Herzlich Flatliner

DIY Kit 2022

Build guide

V1.1 (October 2022)

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Warning

Although you are probably eager to get started, please do not solder anything until you have at least skimmed this guide. It contains advice on building this project that you may be grateful to have read now, and not later, when you've made a hilarious and awful mistake.

This project is suitable for people who have a basic familiarity with soldering and synth DIY projects, but an ambitious beginner could also take on this project and succeed. There are multitudes of excellent guides out there on how to solder well, so this guide will not cover that practice, and assume the reader is already familiar with this.

Introduction

Thank you for choosing **HERZLICH** – this is the guide for the **GABOR** passive octave bandpass filter, which is inspired by old test equipment filters which have since become famous. Although this is not an exact recreation of those, the circuit emulates the same principle by which they work, optimized for use in a modern Eurorack system.

As it is a passive filter, you should expect volume level to drop when using the filter. However, this is easily corrected by amplifying the output with a VCA, and very interesting and musical results can be achieved by patching feedback and extreme levels of amplification and scanning the various filter bands. This filter rewards experimentation, and you will certainly find many interesting and unusual uses for it in both sound design, EQ and mixing duties.

Safety first, pal!

Building your own electronics and musical instruments is a safe and enjoyable hobby, but safety always comes first. When working on this project, please take adequate precautions when soldering and using hand tools. This includes:

- Wearing suitable eye protection when soldering and using side cutters.
- Soldering in a well-ventilated area, either by a window or with a solder fume fan.
- Placing your soldering iron in a suitable, secure position when not in use.
- Washing your hands after using leaded solder.

Tools required

- Soldering iron
- Solder
- Multimeter
- Side cutters
- Pliers
- Flathead screwdriver

Customizing your Gabor

At the time of writing, the Gabor Octave Filter has been discontinued, but sales of PCBs and panels will continue while supplies last. As such, the adventurous DIY'er will find themselves in a fun situation: the opportunity to customize their Gabor.

I'll try to spare you the math, but effectively, the Gabor is designed to span octaves surrounding the midpoint described for each band, ranging from 31.5 Hz to 31.5 kHz. The passband for each band is defined as:

Band frequency: f_0

Low pass cutoff (f_L): $f_0/2$

High pass cutoff (f_H): f_0*2

This is inspired by the original B&K 1613 design documents, which uses this exact specification to define the span of each pass band. Bravely armed with this new knowledge, you can define your own pass bands, and create other filters, such as a Mel-scale filter, or a filter with narrower or wider passbands.

How so, you ask? There are plenty of useful tools online to help you calculate filters, but you effectively want to calculate the configuration of the low pass and high pass filter for each passband to create 22 different filters. I recommend Omni Calculator (https://www.omnicalculator.com/physics/high-pass-filter and https://www.omnicalculator.com/physics/low-pass-filter) as a good starting point in your quest for customization. Referring to the definition from before, you can quickly identify the desired cutoff frequencies for your filters based on f_0 – but keep in mind that you must stick to one capacitor size for each the low pass and high pass filter.

If you do this, I would recommend you redesign both filters with 100nF caps as a starting point. You are of course free to make your own decisions, you're presumably an adult human with a credit card, you can do whatever you want.

The values in the BOM are very exact – yours will not necessarily need to be, and you will not need to use every available resistor slot for every filter. Be mindful, however, not to leave any empty – simple place a 0R resistor or a jumper wire in every slot you do not use. For reference to what resistors are assigned to which filters, please refer to the included schematic drawing.

Building your Gabor from PCBs and panels happens at your own responsibility – I can't know every component you decide to buy or how you assemble your unit, but I think you will find building (and especially customizing or redesigning) the Gabor to be both fun and intellectually satisfying.

Now, go calculate! Go build! Go solder! Go order components! You can do it!

BOM

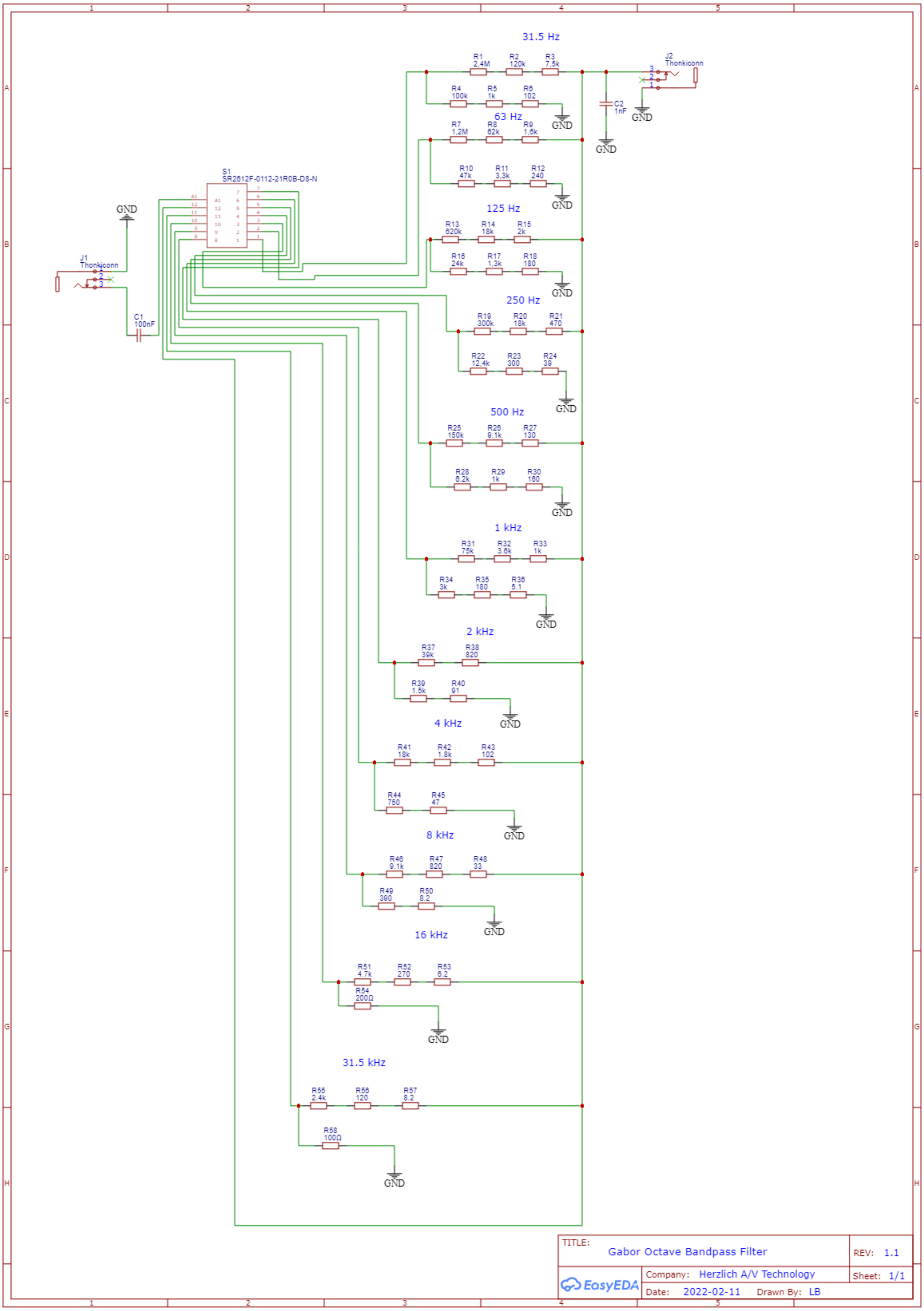
Name	Designator	Quantity
4x1 Pinheaders*	U1,U2	2
12 Pos Rotary Switch i.e. SR2612F-0112-21R0B-D8-N	S1	1
2.4MΩ resistor	R1	1
120kΩ resistor	R2	1
7.5kΩ resistor	R3	1
100kΩ resistor	R4	1
1kΩ resistor	R5,R29,R33	3
102Ω resistor	R6,R43	2
1.2MΩ resistor	R7	1
62kΩ resistor	R8	1
1.6kΩ resistor	R9	1
47kΩ resistor	R10	1
3.3kΩ resistor	R11	1
240Ω resistor	R12	1
620kΩ resistor	R13	1
18kΩ resistor	R14,R20,R41	3
2kΩ resistor	R15	1
24kΩ resistor	R16	1
1.3kΩ resistor	R17	1
180Ω resistor	R18,R35	2
300kΩ resistor	R19	1
470Ω resistor	R21	1
12.4kΩ resistor	R22	1
300Ω resistor	R23	1
39Ω resistor	R24	1
150kΩ resistor	R25	1
9.1kΩ resistor	R26,R46	2
130Ω resistor	R27	1
6.2kΩ resistor	R28	1
160Ω resistor	R30	1
75kΩ resistor	R31	1
3.6kΩ resistor	R32	1
3kΩ resistor	R34	1
5.1Ω resistor	R36	1
39kΩ resistor	R37	1
820Ω resistor	R38,R47	2
1.5kΩ resistor	R39	1
91Ω resistor	R40	1
1.8kΩ resistor	R42	1

750Ω resistor	R44	1
47Ω resistor	R45	1
33Ω resistor	R48	1
390Ω resistor	R49	1
8.2Ω resistor	R50,R57	2
4.7kΩ resistor	R51	1
270Ω resistor	R52	1
6.2Ω resistor	R53	1
200Ω resistor	R54	1
2.4kΩ resistor	R55	1
120Ω resistor	R56	1
100Ω resistor	R58	1
100nF film capacitor	C1	1
1nF polystrene capacitor	C2	1
3.5mm phone jack i.e. PJ398SM	J1,J2	2
Big control knob**	N/A	1
3D printed washer*	N/A	1

* Included with PCB and panel kit. Thanks, Herzlich!

** You can use whatever you want. I recommend TE Connectivity PKB90B1/4.

Schematic



31.5 Hz
R1 2,4M
R2 120k
R3 7,5k
R4 100k
R5 1k
R6 102
63 Hz
R7 1,2M
R8 62k
R9 1,6k
R10 47k
R11 3,3k
R12 240
125 Hz
R13 620k
R14 18k
R15 2k
R16 24k
R17 1,3k
R18 180
250 Hz
R19 300k
R20 18k
R21 470
R22 12,4k
R23 300
R24 39
500 Hz
R25 150k
R26 9.1k
R27 130
R28 6.2k
R29 1k
R30 160
1 kHz
R31 75k
R32 3.6k
R33 1k
R34 3k
R35 180
R36 5.1
2 kHz
R37 39k
R38 820
R39 1.5k
R40 91
4 kHz
R41 18k
R42 1.8k
R43 102
R44 750
R45 47
8 kHz
R46 9.1k
R47 820
R48 33
R49 390
R50 8.2
16 kHz
R51 4.7k
R52 270
R53 6.2
R54 200Ω
31.5 kHz
R55 2.4k
R56 120
R57 8.2
R58 100Ω
GND
C2 1nF
J2 Thonkiconn
J1 Thonkiconn
C1 100nF
S1 SR2612F-0112-21R0B-D8-N
TITLE: Gabor Octave Bandpass Filter
REV: 1.1
EasyEDA
Company: Herzlich A/V Technology
Sheet: 1/1
Date: 2022-02-11
Drawn By: LB

Build guide

Before you do anything, I recommend reading the headline for every step, so you'll be familiar with the process. The build is not particularly hard and is suitable for someone who has tried soldering before or an ambitious beginner. With the DIY kit it's practically paint by numbers, but with resistors and solder instead of paint.

Notice that you may have received sweets with your order. You can use these to distract nearby family members while you work, or you can use them as a performance enhancer while you take a break from soldering.

1. Identify and place all resistors in their appropriate slots on the main PCB.

There is a total of 58 resistors that you must place in each their respective slot. If you bought a DIY kit, I will have numbered the resistors on their paper tab as a service, to make it easy for you to put each in its right place. If you are in doubt, if a paper tab has gone missing or is illegible, use a multimeter to measure the resistance, or use the color band code to determine the value of the resistor. and cross-reference the BOM to see where the resistor belongs. In exceptional cases, the same value resistor is used in multiple places – if there is only one number, cross reference the BOM to see where the other resistors belong. For example, resistor 14 is identical to resistor 20 and 41. 3

Note that R32 may not have a tag attached.

At this stage, using a pair of needle nosed pliers to shape the legs before you put the resistor in, will be helpful, but it's not critical.

2. Solder all the resistors, while holding the PCB firmly against a flat surface.

Now that you have placed all the resistors in their respective slots, carefully turn over the PCB and lay it flat against a hard surface, such as a table, with the resistors facing down towards the table. This will help you ensure they sit nice and even while you solder.

For this step, I find it's easiest to solder one row at a time, then snipping all the legs and moving on to the next row. You may use whatever method you prefer, of course.

3. Solder the capacitors.

Identify the capacitors first: the red box-shaped capacitor is a 100nF film capacitor and goes in C1. You may have to shape the legs slightly to fit. The other, big, round, silvery capacitor is a 1nF polystyrene capacitor, and goes in C2.

The worst is over – but now is a good time to take a break if you need to stretch your legs.

4. Solder the pinheaders to the main PCB.

Place the pinheaders as indicated on the main PCB, flip it over, and solder one leg on each pinheader into place while applying firm pressure on the PCB. You will want each pinheader to be installed flatly and evenly, perpendicular to the main PCB. Once you've checked that everything looks good, solder the rest of the legs.

5. Solder the 3.5mm phone jacks to the small blue PCB.

The small blue PCB contains the 3.5mm phone jacks – install them according to the silkscreen and solder them nice and flat against the PCB. Again, I suggest soldering one leg first and checking your work, you'll save yourself a lot of trouble that way.

6. Solder the small blue PCB to the main PCB.

If you've done everything right so far, this part should be easy – push the small blue PCB against the pinheaders on the main PCB, and solder them together, making sure the connection is flat and perpendicular.

7. Solder the rotary switch.

You're almost done! Insert the rotary switch – there's only one way it will go in, and it may take firm pressure to make it slot in nicely, but it should not require violence. Be careful not to bend the legs. Solder the legs, and you're almost done.

8. Check your work.

Well done on making it this far – take a break to inspect all your solder joints, looking for bad and cold solder joints. Now is also a good time to test continuity between the inner pin of the switch and the leftmost pin of R1 when the switch is in the furthest counterclockwise position. Also test continuity on the pinheaders between the boards. This is a good way to catch if you've made some sort of unusual mistake early on.

I also suggest cleaning your boards with isopropyl alcohol at this point. It's good practice, and it makes your boards look all nice and clean, and it can prevent shorts caused by flux and errant bits of solder you might not have spotted.

9. Install the panel and hardware.

Unscrew the knurled nuts on the 3.5mm phone jacks and the hex nut on the rotary switch. Leave the lock washer in place on the switch and place the 3D printed washer on top of the lock washer. Place your front panel on top, guiding the 3.5mm phone jacks and the shaft of the rotary switch through the holes.

Now, install both knurled nuts on the 3.5mm phone jacks. Tighten them as much as you can with your fingers, or use a size 7 fixed wrench for help, but do *not* overtighten these as you risk stressing the joints beneath. Finally, install the hex nut on the rotary switch, and tighten it just enough that it sits snugly and securely against the board. Do not overtighten this, either, but feel free to use a pair of pliers to help.

Now all that remains is to install the big knob. Twist the rotary switch to the furthest counterclockwise position, and place the knob on top, letting the pointer rest at the *1* index. Screw the locking screw in firmly place with a flathead screwdriver and try turning the switch: it should align well with every index and stop at *12*.

10. Enjoy yourself!

Congratulations, you did it! All that remains now is install the module in your rack and experiment. The Gabor rewards experimental patching, especially feedback, overdrive and wavefolding can generate interesting and unpredictable results.

Be sure to share if you discover a cool patch, either directly or on Instagram at *@HerzlichLabs*!

Troubleshooting

- My module doesn't output any sound!
  - Check all the pass bands: your sound could be above or below the pass band.
  - Check band 12: your sound should be audible on band 12.
  - Check your levels: the module can strongly attenuate certain signals, and it may be necessary to amplify them with a VCA, or even a VCA into a VCA. Feedback patching and experimentation is highly encouraged!
  - Check your work: visually inspect your solder joints, and reflow any joints that look suspicious.
  - Check for continuity: if there's still nothing, check that there's continuity between the joints that should be connected.

- My output is very low in volume!
  - The lowest filter bands go *real* low. They also attenuate the sound a bit. Bring them back up with a VCA, or even a VCA into a VCA. Exploring this path may also lead you down a road of feedback patching, which this module excels at, and is highly encouraged!
  - Keep in mind that it's a passive module: it won't amplify on it's own. Some signal drop is to be expected.

- Something is missing from my kit!
  - Don't panic. Check your surroundings, you may have dropped it somewhere – if it's truly gone, you may have a spare part that you can replace it with. If it's really, truly completely gone, get in touch with me and I'll send you a replacement, it'll be fine.

Contact

This module was designed by me, Lars Bjørn Lehmann, in February 2022. I own and operate Herzlich Audiovisual Technology which is a company founded in Copenhagen, Denmark. I design the circuits, I make the coffee and I send your stuff in the mail – I handle all things that keep the heart of Herzlich pumping.

If you have questions, comments or concerns, you are always welcome to get in touch on the platform where you bought the product, or on lb@herzlich.technology where I strive to answer all messages within 24 hours on weekdays.

Thank you for choosing **HERZLICH**.