BMC016. Dual Nice Quantizer.
Last updated 8-19-2018 – new calibration instructions

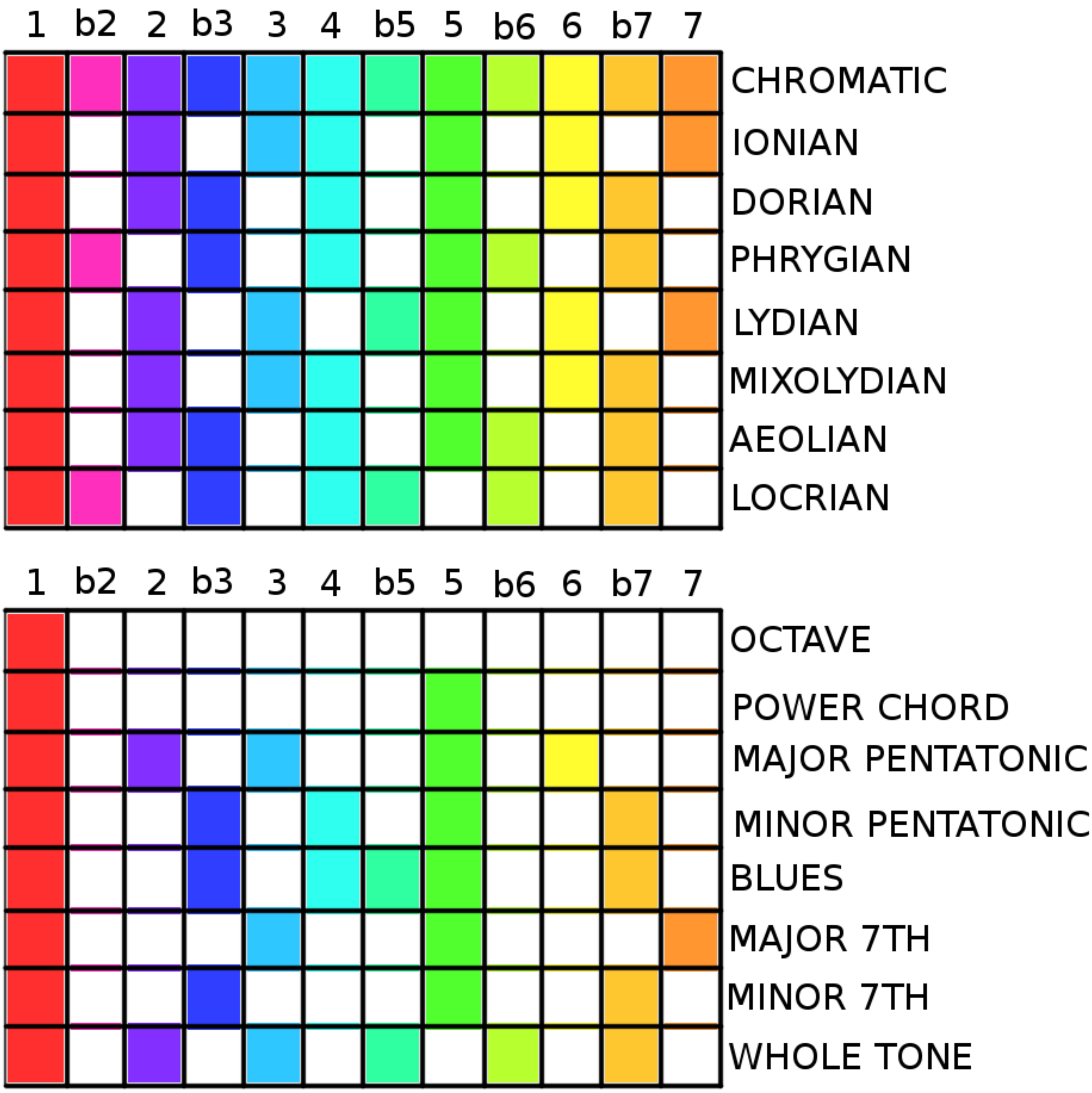
There are two versions of this PCB, if you have a PCB with six trimpots, read THIS DOCUMENTATION instead.

I. Using The Dual Nice Quantizer

A.Features

The Dual Nice Quantizer is a 2 channel voltage quantizer designed to be used with 1v/Octave oscillators. Each channel can be used completely independently of the other, though the input of channel 2 is normalled to channel 1 so a single CV source can easily be used to control two oscillators at the same time. The quantizer is capable of either unipolar (0V to 10V) or bipolar (-5V to +5V) range.

There are 16 musical modes available, split into two banks of 8. The first bank is based upon the "standard" musical modes as well as a chromatic mode. The second bank uses more sparse modes. The chart below shows these modes in order from least clockwise position of mode select to most clockwise position.



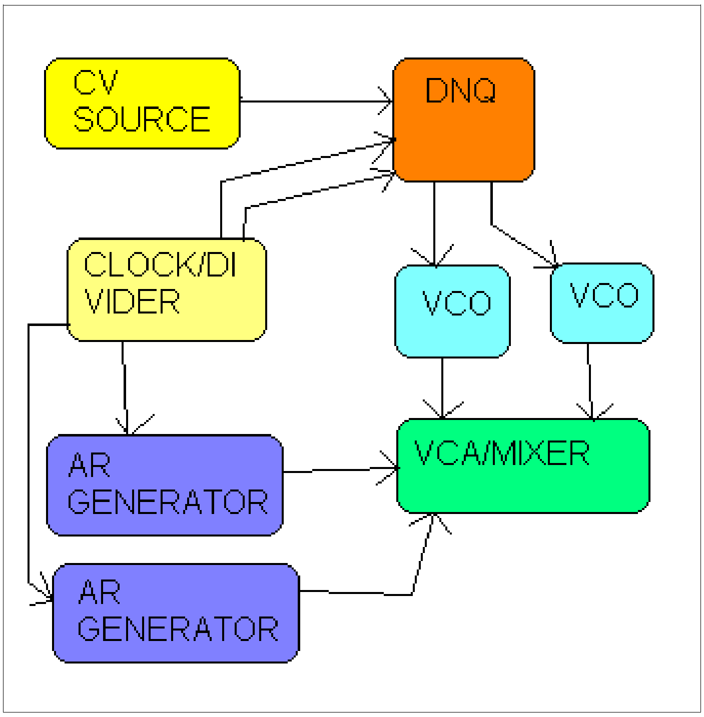
B.Inputs/Outputs/Controls

All Inputs/Outputs/Controls are repeated for each channel.
Inputs:
1.CV Input: This is the control voltage which will be quantized.
2.Auxiliary CV Input: A second control voltage can be mixed with the input voltage.
3.Trigger Input: When nothing is plugged into the input, the quantizer constantly quantizes the voltage at it's input. When a trigger source is input here, the quantizer will only quantize when a trigger is fired.
4.Quantize Input: When the Quantize switch is on, plugging a gate signal into this jack allows you to use a gate to turn quantizing on or off. When off the quantizer will output whatever voltage is input.

Outputs:
1.OUT: This is the quantized voltage.

Controls:
1.Mode Knob: This selects which of the 8 modes in the selected bank is used for quantizing.
2.Mode Switch: This switch selects which bank of modes is used in selecting musical mode.
3.Range Switch: This selects the voltage range, either 0 to +10V or -5V to +5V
4.Quantize Switch: This turns quantizing off or on.
5.CV Attenuate/Offset Knob: When nothing is plugged into the Auxiliary CV Input, this knob adds an offset to the CV input. When there is something plugged into the Auxiliary CV Input, this knob attenuates that voltage.

C.Example Patch



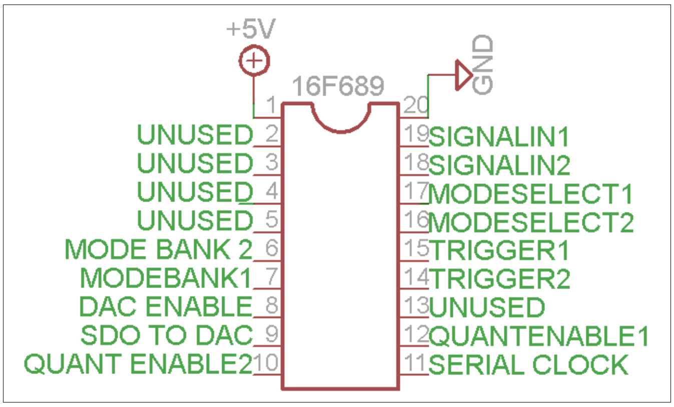
To the right we see an example of a relatively simple patch that can produce musical results easily. The CV source could be an LFO, sequencer, S&H or anything that produces CV. The CV Source is patched to the CV input of channel 1 and is thus controlling both channels of the DNQ. Two of the clock/divider's outputs are being sent to the Trigger inputs of the DNQ. These outputs should be at different divisions so that the two outputs update at different times. The DNQ is contolling the pitch of two VCOs, whose outputs are being modulated by AR Generators being controlled by the Clock/Divider. The VCOs should be tuned to the same pitch before being patched to the DNQ.

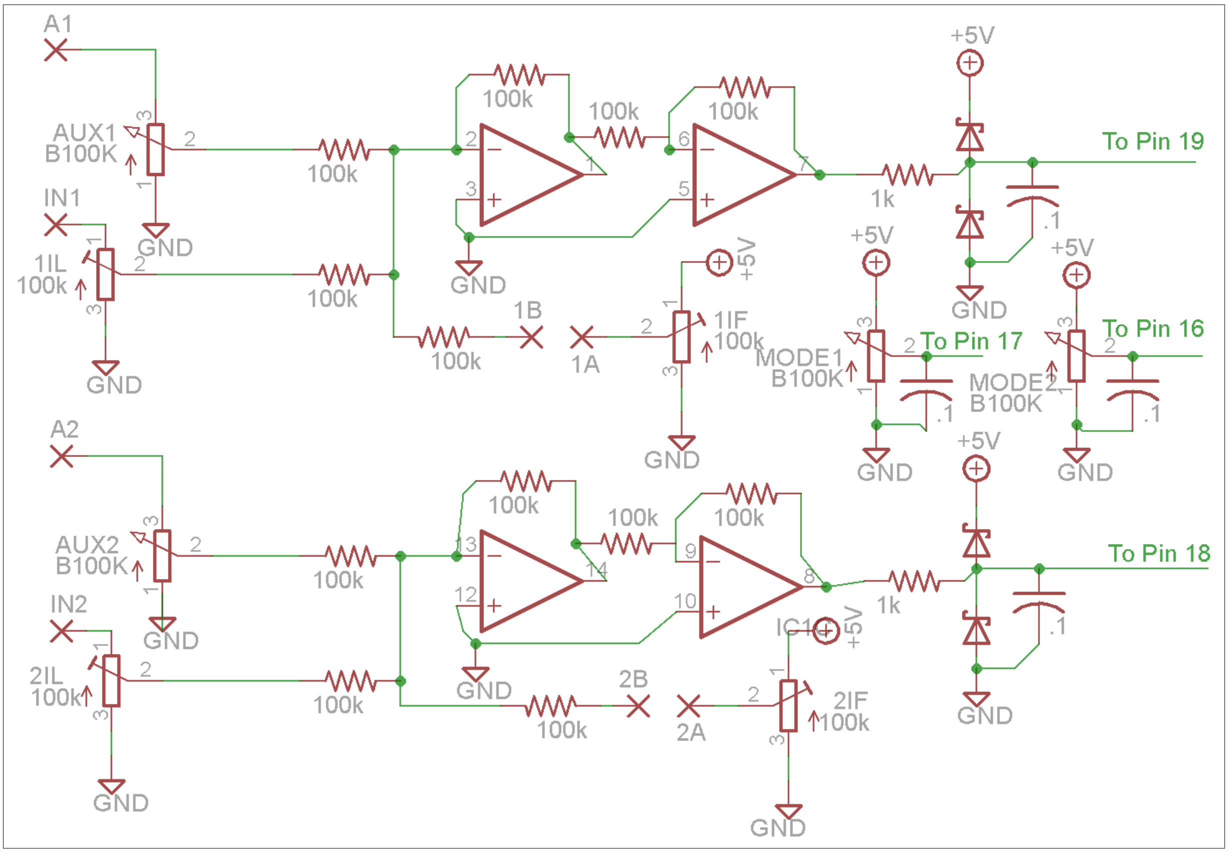
Start with both channels of the DNQ set to the same mode and adjust the offset of one of them so that different pitches are output. As the difference increases one will begin to seem like the "bassline" and the other will seem like the "melody" even though they are from the same CV source. Try adjusting the modes for the different channels.

II. Electronics Description.

A.The Microcontroller

On the right we see the pin out of the 16F689 microcontroller. The things these pins connect to are explained in the next few diagrams. The terms "Digital Input" and "Analog Input" are used because this is how the microcontroller views these signals.

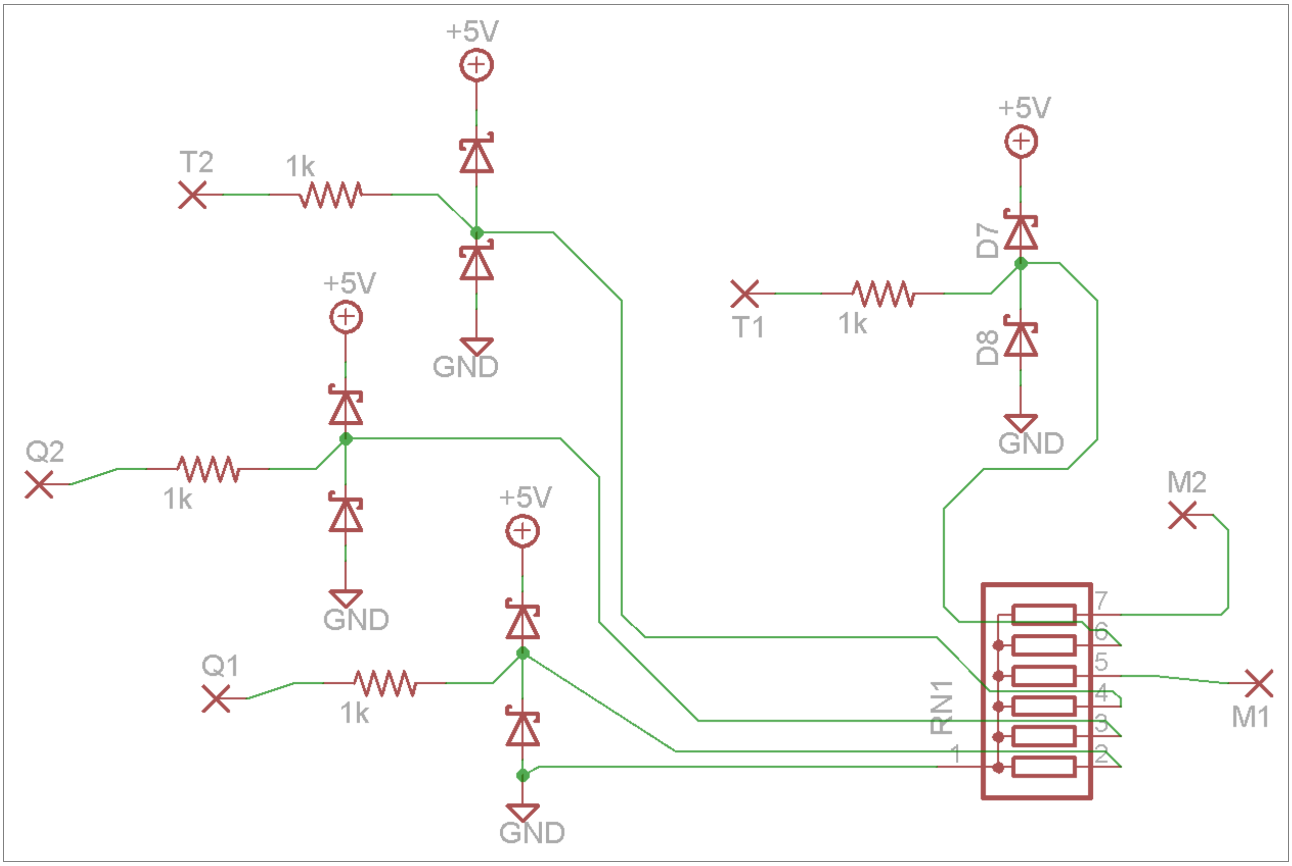




B.Analog Input Circuitry

Above we see the analog input circuitry. On the far left, we see the "Input Offset" trimpot. The point marked "IN1" is the wiring pad for the input jack. This goes through the INPUTLEVEL trimpot and is then summed with the voltage from the auxiliary CV input, and when in bipolar mode, the INPUTOFFSET trimpot's voltage as well. All these voltages are summed by an op-amp in an inverting amplifier with a gain of 1, and then inverted again by another amplifier with gain of 1. After this, we see a 1K resistor and two Schottky diodes forming an overvoltage/undervoltage protection circuit and a .1uf capacitor filtering high frequency noise off of the microcontrollers pins. This is all repeated for channel 2.

Between the two channels we see the knobs for Mode select simply form voltage dividers between 0 and 5V and there are capacitors to filter out any high frequency noise off the microcontroller.

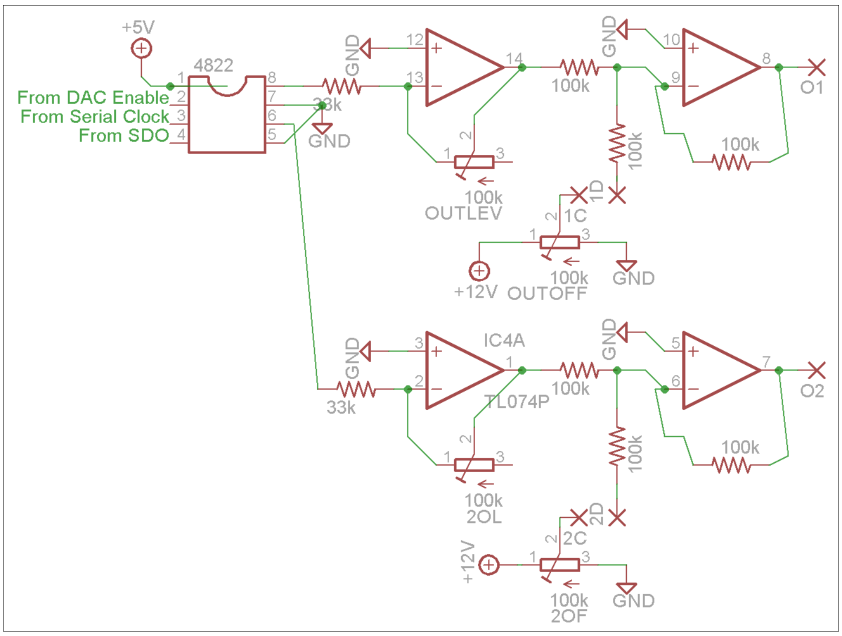


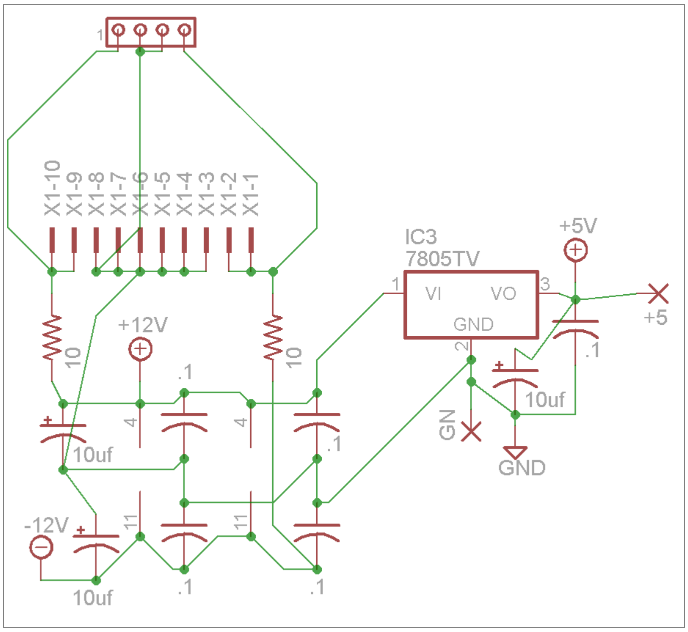
C.Digital Inputs.

Above we see the digital inputs. The inputs which interact with outside signals all go through the same 1K/Schottky diodes networks as the CV Inputs to protect the microcontroller. RN1 is a 100K bussed resistor network which keeps all of the pins at 0V when no signal is input.

D. Output Circuitry.

The analog output circuitry is centered around the 4822 DAC chip. It receives digital data serially from the microcontroller. It's outputs are connected to op-amps which amplify it and when in bipolar operation also offset the signal.





E.Power Circuitry

On the top we see two power connecters, a 10-pin for Eurorack and a 4-pin for MOTM. This circuit works with either +/-12V or +/-15V with no modification. The positive and negative power rails are each filtered through a 10 ohm resistor and a 10uf capacitor. Each rail is sent to the quad op amp with a pair of decoupling caps. The positive rail then goes to a 7805 voltage regulator. The +5V supply then sent to the PIC's power supply and to a wiring pad for wiring up switches.

III. Construction

A.Parts List

Semiconductors

Value	Qty	Notes
16f689	1	Should have come with your PCB
TL074	2	DIP 14 pin package
MCP4822	1	DIP 8 pin package
Schottky Diode	12	SD101c, 1N914 or similar
7805 Voltage Regulator	1	TO 220 Package

Resistors

Value	Qty	Notes
10 ohm	2	All resistors 7.5mm lead spacing unless otherwise noted
1K	6	
100K	18	
18K	2	
100K Array	1	7 pin SIP bussed array. Or make your own.
B100K Pot	4	PC Mount 16mm

100K trimpot	8	3296W package

Capacitors

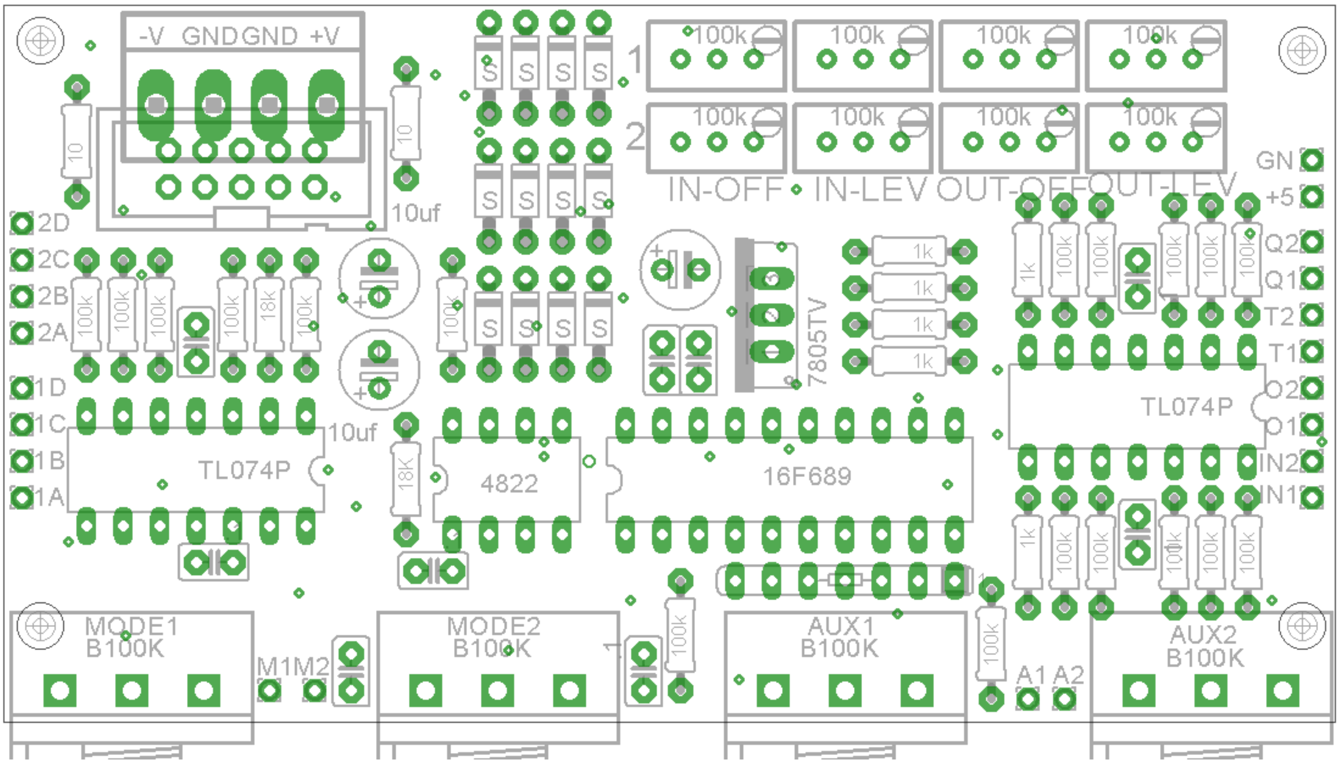
Value	Qty	Notes
.1uf	9	ceramic disk, 2.5mm lead spacing. Value non-critical
10uf	3	Electrolytic

Other

Value	Qty	Notes
8 Pin socket	1	DIP Socket
14 pin socket	2	DIP socket
20 pin socket	1	DIP socket
Power Connecter	1	MOTM or Eurorack
Switching Jack	10	1/4" or 1/8" depending on format
DPDT Toggle	2	Panel mount
SPDT Toggle	4	Panel mount

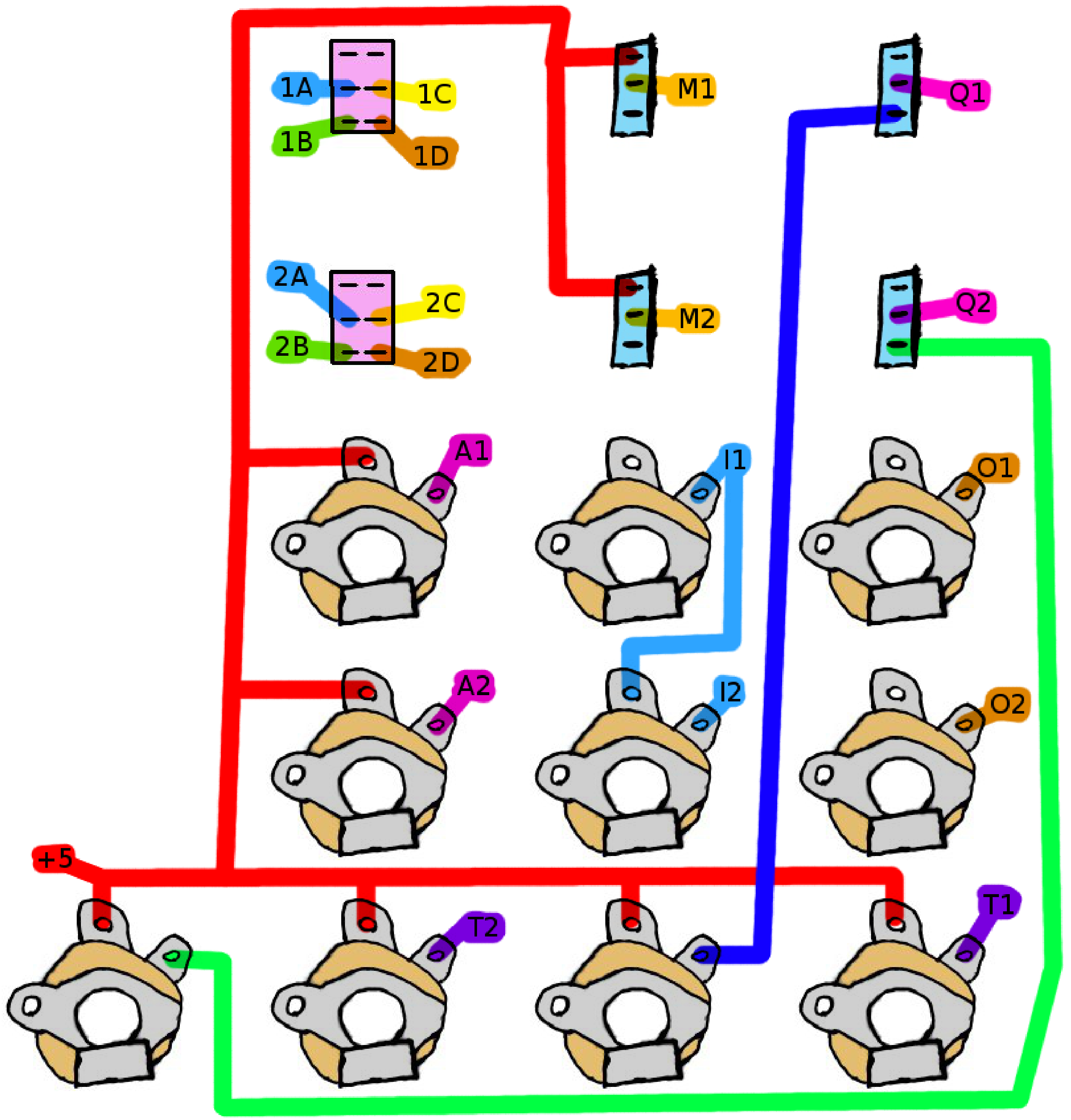
Other than a pre-programmed PIC, 4822, and resistor array all components for building this project in Eurorack are available from www.taydaelectronics.com

B.The PCB/Wiring Information



The PCB is 92mm x 50mm. The pots are spaced 1" apart. Mounting holes are spaced 87mm x 40mm apart.
On the next page is a wiring diagram for the DNQ. 1/4" switching jacks are used to represent the input/output jacks. The top wiring pad is the switch, the righthand is the tip and the lefthand is the sleeve.

I suggest doing the offboard wiring in the following order:
1.+5V connections between all the switches/jacks. I usually will use resistor lead clippings for going between switches or other short distances so I don't have to strip extra wire.
2. Connect from the quantize switch to the quantize jacks
3. The bi-polar switches
4.The mode switches
5.The auxiliary inputs then
6.The quantizer switch/jacks
7.Input jacks
8.Output jacks
9.T inputs
10. Quantize inputs
11.+5V on the PCB to a switch or jack's +5V connection
12.Ground. If you're using a metal panel, just wire to a single sleeve connecter on one jack and the panel will connect the rest.



C.Calibration

These isntructions are for calibrating channel 1, repeat all of them for channel 2 when completed.

0.Plug nothing into the jacks of the DNQ, monitor the voltage on the output with a multimeter.
1.Set the mode selection switch to Octave (non-standard) and turn the mode select knob completely counter clockwise. Turn Quantizing on, and range to unipolar.
2.Turn the offset/attenuate knob fully counterclockwise, then slowly adjust it clockwise until the output voltage changes.
3.Adjust the OUT LEV trimpot until the difference in voltages as you adjust the offset knob is exactly 1V, or the difference in pitch is exactly 1 octave.

4.Plug a CV source into the CV Input, turn quantizing off, and monitor the difference in voltage between input and output.
5.Adjust the INLEV trimpot until there is as small a difference as possible between input and output.
6.Input a +5V CV source to the Auxillary input and monitor the output. Adjust the auxiliary input knob until the output level is at 5.33V.
7.Measure the voltage on pin 19 of the PIC and write the voltage down. It should be between 2.3V and 2.5V
8.Unplug your inputs, and switch to Bipolar (+/-) mode.
9.Adjust the INOFF trimpot until the voltage on Pin 19 is equal to the voltage you wrote down in step 7.
10.Monitor the difference in voltages between input and output and adjust the OUTOFF trimpot until there is as little difference as possible.