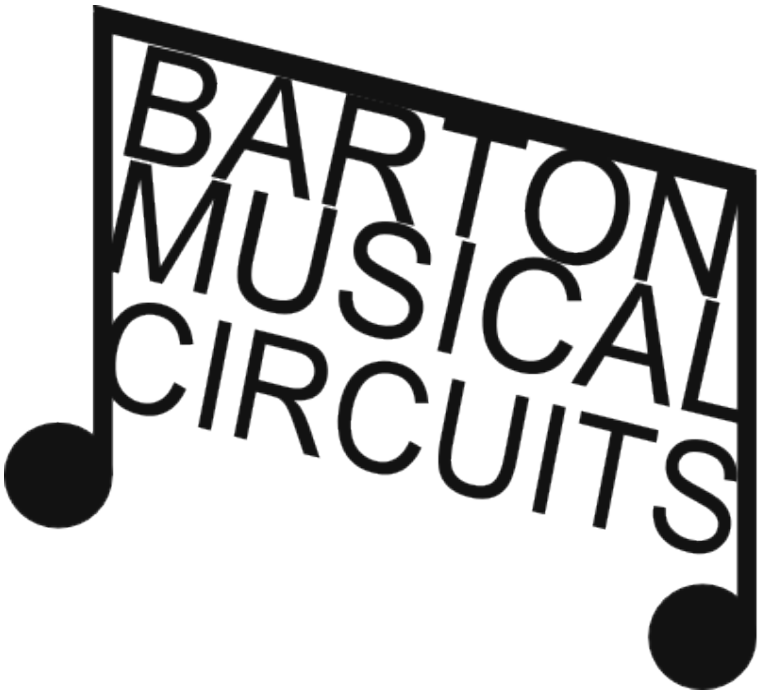

BMC085. 2X Voltage Controlled Low Frequency Oscillator

Last updated 5-18-21

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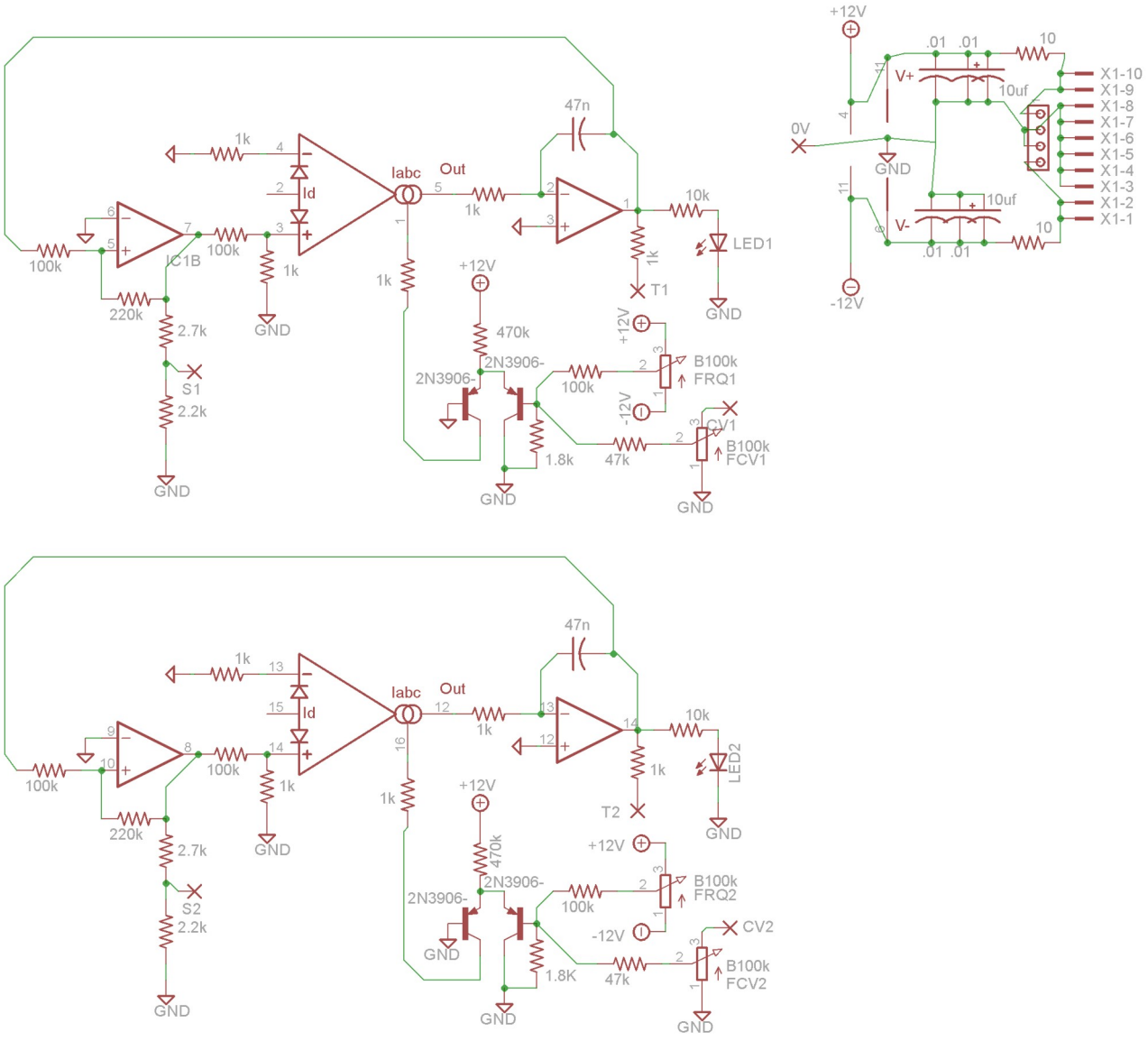
I. Overview

This module provides two voltage controllable low frequency oscillators. Each oscillator has a square and triangle wave output and a single CV input. The oscillator has a maximum frequency of ~25hz and a minimum frequency of .1hz (ten second cycles).

II. Schematic.



Above is the schematic for this module. Each LFO section is identical, but both are shown for clarity. Starting on the left we see an op-amp wired as a schmitt trigger, it's input is coming from the integrator on the right which we'll get to soon. The 100K resistor on the schmitt trigger's input and the 220k in it's feedback path set the threshold of the trigger and tell oscillator when to change phases. The output of the trigger is sent to a 2.7K/2.2K voltage divider that provides the square wave output, marked S1 or S2 on the PCB. The divider takes the +/-12V output and brings it down to a +/-5V output.

The trigger also feeds the LM13700 through a 100K/1K voltage divider, the output must be greatly attenuated in order to not overload the LM13700's inputs. The maximum current sent out of the LM13700 is controlled by the control current on pin1 or 16. This current is provided by a pair of 2N3906 transistors wired as a voltage controlled current supply.

Both emitters are wired to +12V through a 470K resistor with the base of one grounded and the base of the other connected to a variable voltage. As voltages change on the right-hand

transistor's base, it controls the amount of current the left transistor sources to the LM13700. The base of the right-hand transistor is connected to the frequency control and frequency control voltage through a pair of mixing resistors. A 1.8K resistor to ground limits the voltage swing from the controls to the transistor's linear range.

The output of the LM13700 connects via 1K resistor to a TL074 wired as an integrator. The output of this integrator provides the triangle output through a 1K resistor and controls the brightnesss of the indicator LED through a 10K resistor.

In the top right corner of the schematic are the power connections. The PCB has footprints for MOTM and Eurorack style power connectors. The positive and negative voltage rails are filtered by a 10 ohm resistor and 10uf capacitor forming a low pass filter, and additional .01uf capacitors are placed at the power pins of the ICs to provide further filtering.

III. Construction

A.Parts List

Semiconductors

Name	Quantity	Notes
LM13700	1	16 pin DIP Package
TL074	1	14 pin DIP package
LED	2	3mm
2N3906	4	TO-92package

Resistors +/-12V version (as printed on PCB)

Name/Value	Quantity	Notes
10 ohm	2	1/4w metal Film for all resistors unless otherwise noted
1K ohm	10	
1.8K ohm	2	
2.2K ohm	2	
2.7K ohm	2	
10K ohm	2	
47K ohm	2	
100K ohm	6	
220K ohm	2	
470K	2	

Resistors +/-15V version (see section in back for placement)

Name/Value	Quantity	Notes
10 ohm	2	1/4w metal Film for all resistors unless otherwise noted
1K ohm	10	
1.8K ohm	2	
2.2K ohm	2	
10K ohm	2	

47K ohm	2	
100K ohm	4	
120K ohm	2	
300K ohm	2	
470K ohm	2	

Potentiometers

Name/Value	Quantity	Notes
B100K	4	16mm PCB mount pot like THIS. Value not critical any linear taper pot above 10K should be fine.

Capacitors

Name/Value	Quantity	Notes
47nf / .047uf	2	Polyester film type
10nf / .01uf	4	Ceramic disc type, value not critical
10uf	2	Electrolytic rated at least 16V

Other

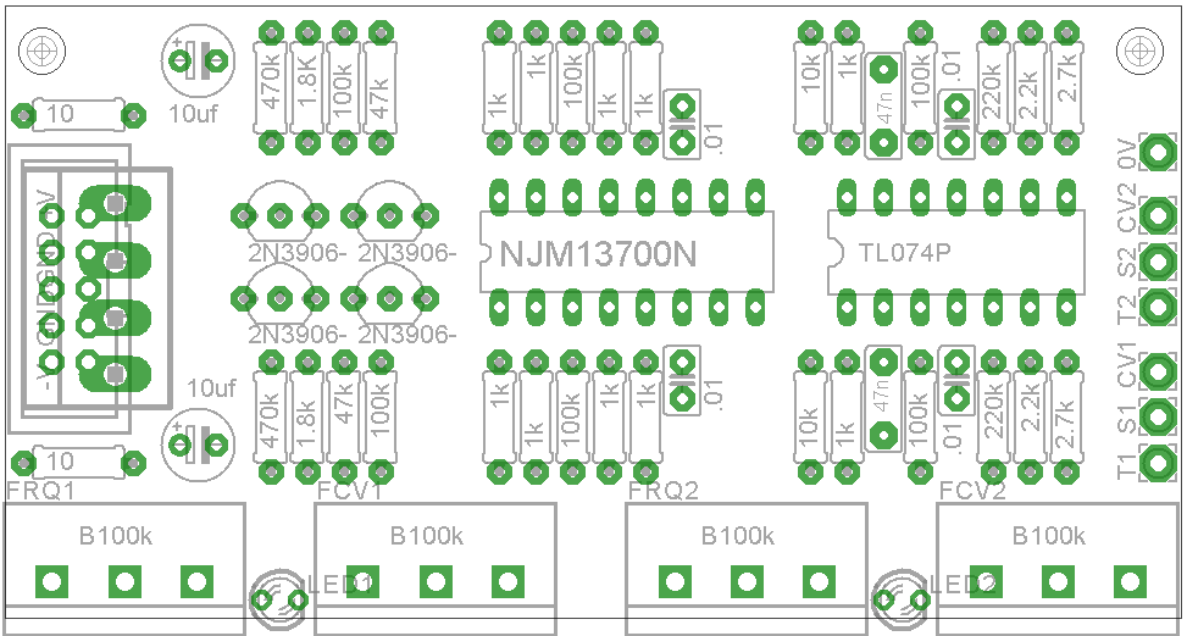
Name/Value	Quantity	Notes
Power connecter	1	Eurorack or MOTM
Jacks	6	
14 pin DIP socket	1	
16 pin DIP socket	1	

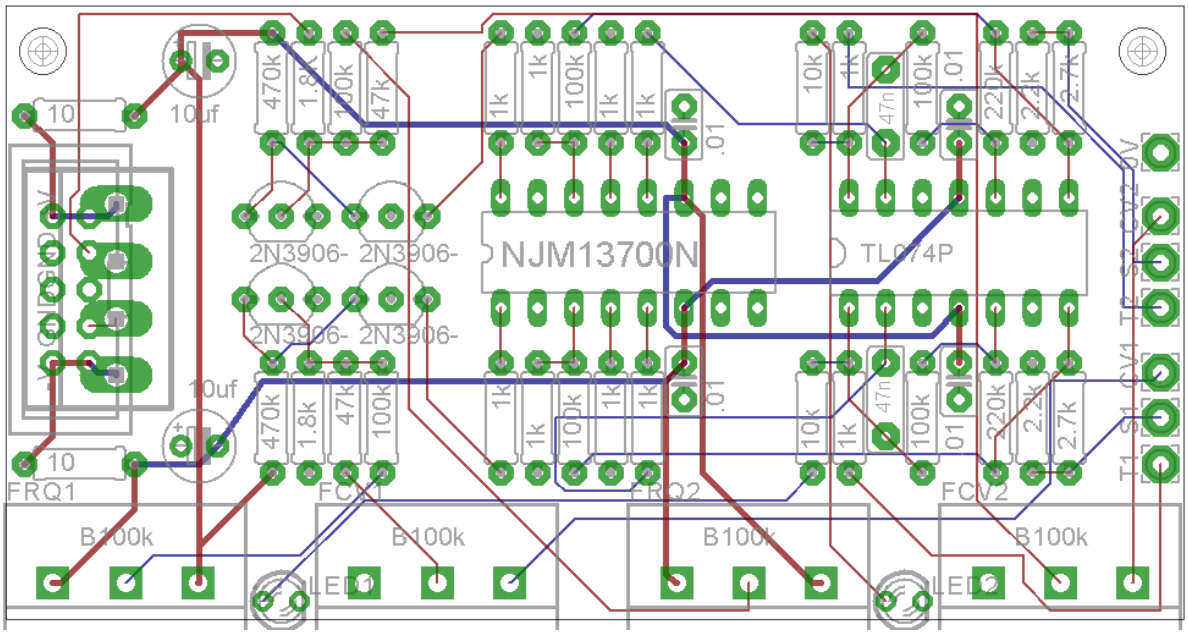
B. The PCB

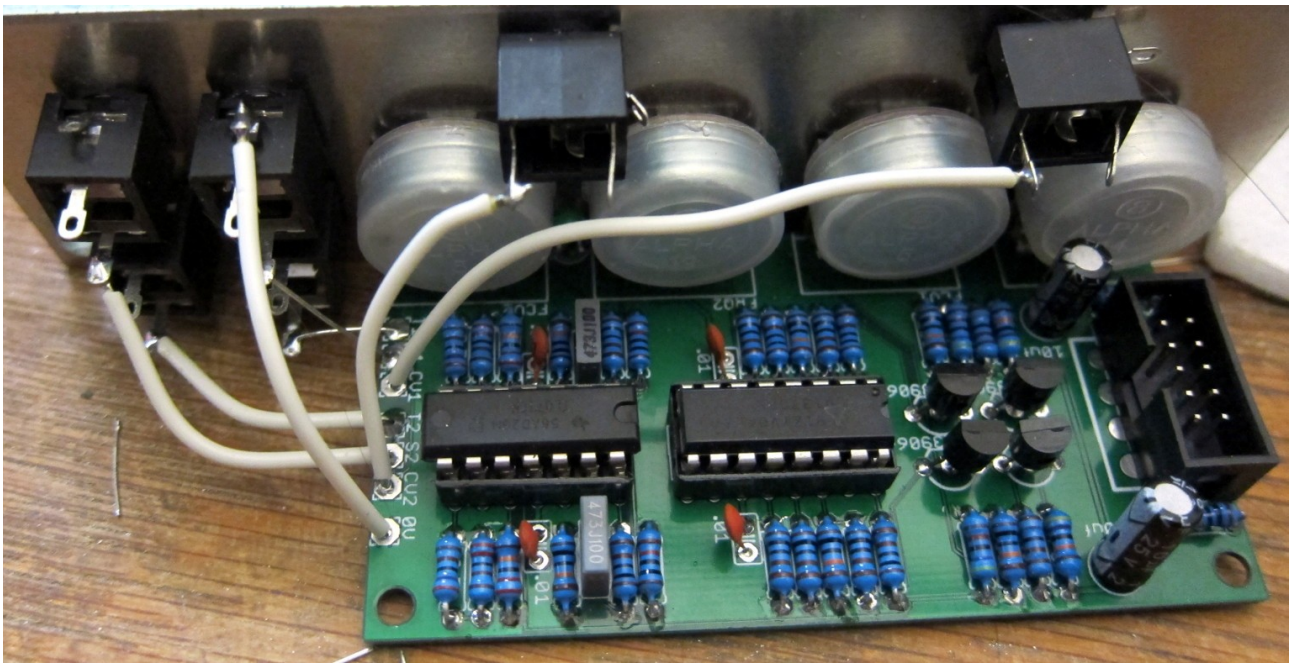
The PCB is 82mm x 43mm. The Pots are spaced 21.59mm apart (0.85”) and the mounting holes are 76.2mm apart.

The legend for the wirepads is as follows, inputs and outputs should be wired to tips of respective jacks:
T1 – Channel 1 Triangle output
S1 – Channel 1 Square output
CV1 – Channel 1 Control voltage input
T2 – Channel 2 Triangle output
S2 – Channel 2 Square output
CV2 – Channel 2 Control voltage input
0V – Ground connection, wire to sleeve of any jack.

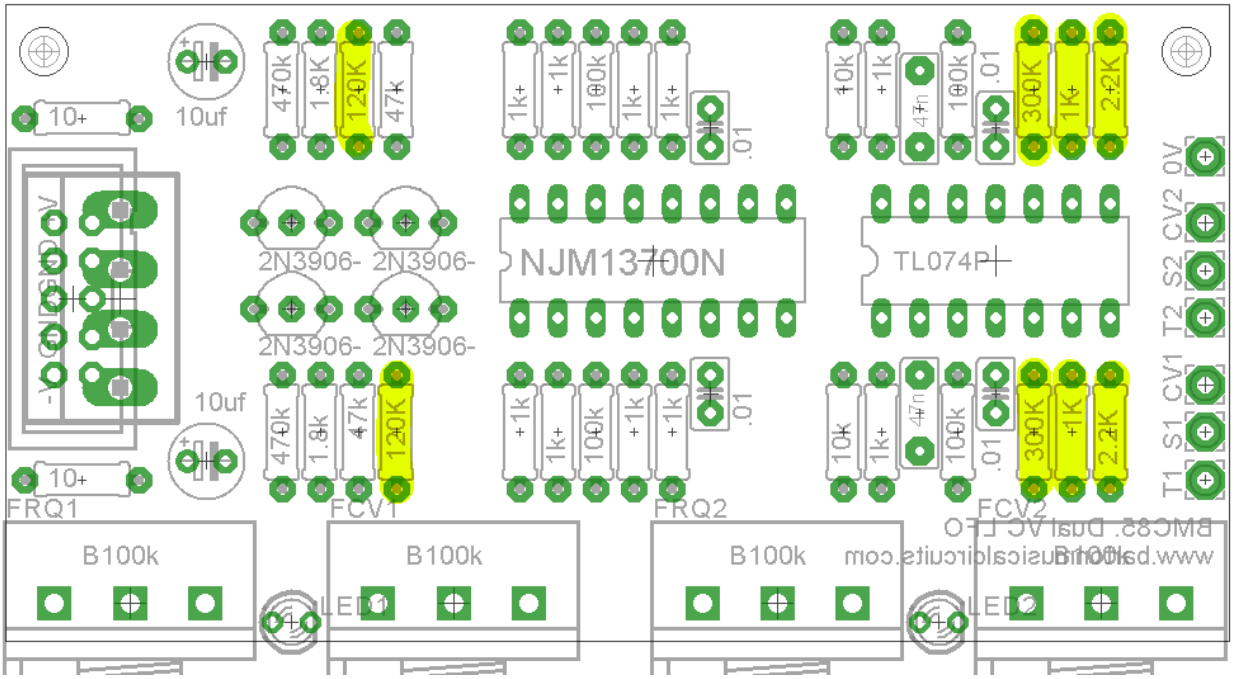
Below are renderings of the PCB with and without traces (ground plane not shown) and a photo of a wired PCB.


10
10uf
470k
1.8K
100k
47k
1k
.01
10k
47n
220k
2.2k
2.7k
2N3906-
NJM13700N
TL074P
0V
CV2
S2
T2
CV1
S1
T1
FRQ1
FCV1
FRQ2
FCV2
B100k
LED


10
10uf
470k
1.8k
47k
100k
1k
.01
10k
47n
220k
2.2k
2.7k
2N3906-
NJM13700N
TL074P
0V
CV2
S2
T2
CV1
S1
T1
FRQ1
FCV1
FRQ2
FCV2
B100k
LED



C. Changes for 15V systems



Above is a rendering of the PCB with the values shown for a 15V build instead of a 12V, the changed resistors are highlighted in yellow. These changes are untested, but should provide performance very close to the +/-12V version. The only other change that I wasn't sure about would be increasing the value of the 470K resistor at the emitter of the transistors, if the oscillator is reaching higher than useful frequencies you can increase the value of this resistor.
The changes are:
1.100K mixing resistor for frequency knobs changed to 120K
2. Square wave output voltage divider changed from 2.7K/2.2K to 2.2K/1K
3. Resistor in Schmitt trigger feedback path changed from 220K to 300K.