Easy DIY Electric Guitar

Circuit Notes for Active Pickup options

Reference: www.mjbauer.biz/Guitar_maker_resources.html

Two options are presented here for connecting a humbucker pickup in an active (powered) circuit. The choice depends on whether the pickup has a 4-wire or single-wire cable. The 4-wire cable gives you access to both coils, so you can implement a "split coil" connection. This allows switching between normal humbucker operation or single coil operation for different sound characteristics.

Provision of a humbucker pickup, with or without an active circuit, is optional. Of course you can opt for a simple single-coil pickup if you are on a tight budget or if you prefer the sound.

The active pickup circuits include a treble-boost pre-amp and headphone amplifier module. If you prefer a traditional passive pickup arrangement, simply wire the output jack (tip) direct to the volume pot (wiper) and wire a 47nF poly-whatever capacitor from the pickup (hot end) to the tone pot (wiper). A switch is not needed.

In the case of a single-wire humbucker (or single coil) pickup, the toggle switch selects between treble boost and treble cut. Optionally, the switch can have a centre-off position where the tone control is open circuited and hence has no effect.

In the case of a humbucker with 4 wires, i.e. both coils accessible, you can substitute a 2-pole 4-position rotary switch, which provides a selection between dual-coil humbucker operation or single-coil operation. The four positions of switch S1 operate as follows:

1. Humbucker mode with treble boost
2. Humbucker mode with treble cut
3. Single-coil mode with treble cut
4. Single-coil mode with treble boost

Maximum treble boost is approx +20dB at 10kHz. This can be changed by using different values for the resistors on switch S1B in the split-coil arrangement. However, maximum boost or cut (depending on switch position) will occur with the pot in its fully anti-clockwise position.

The tone control fully anti-clockwise terminal is marked with the symbol '**o**'. Wired this way, the pot's logarithmic resistance 'taper' gives best gradation of tone over the full range.

Both circuits include a "low battery detector" comprising op-amp U1B and an ordinary yellow LED which functions as a low-current voltage reference. LEDs vary in their forward voltage characteristic of course, so the low-battery threshold voltage must be adjusted accordingly.

The value of resistor R_{TH} is selected as follows: Power up the circuit board with a 7.5V supply. If you don't have a 7.5V power supply, use a 9V battery with a pair of diodes (1N4148) in series with the positive terminal. Measure the voltage across the yellow LED. This is named "Vref" and it should be somewhere in the range 1.7 to 2.2 volts. The value of resistor R_{TH} is calculated using this formula, assuming the battery low-voltage threshold is 7.5V:

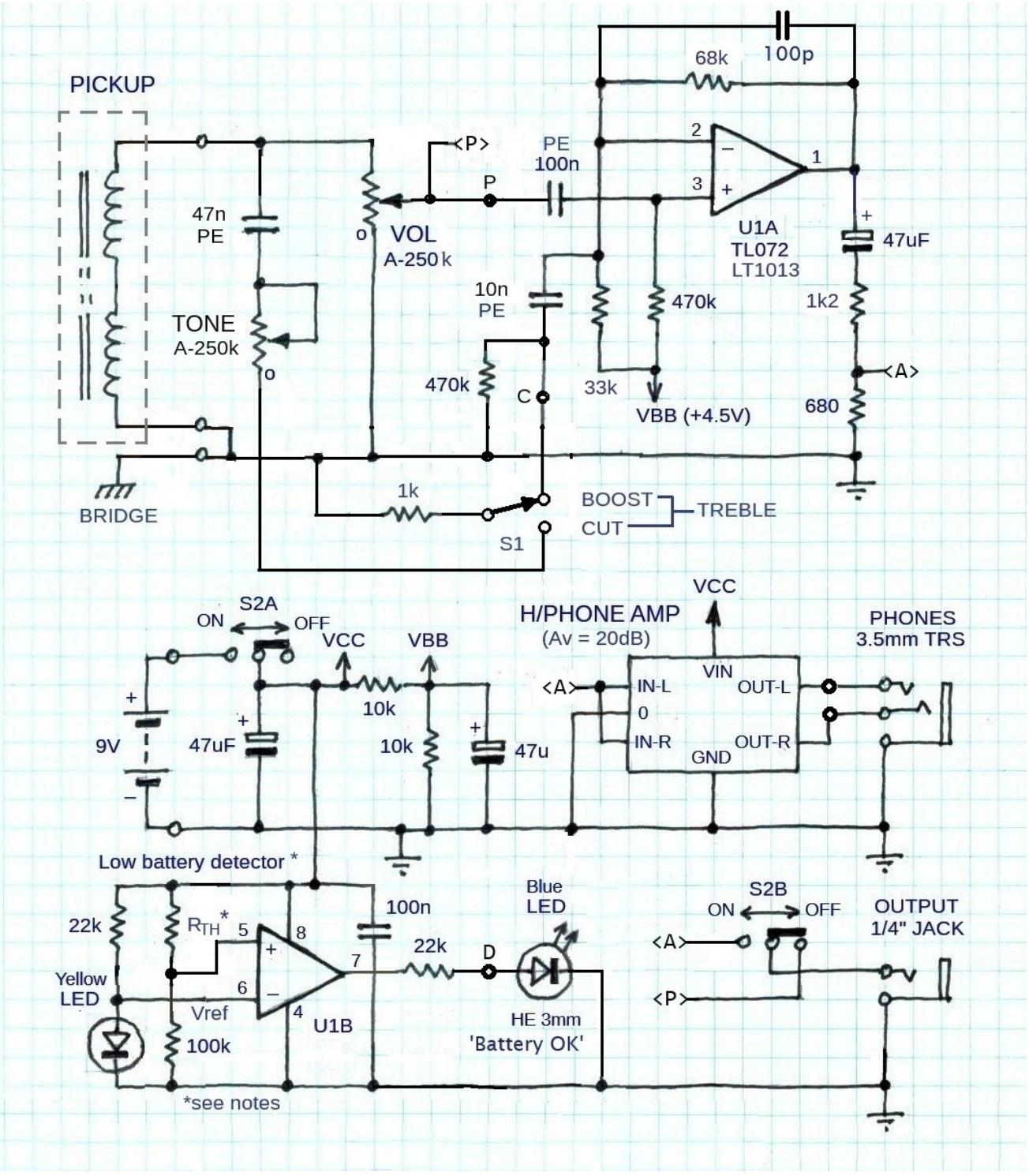
$$R_{TH} = (7.5 - Vref) \times 100 / Vref$$ (The result is in kilohms.)

Example: If Vref = 1.73 (measured), then $R_{TH} = (5.77 \times 100) / 1.73 = 333k\Omega$

Use the nearest available resistor value which in this example is 330kΩ. To increase the low-battery threshold voltage, use a higher resistance value for R_{TH}.

'Battery OK' status is indicated by a high-efficiency blue LED which glows quite bright with only 0.2mA of current flowing, thereby minimising battery consumption.

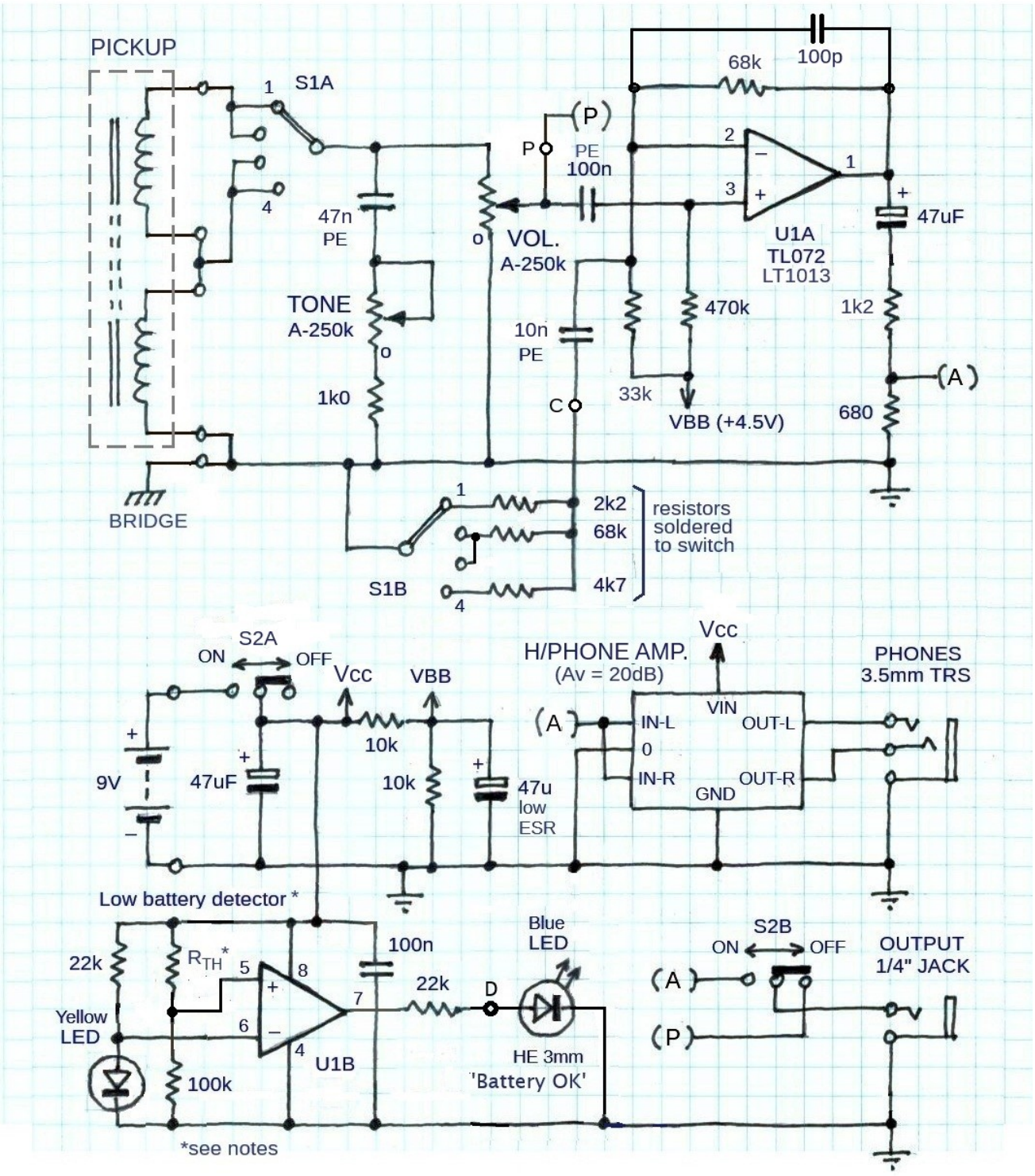
Here is the schematic for a "1-wire" humbucker (or single-coil) pickup:



Capacitors marked 'PE' are polyethylene, polypropylene or polycarbonate.

The dual op-amp IC (U1) preferably should be an LT1013, but it may be a TL072 which is more commonly available. The TL072 is not guaranteed to function properly much below 9V, but many commercial guitar effect units use the TL072 successfully with a 9V battery supply.

Here is the schematic for a 4-wire (split-coil) humbucker pickup:

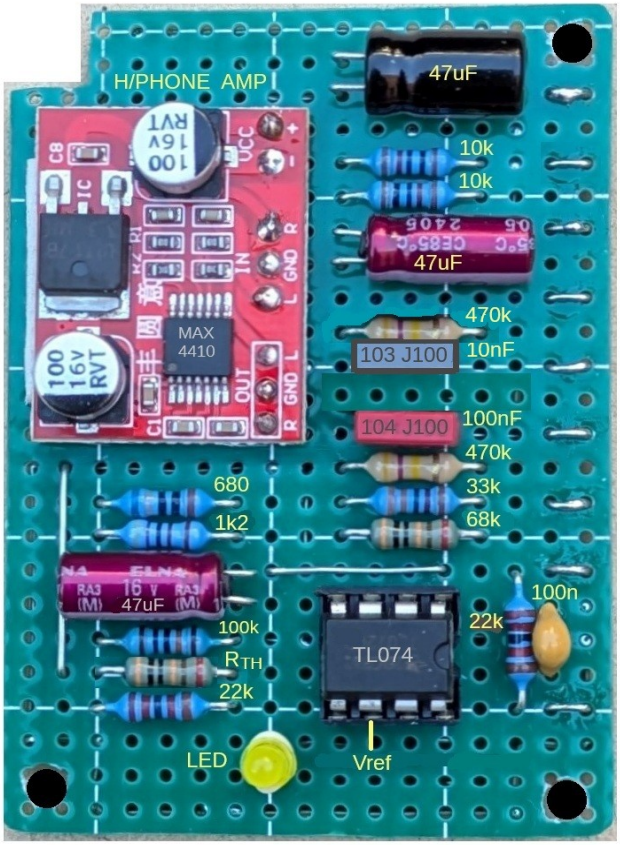


The headphone amplifier is a pre-built module available on AliExpress. The module I chose has a MAX4410 chip and a regulator IC allowing operation up to 12V. It has a gain of +20dB (x10).

Be sure to get a headphone amp module which operates with a 9V supply. Some only work up to 5V. It is also important that the GND terminal is common to input, output and Vcc supply.

The MAX4410 typically draws about 8mA of current from the Vcc supply. The remaining parts of the circuit draw only about 1.5mA total. If you choose to include a headphone amplifier, I suggest to use a rechargeable battery (NiMH) with 8 cells. These have a nominal voltage of 9.6V.

The circuit can be constructed on a piece of prototyping board (aka “perf-board”) as shown in the picture following. If there is sufficient expression of interest from prospective makers, I might do a PCB layout. Email inquiries to: michael@mjbauer.biz



GND

Vcc (+9V via S2A)

OUT-L
OUT-R
PHONES

C (S1)

P (VOL)—(S2B)

A (S2B)

D (LED)

GND

The circuit board sits on top of 3 plastic standoff posts (6mm diam x 14mm long) glued in the control box. The board is fixed in place with self-tapping screws.

The battery is held in place with a pad of adhesive foam tape stuck on top of the volume pot.

A plastic spacer (pad 2mm thick) prevents the internal rim of the lid from pinching the edge of battery when the lid is screwed on.

It’s a tight fit… there isn’t much room left for the battery. In hindsight, the circuit board could have been a few mm shorter lengthwise.