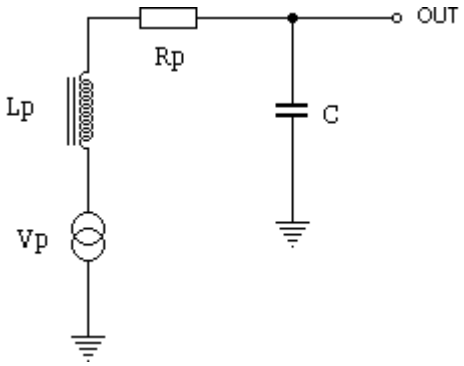
Pickup Simulation

Effects circuit will respond differently to an input from a low impedance signal source such as an op-amp output than when driven directly from a guitar pickup. This can be especially evident with certain types of simple transistor circuits. The classic fuzz face is a good example of a circuit that has a low impedance input which produces a significantly different sound when connected to a guitar pickup than when it is preceded by a buffer or another effects box.



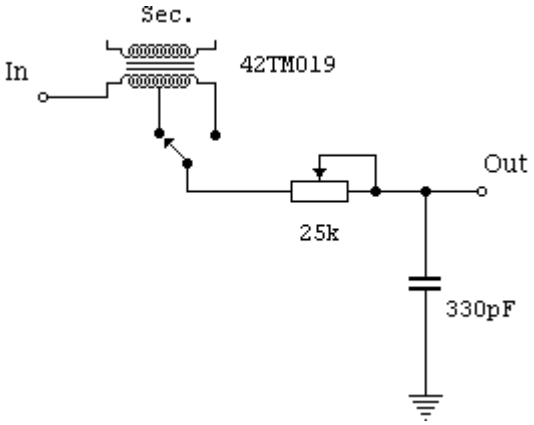
A guitar pickup is not a constant low impedance voltage source. It has a variety of components and the basic representation is illustrated here.

Vp is the voltage signal source of the pickup while Lp is the inductance of the coil and Rp is its the dc resistance. The C component is the capacitance of the tone control and the inherent capacitance of the cable that leads from the guitar to the effects box.

There is some small amount of capacitance in parallel with Lp and Rp, however, it is too small to produce much effect and can be ignored for our purposes.

To simulate the response of a guitar pickup, it is often recommended that some resistance should be added in series with the input of the effect. Typically 10k to 15k is equivalent to the resistance of a guitar pickup and while this does change the source impedance, its response is flat across the frequency range unlike that from the guitar.

The RLC network of the guitar pickup and the connecting cable produces a response that is flat in the lower end of the range but has a peak in the upper mids and rapidly falls off in response at the high end. A simple resistor does not duplicate this response and a more complex circuit may be devised to simulate the guitar pickup.



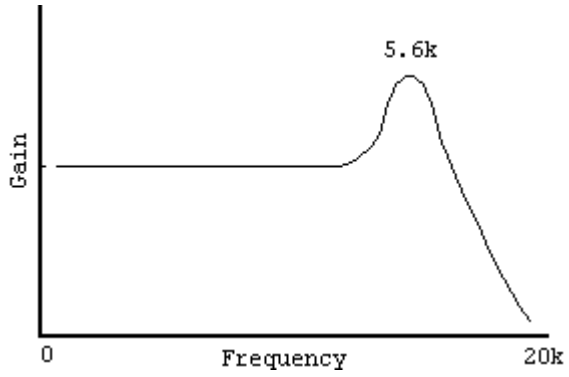
As shown here, an inductor, resistor and capacitor are configured to duplicate the inherent pickup components. The primary winding of a small transformer is used as the inductor. Mouser Electronics carries the

transformer under the part number 42TM019 and it is quite inexpensive.

The secondary of the transformer is not used and its windings are left unconnected. Since the dc resistance of the transformer coil is only about 600 ohms, resistance is added in series with the coil. The 330pF capacitor emulates the capacitance from the tone control and guitar cord. This circuit is inserted between the input jack of the effect and its pc board input.

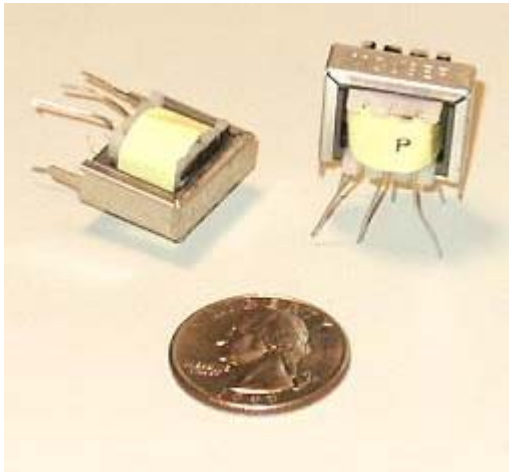
The primary of the transformer has a center tap which proves to be quite useful. When the switch is connected to the center tap, the inductance is equivalent to a single coil pickup. When the switch is toggled to place the full primary winding in the circuit, the inductance and response are similar to humbucking or other high output guitar pickups.

The series resistance has been made variable so that it may be adjusted to more closely duplicate different pickups. Setting it to the mid-point is a good starting position. Adjusting it for more resistance will reduce the peaking of the circuit.



The 330pF capacitor is suggested as an average value but it may be made slightly higher or lower for a different sound. Higher values will move the peak lower down the frequency range and lower capacitance values will move it up. The response of the RLC network shown produces a peak centered around 5600 Hz. and the signal response falls off rapidly after the peak. Other small signal transformers can be used instead of the one specified and if the inductance of the primary is different, the peak will be at a different frequency.

This circuit may be used to add a frequency response before any circuit that will benefit from an input that emulates a guitar pickup. It can add a bit of enhanced high frequency response in addition to converting the signal impedance. The transformer is a miniature device and its physical size is small enough not to present a problem in its placement in a typical stompbox. The Mouser 42TL019 is a smaller transformer with similar response.



This is a passive circuit that requires no batteries to operate and it may be mounted in a small enclosure with a dpdt switch for true bypass, and placed anywhere in the signal chain that proves advantageous.

For example, the output of a Tube Screamer is always buffered and its impedance and frequency response are quite different from that of the guitar pickups. The pickup simulator circuit could be added at the input of the device following your Tube Screamer to get a more realistic response.

Build this simple circuit and give a whole new sound to your Fuzzface or Wah!

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