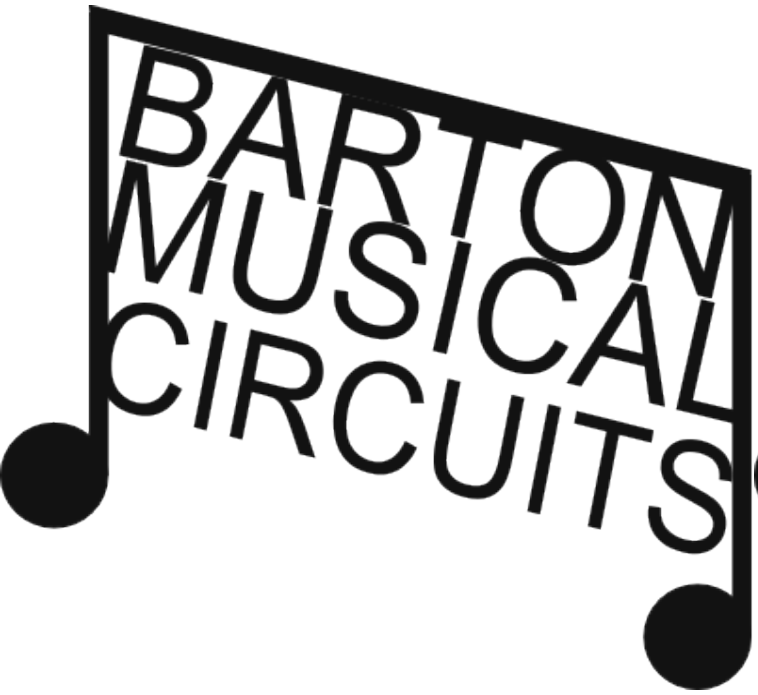
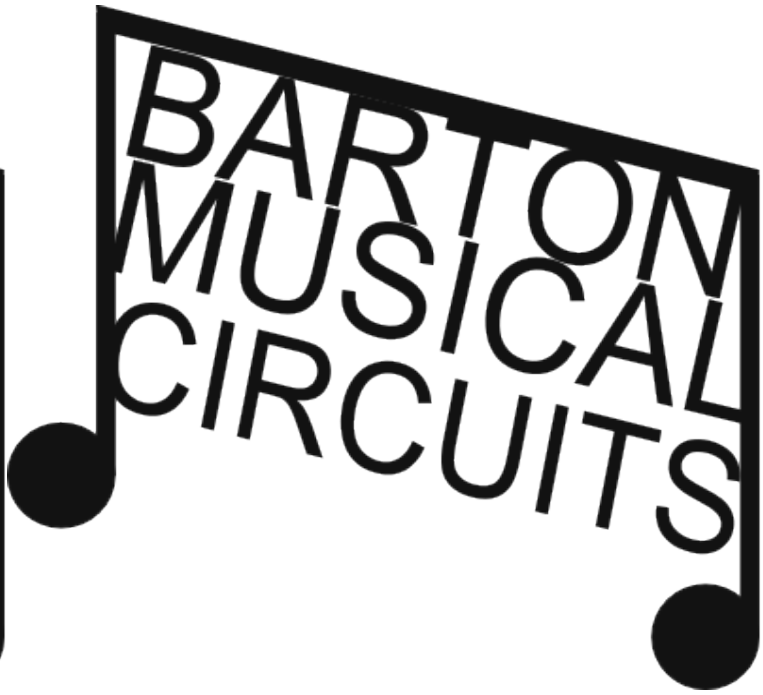




1Song Documentation

Written January 12th, 2014

I.Using The Module

A. What is 1 song?

"1Song" is a simple, microcontroller centered synthesizer module for generative (self composing) music. It both composes the melodies and produces the audio itself, requiring no other modules to make music, but it also features inputs and outputs for timing which help it integrate with other modules in a modular synthesizer system. It can also be built in a stompbox style enclosure without these inputs and outputs and act as a standalone music producer, powered from a 9V battery or power adaptor.

The melodies that "1 Song" produces are not traditional melodies produced from a diatonic scale and using duple or triple meter for rhythms. Instead, it composes by using algorhythms to produce semi-random numbers, and uses these numbers for it's pitch and length a note is held. Notes are held anywhere from 1 to 16 beats, and there are a total of 64 different notes which can be played. The notes are not arranged 12 per octave, but rather as divisions of the highest frequency, the lowest note it produces is 1/64th the frequency of the highest, the second lowest note is 1/63rd, and so on.

B. Controls/Inputs/Outputs

Controls

1.Time - The time knob controls the tempo of the internal clock of the 1 song. At the fastest settings, it will sound more like noises and less like notes, at the slowest settings, it will produce long drones.
2.Length - The length knob controls the number of notes in the melody before it ends. The setting of this knob is read when the "Trigger" button is pressed.
3.Trigger - This button starts or re-starts playing the melody.
4.New - This button tells "1Song" to write a new melody. It will not play the new melody until the Trigger button is pressed. If it is pressed while a melody is playing, it will not change the currently playing melody.
5.Clock Select Switch - When using an external clock, this selects whether an external clock will either: A. Tell 1 Song to play a new note, ignoring it's internal rhythm entirely or B. Advance the internal clock of 1 Song by one beat.
6.Volume - This is an optional knob, that should be built when using 1song as a standalone unit, it attenuates the output level.

Inputs

1.Trigger Input - Input a gate or trigger control here to play a melody.
2.New Input - Input a gate or trigger control here to compose a new melody.
3.Clock Input - Input a clock signal here to synchronize 1 song with your other synthesizer modules.

Outputs

1.Audio Output - This is the AC coupled Audio output of the 1 song.
2.Trigger Output - This outputs a trigger whenever a new note is played.
3.Clock Output - This outputs a trigger whenever the internal clock advances a beat.

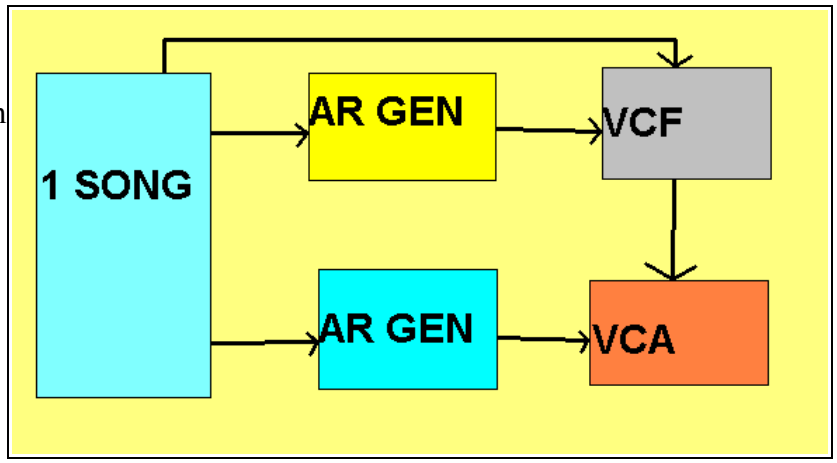
C.Sample Patches

Listen to patch 1 here. Turn your speakers down first, it's a little loud.

Patch 1 isn't really much of a patch at all. It's simply an example of a melody that 1Song can produce. It's output is going straight to the recorder's input, and I'm simply pressing the "play" button.

Listen to Patch 2 here.

Patch 2 is the same melody as patch 1 only it's using the trigger and clock outputs to control a VCF and VCA giving the melody a more dynamic sound. The diagram on the right shows how this patch is set up.

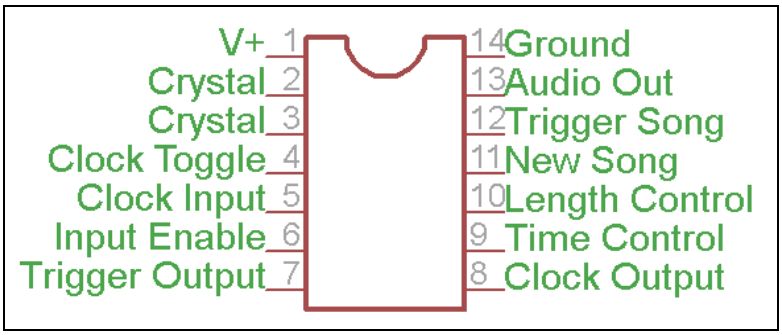


Listen to Patch 3 here.

Patch 3 is an example of the "Trigger" and "New" inputs being controlled by a clock/divider module and the Time/Length controls both being set to very short settings. This gives a mechanical and somewhat harsh sound.

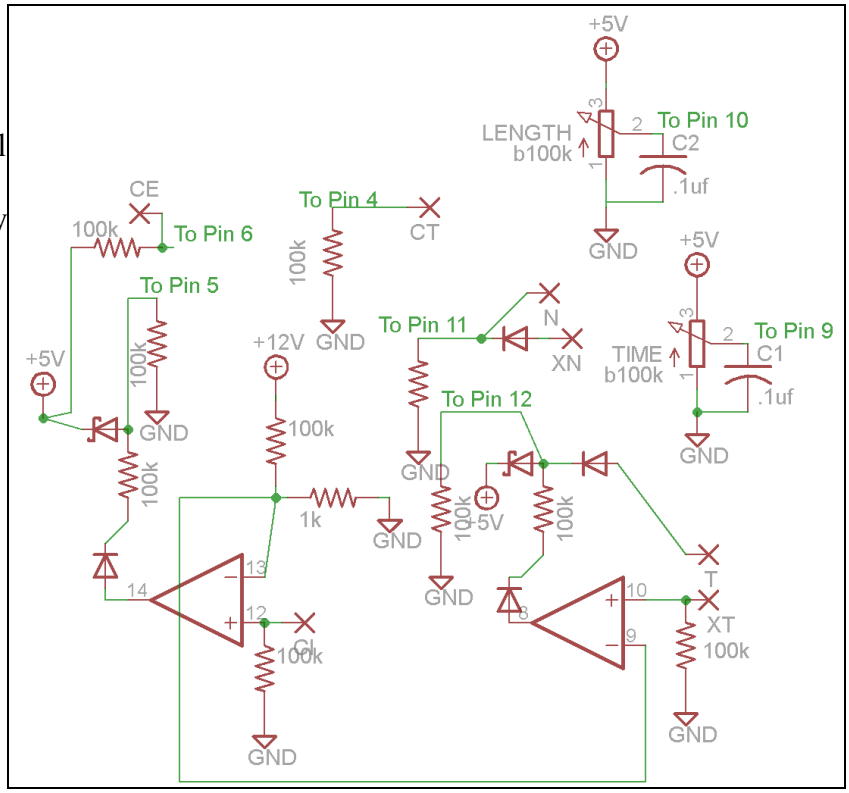
II. Schematics

A. The Microchip



On the right, we see the pinouts for the microcontroller. This chip is at the center of the design. The two pins marked "Crystal" are attached to a 20mhz crystal oscillator and then to a pair of 22pf capacitors to ground. Pins 4, 5, 6, 11 and 12 are all digital inputs, they only detect differences between 0 and 5V. Pins 9 and 10 are analog inputs, they read continiously variable voltages between 0 and 5V. Pins 7, 8 and 13 are all digital outputs, they output either 0 or 5V.

B.Inputs



To the right we see the inputs for the microcontroller. All of the 100K resistors to ground shown in this diagram are actually part of a single bussed resistor array on the PCB.

On the far left, is the Clock Enable input, marked "CE." This is connected to the ring connecter of a stereo jack, so that when used with mono plug cables, it will short out to the sleeve of the jack. This is normally held high at +5V, keeping the clock running.

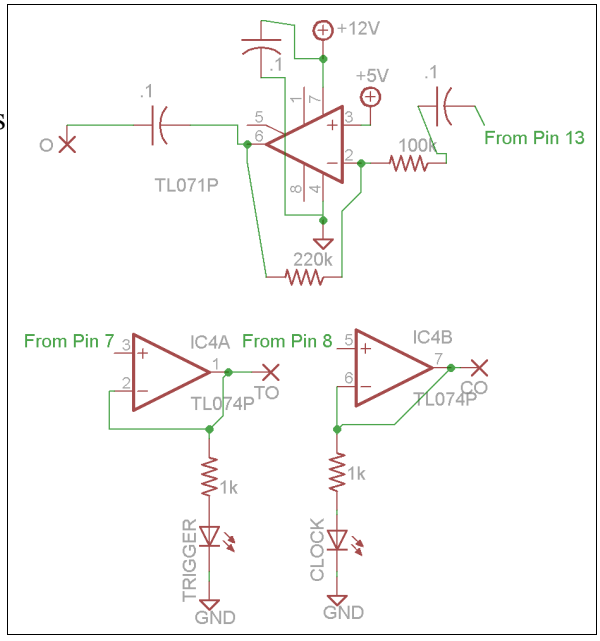
Below that is the Clock Input marked "CI." This input first goes through a comparator, and then a network of resistors and diodes to limit the comparator's output to between 0 and 5V. The reference voltage for the comparator is just above 0V, so any oscillator or clock signal can be used as a clock input.

This reference voltage is also used for the comparator on the External Trigger input, marked "XT" on the lower right hand part of the page. This input goes through a similar set of diodes and resistors, with an added diode adding in the trigger buttons output marked "T."

Above this is the New, marked "N", and External New, marked "XN" inputs. These do not go through a comparator, so you should make sure to use signals which do not exceed +5V. There is a diode protecting from negative voltages, and protecting the output circuitry of the modules which it might connect to.

Above this is the connection for the Clock Toggle switch, marked "CT." To the right are the two knobs controling Length and Time, each with a .1uf capacitor to filter out high frequency noise from causing abherations in the microcontroller.

C. Outputs



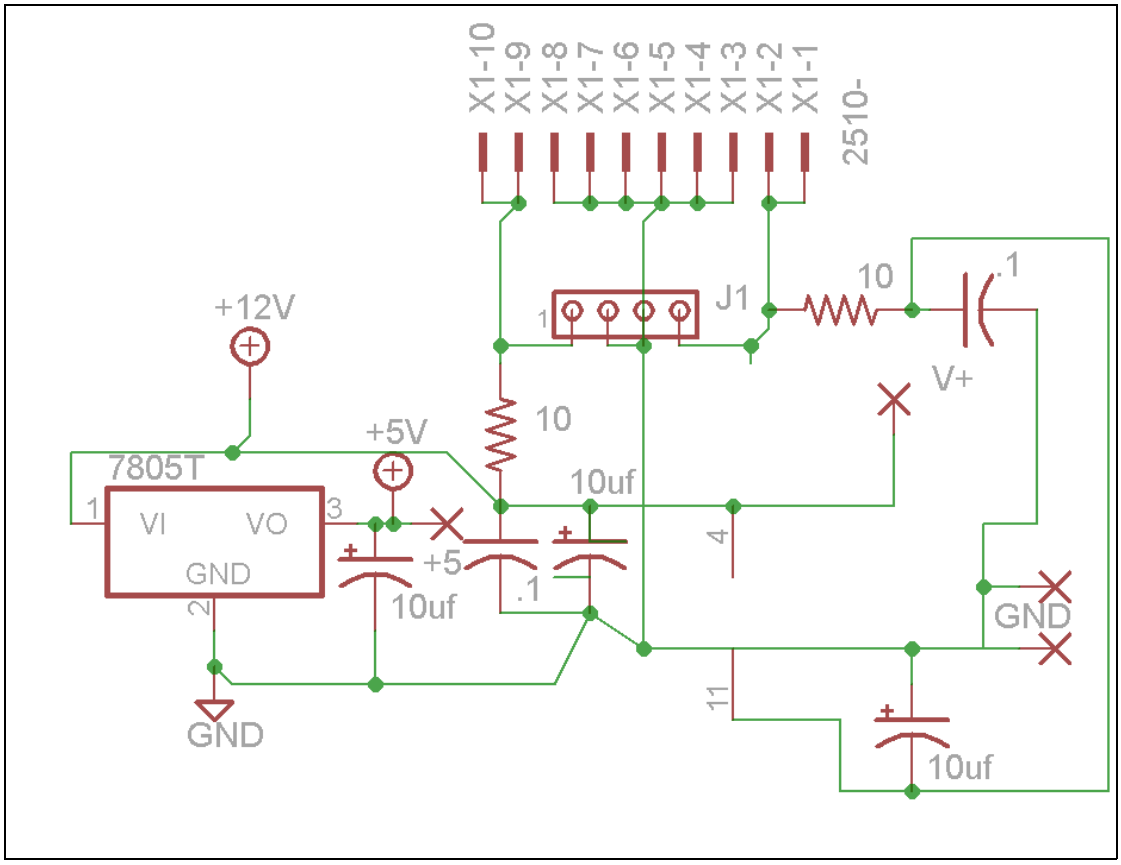
On the bottom right, we see the digital outputs for the circuit. On the top, is the audio output. The output of pin 13 on the microcontroller is coupled to the op amp through a .1uf capacitor into an inverting amplifier. The amplifier is a TL071 run single supply, biased around +5V, so that this part of the circuit can function when run off of a battery, or a synthesizer module's bipolar power supply. The output is coupled from a .1uf capacitor also.

Below this are the identical output buffers for the trigger and clock outs.

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. There is also a second pad for ground and a pad marked "V+" which are to be used when building this circuit as a standalone unit instead of as part of a modular synthesizer.



III. Construction

A.Module Construction

1.Parts List

Semiconductors

Value	Qty	Notes
16F684	1	Pre programmed, should have come with your PCB
TL074	1	14pin DIP, any quad op amp should work
TL071	1	8 pin DIP
7805	1	TO220 package
1n4148	4	
SD101C	2	Or other small schottky
LED	2	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	3	
100K ohm	5	
220K ohm	1	
100K bussed array	1	7 Pin, or stand 6 resistors on their end and make your own.
B100k Pot	2	16mm PC mounted Alpha brand.

Capacitors

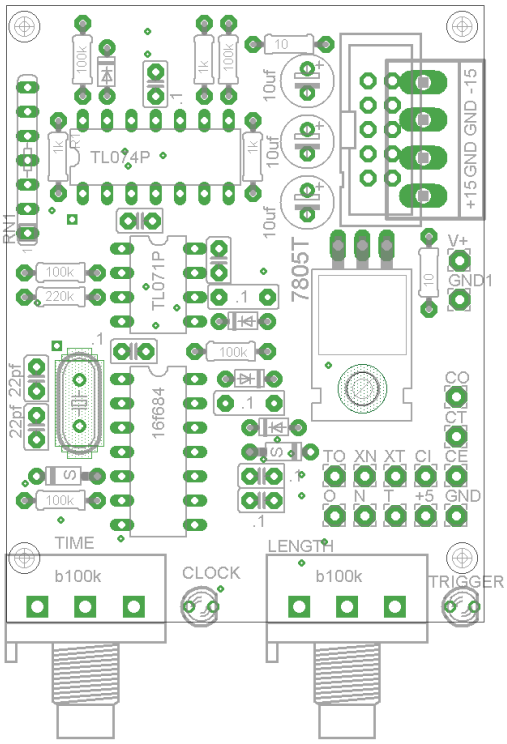
Value	Qty	Notes
22pf	2	2.5mm lead spacing, use cheap ceramics
.1uf	6	2.5mm lead spacing, use cheap ceramics
.1uf	2	5mm lead spacing, use poly box type
10uf	3	2.5mm lead spacing Electrolytic

Other

Value	Qty	Notes
8 pin Dip socket	1	
14 pin Dip socket	2	
20mhz oscilator	1	Crystal oscillator, 5mm lead spacing
Power connecter	1	Either Eurorack or MOTM
Pushbutton	2	Off-(ON) momentary type, panel mount
SPDT or SPST	1	Panel Mount
Mono Jack	5	either 1/8" or 1/4"

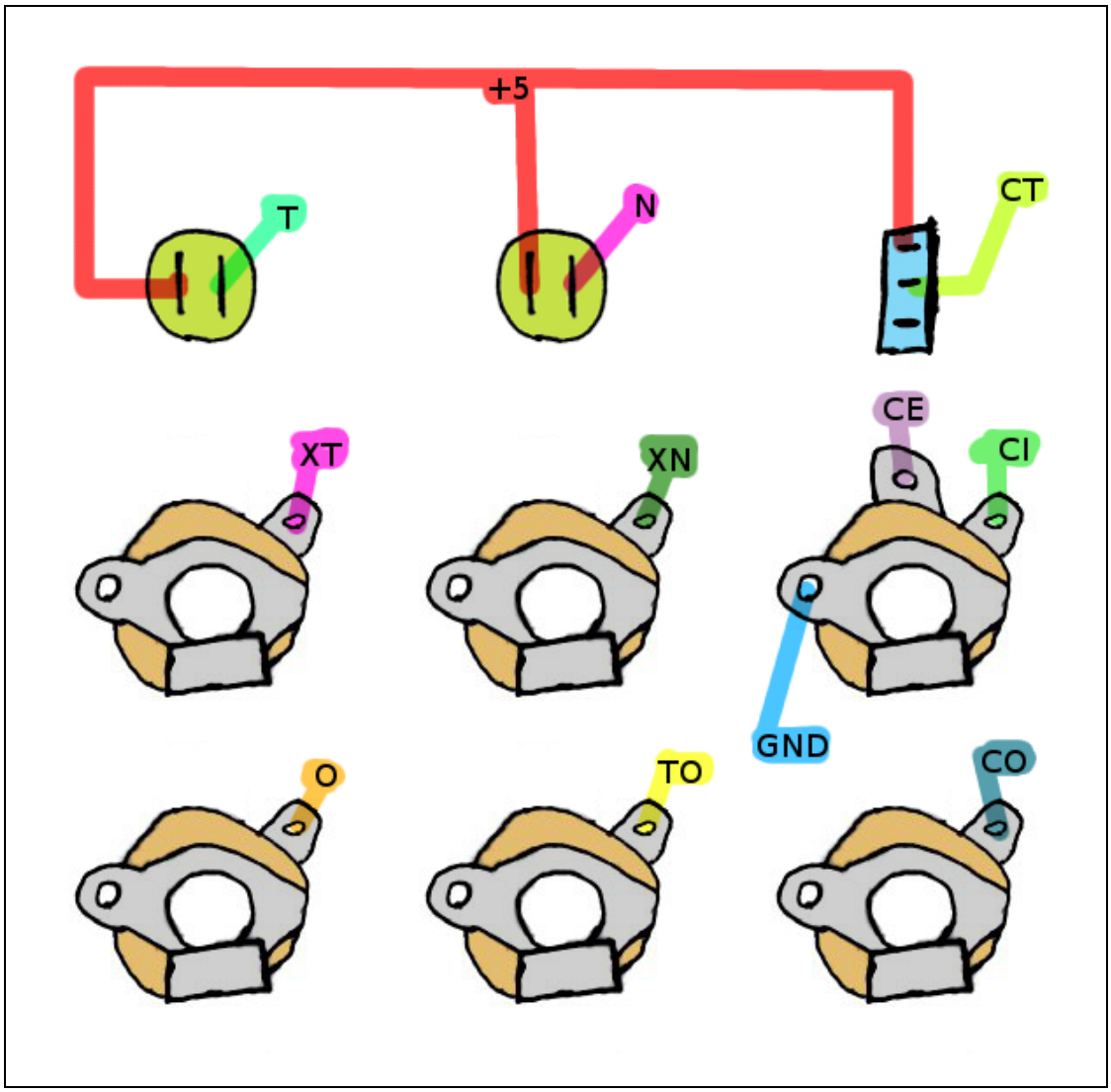
Stereo Jack	1	either 1/8" or 1/4"

2.Wiring/Board Population



When building 1Song as a synthesizer module, no parts should be omitted when stuffing the PCB. The PCB is 65mm x 50mm, the mounting holes are 55mm x 46mm. The pots are spaced 1&1/16" apart.

Below is a diagram showing offboard wiring for the module. The letters indicate the wiring pads on the PCB, and the lines indicate which parts should be connected to those pads, and to each other. The top row is two pushbuttons and a toggle switch. Only the sleeve of the clock input jack is shown as being connected to ground, if using an aluminum panel, this should ground everything, otherwise wire the sleeves of all jacks to ground.



B.Standalone Construction
1.Parts List

Semiconductors

Value	Qty	Notes
16F684	1	Preprogrammed, should have come with your PCB
TL071	1	DIP 8 packaging
7805	1	TO220 packaging
1N4148	1	

Resistors

Value	Qty	Notes
1K	1	7.5mm lead spacing, Metal Film 1/4W unless otherwise noted.
100K	2	
220K	1	
100K bussed array	1	7 pin, or 6 resistors laid up on their ends
B100K Pot	2	PC mounted, 16mm Alpha
A100K pot	1	Panel mounted 16 mm

Capacitors

Value	Qty	Notes
22pf	2	2.5mm lead spacing, cheap ceramic
.1uf	4	2.5mm lead spacing, cheap ceramic
.1uf	2	5mm lead spacing, poly box type
10uf	2	2.5mm lead spacing, electrolytic

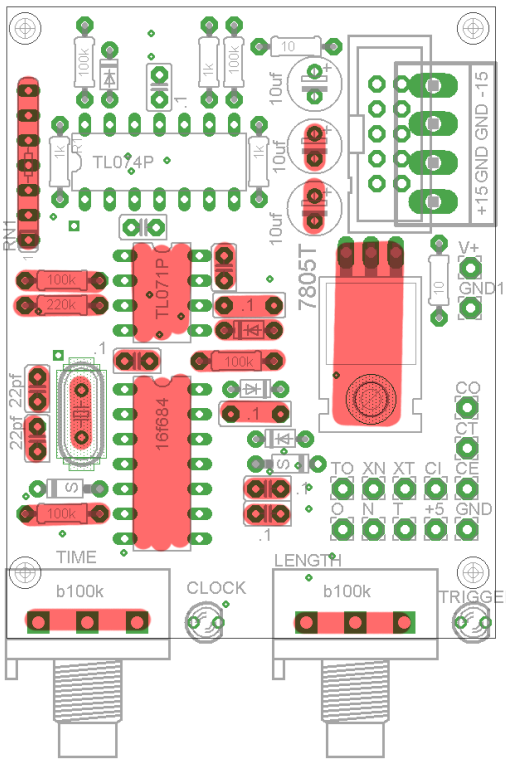
Other

Value	Qty	Notes
8pin DIP socket	1	
14 pin DIP socket	1	
20mhz Oscillator	1	Crystal, 5mm lead spacing
Power Connecter	1	Panel mounted, 2.1mm DC barrel plug type connecter
SPST Pushbutton	2	Panel mounted.
1/4" Jack	1	Mono, panel mounted
Enclosure	1	1590BB

All parts are available from Tayda if you make your own bussed array.

3.Wiring/Board Population

On the right is a diagram of the PCB. Only populate the parts highlited in red.



Below is a diagram showing how to mount the PCB into a stompbox type enclosure. Bend the legs of the pots 90 degrees inwards and install the pots on the bottom side of the board. Only solder one lug of each pot before fastening the nuts, then solder the other two lugs.

Use #4 screws with nuts as standoffs on the holes on the opposite end of the board to ensure the underside of the PCB never makes contact with the enclosure. Use a little finger nail polish on the screw and nut to keep the nut from getting loose.

On the right is a diagram showing the wiring from the board to the panel mounted components. On the left of the diagram, the output of the PCB is connected to a potentiometer acting as a volume control, and then sent to an output jack. Below this, the New and Trigger buttons are each connected to +5V. And on the top right we see the DC power connecter is attached to the +V and GND connecters of the PCB.