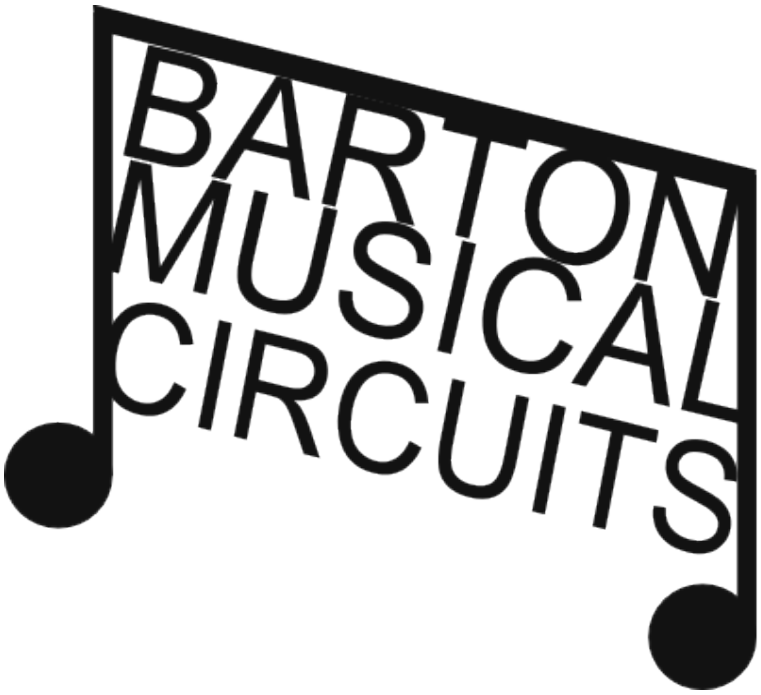

BMC118 Graphic Envelope Generator

Last updated 8-31-2024

If you have any questions, or need help trouble shooting, please e-mail
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I. Overview/Features

This module is a step sequencer designed for use as an envelope generator. It uses sliders to set the output levels of the envelope and loop point toggles to set a portion of the sequence to repeat while the gate input is high. It's capable of creating gated LFO type sounds within an envelope and has a very "hands on" feel of creating envelopes. It can also be used as a standalone LFO or as a clocked step sequencer for pitch CV.

CONTROLS

1. Output Sliders – These sliders set the output level of an individual step. When set down the output is 0v and at the highest point is 4.48V.

2. Loop Point Toggles – These set the loop points for when the gate is high or the LFO toggle is switched on. When only one toggle is flipped up, then that stage will be held. When two toggles are flipped up, they will set the first and last stage of the loop. When more than two toggles are flipped up, the furthest left toggle flipped up will set the first stage of the loop and the furthest right toggle flipped up will set the last stage of the loop.

3. Speed Knob – This controls how quickly the output changes stages. An 8 stage sequence will take 1.5s (0.18s per stage) at the slowest setting and 0.25ms at the fast setting.

4. Speed CV Knob – This attenuates the speed CV input. Higher CV will result in faster sequences.

5. Slew Knob – This controls how smoothly the voltages change going from stage to stage. When turned all the way down, stage changes will be immediate jumps in voltages which can be grating on the ear. As you turn it down the stages will blend into each other. As speed increases, high slew settings can result in a loss of output voltage.

6. Reverse Toggle – This toggle controls how a loop moves. In the down position, the sequence always moves left to right, after the last stage of the loop it returns to the first stage. In the up position, after the last stage of the loop the sequence will reverse it's motion and start moving right to left until it returns to the first stage and then resume moving left to right.

7. LFO Toggle – This toggle tells the module to loop between the selected loop points continuously, allowing for the module to be used as an LFO without external gates or triggers. Inputting a trigger in LFO mode will reset the module to the first stage.

8. Clocked Toggle – When turned on, the module will ignore the Speed control entirely. The trigger input becomes a clock input with every pulse on the clock input advancing the output by one stage. This allows you to control the speed of the envelope by a VCO, or you can turn the LFO toggle on and use the module as a step sequencer.

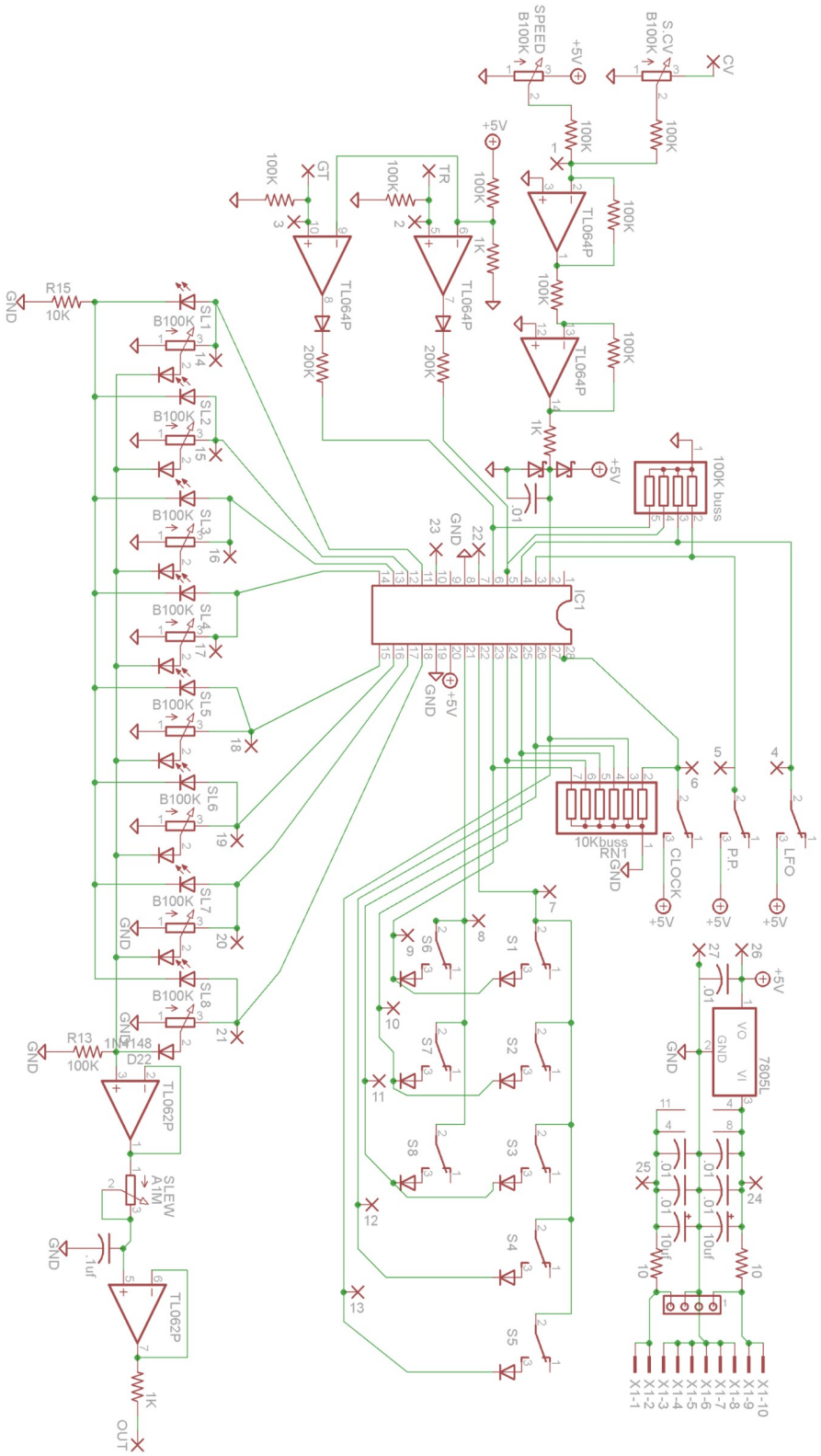
INPUTS/OUTPUTS

1.Trigger Input – A pulse on this input will set the module to the first stage and progress normally, it can be used to restart a sequence in progress or initiate an envelope with no looping. It acts differently when the Clocked Toggle is engaged, see above.

2. Gate Input – This input will start a sequence and cause it to loop between loop points while high. When the output goes low the loop will finish and the rest of the sequence will play. It can be used by itself without the trigger input to initiate a sequence.

3. CV Input – Input for speed control voltage.

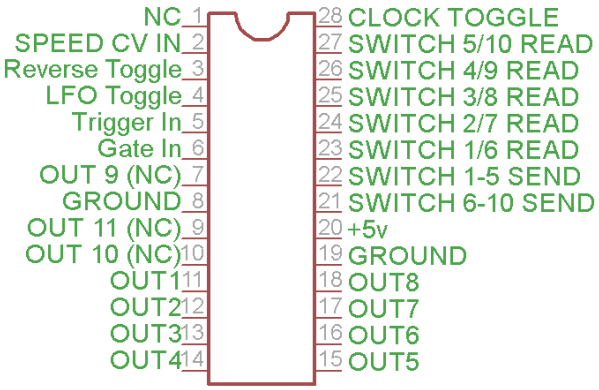
4. Output – The CV output from the module.

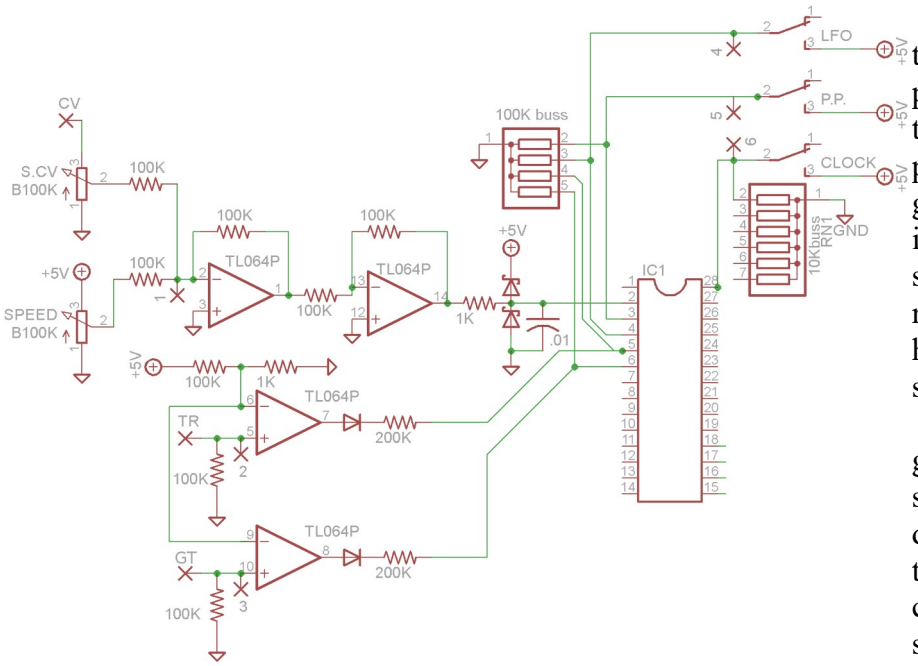


II. Schematic.

Above is the complete schematic for this module. It is reproduced in sections on the next few pages. Throughout the schematic are X's representing wirepads that are numbered 1 through 27. These are the inter board connectors going from the top PCB to the bottom. The microcontroller, TL074 and power connections are on the top PCB, the toggles, pots, jacks and output circuitry are on the bottom PCB.

To the right is the pinout for the 16F913 PIC microcontroller at the heart of this module. Pins marked “NC” are not connected. You may notice that there are outs 9-11 marked on the pinout but they’re not connected. The original version of this module had 10 stages, but I shrank it down to 8 to fit a smaller Eurorack panel (14HP for a single envelope generator is extravagant).
The “OUT” pins go to the slide pots, the Switch Send/Read pins go to the loop point switching, and other pins are used for control inputs.



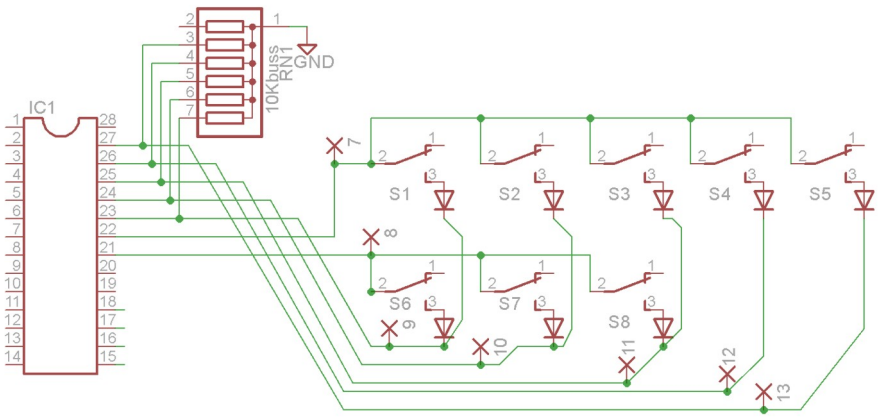


To the left are the inputs and toggles. Voltages from the Speed pot and Speed CV pot are mixed together with 100K resistors and a pair of op-amps wired as inverting gain stages The output of this mix is limited to 0V/+5V by the two schottky diodes after the 1K resistor. A .01uf capacitor filters high frequency noise from the CV signal.

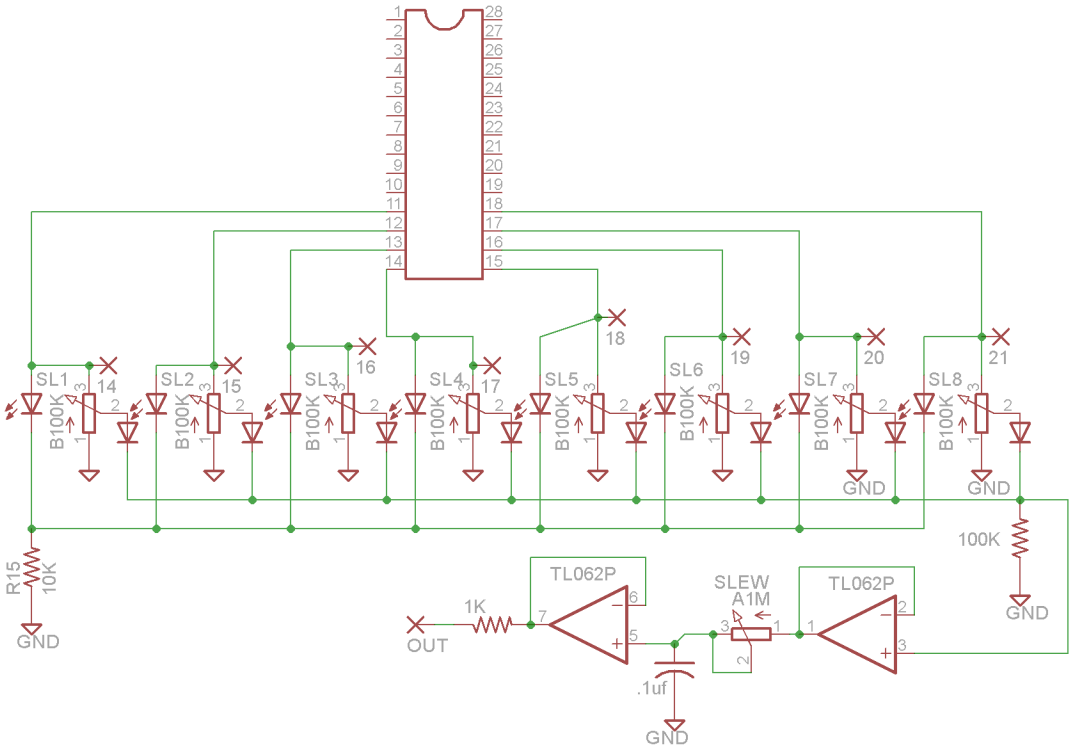
The trigger and gate inputs each go to a comparator stage, these are set up identically with a 100K pull down resistor on the input and thresholds set to 0.05V. The comparators outputs go through a switching diode to only pass positive voltage and then a 200K/100K voltage divider to reduce the output to a voltage that won’t damage the PIC. The 100K to ground is part of a bussed resistor array.

Control toggle inputs all have resistors to ground, this will ground the pin when the toggles are inactive. The Reverse toggle is labeled “PP” on the board.

To the right is the loop toggle scanning circuit. Pin 21 and 22 are output pins of the PIC and pins 23 through 27 are input pins. The input pins are all tied to ground through 10K resistors in a resistor buss. Each output pin sends voltage to a different row of toggles, and input pin reads a single column of toggles. Each toggle has a diode on it’s output to keep them from affecting each other.

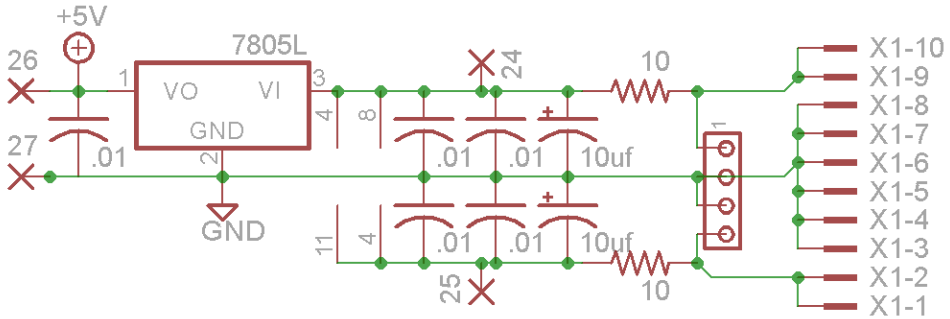


So when pin 22 is at +5V and 21 is at 0V, pin 23 will be seeing if S1 has been flipped or not. When the output pins reverse and 22 is at 0V and 21 is at +5V, pin 23 will now be reading whether S6 has been flipped or not.



Above is the output circuitry. Each output pin connects to an LED, all LEDs connect to ground through a single 10K current limiting resistor. Because only one LED is ever on at a time, this saves us several resistors. The output pins also provide voltage to slide pots wired as voltage dividers, the wiper of each of these connects to a diode allowing current to only flow out of the pot, making it so an inactive output won't affect the active output.

The diodes all connect together at the input pin of an op-amp wired as a buffer with a 100K resistor to ground. The output of the buffer goes into a simple low pass filter circuit formed by a 1Meg SLEW potentiometer and a 0.1uf capacitor to ground. Another op-amp buffer sends the slewed ouput signal to the output jack through a 1K current limiting resistor.



Above is the power schematic. MOTM and Eurorack power connectors are in parallel. The negative and positive voltage rails are filtered by a 10 ohm resistor and 10uf capacitor to create as smooth a voltage supply as possible. 0.01uf capacitors are then palced at the power pins of the op-amps to filter out high frequency noise. The +5V supply for the PIC is provided by a 78L05 voltage regulator.

III. Construction

A.Parts List

Semiconductors

Name	Quantity	Notes
16F913	1	Should have come with your PCB
TL074	1	Dip package, any quad op amp with same pinout should be fine
TL072	1	DIP package, any dual op amp with same pinout should be fine
78L05	1	To-92 +5V regulator
1N4148	18	Or other small signal diode
1N5817	2	Or other small schottky

Resistors

Name/Value	Quantity	Notes
10 ohm	2	1/4W Metal film for all resistors unless otherwise noted
1K	3	
10K	1	
100K	8	
200K	2	
5-pin 100K bussed array	1	Or make your own with 4x 100K resistors
7-pin 10K bussed array	1	Or make your own with 6x 10K resistors
B100K pot	2	PCB Mounted 9mm like this
A1M pot	1	PCB mounted 9mm like this
100K slide pot with LED	8	I used this part. Any of the Bourns pots that have their part number start with "PTL30" should fit the board, the 100K value is not critical, any resistance 1K-1M should be okay. Look out for center detent pots, that would be annoying in this project

Capacitors

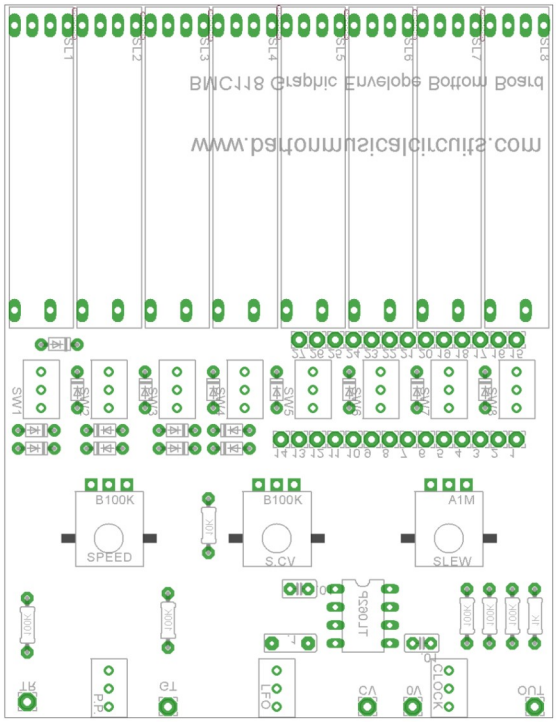
Name/Value	Quantity	Notes
.01uf	6	Ceramic disc
.1uf	1	Poly box type
10uf	2	Electrolytic

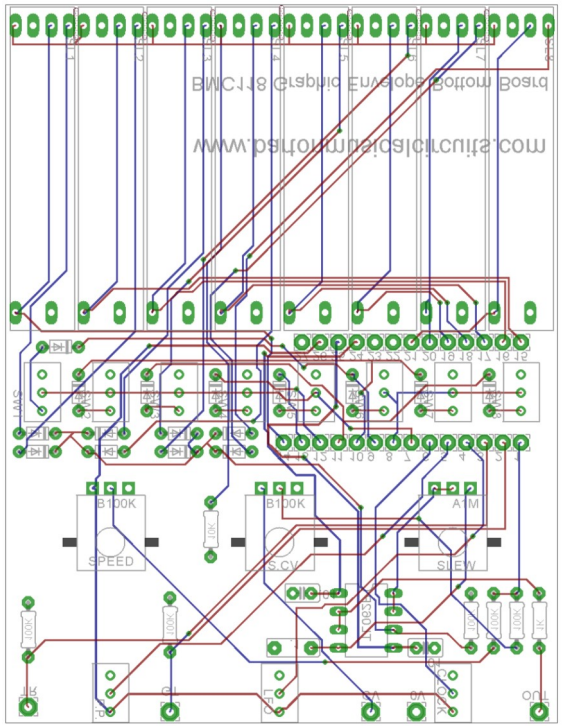
Other

Name/Value	Quantity	Notes
PCB mount SPDT	11	Designed around this part

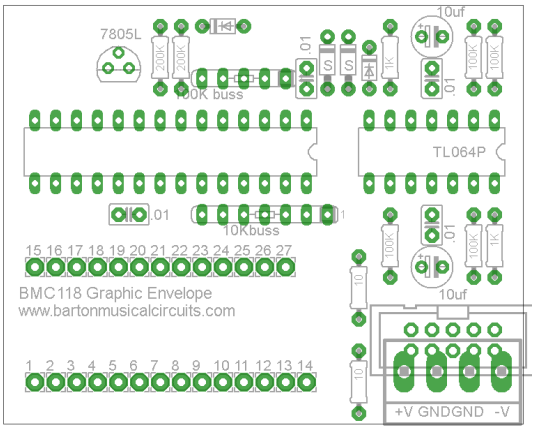
Power connecter	1	Eurorack or MOTM
Jack	4	
8 pin DIP socket	1	
14 pin DIP socket	1	
28 pin DIP socket	1	
Knob	3	
2.54mm Single Row male pin header	27	A row of 14 and a row of 13 pins
2.54mm Single Row female pin header	27	A row of 14 and a row of 13 pins

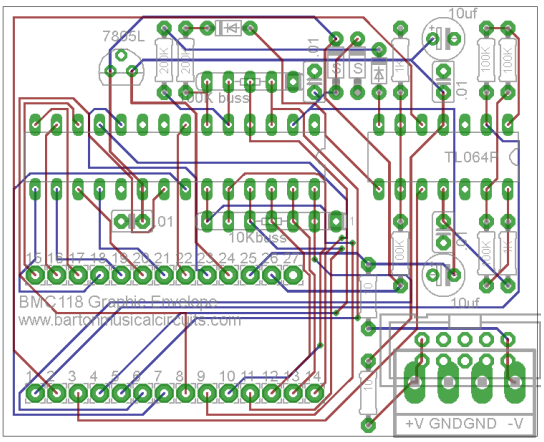
B. The PCBs





Above are renderings of the bottom PCB with and without traces. Sorry some of the text is backwards.





Above are renderings of the top PCB with and without traces.

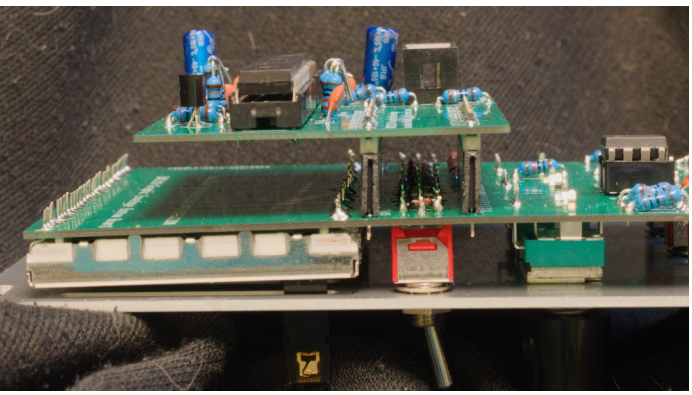
C. Build Order

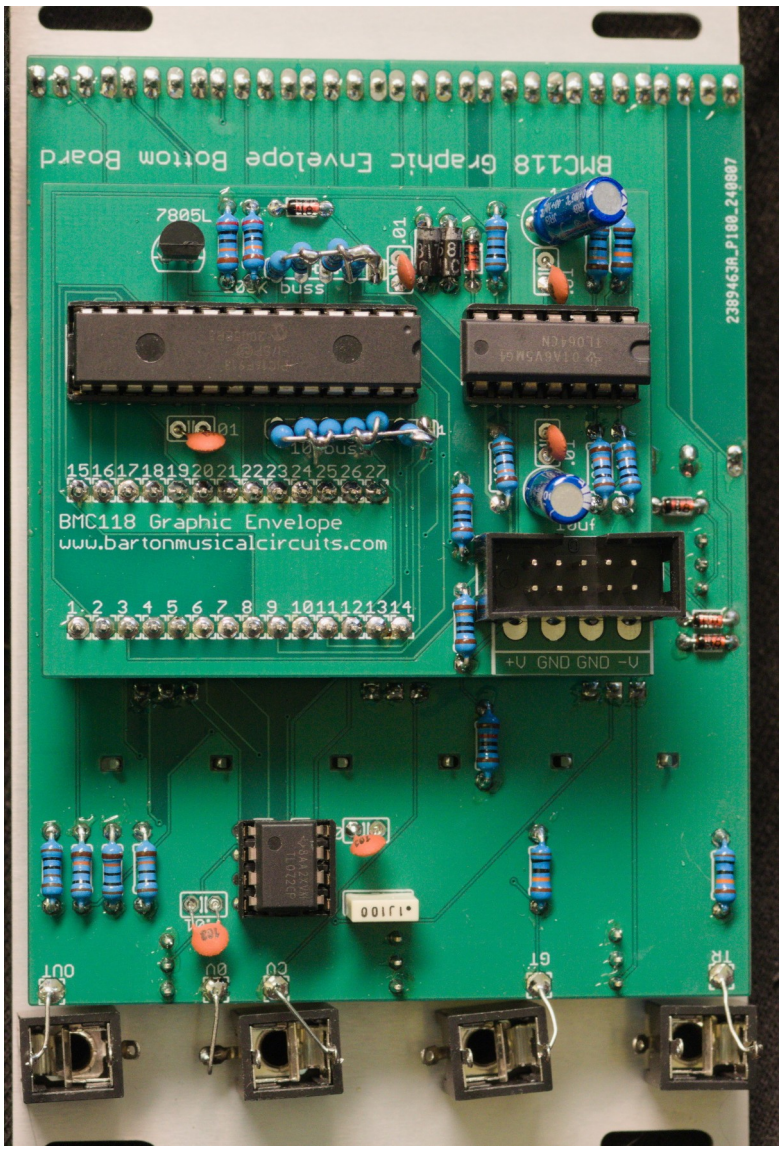
I would build in the following order:
1.Top PCB top components. I would do these in the order of: resistors, diodes, IC sockets, ceramic caps, 78L05, Power socket, Electrolytic caps.
2.Top PCB interboard connector on the bottom of the PCB. I usually do the male connector on the top board, but it doesn't matter.
3.Bottom board top components. I would do these in the order of: resistors, diodes, IC socket, ceramic caps, film cap, interboard connector.
4.Bottom board bottom components. I would do these in the order of: Slide potentiometers, toggles, rotary potentiometers. For all of these, I'd just solder one pad of the component initially and then after the PCB is mounted to the panel go back and solder the rest.

D. Wiring

Wiring is very easy on this project. The wirepads should be connected as follows:
TR – Tip of the trigger input jack
GT – Tip of the gate input jack
CV – Tip of the CV input jack
0V – Ground. Sleeve of any jack.
OUT – Tip of output jack.

Below are some photos of a completed module to use as reference:





E. Pinout for interboard connector.
When troubleshooting the module, this pinout may be useful.

1 = Speed CV sum
2 = Trigger in
3 = Clock in
4 = LFO toggle
5 = Reverse toggle
6 = Clock toggle
7 = Write switches 1 through 5
8 = Write switches 6 through 10
9 = Read 1 6
10 = Read 2 7
11 = Read 3 8
12 = Read 4 9
13 = Read 5 10
14 = Slider 1
15 = Slider 2
16 = Slider 3
17 = Slider 4
18 = Slider 5
19 = Slider 6
20 = Slider 7
21 = Slider 8
22 = Slider 9 (not used)
23 = Slider 10 (not used)
24 = V+ (in Eurorack +12V)
25 = V- (in Eurorack -12V)
26 = +5V
27 = Ground