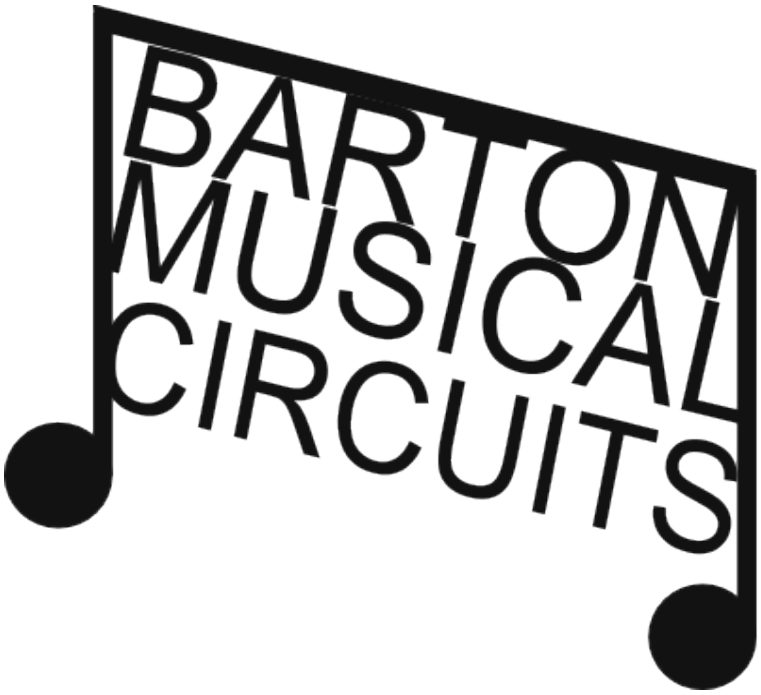


BMC105. JFET Phaser

Last updated 10-8-2023

I. Features

This module is a 12-stage phaser or all-pass filter with resonance control. When the filter's output is mixed with the input, this creates notches in the frequency response. Classic phasing sounds are achieved by modulating the frequency control with an LFO. It can also be used as a 4-stage filter by removing the top PCB and jumpering pins 1 and 2 of the pin connectors together.

CONTROLS/INPUTS/OUTPUTS

1. FREQUENCY KNOB – This sets the initial center frequency of the filter.
2. CV KNOB – This attenuates how much the control voltage input will modulate the frequency control.
3. RESONANCE KNOB – This controls how much of the filter's output is sent back to the input. This is positive feedback and can result in distortion.

4.INPUT JACK – This is the audio input jack.
5.CV JACK – This is the input for the frequency modulation control voltages.
6.OUT JACK – This is the direct output of the filter
7.BLEND JACK – This is the output of the filter mixed with the input signal at a 1:1 ratio.

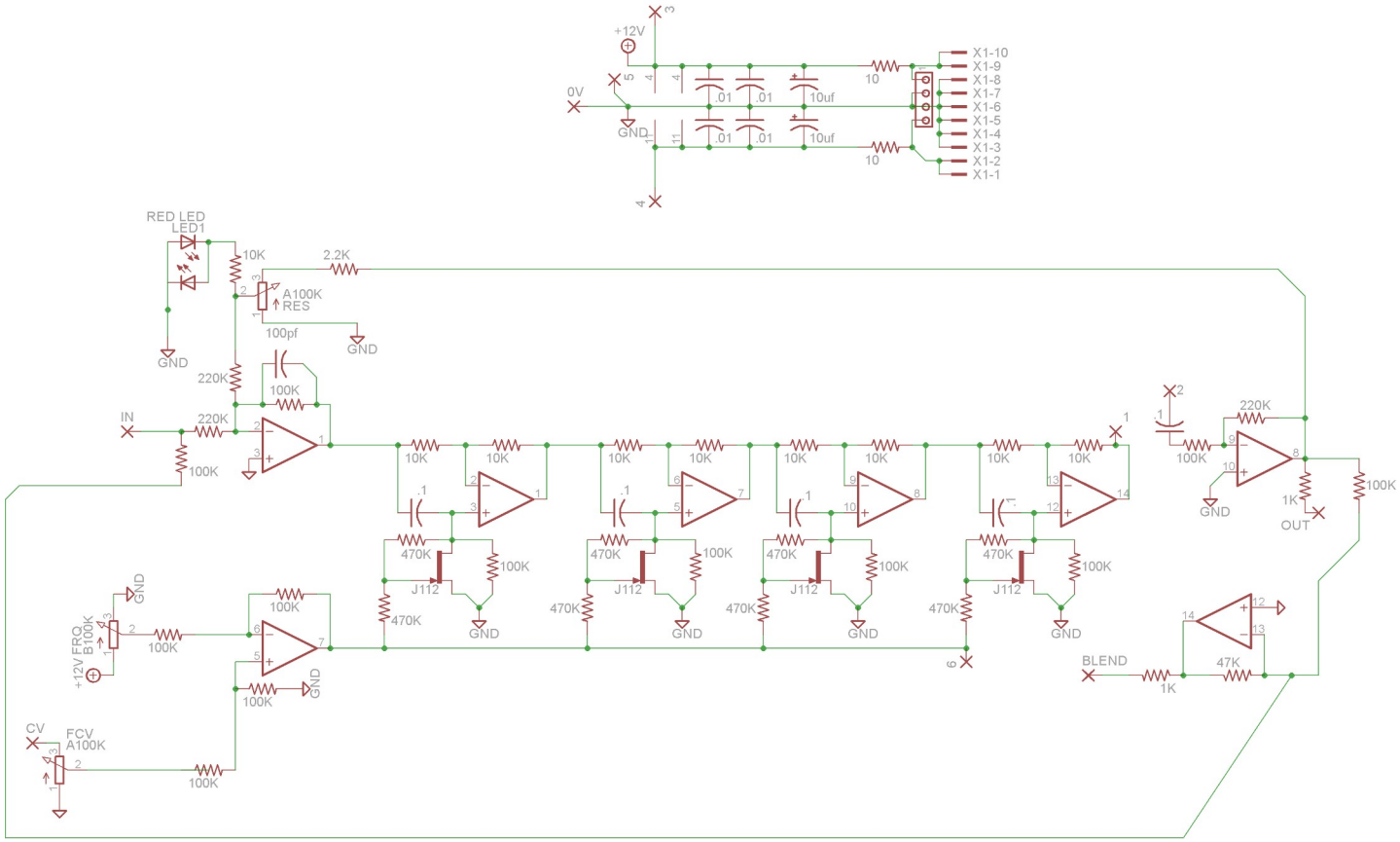
DEMOS

1. VCO Square Wave -> VCA -> Phaser - both outputs are presented as their own file. LFO adjusting Phaser frequency. Only the settings of the phaser module are adjusted.
WET OUTPUT
BLEND OUTPUT

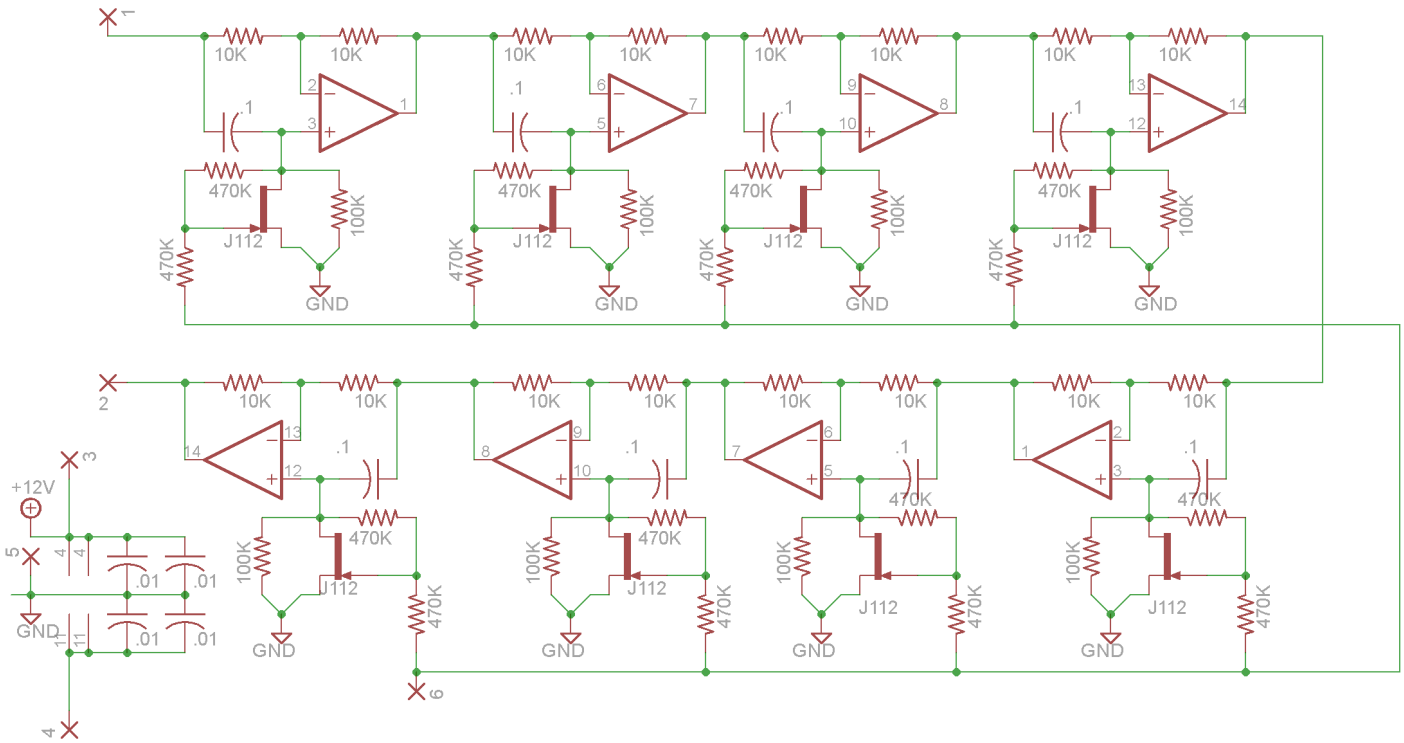
2. Detuning Enveleope. VCO Triangle -> Phaser -> VCA. Blend output. Phaser's frequency is modulated by an envelope creating detuning effect.
DETUNING ENVELOPE

3. Drums - ANALOG DRUM and DIGITAL HI HAT -> Mixer -> Phaser. Blend output. Resonance and frequency controls are manipulated during the clip.
DRUMS

II Schematics



Bottom board above/ Top board below



Above are the schematics for this module's two PCBs. Wirepads marked 1 through 6 are the connectors between the two PCBs. Pad 1 sends audio signal from the bottom board to the top board, pad 2 sends audio from top to bottom, Pad 3 is V+, pad 4 is V-, Pad 5 is ground and pad 6 is the control voltage for the JFETs.

Starting at the "IN" wirepad, the audio input's signal is mixed with the resonance control's

output through 220K resistors and then attenuated with an inverting op-amp. A 100pf in the feedback path filters out very high frequencies. The outputs of this op-amp goes into the first filter stage.

All twelve filter stages are identical, formed by op-amps with 10K feedback resistors. Each stage's output is split, going to the negative input through a 10K resistor, and going to the positive input through a .1uf capacitor. The positive terminal also connects to a 100K to ground and to the drain of a J112 JFET. This JFET acts as a voltage controlled resistor with the voltage on it's gate determining the resistance. The gate voltage is a mix of the drain voltage and a control voltage, mixed together by 470K resistors. The first four filter stages are on the bottom PCB and the last eight are on the top PCB.

After all the filter stages on both circuit boards are complete, the signal goes through a .1uf DC blocking capacitor, this removes any DC offset from the JFET control voltage. The signal is then amplified back up to it's original level and sent to the OUT wirepad through a 1K current limiting resistor. The output signal and input signal are both sent to an inverting op-amp through 100K resistors to be mixed together for the BLEND output. This op-amp uses a 47K resistor to keep the level close to the original signal.

The output is also sent to the RESONANCE pot through a 2.2K resistor. The wiper of the resonance knob connects back to the input mixer through a 220K resistor as well as to a pair of red LEDs through a 10K current limiting resistor. These LEDs will clip the signal to controlthe output levels during high resonance and to prevent wild oscillations.

The control voltages for the JFETs are controlled by the frequency and CV knobs. These knobs' outputs are mixed together by an op-amp wired as a differential. The FREQUENCY knob is wired as an attenuator in reverse with it's output at 12V when counterclockwise and getting lower to 0V fully clockwise. This voltage is sent to the inverting input of the op-amp through a 100K resistor. The CV knob's output is sent to the non-inverting input of the op-amp through a 100K resistor.

The power connection has wirepads for Eurorack and MOTM style connectors in parallel. The voltage rails are filtered by a 10ohm/10uf passive low pass filter. Each op-amp's power pins are filtered by .01uf capacitors.

III. Construction

Parts List

Semiconductors

Value	Qty	Notes
TL064	4	Or any quad package op-amp with the same pinout.
J112	12	TO-92 package. Other N-Channel JFETS should work, but may require adjusting values in the CV mixer.
Red LEDs	2	3mm package

Resistors

Value	Qty	Notes
10 ohm	2	1/4W Metal Film
1K	2	1/4W Metal Film
2.2K	1	1/4W Metal Film
10K	25	1/4W Metal Film
47K	1	1/4W Metal Film
100K	20	1/4W Metal Film
220K	3	1/4W Metal Film
470K	24	1/4W Metal Film
A100K pot	2	16mm PCB mounted
B100K Pot	1	16mm PCB mounted

Capacitors

Value	Qty	Notes
.01uf	8	Ceramic disc. 2.5mm lead spacing
.1uf	13	Film box 5mm lead spacing
10uf electrolytic	2	

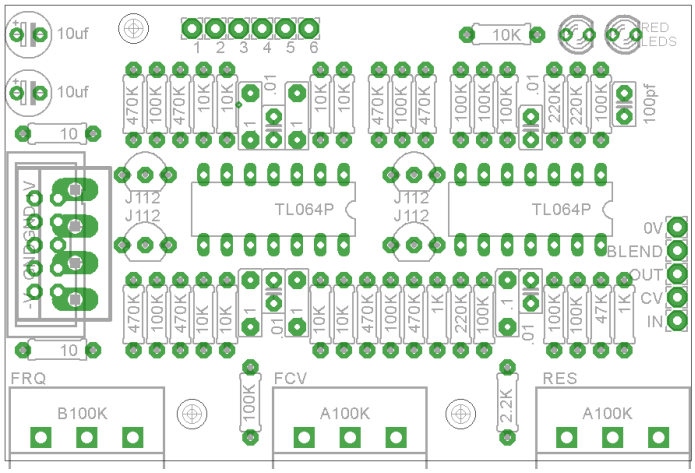
Other

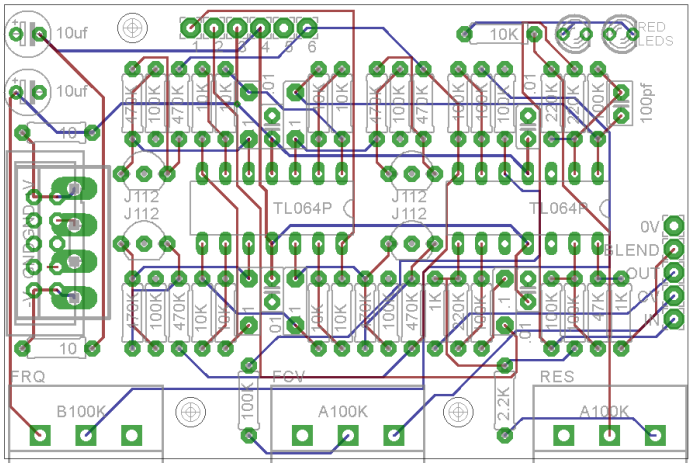
Value	Qty	Notes
Power Connecter	1	Eurorack or MOTM style
Jack	4	3.5mm depending on build
Knob	3	
14 Pin DIP socket	4	
Male pin header	6	2.54mm pitch, may need to buy 40 pin package. The male headers should be attached to the bottom PCB
Female pin header	6	2.54mm pitch, may need to buy 40 pin package. The female headers should be attached to the top PCB

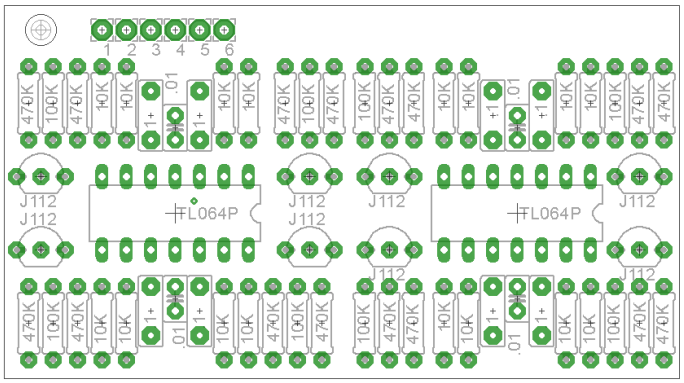
Spacer/screws	1	Optional to keep PCBs together tight. Spacer should be 10-12mm

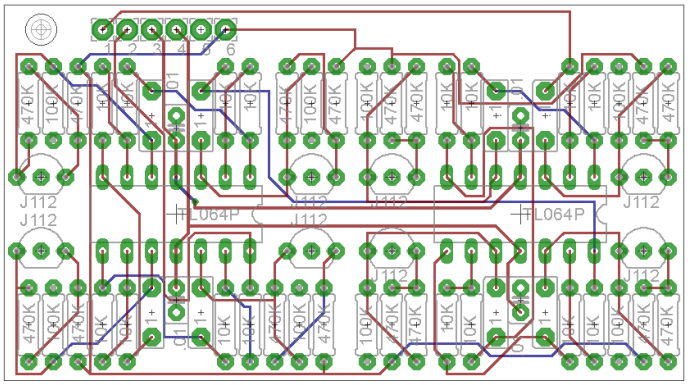
The Board

Below are renderings of the PCBs both with and without traces shown.
The Bottom PCB is at the top, it's measurements are 74mm x 49.5mm, the pots are spaced 28.58mm apart and the mounting holes are 29.2mm apart.
The Top PCB is 70mm x 39mm.



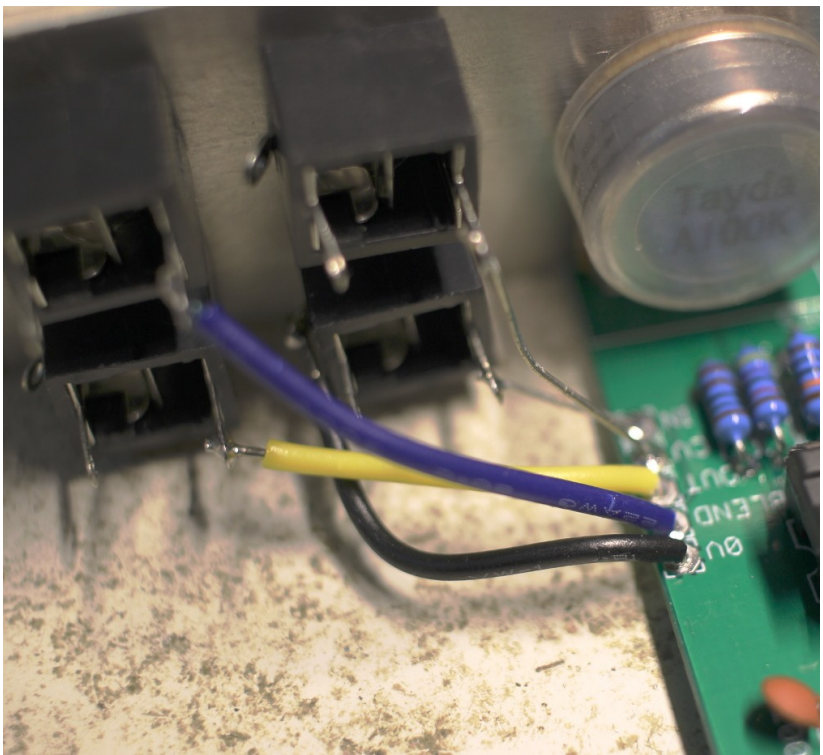






WIRING.
1. Wire the “0V” wirepad to the sleeve connector of any jack to ground your panel and all jacks. If using a non-conductive panel, first jumper the sleeve connectors of all jacks together.
2. Wire the remaining four wirepads, “IN” “CV” “OUT” and “BLEND” to the tip connector of their jacks.

To the right is a photo of a wired module.



MODIFICATIONS.
1. 4 POLE FILTER – Remove the top PCB and place a 2.54mm pin jumper between pins 1 and 2 of the header.

2. 15V ALTERATIONS/FREQUENCY POT – The module should work without alteration on a 15V system, but you may have a large dead zone on the bottom of the frequency pot where the sound is unaffected. The resistor highlighted in red below can be increased to remove this dead zone. I'd try a 150K resistor to start and adjust from there. If there's too much dead zone on a 12V build this modification can be tried as well.

3. RESONANCE CLIPPING – The 10K resistor next to the LEDs (in blue) can have its value changed to control how much distortion the resonance control brings. Increasing the value up to a 22K or 47K will make for a louder output with less distortion when using the resonance control. Decreasing it to a 4.7K or 2.2K will have clipping occur more quickly as you turn the resonance control up.

4.MAXIMUM RESONANCE – The 2.2K resistor is in series with the resonance pot (in yellow). This can be jumpered to increase the maximum resonance level a tiny amount, or the value can be increased to lessen the maximum resonance. Useful if also adjusting the resonance clipping.

5.CV RESPONSE – The 100K resistor in series with the CV attenuator (in green) can be lowered to create stronger response from external CV.