

How to read input shaper graphs: a work in progress

Compilation by Reth (the original Reth)

Data taken from:

3D Printers & a whiteboard [How to Read and Analyze Input Shaper Graphs Generated by Klipper – YouTube](#)

Felix Boisselier (Frix_x): [klippain/docs/input_shaper.md at main · Frix-x/klippain · GitHub](#)

Reth's Voron Trident – serial 1190

Lots of members of the Voron Community

Version 4-24-2024

Introduction

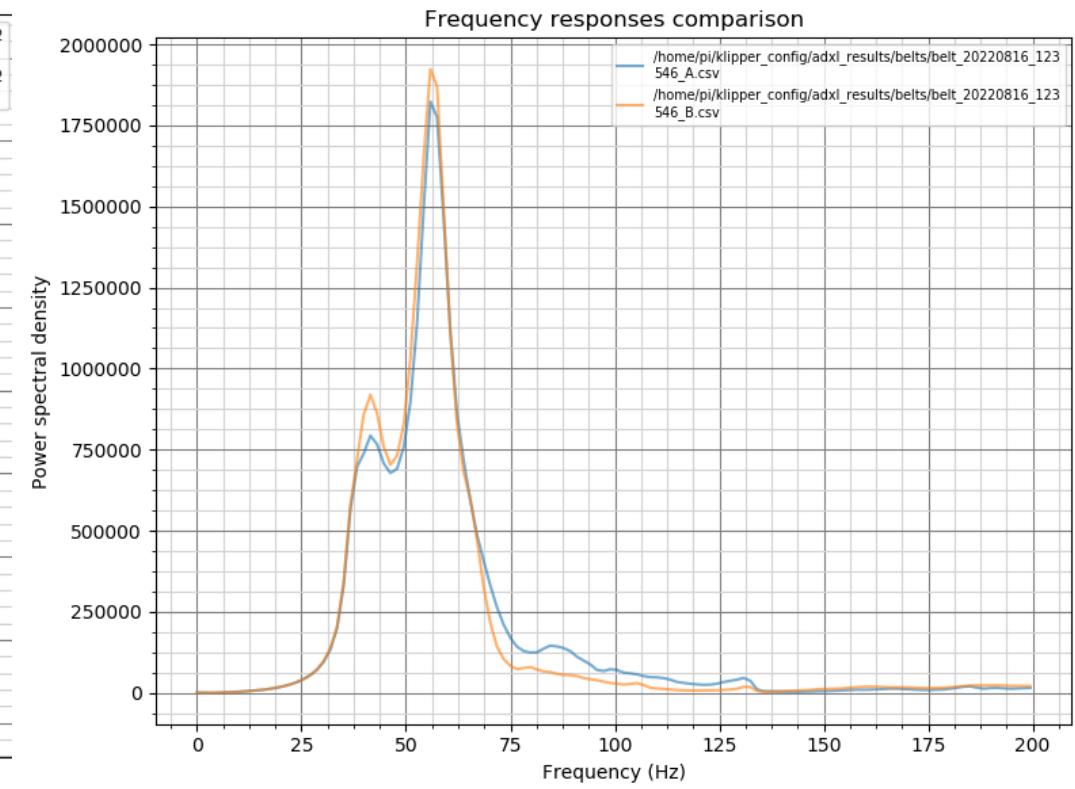
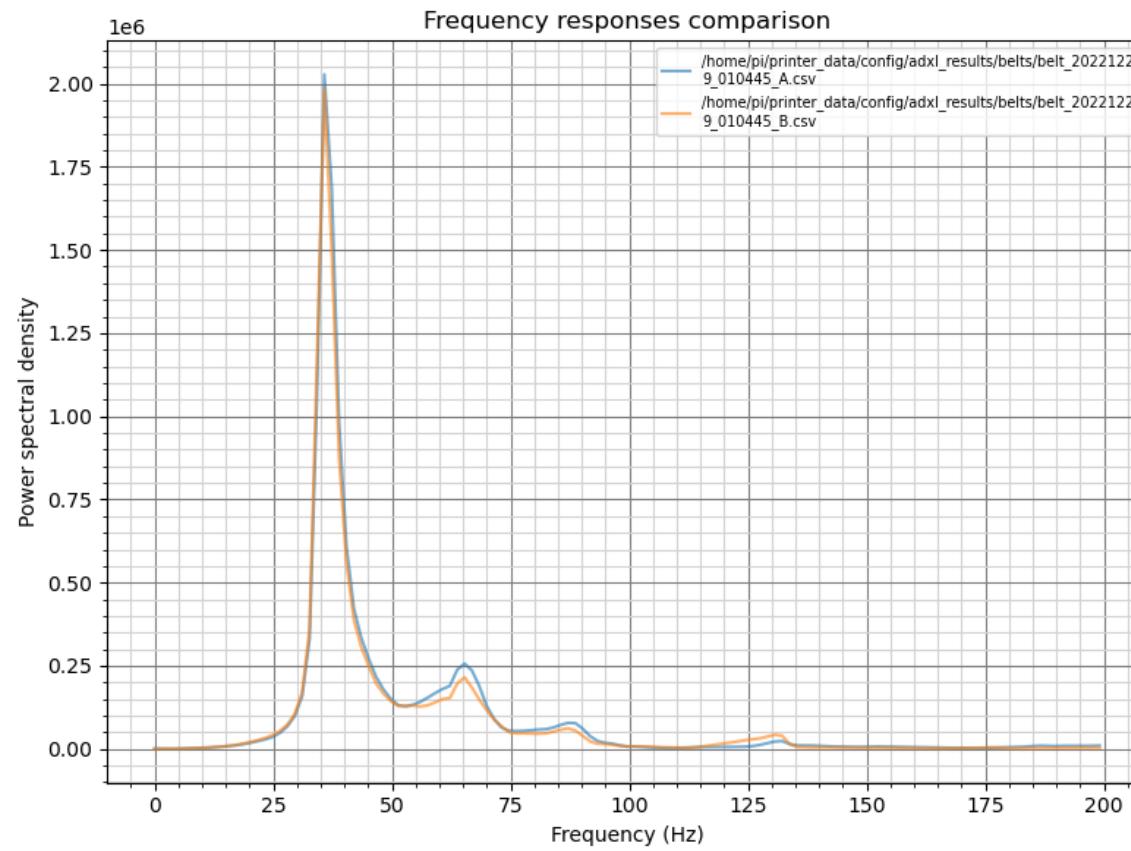
- The following graphs are only applicable to CORE XY printers. Bed slinger, delta, or other style printers will not necessarily be able to match the graphs to mechanical issues as the basic design of the printers are different.
- The purpose of these slides are to present different belt shaper and input shaper graphs with some suggestions on how to go about diagnosing and fixing the issue.
- These graphs were taken from 3D Printers & a whiteboard, Frix_x, my own Trident 350, and members of the Voron Community with annotations provided for clarity.
- Interpretation of input shaper graphs may not be straight forward and it is possible to have multiple issues happening at the same time
- Note: tighter belt tension is not always the answer. Tightening belts to much can lead to new, and not better, print artifacts.

Common Issues

- Belts are showing two spikes, three spikes, one spike, etc.
 - “Ideally” you want belt shaper to have a single peak for A and B belts.
 - However, having two spikes, or even three spikes, may not be an issue.
 - Belt shaper is used mainly for determining if the belts have the same relative belt tension, and by itself is not a great troubleshooting tool for anything other than relative belt tension.
 - Need to run input shaper to confirm an issue.
- Belt shaper and/or input shaper shows a problem do I need to do a test print.
 - Begrudgingly yes. Why, sometimes input shaper can just be wrong. This is because input shaper is done by an ADXL and if the ADXL is not mounted correctly/tightly/etc. then it will not be able to produce good graphs. We need a print to verify the accuracy of what input shaper is reporting.
- Input shaper says I can do 1 million accel.
 - You are most likely looking at ZV. It is not recommended to use. This is because it is a really narrow shaper, basically only canceling the main peak. You might be thinking I have really great graphs I only have a main peak. This may not always be the case. Input Shaper only moves in a very small section of the toolheads total movement. There could be vibrations outside of this movement, belts could stretch overtime, the earths magnetic field could collapse. To be better safe than sorry Klipper recommends you use MZV. Further, I have yet to see a ZV shaper return 0% vibr.

Belt Shaper

Good belt graphs peaks in freq are aligned



Belt Tension

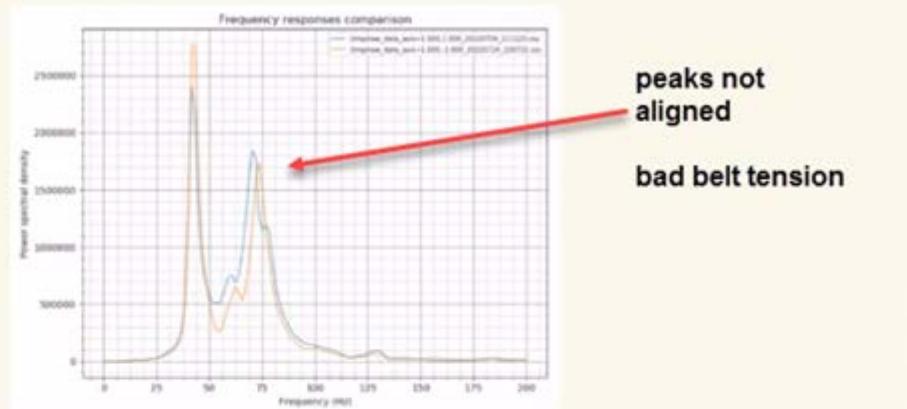
Input Shaper Settings ✓

Absolute Belt Tension ✗

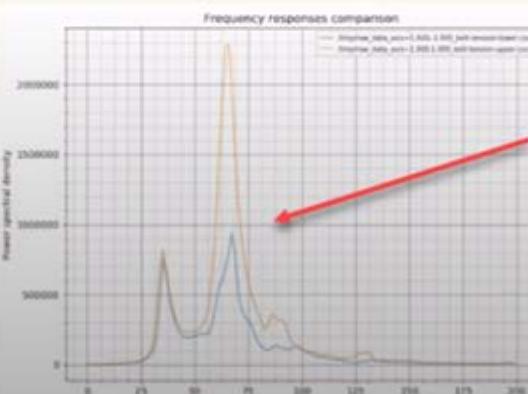
Relative Belt Tension ✓

Issues:

- binding
- loose bolts
- over-dampening
- loose belts
- wire loom issues
- printer design issues

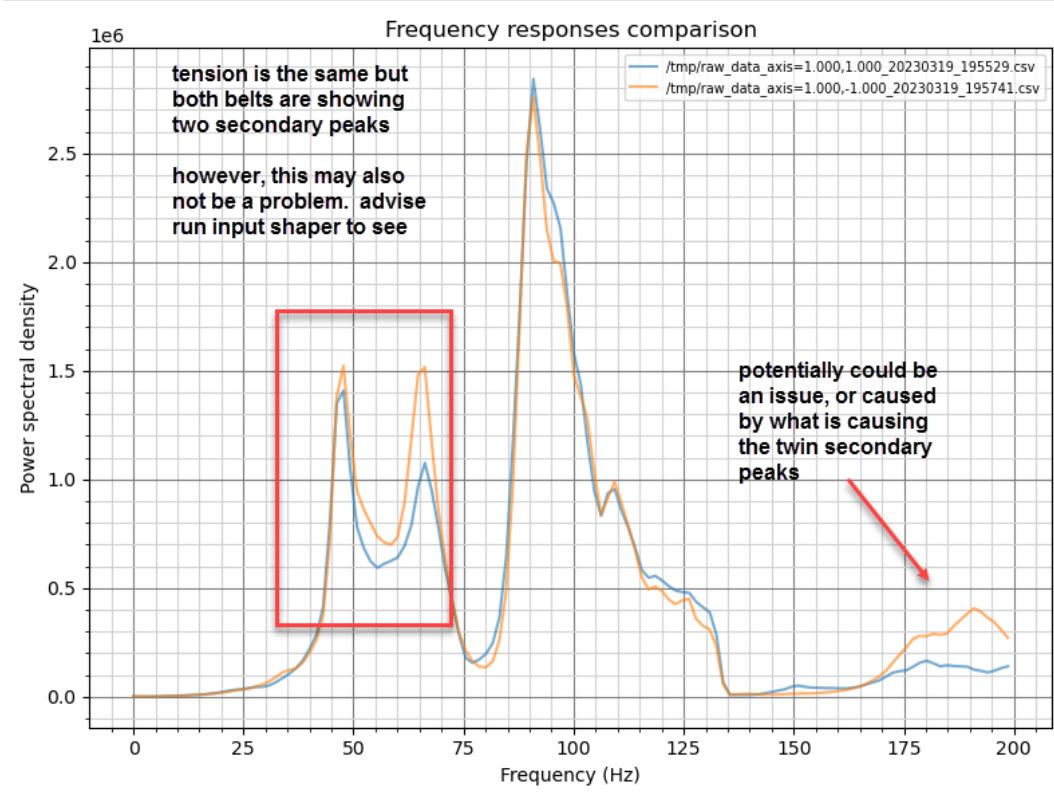
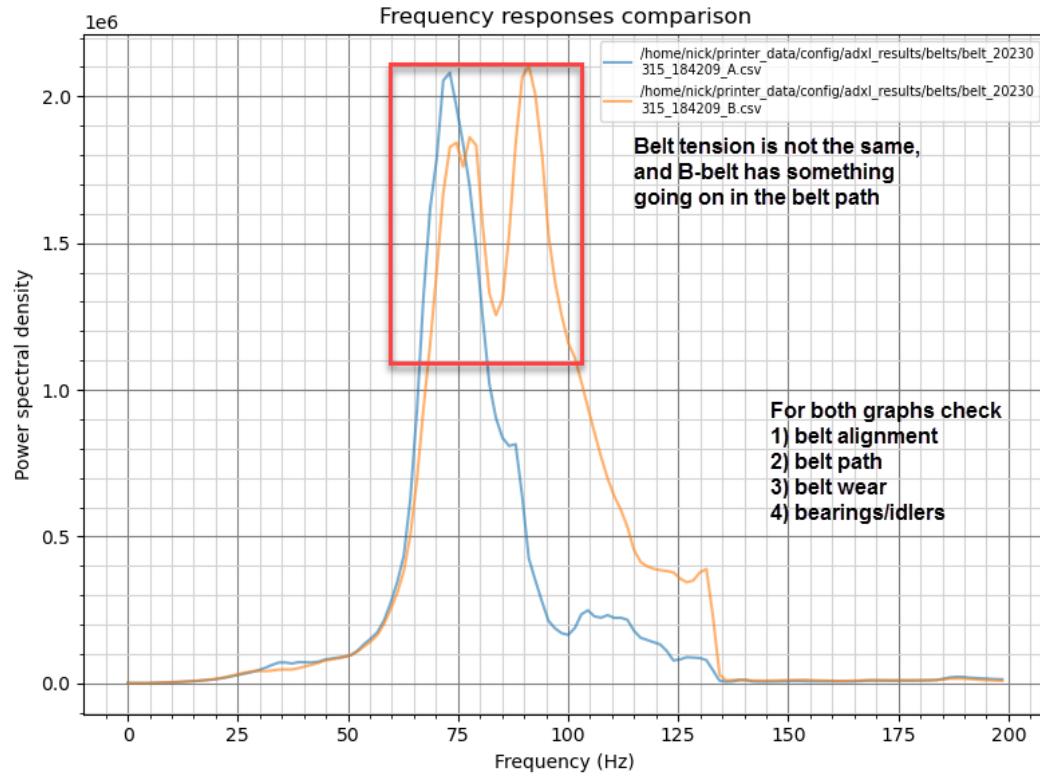


peaks not aligned
bad belt tension



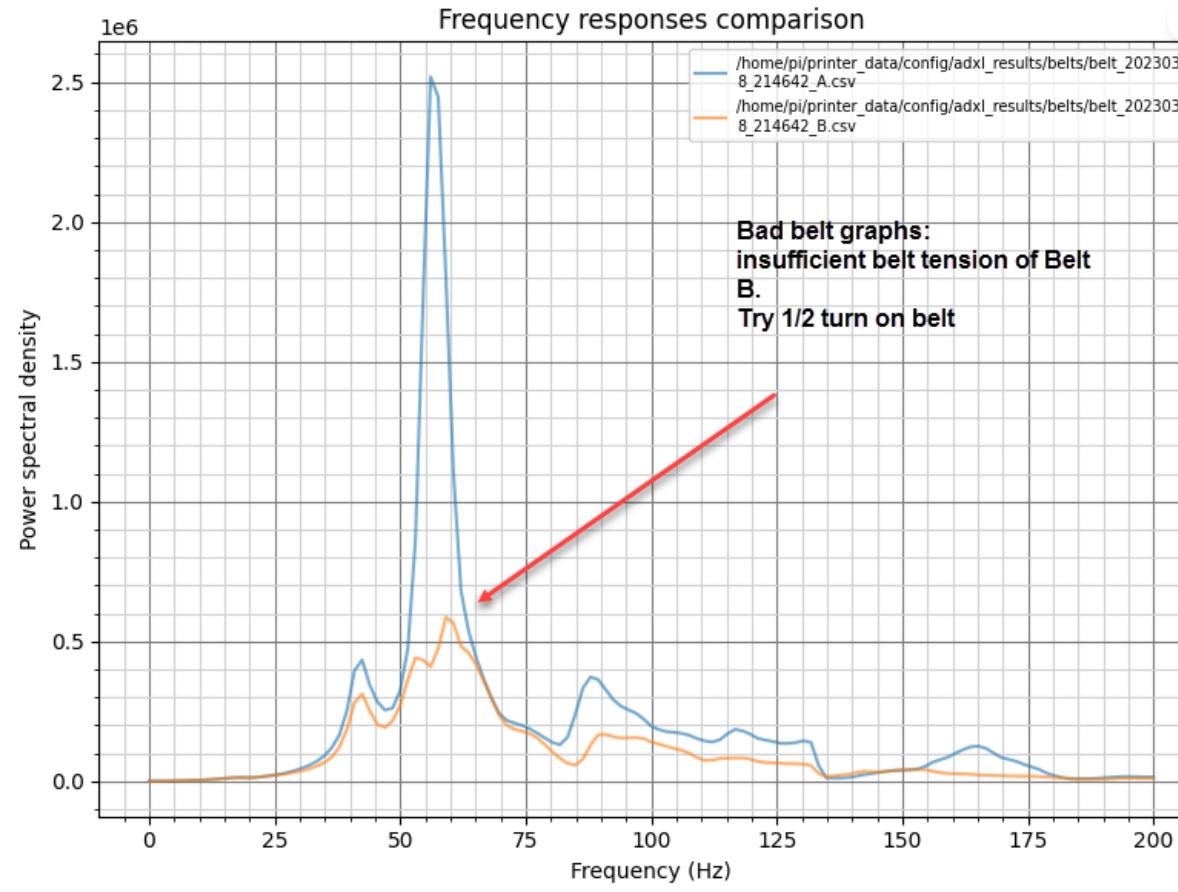
Peaks are aligned, but amplitude is to low.
generally indicates
1) belts were not cut
the same length, or
2) belts length coming
out of the x-carriage is
not the same, or
3) something else in
belt path

Belt Path problem

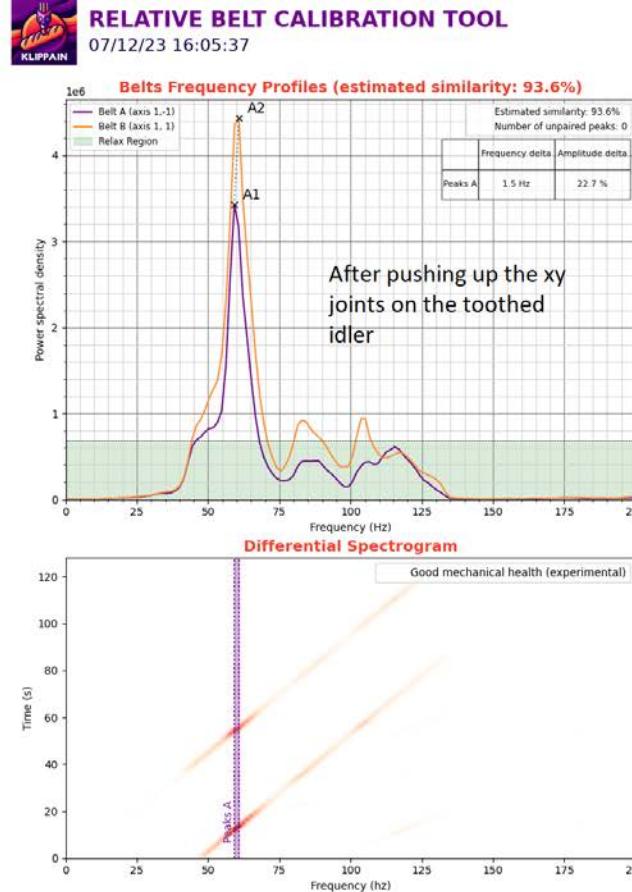
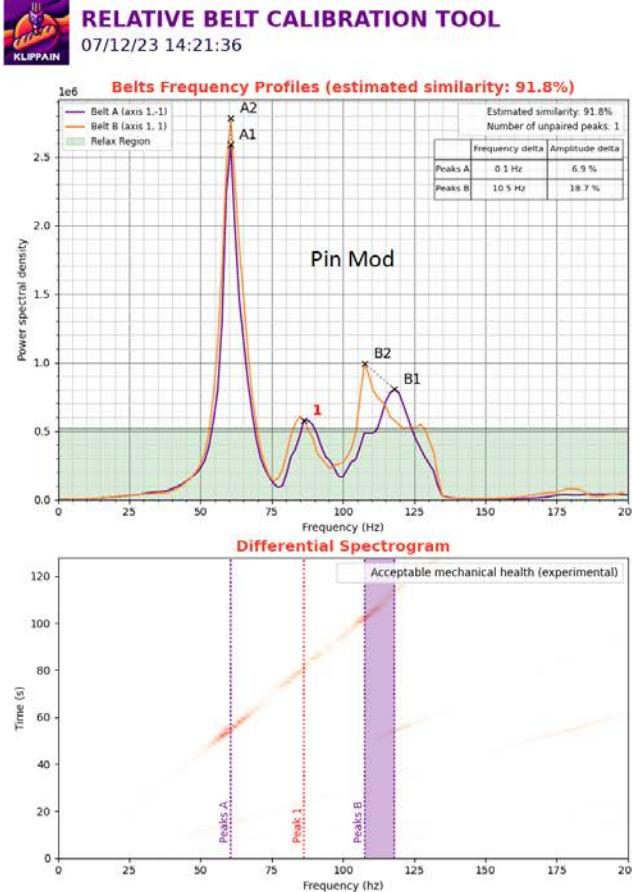


For graphs such as this it is recommended to run input shaper to troubleshoot any issues, and determine if the belt path is a problem

Belt Tension



Pin Mod: may need to push up the xy joint around the idler



What one can see here is that for the pin mod it is really easy to have the plastic around the toothed idler to contact the flange of the toothed idler thereby dampening is belt shaper

Input shaper

How to read input shaper graphs

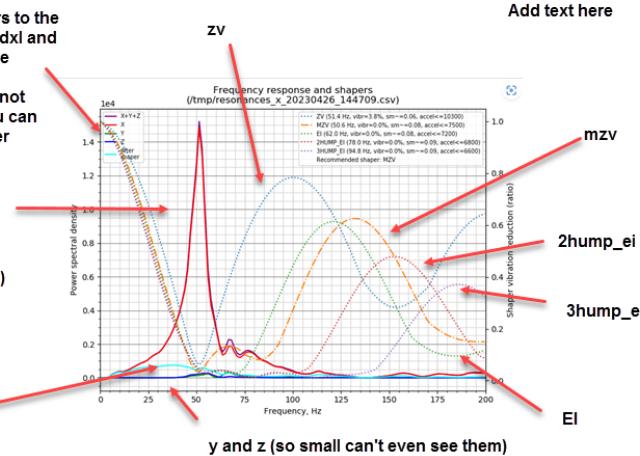
your measured resonance in x, y, and z.
Here x, y, and z refers to the orientation of your adxl and not necessarily to the printers x, y, and z.
If the adxl's x,y,z do not match machines you can change this in klipper

purple is the combination of all axis (x,y,z)

Red is x.

Ideally we want purple to mimic the axis of the shaper. This graph is x so purple (combination) show match red (x). This is because when we measure the x-axis we only want to see x-axis resonance. Does this always happen no.

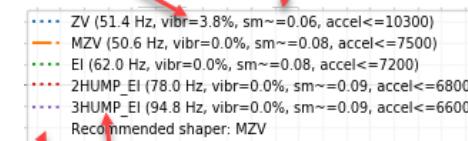
the legends recommended shaper



Add text here
With input shaper you get one or the other.
More vibrations and less smoothing, or less vibrations and more smoothing.
No free lunch here.

Calculated vibration on print if this shaper is used we want zero vibrations

In order to compensate for resonance klipper will smooth the acceleration of the toolhead. This smoothing will be noticed in the print. The amount of smoothing is SM. you can see this if you print a benchy and the lettering on the back is unreadable. Input shaper has smoothed that out to remove resonance in the rest of the print



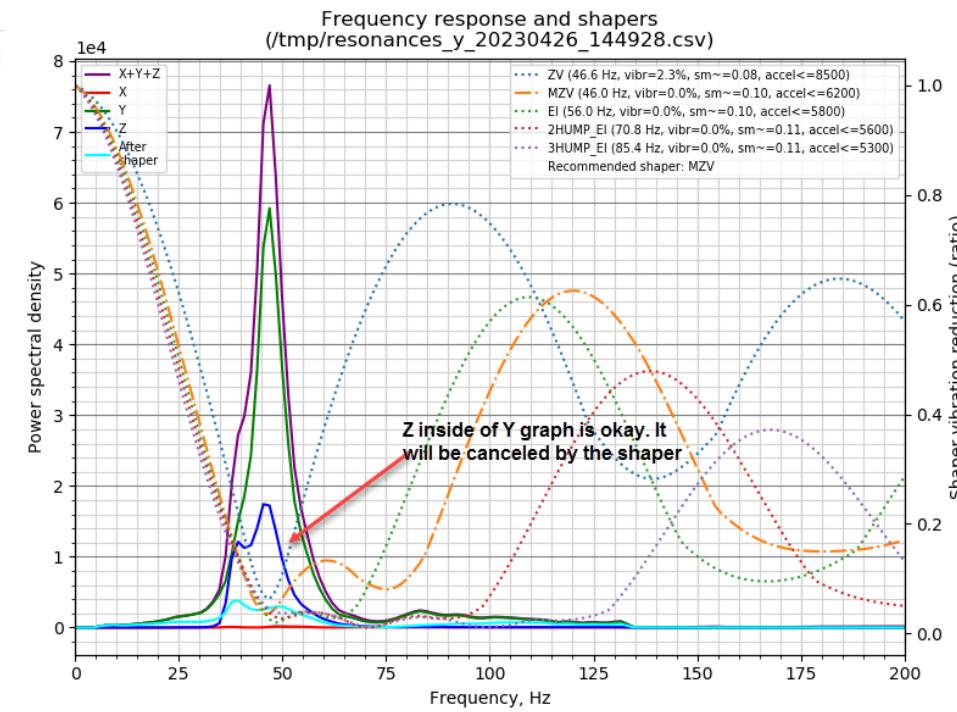
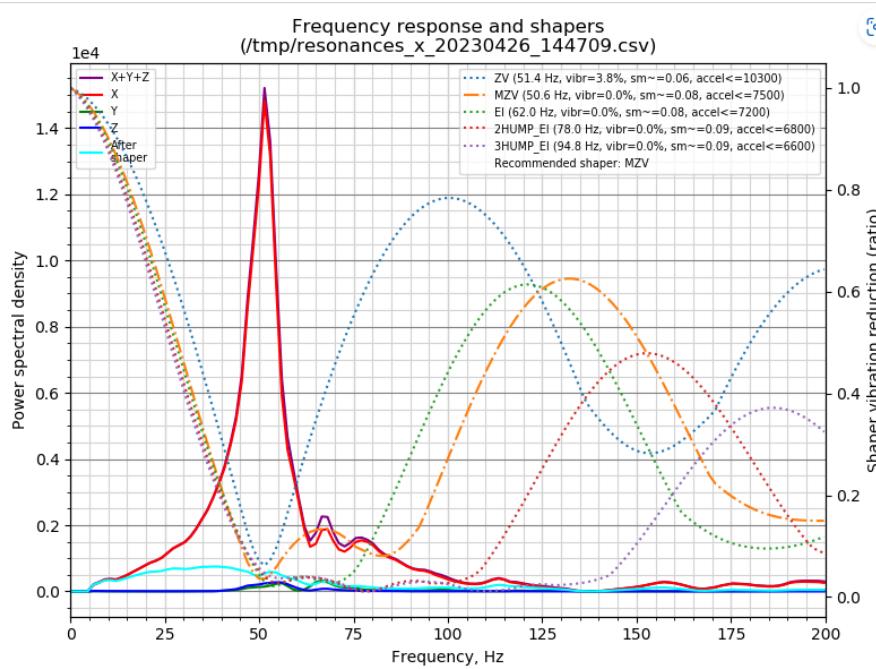
These represent the graphs of each of the input shapers

different input shapers

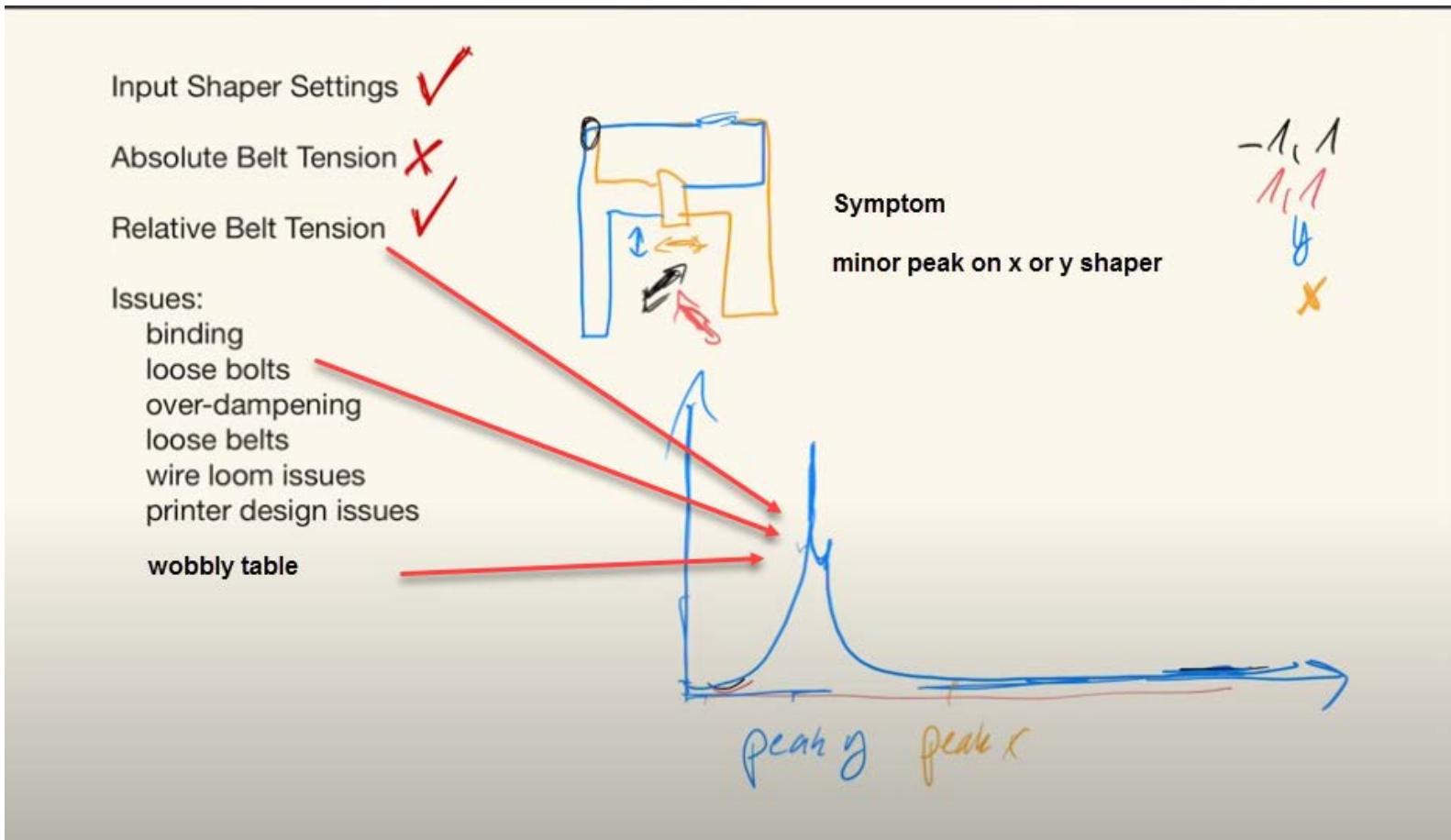
This is what Klipper thinks is best. On the graphs this is the blue lines

- Recommended max acceleration.
Can treat this three ways.
1) set max acceleration in Klipper (printer.cfg) so no moves go faster than this.
2) set your perimeters (internal and external) to be a lot less than this, while allowing infill and other non-visible print moves to be greater than this
3) do nothing, and accept that fact that you want to print fast, and you ain't scared of not ghost[ing].

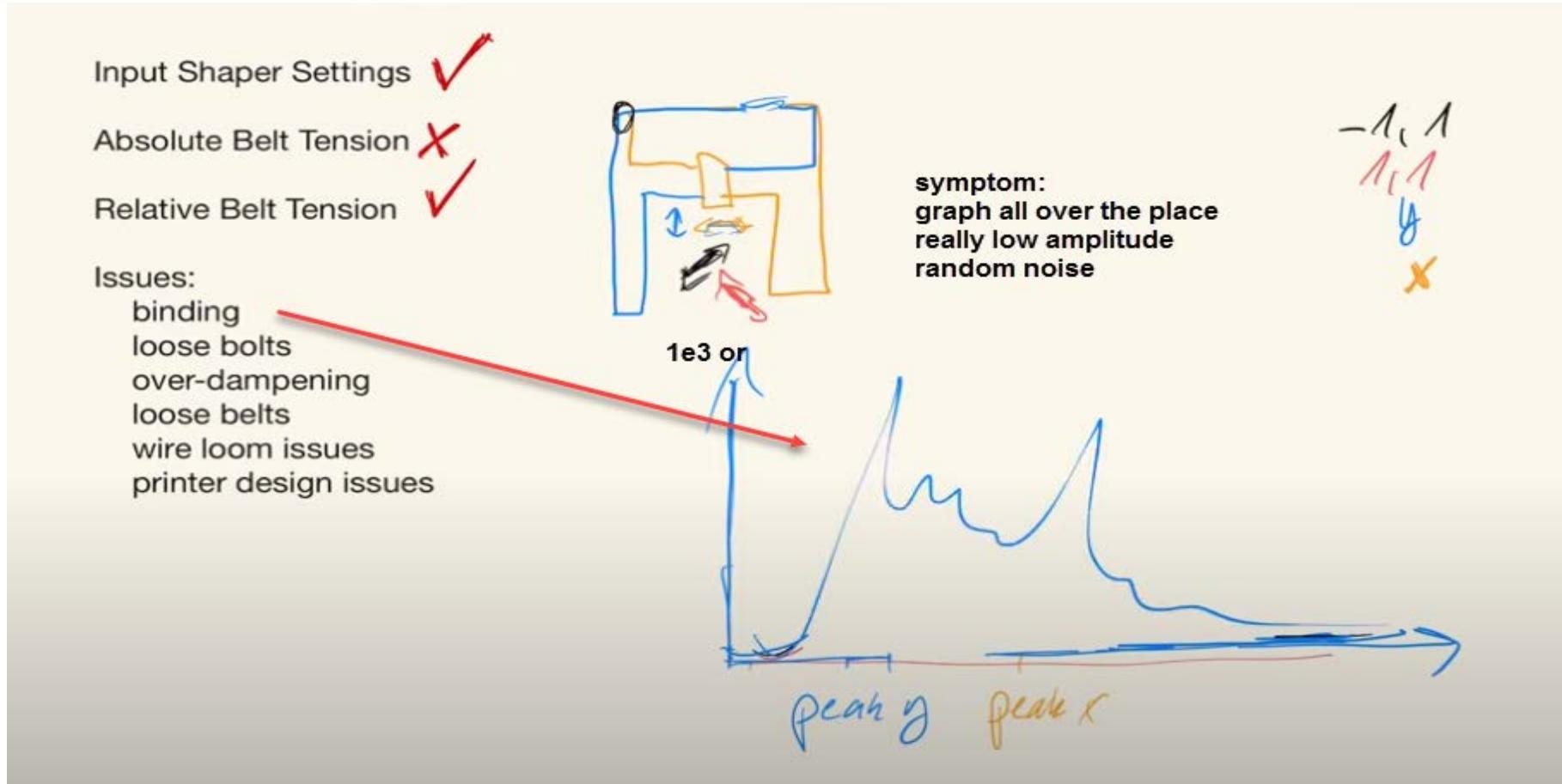
Good Graphs



Binding, Relative Belt Tension, Wobbly table



Binding



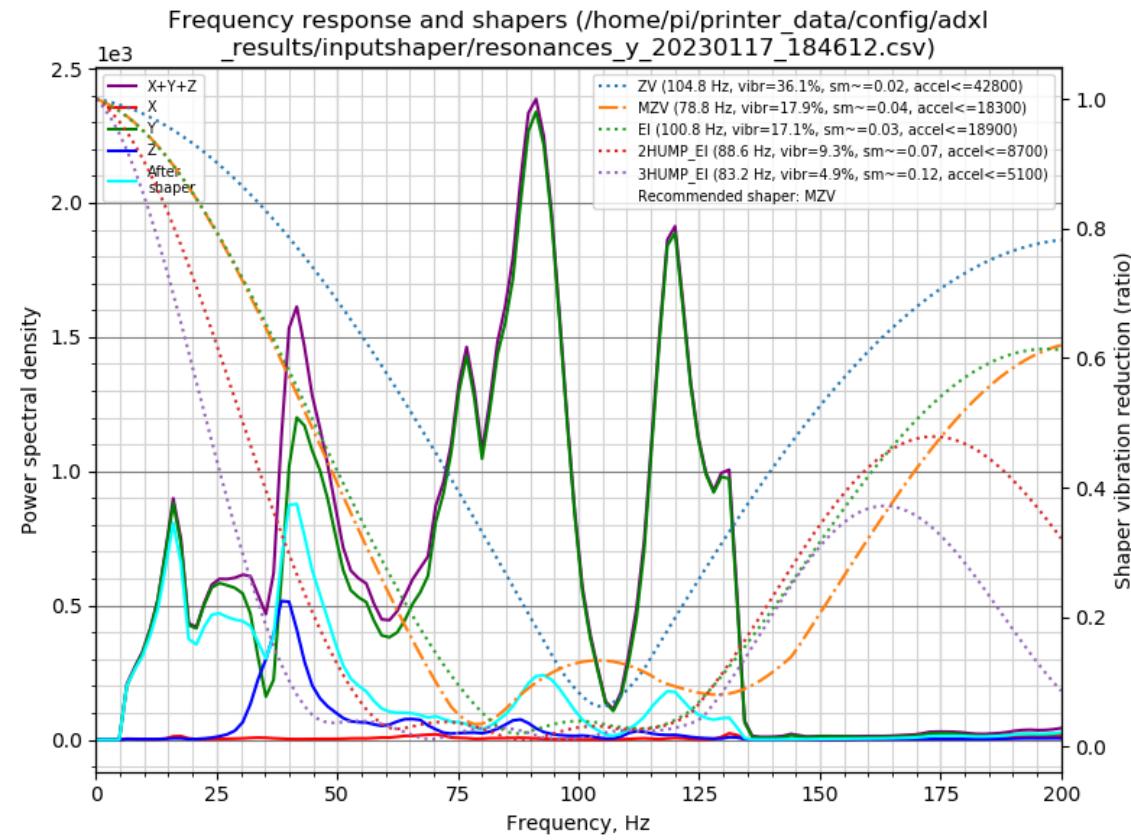
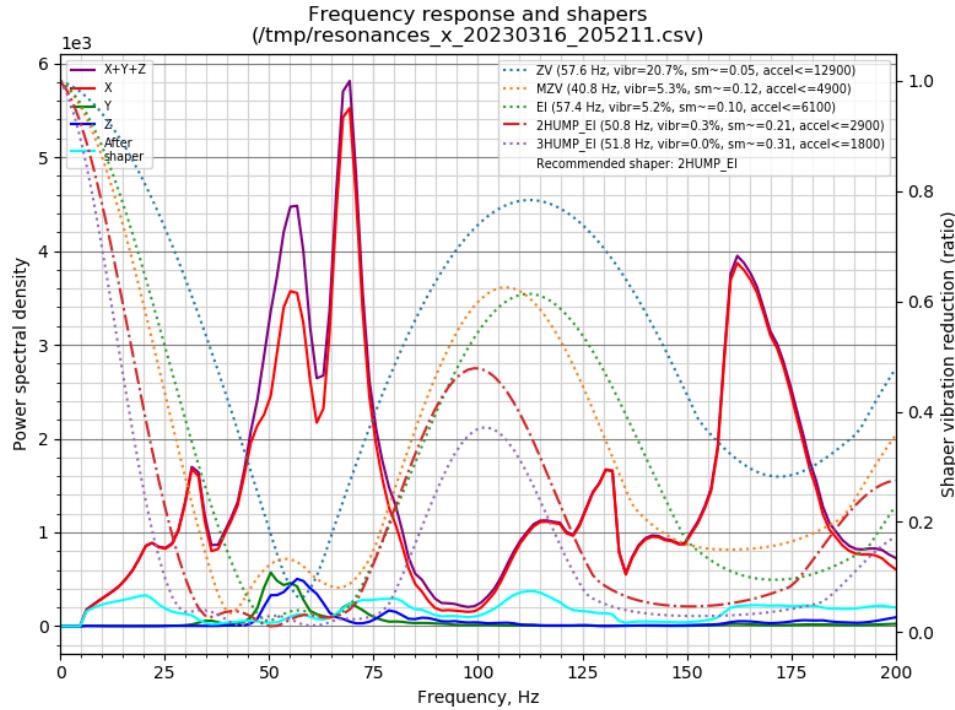
Binding, racking, wobbly table, etc.

check every moving part

start by placing printer on a stable surface (floor)

then check belt path, then derack, then belt tension.

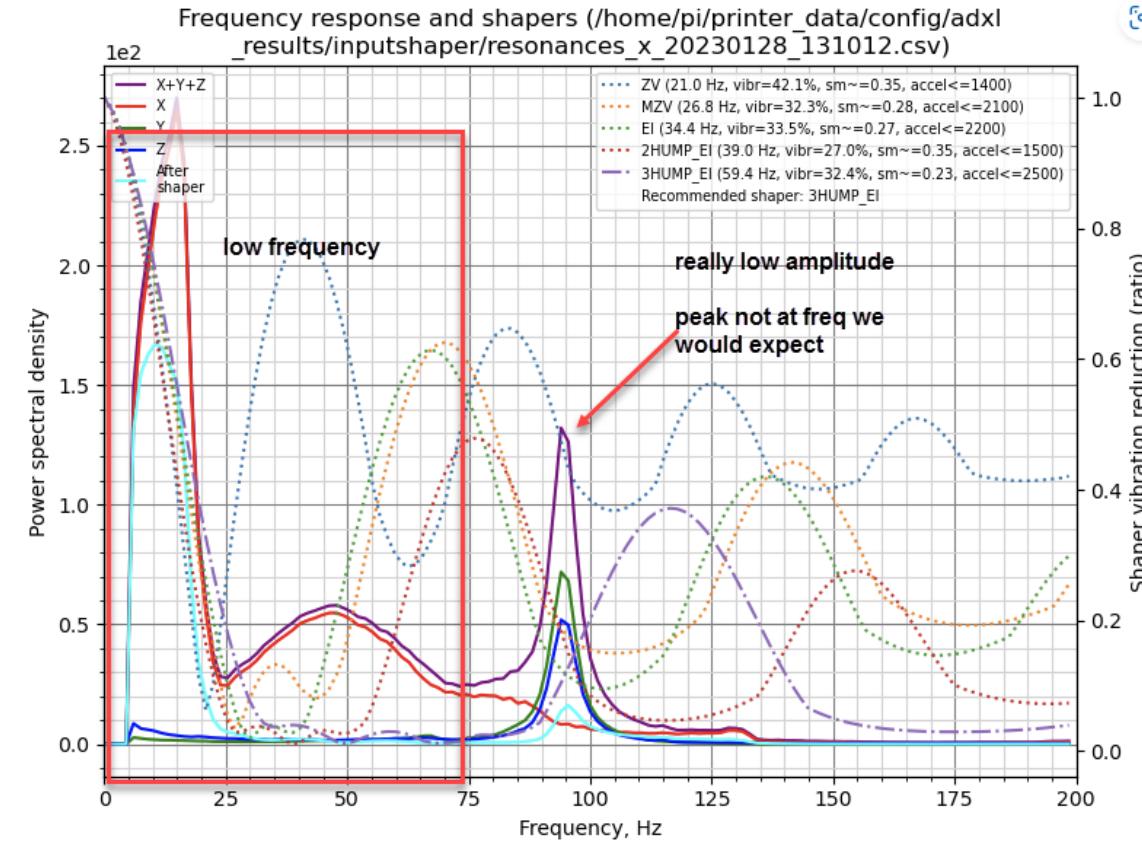
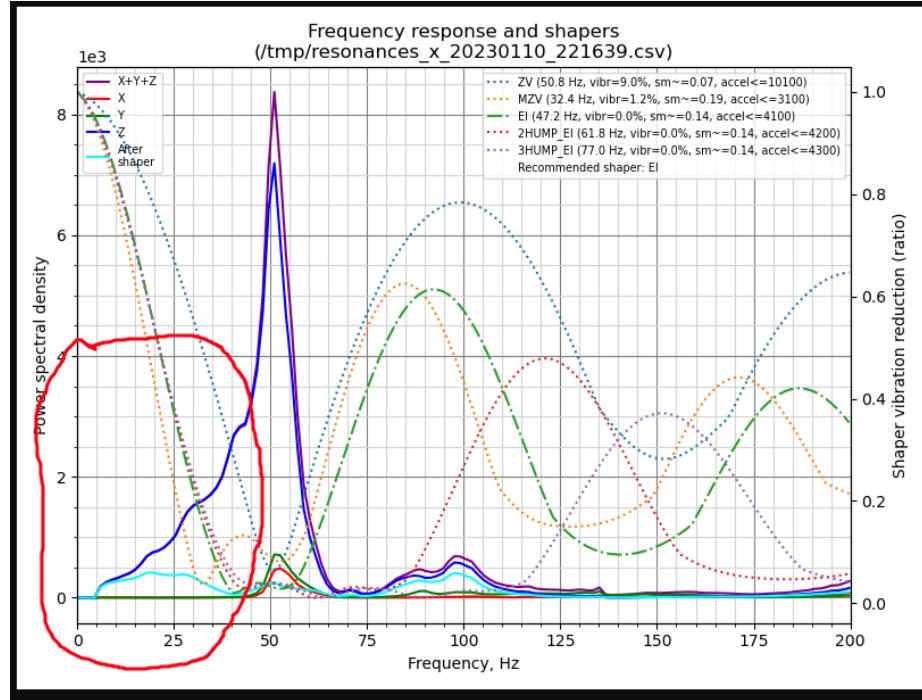
If problem persist consider relubing linear rails, replacing bearings/idlers



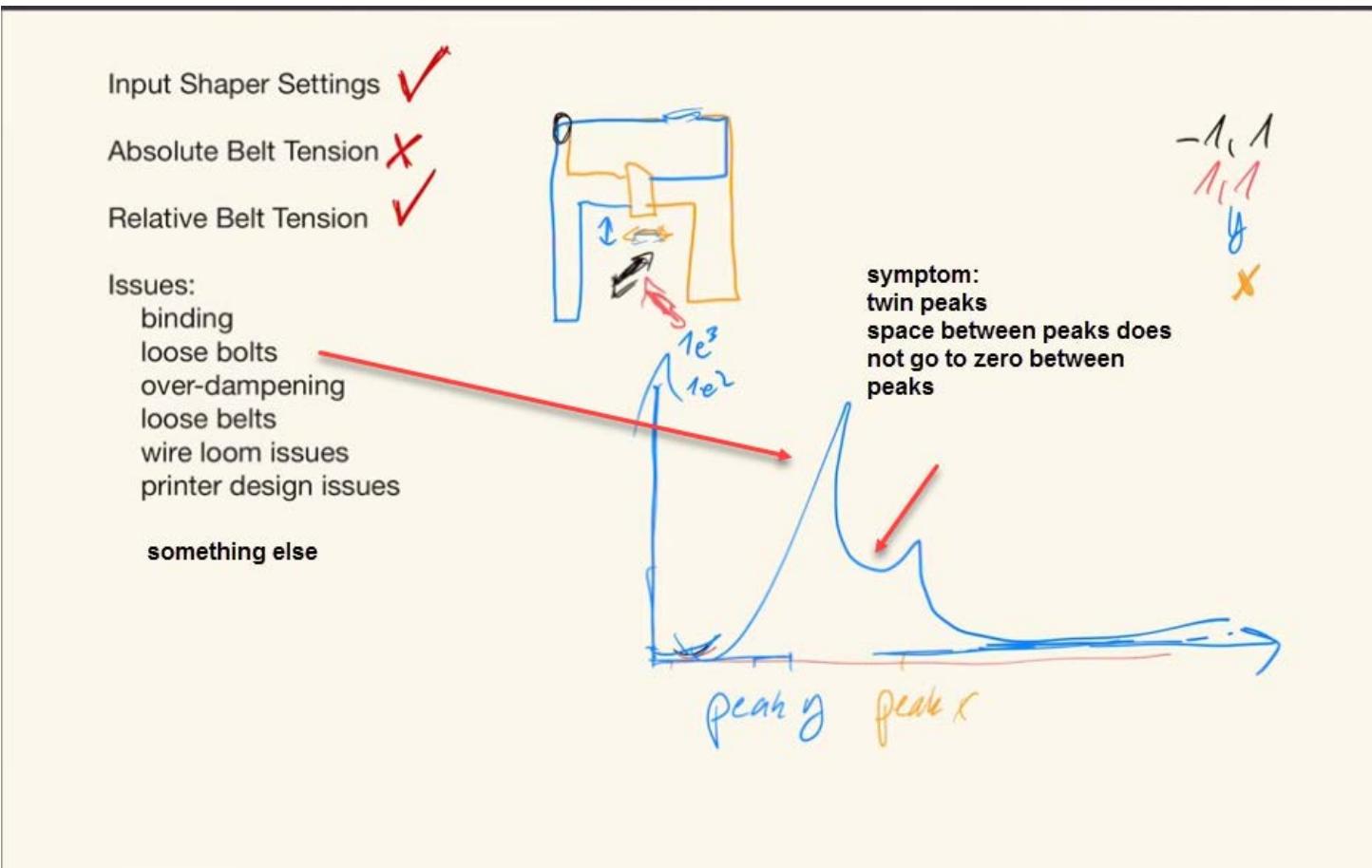
Low frequency – binding or grinding

something is not moving freely

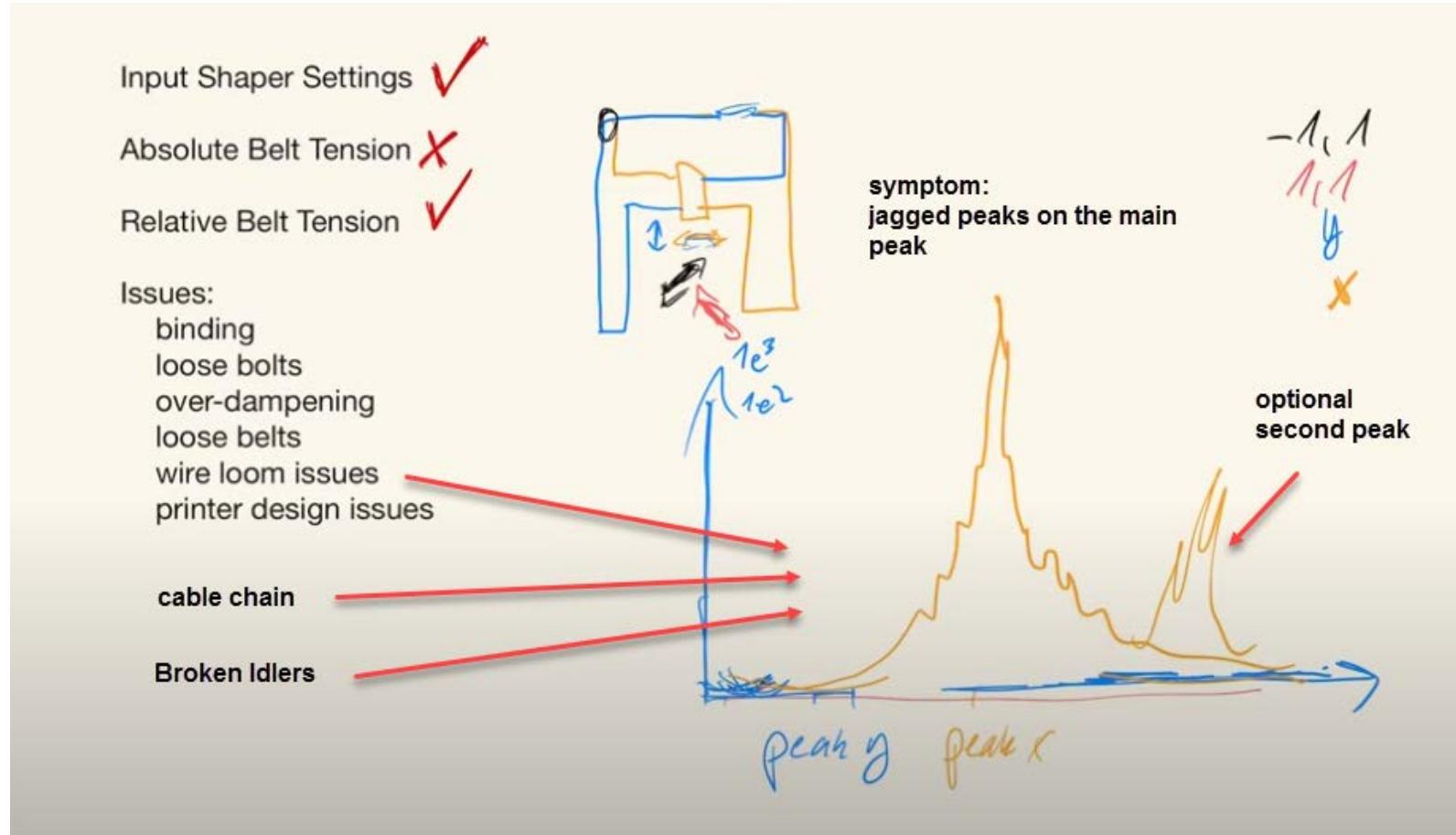
check belt alignment (make sure you have the belt in the middle of the bearings, and not riding on the flange. Make sure bearings have the flange on the outside of the belt bath)
Check linear rails, bearings, and idlers



Loose Bolts



Wireloom/cable chain, Broken Idlers



Wireloom and loose bolt

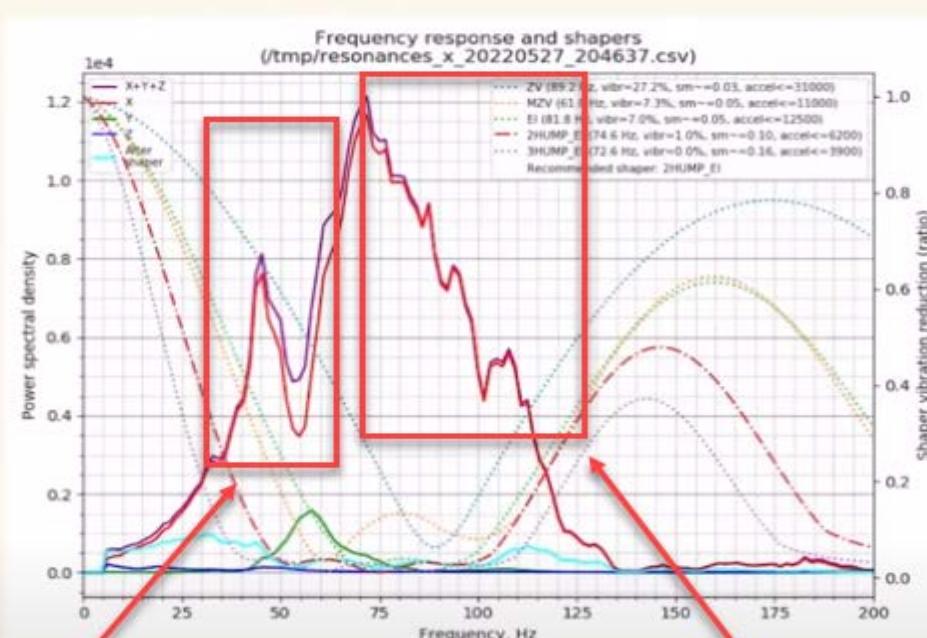
Input Shaper Settings ✓

Absolute Belt Tension ✗

Relative Belt Tension ✓

Issues:

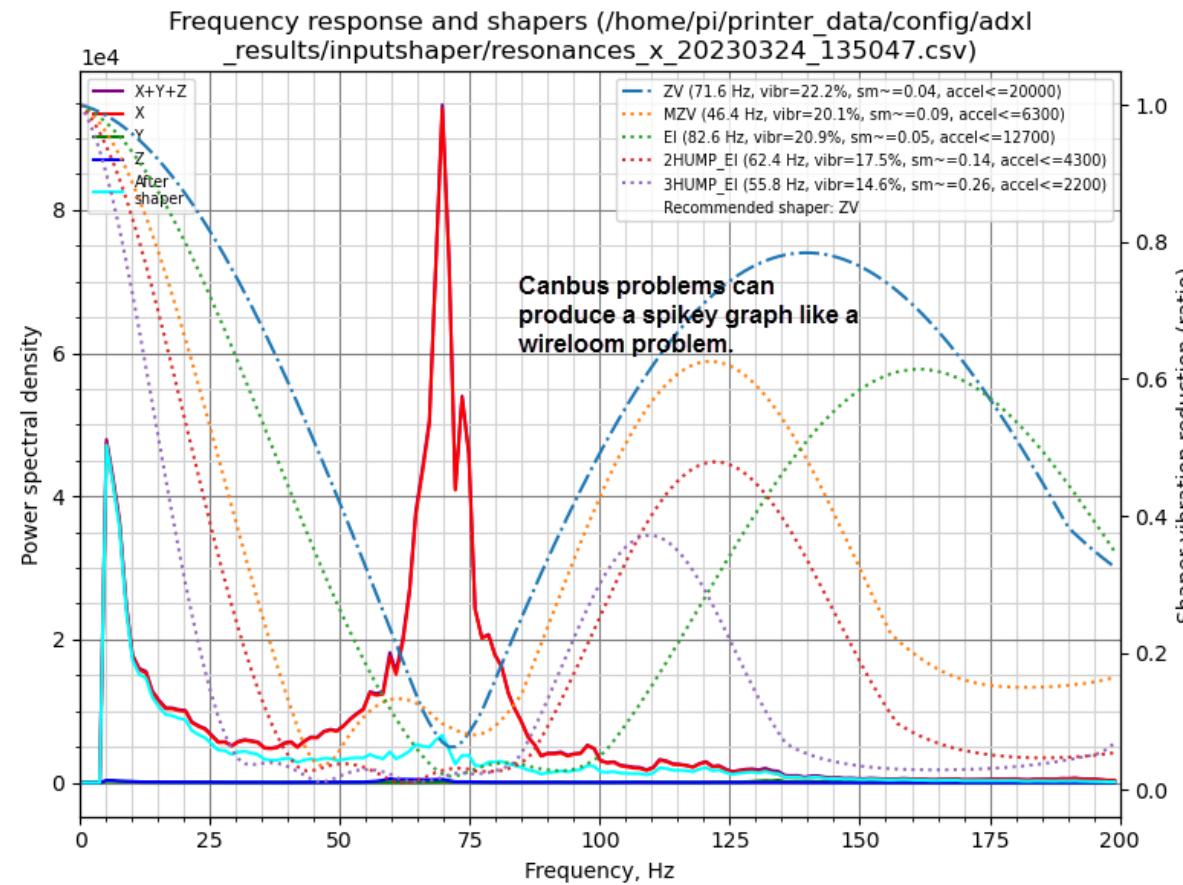
- binding
- loose bolts
- over-dampening
- loose belts
- wire loom issues
- printer design issues



loose bolt:
second peak

wireloom:
jagged peaks

Canbus increase canbus speed to 1M (1 million dollars)

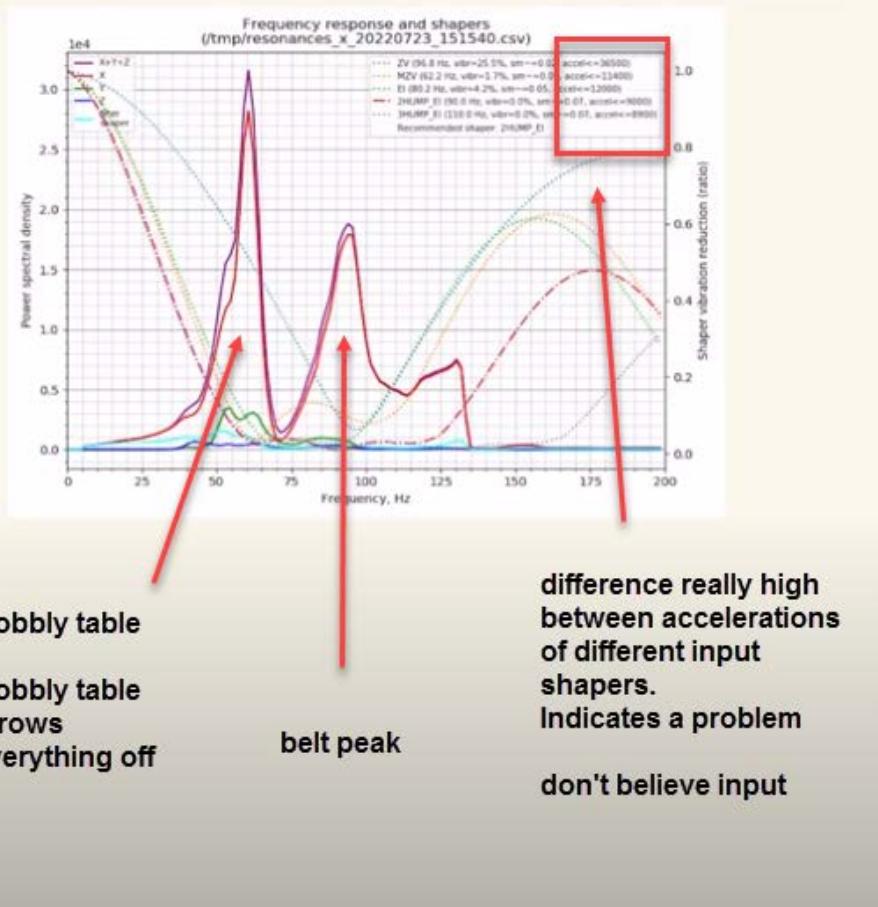


Wobbly table

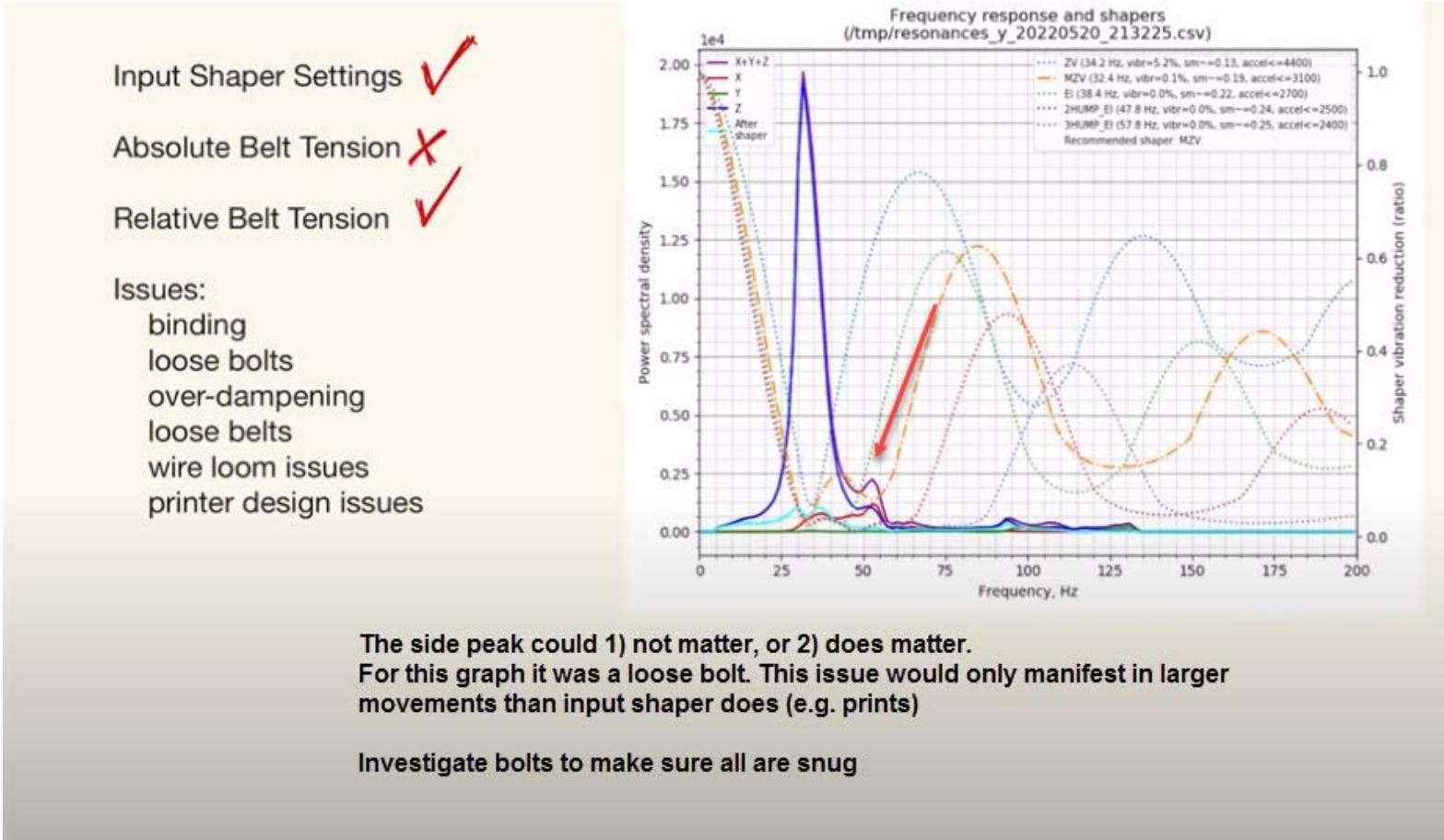
- Input Shaper Settings ✓
- Absolute Belt Tension ✗
- Relative Belt Tension ✓

Issues:

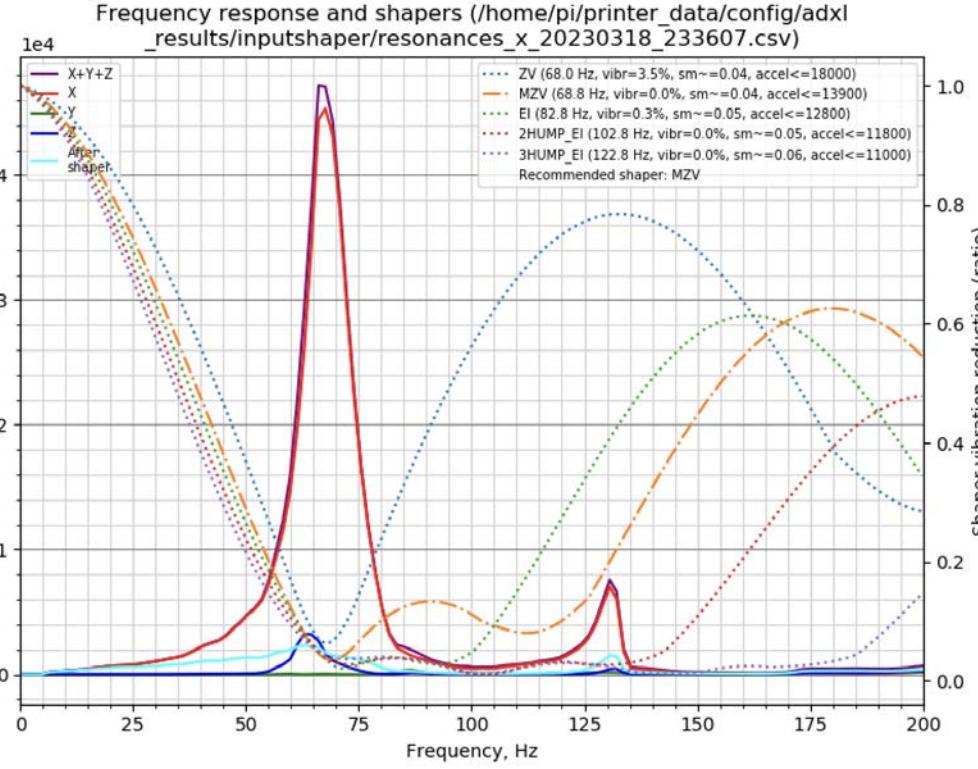
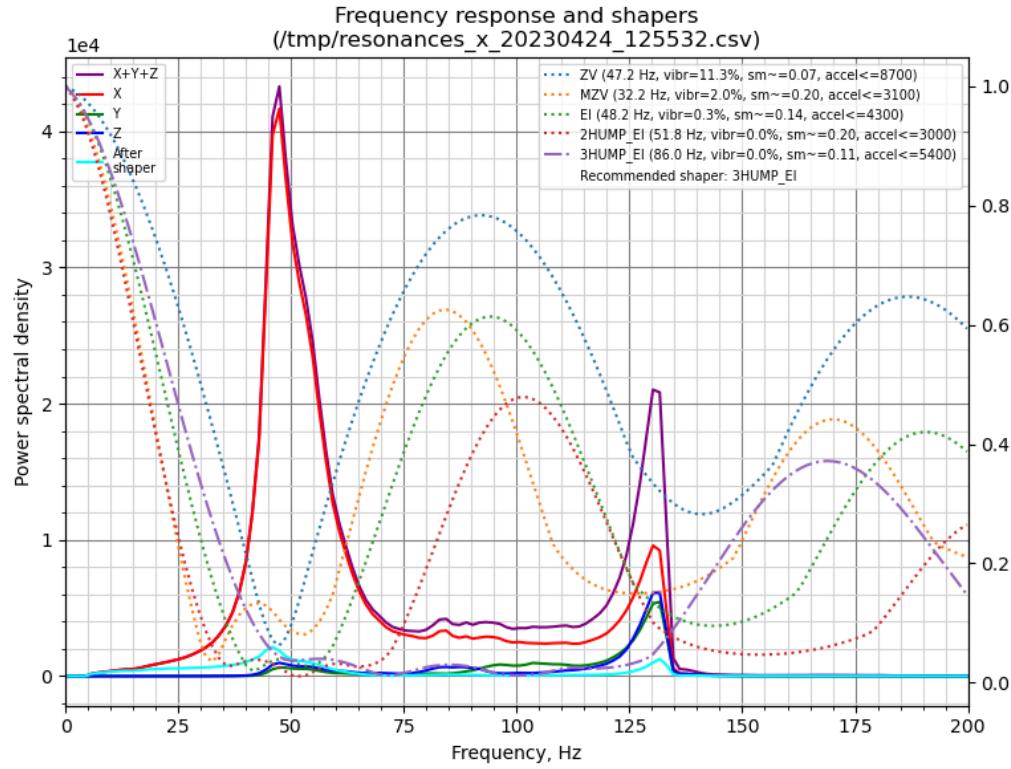
- binding
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Potentially loose bolt or nothing at all



TAP Wobble toolhead in general



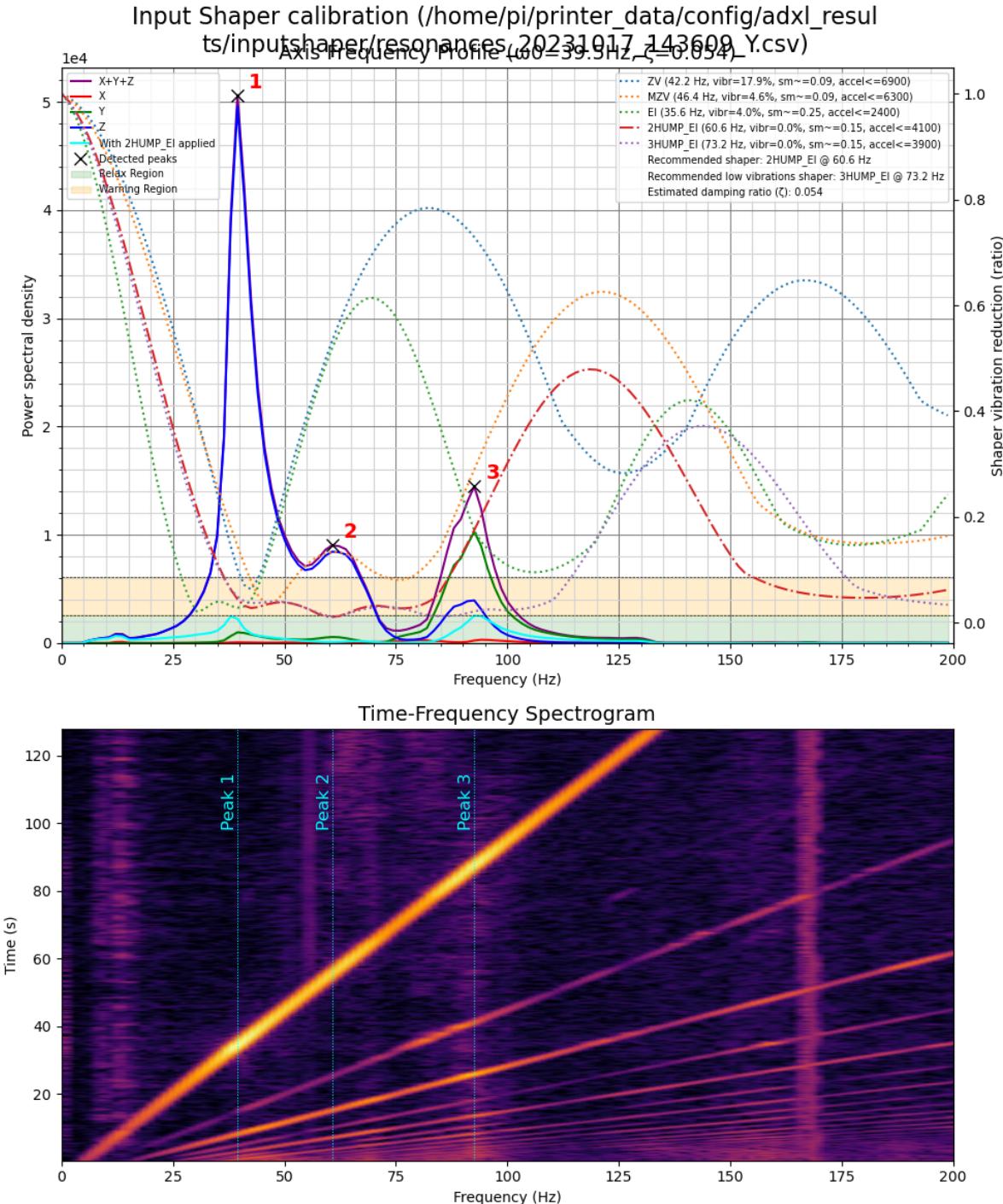
TAP issues are generally around 125hz and have the general shape shown above.

Toolhead issues are also associated with, but not exclusive to, 125hz.

If you see 125hz investigate the toolhead – break it down, and make sure all screws are tight, and your tap magnets are engaged.

Can have 125hz on non-tap machines also

Canbus cable, or TAP linear rail



peak 3
this could be the canbus umbilical cable, or this could be the tap linear rail

The effect as seen is that there is a z excitation. This can be interpreted as an RX (rotation on the x axis) or as something pulling up on the tool head.

A canbus umbilical can pull on the toolhead, also the tap rail may not be good enough and allows for Rx rotation

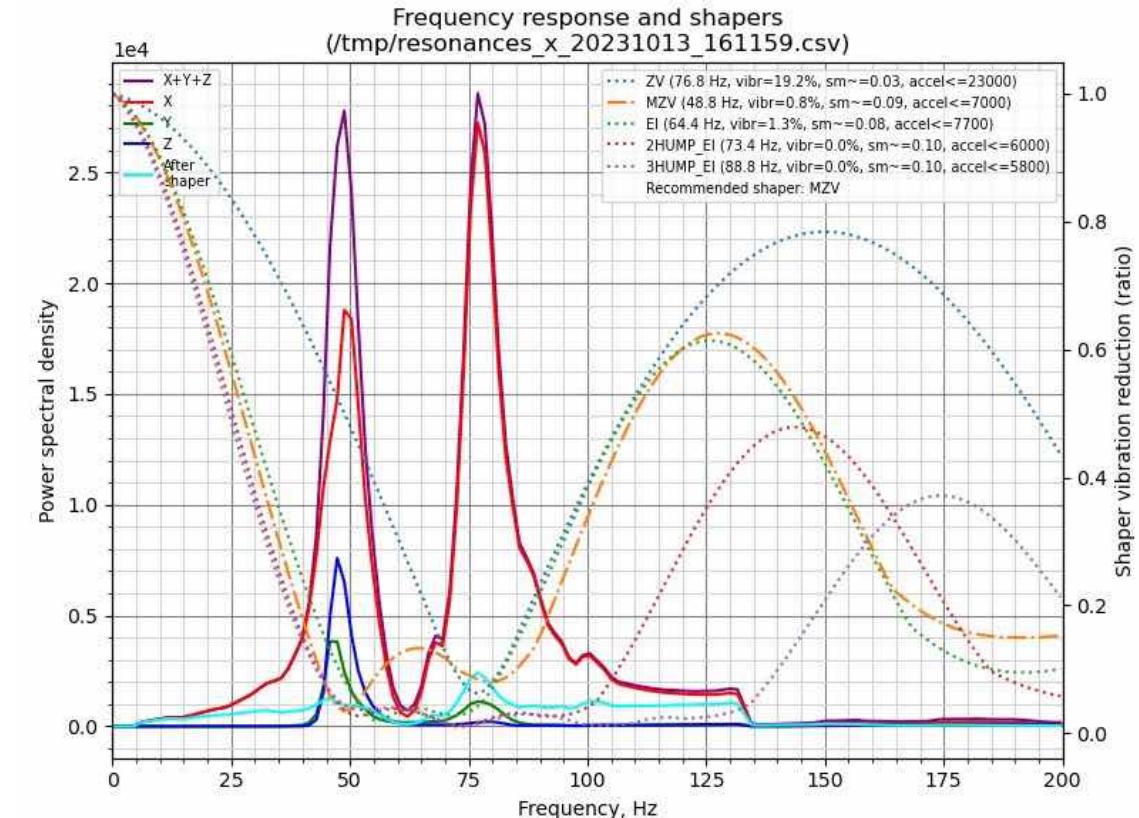
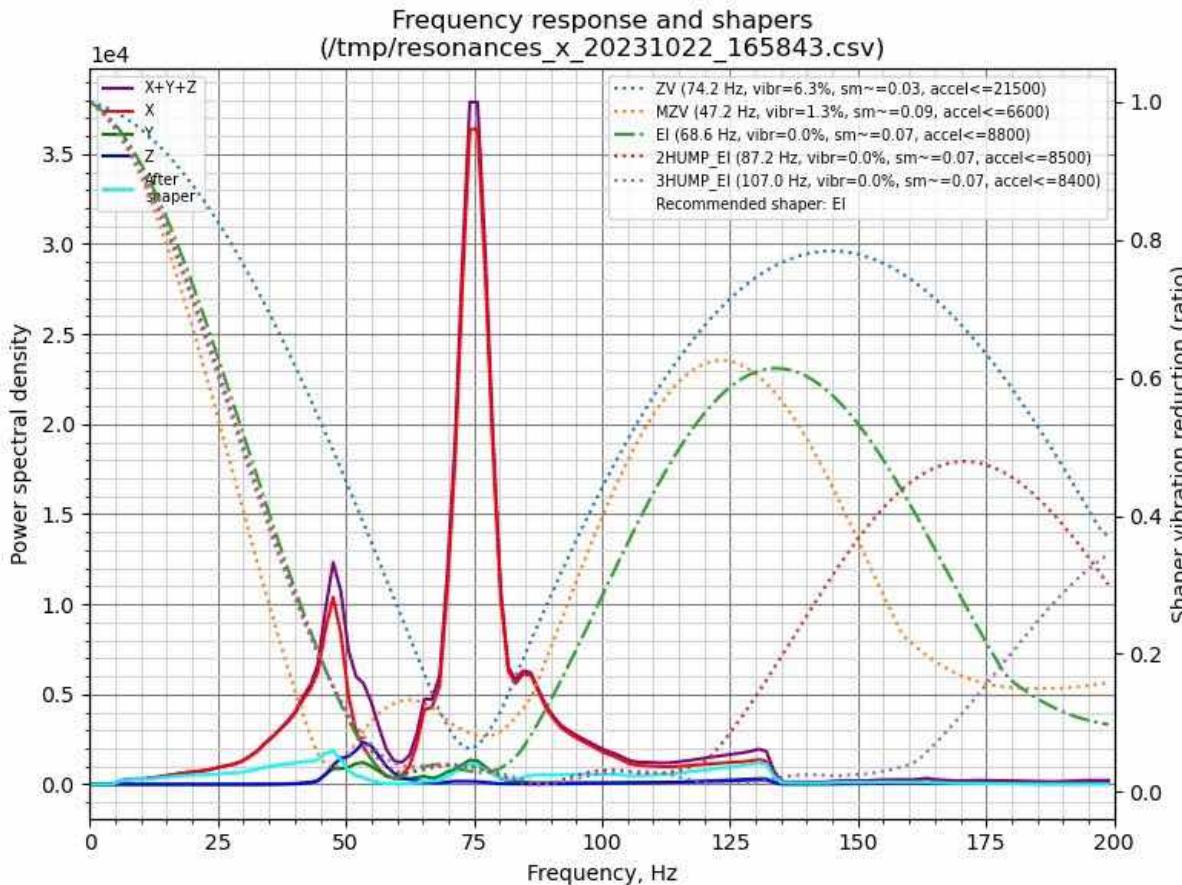
Notice that peak 3 goes to zero on the left and right of it

Potential Bearing issue

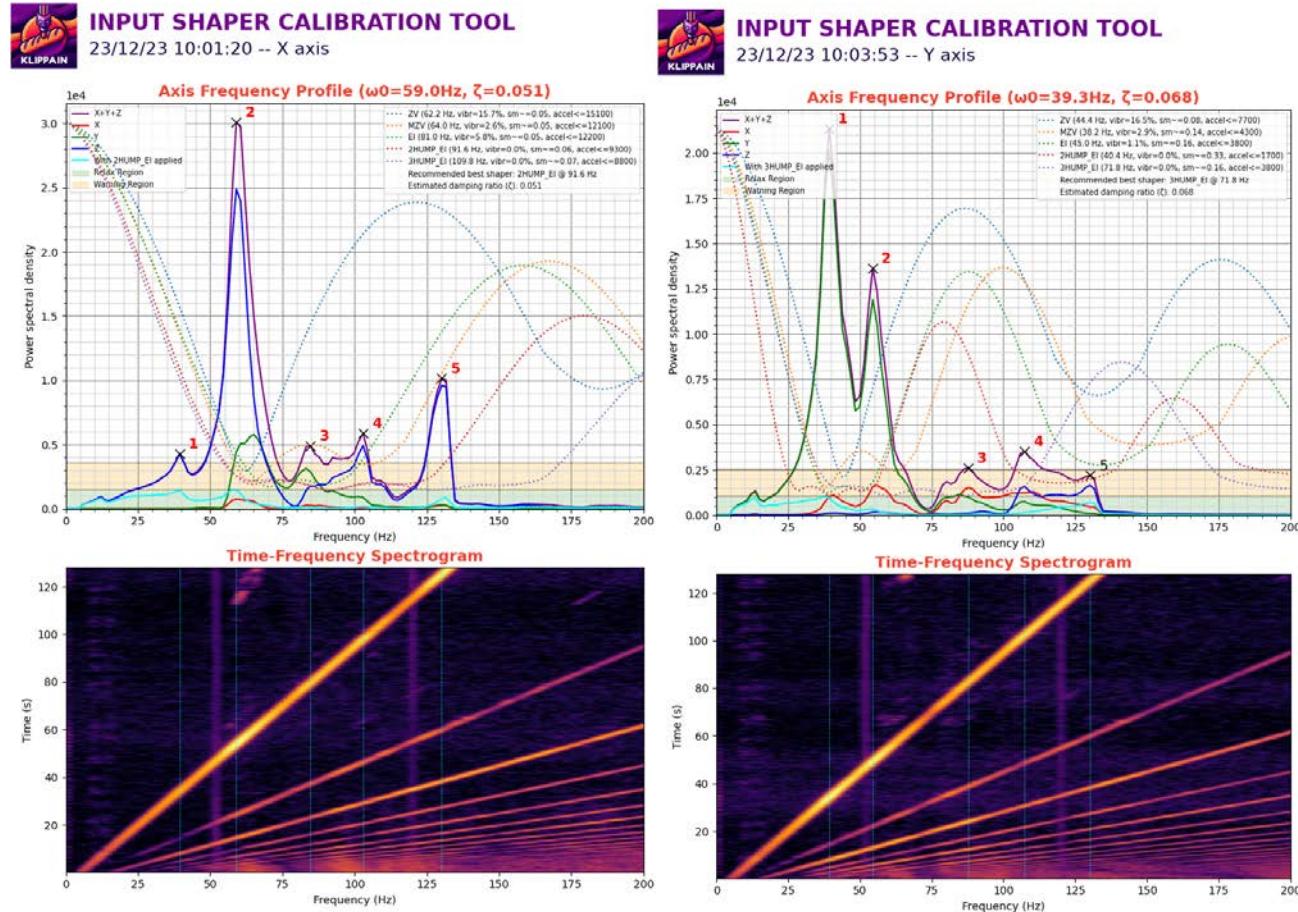
What you see here is two peaks with a valley between them and the valley goes to zero. This is very similar to the canbus, tap, or linear rail.

The difference is the amplitude of the 75 hz spike is equal to or greater than the real freq of around 50hz.

-graphs by rafs2921

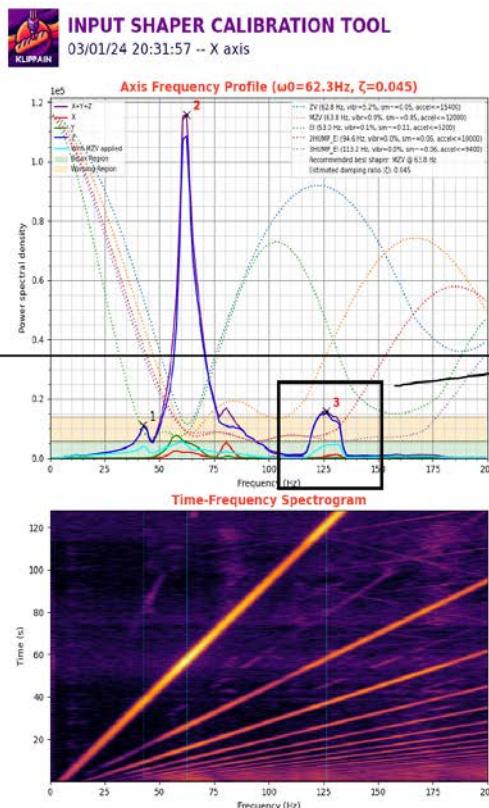
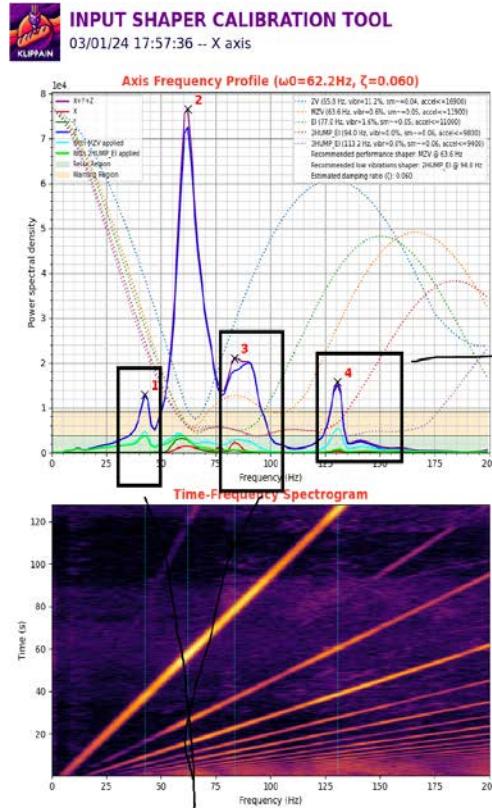


Not using all four screws to secure tap to the x-linear rail – missing two screws.
Likely similar if screws are loose.

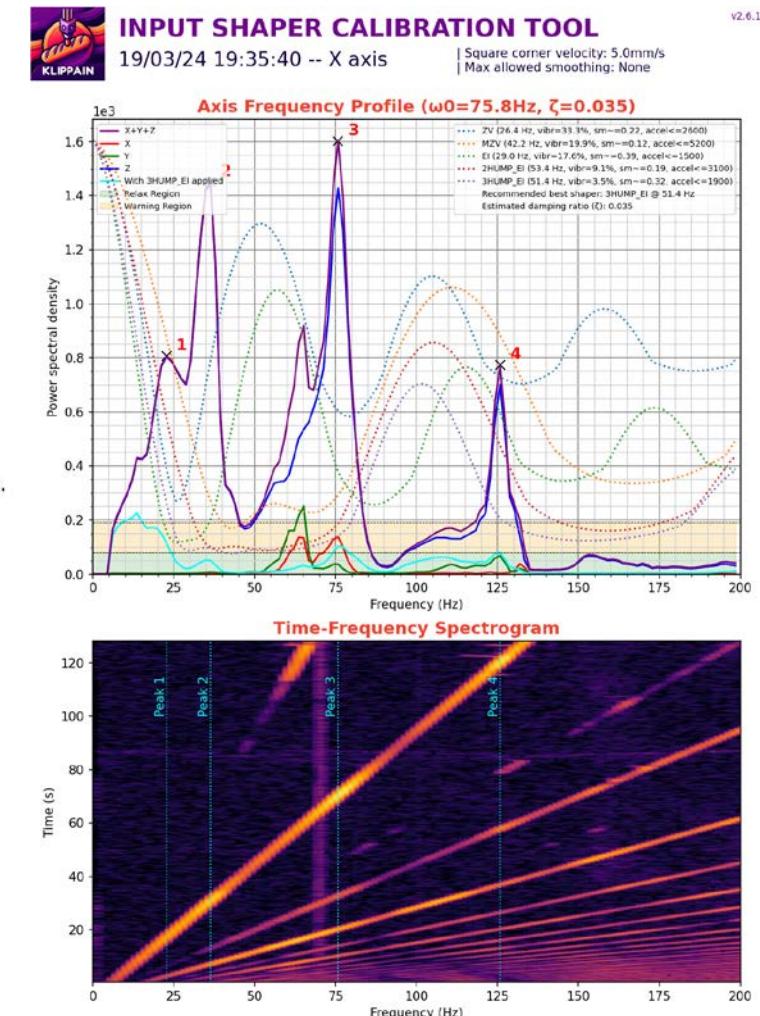


What a bad x-linear rail looks like.

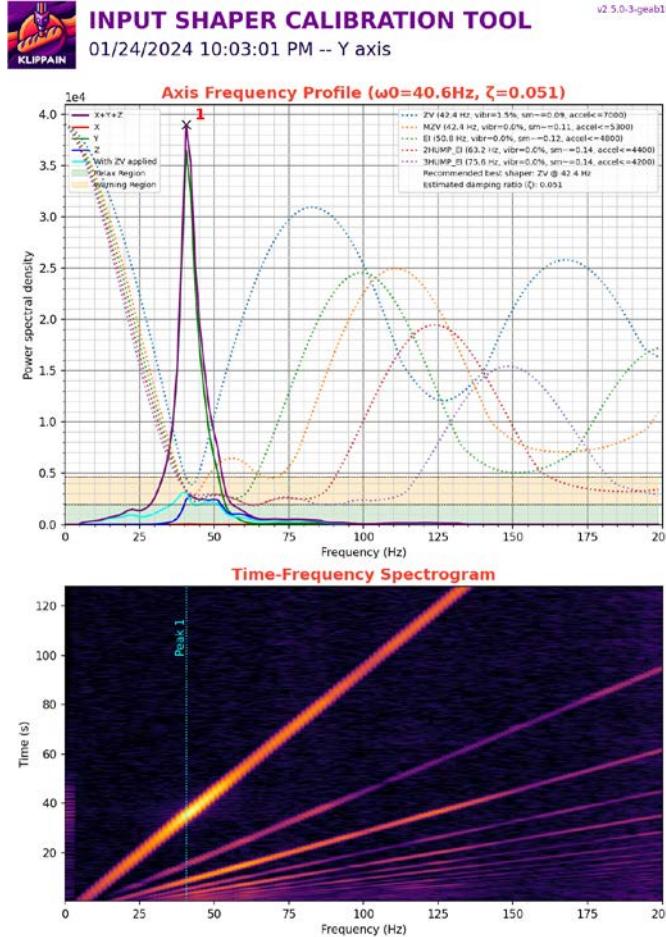
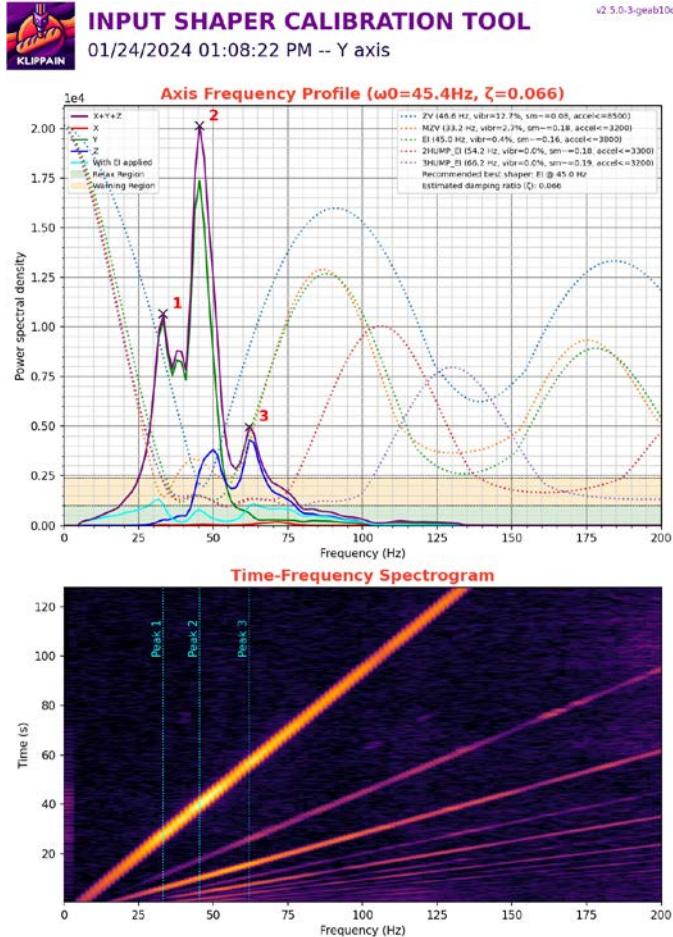
125hz is not the x-linear rail



Tap:
using mellow tap.
likely umbilical is causing some of this.



Printer wobbled on floor. Added dampers to the printer feet



Ioannis_gi V2.6589
Used: Raise It Isolation
Feet for Speaker
Vibration/Ventilation

As additional vibration
damper



Fans effects on graphs

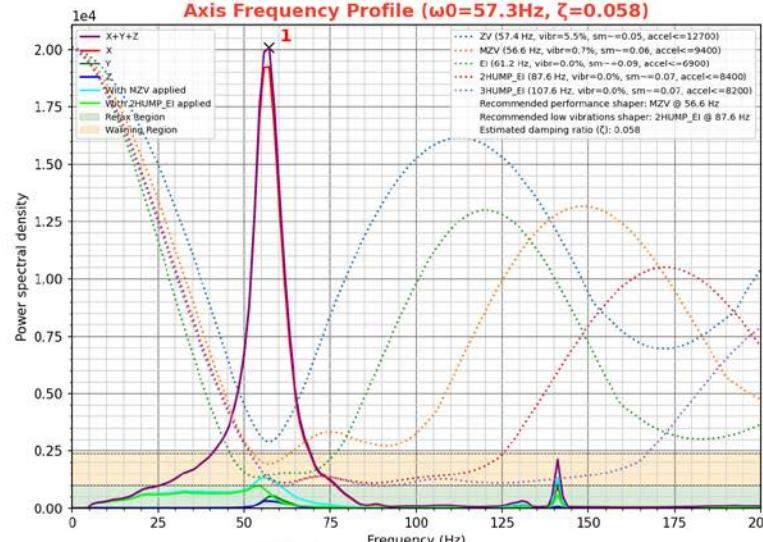
by Nick|VS|V0|V2



INPUT SHAPER CALIBRATION TOOL

23/04/24 12:36:22 -- X axis

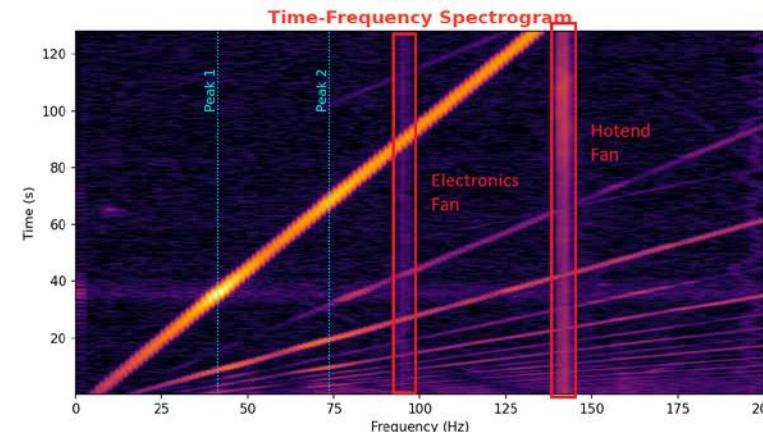
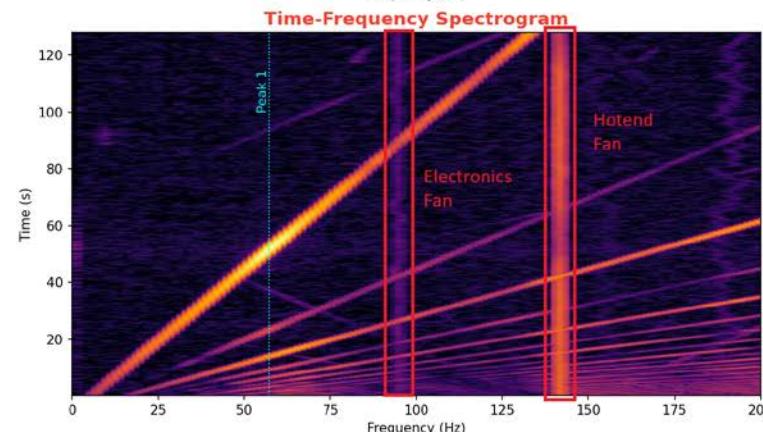
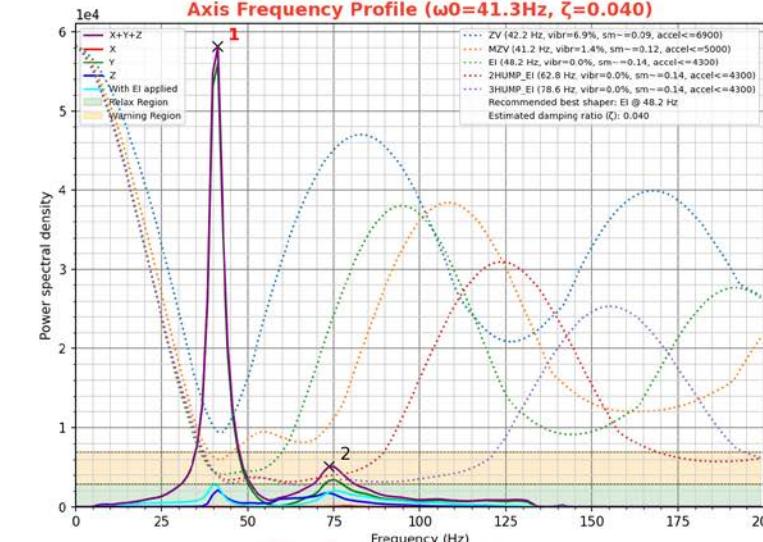
| Square corner velocity: 5.0mm/s
| Max allowed smoothing: None



INPUT SHAPER CALIBRATION TOOL

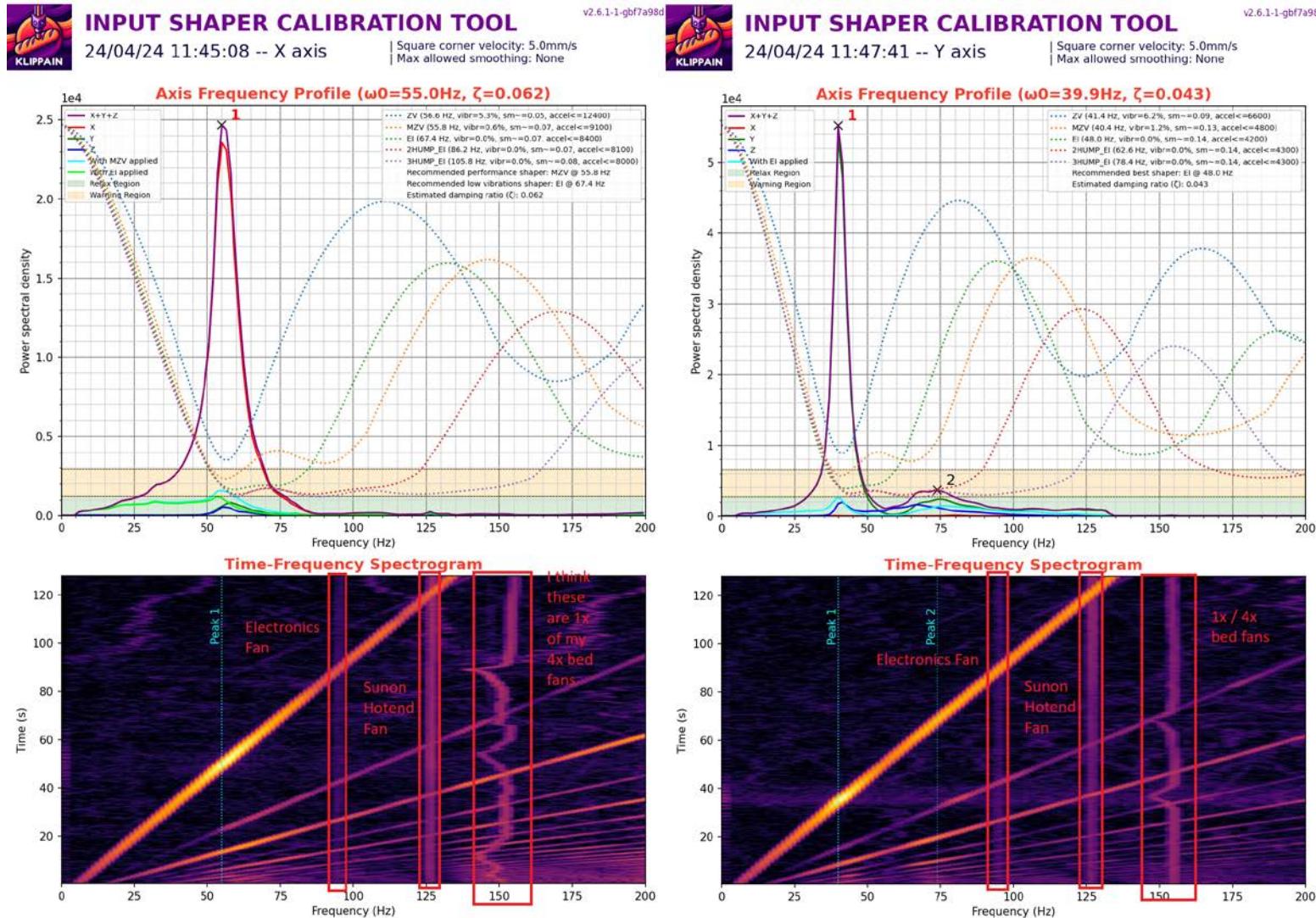
23/04/24 12:39:00 -- Y axis

| Square corner velocity: 5.0mm/s
| Max allowed smoothing: None



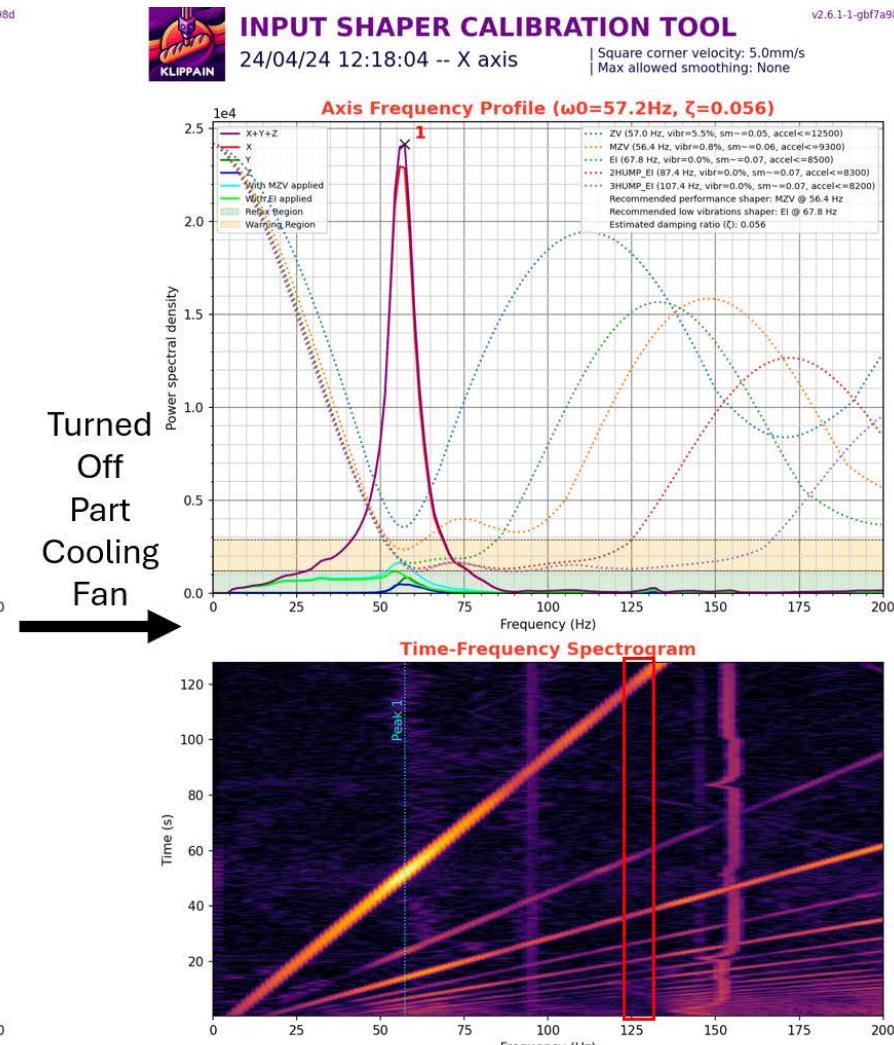
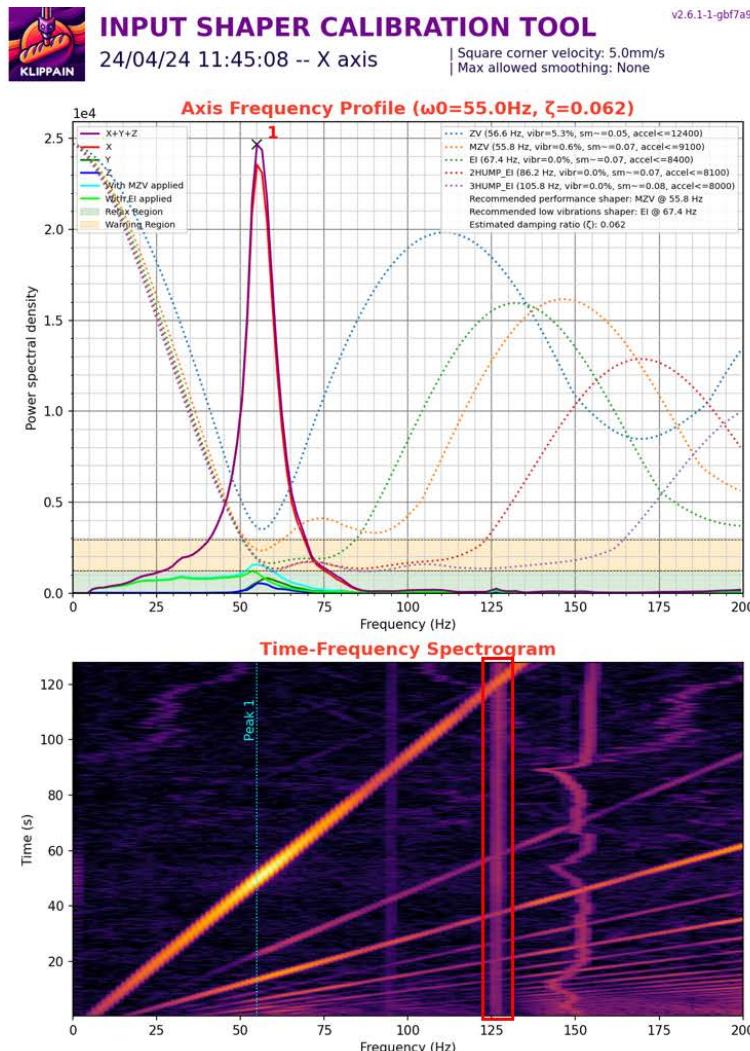
Fans effects on graphs

by Nick|VS|V0|V2



Fans effects on graphs

by Nick|VS|V0|V2



Turned
Off
Part
Cooling
Fan