

## **BMC33. 4046 Wave Shaper**

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## **I. Using The Module**

### **A. What does it do?**

The 4046 Wave Shaper takes an input frequency, and then multiplies it to X8, X4, X2, X1 and then divides it to /2, /4, /8. These multiples and divisions of the frequency are then mixed together to create a new timbre.

### **B. Controls/IO**

**1. Mix pots** – There is a potentiometer for each multiple and division of frequency. When one of the knobs is turned fully clockwise, the output will be approximately +/-5v.

**2. Slew Toggle** – This toggle changes the capacitor used in the filter of the phased lock loop. When using a larger capacitor, tuning is more stable (especially at low frequencies), but the tracking of notes will be slower.

**3. Input Jack** – The output of a VCO should be input here.

**4. Output** – The mixed frequencies are outputted here. This can be greater than +/-5V, depending on how the knobs are set.

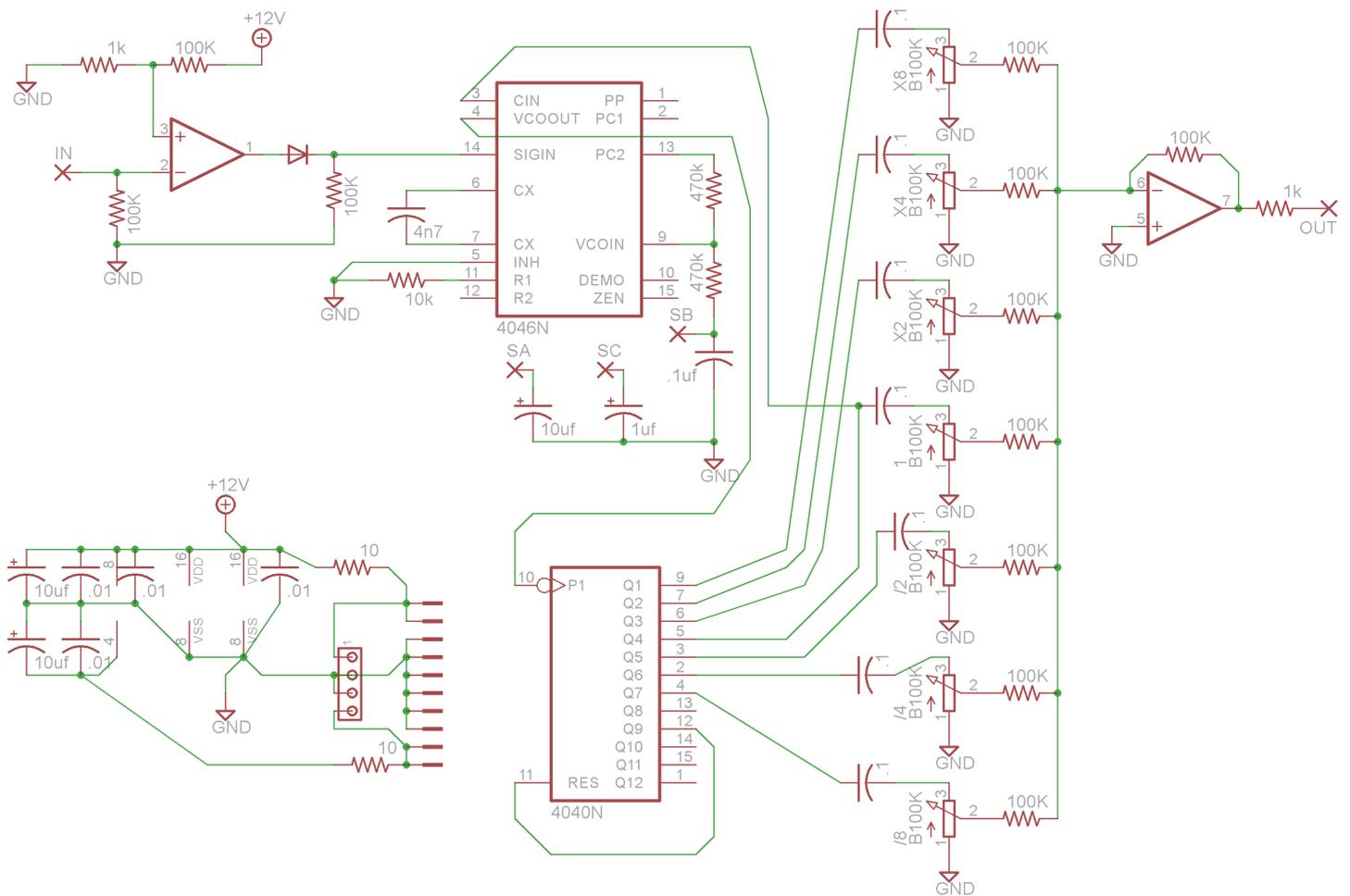
### **C. Demos**

#### **DEMO #1**

In this demo, each of the seven frequency multiples is mixed in, one at a time starting with X8.

#### **DEMO #2**

In this demo, the three settings of the slew switch are shown. First is the largest capacitor, then the second largest, then the smallest and then the sequence is reversed.



## II. Schematic

Above is the schematic for this module. Starting in the upper lefthand corner, we have an op-amp wired as a comparator that takes our input signal and creates a CMOS friendly squared output. This signal is then sent to the CD4046's signal input.

The two 470k resistors and the .1uF capacitor form the filter between the phase comparator's output and the VCO's input. The 1uF and 10uF capacitors are put in parallel with .1uF capacitor when the slew switch is engaged. The 10k resistor attached to pin 11 sets the maximum frequency of the VCO, this resistor value can be experimented with without affecting the rest of the circuit.

The VCO output of the 4046 is sent to the input of the CD4040, which is a binary ripple counter. The 4<sup>th</sup> output of the 4040 (which toggles every 8 inputs) is then sent back to the comparator input of the 4046, this tricks the 4046 into thinking that it's frequency is 8 times too low and adjusts until it's in phase with a divided version of it's output.

The CD4040's outputs are all sent through decoupling caps and then potentiometers wired as voltage dividers. The output of each divider is then mixed at an inverting op-amp gain stage. The gain of the output mixer can be reduced by using a smaller value resistor if you find the output getting too hot. If using a 15V power supply, this should be replaced with a 68K resistor.

The negative and positive power rails are filtered by a 10 ohm resistor and a 10uF capacitor. Each IC also has a .01uF capacitor at it's power pin to filter high frequency noise on the power supply.

### III. Construction

#### A.Parts List

##### Semiconductors

Value	Qty	Notes
CD4040	1	DIP 16 pin version
CD4046	1	DIP 16 pin version
TL072	1	DIP 8 pin. TL062 or other dual op-amps can replace this.
1N4148	1	Or other switching diode.

##### Resistors

Value	Qty	Notes
10 ohm	2	7.5mm lead spacing. 1/4w Metal Film unless otherwise noted on all resistors
1K ohm	2	
10K ohm	1	
100K ohm	11	If building for a 15V system, replace one with a 68K resistor.
470K	2	
B100K Pot	4	PC mounted 16MM Alpha
B100K Pot	3	With solder lugs

##### Capacitors

Value	Qty	Notes
.01uf	4	2.5mm lead spacing, use cheap ceramics
4.7 nf	1	Polyester Film Box type
.1 uf	8	Polyester Film Box type
1 uf	1	Electrolytic
10uf	3	2.5mm lead spacing Electrolytic

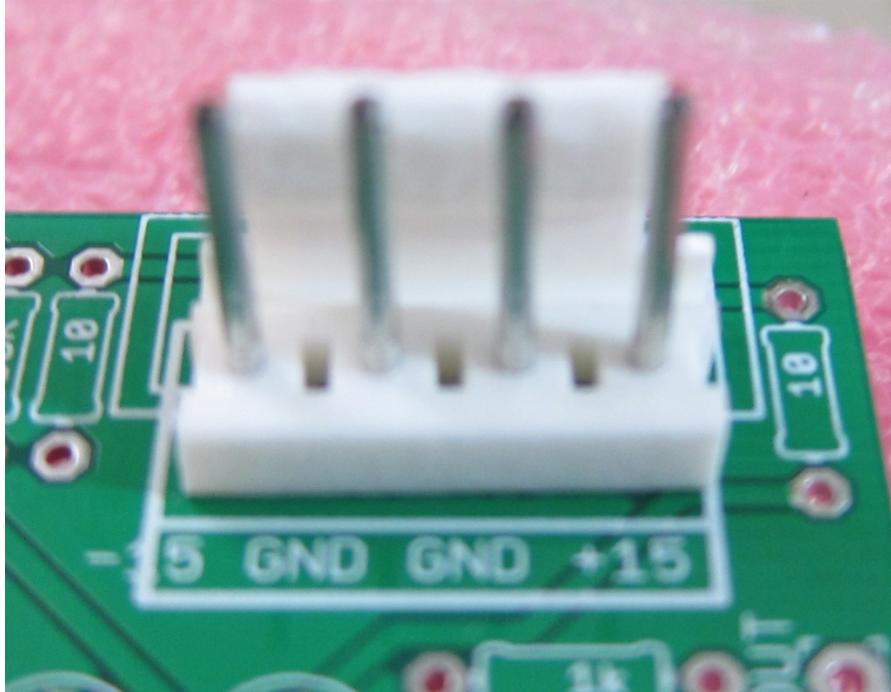
##### Other

Value	Qty	Notes
8 pin Dip socket	1	
16 pin DIP socket	2	
Power Connector	1	either Eurorack or MOTM style. See last section for more information.
SPDT On-Off-On	1	
Jack	2	



## D. Power Header Confusion

On the first run of PCBs there is an error in the MOTM power header footprint which lists the voltages backwards. If you are using an MOTM style header, you should install it backwards, like in this photo:



If you are using a Eurorack style connector, it should be connected as shown on the PCB, with the tab facing out and the red line nearer to the wiring pads.

