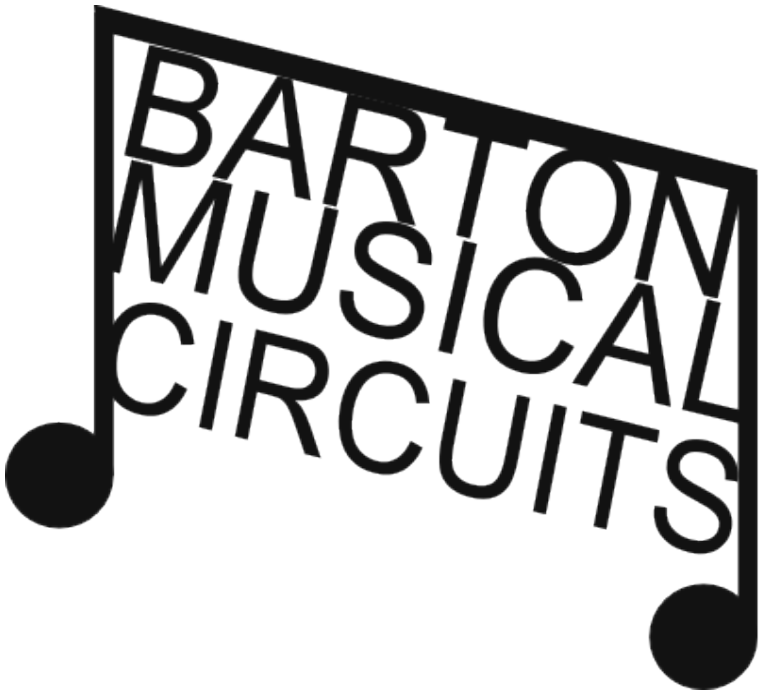


BMC044. 4 Knob Sequencer

Last updated 5-1-2016

If you have any questions, or need help trouble shooting, please e-mail Michael@Bartonmusicalcircuits.com

I. Overview/Features

The design goal when making the 4 Knob was to generate lots of output from a very minimal amount of input and control. The initial prototype only consisted of a clock input and the 4 knobs as input/control but was able to output two voiced 32 step sequences. More controls were added to either filter this output or help it work in sequence with other parts of a modular system.

The way the sequencer works is that it reads the positions of the four knobs and converts these positions into numbers. It then uses these numbers to determine the number of steps in a sequence (2 to 32 is step range) and what each of the four outputs of the sequence should be doing on each of those steps. Each step has a specific set of instructions, like "Add knob 1 to knob 3 and use that number for the output of Voltage 1. Then check if the third bit of knob 4 is on, if so turn on Gate 2." This means that the sequences are not random, though the changes are difficult to predict.

CONTROLS

1.- 4. Knobs – The namesake of the module, each knob's position plays several roles in determining the sequence.

2.Quantize Toggle – This quantizes the voltage outputs so that each only outputs voltages in 1/12V intervals.

3.Length Toggle – This sets the length to 4, 8, 16 or 32 depending on how you've calibrated your sequencer. See calibration instructions at the end of this document.

4-5.Trigger Toggles – These toggles set the Gate outputs to Trigger mode instead, so that a short pulse at the start of a new step is sent instead of a pulse that remains on throughout the step.

6.Reset Button – This tells the sequencer that on the next clock input it should go back to the first step.

INPUTS

All inputs are for timing purposes, they can be used with the outputs of LFOs/VCOs/Clock Generators/Gate/Trigger signals. They all react when the input goes above zero volts.

1.Clock – This tells the sequencer when to move to the next step.

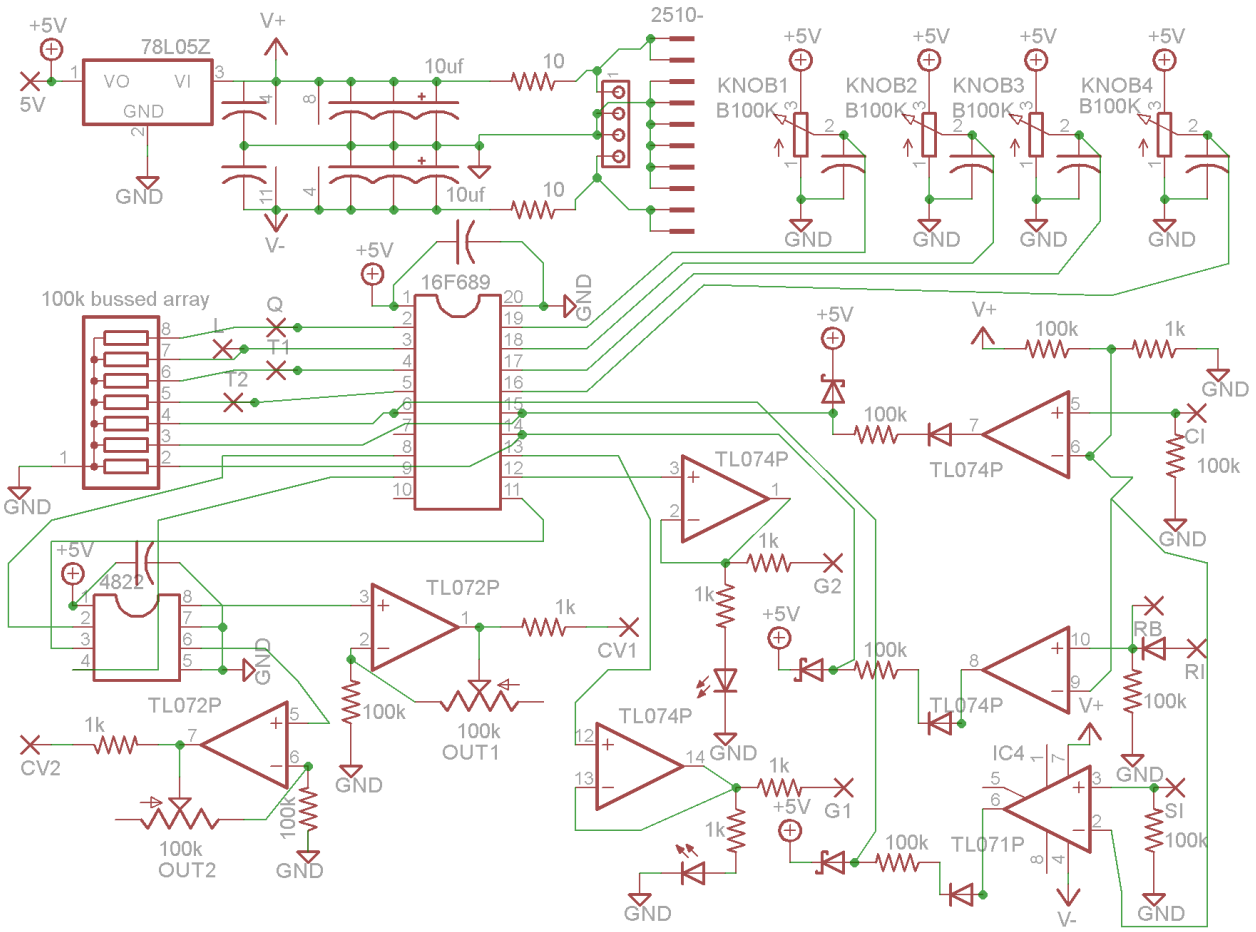
2.Reset – This tells the sequencer that on the next clock input to go back to the first step. This is useful for synchronizing with other sequencers or putting a hard limit on the length of a sequence.

3.Sample – Whenever this is above zero volts, the positions of the knobs are being read. This jack is normalized to +5V so the knobs are read when nothing is plugged in. This allows for sequences to be changed at regular intervals

OUTPUTS

1. - 2. Voltage – Each of these outputs a DC voltage in the range of 0V and 5.333V, the voltage will change on each step of the sequence.

3. - 4. Gate – Each of these outputs a +5V pulse on certain steps of the sequence.



II. Schematic.

Above is the schematic for this module. In the top left corner are the power connections. There are headers for connecting to the external power supply. The positive and negative rails are filtered by a 10 ohm/10uf low pass filter and additional filtering is supplied by .01uf capacitors at the power pins of each of the ICs. A 5V supply is created from the 78L05 voltage regulator.

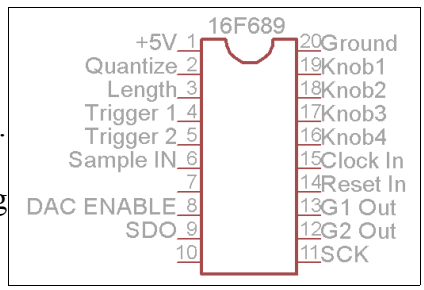
Below the power connections is the 16F689 microcontroller which is the heart of the module. To it's left is a bussed resistor array which provides pull-down resistors for the microcontroller as well as the wiring pads for connecting to the toggle switches. In the top right are the potentiometers for the four knobs, each is wired as a variable voltage source. The wiper of each is filtered by a .01uf capacitor.

On the far right are the timing inputs. The reset input and the reset button are joined together by a switching diode which keeps the button from interacting with whatever module is connected to the reset input. Each timing input is connected to a comparator wired for a .012V threshold. The output of each comparator goes through a switching diode which only passes positive voltage, then a voltage divider composed of a 100K resistor in series with the diode and the 100K pull down resistor. A schottky diode provides assurance that voltage on the microcontroller does not exceed +5V.

Below the microcontroller and to the left are the voltage outputs. The microcontroller sends digital messages to the 4822 serially. The 4822 then outputs two voltages on pins 8 and 6. Each of these is then amplified by a non-inverting amplifier. The OUT1 and OUT2 cermet pots are calibrated to make sure that the quantized voltages are in 1/12V increments.

To the right of the voltage outputs are the two gate outputs. Each one is an op-amp wired as a buffer, with a 1K resistor limiting current to an indicator LED and a 1k output resistor going to a wirepad.

To the right is the pinout for the microcontroller.



III. Construction

A.Parts List

Semiconductors

Name	Quantity	Notes
16F689	1	Should be provided with your PCB
TL074	1	14 pin DIP package
TL072	1	8 pin DIP package
TL071	1	8 pin DIP package
4822 DAC	1	8 pin DIP package
Switching diode	4	1N4148 or other small signal switching diode
Schottky diode	3	1N60P or other schottky
78L05 Regulator	1	TO 92 package
LED	2	3mm

Resistors

Name/Value	Quantity	Notes
10 ohm	2	1/4w metal Film for all resistors unless otherwise noted
1K ohm	7	
100K ohm	9	
100K ohm buss	1	8pin SIP package. Or can be made with 7 resistors
B100K Pots	4	16 mm Alpha linear taper, PC Mounted. Like this.
100K Cermet trimmer	2	3296 package

Capacitors

Name/Value	Quantity	Notes
.01uf	12	Ceramic disc. Value not critical
10uf	2	Electrolytic, at least 16V rating.

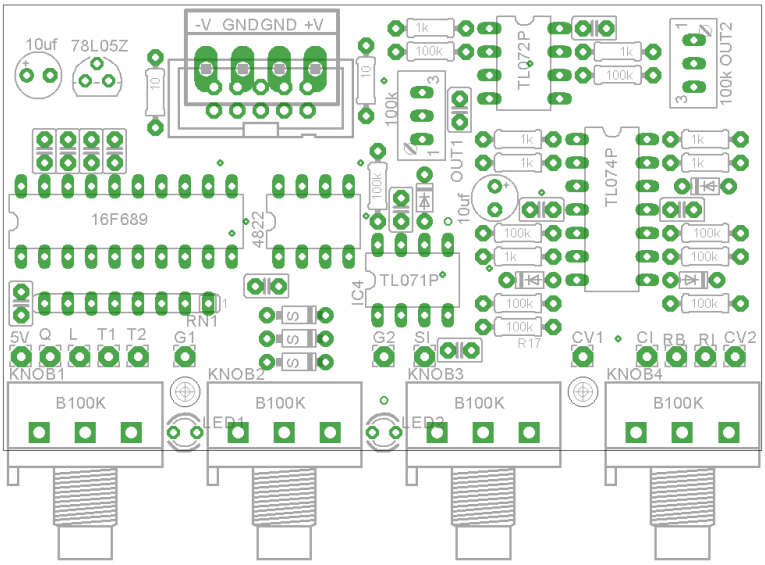
Other

Name/Value	Quantity	Notes
Power connecter	1	Eurorack or MOTM
Pushbutton	1	OFF-(ON). Like this.
Toggle switch	4	SPDT. Like this.
Switching Jack	1	
Mono Jack	6	Switching jack will work as mono jack
Knobs	4	
20 pin DIP socket	1	

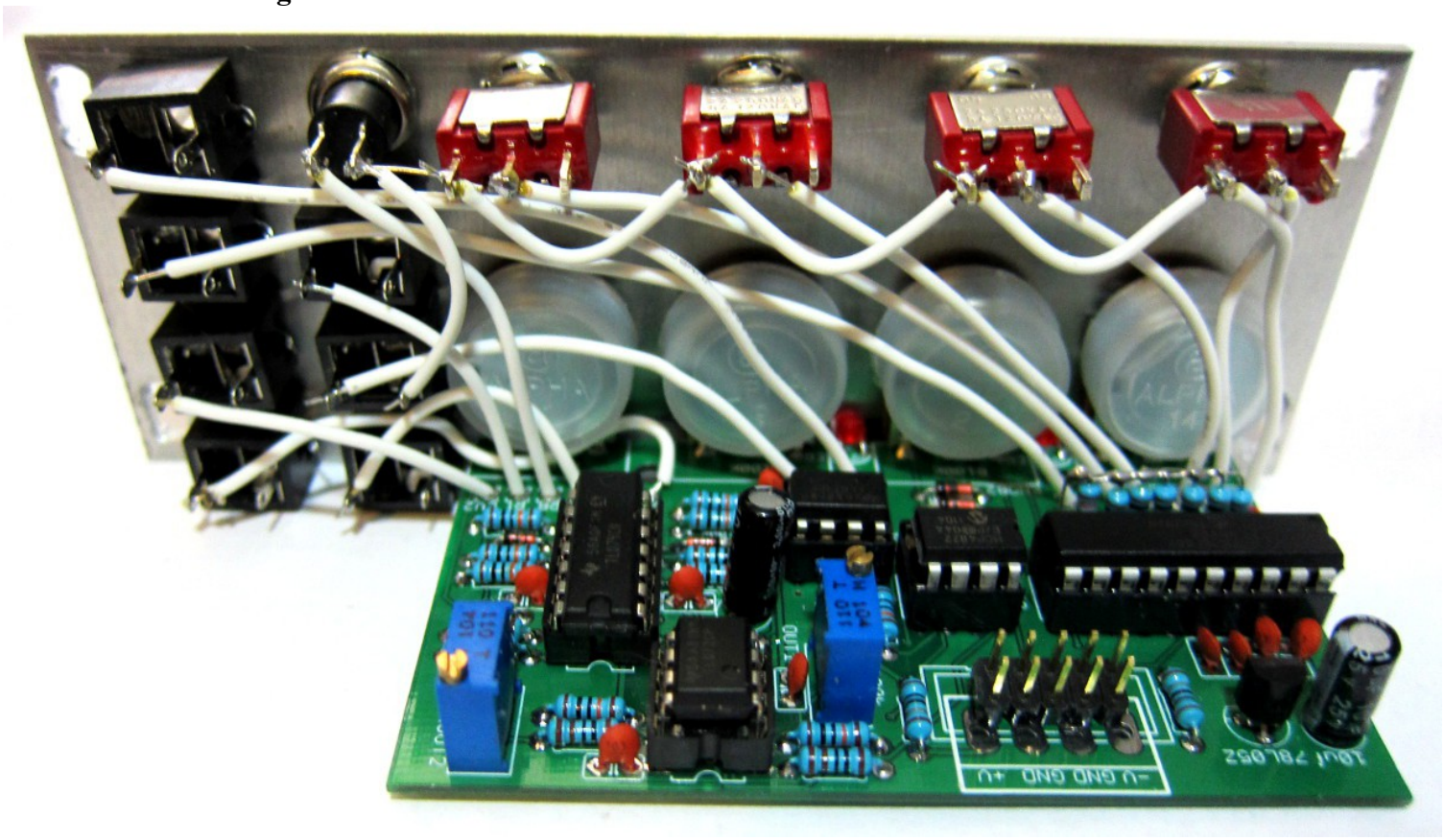
14 pin DIP socket	1	
8 pin DIP socket	2	

B. The PCB

The PCB is 82x48mm. The mounting holes are spaced 43mm apart and pots are spaced 21.59mm apart. Below is an image of the PCB



C. Wiring/Photos



Above is a photo of the wiring. Here is a list of where to connect all the wirepads on the PCB:
5V – Connect to the bottom solder lug of each toggle, one lug of the pushbutton and the switch of the Sample jack.
Q – Middle lug of Quantize Toggle
L – Middle lug of Length Toggle
T1 – Middle lug of T1 Toggle
T2 – Middle lug of T2 Toggle
G1 – Tip of Gate 1 Jack
G2 – Tip of Gate 2 Jack
SI – Tip of Sample jack
CV1 – Tip of CV1 Jack
CI – Tip of Clock Jack
RB – lug of Reset pushbutton
RI – Tip of Reset jack
CV2 – Tip of CV2 Jack

D. Calibration

1.With the unit turned off turn all knobs fully clockwise. Then decide what length you'd like the length toggle to assign when it's switched on. Turn on a single toggle switch before powering up, and when the unit powers on it will read which switch and set the length to this. This can be changed later. The unit will save your setting, so you don't need to do this every time you power on your system.
Q – 32 steps
L – 16 steps
T1 – 8 steps
T2 – 4 steps

2.Turn on the unit. When the software initializes the module will go into calibration mode. The CV outputs should go to their maximum outputs.

3.Adjust the cermet pots until each CV output is at 5V.

4.Move any knob to leave calibration mode.