# HYPEROXIA

# + HYPOXIA

## DUAL PASSIVE HPF/LPF/BPF

## BUILD GUIDE

**V1 - MAY 2024**

# HERZLICH LABS

## Table of contents

## Introduction

Thank you for choosing a HYPEROXIA + HYPOXIA DIY KIT - this build guide will help you in your endeavor to successfully build your new dual passive audio filter - I recommend you read the build guide before starting your build, and I suggest leaving everything in the bags they came in until you are instructed to retrieve something from them. Mostly because there are small parts that can scatter to the floor and disappear forever. Yes, forever. The HYPEROXIA + HYPOXIA is not a difficult build, but you can avoid potential pitfalls by following and familiarizing yourself with the build process before starting.

## Safety

Building electronics is a fun and rewarding hobby, but just as you practice basic safety procedures while cooking, so should you practice basic safety precautions in your workshop. Below are some recommendations on measures you should take while working:

- **Your soldering iron is dangerously hot.** When not in use, be sure to put it somewhere where it will not fall or roll away, and where you are not at risk of snagging the cable and making it fall on something, or yourself, as you work.

- **Be mindful of toxic chemicals and fumes.** I recommend using lead-free solder, working in a well-ventilated area to dissipate fumes, and if you opt to use leaded solder, be sure to wash your hands after soldering, and do not eat or drink in your work area.

- **Wear adequate eye-protection.** A good pair of safety glasses will not obstruct your vision, will be comfortable to wear for extended periods of time, can be had for less than €9 and will, most importantly, protect your eyes from injury. Hot solder can spit, and trimmed leads can turn into projectiles, both of which can cause irreversible damage to your eyes. Make it a habit to wear safety glasses while working.

**You are responsible for your own safety while working** – so please don't e-mail me if you decided squinting your eyes while trimming LED leads was a sufficient alternative to a pair of safety glasses and end up in the emergency room. With proper health and safety precautions, you can look forward to practicing your hobby for many years to come.

## Equipment

You will need some basic hand tools and, ideally, some proficiency with them to successfully complete this project. If you need to buy tools, or if your tools are not up to the task, I recommend buying the best quality tools you can afford - it will serve you best in the long run, and you will not have to continuously upgrade every time a cheap tool breaks or proves insufficient.

I have added some tool suggestions in parenthesis, but please note I have no commercial interest in recommending one tool over another, this is only to help other people find tools they will be happy to use for years to come. You will need:

- A temperature-controlled soldering iron
- Needle-nosed pliers (Engineer PS-01)
- Low-profile side cutter (Knipex 78 71 125 ESD w/ lead catch)
- Good quality lead-free solder
- Safety glasses (Bollé Silpsi)
- Cyanoacrylate glue

The following tools are not strictly necessary, but will prove useful:

- Knurled nut driver (~~Xicon 382-0006~~ **Herzlich Labs knurled nut driver**)
- Socket wrenches (Bahco SL25)
- A decent multimeter
- Anti-static tweezers
- Reverse ceramic tweezers
- Solder braid and liquid flux
- Desoldering pump (Engineer SS-02)

These tools will all prove useful in countless other DIY projects – if you do not own some or any of the tools above, try reaching out to friends or even local hackerspaces, who will more than likely be happy to lend you the tools. Alternatively, you can of course also buy the tools you need, especially if you think you will build more DIY projects in the future.

**The Xicon driver was discontinued, but fortunately now several options for replacements exist, including one I designed myself.*

## Design notes

Ever needed to cut some low end before passing a signal into a reverb? Maybe you need to tame the highs on a hissy digital oscillator, or maybe you want to experiment with bandpass filtering your drums before they hit the mix?

That all sounds great, except your super high end, extraordinarily multi-functional, CV-over-every-parameter, 28hp, multi-pole-output, styroflex-capped, analog, boutique filter is currently occupied sweeping a square wave instead. Yes, another day will have to go by where you can't free up a filter to do some basic filtering duties in your rack, because there isn't enough "rackspace" or "money" to buy a new filter for each and every one of these purposes.

Having designed 0hp "utility" filters in the past (called *Hyperoxia* and *Hypoxia*), I knew too well these struggles, and sought to solve them, but over time the overly miniaturized and finger-unfriendly designs demanded a touch-up. Not wanting to depart from the 0hp format, but also not quite prepared to force it upon the user, I designed the hybrid 1U/0hp format – effectively 1U, but easily converted to 0hp for those without 1U rails (or simply the lack of rackspace).

The lovely thing about the Hyperoxia + Hypoxia filter, is that it can serve both as two independent filters – a HPF and a LPF – or, through the magic of normalization, as a BPF. Simply plug your signal into the HPF input and out of the LPF output, and listen as the magic happens, and you now have a wonderful passive bandpass filter.

Anyway, enough chit-chat, warm up the soldering iron and have fun.

## BOM

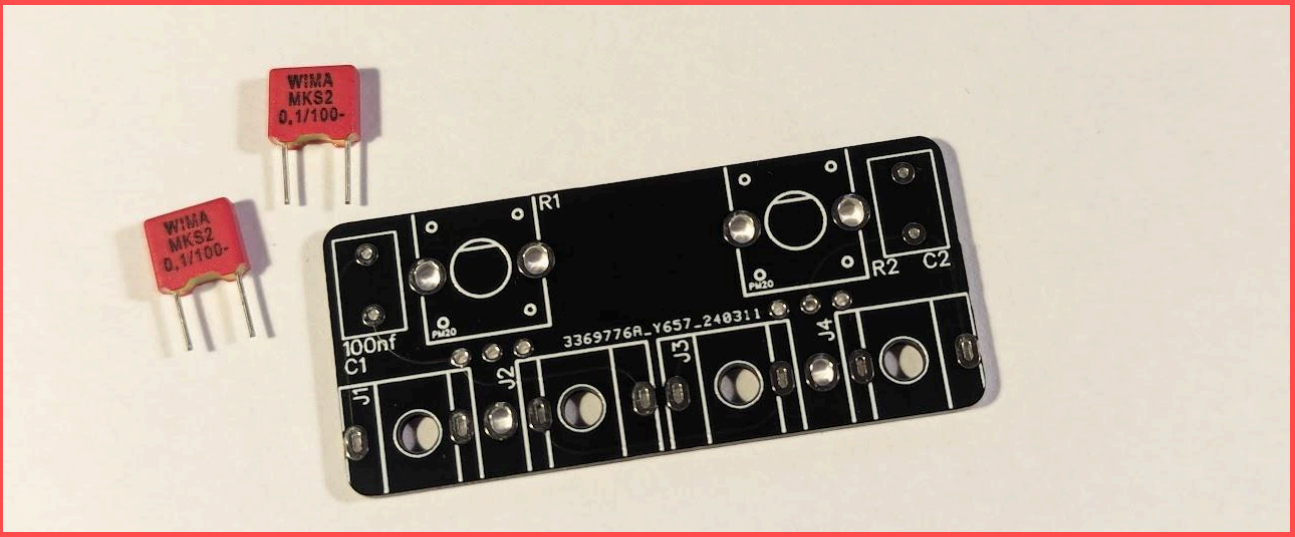
| Component | Qty |
|---|---|
| 50kA pot | 2 |
| 3,5mm jack | 4 |
| 0,1uF film capacitor (WIMA) | 2 |
| M3 brass bolt | 2 |
| M3 brass insert | 2 |

## Build guide

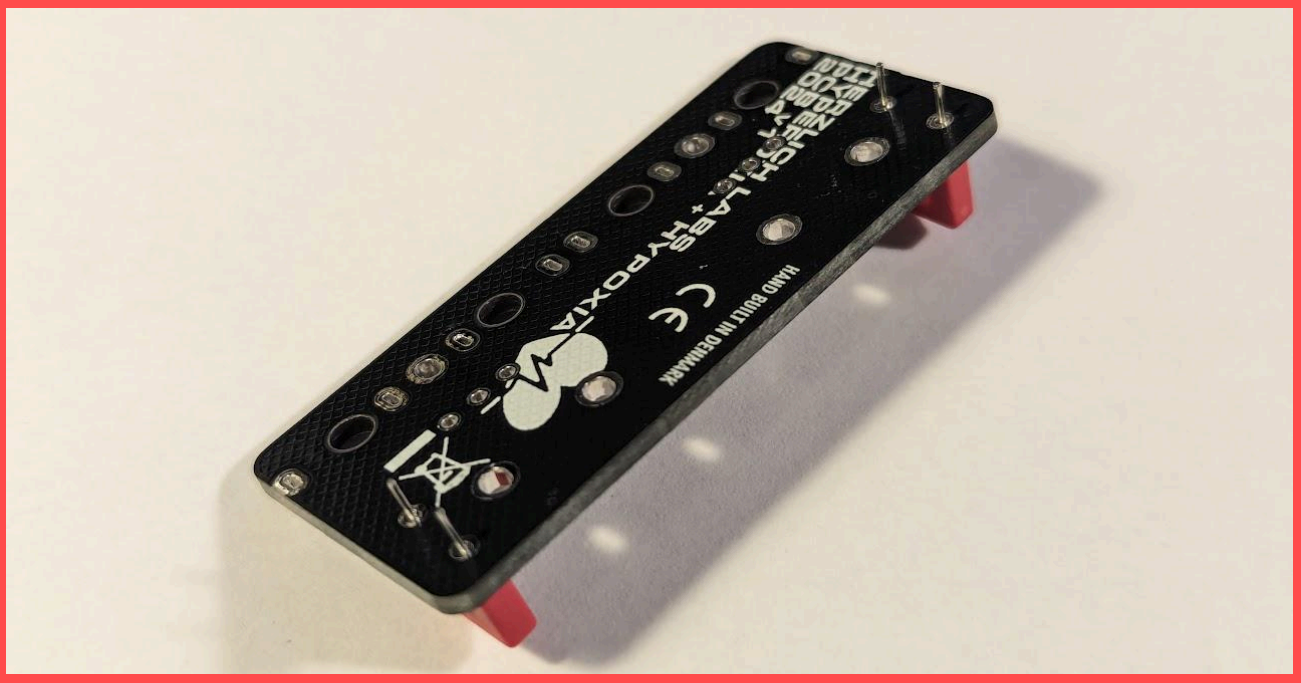
Let's build – don't worry, it's not difficult at all, I promise. Usually, this is the part where I warn you about pitfalls to come, but it's not a difficult build. I still recommend reading the guide briefly before beginning, so you are familiar with the process.

### STEP 1: Populating the PCB

It is good practice to always populate your circuit board with the lowest clearance components first. In this case, the lowest clearance component is capacitors. Stick them right in on the side of the board with the silkscreen indicating C1 and C2, with the rough rectangular outline of the capacitors.




By bending the leads slightly once inserted, you should be able to turn the board around and solder the legs in place easily. Once they are soldered, turn the board over and verify that the capacitors are nice and flush against the board, before cutting the leads close to the board. If something isn't flush reheat the solder joint and press the errant capacitor flat against the board as you let the joint cool. This procedure is applicable to most electronics DIY, so keep it in mind as you go!

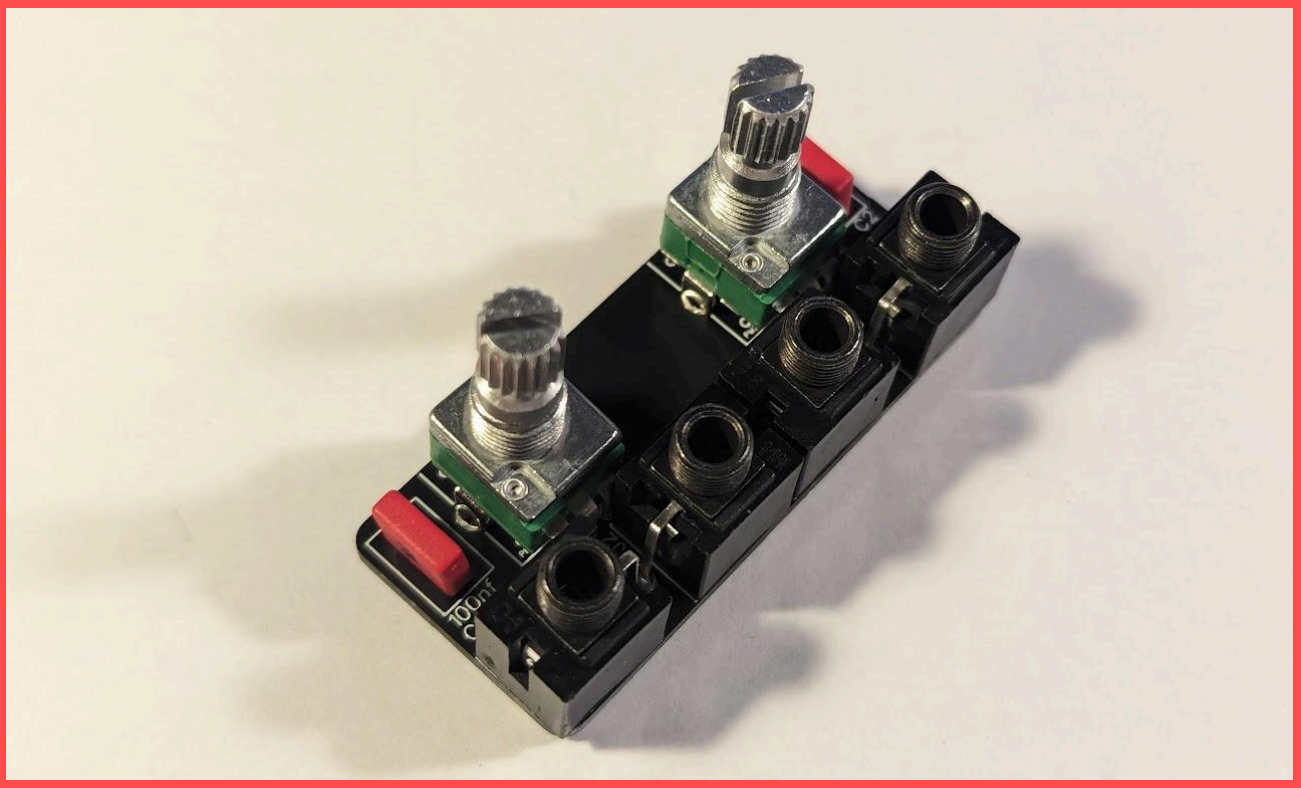



Next, install the 3,5mm jacks. Pay close attention here, as the jacks must be inserted so that they share ground pins (the exposed pin) in pairs. It is **very important** that you insert them like this before soldering, because it's going to be a real hot mess to sort out if you don't. You have been warned.

When soldering the jacks, it is good practice to solder just one pin on each jack first, before turning over the board and checking that everything is flush. If everything looks OK, proceed to solder the rest of the pins, otherwise, use the trick from before to make everything sit just right.

Finally, insert the potentiometers – you may have to bend the leads a bit to make it fit just so, and it may take a bit of pressure to go in, although it should not require violence. Verify that everything is inserted correctly before proceeding to solder the pins.

With that, you are done soldering, and can pat yourself on the back for a job well done.



## STEP 2: Mechanical assembly

As you may have noticed, this device is capable of performing both as a 1U racked unit, or as a 0hp in-line unit. To keep the device a 1U unit, simply skip the final step of the assembly.

Assembly is fortunately both simple and straightforward. Start by taking the front panel, and placing it over the components – if you have assembled the unit well, it should fit snugly. Now, slip the knurled nuts over the jacks and tighten them, making sure not to overtighten one before tightening the rest – it is better to tighten them all loosely first, then firmly at last.


As for the potentiometers, there are nuts included, but they are not strictly necessary. You can install them if this is an exercise you think you will enjoy, but there is no requirement, the front panel is already very securely connected.

Finally, press the knobs over the potentiometers. Use the indices on the front panel to help you align the knob at the 0% or 100% position, making sure the potentiometer is twisted either fully CW or CCW before you do. It is normal to feel some resistance as you press on the knob, but if you need to use a huge amount of force, try taking off the knob and reseating it to get a better fit.

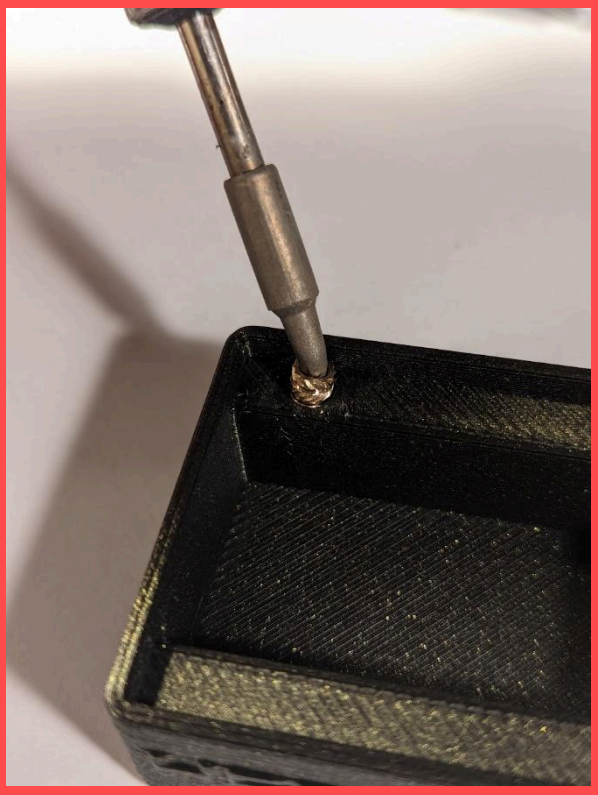

To test the device, simply patch in a harmonically rich signal (such as a square wave) in either the HPF or LPF input, and listen to either the HPF or LPF input to get HPF, BPF or LPF. If something is not working as expected, try reflowing your solder joints.

The device is now ready to use in 1U format. Continue to step 3 to see how to make it 0hp!

### STEP 3: 0hp assembly

Not content with using your 1U rail? Maybe you don't have one? Not to worry, let's make this thing 0hp right away. Take the 3D printed enclosure from the bag, and identify the two knurled brass inserts. Like a weird magic trick, you are going to insert these brass inserts into the holes in the enclosure.

Using a hammer may seem tempting, but you have a much better tool at your disposal: your soldering iron. Place one of the nuts over the hole, so that the narrow end is pointing towards the hole. Now, heat your soldering iron to normal working temperature, and use the tip to gently press the insert into the plastic.



The heat from your soldering iron will disperse into the brass insert, which in turn melts the plastic. Do *not* use more than a slight amount of pressure, let the heat do the work – you're merely guiding the nut into the hole, not pressing it in. Once the nut is just below the surface, give your iron a little twist and release the nut. If you have done this correctly, the nut should stay in place as the plastic hardens around it, forming a very secure connection.

Repeat this process for both inserts, and finally place your module in the enclosure. The inserts will make it easy for the bolts to secure it in place. That’s it, you’re all done!


## Support

Sometimes things go wrong - that's OK! If you have run into trouble while building your module, and you can't seem to get yourself out of trouble, you can reach out to lb@herzlich.technology for assistance. Please send well lit, high resolution photos of your PCBs to help me investigate and identify the problem with you.

-