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http://www.sdiy.org
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Difference Rectifier / Neuron build doc. 10 Jan 2013

Muffs thread: http://www.muffwiggler.com/forum/viewtopic.php?t=71433&highlight=

NEURON

This neuron was inspired by a paper on neural computing and is a variation of a typical analogue neuron circuit. It is not a chaos circuit, read the in depth descriptions on pg1 of the Muffs thread to get a good understanding of this circuit.

To use it: put some LFO and/or EG signals on the inputs, or maybe something from a sequencer. Use the output to control pitch on a VCO or cut-off on a VCF – or anything else you can think of. Twiddle the pots until it sounds good.

It will even work with just one input signal, although is much more interesting with two or three.

It can also handle audio frequencies, so try it out as a wave-shaper. Feed it two or three signals from different VCOs and let them fight it out. Or feed it a VCO signal and a slow envelope or LFO to modulate the audio.

Just some ideas, if you find some other uses, do share!

This circuit is slightly changed from the one on the double neuron PCB. The weight of the offset voltage is halved by the 200k resistor, this gives the pot a more useful range and limits the offset to VCC/2.

DIFFERENCE RECTIFIER

This circuit is a hybrid of two basic op amp 'building blocks' – a difference circuit and a rectifier. Not sure if I have ever seen the two merged together before. It is probably a bad idea except for synth use, where it is a wonderful idea! If you like slightly dodgy maths:

$$V_{out+} = V_{in+} - V_{in-} \text{ if } > 0, otherwise \text{ } 0$$

$$V_{out-} = V_{in+} - V_{in-} \text{ if } < 0, otherwise \text{ } 0$$

Ignoring diode voltage drop

Basically the circuit compares the voltage on the '-' inputs with the voltages on the '+' inputs. The difference between these voltages is fed to the outputs. If the difference is positive it appears on the '+' output, if the difference is negative it appears on the '-' output.

Again, a great way to mix boring CVs to get something interesting, audio frequency wave-shaping and it also can be used as a crude VCA.

Resistors

10Ω - 2

22kΩ - 3

1kΩ - 3

100kΩ - 10 (these are the unmarked resistors on the PCB)

200k - 1

Diodes

1N4148 – 4 (or any regular thru-hole signal diodes).

Pots

100kΩ Linear – 2

I use 100k pots from Song Huei - R0903N-B100k, L-25KC (the 25 is the length of the shaft in mm).

These have little extra tabs which need to be bent out of the way so they are not sitting on the traces. It takes about 5 seconds to do this with needle nosed pliers (see pic below). Maybe I'm just being overly cautious but <insert favourite daggy saying here> 'an ounce of prevention doo doo da doo etc'   *This will not be necessary on vers.2 of this PCB and is only necessary with some brands of pots.*
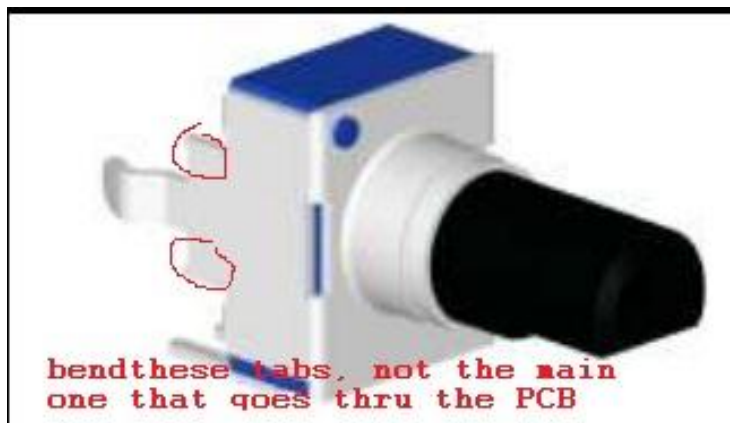
These are single sided PCBs, so the pots will have to be soldered on the solder side of the PCB, solder the side tabs too for a nice firm pot. A bit different if you have built nonlinearcircuits stuff before.
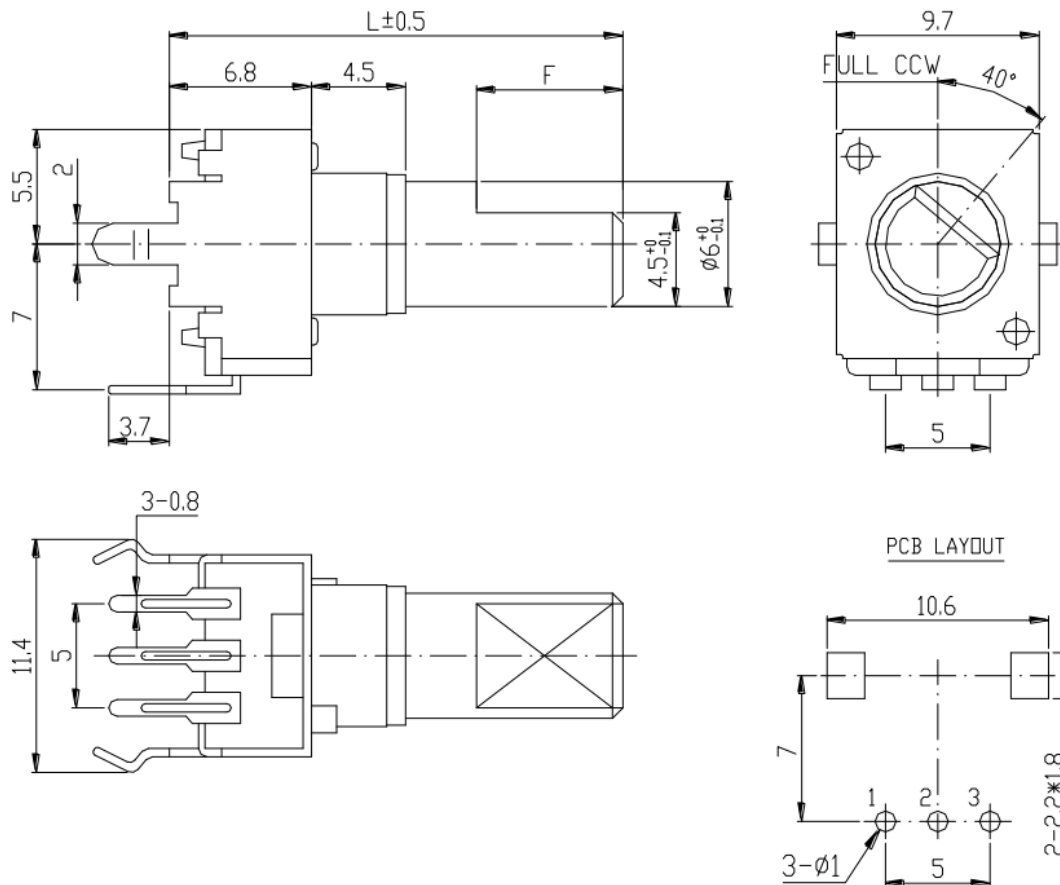
 The pot footprint is very common. Another pot that fits is this Alpha from Altronics - http://www.altronics.com.au/index.asp?area=item&id=R1948

The Alpha pots don't need the tabs bent out of the way

If mounting the pots on the PCB, the panel holes are to be 1 inch apart. Of course, it is better to use pots that have a nut and thread, and then the PCB can be simply mounted to the panel with the pots.

Tabs bent inwards to prevent contact with PCB traces

bendthese tabs, not the main one that goes thru the PCB

This is from the Song Huei - R0903N datasheet, when choosing other pots to buy refer to these dimensions to ensure your choice is correct.

Caps

10µf 25V (or higher) – 2

From 47nF to 100nF – 2

All caps are for decoupling, so any cheap crap will do, the spacing is 2.5mm. An example is here - http://futurlec.com/Capacitors/C100UC.shtml

ICs

TL074 – 1

I'd recommend installing an IC socket.

Connectors

Holes for Power connector suit 3 pin .100". The square hole is for +V, centre is ground and the 3rd is –V. My PSU is +/-12V, the circuit should work fine on +/-15V without any changes, but untested!

The other holes suit a 10 Pin .100" connector……or just solder wires directly to the board.

| o	neuron output
i	neuron input
i	neuron input
gnd	ground
o+	diff-rect positive output
o-	diff-rect negative output
i-	diff-rect negative input
i-	diff-rect negative input
i+	diff-rect positive input
i+	diff-rect positive input

The pots on the PCB are labelled "offset" and "invert"

Possibly panels labels could be more descriptive. The **offset** pot does add an offset voltage to the input signals which determines *when* **the neuron will fire a pulse in response to the incoming signals**. The higher the offset voltage the duller the neuron, a low offset voltage means it will fire every time you look at it funny.
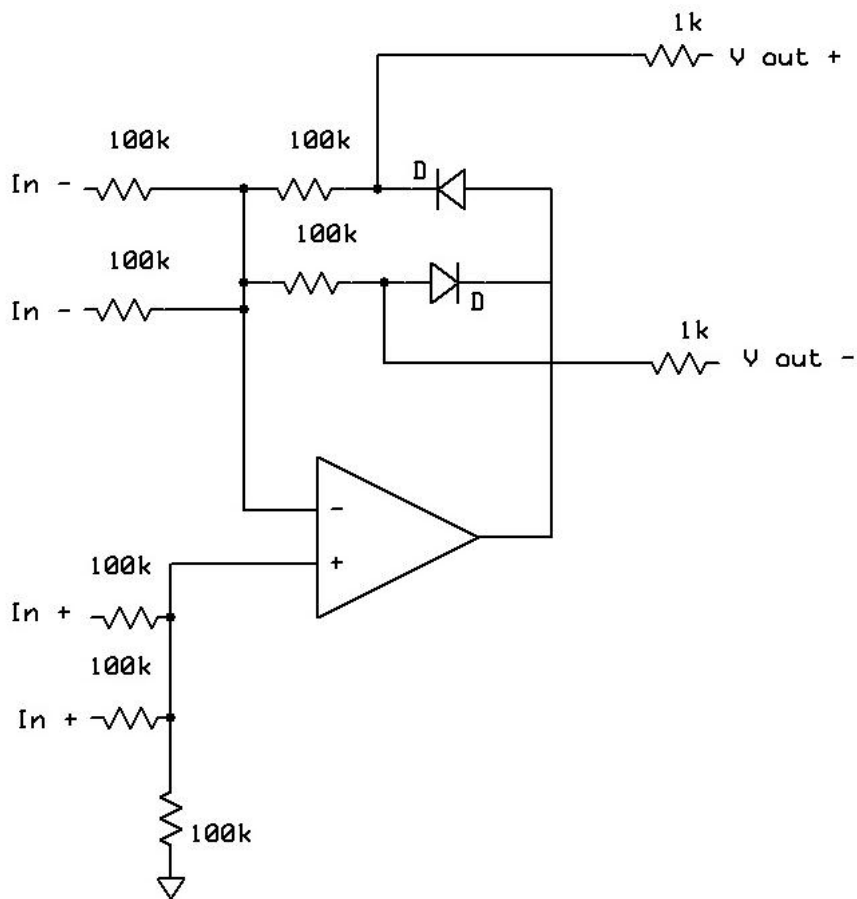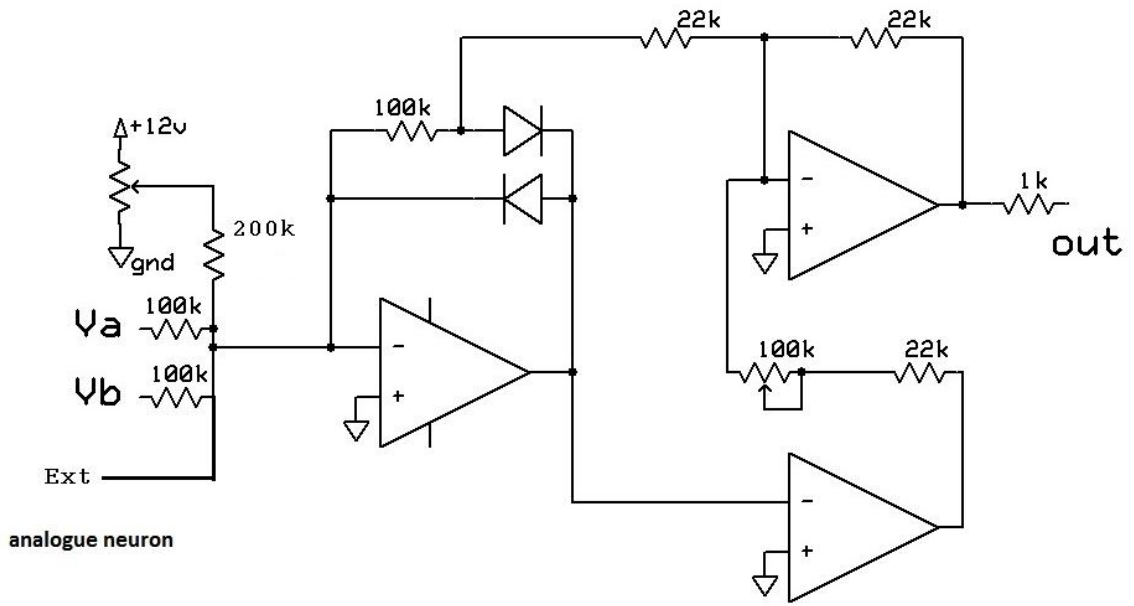
The **invert** pot actually sets **the scale of the neural response**; you could tune it from 'mildly interested' to 'I just crapped my pants'

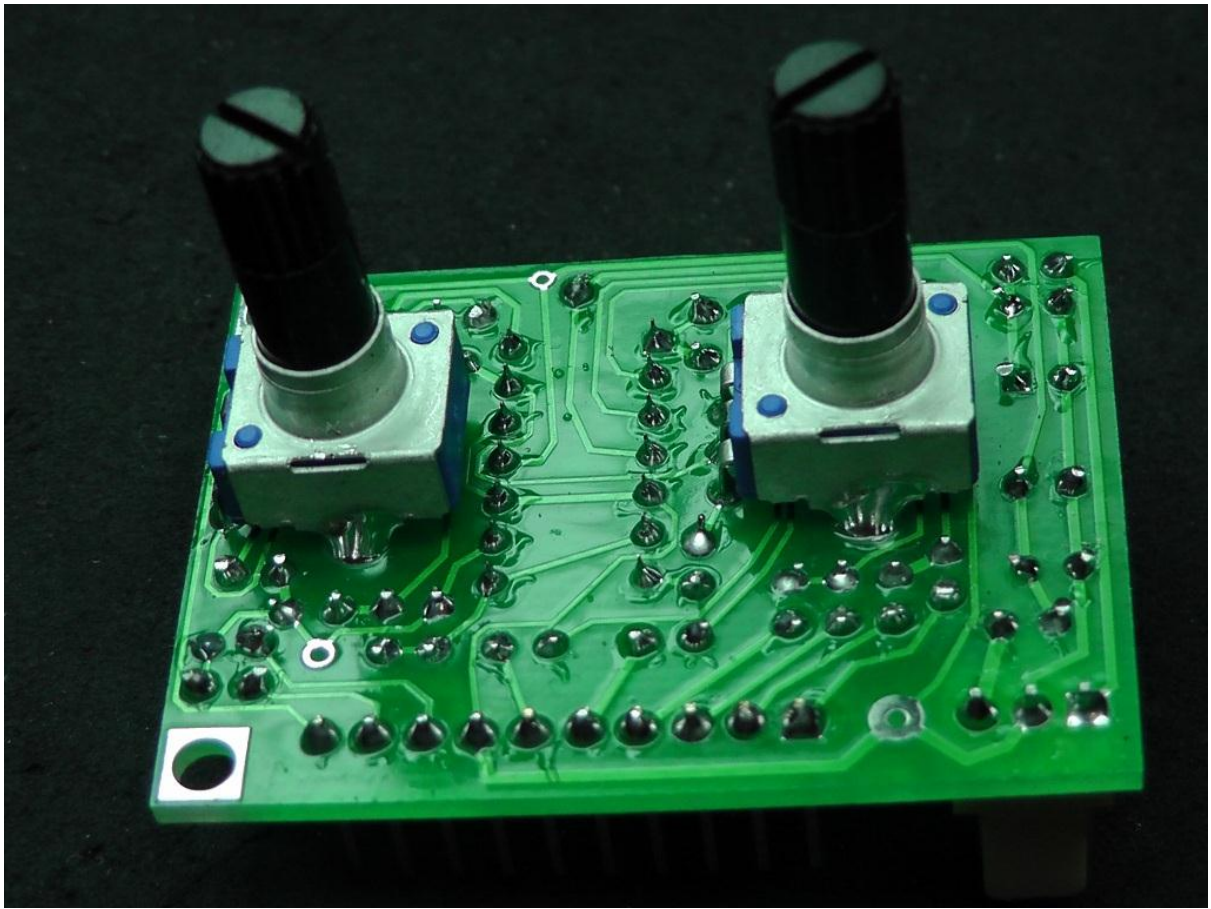The pots are just for the neuron. The diff-rect does not really need them unless you want attenuators everywhere.

Ext input: If you want to have a 3rd or more inputs for the neuron, these can be wired via 100k resistors to the **ext** input. ***Do not connect a socket directly to 'ext'; it must be via a 100k resistor***. If you have panel space, I strongly recommend including a 3rd neuron input. Trust me ☻
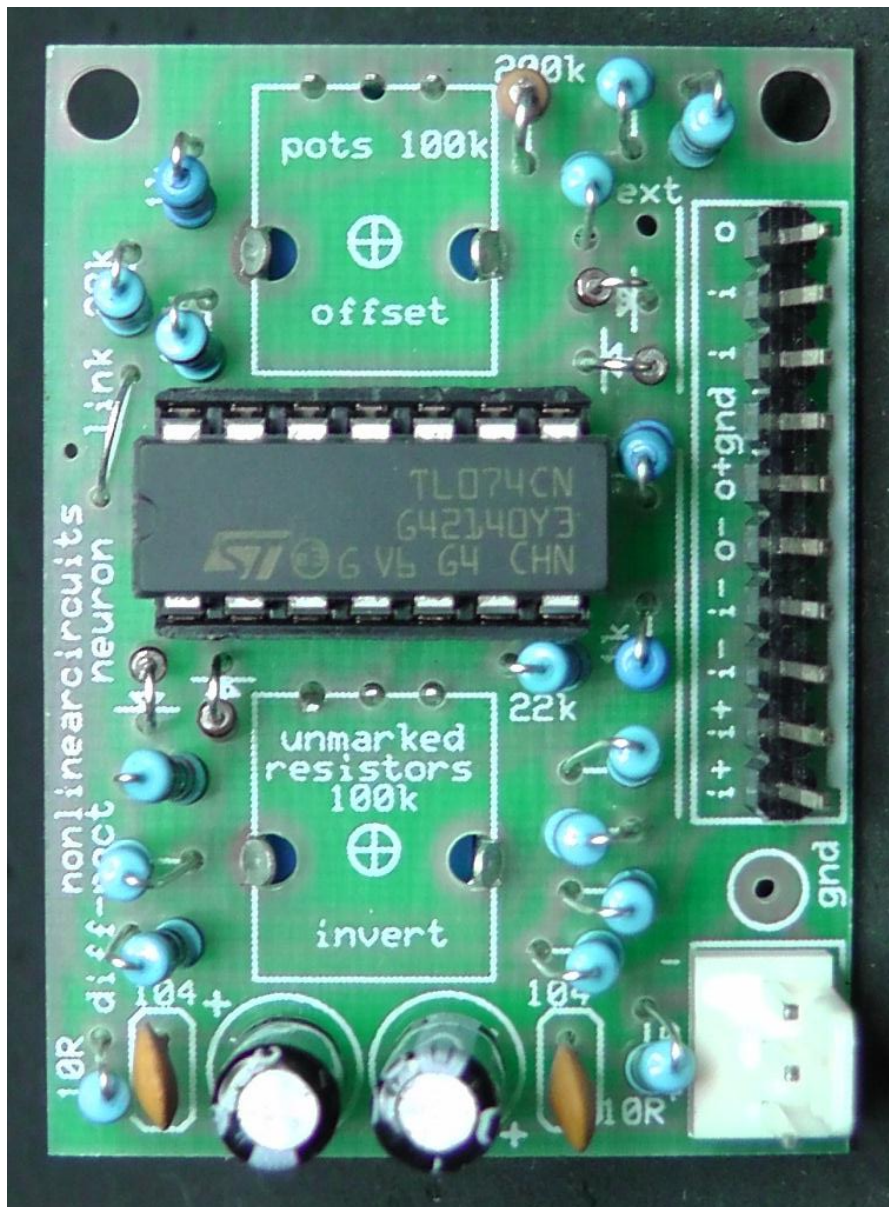

100k soldered to socket

100k   wire   ext
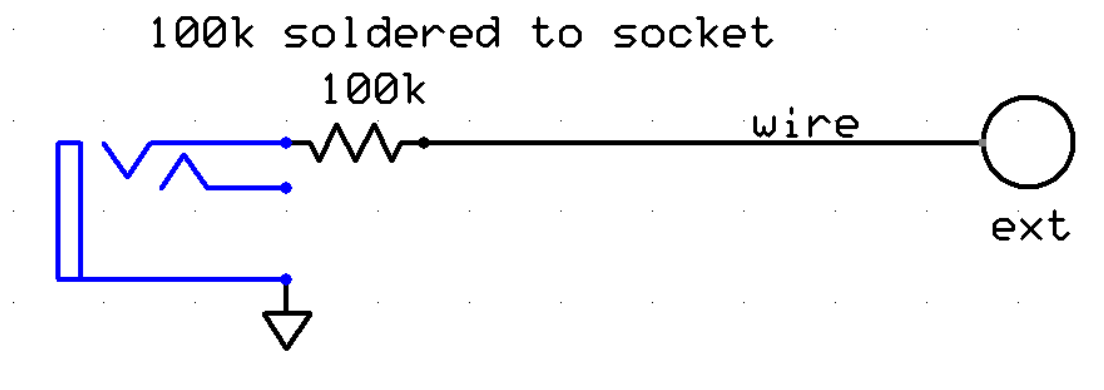
There is a spare GND hole next to the power connector, don't worry about it if you don't need it.

analogue neuron

Difference rectifier

pots 100k

⊕

offset

200k

ext

TL074CN

G42140Y3

⊗ G V6 G4 CHN

nonlinearcircuits · link 22k
diff-rect neuron

22k

4k

unmarked
resistors
100k

⊕

invert

o

i i i

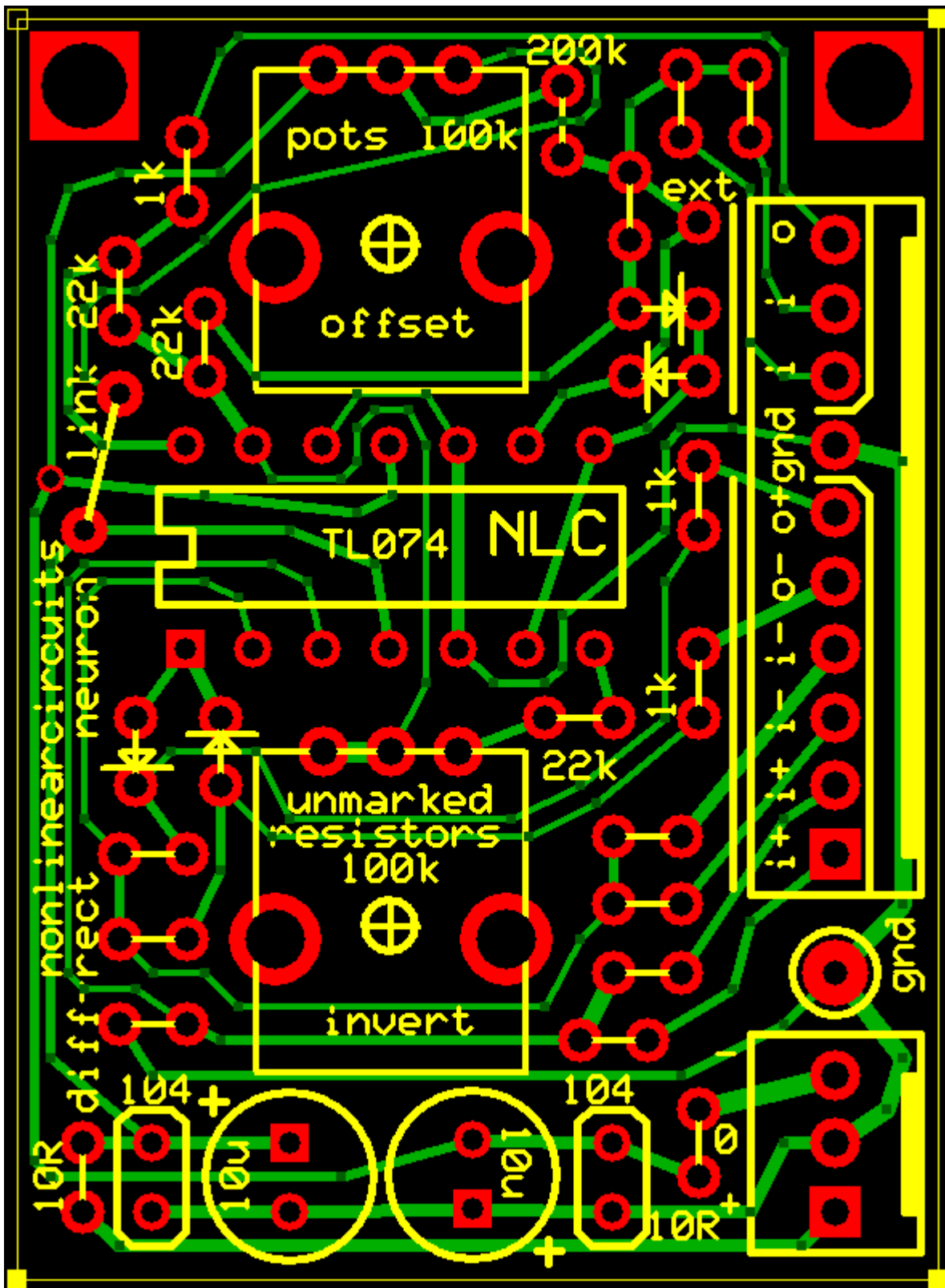- o +gnd

i + i - i - o +

gnd

10R 104

+   +

104

10R

gnd

Any errors or questions please let me know

Thanks, enjoy!

Andrew