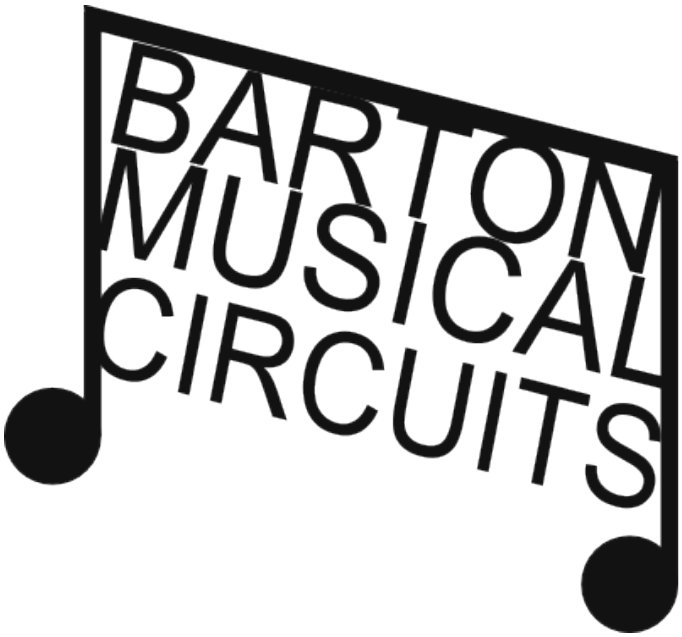


BMC36 Hi Hat Documentation.

Last updated 9-28-2015

I. Using The Delaying AR

A.Features

The Hi Hat is a microcontroller based synth module. It can be built in either +/-12V or +/-15V systems with no modification. It is compatible with the expander from BMC003 (Arpeggiator) for using external control voltage on the 5 analog parameters. It's a descendent of BMC010, Decaying Digital Noise, but offers finer control and the ability to switch between two sets of parameters.

B.Controls/Inputs/Outputs

Controls

1.Close Decay Knob – This sets the rate at which the signal decays on closed hits
2.Open Decay Knob – Same but for Open hits
3.Close Pitch Knob – This sets the rate on closed hits at which random numbers are sampled to generate the digital noise. Further clockwise slows it down more producing less high frequency.
4.Open Pitch Knob – Same but for Open hits
5.Shape Knob – This sets the mix between a logarithmic or linear curve of decay. Full clockwise is linear and full counterclockwise is logarithmic. This control is very interactive with the decay knobs.
6.Reverse Logic Toggle – This reverses the logic of the Open/Close Input. It becomes normally open instead of normally closed.
7.Close Gate Toggle – This sets whether or not closed hits decay at the falling edge of a gate input instead of at the rising edge. This lets you adjust gate lengths of your sequencer as another control for the module.
8.Open Gate Toggle – Same but for Open mode.

Inputs

1.IN – The trigger or gate is input here to control timing of the hits.
2.Open/Close In – Input a gate signal here. When a rising edge is detected on the IN, the OPEN/CLOSE input will be checked, and depending on the setting of the Reverse logic toggle, this will determine whether or not the hit will be open or closed.

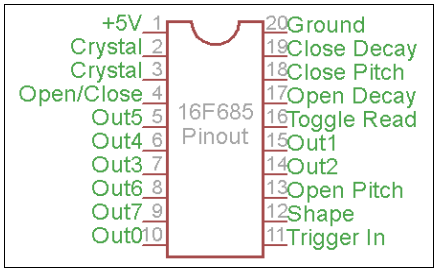
Outputs

1.Out - +/-5V output of decaying noise signal.

II.Schematics

A.The Chip

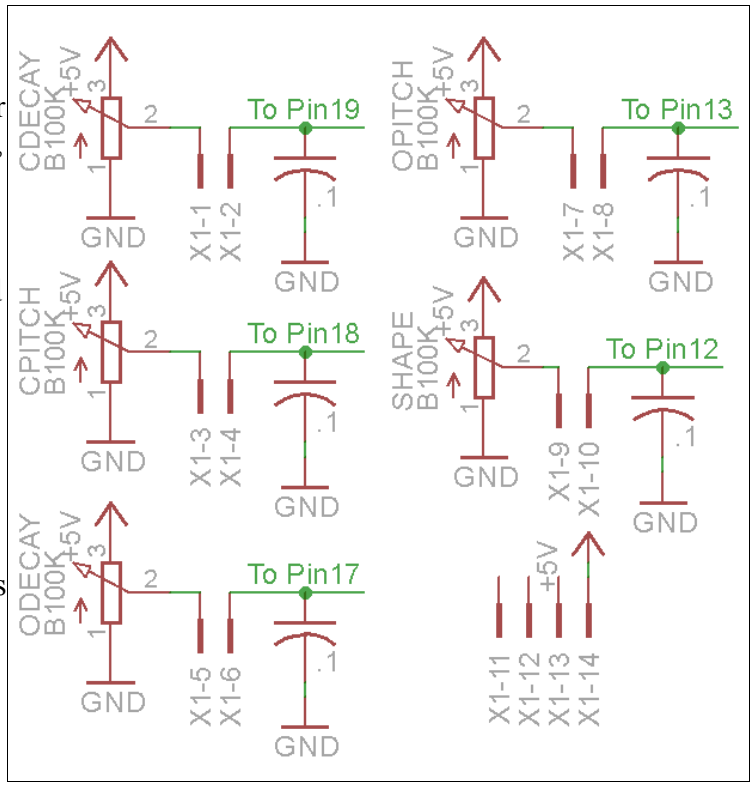
The 16F685 microcontroller interacts with all other portions of the circuit, here is it's pinout. Not pictured is the crystal oscillator. It should be 20mhz with two 22pf capacitors to ground.



B.Analog Inputs.

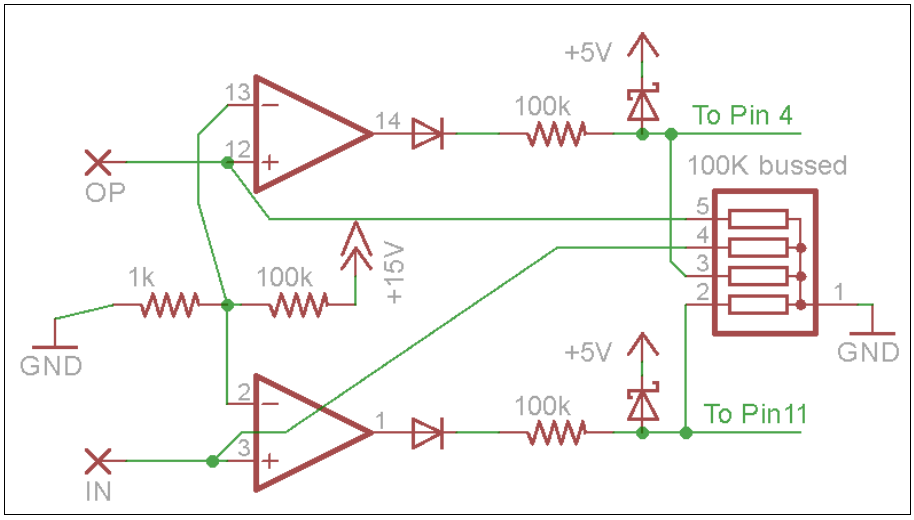
On the right we see the analog inputs on the PCB. Each consists of a 100K linear pot wired as a voltage divider connected to a pin on a 14pin DIL header, with a corresponding pin connected to a . 1uf capacitor and a pin on the microcontroller.

The 14pin DIL header can be used in two different ways. When not connecting the unit to the expander module, jumpers should be placed across the pins so that the pots wipers are directly connected to the microcontroller. When used with the expander, a 14pin connecter is attached between it and the expander module, and the expander mixes the voltage from these pots with attenuated external voltages.



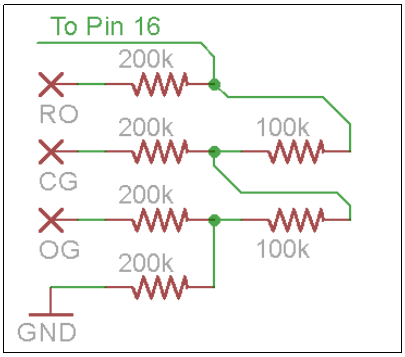
C.Digital Inputs

On the right we see the digital inputs. The Open/Close and Input jacks each go through an identical circuit to prepare the outside signal for the microcontroller. Each is connected to a 100K pulldown resistor (keeping the input at zero volts when nothing is plugged in) and then goes to a comparator. The threshold voltage of the comparator is set by the 100K and 1K resistors, and should turn on when any voltage higher than .1volts is inputted. On the comparator's output is a diode, 100K resistor and schottky diode followed by a 100K pulldown resistor. This network makes it so that the microcontroller only "sees" 0 and +5V, even though the comparator's output is actually +/-12V or +/-15V depending on your system.



D. Switches

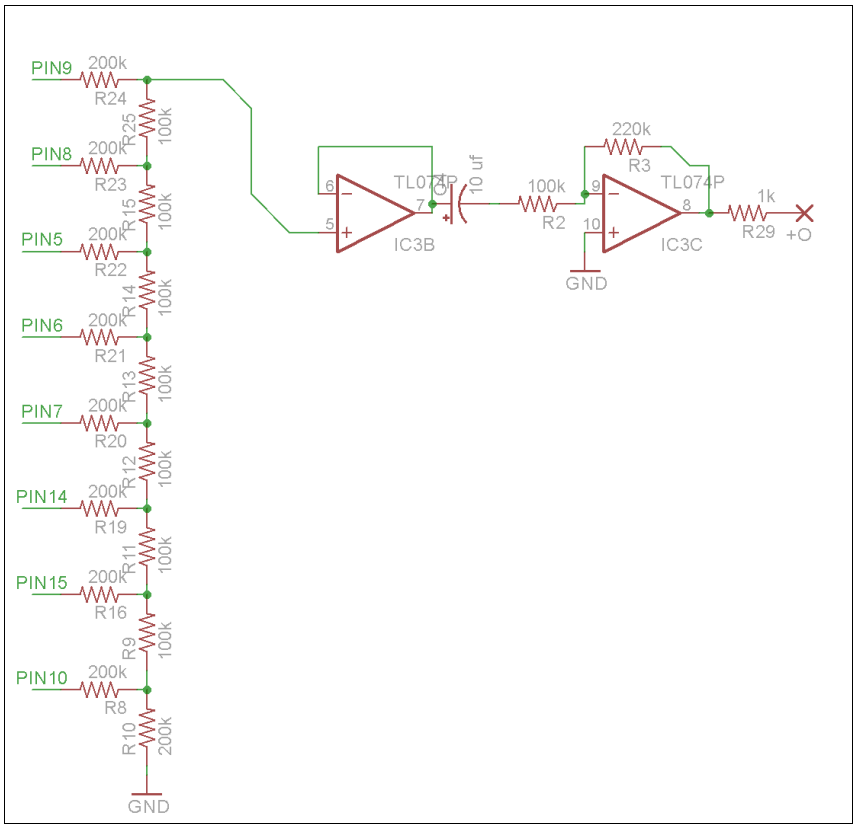
On the right we see the switch network. Each of these wirepads is connected to the center of a SPDT switch. Each of the outside lugs is wired to +5V or Ground. These voltages are sent through a R/2R network which converts the digital On/Off signal into an analog voltage which can be read by an analog input pin of the microcontroller. This is done to save on pin real estate for the microcontroller.



E.Analog Output

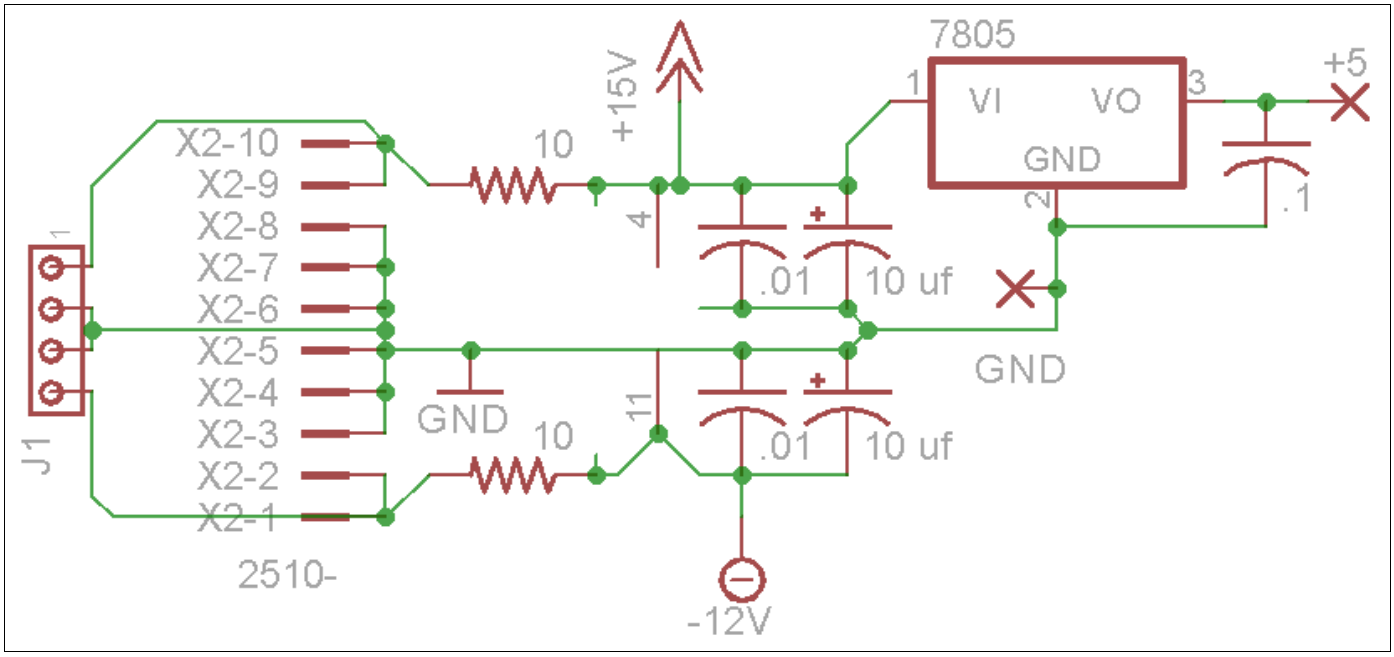
To the right we see the analog outputs. On the far left of the schematic is a R/2R network connected to the digital outputs of the microcontroller.

The output of the R/2R network is sent to a buffer. The buffer's output is still 0/+5V, and because we want a bi-polar signal, it is sent through a 10uf decouplling capacitor, and then to an inverting amplifier with a gain of 2.2 which should give us roughly ~+/-5V. The output of this amplifier goes through a 1K resistor and on to a wiring pad



E.Power Supply

Here we see footprints for two different types of power connecters. The Positive and negative voltage rails go through 10 ohm resistors and are then filtered by 10uf caps, and .01uf caps on the pins of the op amp. The positive rail is then sent to a 7805 voltage regulator which provides +5V reference voltage for the microcontroller.



III.Construction

A. Parts List

Semiconductors

Name/Value	Qty	Notes
16F685	1	Should have been provided with your PCB
TL074	1	14pin DIP package.
7805	1	TO 220 Package
1n4148	2	or other small signal switching diode
1N916	2	or other low wattage schottky

Resistors

Name/Value	Qty	Notes
10 ohm	2	7.5mm lead spacing, 1/4W Metal Film
1K	2	" "
100K	13	" "
200K	13	" "
220K	1	" "
100K bussed array	1	5 Pin, 4 Resistors. Or roll your own.
B100K Lin	5	16mm size, PCB mount.

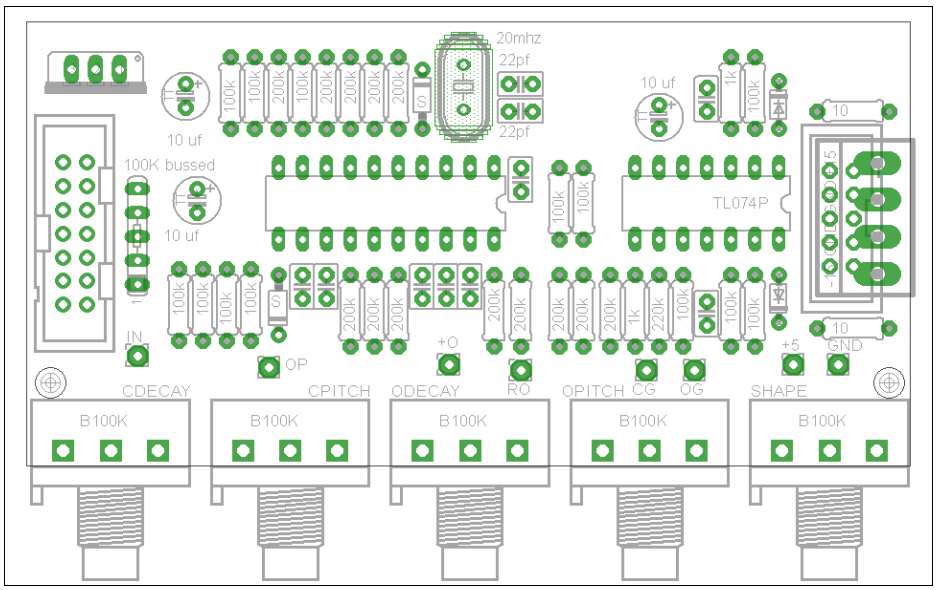
Capacitors

Name/Value	Qty	Notes
22pf	2	2.5mm lead spacing. Ceramic disks ok.
.1uf	8	" "
10uf	3	2mm lead spacing.

Other

Name/Value	Qty	Notes
Crystal Resonator	1	20mhz
20pin DIP socket	1	
14pin DIP socket	1	
14pin DIL headers	1	
Power connecter	1	either eurorack or MOTM style
Jack	3	either 1/4" or 1/8"
SPDT toggle	3	
2.54mm Jumpers	5	For use when not using expander

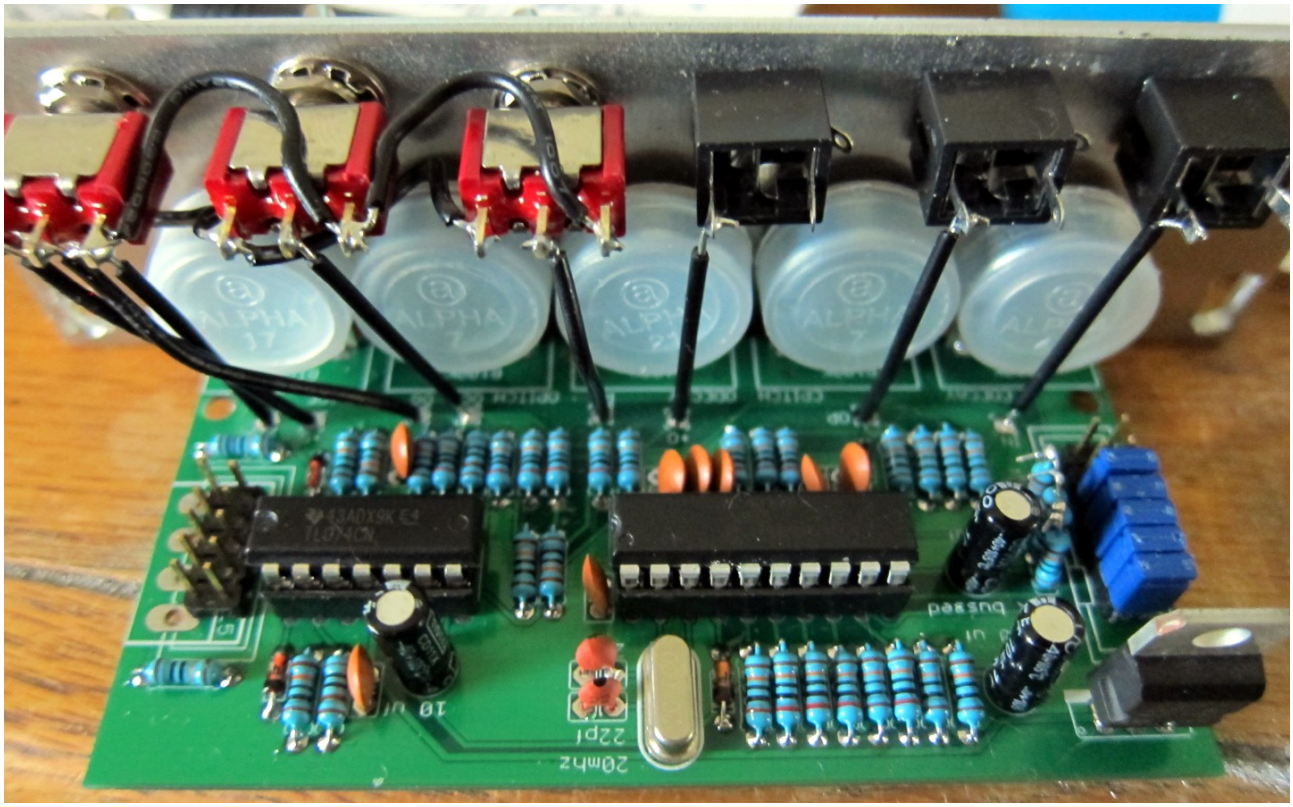
Other than a shrouded header for power/expander connections, all parts for this project should be available from Tayda electronics for very cheap.

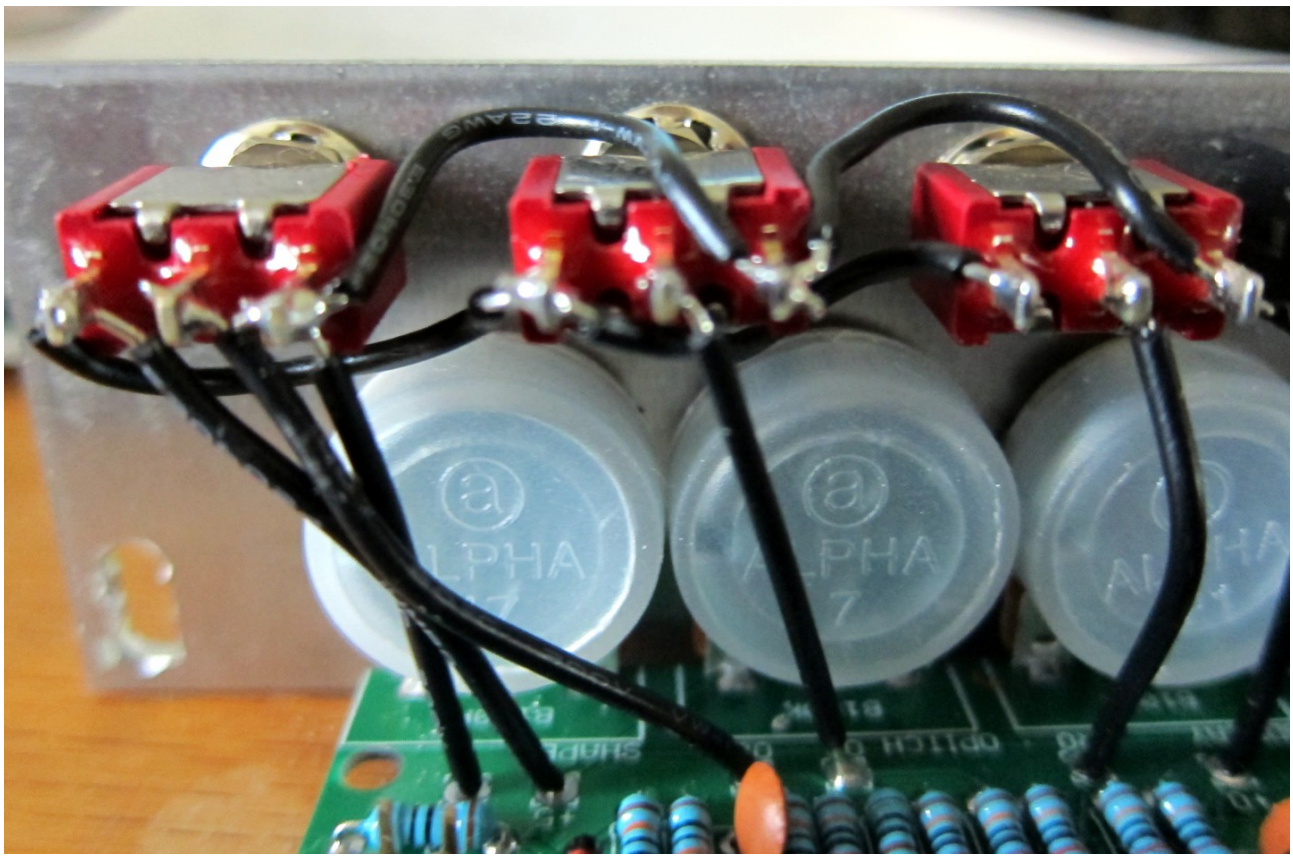


B. The PCB

The board's dimensions are 94mm x 47mm. The pots are spaced 3/4" apart from each other. The mounting holes are 89mm apart.

Below is a photo of a wired unit. If not using the expander, jumpers should be placed as shown in this photo. On the next page is a close up of the wiring of the toggles, if it's unclear from the photos, the ground connection should go to the upper wiring lug and the +5V connection should go to the lower wiring lug.




22AWG
ALPHA
ALPHA