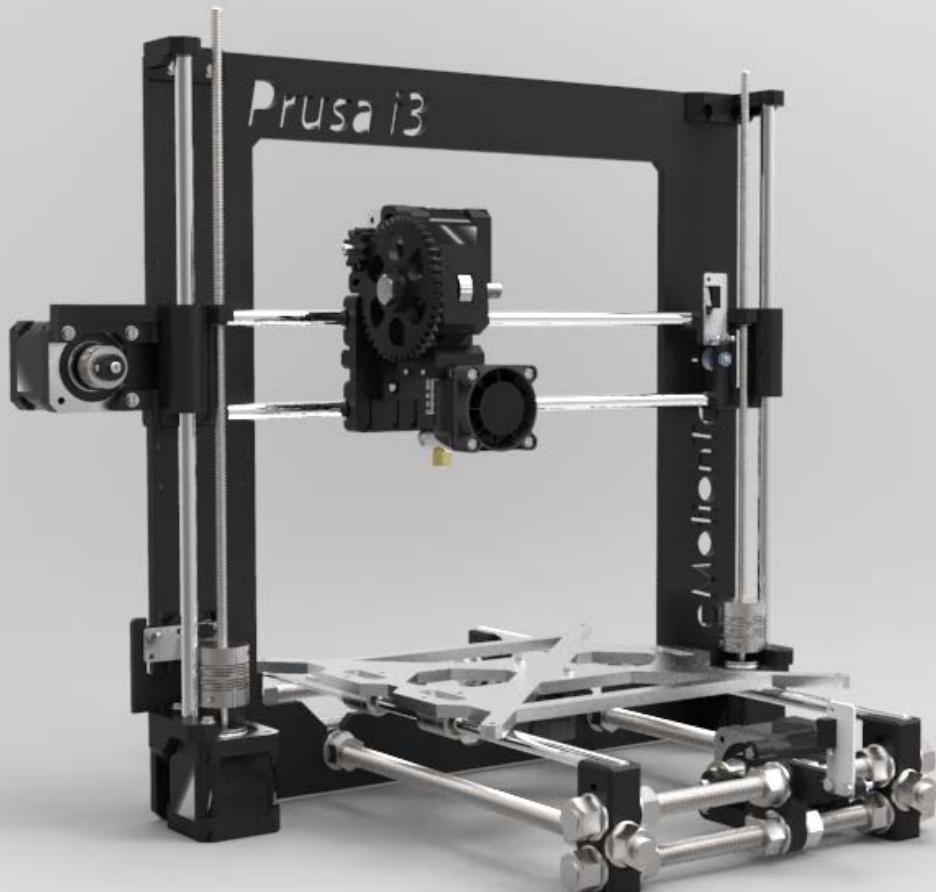


PRUSA MENDEL i3 REWORK



ASSEMBLY INSTRUCTIONS

Introduction

- **Purpose :**

To provide a visual guide needed to build a Prusa Mendel i3 3D Printer.

- **Publisher :**

eMotion Tech – <http://www.Reprap-France.com>

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- **Sources :**

Prusa Mendel i3 EiNSTeIN VARIANT - http://reprap.org/wiki/Prusa_i3_Build_Manual#EiNSTeIN_VARIANT

Modified extruder designed by ch1t0 - <http://www.thingiverse.com/ch1t0/designs>

- **Photo credits :**

Images and 3D illustrations made by <http://www.emotion-tech.com>

RAMPS from the website <http://www.tylercrumpton.com>

Wiring from the wiki <http://reprap.org> translated by Yann CLEMENT

- **Licensing :**

Prusa i3 : GPL (<http://reprap.org/wiki/GPL>)

This document : GPL



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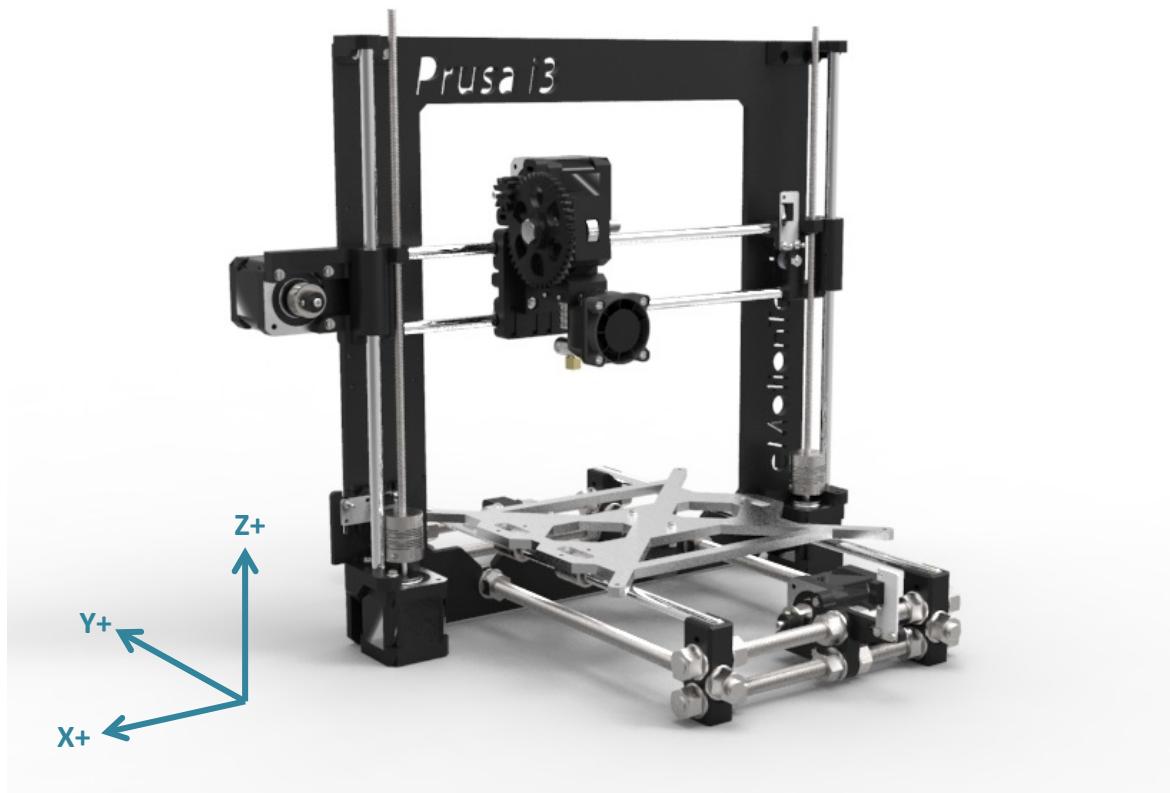
I. Prusa Mendel i3 presentation

Prusa Mendel i3 is the third version of the open source 3D printer Prusa Mendel. Our version is based on an aluminium frame cut by water jet cutter and threaded rods. Axis motion are made on linear bearings, belts and pulleys or threaded rods and NEMA 17 motors.

This version is based on « EiNSTeIN » variant (M10 threaded rods instead of M8). We changed some features:

- Extruder upgrade: Magma Hotend (by Trinity Lab) support.
- New cooling fan duct for Magma Hotend.
- Y Idler with a tensioner system.
- X End Idler with endstop holder.
- Upgrade X End Idler in order to support 624 bearing.
- Y Motor with endstop holder.
- Addition of Z endstop Holder in situ.

The following illustration represents the mechanical body and X/Y/Z axis orientation.



II. Bill of materials

A. Printed Parts



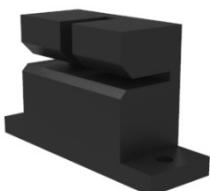
1x X Carriage



1x X End Idler



1x X End Motor



1x Y Belt Holder



4x Y Corner



1x Y Motor



1x Y Idler



1x Z Axis Top Left



1x Z Axis Top Right



1x Endstop Z Holder



1x Z Axis Bottom Left



1x Z Axis Bottom Right



3x Arduino Washer

B. Extruder



1x Wade Extruder Body



1x Extruder Idler



1x Fan Duct



1x Wade Small Gear



1x Wade Big Gear



1x Magma Hotend Kit
(resistor and thermistor included)



1x Hobbed Bolt



1x Fan 4*4

2x Springs

C. Smooth and threaded rods



2x Smooth rod Ø8x320 mm
2x Smooth rod Ø8x350 mm
2x Smooth rod Ø8x370 mm



2x Threaded rod M5x300 mm
4x Threaded rod M10x210 mm
2x Threaded rod M10x380 mm

D. Mechanical parts



11x LM8UU linear bearing



2x Coupling 5*5



1x 624 ball bearing
4x 608 ball bearing



5x NEMA 17 motor



1x GT2 Belt (760 mm)
1x GT2 Belt (900 mm)



2x GT2 Pulley

E. Heated bed



1x PCB Heatbed



1x Glass plate



1x Polyimide tape



4x Binder clip



1x Thermistor

F. Electronics



1x RAMPs



1x Atmega 2560



4x Stepstick



3x Endstop (connecting cables included)



1x Power supply (connecting cable not included)

G. Screws, nuts and washers



- 41x M3x14 mm screw**
- 7x M3x30 mm screw**
- 2x M3x60 mm screw**
- 6x M4x20 mm screw**
- 1x M8x30 mm screw**
- 1x M8x20 mm grub screw**



- 33x M3 nut**
- 6x M4 nut**
- 2x M5 nut**
- 1x M8 nut**
- 34x M10 nut**



- 53x Ø3 mm washer**
- 6x Ø8 mm washer**
- 34x Ø10 mm washer**



- 1x M8 Nylstop nut**



- 5x M3 grub screw**

Note: Screws, nuts and washers are provided in additional quantities.

H. Aluminium frame

**1x Single frame****1x Heated bed mount**

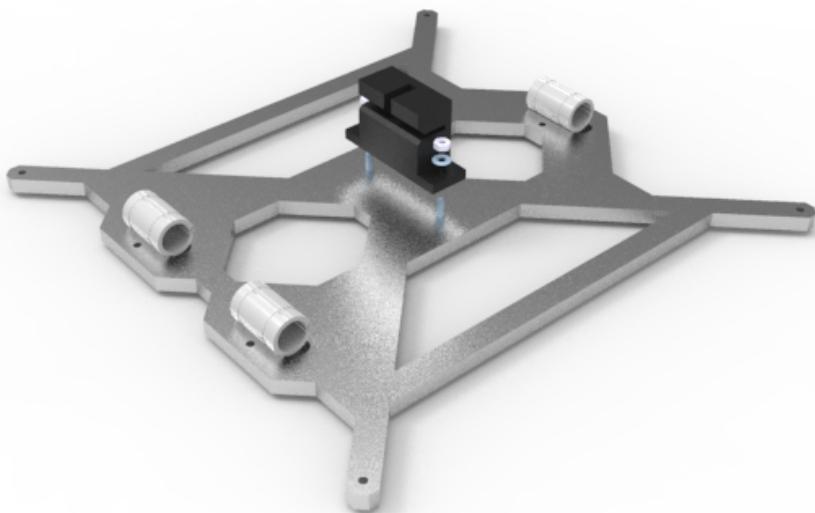
III. Mechanical assembly

A. Y-axis assembly

1. Heated bed mount

Needed parts :

- Heated bed mount
- Y Belt Holder
- 3x Linear bearing LM8UU
- 2x M3x14 mm screw
- 2x Ø3 mm waher
- 2x M3 nut



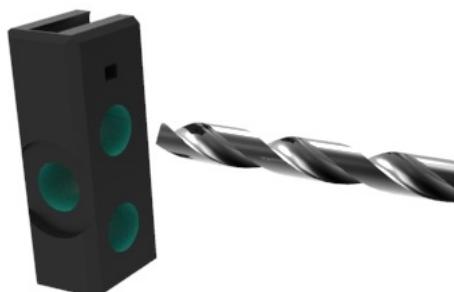
Mount the Y Belt Holder with two M3x14 mm screws, two Ø3 mm washers and two M3 nuts. Y Belt Holder orientation doesn't matter.

Place three LM8UU linear bearings and fix them with three zip-ties.

2. Transverse parts

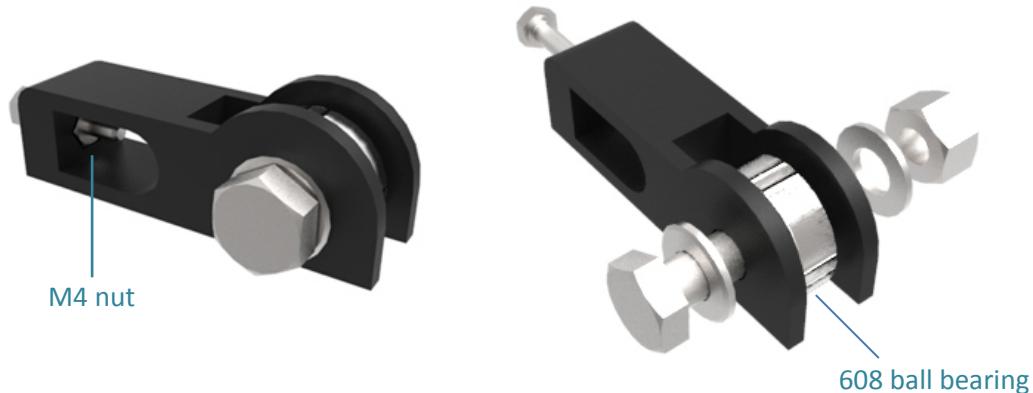
Needed parts :

- 4x Y Corner
- Y Idler
- Y Motor
- 1x Ball bearing 608
- 4x Threaded rod M10x210 mm
- 22x M10 nut
- 22x Ø10 mm washer
- 1x M8x30 mm screw
- 1x M8 nut
- 2x Ø8 mm wahser
- 1x M4x20 mm screw
- 1x M4 nut

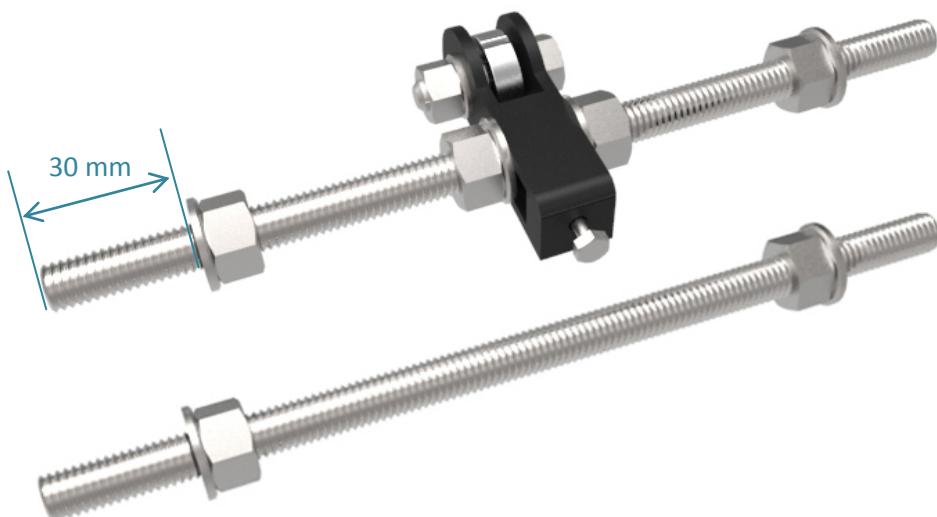


1 Drill with a 10 mm drill the four Y Corner holes (displayed in green). Set counterclockwise rotation and drill progressively and carefully along the axis.

- 2** Y Idler assembly: place a M4 nut inside and put a M4x20 mm screw. In case of difficulty, slightly heat the nut using a lighter or a blowtorch and place it with a clamp. Insert a 608 ball bearing into the groove and slide and M8x30 mm screw with two Ø8 mm washers and a M8 nut. You may have to force the screw into the part. Tighten slightly.



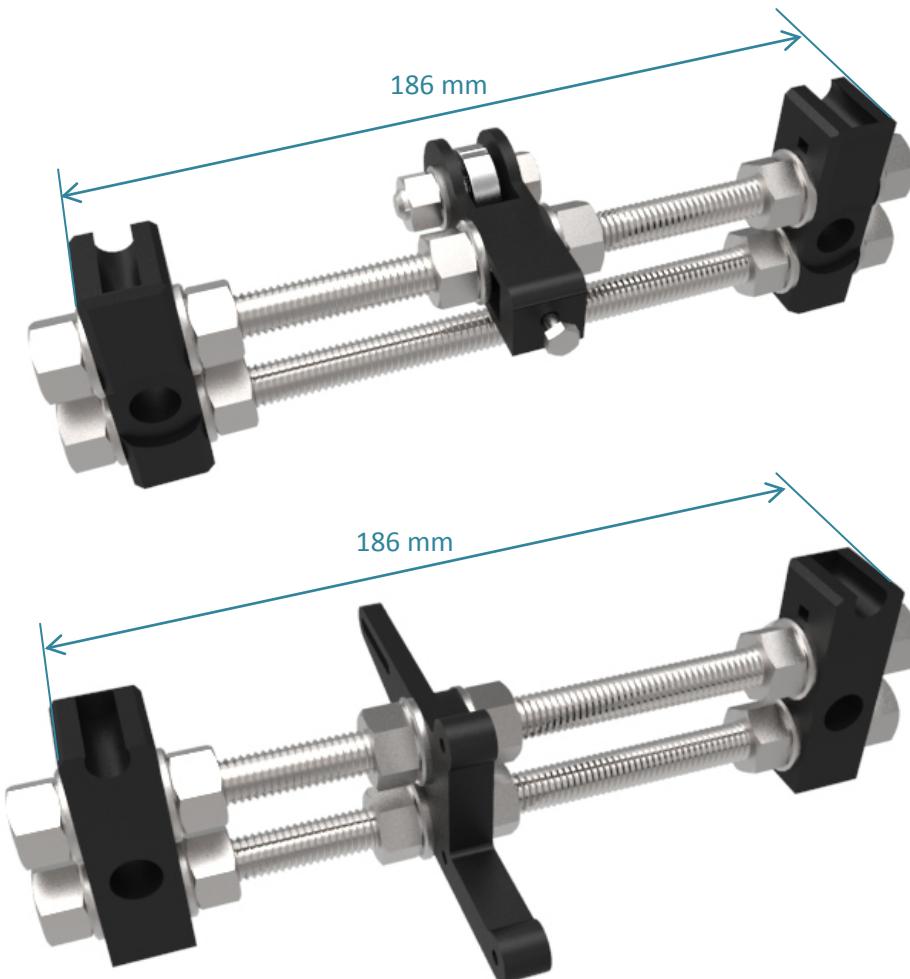
- 3** Slide the Y Idler assembly in the middle of a threaded rod M10x210 mm and between two Ø10 mm washers and two M10 nuts. Do not tighten the nuts. Thread a M10 nut and washer about 30 mm on both ends. Do the same with a threaded rod M10x210 mm.



- 4** Slide two threaded rods M10x210 mm on the Y Motor and fix it with four M10 nuts and four Ø10 washers. Do not tighten the nuts. Thread a M10 nut and washer about 30 mm on both ends.



- 5** Take two Y Corners, the Y Idler assembly and the threaded rod M10x210 mm and fix them with four Ø10 washers and four M10 nuts. Do the same with the Y Motor assembly with two Y Corners. In both cases, adjust the distance between two Y corners (**186 mm**). Slightly tighten the nuts.



3. Assembly with the longitudinal parts

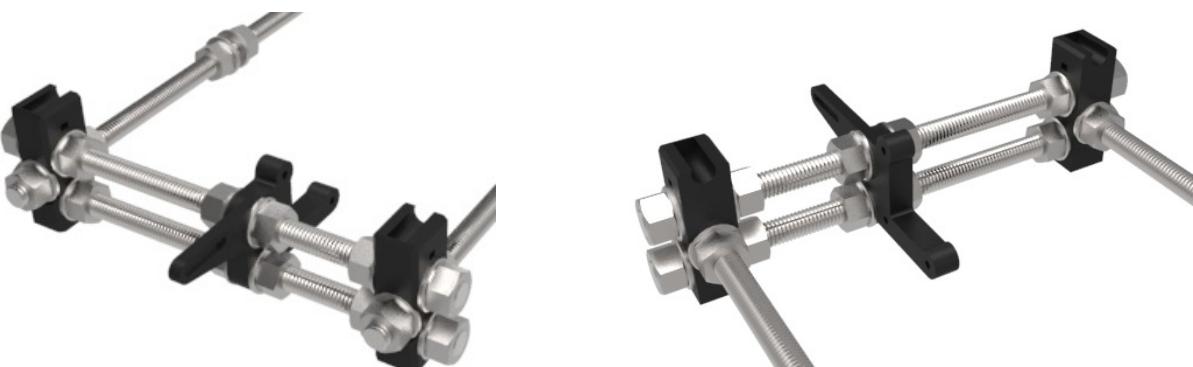
Needed parts :

- Heated bed mount assembly
- Transverse parts
- 2x Smooth rod Ø8x350 mm
- 2x Threaded rod M10x380 mm
- 12x M10 nut
- 12x Ø10 mm washer

- 1 Take two threaded rods M10x380 mm, slide two Ø10 mm washers and thread two M10 nuts in the middle. Thread a M10 nut and washer about 30 mm on both ends.



- 2 Insert the previous rods in a transverse side and fix them with two Ø10 mm washers and two M10 nuts. Do not tighten the nuts yet.

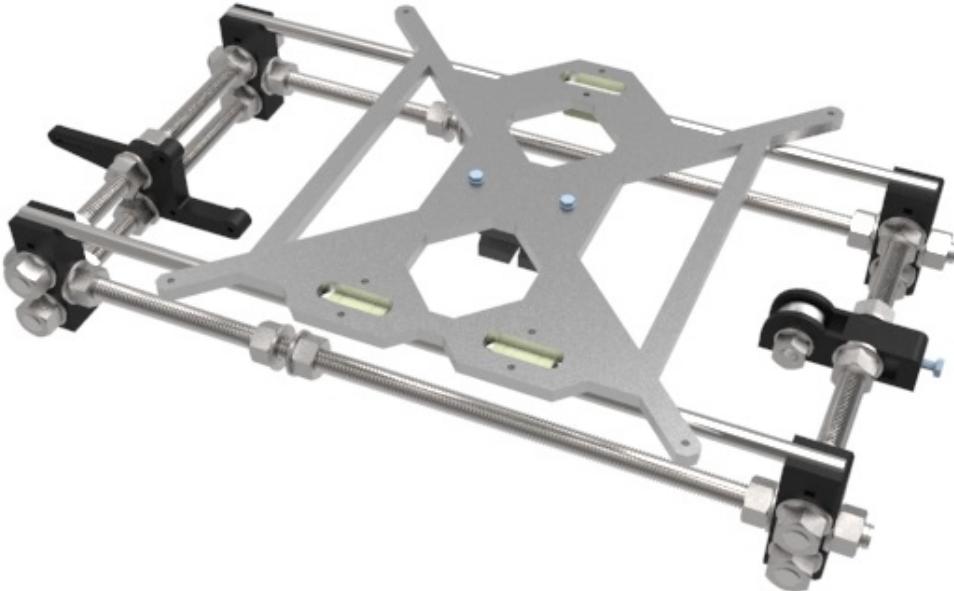


- 3 Insert two smooth rods Ø8x350 mm in Y Corner top until the end.

Slide the Heated bed mount assembly on both smooth rods carefully.

4 Insert the last transverse side on smooth rods Ø8 and threaded rods M10. Fix them with two M10 nuts and two Ø10 mm washers. Fasten the smooth rods with four zip-ties.

Tighten with a wrench the entire assembly with care. Make sure that the four Y Corners touch the ground. Do not tighten Y Motor and Y Idler nuts.



To finish, make sure that the Y-axis move smoothly. Otherwise, verify the distance between Y Corner lateral faces (**186 mm**).

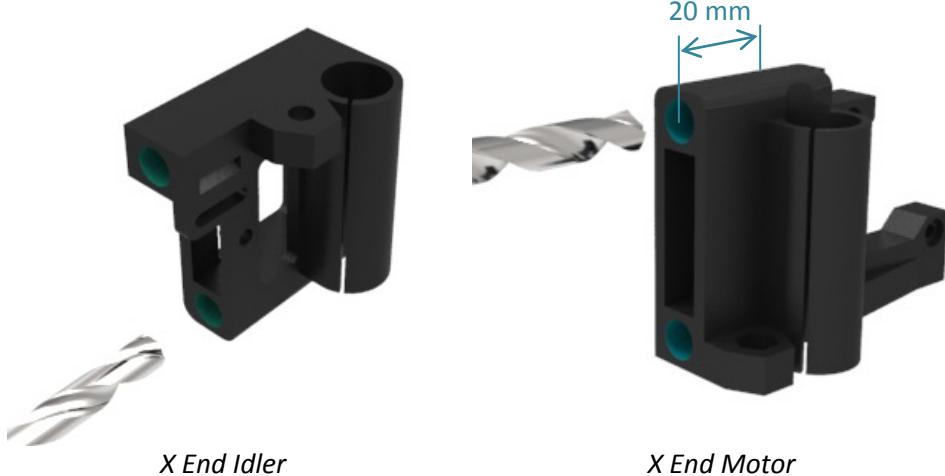
B. X-axis assembly

1. X End Idler & X End Motor

Needed parts :

- X End Idler
- X End Motor
- 1x 624 ball bearing
- 4x LM8UU linear bearing
- 1x Endstop
- 2x M5 nut
- 1x M4x20 mm screw
- 1x M4 nut
- 2x M3x14 mm screw
- 2x M3 nut

- 1** Drill with an 8 mm drill X End Idler and X End Motor holes (displayed in green). Do not drill deeper than 20 mm on the X End Motor. Set counterclockwise rotation and drill progressively and carefully along the axis.



- 2** Push two LM8UU linear bearings in the X End Idler and two LM8UU linear bearings in the X End Motor. They can be pushed with hands but you can use a rubber carefully if necessary.



- 3** Insert an 624 ball bearing (the smallest) between the X End Idler and slide an M4x20 mm screw.

You may have to force the screw into the part. Fix them with an M4 nut and tighten slightly.

4 Insert two M5 nuts in their marks. In order to do that, thread a threaded rod M5x300mm opposite to the nut. Slightly heat the nut using a lighter or a blowtorch then pull the rod. Be careful with this operation.



5 Fix one endstop with two M3x14 screws and two M3 nuts on the X End Idler.

2. X Carriage

Needed parts :

- X Carriage
- 4x LM8UU linear bearing
- Zip-ties

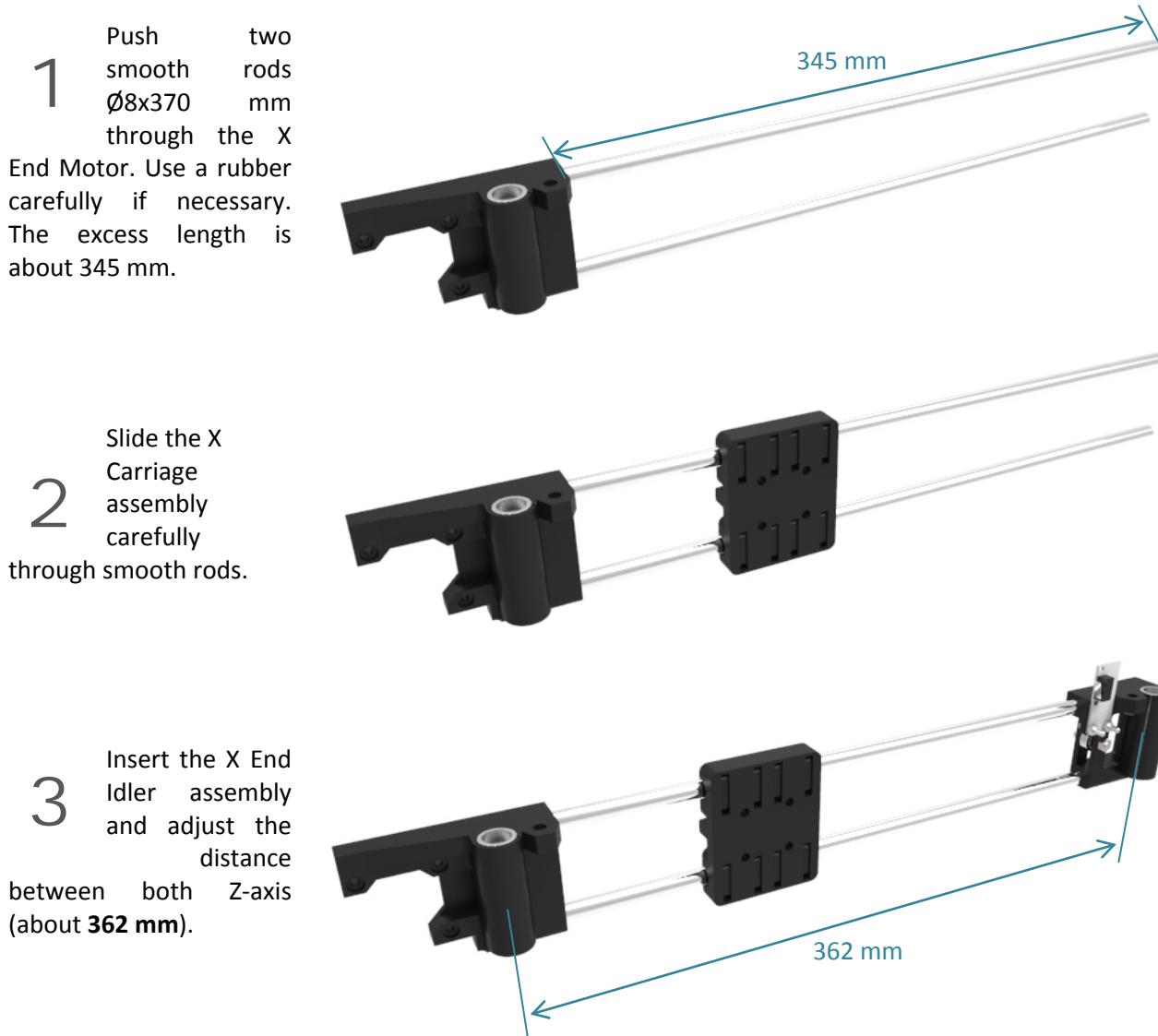


Insert four LM8UU linear bearings on the X Carriage and fix them with eight zip-ties. Make sure to put the « head » of the zip-tie on bearings side.

3. X-Axis assembly

Needed parts:

- X End Idler assembly
- X End Motor assembly
- X Carriage assembly
- 2x Smooth rods Ø8x370 mm



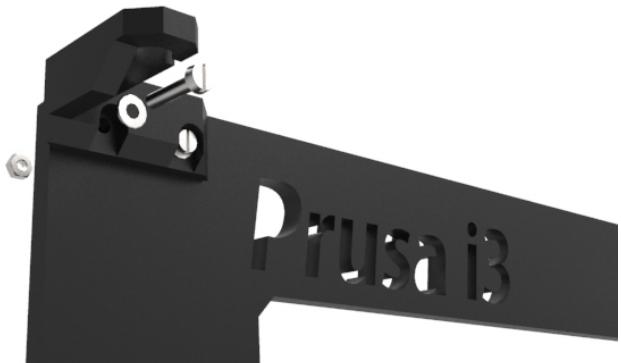
C. Connecting X-axis and Z-axis

Needed parts

- Single frame
- X-axis assembly
- Z Axis Top Left
- Z Axis Top Right
- Z Bottom Left
- Z Bottom Right
- 2x Smooth rod Ø8x320 mm
- 10x M3x14 mm screw
- 10x M3 nut
- 10x Ø3 mm washer

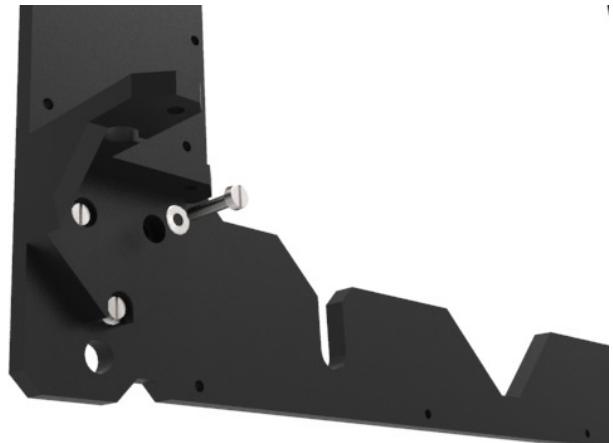
1 Fix Z Axis Top Left and Z Axis Top Right on the single frame with four M3x14 mm screws, four Ø3 mm washers and four M3 nuts.

Make sure that the nut is at the back of the single frame.



2 Fix Z Axis Bottom Left and Z Axis Bottom Right on the single frame with six M3x14 mm screws, six Ø3 mm washers and 6 M3 nuts.

Make sure that the nut is at the back of the single frame.



3 Insert two smooth Ø8x320 mm carefully on both Z Axis Top and slide them by half.

4 Insert the X-axis assembly through smooth rods carefully. Slide the two smooth rods and insert them in both Z Axis Bottom. The two rods do not have to exceed both Z Axis Bottom.

To finish, make sure that the X-axis move smoothly on the Z-axis. Otherwise, verify the distance between both Z-axis (**360 mm**).



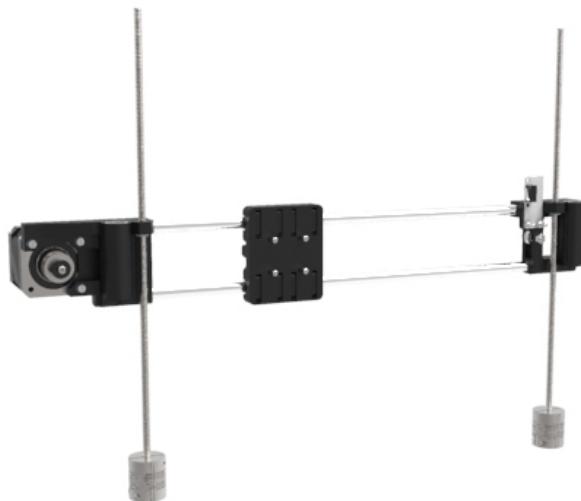
D. Motor assembly

1. Z-axis

Needed parts:

- Endstop Z Holder
- 2x Coupling 5x5
- 2x NEMA 17 motor
- 1x Endstop
- 2x Threaded rod M5x300 mm
- 8x M3x14 mm screw
- 2x M3 nut
- 8x Ø3 mm washer

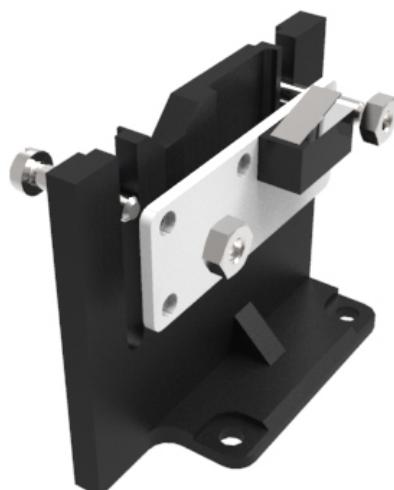
1 Insert a threaded rod M5x300 mm at the half length of a coupling 5*5 and fix it with two grub screws. Do the same for the other rod.



2 Thread each threaded rod in X End Idler and X End Motor M5 nut at half length.

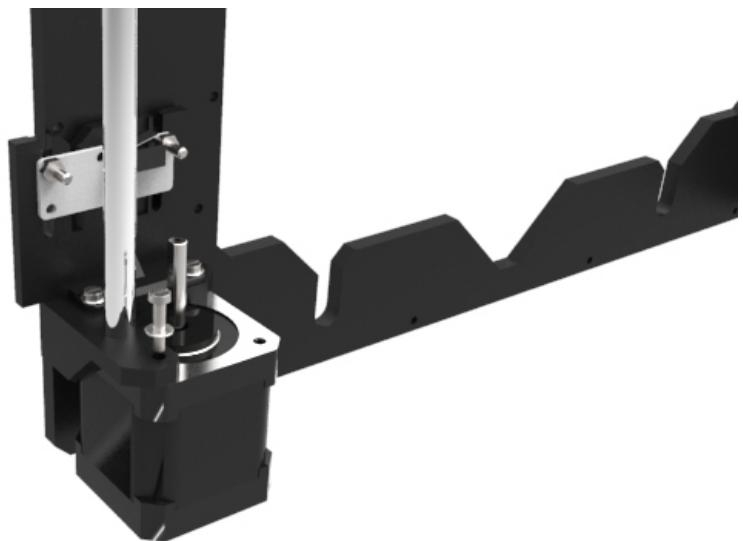
3 Take the single frame assembly and place two NEMA 17 motor with their supply wires against the aluminum frame. Optional feature: cut the supply wires at half-length and insert them through the dedicated hole. If you do not want to weld the wires, you can place them through the bottom notch.

4 Fix an endstop to the Endstop Z Holder with two M3x14 mm screw, two Ø3 mm washers (on the rear) and two M3 nuts. Slightly tighten it at half height. The adjustment will be made in the following.



- 5** Place the Endstop Z assembly on the Z Axis Bottom left and fix it with left motor with three M3x14 mm screws and three Ø3 mm washers.

Fix right motor with three M3x14 mm screws and three Ø3 mm washers.



- 6** Fix both coupling at both motor shafts with grub screws. Make sure to place a grub screw in the face of the flat of the shaft.

Tighten both grub screws with an Allen wrench.



Note : Vous pouvez maintenant passer à la partie 0 « Assemblage du châssis » page 22 où le cadre principal est assemblé avec l'axe Y. Le montage des moteurs des axes X et Y peut-être effectué ensuite.

2. Y-axis

Needed parts:

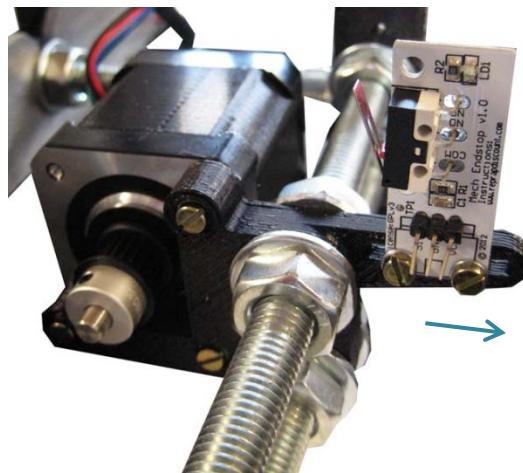
- 1x NEMA 17 motor
- 1x Endstop
- 1x GT2 pulley
- 5x M3x14 mm screw
- 2x M3 grub screw
- 2x M3 nut
- 5x Ø3 mm washer

- 1** Thread two M3 grub screws on a GT2 pulley. Slide this pulley on the motor shaft and fix it. Make sure to place a grub face to face with the flat of the shaft.



2 Place and fix the previous NEMA 17 motor on the Y Motor with three M3x14 mm screws and Ø3 mm washers. Place supply wires down.

Place and fix an endstop with two M3x14 mm screws and two Ø3 mm washers. The endstop have to be on the bottom of the groove.



3. X-axis

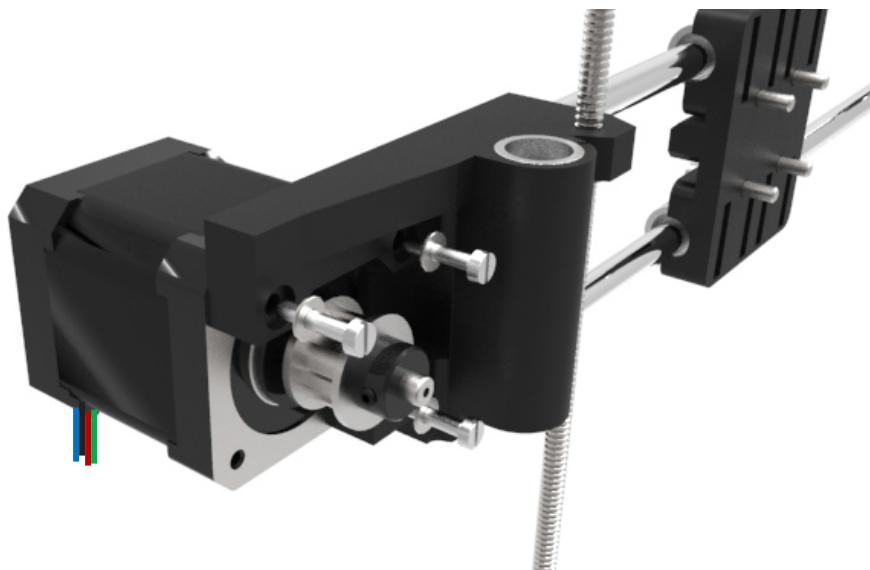
Needed parts :

- 1x NEMA 17 motor
- 1x GT2 pulley
- 3x M3x14 mm screw
- 2x M3 grub screw
- 3x Ø3 mm washer

1 Thread two M3 grub screws on the GT2 pulley. Slide this pulley on the motor shaft and fix it. Make sure to place a grub screw face to face with the flat of the shaft.

2

Place and fix the previous NEMA 17 motor on the X End Motor with three M3x14 mm screws and Ø3 mm washers. Place supply wires down.

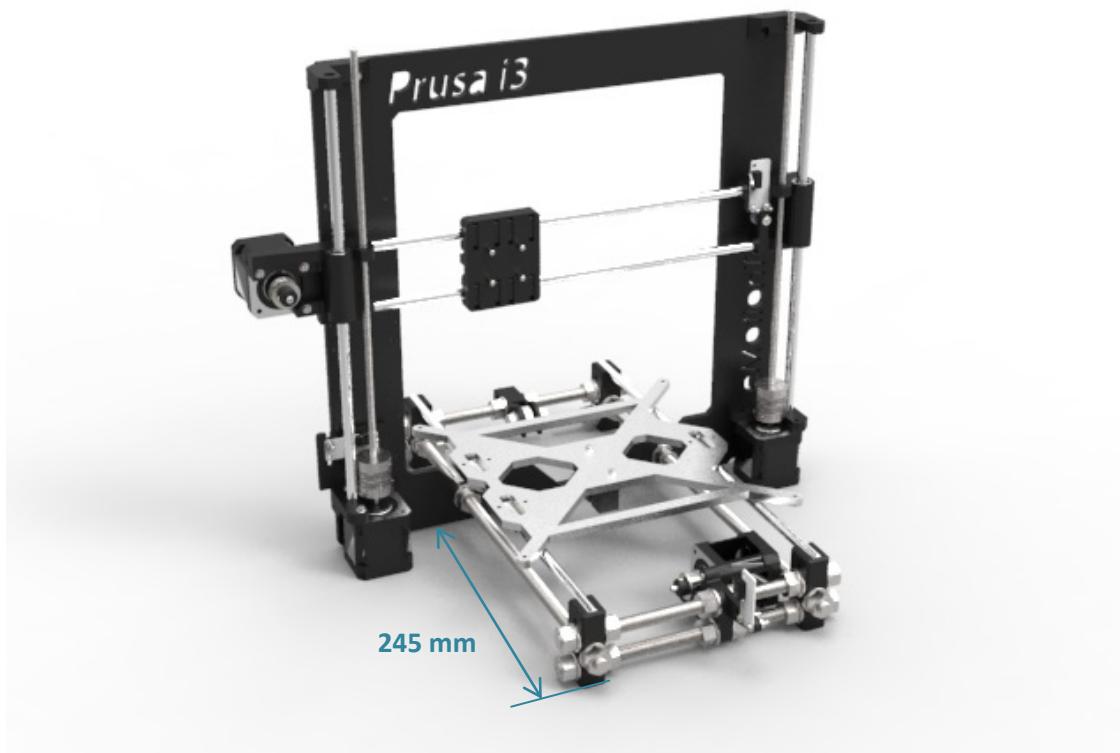


E. Mechanical frame assembly

Needed parts :

- Y-axis assembly
- Single frame assembly

- 1 Insert the single frame assembly between both M10 nuts and Ø10 mm washers which are on the Y-axis assembly. The Y-axis assembly has to be inserted on both single frame grooves. Moreover, the Y Motor has to be placed nearest you.
- 2 Adjust the single frame assembly to have **245 mm** from the front of the aluminium frame to the external side of an Y Corner. Make sure that this dimension is verified on both left and right sides of the heated bed. This setting allows you to maximize printing workspace.
- 3 Strongly tighten both couple of M10 nuts and Ø10 mm washers on the single frame assembly.
Make sure that the mechanical frame is stable.



F. X and Y-axis motions

1. X-axis belt

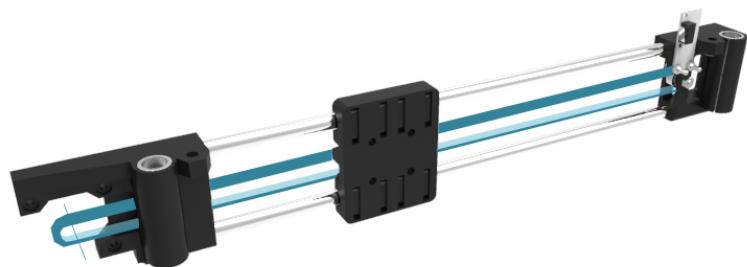
Needed parts :

- GT2 Belt (900 mm)
- Zip-ties

1 Insert one end of the belt on one side of the X Carriage, do a loop and fix it with two zip-ties. The belt should be at the same level as the slot.

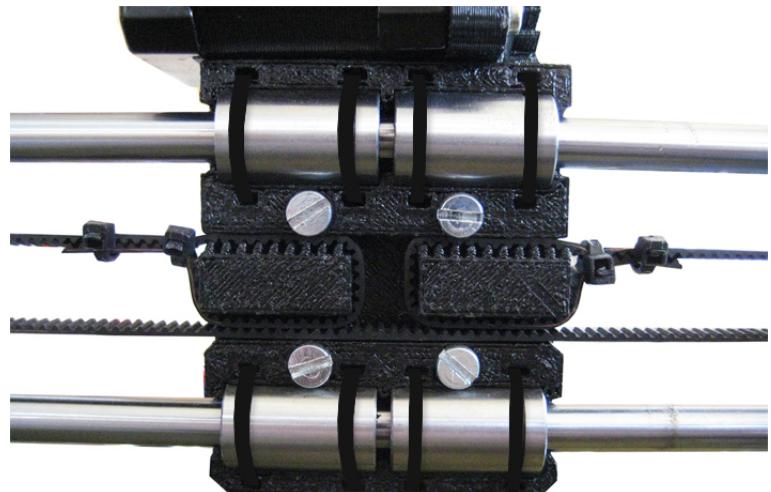
2 Insert the belt either to the X End Idler or to the X End Motor depending to how you placed the belt on the previous step.

Do a loop, temporarily tighten the belt and insert it on the last slot of the X Carriage.



3 Tighten the free end of the belt and fix it with two zip-ties.

This step is difficult so please take the time to make a proper tightening.



2. Y-axis belt

Needed parts :

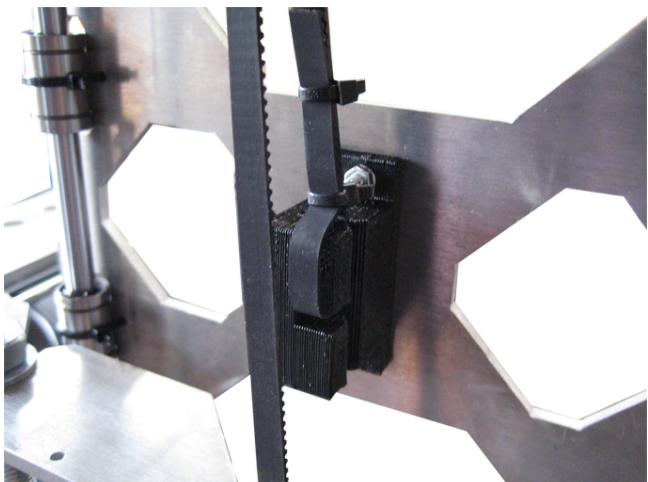
- GT2 belt (760 mm)
- Zip-ties

1 Return your machine and align Y Motor pulley, Y Belt holder and Y Idler bearing. The Y Idler assembly should not be fixed.

2

Insert one end of the belt on one side of the Y Belt Holder, do a loop and fix it with two zip-ties.

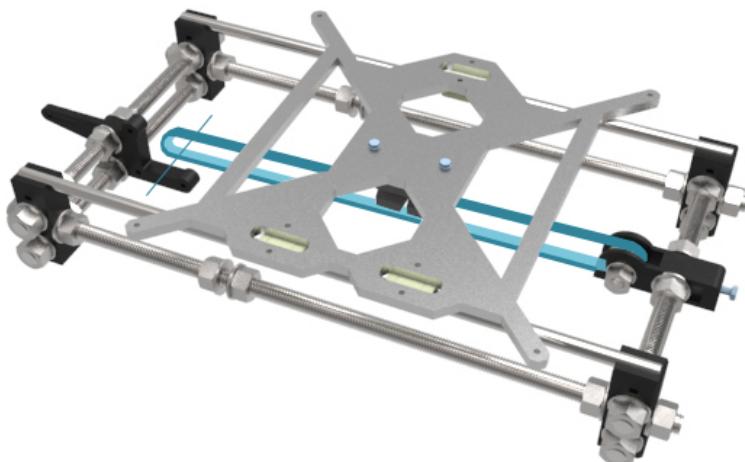
The belt should be at the same level as the slot.



3

Insert the belt either to the Y Idler or to the Y Motor depending to how you placed the belt on the previous step.

Do a loop, temporarily tighten the belt and insert it on the last slot of the Y Belt Holder.



4

Move your Y-axis near the motor. Adjust Y Motor placement to align the belt properly. It will allows you to avoid some friction belt. Make sure that both bolt couples are aligned. Tighten the nuts with hands.

5

Move your Y-axis at the opposite and do the same operation. Repeat the step 4 and 5 until your Y belt is properly aligned.

6

When the belt is aligned, tighten the free end of the belt and fix it with two zip-ties. Slightly tighten the belt and cut both ends if necessary.

7

An M4x20 mm screw located on the Y Idler allows you to tighten properly the belt. Be careful, it is not necessary to strongly tighten the belt, it have to be a little loose.

Congratulations, you have completed the assembly
of the mechanical frame of your printer !

IV. Heated bed assembly

A. Thermistors assembly

Needed parts :

- 2x Thermistor
- 2x Connecting wire (2 pins)
- Teflon wire (not included)
- Polyimid tape

- 1 Insert two teflon wires at both ends to protect the thermistors. Let the ends free to weld connecting wires (see pictures below).
- 2 Weld two connecting wires to both thermistor ends. Repeat this step for the other thermistor. We strongly recommend you to protect the weld with heat shrink tubing or an insulating adhesive tape.

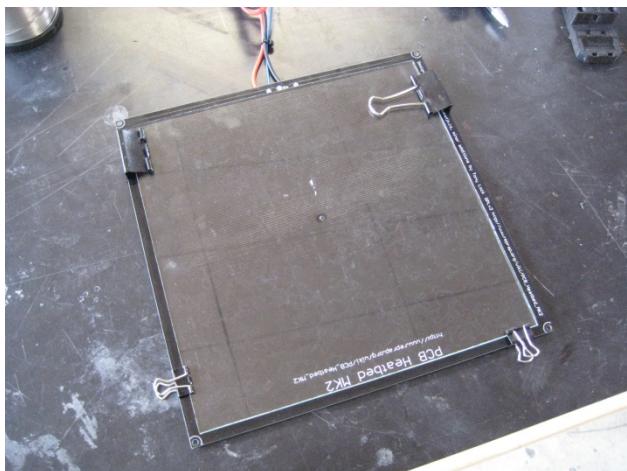


B. Heated bed assembly

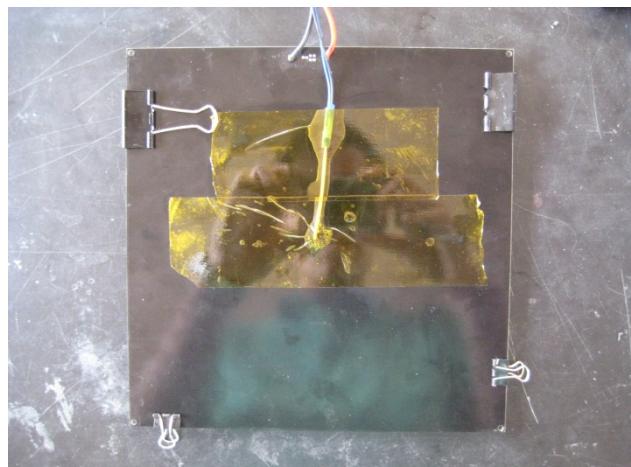
Needed parts :

- 1x PCB heatbed
- 1x Glass plate
- 1x Thermistor assembly
- 4x Binder clip
- 4x M3x14 mm screw
- 4x M3 nuts
- 16x Ø3 mm washer

- 1 Place the glass plate on the top of the PCB heatbed (the face with writing) and fix it with four binder clips.
- 2 Use high temperature silicone and place a drop in center hole (PCB heatbed bottom side).
- 3 Place the head of the thermistor in the center hole and make sure that there is a contact with the glass plate. Fix thermistor wires with some Polyimid tape.

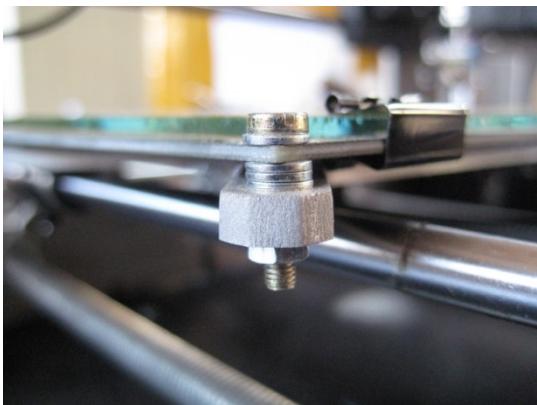


PCB heatbed top side



PCB heatbed bottom side

- 4** Cover the glass plate with Polyimid tape to improve adhesion during future printings. Make sure to remove air bubbles during this step.



- 5** Fix the Heated bed assemby on the Heated bed mount (Y-axis) with three Ø3 mm washers between, one Ø3 mm washer on top, an M3x14 mm screw and an M3 nut on each corner.

V. Extruder assembly

A. Extruder assembly

Needed parts :

- Wade Extruder Body
- Extruder Idler
- Fan duct
- 3x 608 ball bearing
- 1x Fan 4x4
- 1x Connecting wire (2 pins)
- 1x Hobbed bolt
- 2x Springs
- 1x M8x20 mm grub screw
- 4x Ø8 mm washer
- 1x M8 Nylstop nut
- 4x M4 nut
- 2x M3x60 mm screw
- 3x M3x30 mm screw
- 4x M3x14 mm screw
- 6x M3 nut
- 3x Ø3 mm washer

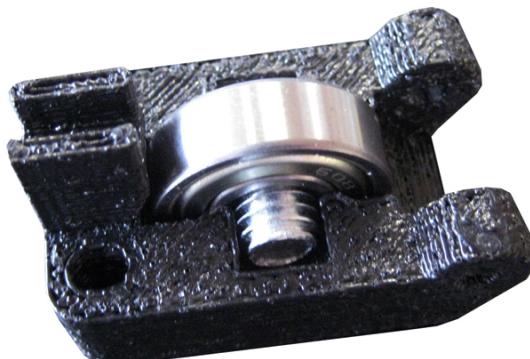
- 1** Insert two M4 nuts in their marks. To do that, slightly heat the nut using a lighter or a blowtorch then push it in his mark. Be careful with this operation.

Keep the two others nuts for a following step.

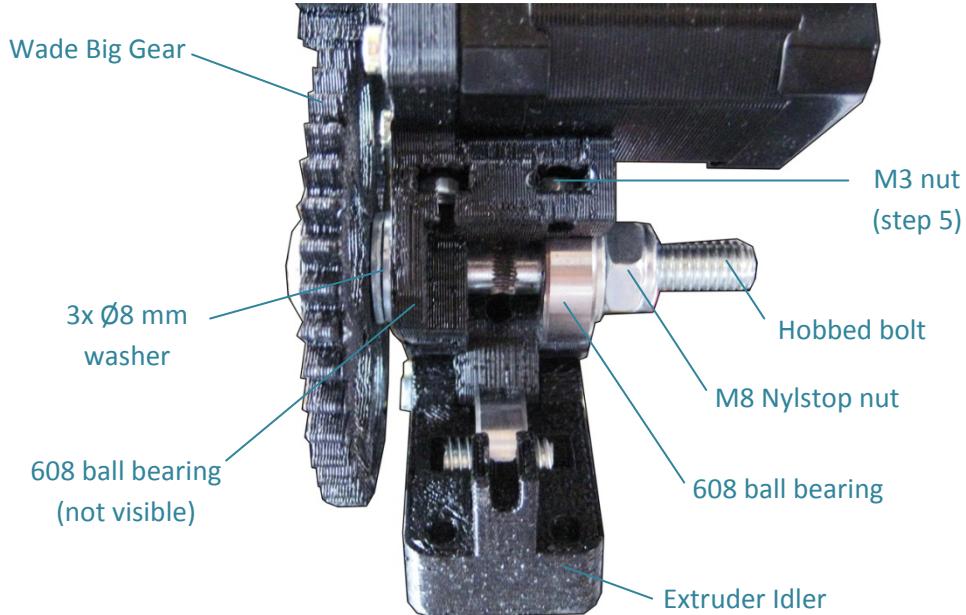


- 2** Slide an M8x20 mm grub screw through a, 608 ball bearing then push this assembly inside the extruder idler. You may have to use a rubber mallet.

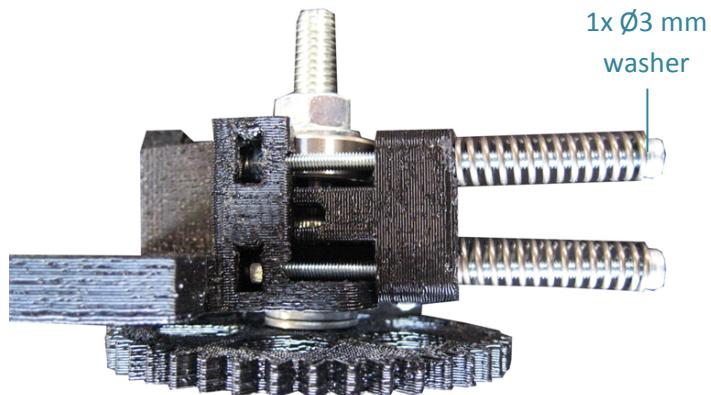
- 3** Fix this assembly to the Wade Body Extruder with an M3x30 mm screw and an M3 nut. Slightly tighten to allow his rotation.



- 4** Slide the Wade Big Gear through the hobbed bolt and slide it in the Wade Body Extruder with the following components: three Ø8 mm washers, two 608 ball bearings, one Ø8 mm washer and a M8 Nylstop nut. Before tightening, make sure that the teeth's is facing the hole.

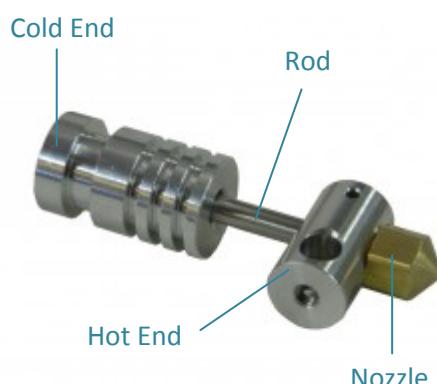


- 5** Insert two M3 nuts in their slots and use two M3x60mm screws with two Ø3 mm washers and two springs to maintain the Extruder Idler.



6

Make sure that the Magma Hotend is correctly assembled (tighten the parts: Cold End, rod, Hot End and nozzle). Clean the Wade Extruder Body Ø16 mm hole and insert the Magma Hotend. You have to force and to spin the Hot End (see illustration below). Thread in the Wade Extruder Body two M3x30 mm screws progressively to maintain the Cold End.



7

Take an 4x4 fan and cut the supply wire at half length. Weld the additional supply wire (black/black and red/red) and weld the plug again. We recommend you to protect the weld with heat shrink tubing or an insulating adhesive tape.

8

Place the fan on the Fan Duct (supply wires down). Make sure that the fan is facing outwards and fix it with M3x14 mm screws and four M3 nuts.

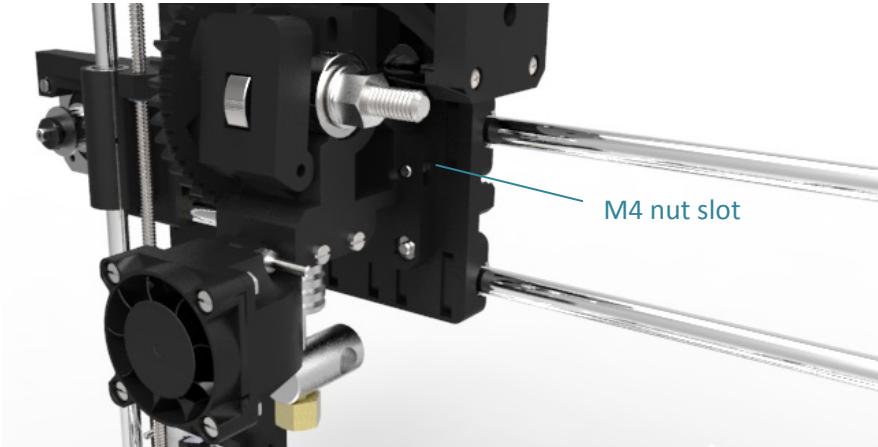


B. Connecting to X-axis

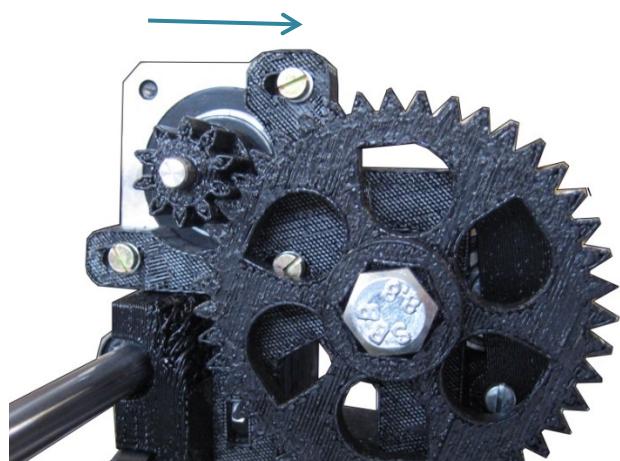
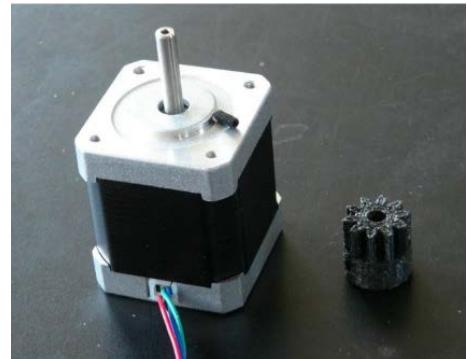
Needed parts :

- Extruder assembly
- Fan duct assembly
- Wade Small Gear
- 1x NEMA 17 motor
- 4x M4x20 mm screw
- 1x M3x30 mm screw
- 3x M3x14 mm screw
- 1x M3 grub screw
- 2x M3 nut
- 3x Ø3 mm washer

- 1** Insert the two previous M4 nuts in their slots and thread M4x30mm screws to maintain the extruder assembly against the X Carriage.



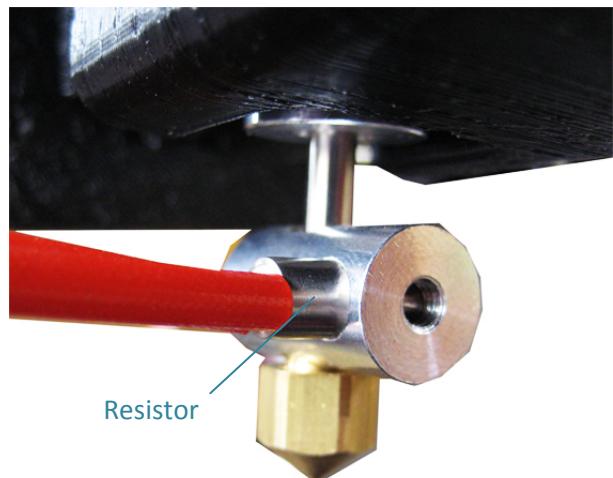
- 2** Slide the Wade Small Gear on the shaft of a NEMA 17 motor with an M3 grub screw and an M3 nut inserted in his slot. If necessary, drill with hands the Wade Small Gear hole with an Ø5 mm drill. Make sure to place a grub face to face with the flat of the shaft.



- 3** Place the motor assembly against the Wade Extruder Body (supply wires upwards). Insert three M3x14 mm screws and three Ø3 mm washers without tightening.

Slide the motor assembly against the Wade Big Gear and thread the screws. Make sure that the backlash is minimum.

- 4 Insert the resistor into the Hot End (in the dedicated hole). Supply wires should extend from the right when you are facing your printer.
- 5 Take the other thermistor assembly, place a drop of high temperature silicone and insert the thermistor head in the little notch of the nozzle. The thermistor head should be against the nozzle.



Note: Make sure that the nozzle can move all along the heated bed. To do that, move the extruder assembly on the x-axis and the heated bed on the y-axis.

- 6 Fix the Fan Duct assembly on the Wade Extruder Body with an M3x30 mm screw and an M3 nut.

C. Nozzle height adjustment

Note : This adjustment must be repeated when an extruder component (the Magma Hotend for example) is changed.

- 1 Move the X-axis to the right. You should hear the endstop "clic" at the end. The nozzle should be near the glass plate edge.
- 2 Rotate simultaneously both Z-axis coupling counterclockwise to move the nozzle down. Move the nozzle down until to be able to pass a sheet of paper folded in half.
- 3 Move the X-axis to the extreme left and make sure that the nozzle is at the same height. Otherwise, hold the right coupling and rotate the left coupling to move the nozzle up or down.
- 4 Once the nozzle height adjustment made, adjust the Z-axis endstop until you hear the « clic ». This position defines Z-axis home.

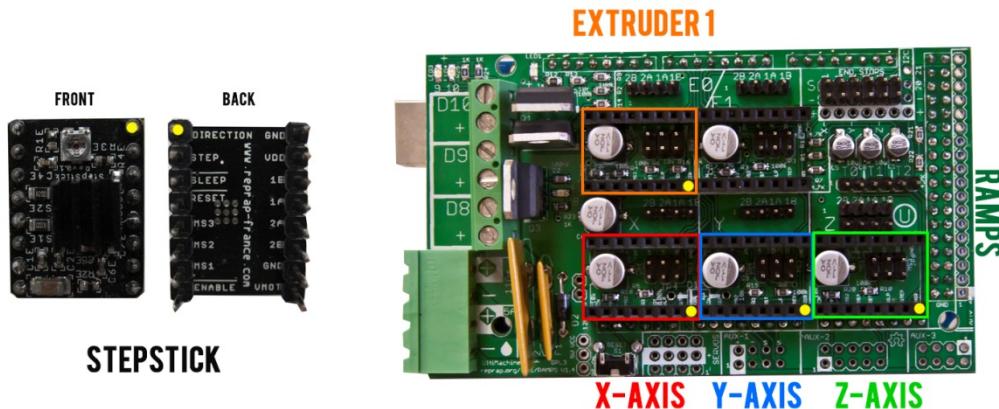
VI. Electronics and wiring

A. Mounting electronics

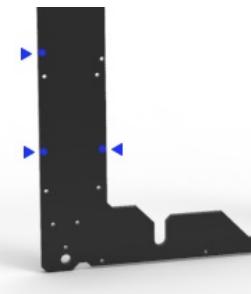
Needed parts :

- RAMPS
- Atmega 2650
- 4x stepsticks
- 3x Arduino washer
- 3x M3x30 mm screw
- 3x M3 nut
- 3x Ø3 mm washer

- 1 Mount the RAMPS on the Arduino Atmega 2560. You may have to cut the welds located below the RAMPS power supply plug. You should have both power supply plugs on the same side.
- 2 Plug each stepstick on the RAMPS according to the illustration below. One location still free to plug a dual extruder for example.



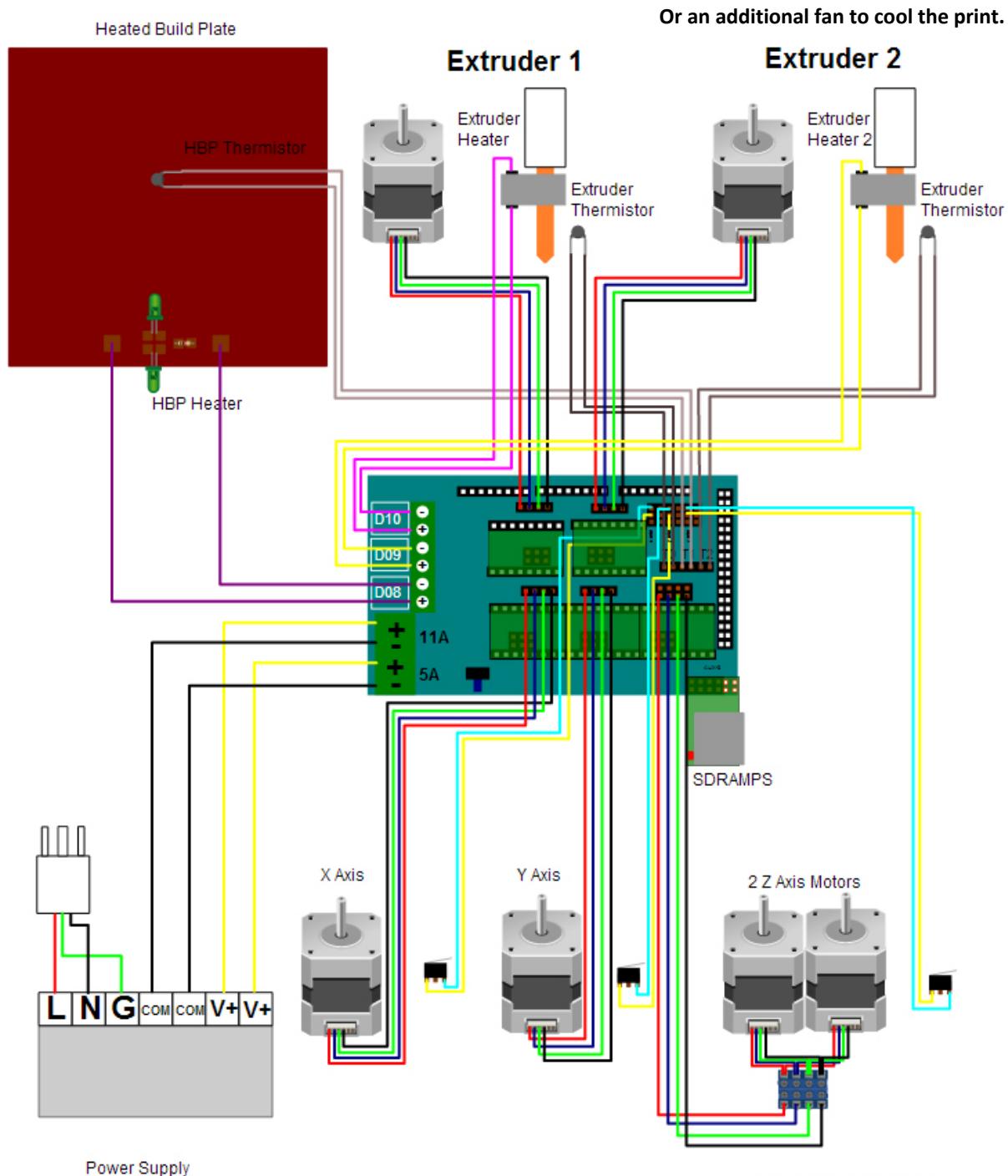
- 3 Fix the electronics assembly at aluminium plate rear with three Arduino washers used to electrically insulate. Power supply plugs are oriented downward. Use three M3x30 mm screws (head on the front), three Ø3 mm washers (on the RAMPS) and three M3 nuts.



B. Wiring

All electrical connections are summarized on this scheme:

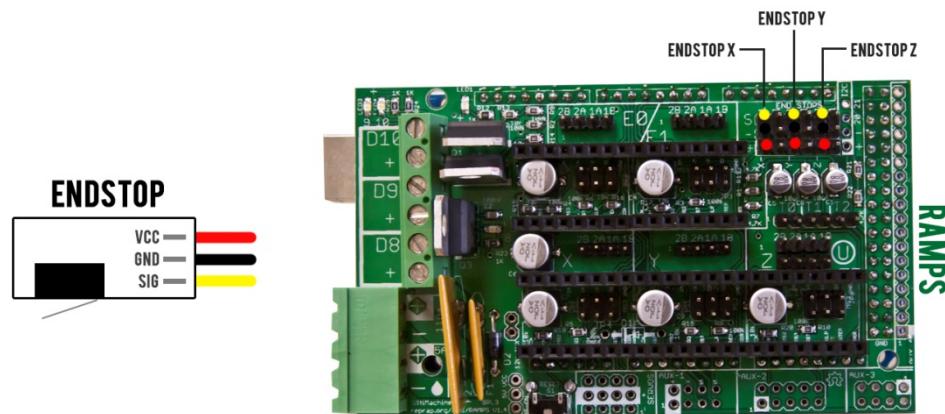
RepRap Arduino Mega Pololu Shield 1.4



Created by Neil Underwood 5/28/2011

1. Endstop wiring

Plug the three endstops to the RAMPS with three connecting wires (wires with an « Endstop » mark) according to the following wiring scheme :



2. Motors wiring

You have to connect both Z-axis NEMA 17 motors to work in parallel. To do that, weld both power supply wires (cut in a previous step) according to their colors : red/red, green/green, blue/blue and black/black. We strongly recommend you to protect each weld with heat shrink tubing or an insulating adhesive tape.

NEMA 17 wires color can change depending on the supplier and there is no risk in case of a wrong wiring. Indeed, the wires are always associated in pairs (one pair for each coil). SO there is no risk if the color of supply wires doesn't match the wiring diagram.

3. Resistor and PCB heatbed wiring

The resistor is not polarized and is plugged to **D10**.

PCB heatbed is plugged to **D08**. Make sure to not invert the positive and negative poles.

4. Thermistors wiring

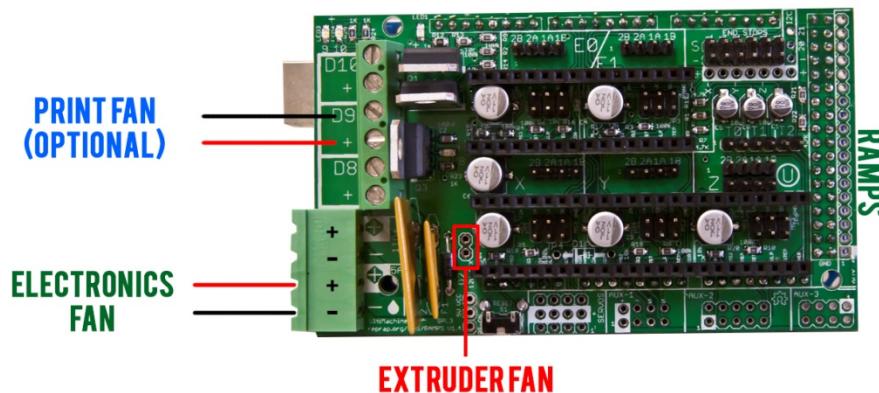
The thermistor is not polarized. Make sure to not invert the PCB heatbed thermistor and the Extruder thermistor.

5. Fans wiring

Plug the extruder fan directly to his dedicated power supply pins (see illustration below).

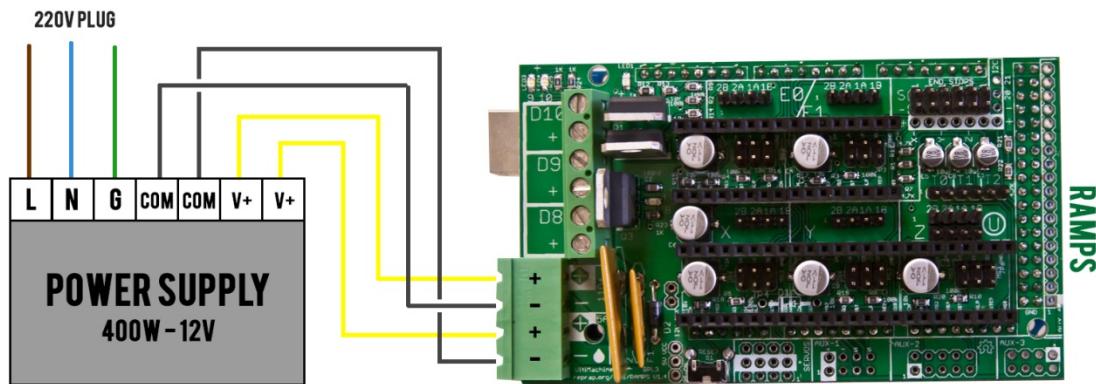
If you have a fan which is cooling the electronics, plug it directly to the RAMPS.

If you have a fan which is cooling the print, plug it to **D09**.



6. Power supply wiring

The principle power supply wire is not included. You have to strip an end of a power cable and to connect to the power supply (L, N, G plugs). Make sure to do this operation properly.



The power supply is connected to the RAMPS with additional connecting wires. You have to strip both ends, make sure to follow the scheme correctly.

Congratulation, you have completed the
wiring of your printer !