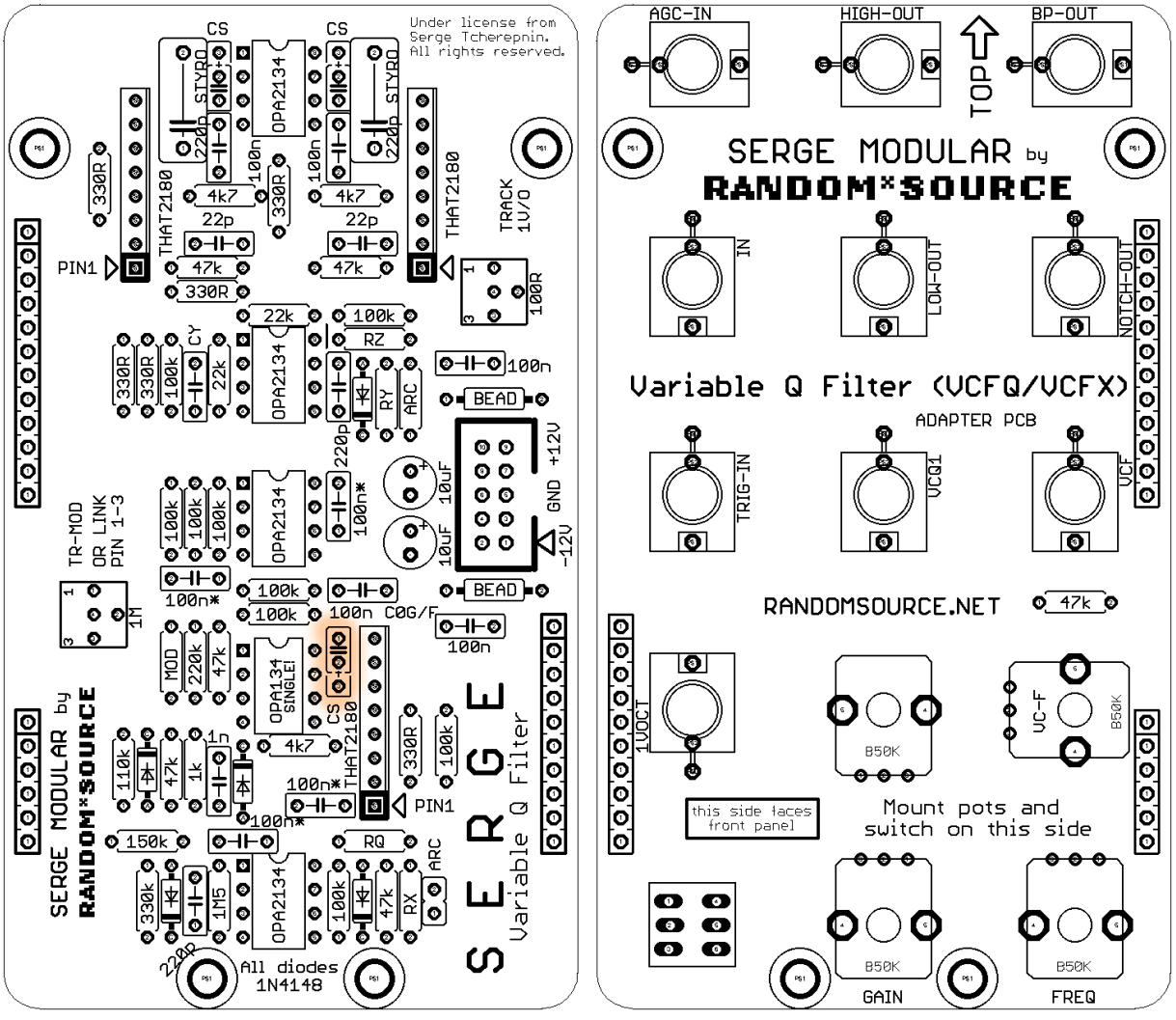
SERGE Variable Resonance Filter (VCFQ) for Eurorack

The Random*Source version of the filter is a licensed and authorized adaption of the legendary Serge filter for Eurorack. It is an updated design that uses 3 **high-end THAT2180 VCAs** for superior audio performance - a change that has been approved by Serge Tcherepnin.

This module is the “Extended Range” version (VCFX) - a switch (“LOW”) extends the range of the filter into the sub-audio range. The filter may then be used to filter low-frequency control voltages. Triggers applied to the TRIG in will cause the filter to go into damped low frequency oscillations, controlled by the Q and the filter’s FREQUENCY.

The Serge Variable Resonance Filter consists of a main pcb and a matching component pcb serving as an interface to the front panel:



Please note:

- The 2180 is available in 3 different versions - A being the most selected (and most expensive) while C has slightly lower specifications, B being in between. Each version has far better audio quality than the VCAs in the original circuit, so any differences between A, B or C are neglectible.
- The module is a faithful implementation of the original Serge circuit designed for Serge voltage levels (black = bipolar, white = CV / unipolar 0-5V, red = Gate 0-5V).
- The main pcb contains an option from the original design (ARC = Auto Resonance Control) that connects the resonance to the frequency and is typically **not** implemented. If you don't intend to use it, leave JP1 ("ARC") open and omit R12 ("ARC").
- Resistor "RMOD" plus the TR-MOD trimpot determine the behavior of the AGC (Automatic Gain Control) input - originally 1 Meg was used, in more recent builds much lower values of 182k are common. 182k leads to higher level, but also more clipping when resonance is turned up. Recommendation is to use 182k for RMOD plus a 1Meg trimpot as TR-MOD turned all the way down (CCW) for a total (initial) resistance of 182k and turn the trimpot up later if need be.
- Be careful: one of the op-amps ("ICG") is a single (OPA134)! Inserting a dual (OPA2134) will kill it! Also, **pay attention to the orientation of the THAT2180s** - pin 1 is marked by a notch on top.
- Capacitors marked "CS" or "CY" are to prevent unwanted oscillations of the op-amps. It is recommended to start with a small cap (**5pF or 7pF) for "CS" next to the single OPA134** (marked orange in the picture above). Ideally that will take care of any issues and you don't have to install anything else. Otherwise add (only if needed), using C0G or Silver Mica as small as possible in the other CS / CY slots.
- SMT bypass caps on the bottom side of the main pcb are an alternative to the 100n bypass caps.
- Board is designed to be powered by a +/-12V stabilized PSU. Please **pay attention to the direction of the power header and the -12V / +12V markings**! Incorrectly connecting the power would cause considerable damage to the ICs. You may want to use resettable fuses instead of ferrit beads (marked BEAD) on the board - see BOM below.

Bill of Materials

Some of the following resistor values are suggestions and may be adjusted according to need/taste (RMOD) - this is DIY!

Resistors (1%)

2	BEAD	F1, F2	Resettable Fuse (PPTC, Bourns MF-R005-0 - carefully bend legs to fit the footprint) or Ferrit Bead
6	330R	R17, R39, R46, R51, R54, R55	
1	1k	R41	
3	4k7	R2, R3, R4	
1	5k1	R37 - marked RY -	
2	6k8	R36 - marked RZ - R27 - marked RQ -	
2	22k	R32, R33	
5	47k	R24, R30, R40, R52, R53	
1	47k	- on the component pcb -	
9	100k	R1, R14, R23, R25, R31, R44, R45, R49, R50	
1	105k	R29 - marked RX -	105k
1	110k	R34	
1	150k	R42	
1	220k	R48	
1	330k	R47	
1	1.5M	R43	
1	-	ARC (AUTOMATIC RES CONTROL)	omit - see comment above - Otherwise, use ARC = 100k & close ARC jumper to link Freq and Q
1	182k	RMOD	- see comment above -
1	1M	TR-MOD	Trimpot (Bourns 3362P or whatever fits) or link pins 1-3 trimmer is an addition (in series) to RMOD - see comment above -
1	200R	T1 (1V/OCT) - marked “100R” on the pcb	Use 200Ω trimpot (Bourns 3362P or anything that matches the footprint) to adjust the tracking of the 1V/Oct input.

Capacitors (min. 35V, 5mm lead spacing except Styroflex / electrolytic caps)

2	22p	C14, C15	Mica or C0G
?	5-10pF C0G or higher as needed	C9, C10, C13 (marked “CS”)	Optional - against oscillations - you might have to install 5pF or 7pF for C13 (marked orange in the picture above). Otherwise install as small as possible if needed.
2	220p STYRO	C16, C17	Styrene/Styroflex
2	220p	C2, C12	C0G (or Styrene)
1	CY	C20	optional, install only if needed against self-oscillation (47pF or smaller)

1	100n	C11	C0G or Film (PET)
2	10uF	C3P, C4P	Electrolytic (or 22uF), 2.5mm lead spacing
1	1n	C1	C0G
8	100n	C3, C4, C5, C6, C7, C8, C18, C19	Bypass caps (not all needed, 6 should do, all 8 won't hurt)
5	100n	CSMT1, CSMT2, CSMT3, CSMT4, CSMT5	Alt. bypass caps (SMT - optional - 1206 or 805)

ICs

1	OPA134	ICG	- Don't confuse with the OPA2134s! -
4	OPA2134	ICP, U1, U2, U3*	Burr-Brown dual op-amp
3	THAT2180	P1, P2, UG	THAT2180C (or THAT2180A or B)
5	1N4148	D3, D8, D9, D10, D11	Diodes

*Using Burr-Brown (OPA) op-amps everywhere might be a bit of an overkill, but they work nicely and I haven't tried anything else. Especially for U3 a TL072 should also do ...

Misc

1	Switch DPST or DPDT	HI / LO mode	Sub-Miniature Switch, e.g. Mountain Switch (Mouser: 108-0043-EVX)
1	Jumper	ARC	- leave open - (unless using the ARC feature)
1	Euro Power header		MTA-100 power connector, Reichelt: WSL 10G
1	SIL header 12pol		pin connectors, linking main pcb to component
1	SIL header 10pol		pcb - using precision strips allows to break off
1	SIL header 6pol		pieces as needed
10	Thonkiconn Jacks		3.5mm Jack Sockets (PJ301M-12) from Thonk
4	Potentionmeter 50k or 100k	linear (B50K or B100K)	Alpha 9mm vertical pcb mount available from Thonk, Tayda

Building

This is simply a suggestion - you might find a different workflow more practical:

1. Use a side-cutter to separate main pcb and component pcb.

2. Mount the Thonkiconn jacks, the pots and the switch onto the component pcb. Pots should sit on the side facing the front panel (as marked on the board). Don't solder them in yet.

3. Carefully mount the component pcb (with the pots etc. inserted) onto the front panel. You may then have to wiggle each pot a bit to get the pots through. Make sure the threads of the pots go through completely and the pots sit right at the front panel. You can even screw the jacks and pots to the panel to make sure of that, but you will have to unscrew them again later.

4. Once everything is nicely in place, solder the pots, jacks und switch onto the component pcb (while the front panel is attached).

5. Stuff the main board, beginning with the resistors, then caps etc.

6. Main pcb and component pcb are to be connected through precision DIP socket and pins. It is recommended to use the pins on the main pcb (facing down, soldered from above) and the pin sockets on the component pcb (standing up, soldered from the front panel side). Break or cut off the pieces you need and stick them together so that main pcb and component pcb form a nice sandwich (don‘t solder yet). Check that you didn‘t leave out any pins / holes and that the sockets are all on the same side (component pcb). Solder all the pins in while keeping the sandwich together - this avoids any misalignments.

7. Carefully separate the sandwich - if you used precision sockets, this may not to too easy - they stick together nicely (giving a good connection).

8. Mount the component pcb onto the front panel again and screw on the pots from the front side.

9. Make sure everything is in place.

10. Attach any screws / spacers if desired and mount the main pcb onto the component pcb.

11. Connect a power cord supplying +12V, GND, GND, -12V to the power-header on the main board and double check the direction of the power header before you turn power on. you should be ready to go :-)

Calibration

Using T1 the **1V/Oct tracking** can be adjusted. Patch the filter to self-oscillate (BAND out to IN jack and turn up the GAIN pot) to do so. However, be aware that there’s no temperature compensation and the 1V/Octave responce can probably not be compared with oscillators.

Power Consumption

Power consumption: appr. 52mA @ +12V and 52mA @ -12V

(Version 04 Feb 2016)