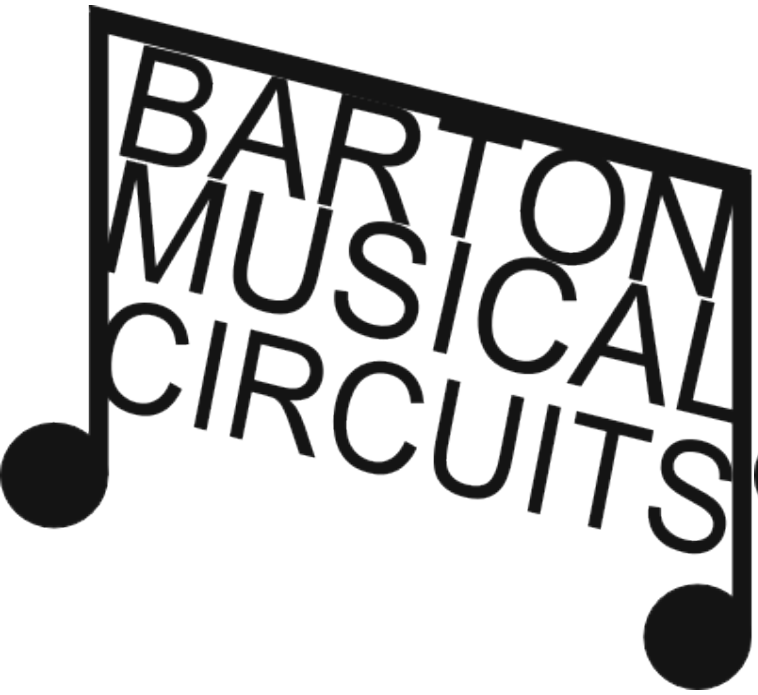
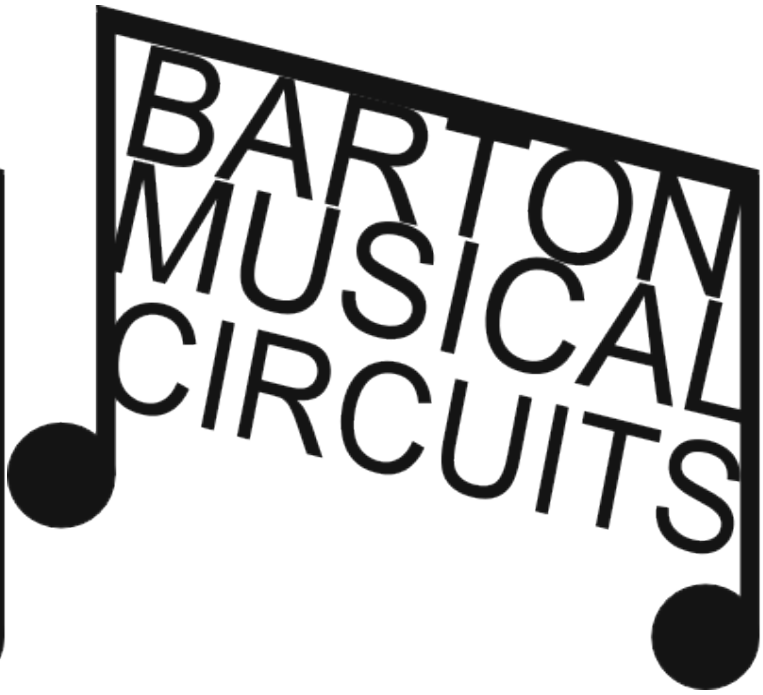




Auto-Seq Documentation

Written April 6th, 2014

I.Using The Module

A. What is Auto-Seq?

"Auto-Seq" is shorthand for "Automated Sequencer." It is a unique step sequencer which programs it's own sequences. There is a small selection of controls to help refine it's sequences to the taste of the composer. There is no way of storing and recalling the sequences which it writes, Auto-Seq is an improviser. If you're interested in random composition, or if you're just tired of the hand cramps that come with programming traditional step sequencers, then this is a module that you might find useful.

B. Controls/Inputs/Outputs

Controls

1. Mode - *The Auto-Seq has a built in quantizer, this knob selects what musical mode it will quantize to. From least clockwise knob position to most clockwise, the modes are Major, Minor, Major Pentatonic, Minor Pentatonic, Fifths and Chromatic.*

2.Length - *This knob controls the length of the sequence. This is measured by the number of input clock pulses before the sequence resets itself. The range of pulses before reset is 1 to 256.*

3.Rhythm Subdivision - *The input clock pulses are run into a 4x clock multiplier and then through a divider. This control selects what division of output is used by the sequencer for functions other than Length. The range is from 4x input to 1/8 input. This knob is only read at the start of a new sequence.*

4.Range - *This selects the range of pitches that Auto-Seq can output. It selects by octave, ranging from one to five octaves. When the sequencer is choosing notes, it will check to see if a note is in range, and if not it transposes the note down an octave. So when increasing range, you will hear the same notes, just in different octaves.*

5.The "One" Switch - *When activated this switch will make sure that a note is played on the first note of the sequence (the "one" of the sequence) and that the note will be the root note of the scale being played (the "one" of the scale).*

6.Portamento - *This switch will turn on portamento or glide between notes. Not all notes will be played with portamento. The effect becomes more noticable as the range of pitches is increased.*

7.Keychange - *This switch sets whether or not the next sequence to be written will be in a new key. When this switch is disengaged, all sequences will be in the key of 0V as their root note.*

8.Straight Rhythm - *This switch, when engaged, sets the sequencer to play a note on every beat. There will be a minor variation on the note length from the gate output. This switch is only read at the start of a new sequence.*

9.New Sequence - *This pushbutton tells the sequencer to write a new sequence. The new sequence will be played when the current sequence finishes.*

Inputs

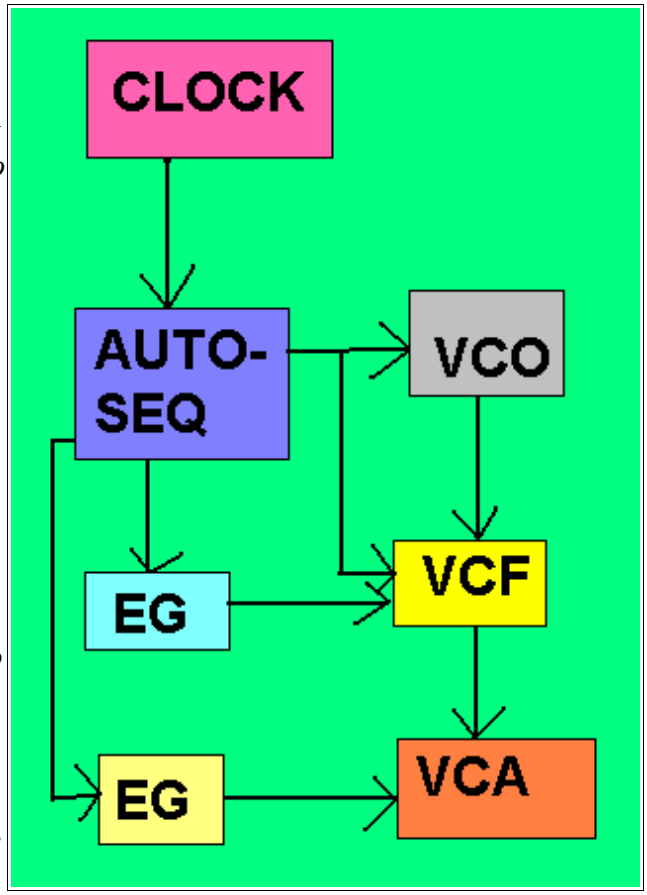
1.Clock - *A series of timing pulses should be input here.*

2.Reset - *This tells the sequencer to play the first note of the sequence on the next incoming clock pulse. It's used to help syncronize with other timing devices.*

3.New - *This input has the same effect as the New Sequence button, but can be activated by a gate or trigger.*

Outputs

1.Control Voltage - *This is a 0 to 6V CV output to be used with 1v/oct calibrated oscillators and VCFs.*
2.Trigger - *This is a short timing pulse that is sent out at the start of every new note. It's range is 0 to 5V*
3.Gate - *This is a timing pulse that is sent out for the duration of a note's length.*
4.End of Sequence - *This is a timing pulse sent out on the last note of a sequence.*



C.Sample Patches

For the first two sound samples, the diagram on the right shows the patch used. A clock is being input to the Auto-Seq. The Auto Seq's trigger and gate outs are being sent to Envelope Generators, which are then being sent to control the cutoff frequence of a VCF and the amplitude of a VCA. The Voltage output is being sent to a VCO and VCF. The VCO's output is being sent to the VCF, whose output is being sent to the VCA. For the third sound sample, this same patch is used, but the clock is also controlling a pair of drum sounds.

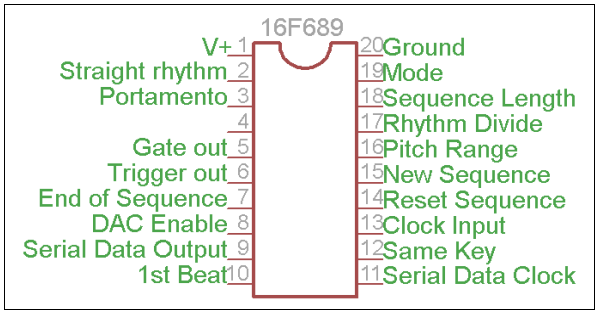
Listen to example 1 here. This mp3 just demonstrates a few different sequences being created by hitting the "New Sequence" button. No other controls are manipulated.

Listen to example 2 here. This mp3 demonstartes all of the knobs being manipulated. First is the musical mode knob, then length, then rhythm subdivision and finally pitch range.

Listen to example 3 here. In this mp3 the Auto seq is paired with a pair of drum sounds to help give context to it's rhythmic changes. The straight rhythm switch, rhythm knob, range knob and the new button are all manipulated in this mp3.

II. Schematics

A. The Microchip

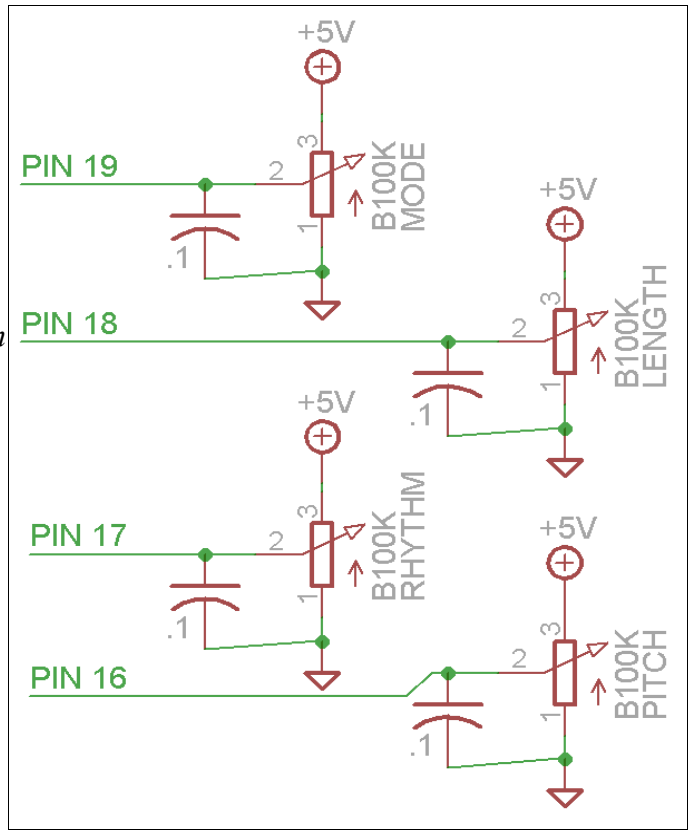


On the right, we see the pinouts for the microcontroller. This chip is at the center of the design and all other schematics presented refer to the chip. Pins 19 - 16 are the analog inputs, these are all connected to knobs and read a variable voltage. Pins 15-12, 10, 3 and 2 are all digital inputs which look for changes between 0 and 5V. Pins 5-7 are digital outputs, which output a change bewteen 0 and 5 volts. Pins 8, 9, and 11 are serial data outputs which connect to the digital to analog converter chip.

B.Inputs

1.Analog Inputs.

On the right we see the four analog inputs. Each of these consists of a 100K linear pot wired as a potential divider between +5V and Ground. The wiper of the pot is connected to a capacitor to ground to filter out high frequency noise and then sent to an input pin on the microcontroller.

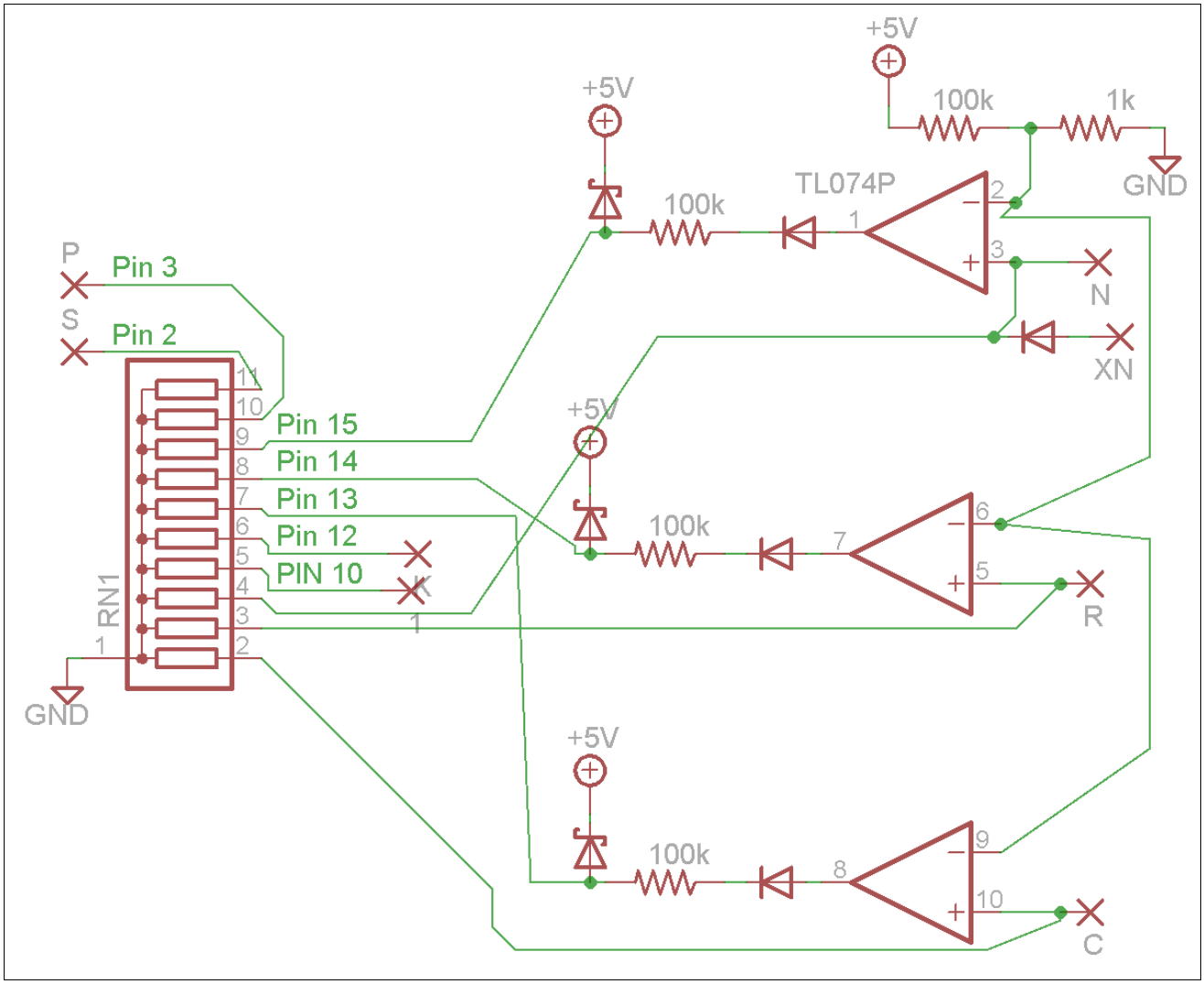


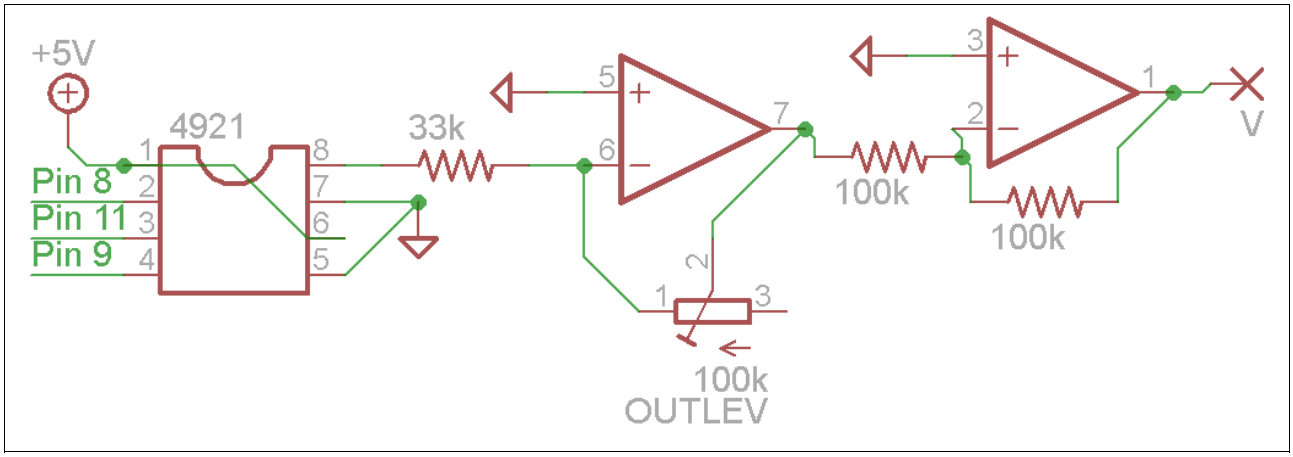
2. Digital Inputs.

Below, we see the digital inputs. On the left of the diagram is a bussed 100K resistor array attached to ground and various other points. On the right we see some op-amps wired as comparators. These ensure that an input signal for the New, Reset or Clock input will be large enough to get a response from the microcontroller. The inverting inputs on each of these is tied to . 05V, so any signal above .05V will turn the input on. The positive inputs of each is tied to ground through a 100K resistor and then attached to the input jack, except for the New input, which first goes through a diode (to protect the output of the driving circuitry from the New switch).

The outputs of these op amps each go through a diode for polarity protection, then a 100K resistor in series with a schottky diode for overvoltage protection, and then a 100k to ground and finally the input pin.

The digital inputs which are attached to switches, are simply connected to the bussed resistor array and then connected to the pins of the microcontroller.

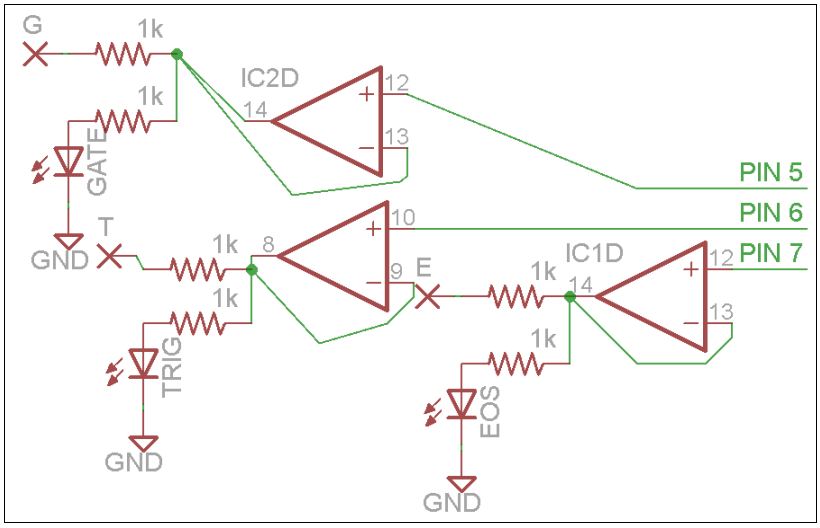




C. Outputs

1.Analog Output

The analog output is pictured above. The 4921 is a digital-to-analog conversioni IC that is controlled by the serial data output of the microcontroller. We see soem pins on the 4921 are connected to the mmicrocontroller, and then it's output is fed into a pair of inverting amplifiers, one of which has a trimpot in it's feedback path. This provides for a non-inverting adjustable amount of amplification.



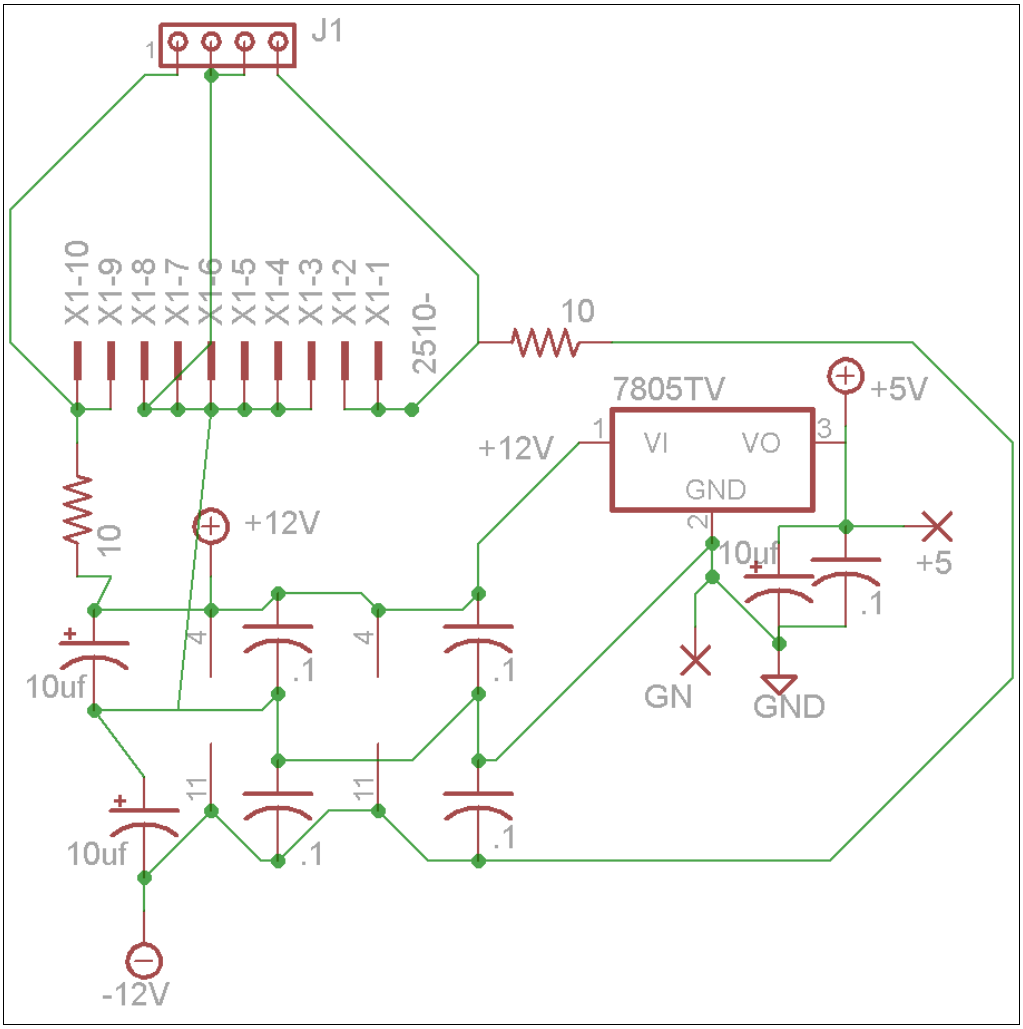
2.Digital Outputs

The digital outputs are pictured above. Each circuit is composed of the same pieces. An op amp is wired as a unity gain buffer with it's input tied to a digital output pin of the microcontroller. The buffer's output is then sent to an LED and an output wiring pad with a 1K resistor in series with each.

D.Power Supply

Below, we see the power supply for the module. At the top are pads for two different kinds of connecters for modular synthesizer systems. The positive and negative rails are filtered by a 10 ohm resitor and 10uf capacitor, and then again at the pins of the TL074 with .1uf bypass capacitors. The +5V supply for the controls and the microcontroller is obtained with a 7805 voltage regulator.

Shown are wiring pads for +5V and GND to connect to the jacks and buttons.



III. Construction

A.Parts List

Semiconductors

Value	*Qty*	*Notes*
16F689	*1*	*Pre programmed, should have come with your PCB*
TL074	*2*	*14pin DIP, any quad op amp should work*
7805	*1*	*TO220 package*
1n4148	*4*	
MCP4921	*1*	*DAC in 8 pin DIP format*
SD101C	*3*	*Or other small schottky*
LED	*3*	*3mm size*

Resistors

Value	*Qty*	*Notes*
10 ohm	*2*	*7.5mm lead spacing. 1/4w Metal Film unless otherwise noted on all resistors*
1K ohm	*7*	
100K ohm	*6*	
33K ohm	*1*	
100K bussed array	*1*	*11 Pin, or stand 10 resistors on their end and make your own.*
B100k Pot	*4*	*16mm PC mounted Alpha brand.*
100K trimpot	*1*	*Multi turn cermet*

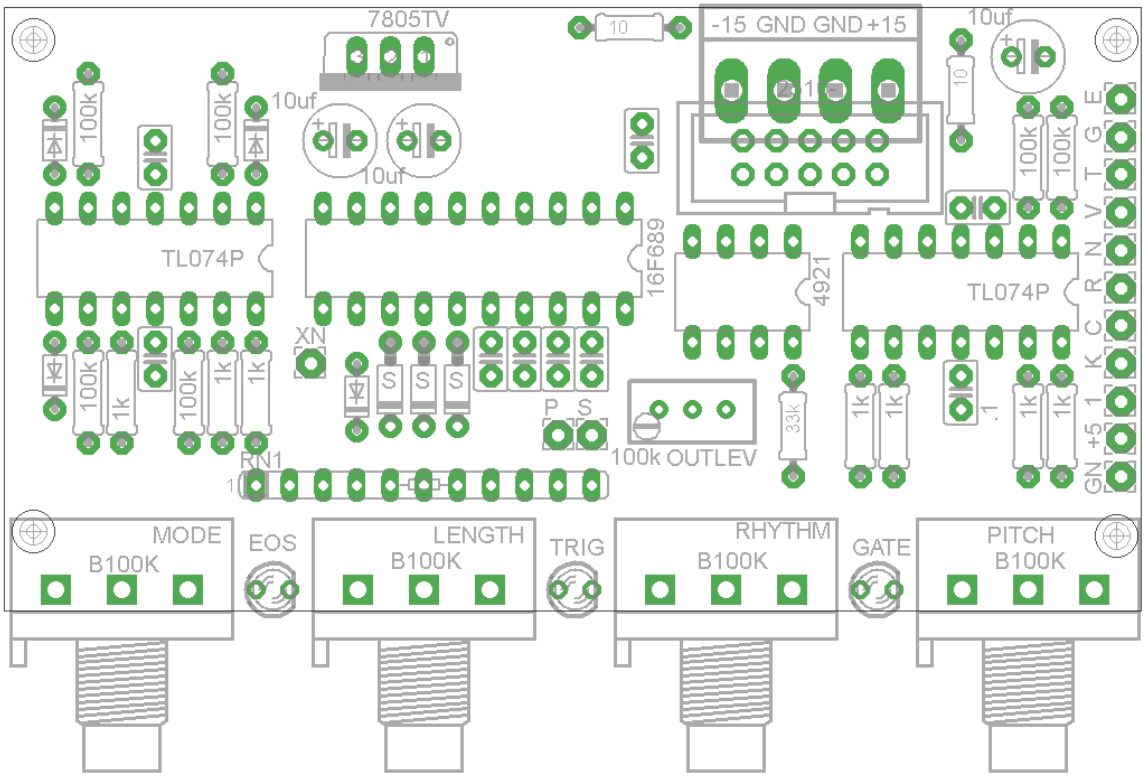
Capacitors

Value	*Qty*	*Notes*
.1uf	*9*	*2.5mm lead spacing, use cheap ceramics*
10uf	*3*	*2.5mm lead spacing Electrolytic*

Other

Value	*Qty*	*Notes*
8 pin Dip socket	*1*	
14 pin DIP socket	*2*	
20 pin DIP socket	*1*	
Power Connecter	*1*	*either Eurorack or MOTM style*
Pushbutton	*1*	*momentary on*
SPDT	*4*	*or SPST*
Jack	*7*	

B.Wiring/PCB Information

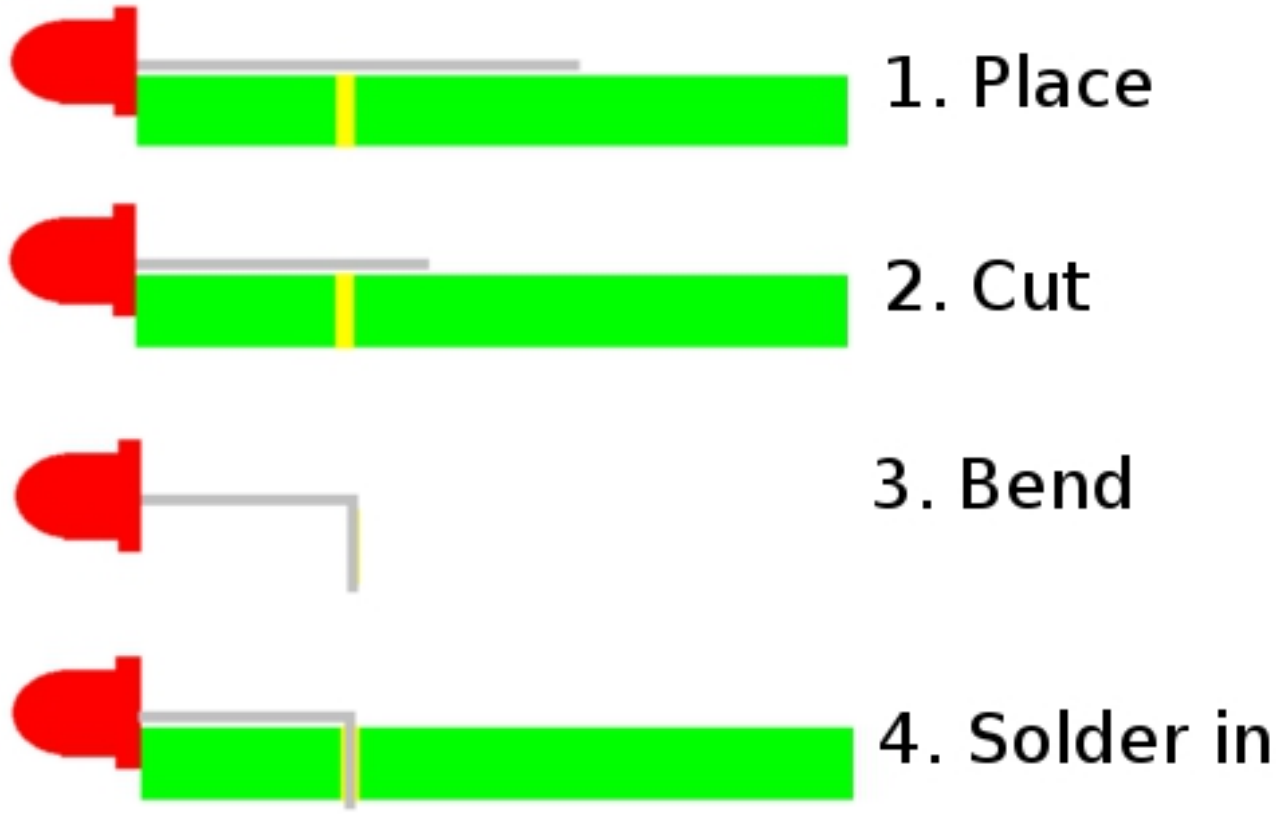


Above is the PCB. It is 86mm x 45mm. The mounting holes are spaced 82mm x 37mm and the pots are spaced 23mm apart.

The wiring pads should be connected as follows (starting from the corner of the PCB nearest the panel):

GN - *Ground, connect the ground tab of one of the jacks*
+5 - *+5V connect to the center tab of all the switches.*
1 - *Input for the "One" control, wire to the bottom tab of a toggleswitch.*
K - *Input for the "Key" control, wire to the bottom tab of a toggleswitch.*
C - *Input for the Clock input, wire to the Clock input jack*
R - *Input for the Reset input, wire to the Reset input jack*
N - *Input for the New input, wrire to the New pushbutton*
V - *Output for the CV voltage, wire to the CV output jack*
T - *Output for the trigger out, wire to the Trigger out jack*
G - *Output for the gate out, wire to the Gate out jack*
E - *End of Sequence output,*
S - *Straight Rhythm input, wire to the bottom tab of a toggleswitch*
P - *Portamento input, wire to the bottom tab of a toggle switch*
XN - External new, wire to the New input jack

To wire the LEDs onto the board, just follow this sequence:



C. Calibration

1.Before powering up, turn all the knobs completely clockwise, then turn the power supply on. The module will now be in calibration mode.
2.Use a voltage meter to read the CV output.
3.Adjust the trimpot until the CV output is exactly 6V.
4.You're done! Moving the knobs to any other position should take you out of calibration mode.