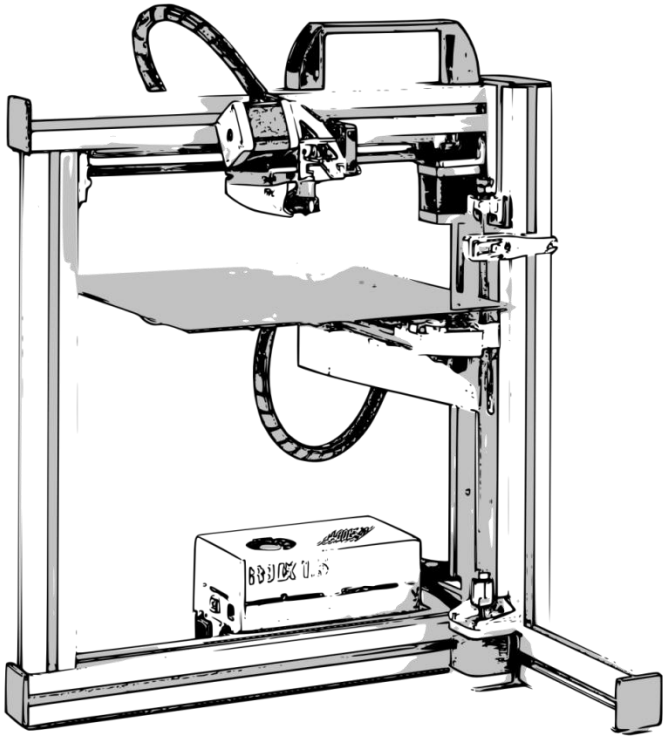
Instruction manual

Felix 2.0, 3d printer-kit

Version2 – 12-April-2013



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1 CONTENTS

2 INTRODUCTION

First of all thank you choosing FELIXprinters! To get your Felix printer up and running as fast and painless as possible please follow this manual carefully. When things are unclear or if you have any remarks or tips, please contact us at info@felixprinters.com. We also recommend looking on our forum and get yourself a forum account. You will benefit from the ability to get downloadable and printable upgrades for your printer. Also it is a great source to obtain more knowledge about your printer and printing in general.

Depending on your skills this kit will take approximately 4-12 hours to assemble and to make your first print. Please read the manual carefully and follow it step by step. Please don't make any shortcuts unless you know what you're doing. It's better to spend a few minutes extra on reading, than to wait a week for new parts.

The manual is build up as follows: Each module starts with a short introduction. After that a Bill of Materials (BOM) is presented. The BOM doesn't contain the small bolts and nuts, because for the assembly of the printer the assortment box of bolts and nuts is required. Further to not bloat the manual, a picture of each part is only displayed in the complete BOM of the printer. This can be found in the Supplement at the end of the manual.

Before starting the build of your printer, it's recommended to check if all parts are present by comparing it with the bill of materials.

3 SPECIFICATIONS

Printing			**Electrical**	
Print Technology	Fused Filament Fabrication		AC input:	100-240V, 50-60 Hz
Build Volume	25.5 x 20.5 x 23.5 cm		Power Requirements	12V DC, 15 Amps
Print Quality	Extreme High Medium Low	50 microns 100 microns 250 microns 320 microns	Connectivity	USB
Postioning Precision	XY: 13 microns Z: 0.4 microns			
Filament Diameter	1.75 mm		**Mechanical**	
Nozzle Diameter	0.35 mm		Chassis	Aluminum profiles
			Build platform	Aluminum plate
Software			XY Bearings	Linear ball bearings
Software Bundle:	RepetierHost + Skeinforge/SFACT		Z bearing	Linear ball bearings
File Types:	.STL		Stepper Motors	1.8 deg angle 1/16 micro-stepping
Supports:	Windows, XP and newer			
	Linux (Ubuntu 12.04+)			
	Mac OS X [10.6/10.7/10.8]			
Physical Dimensions				
Weight	7.5kg			
Shipping Weight	11 kg			
Shipping Box	50x30x30 cm, DIY kit 50x50x60 cm, Assembled unit			
Temperature				
Ambient operating temperature	15-32 °C [60 – 90 °F]			
Storage temperature	0 – 32 °C			
Warmup time				
Heated bed (60 degC)	3 min			
Nozzle (200degC)	1 min			

4 REQUIRED TOOLSET

The following tools are minimally required to assemble and use the Felix printer

Wrenches 7 and 13mm	
Tweezers. (included in kit)	
Nippers.	
Caliper	
Allen Key set. IMPORTANT: they need to be preferably long and have a round head at the end.	 
Pliers	
Drill with a variable speed. When plastic parts need to be drilled out, it should be done with care	
Level	
Drill bits 4, 5mm	
Hammer	
Wire stripper, recommended	
Detergent (Spirit, Acetone, Alcohol)	

5 REQUIRED SKILLS

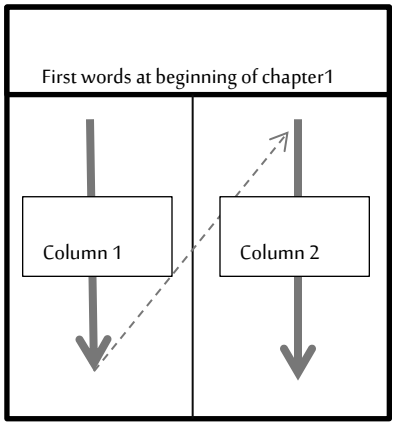
The following skills are required to put the Felix printer together:

- Basic soldering skills
- Skills to assemble a mechanical construction
- Technical insight
- Common sense

If you lack any of these skills or are unsure please get help from someone who can guide you or do this for you

6 IMPORTANT NOTE

To save paper the flow of the document is built up as follows:



7 MODULE 1: FRAME (TIME: 10-30 MINUTES)

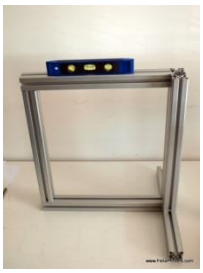
Required for this module

Tools

- Allen key set
- Level reference surface
- Level

Parts

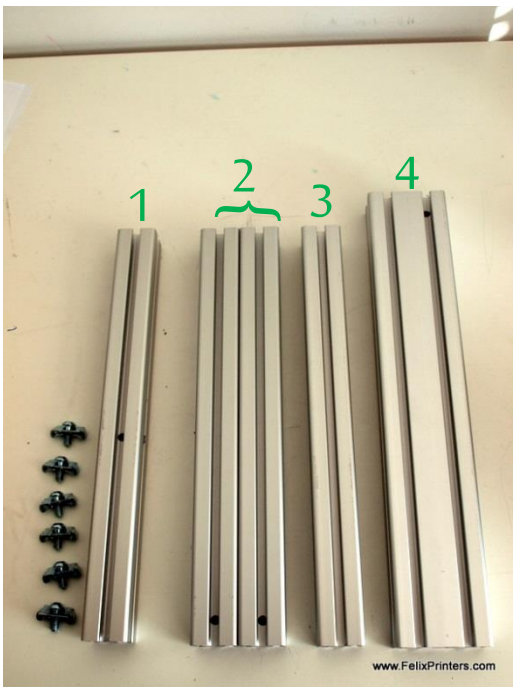
- Bag with description 'frame module'.
- Aluminum beams.



Overview of frame module

The goal of this module is to create the frame on the right. Try to make everything as perpendicular as possible to each other. Let surfaces align as good as possible. A good idea is to use a level tool.

BOM for frame module	
Part	**Amount**
40x40x400 profile, incl 2xM8	1
40x40x400 profile, incl 1xM8, 1xD7	2
40x40x400 profile, incl 3xD7	1
80x40x440 incl work	1
40x40 protective caps	4
80x40 protective caps	1
frame connector set	6
handle incl protective cap	1
hex sockethead bolt M6x1(or M8, depends on the used handle type)	2
t-slot nut - 8 ST M6 (or M8, depends on the used handle type)	2
t-slot nut - 8 ST M4	15
dampning feet	6
strip for putting away cable pieces of 40 cm	2



Collect the parts shown above. Notice the holes in the beams.

To make it understandable, the beams are described as follows:

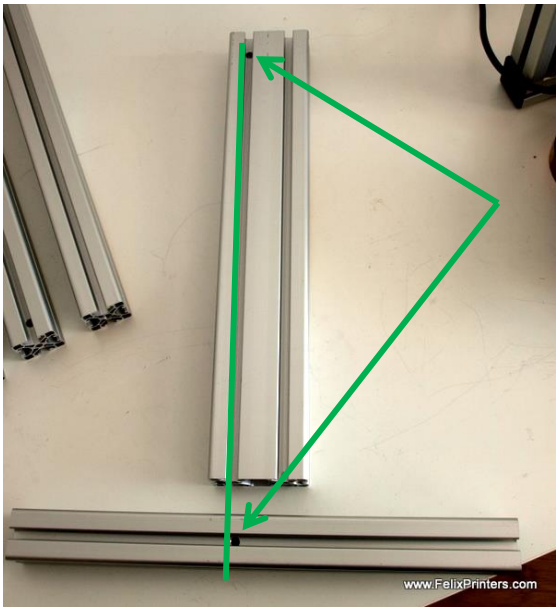
Beam 1: 40x40x400mm beam, has 3 drilled holes

Beam 2: 40x40x400mm beam, has 1 drilled hole and one thread at the far end of the beam

Beam 3: 40x40x400mm beam, has 2 threads at the far ends.

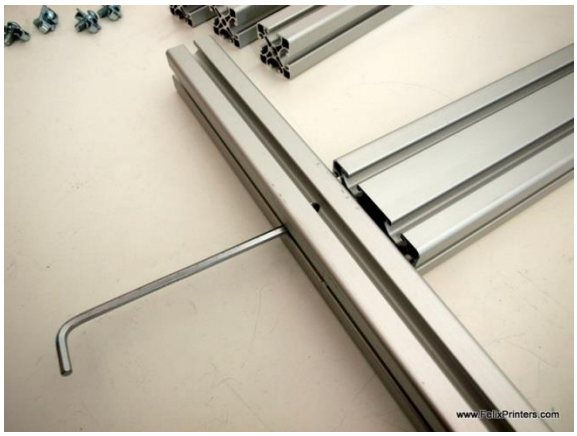
Beam 4: 80x40x440mm beam has one drilled hole and one thread at the bottom.

Some of the beams have a screw thread on the far ends of the beam. These are present for the frame connectors.



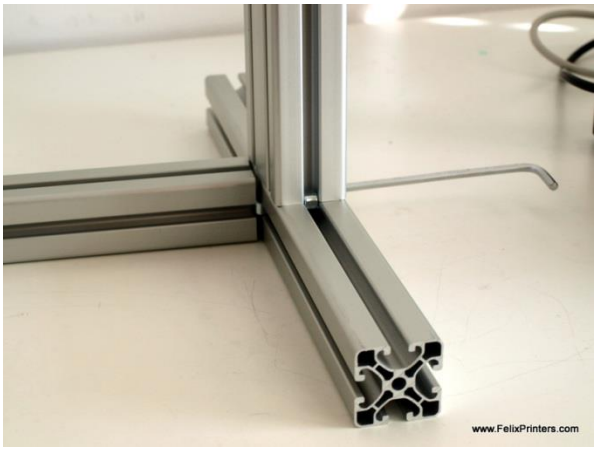
Take beam 4 and 1. They must be connected as oriented in the above picture.

Screw the frame connectors in the bottom of beam 4 as indicated in the figure. Then slide beam 4 onto beam 1.



Slide beam 4 in position. On the side of beam 1 where the hex-key is positioned there are two drilled holes. Tighten the frame connectors by sticking the hex-key through the holes. Do not fix it too tight because fine-tuning/leveling is needed later on.

Slide one of the two beams number 2 onto beam 1. Watch the orientation of the drilled hole.



Turn the frame and fix beam 2 onto beam 1. Again not too tight.

Take beam 3. Screw both frame connectors on the far-ends. Slide it onto beam 2 and tighten it.

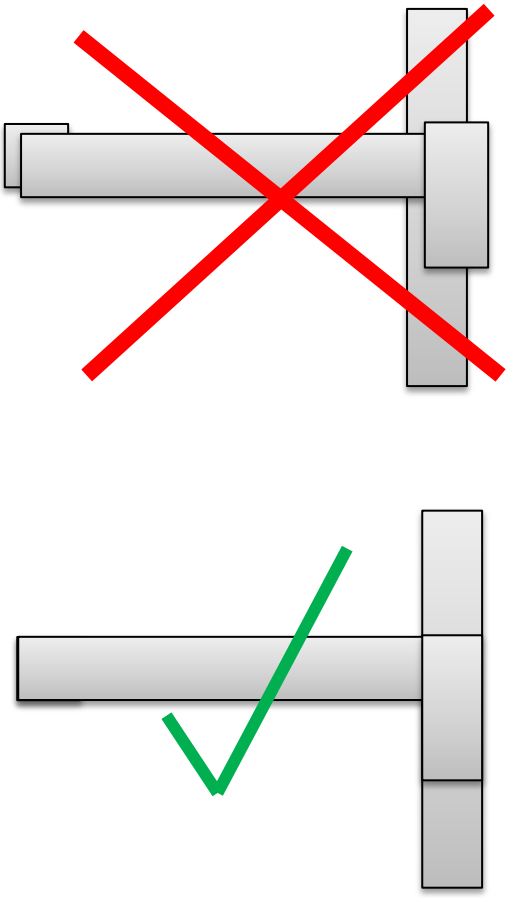
Take beam 2 again and screw the frame connector on it's far end. Then slid it on beam 3 as indicated on the picture.

Next try to slide it also on beam 4.

Thighten the screws, again not too tight.

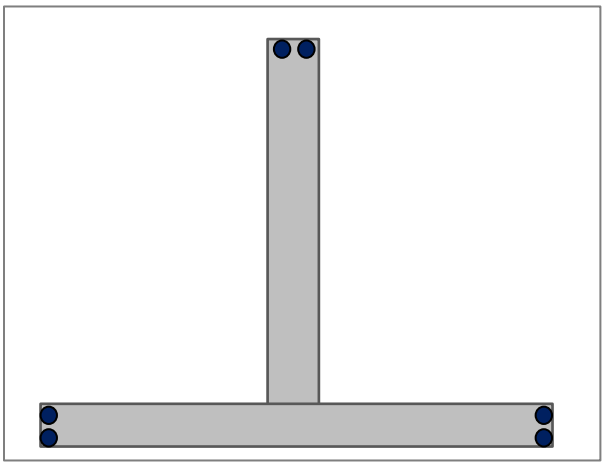
Now it is time for fine-tuning. Try to get every beam as level as possible. Also align the beams as good as possible. See an example in the picture below

Topview of frame



When all the beams are aligned and leveled, it is time to firmly tighten the frame connectors.

Get the protective caps and mount them carefully with a hammer

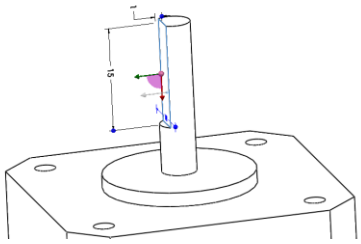


Put the damping feet underneath the frame near the edge

The handle should be mounted in the final stages of assembly.

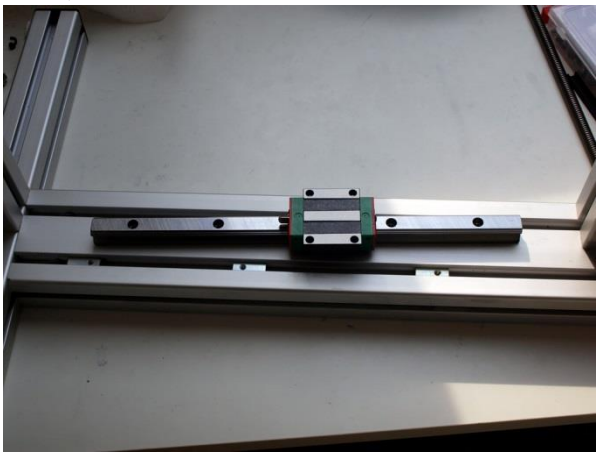
8 MODULE 2: Z-AXIS (TIME: 45-90 MIN.)

Note: Most holes are designed to minimize the need for any post processing, like filing and drilling. Sometimes, however the bolts will not fit smoothly and it therefore needs to be drilled out slightly. Required drill sizes can be 3, 4 and 5mm.

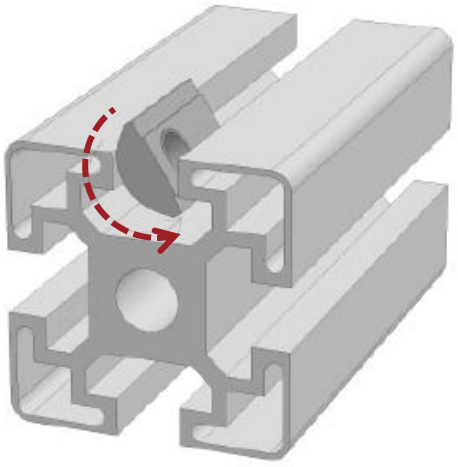


BOM Z-axis	
Part description	**Amount**
Hiwin lineair ball bearing set - HGW15CC1R300Z0	1
Trapezium spindle + bronze nut	1
motor nema 17	2
z-spindelmount bottom - v2	1
pulley_motor_HTD	1
z-axis-motor-bracket_v10_F2	1
z_axis_carrier_pt1_v15_F2_0	1
z_axis_carrier_pt2_v11_F2_0	1
optosensor	2
small bearing	4
z-axis-limitswitch_vane_v6_F2_0	1

Get the parts indicated in the list above.

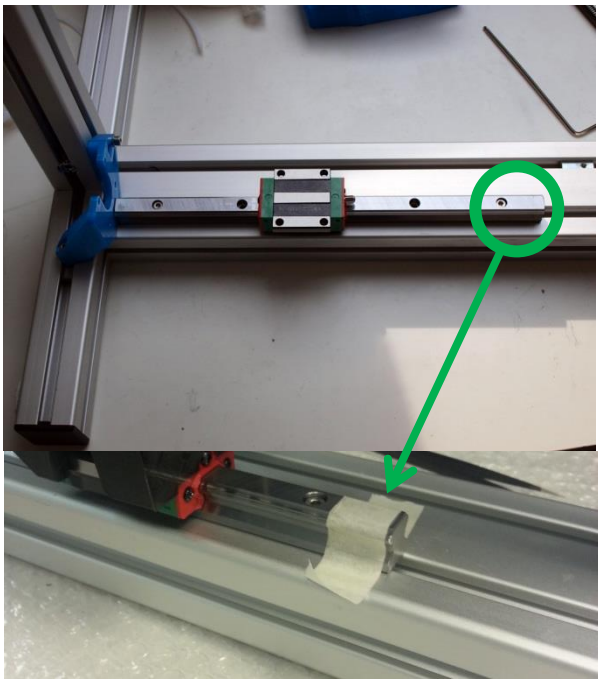


IMPORTANT: DO NOT let the cart of the linear bearing go off the rail. There are small balls in there which might fall out when the cart rolls of the rail.

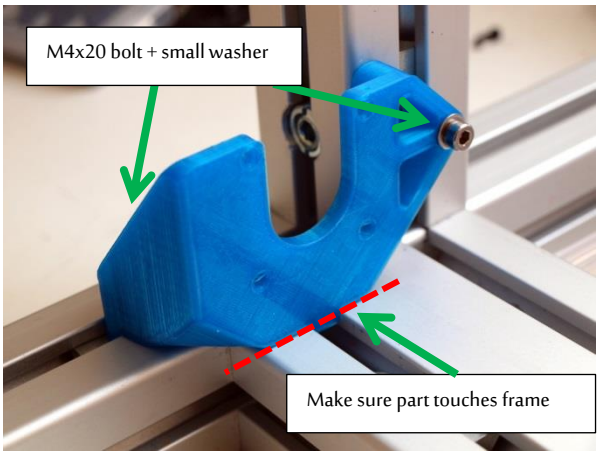


Place the frame on a table let the back face of the wide beam rest on the table surface.

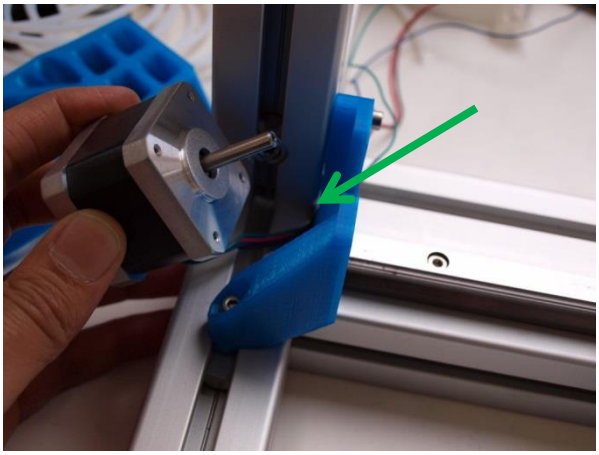
Put three *t_slot nut - 8 ST M4* in the frame as indicated in the picture above.



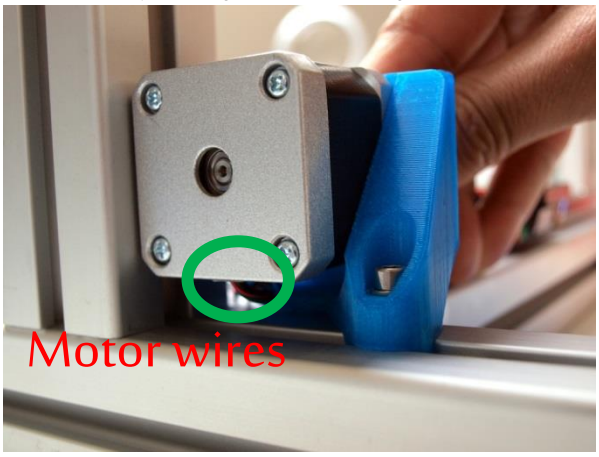
Put some tape on the far edge of the rail to prevent the cart from sliding off.



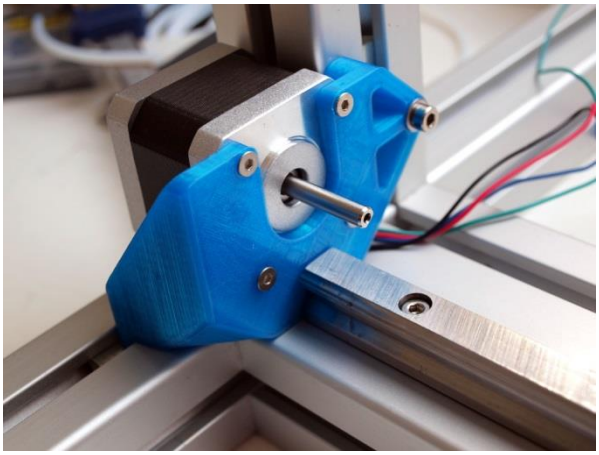
First mount the linear guide loosely onto the frame with M4x20 bolts. Then mount the *z-axis-motor-bracket_v10_F2* onto the frame, indicated above with m4x20 bolts and important use small washers.



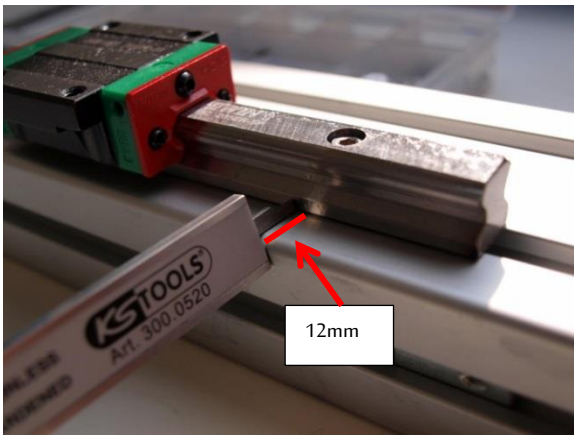
Put the motor in place and guide the wires through the hole



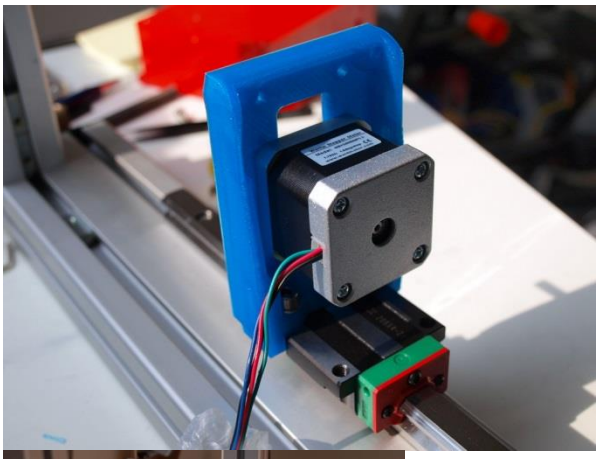
Before mounting the motor make sure the wires are orientated as above

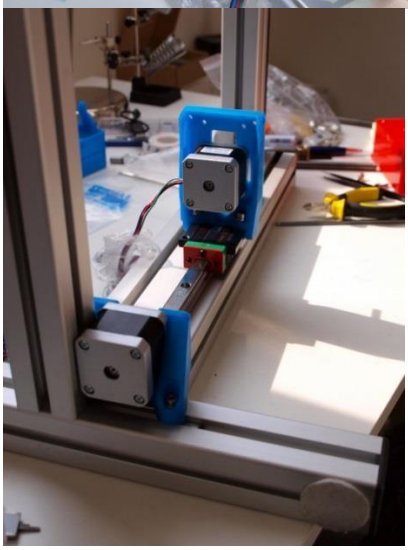


Mount a motor with the m3x8 CSK (countersunk head) bolts.

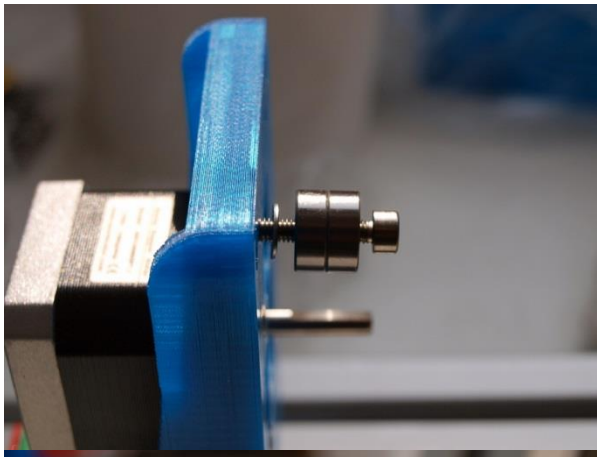


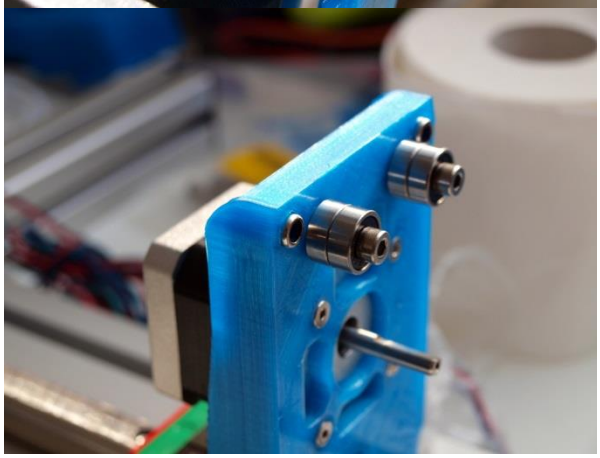
Start to align the z-axis guide. Push the bottom side against the printed part. Measure the distance of the edge as indicated above. The distance should be 12mm.





Mount the z_axis_carrier_pt2_v11_F2_0 onto the cart with two M5x16 bolts. Don't forget to place the m5 washers. Mount a motor onto the plastic part. IMPORTANT: match the orientation of the wires according to the picture.



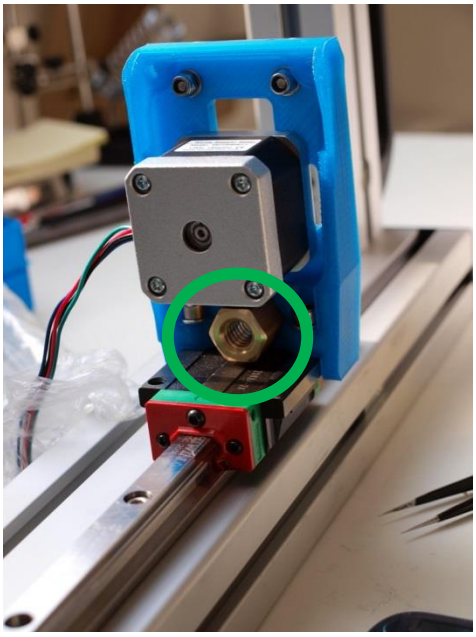


Mount the 2 bearings.

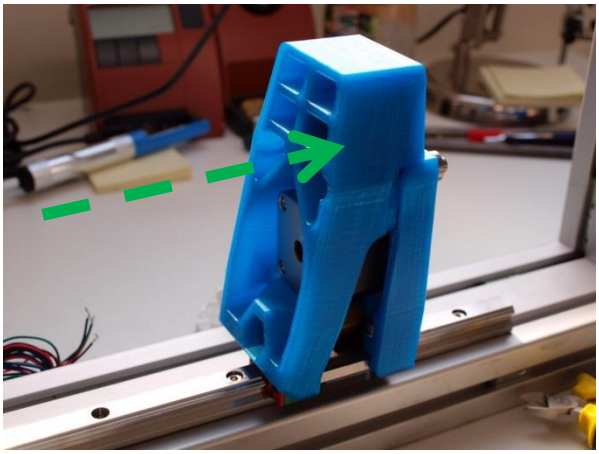
Order from right to left.

M4x25 bolt, 2x small bearing, small washer, plastic part, small washer, M4 self locking nut.

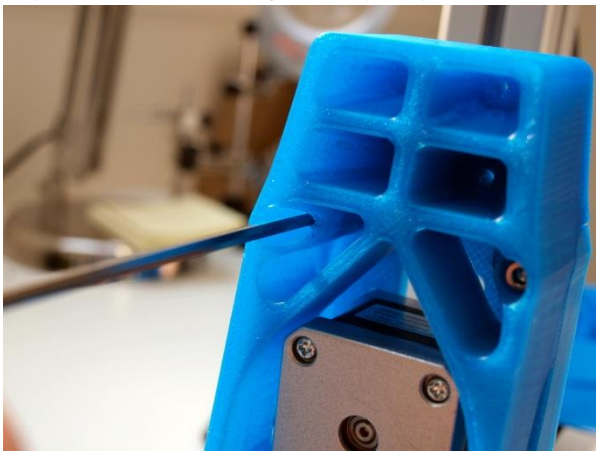
Then insert 2x m4 selflocking nuts besides the just mounted rolls into the plastic part as shown in the picture above.

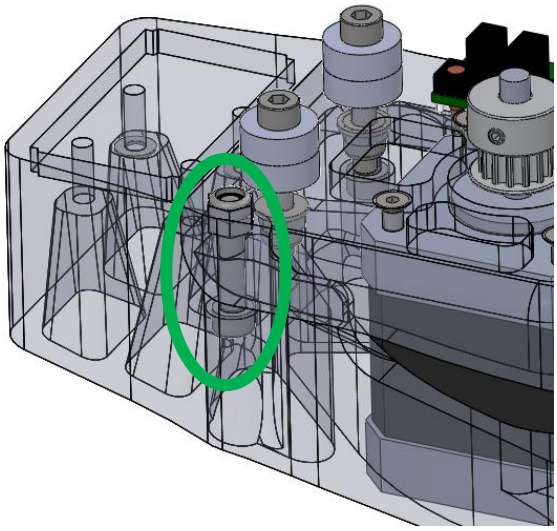


On the bottom insert the bronze nut into the plastic part.

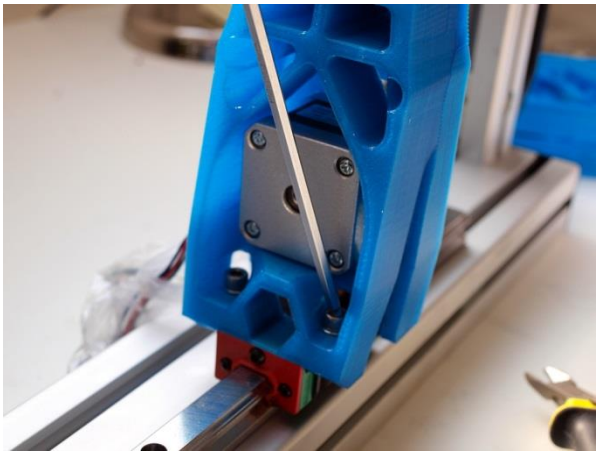


Take the *z_axis_carrier_pt1_v15_F2_0* part and slide it as indicated on the picture above onto the already mounted plastic part.

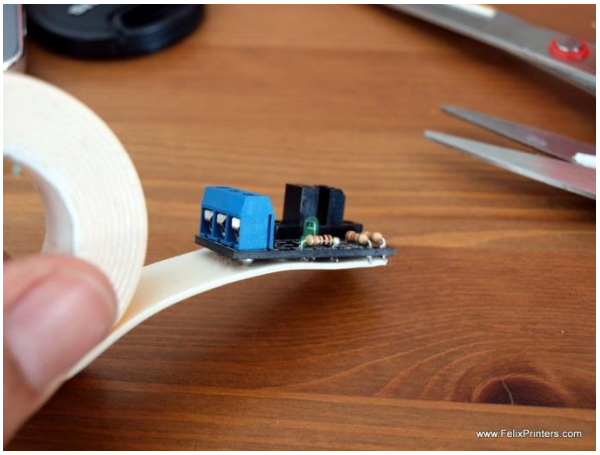




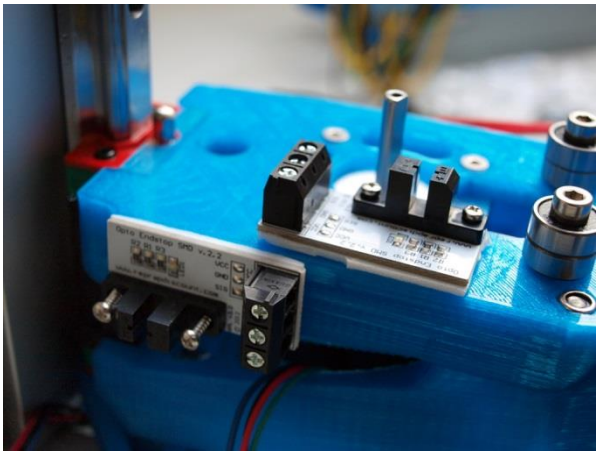
As indicated screw on both sides m4x20 bolts into the part to clamp the 2 big plastic parts together.



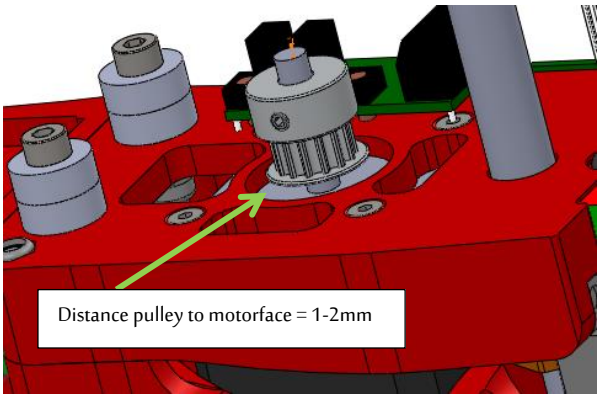
Mount the big part onto the cart of the linear bearing with M5x16 bolts, don't forget the M5 washers!



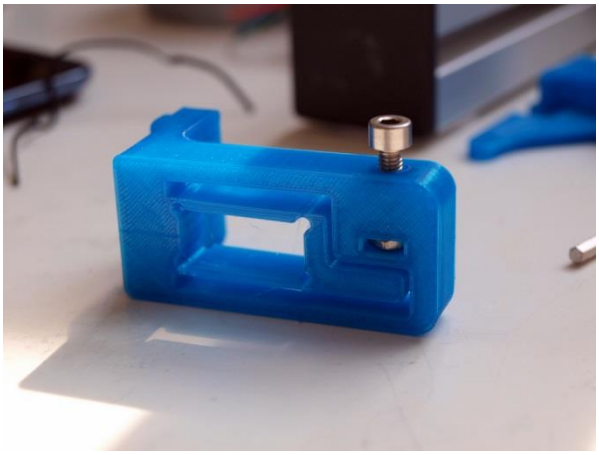
Put a piece of the supplied double side tape underneath 2 opto-sensors

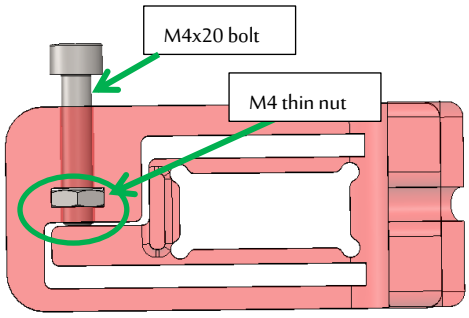


Mount the opto-sensors with the small Philips head screws. (Depending on the delivered batch it could be bronze or stainless steel screws)

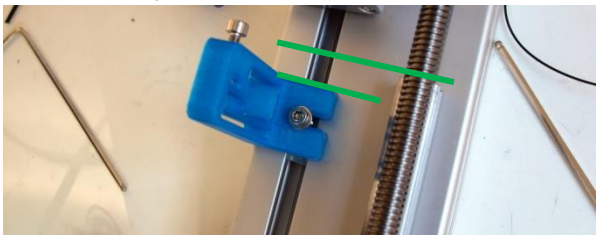


Place the pulley upside down on the motorshaft. The distance of the bottom of the pulley to the faceplate of the motor should be 1-2mm.

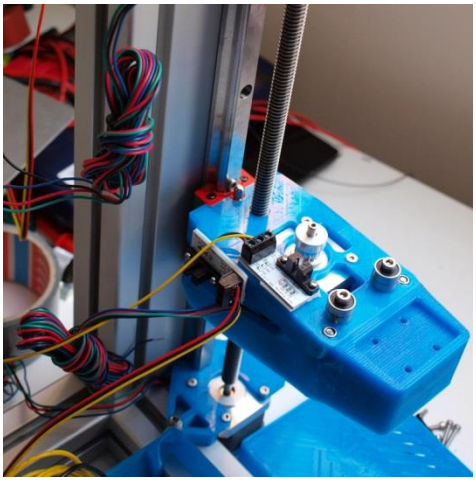


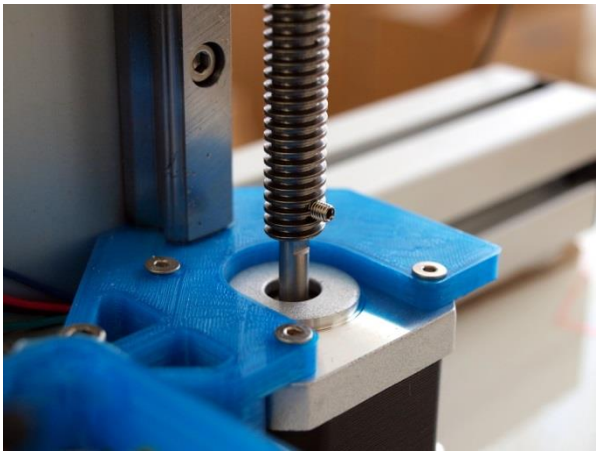


Take the z-axis_limitswitchvane and slide the nut into the slot. On top screw in an m4x20 bolt. Don't screw it all the way in, let the tip of the bolt touch the flange as indicated in the picture.



Mount the z-axis-limitswitch vane with an m4x20 bolt + washer. The bracket should be approx. 1cm from the top of the rail. This is the adjusting mechanism for the z-axis height and will be covered later for finetuning.



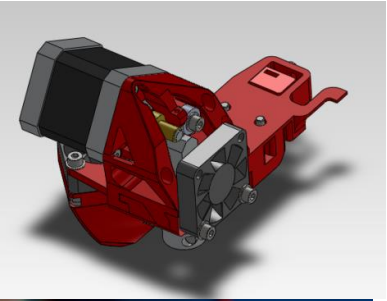


CAREFULLY Screw in the z-axis spindle from the top until it reaches the motor and place the z-axis assembly in the middle. Make sure the brass nut is inside the z-axis carrier assembly.

NOTE: It is important not to force the spindle in because when it is not straight anymore it will affect print-quality.

Congratulations, you've finished the z-axis module.

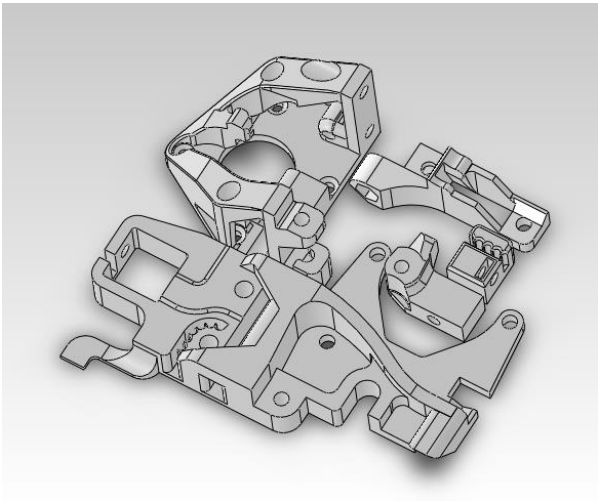
9 MODULE 3: THE EXTRUDER (TIME: 30-90 MIN.)



Collect the following tools

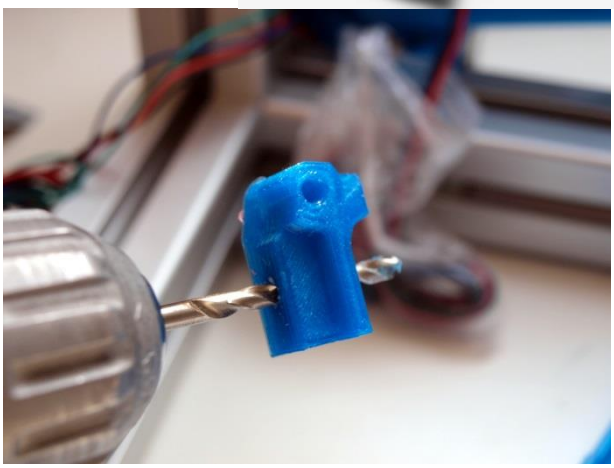
- Allen key set
- Large file
- Drill 4mm

BOM Extruder	
Part description	**Amount**
Extru_base_v9_F1_5	1
Extru_base_pt2_v5_F1_5	1
Extru_base_pt4_F1_5	1
Extru_arm_v5_F_1_5	1
Extru_airduct_v2	1
motor nema 17	1
Fan 40x40x10mm	2
small bearing	1
extruder_insert_piece	1

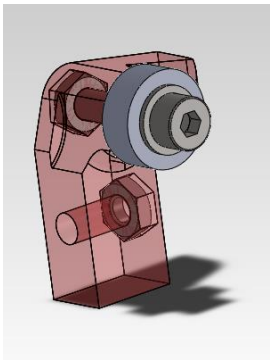


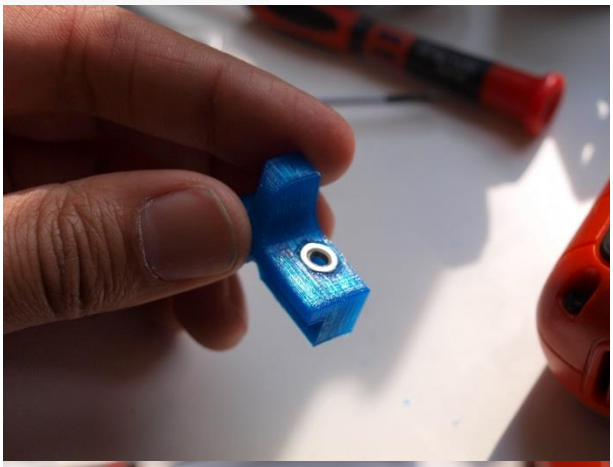
We need the above printed parts

We will create small sub assemblies and then join them together

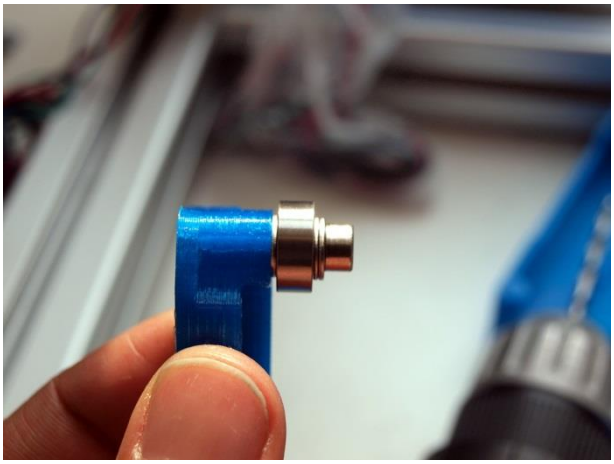


Get the extu_arm part and clean out the hole with a 4mm drill as shown above slowly.



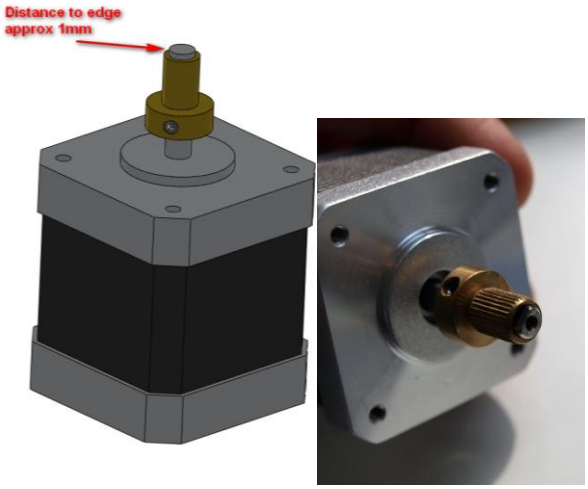


Insert a thin nut m4 as shown above. Before doing that clean the hole out a little and insert the nut.



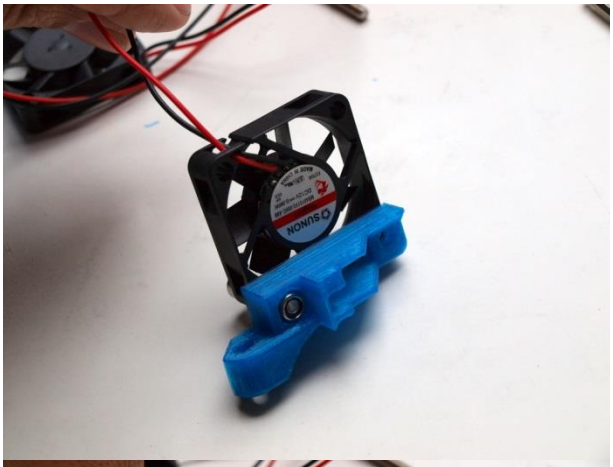
Mount parts onto the extruder arm:

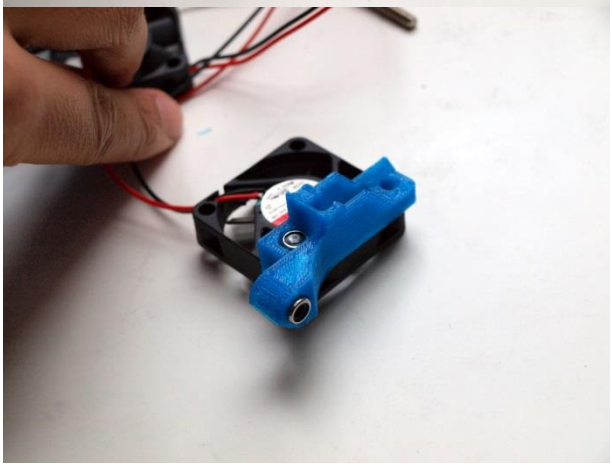
From right to left. M4x20 bolt, 2x small washer, bearing, small washer, plastic part, thin nut.



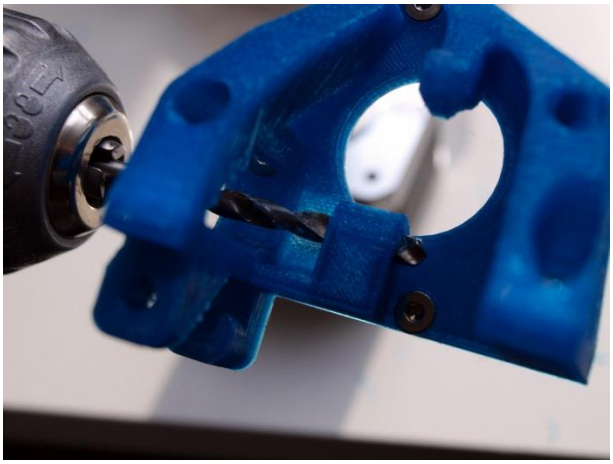
Mount the extruder wheel onto the motor with the little set-screw from the bag of the extruder wheel. The set-screw should not stick out more then 0.5mm, because it might then scrape the surrounding plastic parts..

NOTE 1: sometimes the tolerances of the extruder wheel are tight. It is very difficult to get it on the motor-axle. DO NOT force it on there, but try to drill out the hole with a 5mm drill, until it fits smoothly on the motor-shaft.

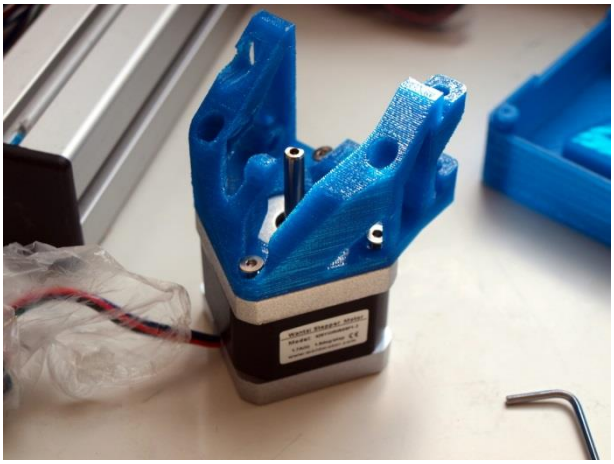




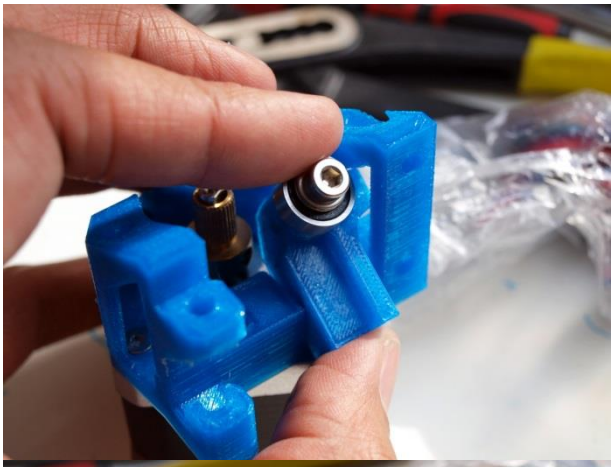
Insert the m4 self locking nuts into the hexagon holes of the extru_base_pt4, use an m4x20 bolt including washer as indicated above. Make sure the wires match and also the orientation of the sticker on the fan. The fan blows out air at the side of the sticker.

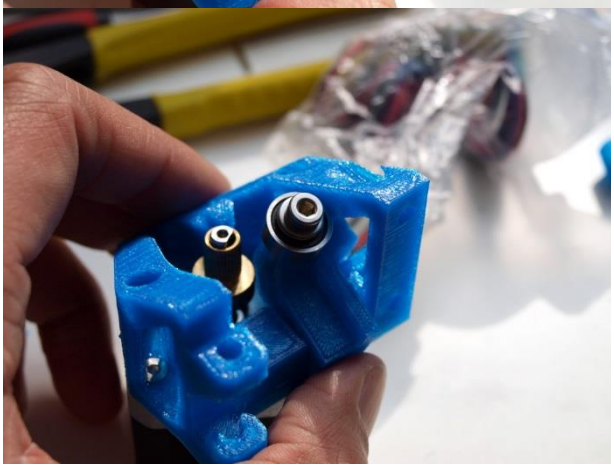


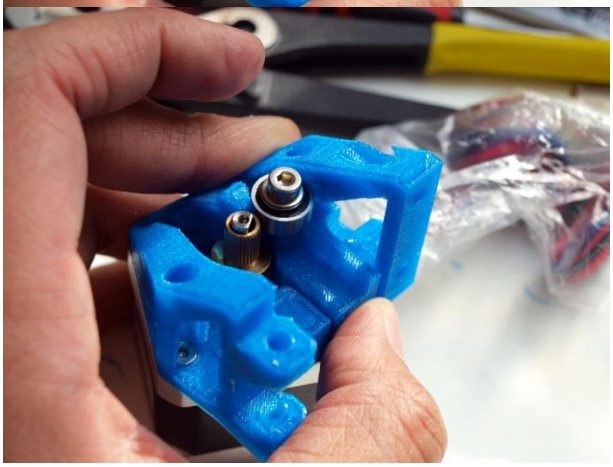
Take the extru_base_pt2 and drill out the hole with a 4mm drill as shown above.



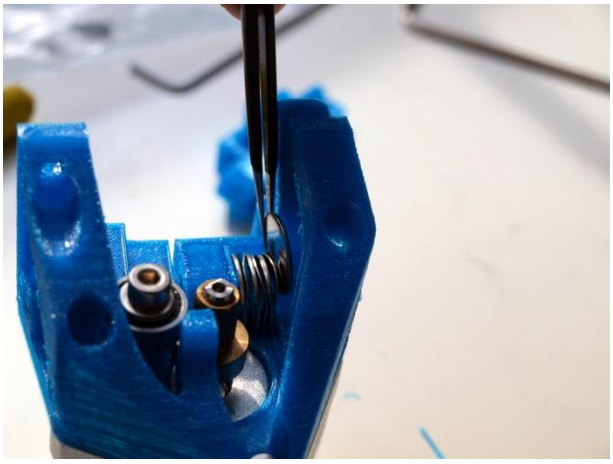
Mount the motor onto the extru_base_pt2 part displayed above and match the orientation of the wires.

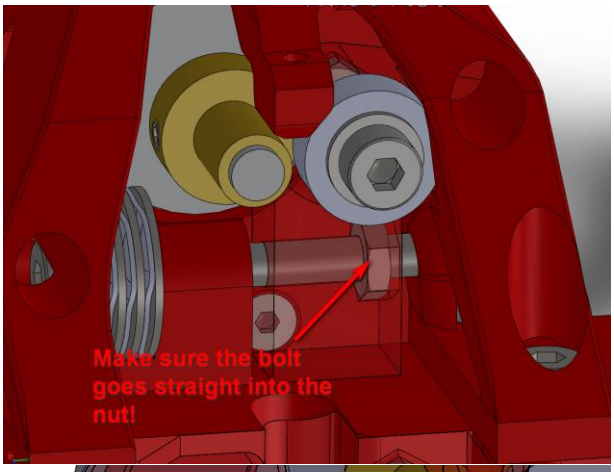


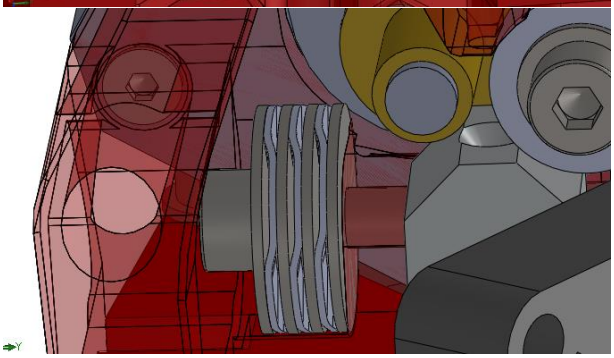




Insert the extruder arm as shown above.

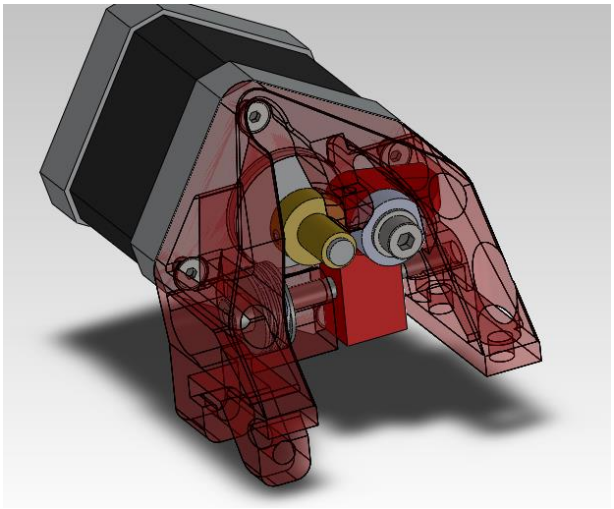




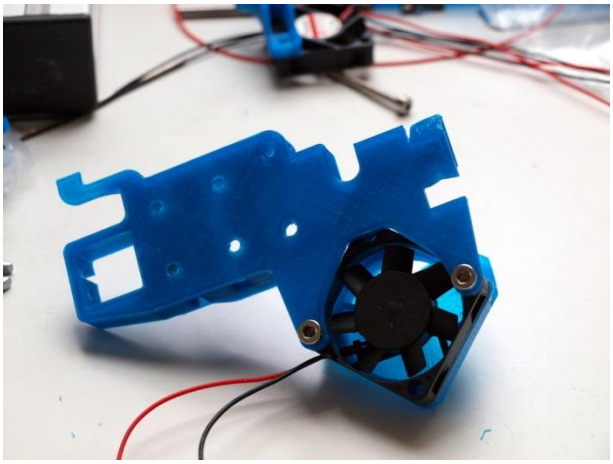


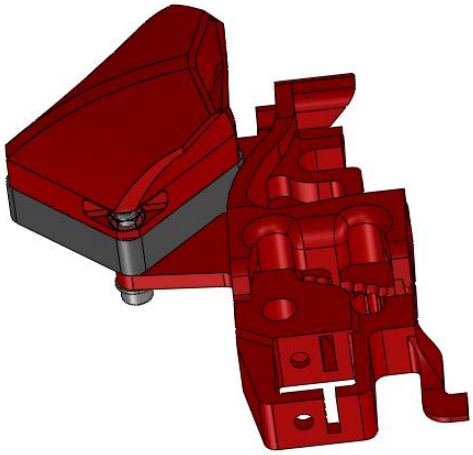
Mount the extruder arm onto the just mounted parts. An m4x40 bolt is required. Use 4 large washers and 3 curved washer as shown in the picture above. **NOTE: Make sure the bolt goes straight into the nut!**

This bolt and washer combination will be used to put some tension on filament which will be pushed down into the hot-end.



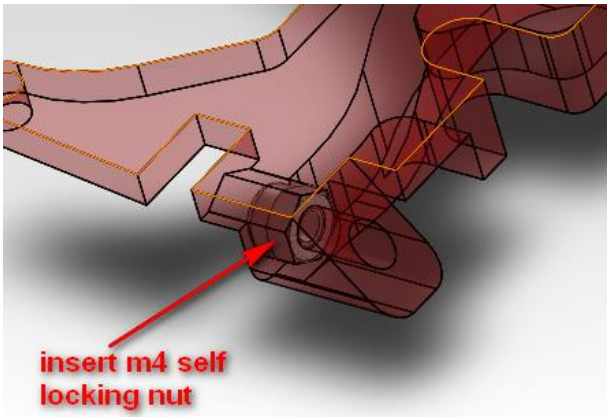
The cad drawing above displays how the sub-assembly should look like.

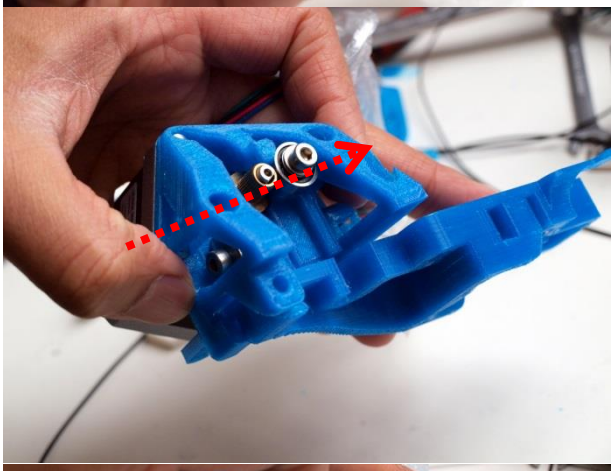


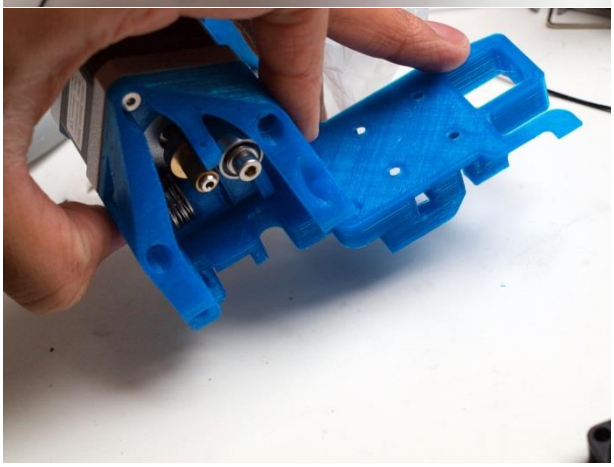


Mount the fan and airduct with m4x20 bolts onto the extruder base. Use m4 selflocking nuts and also use washers.The bolts don't have to go all the way through the self locking part of the nut.

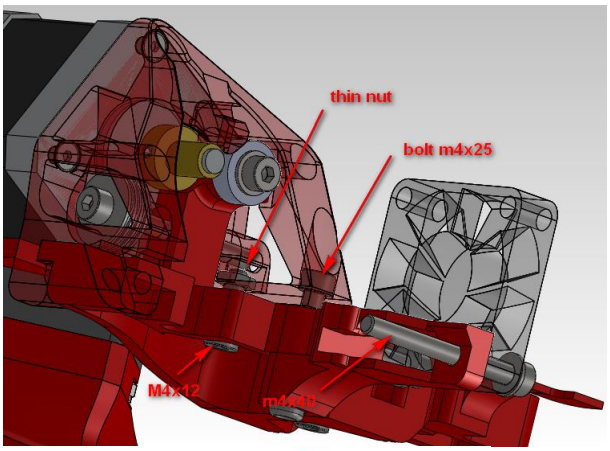
NOTE: watch the orientation of the wires and also make sure the sticker of the fan is facing downwards.

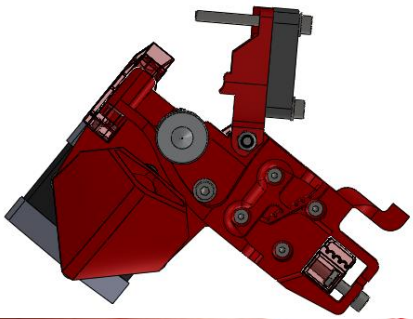


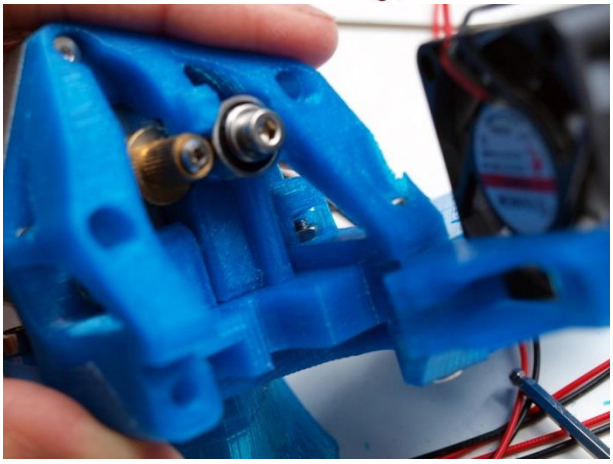




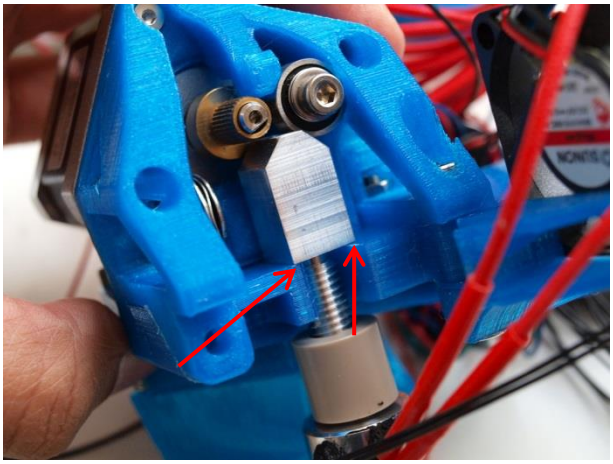
Slide the motor-subassembly onto the base.



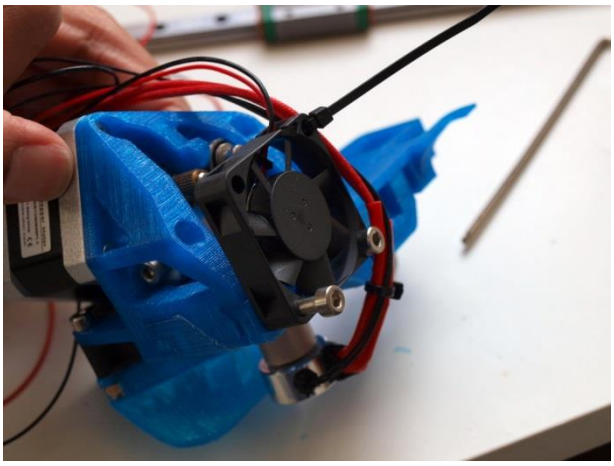




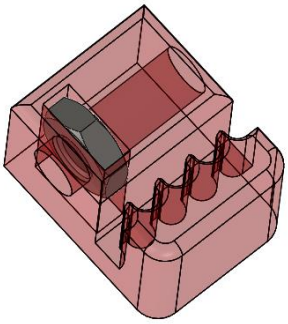
Mount the extru_base_pt4 as shown above.

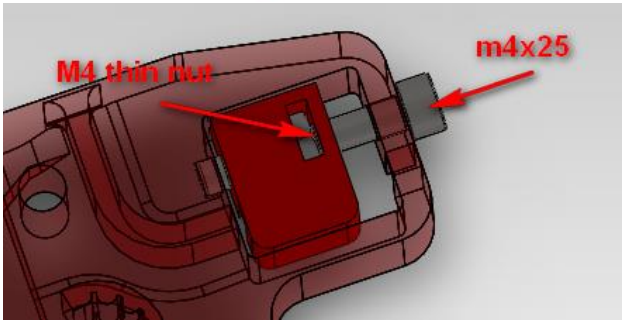


Move hot-end into slot and make sure edge of hot-end touches the base of the extruder.



Close the hinge door and screw in the m4x40 bolt. Make sure the hot-end is not free to move, otherwise exert more force on the m4x40 bolt. Guide the cables as shown above. Use the hole of the fan and a cable-tie to fix the hot-end cables. Make sure it is done this way, it also gives tension release to the hot-end cables.



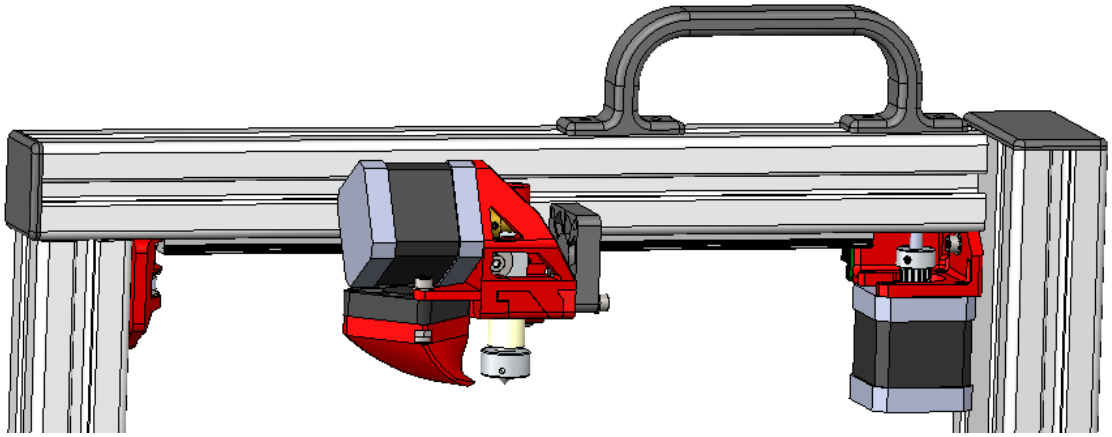


Insert the belt tensioning part as shown above.

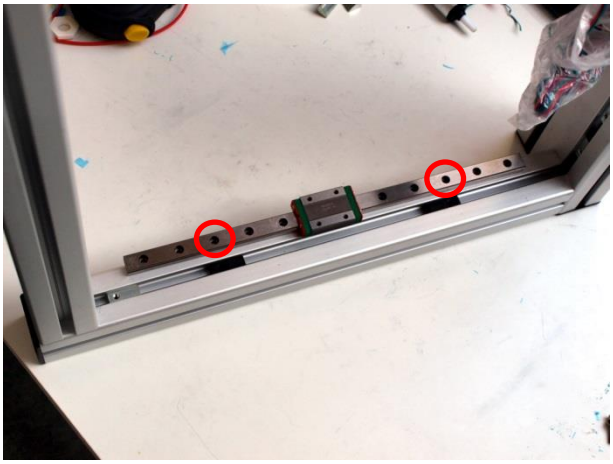
Congratulations you've finished the extruder module!

10 MODULE 3: THE X-AXIS (TIME: 30-60 MIN.)

Note: Don't waste any belt. There is only one long belt in the kit, which must be divided in such a way that it is usable for the x and y-axis.

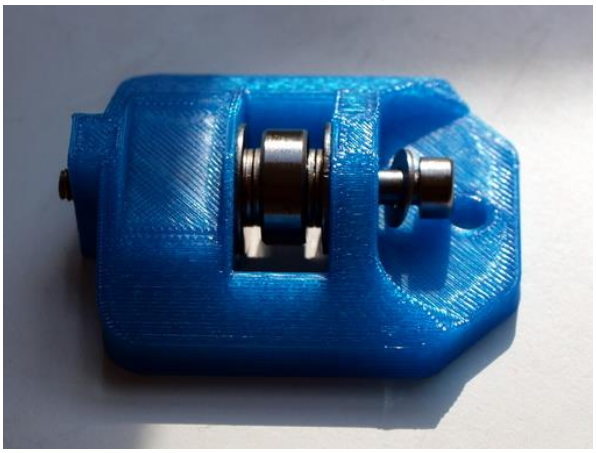


BOM x-axis	
Part description	**Amount**
x-stage-motor-bracket_v6_F1_5	1
x-axis belt mount_v6_F1_5	1
Hiwin lineair ball bearing set	1
pulley_motor_HTD	1
motor nema 17	1
bearing 624	1
optosensor	1



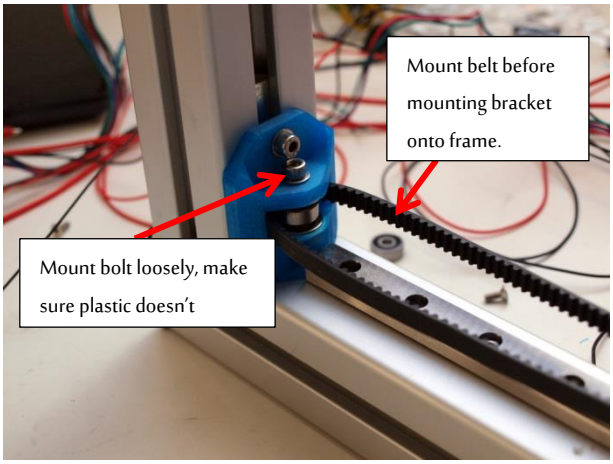
IMPORTANT: DO NOT let the cart of the linear bearing go off the rail. There are small balls in there which might fall out when the cart rolls of the rail.

Put the frame **upside down**. Mount the hiwin rail loosely onto the beam. Use 2 black t-slot nuts with m3 holes in them with m3x12 bolts to mount the rail. Also place a m4 t-slot nut as indicated in the picture above, that one will be used for the x-axis belt mount part.

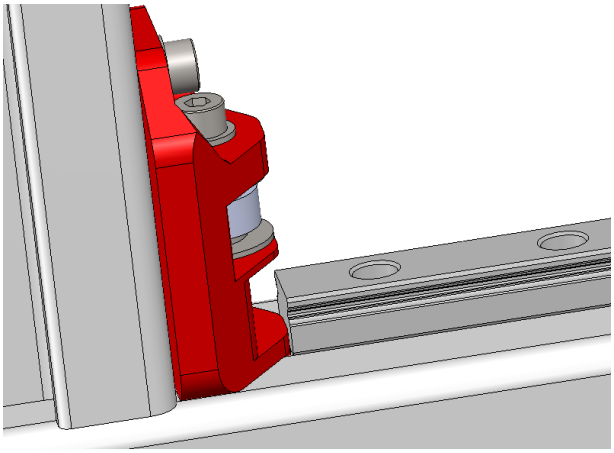


Pre-assemble the x-axis belt mount part. From right to left.

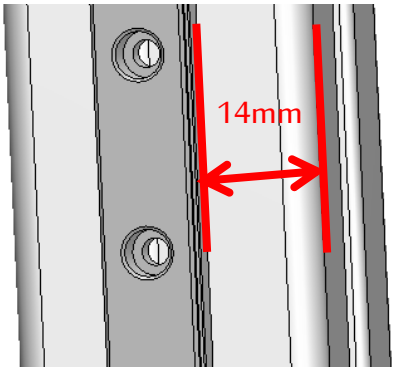
M4x40 bolt, small washer, plastic part, large washer, 2x small washer, bearing, 2x small washer, large washer, plastic part.



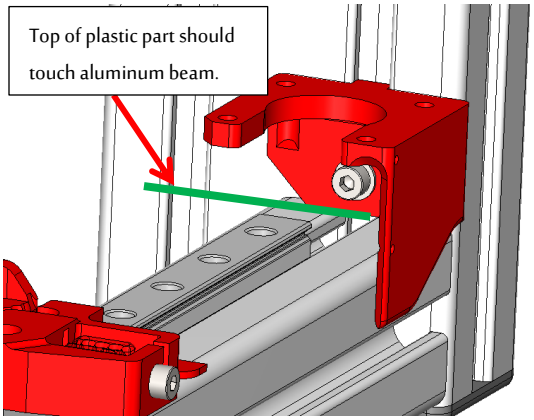
IMPORTANT MOUNT THE BELT BEFORE MOUNTING THE BRACKET SHOWN ABOVE: Guide the belt over the bearing as shown above before mounting the sub-assembly to the frame. The top-bolt in the picture is an m4x16 bolt, also use a washer.



Position and fix the rail onto the frame. Let the rail touch the x-axis belt mount part.

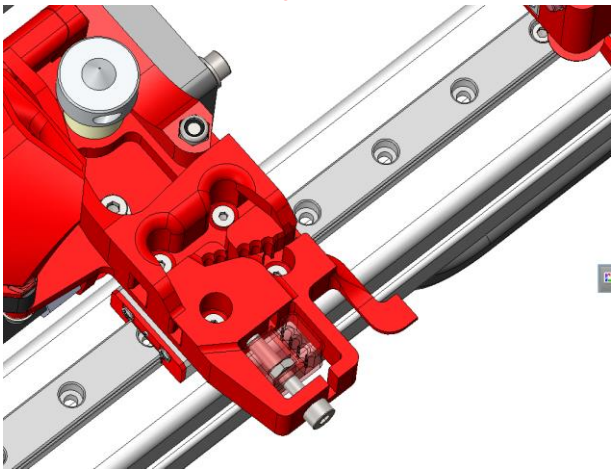


The distance along the rail and the edge of the beam should be 14mm. This way it is centered perfectly over the slot of the beam.

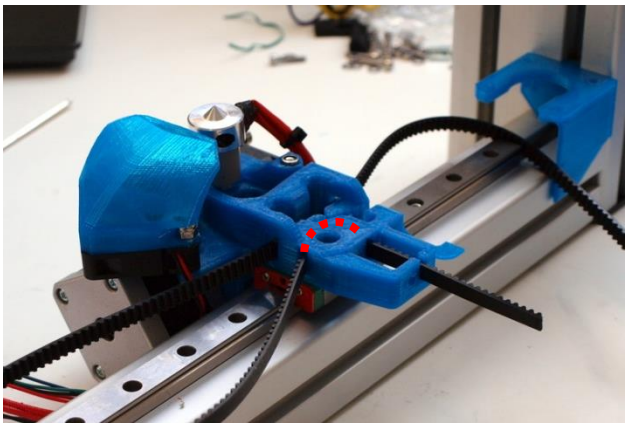


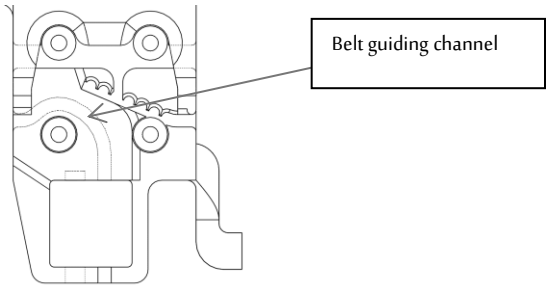
Mount the x-axis motor bracket onto the frame with an M4x16 bolt, use a small washer underneath the bolt-head.

IMPORTANT: The top of the plastic part should touch the top aluminum beam as indicated in green above.

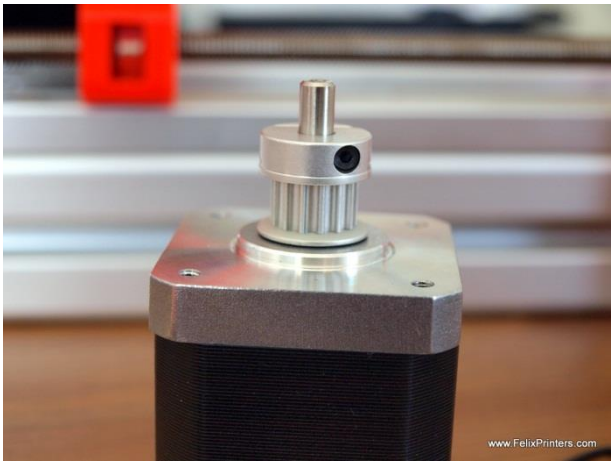


Mount the extruder assembly onto the cart of the linear guide, with 4 m3x6 countersunk bolts.

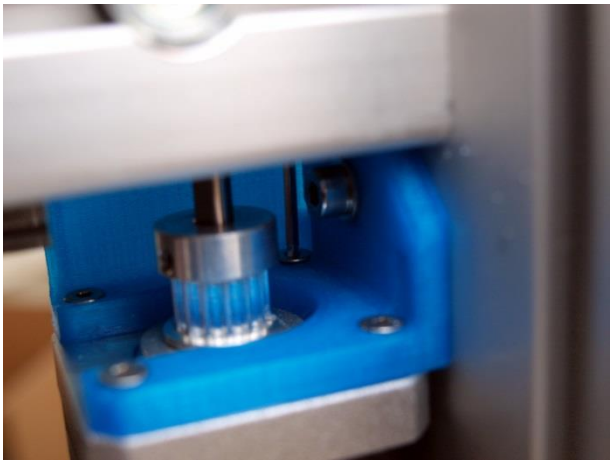




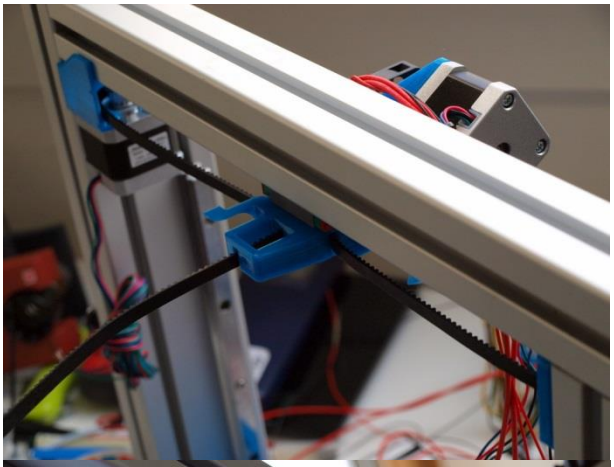
Guide the belt through the extruder carriage.

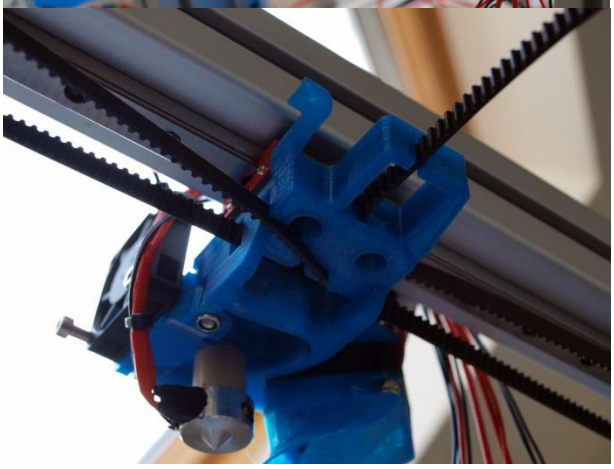


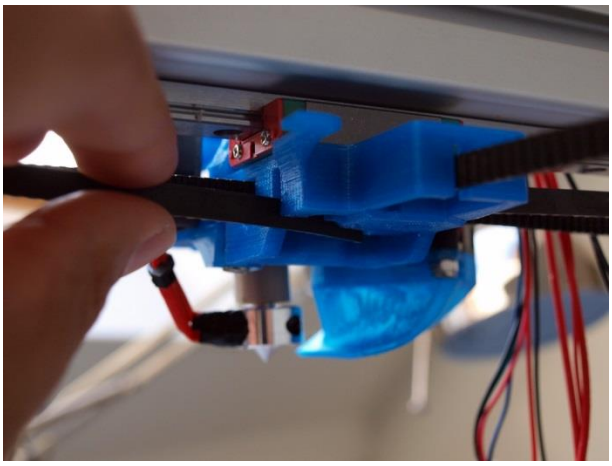
Mount a pulley onto the motor-shaft upside down. The distance between the bottom of the pulley and the face of the motor should be approx 0.5mm, this can be adjusted later on if required.



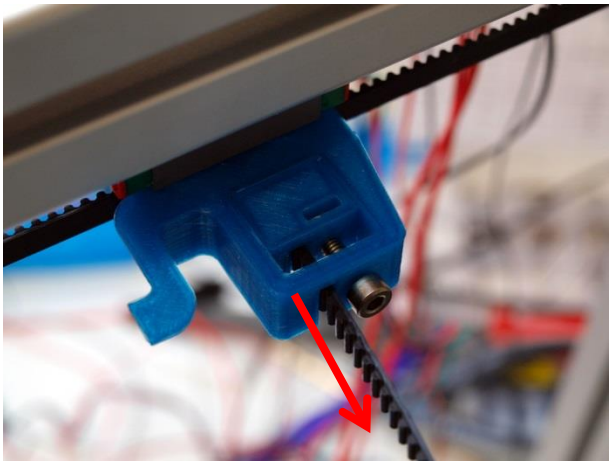
Turn the frame in its upright position and mount the motor onto the bracket. Notice the orientation of the motor.



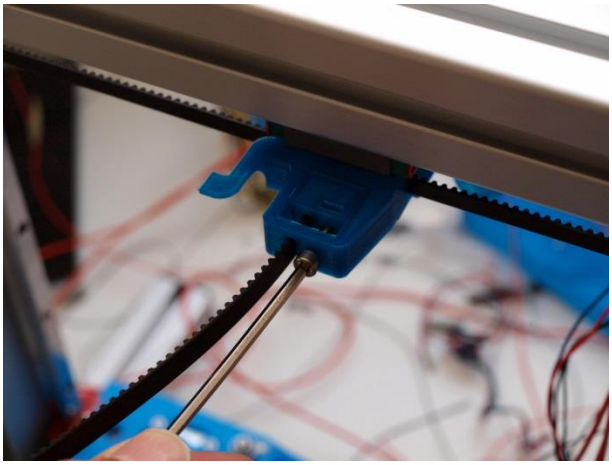




Guide the belt over the motor pulley back to the extruder carriage and insert it in the toothed slot

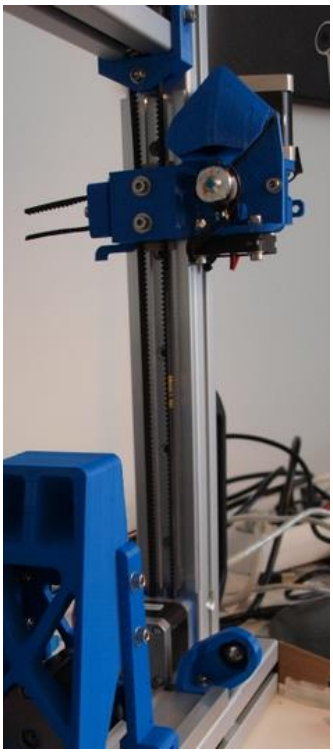


Pull on the belt as indicated above and place the small tensioning bracket in place when there is some tension on the belt. Place it just like the picture above, that there is still some room to put more tension on the bolt.



When you turn the bolt clockwise the belt will get more tension.

Put some double sided tape on the opto-sensor and mount it onto the bracket with the small philipshead screws.



It finally should look like the picture above. This however is a picture from an older revision.

Cut off the remaining piece of belt. Only 2cm should stick out of the end of the extruder base. **Don't waste any belt. There is only one long belt in the kit, which must be divided in such a way that it is usable for the x and y-axis.**

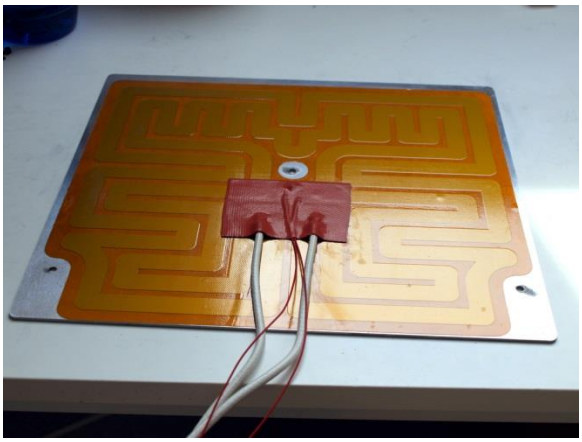
You have now finished the x-axis!

11 MODULE 5: TABLE (TIME: 1-2 HOURS)

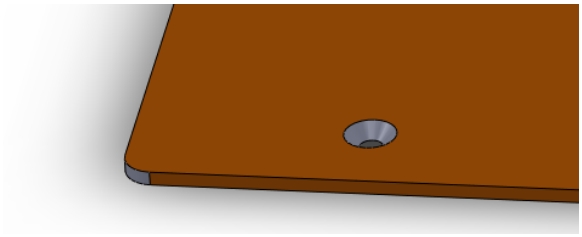
Important notes:

Work carefully; this will benefit the print quality. Make sure that you don't warp the surface of the table by exerting too much force /weight on the table

BOM table	
Part description	**Amount**
table_2mm	1
Foil heater	4



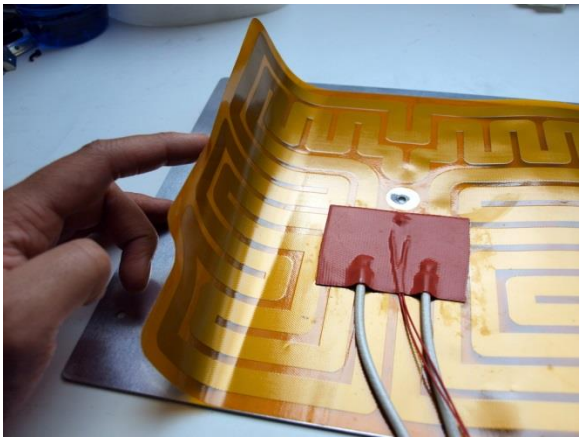
The goal of this module is to get the foil heater onto the aluminum plate. The picture above shows the back/bottom side of the plate.

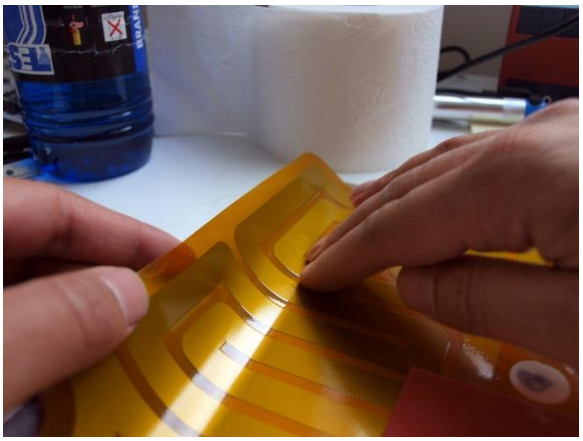


For illustrative purposes the view above is the top-side. Where you can see the countersunk hole.

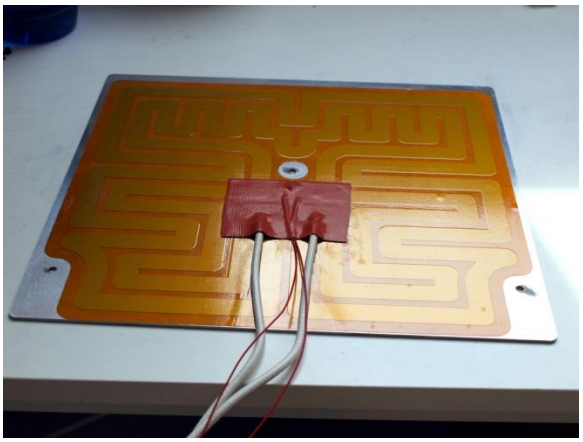
Clean the backside of the plate with detergent.

SLOWLY and CAREFULLY remove the protective layer from the foil heater. The adhesive layer should remain intact as good as possible.



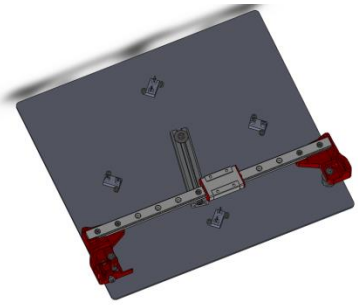


Place the sticker without bubbels on the surface. By wiping it piece by piece on the surface from the middele to the edge.



It should finally look like this.

You are done with assembly of the table.

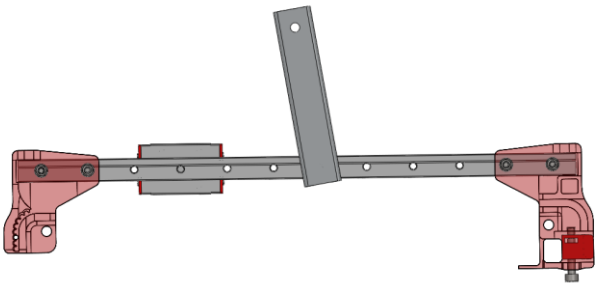


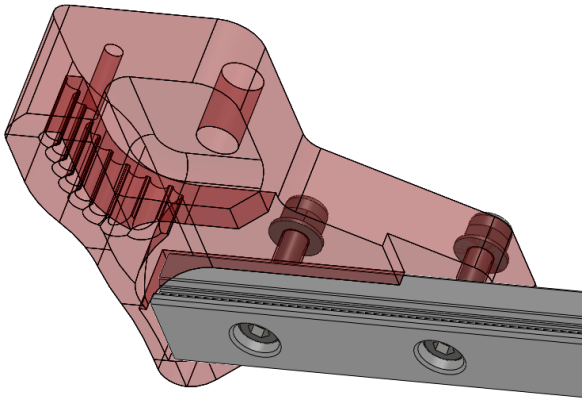
12 MODULE 6: Y-AXIS (TIME: 10-30 MIN.)

Required tools for this module

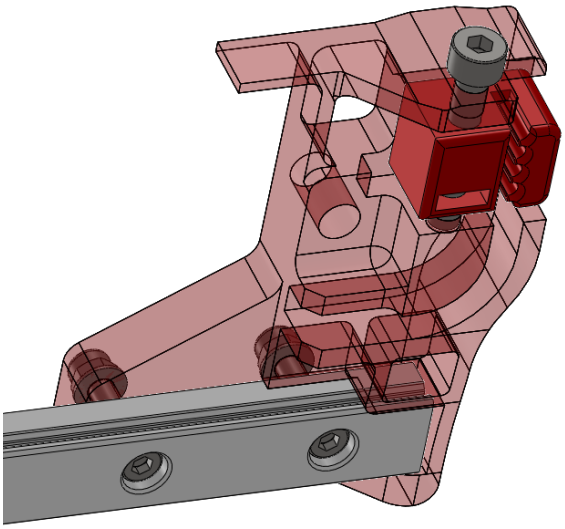
- Allen key set.
- wrench

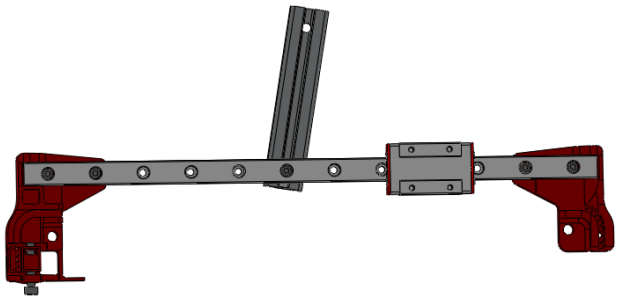
BOM y-axis	
Part description	**Amount**
y-stage bracket pt1_v6_F1_5	1
y-stage bracket pt2_v6_F1_5	1
y-stage bracket pt4_v4	1
20x10_aluminum profile + protective cap	1
t_slot_nut_5	1
Hiwin lineair ball bearing set	**1**
t_slot_nut_5_M3	**2**
t_slot_nut_8_M3	**3**
ISO 10642 - M3 x 6 --- 5N - CSK	**5**
Hexagon socket head cap screw DIN 912 - M3 x 8	**2**
Hexagon socket head cap screw DIN 912 - M3 x 12	**4**
Hexagon socket head cap screw DIN 912 - M3 x 16	**10**
Prevailing torque type hexagon nut ISO 7040 - M3	**6**
Washer ISO 7089 - M3	**6**



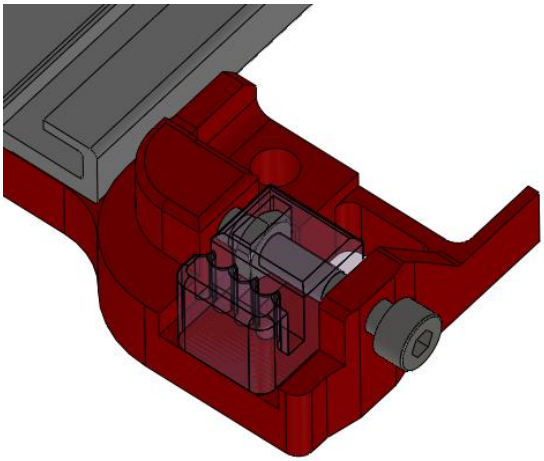


IMPORTANT: DO NOT let the cart of the linear bearing go off the rail. There are small balls in there which might fall out when the cart rolls of the rail.





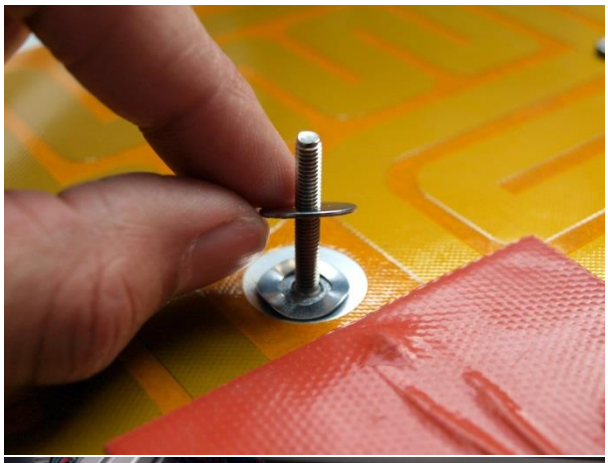
Mount both brackets onto rail with m4x16 bolts and the m3 self locking nuts. Don't forget to place the washers

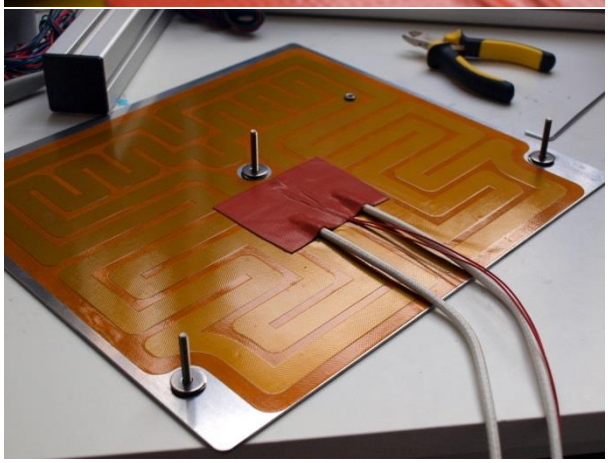


Mount the small *y-stage bracket pt4_v4* onto the *y-stage bracket pt2_v5_F1_5*. Use a m4x25 bolt and a m4 nut. This small part is needed to tension the belt later on.

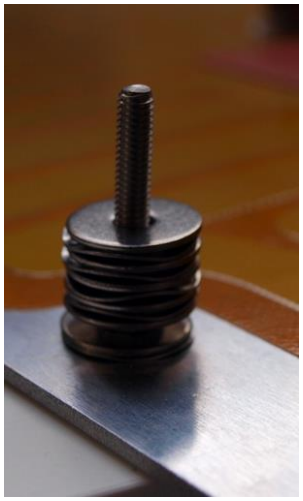
Get the small aluminum beam, first put the plastic cap on it, next to the drilled hole. This can be done with a hammer.

Slide in the small t-slot nut on the other side, and mount this beam onto one of the middle 2 holes of the y-axis rail with a M3x8 bolt.

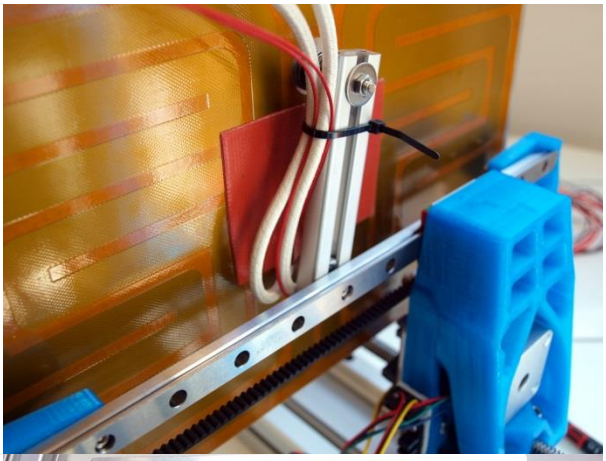


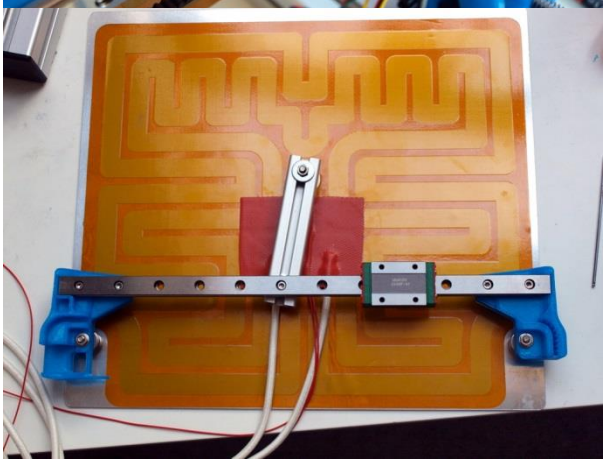


Take the table assembly and place the m4x30 countersunk bolts as indicated above on the three holes in the table. Put a curved washer, large washer and fix those with a m4 thin nut.

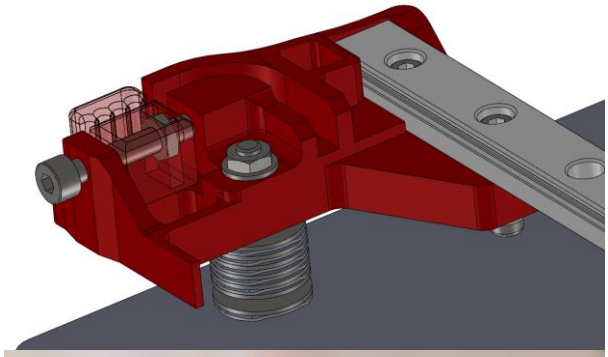


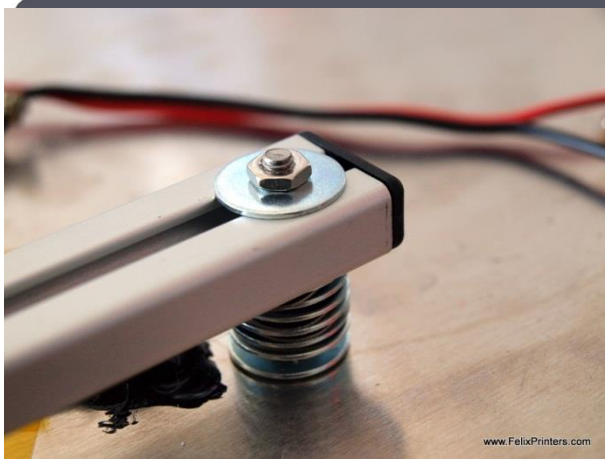
On top of the just mounted washers place per each bolt, 5 large washers and 4 curved washers.



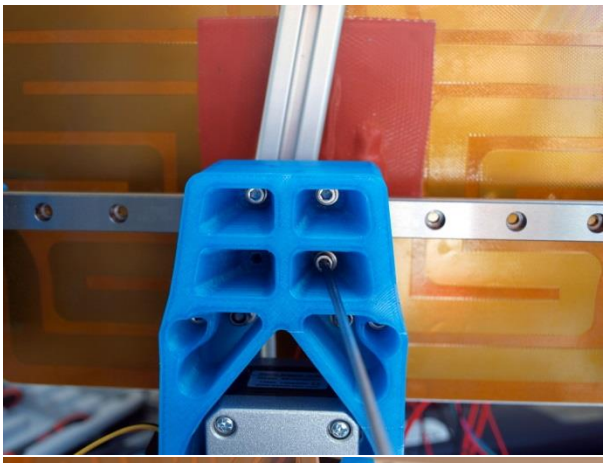


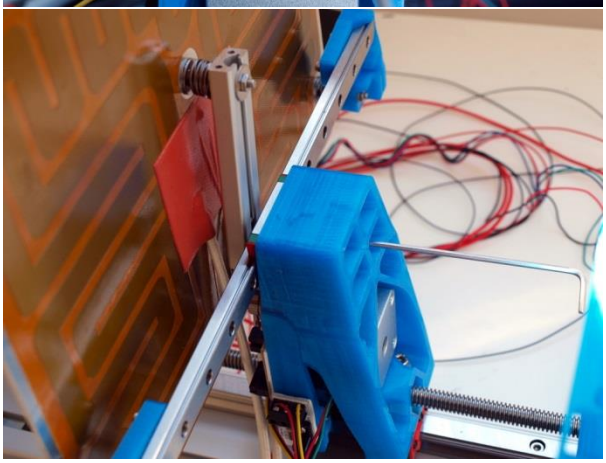
Now place the y-axis onto the table. When it doesn't directly fit, there is no need to file any parts. The three bolts can be slightly re-oriented. This can be done to exert a little sideway force on the bolt. When it still doesn't fit, you could try to adjust the position of the small aluminum beam.



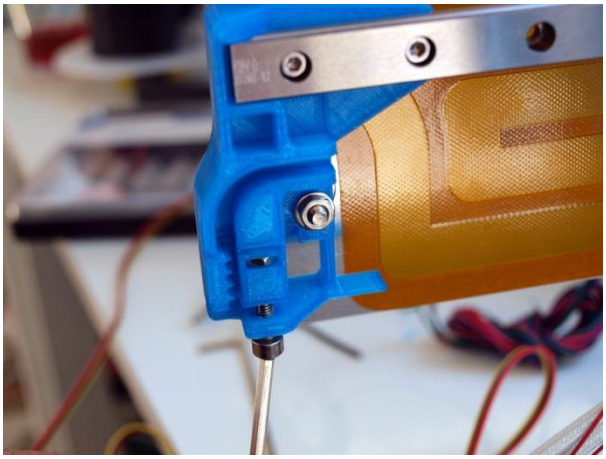


After placement mount table bolts with an M4 thin nut. Use a small washer underneath the m4 nuts at the plastic parts. Use a large washer for the bolt at the small aluminum beam.



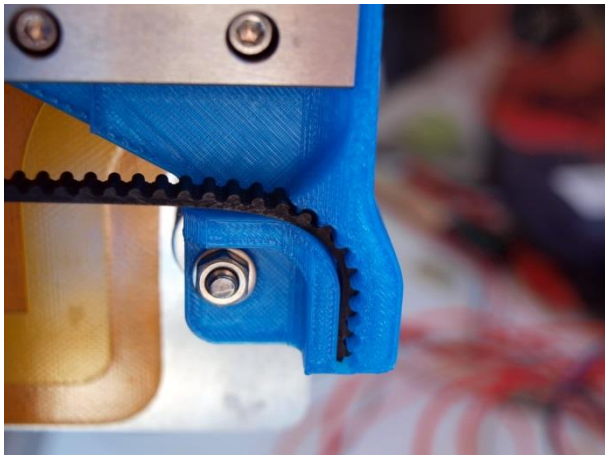


Re-orientate the frame by placing the wide beam onto a table. Mount the y-axis cart on the z-axis part with four M3x16 bolts with the m3 washers.

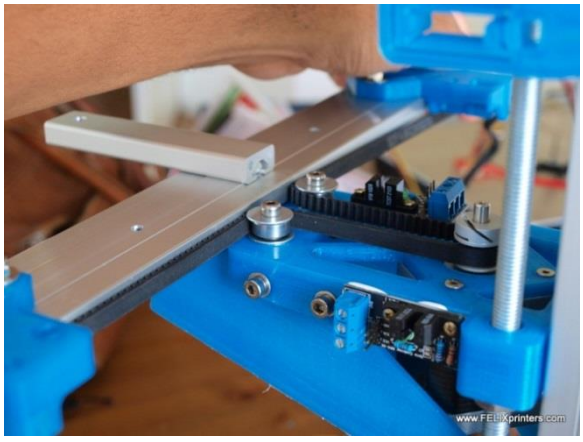


Mount the y-stage bracket pt4 onto the y-stage bracket pt6 with an m4x25 bolt.

Now it is time to put the left over belt from the x-axis onto the y-axis. Take the belt and cut it off straight.



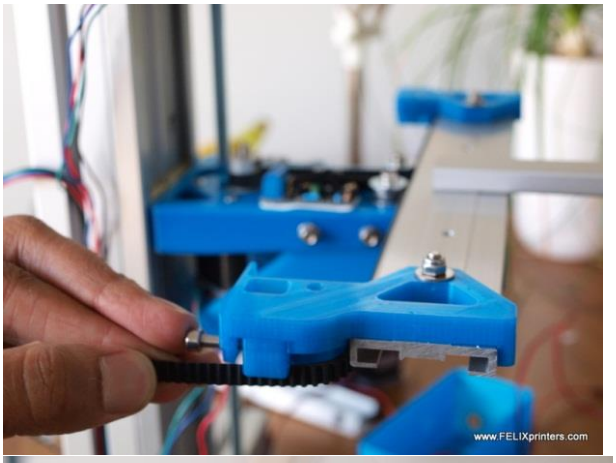
Push the belt inside the bracket. Let the belt make contact with as much teeth of the bracket as possible. Also push it as far as possible, use a small allen key for that. If you have misplaced the belt or you want to remove it, on top of the bracket is a small hole which can be used to push out the belt with a small allen key.

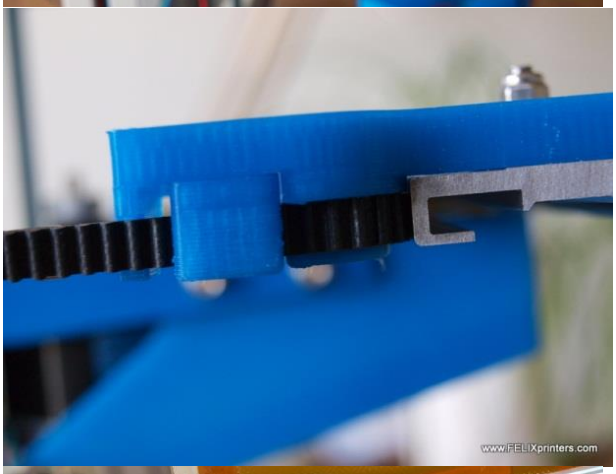


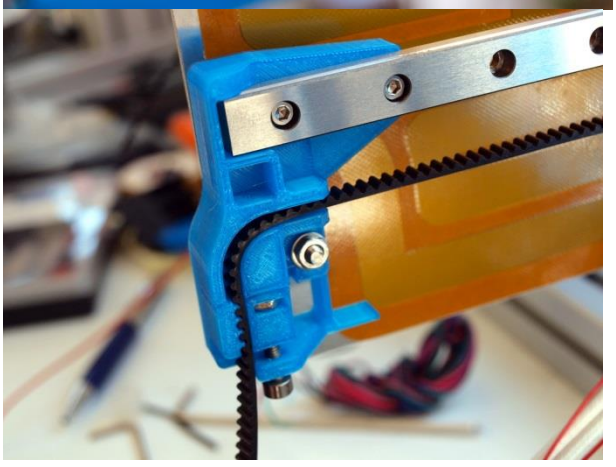
Guide the belt over the pulley and 2 bearings as indicated above.

NOTE 1: The pictures are from the Felix 1.0, but the procedure is the same.

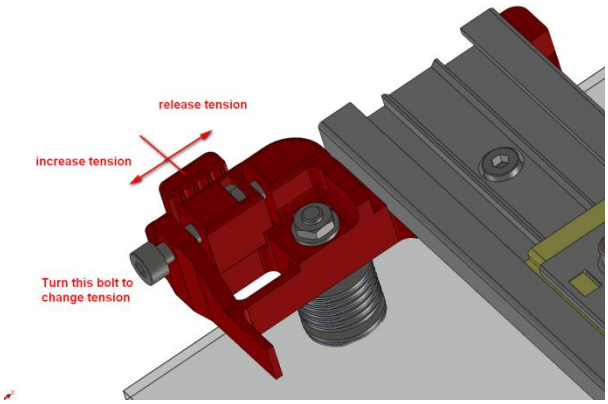
NOTE 2: If you are doing this module before assembling the x-axis module, do not waste unnecessary pieces of belt, because it is needed for the X-axis!!







Push the belt into the small printed clamp, while at the same time tensioning the belt by hand. Important is that the small clamp is touching the right edge of the bigger part as shown in the picture above.



Next step is to tension the belt by turning the tensioning bolt. See picture above. The belt should be tensioned when the distance between the parts is approx. 1 to 2 mm.

Check if you applied enough tension by pushing the belt as displayed above. It should feel firm.

Congratulations, you are done with the mechanics of the printer.

13 MODULE 7: ELECTRONICS (TIME: 2-4 HRS.)

The goal of this module is to install all electric wires and to neatly put them away in the frame.

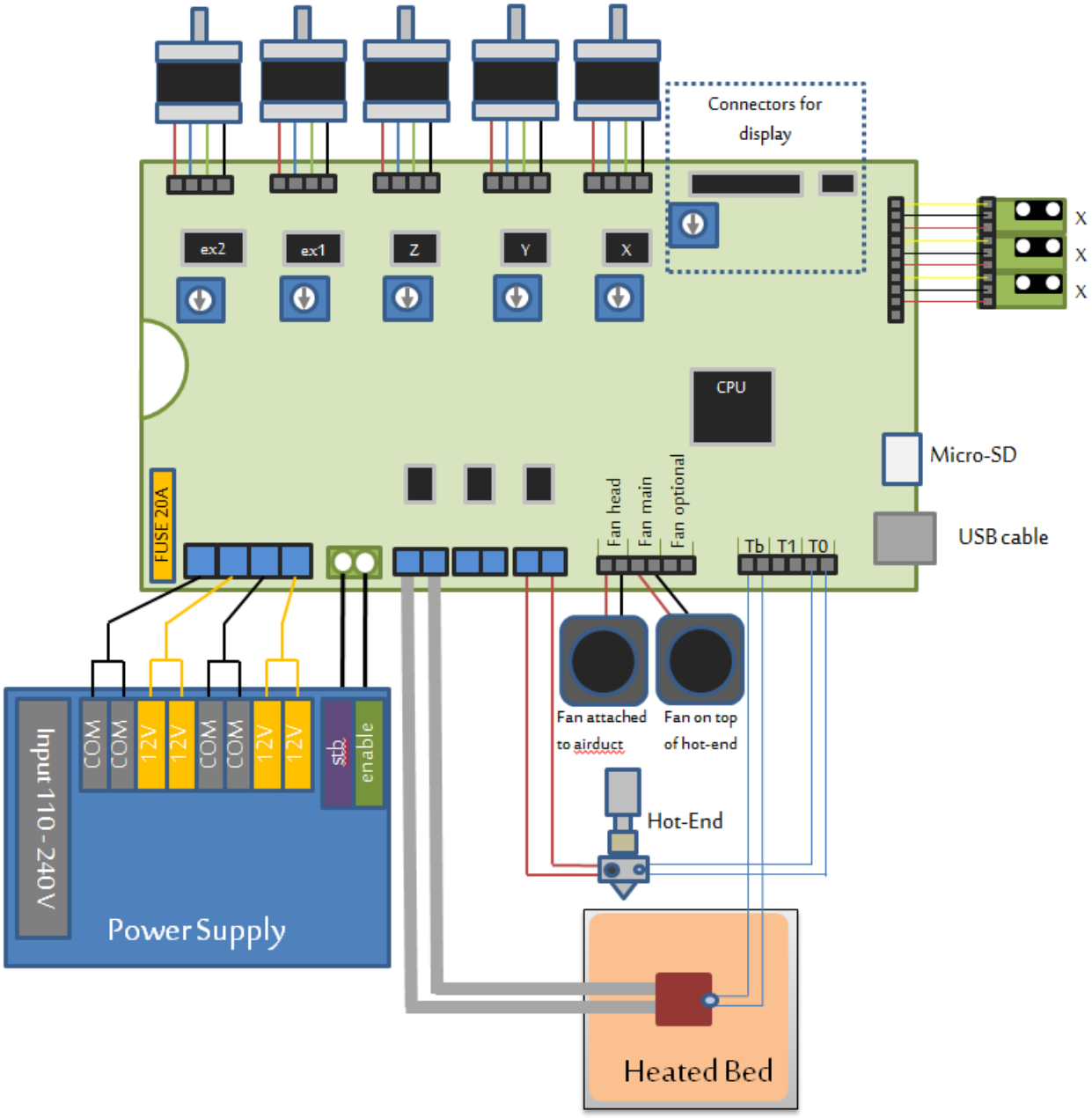
The required tools for this module are:

- Nippers
- Screwdriver, flat and philipshead

IMPORTANT: Make sure you are grounded and make sure you cannot create static electricity.

Static electricity can kill the electronics board. To prevent it do the following:

- make sure you have no shoes or other isolating footwear on.
- Prevent touching any components on the board.
- When grabbing the electronics board grab it from the side
- Prevent very dry environment
- Do not wear any fleece or synthetic clothing.



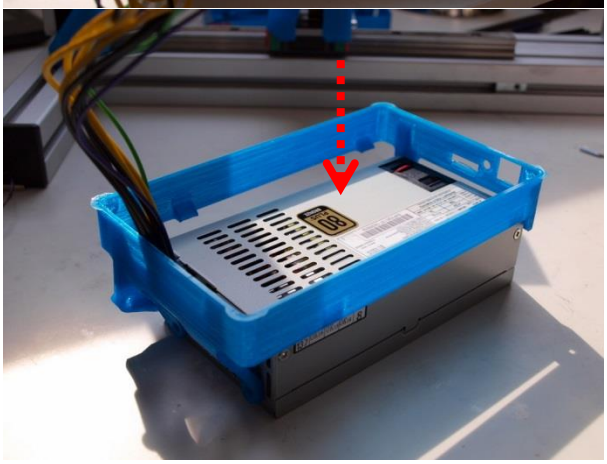
To make the printer work properly the schematics below must be matched. This chapter will guide you step by step to match the schematics above.

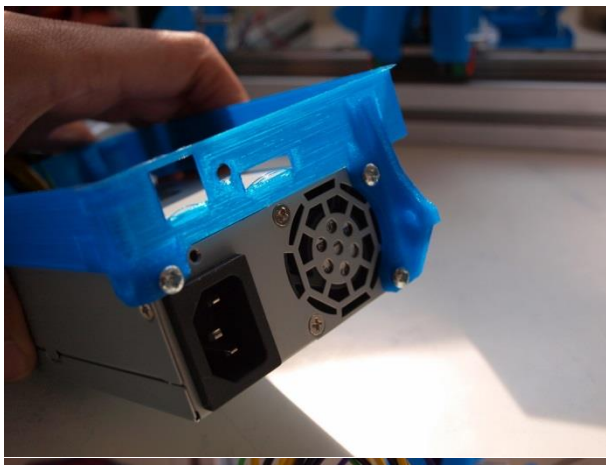
NOTE: It is important that the cables are placed as neatly as possible. Placing the wires in a messy way, can lead to EMC problems. The electronics can become sensitive to outside influences and lead to unreliable printing. For instance when a lamp is switched on or off the electronics could stop working until you reset it again.

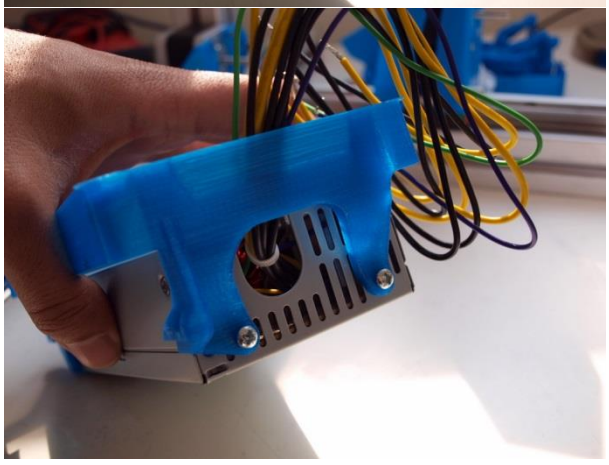
13.1 MOUNT THE POWERSUPPLY.

BOM Electronics	
Part description	**Amount**
Electonics_case_F_2_0_v3_base	1
Electonics_case_F_2_0_v4_cap	1
Felixprinters electronics	1
mini-ATX-seasonic	1
Power Cable EU,USA,Australian or British	1
Pre-crimped cables 3 threads	3
USB cable 1.8m	1

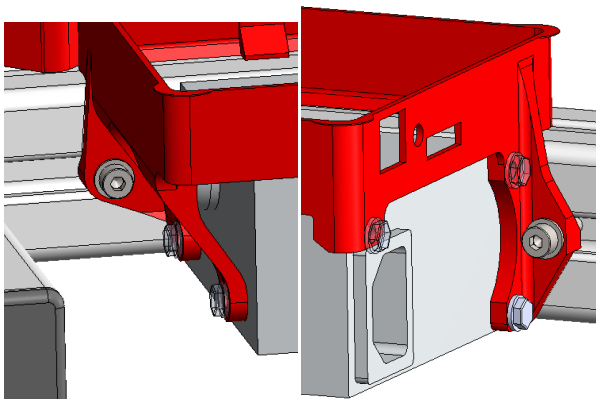
Get the parts described in the table above.

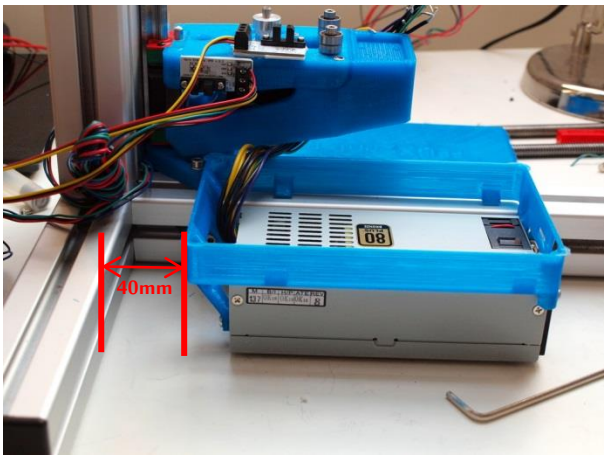




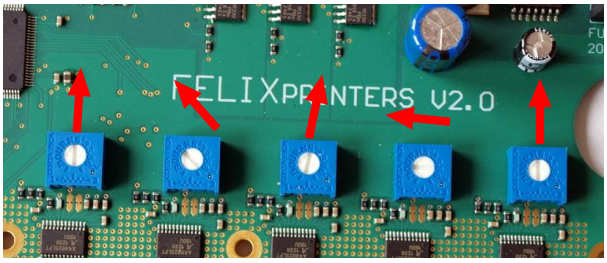


Mount the electonics case base part onto powersupply with the powersupply screws (short thick philips head screws). Slide the part on the powersupply from the top.

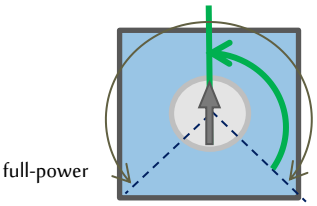




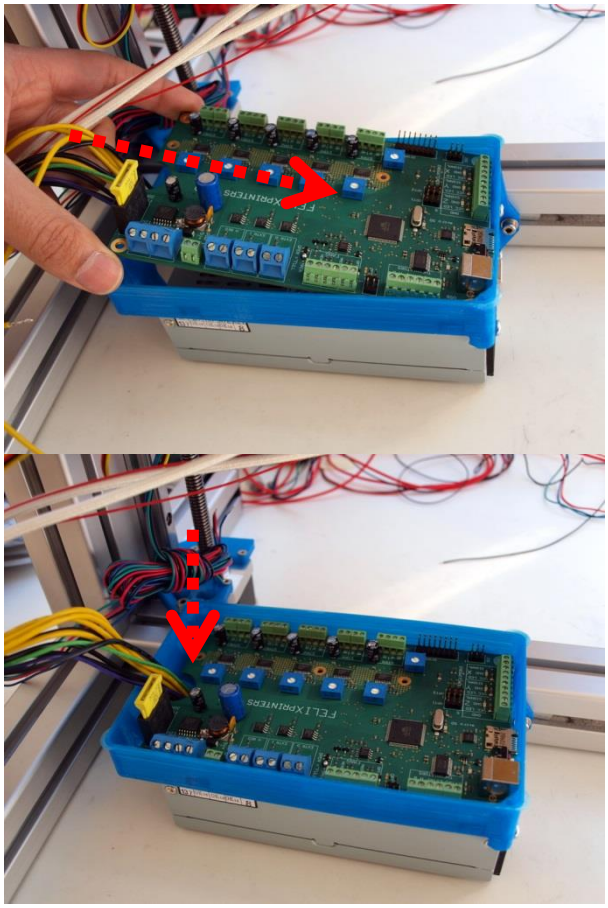
Mount the powersupply assembly onto the frame with m4x16 bolts including washers.



Before mounting the electronics make sure the potmeters are set ok. The pot-meters shown in the figure above regulate the power to the motors.



The pot meters have a turning range. Fully counter clockwise is full power to the stepper drivers. Fully clockwise is no-power to the stepper drivers. Be carefull with turning the potmeter to full power. Over time the stepper drivers may become too hot. There is a self protection mechanism in the chip which will temporarily turn the chip off to cool itself down. It will protect itself, but this is off course unwanted behavior as it will give intermittent movement during printing. Do the following as a starting point. If this occurs, then lower the power.

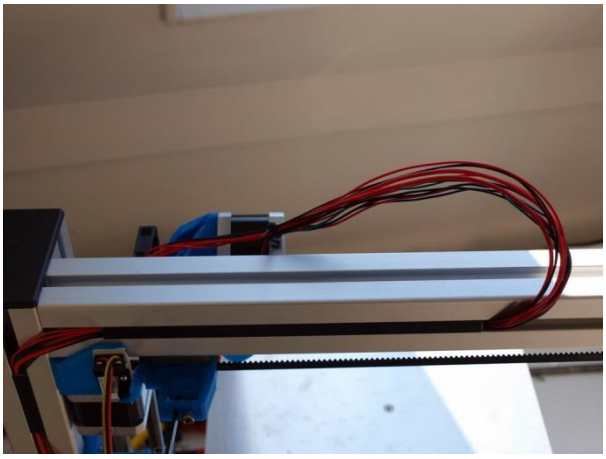


Slide the electronics box in like displayed above.

13.2 GUIDE WIRES

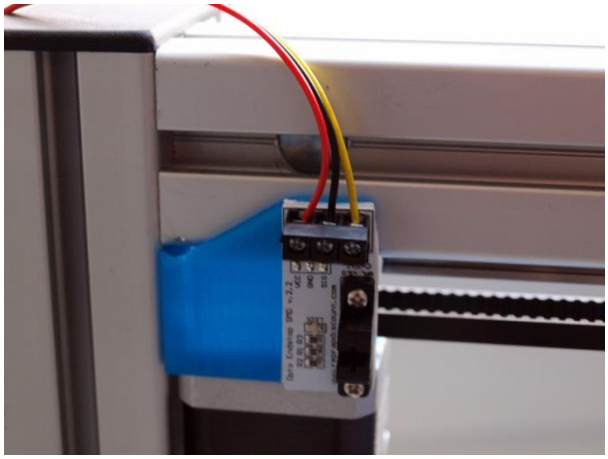
Cut a piece of 20cm from the frame strips. Remove sharp edges, to prevent damage to cables.

For your reference please put marks on the ends of cables. During mounting it will become hard to distinguish the cables when they reach the electronics board.

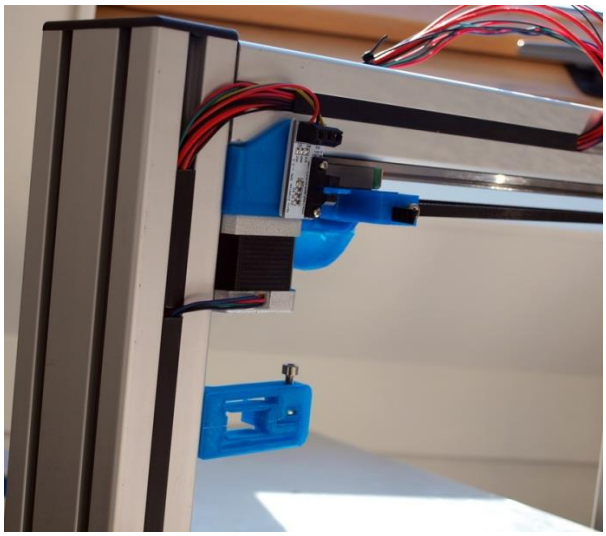


Make a nice loop for the cables which come from the extruder. It must be small/large enough that the cable doesn't get stuck around the far edge of the top beam, when the extruder is at its end position in x-direction, but there should also not be too much tension.

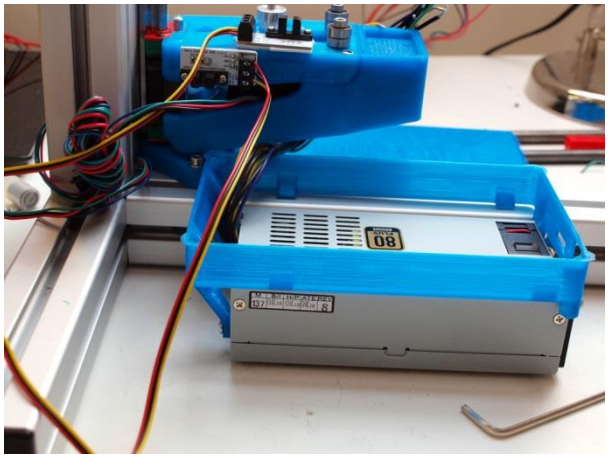
Place the cables behind the just cut off strip.



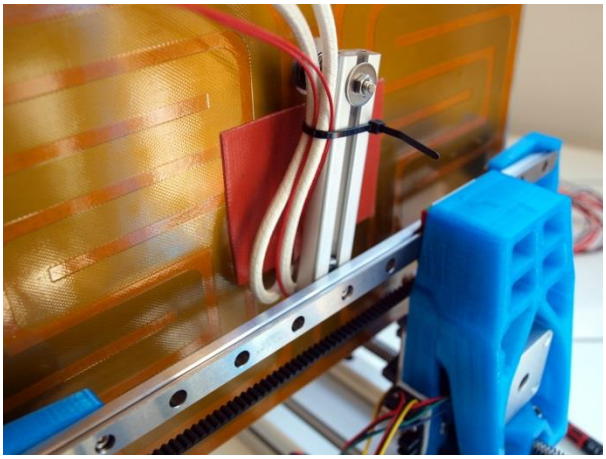
Take the 3 wire cable and mount it onto the sensor as shown above.



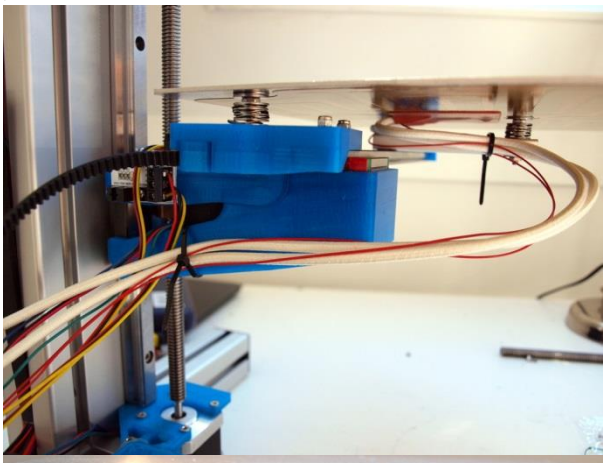
Cut off 5cm and 12cm of strip and guide the cables as indicated above.

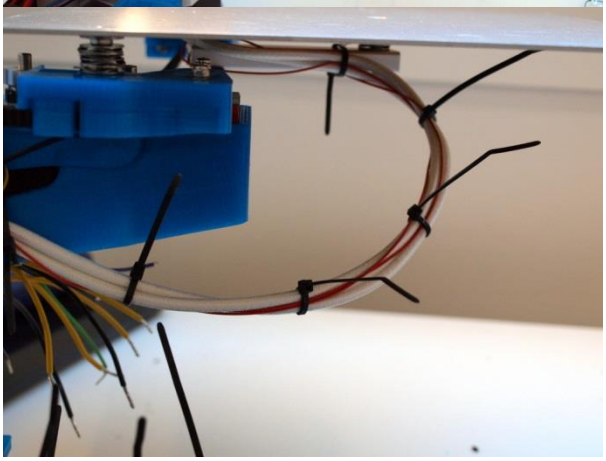


Mount the wires for the opto-sensors of the y and z-axis.

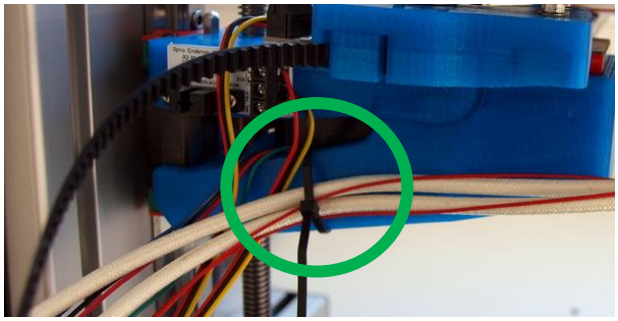


Guide the cables of the z-axis table like indicated above. Make sure the wires are mounted to the small aluminum beam as indicated above. This provides tension relieve to the wires.

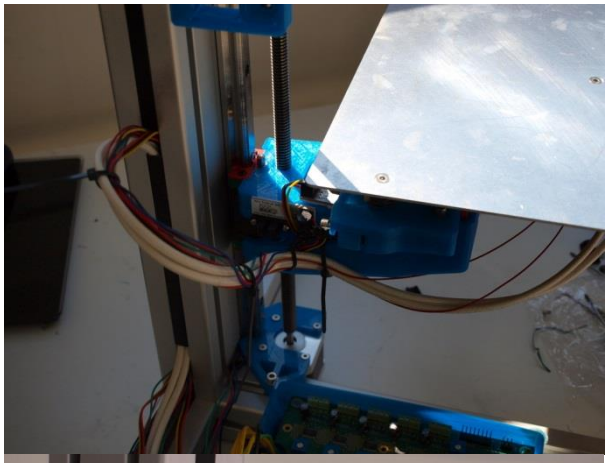


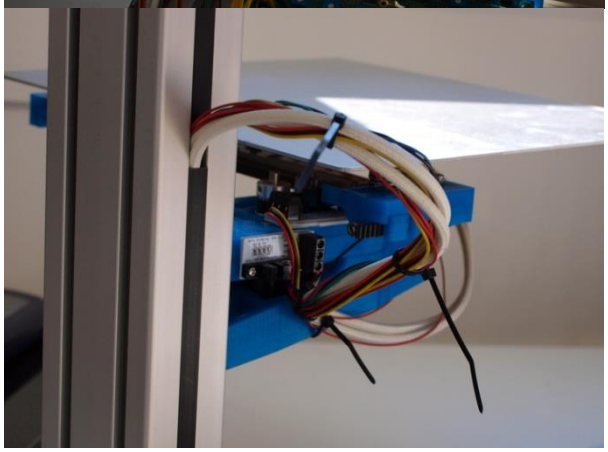


Make a loop as indicated above. Make sure that when moving the table from one side to the loop is just long enough. Make use of cable ties to better form the loop. They can easily be removed later on.



Guide the cables of the foil-heater along as shown above. Wrap a cable-tie around it to again provide tension relieve on the cable.



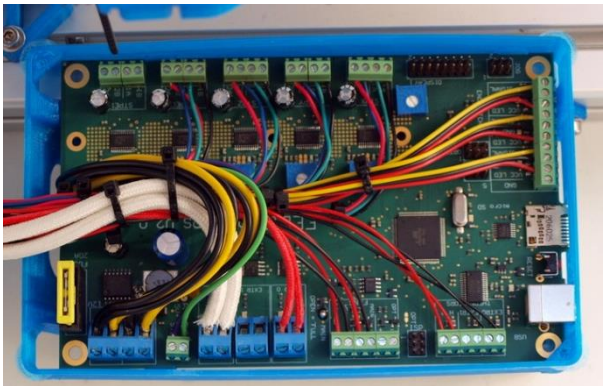


Cut off a piece of 14 cm of frame strip.

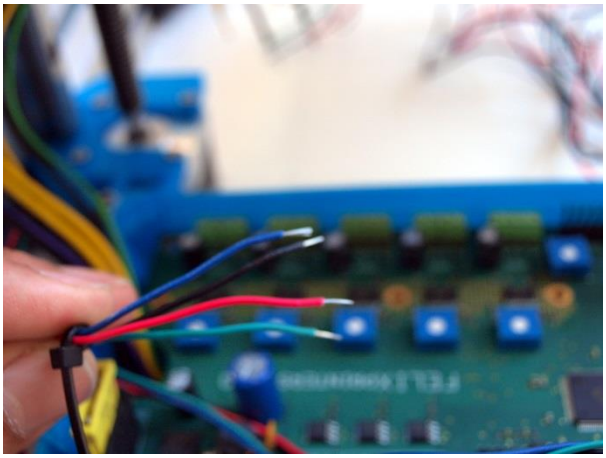
Make a second loop and guide it as shown above. This loop is necessary to let the table move up and down. Again make use of the cable ties to form the loop.

13.3 CONNECT ALL WIRES TO THE ELECTRONICS BOARD.

We now will connect all the wires to the electronics board and make it look like this



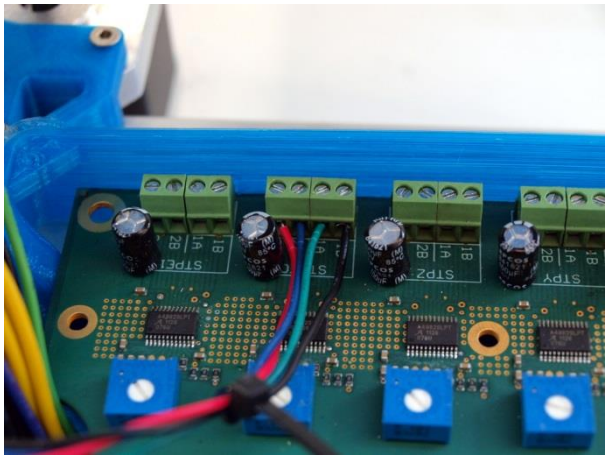
Step by step we will connect the wires to the board



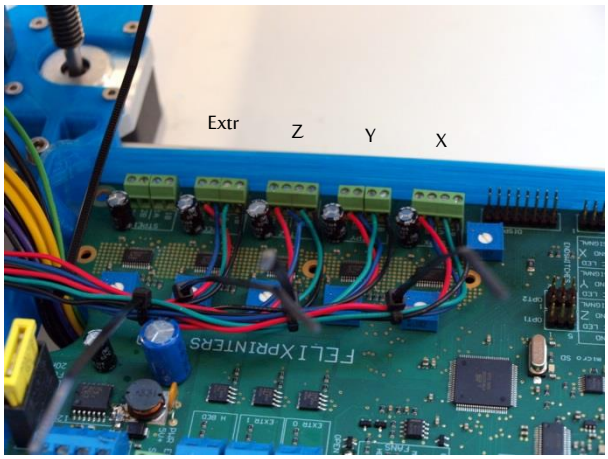
All wires have to be screwed under a screw terminal. These are the steps:

- Cut the wire to length,
- Strip the wire ends approx. 5mm, like shown above. Not too long because that could potentially cause a short circuit with other wires.

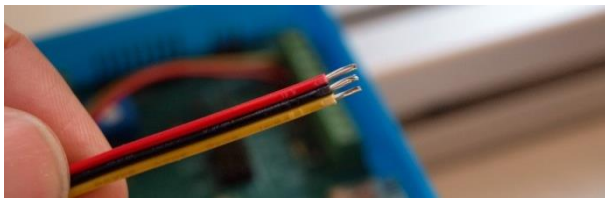
TIP: It is recommended to use cable-ties to form nice cable loops and get a nice wiring job. You can remove excessive ones on the go.



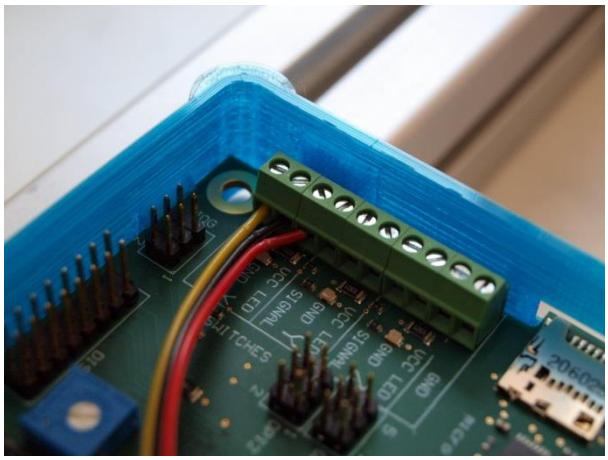
Mount the extruder motor like indicated above.



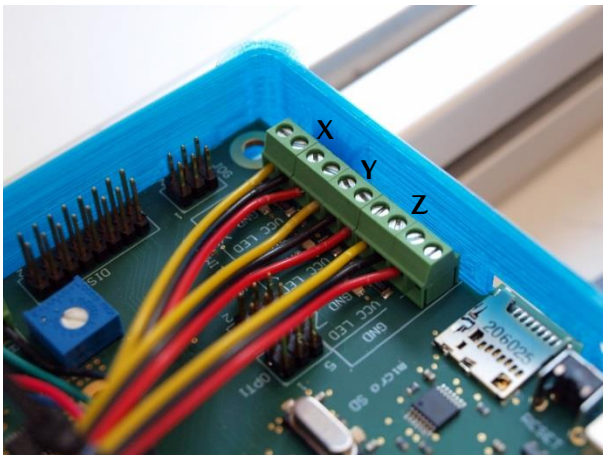
Do this for the rest of the motor wires. Note the cable ties.



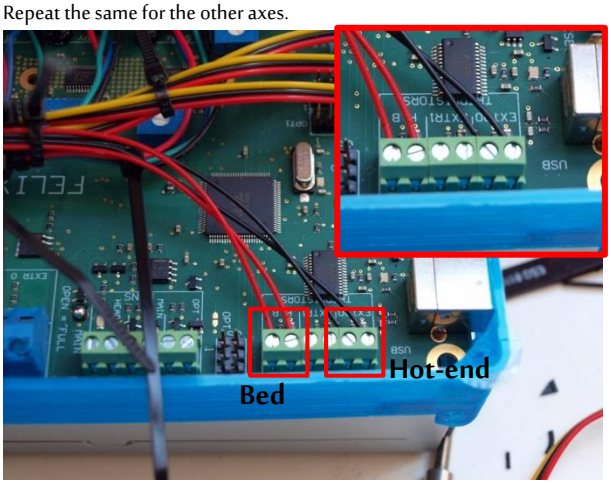
Take the wires of the x-axis opto-sensor, strip the ends.



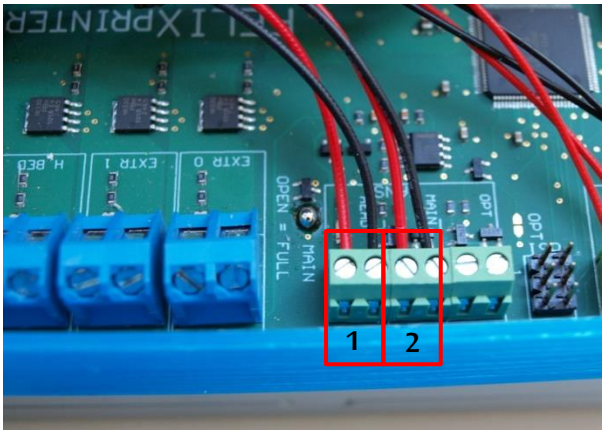
Mount it as indicated above.



Repeat the same for the other axes.



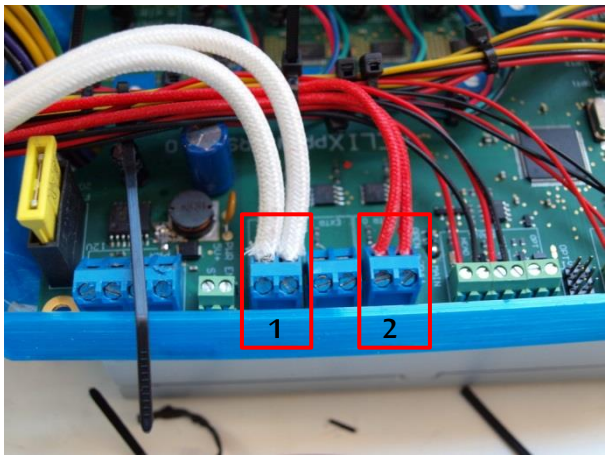
Connect the thermistors(temperature sensor) of the heated bed(red wires) and hot-end(black wires)



Connect the wires of the fans.

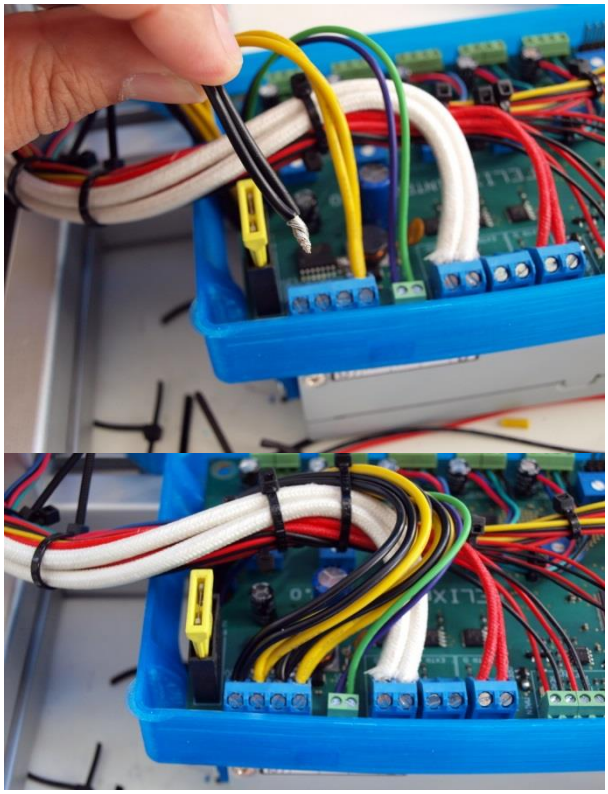
1. Switchable fan which blows air through the airduct of the extruder.
2. Fan which is always on and cools the top part of the hot-end.

IMPORTANT: match the color (polarity) of the wires.



Connect the heater wires of the bed and hot-end

1. Bed
2. Hot-end

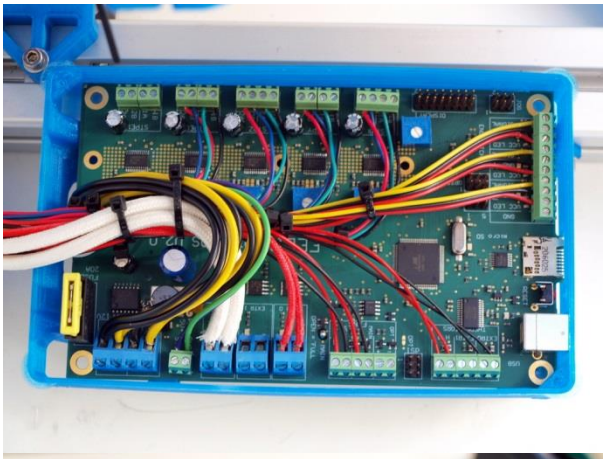


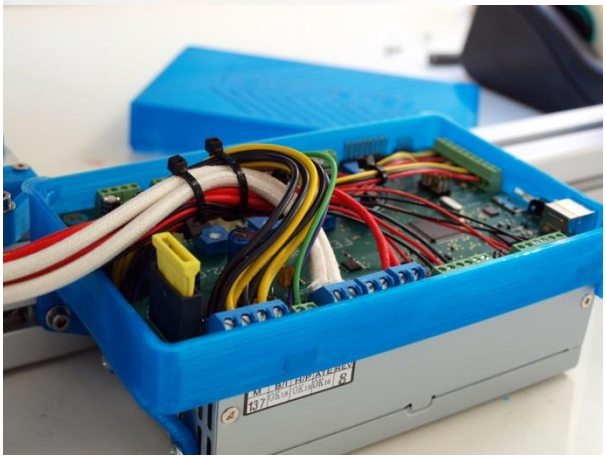
Connect green and purple wire.

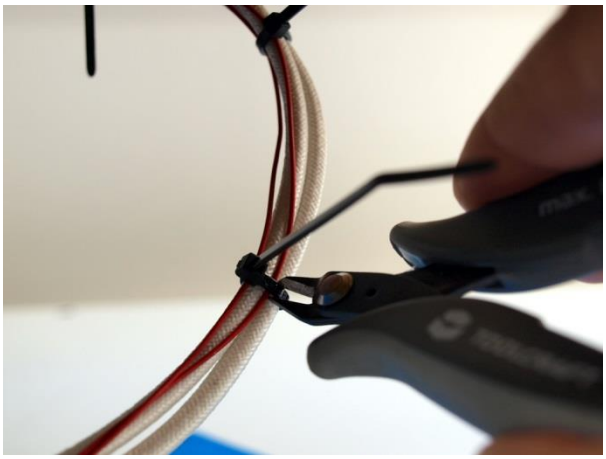
Green wire functions as an on-off switch for the printer.

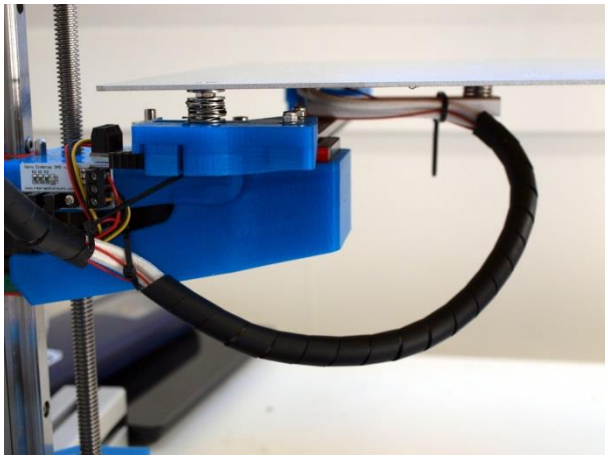
The purple wire is the standby power for the logic of the electronics.

Then mount the yellow and black wires. In total there are 4 black and 4 yellow wires. Join the wires together as shown above and mount them under the terminal blocks.



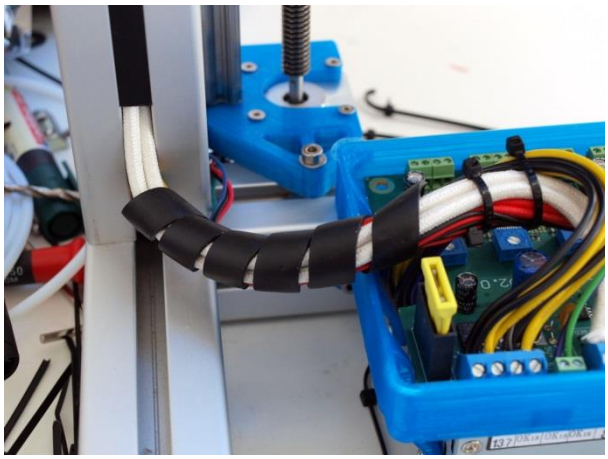






Remove the cable-ties which hold the loops together. Now put the cable spiral around it and cut to length.

Do this also for the z-axis loop and the x-axis loop.



Finally for the loop which enters the electronics cabinet.

Congratulations you have finished the electronics part and it is time for some finishing touches.

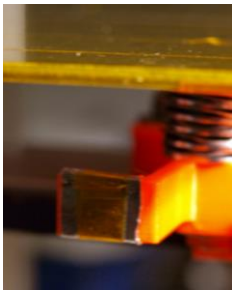
14 FINISHING TOUCHES (TIME: 30-45 MIN.)

1. **Check all the bolts if they are tightened correctly.**

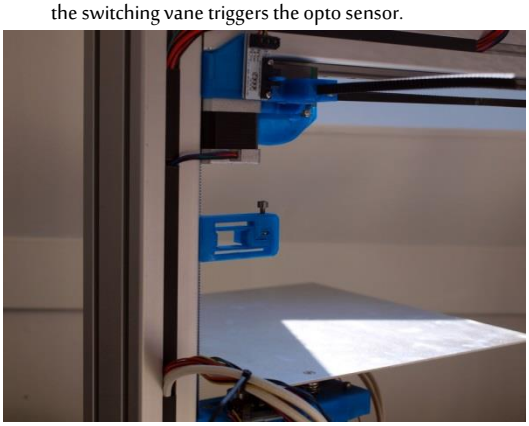
2. **Check if all the axes can move freely, without cables being jammed.**

3. **Put a little bit of oil or grease on the z-spindle, to make it run smoothly. Preferably a thicker kind of grease or oil, we use motor-oil.**

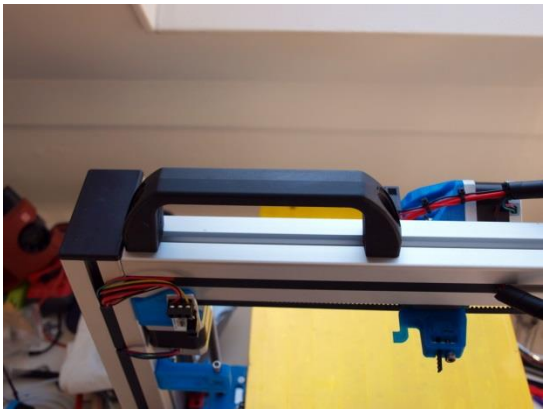
4. **When you have a printer with a shining through color, the opto-sensors of the axes might not work. To make them work you can put one of the following things on the switching vanes:**
    a. **Tippex**
    b. **Non-shining through tape on the flange**
    c. **Piece of aluminum foil**



5. Make sure the z-axis limit switch is put it 5 cm below the top edge of the z-axis rail. This way you prevent the hot-end from hitting the table before the switching vane triggers the opto sensor.

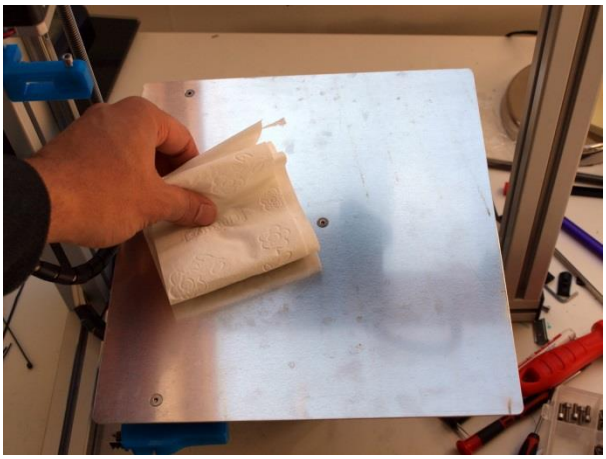


6. Mount the frame handle. Use the supplied M8 (or M6 frame nuts depends on the handle type delivered) and bolts to mount it. Place the frame holder as close to the vertical frame beam as possible.

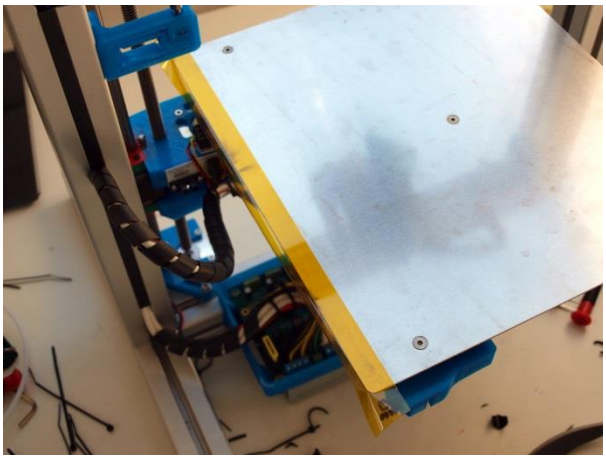


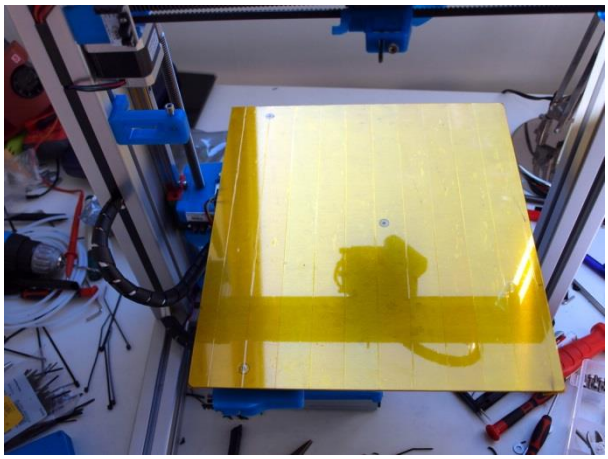
Prepare the heated bed.

In this step the goal is to put a layer of tape on the surface of the heated bed. This layer makes sure the extruded plastic will correctly stick on the bed.



Degrease/clean the bed with some detergent. We use spirit, but alcohol, thinner, nail polish remover will work also.





Put strokes of the supplied tape on the heated bed. Try to do this with as little bubbles and overlap of the strokes as possible. The better you do this the nicer the bottom surface of the printed parts will be.

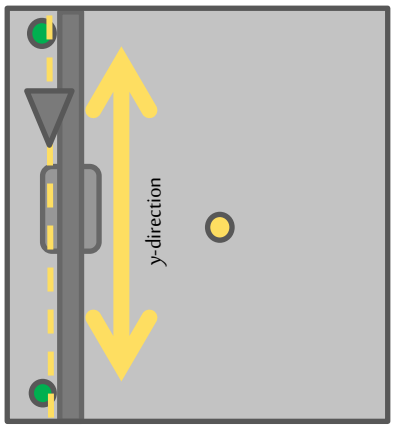
Fold the overhanging strokes of plastic around the edges. Then afterwards clean the surface with detergent.

Supplied with the kit is kapton tape. After several tests with different kinds of tape we recommend the following:

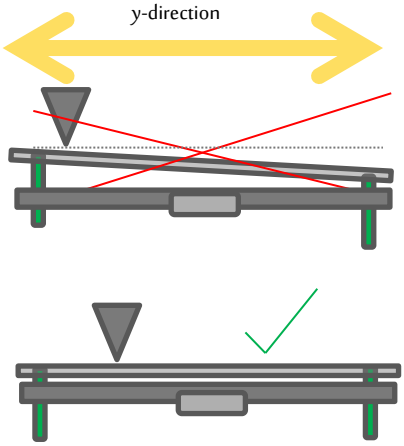
- Kapton tape. Very good for printing.
- PVC tape, has the same sticking quality as kapton tape, but significantly lower costs. Downside is the durability of the tape. Needs to be replaced more often.
- Painterstape. This is only recommended for very small parts, with small contact surface to the bed. With PLA filament this tapes sticks so well that the printed parts are extremely hard to remove from the bed. To not damage the build platform for certain parts we had to remove the parts including tape. This tape is also a suitable tape for printing with ABS.

15 CALIBRATION OF TABLE (5-15 MINS)

For a successful print it is important that the table is properly calibrated, which means it should be level. The table can be leveled by turning the 3 M4 nuts underneath the heated bed. !!The calibration is done by moving the axes by hand, not via interface of computer!!



Top view of table

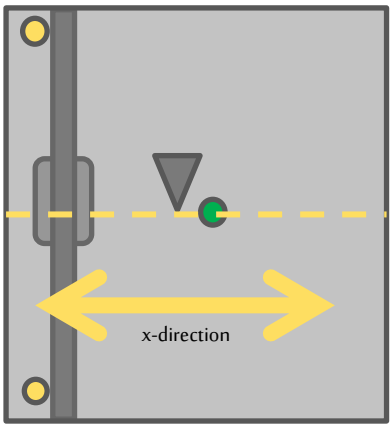


Right or left view of table

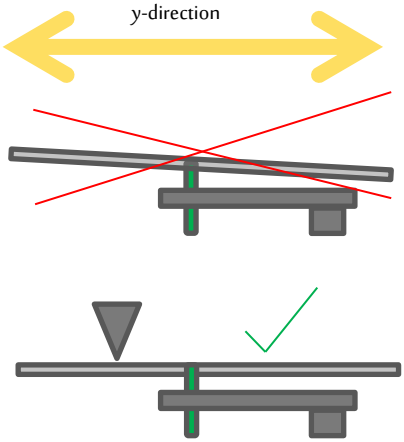
Step 1:

Calibrate the table in y-direction.

1. Move the X-axis carriage(extruder) to the homing sensor
2. Move the Y-axis (heated bed) to the homing sensor
3. Move the table up until approximately 1mm from the hot-end.
4. Goal is to move the y-axis and to get the distance between the tip of hot-end and the heated bed the same over the whole movement.
5. Move the bed over the hole movement range and while moving adjust the 2 adjustment nuts underneath the plastic parts under the table along the rail to level out the table in y-direction.
6. Move the table a little closer to the hot-end and repeat the previous step until the distance is the same over the whole length.



Top view of table



Front view of table

Step 2:

Calibration in x-direction

7. Move the table to the middle of its movement range
8. Move the X-axis carriage over it's movement range. While moving check the distance between the hot-end and bed. If the distance is not even, adjust it with the nut which supports the middle of the table.

You are done-calibrating the table.

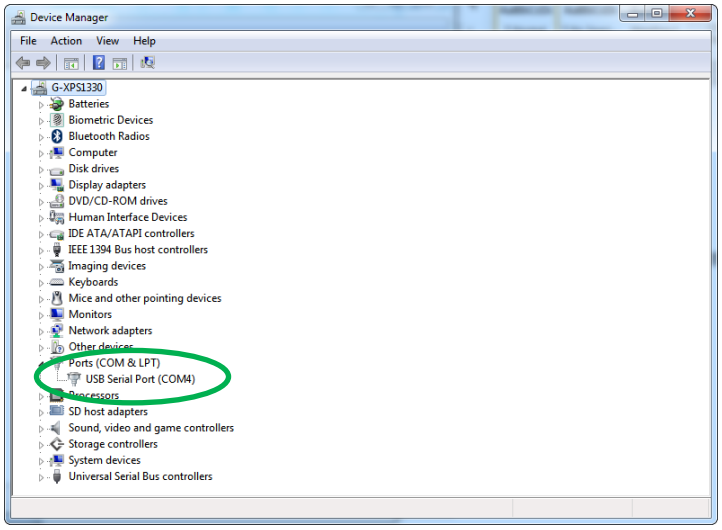
16 MAKING PRINTER READY FOR OPERATION. (30 – 60 MINS)

The software used to control the printer is open source. It is available for different platforms. This manual currently only covers the WINDOWS version of the print software. For other platforms, guides should be available on the internet.

16.1 PRINTER PREPARATION

These are necessary steps to make your printer and the computer able to communicate to eachother.

1. Plug in the powersupply cable. NOTE: without the powercable the electronics don't work. It needs the voltage of the purple wire to drive the logic of the board. The power to the rest of the board is controlled by the CPU when needed.
2. Plug in the USB cable into the computer
3. Your operating system should find the correct drivers automatically
    a. if the drivers are not found automatically then download drivers from here: http://www.ftdichip.com/Drivers/VCP.htm.
4. Go to start->right-click on "Computer"-> click properties -> in left pane click "Device Manager"

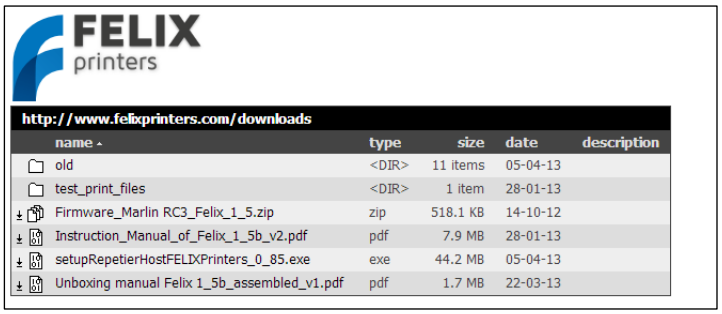


Note what COM-port is present. If there are more than one COM ports available unplug the RAMPS USB cable, and re-plug it again. Check what port number is appearing and disappearing. This port number will be used for the next step.

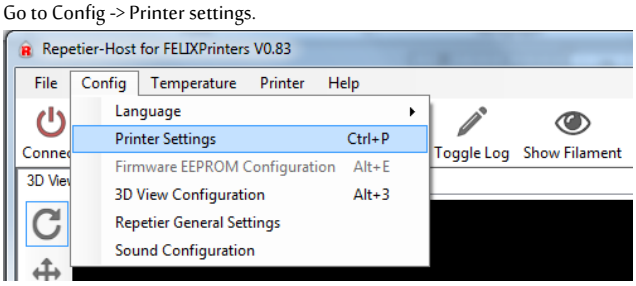
16.2 PRINTER SOFTWARE – REPETIER-HOST

This software controls the printer and processes your CAD files to be printable.

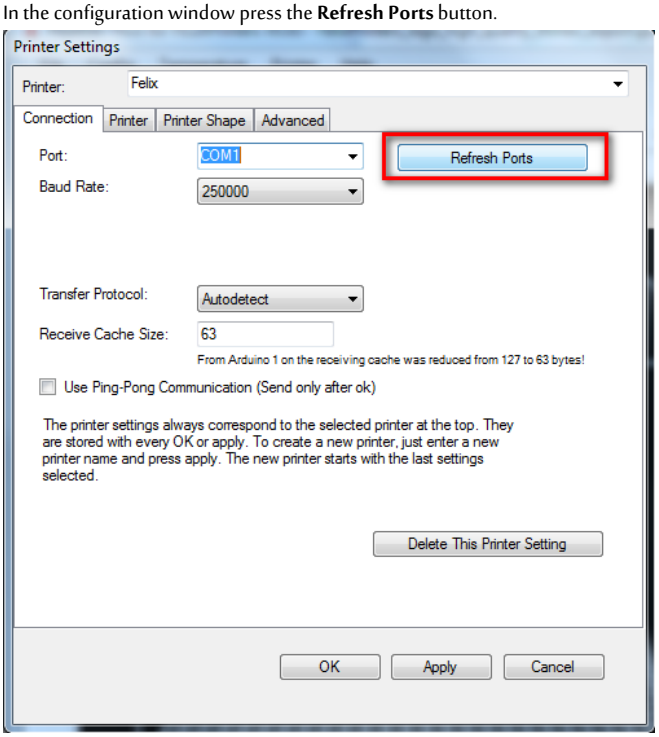
1. Download latest version of Repetier-Host from www.felixprinters.com/downloads



2. Run the **setupRepetierHostFELIXPrinters_0_xx.exe** file and follow the installation instructions.
3. Make sure the power cable and USB cable of the printer are connected.
4. Start Repetier-host.
5. Go to Config -> Printer settings.



In the configuration window press the **Refresh Ports** button.



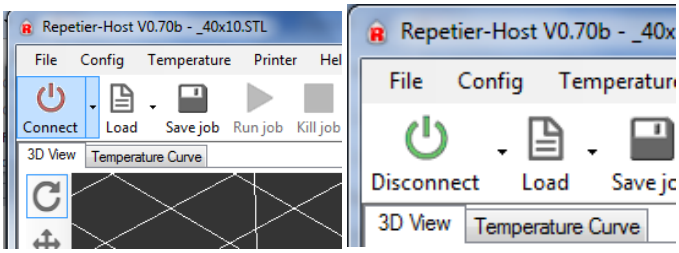
Choose the COM-port which belongs to your printer. This is the same COM-port obtained from previous chapter. The COM1 in the pictures is probably different for your situation.

16.3 CALIBRATE THE Z-DIRECTION/ CONNECT TO PRINTER

To obtain good quality prints it is **essential** that the heated bed is **level** and that the distance between the hot-end and the bed is close enough.

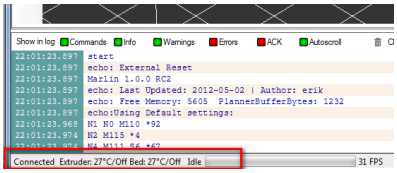
The leveling was done prior to the software installation. So now it is time to calibrate the z-axis height with the z-axis limit switch vane. Make sure if you have a shining through color printed parts for the printer to apply the tape, tipexx to the limit switch vanes.

1. Connect to the printer. (The connect button should turn green)

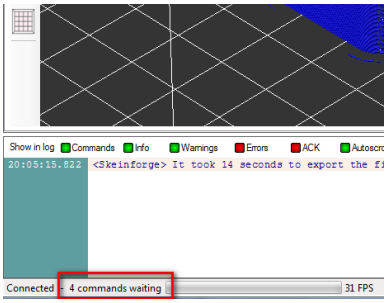


Other checks to see if the printer is connected properly:

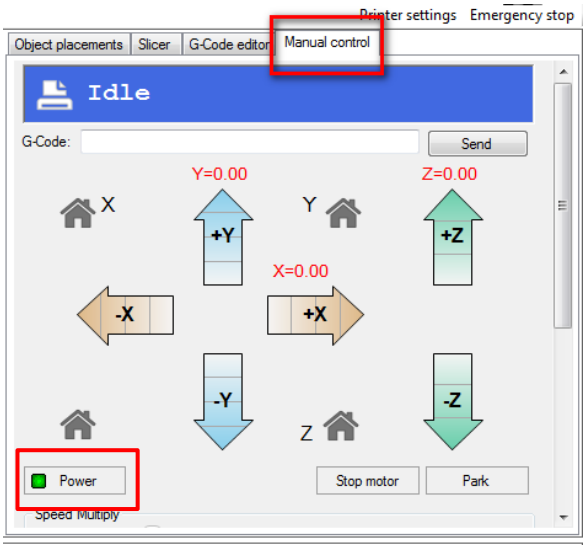
On the bottom of the repetier host program the following should be displayed



If you see **... commands waiting**, press the reset button on the side of the electronicsboard. Next to the SD card and USB connector.



2. Go to the *manual control* tab



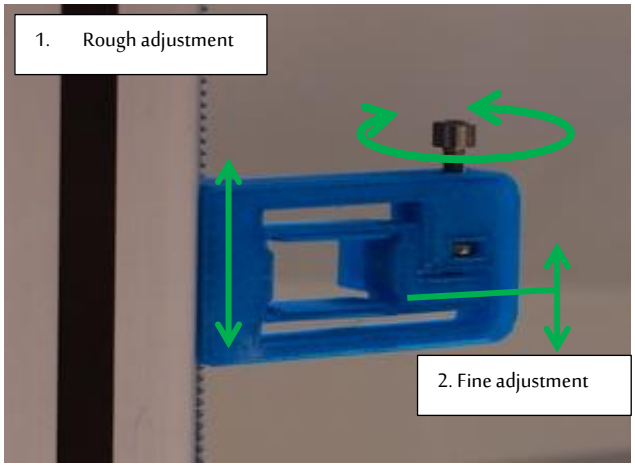
Now it is time to calibrate the z-height.:

When doing the following steps, hold your hands on the powercable. Plug it out if something goes wrong.

- Press the Power button. This will turn on the power circuit of the electronics board. Do the following checks to ensure you have connected the wires correctly.
    - Make sure the fan which blows air on top of the hot-end is spinning

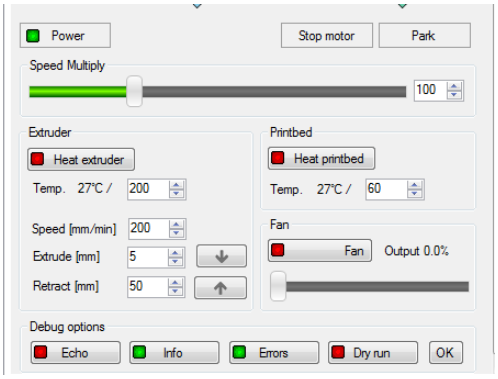
- Make sure the leds of the opto-sensors on the electronics board and on the opto sensors are burning. Make sure the lights of these opto-sensors goes out when they are triggered. So if the the flanges goe into the limit-switch the light should turn off.

- Make sure the bed is at least 5 cm from the hot-end.
- Press Home X, then move the x axis back and forth. The axis will only move in positive direction if the Home X button is not pressed.
- Press Home Y, move the y axis back and forth.
- Press Home Z
- The distance between the table and hot-end is probably too large.



-
- Turn the screw in such a way that the flexible vane mechanism goes downwards. Do this approx. till ¾ of the possible stroke. Move the complete part a little bit up and press Home Z again.
- Repeat this until the table is approx. 3 mm from the nozzle. Now fix the bracket to the frame and start homing again. Now repeat this procedure to get the nozzle closer and closer by turning the little screw as shown in the picture above.
- Do this a couple of times until the distance is less than the thickness of a piece of normal paper.

Scroll down the manual control window.



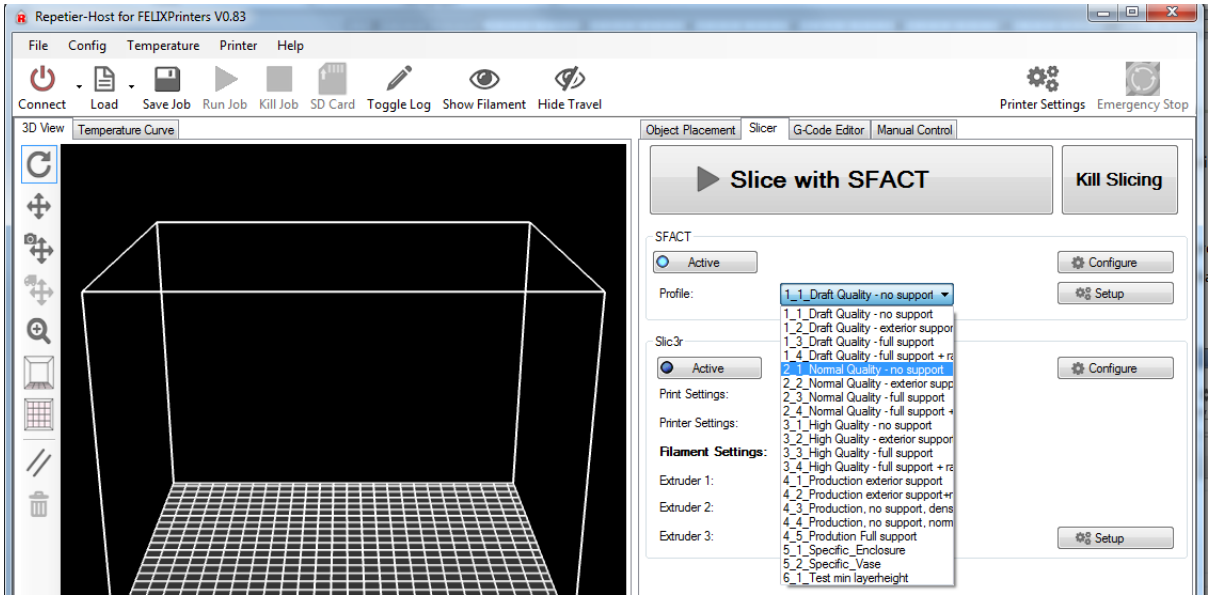
- Check if the switchable fan mounted to the airduct is working.

  Move the slider to 100% and press the fan button

You are almost ready to do your first print, please proceed to the next section.

5. The software is configured for printing and it is now time to slice and print your first object.
   Get your test file from here: www.felixprinters.com/downloads/test_print_files . In this tutorial the smallest file is used.
   _40x10.STL.

Go to the **Slicer** tab. You'll see two type of slicers. The first one is SFACT and the second one is Slice3r. SFACT is the preferred choice and has optimized profiles for the felixprinter. Slice3r is a faster slicer, but is less reliable than SFACT, which means that some models don't get sliced correct.



There is a large choice of slicing profiles. For the first test it is recommended to choose the **2_1_Normal_Quality** profile.

Short explanation of the slicing profiles:

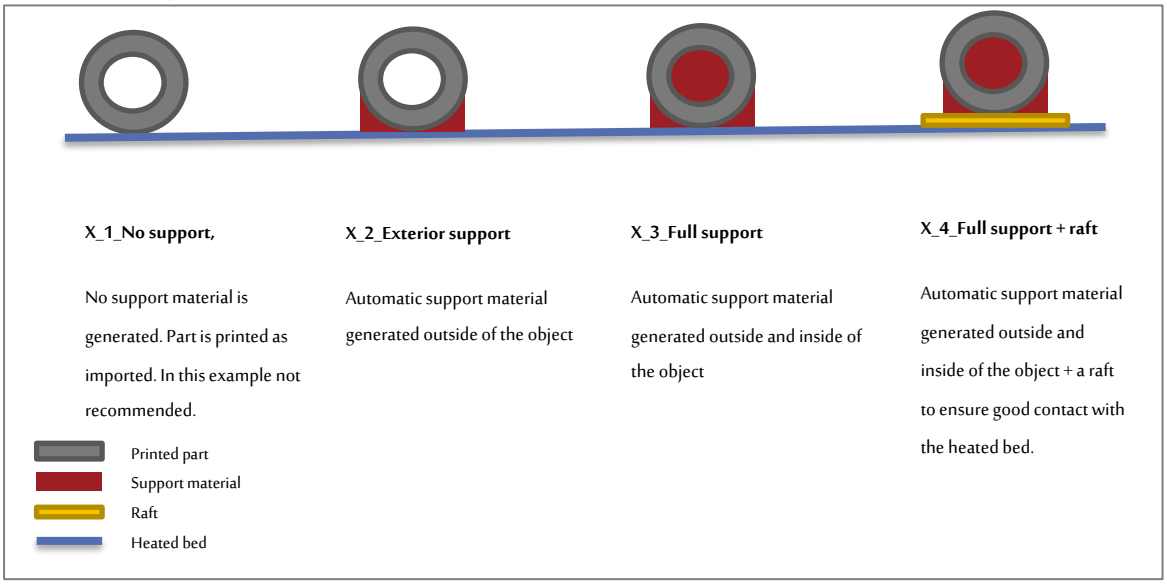
Profile 1_1 to 3_4: are profiles setup for everyday printing.

Profile 4_1 to 4_5: are profiles optimized for our production parts. These are the profiles used to produce the printed parts of your printer. When printer upgrades are provided, these can be used to slice your parts.

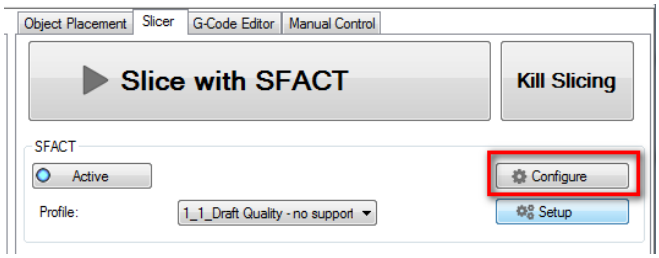
Profile 5_1 to 5_2: are used for specific cases

Profile 6_1 and further: are used for testing purposes.

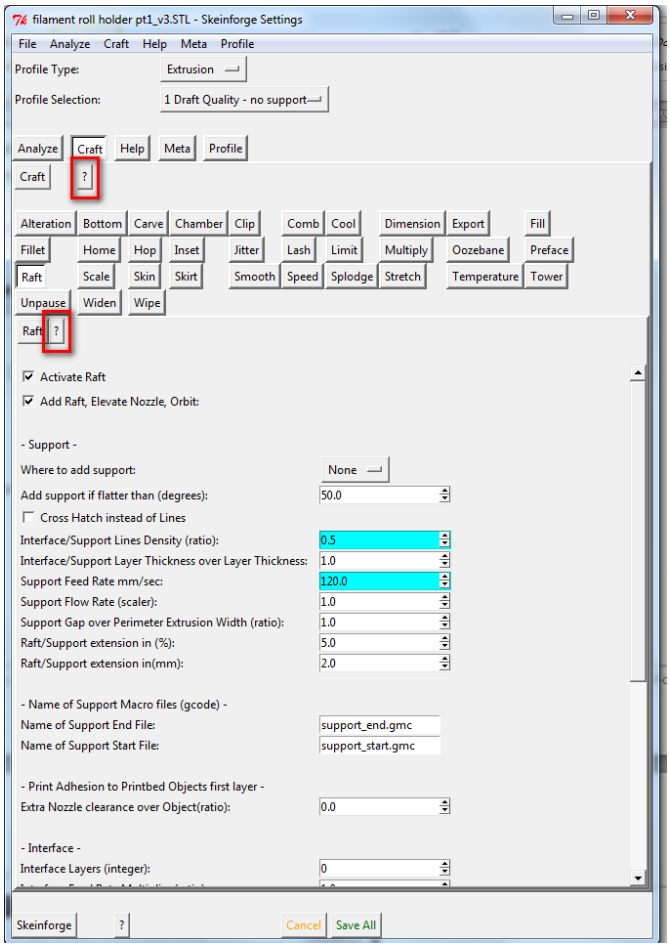
The structure of the profiles 1 to 4 is done like this:



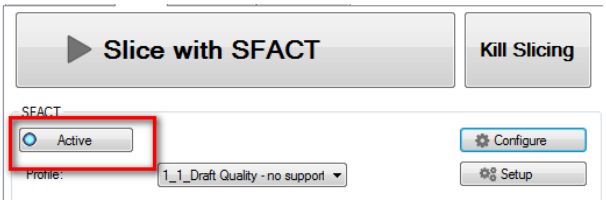
The profiles are easy to adjust and tweak yourself for further improvement. To do this just click the configure button



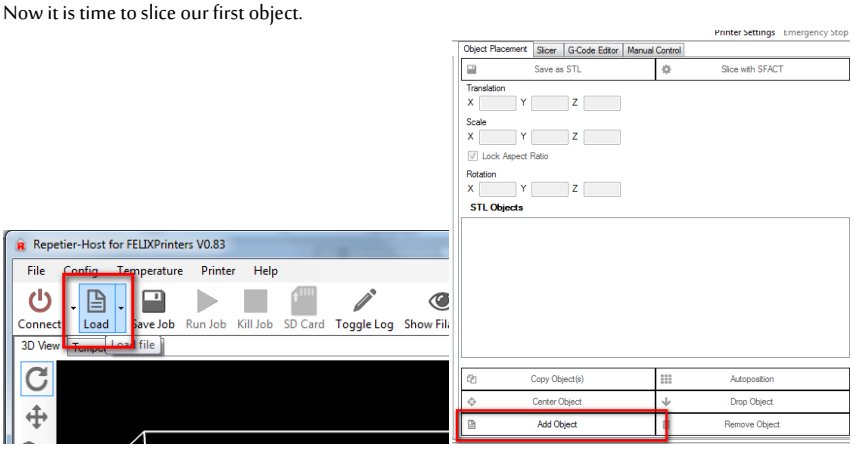
This will show a very elaborate amount of settings to tweak. Don't worry every setting is well documented. If you are interested to know more just click the question mark button as indicated in the figure below.



6. Now back in the repetier main interface make sure the SFACT slicer is activated and select one of the profiles.



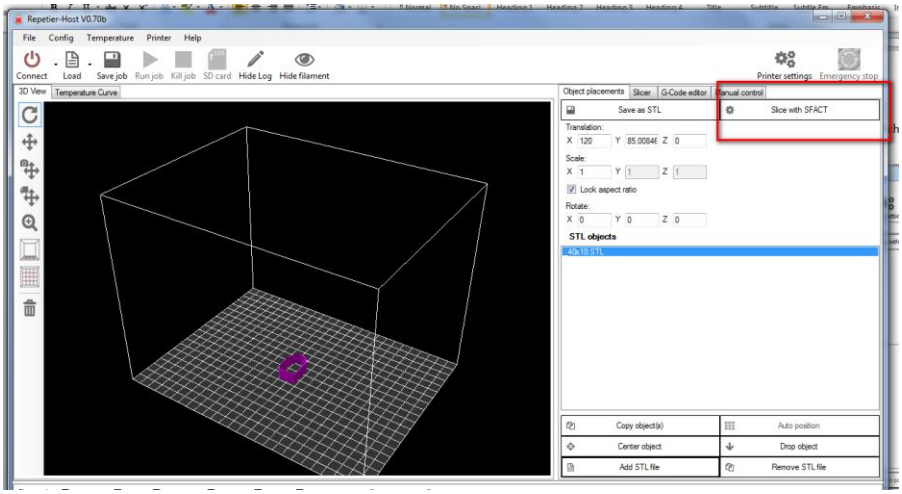
7. Now it is time to slice our first object.



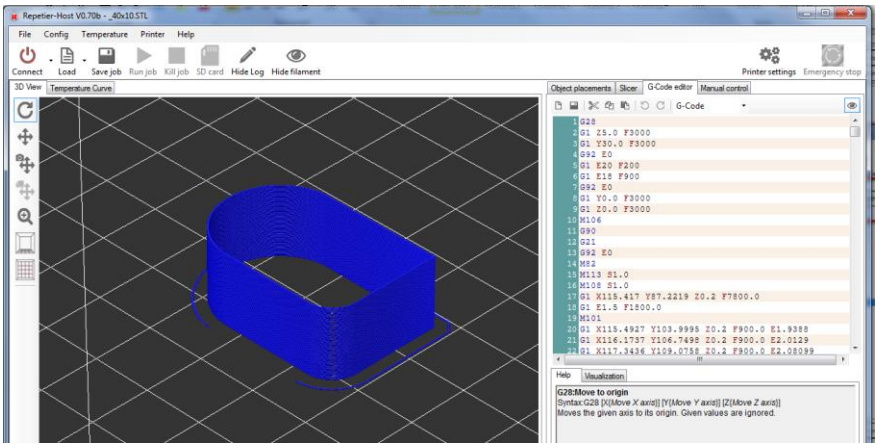
Press the *Load button* or in the Object placement tab, *Add Object button*.

Then navigate to the folder where you downloaded the _40x10.STL file or any other STL file.

8. Slice this file and prepare it to print. Press the *Slice with SFACT* button



When the program is done after slicing the interface should look like this:



You have now sliced your first object and are ready to go to the next step.

16.4 OPTIONAL: FIRMWARE INSTALLATION

Sometimes the firmware of the electronics board can get updated; this chapter explains how to do it. For your first print this chapter is not necessary.

Go to the FelixPrinters http://www.felixprinters.com/downloads/ and follow the download links to get all the required software.

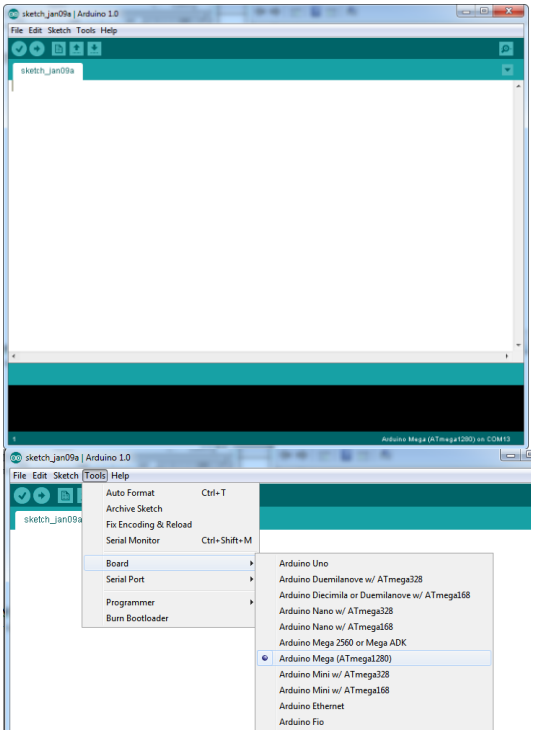
This step requires the following software:

- Arduino, www.arduino.cc platform to upload firmware to the printer.
- FELIXprinter firmware (check the revision of the printer). Contains printer settings for correct operation of your Felix printer.

Steps to upload new firmware to the FelixPrinter

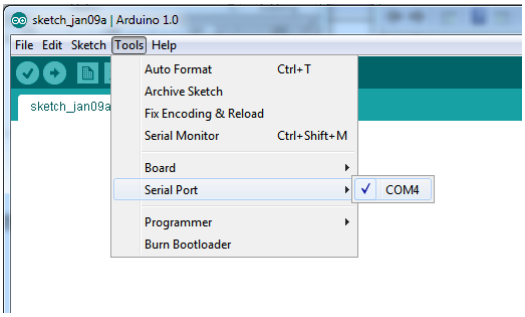
1. Start Arduino software

   It should look like this:



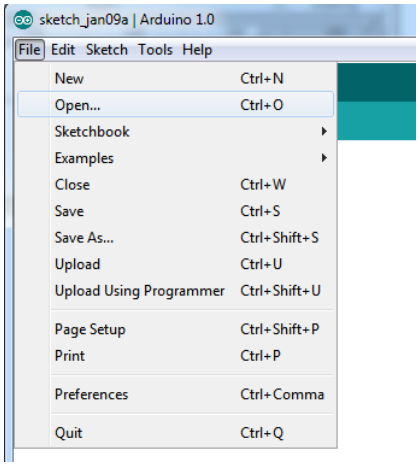
   Select the correct platform:

   Tools -> Board-> Arduino Mega(ATmega1280)



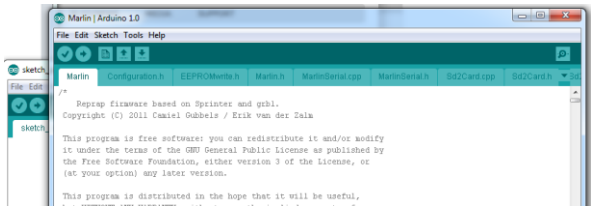
   Select the correct Serial Port which you've noted earlier

   Tools -> Serial Port -> COM...

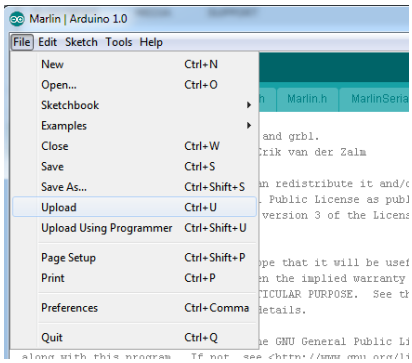


Extract the downloaded FelixPrinter firmware to some folder.

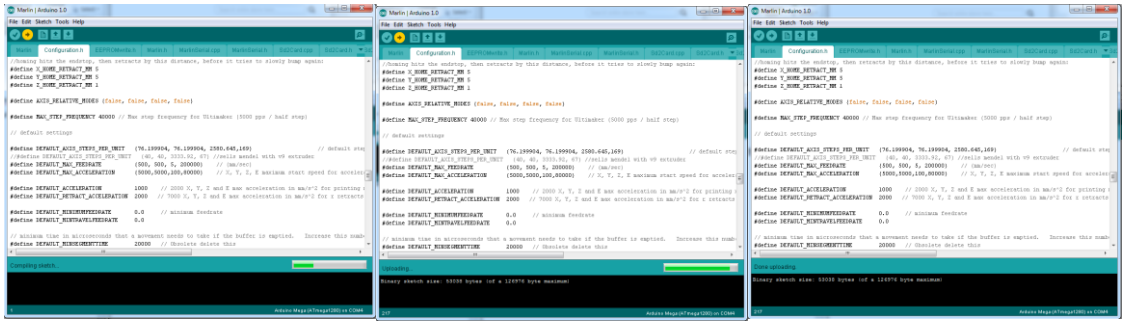
Open this folder through the Arduino interface and click on the *Marlin.INO* file.



A new window will pop-up, with all the source firmware files. All the settings for the FelixPrinter to work correctly are configured. Feel free to browse around the files to get a better understanding of how it all works.



It is time to upload.



You are done with the firmware upload.

17 IT'S TIME FOR PRINTING! (15- 30MINS)

After all the hard work of the assembly and setting up the machine it is time to get some reward by means of your first successful print.

Before pressing the "Print" button make sure of the following

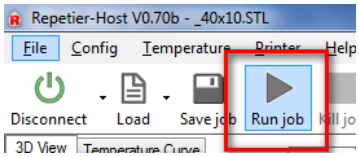
In the manual control window do the following.

- Heat up the extruder to 195 degC
- Heat up the heated bed to 55 degC
- Move the table down 10mm

If the extruder is heated up, check or make sure that the following is true

- Printer axes can move without obstructions
- Remove all plastic residues on the heated bed.
- Degreased heated bed surface
- When all axes are homed the hot-end is not touching the table.
- The supplied filament with the kit is PLA. The optimal temperature depends on the type of filament used. When using PLA check if the temperatures of the hot-end and the heated bed are between 180-210 and 30-60 degrees C respectively. When using ABS these temperatures should be somewhere around 210-250 and 70 – 100 degrees respectively. The heated bed temperatures can be much lower with painters tape.
- To find the correct temperature for optimal extrusion, start with a low temperature. Then go up slightly. When the temperature is too high, you might hear some pops and sisses coming from the hot-end. When the temperature is too low the extruder motor will have a hard time extruding. When printing at high speed, the temperature of the filament should be a little higher.
- Move down the table 10mm and insert the filament in the extruder. Run the extruder until a steady flow of plastic comes out. Remove this with tweezers.
- When there is not a continuous flow coming out of the nozzle, make sure the extruder arm is properly tensioned. Turn the m4 bolt clockwise to put more tension on the filament, so the filament will pulled into the hot-end better. But watch out, too tight and the motor will have a hard time to turn and the filament might be squashed so wide that it gets clogged into the hot-end.

When these steps are OK, you are ready to press that print button.



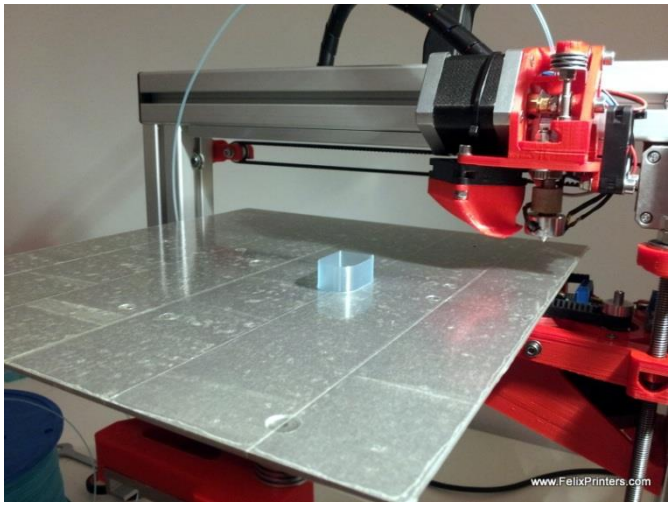
If the calibration was done ok the print should finish without any problem.

The most probable cause of failure could be the wrongly adjusted z-height of the first layer.

Two things can happen:

- The plastic won't stick to the heated bed. This means the distance between the table and the hot-end is too large
- The first layer sticks but seems squashed, compared to the other layers. This means the hot-end is too close to the table.

If one of the above failures happens, adjust the z-axis switch vane accordingly.



If the print looks like the picture above than congratulations your printer is completed!!

IMPORTANT info:

To keep the hot-end running as long as possible, let the filament run through a dust collector like a small piece of sponge. The filament picks quite a lot of dust due to static charge or dirt from the factory. This will all enter the hot-end and partially stick in there and finally clog the nozzle. When this happens the hot-end needs to be drilled out when hot from both sides. A tutorial for this is available on the forum on the website.

When changing different kind of filament it can be done in 2 ways:

1. Just cut the old part just above the extruder and keep running the extruder until you can feed the new filament.
2. Retract the current filament out of the extruder and then insert the new one.
    - To get the old filament out, retract 50 mm with a high velocity (1000mm/min). This is advised because fast retraction reduces stringing to a minimum. The little strings of molten plastic are able to jam the inlet of the hot-end. When this happens, you need to take out the hot-end and remove the plastic.
    - Then feed it again with a low velocity of 200mm/min.

18 QUEST TO HIGH QUALITY PRINTING

After experimenting a little with the printer, you probably want to get the most out of your printer. This chapter addresses some categories to increase print quality.

18.1 THERMODYNAMICS

Filament printing temperature is an important parameter. There is usually one optimal temperature to print at, this is different for each material type and even for different colors of the same material.
PLA prints somewhere between 180 to 210 degrees C.
ABS from 220 to 250 degrees.

This will happen when printing at too low temperature:

- The printed parts will become brittle, because the printed layers do not stick very well.
- Extruder needs a lot of force to push the filament through the nozzle. It can happen that at high print speeds, the force demand could not be fulfilled, which result in skipped steps of the extruder motor.

When printing at too high temperatures:

- You will experience ooze(little strings) of the filament.
- You could hear bubbles pop, this can be evaporated water inside the filament.
- Printing small prints will be difficult because when printing the next layer, the previous layer could still be soft.

TIP: when printing very small objects try to print at low speed or try to print more at once, this gives to previous printed layers time to cool down a bit.

Heated bed

The first layer which is in contact with the heated bed is the foundation of the printed part. You want to make sure that this first layer is near perfection. Sometimes it can be troubling to get parts to stick to the bed, or parts can come loose at the edges after a while. This can be because of the following:

- Bed surface is not degreased enough.
- Temperature of the heated bed is too low, try increasing it with 5 degrees
- Bed is not level. Make sure the bed is perfectly level, especially for large prints it can be that the distance of the hot-end to the bed is too much at one side of the print, when the bed is not level.
- Print speed of first layer is too fast.
- Hot-end temperature is too low. Try increasing it 5 degrees.

18.2 MECHANICS

Belts/Pulley's

Usually when perimeters of experiencing bad print quality, this can mean the following. Make sure the pulley's are tightened.
1: Pulley's are not tightened enough
2: Belt tension is not high enough.

Hot-end

Check that the hot-end is fixed in the extruder carriage. If not, the prints will come out ugly.

18.3 SOFTWARE.

High print speeds is nice, but you will suffer print quality. To have a good compromise between speed and quality, an infill speed of 80mm/s is a good start, then take the perimeter speed at 30 or 40mm/s.

19 FAQ

Q: Sometimes the extruded filament looks ugly or has a varying diameter:

A: Not homogenous extruded filament can be caused by the following:

- Check the filament quality. Bad quality filament can have a varying diameter from 1.95 to 1.4mm instead of a continuous 1.75mm.
- There is not enough tension on the extruder arm. Increase the tension on the extruder arm a little. Be careful by not to put too much tension, because the extruder motor can have a hard time turning
- Filament gets stuck somewhere. Check if the feed of filament to the extruder is going without any obstructions.

Q: There is a lot of backlash in the axis-movement:

A: Check the following:

- The belt is tensioned properly
- The set-screw on the motor-pulley is tightened enough

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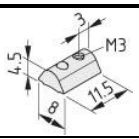
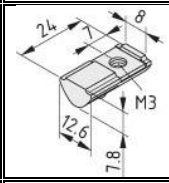
21 BOM FELIX 2.0

Bolts and screws	Amount	
ISO 4029 - M3 x 6-N - Set screw	6	
ISO 10642 - M3 x 6 --- 6N - Countersunk	5	
ISO 10642 - M3 x 8 --- 8N - Countersunk	18	
ISO 10642 - M4 x 30 --- 30N - Countersunk	4	
Hexagon socket head cap screw DIN 912 - M3 x 8	2	
Hexagon socket head cap screw DIN 912 - M3 x 12	3	
Hexagon socket head cap screw DIN 912 - M3 x 16	10	
ISO 4762 M4 x 12 --- 12N	2	
ISO 4762 M4 x 16 --- 16N	6	
ISO 4762 M4 x 20 --- 20N	15	
ISO 4762 M4 x 25 --- 25N	6	
ISO 4762 M4 x 40 --- 20N	4	
ISO 4762 M5 x 16 --- 16N	5	
Washer ISO 7089 - M3	10	
Washer ISO 7089 - 4 - (small washer)	25	
Washer ISO 7089 - 5	5	
crinkeled washer	20	
Corrosserie ring - M4 - (large washer)	25	
Prevailing torque type hexagon nut ISO 7040 - M3	6	
Hexagon Thin Nut ISO - 4035 - M4 - N	15	
ISO 7040-M4-N - self prevailing nut	12	
Powersupply screw	6	
bronze small screw	8	

t_slot_nut_5_M3	2	
t_slot_nut_8_M3	3	
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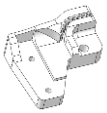
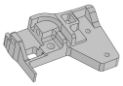
x-axis belt mount_v 6_F1_5	1	
y-stage bracket pt1_v6_F1_5	1	
y-stage bracket pt2_v5_F1_5	1	
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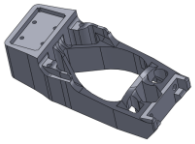
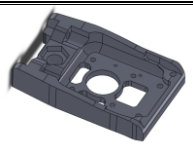
z_axis_carrier_pt1_v15_F2_0	**1**	
z_axis_carrier_pt2_v11_F2_0	**1**	
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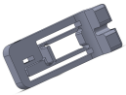
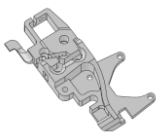
z-axis-limitswitch_vane_v6_F2_0	**1**	
Extru_base_v9_F1_5	1	
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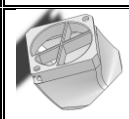
Extru_airduct_v2	1	
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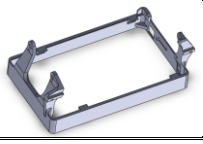
Electonics_case_F_2_0_v3_base	**1**	
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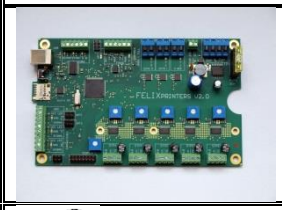
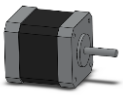
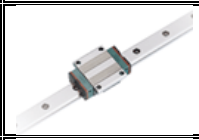
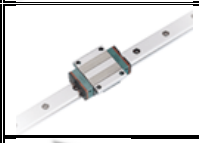
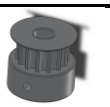
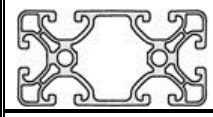
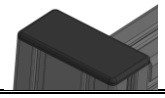
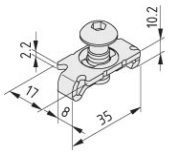
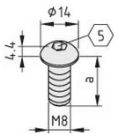
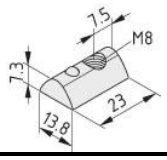
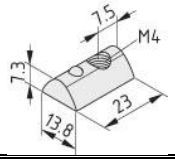
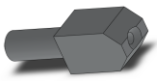
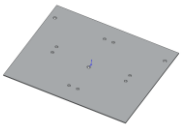
Electronics		
Heater Cartidge incl 2m wires (pre-assembled in hot-end)	1	
Thermistor incl 2m wires (1 is pre-assembled in hot-end)	2	
FELIXprinters electronics.	1	
Fan 40x40x10mm	2	
mini-ATX-seasonic, powersupply	1	
Power Cable EU(optional)	1	
Power Cable USA(optional)	1	
Power Cable Australian(optional)	1	
Power Cable British(optional)	1	

optosensor	3	
motor nema 17	4	
Kapton Foil heater, including thermistor, heater and wires	1	
precrimped cables 3 threads	3	
Shielded USB cable 1.8m	1	
Mechanics		
Hiwin lineair ball bearing set small	2	
Hiwin lineair ball bearing set – large	1	
pulley_motor_HTD	2	
Toothbelt 1.5m	1	
bearing 5x12x6	6	
extruder_insert_piece	1	

Frame		
40x40x400 profile, incl 2xM8	1	
40x40x400 profile, incl 1xM8, 1xD7	2	
40x40x400 profile, incl 3xD7	1	
80x40x440 incl work	1	
40x40 protective caps	4	
80x40 protective caps	1	
frame connector set	6	
handle incl protective cap	1	
hex sockethead bolt M8x16 buttonhead or M6x16 bolt depending on handle type	2	
t-slot nut - 8 ST M8 or M6 depending on handle type	2	

t-slot nut - 8 ST M4	**15**	
dampning feet	**6**	
strip for putting away cable pieces of 40 cm	**2**	
y-axis mid-table support 20x10_profile + protective cap	1	
Fabricated parts		
Assembled Hot-end, containing	**1**	
Hot_End_base_1.75mm	**1**	
Hot_End_peek_isolation_1.75_v2	**1**	
hot_end_heated_nozzle_1.75	**1**	
table_2mm	**1**	
Trapezium spindle rod 10x2, 330mm	**1**	
Trapezium hexagon nut 10x2, brass	**1**	
Others		
tweezers	**1**	

Kapton tape for heated bed	1	
cable ties, set of 100	1	
cable spiral 1.25m	1	
piece of selfadhesive tape 15cm	1	
Piece of filament to start 5m	1	