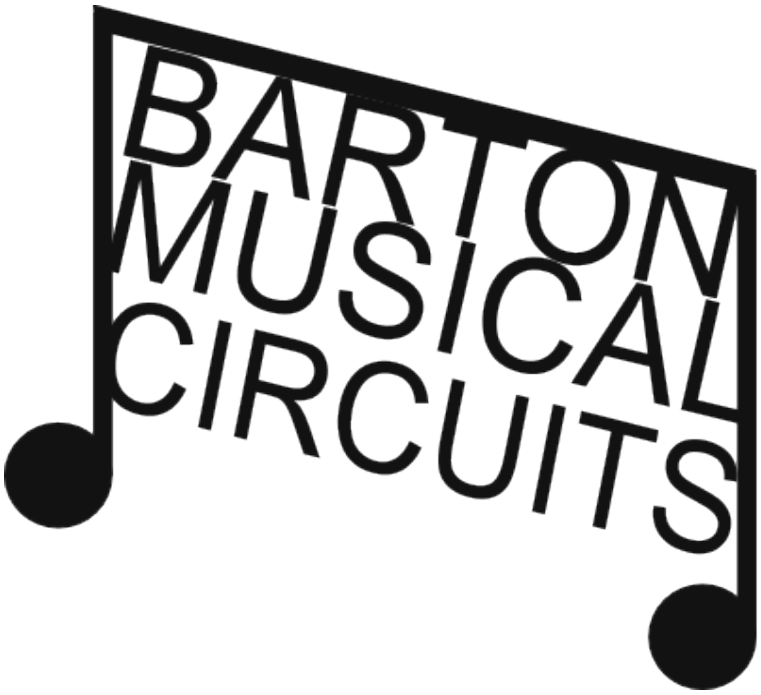

BMC102. Synched Resonator

Last updated March 20, 2023

If you have any questions, or need help trouble shooting, please e-mail Michael@Bartonmusicalcircuits.com

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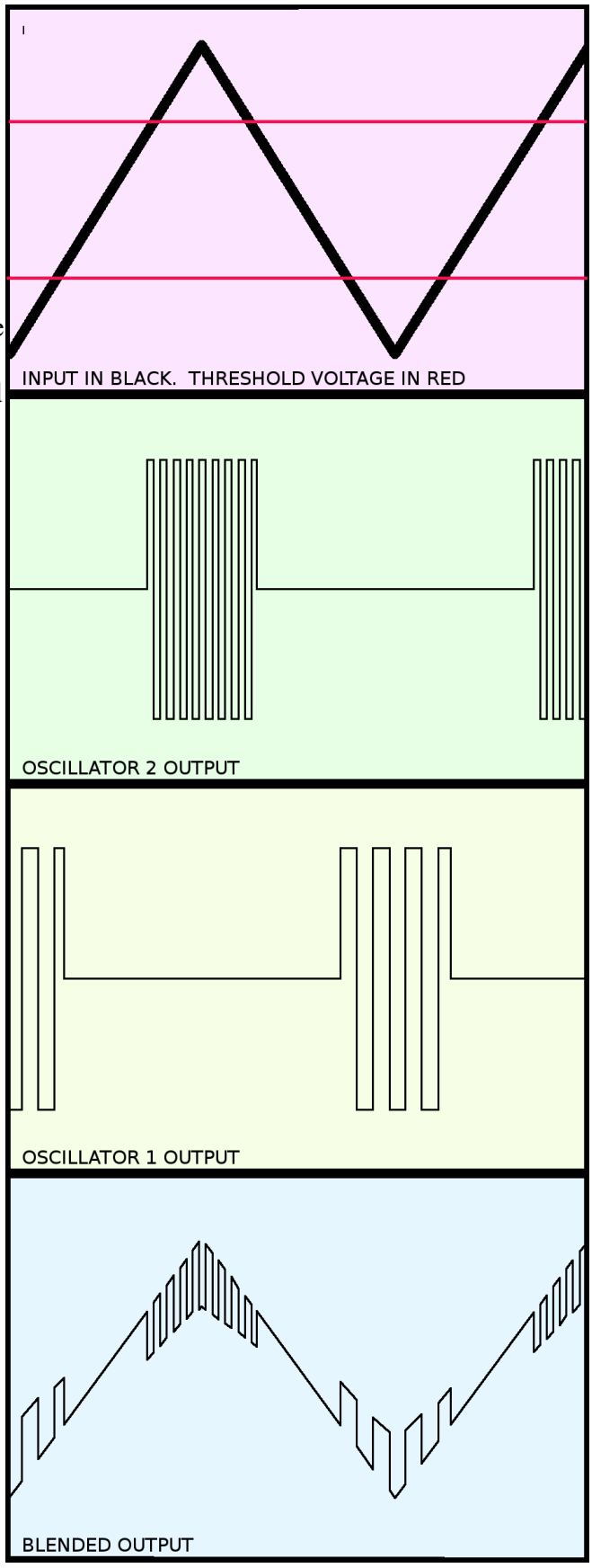
I. Overview/Features

This module uses two synchronized oscillators to resonate with an input signal when the signal is above or below a threshold voltage. This creates two frequencies ringing with the input as the polarity of the input changes. A single threshold voltage controls both oscillators and can be modulated by control voltage.



CONTROLS

1.AC Toggle – When engaged, removes any DC offset to the input signal.
2.Threshold Knob – Sets the threshold voltage. When turned all the way counter-clockwise, the oscillators should never turn on and when turn all the way clockwise they should be on all the time.
3.Threshold CV Knob – Attenuates an external voltage that's summed with the voltage from the threshold knob.
4.Frequency Knobs – These two knobs control the frequencies of the two oscillators. Frequency range goes from 10hz to 2Khz.
5.Blend Knob – This controls how much the input or oscillators signal is present at the blended output. Completely clockwise is all input and counter clockwise is all oscillators.

INPUTS

1.Main input – main signal input, works best with a +/-5V waveform.
2.Thresh CV In – Input an LFO, EG or other CV to modify the threshold.

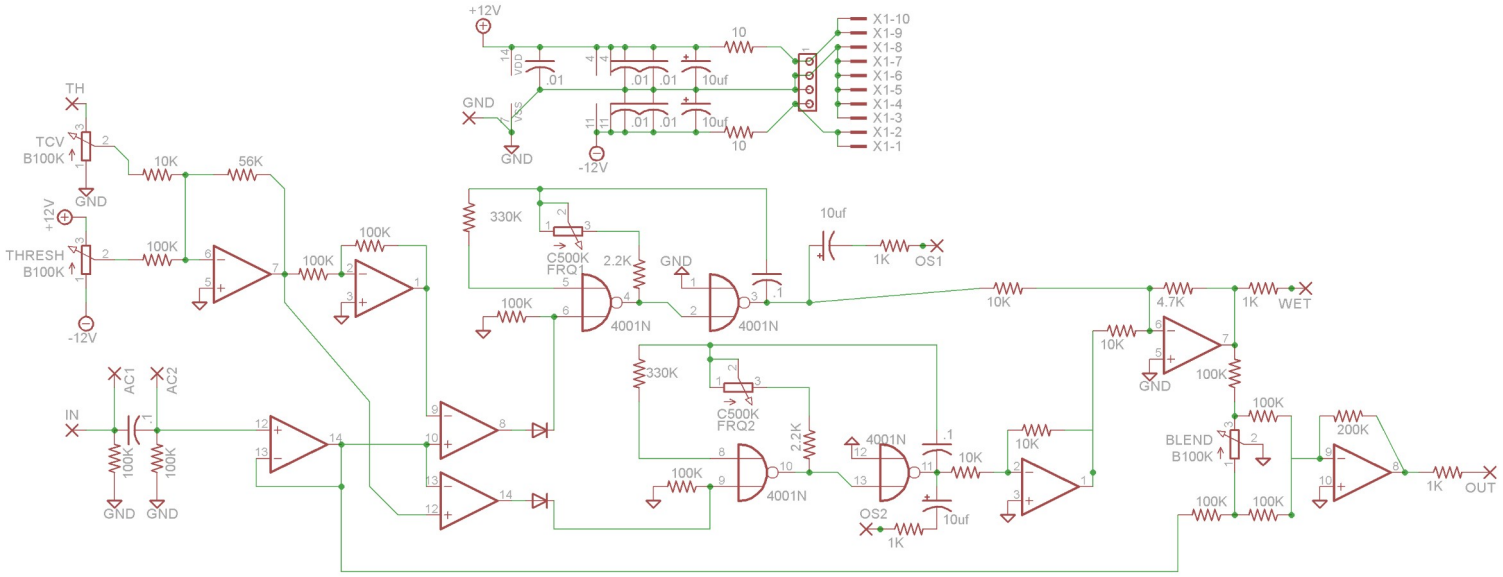
OUTPUTS

1. Oscillator Outputs – Each oscillator has a dedicated output.
2. Wet Output – This outputs the two oscillators mixed together.
3. Blend Output – This outputs the two oscillators mixed with the input signal. (this wirepad labeled "OUT" on the PCB)

SOUND SAMPLES

Stereo Patch – A sine Wave goes through a VCA and into the Synched Resonator. The two oscillator outputs are panned left and right and the clean signal is in the center. Only the threshold and frequency knobs on the Synched Resonator are adjusted.

Mono Patch - A triangle wave is fed to the Synched resonator and CV from an envelope generator is fed to the Threshold CV. Outputs is from the blended output, with the knob at 66% percent for most of the patch. The frequency, Threshold CV and Blend knobs are the only ones adjusted.



II. Schematic.

Starting in the lower left we see the "IN" wirepad. This connects to a 100K resistor ground and .1uf coupling capacitor with the AC1/AC2 wirepads connected to either side of the capacitor. When the AC coupling switch closes, this capacitor is bypassed and allow DC offset to affect the sound. The coupling cap connects to another 100K resistor to ground and then to an op-amp wired as a unity gain buffer. The output of this buffer connects to two op-amps wired as comparators and to the blend controls.

In the upper left we see the Threshold potentiometer and Threshold CV input and it's potentiometer. The voltages on the wipers of these pots are mixed together by an inverting op-amp, the CV goes through a 10K mixing resistor while the Threshold knob goes through a 100K, since the threshold knob's output goes from -12V to +12V and the CV might only be from 0 to +5V.

This mixed and inverted signal is sent to the positive input of one of the comparators, making it an inverting comparator, only outputting a high voltage when the input signal is below the threshold. The mixed and inverted signal is then sent to another inverting gain stage to create a mixed and non-inverted signal that's then sent to the negative input of the other comparator, making it so this stage turns on when the input signal goes higher than the threshold.

The outputs of these comparators are limited to positive voltages only by diodes and connect to inputs of CD4001 NOR Gates. These inputs have 100K resistors to ground to set the inputs at 0V when the comparators are low, the CD4001 is powered by 0 to +12V, so the diodes and pull down resistors make sure the input signals don't go out of the voltage range of the chip. When the comparators are inactive and the input is grounded, the NOR gate will act as an inverter and the oscillators will start to oscillate. When the comparators activate and bring the input up to +12V, the output of the gate will stay at 0V and oscillation will stop.

The oscillator sections are composed of two NOR gates, the one getting turned on and off by the comparators, and another that's permanently wired as an inverter. The second gate's output is connected to a capacitor that connects back to the output of the first gate through the frequency pot and to the other input of the first gate through a 330K resistor.

The output of the first gate is inverted by the 2nd gate, and the 2nd gate's output is then fed back to the input of the first gate, but through a capacitor which takes time to charge and discharge. This creates a feedback loop with a slew rate that's determined by the frequency knob and the capacitor. When the 2nd gate's output goes low, the 1st gate's output is high and the voltage on the input of the 1st gate will begin to rise as output 1 charges the capacitor through the frequency knob. Eventually the voltage rises high enough to change gate 1's state from high to low and the 2nd gate then follows, going from low to high. Now the voltage on the 1st gate's input will begin to lower as

the 2nd gate's output charges cap and gate 1's output provides a path for discharge.

This gated oscillator circuit is one I found in Don Lancaster's CMOS Cookbook, and I recommend reading it for a more thorough explanation of this circuit.

The individual oscillator outputs are AC coupled by 10uf capacitors in series with 1K resistors. The output of the bottom oscillator is then inverted and sent on to a mixing stage. The inversion makes it so that one oscillator is providing the positive voltage swings and the other the negative swings. The output of this stage is sent to the WET output through a 1K resistor, and then on to the blend control.

The two sides of the blend control are identical with a 100K resistor in series with the outside lug of a potentiometer with its wiper grounded. This creates two parallel voltage dividers with the pot controlling which signal is attenuated more. The signals are then mixed together and amplified by an inverting mixer stage that connects to the blend output through a 1K resistor.

At the top of the circuit are the power connections. The TL074s are powered on +/-12V and the CD4001 by just the 12V and ground. .01uf capacitors are attached near power pins to limit high frequency modulation of the power supply and 10uf capacitors and 10 ohm resistors create low pass filters to further stabilize.

III. Construction

A.Parts List

Semiconductors

Name	Quantity	Notes
TL074	2	DIP package
CD4001	1	DIP package
1N4148 diode	2	

Resistors

Name/Value	Quantity	Notes
10 ohm	2	1/4W Metal film for resistors unless otherwise noted
1K	4	
2.2K	2	
4.7K	1	
10K	5	
56K	1	
100K	11	
200K	1	
330K	2	
B100K potentiometer	3	16mm PCB mounted
C500K potentiometer	2	16mm PCB mounted, use B500K if C500K is unavailable.

Capacitors

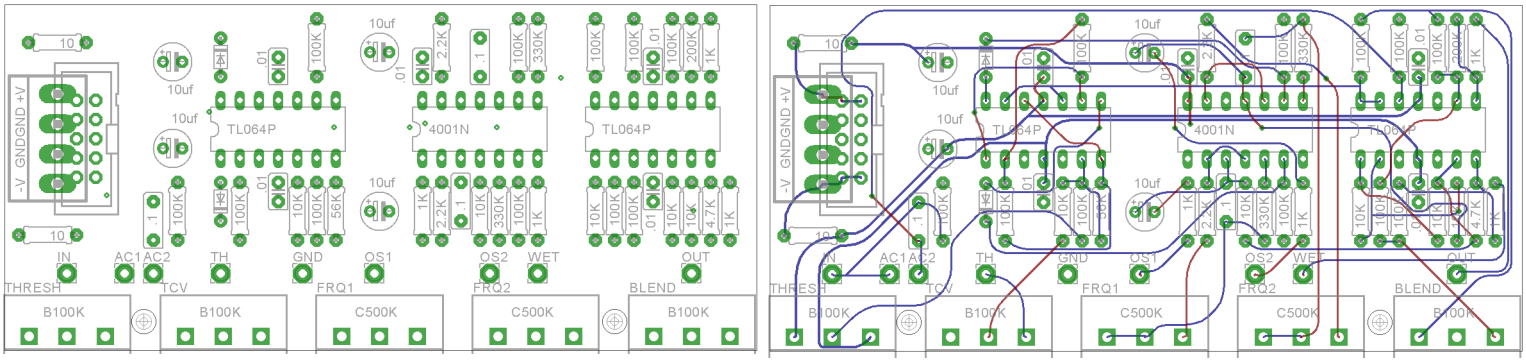
Name/Value	Quantity	Notes
.01uf	5	Ceramic disk
.1uf	2	Film boxed caps

10uf	4	Eletrolytic

Other

Name/Value	Quantity	Notes
Power connecter	1	
Jack	6	
SPDT Toggle	1	
14 pin DIP socket	3	

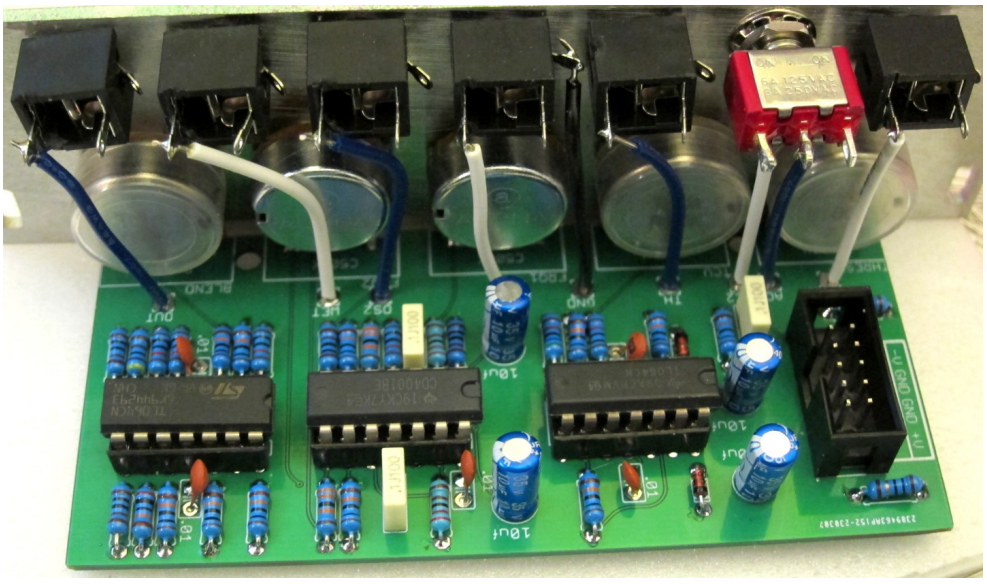
B. The PCB



Above are renderings of the PCB with and without traces. The PCB is 100mm x 46mm. Pots are spaced 20.63mm apart

Wirepads should be connected as follows:
IN – tip of input jack
AC1 – center lug of SPDT
AC2 – bottom lug of SPDT
TH – tip of threshold CV input jack
GND – Sleeve of any jack
OS1 – tip of oscillator 1 output jack
OS2 – tip of oscillator 2 output jack
WET – tip of wet output jack
OUT – tip of blended output jack.

To the right is a wired unit to use as a reference.



TWEAKS

1.THRESHOLD MIXING – To adjust how much control the threshold CV knob has versus the threshold knob, the resistors in red and yellow can be adjusted, with red controlling the Threshold knob and the yellow controlling the CV knob. Decreasing a resistor value will give the knob more weight in controlling the threshold.

If building for a +/-15V system, changing the 100K to a 120K might be necessary. On a 12V system, if you can't get the threshold high enough to turn off all oscillations, try changing it to an 82K.

2.FREQUENCY ADJUSTMENTS – To increase the overall frequency range, the simplest change is to lower the value of the .1uf capacitors. To adjust the maximum frequency, adjust the 2.2K resistors highlighted in blue with smaller values to raise the max frequency and larger values to lower it.