

Electromagnet Fabrication, Version 3.

This uses - Wire coathangers. Mine have a wire diameter of 1.8mm, but you may need to improvise with different thread size for the electromagnets and brass busbar if this is unavailable..

High quality M2 Die and miniature die wrench. Because the wire is fairly flexible, use a sharp die, otherwise the wire is going to snap inside it as you tap the threads. The 1.8mm wire diameter, instead of 2mm for an M2 thread, is also going to help.

Electric drill - Is better the less wobble in the chuck you have.

Parrot cutters

Fine toothed file.

Roll of 0.1mm diameter copper wire.

<https://au.rs-online.com/web/p/copper-wire/3377088?gb=s>

0.15mm or larger copper wire for flying leads. Maybe larger, it is still easy to snap at the connector. The colourful stuff is handy if you want to colour code the rows.

<https://au.element14.com/multicomp-pro/rrp-a-105/wire-0-15mm-assorted-pk-4/dp/5017233>

3d printed "Electromagnet ends", found in STL files, 2 per electromagnet. You can colour code these by row if you like.

PCB pin socket connectors - I use these

<https://www.jaycar.com.au/pc-pin-sockets-to-suit-pcb-pins-pack-of-25/p/HP1260>

6-10mm clear heatshrink

3mm heatshrink.

Multimeter

Calipers

This process can take around 15-25 minutes per electromagnet. Which is annoying! Feel free to improve this process, maybe with a winding machine, as long as it can do nice tight windings. We are winding to the diameter, not a particular number of turns. We want the dimensions to be as accurate as possible, especially in the length or the screw thread.



Cutting up the coathangers, with parrot cutters. The finished electromagnets are going to be 25mm long, but give extra at this stage so that we

can put one end in a vice. We need the shaft to remain smooth so we don't damage the windings.



If the coathangers are plastic coated, this is beneficial to protect them a bit more. Strip 15mm or so from the end we are going to shape and thread.



With the wire in the drill chuck, not too tight, round the tip.



Holding the sacrificial end in the vice, cut a 7mm M2 thread.

<https://www.youtube.com/watch?v=DcXDc3cf7jc> is a good tutorial, ours should be a lot easier to cut and shouldn't require force. If you are forcing it, the wire is going to twist and snap inside the tool. Use a cutting lubricant if you like.



It is easier to cut and measure the 7mm exactly with the wire still in the tool, if the width of the cutter and tool is taken into account. My tool gives a measurement of 1.8mm like this, in order to measure exactly 7mm. Consistency is key! 0.1mm is a good tolerance to try and achieve between components.



Final trim of the end that was held in the vise, for a 25mm total length.



Using some solder, the insulation is burned off the initial tip of wire. Don't breath the fumes! This tip is then soldered to the body, just above the thread. It needs a hot iron, especially with lead free solder, I use 360 to 400C. We are going to lay down a little bead of solder first - that area might need to be

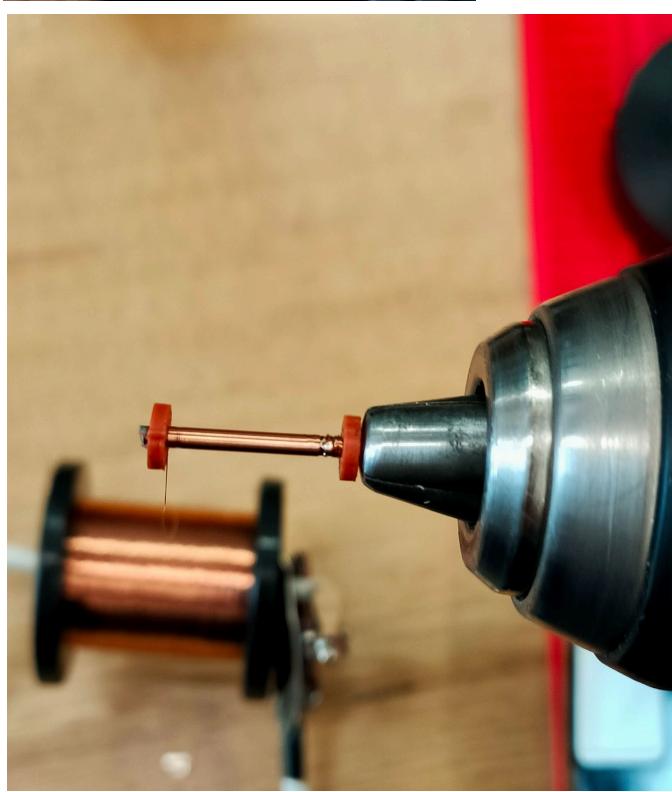
polished, and have solder and the soldering iron rubbed back and forth a few times until it begins to stick. Once there is a nice little bead, the wire can be soldered into it. Direction Is important! We are going to be winding clockwise, and the wire direction needs to match so we aren't bending back over.



Once cooled, first guide goes on, with exactly 5mm of thread protruding.



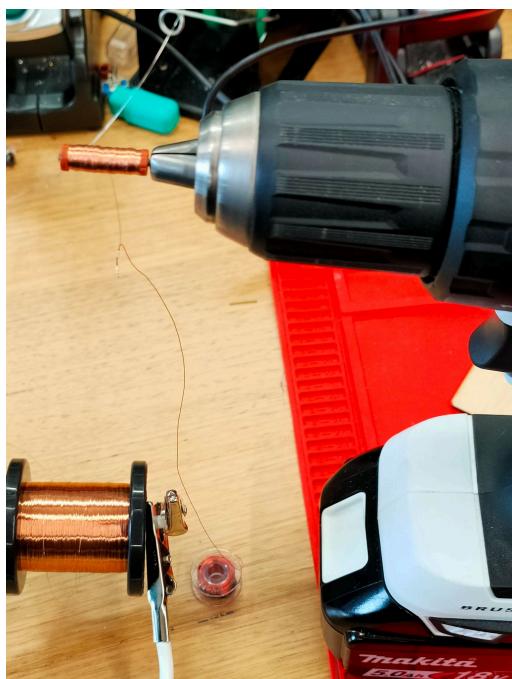
Other end pushes on, with the two holes facing out. These holes match the U shaped driver bit found in precision screwdriver kits. Leave a little bit of metal protruding, and then crimp and squash this slightly in order to stop the guide from sliding off once we start winding.



The threaded end goes firmly but lightly in the drill chuck. Going clockwise, try and do tight windings all the down and back. There will come a point where the tight winding fails, and you can just go all out.

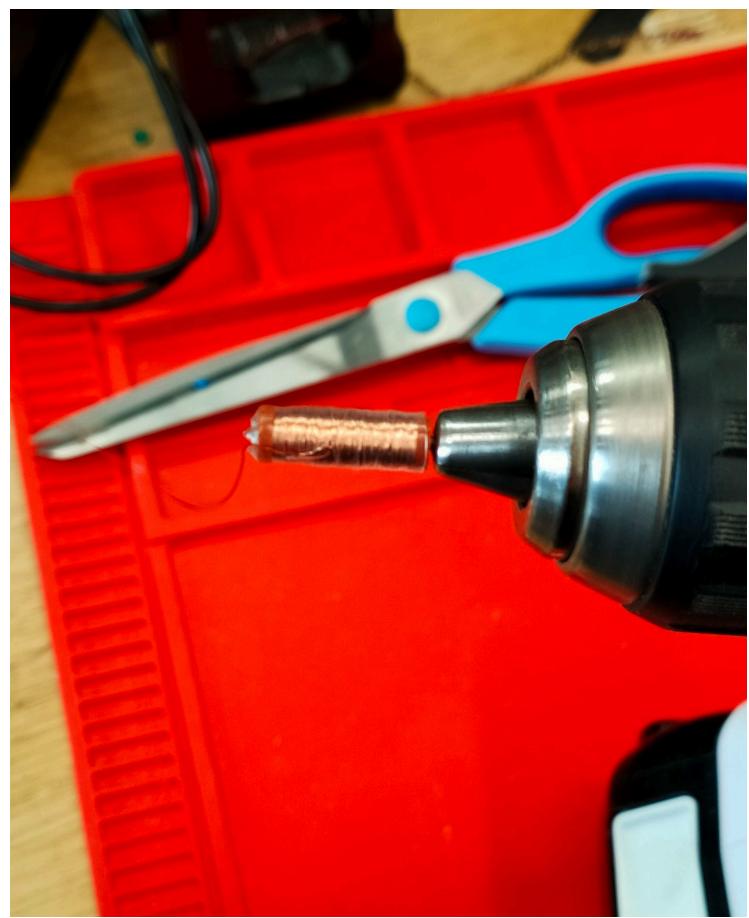


Wind evenly and consistently until a little under the guide diameter.



The larger wire spliced in for flyleads.

Heatshrink is applied over full length, with about 40-50 mm of flylead protruding out the back. Try to get the heatshrink to wrap over the end guide, without impeding on the driver holes, but be flush or halfway over the guide on the threaded end.



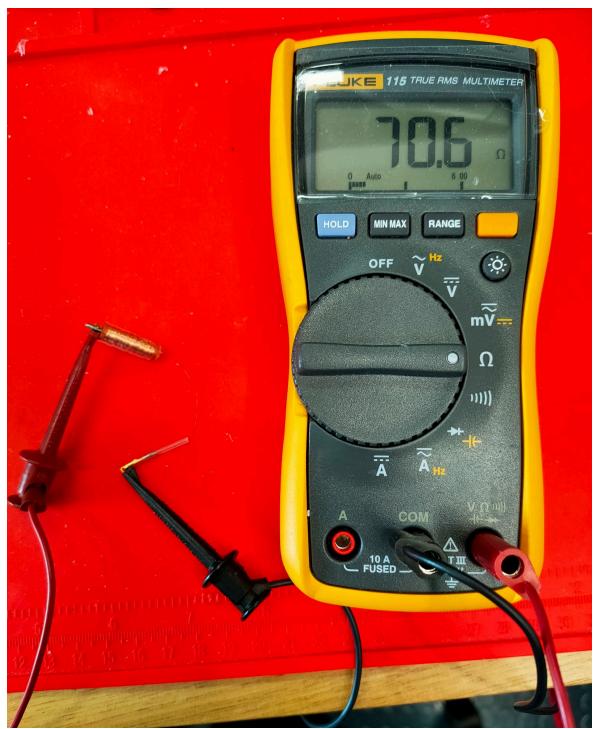


Remove the insulation from the tip of the wire with solder again.

Connector is crimped. If you have this special molex style crimping tool, that is good, otherwise if just using pliers, solder the wire and the crimped connection.



Heatshrink applied



Final result should measure around 70 ohms.  
+/- 5 Ohms shouldn't matter too much, the distance between the tip and the pot magnet will be much more important to keep consistent.