Pickup Test Coil Assembly

Ken Willmott 2021-03

Description

This coil is used to induce a signal in a guitar pickup for the purposes of measuring the pickup frequency response characteristics. It is designed to be driven by a signal generator or audio interface headphone output, and placed in close proximity to the pickup face in order to induce a signal in the pickup by magnetic induction. The magnetic field that the coil produces emulates the time varying magnetic field that the guitar strings produce when they vibrate in front of the pickup.

This is the most common type of pickup test coil, where the test field encompasses the entire pickup. It is also possible to use smaller coils in order to measure a smaller area of the pickup assembly. Experiments have shown that, when used properly, it has minimal effect on the pickup's response due to its proximity to the pickup's electromagnetic circuits.

Guitar pickups work by magnetic induction of electrical currents in the pickup coil when a time varying magnetic field is applied (normally, from the strings). This means that every pickup follows, at least closely, Faraday's Law of Induction which results in the output signal increasing by 6dB/octave or 20dB/decade as the frequency increases. This is the natural mode of signal production in an electric guitar, and produces its characteristic sound.

However, this aggregate response is not ideal for analysis of the important pickup characteristics that derive from the electrical response of the pickup components alone. For this reason, an integrator circuit is normally also required to apply an inverse response of -6db/octave or -20dB/decade, to compensate for the increasing slope produced by magnetic induction. The V5.9 integrator device can be used for this purpose. Some testing can be performed using only a test coil, with the pickup connected to an audio test device through a resistor network.

To produce an accurate plot of output versus frequency, the magnetic field intensity must be constant regardless of frequency. The magnetic field intensity of a coil is proportional to applied current. Since the coil is an inductor electrically, a constant applied voltage would not produce a uniform current at different frequencies. So, it is necessary to incorporate some kind of current regulation in the coil, since the signal generator is generally a voltage source. A series resistance will work for this, if the reactive impedance of the coil is much smaller than its resistance at the highest test frequency used. It is helpful to keep the coil inductance value low in order to achieve this. Most signal generators and also headphone outputs already have an internal resistance that can provide this function if the coil inductance is low enough, thus it may be possible to connect a coil directly. However, I include a 100 ohm resistor in the circuit to ensure that there is an adequate margin regardless of what device is driving the coil.

Specifications

Parameter	Value	Units
Typical drive level	1	Vrms
Maximum drive level	5	Vrms
Coil inductance	100	uH
DC resistance	100	ohms

Materials

- Humbucker bobbin
- AWG# 30 magnet wire
- 1-7/8” Kapton tape
- 1/2” Kapton tape
- 36” AWG# 26 stranded insulated 2 conductor wire
- 100 ohm 1/2W axial lead resistor
- 3/4” heat shrink tubing

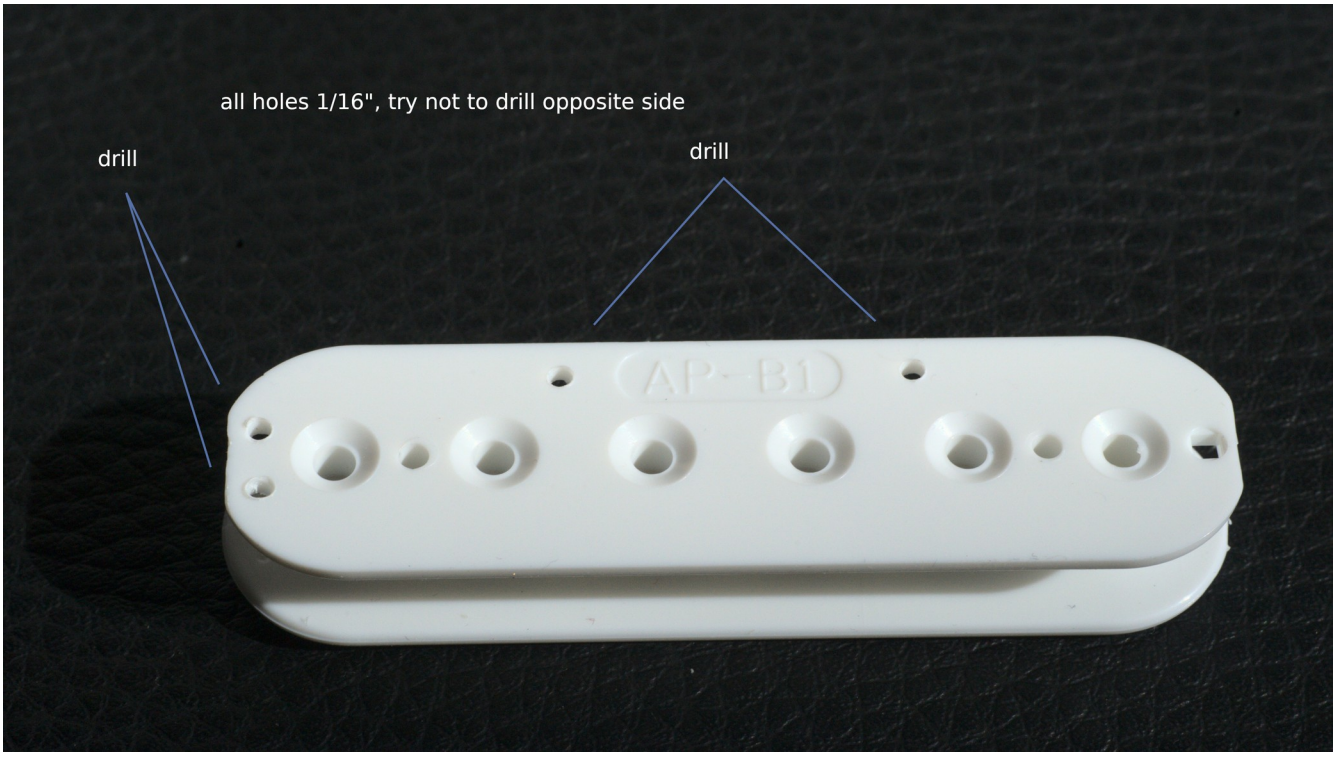
Tools

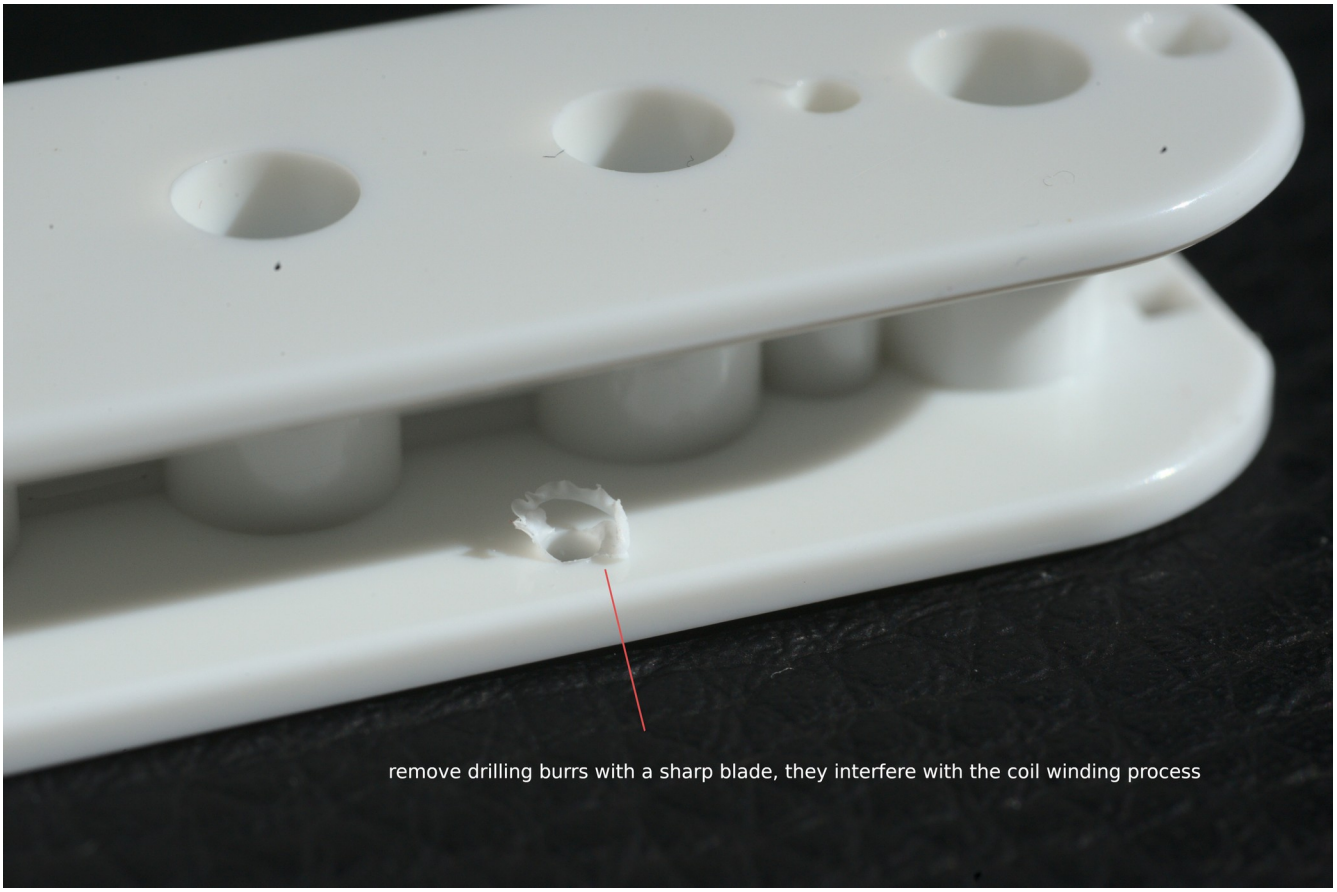
- Wire cutter
- Soldering iron
- 1/16” drill bit
- hand drill or drill press

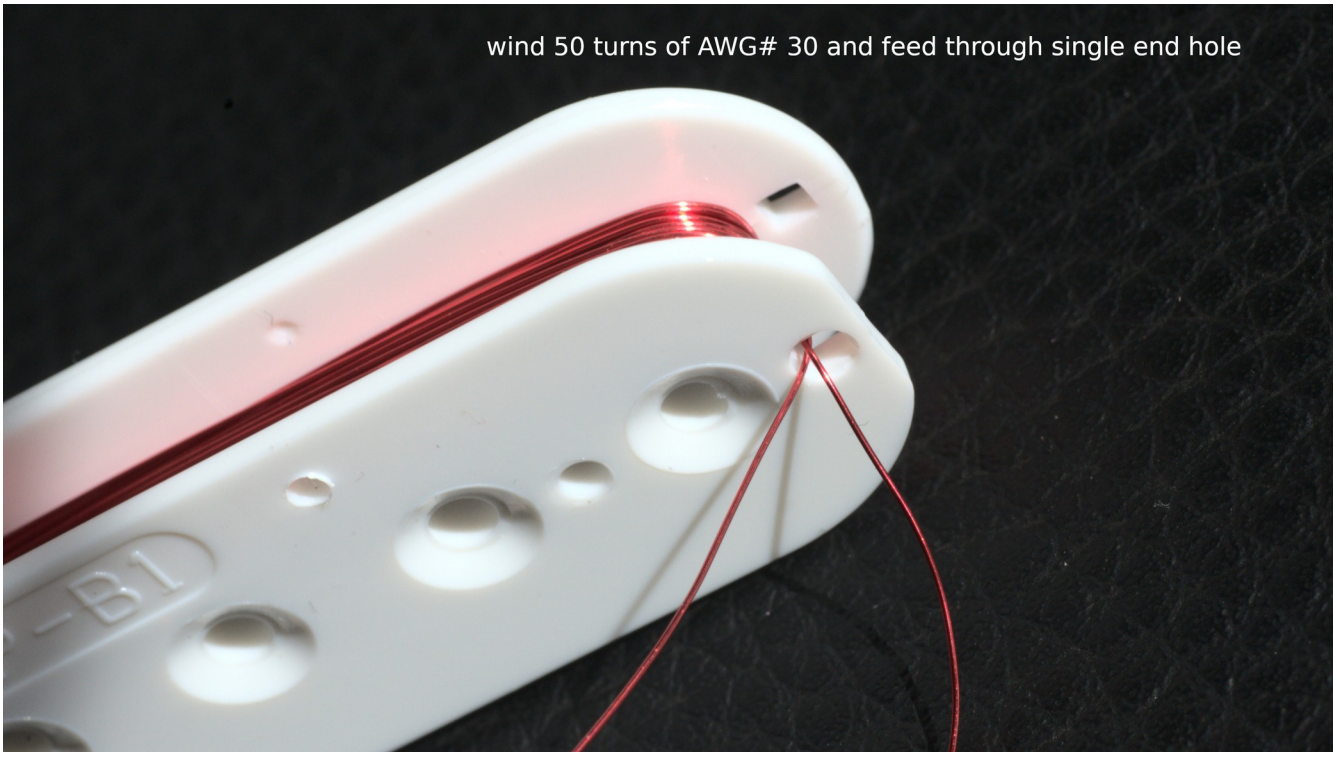
Procedure

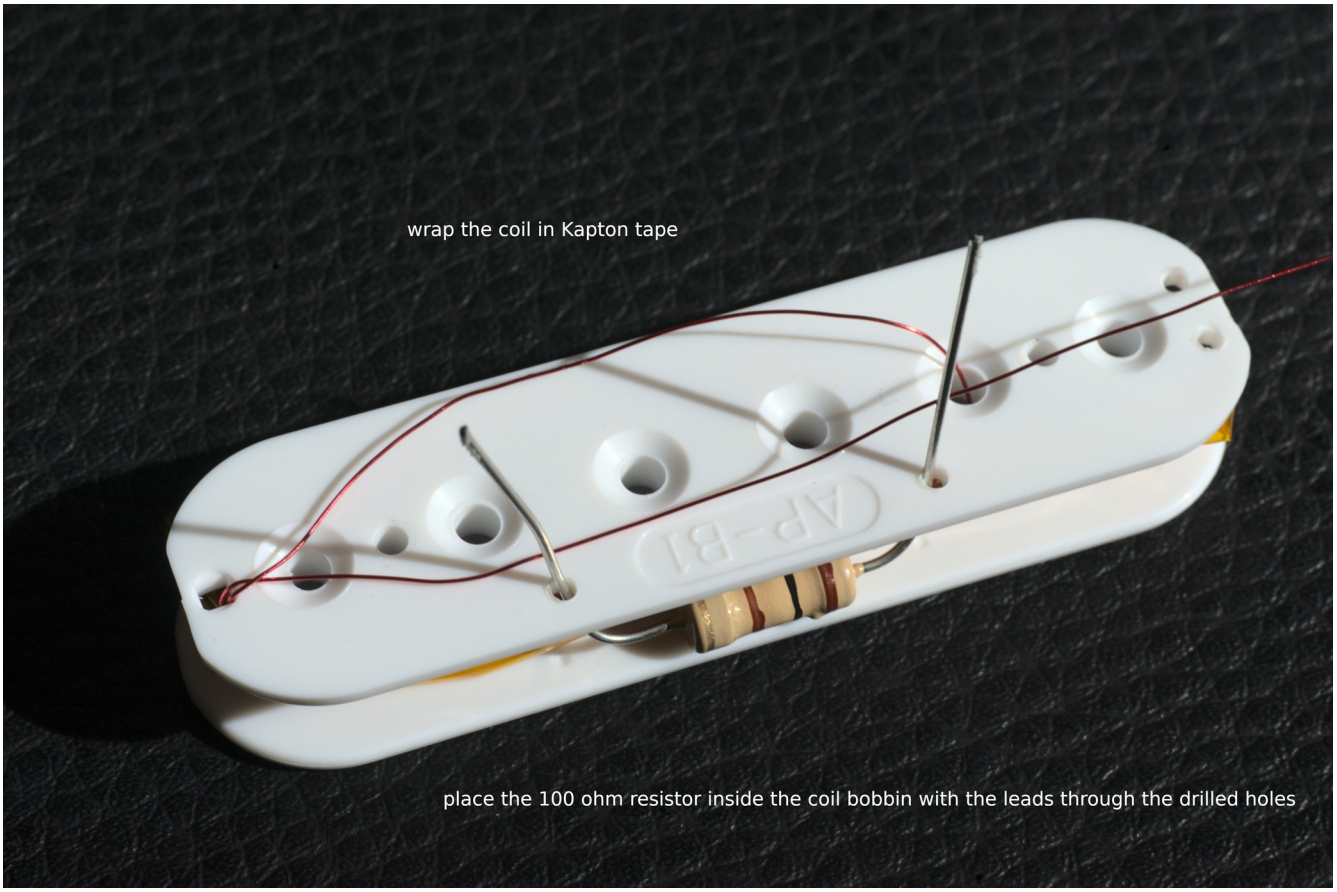
Follow the steps illustrated in the following images. The coil winding itself is not shown, but it consists of securing the bobbin to a handle or bench jig, and applying turns by hand. A motorized method could be used but the turns can be applied by hand in just a few minutes.

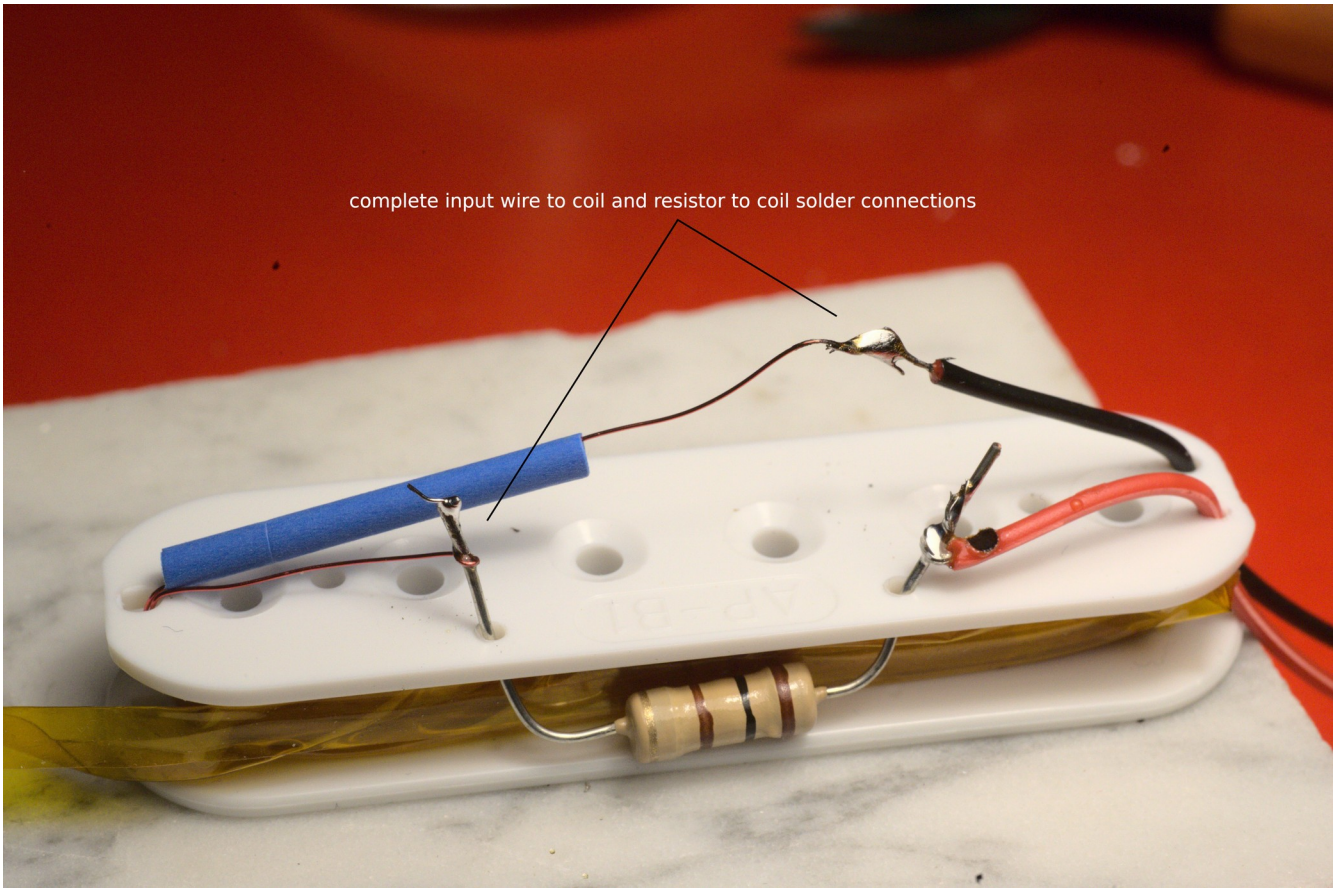
Pay attention to soldering technique, ensure that there are no shorts or cold solder joints. The side opposite to the side that carries the components, should be kept as flat as possible when the tape is wrapped around the bobbin. That is so it will remain in a fixed, stable position when it is used on the top of a single coil type pickup.

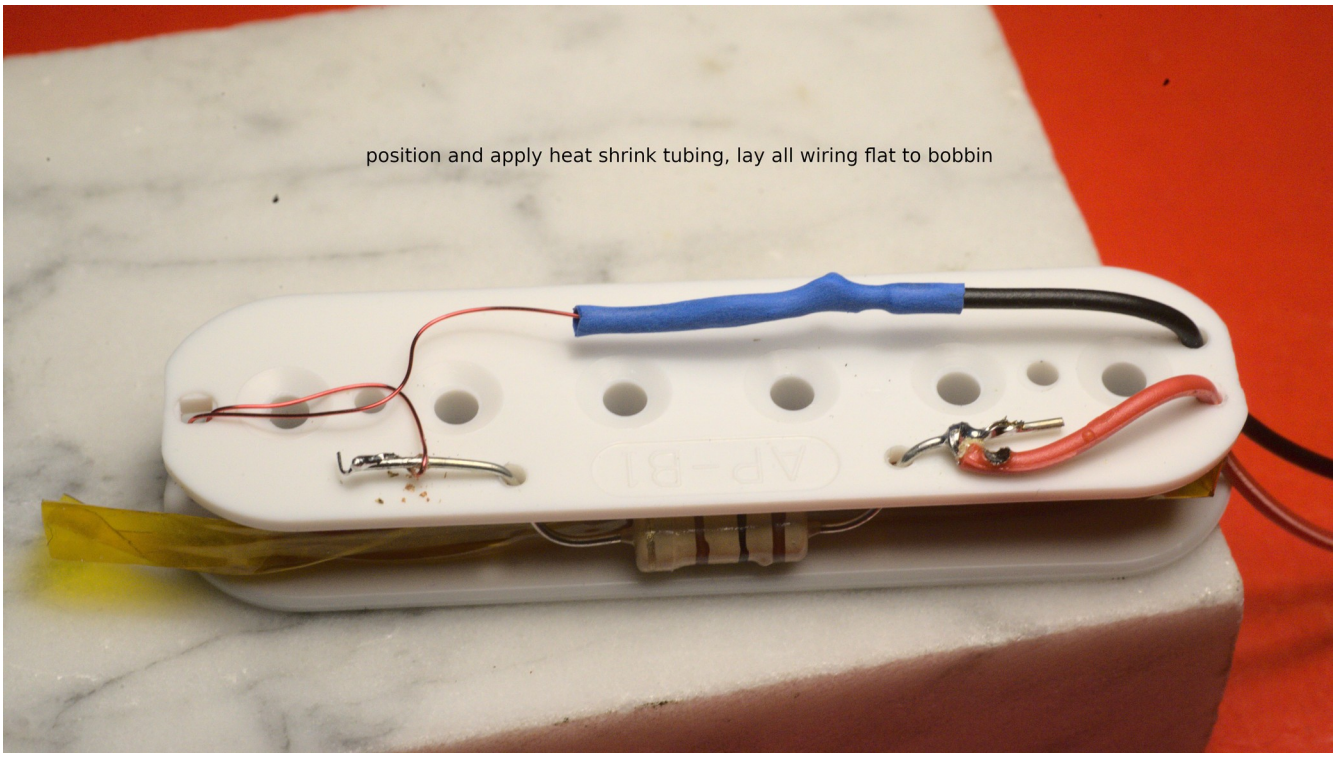

all holes 1/16", try not to drill opposite side
drill
drill
AP-B1


remove drilling burrs with a sharp blade, they interfere with the coil winding process

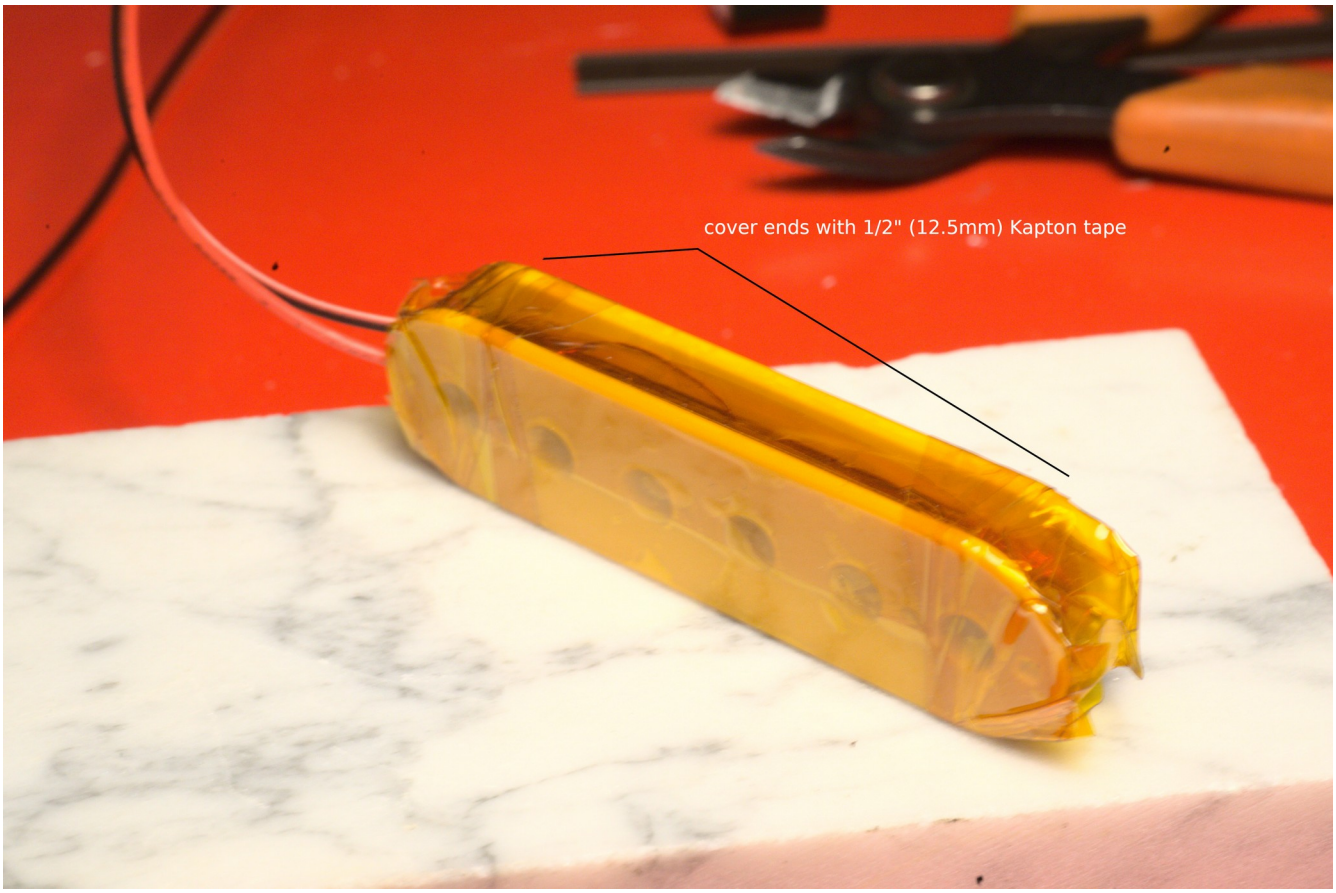

wind 50 turns of AWG# 30 and feed through single end hole


wrap the coil in Kapton tape
place the 100 ohm resistor inside the coil bobbin with the leads through the drilled holes


complete input wire to coil and resistor to coil solder connections


position and apply heat shrink tubing, lay all wiring flat to bobbin


apply 2 turns of 1-7/8" (47mm) Kapton tape


cover ends with 1/2" (12.5mm) Kapton tape

References

https://github.com/KenWillmott/integrator/wiki