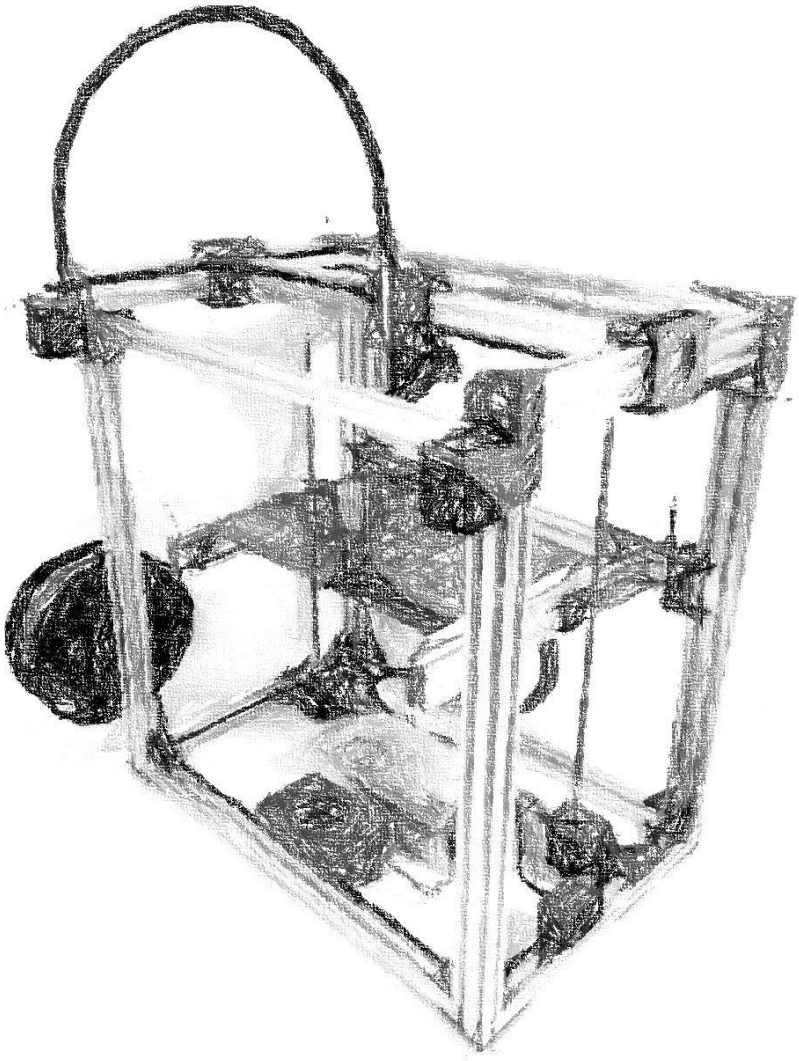
D-Bot Core-XY 3D Printer

Build and Configuration Guide

-Work In Progress-



March 2016

D. Spaulding

Disclaimer

This guide is meant to serve as an informational resource for building a D-Bot 3D printer. It is not meant to be a 100% complete instructional manual. This is not a commercial 3d printer kit, it is an experimental prototype design. If you have no experience with power tools, mechanical assembly, electronics, or electrical wiring, please do ***not*** attempt this project. Incorrectly wiring electrical components, especially those involving AC line voltage can start fires or cause fatal injury.

1. Introduction

- Format
  This guide contains multiple hyperlinks for file downloads and reference videos. The recommended viewing method is via PC rather than printout.

- Background
  The D-Bot printer is based on cfeniak's C-Bot 3D printer, which was designed with the goal of making a robust scalable Core-XY 3D Printer. The D-Bot is just one example of a printer which uses that base design and builds upon it. The original C-bot design featured a cantilevered bed and the D-bot design attempts to have a more stable build platform by moving the Z motors forward so that the print bed is lifted from its center of gravity. The secondary goal of the D-Bot design was to reduce the overall cost of the printer without sacrificing build quality. Other differences include changing some rails to 20mm height instead of 40mm, relocation of the X and Y endstops to simplify homing, and CAD modifications to printable parts either for structural or aesthetic reasons.

- Required Tools
  1. Metric Tape Measure
  2. Metric Allen Wrenches
  3. Miter Saw or Hacksaw
  4. M5 Thread Tap
  5. Phillips Screwdriver
  6. Adjustable Crescent Wrench
  7. Needle Nose Pliers
  8. Digital Caliper
  9. Utility Knife
  10. Wire Strippers
  11. Soldering Iron w/ Solder (Pb free recommended)
  12. Multimeter

- Recommended Assembly Related Items
  1. Heat Shrink Tubing
  2. Electrical Tape
  3. Zip Ties
  4. Super Glue
  5. JB Weld Epoxy
  6. 3-In-1 Oil

2. Ordering Parts

Read this build guide completely before ordering parts in case alternatives/ variants are wanted. Review the bill of materials, make sure you can buy all of the parts or find good alternatives and decide on optional components. Cheap ebay parts from china can take a month or more to arrive.

More information on parts selection:

- Hot End: This design uses an E3D V6 all metal hot end which can print PLA, ABS, and other filaments such as nylon. A cheaper option is the E3d lite6 which can print PLA and ABS for around half the cost. If a different hot end is selected, the bracket on the front of the print carriage may need to be swapped with a different bracket or redesigned.
- Control Board: This design uses a RAMPS/Arduino setup, which is one of the most common among DIY 3D printers, it is very cheap and simple and it works. Other options include Rumba/Rambo boards which are essentially RAMPS+Arduino on one board. Smoothieware based boards such as Smoothieboard or Azteeg X5 offer a different firmware option. Choose whatever control board you think will give you a good performance/cost ratio. This guide is written for a build using a Ramps 1.4 board.
- Heated Bed – The heated bed chosen for this design works well enough for PLA and PETG but it takes very long to reach ABS temps (100C) and it has trouble maintaining that temperature. For ABS printing, research different 200x300mm heated beds which are well reviewed for use in printing ABS. If using the grid heated bed, one option for easily reaching 100C fast is to use a secondary 24v power supply. If a 24v supply is used, the supply must be rated for 500W and bed wiring must be rated for at least 20A.
- Other potential Extras:
    - Auto bed leveling (aka crooked bed compensation) is not needed for this printer. This design features an X Y gantry which is very stable in the Z direction. Manual bed leveling only needs to be performed occasionally and it only takes a minute to achieve nearly perfect leveling with a playing card and an Allen wrench.
    - LCD Display/SD storage can be implemented depending on the control board chosen. Many Ramps kits come with an LCD display. The default configuration for this printer is operating via a PC connection to Repetier Host for slicing, Gcode transmission, and print monitoring.

3. Cutting V-Slot Extrusions

- Layout, measure, and cut the six V-slot rails to the proper lengths as shown in Figure 1. Label alphabetically as shown, these labels will be referenced during assembly.

- Cut V-slot railing pieces before printing plastic parts. If there are incorrect cuts made, plastic parts adjacent to the affected rail(s) can be modified in CAD to compensate for slightly incorrect cuts (this may or may not have happened to the author of this guide).

- Alternate frame railing lengths sized for a 300x300mm (12”x12”) bed are shown in the appendix.

- Options for cutting:
  1. Cut with a hacksaw – ok quality, if done carefully
  2. Miter saw with a wood blade – somewhat ok, if done correctly
  3. Miter saw with non-ferrous blade – best, this approach can give perfect clean cuts
  4. If you do not have access to the proper tools, contact a local metal shop, mechanic, welder, or other professional that can cut aluminum railing to length for a (hopefully small) fee.

- Do not use an abrasive blade chop saw meant for cutting steel. It will leave very jagged rough cuts because it melts aluminum when cutting through.

- Measure twice, cut once!

- 20x40mm V-slot Railing pieces needed:

  (4) at 520mm - A, B, C, D
  (1) at 463mm - G
  (1) at 488mm - R
  (1) at 448mm - Q
  (2) at 333mm - E, F
  (2) at 313mm - O, P

- 20x20mm V-slot Railing pieces needed:

  (3) at 463mm - L, M, N
  (1) at 503mm - K
  (2) at 313mm - H, J

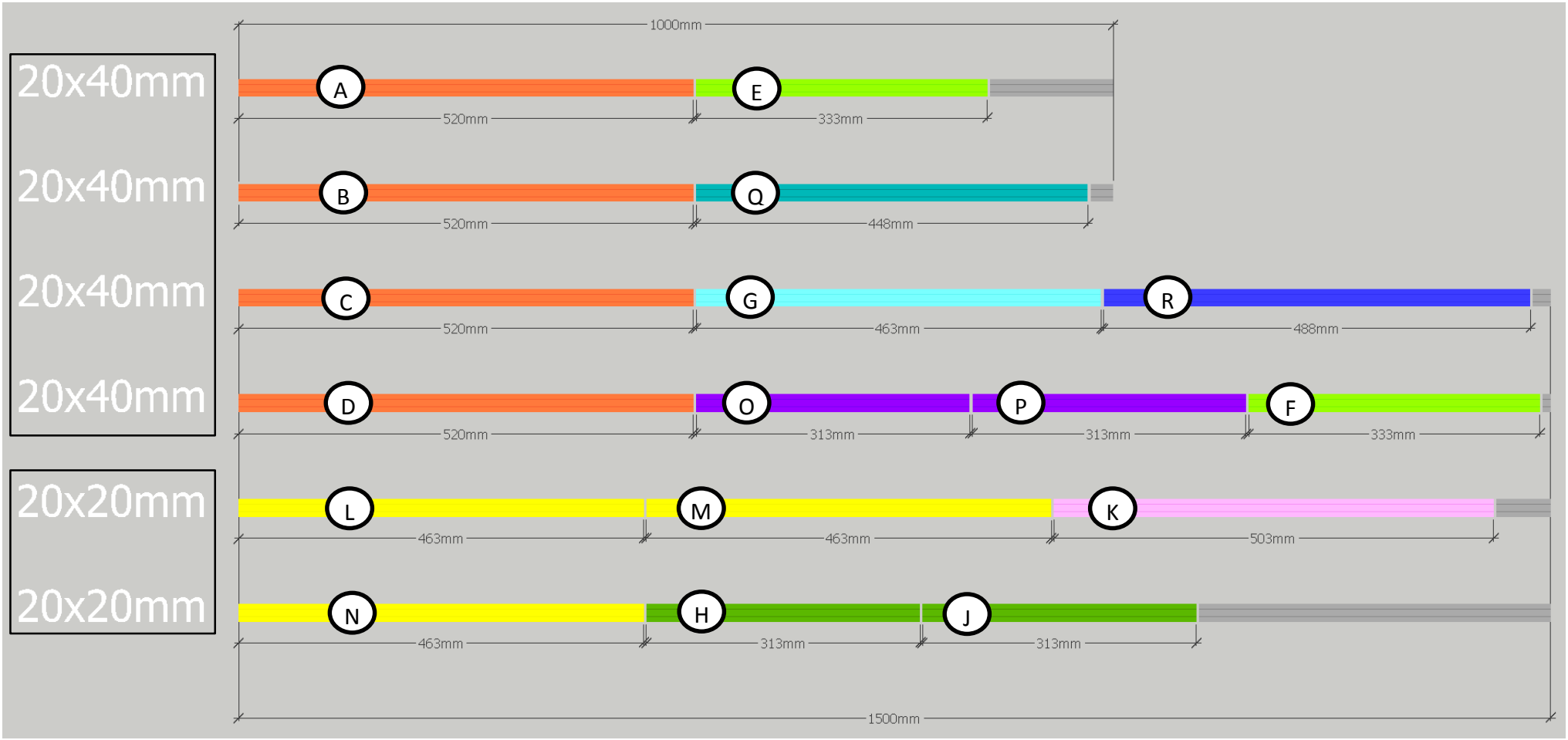


Figure 1: V-slot railing cut diagram

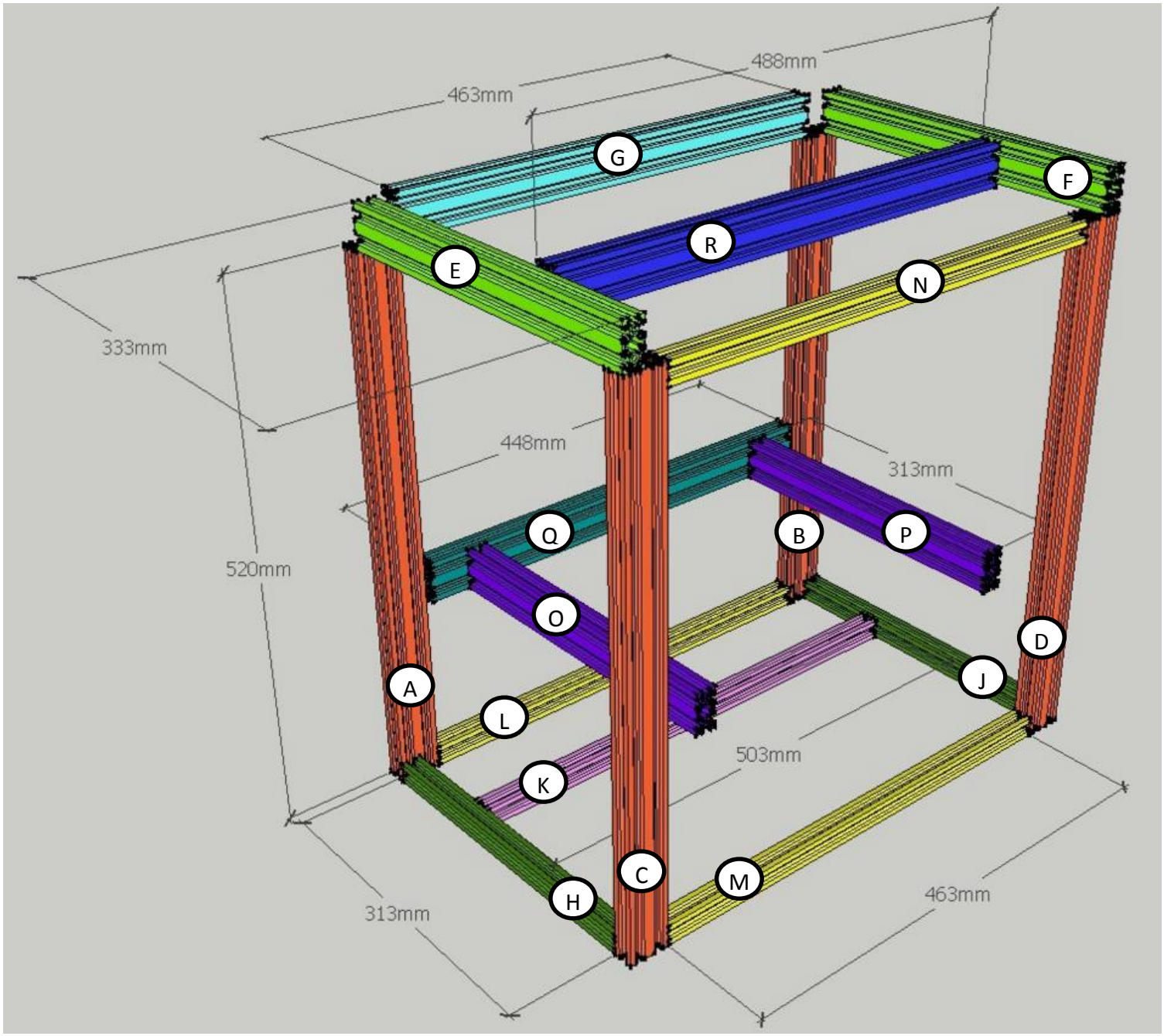


Figure 2: V-slot frame reference diagram

M5 thread tapping

Figure 3 shows which locations on the V-slot rails need to be M5 thread tapped. V-slot ends are predrilled correctly to the size needed for M5 threads. Use oil on the thread tap, repeatedly reverse the tap to avoid jamming and breaking. Practice thread tapping on some of the leftover scrap V-slot pieces. [Here is an example thread tapping video.]

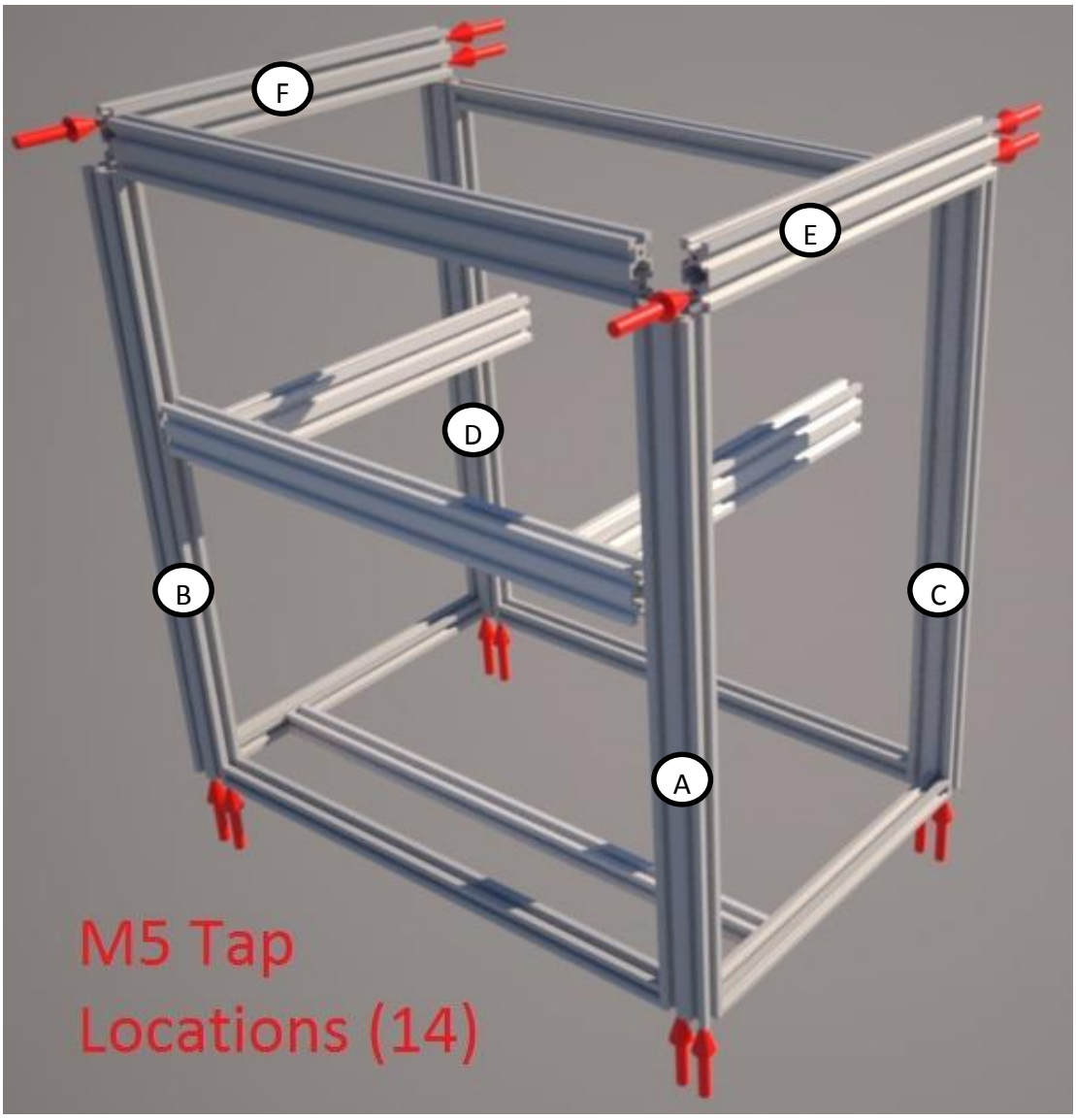


Figure 3: M5 Thread Tap Locations

4. Printing Parts

- All printable parts required are on the D-Bot Thing Files Page. The required quantity for each part type is indicated by the number at the beginning of each file name.

- Optional components can be printed on the D-Bot itself and added later to avoid extra initial printing. This is especially helpful when parts must be printed on a shared public printer or bought from a third party.

- Any part which will be bolted to the aluminum frame has the potential to crack when tightened. This can be avoided by printing structural parts at 100% infill or at least a high infill percentage and several shells which will provide more structure behind mounting holes. It will take more plastic but it is worth it to have all parts as rigid as possible for a strong frame.

- If possible, print structural parts in PETG or ABS rather than PLA. After a few months of use, printers with PLA components exhibit cracked edges due to vibration even when printed at 100% infill.

- Parts can be printed at 0.1mm or 0.2mm layer height, whichever is preferred.

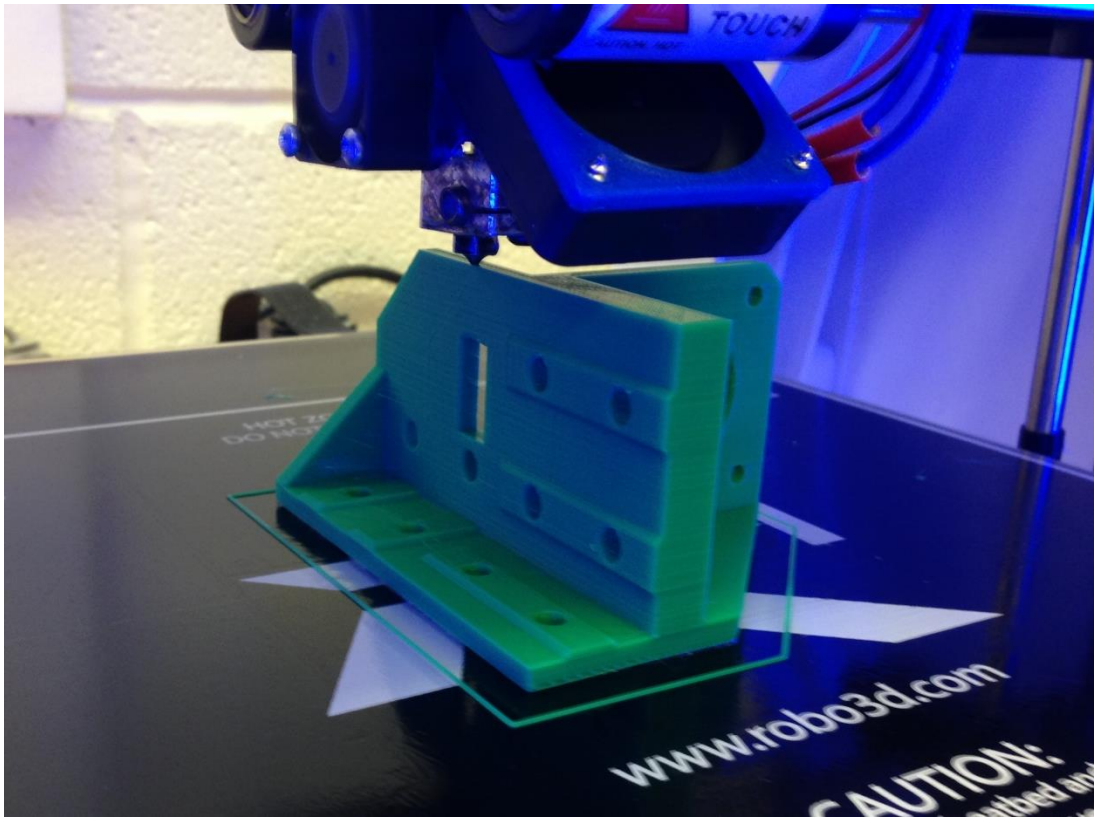


Figure 4: Right Front motor mount printed on a Robo3D R1

5. Mechanical pre-assembly

- Assemble Wheel Units (20 total)
  Each wheel unit consists of an openbuilds mini V wheel with a MR105ZZ bearing inserted on each side and a 1mm plastic shim in between the two bearings. Do not forget the 1mm shims, without them the spacers will push in on the bearings and they will bind when tightened, the shim gives something for the bearings to push against so they will not bind. Assemble all 20 wheel units per Figure 5.

  Parts Needed:
  (20) OpenBuilds mini V wheels
  (20) Printed Bearing Shims
  (40) MR105ZZ Bearings

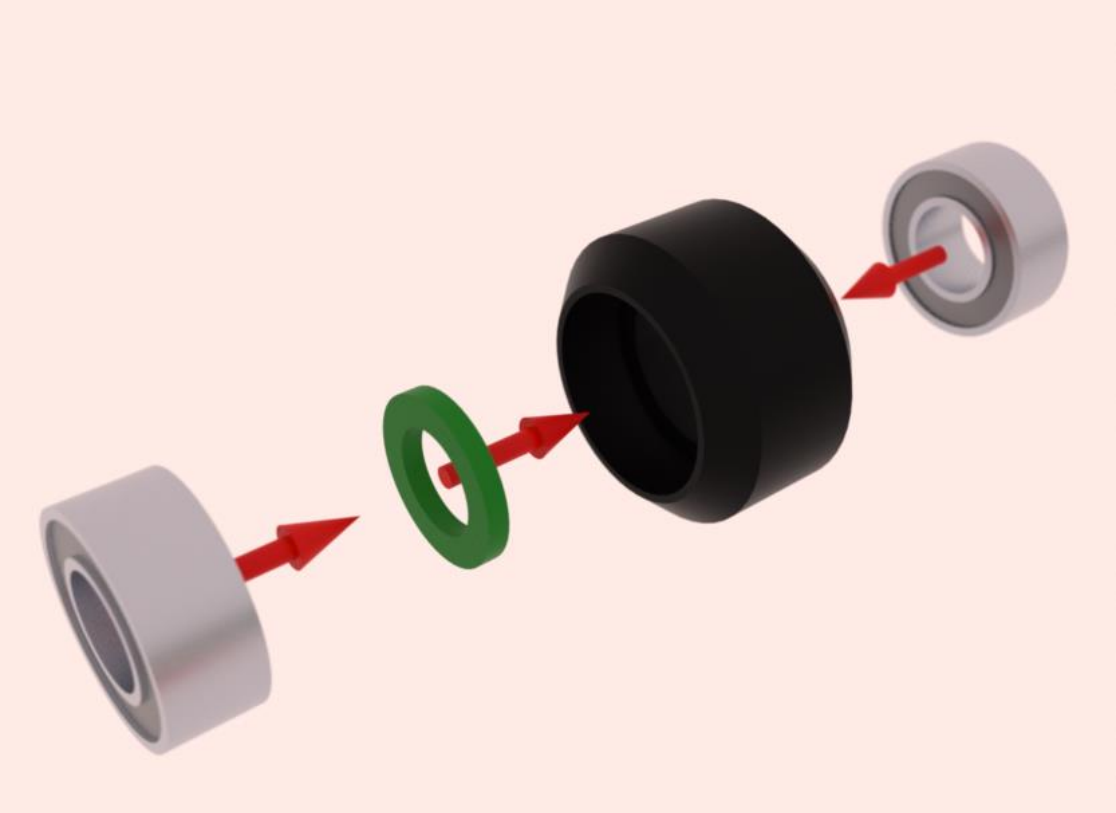


Figure 5: Wheel unit Assembly

- Rear Idler bearings
  Insert idler bearing assemblies into the rear *left and right* idlers (4 locations) as shown in Figure 6. The idler bearing assembly is: (bolt > plastic > flange bearing > washer > flange bearing > plastic > nut), mounted in each rear idler housing. One bolt is inserted from above and one is inserted from below. The lower idler bolt is inaccessible after frame assembly.

  Parts Needed:
  (8) F623ZZ Flanged Bearings
  (4) M3 25mm bolts
  (4) M3 Nuts (standard)
  (4) M3 washers

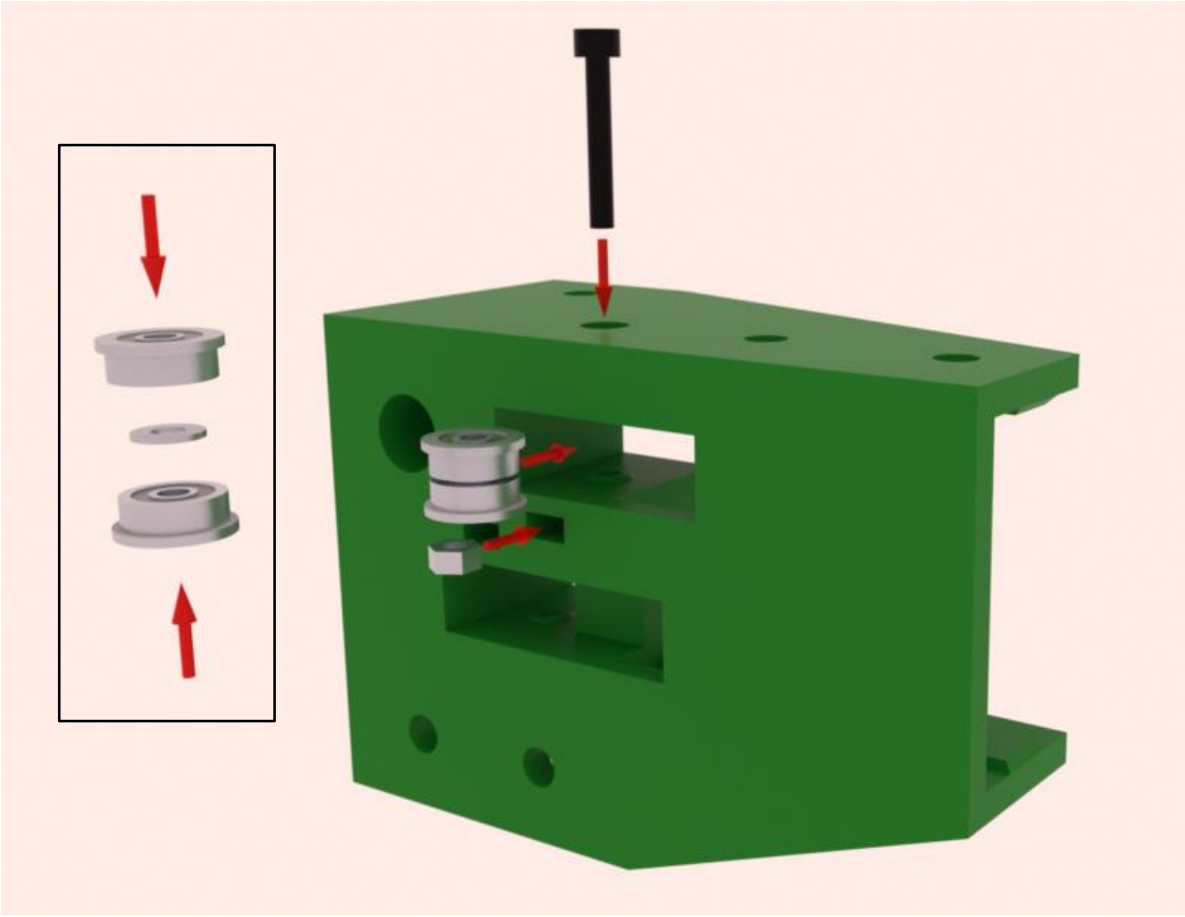


Figure 6: Rear Idler Bearing Assembly

- H-Bar End Idler bearings

  Insert idler bearing assemblies into the *left and right* H Bar Ends (4 locations) as shown in Figure 7. The H-Bar idler bearing assembly is: (bolt > washer > plastic > flange bearing > washer > flange bearing > plastic > washer > nylock nut), mounted in each H Bar end. One bolt is inserted from above and one is inserted from below.

  Parts Needed:
  (8) F623ZZ Flanged Bearings
  (4) M3 25mm bolts
  (4) M3 Nuts (nylock)
  (12) M3 washers

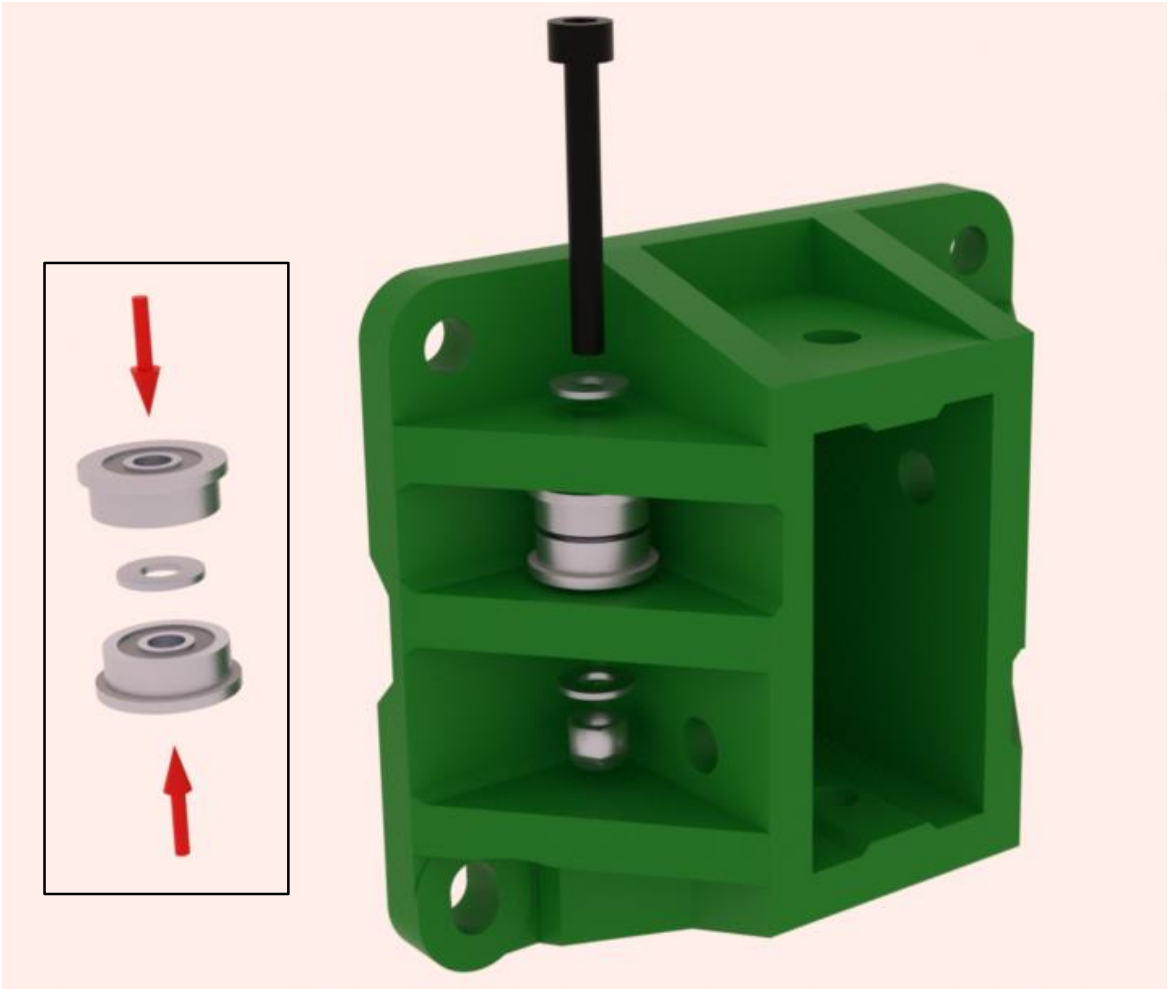


Figure 7: H-Bar End Idler Bearing Assembly

6. Assembling the Frame

- Put an M5 10mm bolt with an M5 washer through each plastic frame part where needed and put a square nut on the end of the bolt. Leave off the 14 bolts which attach to tapped holes for now. Some M5 bolt mounting locations are countersunk and do not need M5 washers. Once nuts and bolts are placed on plastic pieces, slide each part onto the V-slot rail from the open end as shown in Figure 8. The square nuts need to be lined up with the V-slot ends.

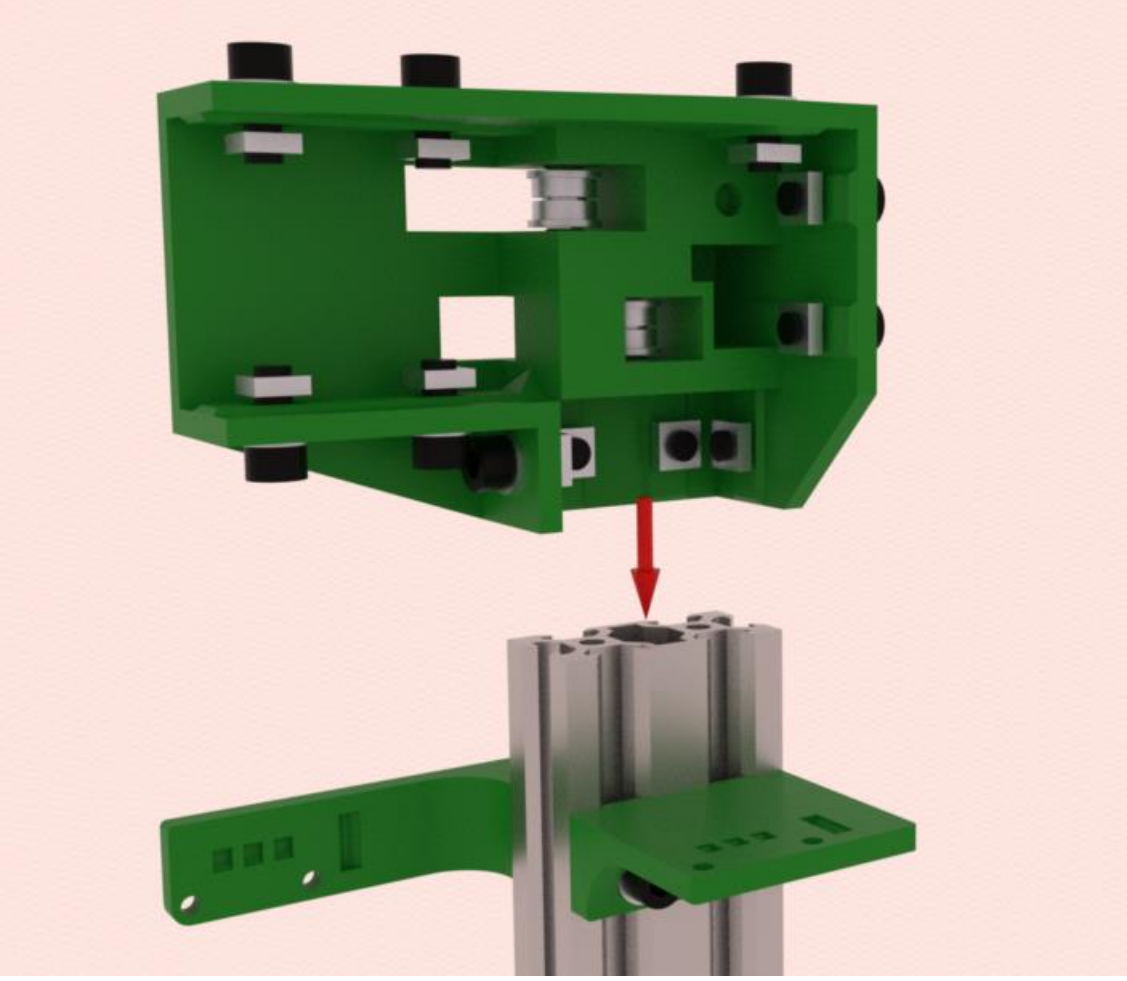


Figure 8: V-Slot and square nut alignment example

- For future add-ons or changes, square nuts can be inserted into the face of the V-slot rails after the frame has been assembled. Insert the square nut into the slot at an angle and tilt up, a small tap pushes it past the lip of the railing.

- Attach the Right Rear Idler, Z Endstop Bracket, Y Endstop Bracket, two Corner Brackets, and one 3x3 Plate onto Rail B.
- Attach a 2x1Plate and a 3x3Plate onto Rail J.
- Attach Rails F and J to Rail B.
- Tighten Rear Idler bolts which are blocked by adjacent bolts with needle nose pliers.

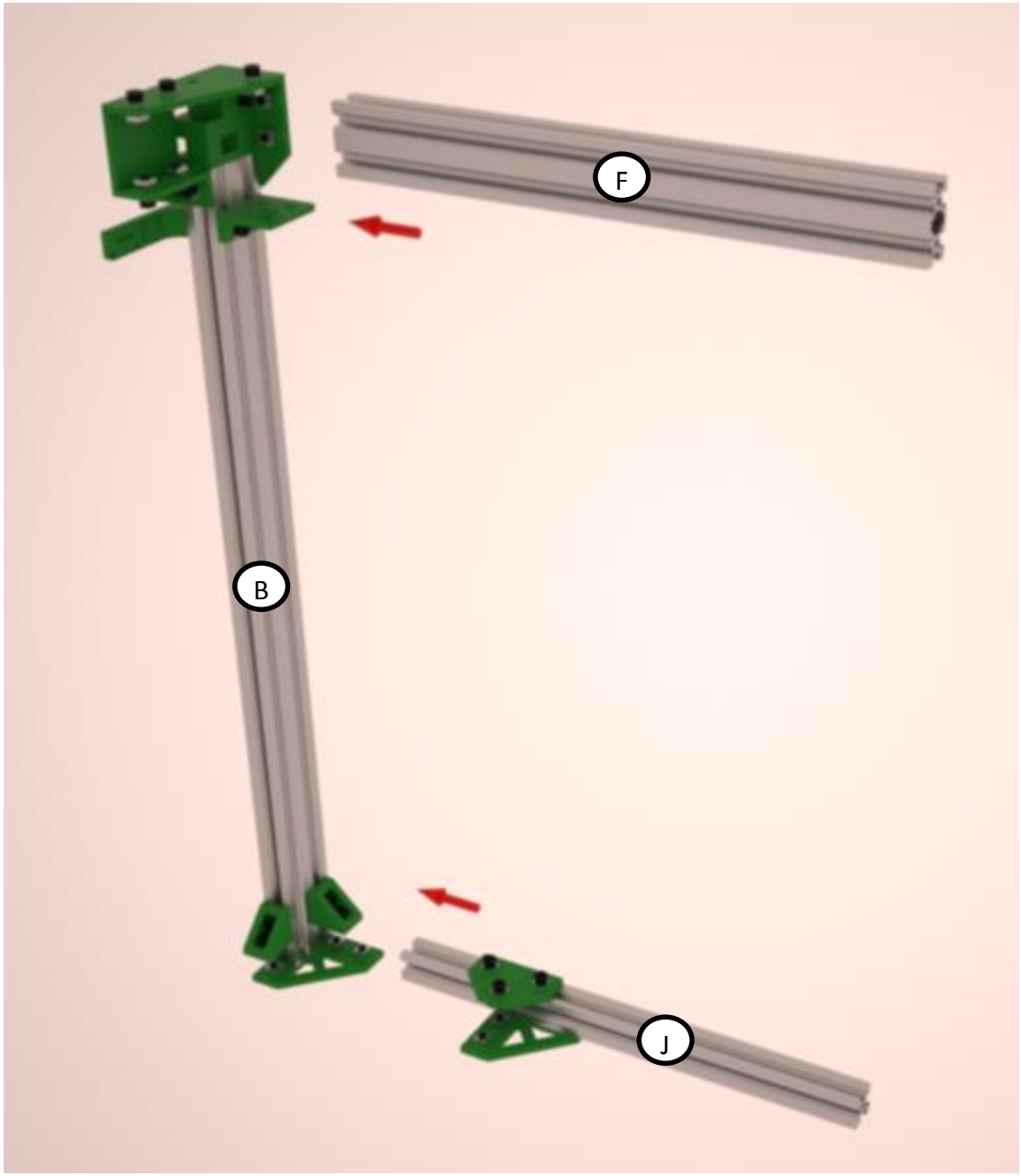


Figure 9: Right Side Frame Assembly

- Attach the Right Motor Mount, two Corner Brackets, and one 3x3Plate to Rail D.
- Attach Rail D to complete the right side of the frame.

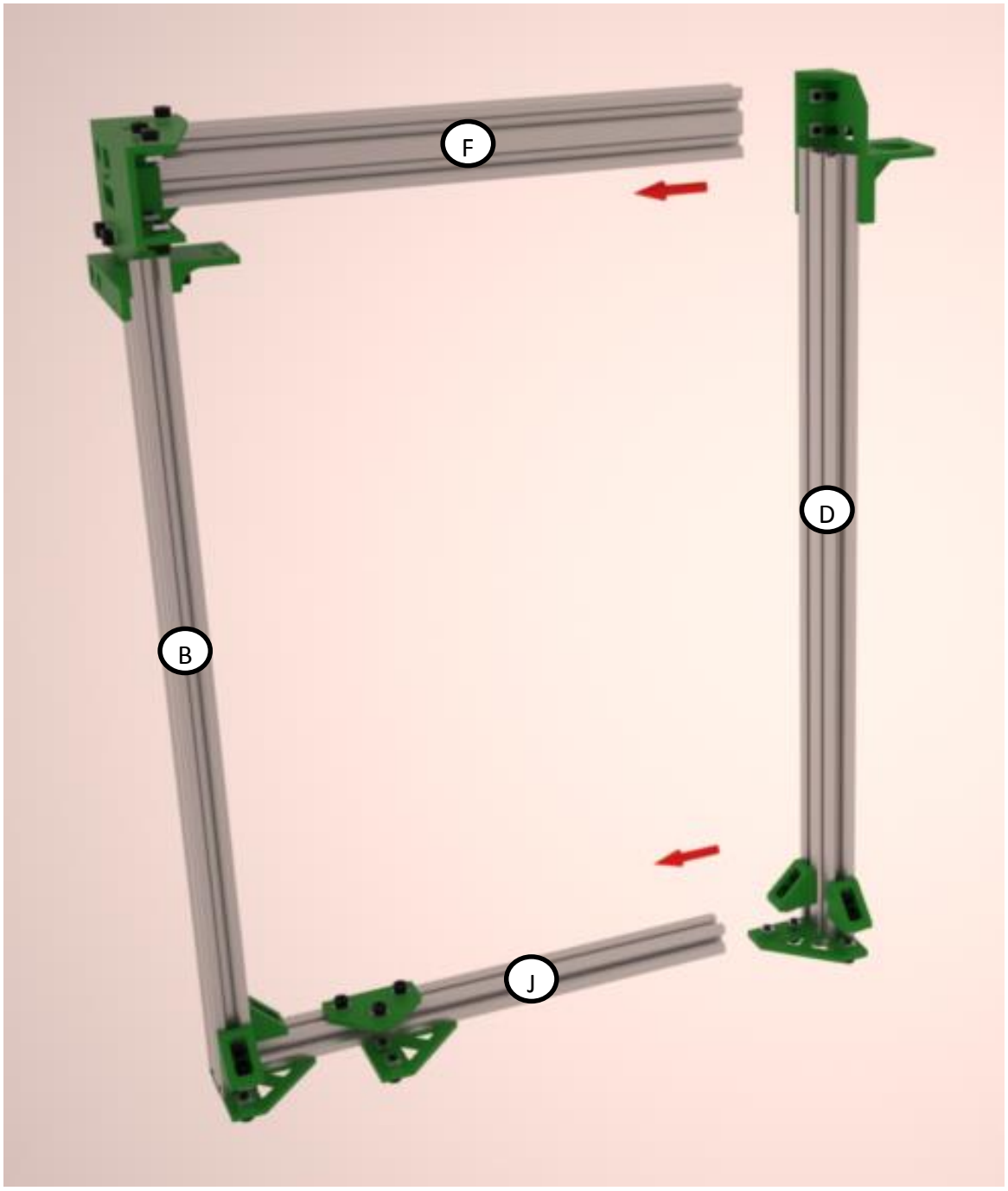


Figure 10: Right side Frame Assembly Continued

- Attach the Left Rear Idler, two Corner Brackets, and one 3x3Plate onto Rail A.
- Attach a 2x1Plate and a 3x3Plate onto Rail H.
- Attach Rails E and H to Rail A.

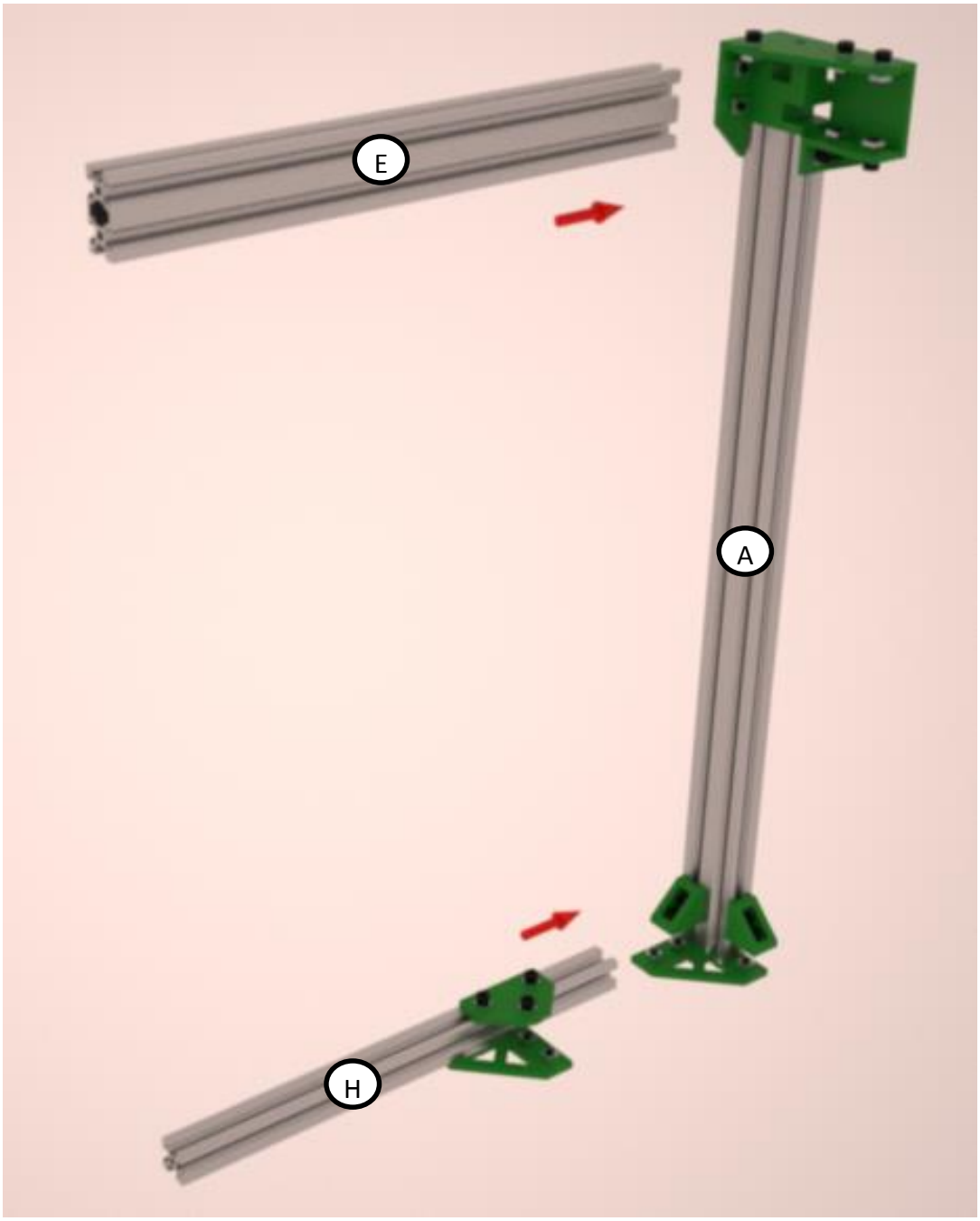


Figure 11: Left Side Assembly

- Attach the Spool Holder to Rail C. The spool holder is composed of an M5 75mm bolt, an M5 nylock nut, an M5 15mm washer, and an M5 square nut as shown in Figure 12

Figure 12: Spool Holder

- Attach the Left Motor Mount, the Extruder Bracket, two Corner Brackets, and one 3x3Plate onto Rail C.
- Attach Rail C to complete the left side of the frame.

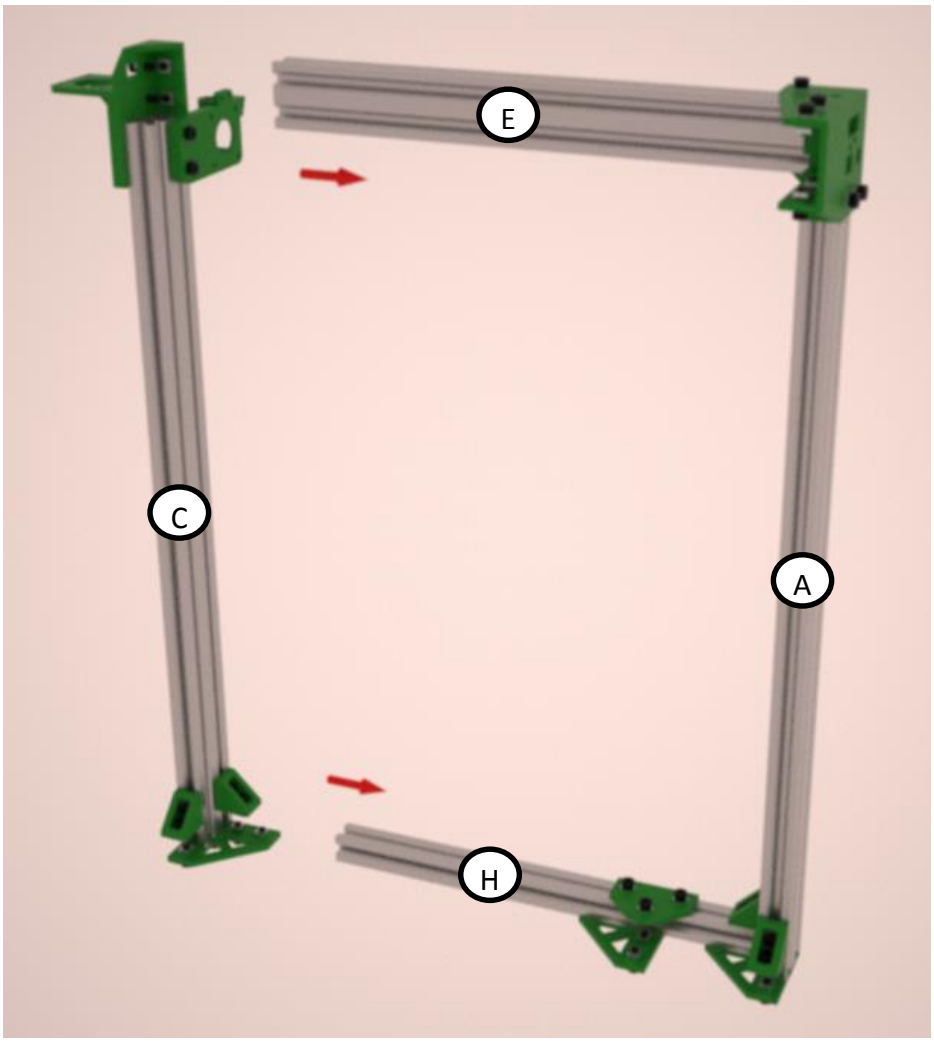


Figure 13: Left side continued

- Attach two Z Motor Mounts to Rail K.
- Attach Rails G, L, K, and M to the right side frame assembly.

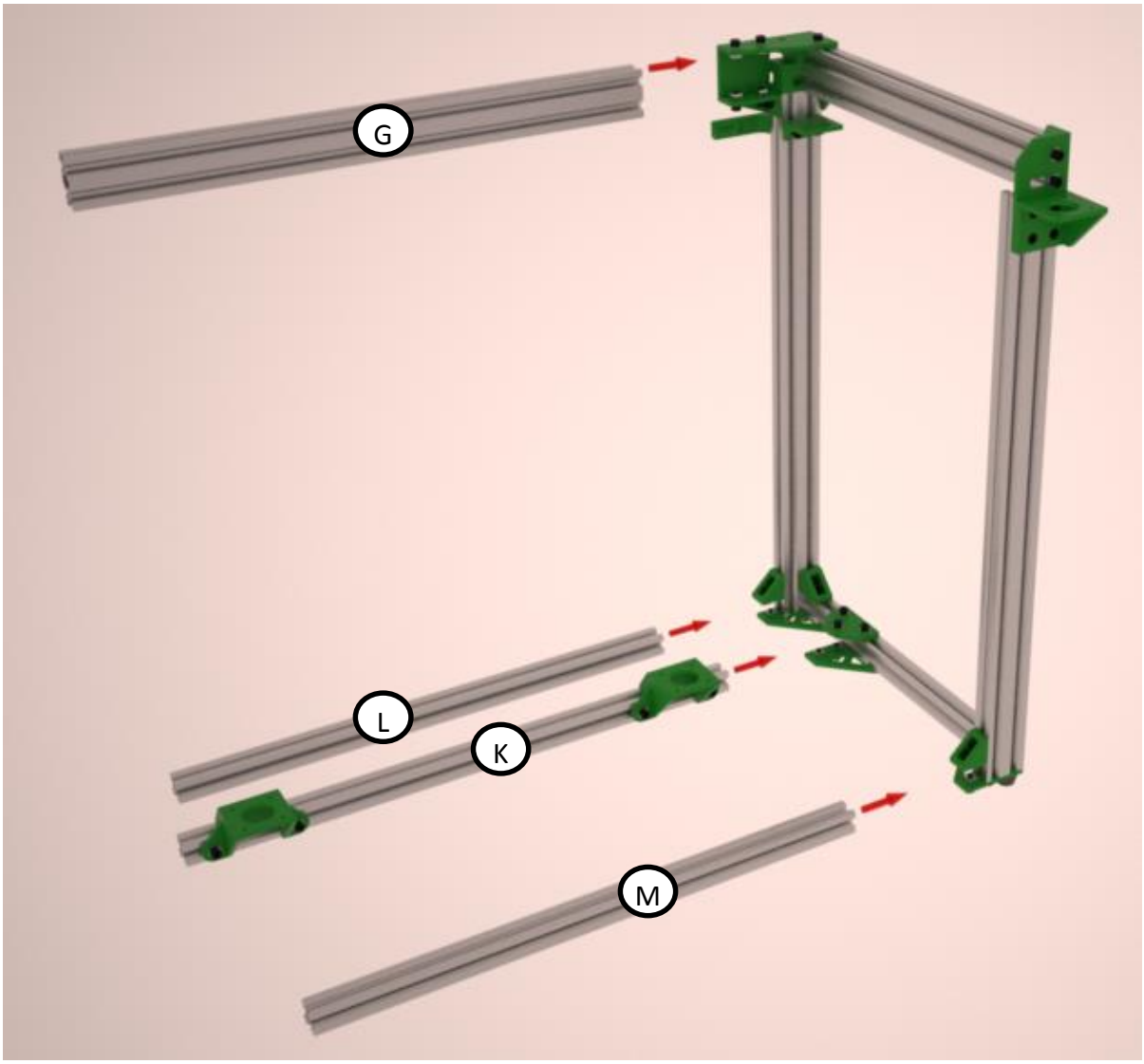


Figure 14: Middle Rail Assembly

- Attach Rails G, L, K, and M to the Left side frame assembly.

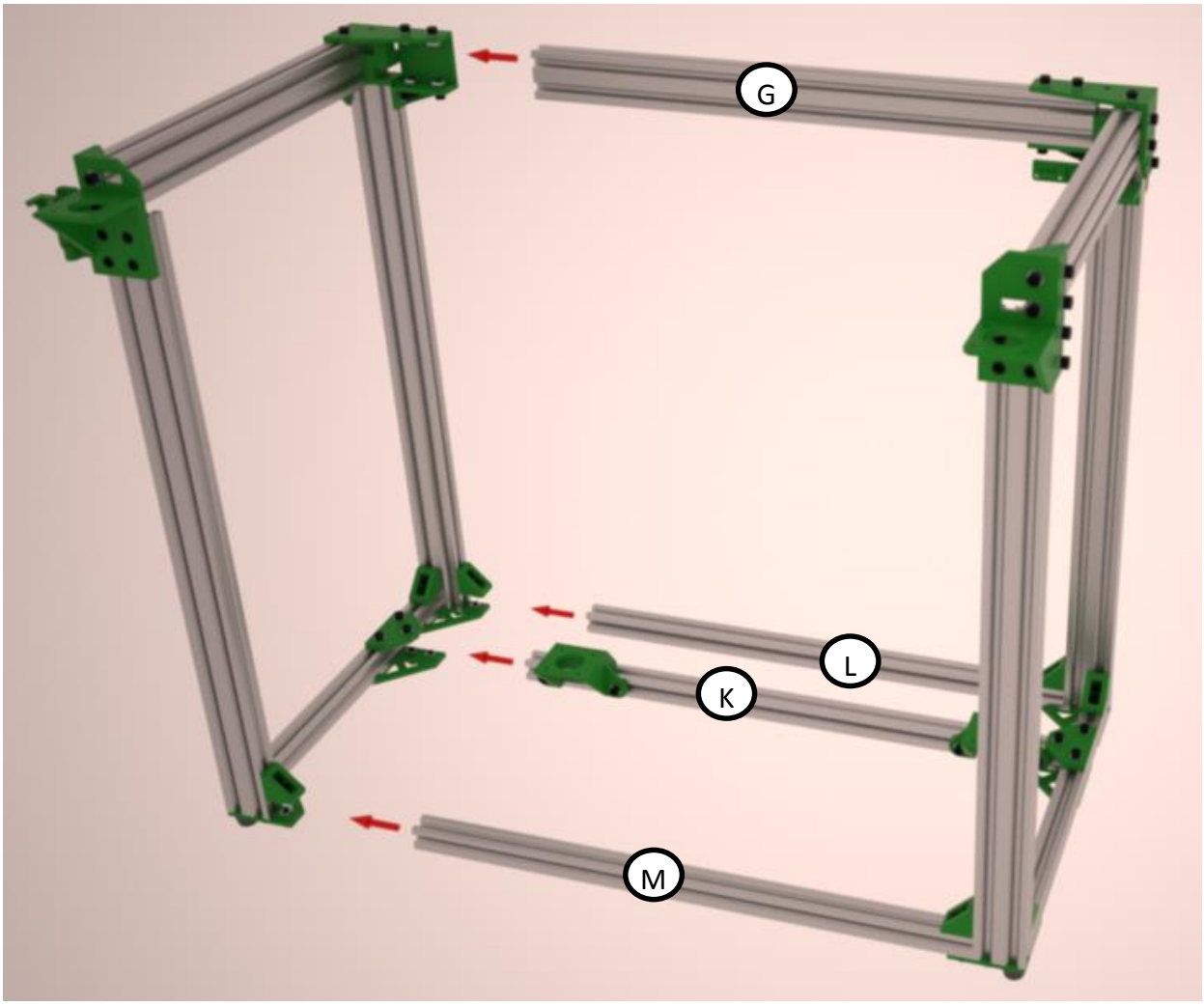


Figure 15: Left and right sides

- Attach two Corner Brackets onto Rail N.
- Attach Rail N to the front of the frame assembly

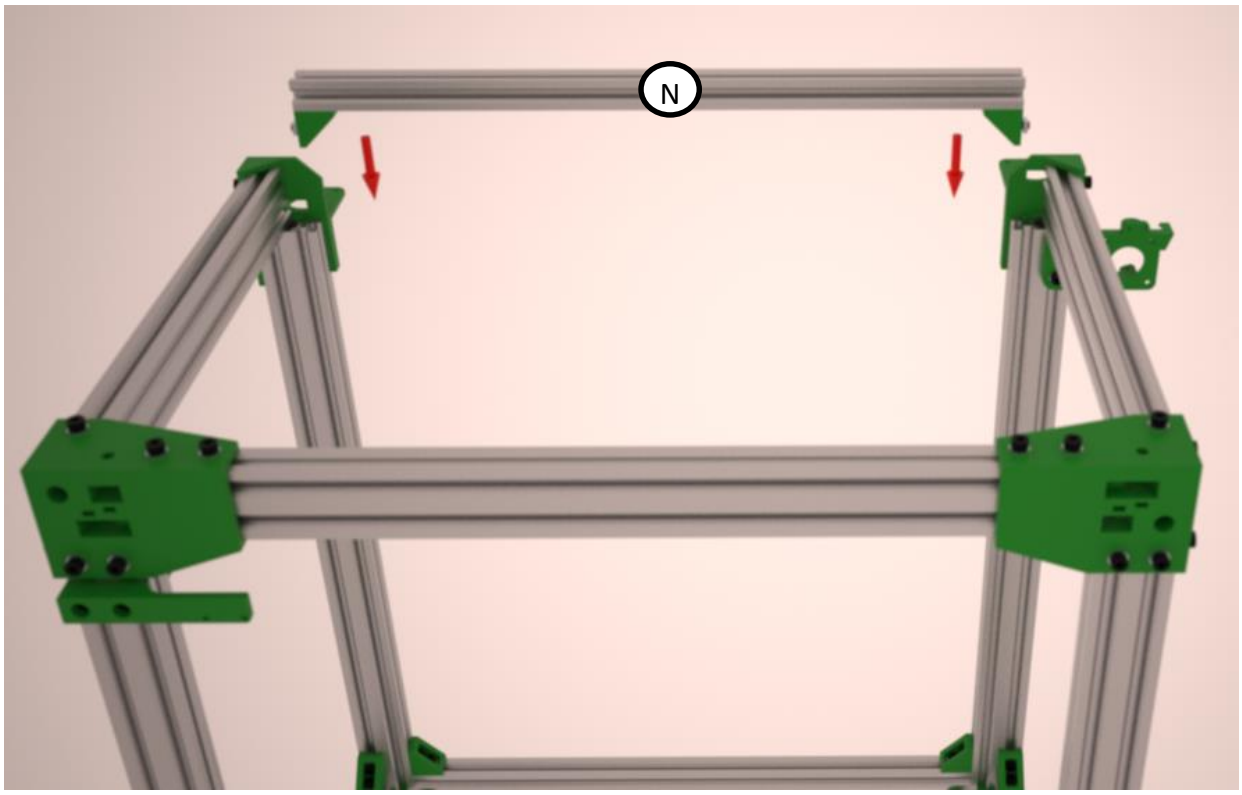
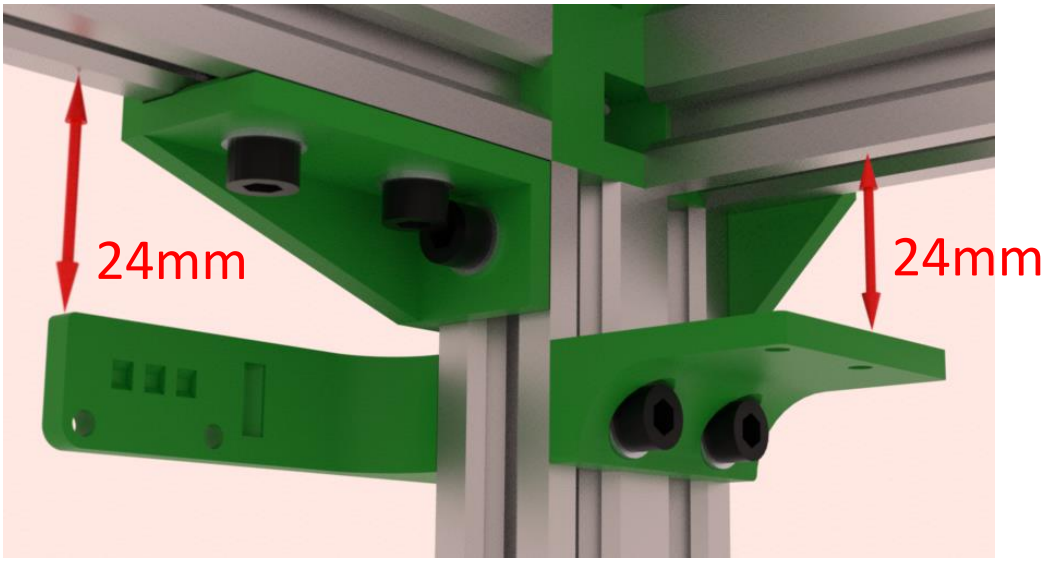
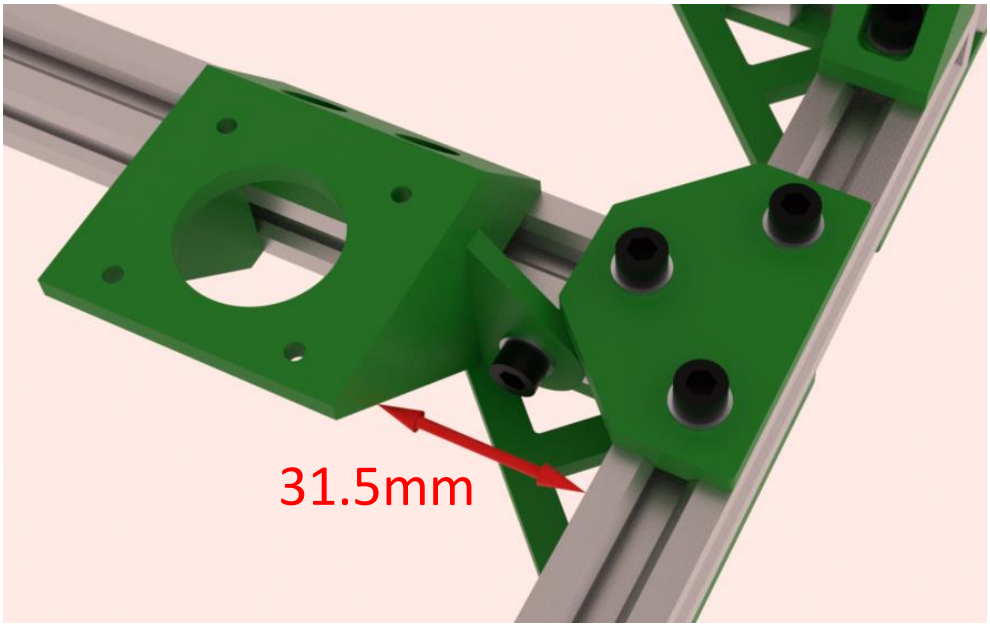
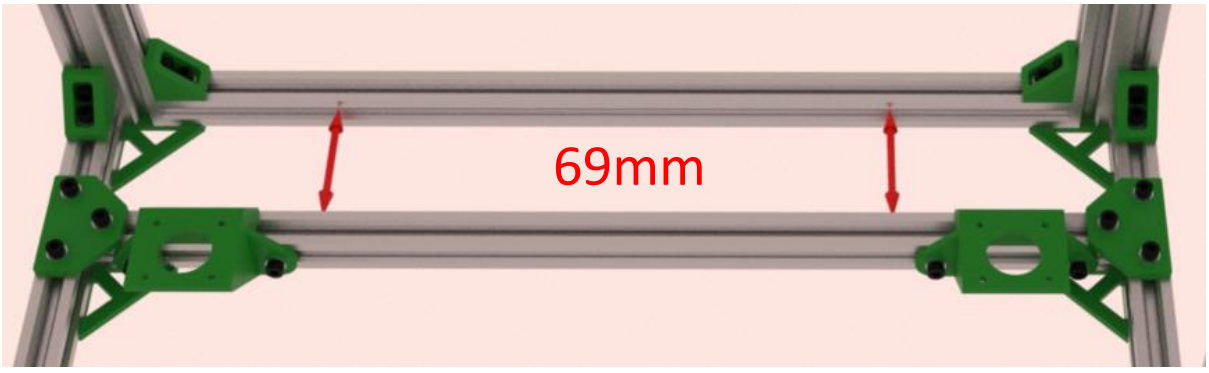


Figure 16: Center front rail

- Adjust the following parts according to the dimensions shown. Tighten bolts.







- Attach four rubber feet to the four corners of the bottom with M5 10mm bolts.
- Attach remaining bolts which thread into tapped ends indicated in Figure 3 (14 total).
- Tighten all M5 frame bolts snugly but not tight enough to cause cracking of plastic parts.
- Measure between Rails A and B at the top and bottom of the frame, verify that the two rails are parallel to within 0.5mm. Loosen up lower corner brackets or rear idlers to make adjustments and leave a slight gap at the end of either Rail L or G in order to make rails A and B parallel.
- Measure between Rails E and F using the same technique, make adjustments to the gaps at the end of Rails G or N so that Rails E and F are parallel to within 0.5mm.

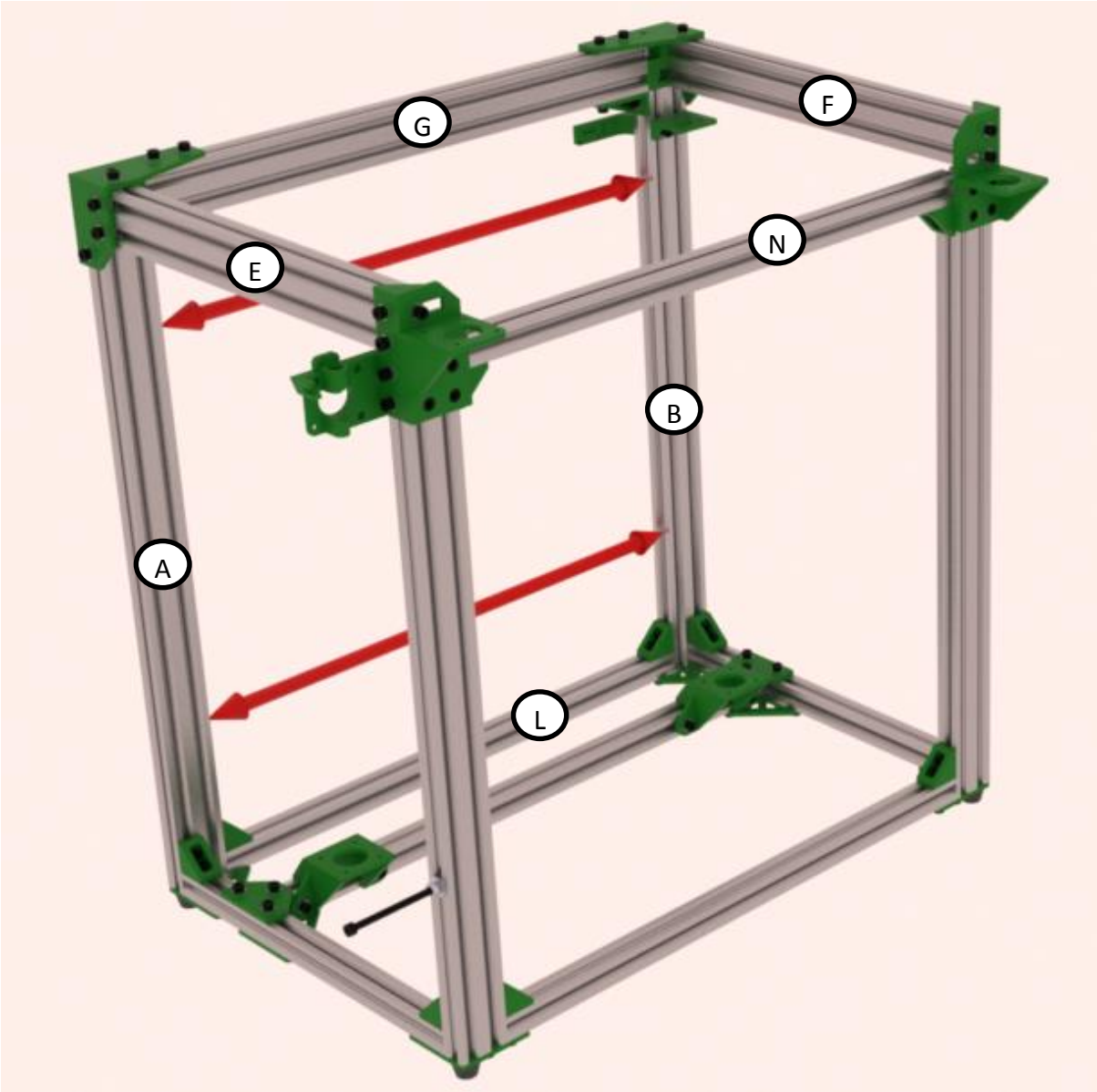


Figure 17: Assembled Frame

7. Z Platform Assembly

- Place a standard M3 nut into each of the four bed supports.

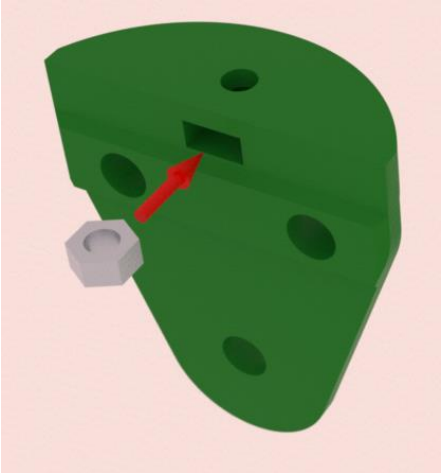


Figure 18: Bed Support

- Attach four 3x3 Plates, four Corner Brackets, and the Z Endstop Bolt Holder to Rail Q.
- Attach two Bed Supports and a Lead screw Bracket to Rail O.
- Attach two Bed Supports and a Lead screw Bracket to Rail P.
- Attach Rails O and P to Rail Q.

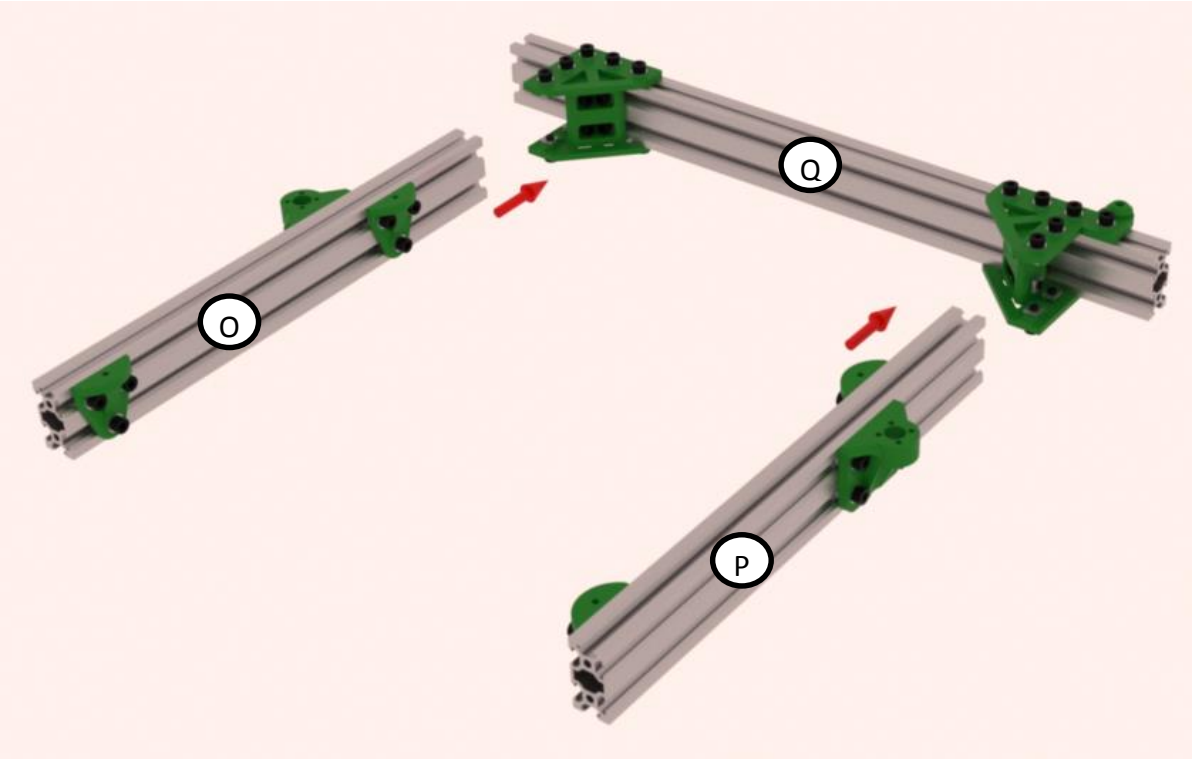


Figure 19: Z Platform Frame assembly

- Adjust Z platform parts according to Figure 20. Both sides are symmetrical.
- Verify that the distance between rail O and rail P is 317mm.

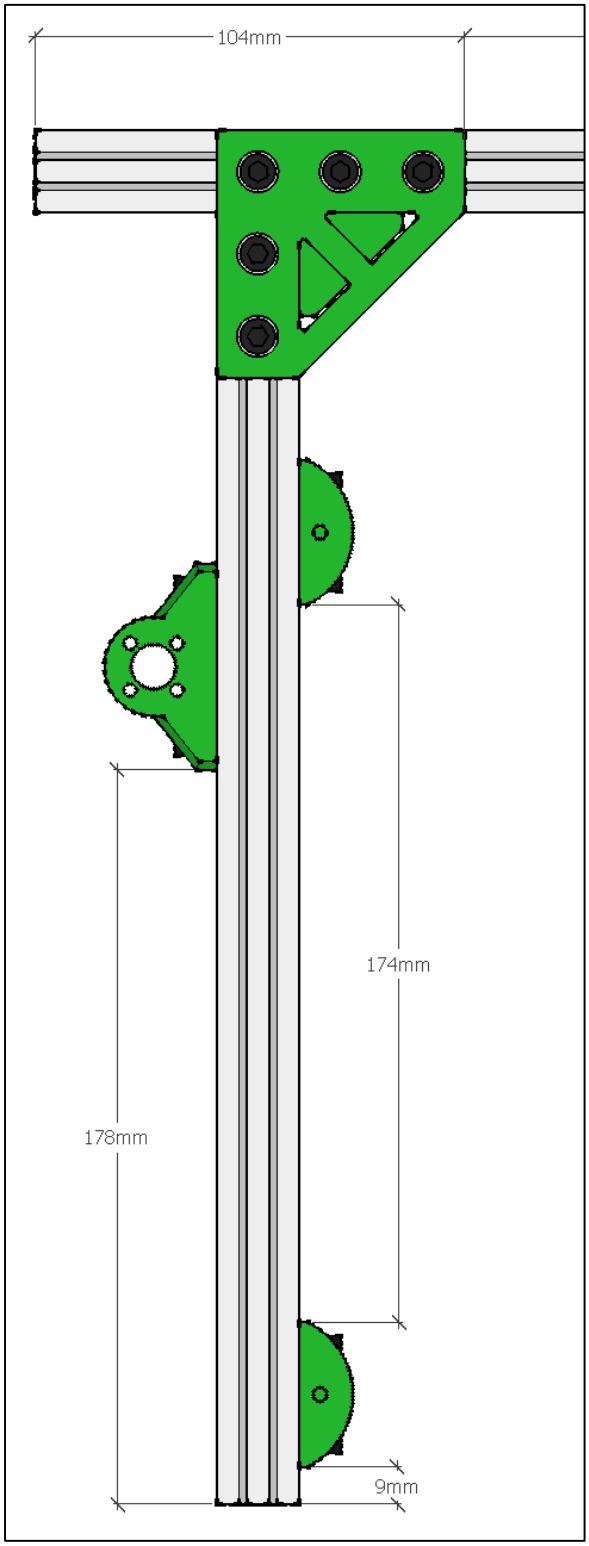


Figure 20: Z Platform Dimensions

- Attach four Z Wheel Guides to rail Q (two on each end). Lightly tighten bolts, final adjustment and tightening will occur after Z platform is aligned within the frame.

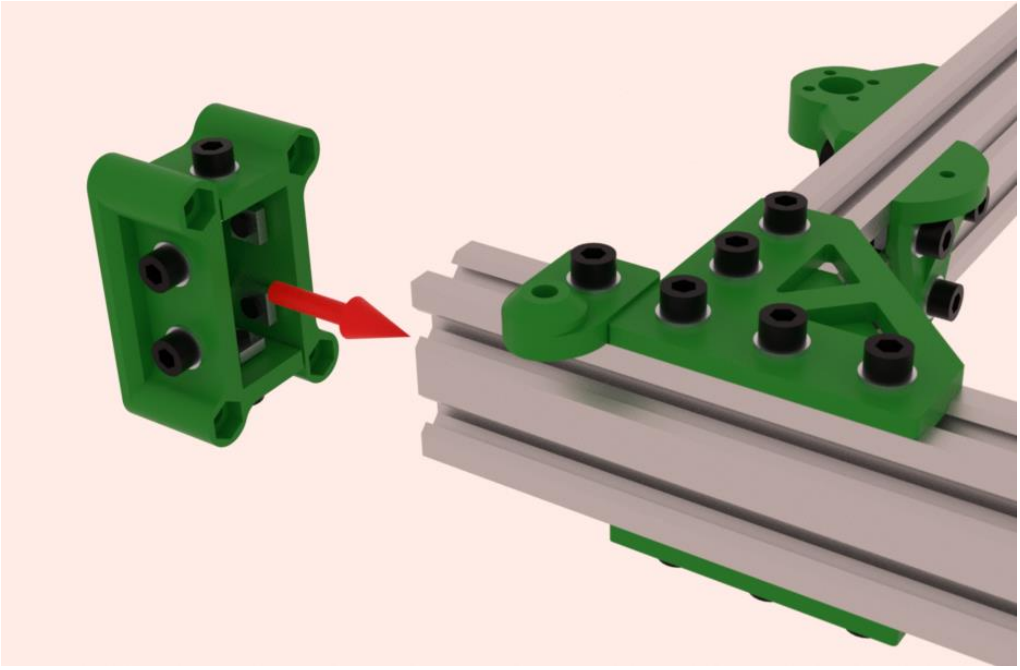


Figure 21: Z Wheel Guide installation

- Insert four wheels into the front facing Z Wheel Guides. Set aside parts for the four rear wheels to be used after Z platform installation.

  Parts Needed:
  (8) Wheel Units (assembled on page 9)
  (8) M5 nuts
  (8) Wheel Spacers
  (8) M5 40mm Bolts

Figure 22: Z Wheel Assembly

- Install the Z platform into the frame, rest platform on the Z motor mounts.
- Line up the four Z wheels with the rear legs. Loosen the Z Wheel Guide bolts and adjust as needed to align the Z wheels with the V-slot grooves in the legs.

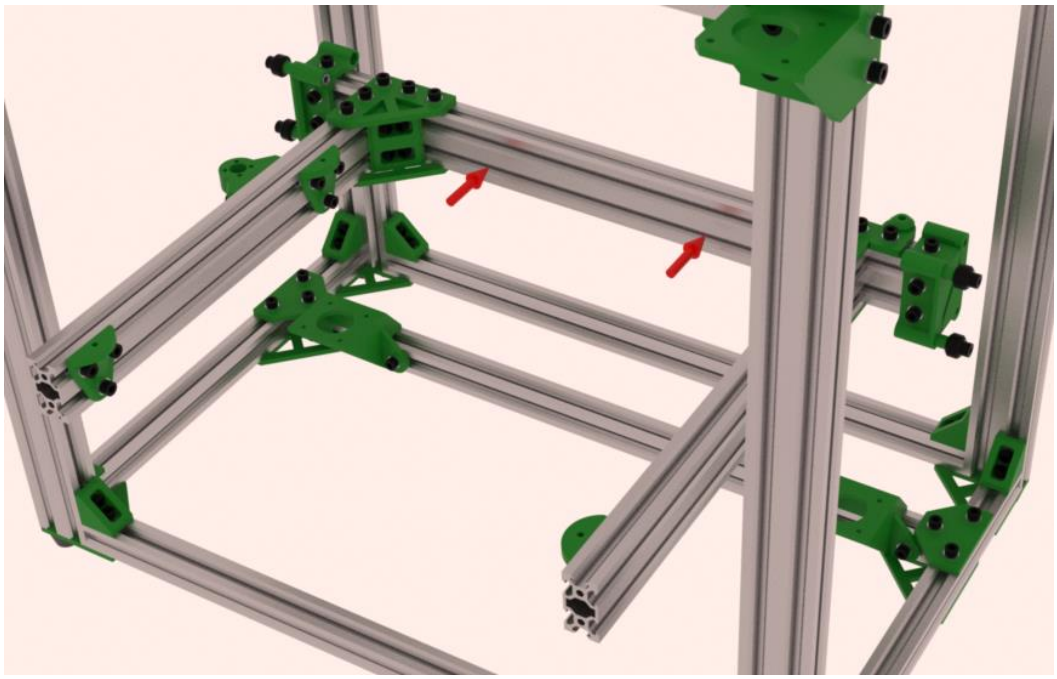


Figure 23: Z Platform installation into frame

- Insert four wheels into the rear Z Wheel Guides.

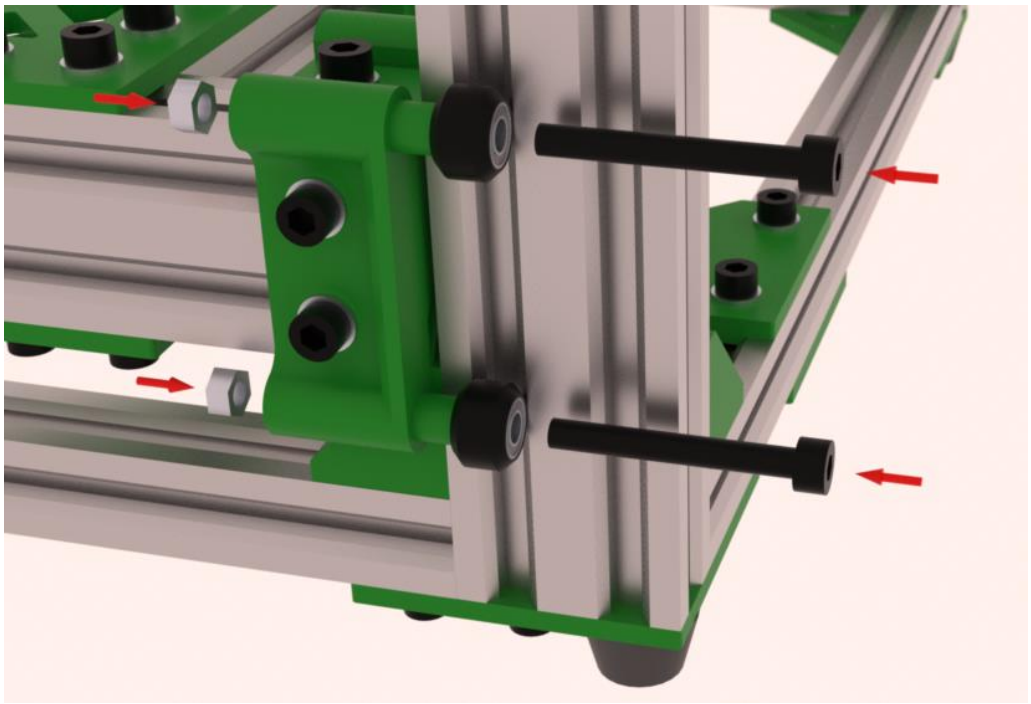


Figure 24: Rear Z Wheel installation

8. XY Gantry Assembly

Work In Progress

9. Print carriage assembly

Work In Progress

10. Extruder and Bowden Assembly

Work In Progress

11. Wiring

Wire all components according to the D-Bot electrical configuration Diagram if setup in the stock configuration. Make changes as necessary for extra components/ different parts. The recommendation is to wire components loosely until all functionality can be confirmed so that fixing and moving wiring can be done easily. Final wire routing is up to the discretion of each builder according to personal preference. Wiring can be run as neatly as desired or left loose and disorganized as long as all connections are properly made and all wiring that connects to moving components have proper strain relief. Never rely on solder joints or electrical connections to secure wiring.

Verify jumpers are placed on all pairs of pins under each of the stepper driver boards (15 jumpers total)

Relay must be bolted to aluminum rail for heat dissipation

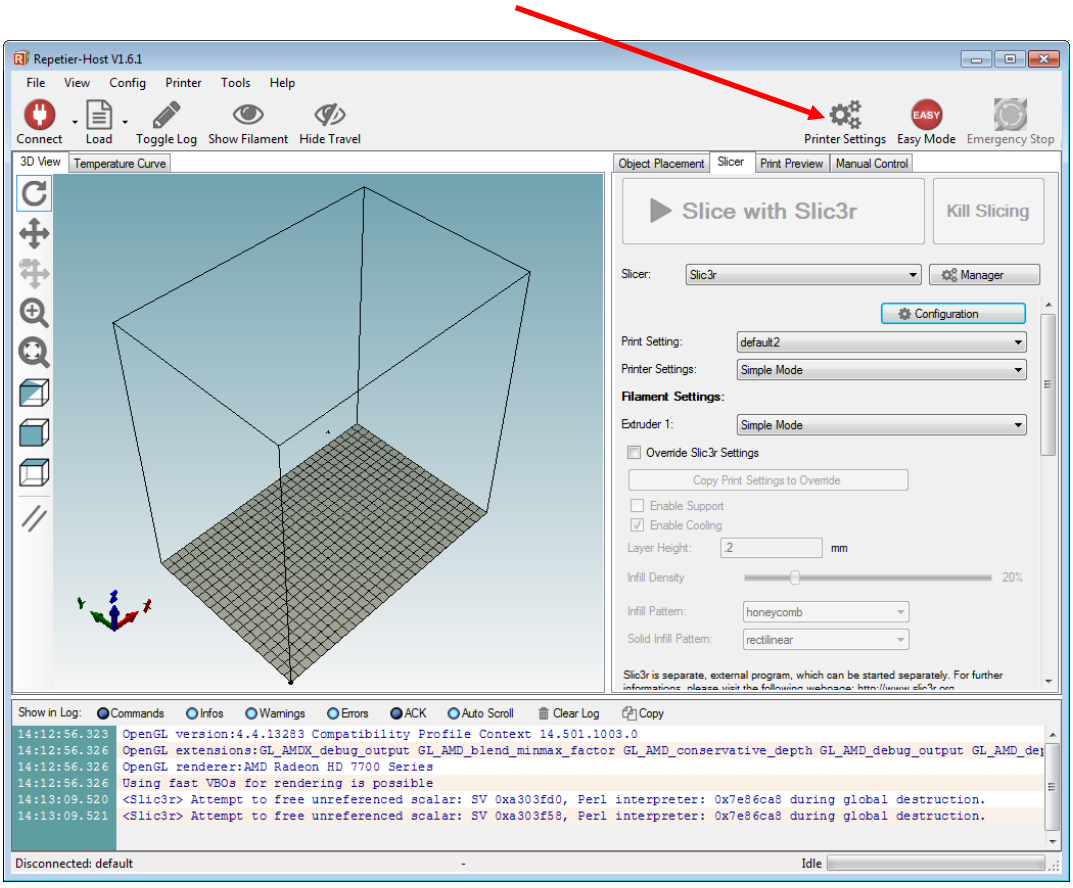
Work In Progress

12. Belts and Pulleys

Work In Progress

13. Software Configuration and Initial Set Up

- Connect Arduino/Ramps 1.4 board to PC via USB-B cable. Do not turn on 12v power yet.
- Tune stepper motor drivers using the technique shown here. The D-Bot stepper drivers are set to approximately 0.55 volts.
- Download Arduino from https://www.arduino.cc/en/Main/Software and install.
- Download D-Bot_Marlin.zip from http://www.thingiverse.com/thing:1001065/#files
- Unzip *D-Bot_Marlin.zip*
- Open *D-Bot_Marlin>Marlin>Marlin.ino*
- Set Tools>Board>Mega 2560
- Set Tools>Port> (Change to the COM port used, this may require some trial and error)
- Click verify (checkmark), then upload (arrow).
- If you cannot connect or if you receive a timeout error, you may need to download and install the CH341SER driver. Some Chinese knockoff Arduino boards use a serial chip which is not the same as normal Arduino boards.
- Download Repetier Host from http://www.repetier.com/download-now/ and install, skip the installation of Repetier Server.
- Open Printer Settings and configure per the following 4 pages.



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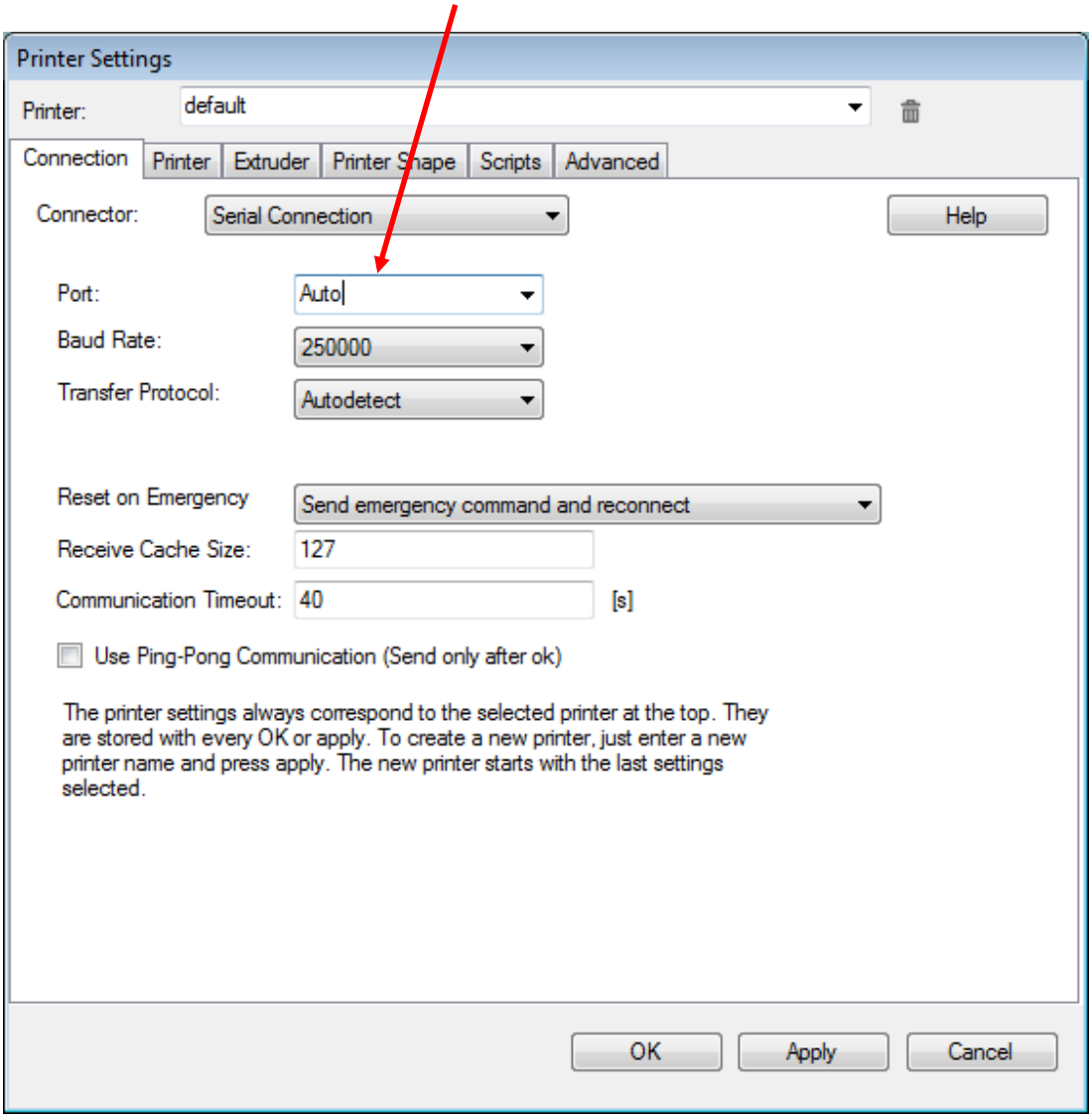
Set Port to the same COM port used to upload the firmware via Arduino.



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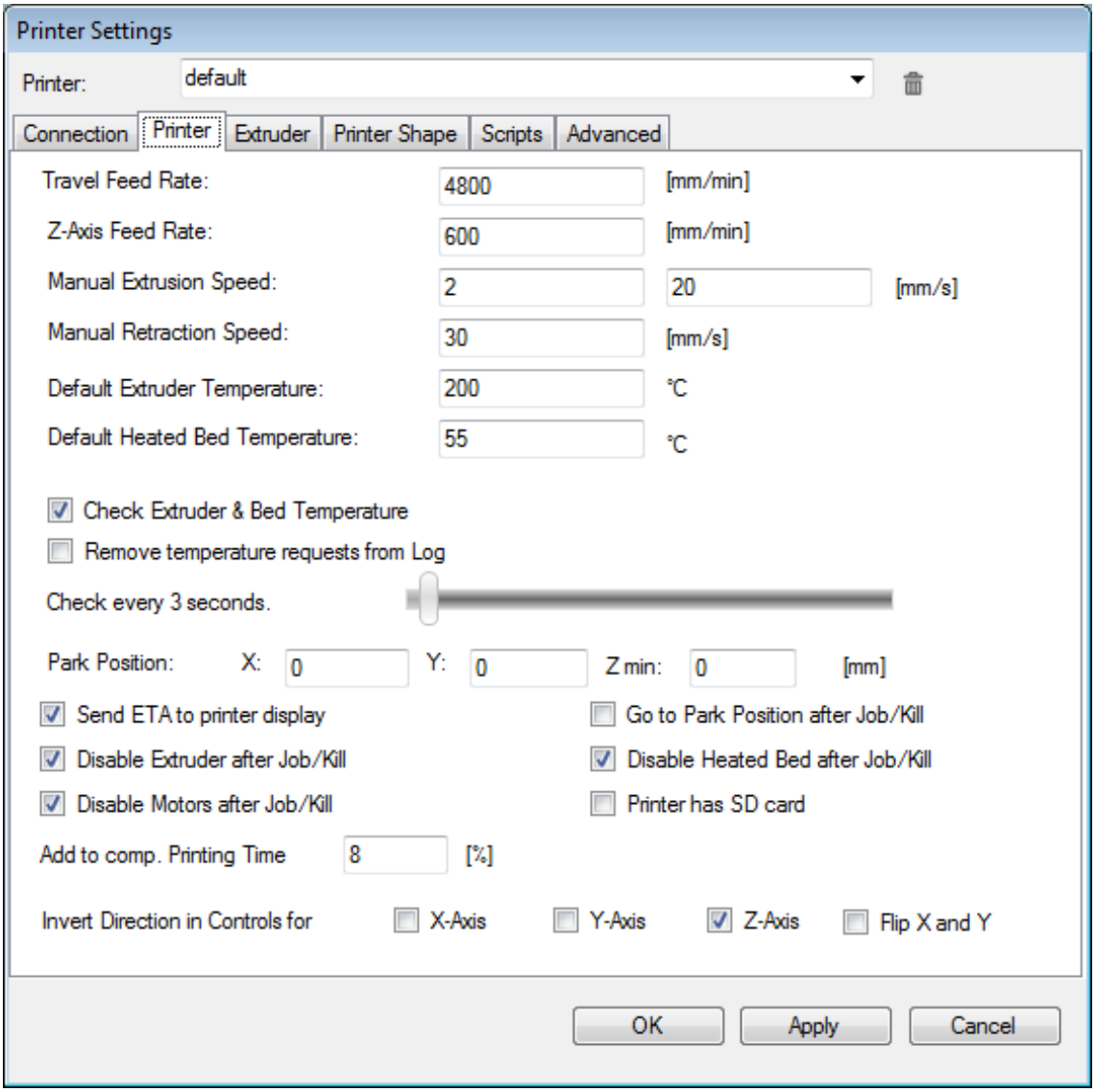

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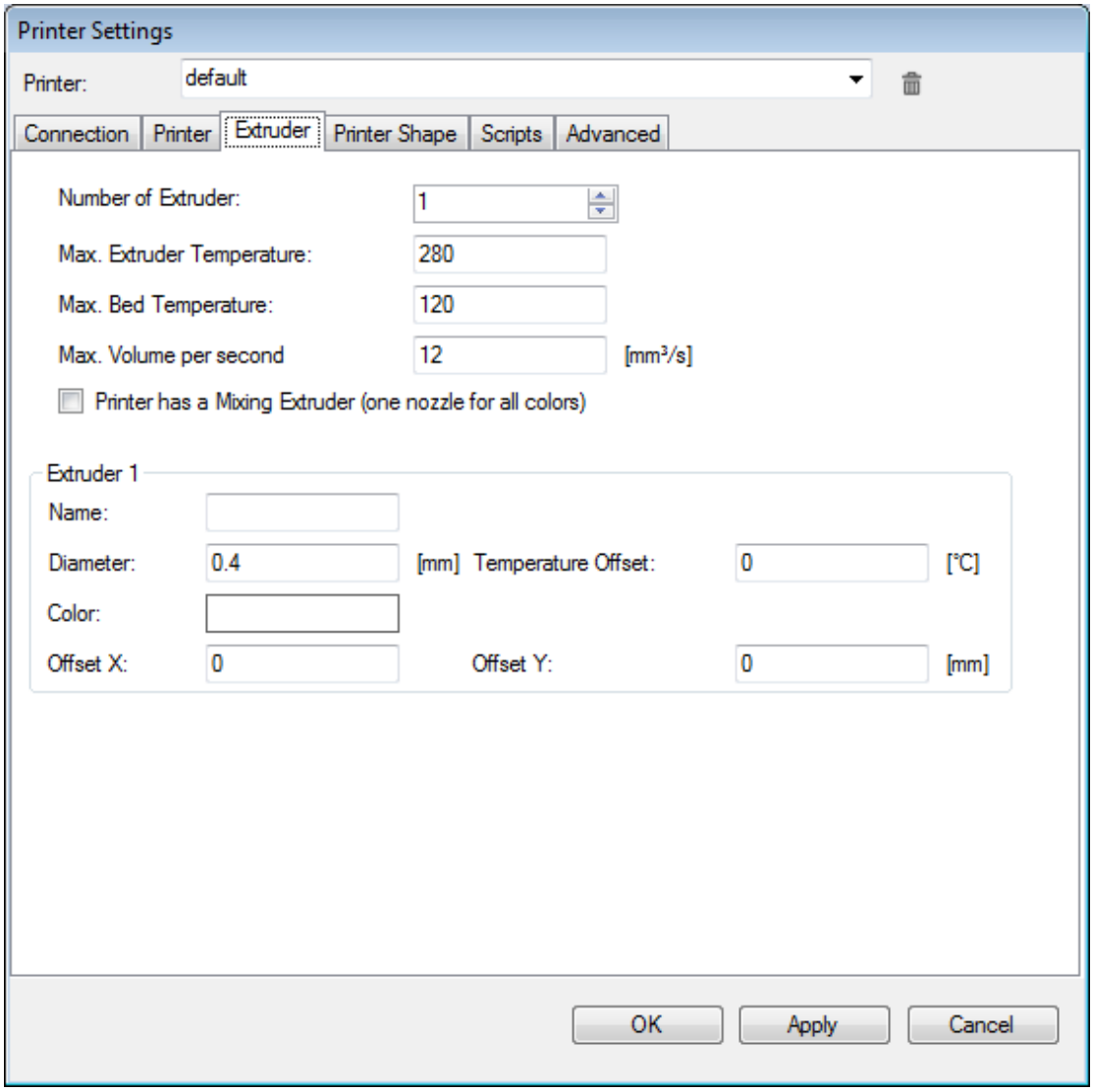

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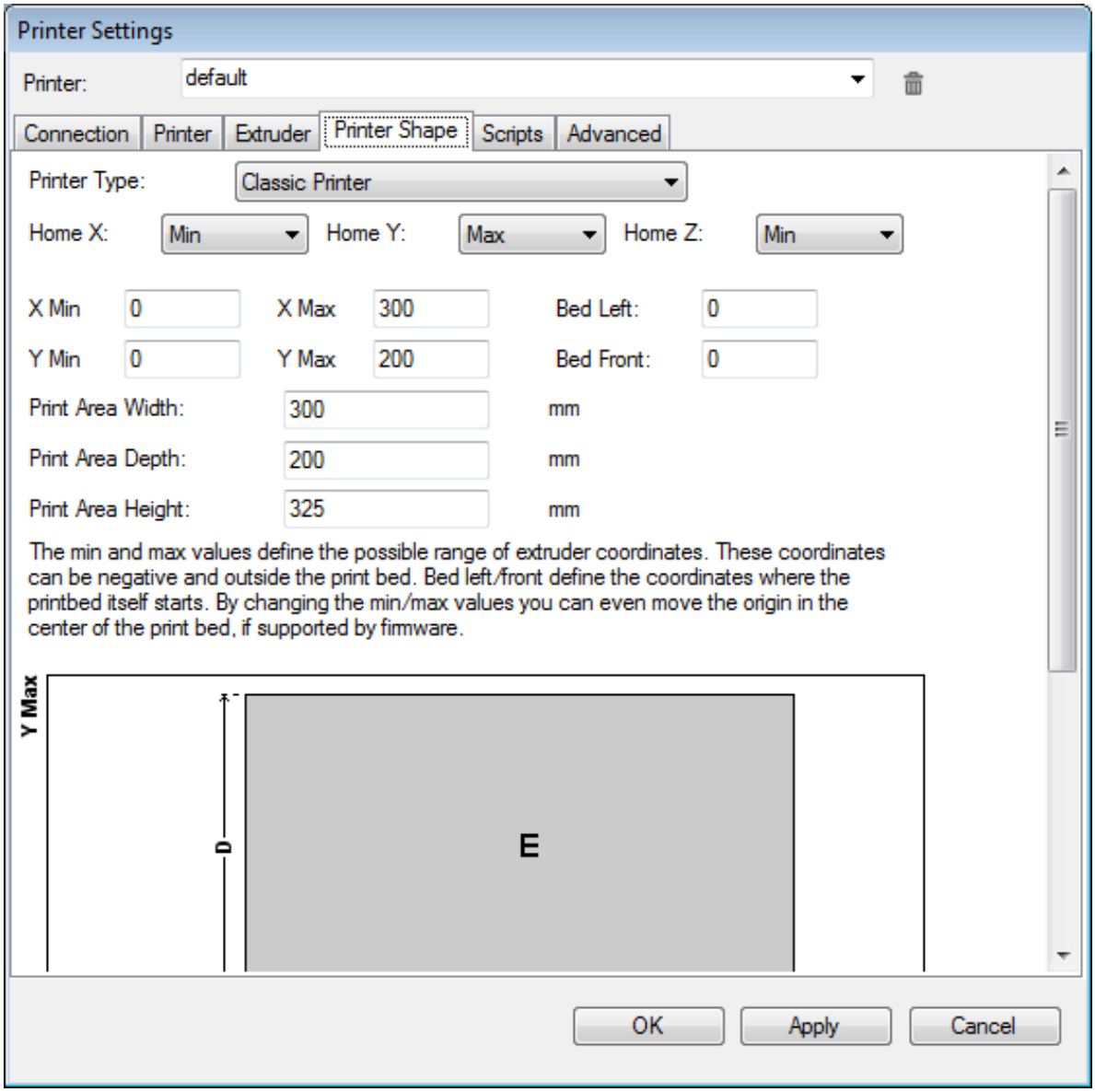
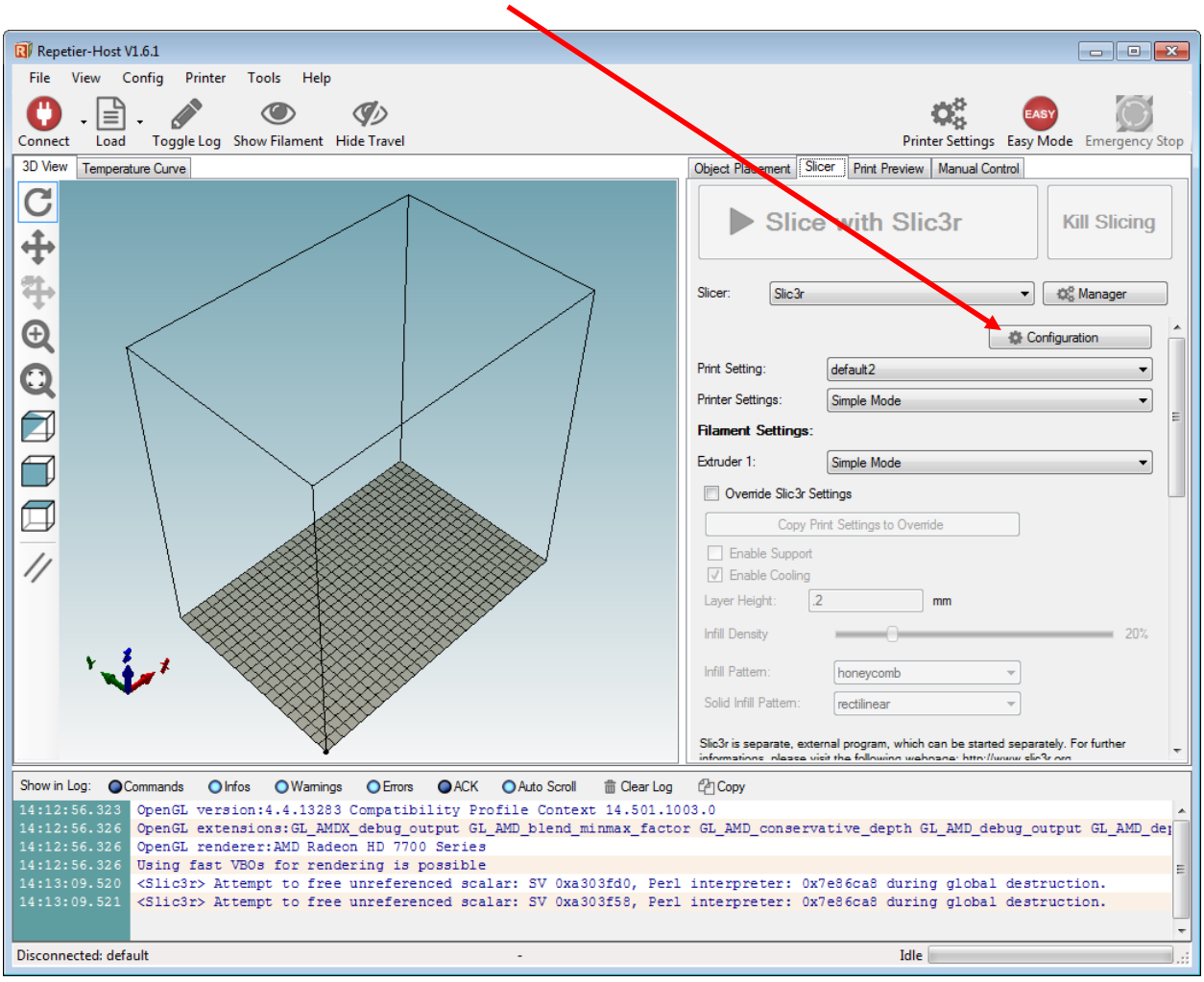
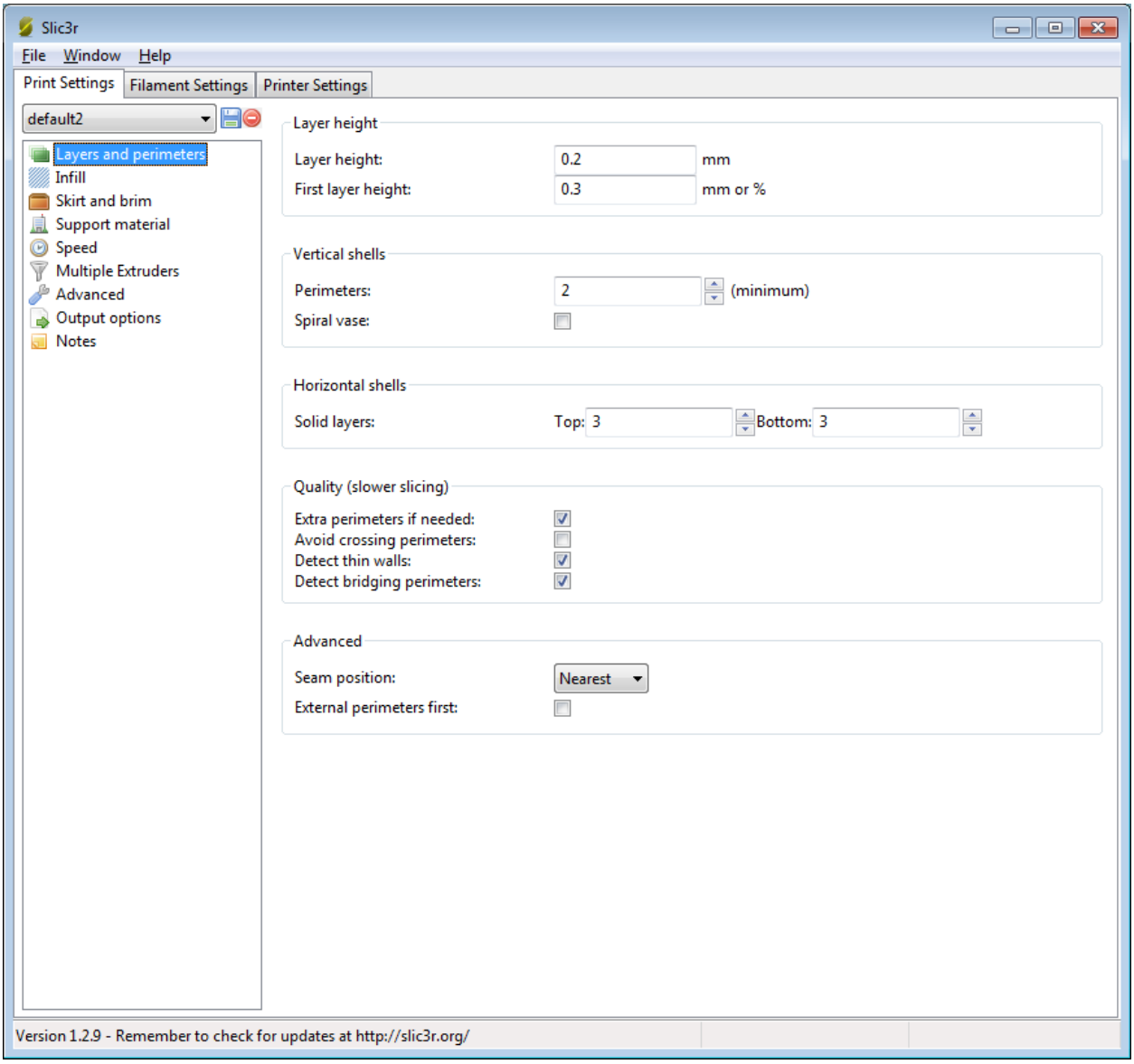


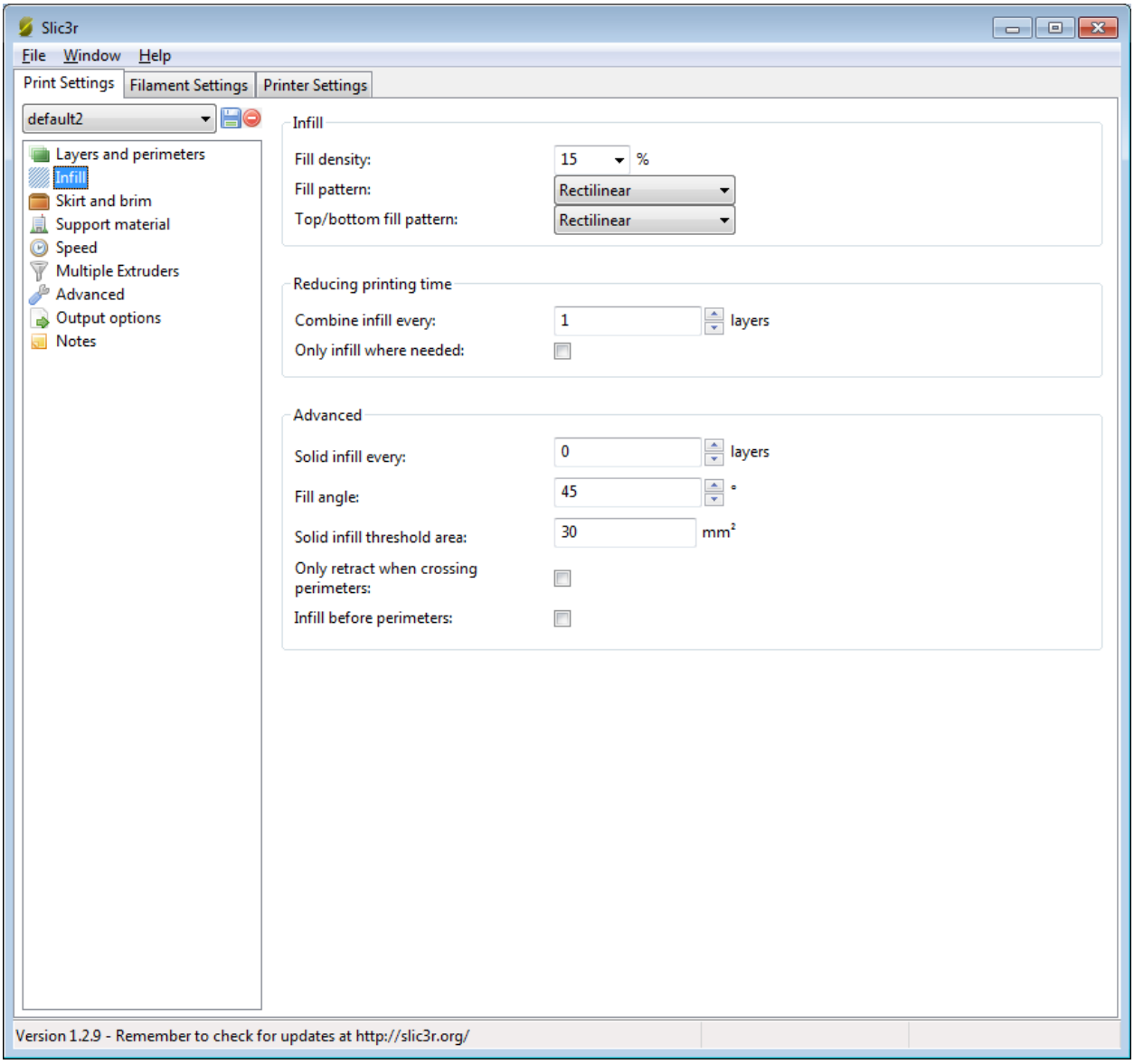
Configure Slic3r per the following 9 pages. These settings serve as a good starting point for D-Bot printing. Some settings are required for proper function (bed shape, retract) and some settings can be adjusted based on further testing or based on individual print requirements (infill, layer height, etc).



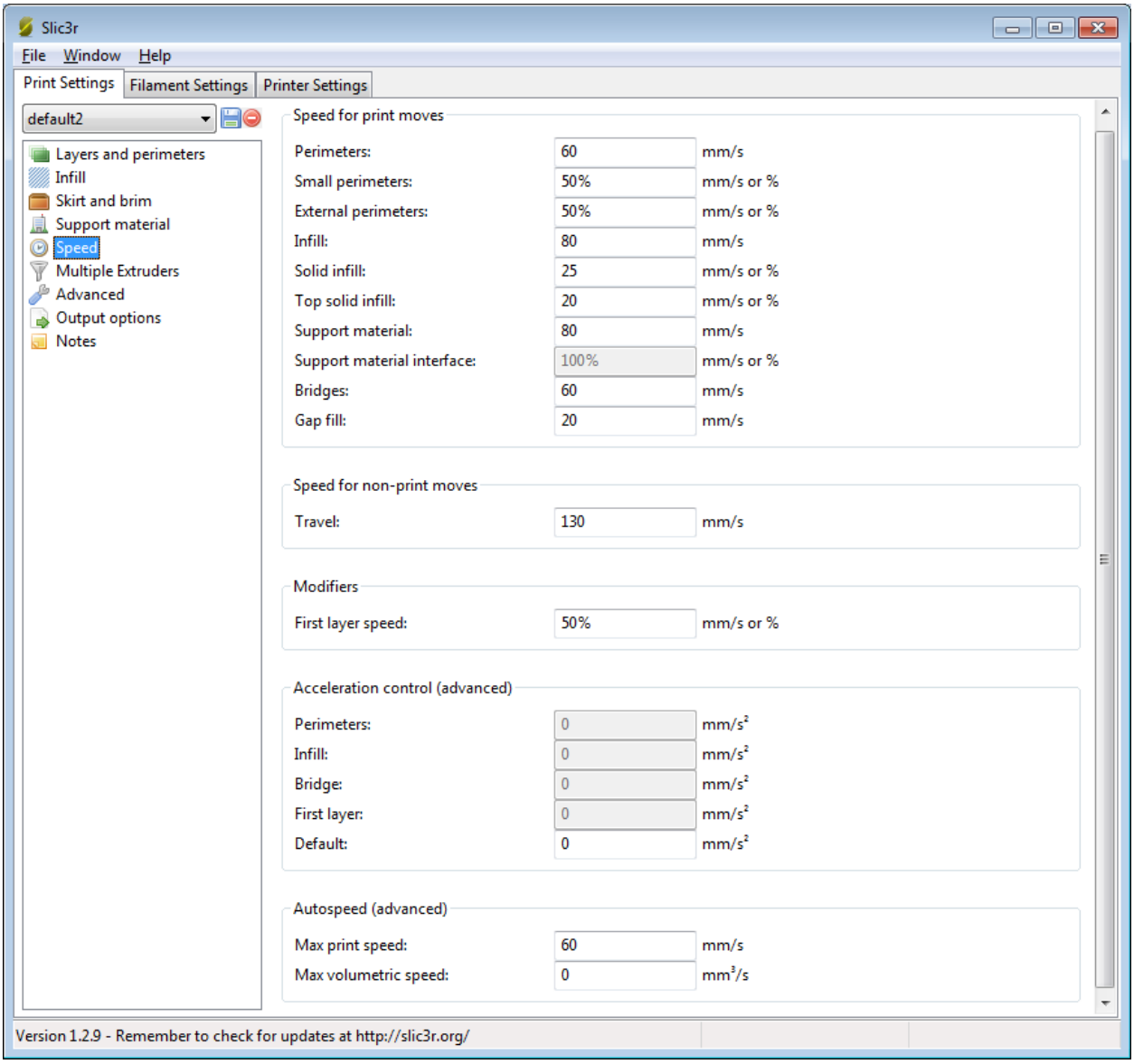
Slic3r Settings Page 1 of 9



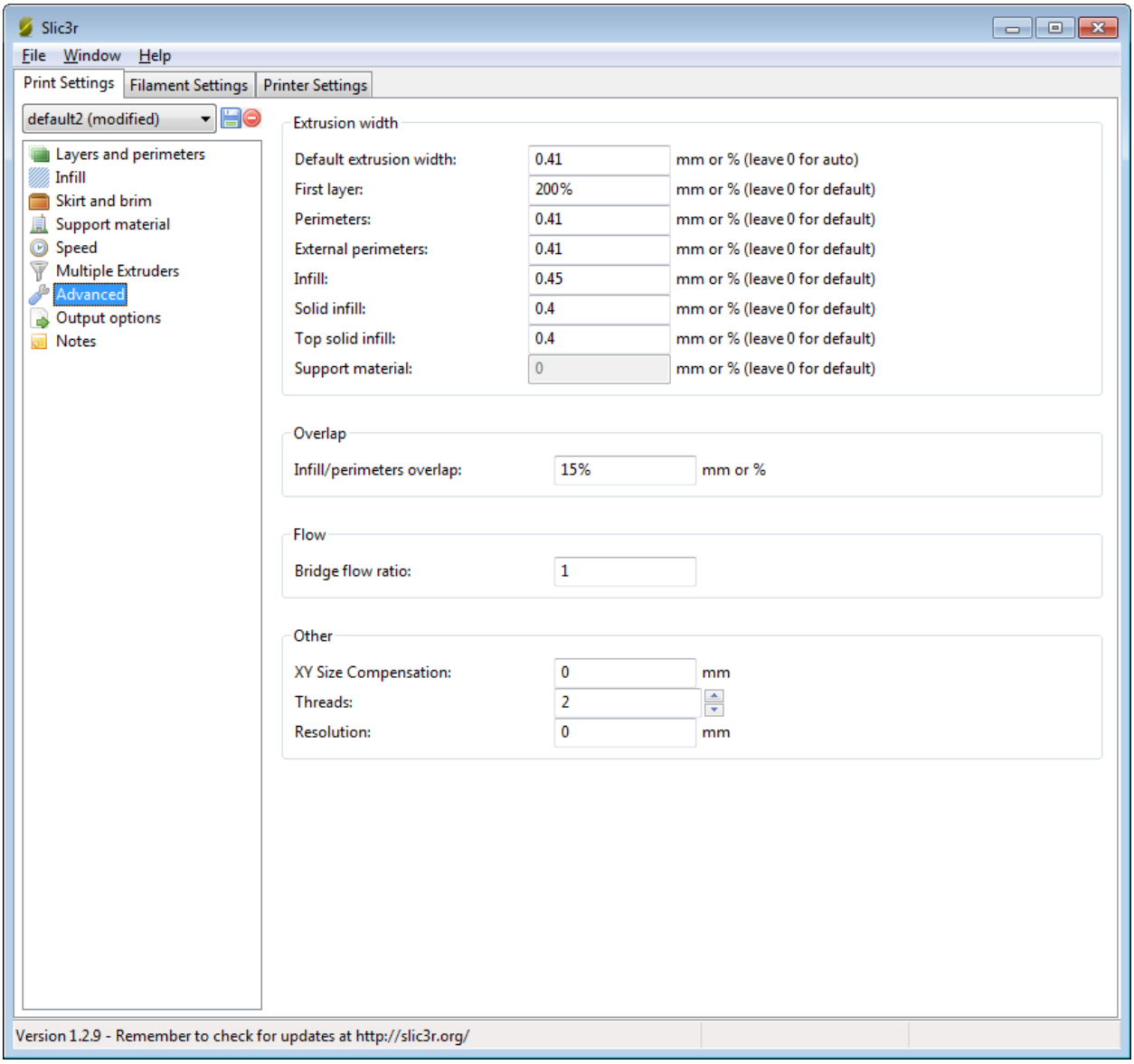
Slic3r Settings Page 2 of 9



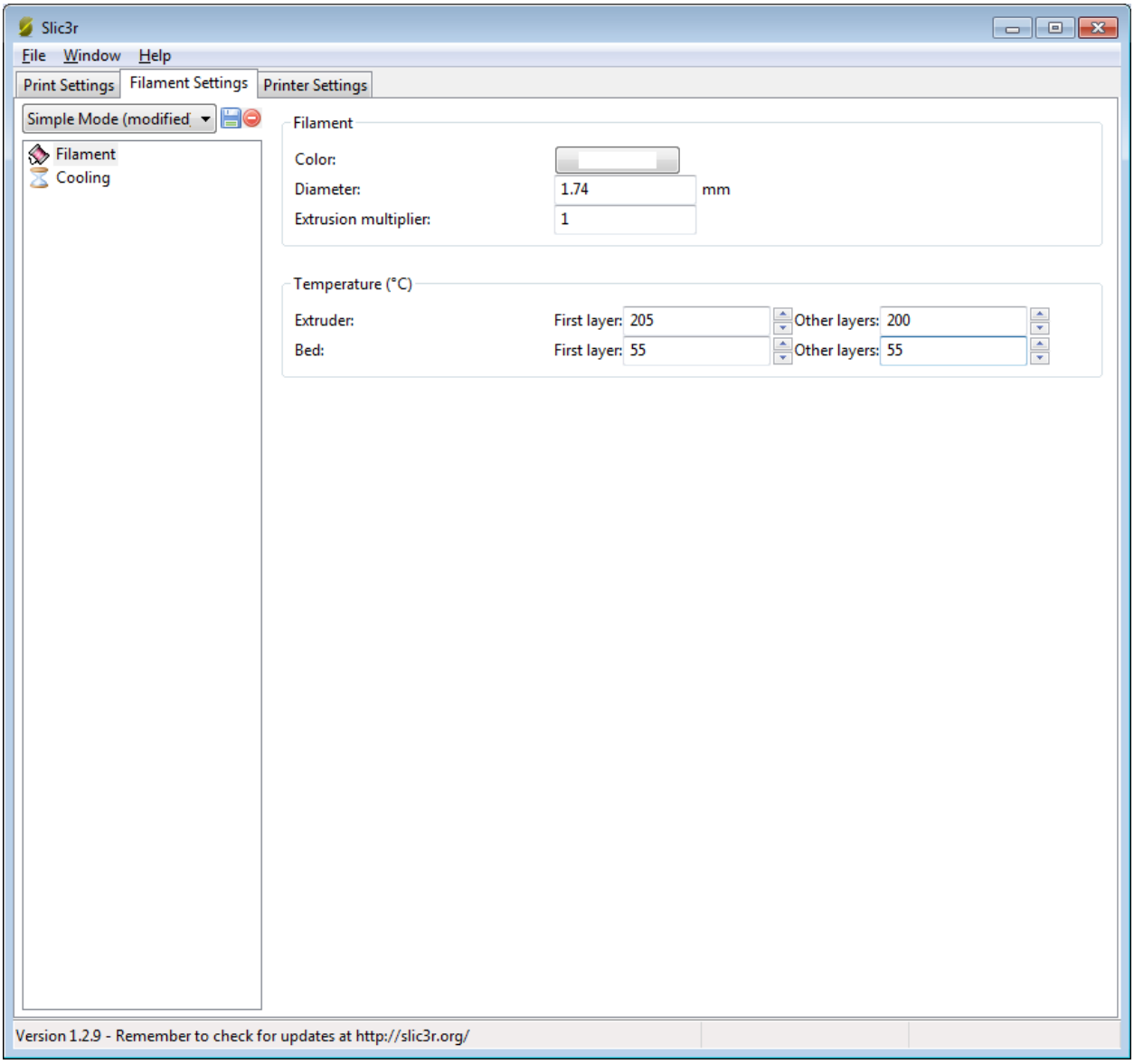
Slic3r Settings Page 3 of 9



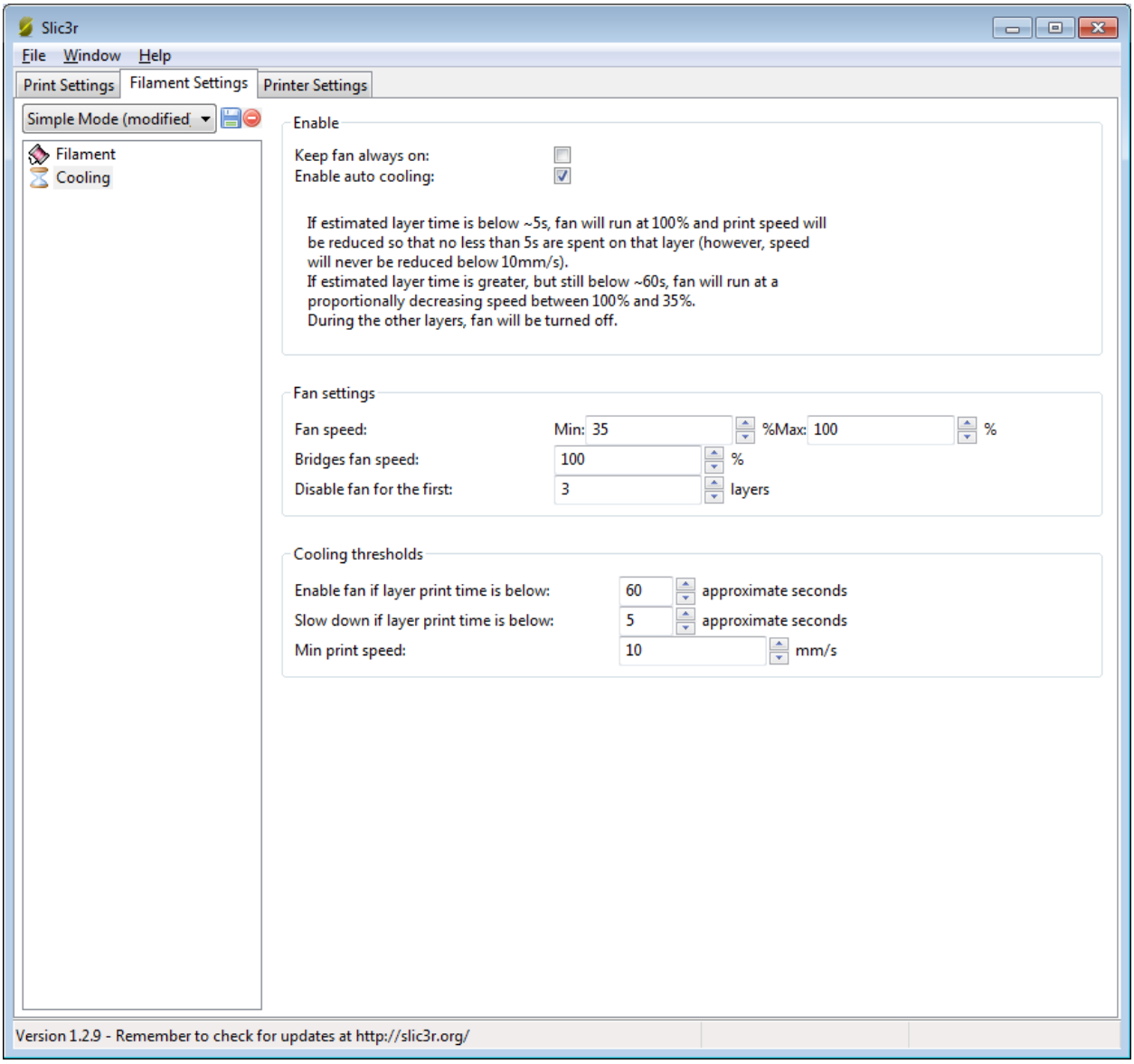
Slic3r Settings Page 4 of 9

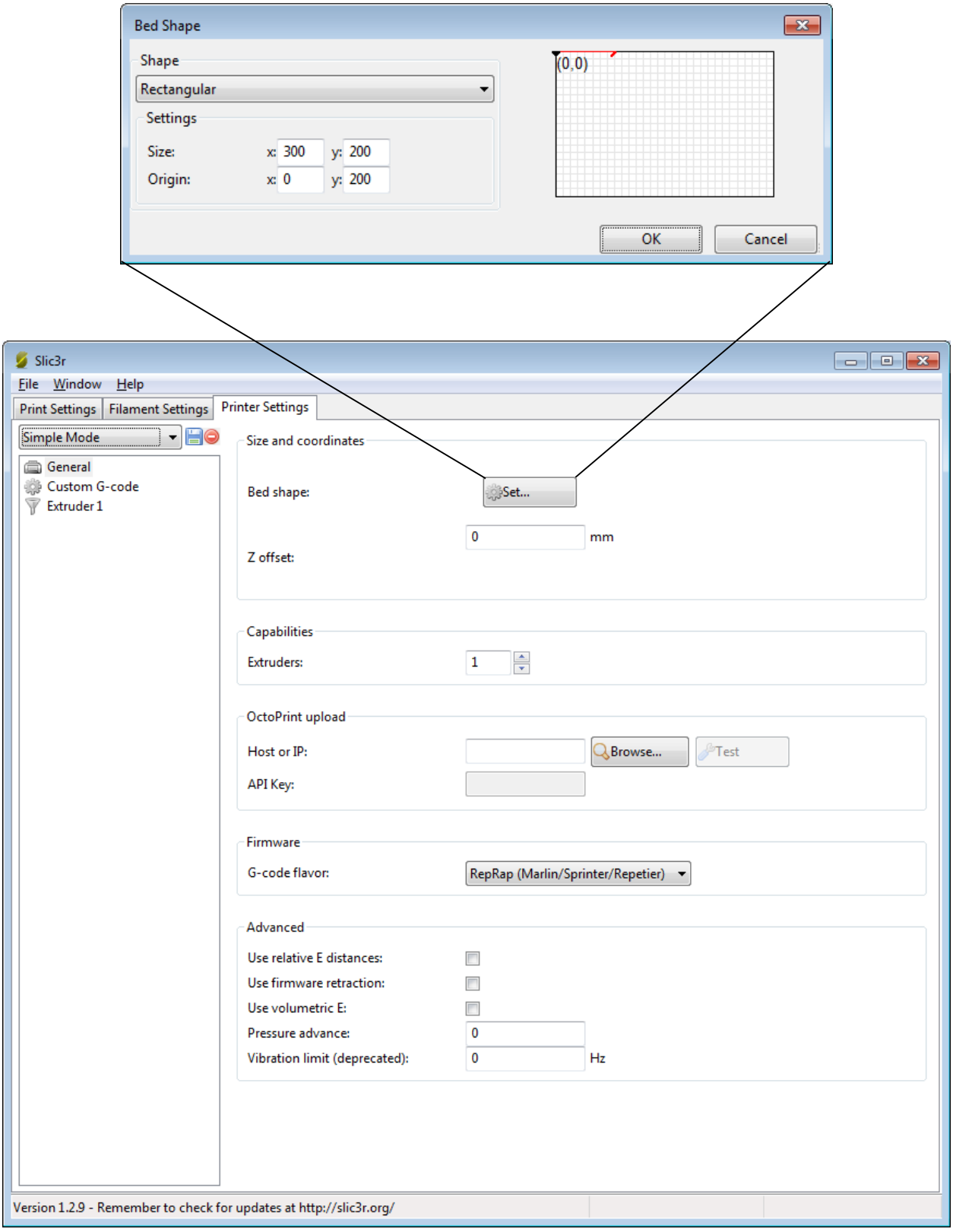


Slic3r Settings Page 5 of 9

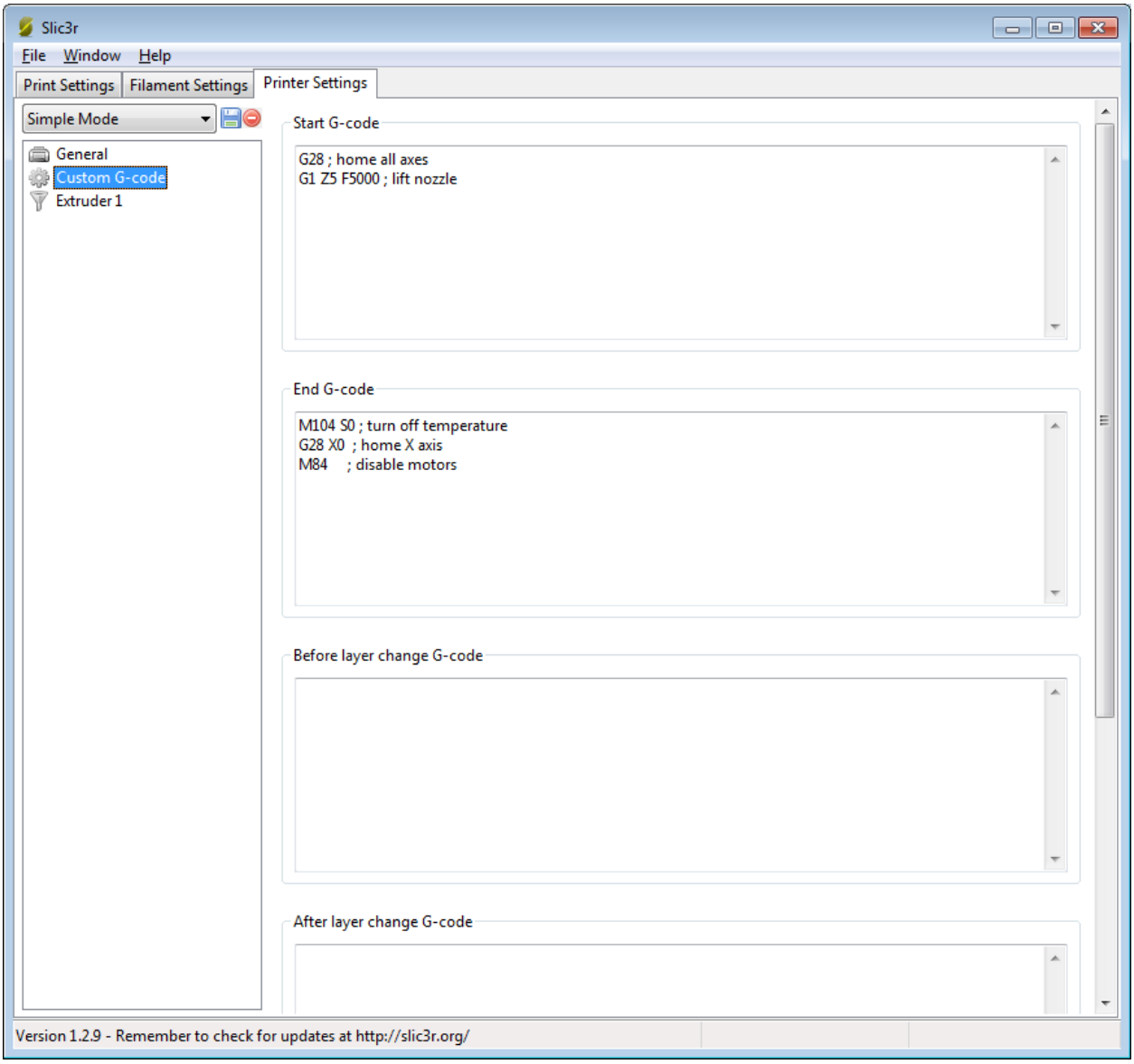


Slic3r Settings Page 6 of 9

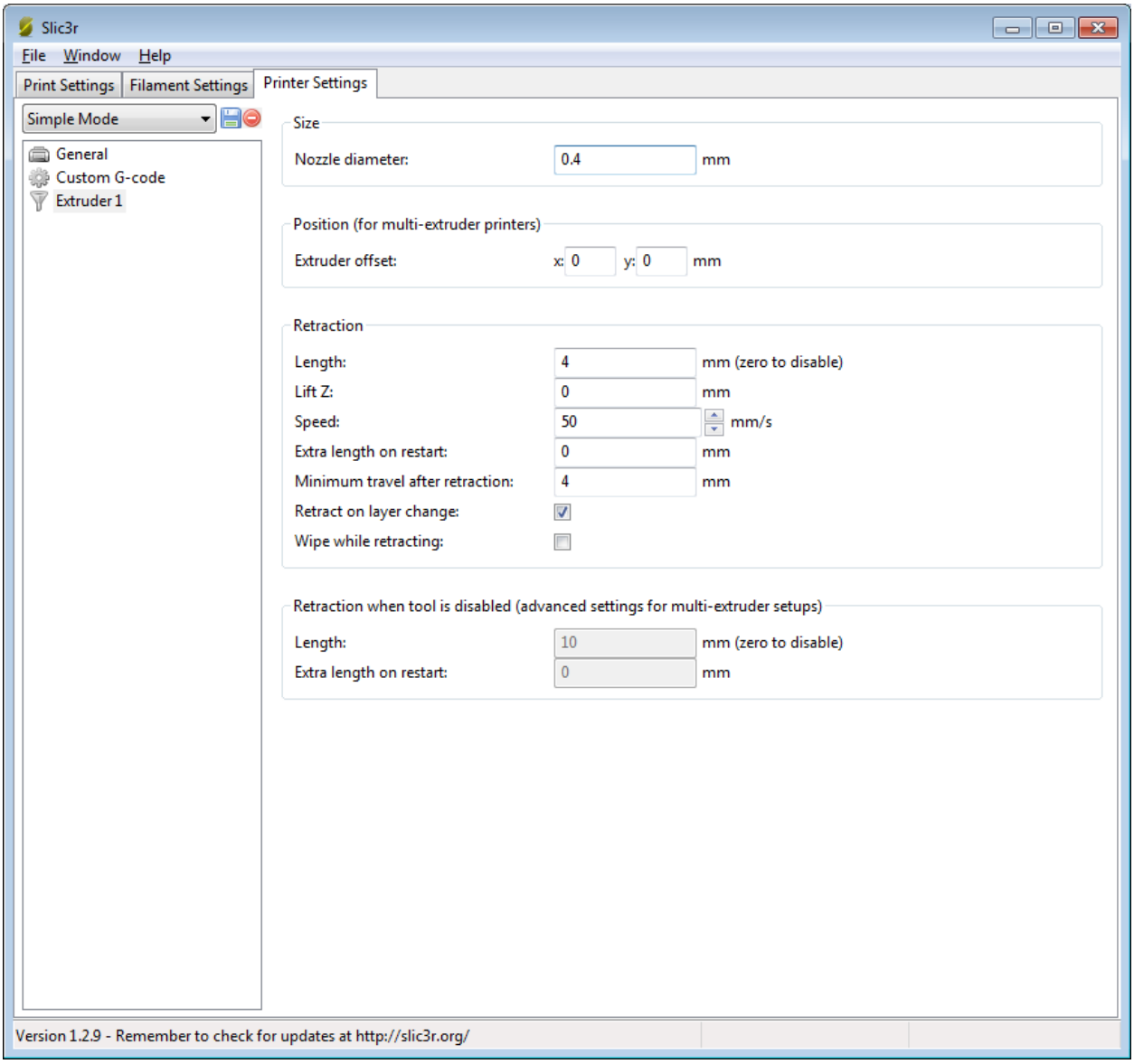



Bed Shape
Shape
Rectangular
Settings
Size: x: 300 y: 200
Origin: x: 0 y: 200
(0,0)
OK
Cancel
Slic3r
File Window Help
Print Settings
Filament Settings
Printer Settings
Simple Mode
General
Custom G-code
Extruder 1
Size and coordinates
Bed shape:
Set...
Z offset:
0
mm
Capabilities
Extruders:
1
OctoPrint upload
Host or IP:
Browse...
Test
API Key:
Firmware
G-code flavor:
RepRap (Marlin/Sprinter/Repetier)
Advanced
Use relative E distances:
Use firmware retraction:
Use volumetric E:
Pressure advance:
0
Vibration limit (deprecated):
0
Hz
Version 1.2.9 - Remember to check for updates at http://slic3r.org/

Slic3r Settings Page 8 of 9



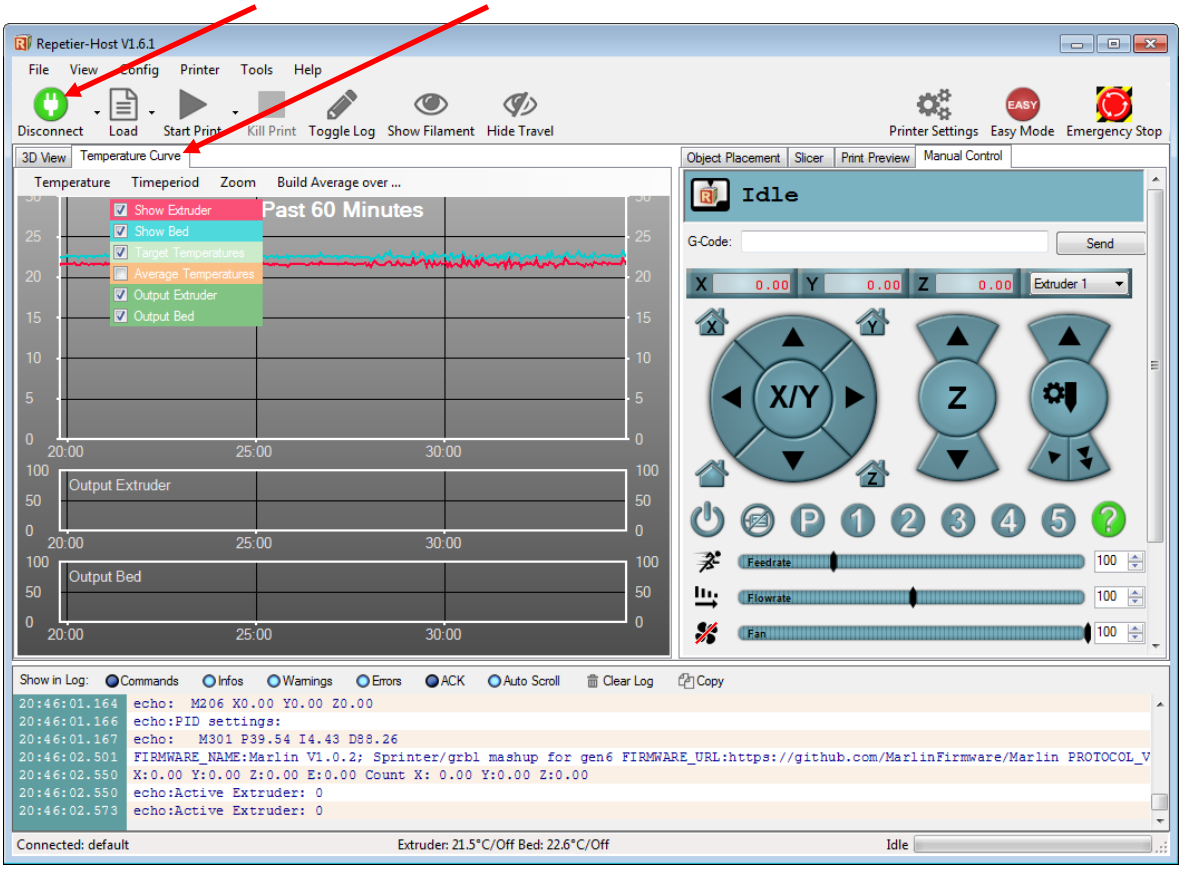
Slic3r Settings Page 9 of 9



14. Initial Testing

- Turn on the 12v power supply and verify when powered up that the hot end heatsink fan runs and that it does not shut off as long as main power is turned on. If the hot end heatsink fan shuts off at any point then something may be wired incorrectly.

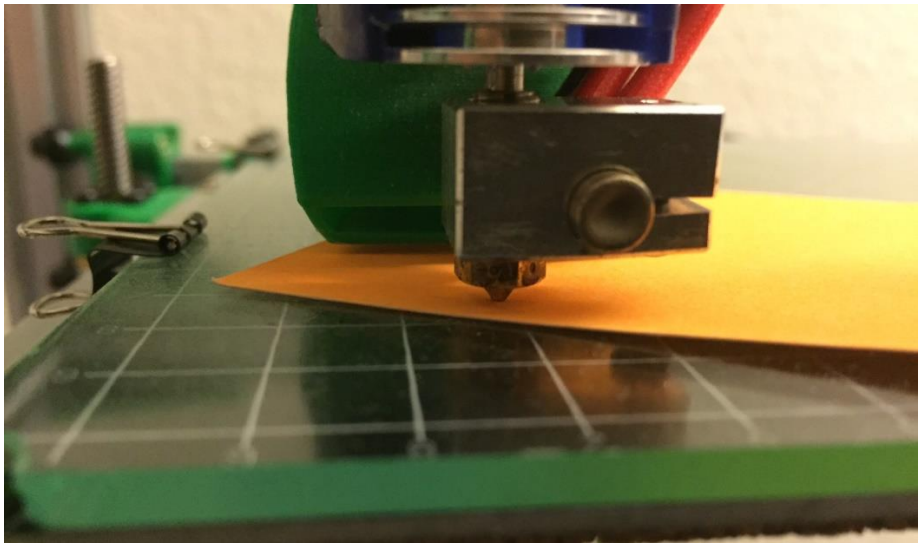
- Click the Connect/Disconnect button to enable communication with the printer. On the Temperature Curve tab of Repetier Host, verify that the Extruder and Bed temperature plots are steady at ambient temperature (between 20C to 25C). If they do not correspond to ambient temperature, thermistor settings may not be correct in *configuration.h* or thermistors may be wired incorrectly. If the bed or extruder temperature is ramping up without being enabled via Rep Host, something may be wired incorrectly or the Ramps board may be faulty.



- Review the Repetier Host manual control guide to become familiar with the interface and icons http://www.repetier.com/documentation/repetier-host/rhmanual-control/

- Raise the Z endstop bolt (M5 40mm) as high as possible to guarantee that the nozzle will not impact into the bed during initial test movements.

- Initial Z endstop calibration and bed leveling:
  1. Home the Z axis and make sure that the bed stops several millimeters away from the nozzle. Keep your mouse over the Emergency Stop button in Repetier Host and stop the movement if needed, you don't want the nozzle to crunch into the glass.
  2. Lower the Z endstop bolt by a couple millimeters and home Z. Repeat this process until the nozzle is close to the bed, almost touching. See video demonstration here
  3. Move the print carriage by hand near each corner of the bed and verify distance between nozzle and glass is approximately 0.2mm (thickness of an index card). You should feel slight resistance when an index card is inserted between the nozzle and glass. If you can't move the XY gantry by hand, click the motor disable button in Rep Host (just left of the P button).
  4. Adjust the M3 corner bolt nearest the nozzle to either raise or lower the bed to achieve the correct distance.
  5. Repeat for each of the corners, then at each of the four corners again to verify perfect leveling.
  6. You should not need to adjust the Z endstop bolt again, all bed leveling and adjustment will be done via the four M3 bed screws.



- Using Repetier Host controls, move all three axes and verify proper direction of movement. If the hot end moves in the wrong direction, wiring or firmware configuration may be incorrect.
  (Never disconnect or change control board wiring while the power is on, this includes power supplied via USB cable also.)

- Verify operation of all three endstops, if the hot end or bed moves away from the end stop instead of towards it, a parameter may be wrong in the Rep Host settings or the

Marlin configuration files. The X endstop position can be fine-tuned by adjusting the M3 25mm bolt that points at the X endstop. The nozzle should line up with the left edge of the bed grid when homed.

- If the print carriage is pushed all the way to the back and the Y endstop is activated, the printer will not home to X when commanded. This is an issue with Marlin/ Repetier. Manually push the print carriage away from the Y endstop until the LED turns off before engaging the homing command.

- Calibrate Bowden extrusion steps per this example video. Extrusion length calculation is in the last half of the video, ignore stepper driver tuning directions, this has already been completed for the D-Bot. When inserting the Bowden tube into the hot end, make sure that the tubing inserts all the way in and is seated into the heatbreak.

- PID Temperature Feedback Tuning:

  Proportional Integral Derivative Tuning is an essential step to guarantee proper operation of the temperature feedback loops of both the hot end and the heated bed. Do not skip this step and do not assume that the values preloaded in the configuration file can be reused; each printer derives different PID values based on slight differences in wiring and hardware.

  PID tuning - Hot End:

  Begin the PID autotune routine for the hot end by typing `M303 E0 S200 C8` into the Rep Host G-code interface, then click Send. The nozzle will automatically heat up to 200C and cycle around that set point 8 times then it will cool down.

Once complete, Repetier Host will report three final Kp Ki and Kd values as shown below. Enter these values into the indicated section of the configuration file stored at *D-Bot_Marlin>Marlin>configuration.h.* Marlin lists these as Ultimaker settings but that is just a default name.

```
04:04:11.862  Kp: 66.43
04:04:11.863  Ki: 11.42
04:04:11.863  Kd: 96.60
04:04:11.868  PID Autotune finished! Put the last Kp, Ki and Kd constants from above into Configuration.h
```

```
PID_FUNCTIONAL_RANGE then the PID will be shut off and the
heater will be set to min/max.
  #define PID_INTEGRAL_DRIVE_MAX PID_MAX  //limit for the
integral term
  #define K1 0.95 //smoothing factor within the PID
  #define PID_dT ((OVERSAMPLENR * 10.0)/(F_CPU / 64.0 / 256.0))
//sampling period of the temperature routine

// If you are using a pre-configured hotend then you can use one
of the value sets by uncommenting it
// Ultimaker
    #define  DEFAULT_Kp 39.54
    #define  DEFAULT_Ki 4.43
    #define  DEFAULT_Kd 88.26

// MakerGear
//    #define  DEFAULT_Kp 7.0
//    #define  DEFAULT_Ki 0.1
//    #define  DEFAULT_Kd 12

// Mendel Parts V9 on 12V
//    #define  DEFAULT_Kp 63.0
//    #define  DEFAULT_Ki 2.25
//    #define  DEFAULT_Kd 440
#endif // PIDTEMP

// Bed Temperature Control
// Select PID or bang-bang with PIDTEMPBED. If bang-bang,
BED_LIMIT_SWITCHING will enable hysteresis
//
// Uncomment this to enable PID on the bed. It uses the same
```

PID tuning – Heated Bed:

Similar to the hot end PID tuning, begin the PID autotune routine for the heated bed by typing `M303 E-1 C8 s60` into the Rep Host G-code interface, then click Send. The heated bed will automatically heat up to 60C and cycle around that set point 8 times then it will cool down. This will take several minutes longer for the bed compared to the hot end. Once complete, Repetier Host will report three final Kp Ki and Kd values as shown below. Enter these values into the PIDTEMPBED section of the configuration file stored at *D-Bot_Marlin>Marlin>configuration.h.* Note: this is not the same section used above, these parameters begin with `DEFAULT_bed`.

```
04:04:11.862  Kp: 66.43
04:04:11.863  Ki: 11.42
04:04:11.863  Kd: 96.60
04:04:11.868  PID Autotune finished! Put the last Kp, Ki and Kd constants from above into Configuration.h
```

```
#ifdef PIDTEMPBED
//120v 250W silicone heater into 4mm borosilicate (MendelMax 1.5
+)
//from FOPDT model - kp=.39 Tp=405 Tdead=66, Tc set to 79.2,
aggressive factor of .15 (vs .1, 1, 10)
    #define   DEFAULT_bedKp 398.58
    #define   DEFAULT_bedKi 73.71
    #define   DEFAULT_bedKd 538.78

//120v 250W silicone heater into 4mm borosilicate (MendelMax 1.5
+)
//from pidautotune
//    #define   DEFAULT_bedKp 97.1
//    #define   DEFAULT_bedKi 1.41
//    #define   DEFAULT_bedKd 1675.16
```

- Once the six parameters for the hot end and bed Kp Ki Kd settings are entered into *configuration.h,* save the file and close. Reupload *D-Bot_Marlin>Marlin>Marlin.ino* by using the same process as the initial firmware upload. Rep Host needs to be disconnected (connect/disconnect button under the File menu) or closed completely in order for Arduino to connect to the Mega 2560/Ramps.

- Using Repetier host, manually enable the hot end and enter various target temperatures sequentially from 50C to 250C and watch the temperature curve tab. The temperature response should show sharp transitions with minimal overshoot at each temperature plateau as shown in the following Figure. Repeat the same process for the heated bed using temperatures from approximately 40C to 90C.

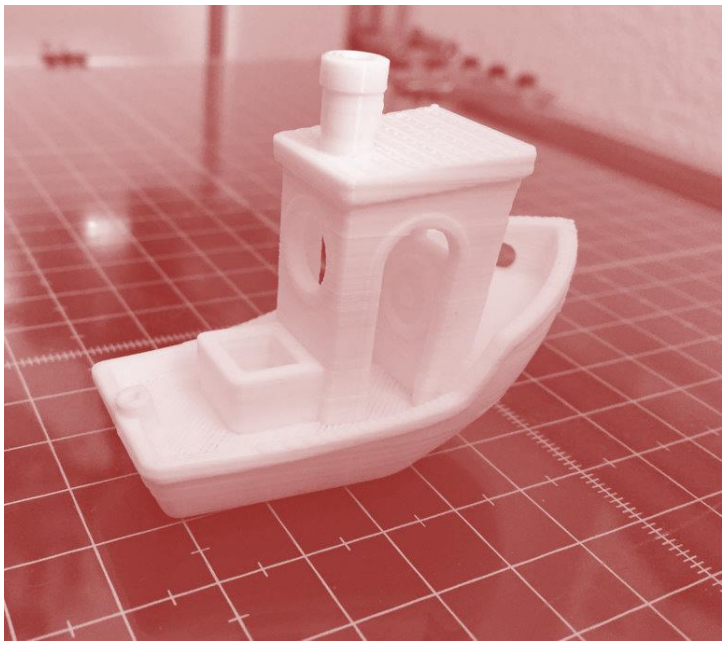


Figure n: Temperature transition test

15. Maintenance and Normal Operation

Work In Progress

16. Appendix

Work In Progress

Railing lengths required for a build based on a 300x300mm bed: