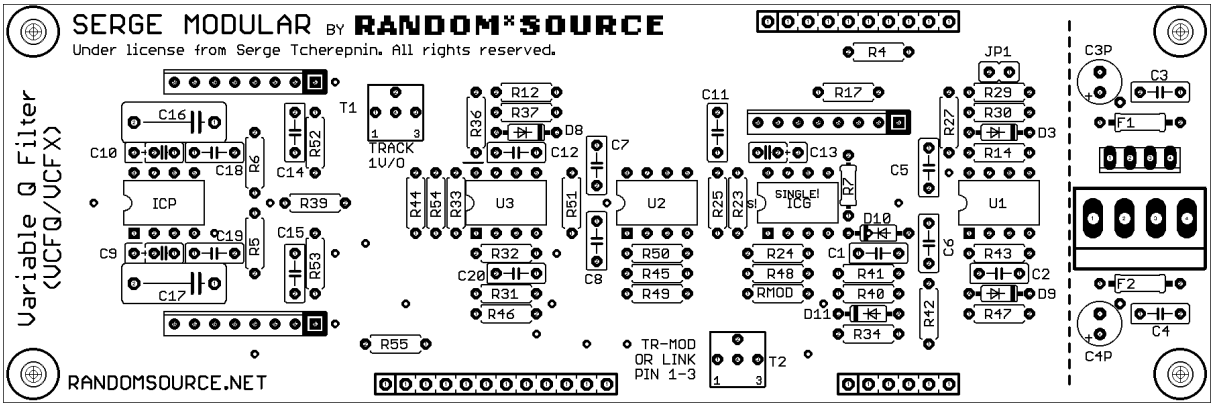
SERGE Variable Resonance Filter (VCFQ)

The Random*Source version of the filter 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.

Main pcb (showing reference designators):



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 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!
- Capacitors marked "CS" or "CY" should be omitted - add only if needed.
- SMT bypass caps on the bottom side of the main pcb are an alternative to the 100n bypass caps.
- Orientation of the main pcb: **power header is at the bottom** (when looking at the module upright, e.g. in a rack).
- Board is designed to be powered by a +/-12V stabilized PSU only (+/-15V is untested/unsupported and will require some value changes to not kill the THAT2180s).

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	10R	F1, F2	alt: FERRIT BEAD
6	330R	R17, R39, R46, R51, R54, R55	
1	1k	R41	
3	4k7*	R2, R3, R4	(*increase to 5k1 in case of a +/-15V power supply - unsupported!)
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 - trimmer is an addition to RMOD - see comment above -
1	200R	T1 (1V/OCT)	Trimpot (Bourns 3362P or anything that matches the footprint) to adjust the tracking of the 1V/Oct input.

Capacitors

1	4p7 (or 5p)	C13 ("CS" next to the single op-amp)	C0G
2	22p	C14, C15	C0G (or Mica)
2	220p STYRO	C16, C17	Styrene/Styroflex
1	47p C0G	C10 ("CS" - see pic above for location)	C0G - or 82p - for a nice round SINE when patched to self-oscillate (HP into IN, GAIN and Q turned up)
2	220p	C2, C12	Mica or C0G (or Styrene)
1	CS	C9	optional, install as small as possible (5pF or 10pF) if needed
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)
1	1n	C1	C0G
8	100n	C3, C4, C5, C6, C7, C8, C18, C19	Bypass caps (not all needed, 6 should do)
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 THAT2180B or A)
5	1N4148	D3, D8, D9, D10, D11	

*Using Burr-Brown (OPA) op-amps everywhere might be a bit of an overkill, but they work nicely. Feel free to experiment with other op-amps (**don't mix single and dual up!**) but beware that you may have to adjust the CS cap values ...

Misc

1	Switch DPST or DPDT	HI / LO mode	NKK M2022SS1W01
1	Jumper	ARC	- leave open - (unless using the ARC feature)
1	MTA-156		MTA-156 power connector
1	SIL header 12pol		pin connectors, linking main pcb to component pcb - using precision strips allows to break off pieces as needed
1	SIL header 10pol		
1	SIL header 6pol		
1	Banana Jacks	TRIG IN (red)	Emerson-Johnson Mouser: 530-108-0902-1 (red) or Thonk

6	**Banana Jacks**	**Outputs, (audio) Inputs, BIPOLAR (black)**	**Emerson-Johnson Thonk / Mouser: 530-108-0903-1 (black)**
3	**Banana Jacks**	**CV / unipolar (blue or white) VC Q, VC F, 1V/Oct**	**Emerson-Johnson Thonk / Mouser: 530-108-0910-1 (blue), 530-108-0901-1 (white)**
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. Mount the Banana jacks and the switch onto the front panel.

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

3. Mount the pots 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.

4. Carefully mount the component pcb (with the pots 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 pots to the panel to make sure of that, but you will have to unscrew them again later.

5. Once everything is nicely in place, solder the pots onto the component pcb (while the front panel is attached). DO NOT SOLDER THE BANANA JACKS YET!

6. Solder short pieces of (stiff) wire - about 10mm long - into the pads for the switch. These should stick up in the air (on the side facing the main pcb). These wires should only go through the pcb as much as required to solder them in (i.e. should not stick out much on the other side, especially not touch the front panel or anything else!). DO NOT SOLDER THEM ONTO THE SWITCH YET! Remove the component pcb if you have not already done so.

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

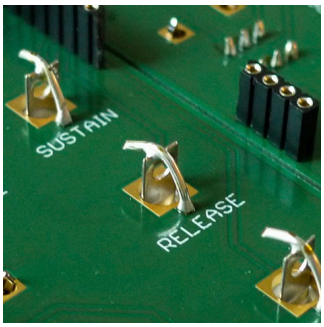
8. Main pcb and component pcb are to be connected through precision DIP socket and pins. It is recommended to use the pins on the main pcb (facing down, soldered from above) and the pin sockets on the component pcb (standing up, soldered from the front panel side). Break or cut off the pieces you need 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.

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

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

11. Make sure everything is in place.

12. Solder the banana jacks in. You can either solder them directly to the surrounding vias (i.e. the ring around) or - which makes removing easier should you ever need to do that - by inserting a stiff (bare) wire into the little hole (via) and solder that wire to the top of the banana jack:



13. Solder the wires for the switch onto the corresponding switch terminals.

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

15. Connect a power cord supplying +12V, GND, GND, -12V to the MTA-header on the main board and you should be ready to go :-)

Calibration

Using T1 the **1V/Oct tracking** can be adjusted. Patch the filter to self-oscillate (HI out to IN jack and turn up GAIN pot and Q pot) to do so. You can also use BAND out but the wave will probably not as round / clip. Be aware that there's no temperature compensation.

(Version 1 February 2017)