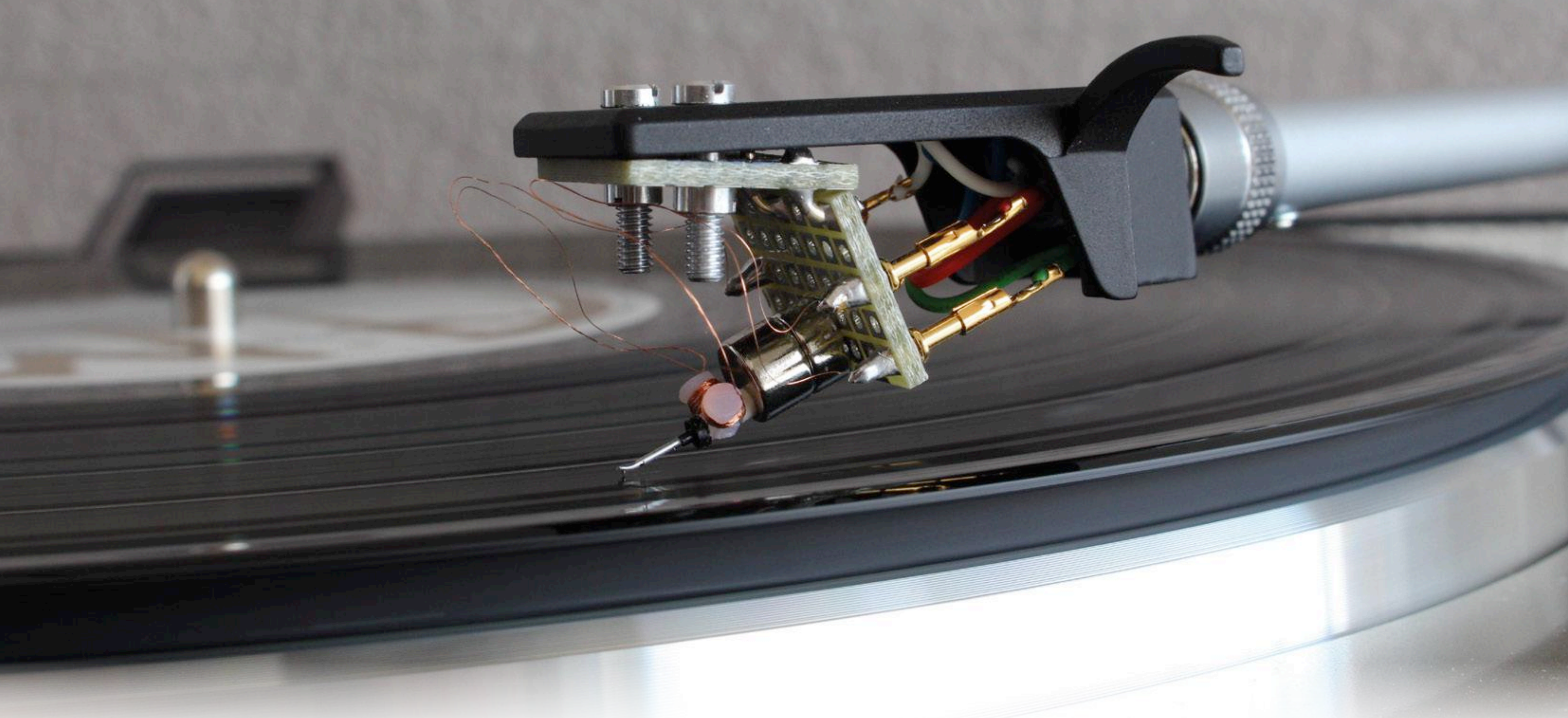
HOMELAB PROJECT

DIY MC Element

Impossible? Of course not!



By **Julia Anina Dietrich** (Switzerland)

As the topic of her physics final exam essay, student Julia A. Dietrich examined whether it is possible to construct an MC pick-up element yourself. It turns out that with some skill and patience and even without any special tools this is quite possible.

The vinyl disc is entirely back in vogue after having disappeared — come to think of it, actually it was never completely gone! Despite a number of irrefutable advantages of the CD (such as freedom from scratches and noise) many audiophiles swear by the black disc, which is said to sound 'more musical' and 'warmer'. In any case, a record player is relatively low-tech compared to a CD player. So much in fact, that it is possible to fabricate a moving-coil element

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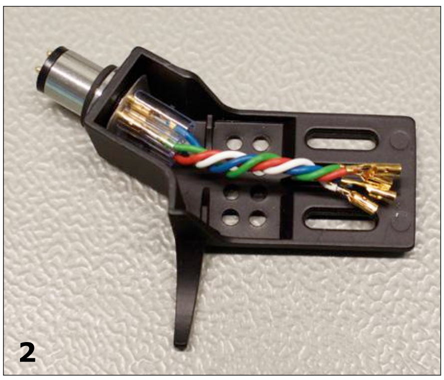

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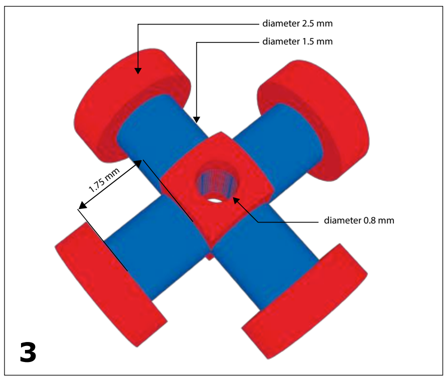

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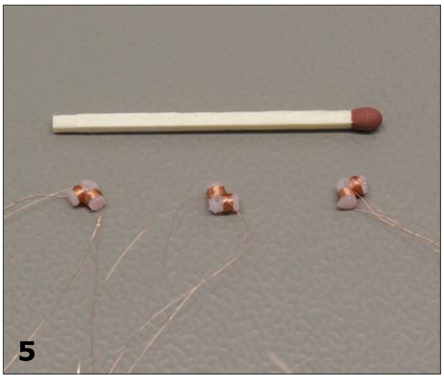

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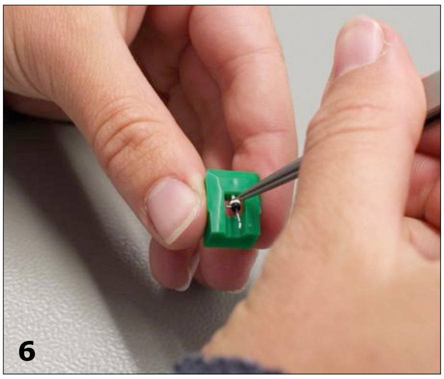

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yourself that — at least to the ear — performs just as well as a bought, ready-made version, as we will demonstrate with this contribution.

Preparations

To carry out this project I required remarkably few tools and materials: side-cutters, scissors, fast-curing glue and a few meters of winding wire with a diameter of 0.05 mm (42 AWG) (**Figure 1**). In addition, of course, an empty head shell (element holder) into which the DIY element will be built (**Figure 2**) and a couple of bobbins to wind the coils on. I wanted to build an MC element. With these, the coils are attached to the needle and move in a stationary magnetic field, so that a voltage is induced. That is why I needed a bobbin that was very light yet offered space for two mutually perpendicular coils. The latter is required in order to obtain a stereo signal. Earlier experiments (not described here) indicated that each coil needed to have about 150 turns.

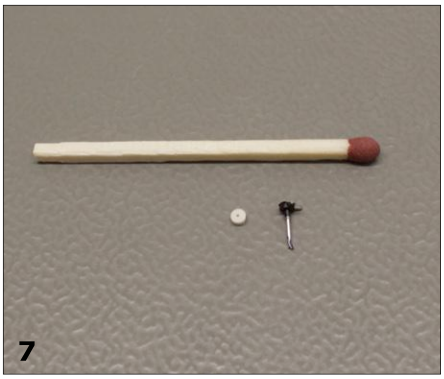
My fellow student Nikola Mastelic made a 3D drawing of the bobbin (**Figure 3**). Subsequently 20 samples of this bobbin were made using a 3D printer. During the first winding attempt it turned out that the four-legged ‘cross’ was still too large. Because the needle is small and short, the bobbin would touch the record and that is of course not the intention. That is why I cut off two of the four ‘legs’.

The winding

Each coil requires a length of winding wire about 2 m long (6.5 ft.) to hand wind the 150 turns (**Figure 4**). Because the bobbin is very tiny and the winding wire very thin, this is a fiddly job of the first order. Nevertheless, after a bit of practice this was reasonably easy to do. I made four bobbins this way (that is eight coils in total). The first attempt, after a closer inspection, the result was found to be unusable and disappeared into the bin. I continued with the three remaining ones (**Figure 5**). After the coils were wound I fixed the windings in place with a small drop of instant glue.

The needle

Now it was the needle’s turn. This I (obviously) didn’t cut myself, but ordered ready-made — this is not difficult at all and they are not all that expensive either. Ex-factory these needles are mounted in a plastic holder, so that they can be inserted into a conventional MM-element, so small magnets were already attached to the needle. I removed these with tweezers. For all that, at my first attempt the needle jumped from the tweezers. To this day I have not managed to find it again, so it was fortunate that I had bought a few spare ones (**Figure 6**). A small disc of foam allows movement of the needle. Because this disc is required later, I removed it carefully so that it would not be damaged (**Figure 7**).



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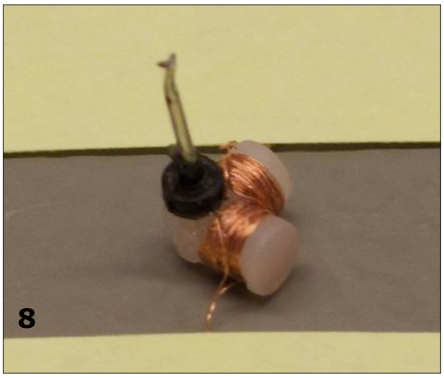

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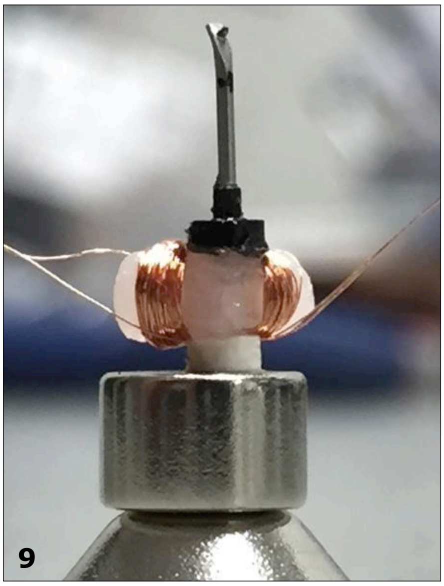
Mounting

Now the time has come to glue the needle to the bobbin. Since this will become an MC element, the needle needs to be attached to the bobbin. The flexible part of the element will be behind the coils. When gluing, I had to make sure that the needle was at the correct position with respect to the coils, to ensure good channel separation later. I therefore first held the bobbin in place using yellow Post-it notes, and then picked up the needle with tweezers, dipped the back end into a drop of glue and inserted it carefully into the bobbin. This worked really well for all three of the elements that I built (**Figure 8**).

For the magnetic field in which the coils will move, I ordered a number of round magnets of various sizes. The type with a diameter of 6 mm and a thickness of 4 mm turned out to fit best. Between this magnet and the bobbin comes the foam disc from **Figure 7** that acts as the flexible element. This small disc therefore has to be glued directly to the magnet… the next challenge.

On my first attempt I held the disc with tweezers, allowed it to soak up a little bit of glue and then placed it on the magnet. However, the foam absorbs too much glue and after drying is much too hard and therefore no longer usable as a flexible element. Therefore, on my second attempt I used a toothpick to apply a very small amount of glue to the magnet and used that to glue the disc. Now the foam plastic disc remained flexible.



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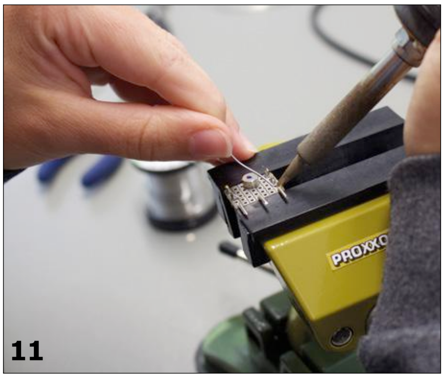

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Low-tech versus high-tech

Compared to a CD player, a record player is, in principle, a low-tech device. To be able to play a CD an entire infrastructure has to be in place, which all has to operate flawlessly. For starters, without power nothing can be done with the silver-colored disc. The laser for scanning, the detector, the microcontroller for decoding the signal and of course the control and positioning of the reading assembly all have to operate faultlessly. If even only a small part doesn't operate correctly then it becomes impossible to play the contents of the CD or even retrieve any of it.

Compare that to the gramophone record. The original vibrations in the air

14a

14b

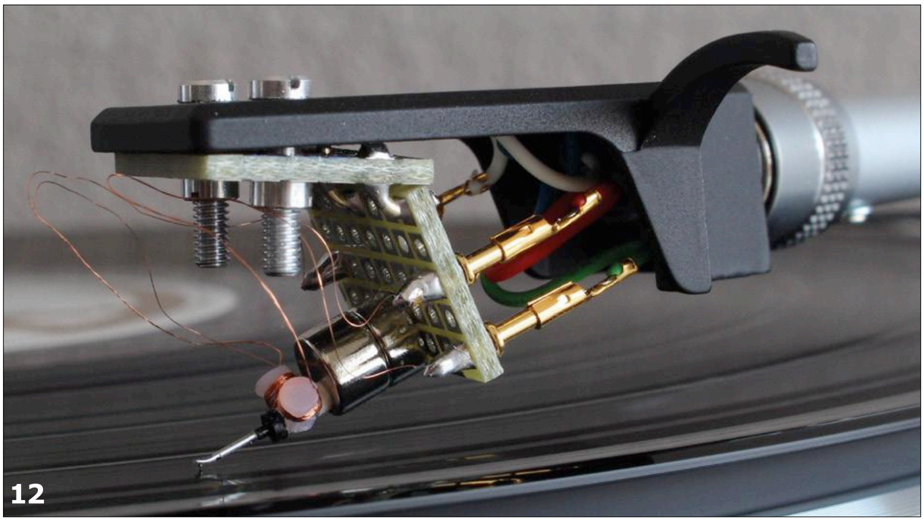
Subsequently I attached the magnet, now with the foam disc, to a conical magnet salvaged from an old loudspeaker. I then glued the bobbin with the needle to the disc using a very small amount of glue. With this I had to make very sure (by eye) that the coils would not be outside the field of the round magnet. The result of all this fiddly work can be seen in **Figure 9**.

Final mounting

In order to be able to mount the assembly of **Figure 9** in the headshell (and then in such a way that the needle will rest at the correct angle in the groove of the record), for each of my three elements I used two small pieces of prototyping board, which I first cut to size (**Figure 10**).

In one of these pair of boards I drilled holes that allowed the element to be screwed to the headshell. In the other board, four suitable circuit board pins were soldered for the connecting wires. Between these pins I glued a magnet that has the same diameter as the magnet to which the needle is attached. Both magnets are later (carefully) brought together. In this way it remains possible to adjust the angle of needle a little (**Figure 11**).

Both circuit boards are joined together using three small pieces of stiff wire. Finally the wires from the coils have to be attached to the circuit board pins and then the DIY element can be mounted in the holder (**Figure 12**).



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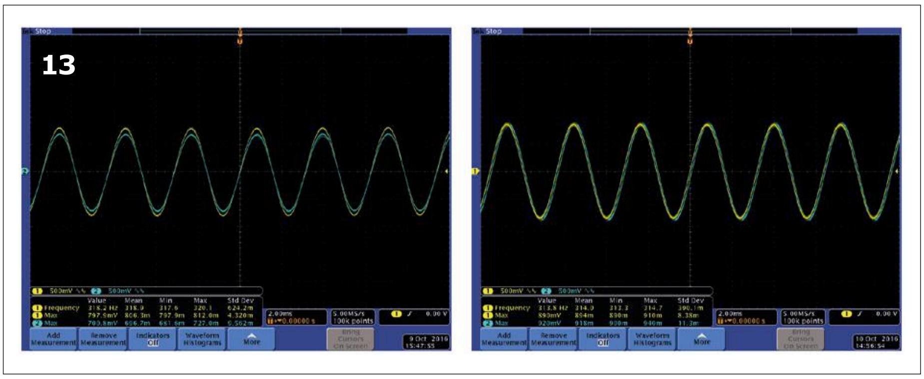
Assessment

In order to be able to assess the characteristics of the element in practice, I naturally needed a good preamp (since many modern amplifiers don't have a phono input any longer). That is why I decided the build the **Supra 2.0 Preamp** from the Elektor July & August 2016 issue. This is an MM amplifier, i.e. for elements with a moving magnet. Because MC elements generate a much smaller voltage, a small change was required to this preamp. This is described in the

are, without fuss, cut as mechanical vibrations into a carrier; no coding, no complicated signal processing. Well yes, the principle was already patented by Edison in 1877. And because a gramophone record is such a low-tech sound carrier, it can (in a moment of need) be played without any infrastructure (meaning that, in any case, with a bit of effort, the contents can be retrieved). The only things that we need for that is a pencil or something similar that can serve as a spindle, a piece of paper rolled into a horn and a pin to sense the groove (**Figures 14a, 14b**)!
Try it yourself — but don't use an irreplaceable unique vinyl copy for this...



January & February 2017 issue of Elektor Magazine.
With the aid of a special test record, I made several measurements in order to compare my DIY element with a ready-made, commercial version. **Figure 13** shows an example. On the left is the signal from my own element at a needle deflection of 50 µm, on the right the signal from a bought element.

It turns out that with the DIY version both channels do not generate the same amplitude signal, probably because the needle is not resting perfectly square in the groove. However, when judged by ear, no difference is detectable. Certainly not a bad result for an experiment in do-it-yourself! ⏮

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