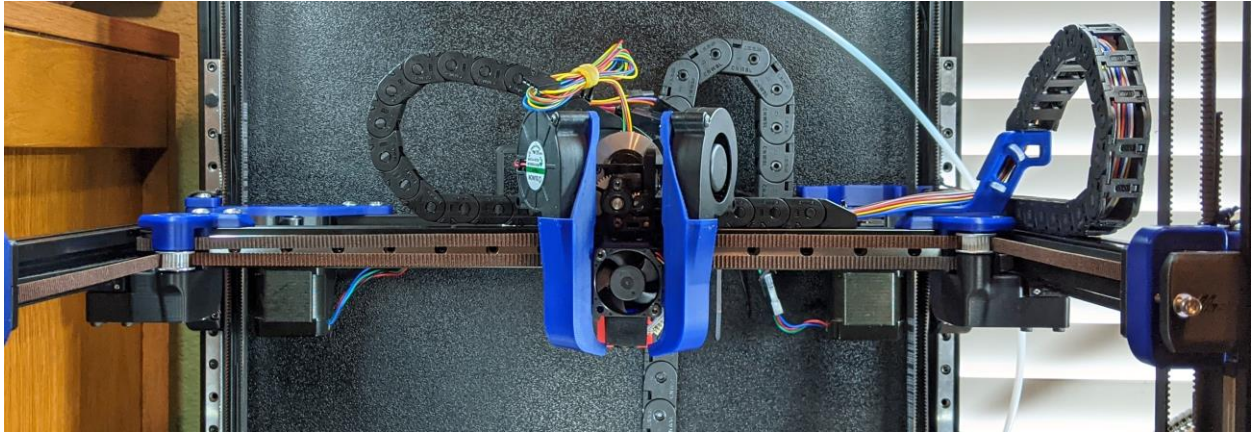
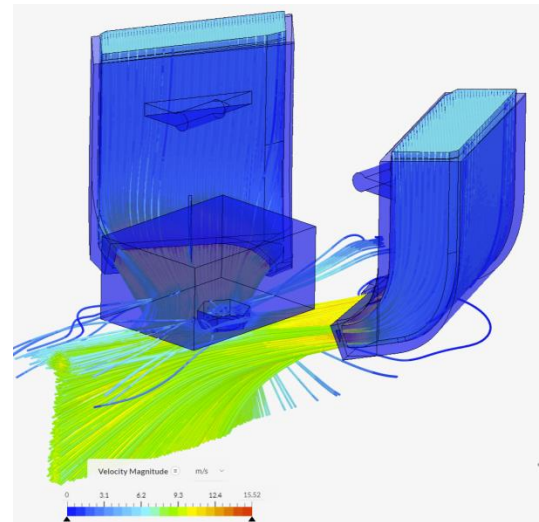


Mantis (Dual 5015 Toolhead) by Long



Features:

- Compatible with MGN12 X-Rail. Dragon Hotend only right now.
- Dual 5015
 - Left to Right airflow balance is no longer an issue
 - Single piece ducts without splitting and fewer bends = less duct losses
 - Total airflow is ~3x more than Longsfang using the same fans.
- Lighter
 - This entire tool head weighs ~290g including the carriage
 - Spec AB is ~470g. Spec AB with gailieo is ~375g.
- Stiffer
 - Single piece carriage and hotend mounts are stiffer than spec.
- Detachable Bed Probe (magprobe)
 - Decreases weight and allows shrinkage of the carriage.
 - Direct probing of the bed surface. Allows usage of any bed surface.
- More balanced
 - Hotend is moved closer the rail +y, and upwards +z
 - Gain in Y and Z travel (~5mm each)
- Decreased length from extruder to hotend
 - Bowden from mini-sherpa to Dragon is only 19mm
- X-endstop relocated to carriage. Easy to transition to umbilical if desired.
 - Y-endstop can still be from the spec endstop pod on the right xy-joint.
- Area around heat block is very open. Ducts give wide berth to block. Duct shouldn't have any issues with melting.
 - Josh Murrah has been printing ABS at 300c without duct melt.



Cons:

- There are now alternative idlers that allow use of Mantis without any loss of build area
 - Thanks to Phalanx - <https://github.com/selliott79/Other-V2-Idlers>
 - With spec front idlers, you will lose space at the front corners of the bed ~10mm in X at each idler.
- Some parts like the ducts and hotend mount are a bit tricky to print.
- Thumb screw for the mini-sherpa will not fit. Use a buttonhead to save space.
 - I bought 6mm diameter x 0.9mm coil diameter x 10mm length springs for extra clearance.
 - (Replaces stock 6mm x 1mm x 12mm spring)
 - Depending on how much you tighten your screw, the 12mm one will work.

BOM, References, Acknowledgements:

- **Fasteners**

- m2 x 10 (or m2 x 12) self tapping screws
 - This is a standard Voron part used to attach the Omron microswitches
- m3x6x4 heatsets
- m3x20 SHCS x2 (upper screws to attach hotend mount to carriage)
- Assorted BHCS (all other screws can be button head to save weight)

- **Other**

- m6x3 magnets x11
- larger diameter magnet stack (used if soldering directly to the m6x3 magnets) so that magnetic field loss is minimized during soldering)
- D2F-5 Omron microswitch for magprobe. D2F-5L works too if you just rip the lever off.

- **Fans**

- 5015 fans x2
 - I recommend Sunon (12v) or Delta (24v) however any 5015s should be fine.
 - Sunon: <https://www.digikey.com/short/zrwpw9>
 - Delta>Sunon>GDSTime>Winsinn
- 3010 Hotend Fan
 - I'm using Sunon 3010v1 (12v) currently <https://www.digikey.com/short/t5dpqw4w>
 - Looks like JoshMurrah has been running this fan at 40% without issue so quieter fans will definitely work.
 - I think the Sunon 3010v2 (12v) will probably work but haven't tested yet
<https://www.mouser.com/ProductDetail/Sunon/MF30101V2-1000U-A99?q=EU6FO9ffTwfZ4Kz3LWY0zg%3D%3D>

- **Mini-Sherpa**

- See the Annex guide for its instructions and BOM.
- https://github.com/Annex-Engineering/Sherpa_Mini-Extruder
- <https://www.youtube.com/watch?v=3WogD5IUwAM>

- **Mag Probe**

- My version is highly inspired by the Annex Mag Probe. ***Credit to ANNEX for their awesome work here.*** The mag probe and being able to remove the bulk of the Omron probe is a major factor in what made this tool head possible. Please see their mag probe repository for the original.
- https://github.com/Annex-Engineering/Quickdraw_Probe

- **Ark's MGN12H Mod**

- There may be several mgn12 mods floating around. This is one of them:
- https://github.com/VoronDesign/VoronUsers/tree/master/printer_mods/arkeet/mgn12

- **JoshMurrah**

- Just wanted to note him here as he has been extremely helpful in some insane stress testing. His speed benchies have been fun as hell to watch and a motivation for me to keep improving. His testing has resulted in a lot of improvements to this toolhead.

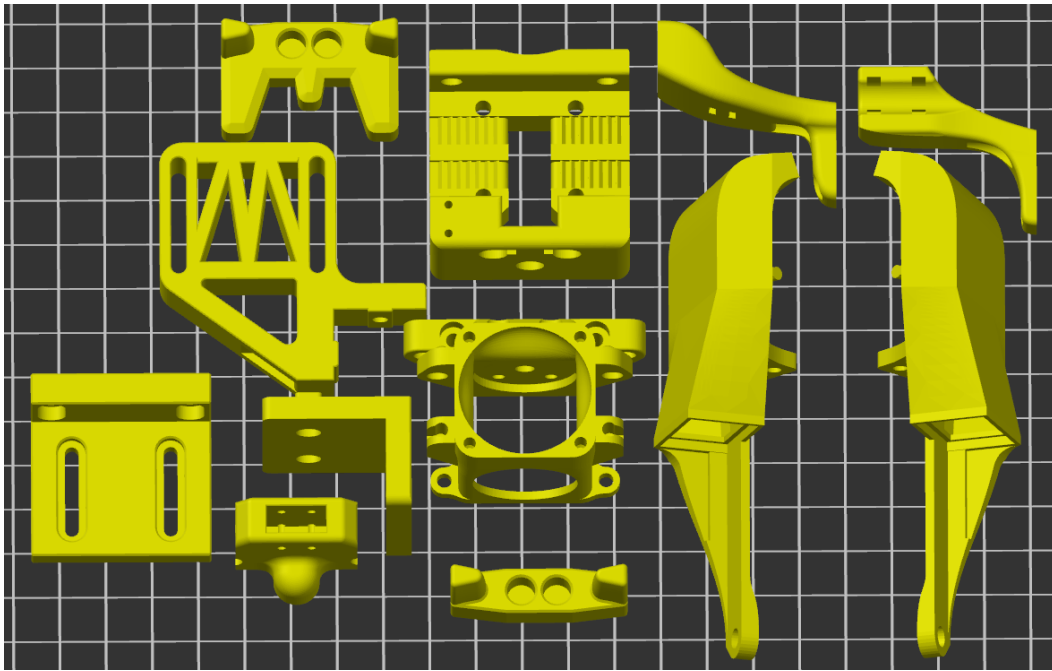
- **JosAr**

- Thank you to JosAr for his work on creating a gantry mounted magprobe dock.

- **Phalanx**

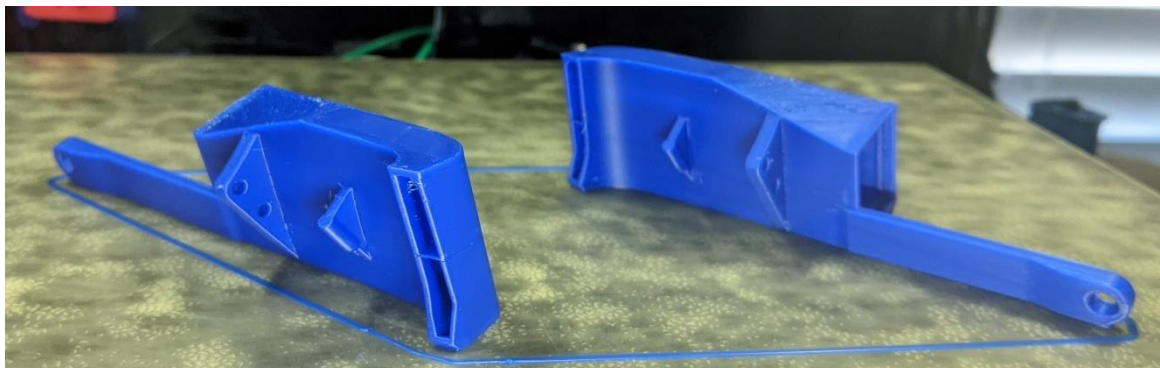
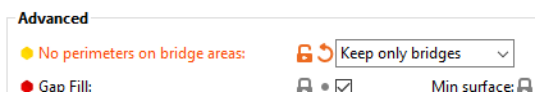
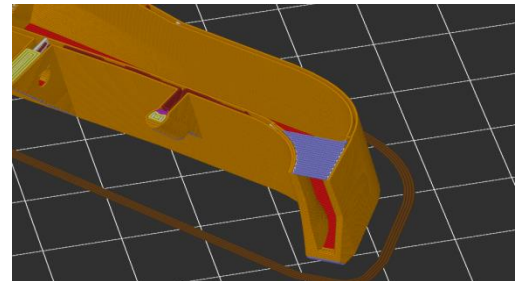
- For his "Other V2 Idlers" - <https://github.com/selliott79/Other-V2-Idlers>

Print Orientation:



Slicer Tips:

- **Perimeters/Shells**
 - 3-4 Perimeters and low infill is adequate.
 - Josh Murrah is using 3perim/40% on his toolhead used in speedruns.
 - I've been using 4 perimeters/15%
- **Ducts**
 - Check that this outlet divider is sliced in a sane way.
 - In superslicer, I find the "keep only bridges" option under "Perimeters & Shell" works well for the ducts
 - The ducts have some tough overhangs, so orient the part so the overhangs print the best for you. Prioritize good quality for the outlet. The 5015 mount surface will generally be rough, but that's ok.



Carriage Assembly:

Magnets:

- **Solder Method**

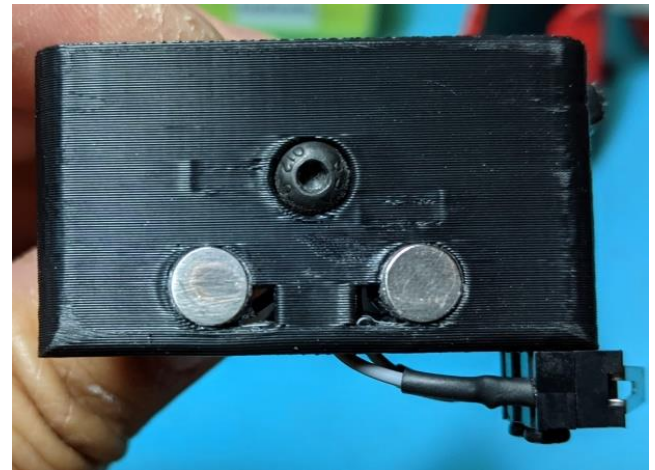
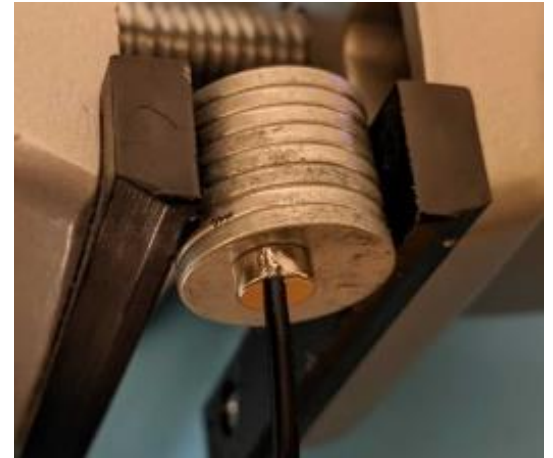
- Sand the side of 2 m6x3 magnets. Place a magnet on a bigger stack of magnets then solder a piece of wire to the side as shown.
- If you don't have the magnet on the bigger stack, your magnet will lose some of its magnetic field. It'll probably be ok because the unsoldered magnet sits on top and to the outside, but I haven't tried.
- **Put some superglue into the magnet holes.**
- Place the second magnet on top of the soldered magnet, and then press the two magnets into the hole so the unsoldered magnet is out. The magnets should be "proud" of the carriage.

- **Wire Pinch**

- Josh Murrah was able to attach his magnets by fanning out the wire then compressing the wire between the carriage and magnet and gluing in place. This method appears to be working fine for him.
- The carriage uses 2 stacks of 2 magnets and a m3x6 button head

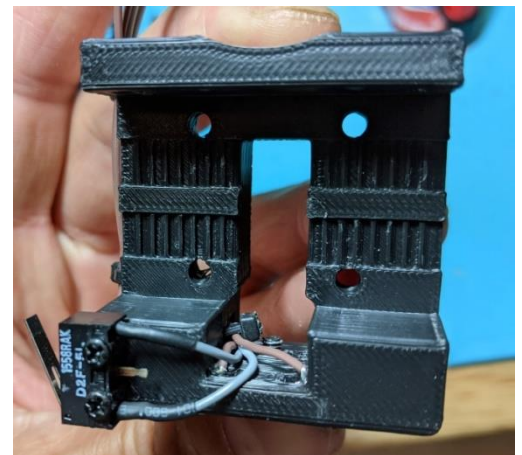
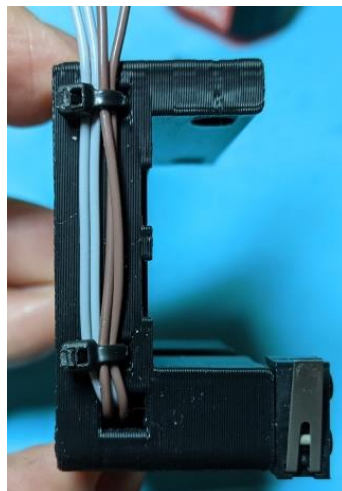
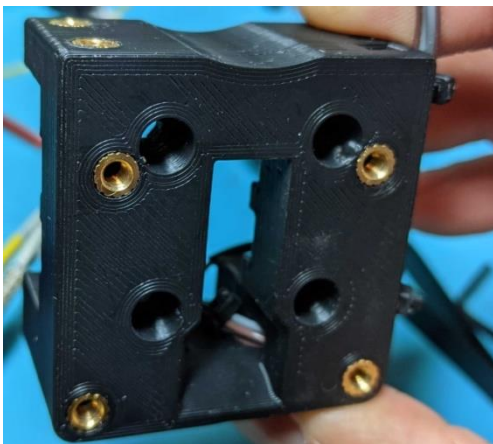
- **Misc Notes**

- Adjust the tilt of your magprobe by screwing in and out the button head screw on the bottom of the carriage
- Do not forget to put superglue into the holes in the carriage prior to putting in the magnets.
- Hole on left side of carriage is for ADXL mounting. (new in carriage v1.032. Thanks @Koonweee)



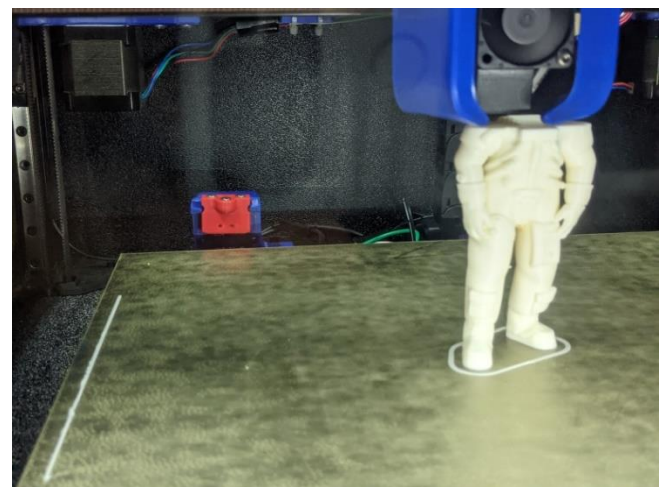
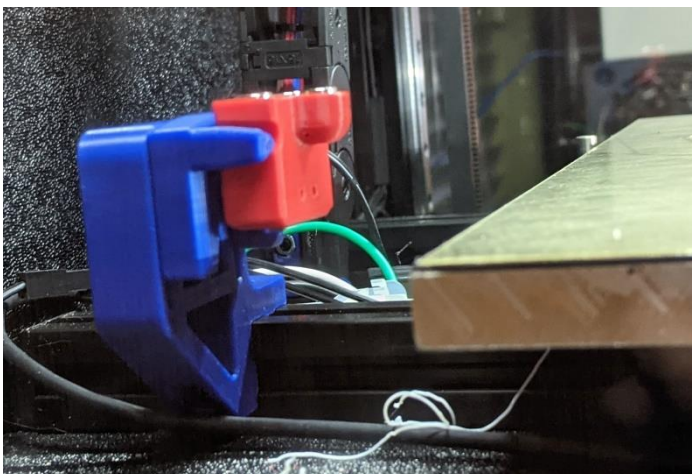
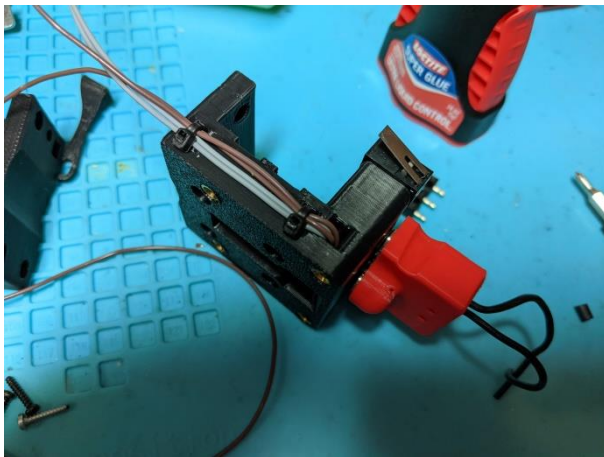
Heatsets:

- As shown on front and top. There will be an extra hole on top/right. This extra hole is currently unused.



Mag Probe Assembly:

- Solder a short length of flexible wire to two m6x3 magnets then press the magnets into the holes.
- Alternatively, fan out the wire and press/glue in the magnets.
- When pressing in the magnets, I used a clamp and a flat surface to try to get the magnets flat.
- Screw in two of the m2x10 or m2x12 self-tapping screws (silver ones on the red pictured magprobe below) prior to soldering the microswitch in. Take care not to damage the wires.
- Solder the other ends of the wires to the **outer prongs (NC)** of the D2F-5 microswitch. Note the image with the black magprobe is an older version.
- Press in the D2F-5 microswitch now and screw in two more m2x10 or m2x12 to secure the microswitch. If there is any play in the microswitch, use some superglue to remove the play.
- Test fit the magprobe to the carriage and adjust the level of the probe using the m3 button head on the bottom of the carriage.
- Insert magnets into dock arms and secure to bed extrusion or gantry extrusion.
 - Most of my testing has been on the bed mounted dock, but the gantry mounted docks seem to be very popular and work well (prob even better than the bed mounted one).
- You don't have to remove your bat85 diode when wiring in the wires to the magnets on the carriage, just omit the 24v.
- Video of docking and undocking. Build your own macros or see annex engineering for their macros.
 - <https://youtu.be/hdD8uaDW-pA>



Magprobe Config:

- This can be a bit daunting...You can do it though!
- I highly recommend you print extra dock arms while you are figuring this out—especially if you are doing bed extrusion mounted.
- The general movements for docking and undocking are in Macros_and_Config.txt
 - Note this is for my bed mounted magprobe dock.
 - don't forget to home y before x in homing_override.

```
# Get Probe
[gcode_macro Get_Probe]
gcode:
  G0 X46.3 Y305 Z20 F12000      #Spot above where the carriage magnets line up with the magprobe magnets
  |                               # (with magprobe in the dock)
  G0 X46.3 Y305 Z2 F3600        #move -Z where all the magnets pairs first fully grab onto each other
  G0 X46.3 Y290 Z2 F1800        #Move -Y so the probe is fully clear of the the arms of the dock
  G0 X46.3 Y290 Z20 F3600       #move +Z so any move from here clears the buildplate.

# Dock Probe
[gcode_macro Dock_Probe]
gcode:
  G0 X46.3 Y290 z10 F12000      #Above +Z and forward -Y of where magprobe side cutouts line up with dock arms
  |                               # (allows build plate clearance for next downward move to line up magprobe to arms)
  G0 X46.3 Y290 Z2 F3600        #Location where the side cutouts of the magprobe line up with the front of dock arms
  G0 X46.3 Y305 Z2 F3600        #move the magprobe +Y into the dock, engaging the arms
  G0 X80 Y305 Z10 F1800         #move +X and +Z to disengage the magprobe from the carriage
  G0 X80 Y290 Z20 F3600         #Move +Z and -Y to a safe spot where further moves won't collide with dock
```

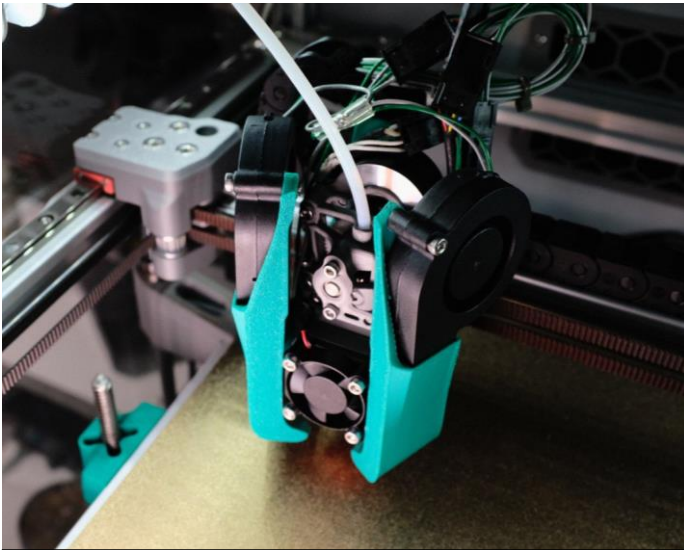
- **For smart macros**
 - See the annex repo for their magprobe at:
 - https://github.com/Annex-Engineering/Annex-Engineering_Other_Printer_Mods/tree/master/All_Printers/Microswitch_Probe
 - Or the Klicky probe repo at:
 - <https://github.com/jlas1/Klicky-Probe>

Notes for building on a Voron 1.8:

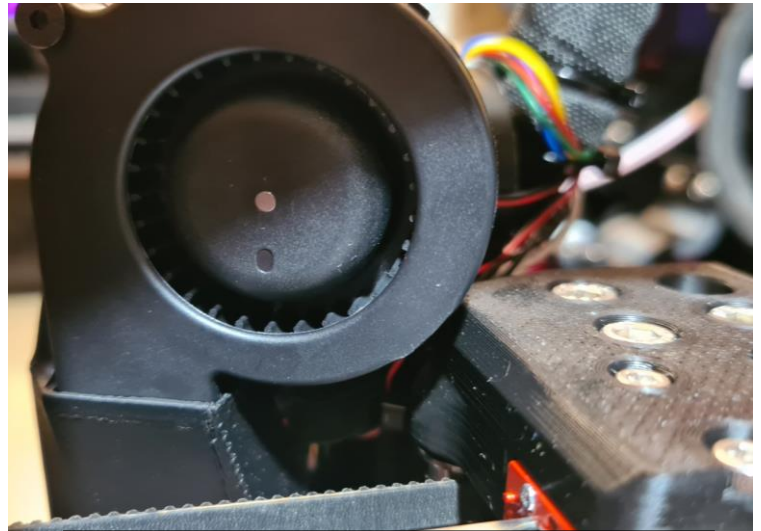
- You will need to cut the rearward “ears” off the 5015 fans for clearance.
- OscarGM was able to get the standard length ducts (found in the 2.4 folder) to clear.
- The ducts in the 1.8 folder have 2mm extra clearance, and should clear with most fans.

Acknowledgements:

- Just wanted to thank GarretWP, OscarGM, and Koonweee for being the brave souls who worked to get compatibility with 1.8. It wouldn't have happened without their feedback.



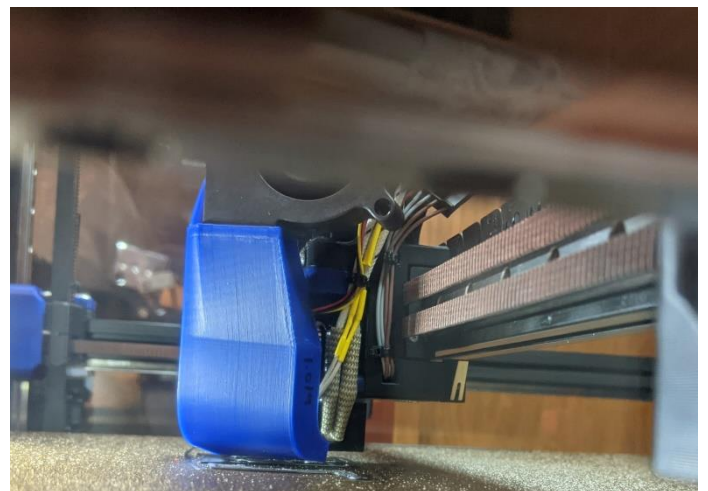
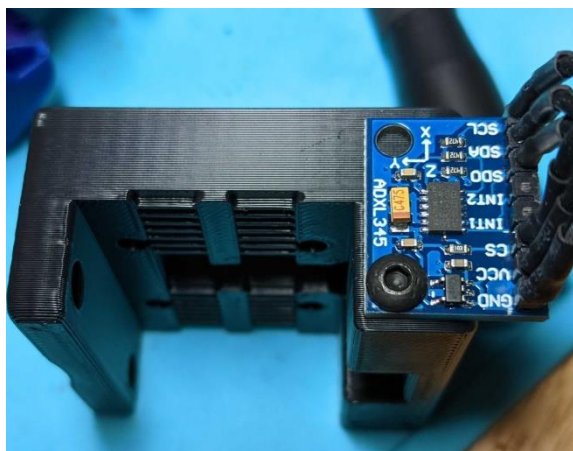
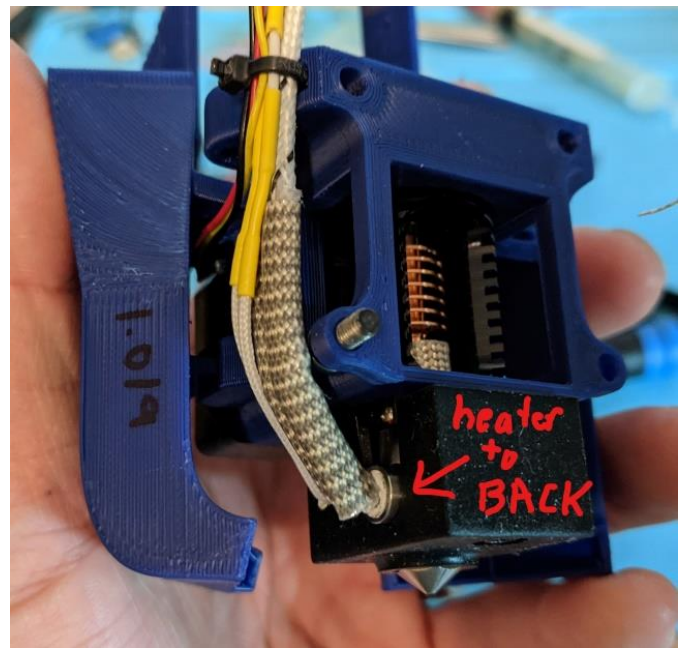
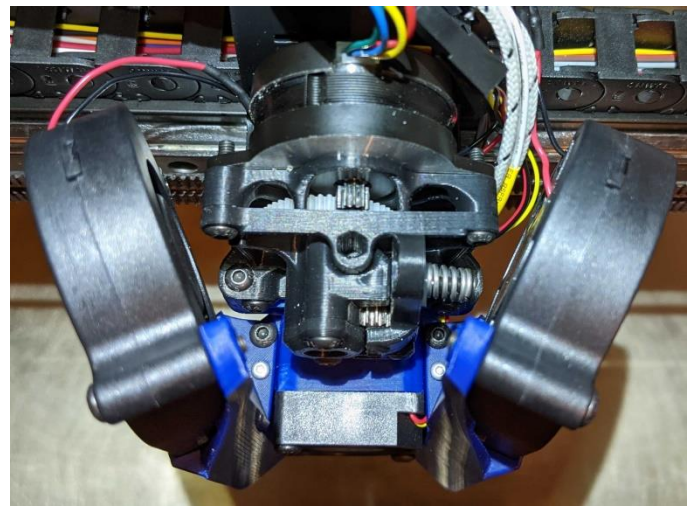
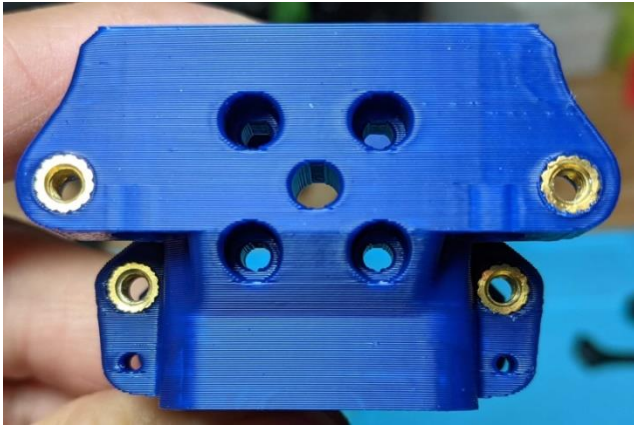
Koonweee's Voron 1.8 using 2mm extended ducts



OscarGM's Voron 1.8 with standard length ducts (found in the 2.4 folder)

Final Assembly:

- Use button heads for everything if possible.
- ****note the heater cartridge location****
- ADXL can be mounted two ways as shown.



Firmware Settings:

- With my Sunon I have been able to pwm down to 7% using these settings
kick_start_time: 0.5
off_below: 0.05
cycle_time: 0.008
- This is what I'm using for my probe settings in firmware. I'm using <https://github.com/ctso/klipper/commit/75beccd22a70b49b50ae20391b5c0054113eb7b7> to ignore the first probe (helps with the slight amount of backlash in Z-drives with a Voron 2.4).

```
[probe]
# Mag Probe
x_offset: -1.95      #This will be +1 or -1 depending on which way the nub on your magprobe microswitch is oriented.
y_offset: 32.95
z_offset: 2.4

speed: 5
samples: 3
sample_retract_dist: 1.5
samples_tolerance: 0.006
samples_tolerance_retries: 5
drop_first_result: true #only used if you're using the ignore first probe.
```

- Homing override to home y before x.

```
[homing_override]
axes: z
set_position_z: 0
gcode:
  G90
  G0 Z5 F600          # move up a little for clearance
  G28 Y
  G28 X













  G0 X200 Y305 F3600  # home on z pin at this location (update your own)
  G28 Z

  G0 Z10 F1800        # move up a little for clearance
  G0 X150 Y150 Z30 F3600 # Go to middle of bed
```





Slicer settings:

- This is currently what I've been using for ABS as far as cooling with my Sunon 5015s. Not sure where I'll end up here, but it's a starting point.
- Don't be afraid to pump the fan up with ABS, especially for overhangs and short layer times. The higher fan percent will increase your chamber temps and offset the higher fan usage. I often see 55c+ chamber temps in my uninsulated Voron 300. If I'm printing a single ABS part with short layer times I'll often use 50%+ fan for the whole part. I haven't had issues with layer splitting when I do this.

Fan speed - default

 Run the fan at default speed when possible:		<input checked="" type="checkbox"/>
 Default fan speed:		<input type="text" value="12"/> %
 Bridges fan speed:		<input type="text" value="35"/> %
 Top fan speed:		<input type="text" value="-1"/> %
 External perimeter fan speed:		<input type="text" value="-1"/> %
 Disable fan for the first:		<input type="text" value="1"/> layers

Short layer time - began to increase base fan speed

 Enable fan if layer print time is below:		<input type="text" value="45"/> approximate seconds
 Max fan speed:		<input type="text" value="75"/> %

Very short layer time - began to decrease extrusion rate

 Layer time goal:		<input type="text" value="5"/> approximate seconds
 Max speed reduction:		<input type="text" value="90"/> %
 Min print speed:		<input type="text" value="15"/> mm/s

Behavior

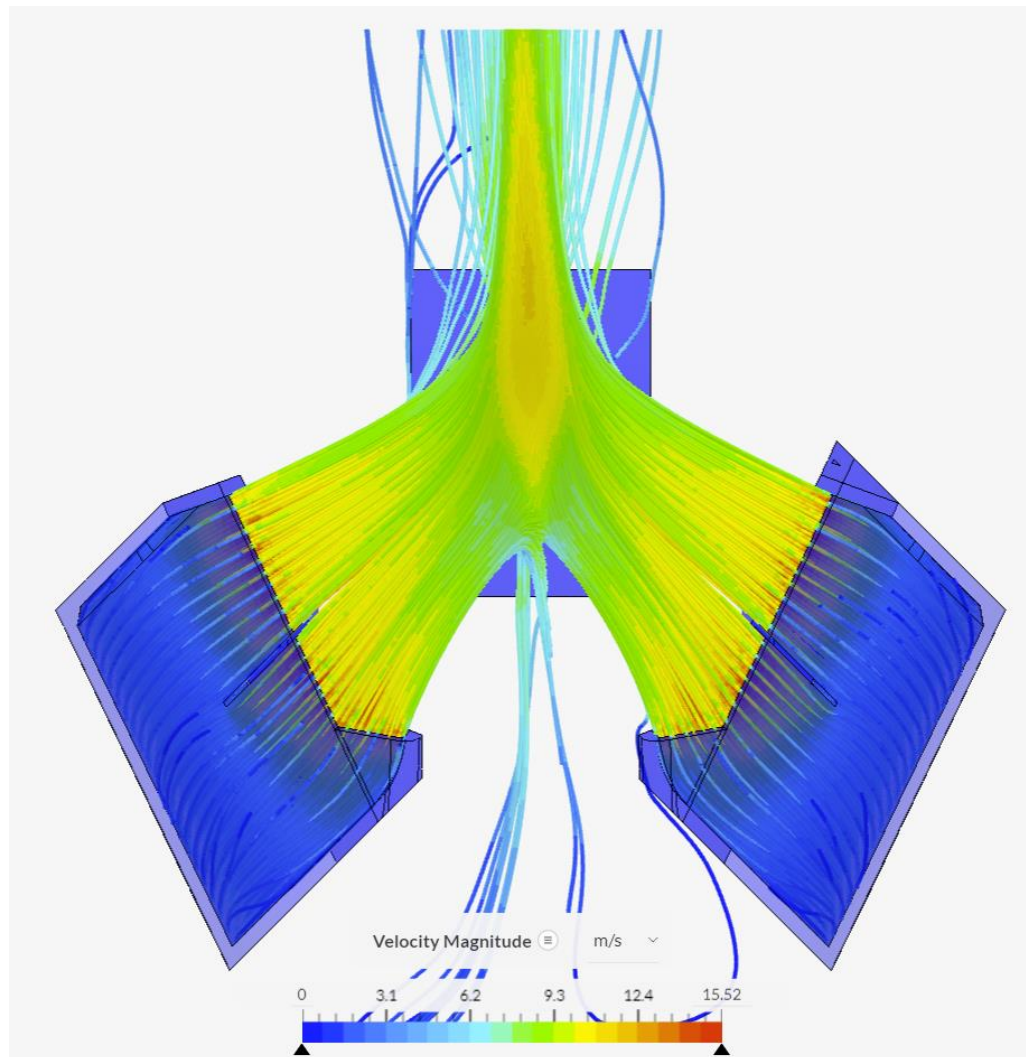
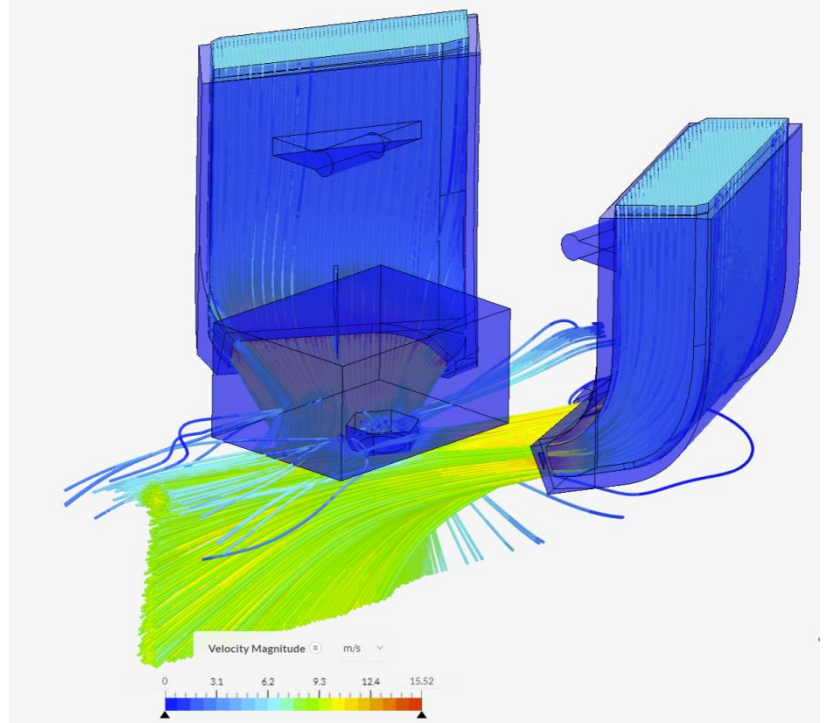
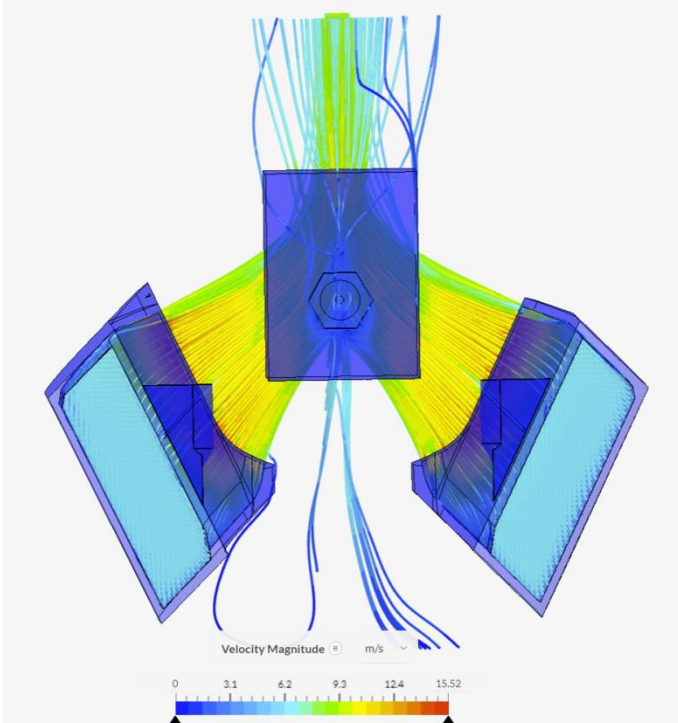
Fan will run at 12% by default, at 35% over bridges, except for the first layer where the fan is disabled.

If estimated layer time is below ~45s, but still greater than ~5s, fan will run at a proportionally increasing speed between 12% and 75%, at 35% over bridges if it's above the current computed fan speed value ; except for the first layer where the fan is disabled.

If estimated layer time is below ~5s fan will run by default to 75% (except for the first layer where the fan is disabled) and print speed will be reduced so that no less than 5s are spent on that layer (however, speed will never be reduced below 15mm/s or up to 90% reduction)

CFDs:

- Tons of CFD work was done for this toolhead.



Changelog:

version	notes
1.016	move duct forward 4mm. Chamfer front upper lip 1mm down 7 mm back
1.017	Move duct back to 1mm forward of nozzle. Front duct angle to 15 degrees. Front duct height to 5.5. increase duct clearance to 2 from 1.25. Change lip to 2/2mm.
1.018	Move duct forward to clear. Change angles a little. This has very high velocity!
1.019	change upper duct mount to use plastite. Thicken lower duct wall by 0.2mm to 0.8mm
1.020	increase duct height by .2mm, decrease outlet height to 5.4 from 5.9
1.022	Shorten length of duct by 5mm (from 30 to 25mm)
1.023	move duct forward by 6mm (from 1.022)
1.024	from 1.019, change duct angle from 45 degrees to 50 degrees. 25mm nozzle length
1.025	From 1.019 narrow outlet by 1mm. Raise front and back by 0.5mm
1.026	from 1.025 lower front back by 0.5mm. Raise back by 0.3
1.027	increase duct height to 5.4mm. Raise back by 0.3mm to 3.4mm
1.028	From 1.027. change front lip so that it is a little bigger. Also it angles down slightly.
1.029	from 1.028. increase forward aspect of lip from 2mm to 4mm
1.030	adjust lip some and rear angle
1.031	increase duct height by 0.25mm. Chamfer the front lip. Adjust front lip a little.
1.031.1	Raise back duct by 0.25mm
1.031.1	Heatset Duct Mount - Swap rear duct mount to heatset/m3x6
1.032	Make a cut of rear outlet at 20 degrees prior to shelling to focus rear part of flow.
1.033	change nozzle angle of back to 8degrees from 6. Not sure if this is better than 1.031.1 yet
1.033.2	upper duct mount arm is now 4mm thick and the space around the m3 hole on the upper mount is a little thicker
1.034	Skipped due to cad problem
1.035	move duct forward 2mm
1.036	Moved Duct back 2mm and a few fixes for things
1.037	modify upper arm duct mount to be much stronger. Uses new divot/cup instead of second screw. Chain_anchor v3.2 - ziptie holes on front moved up, added rear ziptie holes. Hole added to carriage v1.037 on left side to mount ADXL.