Wire Spool Holders And Toroid Mounts Ease Prototyping Of Magnetic Parts

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Two of the practical considerations in magnetic component construction are how to hold a spool of wire so that wire can be easily dispensed from it when constructing prototype parts and how to mount small toroids on circuit boards. This article offers tips on how to make prototype magnetic component construction less cumbersome.

The article begins with a recipe for constructing simple wire spool holders that can be used on the bench to build transductors (i.e. transformers and coupled inductors). While this is a simple enough concept, if you've not gone through the exercise of building such fixtures before, you may spend some time searching for suitable, readily available materials and appropriate dimensions, which are conveniently provided here. Similarly, the discussion on mounting small toroids using DIP headers offers a low-cost, convenient mounting option with tips on making these headers work.

Wire Spool Holders

Spools of wire or solder are often conveniently held by a rod that allows the wire on the spool to be dispensed by pulling on it. Having a spool free to rotate and dispense solder can be an improvement on the workbench. Those who work with spools of magnet wire and manually wind prototype magnetics parts can benefit even more from a spool holder that allows the spool to rotate freely while winding turns onto cores. A spool holder can also be useful in pulling a given length of wire off a spool, especially if multiple strands of it will be twisted together with a drill.

Spool holders are rather simple: a rod supported by a U-channel structure that allows its removal. An example of a simple spool holder made out of a styrofoam corner from packing material is shown in Fig. 1.

Fig. 1. Quick and easy spool holder, cut from the corner of styrofoam packaging with ½-inch PVC pipe section.

The rod is a section of 0.5-inch CPVC plumbing pipe, which conveniently fits magnet-wire spools and also solder spools, is ordinarily used for plumbing hot water and available in longer lengths at plumbing supply stores. Most merchants will cut a shorter length for you than the standard 20-foot sections. Alternatively, buy a PVC pipe cutter. These scissors-like tools are low-cost and make a clean, easy cut without the plastic shreds that a hacksaw creates, requiring sandpaper or emery cloth to finish. With a cutter, a standard 20-foot pipe section can be reduced to two ten-foot or four five-foot sections for transport in a car or truck.

For more durability, the drawing in Fig. 2 is the building plan for a wooden holder. This holder also uses the same half-inch CPVC pipe. Its width is sufficient to hold two standard-sized magnet-wire spools. The width of

the holder can be varied arbitrarily but is kept to a minimum for holding two spools of magnet wire with some margin between them and the spool-holder ends. The given width is a tradeoff between bench space utilization and the number of spools available. Many transductors (i.e. transformers or coupled inductors) can be wound from two sizes of wire and no change in spools is required for a winding session. By keeping the holder small, it is more easily oriented on a bench to facilitate winding.

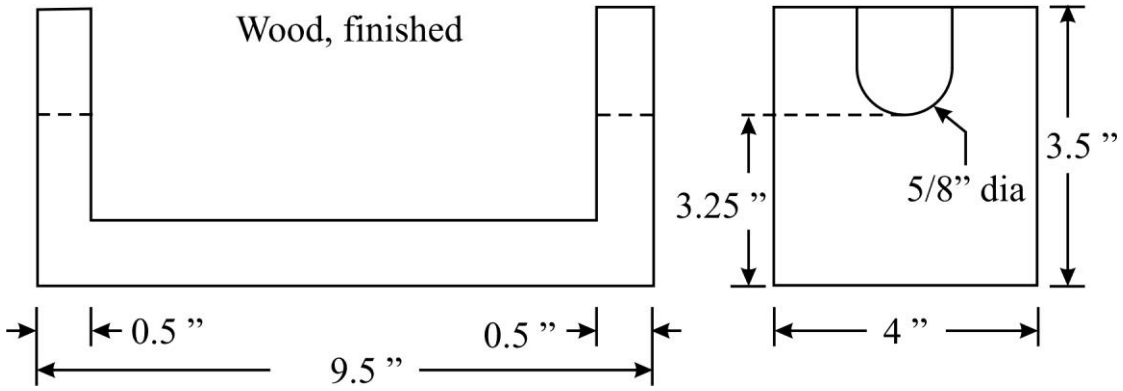
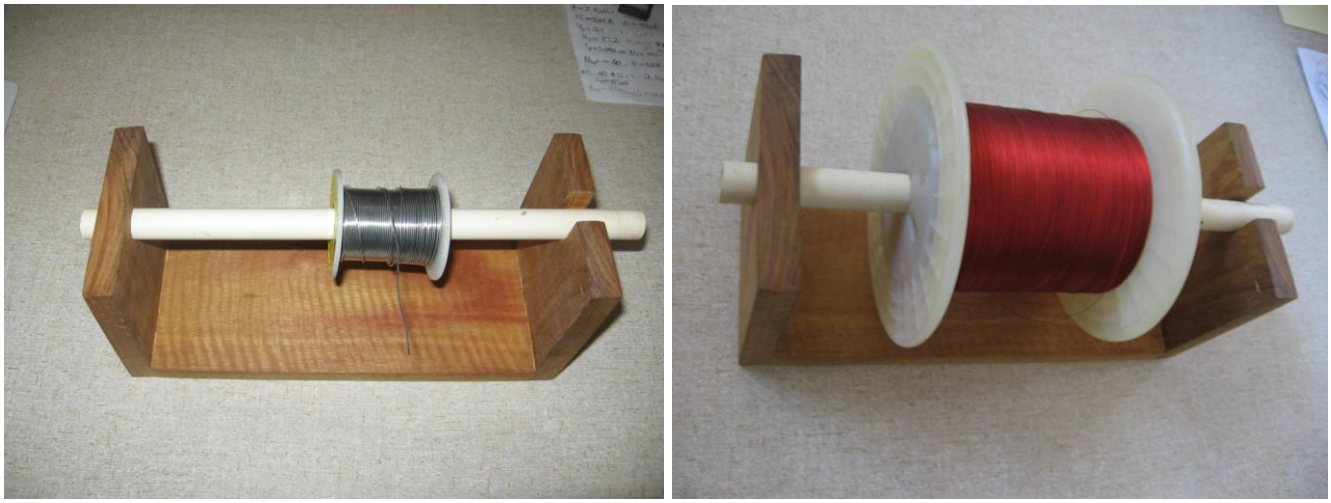


Fig. 2. Drawing for constructing a wooden spool holder.

Using the dimensions provided in Fig. 2, a wood craftsman built the holder in Fig. 3, which is pictured first with a solder spool (a) and then a magnet-wire spool (b).



(a) *(b)*

Fig. 3. Wooden spool holders, built per Fig. 2, holding a solder spool (a) and a standard-size spool of magnet wire (b).

Make sure that the hole on the left side of the holder is large enough to allow the pipe section to be easily removed by pulling the pipe to the right and lifting out of the U-channel. CPVC pipe is strong enough to easily hold full spools and also carry those spools. An alternative design would replace the hole in the left vertical section with a removable slot like that in the right section. This too is a workable scheme, though having the hole keeps the pipe from vertical motion while pulling wire from the spools.

It is slightly less convenient to have to pull the spools and pipe rightward to remove them, but this is a minor penalty for the advantage of eliminating upward bounce while winding. Heavy spools will not be inclined to lift up with a dual-slot holder, though smaller spools or those running low on wire can annoy if they bounce upward while rotating.

An alternative construction is to take one piece of 1/4-in. steel bar used for reinforcing concrete (called “rebar”) and use a steel pipe or large wrench to bend it into a holder with the above dimensions. It would be comparable in weight and sturdiness, though conductive. The wood holder, however, is a more precise fit for the rod and no more expensive to build than a rebar holder.

Toroid Mounts

Toroidal magnetic cores for magnetic components have some advantages over other core shapes: a more contained field that causes less circuit noise, lower thermal resistance, lower cost, and large window area per volume. Some Micrometals toroid iron-powder cores (see reference 1) are shown stacked below in Fig. 4. The disadvantages are the difficulty of winding them and also of mounting them, especially when many windings are involved. Whole catalogs of toroid mounts offer many possibilities, such as the Lodestone Pacific Issue G catalog (see reference 2). Yet like transductors themselves, so many possibilities for toroid mounting exist that they are essentially custom items.

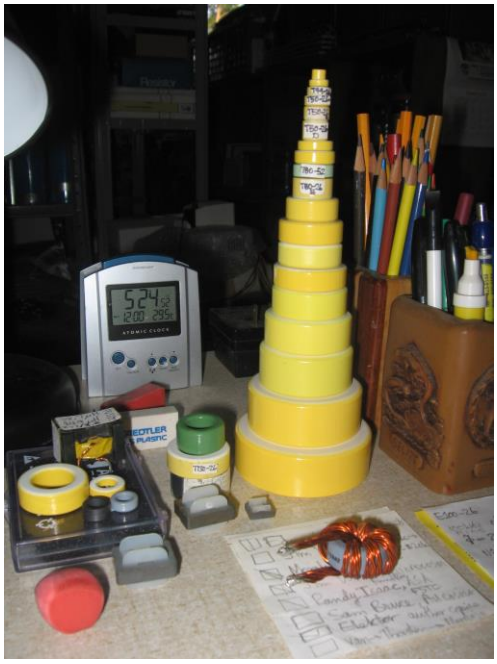


Fig. 4. Samples of (mostly) powdered-iron toroid cores. How can they be mounted on a circuit-board?

What works well in some cases is to use DIP headers for smaller toroids. Shown in Fig. 5 are examples of the use of DIP4 and DIP8 headers as toroid mounts for T37 (DIP4) and T50B (DIP8) toroids. Some windings on the T50B core are terminated underneath the header block on the insertable side of the pin. If the wire size is small, this avoids insertion problems, even when inserted into a DIP socket.

Use of sockets in other than prototype units is not recommended, especially for the parts shown, because their weight will cause them to be displaced from the socket with handling and shipping. By soldering them directly into the board, the header and part is solidly mounted and capable of passing moderate (not necessarily automotive) shake and vibration tests

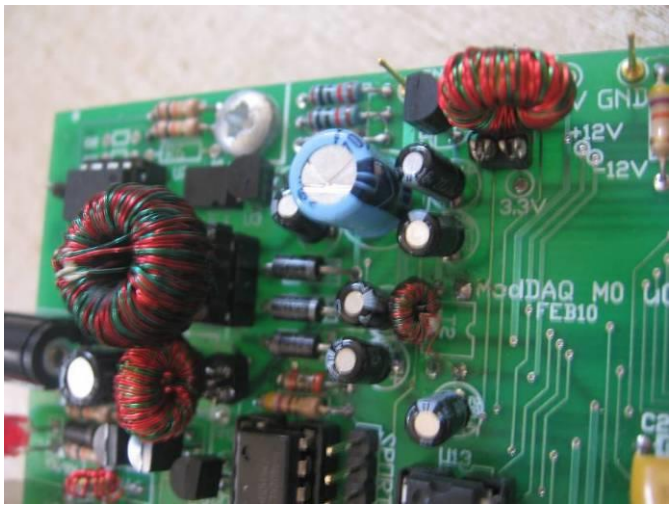


Fig. 5. Examples of toroid magnetic parts mounted to DIP headers for insertion into DIP sockets on the board.

Because DIP headers are used in industry in higher volume than any particular semi-custom toroid mount, they are also lower in cost. This fact motivates a search through parts catalogs (such as those of Digi-Key and Mouser) for all kinds of high-volume interconnection technology that can be adapted as toroid mounts.

A general solution is to simply use single-row, 0.1-in. pitch, square-pin headers, as shown in Fig. 6c. The winding leads are attached to the correct pins on the top side of the headers and the bottom side is inserted into the row of holes of the circuit-board. Unless the winding wire is of small gage (perhaps smaller than 37 AWG), the looseness of the header rows from the core should not break winding wires if handled carefully.

In magnetics production, a simple jig (such as a sheet of high-temperature foam) can hold DIP headers in place while the wound toroid is attached to them. The assembled unit can then be held rigid by placing the headers in a foam sheet carrier while wrapping the unit in a plastic bag or a box with securing baffles. At the other end, the board assembler removes the units by hand, solders them into the boards one at a time, and hot-glues the cores to the board.

Another solution to the toroid mounting problem is to use no mount other than the assembled circuit-board itself. It saves the cost of a customized mounting platform at the expense of slight additional care in handling.

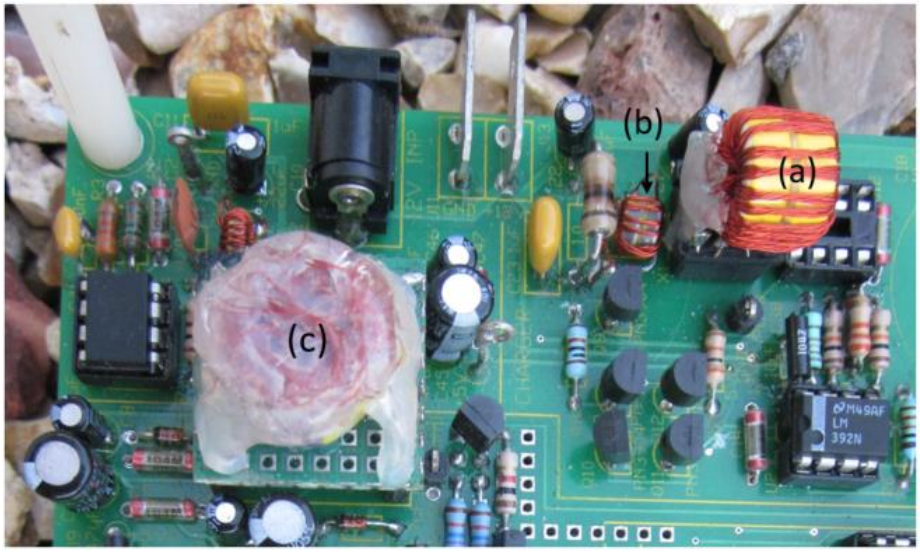


Fig. 6. Three toroid board mounts: upper-right, two stacked T44-26 cores on an 8-pin header (a); left of (a), stacked T26-26 cores with inductor leads soldered directly into board (b); lower-left, coupled inductor with leads soldered directly to a protoboard (c) with 0.1 inch pins descending into 0.1-in. single in-line (SIL) sockets beneath.

In closing, various methods for simplifying prototype magnetic component construction can make prototype builds less troublesome. Simple spool wire dispensers and toroid board mounts are two of them.

References

1. Micrometals website.
2. Lodestone Pacific website.

About The Author

Dennis Feucht has been involved in power electronics for 30 years, designing motor-drives and power converters. He has an instrument background from Tektronix, where he designed test and measurement equipment and did research in Tek Labs. He has lately been working on projects in theoretical magnetics and power converter research.

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