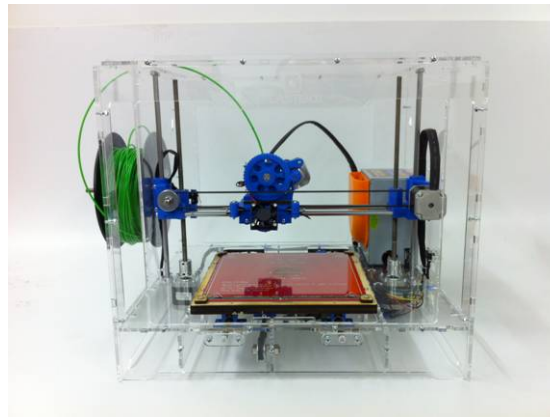




Mendel 3D Printer Assembly



Appendix Z
RAMPs setup

Step 1: Adding jumpers

Parts Needed:

- Plastibot Mendel Printer
- Computer

Tools Needed:

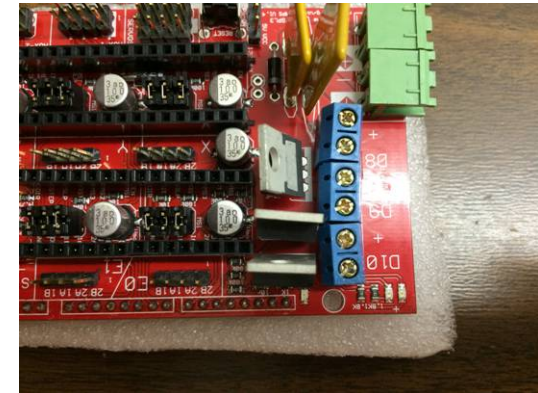
- Your hands



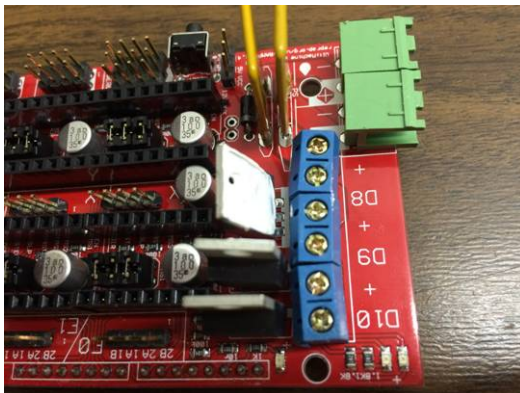
Open the ESD bag and remove the RAMPS card. Locate the small bag with the jumpers and remove them.



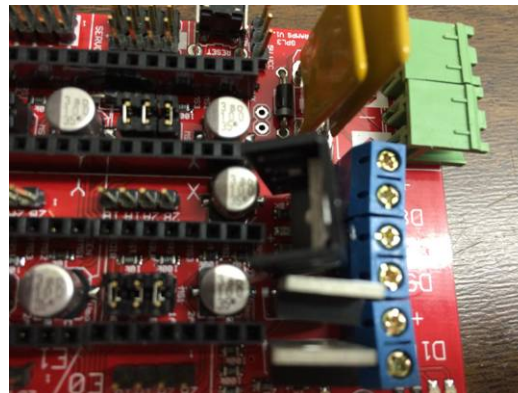
Insert jumpers (3 on each pololu for a total of 15). Insert them with the metal part of the jumper facing up.



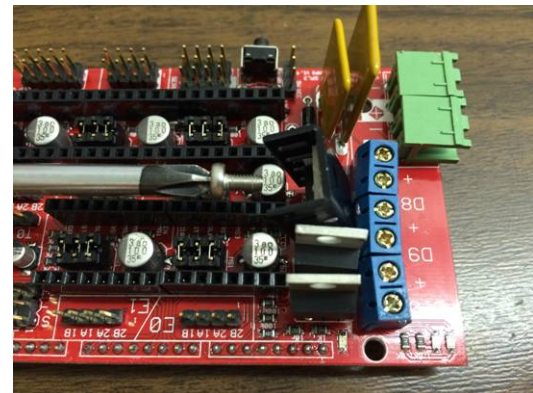
Push the mosfet transistor forward a little bit as shown.



Apply a small dab of thermal paste on the mosfet transistor. Use a small screwdriver to help spread it evenly.



Place the heatsink on the back of the mosfet with the screw hole on the top half and align the heatsink hole with the Mosfet hole.



Place the M3 x 6mm screw on a screwdriver and insert thru the front of the mosfet

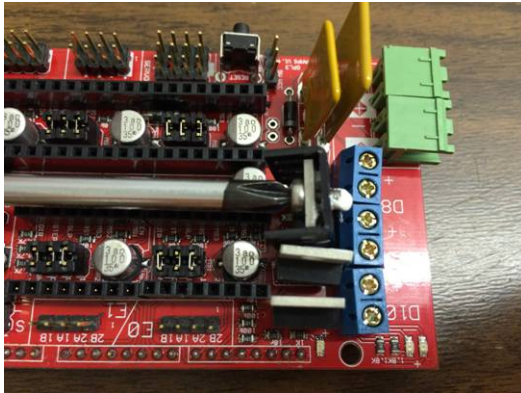
Step 2: Adding Mosfet Heatsink

Parts Needed:

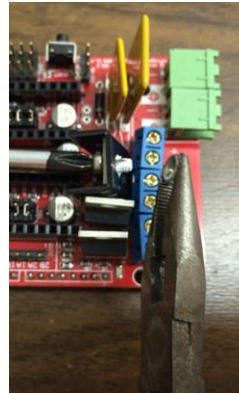
- Plastibot Mendel Printer
- Computer

Tools Needed:

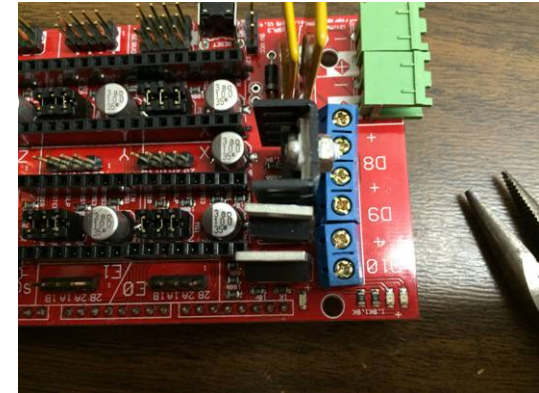
- Your hands



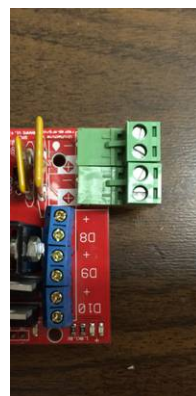
Wipe the excess thermal paste from the screw tip



Grab the M3 nut with the nose pliers and place it against the screw tip



Tighten the screw .



Plug the power connectors.



Remove one of the pololus from the ESD bag.



Grab it from the 2 edges without pins.

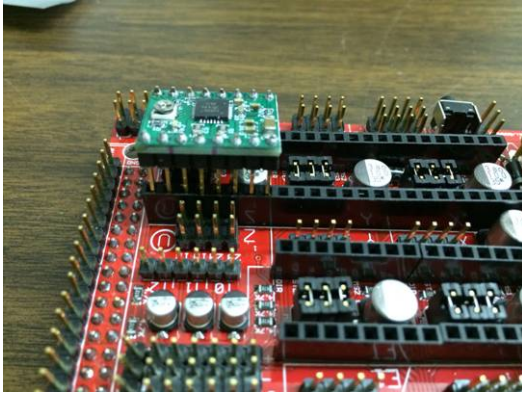
Step 3: Adding Pololus

Parts Needed:

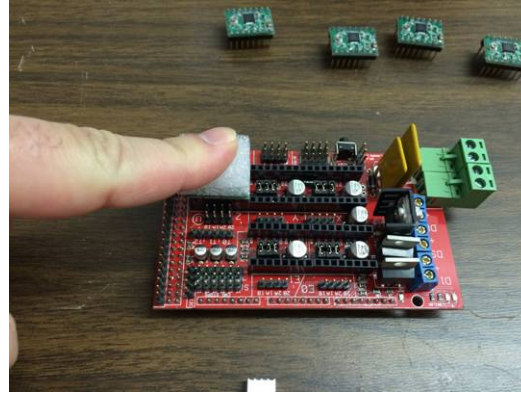
- Plastibot Mendel Printer
- Computer

Tools Needed:

- Your hands



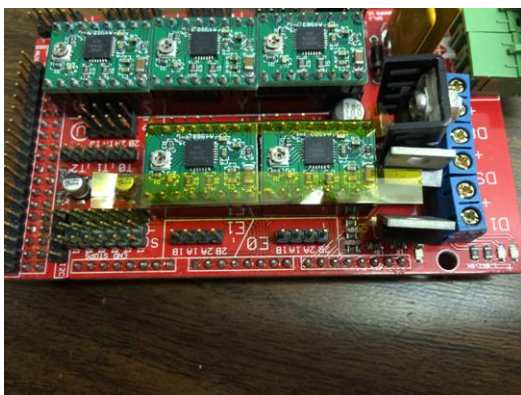
Place it on the base connector and align both rows of pins.



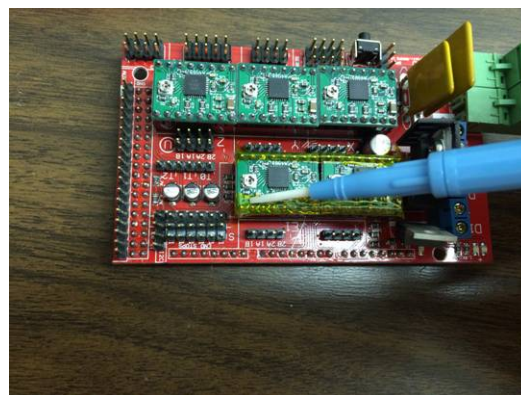
Use the ESD cushion to push down the pololu into position. Repeat for the remaining 4 pololus



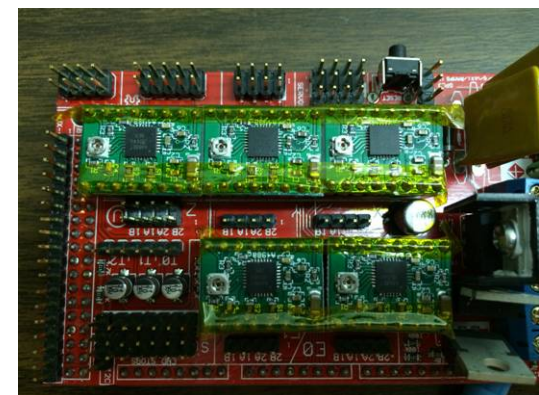
Cut a piece of Kapton tape long enough to cover the row of 2 pololus and apply using the ceramic screwdriver to help stick the kapton tape.



Apply kapton tape on the other edge of the pololus as shown



Use the ceramic screw driver to fold and stick the kapton tape



Repeat for the row of 3 pololus.

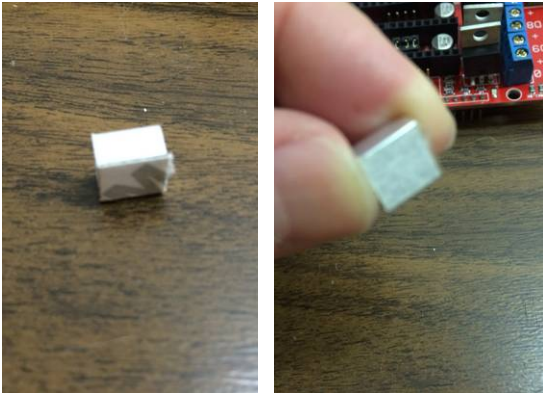
Step 4: Adding Heatsinks to Pololus

Parts Needed:

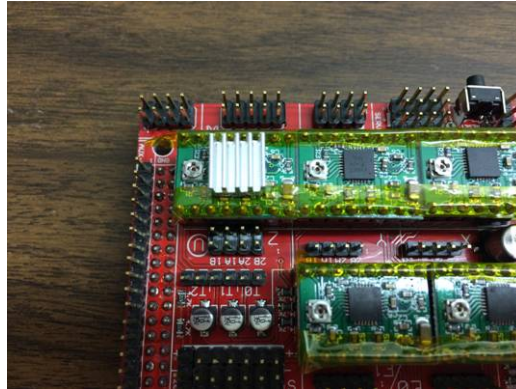
- Plastibot Mendel Printer
- Computer

Tools Needed:

- Your hands



Take one of the heatsinks that came with the pololus. Remove the paper protector from the sticker.



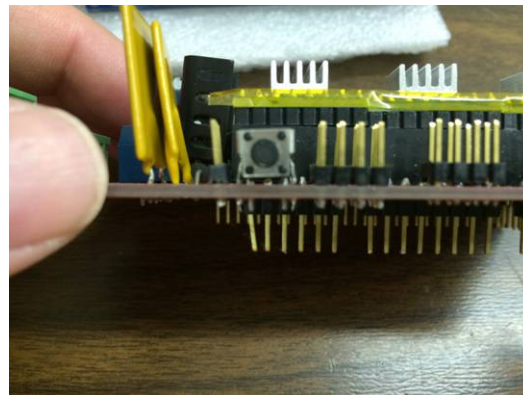
Place the heatsink on top of the integrated circuit, but centered across the pin rows.



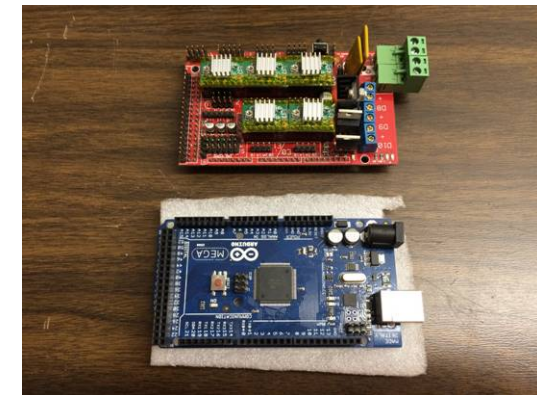
Repeat for the remaining 4 pololus



Remove the arduino from the ESD bag and place it on top of the antistatic sponge.



Take a look at the pins underneath the RAMPS card and make sure all pins are parallel. If you see pins bended use the nose pliers to straighten them



Place the RAMPS next to the arduino card as shown.

Step 5: Plugging RAMPS to Arduino board

Parts Needed:

- Plastibot Mendel Printer
- Computer

Tools Needed:

- Your hands



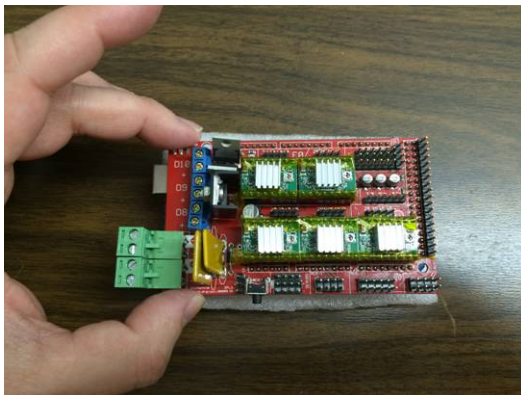
Place the RAMPs on top of the Arduino and align the first row of pins



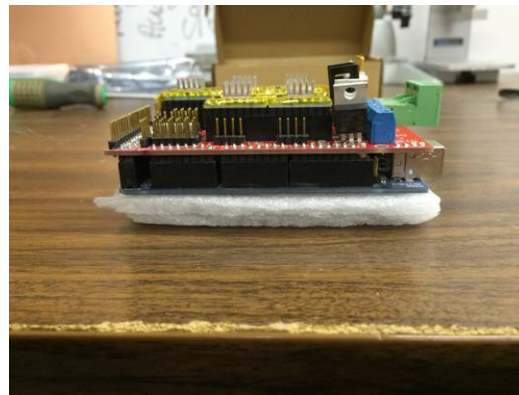
Turn 90 degrees on Z axis and align the double row of pins in the back.



Turn 90 degrees on Z axis and align the third side.



Using your 2 thumbs and 2 index fingers press down the RAMPs until all pins are fully connected.



This is how it should look once properly connected. Golden pins fully covered by connector.



Set your multimeter to Measure DC voltage in the milliVolts range.

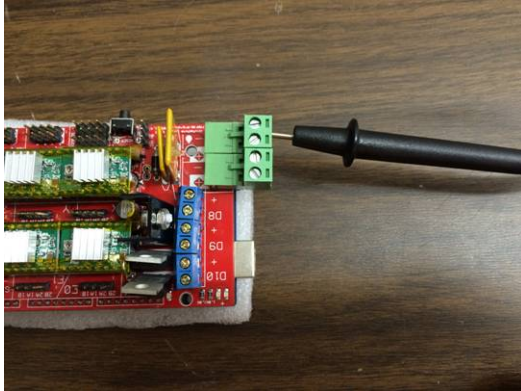
Step 6: Limiting current to pololus

Parts Needed:

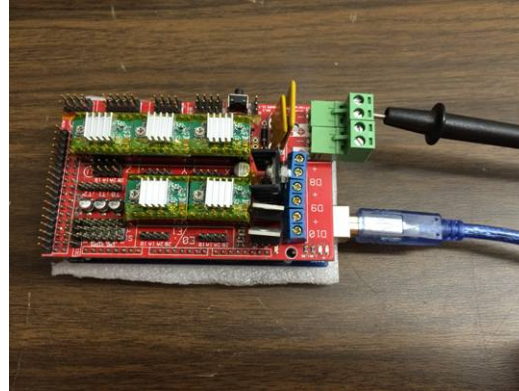
- Plastibot Mendel Printer
- Computer

Tools Needed:

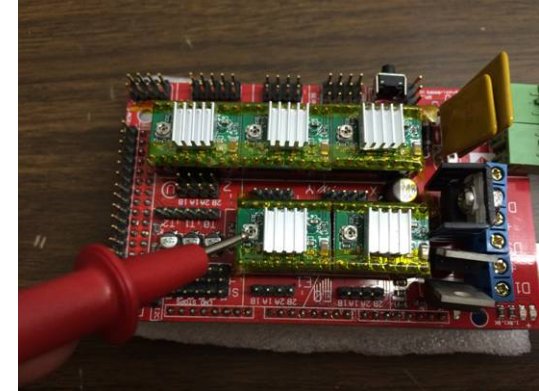
- Your hands



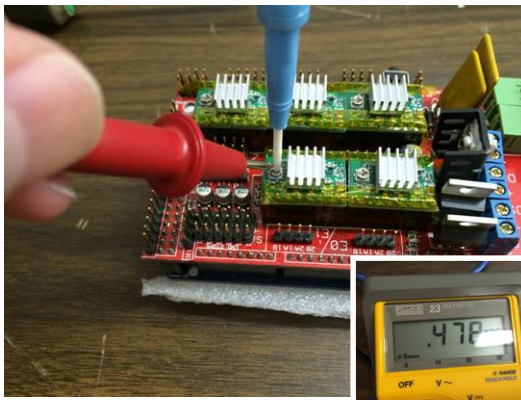
Insert the Ground lead (black lead) into the power connector negative setscrew as shown.



Plug the USB connector to the ramps and to the computer.



Touch the variable resistor for E1 with the red test lead.



Use the ceramic screwdriver to adjust the variable resistor until multimeter reads 0.48 Volts.

Repeat the same process for pololus X, Y, and E0.



Repeat the same process for pololu Z but adjust this ones to 0.72 Volts instead. .

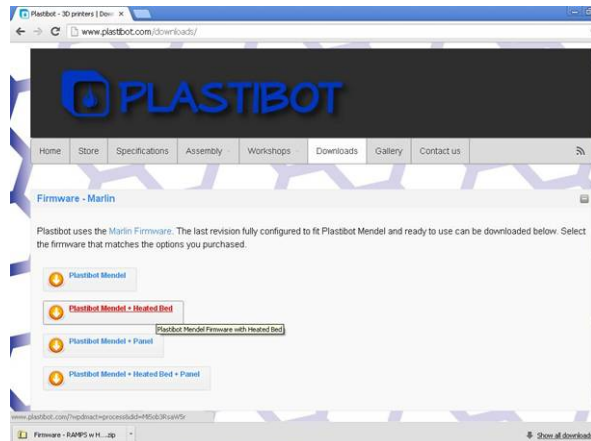
Step 7: Loading the Firmware

Parts Needed:

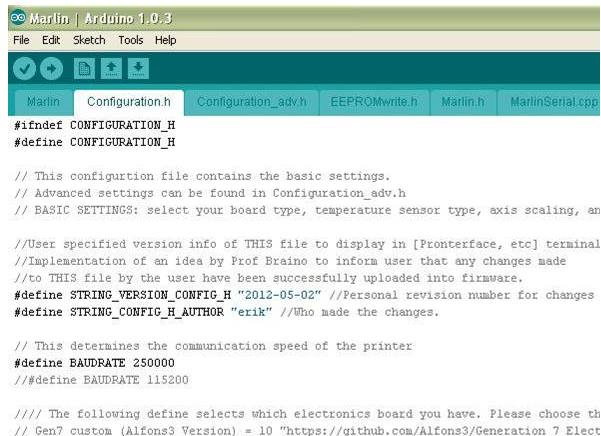
- Plastibot Mendel Printer
- Computer

Tools Needed:

- Your hands



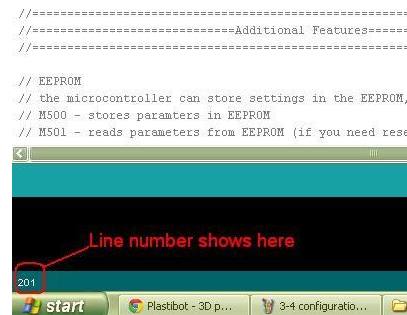
Go to www.plastibot.com/downloads and download the latest firmware corresponding to your setup (ie. Standard, heated bed, etc)



That should open a bunch of files. Look for the tab called "Configuration.h" and click on it.



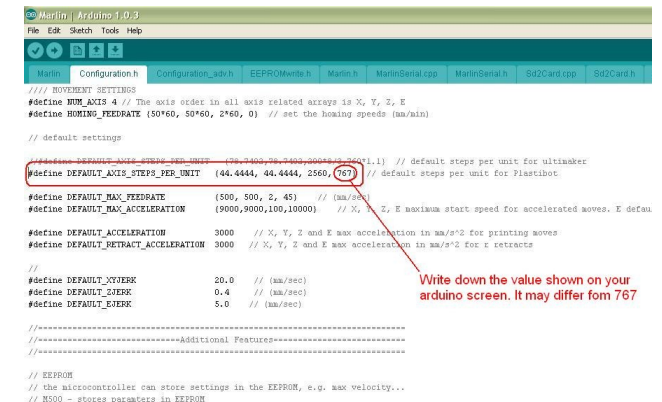
Go to the plastibot folder you created earlier and create a subfolder called Firmware. Click the file you downloaded and extract to the firmware folder.



Scroll down to line # 201. It should read like this: `#define DEFAULT_AXIS_STEPS_PER_UNIT {44.4444, 44.4444, 2560, 767}`



Open Arduino and from the menu select File/Open, Go to your plastibot folder and select the following file: `plastibot/firmware/marlin/marlin.pde`



The last value of 767 is the default number of steps per 1mm of extrusion. Write down that number. You will need it later on.

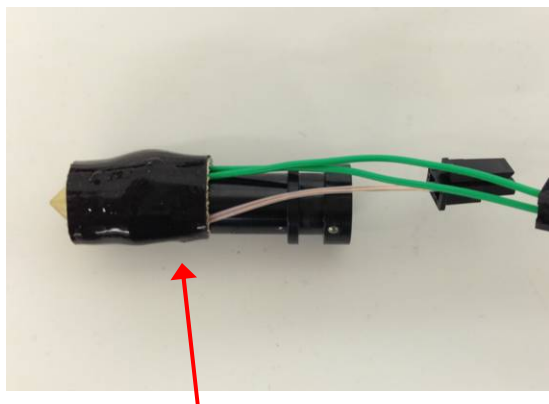
Step 8: Hotend Identification

Parts Needed:

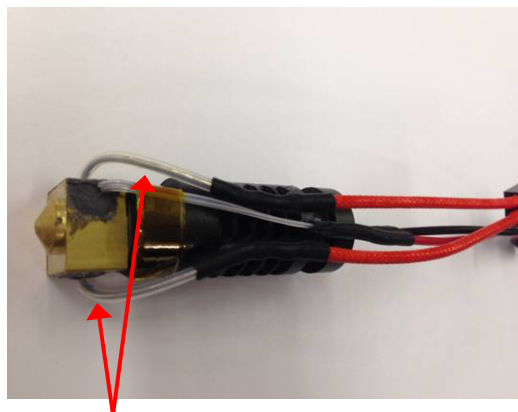
- Plastibot Mendel Printer
- Computer

Tools Needed:

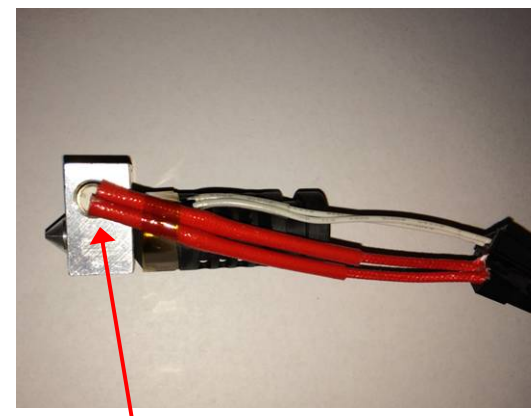
- Your hands



MakerGear Hotend has a black fiberglass insulator sleeve covering the nozzle



The Resistor J-Head Hotend has a bare square brass nozzle with resistor leads coming out on both sides



The Heat Cartridge J-Head Hotend has all leads coming out of the same side of the aluminum nozzle and covered with kapton tape (kapton tape removed on picture above).

```
//=====
//=====Thermal Settings =====
//=====
//
//--NORMAL IS 4.7kohm PULLUP!-- 1kohm pullup can be used on hotend
//
//// Temperature sensor settings:
// -2 is thermocouple with MAX6675 (only for sensor 0)
// -1 is thermocouple with AD595
// 0 is not used
// 1 is 100k thermistor - best choice for EPCOS 100k (4.7k pullup)
// 2 is 200k thermistor - ATC Semitec 204GT-2 (4.7k pullup)
// 3 is mendel-parts thermistor (4.7k pullup)
// 4 is 10k thermistor !! do not use it for a hotend. It gives bad
// 5 is 100K thermistor - ATC Semitec 104GT-2 (Used in ParCan) (4.
// 6 is 100k EPCOS - Not as accurate as table 1 (created using a f
// 7 is 100k Honeywell thermistor 135-104LAG-J01 (4.7k pullup)
//
```

Each hotend use a different Thermistor therefore need different tables on the firmware in order to provide accurate temperature readings.

```
// 52 is 200k thermistor - ATC Semitec 204GT-2
// 55 is 100k thermistor - ATC Semitec 104GT-2

#define TEMP_SENSOR_0 8
#define TEMP_SENSOR_1 0
#define TEMP_SENSOR_2 0
#define TEMP_SENSOR_BED 1
```

On your firmware, scroll down to line 92

```
// 52 is 200k thermistor - ATC Semitec 204GT-2
// 55 is 100k thermistor - ATC Semitec 104GT-2

#define TEMP_SENSOR_0 8
#define TEMP_SENSOR_1 0
#define TEMP_SENSOR_2 0
#define TEMP_SENSOR_BED 1
```

Enter a 1 if you have a MakerGear hotend.
Enter a 5 if you have a Resistor J-Head
Enter an 8 if you have a Heat Cartridge J-Head

Step 9: Hotend Profile

Parts Needed:

- Plastibot Mendel Printer
- Computer

Tools Needed:

- Your hands

```
// Makergear
// #define DEFAULT_Kp 7.0
// #define DEFAULT_Ki 0.1
// #define DEFAULT_Kd 12

// Plastibot with J-Head - Resistor
// #define DEFAULT_Kp 80.67
// #define DEFAULT_Ki 13.53
// #define DEFAULT_Kd 120.27

// Plastibot with J-Head - heat cartridge
// #define DEFAULT_Kp 24.38
// #define DEFAULT_Ki 1.27
// #define DEFAULT_Kd 116.62
```

Each hotend uses a different heating element therefore needs different PID Profiles in the firmware in order to keep temperature in check.

```
// Plastibot with J-Head - Resistor
// #define DEFAULT_Kp 80.67
// #define DEFAULT_Ki 13.53
// #define DEFAULT_Kd 120.27

// Plastibot with J-Head - heat cartridge
// #define DEFAULT_Kp 24.38
// #define DEFAULT_Ki 1.27
// #define DEFAULT_Kd 116.62

// Mendel Parts V9 on 12V
// #define DEFAULT_Kp 63.0
// #define DEFAULT_Ki 1.27
// #define DEFAULT_Kd 116.62

147 Arduino/Genui
```

On your firmware, scroll down to line 147

```
// Plastibot with J-Head - Resistor
// #define DEFAULT_Kp 80.67
// #define DEFAULT_Ki 13.53
// #define DEFAULT_Kd 120.27

// Plastibot with J-Head - heat cartridge
// #define DEFAULT_Kp 24.38
// #define DEFAULT_Ki 1.27
// #define DEFAULT_Kd 116.62

// Mendel Parts V9 on 12V
// #define DEFAULT_Kp 63.0
// #define DEFAULT_Ki 1.27
// #define DEFAULT_Kd 116.62

147 Arduino/Genui
```

Enable the corresponding profile for your hotend by removing the "//" for all 3 lines. Ensure the other profiles have "//" characters.

Step 10: Loading the Firmware (cont.)

Parts Needed:

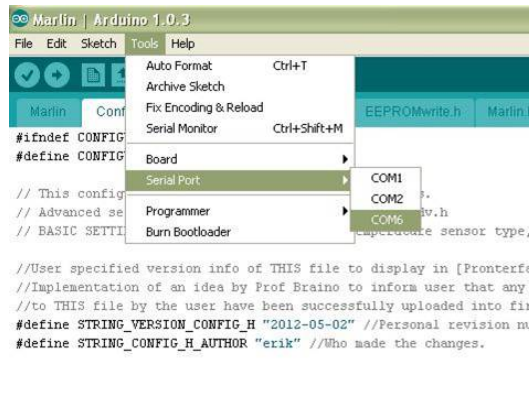
- Plastibot Mendel Printer
- Computer

Tools Needed:

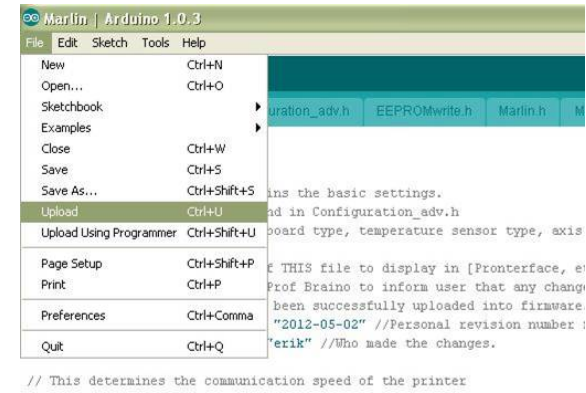
- Your hands



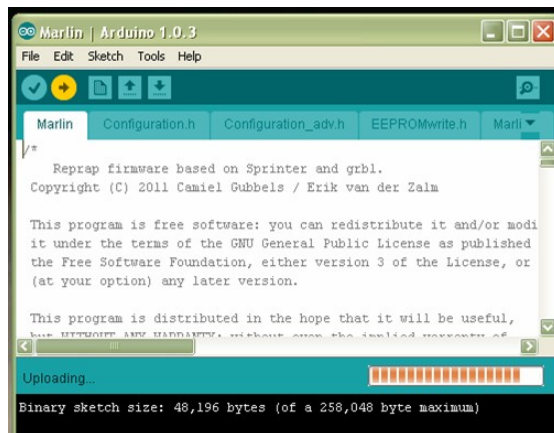
From the Arduino menu, select "Tools
→ Board → Arduino Mega 2560



On the arduino menu, select "Tools →
Serial Port → COMxx, where xx is the port
that was assigned to your printer, usually
a number higher than 4.



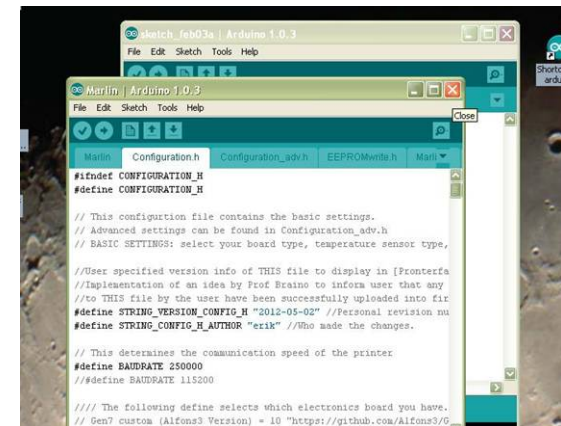
From the Arduino menu select File →
Upload to I/O board. Alternatively you could
use the icon to upload.



The bottom section will show "Uploading to
I/O board"



Then after a couple of minutes it will
change to "Done Uploading"

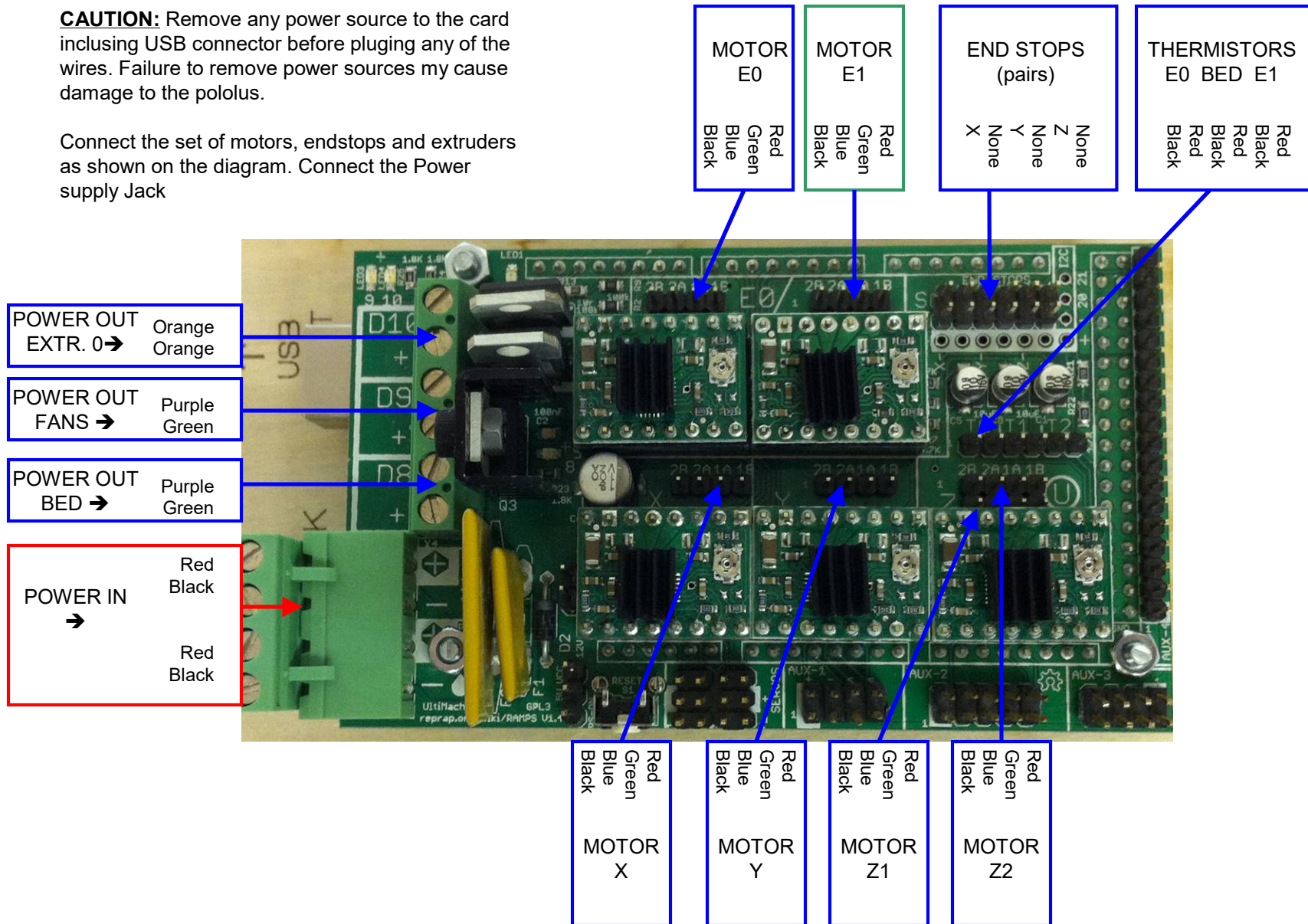


That's it. Save and Close the arduino
program. Note that there may be more
than one session open. Close all of them.

Step 11: Card wiring.

CAUTION: Remove any power source to the card including USB connector before plugging any of the wires. Failure to remove power sources may cause damage to the pololus.

Connect the set of motors, endstops and extruders as shown on the diagram. Connect the Power supply Jack



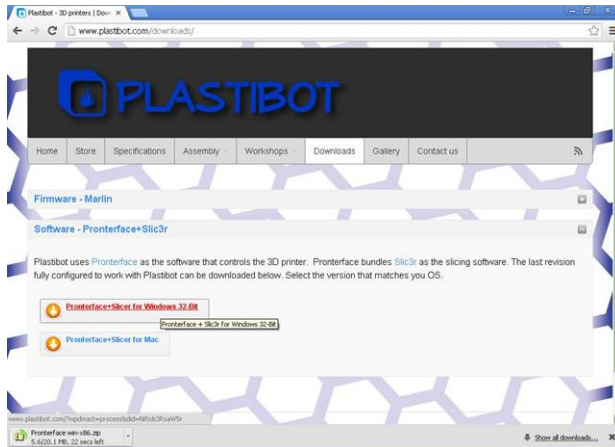
Step 12: Installing Pronterface

Parts Needed:

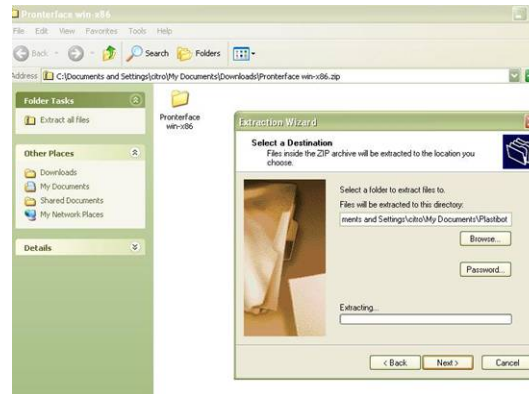
- Plastibot Mendel Printer
- Computer

Tools Needed:

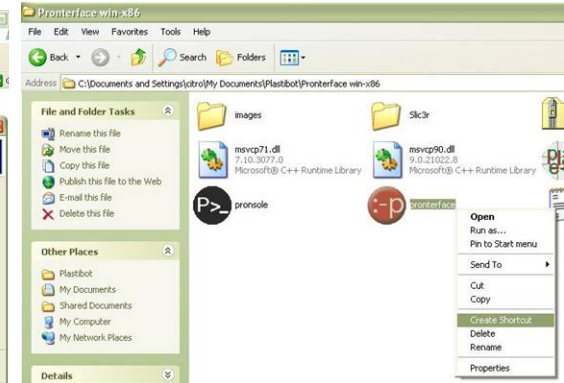
- Your hands



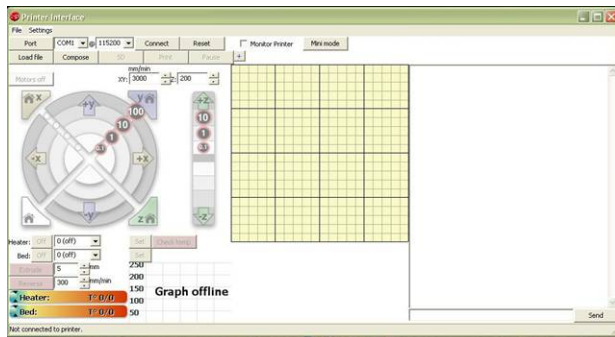
Go to www.plastibot.com/downloads and download pronterface corresponding to your OS (i.e Windows or Mac)



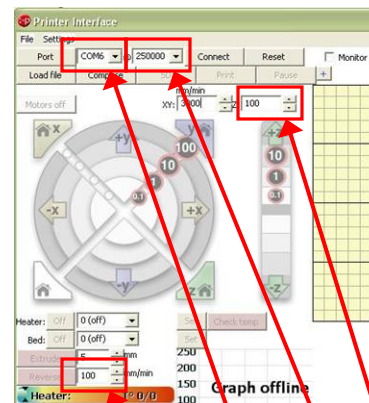
Click on the file you downloaded and extract into the Plastibot folder.



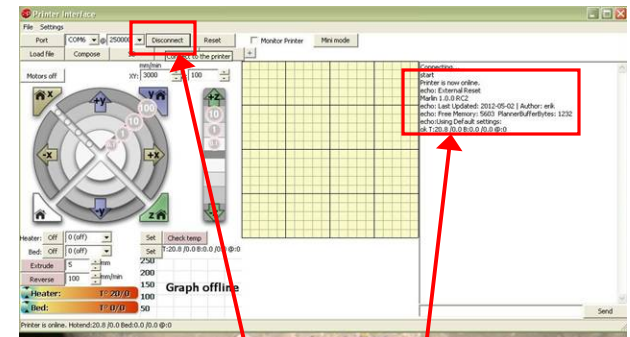
That should create a folder called Pronterface. Navigate to that folder and right click the file "pronterface.exe". Then from the menu select to create a shortcut and move the shortcut to your desktop.



Plug the USB cable to the RAMPS then Click the pronterface shortcut you just created. The following screen should open up.



Make sure Port shows COMxx where xx is the port assigned to your printer. Make sure the communication speed is 250,000. Change Espeed to 100 and Zspeed to 100



Click "connect". The status section will show you are connected. Proceed to plug the power cable on your printer to the electrical outlet and turn on the switch.

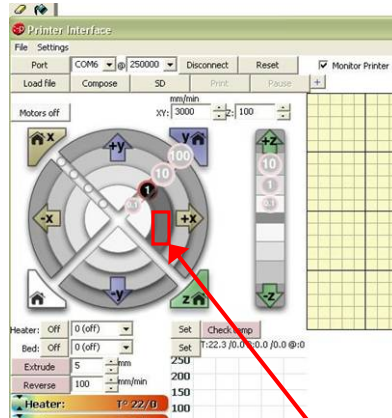
Step 13: Validating Motors and Endstops function

Parts Needed:

- Plastibot Mendel Printer
- Computer
- Pronterface

Tools Needed:

- Your hands
- Ruler



On Pronterface click on the right +X arrow for the ring that shows a value of 1. that should move the X Carriage by 1mm to the right.

You should see the shaft of Motor X turn clockwise slightly (about 1/20th of a turn) and get fully energized meaning you won't be able to move the shaft.

If movement direction is NOT correct then take note of that. We will fix on the next step. If there is no movement at all also take note and we will fix on the next step.



Now click on the ring showing 10, and verify that it actually moves about 1/2 turn.

Repeat for -X. clicking the ring with -10. It should move counterclockwise about 1/2 turn. Now keep pressed the X endstop switch with your finger, and click on -10 once again. At this time there should be no movement. If there is movement take note and we will troubleshoot on the next step.

Repeat the previous steps for the Y and Z carriages. Document your findings

Step 14: Validating Heaters and Extruder motor

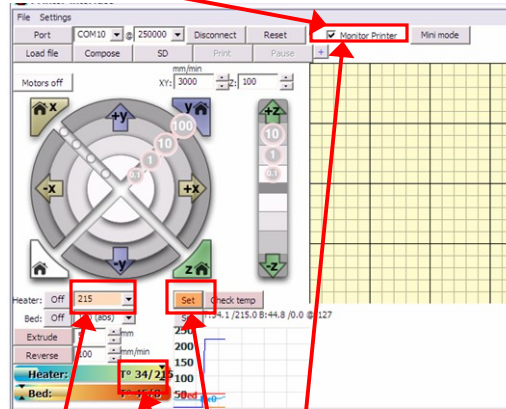
NOTE: Make sure **"Monitor Printer"** is selected otherwise temperature won't update on Thermometer.

Parts Needed:

- Plastibot Mendel Printer
- Computer

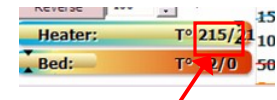
Tools Needed:

- Your hands

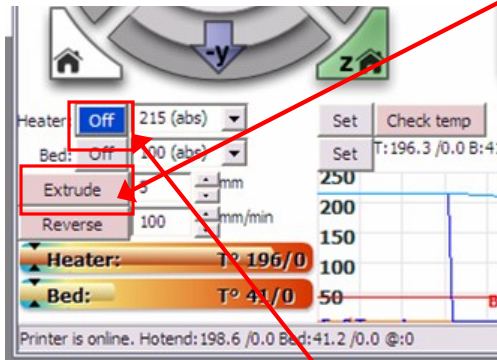


Grab the hotend nozzle with the helping hands so that it hangs on the air as it will get hot.

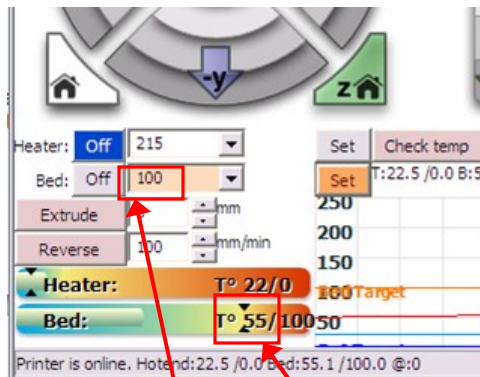
On Pronterface, set the heater temperature to 215 and click set then wait a couple minutes until the Heater thermometer shows 215. Make sure "Monitor Printer" is selected otherwise thermometer won't update.



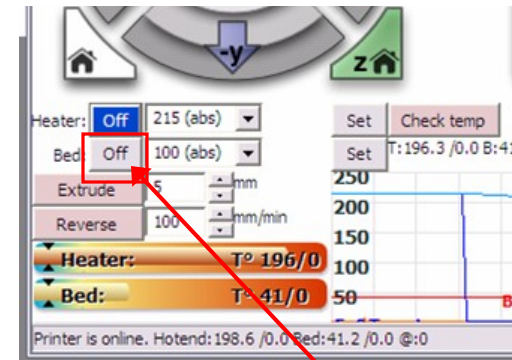
Once the heater reached temperature, click on the extrude button. The Extruder Motor should turn clockwise. If it turns the other way take note.



Click the heater off.



Set the Bed Temperature to 100 and click set. Check the Thermometer to see if it's raising. It will take about 10 min to reach temperature.



Click the Bed off.

Step 15: Troubleshooting Motors, Endstops and Heaters.

The following matrix shows common problems, it's root cause and possible solutions. Use it to solve any problems found on the 2 previous steps. Make sure the printer is turned off and unplugged before doing any change.

Category	Problem	Possible Root Cause	Possible Solution
X, Y, Z, E Motors	Motor spins in the opposite direction	Connector is connected backwards	Disconnect, turn the connector 180 degrees and reconnect.
	Motor doesn't move at all	Cable disconnected or connected in the wrong place?	Connect properly
	Motor is connected but it doesn't move at all	One of the wires in the connector could not be making contact	Verify all 4 cables on the connector to ensure the crimps are all the way into the plastic receptacle. Use a multimeter (if available) to check continuity on the motor wire. Each set of adjacent wires on the connector should read between 1.4 and 4 Ohms.
	Motor makes like it tries to move but it doesn't	One of the wires in the connector could not be making contact	Verify all 4 cables on the connector to ensure the crimps are all the way into the plastic receptacle. Use a multimeter (if available) to check continuity on the motor wire. Each set of adjacent wires on the connector should read a couple Ohms.
Hotend or Bed Heating Element	Heater is not heating up.	Cable disconnected or connected in the wrong place?	Connect properly
	Heater is properly connected but still not heating up	One of the cables on the connector might not be making contact	Use a multimeter (if available) to check continuity on the heater wires (red to red wires on the Hotend, Green to purple wires on Heated Bed). It should read around 6 Ohms for hotend and ~2 Ohms for Heated Bed.
	Heater is properly connected, measures continuity, yet is not heating up.	Thermistor properly connected?	Connect properly
	Heater is properly connected, measures continuity, Thermistor is connected, yet is not heating up.	Thermistor connector not making contact.	Use a multimeter (if available) to check continuity on the Thermistor wires (grey/grey wires) It should read around 100 KOhms.