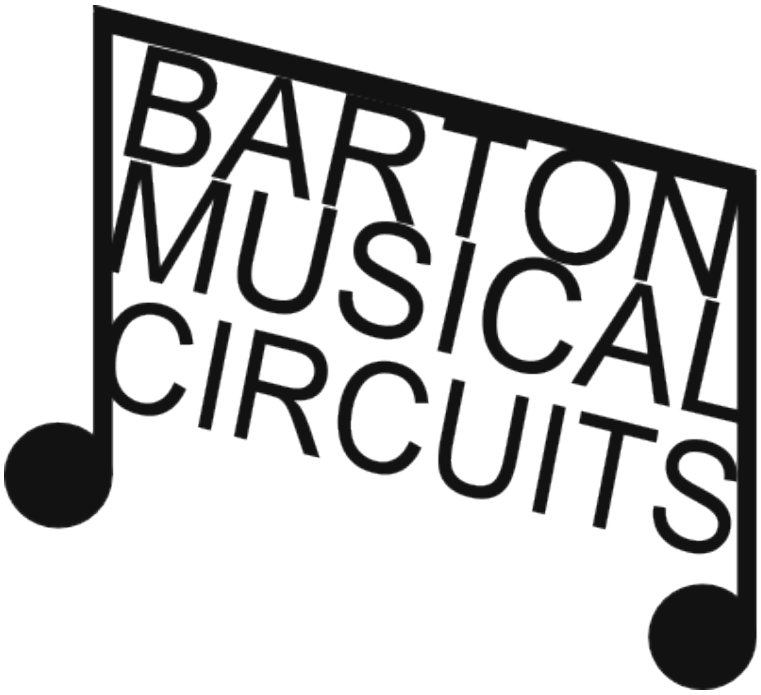

BMC111. CMOS Chime

If you have any questions, or need help trouble shooting, please e-mail
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I. What it Does

This module is a percussive voice composed of four CMOS based square wave oscillators mixed together to create metallic chime or odd pitched percussion sounds. The oscillators can be tuned to 200hz-4.8khz and two have individual mute switches so you can select between using 2, 3 or 4 oscillators simultaneously. The loop switch causes the envelope to retrigger when reaching its end, creating polyrhthmic possibilties.

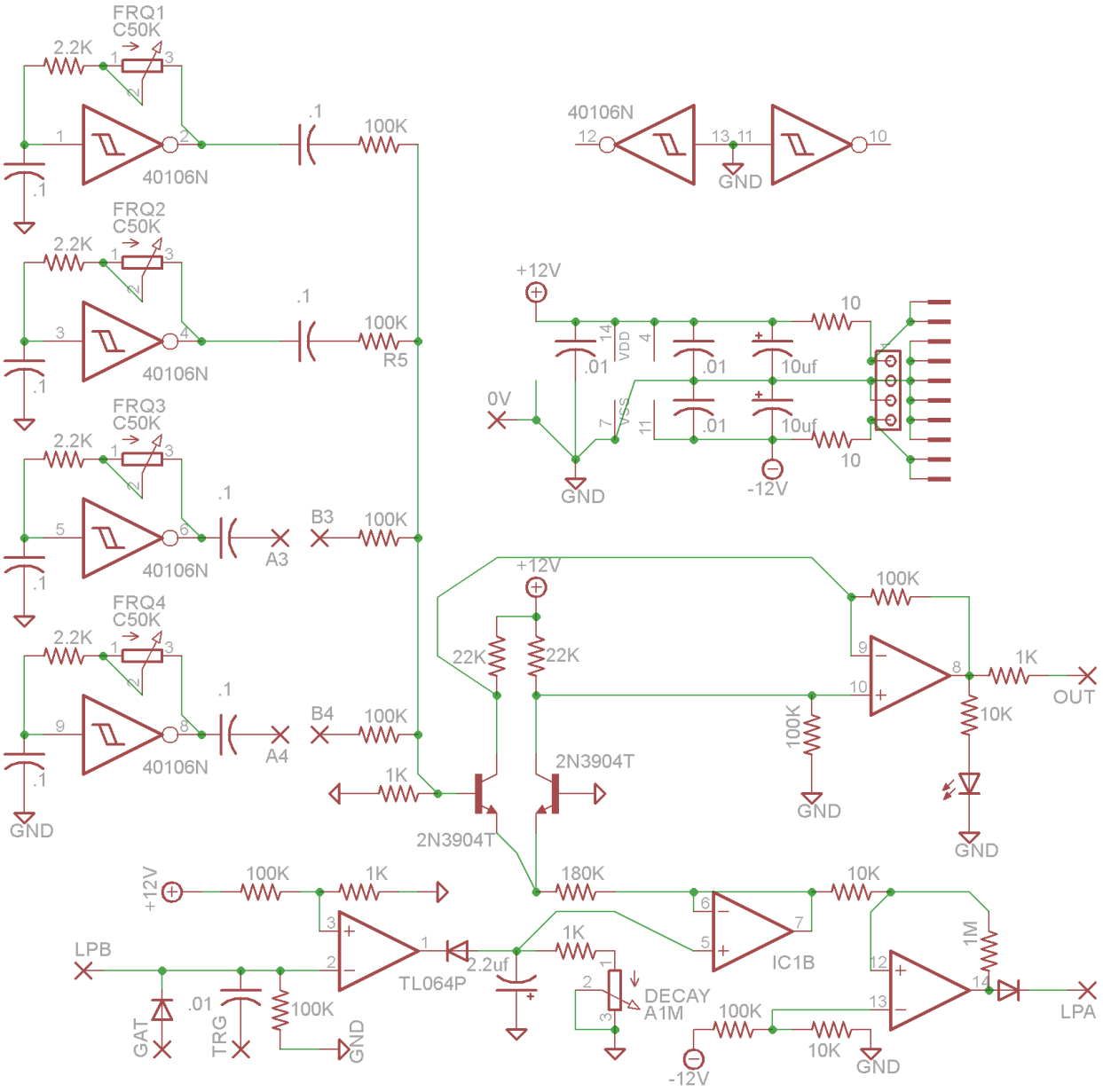
The module should work with +/-15V systems without modification.

CONTROLS/INPUTS/OUTPUTS

1. Decay Knob – This sets the decay of the envelope. The decay range goes from 20 milliseconds to 5 seconds.
2. Frequency Knobs – These set the frequencies of individual oscillators, with a range of 200hz to 4.8khz
3. Loop Toggle – This toggle sends a trigger back to the input when the envelope reaches it's end, causing a new hit. Incoming trigger or gate signals will still trigger the module.
4. Mute Switches – These two switches each mute an oscillator, allowing for simpler harmonic contents.
5. Trigger Input – Inputting a gate or trigger to this jack will produce an amplitude envelope that immediately starts to decay.
6. Gate Input – Inputting a gate here will produce an envelope that stays high until the gate goes low.

SOUND DEMO. (turn down volume, slightly loud and annoying)

This demo starts with two oscillators only. Tuning is adjusted to produce different harmonic combinations and show the range of frequencies. A third oscillator is added, then a fourth with tuning continuously adjusted. The decay is then altered and the loop switch engaged showing the rhythmic possibilities of the loop and the range of decay times.



II. Schematic

Above is the schematic for this module. Starting at the top left, we see the four oscillator circuits. These are based on the CD40106 schmitt-trigger inverter. When the output is at +12V, current will flow through the Frequency pot and 2.2K resistor to the .1uf capacitor to ground, charging it and raising the voltage on the input pin. Eventually the voltage on the input pin will get high enough that the chip will change the output from +12V to 0V, and then the capacitor will discharge through the resistors into the output. These output changes produce our oscillations.

The oscillators go through .1uf decoupling capacitors to 100K mixing resistors, except for the third and fourth oscillators which go through toggle switches before the mixing resistors. When these switches are open, these channels are not mixed in with the others, muting them. The mixing resistors meet at the base of a 2N3904 and are attenuated by a 1K resistor to ground.

This 2N3904 has it's emitter connected to another 2N3904 which has it's base grounded. These transistors and the differential amp form a voltage controlled amplfier. This couples the oscillator signal to the 2nd 2N3904 with inverted voltages. Both emitters are receiving negative voltages from the envelope generator. The collectors connect to +12V through 22K load resistors and the collector signals are then sent to a differential amplifier which will amplify the oscillator signal but remove any DC offset from envelope generator. The output of this differential amplifier is then sent to an LED indicator through a 10K brightness control LED and to the output jack through a 1K resistor.

The envelope generator circuit has three inputs; the input from the Loop toggle (LPB), the input from the gate jack (GAT) which goes through a diode first to keep negative voltages from affecting the other inputs, and the trigger input (TRIG) which goes through a .01uf capacitor which forms a high pass filter with the 100K pull down resistor reducing incoming gate signals to a short pulse.

These signals go to a TL064 wired as an inverting comparator. Because the VCA reacts from negative voltages we're using an inverting comparator to have a negative voltage envelope. The threshold is set by the 100K/1K resistors to +12V/0V that connect to the positive terminal of the op-amp. The output of the comparator goes through a diode to only pass negative voltage, this connects to a 2.2uf electrolytic capacitor and the 1M Decay pot. When the input of the comparator goes high the output will go negative, charging the capacitor with negative voltage, which will then slowly discharge through the 1M pot to ground. This voltage is then buffered by another op-amp and sent to the VCA through a 180K resistor and onto a schmitt-trigger used by the loop control.

The schmitt trigger in the bottom right has its threshold voltage set by the 100K resistor to -12V and 10K resistor to ground hat connect to it's negative terminal. These set the threshold to -1.2V. The 10K input resistor and 1M feedback resistor provide a small amount of hysteresis, so when the input voltage goes slightly above -1.2V, the output will go high and remain high until the input voltage goes back below slightly below -1.2V. This hysteresis is there to make sure that the envelope generator gets a long enough pulse to allow the capacitor to fully charge. Increasing the 10K input resistor's value will make for a longer pulse.

The PCB has footprints for eurorack and MOTM style power connectors. Positive and negative voltage rails are filtered by 10 ohm/ 10 uf low pass filters and .01 uf capacitors are placed near the power pins of ICs for further filtering. The op-amps are powered off the +/-12V rails and the CD40106 is powered off of the +12V/0V.

III Construction

A.PARTS LIST

SEMICONDUCTORS

Name/Value	QTY	Notes
CD40106	1	
TL064	1	Or other quad op-amp
1N4148	3	Or other small switching diode
2N3904	2	TO-92 package
3mm LED	1	

RESISTORS

Name/Value	QTY	Notes
10	2	1/4W metal film
1K	4	1/4W metal film
2.2K	4	1/4W metal film
10K	3	1/4W metal film
22K	2	1/4W metal film
100K	9	1/4W metal film
180K	1	1/4W metal film
1M	1	1/4W metal film

A1M Potentiometer	1	16MM PCB mounted
C50K	4	16MM PCB mounted. B50K can be used if C50K unavailable.

CAPACITORS

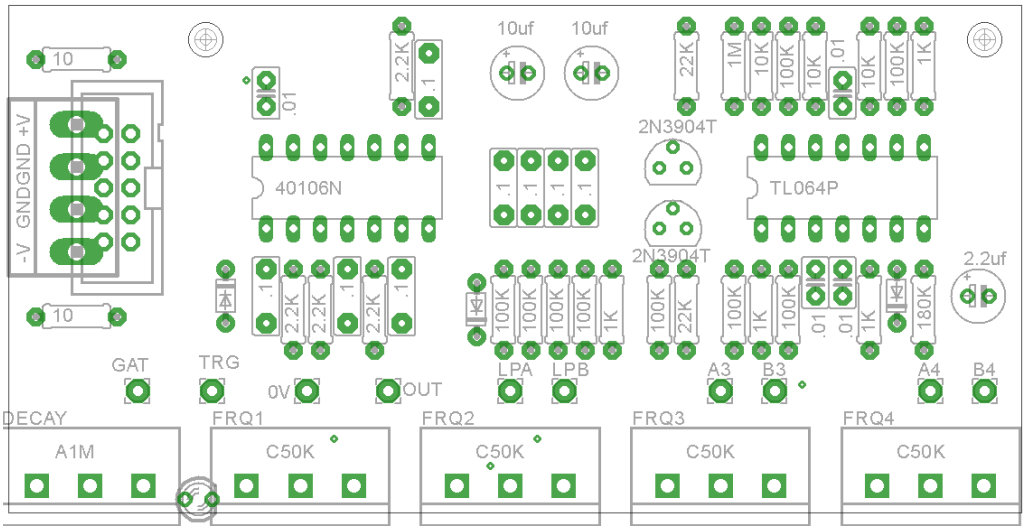
Name/Value	QTY	Notes
.01uf	4	Ceramic disc
.1uf	8	Box film type
2.2uf	1	Electrolytic
10uf	2	Electrolytic

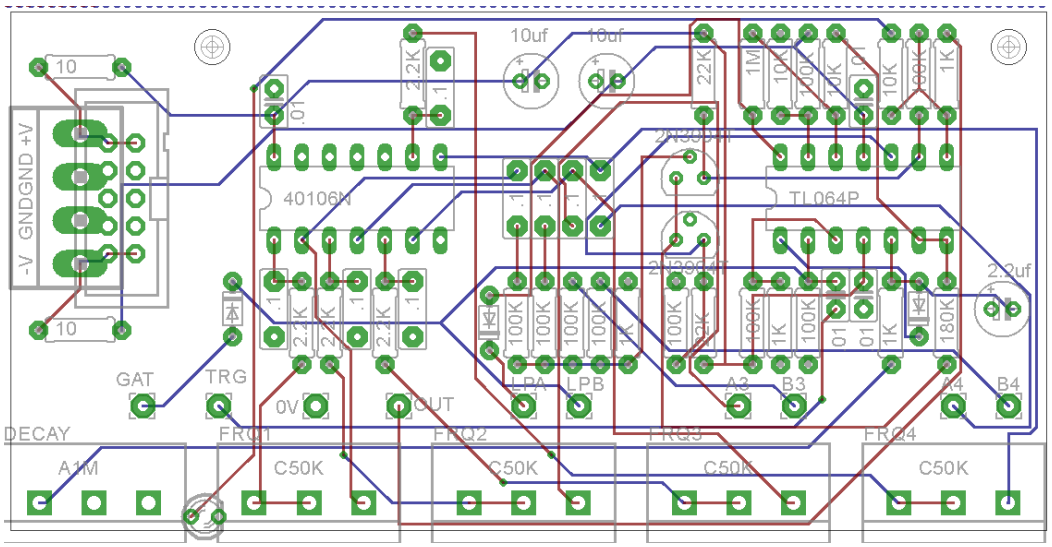
OTHER

Name/Value	QTY	Notes
SPDT Toggle	3	
3.5mm Jack	3	Like these.
Power connector	1	
14 pin DIP socket	2	

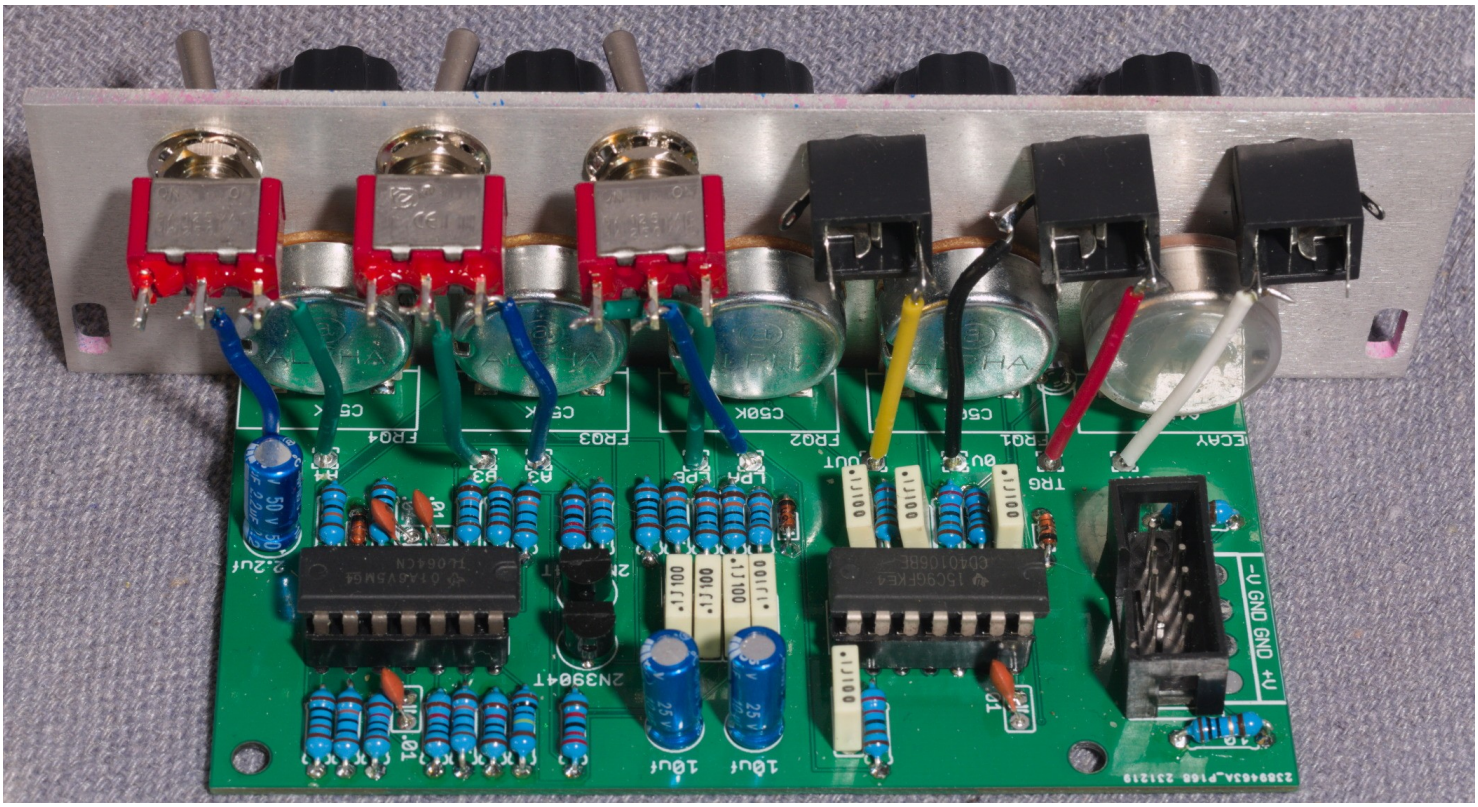
B. THE BOARDs

Below are renderings of thePCB, both with and without traces present. The PCB is 97mmx48mm, the pots are spaced 19.7mm apart.

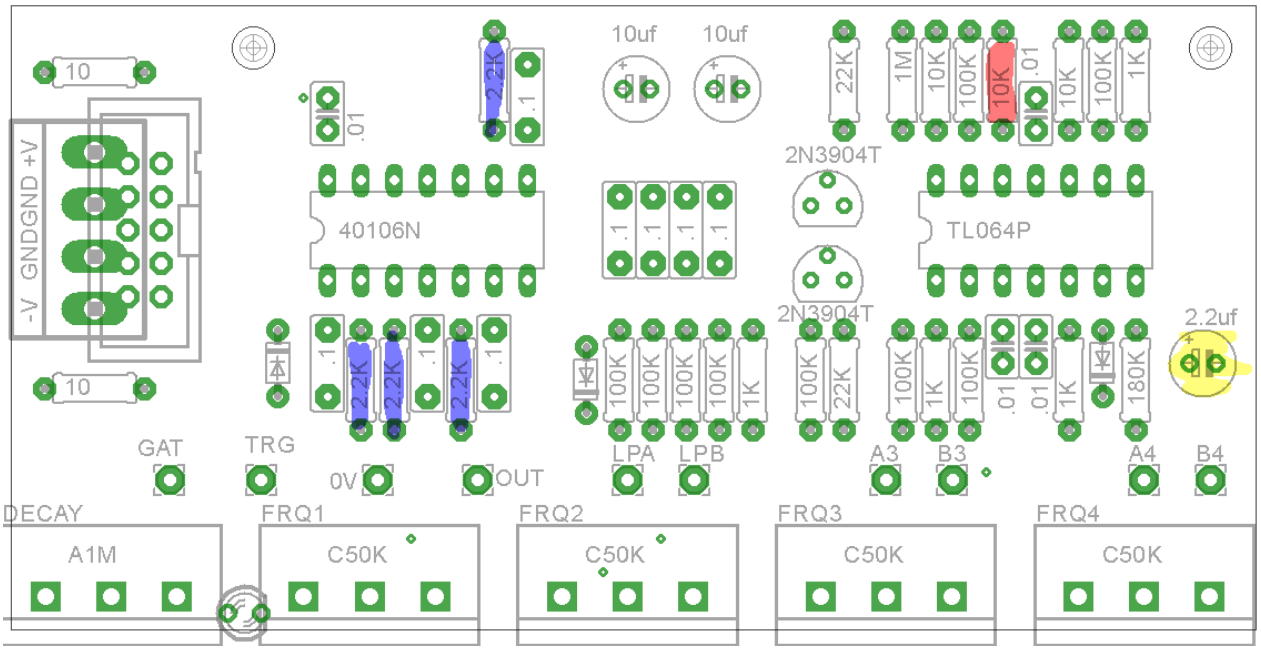



10
-V GNDGND +V
10
40106N
10uf
10uf
22K
1M
10K
100K
1K
TL064P
2.2uf
GAT
TRG
0V
OUT
LPA
LPB
A3
B3
A4
B4
DECAY
FRQ1
FRQ2
FRQ3
FRQ4
A1M
C50K
C50K
C50K
C50K

C. Wiring.
Wirepads should be connected as follows:
GAT – tip of gate input jack
TRG – tip of trigger input jack
0V – sleeve of any jack
OUT – tip of output jack
LPA – Center terminal of loop toggle
LPB – Bottom terminal of loop toggle
A3 – Top terminal of Mute 3 toggle
B3 – Center terminal of Mute 3 toggle
A4 – Top terminal of Mute 4 toggle
B4 – Center terminal of Mute 4 toggle
Below is a photo of a wired module to use as a reference.



D. Tweaking the circuit.



1.Maximum frequencies. Highlighted in blue, the 2.2K resistors set the maximum oscillator frequency, if you'd like to raise the maximum frequency up to the upper limits of hearing, lower the resistor values to 1K or 470 ohm. To lower the maximum frequency for finer control with the frequency pots, increase the value of these resistors to 4.7K or 10K

2.Decay rate. Highlighted in yellow, the 2.2uf capacitor sets the overall decay rate. To achieve longer maximum decays, increase it to a 4.7uf or 10uf. For finer control over short decays, replace it with a 1uf or 0.47uf capacitor.

3.Loop pulse length. Highlighted in red, the 10k input resistor for the loop schmitt trigger can increase the length of output pulses by decreasing its value down to 6.8K or 4.7K.