippers
- Pliers
- Scissors

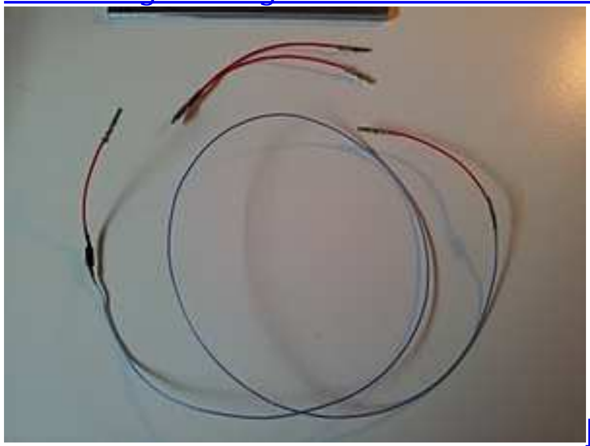
- Pan head screwdriver

Step 1: Assemble the thermistor

Follow these instructions to prepare your thermistor.

Step 2: Assemble the heat element

id=”" align=”aligncenter” width=”300″ caption=”nichrome and thermistor wiring”

[2]

To connect the Nichrome wire to the PTFE insulated wire, cut the insulation from a ferrule and slide the Nichrome and PTFE insulated wire in from each end, then crimp the two wires together. Cover the join in black heatshrink to electrically insulate the join.

The main failure point seems to be the contact areas between the nichrome and the connecting wires, so these need to be as good as possible.

- You can’t easily solder nichrome. Solder just doesn’t seem to flow onto the metal.
- You can tin the ends of the connecting wires with solder. This should help to prevent the rapid oxidation of the bare copper caused by the heat of the nichrome.

- You need to increase the contact area between the wires. Rather than placing them side by side in the crimp tube, I wrapped my nichrome wire tightly around a fine screwdriver to form a spiral and then inserted the connecting wire through a new crimp tube and into the spiral.

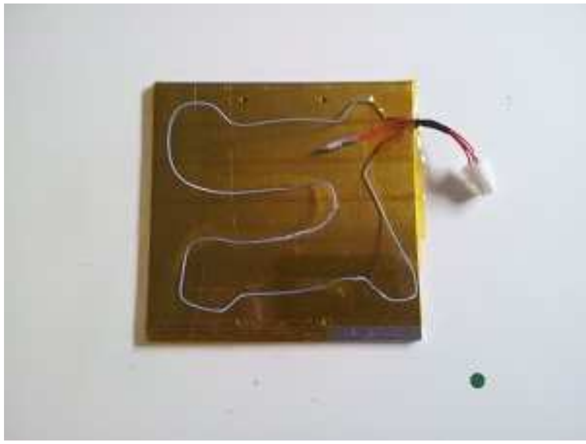
- Finally, you need a strong crimp tube that will grip the wires firmly and resist any movement as the bed moves back and forth. The supplied wire ferrules are marginal for this application; a ring terminal with the terminal clipped off is a much better choice.
- If you really want to solder the nicrome, this is how to do it:
  Strip the Nicrome wire end.
  Lightly sand the wire with fine sand paper; it will ONLY tin the part you sanded!
  Immediately cover the sanded end with PLUMBING solder flux; this is Zinc Chloride based.
  Using either lead free solder (see below) or 60/40 plumbing solder, tin the end of the wire; it will have to get quite hot to tin. You may also have to repeat the above steps more than once.
  Wipe immediately with a paper towel.
  Clean the wire end with rubbing alchohol and/or your favorite flux remover; this is **CRUCIAL**! Zinc Chloride flux will eat up your electronics if you leave it on!
  Cut the terminal off of an un-insulated crimp on terminal (such as a ring terminal) that is a good fit for your wire; the wires should almost fill the barrel. You can double over either the Nicrome or the copper to get it full.
  Crimp the terminal.
  Tug firmly on the wires; they **MUST NOT** pull out!
  Solder the joint using lead free electronics solder (and conventional flux if you don't have flux cored solder).
  Clean it again, **carefully**!

Don't use the eutectic tin lead solder (Sn63Pb37) for this application; its service temperature is too low. Lead free silver tin solders will take 175C. The best choice is made of Tin (95 to 96.5%) with the balance Silver. $Sn_{96.5}Ag_{3.5}$ is going to do the best if you can find it; it does the best job wetting stainless steel. Solder labelled "Sillver Bearing Solder" is $Sn_{96}Ag_{4}$ and will work very well. The tin/silver/copper alloys should work OK here too.

Before laying out the Nichrome wire, it is HIGHLY advisable to cover the underside of the Aluminium bed in Kapton. In fact, if you have access to fiberglass tape, a layer of that both under and over your Nichrome is a really good idea. Oddly enough, fiberglass tape for electrical wiring applications is often available in the the electrical department of large hardware stores. A good industrial supply place or electrican's supply house will definitely have it. 3M/Scotch type 27 is a good choice (link below) and is rated for continuous service at 150C! It is also called high temperature glass cloth tape. Photos of this method and the soldered splice discussed above are in Thingiverse at: http://www.thingiverse.com/thing:13939

http://www.shop3m.com/80012020352.html?WT.mc_ev=clickthrough&WT.mc_id=shop3m-AtoZ-3M-Glass-Cloth-Tape

The side with holes beveled is the top; heater wires go on side without beveled holes.



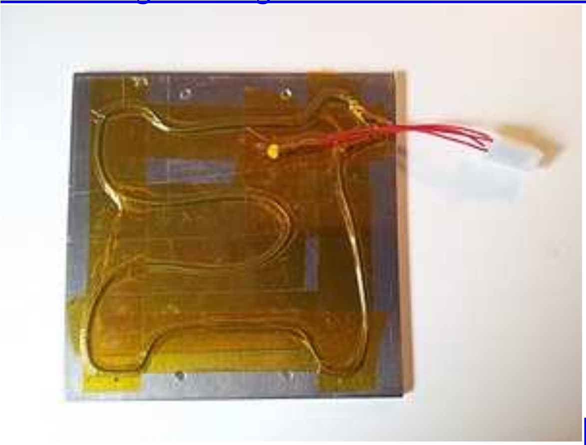
This will reduce the risk of shorting the heater (and potentially other circuits) in the event that the Nichrome insulation fails. (The following images were taken without this extra insulation layer. The bed has subsequently been modified to include this).

id="" align="aligncenter" width="300″ caption="Nichrome wire temporarily taped"

[3]

Note the Nichrome wire path. This is designed to give even heating of the build platform. The nichrome wire should not protrude outside the area of the Aluminium bed plate, and should not be closer than 5mm to any edge.

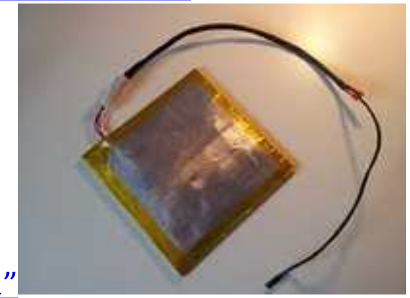
id=”" align=”aligncenter” width=”300″ caption=”Nichrome and thermistor fitted”

[4]

Step 3: Insulate the heatbed

[id=”" align=”aligncenter” width=”200″ caption=”Nichrome and thermistor fitted”

[5]

[id=”" align=”aligncenter” width=”200″

caption=”Heat shield fitted”
[6]

Tape around the perimeter of the heatbed to secure the heat shield.

Step 4: Heatbed wiring loom

The heater connecting wires should be high temperature, high current capacity wires (the thick red silicone insulated wire), cut to a length of 200mm. For the thermistor input wires, use some spare from the motor wires.

The Molex connectors are keyed to only allow connection in one orientation. The male crimp pins fit into the female connector only. The pins are also keyed in the connector; the grooved side of the pin matches the key inside the pin hole. They lock into place when you have inserted them far enough; give them a tug after you insert them to make sure they locked. Don’t try to fit the male pins into the male connector.

It is possible to remove a Molex pin from a connector after installation. The easy way is to use a removal tool; it looks like a set of tweezers with very skinny points. You slide it over the pin and into the matching slots on the connector body to make the latches retract, then pull the pin out. You may be able to make the tool from sheet metal once you know that it needs to snake down those two tiny slots!

In case you get in trouble, these Molex connectors are the 0.165″ pitch Mini-Fit Jr. connector series. The female pins are 39-01-0039-C and the male ones 39-01-0041-C.

Step 5: Mounting the heatbed

RP parts	Quantity
	1
	1

Hardware	Quantity
Bed mounting plate	2
#6×3/8″ self tapping screw	4
M3x30mm cap head screw	3
M3 nut	10
M3x16mm screw	4
M3 washer	10
Bed spring	3

Insert an M3 nut into the hexagonal recesses, two on the double spring anchor, and one on the single spring anchor. Screw the spring anchors to the frog using the M3x16mm screws, and an M3 nut on each screw. The pressed-in nuts go on the BOTTOM of the spring anchors! Use a little superglue on them if they are loose.

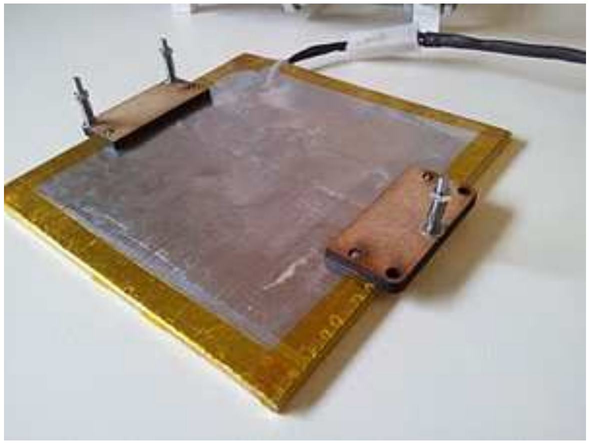
 

The Aluminium bed plate is to be screwed to the laser cut bed mounting plates using four #6×3/8″ self tapping screws.

(note from TheCase: had to re-drill the holes in the aluminum bed with a 9/64″ bit to allow the #6 screws to pass through)
(note from Rob: Same situation with mine (Huxley #20), used a 3.5mm drill bit to enlarge the holes. My 4 screws

were in bag #13, not #2 as indicated by the packing list)

Now insert one M3x30mm screw through the centre hole of one of the bed mounting plates, with a washer either side of the laser cut part. Slide a bed spring onto the screw then secure with an M3 nut, screwing the latter on such that at least 5mm of thread protrude beyond it. Repeat this process with two screws on the other side.



NOTE: Ensure the number of springs you have on each side matches the position of the spring anchors. The bed heater and thermistor wires should protrude from the end nearest the Y axis motor.

Finally, attach your heatbed to the machine by screwing the M3x30mm screws into the captive M3 nuts in the spring anchors. The heatbed needs to clear the Y axis end brackets as it goes right over them during normal operation.

Next step

Hot end assembly

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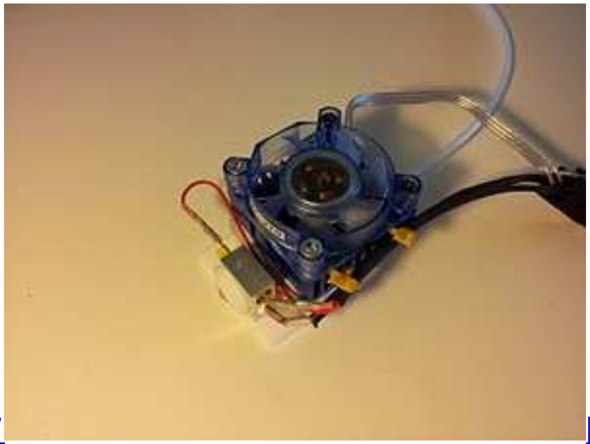
Goal

By the end of this stage, your hot end will look like this

id=”" align=”aligncenter” width=”300″ caption=”Assembled hot end”  [1]

Tools

You will need the following tools:

- Allen key
- Small screwdriver

- Pliers
- Adjustable spanner
- Heat source (small blowtorch)

Step 1: Assemble the thermistor

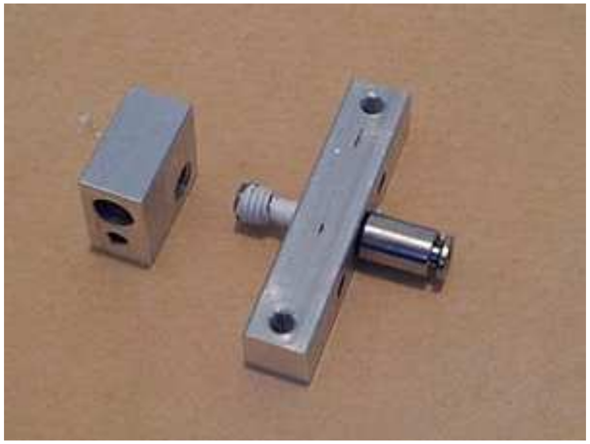
Follow these instructions to prepare your thermistor.

Step 2: Assemble the machined parts

Screw a pneumatic fitting into the heatsink block by hand as far as you can. Coat the countersunk end of the barrel in heatsink compound and screw this into the other end of the heatsink block, again by hand until it butts against the pneumatic fitting.

Now unscrew the pneumatic fitting by up to 1/2 a turn, then screw the barrel in a little further until it stops. Now tighten the pneumatic fitting by gripping its outer diameter with a pair of pliers.

Wrap some PTFE plumber’s tape around the free end of the barrel, ensuring you wrap in the direction of the threads, so that when you screw the barrel into the heater block, the PTFE tape stays in place.



Screw the heater block onto the barrel to the end of the thread. NOTE the orientation of the heatsink block in the image above.

NOTE: Before fitting the brass nozzle, it is worth ensuring the inside is clean. Although a contaminated melt chamber will not break your machine, it will likely cause failed prints.

Wrap the nozzle in PTFE plumber’s tape, again ensuring it follows the direction of the threads, and screw this into the open end of the heater block, by hand, until it butts against the barrel.

Hold the heater and heatsink blocks in one hand, ensuring they are parallel, then tighten the nozzle using the pliers. Do not try to overtighten at this stage, the trick comes next, (if you do not like the idea of the following instruction, there is an alternative solution which will be given after the hot end is wired and connected to the electronics).

Hold the heater block with an adjustable spanner (mole grips would also work), and heat the heater block with the blowtorch.

This needs to be a powerful heat source as you need to heat the Aluminium heater 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 and holding the cold end of the spanner, tighten the nozzle with the pliers. 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.

Step 3: Attach the fan assembly

Prepare the fan assembly by removing the adhesive tape from the back face of the heatsink. DO NOT discard this tape as it can be cut and used to attach the SMD heatsinks to the A4988 stepper driver ICs.


Fit a couple of zip ties between the fins (which will later be used to secure the hot end wiring).

Now spread a thin layer of heatisnk compound on the back face of the heatsink between the 3.2mm diameter holes.

Using 2 M3x25mm screws to attach the fan assembly to the heatsink block, with the heatisnk block protruding below the fan assembly.

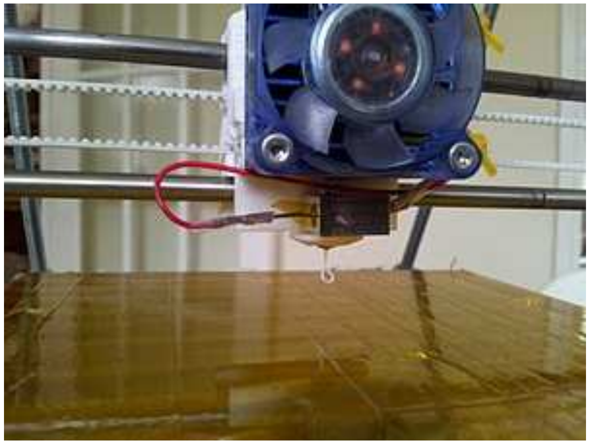
Step 4: Fit the heat shields

The PTFE heat shield attaches to the heatsink block using the 2 M3 countersunk screws and stood off the block using an M3 washer over each hole.


The heat spacer (PTFE strip with 3 holes in it) slides over the pneumatic fitting and has an M3x16mm screw fitted in each of the outer holes. These screws should only be screwed in a couple of turns as they are used to mount the hot end to the nozzle mount on the X carriage.

The final step is to screw the PTFE nozzle shield onto the nozzle.

NOTE: the nozzle must protrude beyond the PTFE nozzle shield.



If this is not the case, cut some material from the nozzle shield with a craft knife (PTFE is quite soft). If the nozzle shield will not screw right up to against the Aluminium heater block, cut some material from the bottom of the PTFE shield plate.

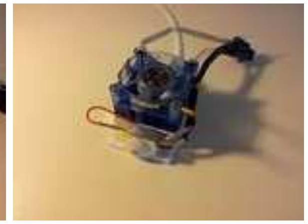
Step 5: Add the electrical components

The power resistor can now be fitted inside the heater block. This needs to be a push fit into the hole, so if it's a little loose, wrap a small amount of Kapton tape around the resistor and push it into place. Trim the resistor wires to about 10mm in length.

Assemble your thermistor as per these instructions, leaving the PTFE insulated wires approximately 90mm long.

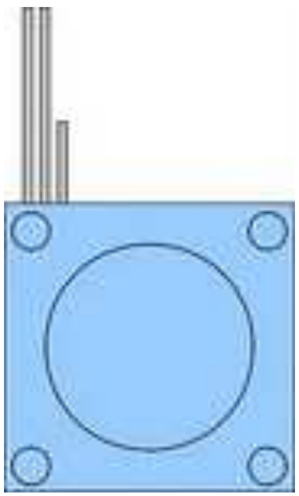
For the resistor wires, cut one to 90mm in length, and another to 120mm. Crimp or high temperature solder a crimp terminal onto one end of each of these wires, and insulate with a short length of PTFE heatshrink.

Fill the thermistor hole in the heater block with heatsink paste, then push the crimp terminals onto the resistor wires, push the thermistor into its hole, and secure all of the wires using the 2 zip ties which were earlier fitted between the fins of the heatsink. Using 2 zip ties ensures the wires do not snag on other machine components during printing, and also ensures the thermistor remains in the hole.

Crimp or solder a male pin onto each of the free wire ends, then push these into the female 6-way molex connector.

Cut the fan wires to a suitable length, and fit a male pin onto the two leftmost fan wires (when looking at the fan as from the image below).



Alternately working from the plug end see picture below
IMG_0262

Push these into the last two positions of the female molex connector. The leftmost wire in the diagram above must be connected to ground, and the central wire to 19v.

Next step

Extruder drive assembly

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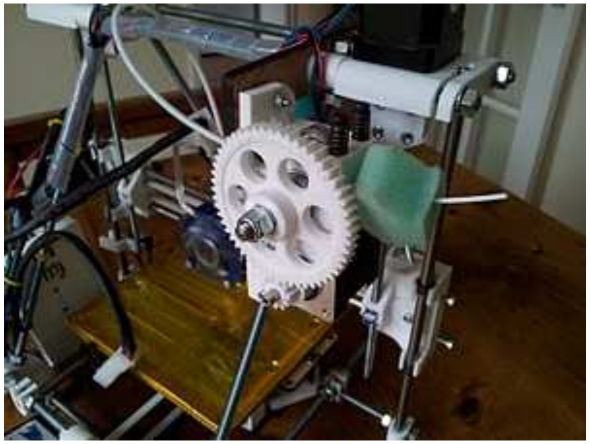
Goal

By the end of this stage, your machine will look like this (wiring optional by this stage)



Tools

- 2 x 10mm spanner
- Allen key

Step 1: Hobbed stud assembly

RP parts	**Quantity**
	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

Slide the hobbed stud through the 8mm hole in the M6-block, then fit the two 626 bearings.

Note the orientation of the stud in the image above.

Place 2 M6 plain washers onto the stud, then the large gear, the M6 full nut, the M6 split washer and finally an M6 nyloc nut.


Screw the second M6 nyloc nut onto the other end of the stud until the latter can no longer move from side to side, but can still rotate easily.

Now adjust the nuts until the hobb is aligned to the 2mm diameter holes which will guide the filament. When you are happy this is in the right position, tighten the M6 full nut inside the gear against the M6 nyloc nut.

Before fitting the motor in the next step, you may want to place 2 captive M3 nuts in the bottom of the M6-Block; they will be needed in Step 3: Idler assembly, but are very difficult to place after the motor is mounted.

If they are not snug enough to hold themselves in, cover them with a piece of sticky-tape for now.

Step 2: Fit the motor

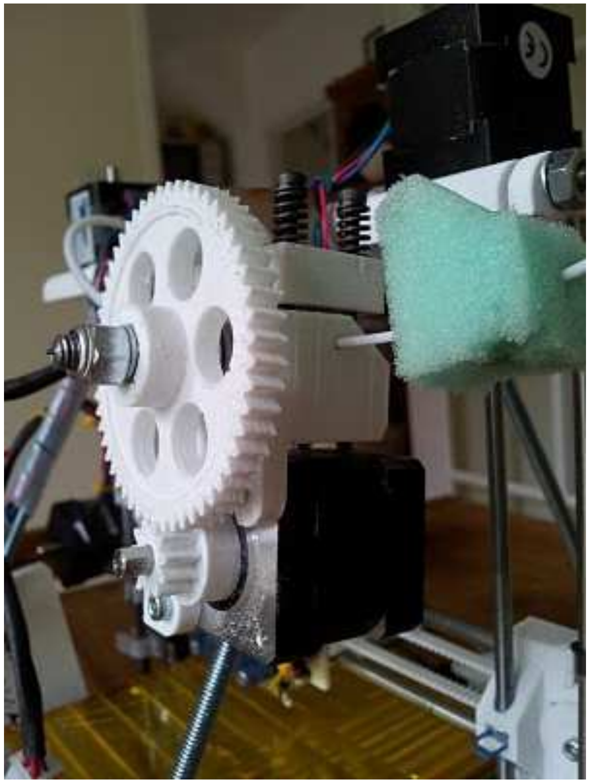
RP parts	Quantity
	1
Hardware	**Quantity**

NEMA 14 stepper motor	1
M3x10mm socket set screw	
M3x8mm screws	3

Fit the M3 nut into the recess in the small gear, then screw in the M3x10mm socket set screw. SLide this over the motor shaft with the flat on it, and tighten the M3 screw to secure the gear. Ensure the gear teeth are facing away from the motor.

Using an M3x8mm screw in the outside hole, fit the stepper motor to the M6-block, such that the two gears mesh well. Tighten this screw, then remove the hobb assembly (by removing the M6 nyloc nut furthest from the gear) so you can fit the remaining two M3x8mm screws to secure the motor.

Finally, replace the hobb assembly.



Step 3: Idler assembly

RP parts	Quantity
	1

Hardware	Quantity
M3x25mm screw	1
626 bearing	1
M3x45 screws	2
M6x20mm socket set screw	1
M3 washers	4
M3 full nuts	3
Springs	2

Slide the 626 bearing over the M6x20mm socket set screw and fit this into the Idler bracket.

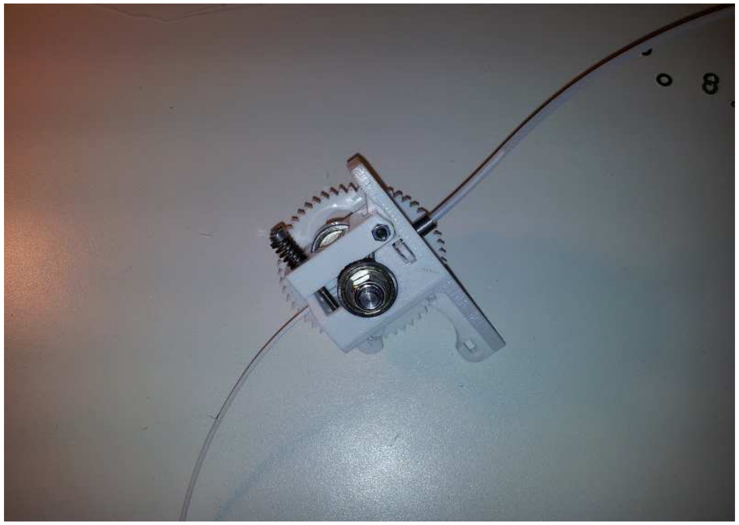
NOTE: If your idler looks different than in the above photo, please see these instructions for assembly.

Place the idler bracket over the 3mm diameter hole in the M6-block and insert the M3x25mm screw. The springs are compressed using the M3x45mm screws pulling against the captive M3 nuts which you must slide into the hexagonal holes behind the motor.

Step 4: Fit the bowden+pneumatic fitting

You'll need

- Pneumatic fitting (push in pneumatic fitting with the O-ring on really short M5 threaded end, just like you used in the hot end assembly)
- flat M5 nut
- Bowden tube (Teflon tube about 2mm diameter)



Just below where the 3mm x 25mm screw goes as the hinge pin is a slot. Slide the 5mm nut in here and push it in until you can see it centred in the large hole in the flat side of the body of the extruder. Screw the pneumatic fitting (If you are not sure what this is, you used one on the hot end.) into this nut. The bowden tube is the flexible translucent tube. This will push fit into the end of the pneumatic fitting. The other end of the tube connects to the hot end. You may want to wait until you are almost ready to print before you connect this tube as it may get in the way while you tidy the wires and connect things up.

Step 5: Fit your extruder drive mechanism to the frame

Loosen two M6 nuts from the top cross bars (on the opposite side to the X axis motor), fit the laser cut extruder drive holder, then tighten the two M6 nuts back up against this. Fit the extruder drive mechanism to the extruder drive holder using an M3x20mm screw and an M3 nyloc nut. The extruder block can be spaced off from the extruder drive holder by sandwiching an M3 nut between the two (on the M3 screw) if you want it to hang vertically. If you want the motor to rest on the threaded rod at an angle, just put it together without the extra M3 nut.

Next step

Assembling the electronics

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Introduction

The eMAKER Huxley 3D printer uses the Sanguinololu version 1.3a electronics to control all of its functions. This is powered from a 120W laptop power supply, and controls the hot end and heated bed, as well as axis motion. The Sanguinololu electronics can be configured in many ways, and the eMAKER Huxley kits have been put together with a specific bill of materials, all of which will be detailed below.

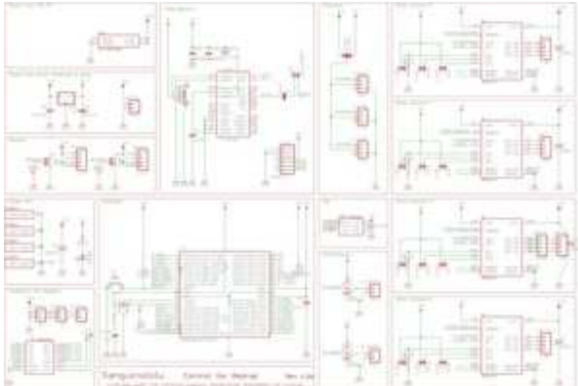
Standard Sanguinololu information

The RepRap wiki has a comprehensive guide to the Sanguinololu electronics here.

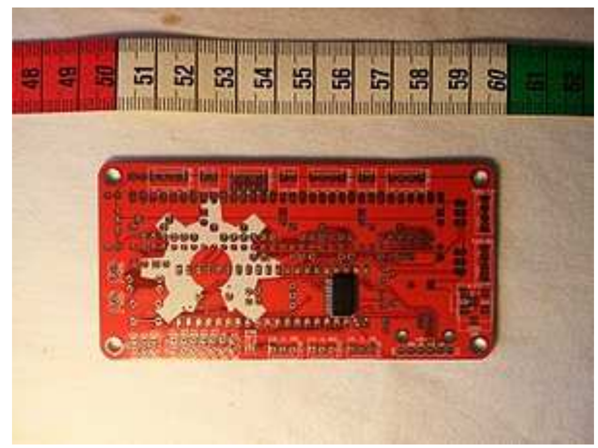
eMAKER changes to the standard electronics

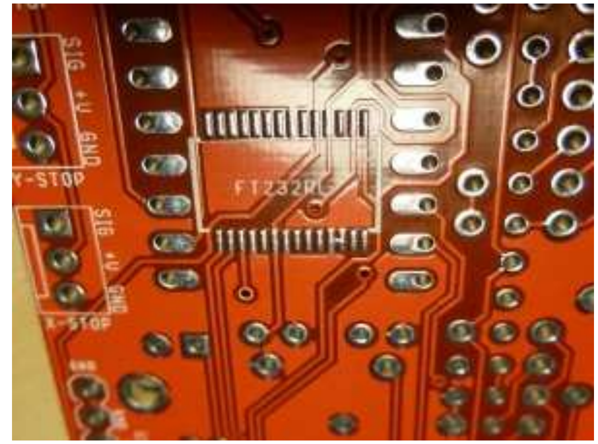
- Screw terminals for power and heater outputs.
- Molex mini-fit Jr connectors for the heated bed and hot end wiring looms for easy (dis)connection.
- 12v cooling fan and Pololu stepper driver heatsinks supplied to keep the electronics cool.
- SMD heat sinks for the A4988 stepper drivers. These may be fitted using strips of heat transfer tape obtained from the back of the extruder fan.

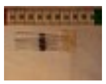
Schematic

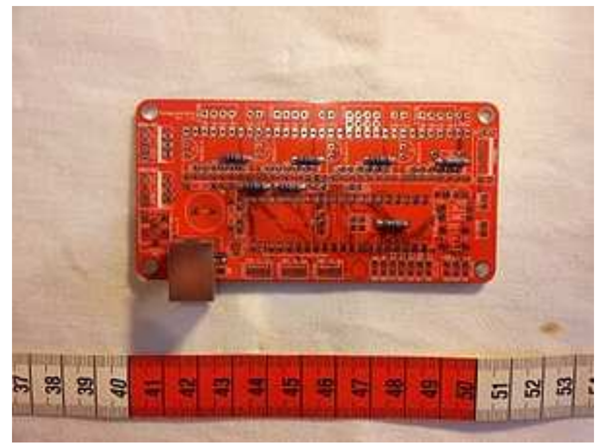


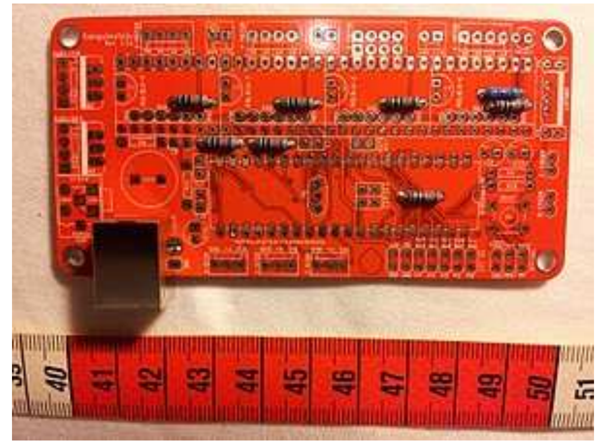
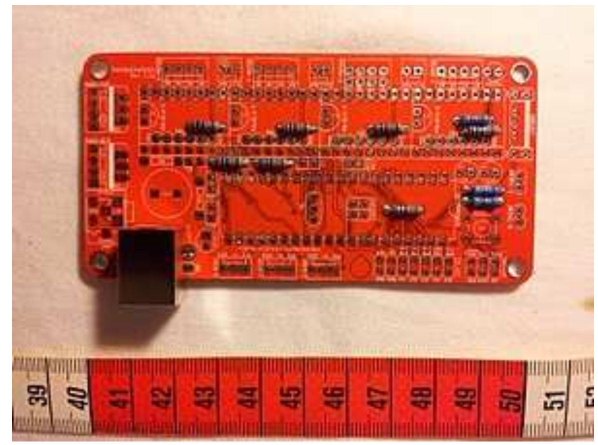
PCB Assembly

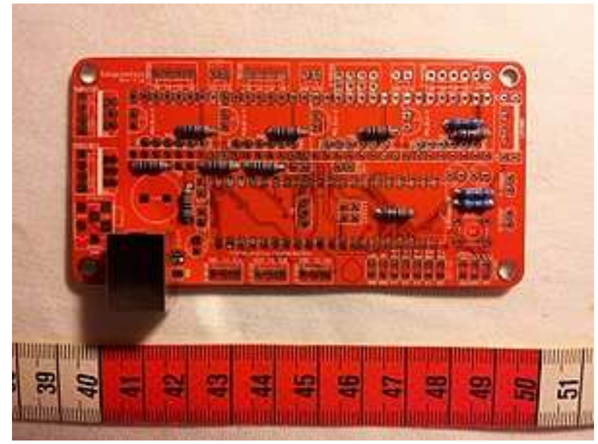
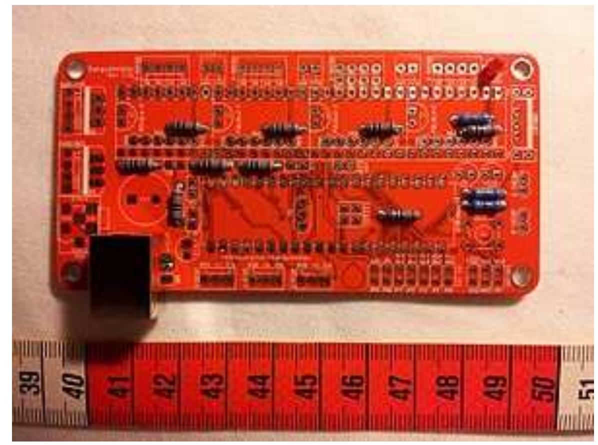
Part	Value	Device	Notes	Board
IC100	FT232RL		Surface mounted on the underside of the board.This can be done with a standard soldering iron and some flux. See these videos for inspiration:http://www.youtube.com/watch?v=bvo8Xj_yn3whttp://www.youtube.com/watch?v=t06malVew40	



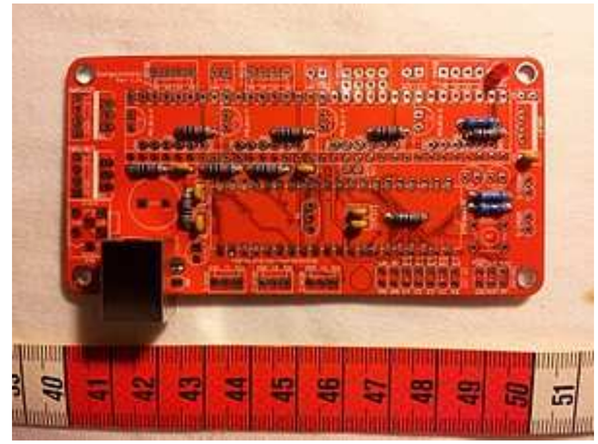
J1	USB		USB Type B socket
R2	100k		1/4 watt axial resistor
R3			
R4			
R5			
R7			
R8			
R12			

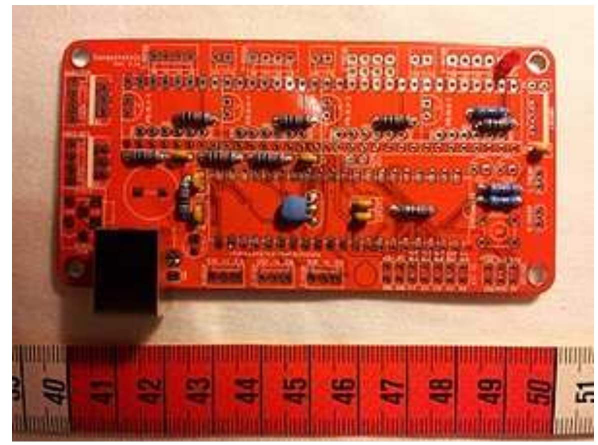


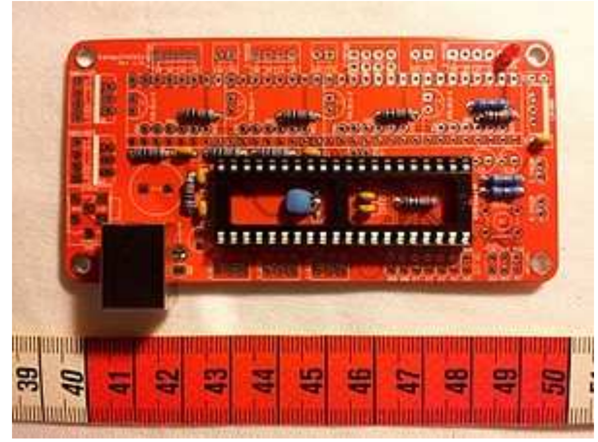
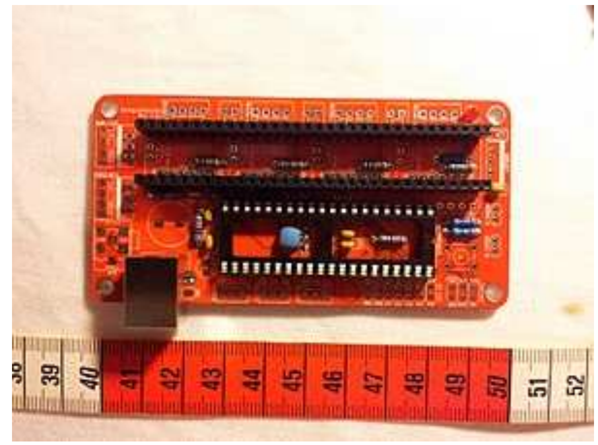
R1	1k		1/4 watt axial resistor	
R9	4k7		1/4 watt axial resistor	
R10				

R6	10k		1/4 watt axial resistor	
R11				
LED1	LED		Red LEDThe short lead (negative) should be in the hole closer to the center of the board.	

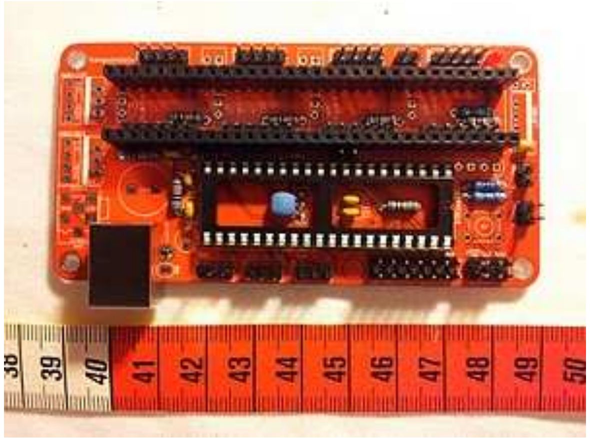
C6	0.1uF		Capacitor
C7			
C8			
C11			
C13			
C14			
C15			
Y1	16MHz		Resonator





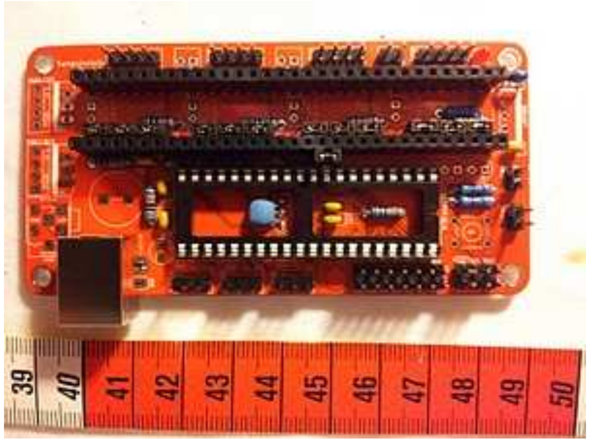
IC2	40pin Sckt		ATMEGA644 socket, careful attention should be paid to the polarity of the socket.	
			0.1″ Female headers	

0.1″ Male headers (use spare female headers to align the double headers. The two header sets (::::::: ::) in the bottom right corner also need to be aligned to take the SD breakout board)



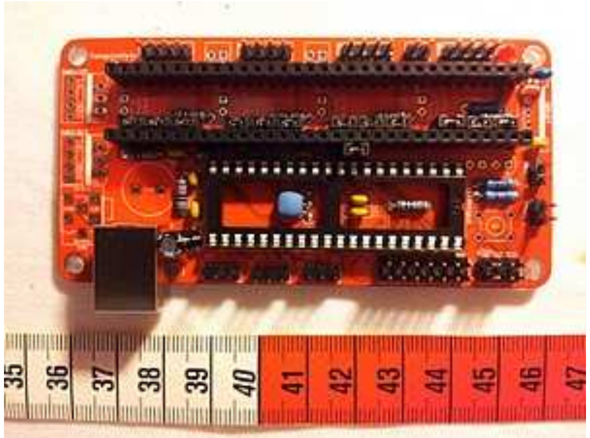
C5 .33uF Capacitor

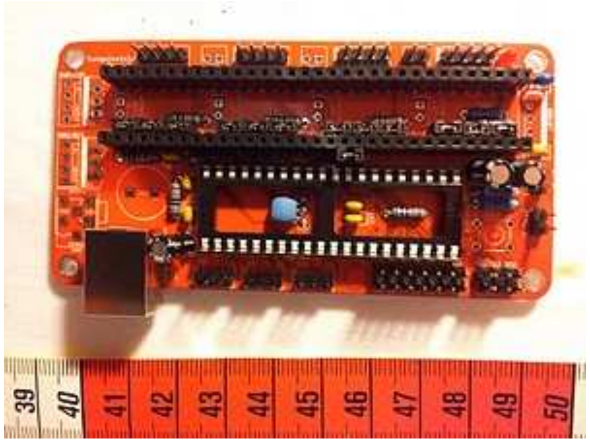
Microstep setting shunts. 12 required to set all axes to 1/16th microstepping, and one for the autoreset.



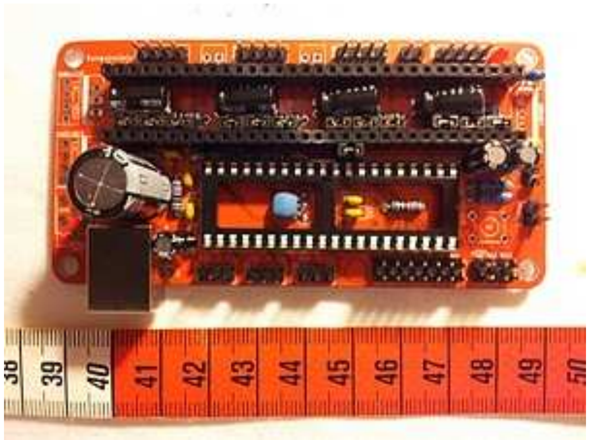
C16 4.7uF

Capacitor (shorter leg is for the hole marked with a “-”)

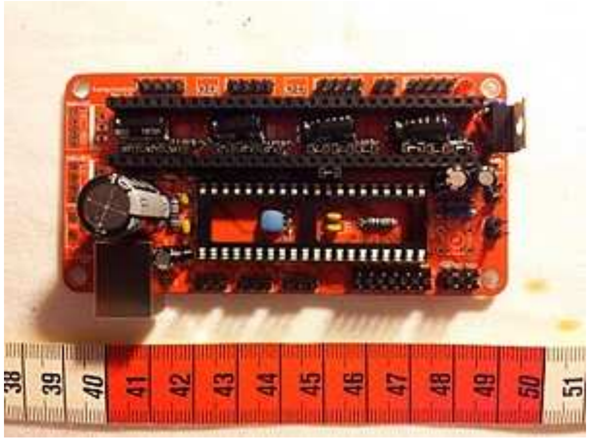


C9; C10	10uF	Capacitor (shorter leg is for the hole marked with a “-”)	
C1 C2 C3 C4	100uF	Capacitor (make sure they lie flat like in the picture, as the stepper drivers will be slotted in over them)	

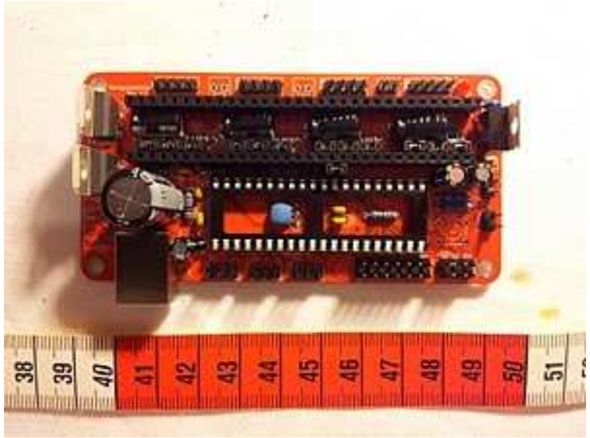
C12	1000uF	Capacitor



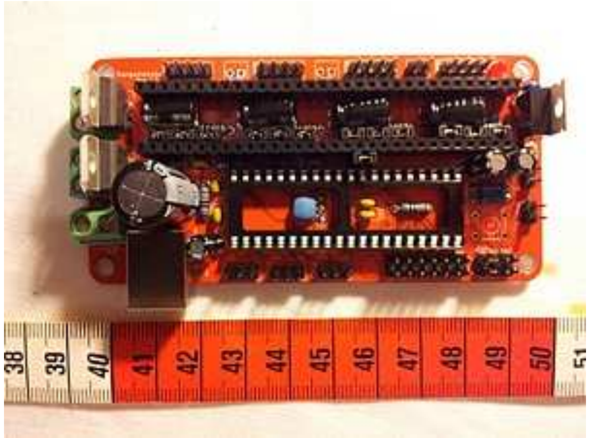
	LM7805	Voltage regulator

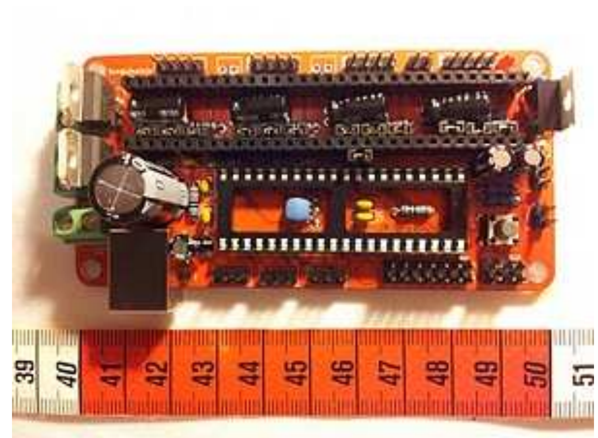
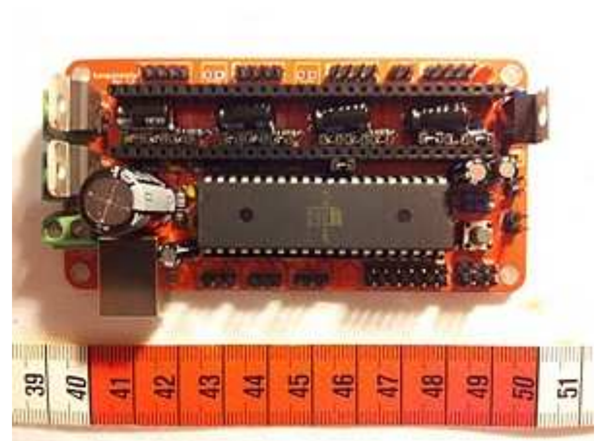


Mosfets for driving heaters



Screw terminals for heater outputs and power input

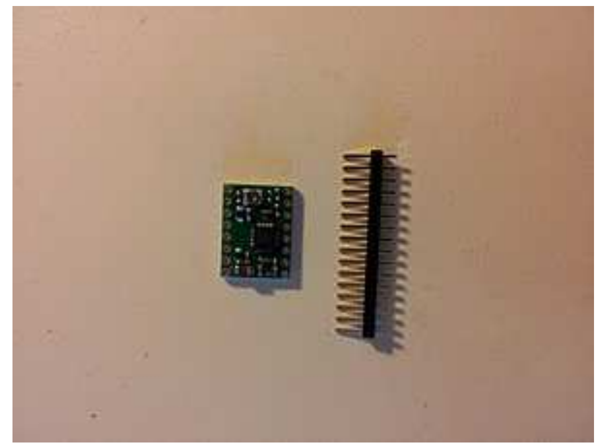


	Reset switch			
	Atmega 644P microcontroller			

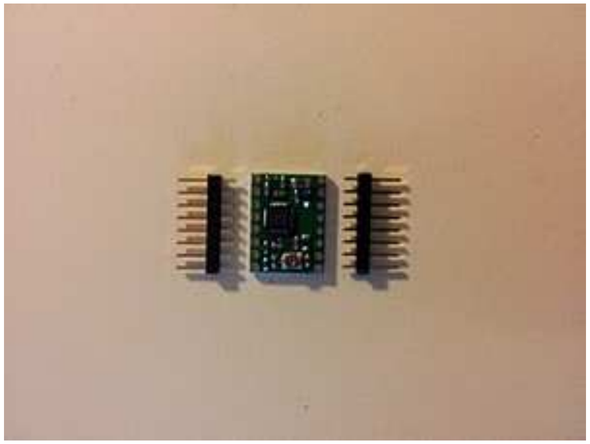
Stepper driver assembly

Part	Value	Device	Notes	Board

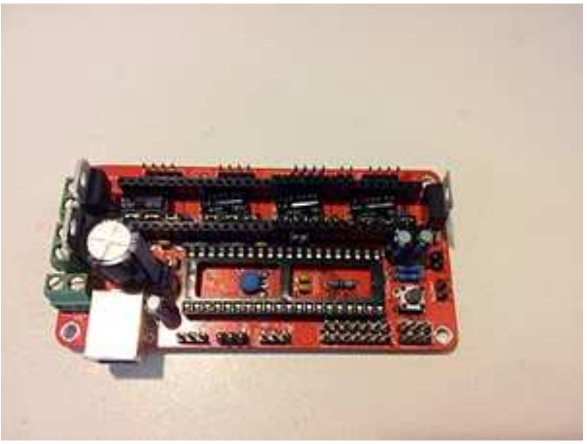
A4988 Pololu Stepper driver



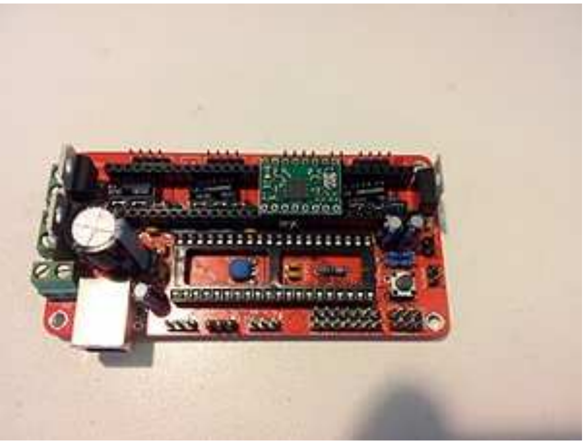
0.1″ male header pin strip cut in half.



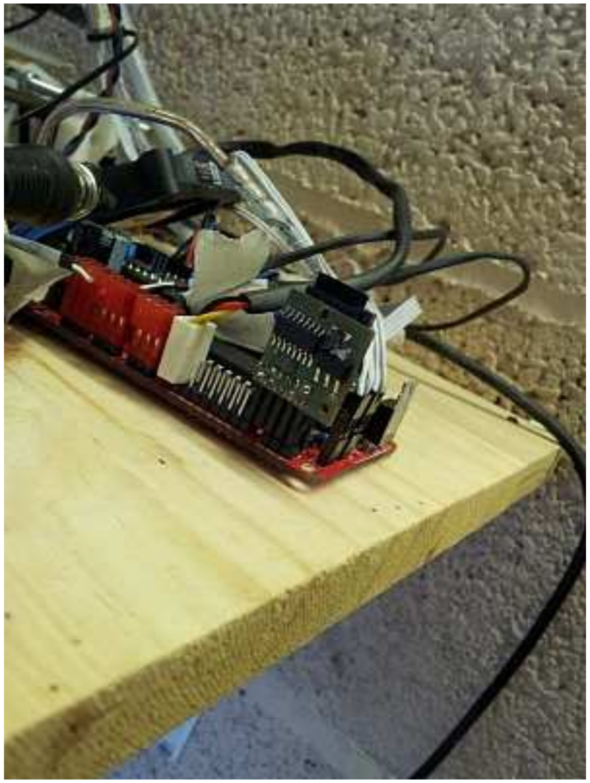
0.1″ male header pins pushed into Sanguinololu female headers.



A4988 stepper driver PCB dropped onto 0.1″ male header pins for soldering. (The heatsink can be attached to the A4988 chip later using the technique described in the Hot End assembly instructions.)



SDSL (Sanguinololu microSD daughter board)



Next step

Wiring

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Goal

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

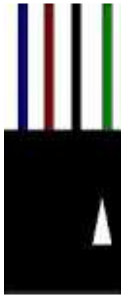
Tools

- Wire strippers
- Crimp tool (optional, terminals may instead be soldered, the Molex 63811-1000 tool will crimp all the sizes in the kit)
- Small screwdriver

Step 1: Motors

The motors have been provided with 1m long wires. This is more than is required to connect the motors. The surplus may be used to connect the endstops and thermistors.

Route your motor wires to the Sanguinololu board, and cut them to the required length (keep the spare for later use). Crimp or solder a terminal onto the end of each wire, then push each wire into a 4 way female connector in the sequence shown below; you should hear a tiny “click” as the terminal latches into the housing. Always give the wire a little tug to make sure its latched; they will slide back when you try to plug them in if they aren't latched. If you need to pull out a terminal, lift gently up on the little plastic finger that bears on each termial and you can pull it out. If you need to buy more pins, they may be Molex SL (stackable linear 70058) series. There are lots of female pin part numbers, but this one should do the job: SL™ Crimp Terminal 70058, 24-30 AWG, Reel Selective Gold (Au) from Molex.com. Lots of companies stock and sell these.



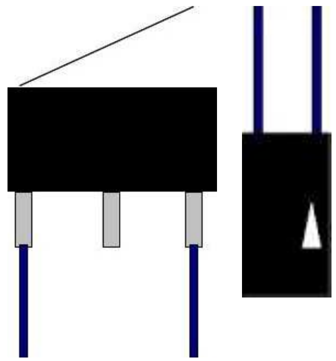
The correct order is Blue – Red – Black – Green with green in the most right hole of the connector, marked with a little arrowhead.

Plug the motor connector into the matching output header pins. Ensure the connector is fully seated on the pins.

Step 2: Endstops

Connect your endstops using the spare wires from the previous step. 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.

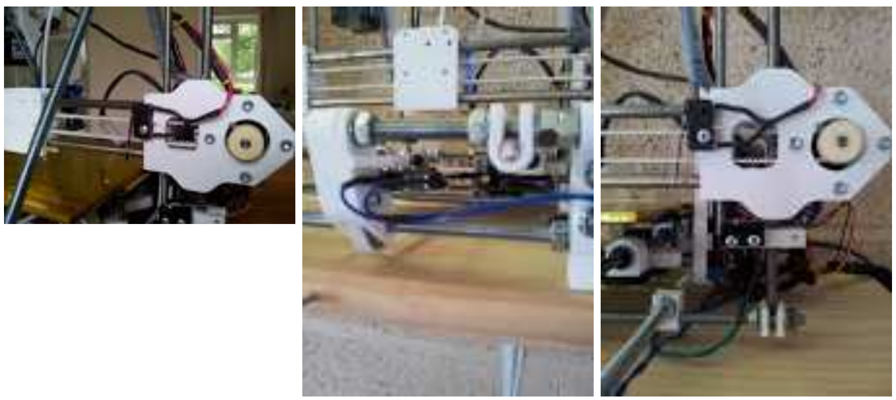
For the limit switch end, crimp or solder a terminal onto the end of the wires, then cover with some heatshrink to insulate the terminal. Push these onto the outer pins of the limit switch.



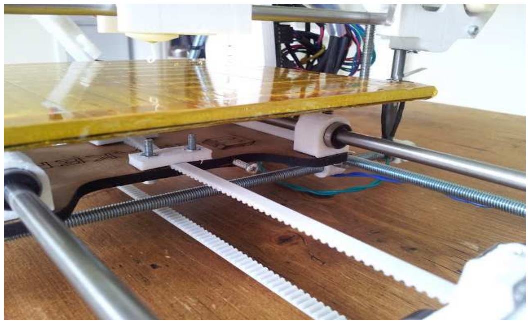
For the other end of the wires, again crimp or solder a terminal onto each wire, then push into the outer positions of a **3 way female connector**. Push this onto the relevant endstop input header pins (either way round).

Note: The endstop wires should be twisted lightly to reduce inductive “noise” coming from the stepper wires. You should also route the endstop wires separated from the stepper wires. Make sure the Y-stop wires don’t hit the frog and the bearings.

The endstops should be mounted as per the images below



The endstop switch holes should be drilled out to 3mm diameter so they can be mounted using #4×1/2″ self tapping screws (alternatively, #2-56 and M2.2 screws will fit the switch, but are not included). The X and Z stops will work without any other modification, but the Y stop requires something sticking out of the frog for it to touch; a self tapping screw will allow you to adjust it later to make the home position match the corner of the bed.



Step 3: Heatbed

Assemble the heatbed wiring loom as per the instructions on the heatbed assembly page.

- Nichrome to the corresponding screw terminal
- Thermistor to the corresponding molex marked “b-therm” (opposite side of the screw terminals, so prepare your wire to have more length for one or the other)

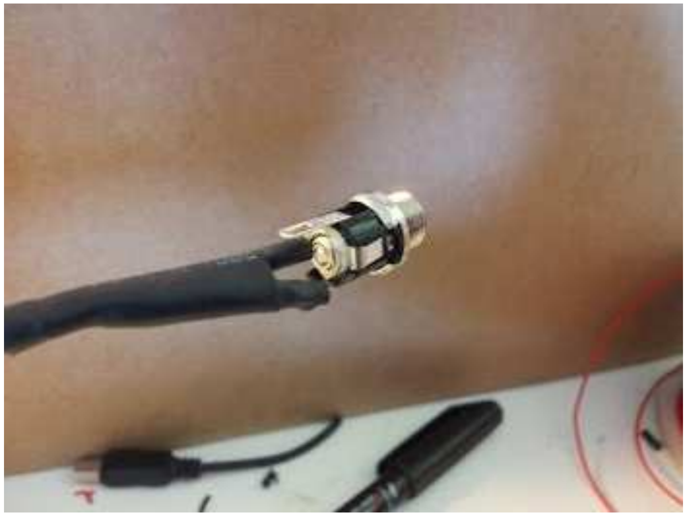
Step 4: Hot end

- Resistor to the corresponding screw terminal
- Thermistor to the corresponding molex marked “e-therm”
- Fan to the two position molex by the “E-Motor” connector; +12 is the pin closest to this connector.

Step 5: Jack connector

The power from the 19v power supply comes through the connector with positive in the centre and negative around the outside

You need to solder one wire to the leg which is connected to the central pin (number 3 below), and one wire to the leg which is connected to the outside contact (number 1). The extra outside contact is a switch that opens when you plug in a power supply. If you are not sure which one is which, plug the power supply in and check which pins are powered with a voltmeter. You can avoid the whole question by simply connecting BOTH outside contacts to the negative wire (number 1 and 2). A short length of black heatshrink may be slid over each of the two soldered legs to electrically insulate them.



The wire coming from the central positive pin should be screwed into the positive side of the Sanguinololu's power screw terminal. The other wire is to be screwed into the side marked GND.

/!\ Pay attention to not invert your power supply otherwise it will probably blow the big capacitor (1000µf) and/or other things.

The fan comes with a molex connector on it. Using a needle, push down gently in the little slot on the side of the connector to free the latch and slide each pin out one at a time. These pins are diffent from the ones used on the steppers! Slide them back into the white connector body that came with the fan in the SAME orientation they came out; they only go in one way! The correct order, with the slots down on the table, the wiring holes pointing toward you, and the two orientation tabs looking at you, is Red, Black, then Yellow. It plugs into the end pair of pins on the row of double molex headers; the micro SD card goes on the end toward the mounting screw hole. When it is plugged in correctly, the red wire is on the side toward the Pololus. The red wire goes on a pin labelled “12V”. The orientation tabs and the connector design make this the ONLY direction that it can be inserted.

Next step

Commissioning

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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)

Step 1: Communication

Before you start trying to talk to your machine, you need Python and the dependencies. If you know how to do this, you can install the dependencies listed here. If you need more instructions, go to the link below and follow the instructions (4 items to download and install in order for Windows):

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

And go here for Windows 7:

http://www.emakershop.com/forum?vasthtmlaction=viewtopic&t=238

You may need to go into the pyreadline-1.7 folder and click setup, which will made a command window pop up for a moment; this may or may not be needed.

The first thing to establish is that you can communicate with your machine. You will need to install and run the eMAKER Pronterface software, which you will find in our github repo here. The button to download a ZIP file is near the upper left.

Connect your Sanguinololu to a USB port on your computer, then run pronterface.py and select the active serial port in the upper left. 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 will need to rename .pronsolerc-example to .pronsolerc in your Printrun installation folder.

Step 2: Axes

Motor movement

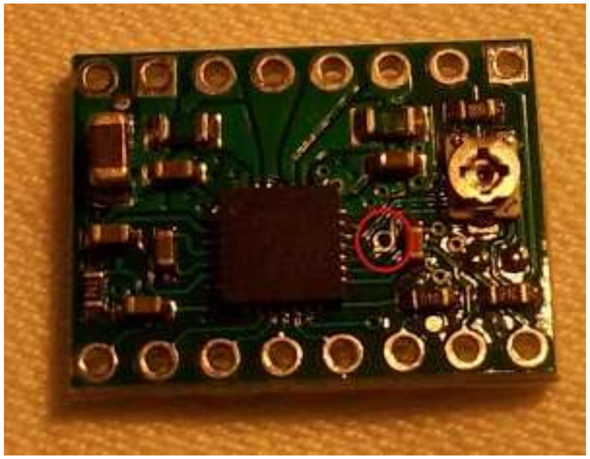
It is a good idea to verify you have no short circuits in your motor drive electronics. To minimise the cost of a fault, test each axis in turn by fitting one stepper driver in each of the 4 positions on the Sanguinololu, and command a motor to move.

To do this, you will need to connect the motor to the relevant header pins which match the position of the stepper driver board. It is best to use the extruder motor for this test since this can rotate freely without hitting anything.

DO NOT CONTINUE WITHOUT SETTING CURRENT LIMITS!

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

Connect power to your electronics, then set the current limit on your stepper driver to a maximum of 1 Amp. This equates to a reading of 0.4v on the Ref exposed via on the stepper driver board (circled in red below). Put the (+) test probe on this Ref and put the (-) probe to ground (one of the 4 large mounting holes on the Sanguinololu). Adjust the Potentiometer on each driver board (it looks like a screw) to set the current limits.



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 wiring diagram to check your wiring.

http://reprap.org/mediawiki/images/2/2a/Sanguinololu12.svg

REMOVE power from the Sanguinololu, then repeat the above test for the other 3 axes. **Disconnecting the motor whilst the driver is powered will result in damaging the A4988 stepper driver IC**. For each axis test, replace the X in the above command with the relevant axis letter (X,Y,Z,E).

Axis movement

Having verified you can drive all four axes, fit all the stepper drivers to the Sanguinololu and set their current limits as before.Cycle the power to your electronics then move all axes to the centre of their travel by hand.

Now command each axis in turn, ensuring each moves in the direction you expect. If an axis moves in the opposite direction, turn off the power, then rotate the motor wires connector for that axis by 180 degrees.

Endstops

To test the endstops, repeat the above test for the X, Y and Z axes in turn, this time with a much slower feed and a larger negative distance, for example

G1 X-20 F100

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.

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

A 150mm steel rule is best for this step. Place the rule on top of each X end in turn and measure the distance to the Z motor mount. Rotate the Z motors until both X ends are the same distance from their respective Z motor mount.

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.
- Adjust the height of the Z axis endstop, and repeat until your height is set.

When you get fed up with physically adjusting the endstop, you can offset the Z height as follows:

To adjust the Z height in firmware, send the command **M203 Z<value>** from the Pronterface software, 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. Adjustments may be made in the range from -1.28mm to +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.

Step 4: Heaters

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. It is easy to plug either the heater wires or thermistor wires back to front between the bed and nozzle heater pin headers.

Next step

PRINT!

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Introduction

The eMAKER Huxley is being sold as a complete printing solution, as such the eMAKER 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 printer

The standard Huxley print profiles include a start-up routine which will prepare the printer before the print starts. *This routine does not, however, include a command to wait for the heatbed to reach the desired temperature*. This is because it can take up to 20 minutes for the heatbed to reach the target temperature for ABS printing. It would be quite disconcerting for the printer to sit apparently idle and for it to suddenly start after all that time.

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

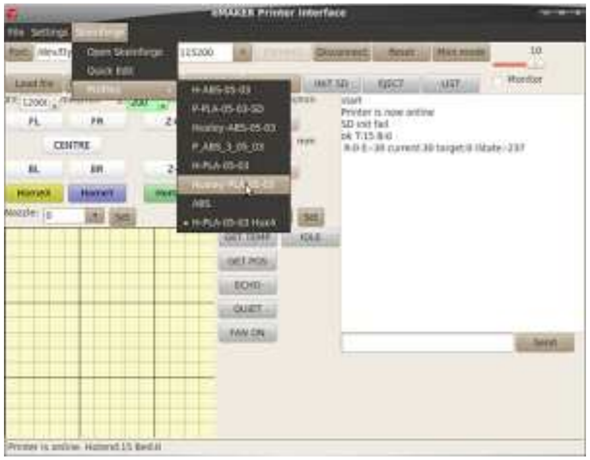
- 95C for PLA
- 140C for ABS

On the Huxley printer, the headbed temperature is measured on the underside of the build surface, so do not be alarmed if these temperatures seem higher than you might be accustomed to.

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 G-Code file (print commands are G-Codes, see this reference). The conversion to G-Code is performed using a tool called “Skeinforge” which takes a 3D model in STL format, slices it into layers and determines the path that the print head will follow to build your object. Skeinforge has a plethora of configuration settings to control the conversion process. Rather than have to have to set these yourself, you can use one of the predefined “Profiles” which are tuned for your eMaker Huxley for various materials (e.g. PLA and ABS).

Choose a profile by navigating to the Skeinforge->Profiles menu. If no profiles are visible, select Skeinforge->Open Skeinforge, and select a profile from the “Profile Selection:” drop-down menu. You should select “Huxley-PLA-05-03″ if you’re printing with PLA, or “Huxley-ABS-05-03″ if you’re printing with ABS. Once you’ve selected the profile you want, you can close Skeinforge by selecting File->Quit. The Printer Interface software will conveniently remember your selection and will make the profile you selected available in the Skeinforge->Profile menu for quick selection as shown below.



Now that you’ve selected a profile, you’re ready to convert your 3D model into G-Code. The 3D model will need to be in the STL file format. Click on “Load file” and select an STL file to process it. You will see progress of this process in the log window. Once the conversion is complete, Skeinforge will save the converted G-Code file into the same location as the original STL file.   Once complete, the log will indicate how much filament will be used to print the model.

If you’ve already generated G-Code for your model, you can save time by loading the pre-processed G-Code file instead of doing the conversion again. Note, however, that if you change materials or Skeinforge profiles or settings, you should re-generate the G-Code file.

Now you’re ready to either print direct form USB or copy the file to the MicroSD card in the machine. If printing from USB, you will need to load the processed file since the software currently only automatically loads .gcode files and the eMAKER Huxley print profiles output .pla and .abs files.

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. You can do this through the printer interface with the SD card in the printer, but it is much quicker to insert the card into the host PC and copy the file. If you copy the file on your computer, make sure you press the “INIT SD” button in the Printer Interface software after the is re-inserted into the printer.

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 positions.
2. The nozzle is heated to the relevant extrusion temperature (set in the Skeinforge “Temperature” plugin).
3. Once the 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 automatically de-activated. This can be a useful feature as it allows the Z height to be tweaked and the X axis to be leveled 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, send the command **M203 Z<value>** from the Pronterface software, 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. Adjustments may be made in the range from -1.28mm to +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.

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 from machine to machine. This is due primarily to the actual filament diameter, and to variations in the effective diameter of the hobbed stud (a smaller diameter hobbed stud will require a higher number of steps for a given extruded volume and vice versa).

Setting filament diameter

The filament diameter should be measured (with a vernier caliper, micrometer or other precision tool) and the value entered in the Skeinforge “Dimension” plugin.

Setting E steps per mm

The E steps/mm parameter is set in the printer firmware. The E steps/mm setting can be adjusted without uploading new firmware, by sending the command **M92 E<value>**, where **<value>** 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 extruded filament, and no extra plastic at the ends of the lines as shown in these prints:

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

Testing to determine a good value for E steps/mm

You will have to do some experimentation to determine a good value for E steps/mm for your printer. 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)!

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 the 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. Send the 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.

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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) 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 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:

1. - Bowden tube has popped out of the pneumatic fitting.
2. - Extruder motor does not move much but makes a squeaking noise.
3. - Extruder motor rotates. but the gears do not.
4. - 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 wiring 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.

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