Unpacking

Tools needed

- A trusty knife

(click any image to make it bigger)

Here is what you should find in the package:

Roll of filament

Bag of electronics

Smooth and threaded rods

Wooden plates

Printed parts

Bag of linear bearings, belts, wires

Heated bed, glass plate, and wooden bed plate

Power supply

Bag of fasteners

Roll of Kapton

Motors and zipties

- Back to TOC
- Forward to Electronics assembly

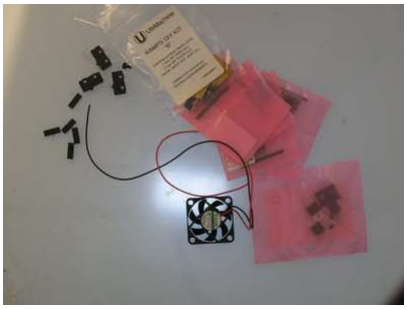
Electronics assembly

Tools needed

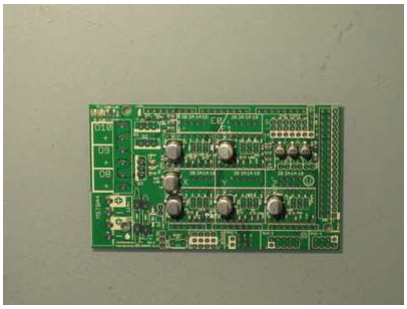
- Soldering iron
- Side cutters
- Patience
- Steady hands (lay off the coffee, this won't take long)

(click any image to make it bigger)

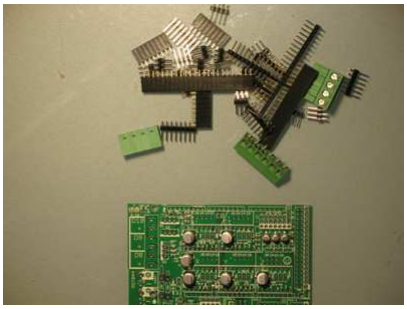
Here is what you need to assemble your electronics. Take your time to find these items in your kit:



Unpack your PCB from its protective packaging:

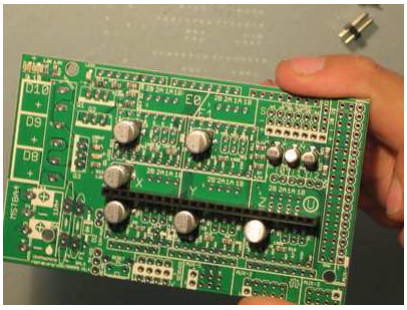


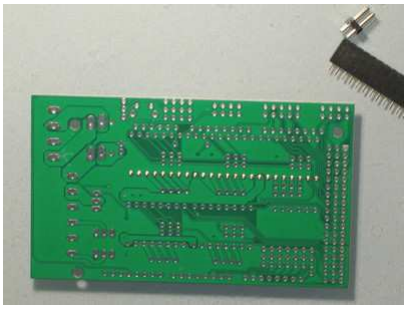
Unpack bag "A":



Place a 24 pin female header into the row of holes just below the "X Y Z" markings.

Flip the board over:

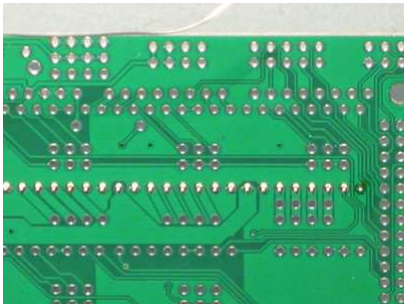
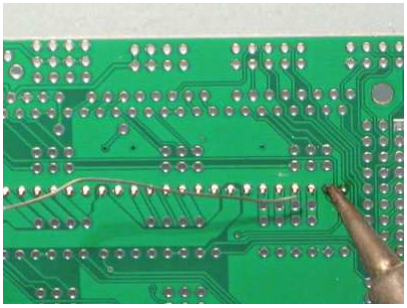
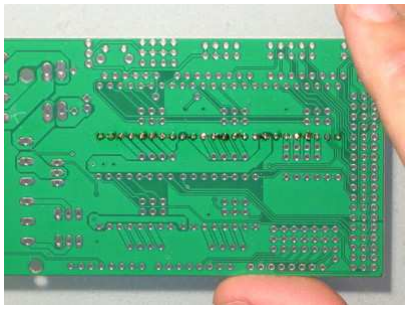




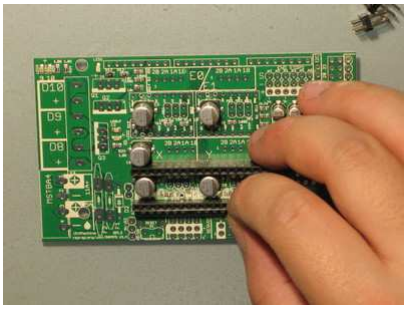
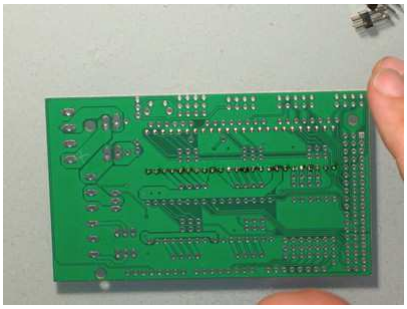
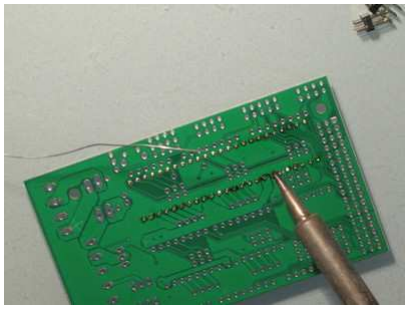
Solder each pin:

- Heat both the pad and the pin by touching them with the soldering iron at the same time.
- While still holding the soldering iron to the pin, feed in some solder.
- Remove the solder as soon as it flows around the pin and the pad.

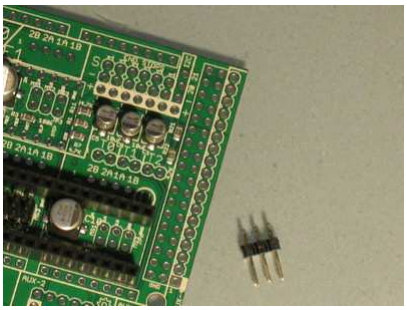
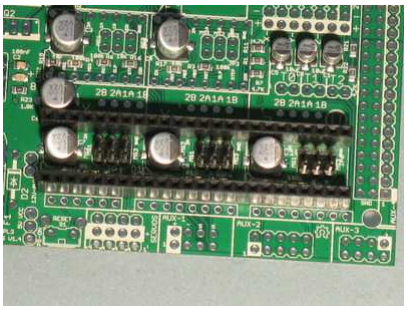
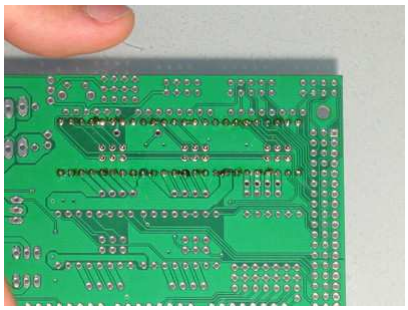
- Remove the soldering iron.

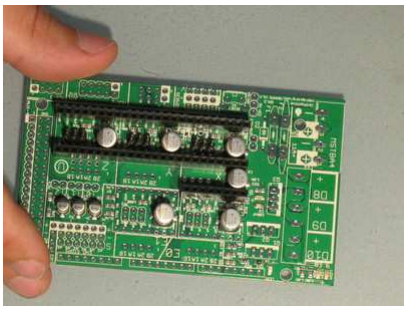
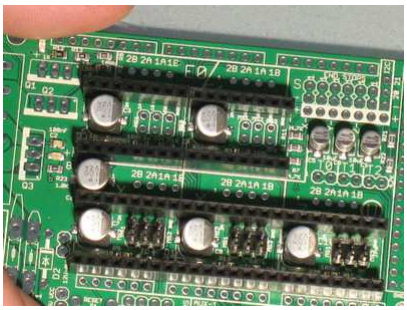
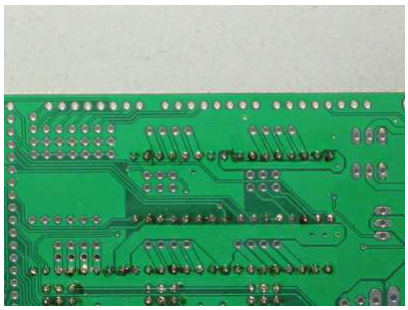
Repeat with the second header:

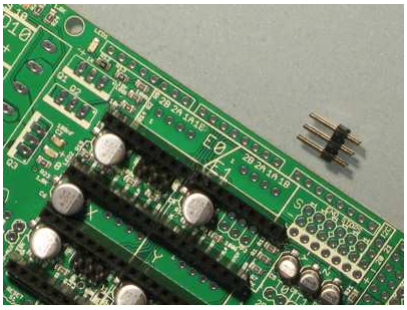
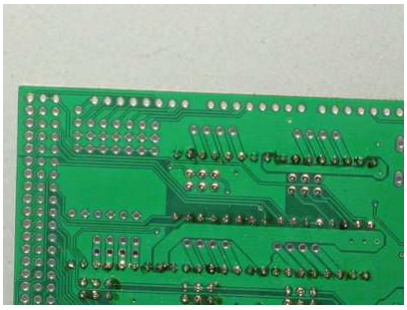
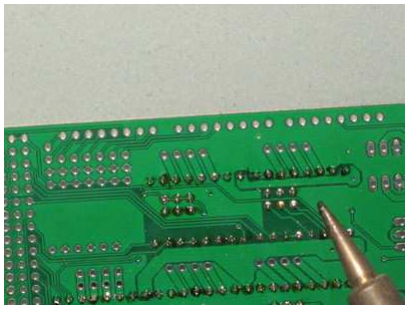
Place three 2x3 pin headers in the fitting spots between the two headers you just soldered and solder them. There is a way to put three of them in at once and still flip the board over, but it requires some acrobatics. If you can't manage it, do one at a time.

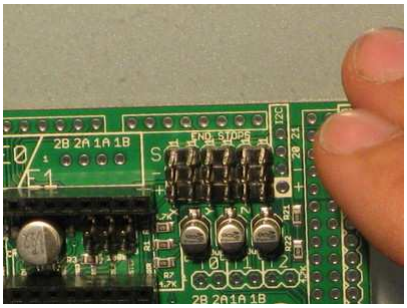
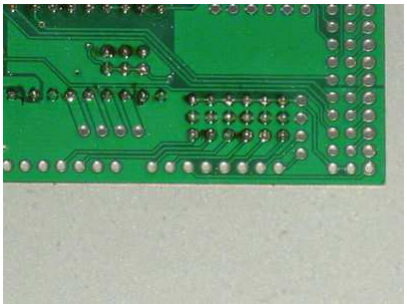
Put the 4 8-pin headers in and solder them:

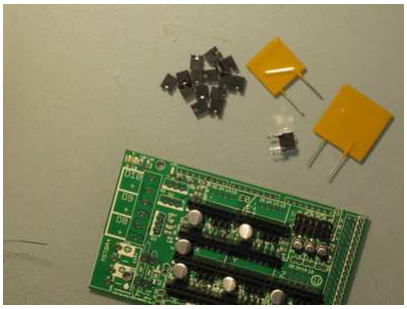
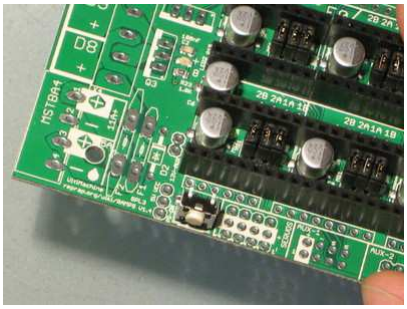
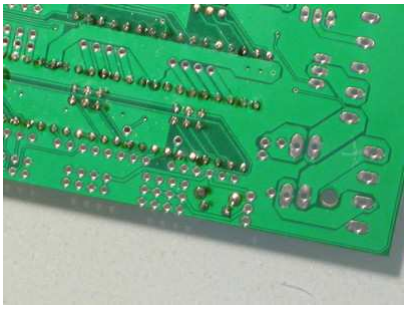
Solder in the 2x3 pin headers for these too:

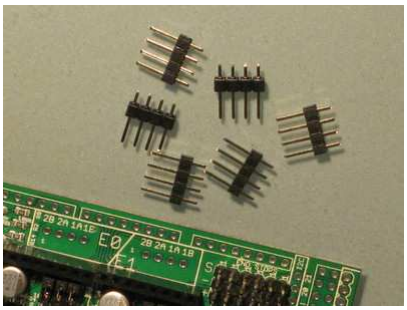
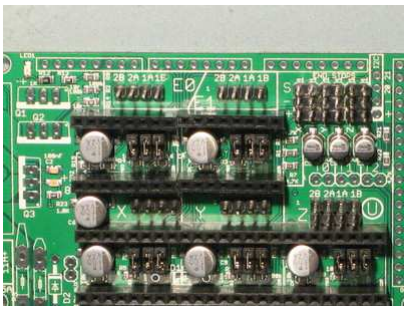
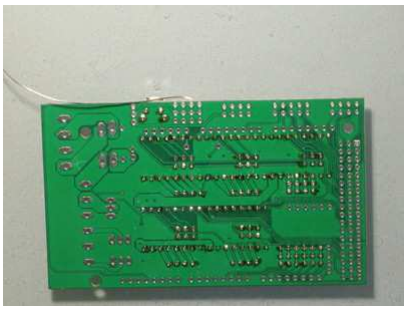
Now put the three 2x3-pin headers where it says "endstops" and solder those in too:

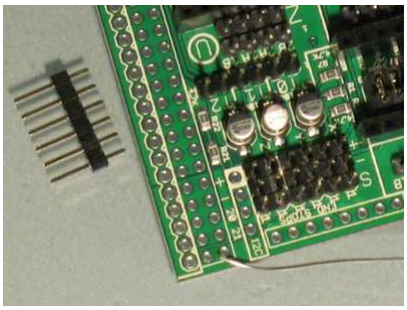
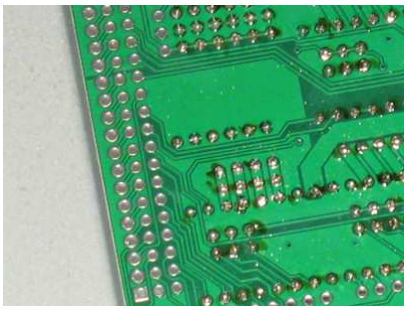
Unpack bag "B" and put the 15 jumpers on the headers you soldered (everywhere except endstops). Then solder on the reset button.

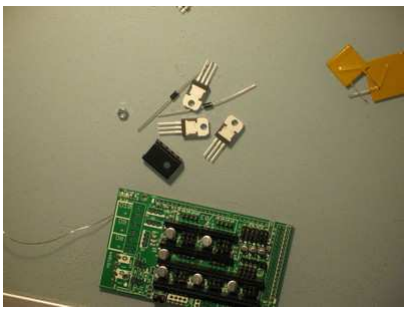
Find the 4 pin headers for the motor connectors and solder them on:

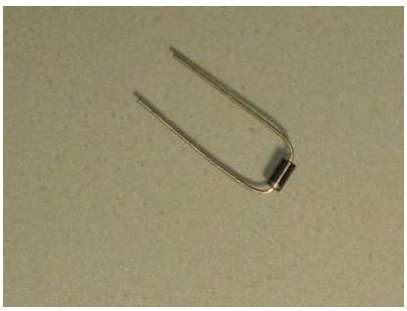
Put a 6-pin header where it says T0|T1|T2 and solder that on.

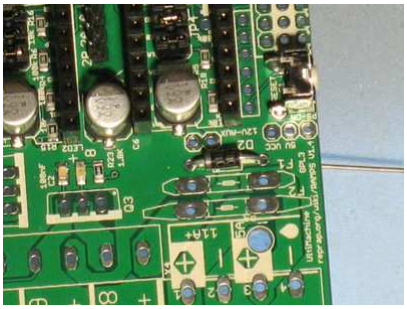
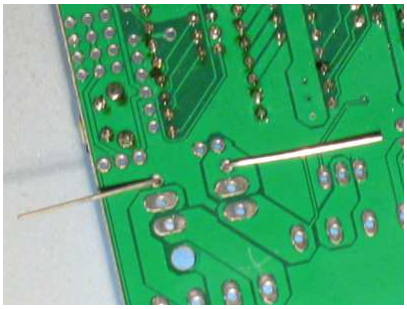
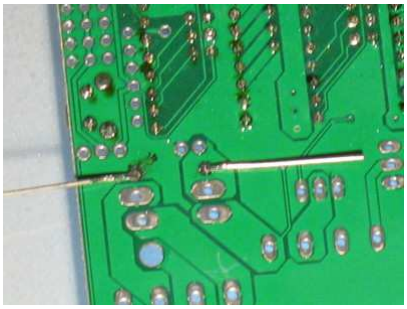
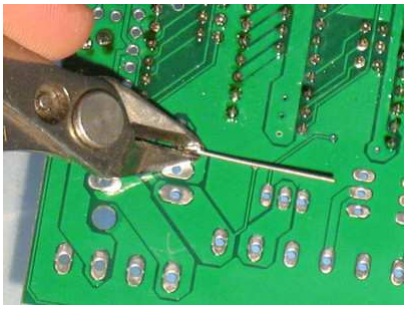
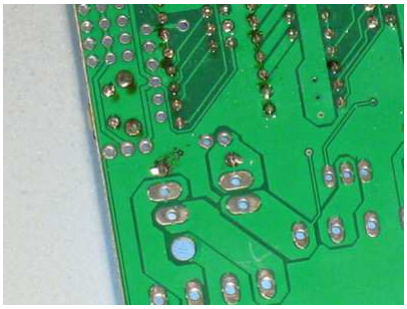
Unpack bag C:

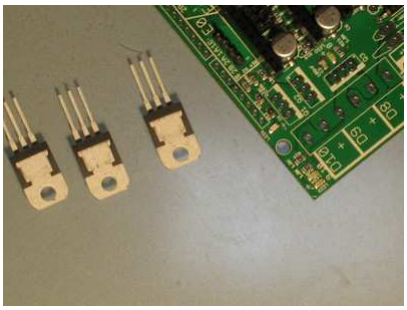
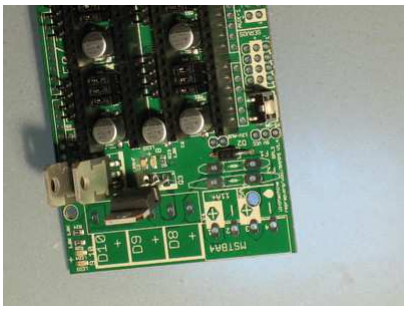
Bend the legs of one of the diodes:



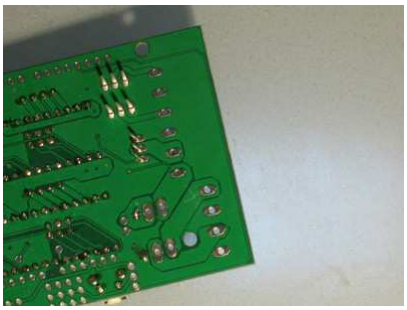
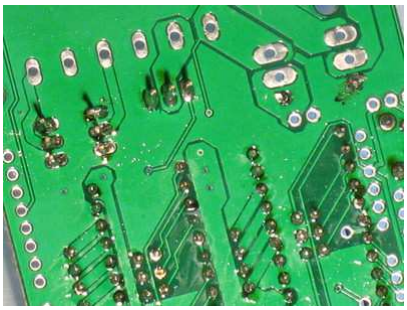
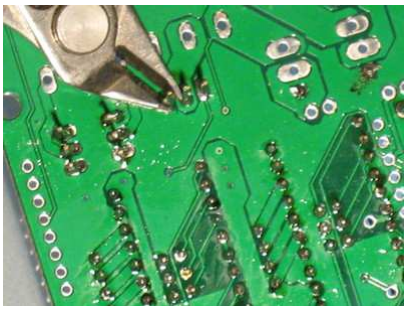
Solder it on and trim its legs. Watch out for the orientation, this is critical!

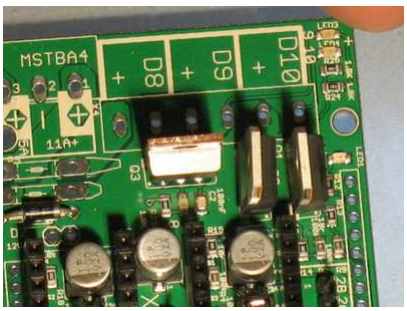
Put the three FETs in place. Watch out for the orientation again. Put them in exactly as shown:

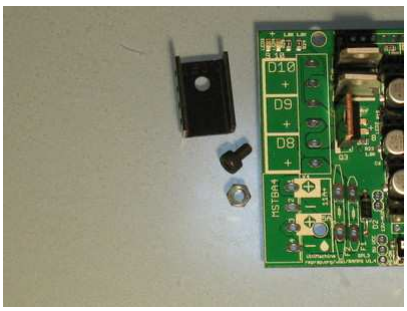



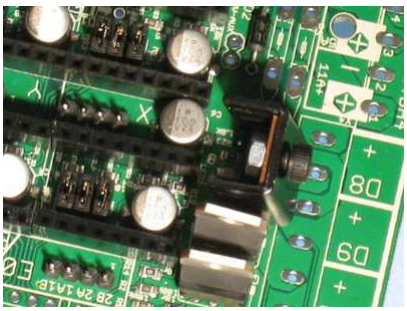
Solder and trim. These will need a lot of heat to solder. Be patient, give the pad time to heat up. The solder should flow nicely. If it's sticking to the pin but not the pad, heat it longer.

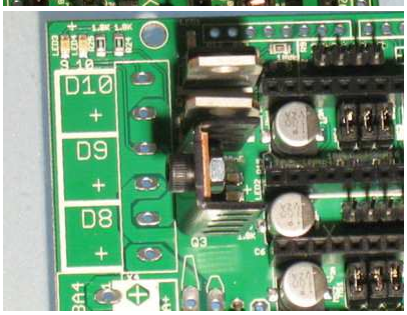




Put a heatsink on the bed FET:

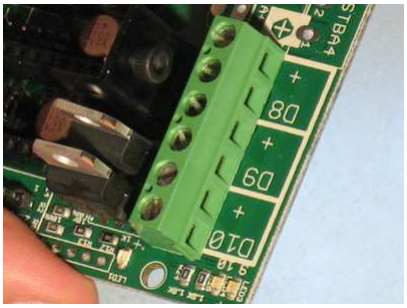
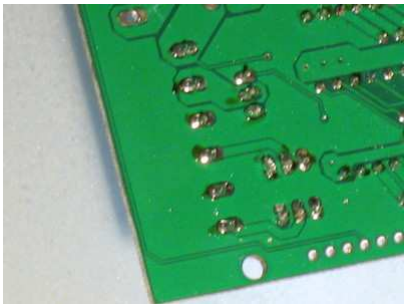




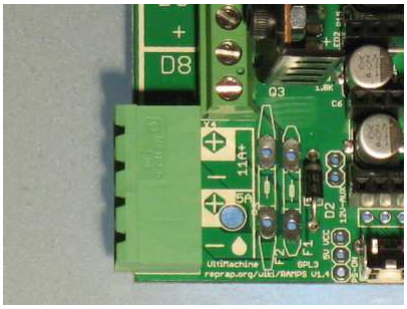
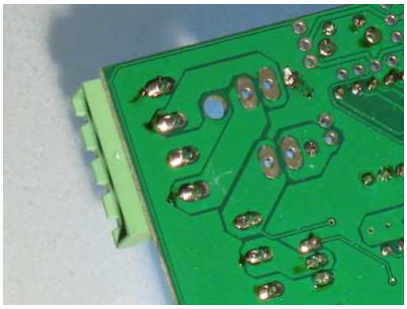




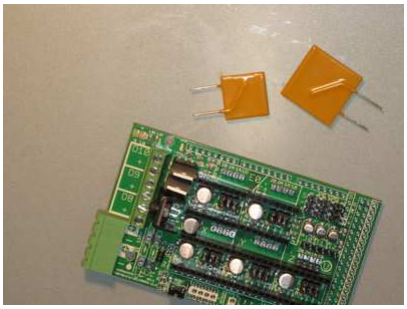
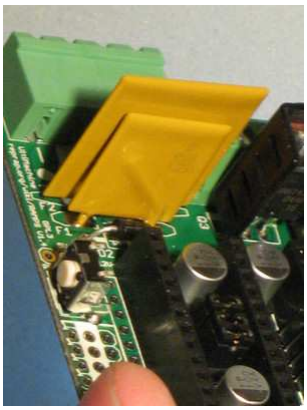
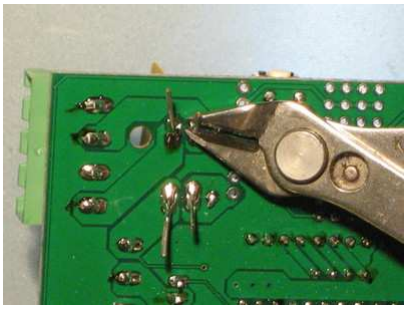
Attach and solder the screw terminal block. Again, take your time heating up those pads:

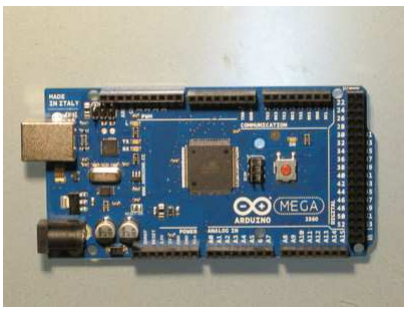
And the 4 pin power connector. This one has huge pads too:

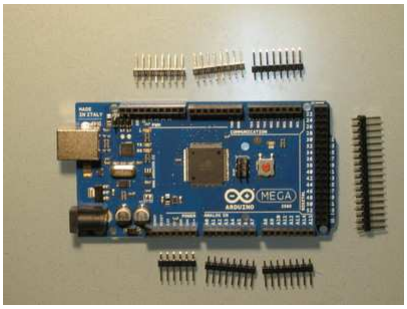
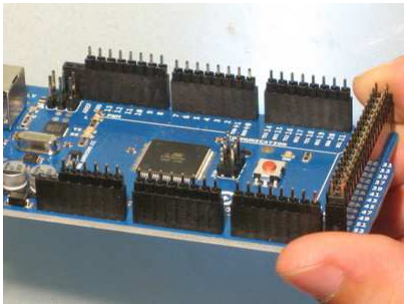
Put in the two fuses as shown. Solder and trim:

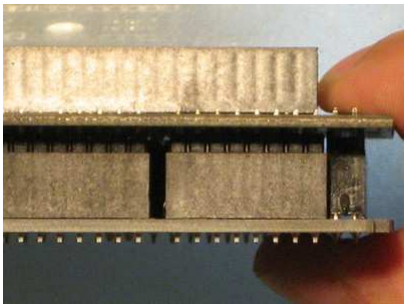
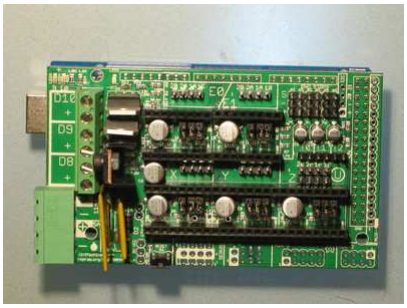
Unpack your Arduino. SAVE THE PACKAGING! YOU WILL NEED IT!

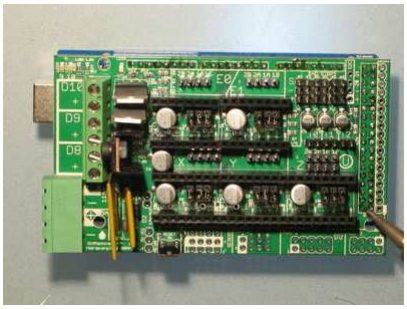
Place the headers from bag A on the Arduino as shown. Long side goes down, short side sticks up.

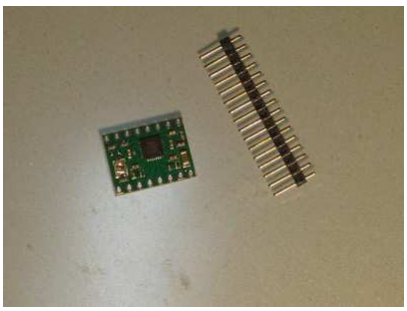
Place your RAMPS board on top:

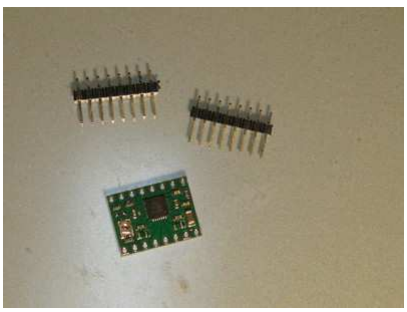
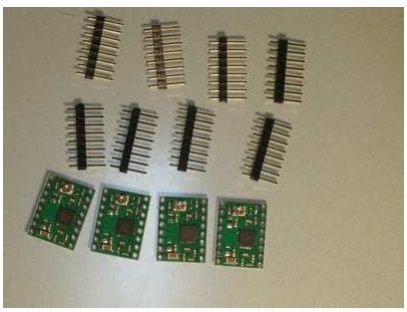
And solder all the pins in place on the top side.



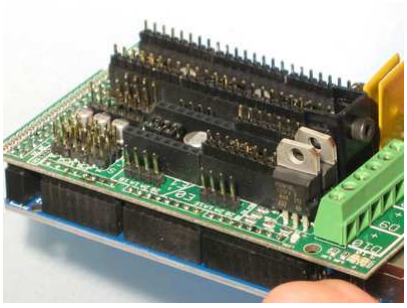
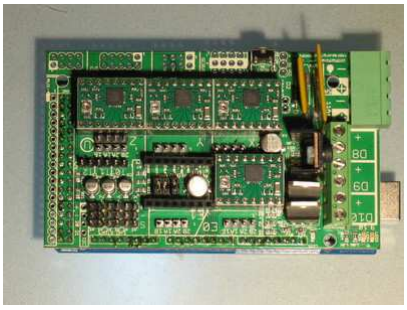
Unpack your motor drivers.

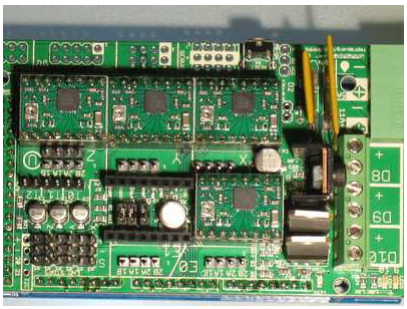
Break each 16 pin header into 2 8-pin ones. Use side cutters while holding both sides, or they will fly across the room and into spectator's eyes.

Place the headers on your RAMPS, and the motor drivers on them as shown. Watch out for the orientation.

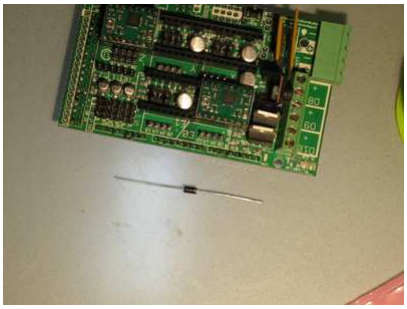
Solder them in place:



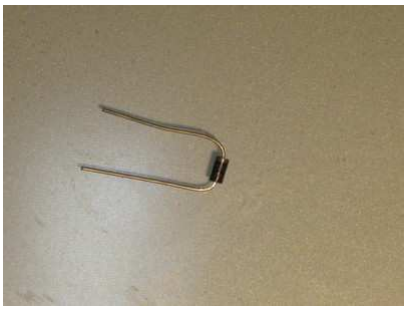
OPTIONAL If you want, you can add a second diode so your electronics will be powered even with USB disconnected. This is useful if you want to print from SD.

Do NOT do this if your supply voltage is greater than 19V.

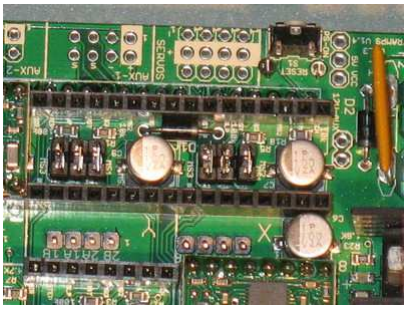
Remove the X and Y motor drivers.

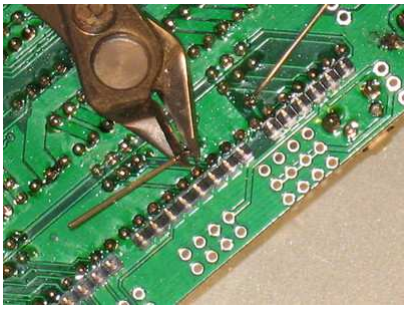


Bend the diode leads.

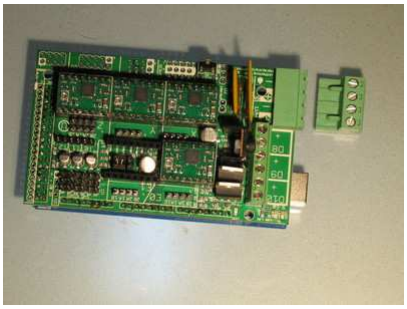


Solder the diode as shown. Watch out for the orientation. If it's the wrong way around it will not work.





Your electronics are now ready!



- Back to TOC
- Forward to Hotend, thermistors, heated bed, endstops

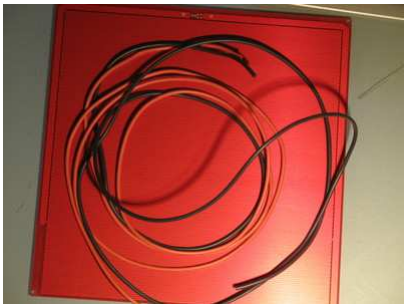
Hotend and thermistor assembly

Tools needed

- Soldering iron
- Side cutters
- Wire strippers
- Crimping tool or narrow pliers
- Patience
- Multimeter

(click any image to make it bigger)

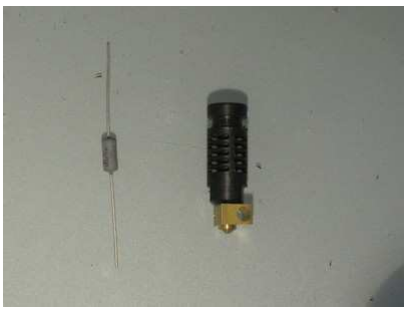
Take your heated bed and high current cables:



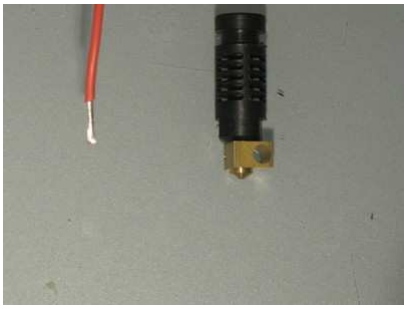
Cut about 80cm of each cable and set it aside for the hotend. The remaining cable is what we will use for the bed. Strip one end of each of the bed cables and twist the strands:

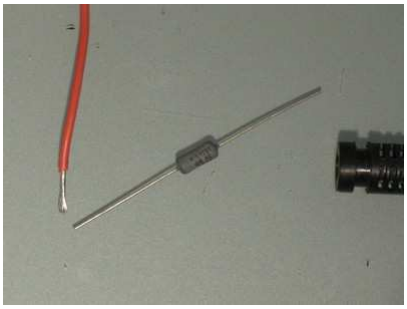
Solder the cables in place. Tin the pads first by heating them and applying some solder. Then place the cable end in the bead of solder and heat it while adding solder. Make sure the cable is firmly attached to the solder bead before removing heat. After removing the heat, hold the cable in place as it will take several seconds for the solder to cool.

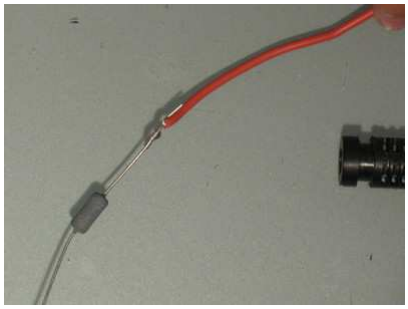
Take your hotend and its power resistor.



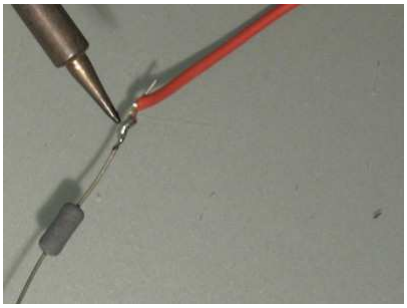
Strip the end of one of the 80cm hotend cables. Twist the cable and the resistor leg firmly around each other.



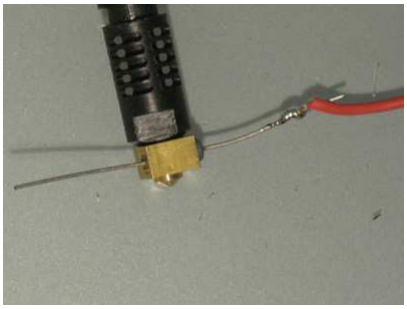
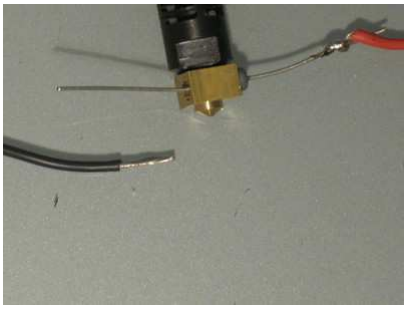




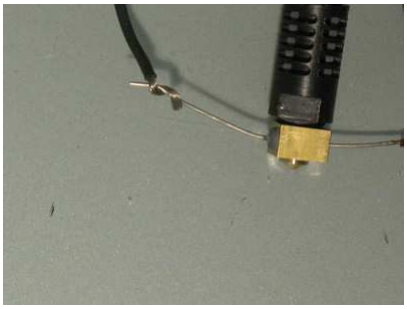
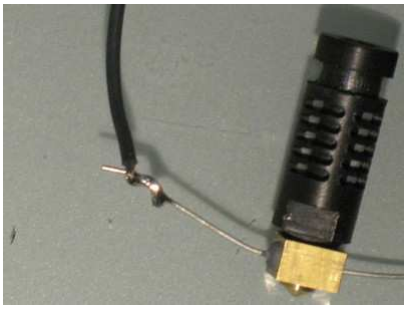
Solder the wire in place.



Push the resistor into the hotend and strip the other 80cm hotend wire.

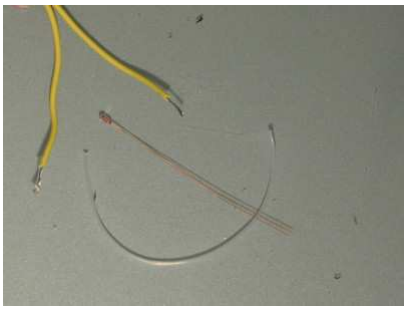



Twist and solder the second wire.

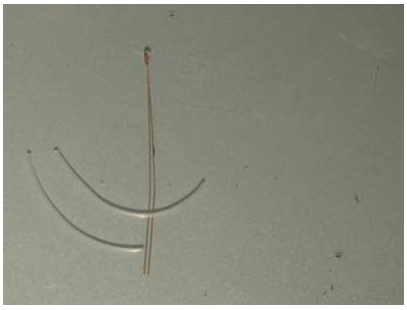
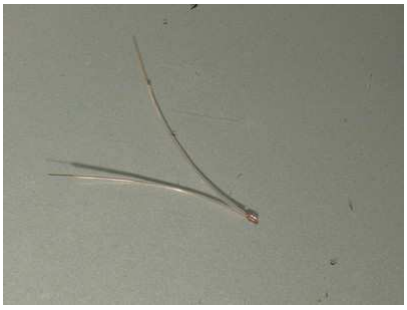



Take the long yellow cable and cut two 80cm lengths from it. Strip each end of each of the 80cm lengths of wire. Then find the ptfe tubing and thermistor for the hotend.

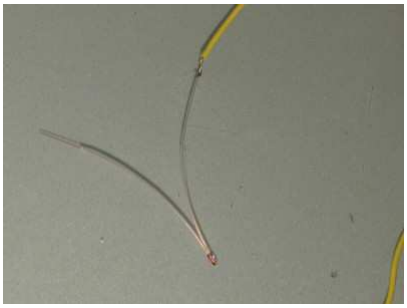
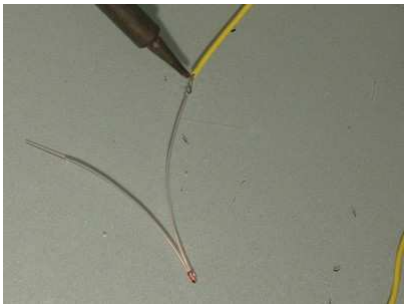
Note: If you do not have PTFE tubing, it is also possible to insulate each of the thermistor legs with kapton. Be very careful as they are fragile.



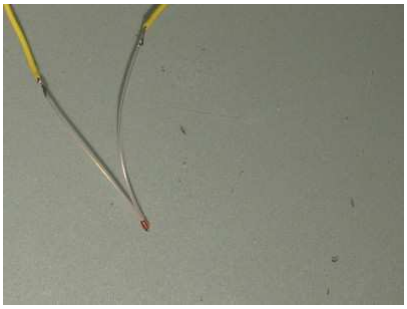
Cut two short lengths of the tubing and slide them onto the thermistor legs, leaving about a cm on each leg uncovered.

Twist one end of one of the 80cm wires around the exposed part of the thermistor leg and solder it in place. Make sure to make the twist close enough to the thermistor that the tubing cannot move.

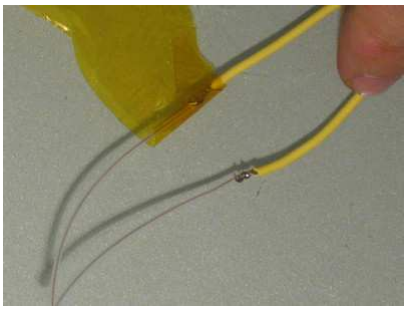



Repeat for the other 80cm wire and the other thermistor leg.

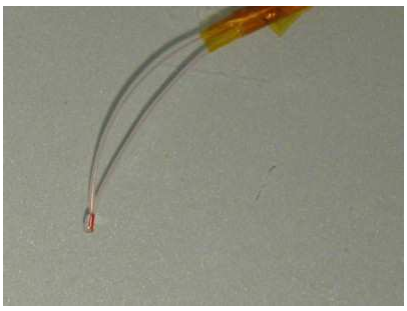


Find your roll of Kapton.

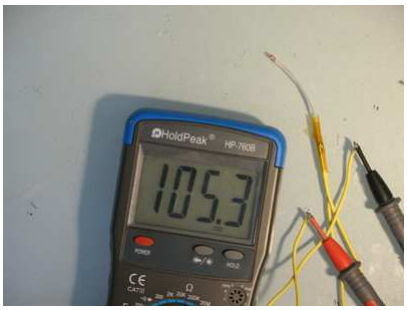
Cut off a short strip of kapton and wrap it around one of the solder joints several times.



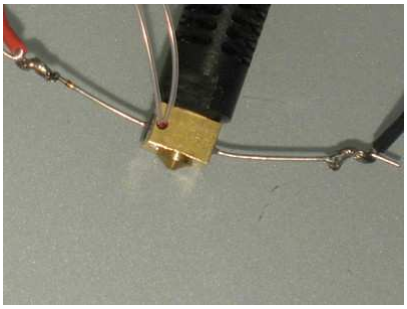
Now wrap the second joint as well, taping them together.



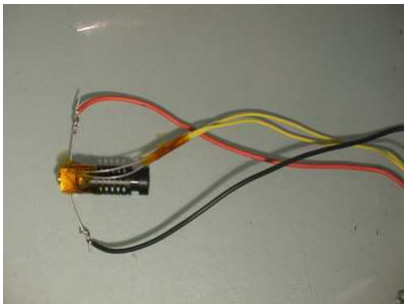
Use your multimeter to measure the resistance of the thermistor on the other end of the 80cm cables. It should be near 100kOhm at room temperature and drop when you hold the thermistor in your hand. If the resistance is zero, you have a short. Find it and eliminate it.



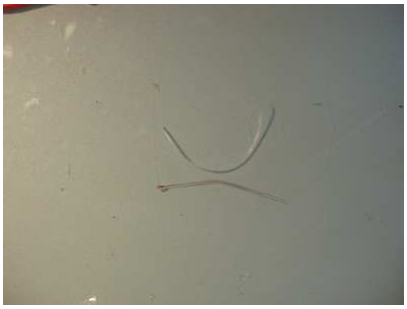
Place the thermistor in the hole in the hotend.

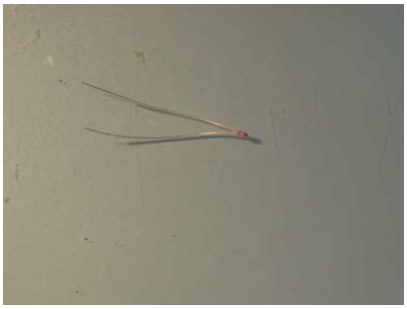


Use a narrow strip of Kapton to secure the thermistor to the hotend. Wrap around several times, but make sure to keep the nozzle clear. Once done, measure the resistance again to make sure you have no shorts.

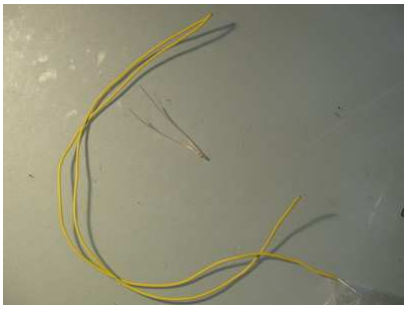
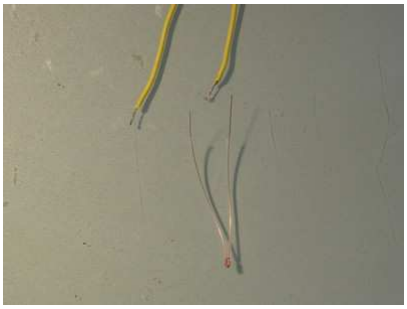


Take the second thermistor and place tubing on it as before. This will be the bed thermistor.

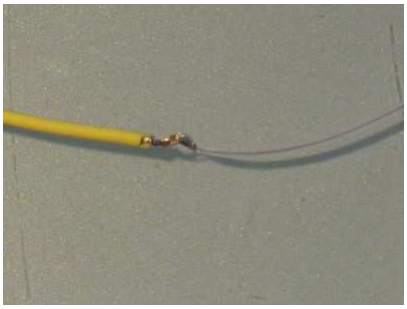
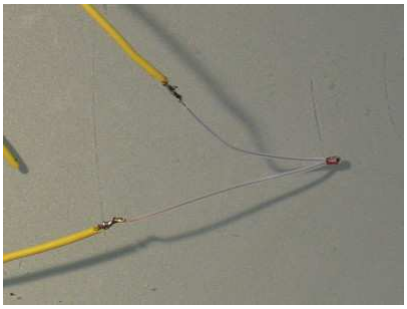
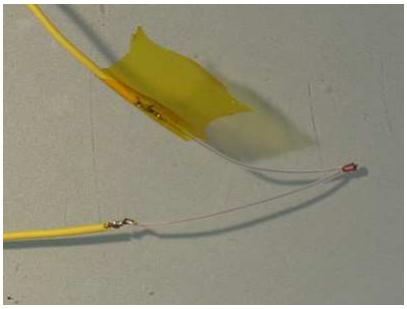
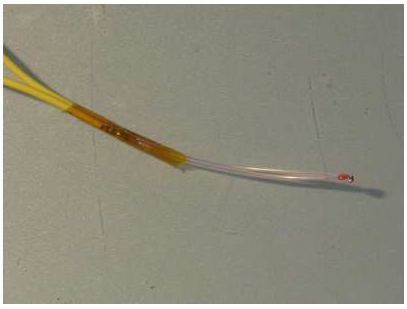
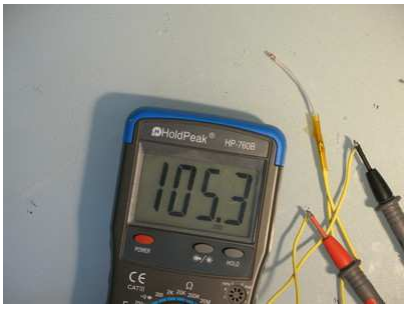


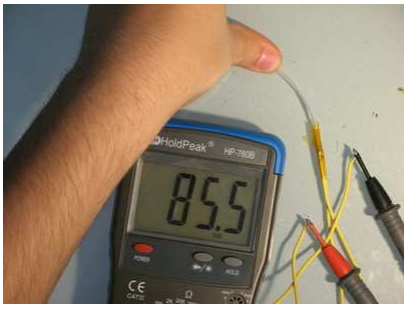


Cut the remaining piece of yellow cable exactly in the middle and strip each end of each side.

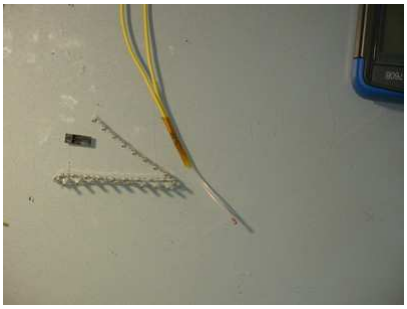



Attach, insulate and test the thermistor as before.

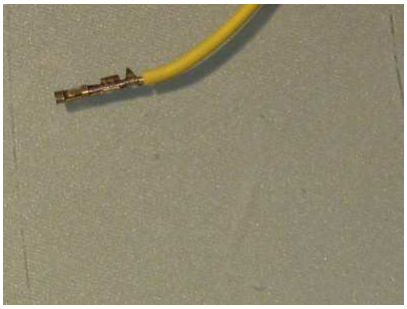








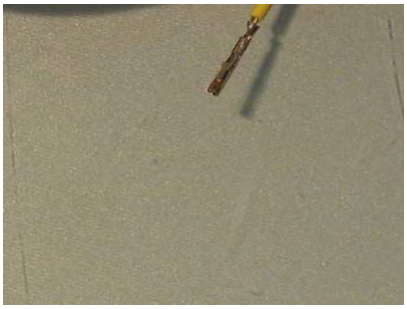
Find the crimp pins and two-pin connector housings.



Place each wire end in a crimp pin.



If you have a specialized crimping tool, use it. If not, use pliers to close the wings of the crimp pin over the wire. Make sure you have a solid connection with no bits sticking out.

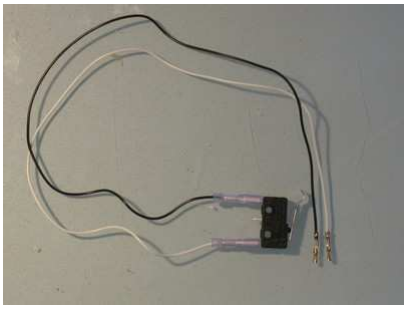


Place the bed thermistor pins into a housing. The order does not matter. They must click TWICE as they go in. Do the same for the hotend thermistor. Each thermistor goes into its own housing.

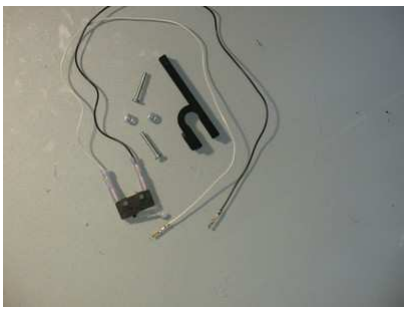
Find your endstop switches, endstop wires, and 2 pin housings.

Separate the two short wires from the 4 long ones.

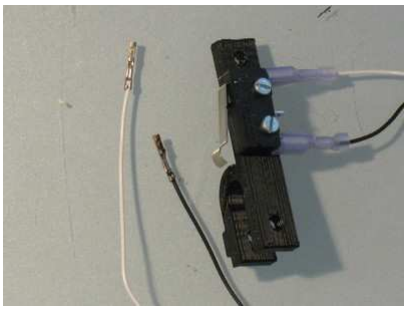
Attach the short wires to one of the switches.



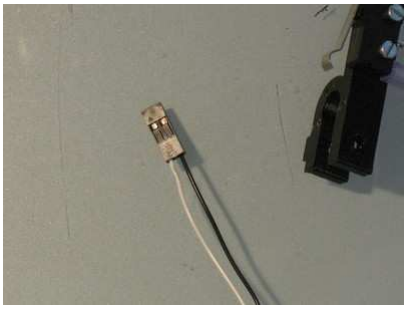
Find one of the endstop holders, and two M2.5 bolts and nuts. Be careful not to use M3 ones, as they look very similar. M2.5 bolts will fit through the holes on the switches, M3 will not.



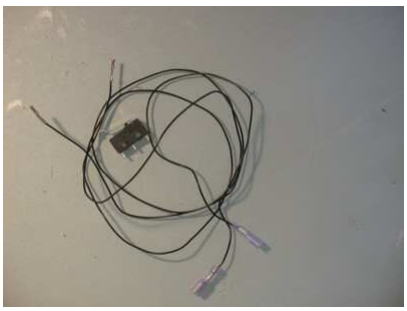
Attach the endstop to the holder as shown.

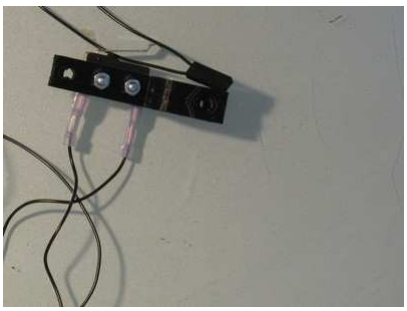


Place the two pins in one of the 2-pin housings.

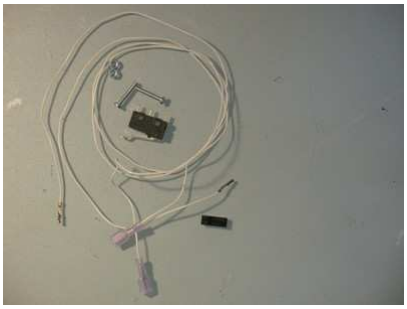
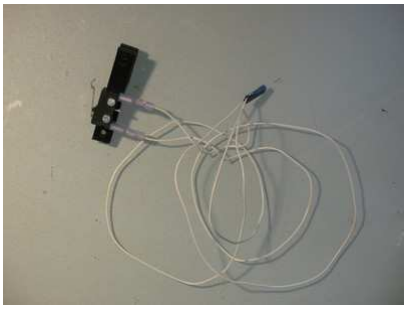


Take the two long black cables and repeat the process with one of the other endstops.





And do the same with the two long white cables.

Your bed, hotend, thermistors and endstops are now ready.

- Back to TOC
- Forward to Y-axis

Y axis assembly

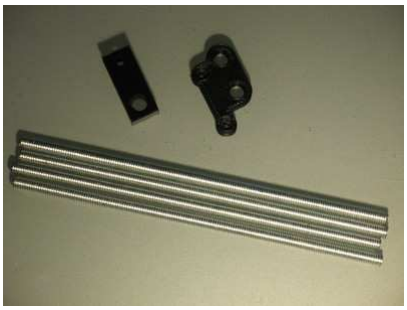
Tools needed

- Drill
- 8mm drill bit
- 3mm drill bit
- Ruler
- Pen
- Piece of scrap wood with a straight edge
- Side cutters
- Size 13 wrenches (2 pcs) OR
- 1 adjustable wrench and one size 13 wrench
- The box from your Arduino (I TOLD YOU to save it)
- Patience

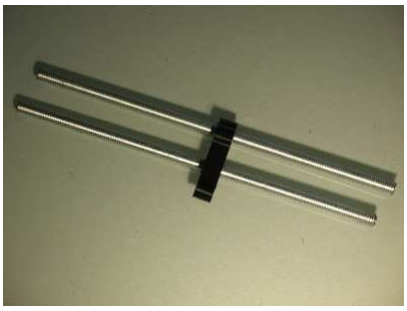
(click any image to make it bigger)

Find two of the LONG smooth rods (there are long and short ones), the bag of fasteners, all the M8 threaded rods, and the printed parts shown in the picture:

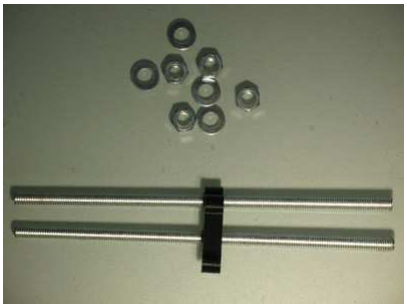
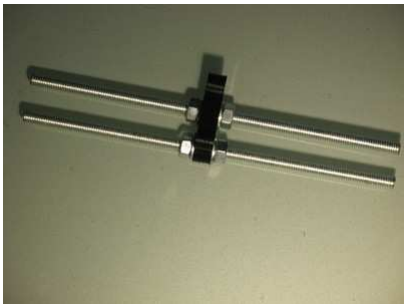
Take the 4 20cm threaded rods and these two parts:



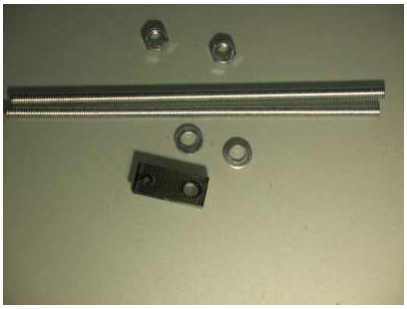
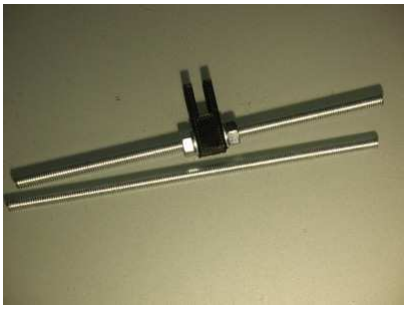
If necessary, use the 8mm drill bit and 3mm drill bit to clean out the holes in the parts. Thread two of the threaded rods through the y motor holder parts (the one with the 2 3mm holes in it):



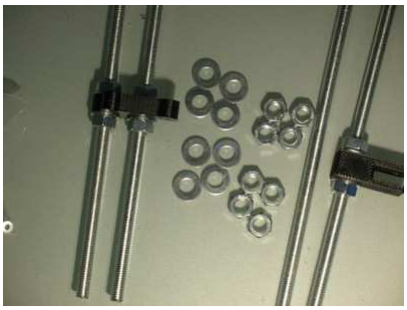
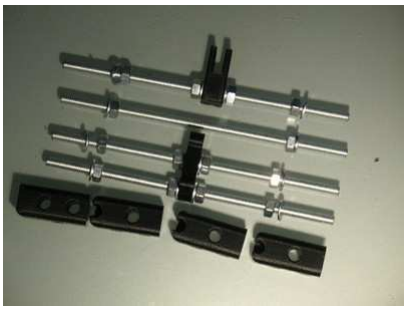
Place a washer and nut on each side of the part. No need to tighten this yet.

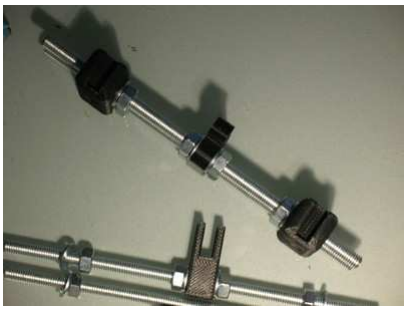
Repeat for the other side. Thread a rod through the part and put a nut and washer on each side:

Place a nut followed by a washer on each end of each of the 20cm rods.

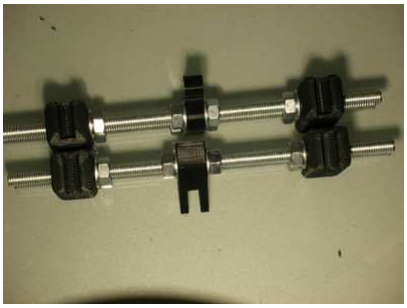



Place 2 of the Y-corners (printed) on the ends of the rods. Make sure the open side is pointing the same way as the motor holder in the middle, just like in the photo:

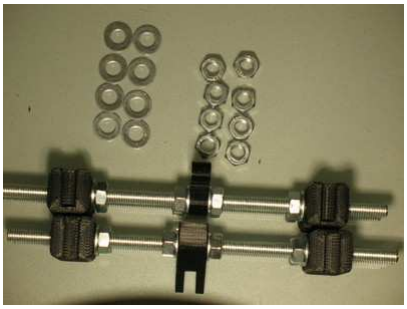
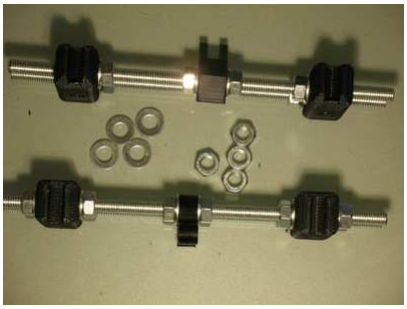


Take your arduino box. Adjust the distance between the two printed parts so that the long side of the box just fits between them. Check that the distance is the same on the bottom too.

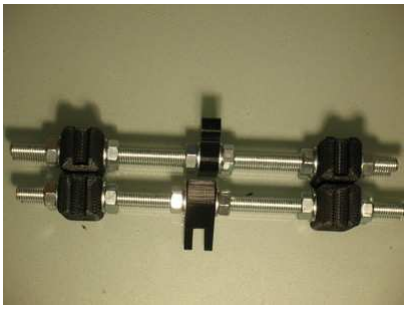
Do the same for the other rods. This time the open side of the printed pieces points the same way as the forked side of the center piece. Check the distances with your arduino box.



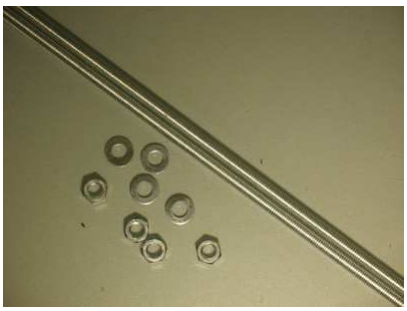
Place four washers and nuts on the ends of the motor holder side (the one you built first). Tighten the nuts, and check/adjust with your arduino box to make sure the distance is still correct.

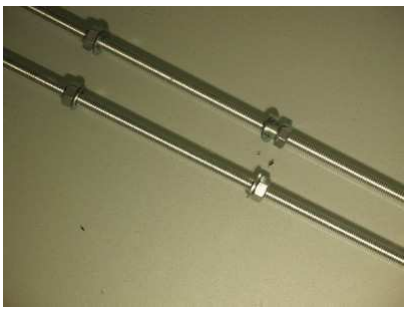
Repeat for the other side and make sure the distances are correct again.



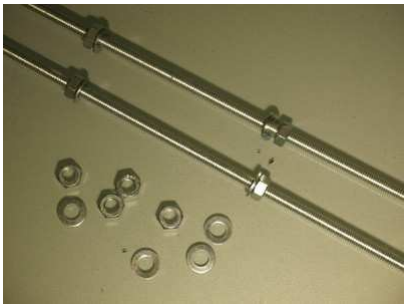
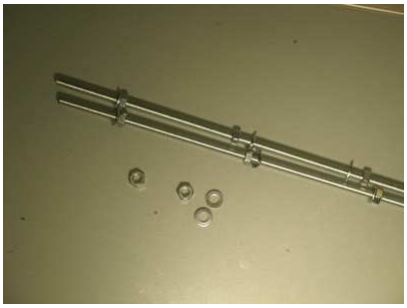
Now, take the long threaded rods, 4 M8 washers and 4 M8 nuts.

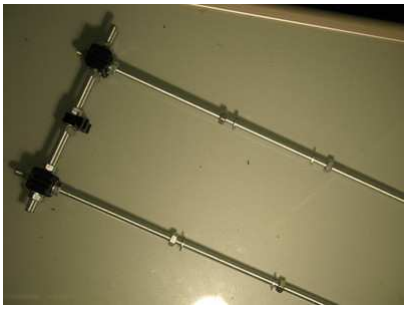
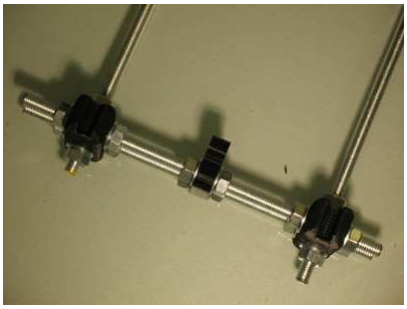
Put two washers in the middle of each rod, and a nut on each end to hold them in. Leave those around 10cm from the middle of the rod.



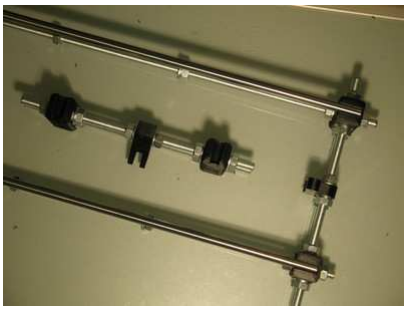
Put a nut on one end of each rod, followed by a washer.

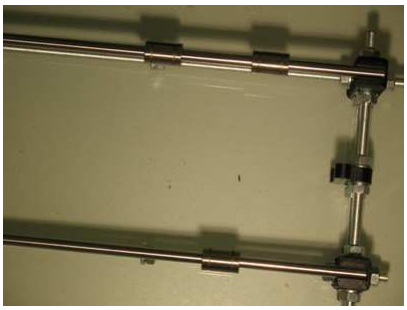
Put the motor holder end onto the ends of the threaded rods, and put a washer and nut on the other side to hold them in. Tighten the nuts.

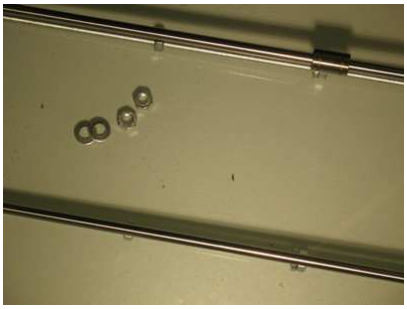
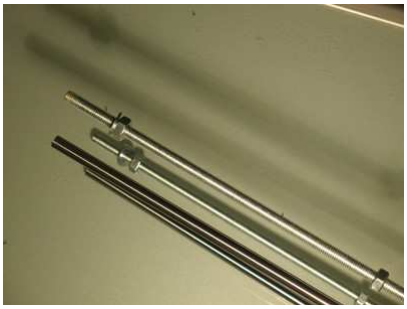
Slide the long smooth rods into the holders, all the way in. They might be a fairly tight fit. They'll fit eventually.



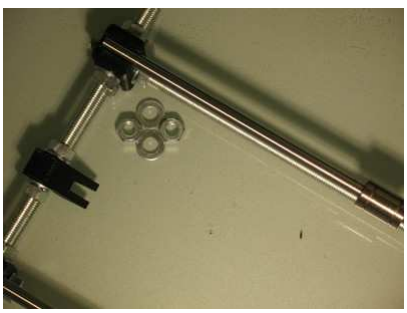
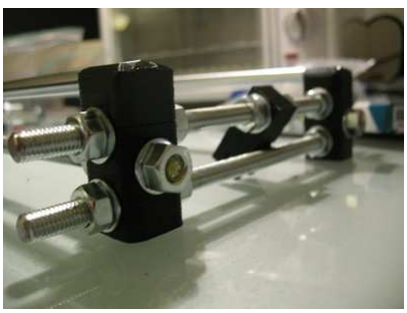
With the motor holder to your right, slide three linear bearings onto the rods. Two on the top rod, one on the bottom.

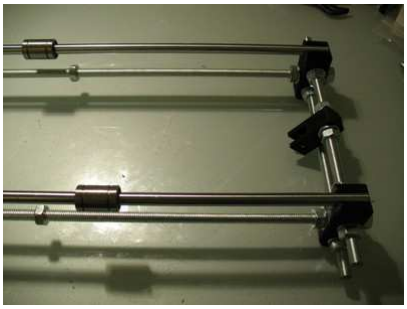
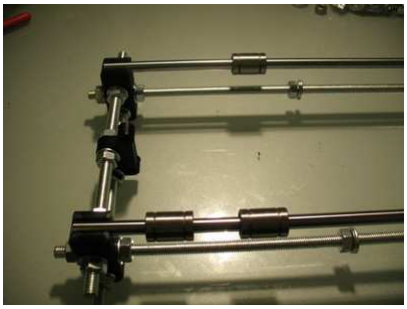
Put a nut followed by a washer on the free ends of the threaded rods, about 5cm from the end.

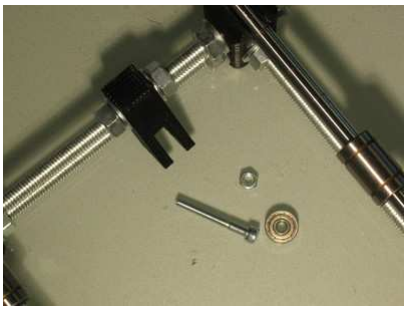
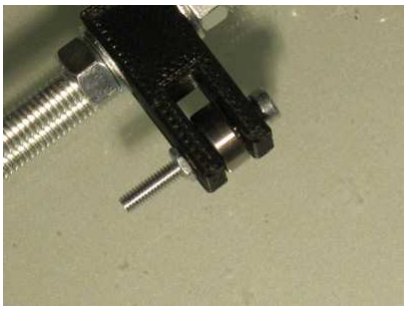
Slide the smooth rods into the printed parts, all the way in. Make sure the threaded rods go through the holes. Put a washer and nut on the outside of each.

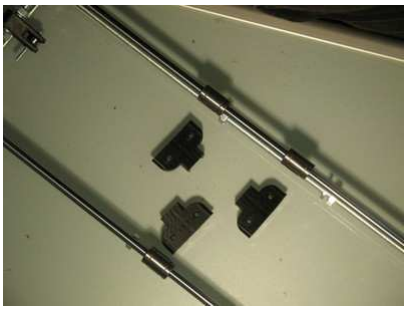
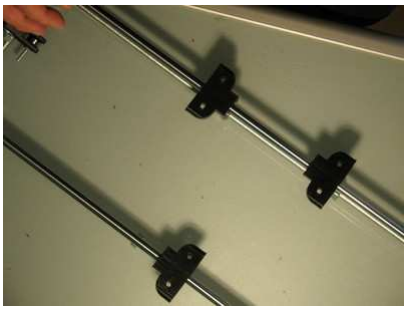
Tighten the inner and the outer nuts against the printed part.

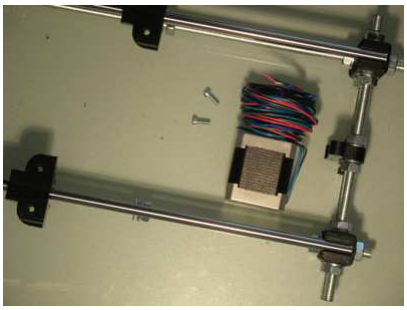
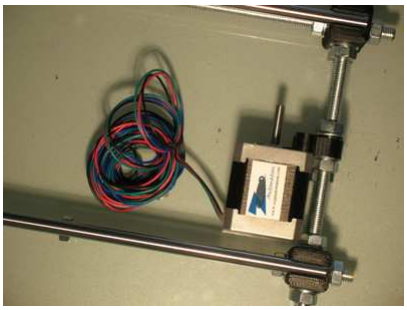
Use a bearing, an M4 nut, and an M4 bolt to make an idler bearing as shown.

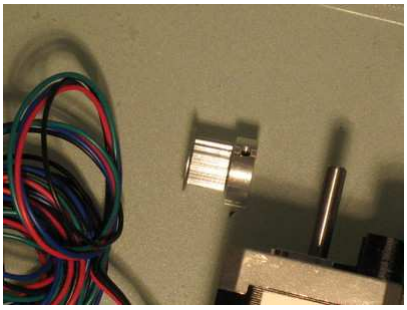
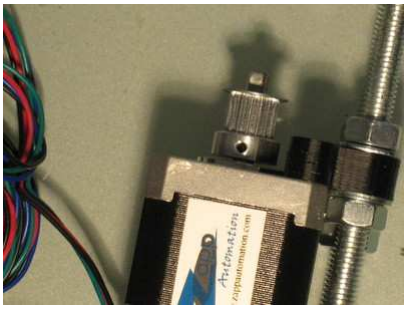
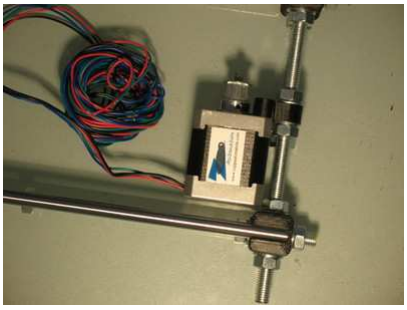
Place the three bed holders on the linear bearings as shown. They will snap in with a bit of force.

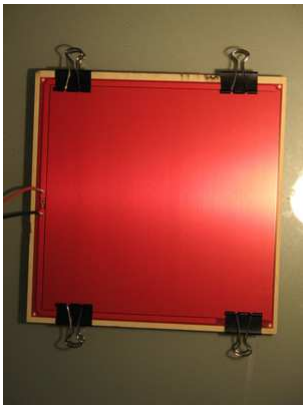
Take one NEMA17 motor and two M3x10 bolts and attach the motor to the motor holder. Wires may be on either side, but NOT on the top or bottom.

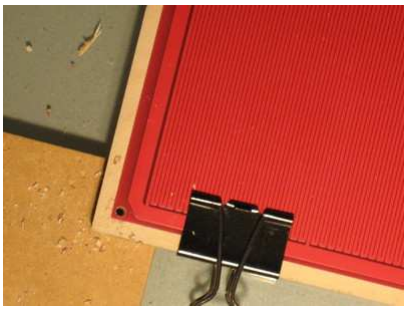
Take a pulley and attach it to the motor shaft. Make sure the setscrew on the pulley aligns with the flat of the motor.

Use the 4 clips to attach the heated bed PCB to the square wooden plate. Put a 3mm or 3.2mm drill bit in your drill.

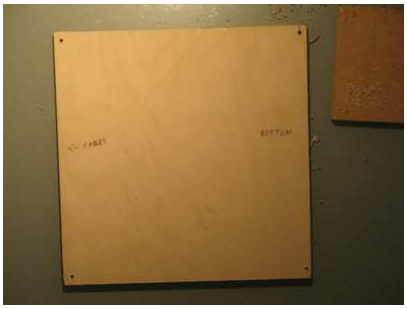



Using a piece of scrap wood as a base, drill through all 4 corners of the heated bed.

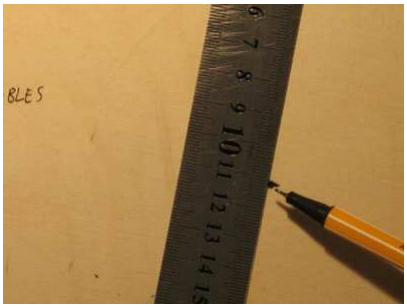
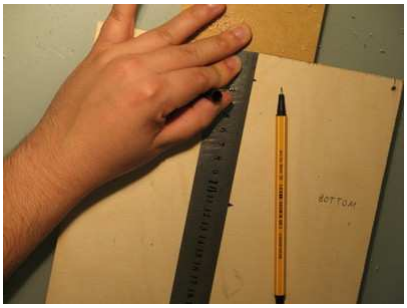
Remove the clips, and mark the side you just drilled "top" and also mark the direction that the wires of the heatbed were pointing when you drilled the holes.

Flip the board over, and mark the other side "bottom" and mark the same direction as before so you know which way the cables went.

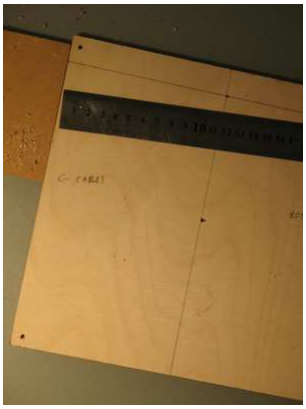
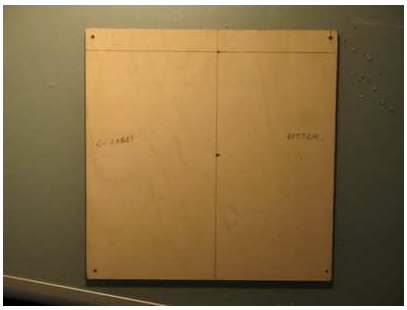


Place your piece of scrap wood against the top, align your ruler with it, approximately in the middle of the board, and draw a line down the middle.

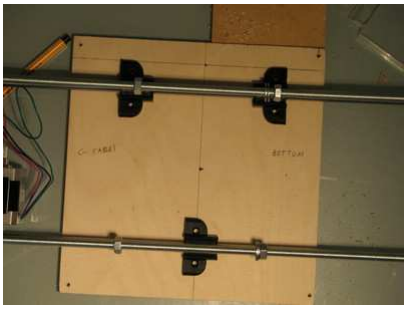
Without lifting the ruler, make a mark at 112mm from the edge, and another mark at 20mm from the edge.

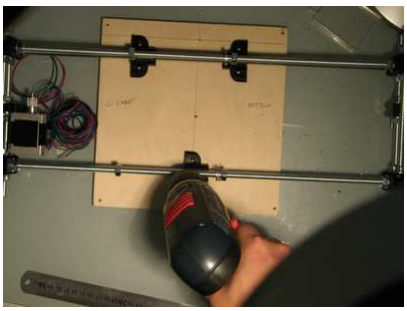
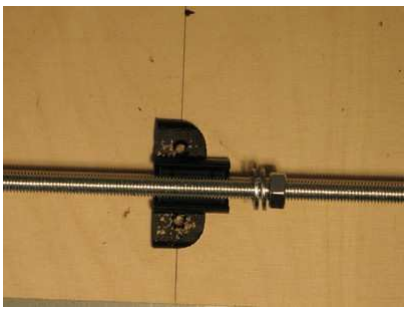
Now move your piece of scrap wood to the side, position your ruler on the 20mm mark, and draw a line through.

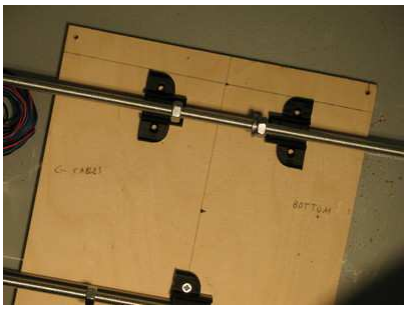
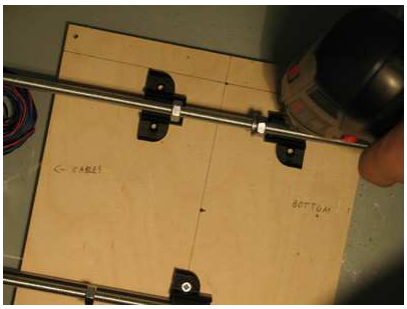
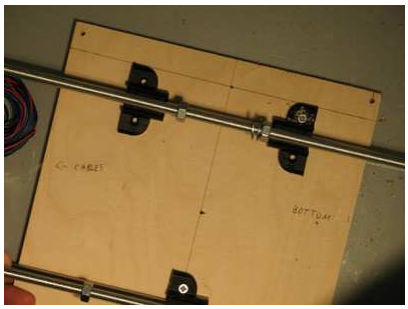
Flip your y axis upside down and balance it on the plate. Position the two printed bearing holders on top so that their top touches the line you marked. Position the third bearing holder so the vertical line is visible through its mounting holes.



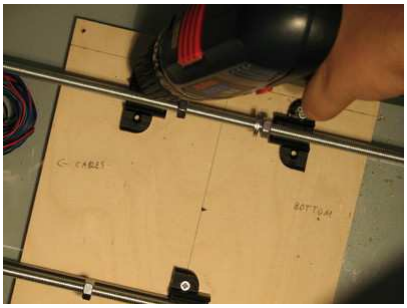
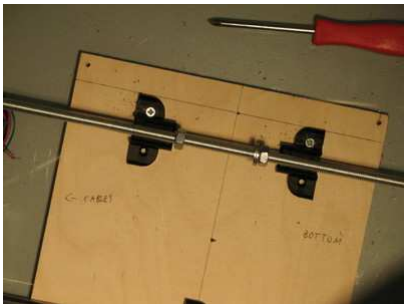
Drill through each hole exactly on the line and attach the printed part to the wood with two wood screws.

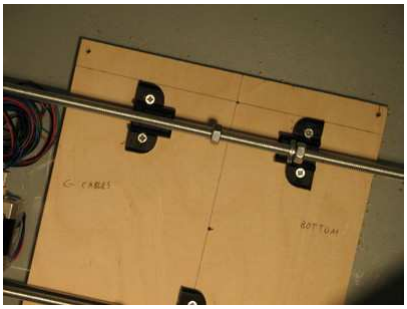

Position the top right printed part so that its top is aligned with the line and it's horizontally about halfway between the line you drew and the edge of the plate. Drill the top hole and insert a screw.

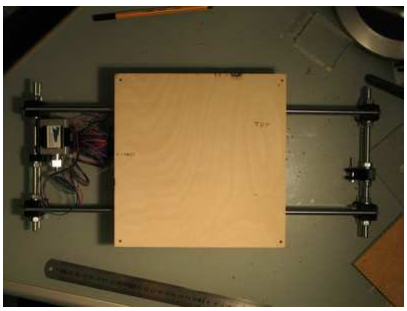
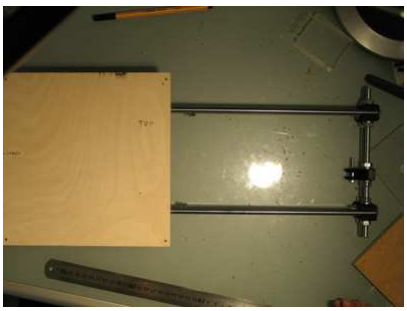
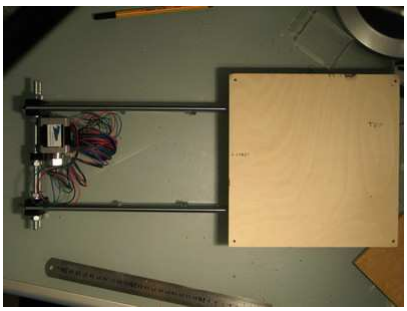
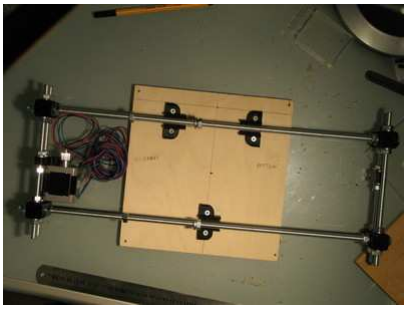
Position and mount the top left part the same way. Make sure they are both alighed with the horizontal line.

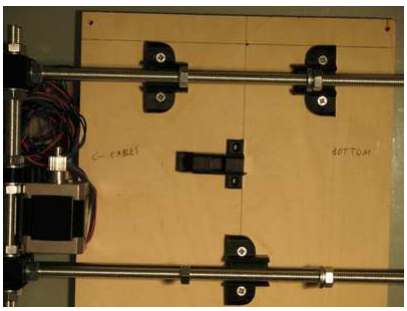
Now add the bottom two screws.



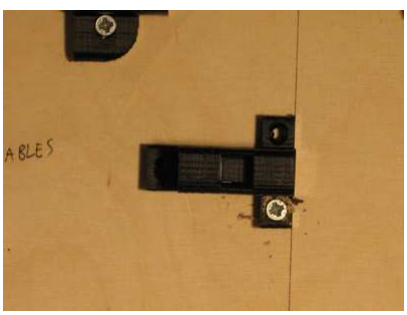
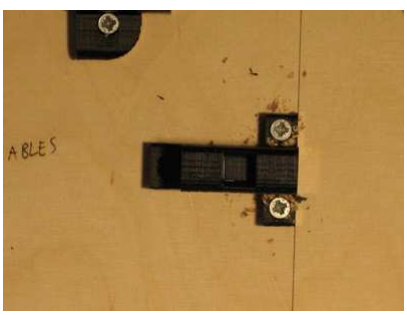
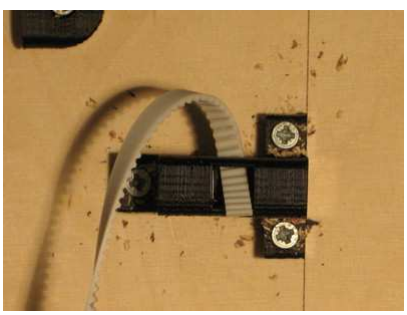
Flip the axis, test that it can move freely and then flip it over again.

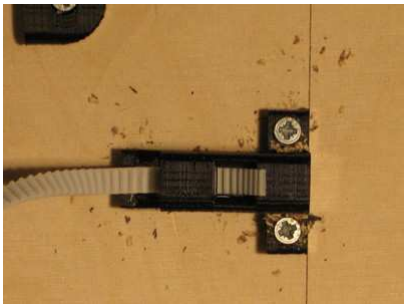
Align the belt holder with the line marked so that it points towards the motor:



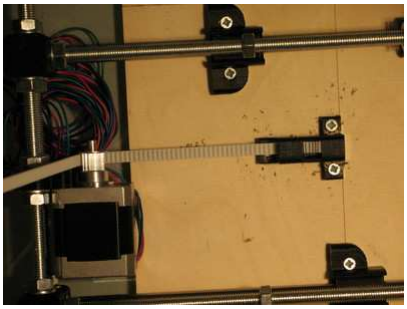
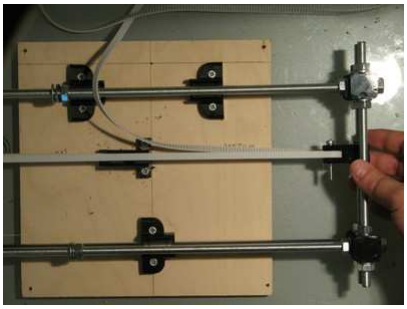
Attach it to the bed and thread the end of the belt through it.

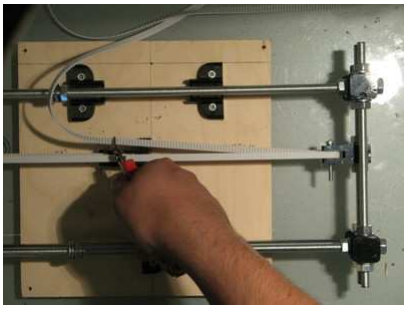
Make sure the belt end stays snugly in place. If it won't stay, shim it with an M3 washer or a piece of card.



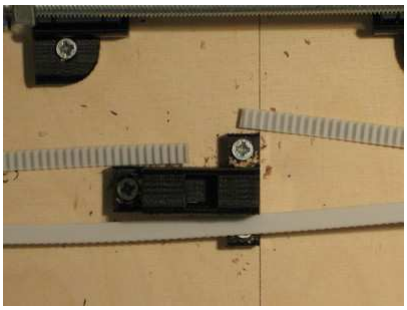
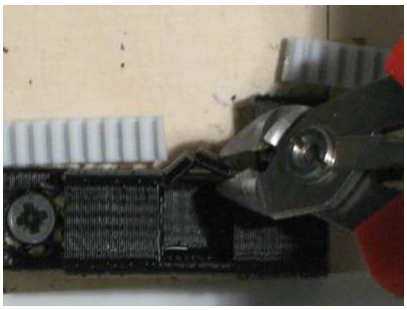
Pass the belt over the motor and idler

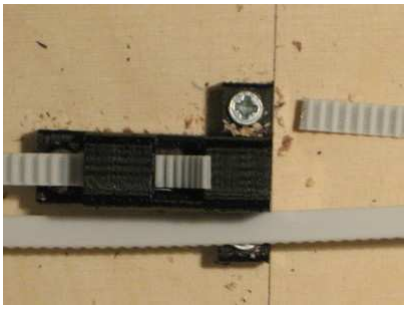
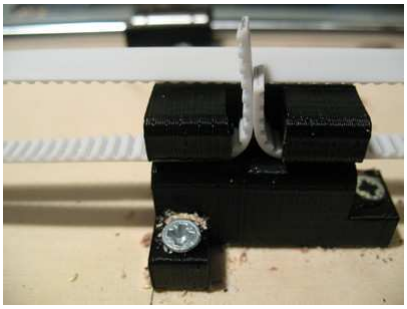
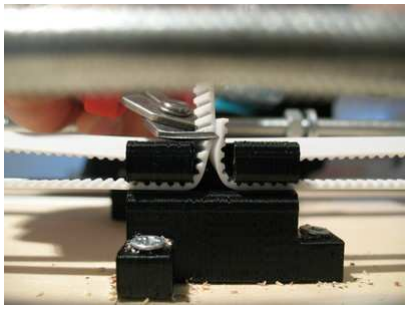
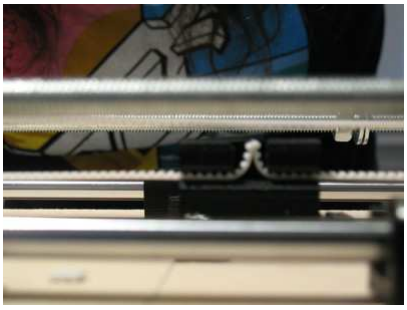
Cut the belt, leaving a couple cm of extra length.



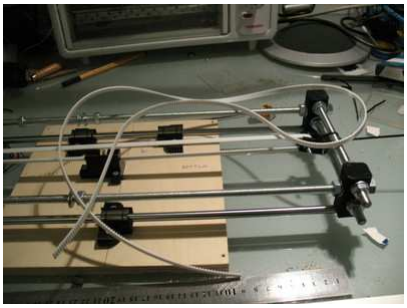
Remove the support structure on the belt holder and reinsert the belt on one side.

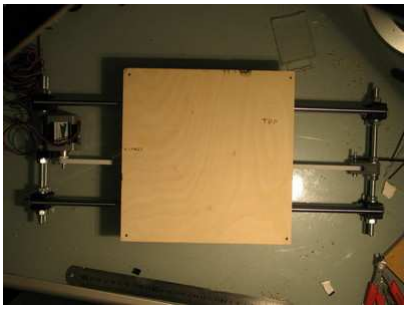
Insert the belt on both sides so that it's tight. Cut the excess belt.

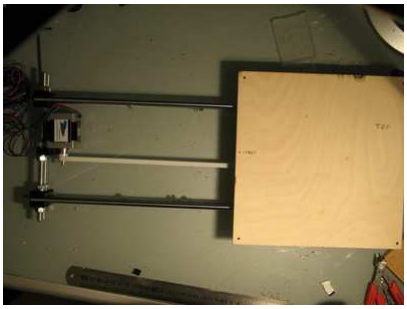





Use a ziptie to tension the belt if necessary. Put the second length of belt aside for the X axis.

Check that your Y still slides smoothly. It will feel rougher because of the detent torque of the stepper. You should be able to feel each step.





- Back to TOC
- Forward to X-Axis

X axis assembly

Tools needed

- Soldering iron
- Drill
- 3mm drill bit
- 5.5mm drill bit
- Hex keys for M3 bolts and M3 grubscrew
- Patience

(click any image to make it bigger)

Find the following printed parts and the packets of bearings:

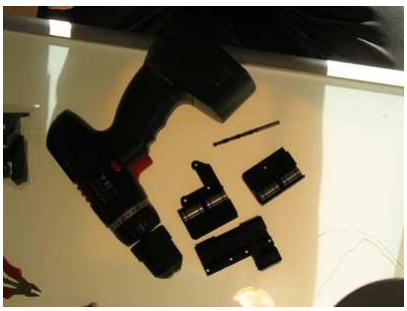

Firmly press two bearings into the idler piece. Make sure the are exactly in line and fit in the grooves provided. They should not be able to move in any direction once inserted, and a smooth rod should pass through them both smoothly.


Repeat the same procedure for the motor end.

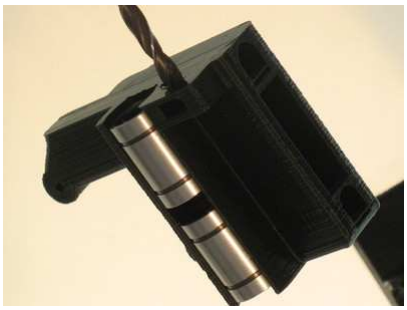
Place two bearings into the X carriage as shown.

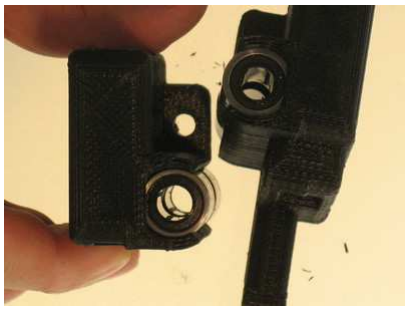
And another one on the other side. You will have one left over from the Y axis assembly.


All done. Now get your 5.5mm drill bit and your drill.

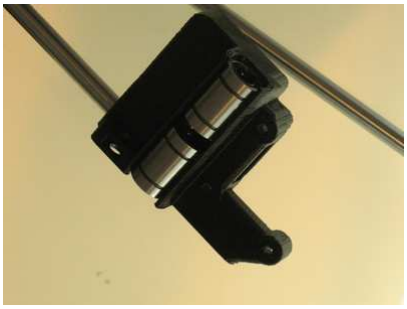
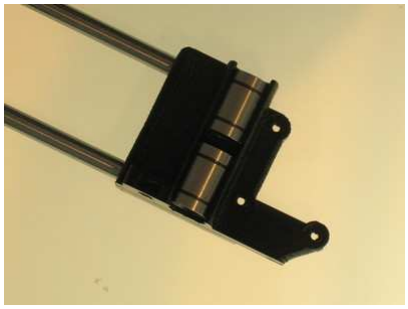



Drill from the bottom of both x-ends. Also drill out the 3mm holes of the x carriage where the belt clamps go.

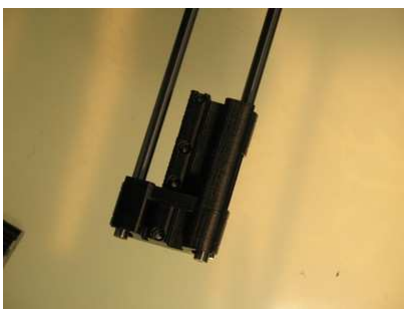
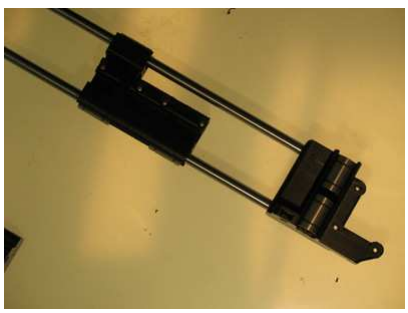




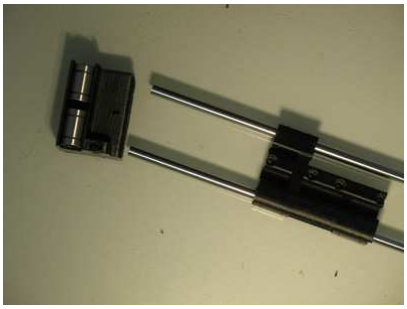
Get the long smooth rods and insert them into the motor end.

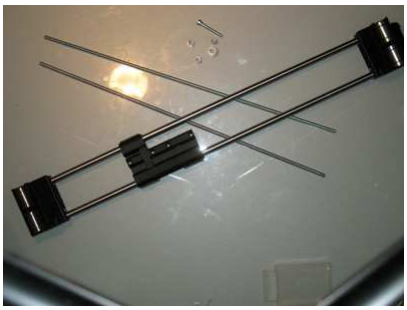
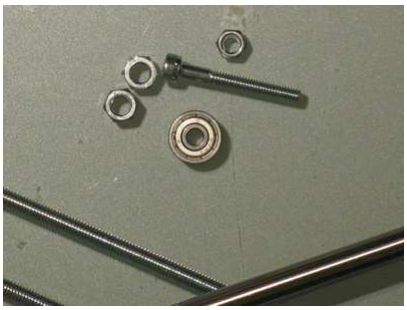
Slide the carriage onto the rods in the orientation shown:

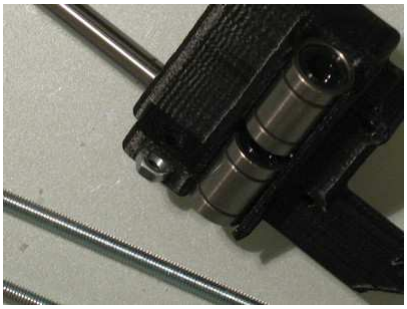
Double-check the orientation, then place the idler end on the rods. You will adjust its position later. Make sure the carriage slides smoothly from end to end.



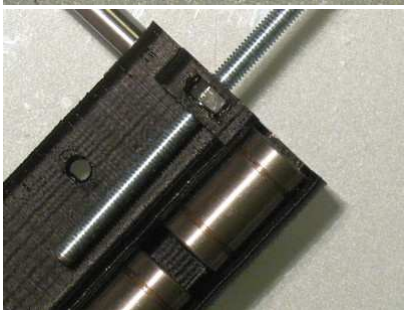
Find the M5 threaded rods, the two m5 nuts, the M4 nut and bolt and the 624 bearing.

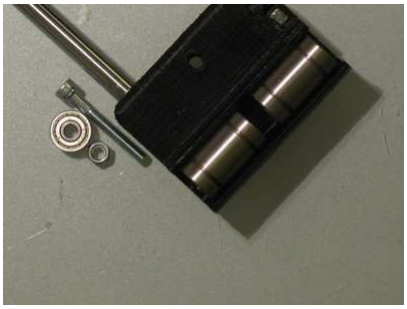
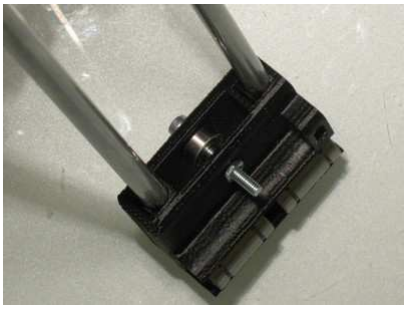
Insert the M5 nuts into the x ends. Use a soldering iron if necessary to force them in deeper. They must align with the holes so that the M5 rods can go through with minimal friction.



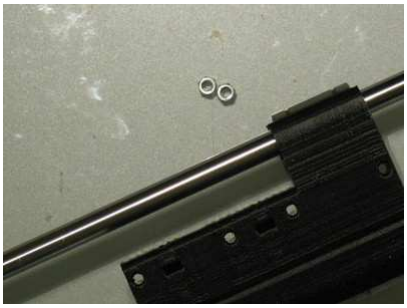
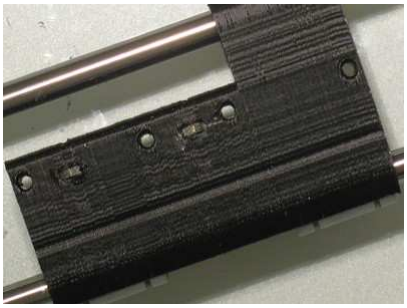




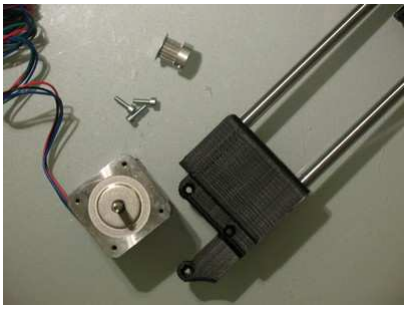
Use the 624 bearing, the M4 bolt and the M4 nut to make an idler, as shown:

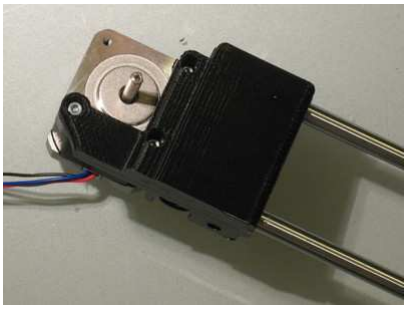



Take two M3 nuts (make double-sure they are M3 and not M2.5) and place them in the nut traps. If necessary, use a soldering iron to carefully melt them in.

Use 3 M3x10 nuts to attach a motor to the x axis end.





Place a pulley on the motor so that the thin end nearly, but not quite, touches the motor. Tighten the grubscrew against the motor flat VERY TIGHTLY.

- Back to TOC
- Forward to Frame assembly

Frame assembly

Tools needed

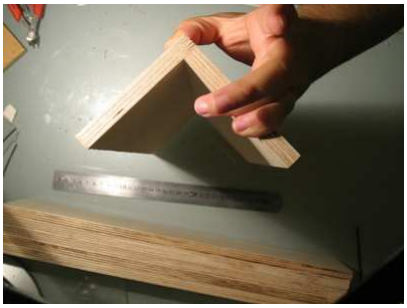
- Drill
- 3mm drill bit
- 8mm drill bit
- Pen
- Countersink bit
- Screwdriver or screwdriver bit
- (Optional) second drill or power screwdriver
- Something flat and 3mm thick (2x). I used 4 1.5mm thick scrap PCBs, but you can use anything you want.
- Patience

(click any image to make it bigger)

Find the wood panels. You should have six of them the same size (450mm) , and one that is longer.

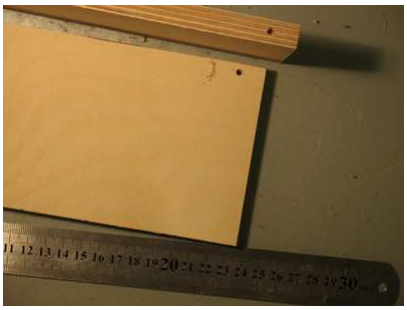

Put the longer one aside

Take two of the 450mm panels and put them edge to edge on a flat surface, forming a corner.

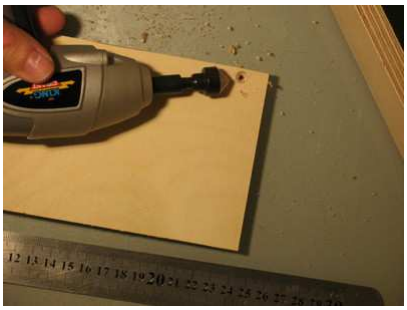



Have a friend or a clamp hold them in place and drill through one into the center of the other, about 2.5cm (1 in) from the end.

Make super-sure the panels line up when you drill.

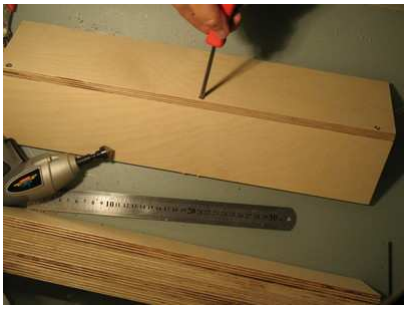



Countersink the hole on the flat side and add a screw. Make sure the edges line up.




Repeat on the other end, again about 2.5cm (1 in) from the edge.


And in the middle

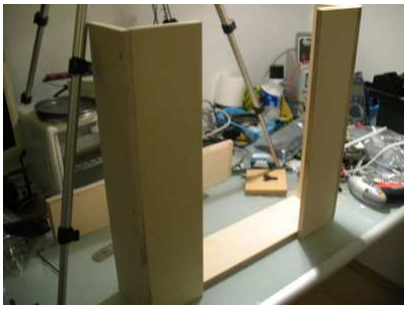


Congratulations, you now have one side of your frame. Now do it again:

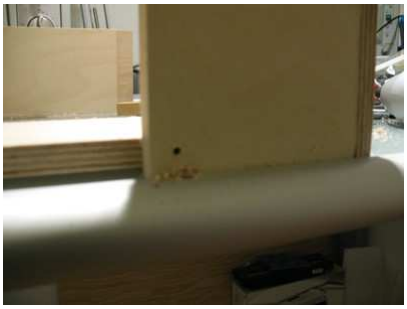
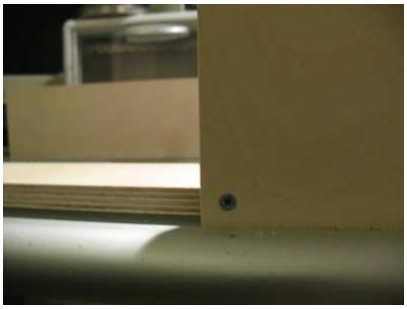
Orient the two sides so the screws point TO THE SIDE in both panels.

Place the corners approximately 450mm apart (inside to inside) and place a 3mm spacer in each one.

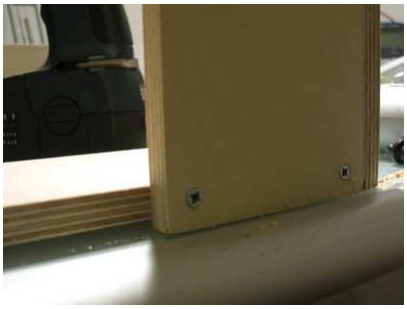
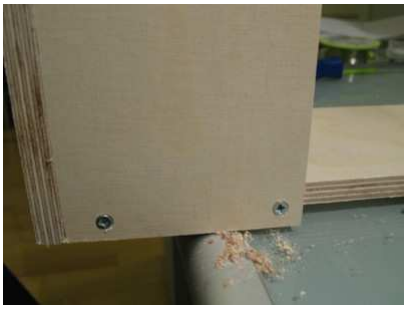
Place a 450mm panel between them (not the long one!)


Drill into the middle of the panel from the front, countersink and add a screw. Make sure the spacers don't move around when you drill. You want the bottom panel to be flat and 3mm off the table.

Put two screws on the front on each side.

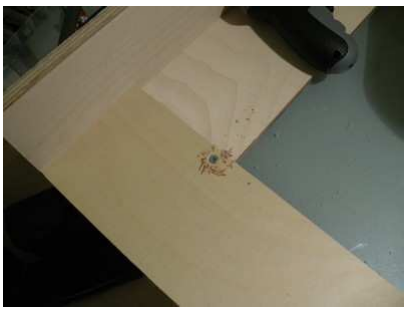
Now, pressing the frame sides in so they are flush against the panel, put two more screws in on each side, this time on the side panels:


Isn't that nice? Now lay it flat with the panel you just added away from you:


Place another 450mm panel in, and align it with the edge

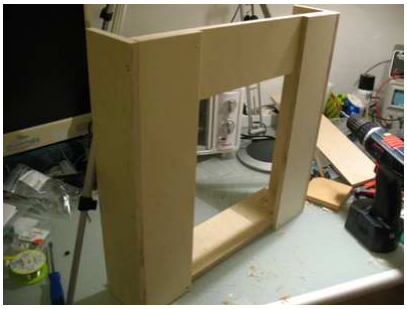
Keeping it aligned, drill, countersink, and add a screw. Be careful not to drill through the table.

Repeat on the other side:

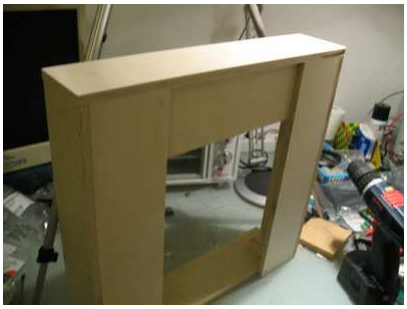


Add two more screws on each side as shown. Don't ruin your table.


There, an almost-ready frame.

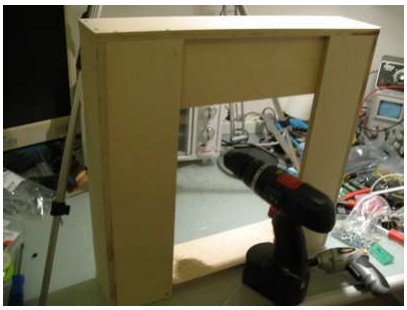


You should only have the long piece left now. Place it on top and align it with the edges.

Attach it to the corners with 4 screws on each side. YOu know the drill.

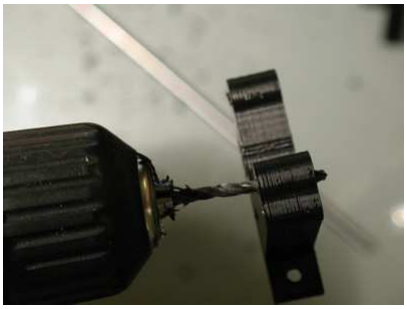

And there it is!



Now, find these 4 pieces.

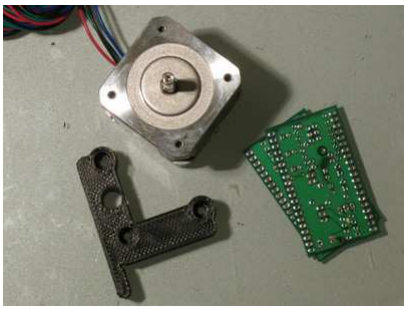
Make sure the smooth rods can fit inside snugly but smoothly. If they cannot go through, drill out the holes a bit with an 8mm drill bit.

Drill out the 3mm holes with a 3mm drill bit



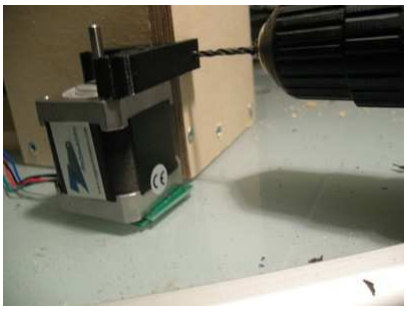

Excellent. Now take this piece

Take your trusty 3mm spacer and a motor too.

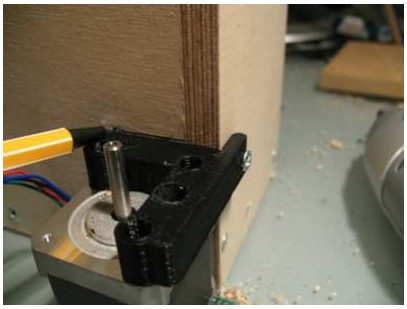


Put the motor on the spacer, put the printed piece on the motor and align it all with the frame.

Drill into the side through the hole and attach a screw but do not tighten.



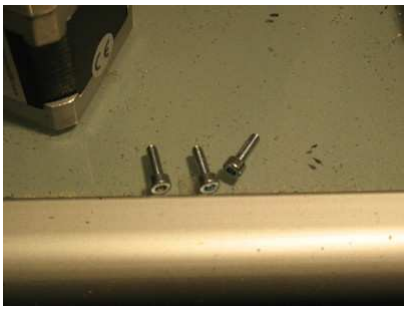
Mark the top of the printed part so that it's flat on the motor.

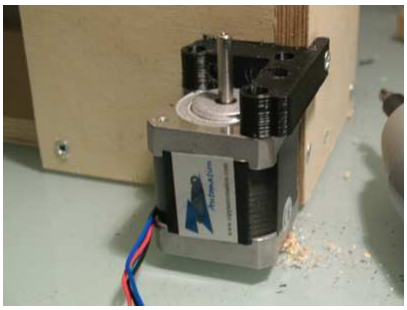


Remove the motor and spacer, hold the piece against the frame aligned with the line and drill the second hole.

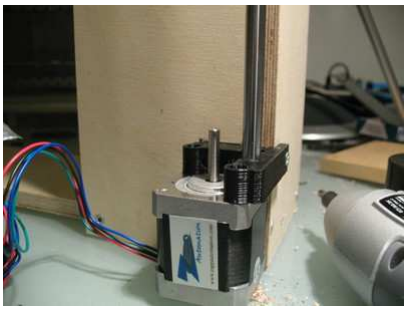
Now carefully tighten both screws. Do not overtighten or you will break the part.

Use 3 M3x10 bolts to attach the motor to the printed piece, wires pointing to the inside.





Stick a smooth rod into the printed part while holding the motor. The smooth rod should touch the motor body.



Carefully slide this part onto the smooth rod and align it with the frame just below the top panel:


Drill and attach with screws as before. Do not overtighten.

Repeat the same thing on the other side:

And your frame is done:

- Back to TOC
- Forward to Z axis and bed assembly

Z axis assembly

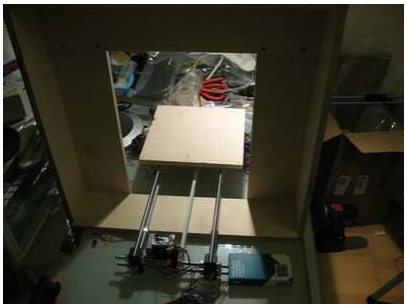
Tools needed

- Drill
- 3mm drill bit
- Piece of scrap wood with a straight edge
- Side cutters
- Your Arduino box
- Countersink bit
- Screwdriver
- Patience

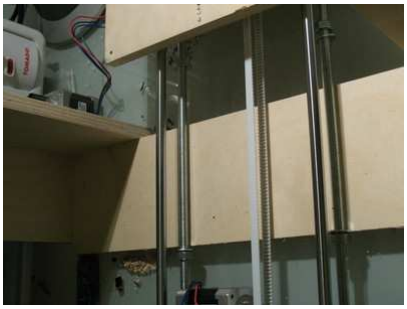
(click any image to make it bigger)

In this episode, we will attach the Y and X axes to the frame and build the Z axis.

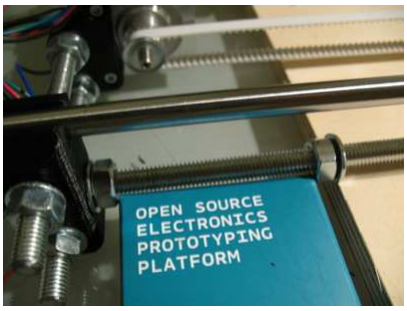
Dig out your Y axis and stick it on the frame, motor on the inside as shown:




Adjust the nuts on the bottom threaded rods so they are close to the plate in the middle. The threaded rods themselves should be just about touching the plate.

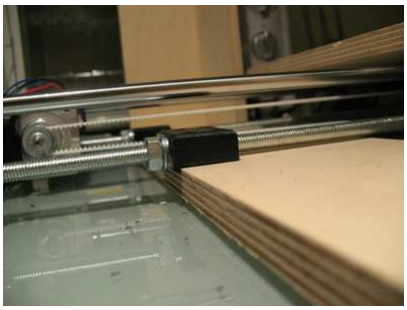



Place the Arduino box between the nuts on the motor side and adjust them until it just fits.

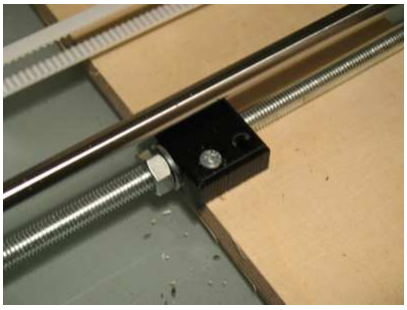


Find 2 of these parts:

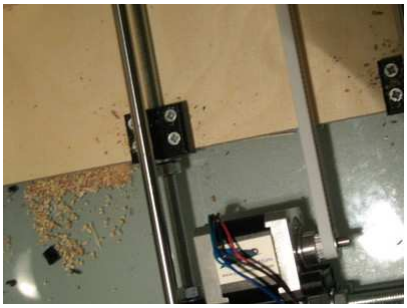
Place them on the threaded rods so that the little lip they have hooks on the corner of the board. Do not move the nuts along the rod.



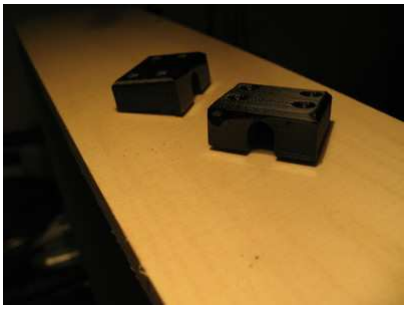
Drill and screw down ONE hole on each of them.



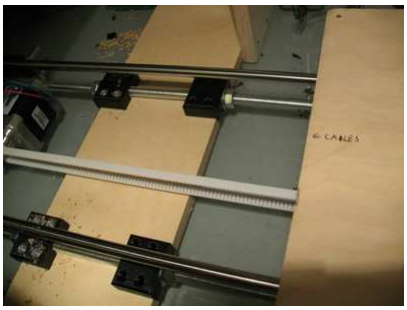
Then put in the other six screws.

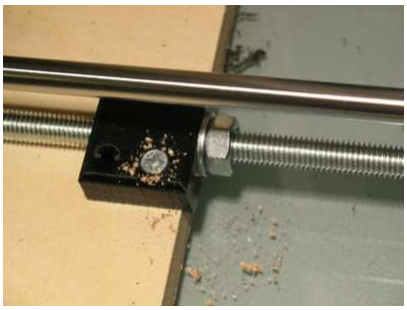
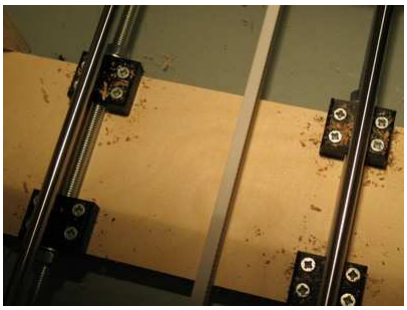
Find the other two and pkace them on the rods as before:



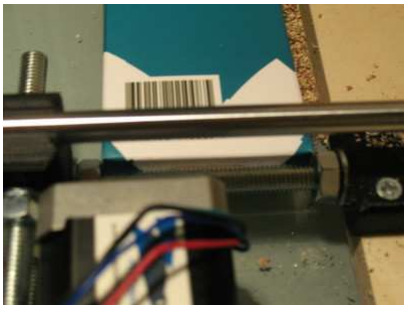

Place the nut and washer against them.



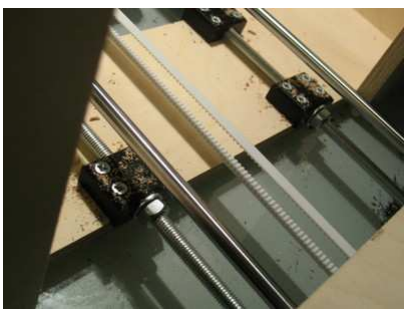
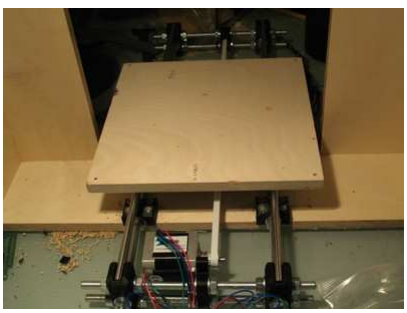
Screw both of them down and tighten the nuts.

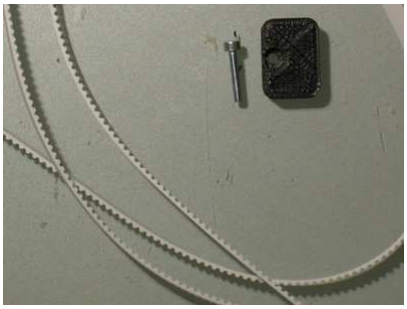
Make sure the nuts on the other side have not moved. Adjust if necessary.

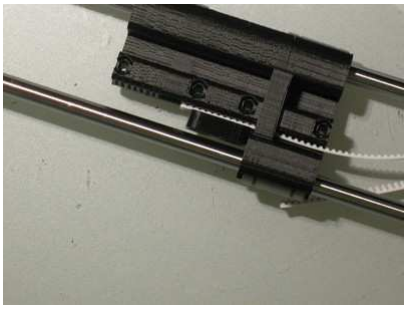
And there you are. Your Y axis is attached. Clean out the dust you made from the inside of the frame.

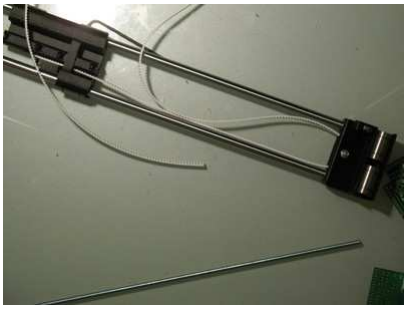
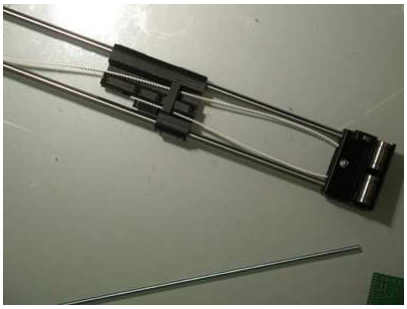
Get an M3x16 bolt, the remaining length of belt, and this printed part



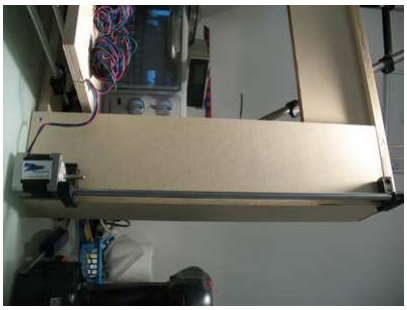
Attach the belt to your X axis carriage as shown and tighten it down.



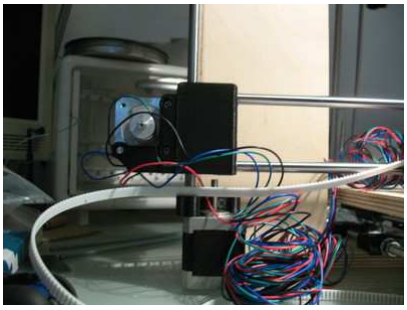

Pass the belt through the idler bearing and carriage.

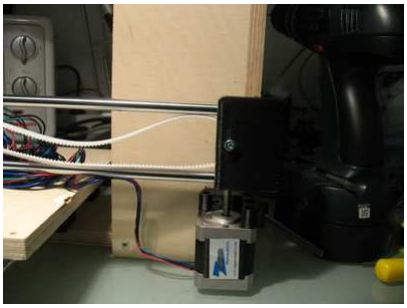
Slide the smooth rods of your frame up through the top printed parts. Hold the printed part to prevent breaking it.



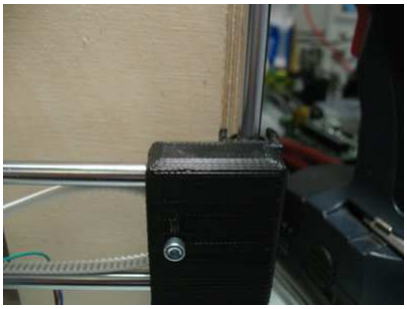

Place your X axis on the bed and pass the left frame rod through the motor side of the X axis and back into the motor holder on the bottom.



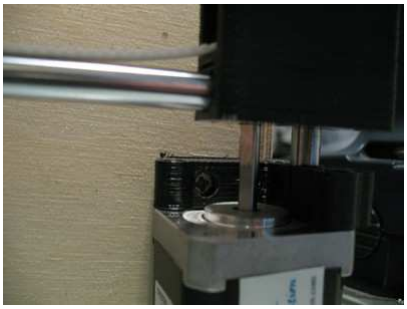
You will notice the other end is probably not aligned.



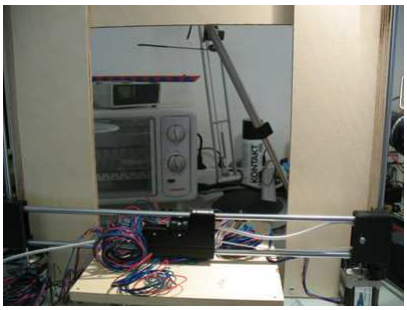
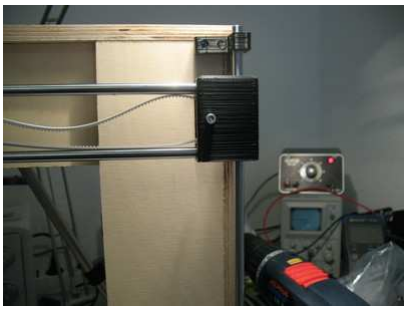

While holding the motor end of the X axis, adjust the idler end so it's exactly under the smooth rod.



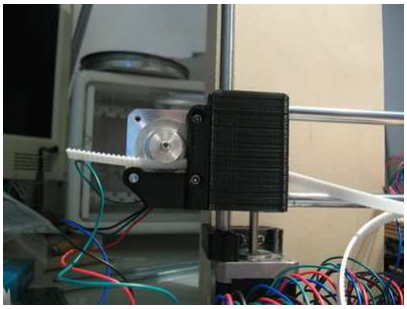
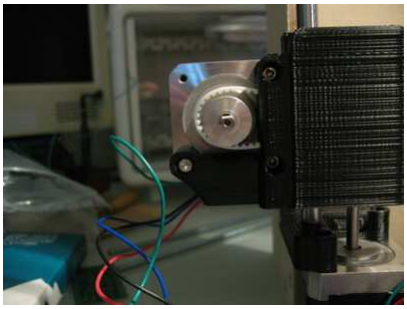
And pass the smooth rod through the idler and into the motor holder below.



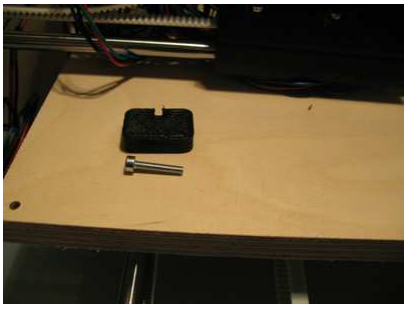
Make sure your X axis slides up smoothly and comes down by its own weight easily.

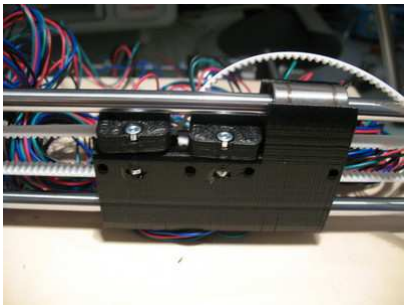
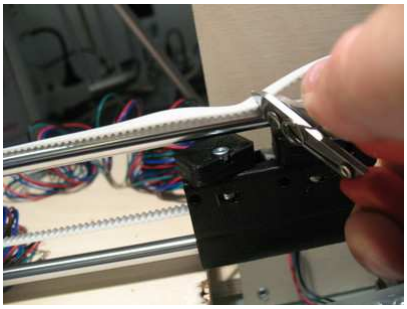
Pass the belt over the motor pulley.

Find another M3x16 bolt and another belt holder part.

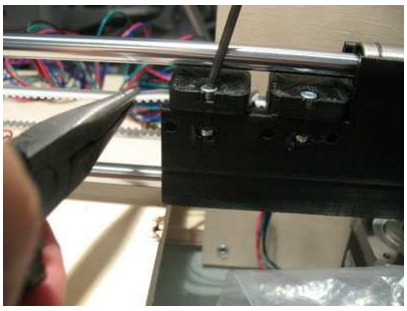


Check how far the belt extends when pulled tight and cut it to size a few mm longer than it needs to be.

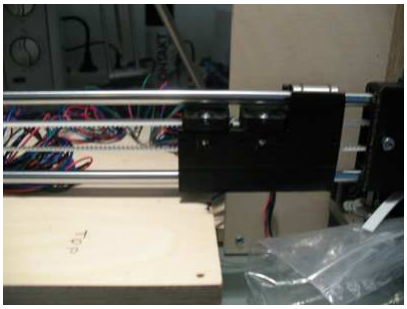
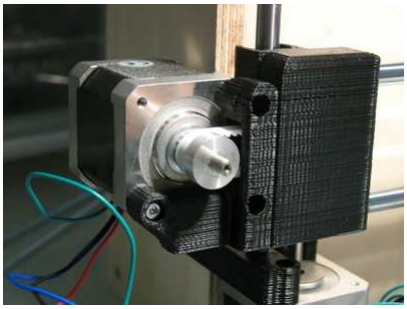
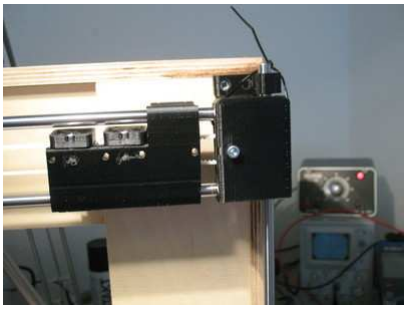
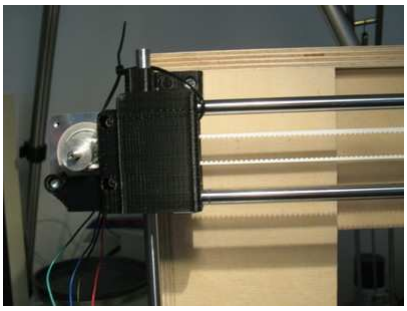



Either have someone hold the carriage or drive it all the way to the idler side.

Now, while holding the belt REALLY tight, tighten down the clamp that holds it in place. Don't let it slip.



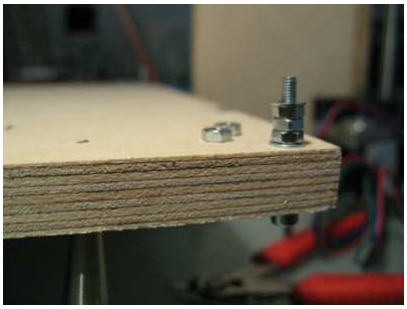
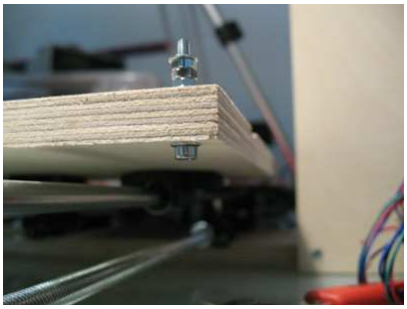
Once your belt is nice and tight, temporarily attach your X axis to the top of the frame so it's out of the way.

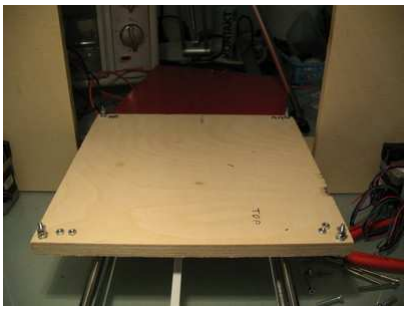
You will need a bunch of M3x40 bolts, your heated bed PCB, M3 washers and M3 nuts.

Put a washer on each bolt.

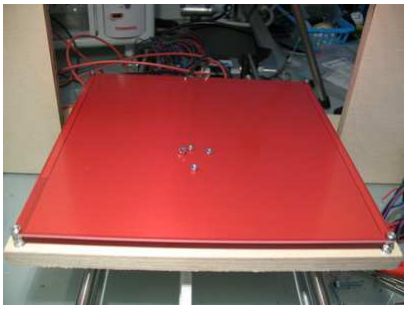
Stick the bolt through the Y axis plate from underneath, and put a washer, three nuts, and another washer on top. Tighten them all really well.

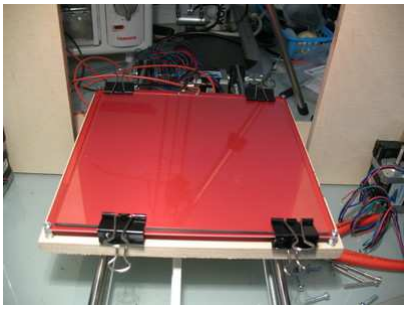
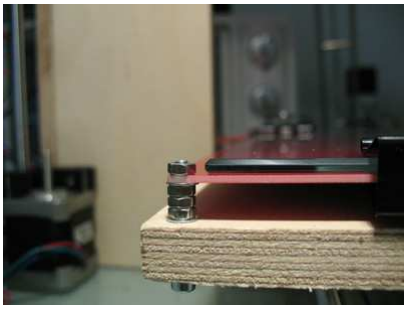
Repeat for all corners of the bed.



Stick your PCB on top and place another nut on top of each bolt. It should be approximately flush with the top of the bolt.



Clamp your glass plate on top and check that the bolt does not extend beyond the surface of the glass. If it does, add another washer underneath each corner of the PCB.

Take the glass plate back off the PCB and find this piece of tubing:

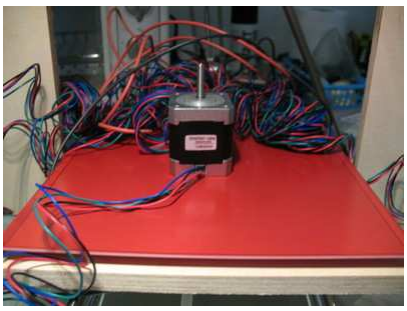
With a reasonable amount of violence, slide it down the motor shaft at least a centimeter or so (1/2in).

Cut it off about 15mm from the top (slightly over 1/2in).

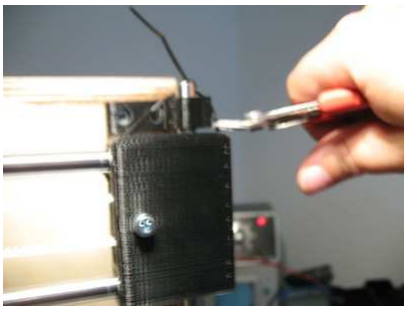
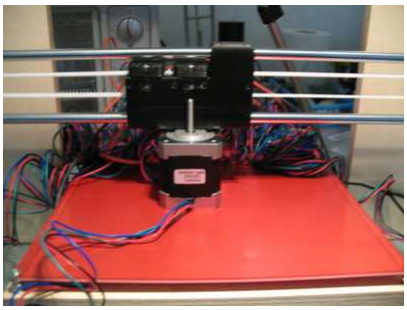
Repeat on the other side:


Move the X carriage to the middle of the frame

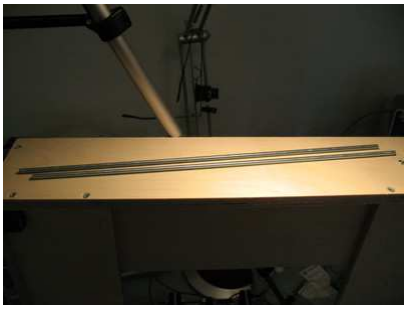
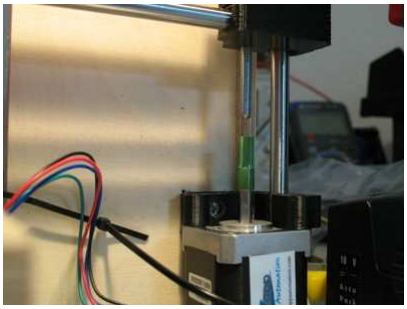
Place a motor or other roughly rectangular object in the middle of the bed.



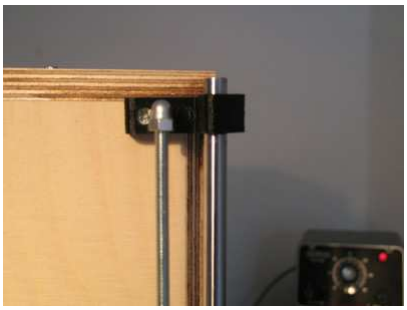
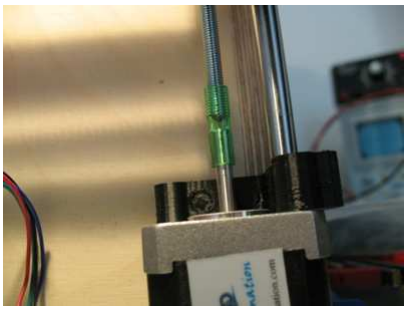
Lower the X axis down so it rests on the roughly rectangular object.

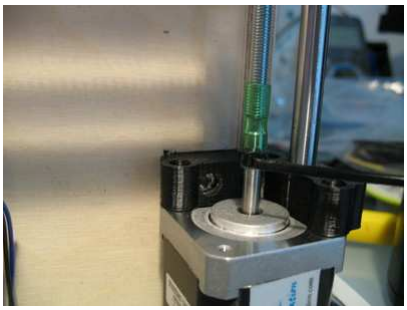
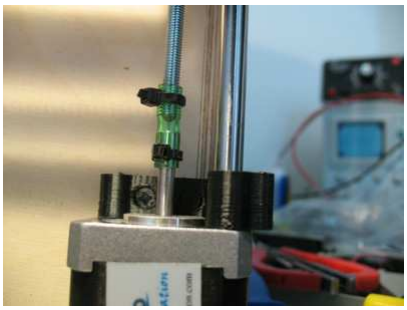
Find the two M5 threaded rods and thread them through each side of the X axis.

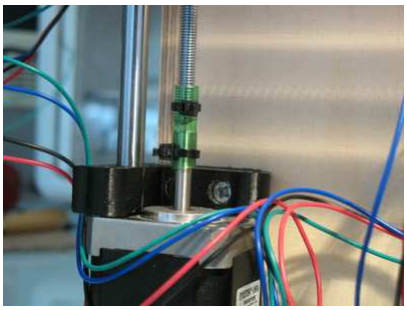
Place an acorn nut on top of one of the M5 rods and use that nut to turn the rod down into the tubing.

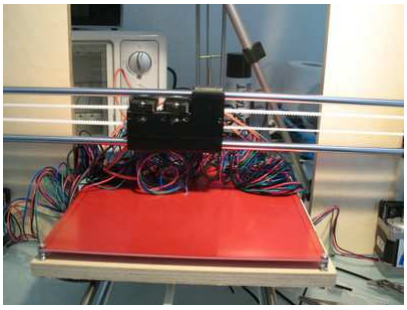
Place a ziptie around each end of the tubing and tighten them really tight.

Repeat on the other side.



Remove the roughly rectangular object. Your Z axis is ready!



- Back to TOC
- Forward to Extruder assembly

Extruder assembly

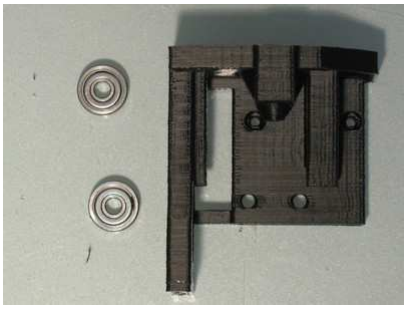
Tools needed

- Drill
- 3.2 or 3.5mm drill bit
- Side cutters
- Hex keys
- Patience

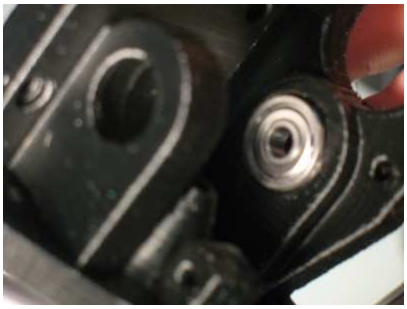
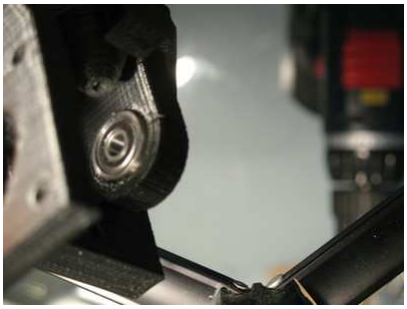
(click any image to make it bigger)

Find the extruder bits and hardware pack.

Take out the two 625 bearings.

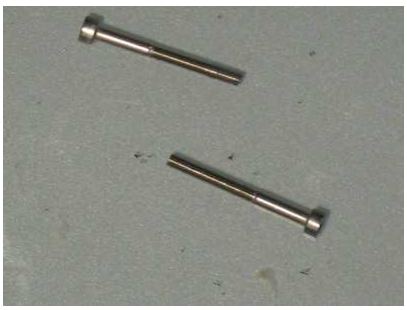
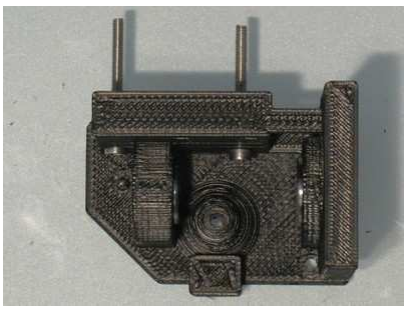


Using violence as necessary, force the two bearings into the recessed areas in the extruder body.

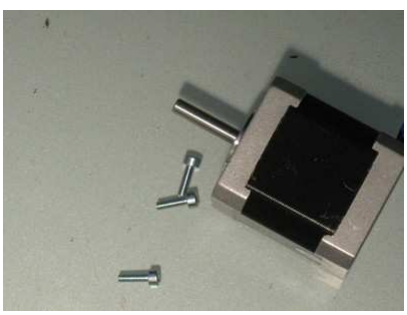
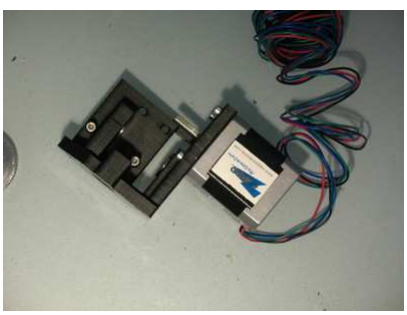



Drill out all the 3mm holes with a 3.2 or 3.5mm drill bit.

Take the longest M3 bolts in the pack and stick them into the extruder body.

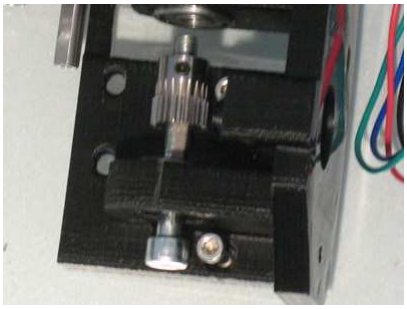



Mount the motor to the extruder body, cables as shown.

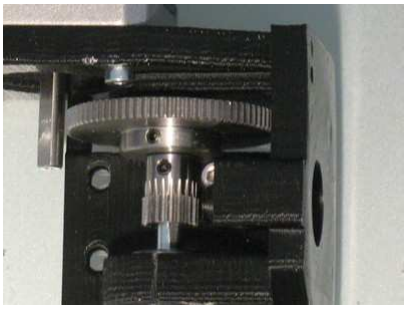



Find the gears, grub screw, and filed-down M5 bolt.

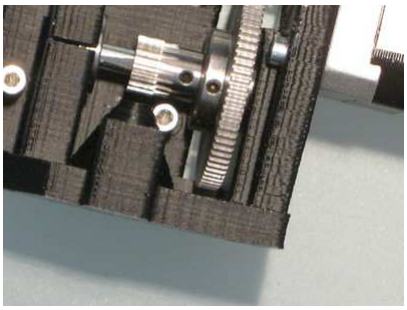
Slide the bolt into the extruder body from the side opposite the motor, and place the small gear onto the shaft as shown.



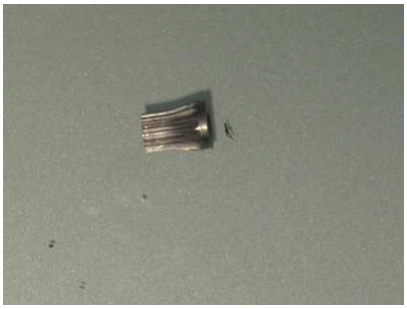
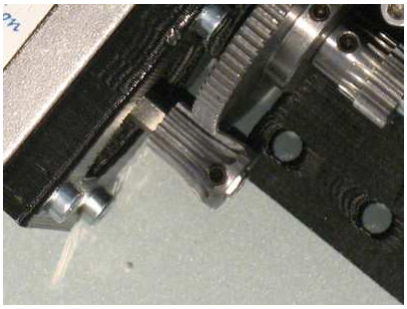
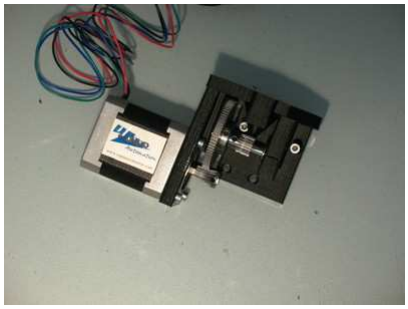
Insert a grub screw into the large gear and place it on the shaft, then slide the M5 bolt all the way through the gears and the bearing on the motor side.



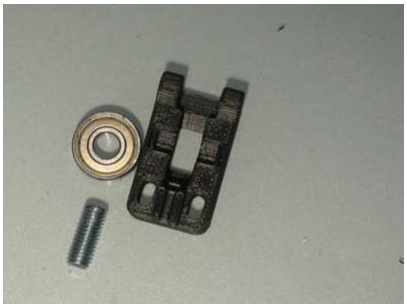
Align the teeth of the small gear with the cone in the extruder body and tighten its grubscrew onto the flat of the bolt. Repeat with the large gear.



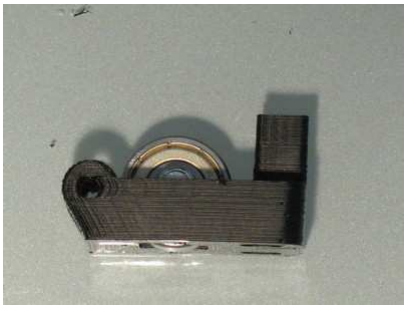
Take the bevelled gear and slide it onto the motor shaft so it meshes with the large gear. Tighten it onto the flat of the motor.

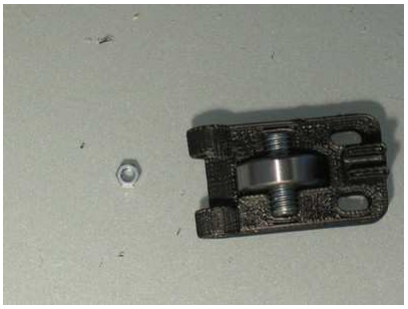
Find the idler parts.



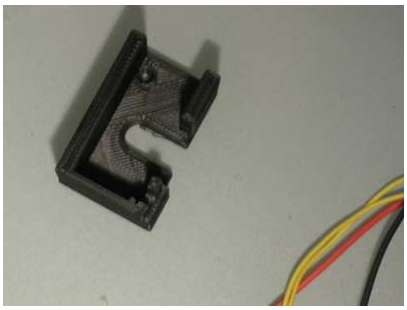
Place the bearing on the M8 grub screw and press both, with reasonable violence, into the idler body.



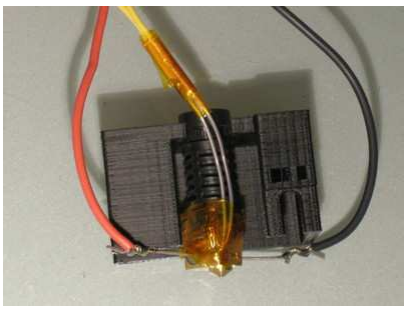
Drill out the 3mm holes of the idler then place a nut into the nut trap.



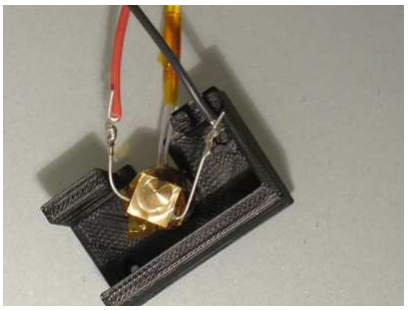
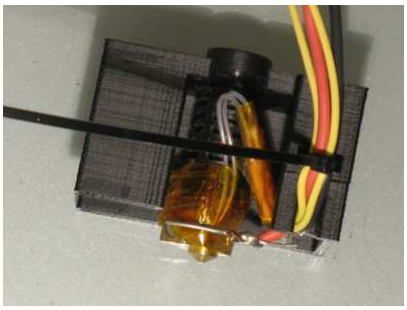
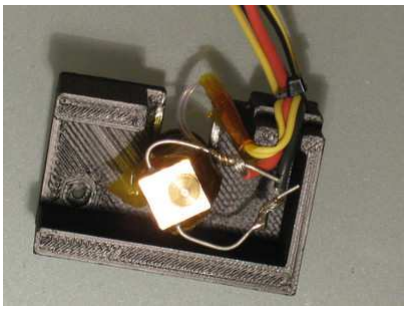

Drill out the 3mm holes of the fan shroud and clean up the edge of the u-shaped groove.



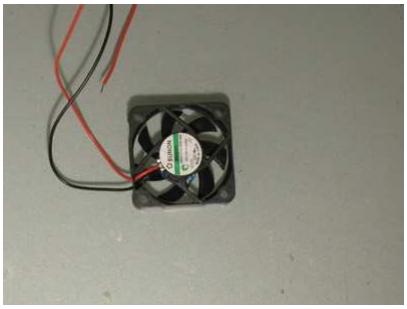
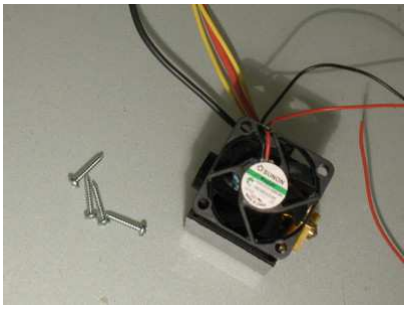
Using slightly more than reasonable violence, force the hotend into the u-shaped groove.



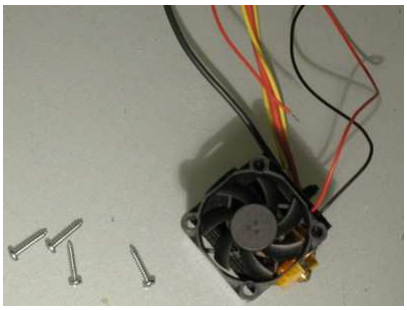
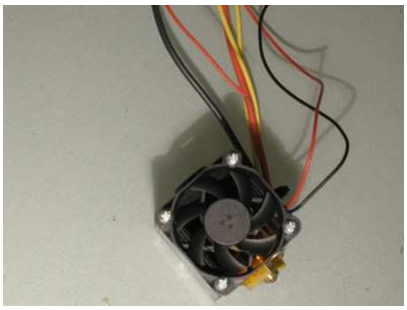
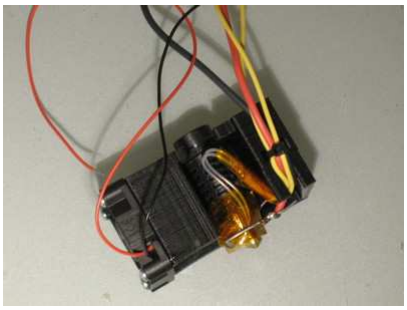
Bend the leads so they don't touch anything and then ziptie them all out of the way.

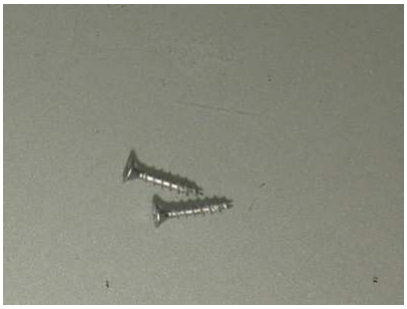
Find the fan and mounting screws.

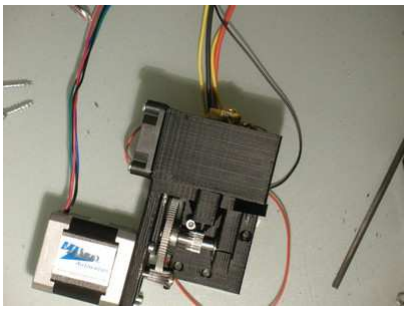
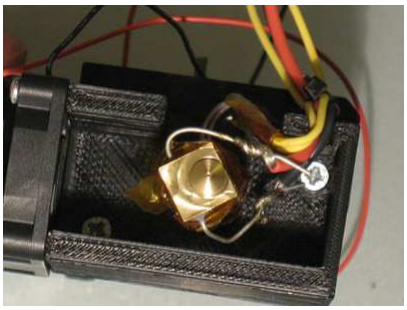
Mount the fan to the fan shroud as shown, with airflow direction (indicated on the fan by an arrow) towards the hotend and cables on the side where the current cables are ziptied.

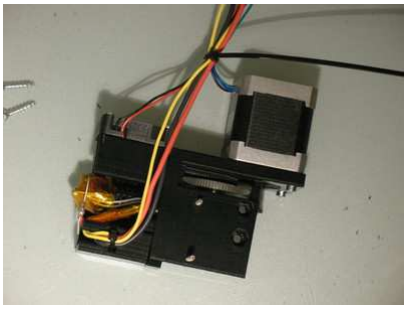
Take two screws.



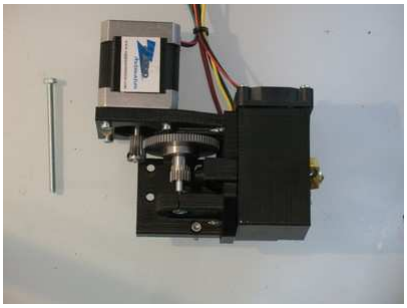
Attach the fan shroud to the extruder body.

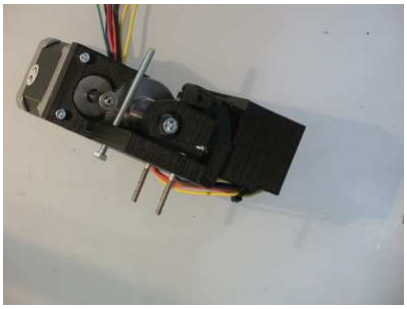
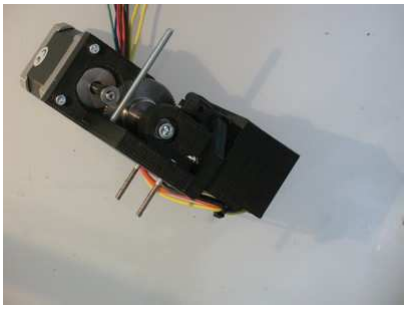
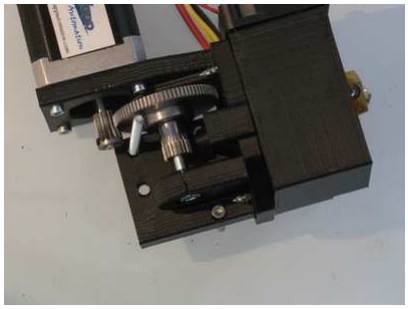
Route the cables out to the motor side, and ziptie them to the motor wires.



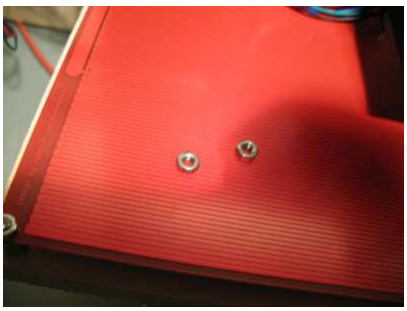
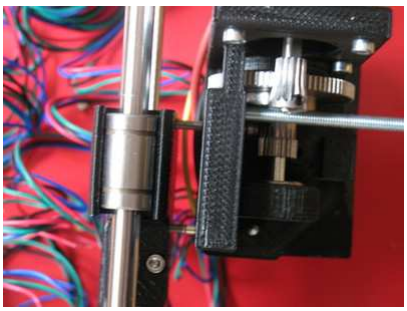
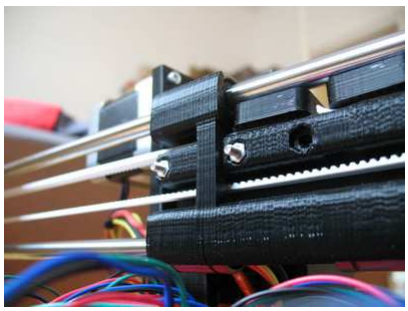
Take the long hex-headed bolt.



Place it in the extruder as shown.

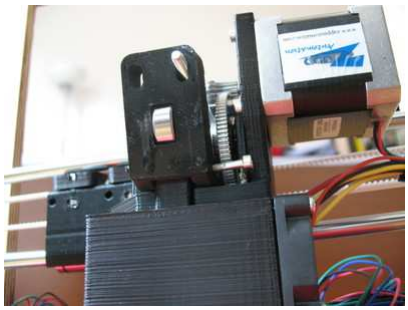




Use two M3 nuts to attach the extruder to the carriage.

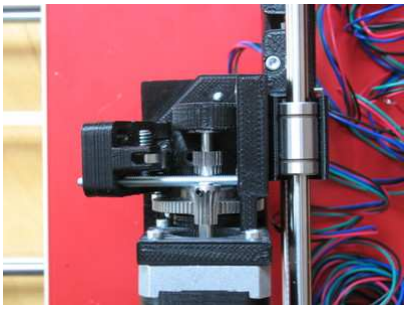




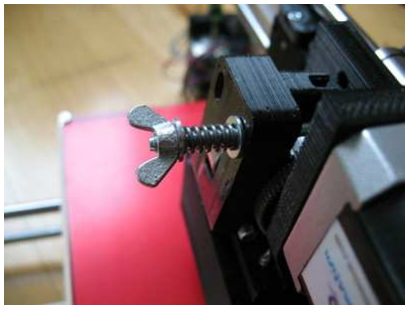
Attach the idler to the extruder body with a bolt.





Use two washers, a wingnut and a spring to fix the idler in place.





Your extruder is ready.

- Back to TOC
- Forward to Wiring

Wiring

Tools needed

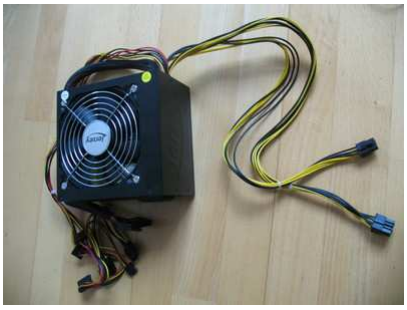
- Drill
- Screwdriver
- Marker
- Side cutters
- Wire stripper
- Zipties
- Pliers or crimp pliers
- Tissue paper
- Bowl of water

- Multimeter

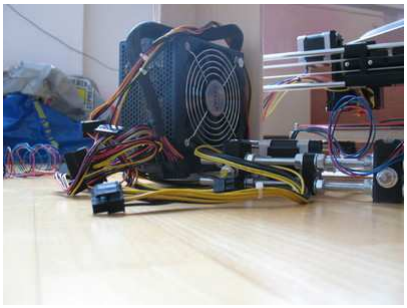
(click any image to make it bigger)

Unpack your power supply

Put all the wires except the two yellow-black ones to the side.

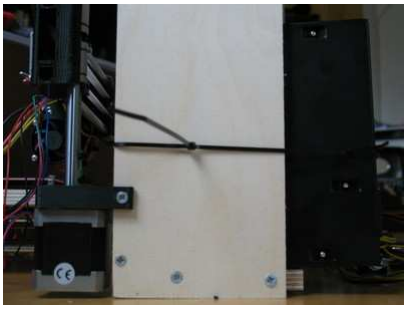


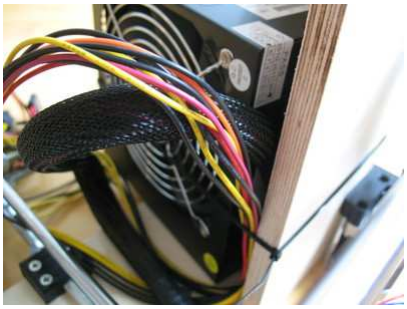
Place the power supply into the frame as shown. The yellow-black cables should be on the bottom pointing to the Y axis rods. All other cables should be trapped between the power supply and the frame.



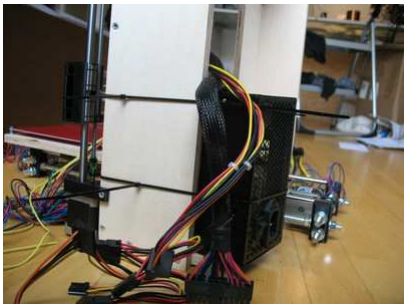
Take 4 zipties and join them to make one very long ziptie

Place this contraption around the power supply, attaching it to the frame. Pull tight.

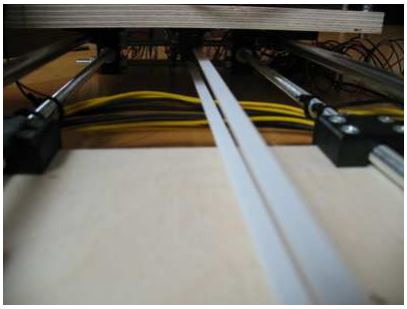
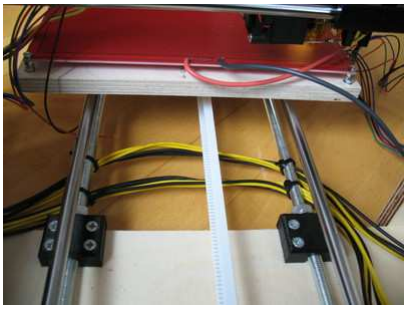
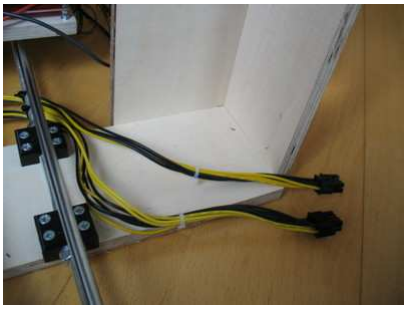




Repeat with another set of 4 zipties.

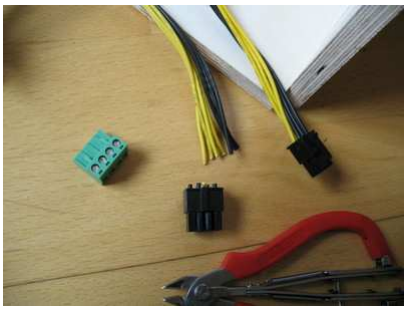



Use zipties to route the yellow-black wires under the Y threaded rods.

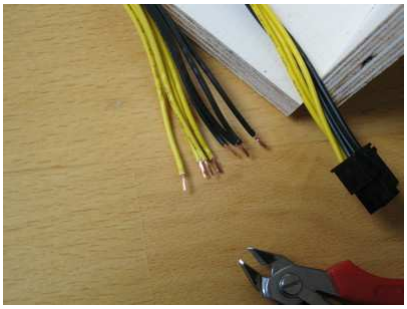




Tie all other cables together.

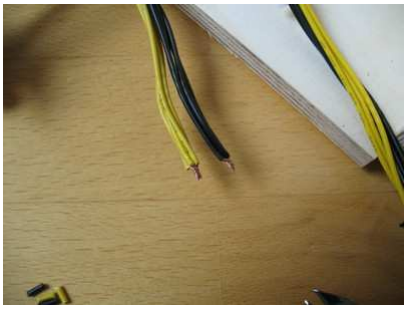
Take the cable woth 4 yellow and 4 black wires and cut it near the connector.



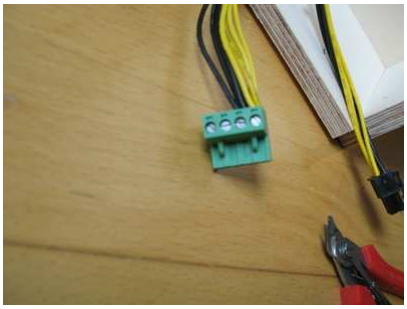
Strip all 8 wires.



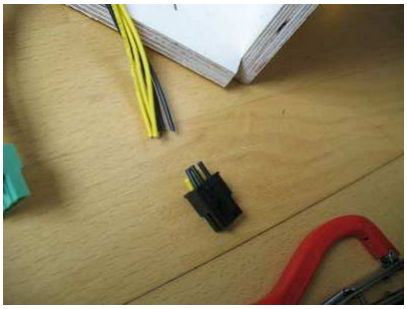
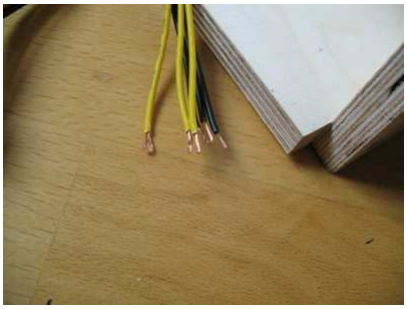
Twist all wires of the same color together.



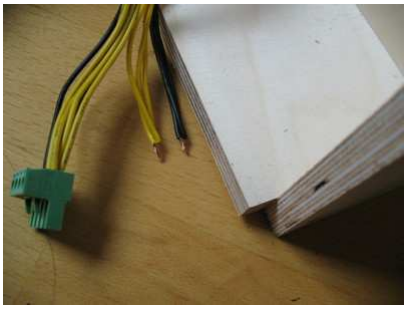
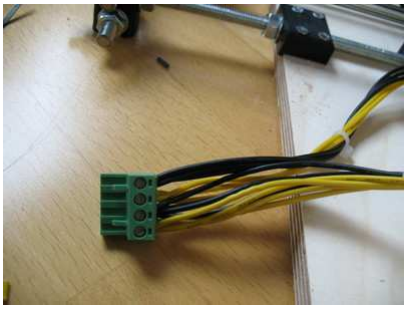
Attach them to the power connector as shown. Make sure all 8 are tightly held inside.



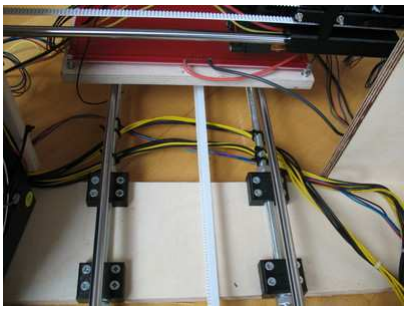
Same drill with the 3 yellow / 3 black cable. Cut, strip.

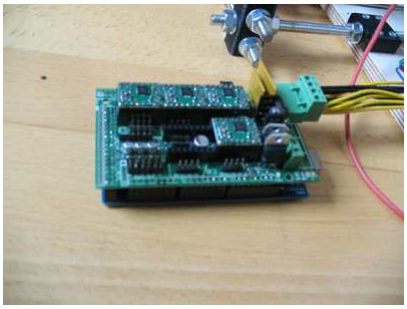
Twist and attach.

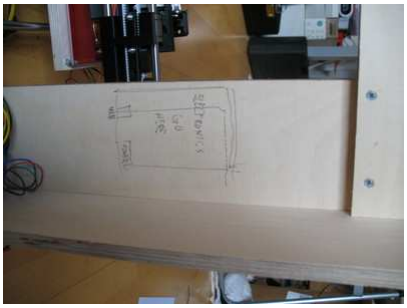
Route the Z motor cable on the power supply side under the threaded rods as well.



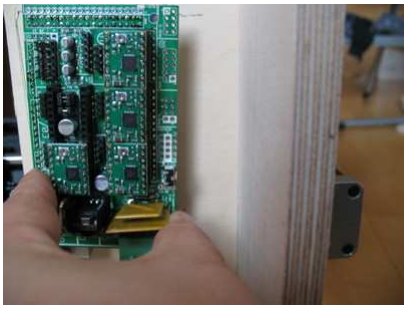
Plug the power connector into your electonics.



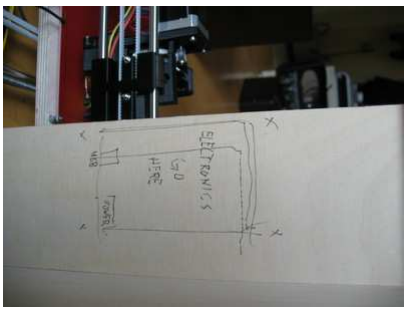
Place the electronics about halfway up the frame, about 1cm from the inside edge. Use a marker to mark the approximate outline.

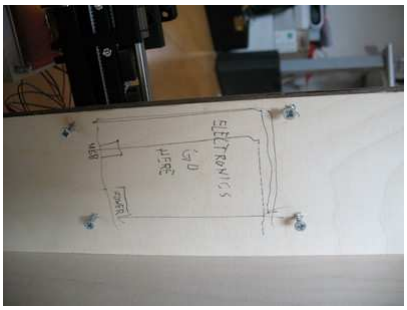
This is where your electronics go relative to the edge.



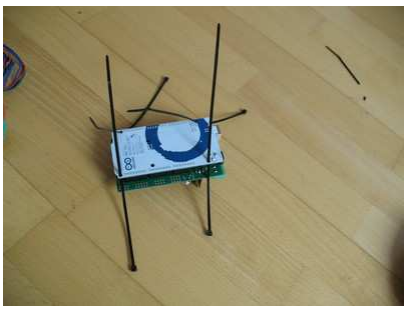
Mark an X about 2cm above the upper corners and below the lower corners.



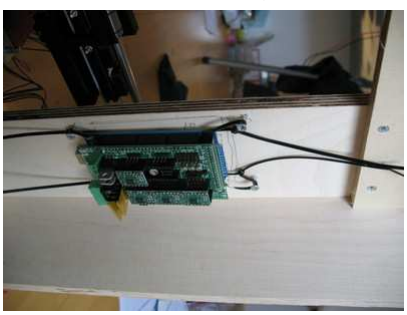
Drive a screw into each X.



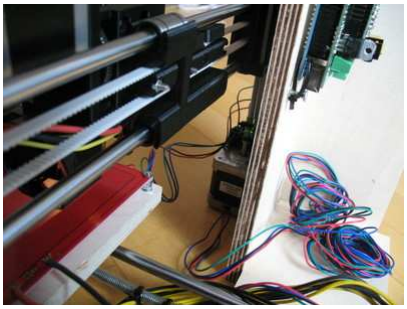
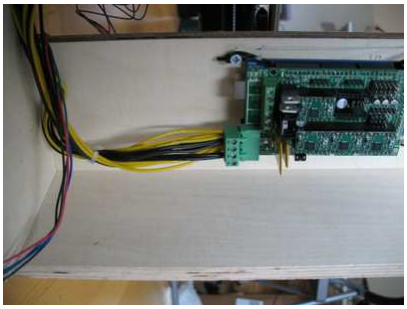
Detach the power connector and run a ziptie through each of the 4 mounting holes in the corners of the Arduino.



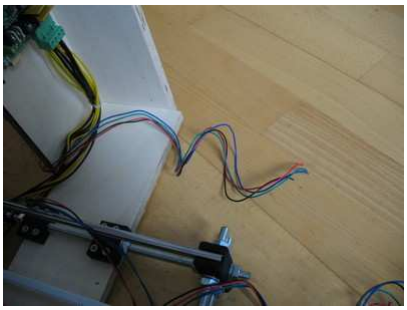
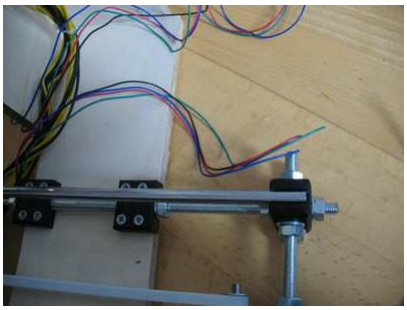

Attach the arduino, USB and power connector down, to the 4 screws.



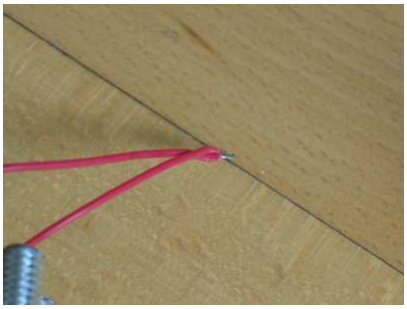
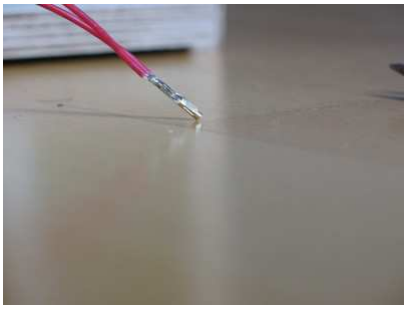

Pull the Z motor cables into the frame. Reattach the power connector.

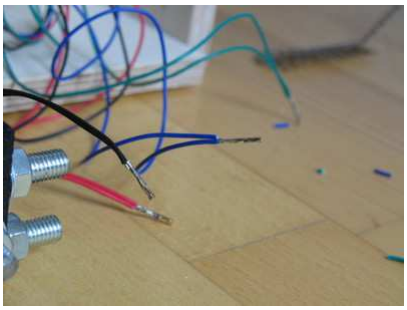
Cut cables coming from both Z motors to about the length shown. A bit longer is no problem.

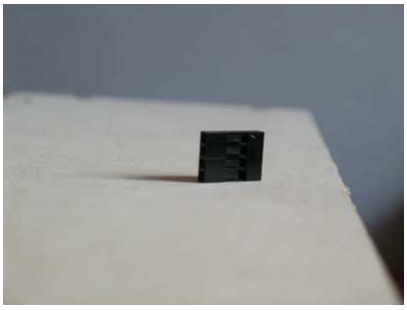
Strip the two red wires and twist them together. Attach a crimp pin to the twisted part.

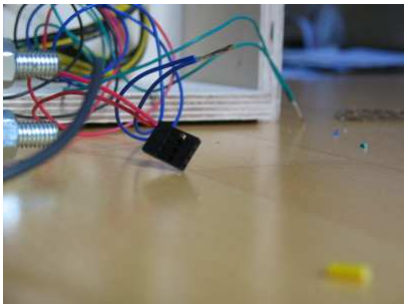
Repeat with the other colors.



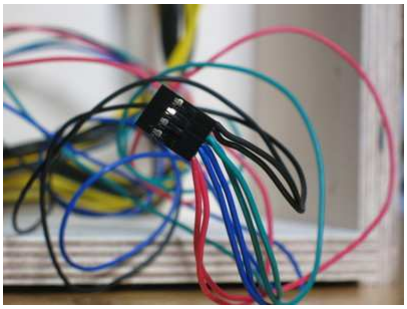
Take a crimp housing. Note where the bit with the triangle is.



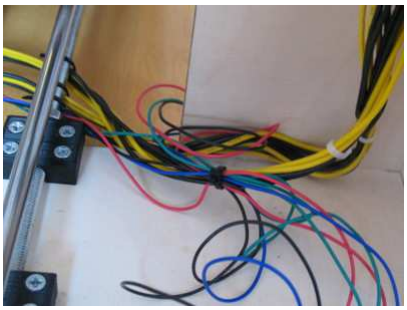
Insert the red wire into the crimp housing where the triangle is. It must click TWICE.

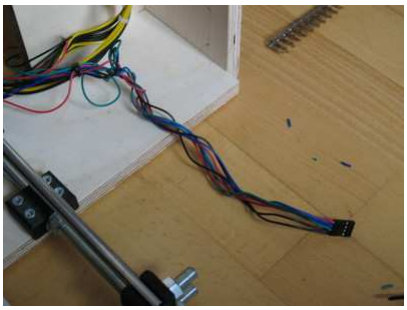


Repeat for the other wires in the order RED-BLUE-GREEN-BLACK.

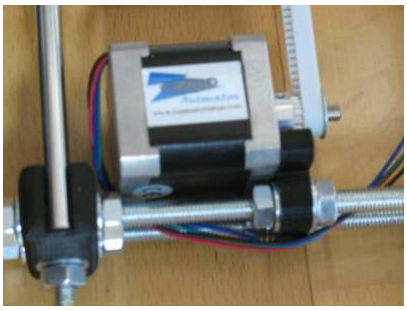


Tie the Z motor cable to the power cables and twist the wires to make them neater.

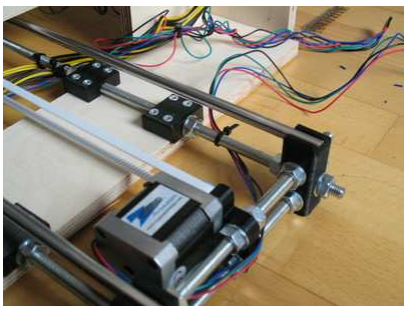




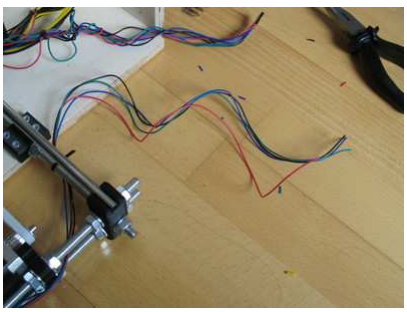
Route the Y motor wiring as shown:



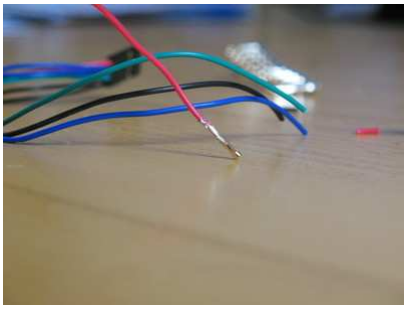
Ziptie it to the threaded rod next to the electronics.



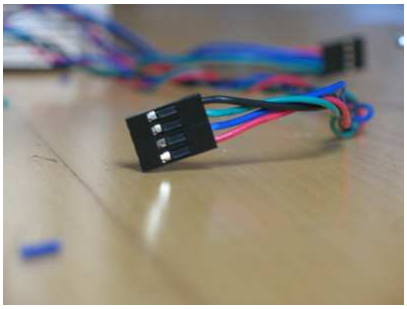
Cut the wires about as long as on the Z.



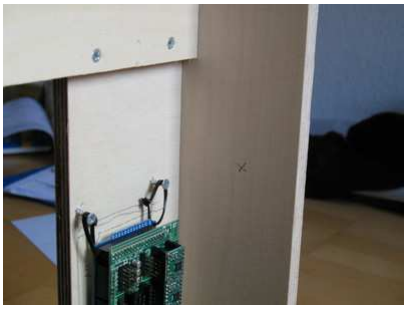
Strip each wire and crimp it, this time crimping both the exposed wire and the insulation.



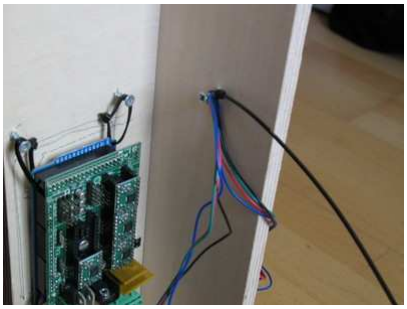
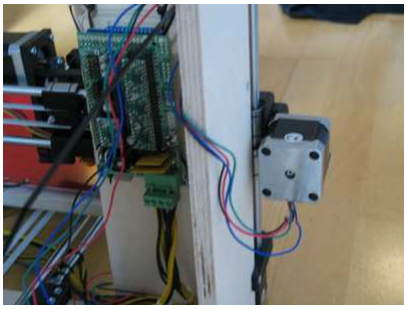
And insert into the housing as before. RED-BLUE-GREEN-BLACK.



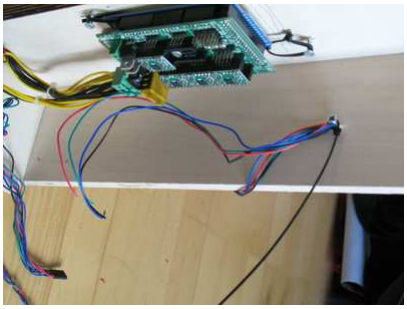
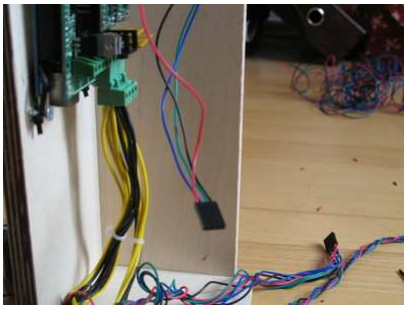
Mark an X slightly higher than the electronics on the side wall and put a screw into it.



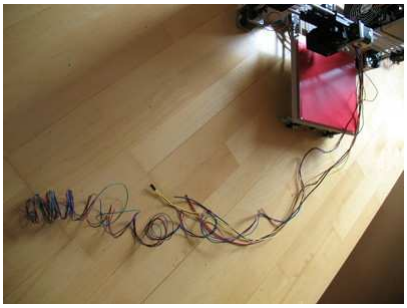
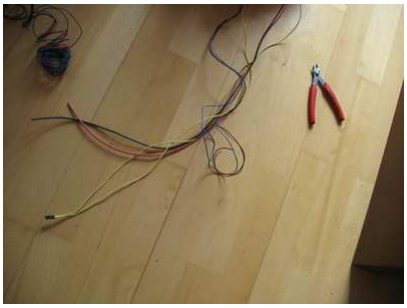

Attach the X motor wires to the screw with a ziptie, making sure they have plenty of space to move on the outside. The X motor has to be able to go all the way up and down the axis without the wires stretching.

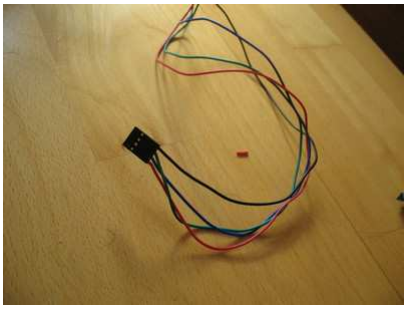
Cut the wires to size as shown, then strip and crimp. Insert into housing, RED-BLUE-GREEN-BLACK.

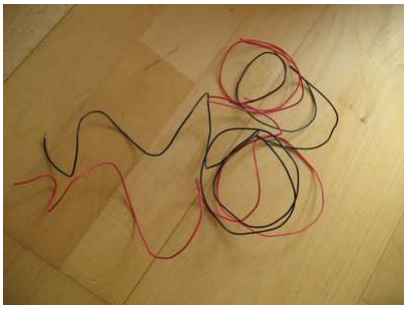
Take all the wires coming from the extruder. Cut the motor wires so they are as long as the thick wires from the hotend resistor.

Strip, crimp, insert. Red-Blue-Green-Black. You know the drill.



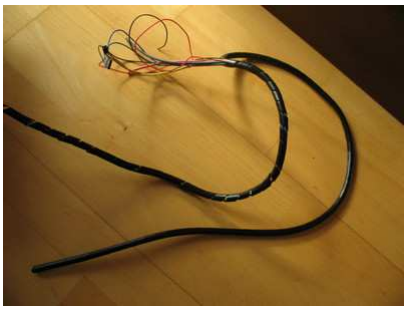
Find some leftover red and black wiring from your motors.



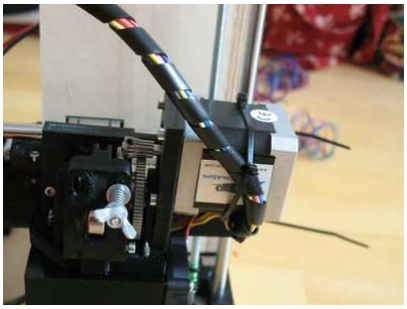
Strip the ends and twist them together with the wires coming from your hotend fan. Insulate with some Kapton or electrical tape.

Take the thicker cable wrap tubing.

Wrap it around the bundle of cables leaving some 10cm at the end. Cut off the remaining wrap tubing.



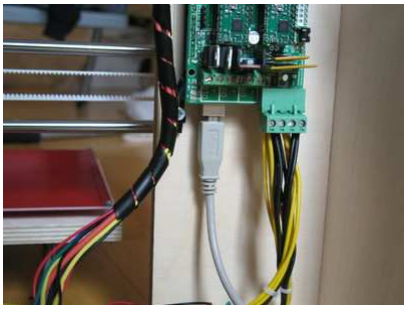
Using two zipties attached to each other, tie the cable bundle to the outside of the extruder motor, making sure none of the cables interfere with the hotend or fan.



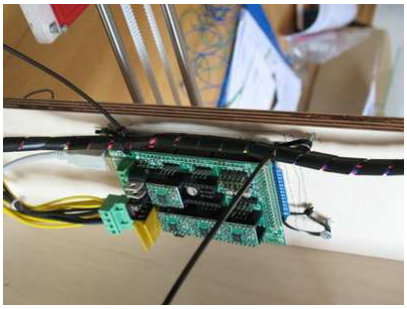
Mark and place a screw in the vertical panel.


Attach the USB cable to your electronics.

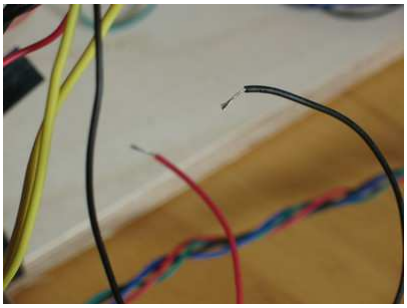
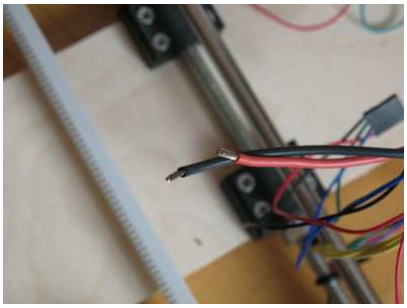
Leaving enough slack for the extruder to reach the far bottom, away from the electronics, without stretching the cable, route the cable bundle over the screw you just placed and along the electronics.



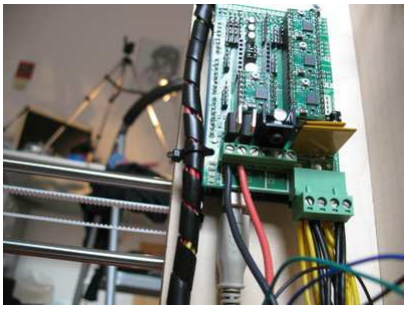
Ziptie it to screw you just placed, to the RAMPS mounting hole and to the top electronics mounting screw.



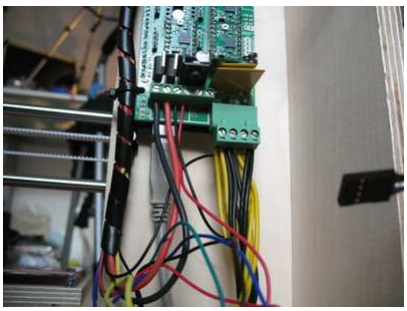
Strip the ends of the fan and hotend resistor cables.

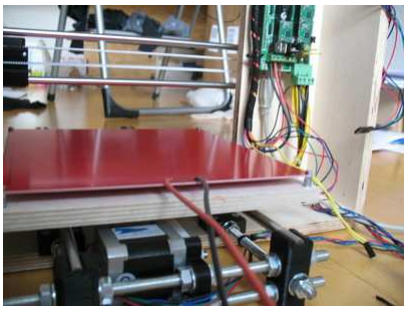
Insert the hotend cables as shown:



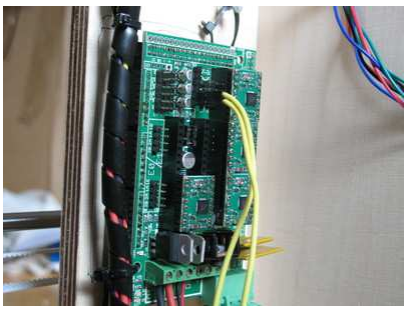
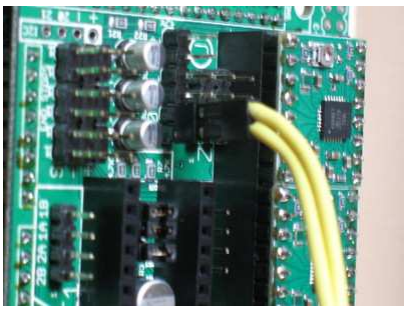
Repeat with the fan cables:



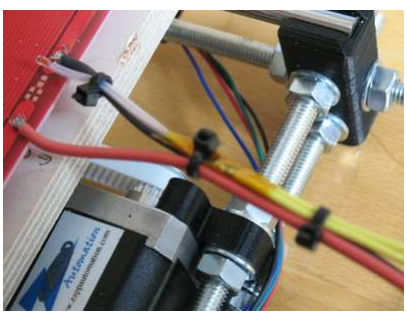
Make sure the cables do not interfere with the bed. If necessary, ziptie them out of the way.



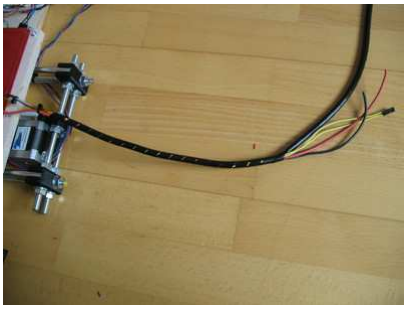
Plug in the hotend thermistor cable:

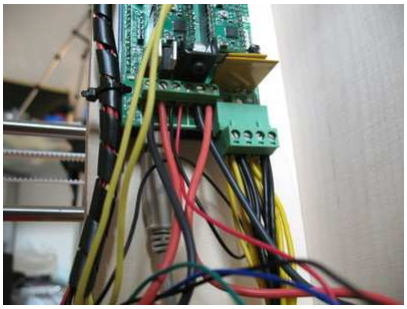
Attach the bed thermistor to the bed as shown:



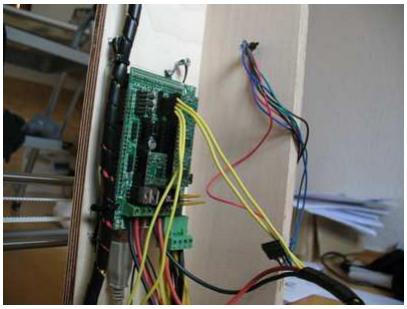
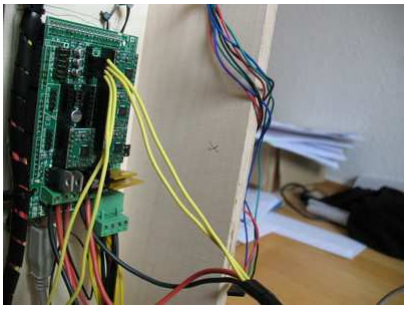
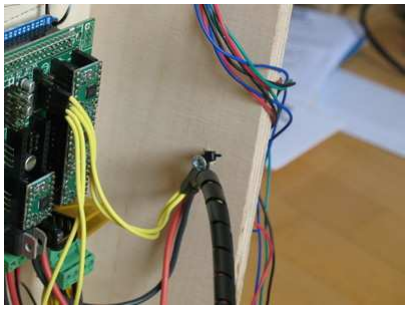

Wrap the remaining thick cable wrap tubing around the bed heater and thermistor wires. Leave some 15cm on the end unwrapped and cut the wrap tubing.



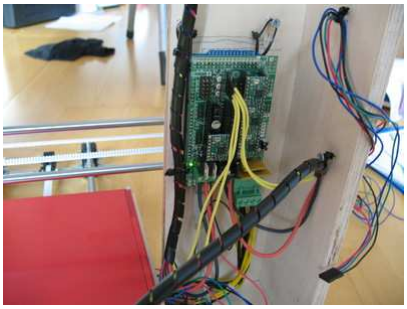
Connect the bed heater wires to your electronics as shown.



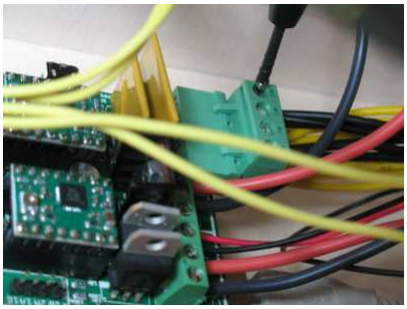
Connect the bed thermistor and attach the wires to the frame so they don't move around as shown.

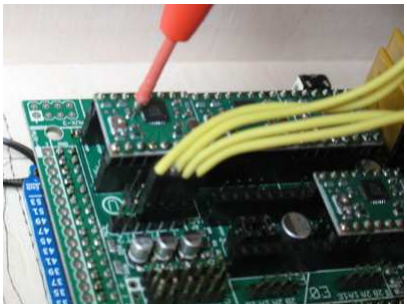
Plug the USB cable into a powered USB port. The LED on your electronics should blink.

Set your multimeter to measure DC voltage. Place the black probe of the multimeter on the outermost RAMPS power connector screw, over the black wires.

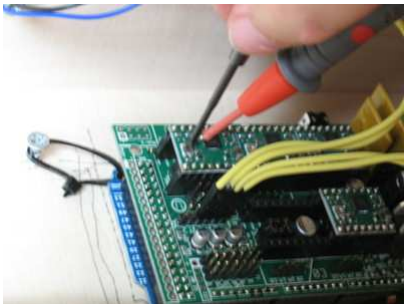


With your other hand, place the red probe on the little silver circle (via) near the chip on the Z motor driver as shown.

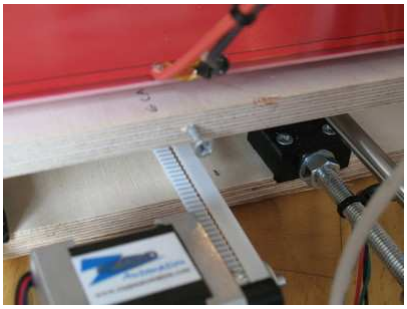
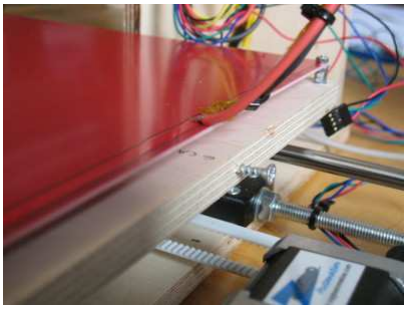
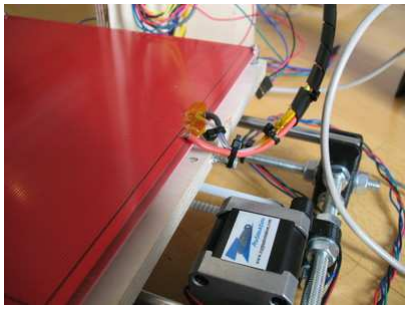


With your third hand, adjust the potentiometer (little screwable thing) until your multimeter shows 0.4V. If you have less than three hands, either get someone to help you or adjust in small increments and measure in between.

Repeat for all the motor drivers.

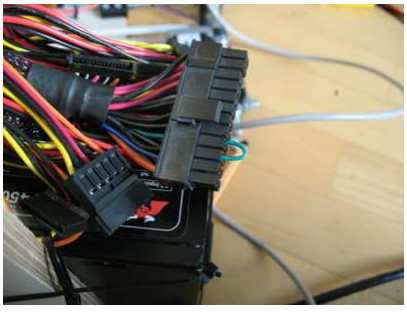



Tie down the bed wires with a screw so they don't move around when the bed does.

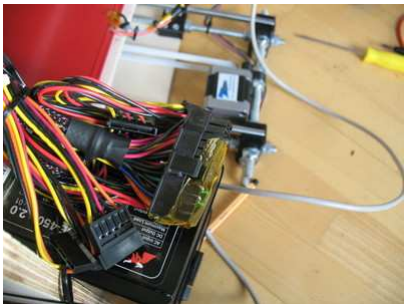




Take a piece of the leftover motor wires and strip both ends.

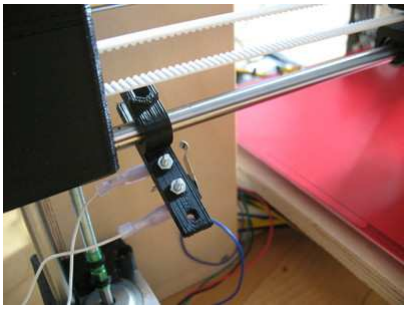
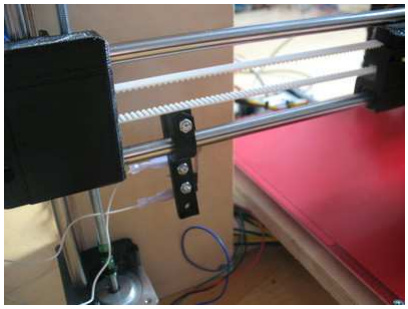

Insert it into the ATX power connector so it shorts the green wire to the black, as shown.



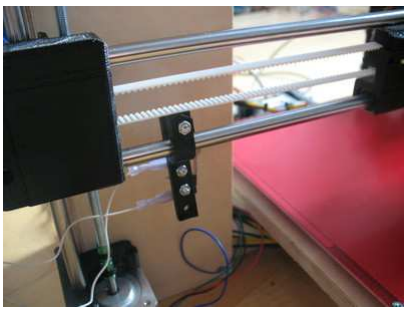
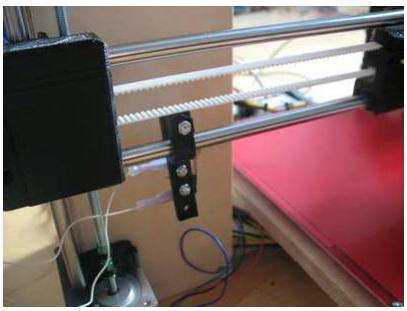
Cover the contraption with a bit of Kapton.



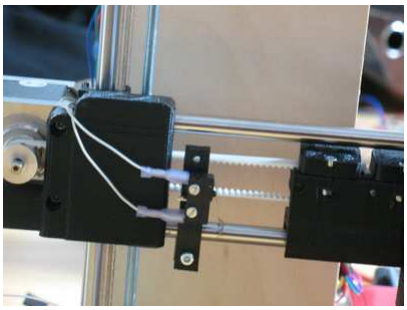
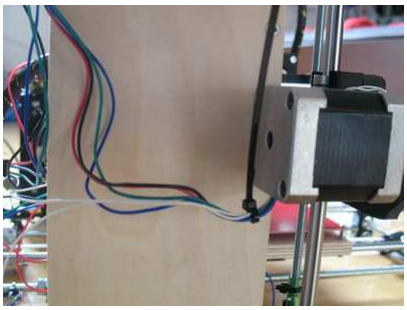
Using an M3 bolt and nut, Attach the endstop with the TWO WHITE WIRES to the X axis on the motor end as shown.

Rotate the endstop so it's in the way of the carriage and triggers when the nozzle is over the mounting nut in the corner of the bed.

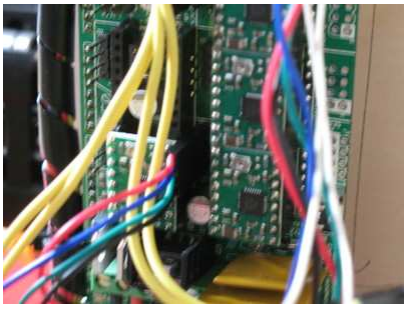



Tighten the nut, and route the wire as shown:

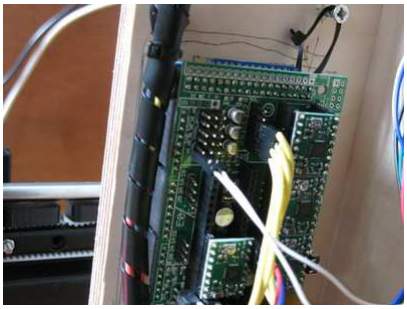



Use the thinner cable wrap to join the endstop wires together with the motor wires.

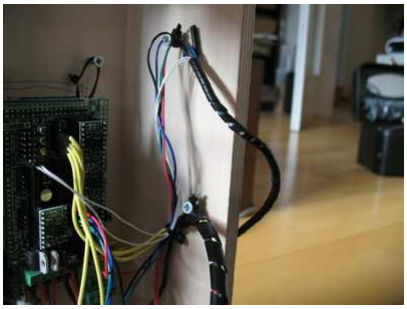
Plug the X axis motor cable into the electronics as shown, red wire goes on top.



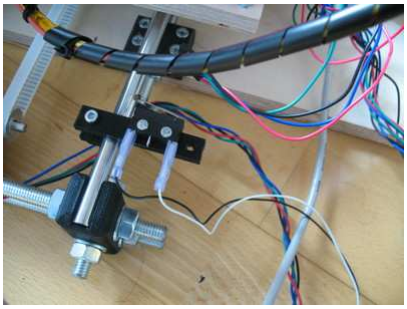
Plug in the endstop wire as shown too.



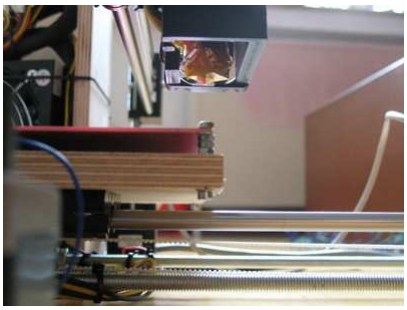
Ziptie the motor and endstop wire to the bed wires.

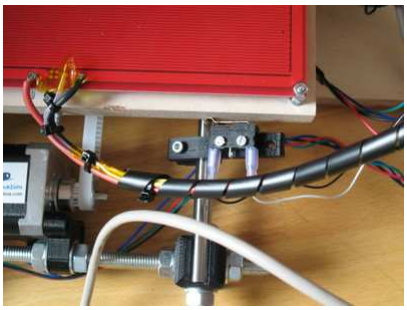


Attach the Y endstop (with the two different-color cables) as shown

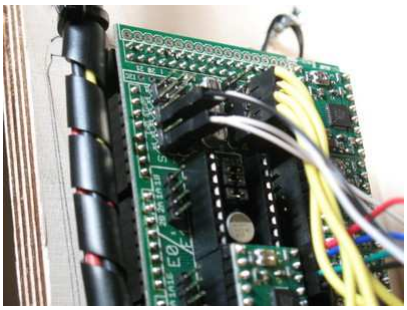


When the bed goes into the frame such that the extruder nozzle is at the front of the bed, over the nut in the corner of the bed, the endstop should trigger.

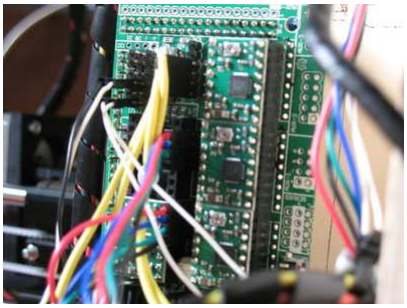




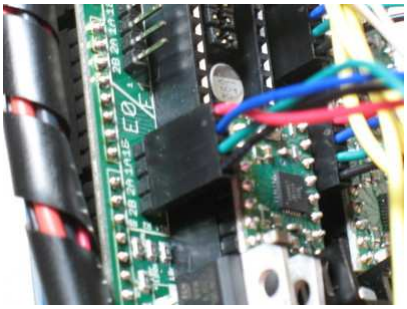
Plug in the Y endstop cable. Note the gap between the X and Y endstops.



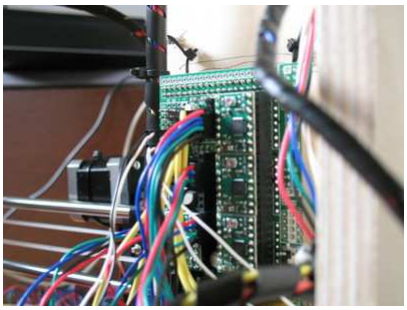
Plug in the Y motor cable, red wire on top.



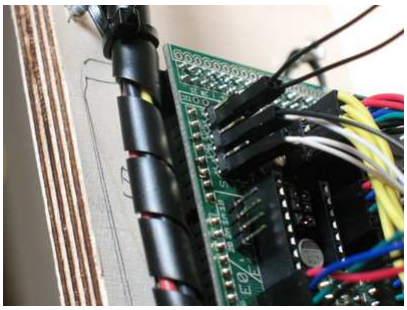
Plug in the extruder motor cable, red wire on top.



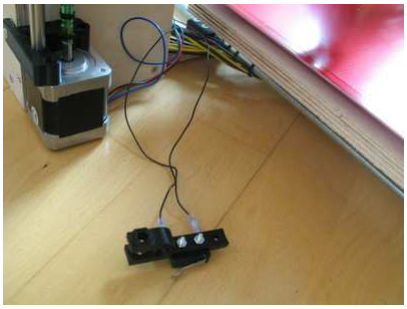
Plug in the Z motor cable, red wires on top.

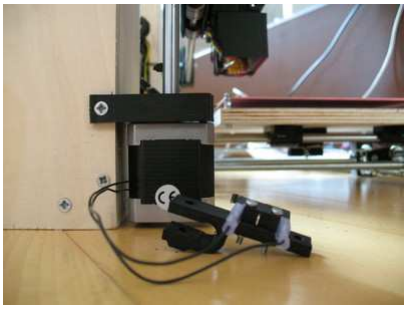


Plug in the Z endstop, with the two black cables.

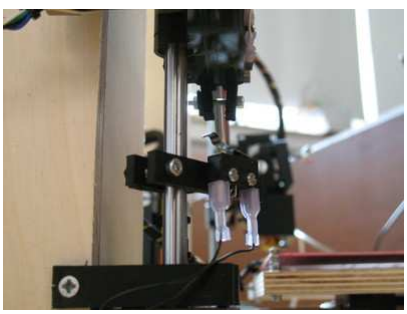


Route the cables through the frame, under the motor.

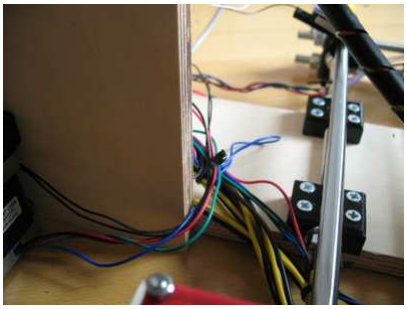




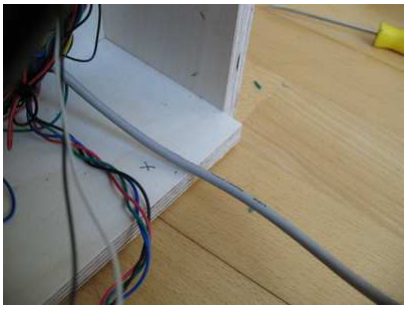
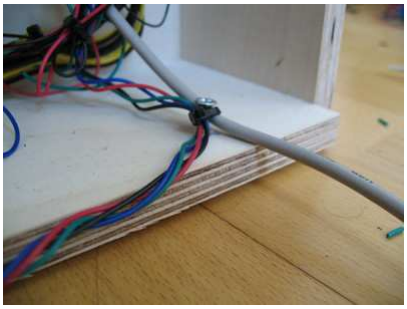
Attach the endstop, but do not yet tighten it.



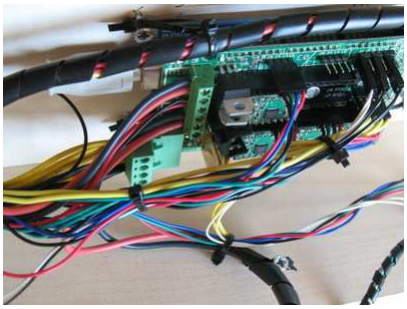
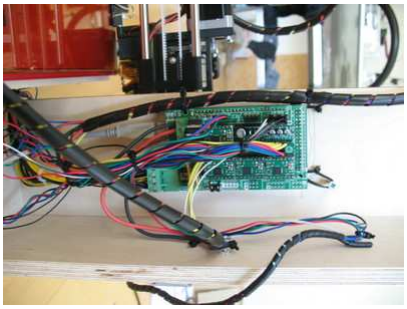
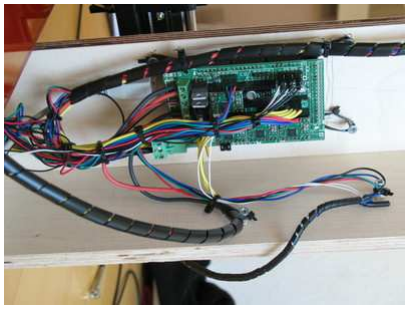
Ziptie the cables to the Z motor cables.



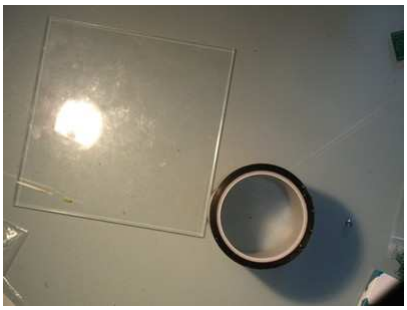
Attach the Y motor cables and the USB cable to a screw on the bottom of the frame.

Going from top to bottom, ziptie the wires into a neat bundle

Take your glass plate, kapton tape, tissue paper and a bowl of water.

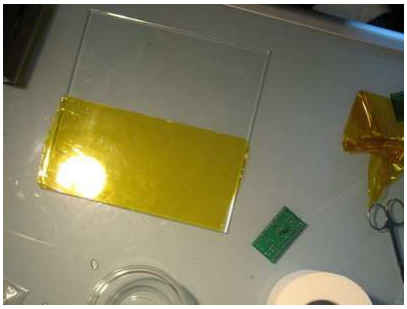



Generously wet the plate.

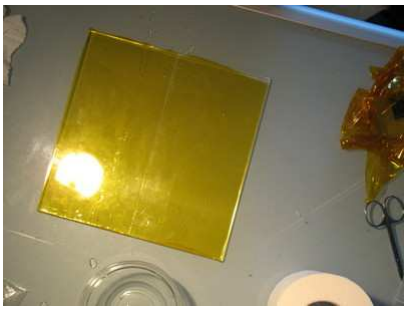
Tape some Kapton to the table, stretch it, and position the glass plate underneath it.

Use a flat object to push the Kapton onto the glass. Avoid bubbles. If you do get bubbles, use the flat object to push them to the side.

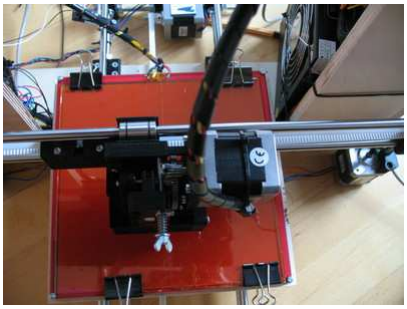
Cut the Kapton on both sides.



Once dry, wet the remaining plate and do it again. Try to align the two Kapton stripes so that there is no overlap and minimal gaps.



Clamp the glass, Kapton side up, to the bed.



And you're done with mechanical assembly.

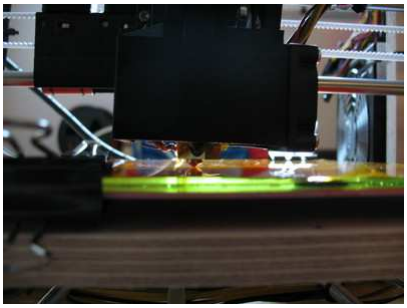
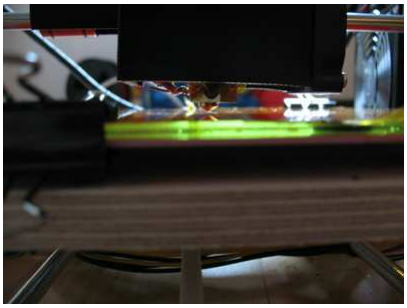
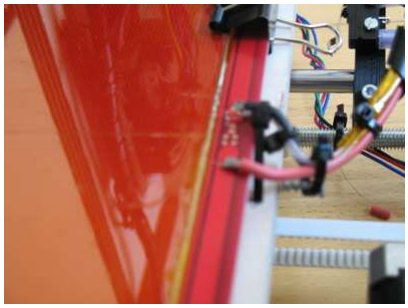
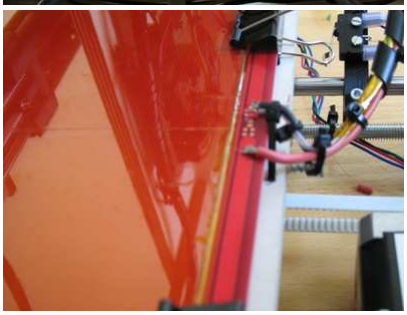
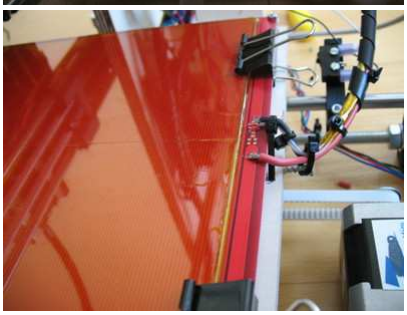
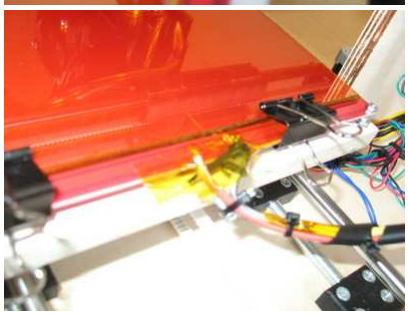
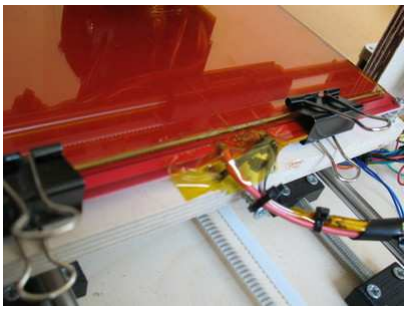
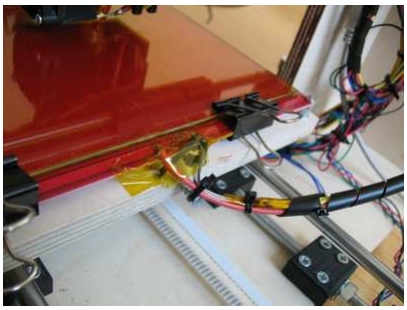
- Back to TOC
- Forward to Software setup

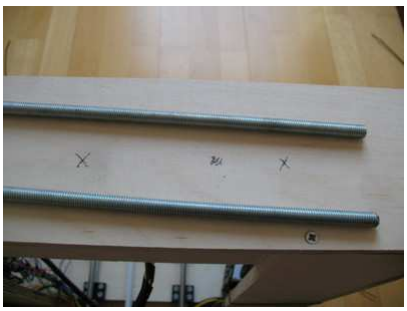
Software setup, Z leveling and optional spool holder.

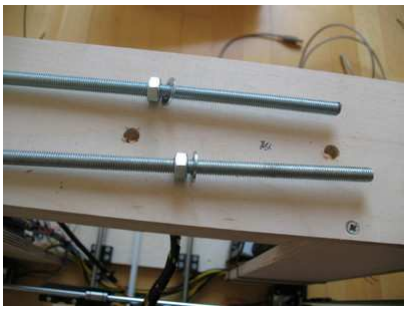
Tools needed

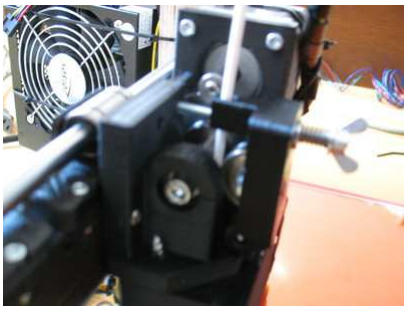
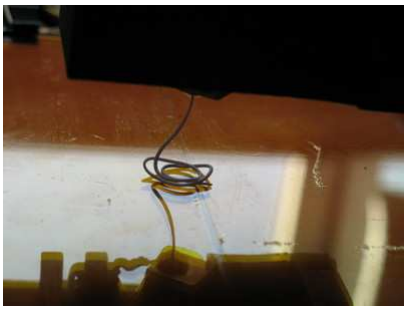
- Computer
- Internet connection
- Tweezers
- Sheet of paper (optional)
- Drill
- Marker
- Side cutters
- Zipties

(click any image to make it bigger)





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