BMC034. Switched Resistor Voltage Controlled Filter Version 1.1

Last updated August 17, 2022

VERSION 1 documentation can be found here.

REVISION HISTORY:

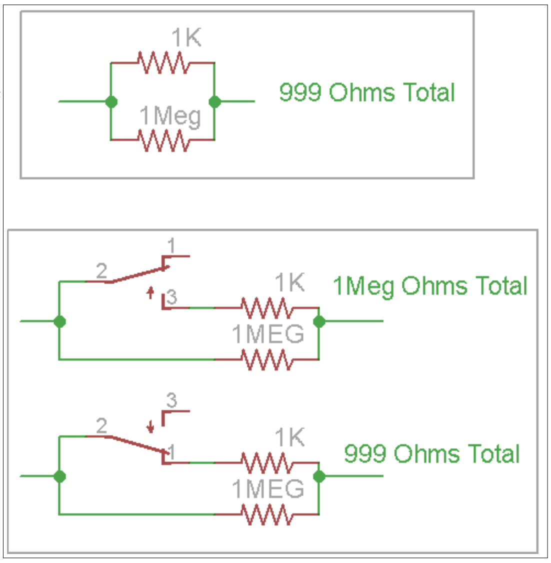
Version 1.1 changes were made to make transition from internal clock to an external VCO as clock smoother. One resistor was added to the clock's output to attenuate it and a value was changed in the comparator section to help compensate.

I. What is it?

-What it does/Switched resistors explained

This is a voltage controlled filter module which utilizes analog switches to adjust the frequency of the filter. The module features two state-variable filter sections which share a common frequency control, these can be used in series for heavier filtering or in parallel to work with stereo sound sources.

The basic concept of using switched resistors is relatively simple. When two resistors are in parallel with each other, the overall resistance is lower than each of the two resistors on it's own (as can be seen on the top of the diagram on the right). If you put a switch in series with one of the resistors, you can then alternate between two levels of resistance (bottom of diagram).



If this switch alternates between the two levels of resistance fast enough, the two different levels of resistance will appear like a single resistance that is somewhere between the two states. For a filter, "fast enough" just means faster than our ear can pick up on. Once the switch is alternating fast enough to not hear it, you can get variable levels of resistance by using pulse width modulation.

-Controls

Knobs
1.Frequency – Controls the frequency of both filters.
2.Frequency Modulation – Attenuates a modulating cv input for the frequency control.
3.Resonance 1 – Controls the amount of emphasis on the selected frequency of the filter for channel 1.
4.Resonance 2 – Same, but for channel 2.

Inputs
1.Clock – An oscillator should be input here, it will be used as the clock for the analog switches in the circuit. Pulse waveforms should not be used.
2.CV – This is the input for the frequency modulation CV.
3.Input 1 – Signal input for channel 1
4.Input 2 – Signal input for channel 2

Outputs
1.Low pass 1
2.Band pass 1
3. High pass 1
4.Low pass 2
5.Band pass 2
6. High pass 2

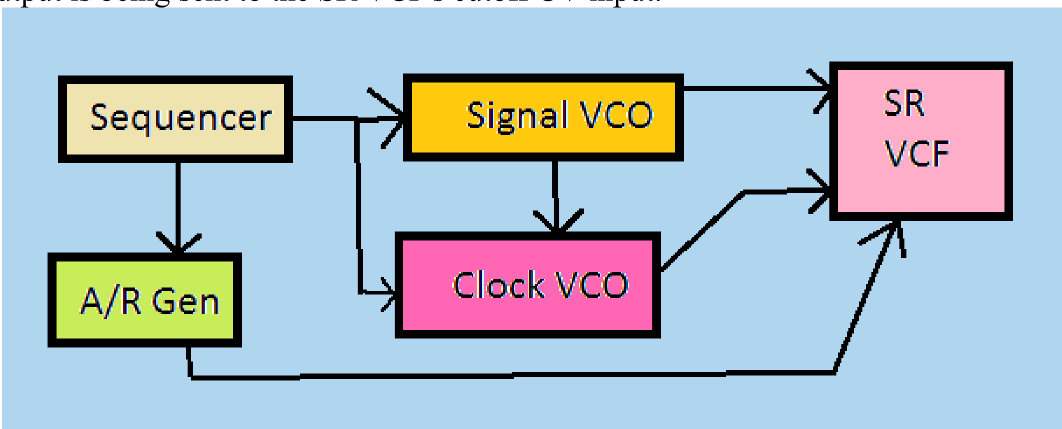
-Demos

1. **Frequency Cutoff sweep/ Single vs Series.**

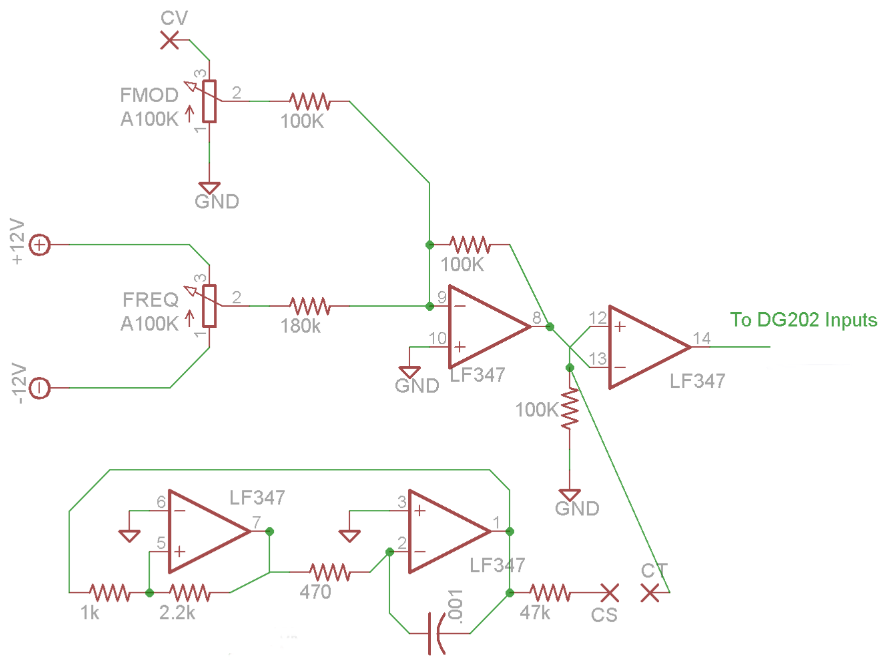
In this mp3 you hear a saw wave through a low-pass filter. The cutoff frequency is swept from low to high. In the first sweep you hear it through a single filter section, in the second sweep you hear it being filtered through both low-pass filters in series with each other.

2. **The Vowel Patch**

In this mp3 you hear a patch creating vowel like sounds using the SR VCF. This patch is also explained in this youtube video. A sequencer's 1V/oct output is sent to two VCOs. The Clock VCO is tuned several octaves higher than the signal VCO and it is synced to the Signal VCO. The Signal VCO's ramp output is being sent to the SR VCF's signal input, and the Clock VCO's ramp output is being sent to the SR VCF's clock input. The sequencer is also sending triggers to an A/R generator whose output is being sent to the SR VCF's cutoff CV input.



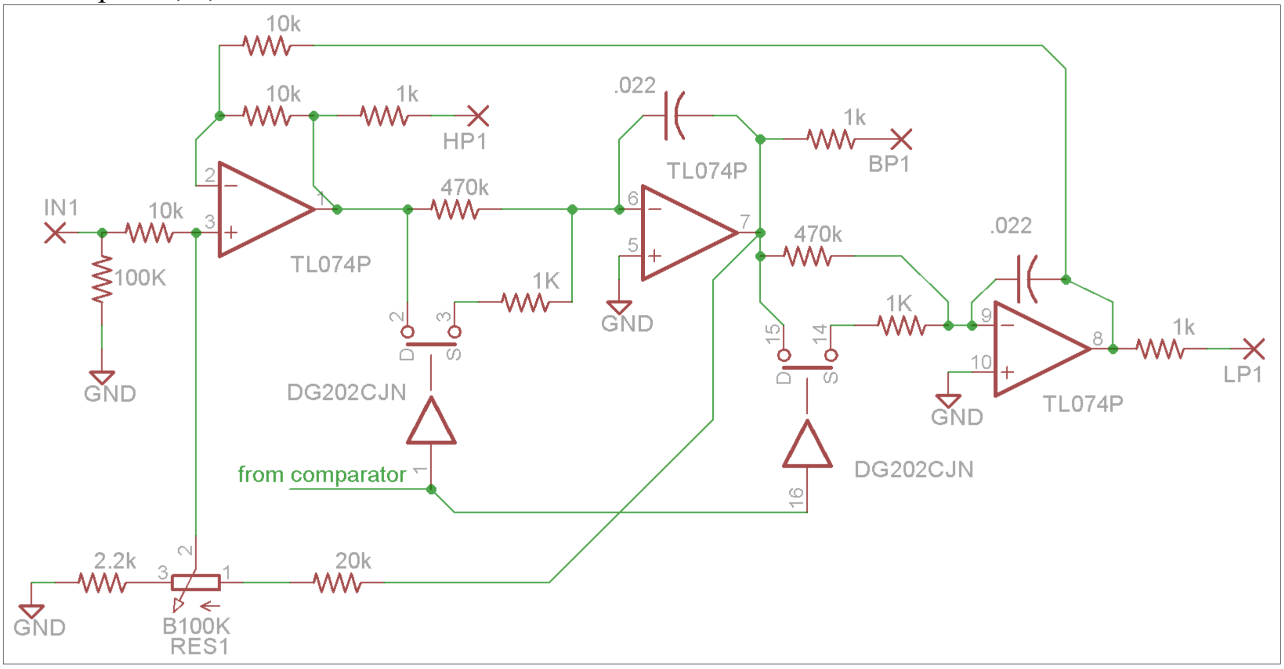
II Schematics



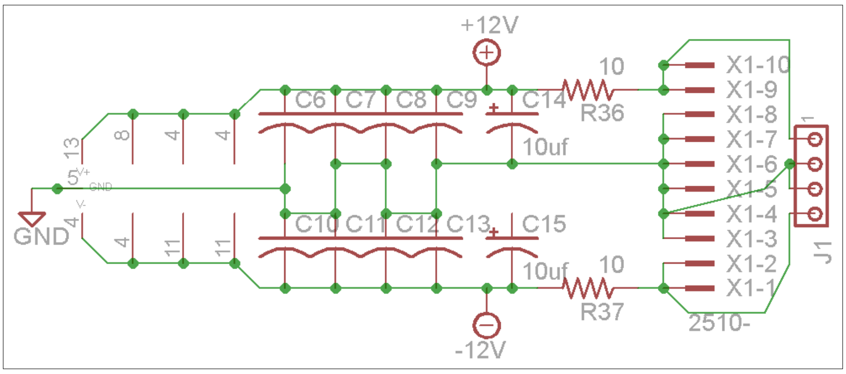
Above is the schematic for the frequency control. On the bottom left of the diagram is a triangle-wave oscillator created by combining a Schmitt trigger with an integrator. **NOTE FOR +/-15v BUILDERS: Replace the 2.2k resistor with a 3.3k.** The output of this goes to the switch connector on the clock jack through a 47K resistor.

The tip connector of the clock jack (marked "CT") then goes to the non inverting input of an op-amp wired as a comparator. The inverting input is attached to another op-amp wired to mix the manual frequency control with the modulating CV.

The output of the comparator is then attached to the input pins of the DG202 analog switch, these are pins 1, 8, 9 and 16.



Above we see the schematic for one of the filter sections. The op amp on the far left is a differential amplifier which mixes our input signal with positive and negative feedback from our output. It's output is the high pass. The differential amplifier feeds into one of two integrators, each integrator has a switched resistor on it's input. The first integrator's output is the bandpass and then splits off into a negative feedback path on the bottom part of the diagram and into a second integrator. The output of the second integrator is the low-pass output and also is sent back to the differential amplifier.



Above is the schematic for the power section. The positive and negative supplies are filtered with a 10 ohm and 10 uf capacitor, then the power pin of each IC has a .01uf capacitor near it to filter out high frequency noise.

III. Construction

Parts List

Semiconductors

Value	Qty	Notes
TL074	1	14 pin DIP package
LF347	1	14 pin DIP package
TL072	1	8 pin DIP package

DG202	1	16 pin DIP package

Resistors for +/-12v

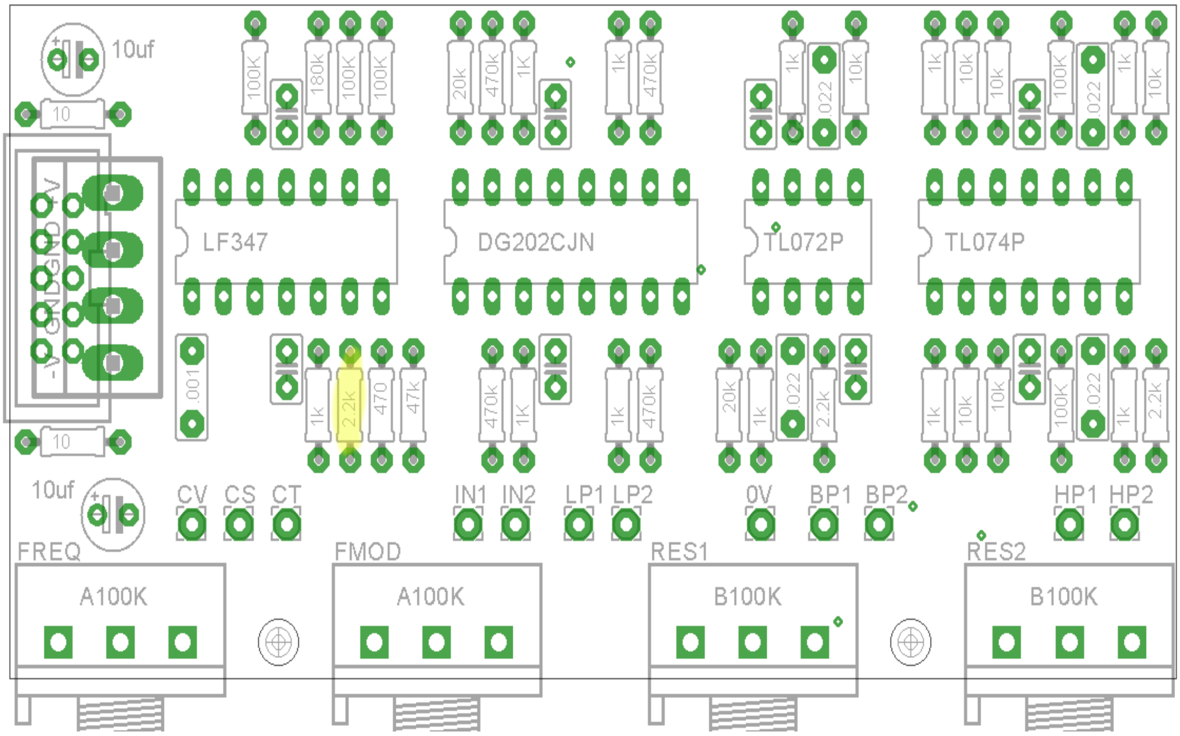
Value	Qty	Notes
10 ohm	2	All resistor 1/4W Metal Film unless otherwise noted
470 ohm	1	
1K	11	
2.2K	3	
10K	6	
20K	2	
47K	1	
100K	5	
180K	1	
470K	4	
B100K Pot	3	16mm PCB mounted
A100K Pot	1	" "

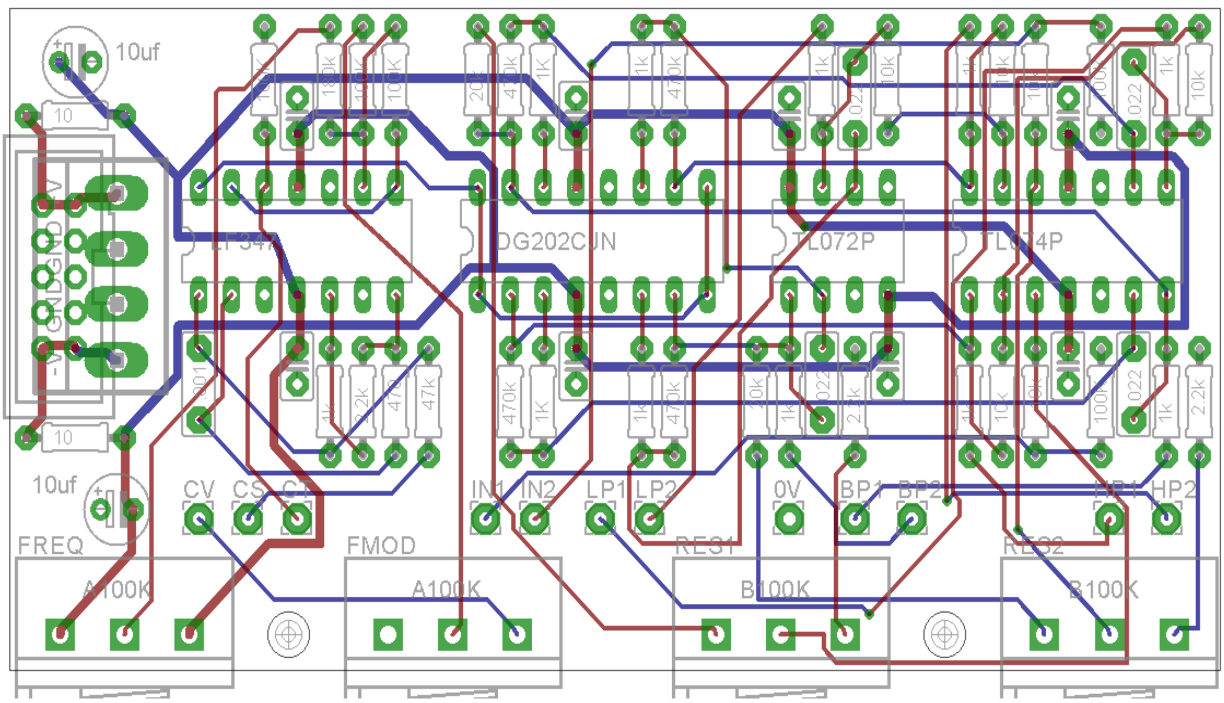
Capacitors

Value	Qty	Notes
.01uf	8	Ceramic disc, value non-critical
.001uf	1	Poly box type
0.022uf	4	Poly box type
10uf	2	Electrolytic

Other

Value	Qty	Notes
Power Connecter	1	Eurorack or MOTM style
16 PIN	1	
14 Pin DIP Socket	2	
8 PIN DIP Socket	1	
Knob	4	
Jack	10	At least one should be a switching jack.



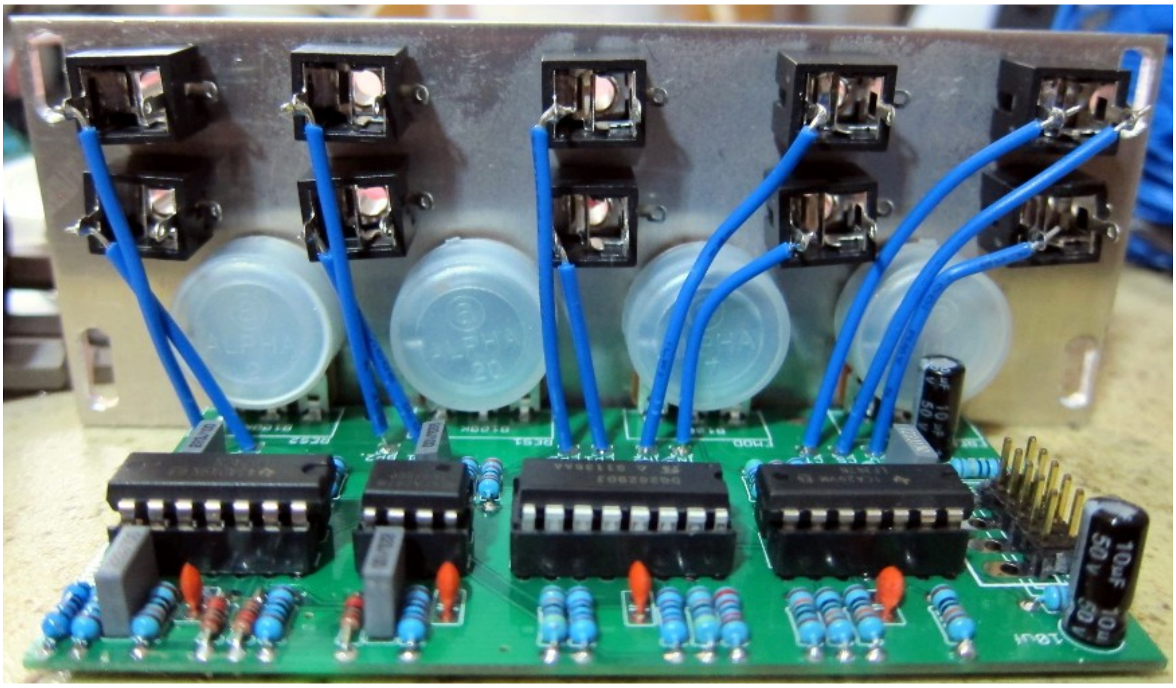


The Board
Above are renderings of the PCB with and without traces.

In yellow is the resistor which should be replaced if using a +/-15V power supply.

The board's dimensions are 93mm x 47mm. The mounting holes are 2". The pots are spaced 1" apart.

On the next page is a photo of the wiring of the module.


ALPHA