BARTON MUSICAL CIRCUITS

BMC031. Quad Trapezoidal LFO Rev2

Last updated 7-8-2023

Rev 1.1 Documentation here

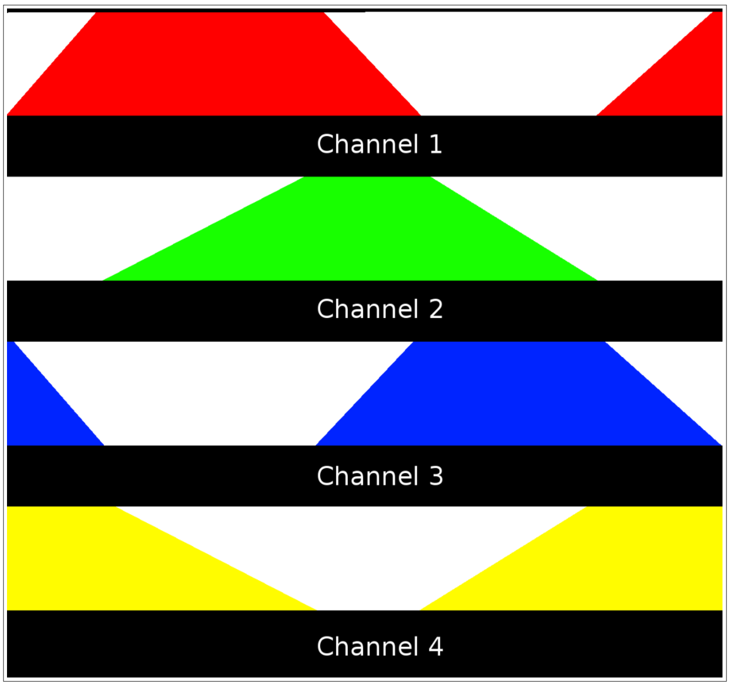
Rev 1.0 Documentation here

REVISION HISTORY

Rev 2 Changes:

1. Changed where feedback is taken for charge buffer to better account for diode drops.
2. Removed diodes and added a resistor to schmitt trigger to improve stability.
3. Changed timing capacitors to non-polarized 10uf for increased range and lower parts count.
4. Increased LED current limiting resistors to 10K to lower brightness and save on current.

I. Features



The Quad Trapezoidal LFO is a single LFO with four outputs. To the right is a diagram showing how the four outputs interact with each other. As you can see, the four outputs are in step with each other. When the previous output reaches it's peak, the next output begins to ascend. And when the previous output reaches it's lowest voltage, the next channel begins to descend. When a output is neither ascending or descending it holds it's voltage. The voltage range of all four outputs is +5v/-5V.

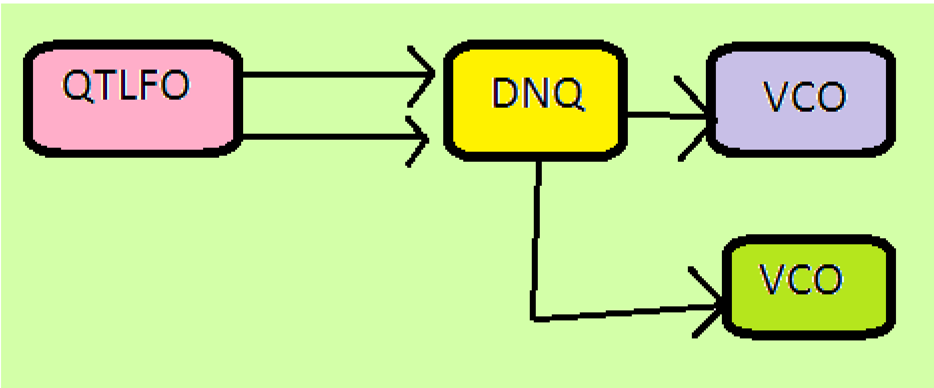
The diagram to the right shows linear rises and falls. On a real unit the voltage changes are logarithmic.

There are four knobs which control the module. Each controls the time it takes for the rising voltage of a channel, which also controls the falling time of it's inverse channel, and the holding time for the other two channels. So, by increasing the rising time of channel 1, you're also increasing the time it takes for channel 3's voltage to fall, the amount of time that channel 2 stays at -5V and the amount of time that channel 4 stays at +5V.

PATCHES

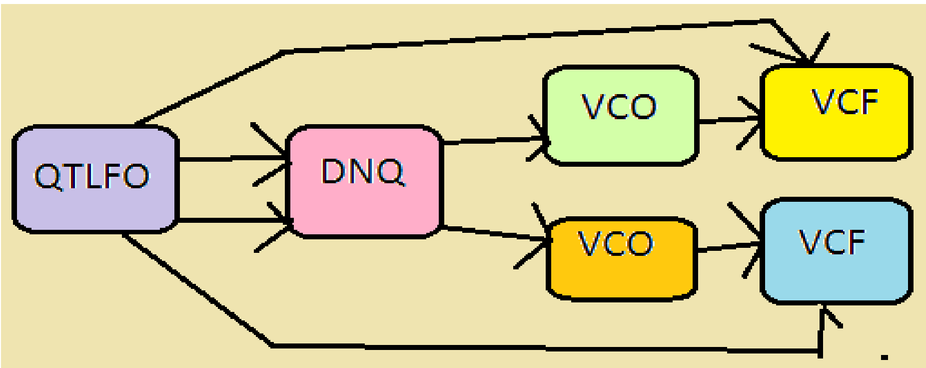
Patch #1

Outputs 1 and 3 are going to the inputs of a DNQ module. The outputs are then sent to a pair of VCOs.



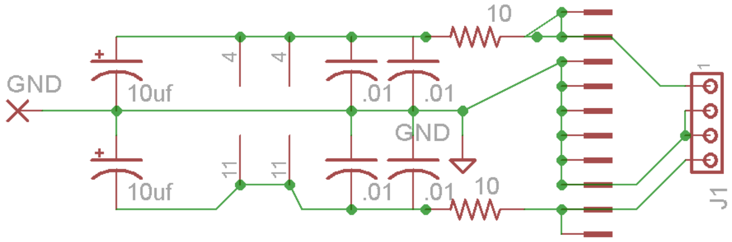
Patch #2

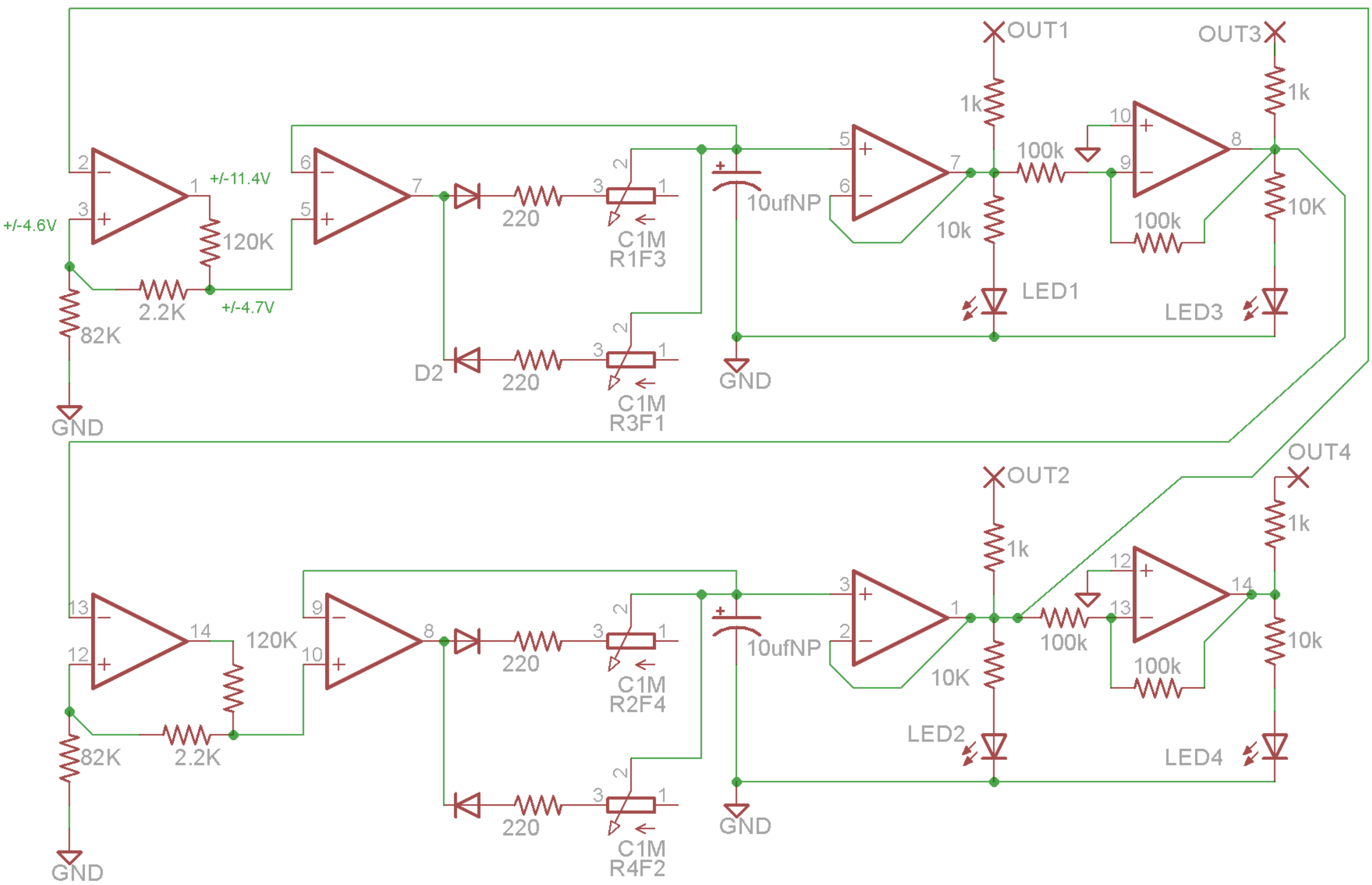
This is the same patch, but the VCOs are then being sent to VCFs. The cutoffs of the VCFs are being controlled by outputs 2 and 4 of the QTLFO.

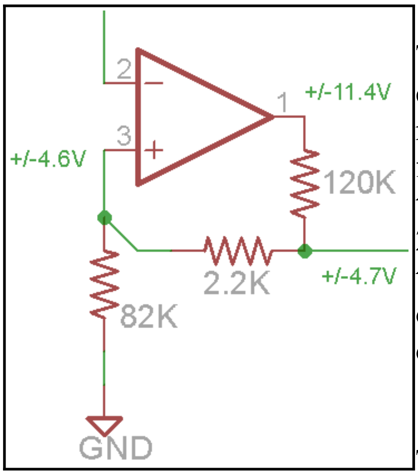


II Schematics

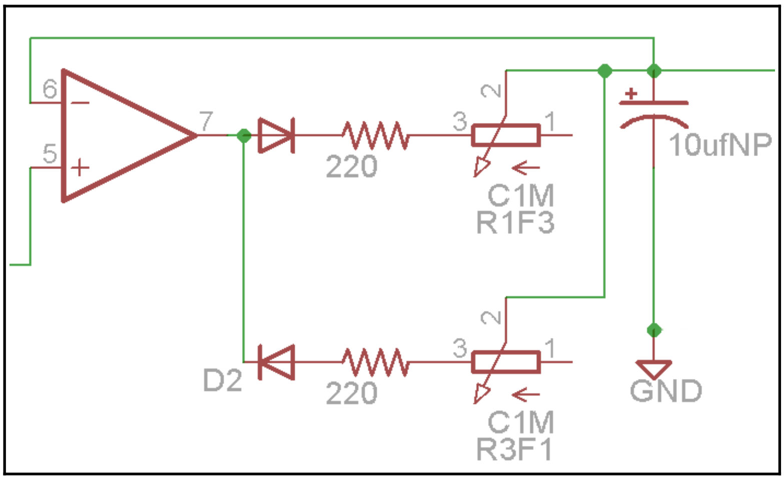
Below is the master schematic for the module, and on the next page is an explanation of the different parts of the circuit. As you can see, the circuit for channels 1 and 3 is repeated for channels 2 and 4 with the only difference being which channel feeds the Schmitt triggers on the left.



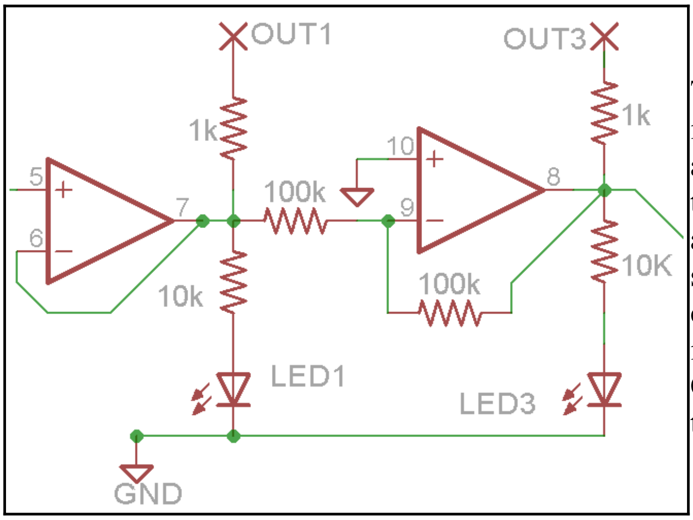




The op-amp to the left is wired as an inverting Schmitt trigger. The negative terminal is connected to the output of one of the other channels The output of the op-amp is connected to a voltage divider made up of three resistors, a 120K, 2.2K and 82K. The voltage that forms between the 120K and 2.2K is the output voltage and is sent to the buffer/charge section. The voltage between the 82K and 2.2K resistors is then connected tot he positive input to set the threshold. The threshold voltage is set slightly lower than the output voltage to make sure slight variances in resistor values in other parts of the circuit don't cause the oscillator to lock up.

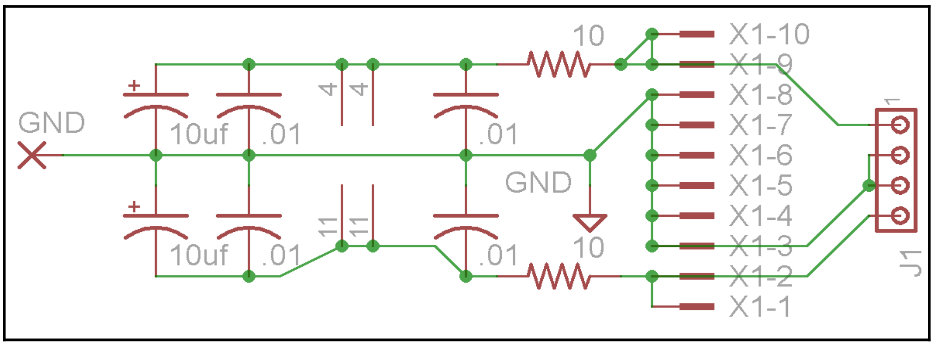


To the right is the buffer/charge section. The output voltage of the Schmitt trigger is sent to the non-inverting input of an op-amp. This op-amp connects to diodes placed in opposite orientations that are in series with variable resistance formed by a resistor in series with a potentiometer wired as a rheostat. The current through these diodes charges or discharges a 10uf capacitor to create our output voltage. The potentiometers control the rate of charge/discharge. The negative input of the op-amp connects to this voltage to provide negative feedback to the buffer.



To the left is the output section. The left op-amp is wired as a buffer. It's output is connected to an LED through a 10K resistor and a wiring pad through 1K resistors. The op-amp on the right is a unity gain inverting stage, which inverts the signal from the first buffer. It's output is also connected to a wiring pad and an LED. The inverted output is sent to the next schmitt trigger. On outputs 2/4 the non-inverted output is sent to the next schmitt trigger.

To the right is the power connections. There are footprints for MOTM and Eurorack style power connecters on the PCB. These are in connected to the PCB's power rails through a pair of 10 ohm resistors and then filtered with a pair of 10uf capacitors. There is additional high frequency filtering on the power pins of the two TL074s.



III. Construction

Parts List

Semiconductors

Value	Qty	Notes
TL074	2	14 pin DIP package
1N4148	4	Or other small signal switching diode, just be consistent with diode type throughout the circuit.
LED	4	3mm

Resistors for +/-12v

Value	Qty	Notes
10 ohm	2	1/4W Metal Film
220 ohm	4	1/4W Metal Film
1K	4	1/4W Metal Film
2.2K	2	1/4W Metal Film
10K	4	1/4W Metal Film
82K	2	1/4W Metal Film
100K	4	1/4W Metal Film
120K	2	(Change to 160K for +/-15V supplies)
C1M Pot	4	16mm PCB mounted

Capacitors

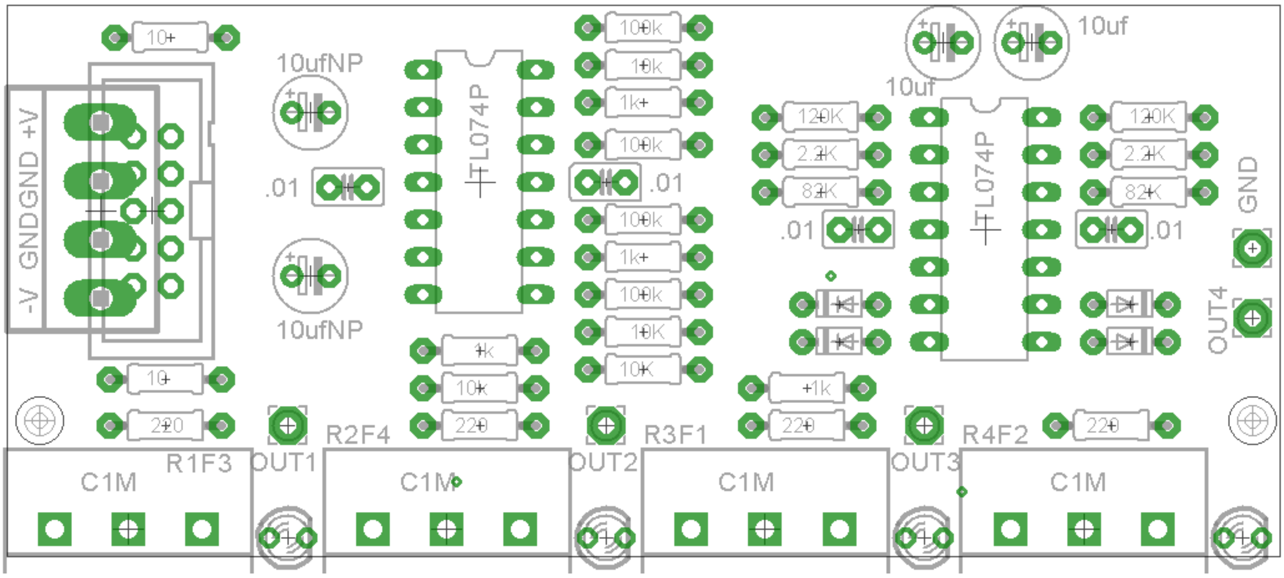
Value	Qty	Notes
10uf Non-polarized	2	Electrolytic
10uf	2	Electorlytic
.01uf	4	Ceramic disc.

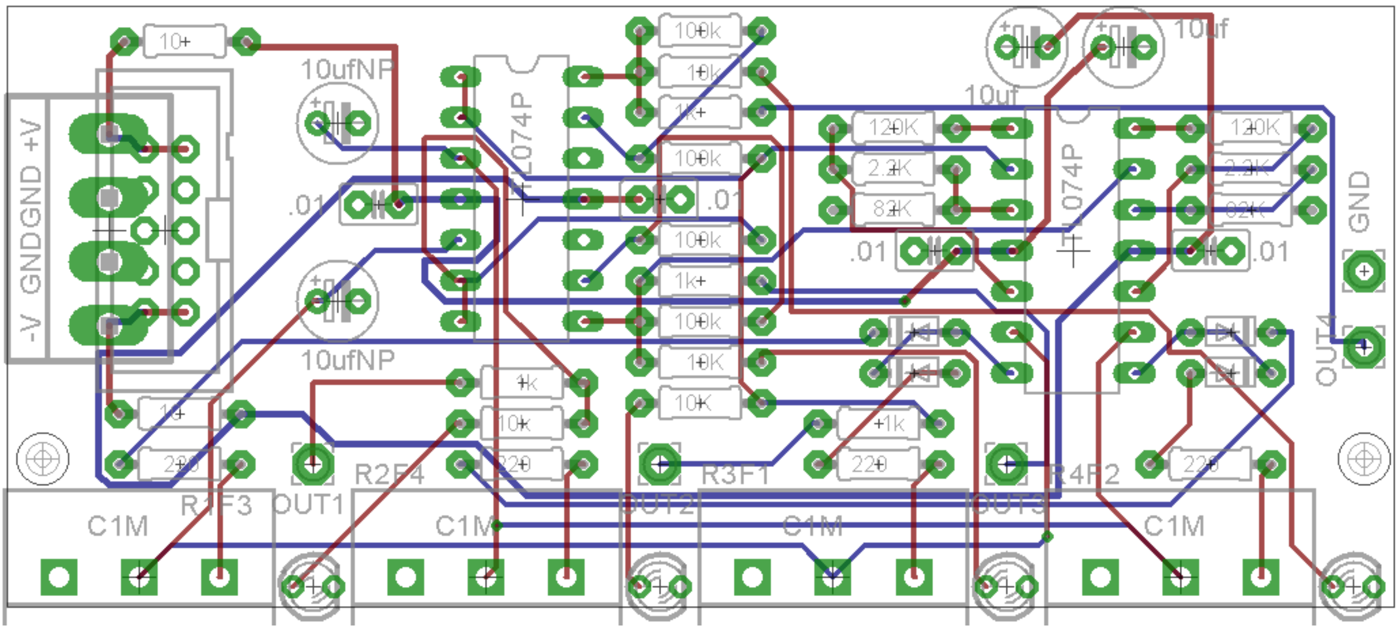
Other

Value	Qty	Notes
Power Connecter	1	Eurorack or MOTM style
14 Pin DIP Socket	2	
Knob	4	
Jack	4	

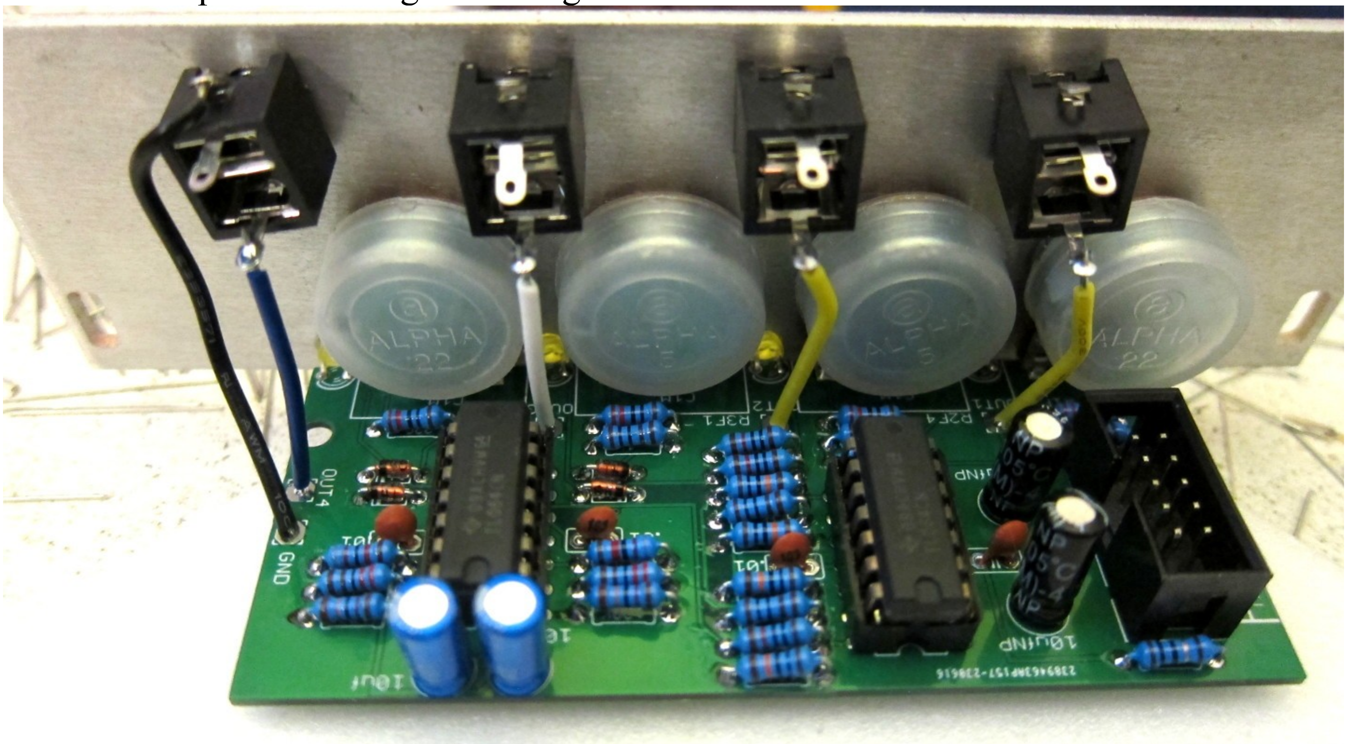
The Board

The board's dimensions are 87mm x 39mm. The mounting holes are 82mm x 28mm apart. The pots are spaced 21.6mm apart. Below are renderings of the PCB with and without PCB traces shown. In the image with traces, the ground fill is not shown, so assume unconnected pads are connecting to ground.





Below is a photo showing the wiring for the module:



Installing LED Sideways

The PCB indicates that the LED should be mounted parallel to the board, do not do this. Leds should be pointing in the same direction as the pots. The leads of the LED should be bent at a 90 degree angle, the easiest way to install them is in four steps:

1. Place the LED on the edge of the board facing out with it's leads going over it's pads on the PCB. Make sure the bottom lip of the LED is flush with the board.
2.Clip the leads 2 or 3 mm past the pads on the PCB.
3.Bend the LED leads 90 degrees 2 or 3mm from the edge.
4.The LED should pop into place easily.