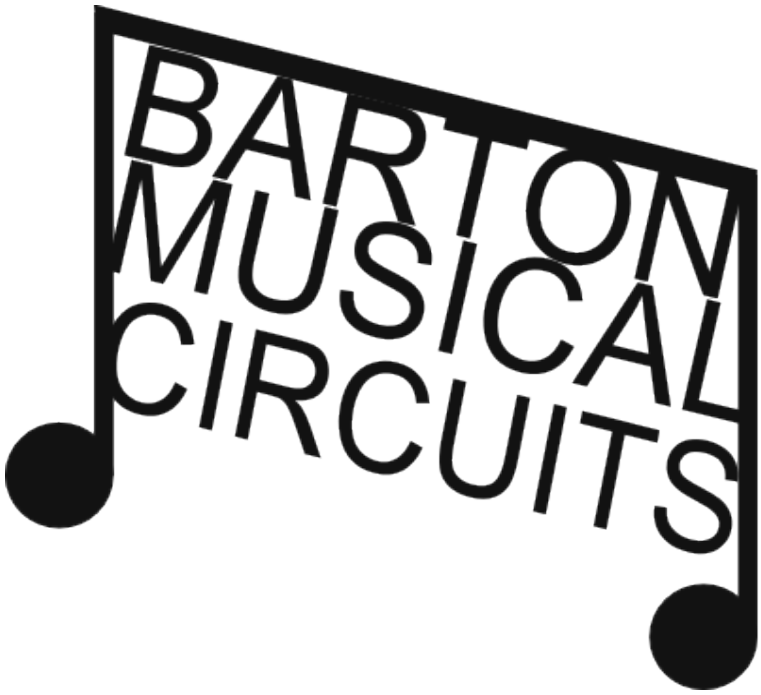


BMC038. Panel Keyboard.

Last updated 11-16-2015

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

I. Overview/Features

This module is a keyboard, only mounted with your other modules in your modular synthesizer rather than in a separate housing. It does this by using a small number of push-buttosn instead of traditional keys. This can be used like a traditional keyboard to play melodies, or it can be used a precision voltage reference for voltage controlled parameters in other modules.

CONTROLS

-Pitch select buttons. There are 12 buttons corresponding to a chromatic scale. They are arranged like a typical keyboard with sharp/flat notes in a seperate row. Whenever two buttons are pressed at the same time, the lower in pitch of the two will be output.
-Octave select knob. This knob selects which of five octaves the keyboard will output. There are 4 LEDs above the knob which give visual feedback for which octave is active.
-Slew knob. This knob adjusts the rate of slew/glide/glissando between notes. Fully counterclockwise is no slew at all.

OUTPUTS

-CV output. This output goes from 0 to 5VDC in $1/12^{th}$ volt intervals to corresond to the 1v/octave standard commonly used in synthesizer modules.
-Trigger output. This is a short pulse output whenever a pitch select button is pressed. It alternates between 0 and 5VDC
-Gate output. This pulses up whenever a pitch select button is pressed and remains high (5V) until the button is depressed.

II. Schematic.

The schematic is on the next page. I'll briefly describe the different parts of the circuit to help people understand the module. At the top center is the 16F689 PIC microcontroller (the PCB has it labeled as a 16F685, this is a typo and should be ignored) which is the heart of the module.

On the far left, we see the octave display LEDs. Pin2 of the PIC is connected to the cathodes of the red LEDs and the anodes of the green LEDs, so this allows it to control which set of LEDs are active, by either being a current sink for the reds or source for the greens. Pin 13 controls the anode of the first red LED and the cathode of the first green, and Pin 3 does this for the second set. This allows us to control 4 LEDs with only 3 pins.

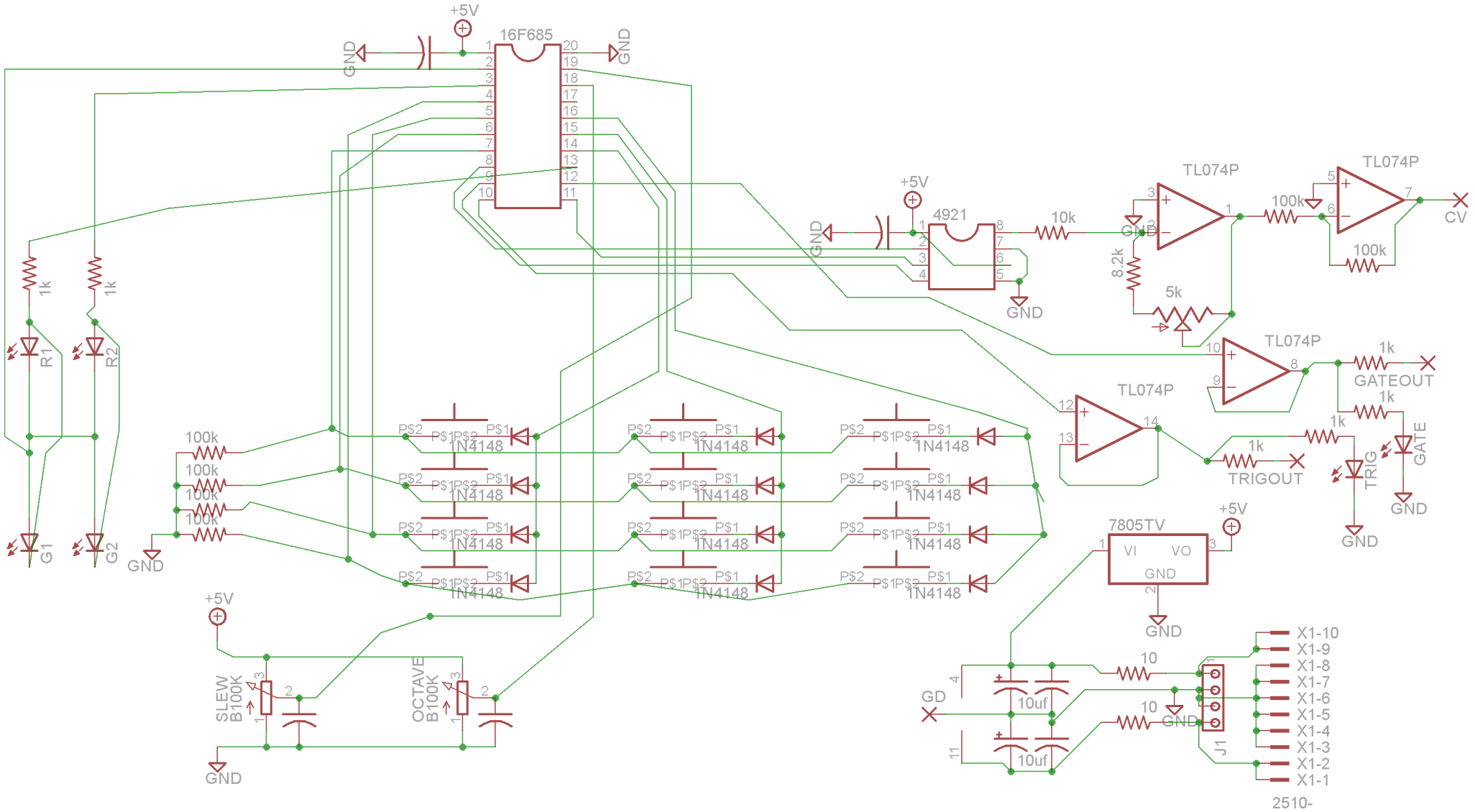
To the right of these, we see the switch matrix. Pins 14 through 16 are the outputs. And pins 4-7 are the inputs. When a single output pin is turned on, if any of the four switches that it is connected to through the diodes is closed, then the corresponding input pin will read this. This allows us to get 12 switches from only 7 pins.

Below the switch matrix to the left are the two potentiometers. Each is connected to +5V and ground on it's outer lugs and it's wiper is connected to a pin on the microcontroller. The wipers are also filtered by a .01uf capacitor. Slew is connected to pin 19 and Octave is connected to pin 18.

To the right of the switch matrix we see the gate and trigger outputs. Each of these consist of a section of the TL074 op-amp wired as a unity gain buffer, the output of which goes through a 1K resistor to the corresponding output jack and a 1K current limiting resistor to an LED. The trigger output comes from pin 10 and gate comes from pin 12.

Above these outputs we see the DAC and CV output circuitry. The 4921 is a serial digital-to-analog converter (DAC). It receives data from the microcontroller on pins 2, 3 and 4 and then outputs a corresponding voltage on pin 8. This voltage is then connected to a pair of inverting amplifiers in series. The first has a trimpot in it's feedback path to fine-tune the output voltage.

Finally on the bottom we see the power supply connections. There are eurorack and MOTM power connecter footprints, these are connected to a low pass filter of a 10 ohm resistor and 10uf capacitor. The power rails go to the TL074 and a 7805 voltage regulator.


+5V
GND
16F685
1
2
3
4
5
6
7
8
9
10
20
19
18
17
16
15
14
13
12
11
1k
1k
R1
R2
G1
G2
100k
100k
100k
100k
GND
P$2
P$1
1N4148
+5V
SLEW
B100K
OCTAVE
B100K
GND
+5V
4921
GND
10k
TL074P
8.2k
5k
100k
TL074P
100k
CV
TL074P
1k
GATEOUT
TL074P
1k
1k
TRIGOUT
1k
TRIG
GATE
GND
GND
+5V
7805TV
VI
VO
GND
GND
GD
10uf
10uf
10
10
GND
J1
X1-10
X1-9
X1-8
X1-7
X1-6
X1-5
X1-4
X1-3
X1-2
X1-1
2510-

III. Construction

A.Parts List

Semiconductors

Name	Quantity	Notes
16F689	1	Provided with PCB
MCP4921	1	DIP packaging
TL074	1	DIP packaging
7805	1	TO-220 packaging
Red LED	4	3mm size
Green LED	2	3mm size
1N4148	12	Or other small switching diode

Resistors

Name/Value	Quantity	Notes
10 ohm	2	1/4W metal film through hole
1K	6	1/4W metal film through hole
8.2K	1	1/4W metal film through hole
10K	1	1/4W metal film through hole
100K	6	1/4W metal film through hole
B100K Potentiometer	2	9mm Right angle PCB mount. Like this.
5K Cermet Potentiometer	1	3296W packaging

Capacitors

Name/Value	Quantity	Notes
.01uf	6	Cheap ceramic disc
10uf	2	2.5mm lead spacing, 5mm width.

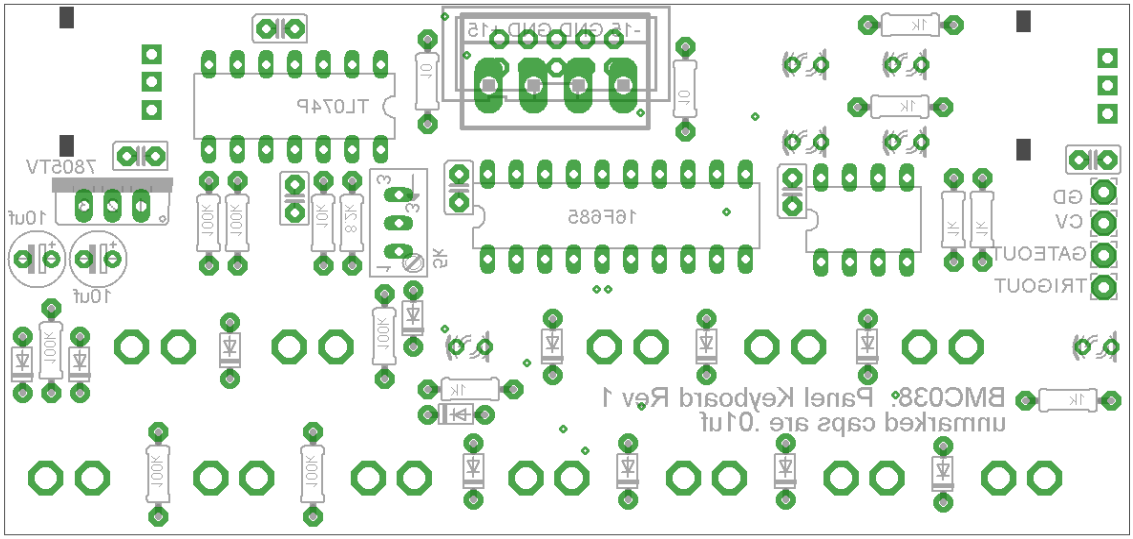
Other

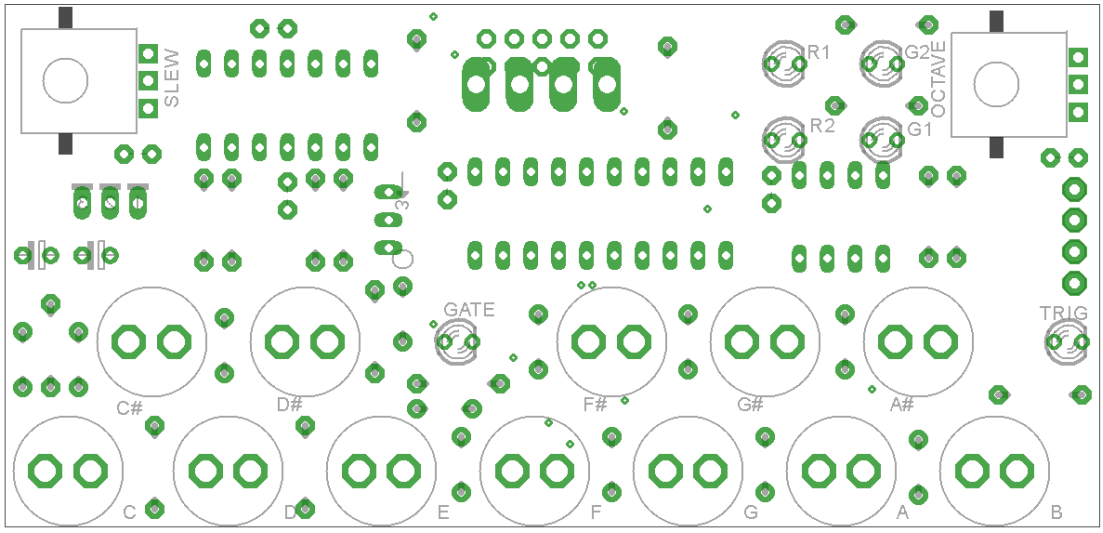
Name/Value	Quantity	Notes
Power connecter	1	Eurorack or MOTM
Push-button.	12	Normally open, panel mount. Like this.
Knobs	2	
Jacks	3	
8 pin DIP socket	1	
14 pin DIP socket	1	
20 pin DIP socket	1	

B. The PCB

Below are images of the two sides of the PCB. As you can see all of the parts which mount with the panel are on one side, and everything else is on the other side. The jacks are not mounted to the PCB, this allows the PCB to be used in different formats of synthesizers without requiring different PCBs for different jacks.

I advise that the parts facing away from the panel be attached to the PCB first. For the parts which attach to the panel, I advise that you only solder one connection for each part before mounting it to the panel. This allows for more "give" to the parts making it easier to mount, and also puts less stress on the PCB during the mounting process. After everything is securely fastened, resolder these connections, then solder in the rest of the connections.



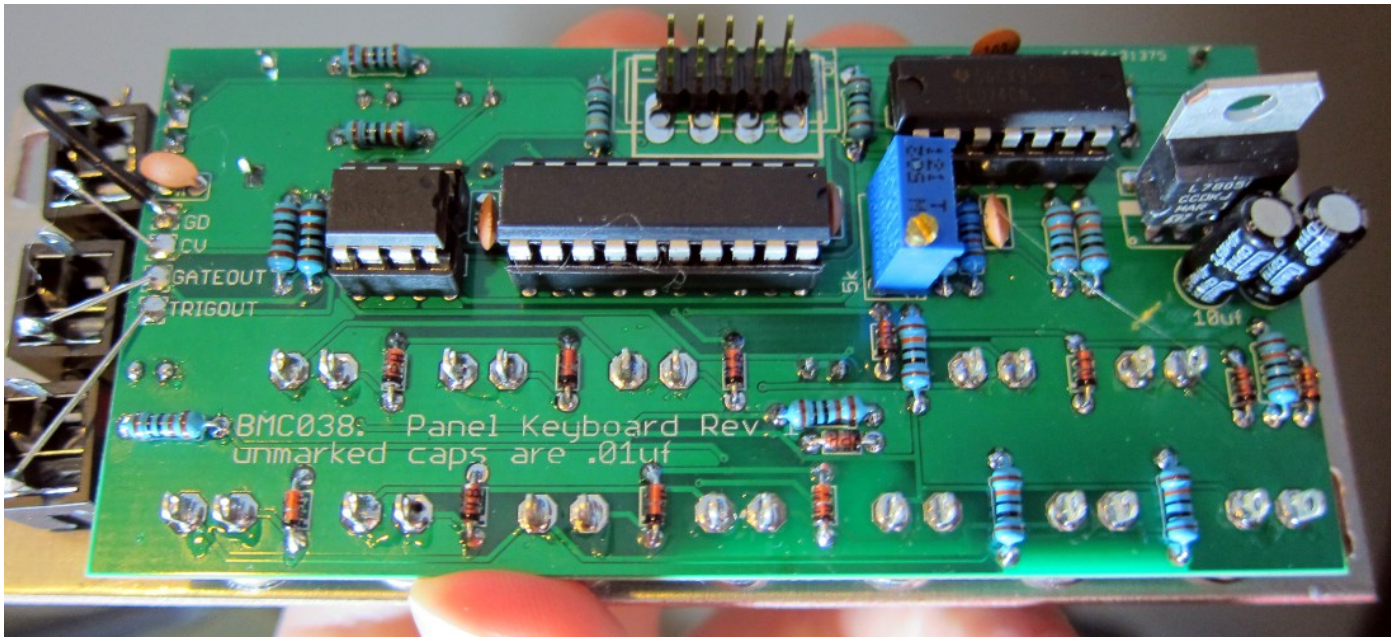


C. Calibration

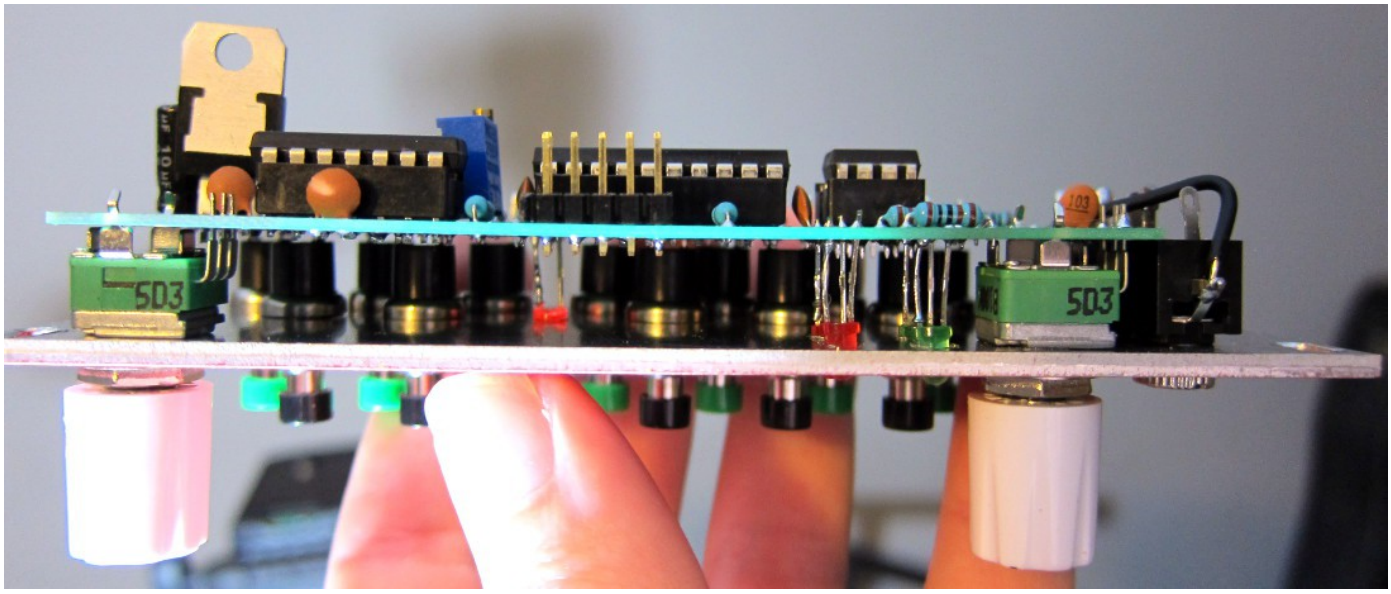
1.Set up a volt meter with the black lead to ground and the red lead to the CV output jack.
2.Turn the octave knob so that only LED R1 is lit up, and press the "C" button (top key). Turn slew all the way off.
3.Adjust the trimpot until you get exactly 1V on the output.
4.Turn the octave knob clockwise until no LEDs are on, then press "C" again.
5.Adjust the trimpot until you get exactly 2V on the output.
6.Repeat this for the next two octaves adjusting for 3V, then 4V.

D.Photos/Final Thoughts

Here are a couple of photos of a completed unit to give an idea of how it all comes together.



The jacks are close enough to the wirepads that I just used the clipped off leads from the resistors, this saves wire and saves time stripping wires. I used bulk two row header clipped off instead of a shrouded header for my power connecter.



Here's a side view of the completed unit. I did not use the washers that come with the pushbuttons, if you decide to use them, you may need to add washers for the pots as well.