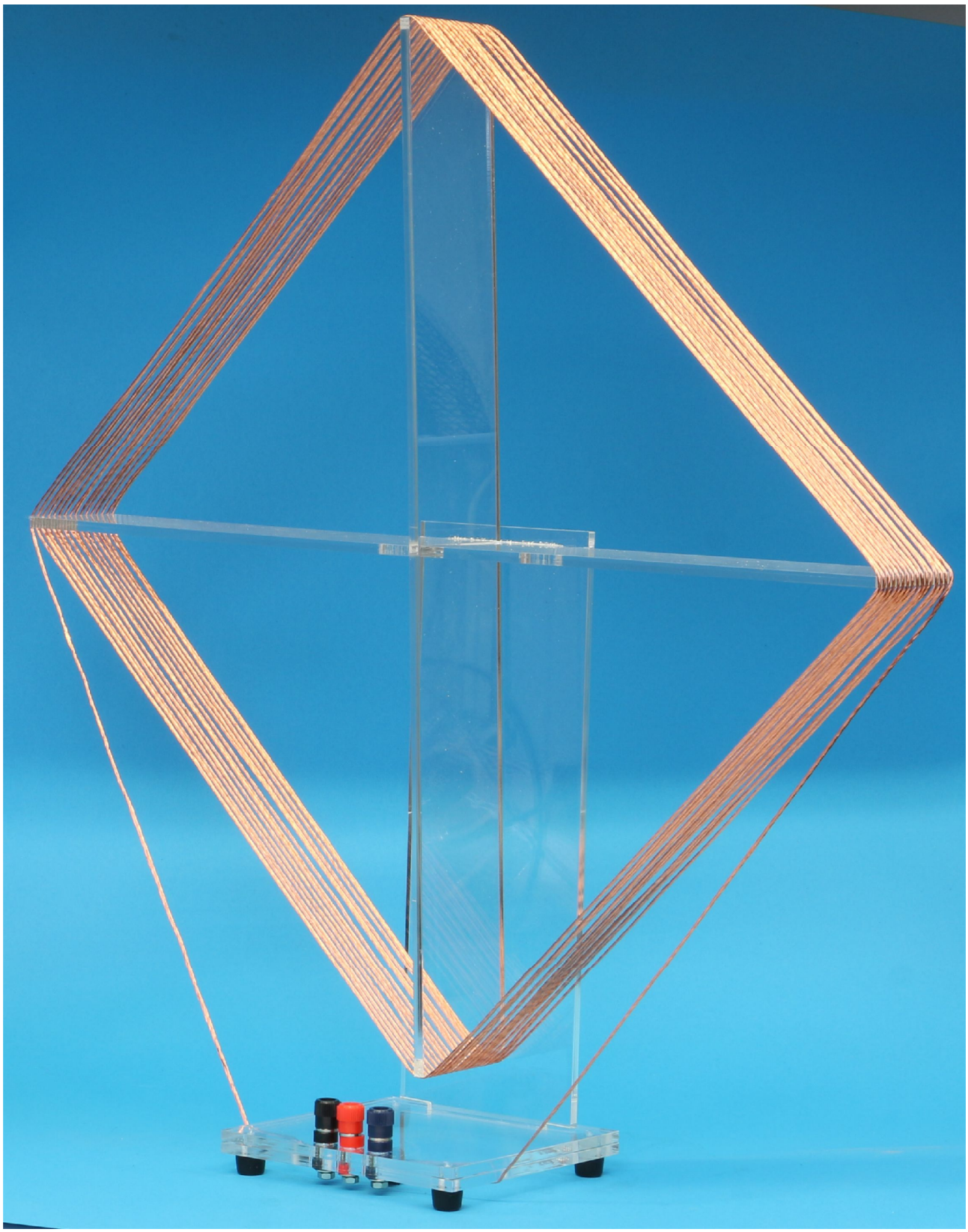
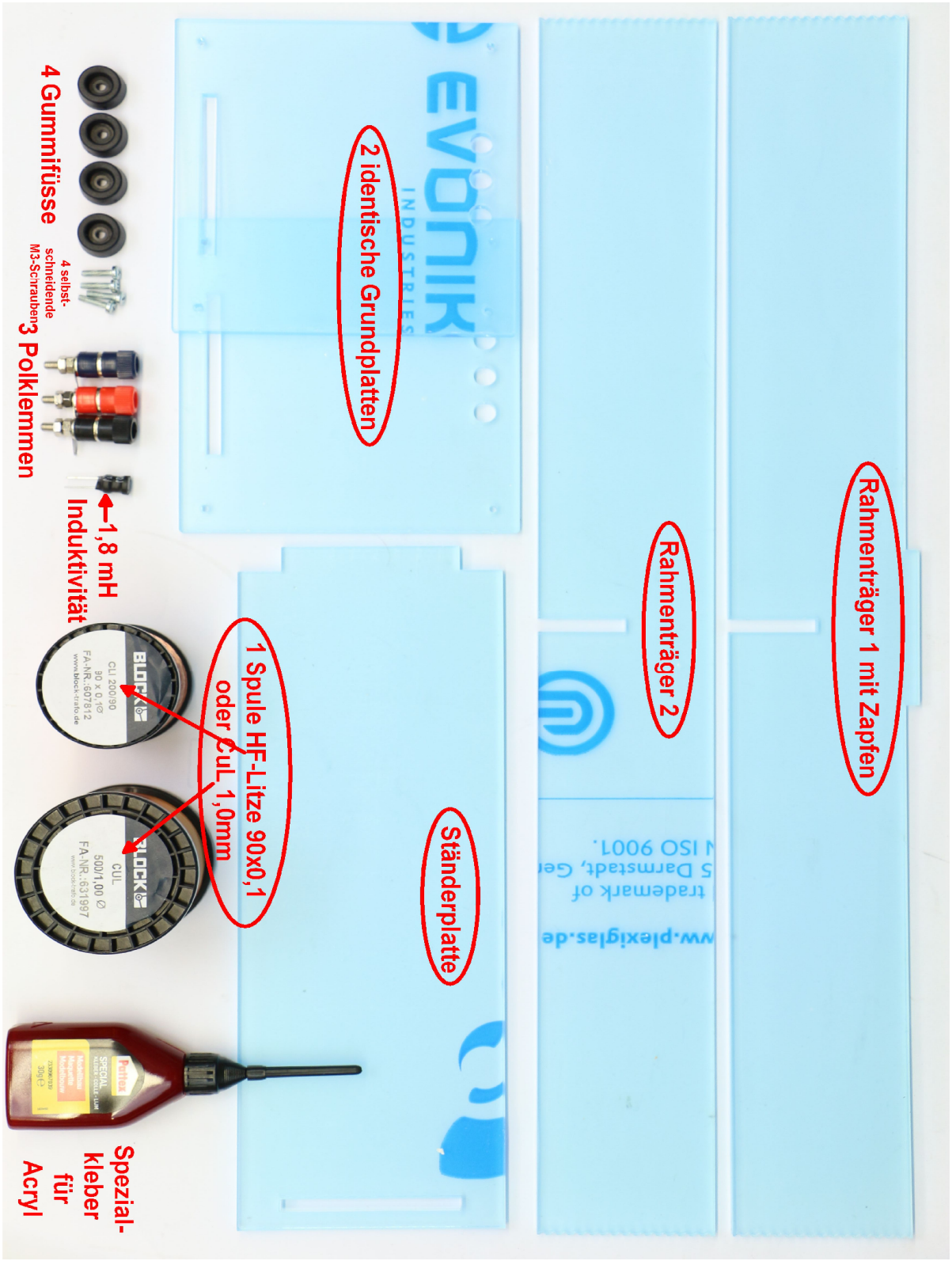
Assembly Instructions for Acrylic Frame Antenna



Individual components of the construction kit



Introduction:

Take your time and be patient when assembling your frame antenna. The special plastic adhesive needs to cure overnight, twice. So, you will need at least 3 days for assembly.

Even inexperienced individuals can easily accomplish the construction using either this guide or our video tutorial on our English YouTube channel "Kainkaabs."

https://youtu.be/WBhju6XVW6U

The author of this guide, who is also not particularly skilled in craftsmanship, successfully built the antenna without any errors on the first prototype.

Preliminary notes:

The acrylic glass parts have protective film on both sides. To remove it, lift the film from one corner using your fingernail and peel it off completely. It is best to do this when the parts are needed for assembly. Acrylic glass attracts dust like a magnet (static charge), and every fingerprint is visible. Therefore, only touch the edges of the acrylic glass parts. For cleaning, it is best to use a microfiber cloth (possibly slightly dampened). Alcohol and most other cleaning chemicals will damage the acrylic glass! However, a drop of mild dishwashing detergent ("Pril") or mild liquid soap dissolved in water is safe to use.

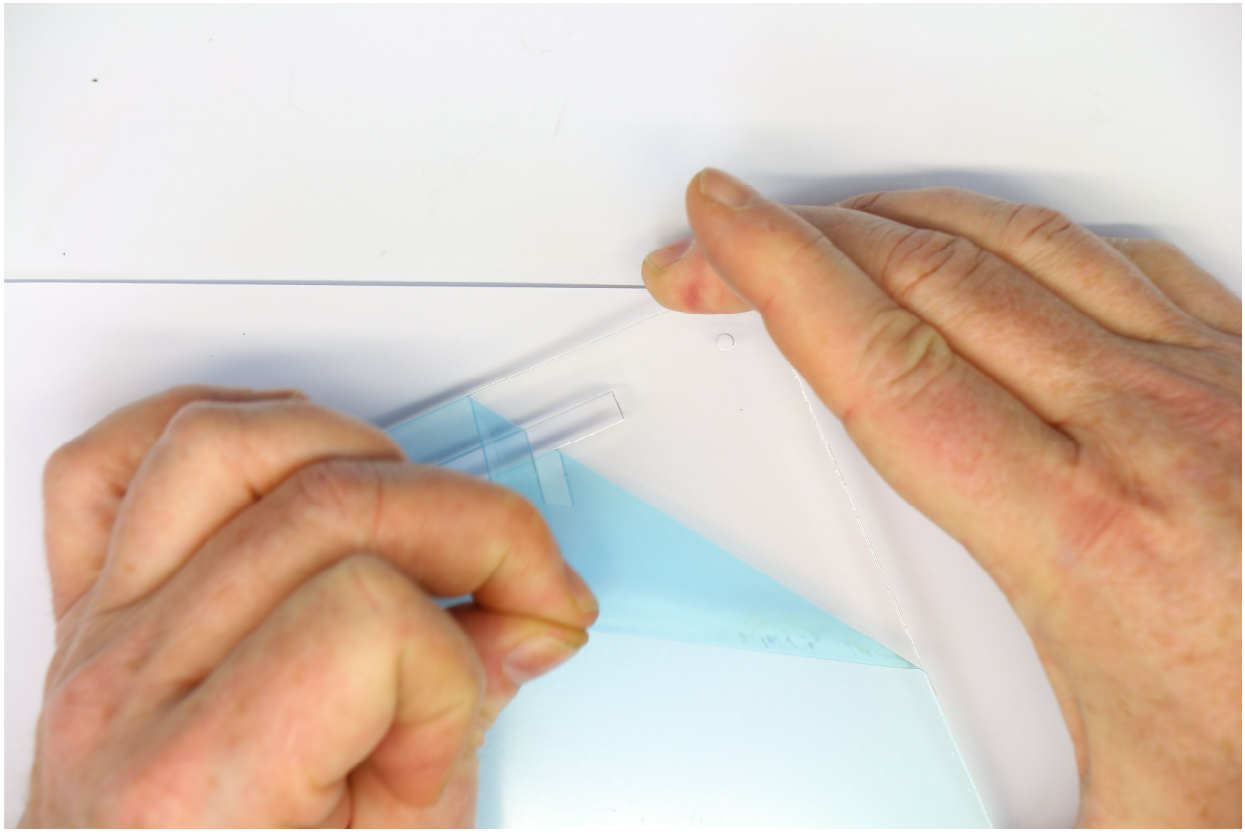
Required Tools:

- Phillips screwdriver
- Soldering station with temperature set to >350°C, wide chisel tip, 0.7...1 mm solder
- 7mm open-end wrench, ratchet with 7mm socket, or flat-nose pliers
- Tesa tape for temporary fixation of the winding
- Set square or 90° angle for aligning the frame cross
- Optional: microfiber cloth for cleaning the acrylic glass parts

1. Base plate with rubber feet, terminal clamps, wire start, and stand plate

The two base plates are identical but not completely symmetrical to each other.
Therefore, the drill holes and slot on the base plates only align perfectly and overlap each other in one specific orientation.

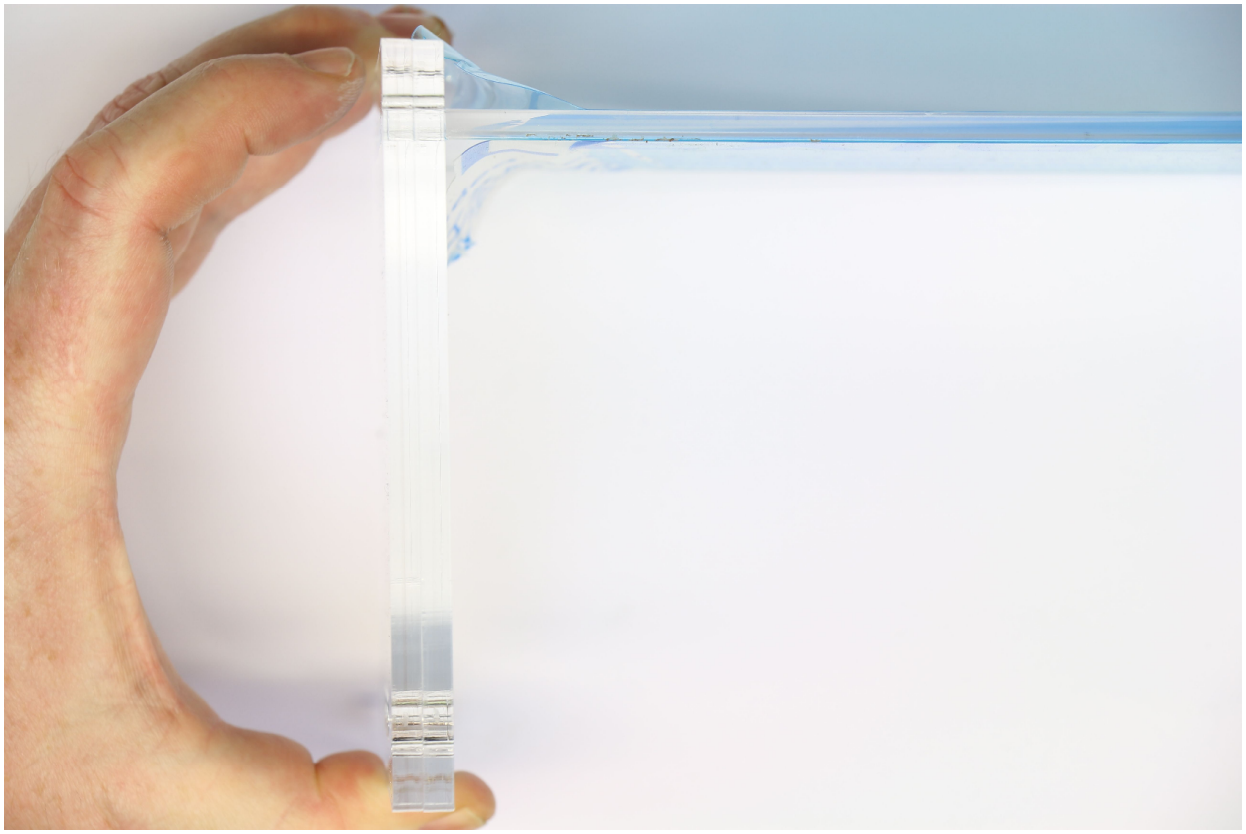
1.) Remove the protective film from both sides of the two identical base plates.



2.) Place the two base plates perfectly aligned on top of each other.

3.) Remove the protective film from the bottom pin of the stand plate.

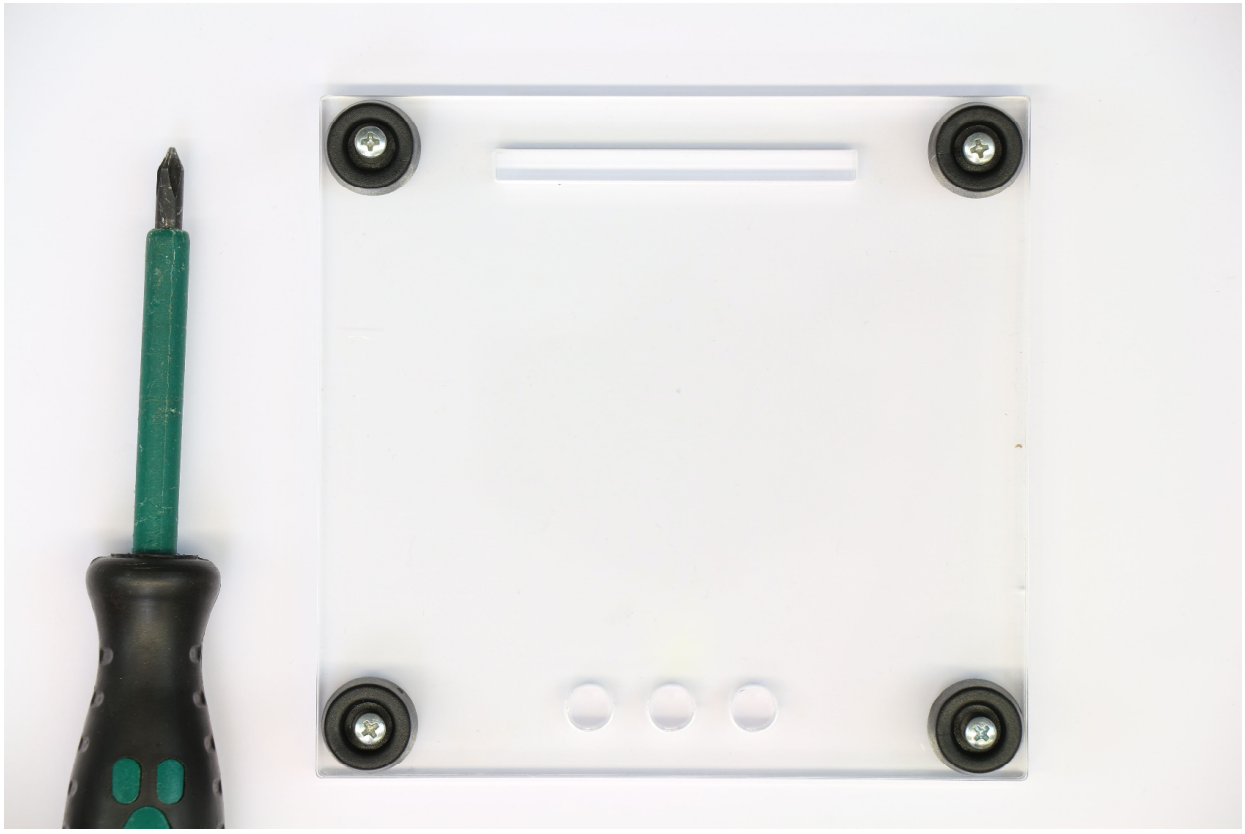
4.) Insert the stand plate with the bottom pin into the slot of the two stacked base plates.
If necessary, one of the base plates may need to be flipped, as the base plates are not completely mirror-symmetrical.



5.) Remove the stand plate and place the two stacked base plates perfectly aligned and flat on the table.

6.) Screw the 4 rubber feet into the base plates using self-tapping screws and a properly fitting Phillips screwdriver.

Turn each screw only 2-3 revolutions before moving on to the next screw.
Especially at the transition between the two plates, apply some pressure on the screwdriver to prevent any gaps from forming between the plates if a screw does not go directly into the lower plate.
In that case, turn the screw back slightly and then screw it in again with more pressure.
Finally, reinsert the stand plate into the slot and check the fit.



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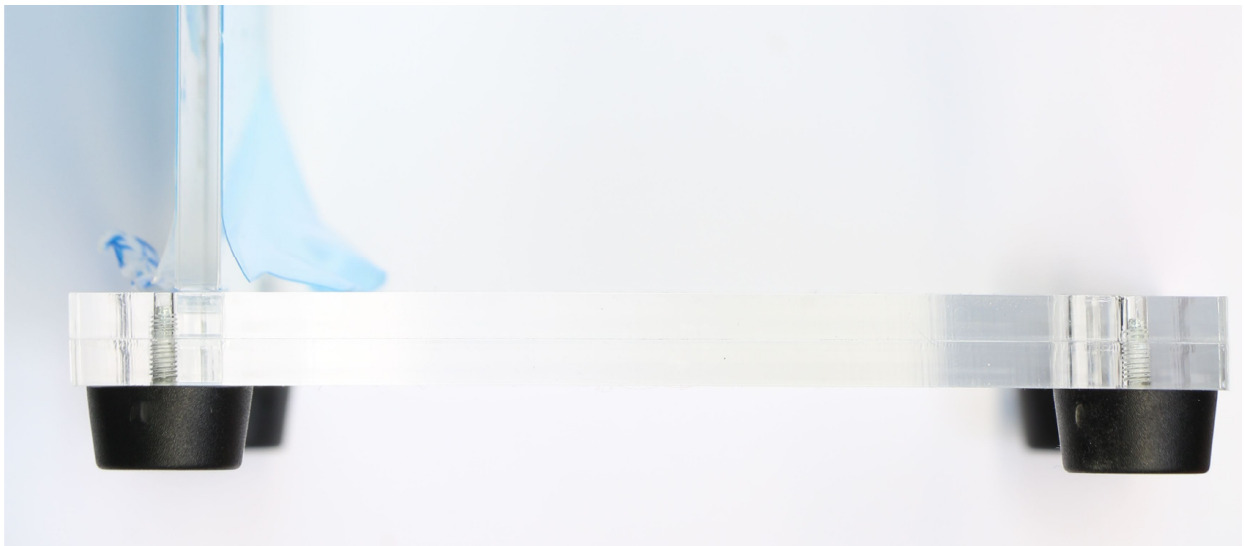
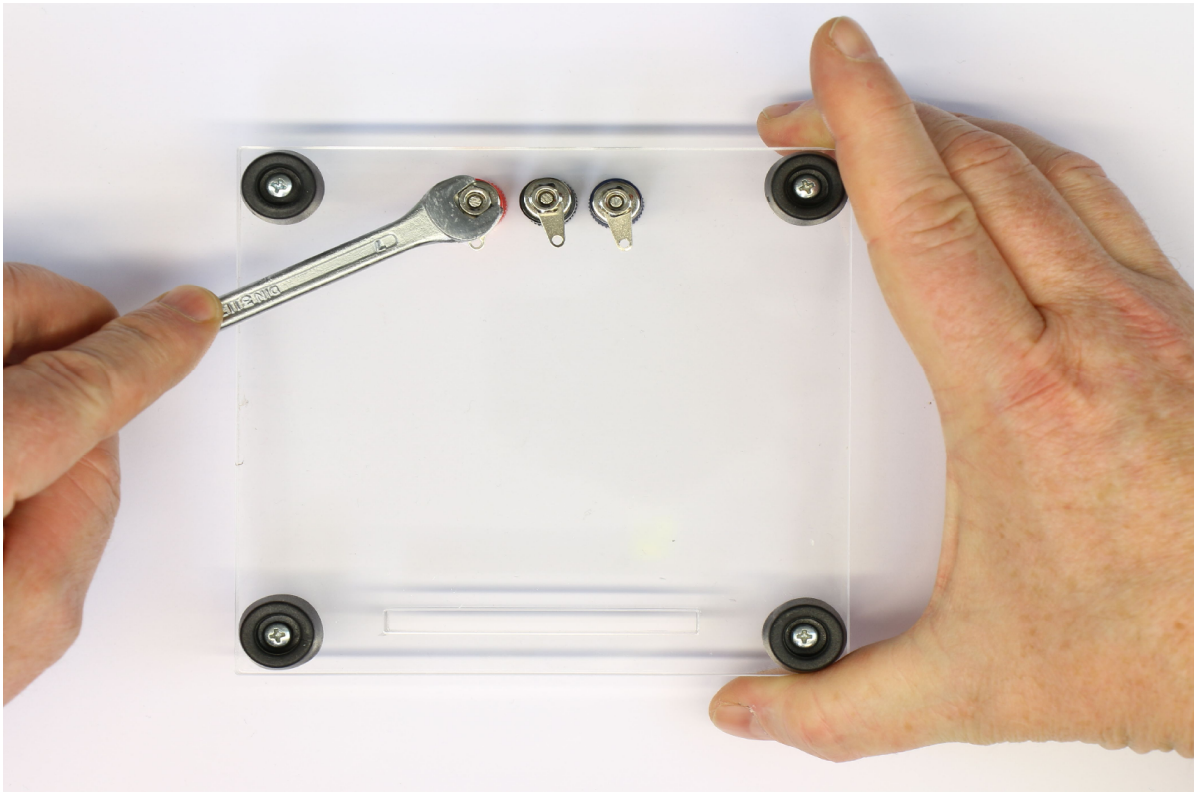


7.) Now unscrew the 3 terminal clamps.

For the actual terminal clamp, only the large colored spacer sleeve remains on top.
On the underside, the loose parts are arranged as follows in the picture:

- Small colored spacer sleeve (align the small step with the hole in the acrylic glass)
- Metal washer
- Soldering lug
- Nut

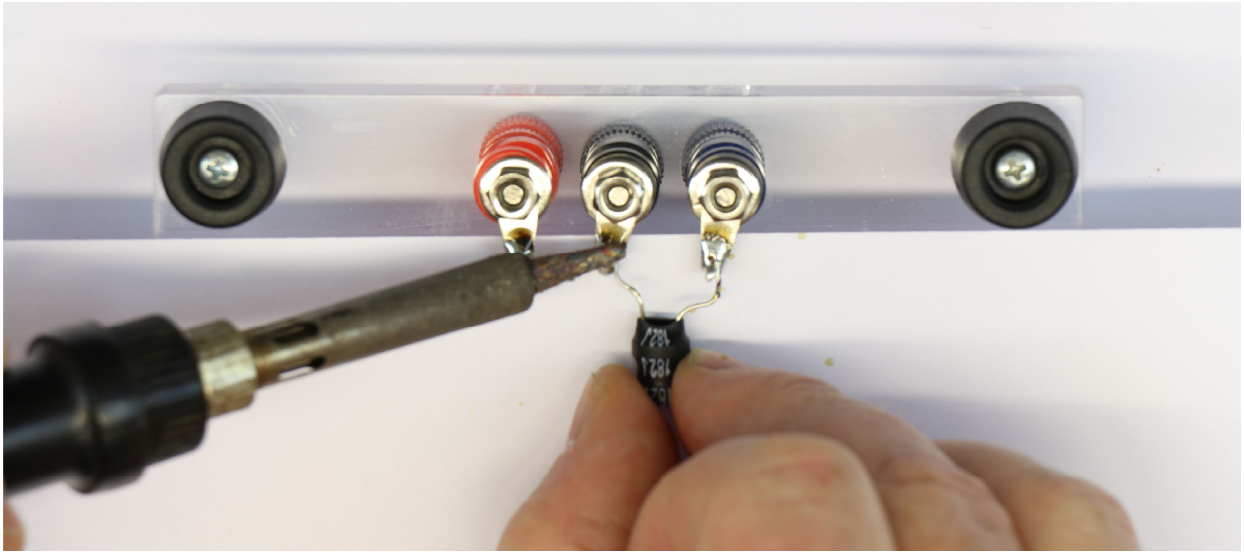
8.) Start by hand-tightening the 7 mm nut.



Then use a 7 mm open-end wrench, a ratchet with a 7 mm socket, or flat-nose pliers to securely tighten it. Ensure that the soldering lugs are parallel to each other and aligned towards the inside of the base plate.

9.) Place a sheet of paper under the soldering lugs to protect against solder splatters, and tin the soldering lugs with solder (0.7...1.0 mm).

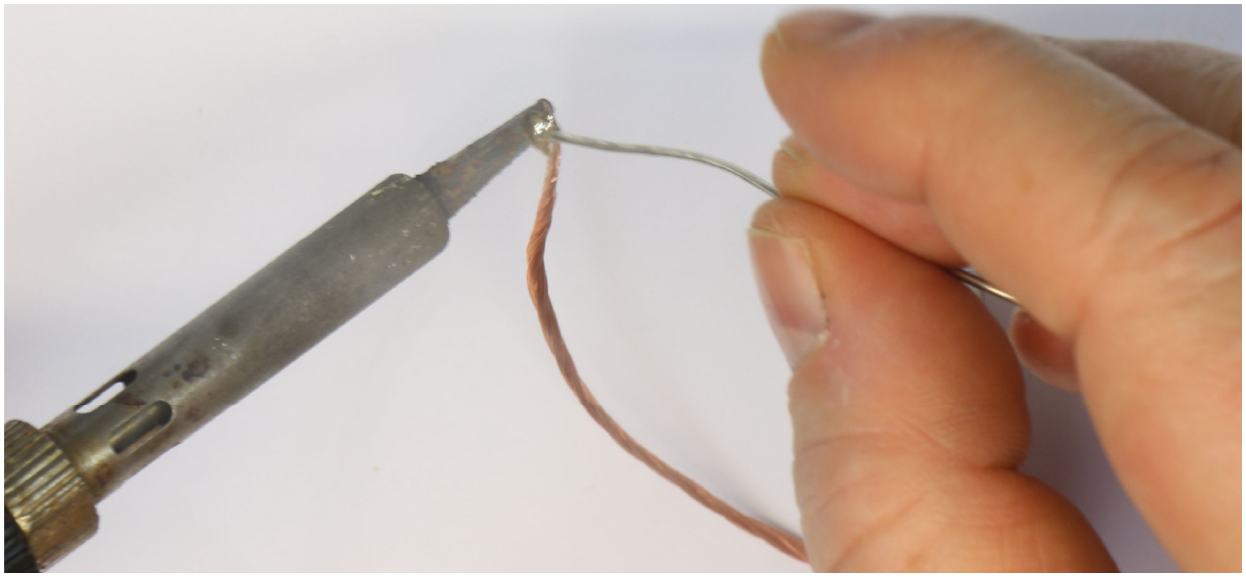
10.) Pre-tin and slightly angle the connection legs of the 1.8 mH inductor.
Then solder the ends to the soldering lugs of the middle terminal clamp and one of the outer terminal clamps using fresh solder.



11.) Now remove the adhesive tape from the coil with HF wire or enameled copper wire.

Caution: Tinning the wire end without residue is only possible if there are no adhesive residues on the wire or HF wire. Therefore, if necessary, shorten the wire or wire so that the part to be tinned is free of adhesive residue!

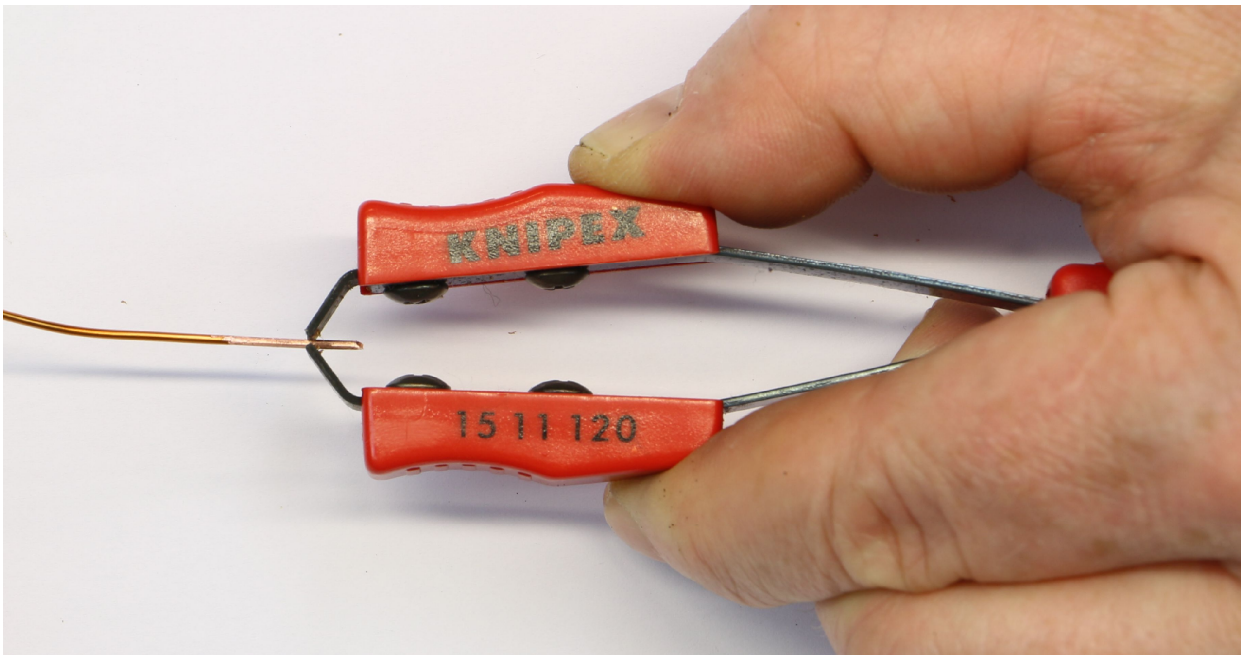
For HF Litz wire:
Set the soldering iron to 400...450°C. The polyurethane insulation only decomposes above 350°C. Due to the cooling of the soldering tip when in contact with solder and the wire, the soldering tip must be significantly hotter than 350°C at the beginning.
Tinning works best with electronic solder wire of 0.7...1 mm diameter.
Tin the end to a length of about 1 cm and apply solder several times.
It is extremely important that each individual wire of the HF wire is tinned.
Therefore, it is necessary to "cook" for several seconds to ensure that the HF wire is tinned all the way to the innermost wire strands.
If necessary, take breaks and remove the black flux residue.
This can be done by wiping with fingers or fingernails while the wire end is still hot.



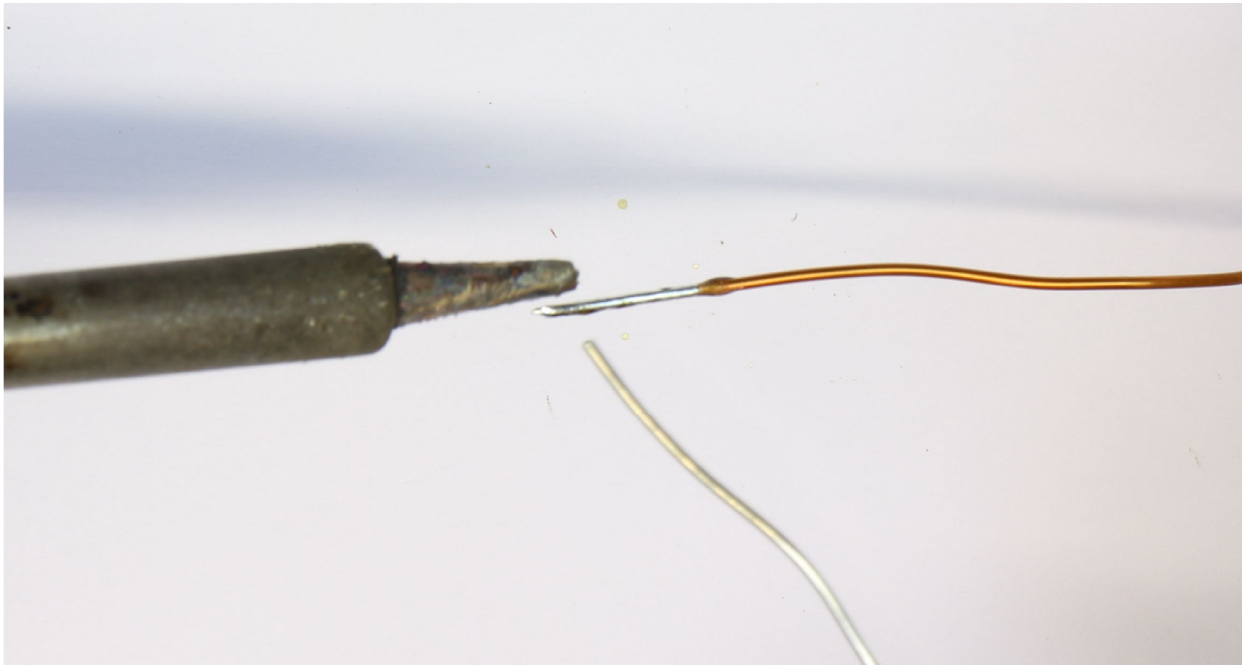
Alternatively, you can unravel the bundle of wires for about 1...2 cm and tin the individual wire strands or small bundles. Then twist the wire strands back together at the end and tin them together again.

Alternative tinning method:
Obtain a small amount of spirit (**ethanol alcohol**, not methanol or isopropanol!).
Heat the end of the HF wire with a lighter or small gas burner.
(Do this outdoors and not in enclosed spaces. Fire hazard!)
The polyurethane insulation layer will burn off, and the copper will oxidize to copper oxide.
Quickly dip the hot end directly from the flame into the spirit.
Through a chemical reaction, the copper oxide will be reduced to elemental copper.
No black residues of copper oxide or burnt polyurethane insulation should remain. Repeat the process if necessary.
The now bare copper wire can easily be tinned with solder.

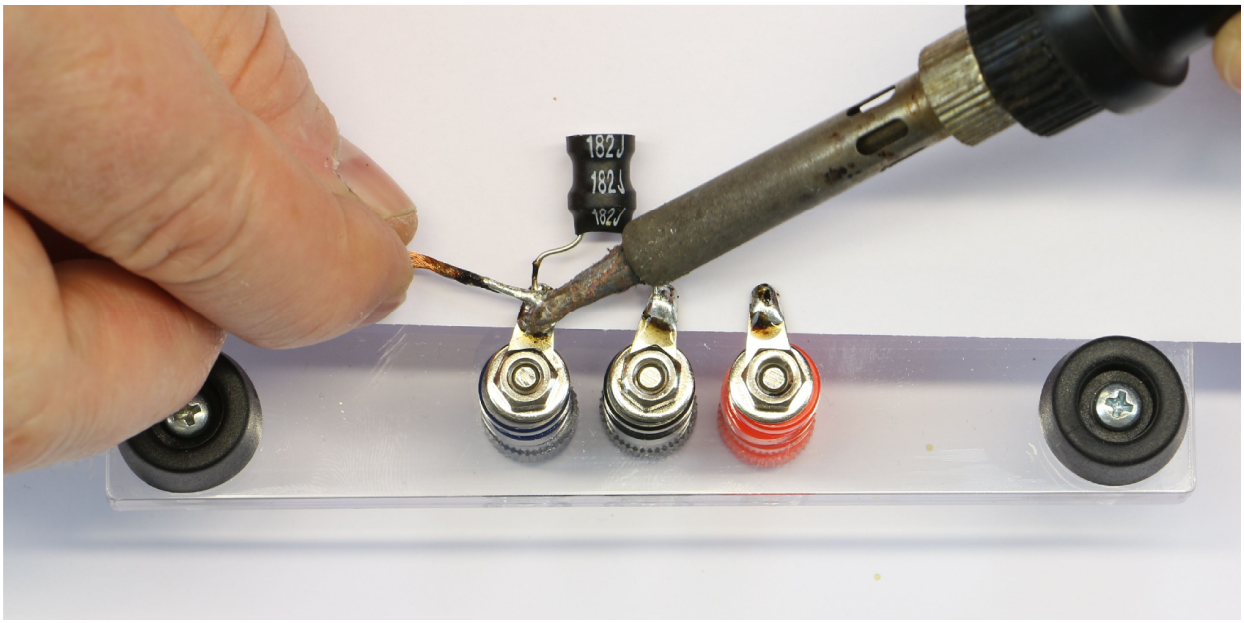
For enameled copper wire:
Remove the enamel coating from the wire end with fine sandpaper or a lacquer-stripping tweezer, leaving approximately 1-2 cm of bare wire.



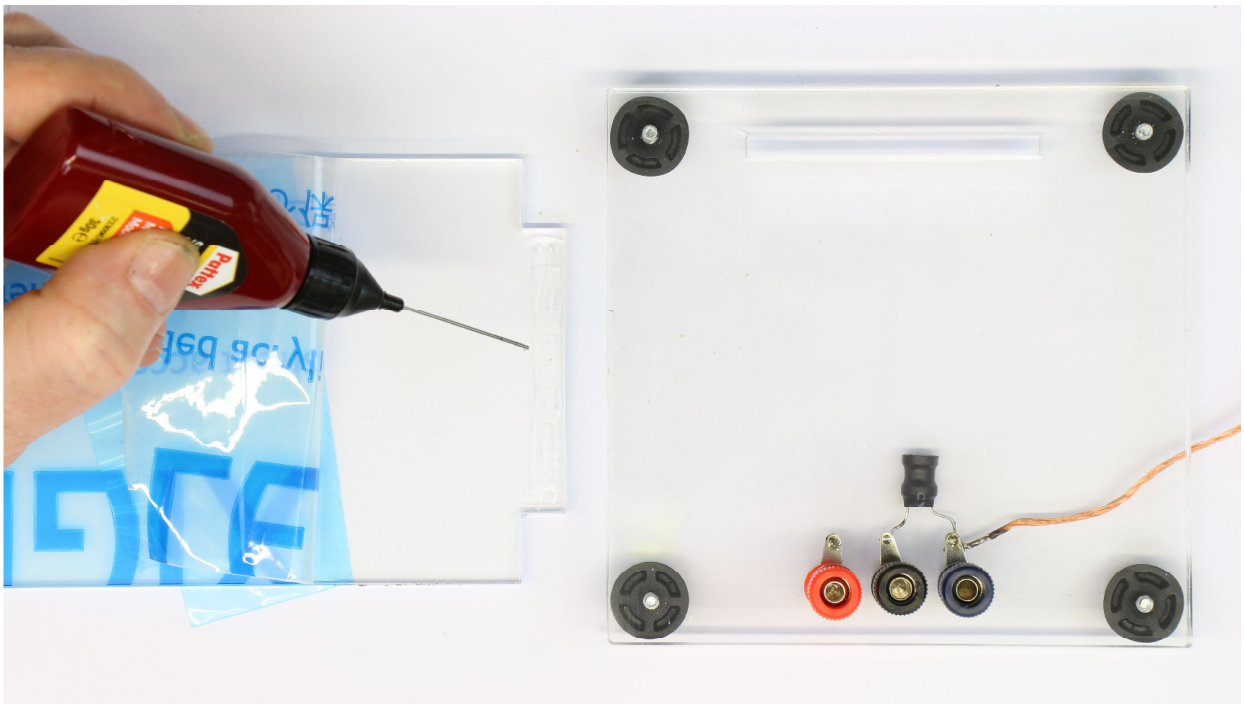
In the picture, you can clearly see the color difference between the bare copper on the right end and the still coated copper wire on the left.
Set the soldering iron to 350...400°C.
Tinning works best with solder wire of 0.7...1 mm diameter.
Tin the wire end for approximately 1 cm in length all around, and if necessary, apply solder multiple times.



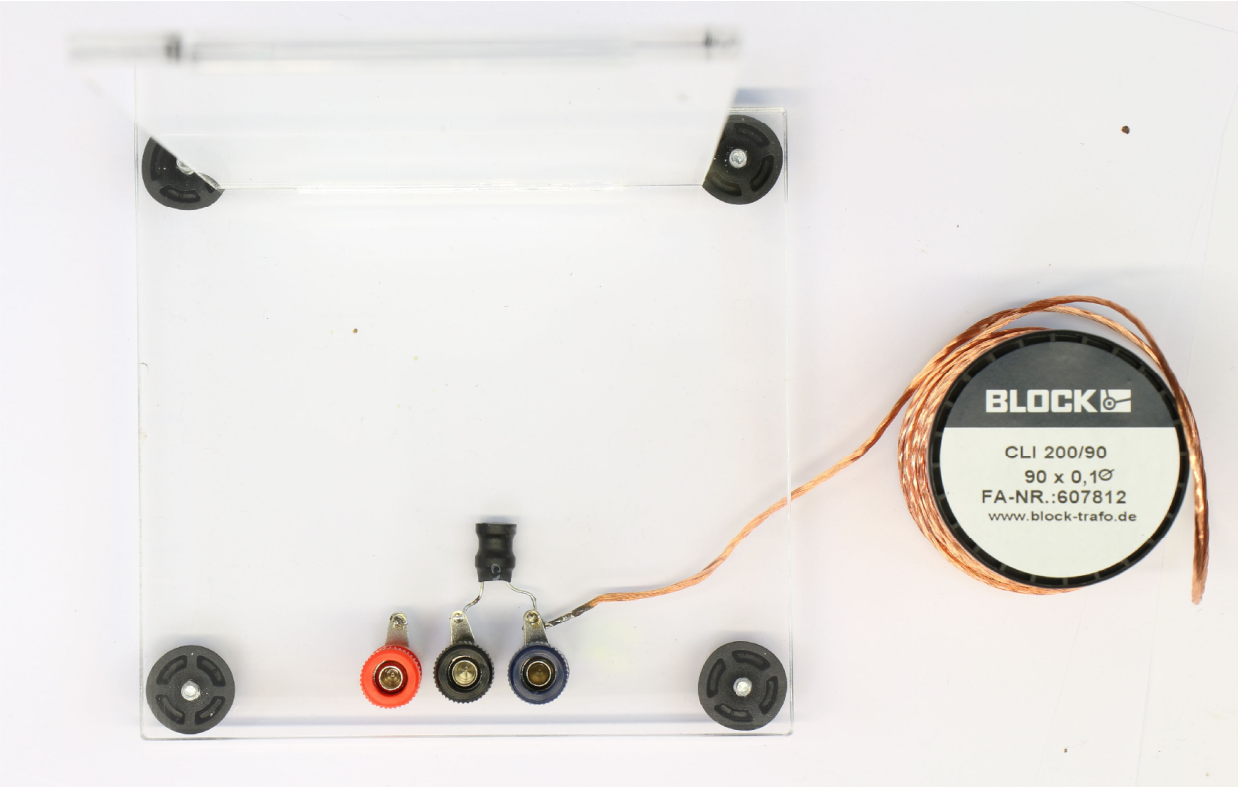
12.) Solder the tinned end of the HF wire or CuL wire to the solder lug of the outer terminal clamp, where the 1.8 mH inductance is also soldered. Again, place a protective paper underneath and add some fresh solder.



13.) Now, partially peel off the protective film of the base plate at the end of the pin. Carefully apply several strips of the special adhesive to both sides of the pin.



14.) Carefully center and insert it above the base plate.

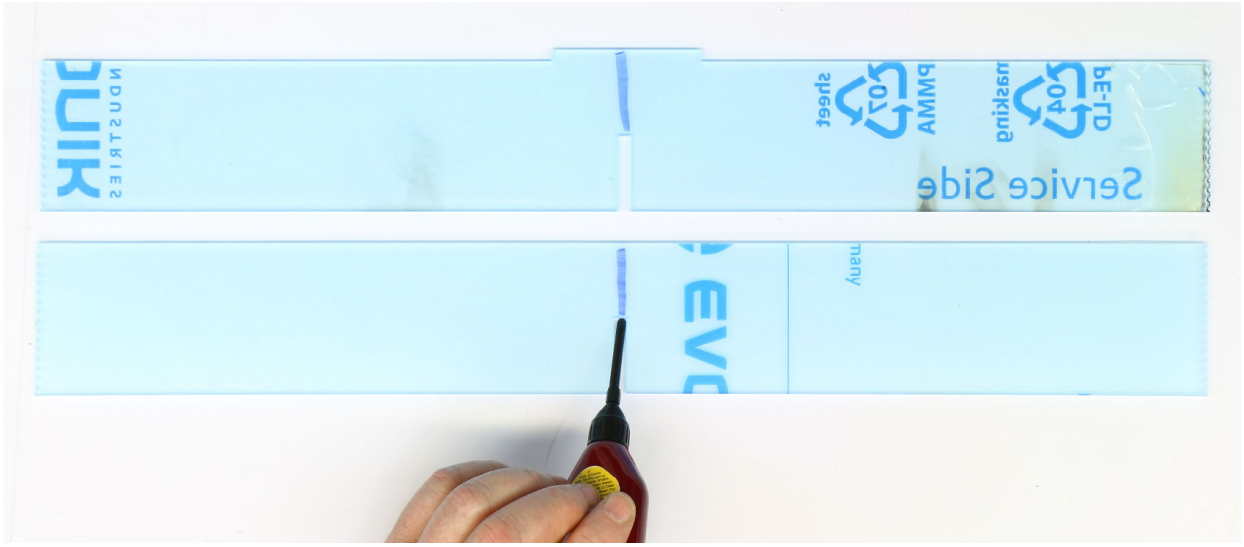


Allow the glue to cure overnight!

2. Frame Cross, Stand Plate, and Base Plate

15.) The illustrations here show the two bars of the frame cross still with the protective film, and (marked in blue) the areas where the adhesive is applied.

A drop of adhesive is applied inside the rear end of the slots.



The adhesive is applied on both sides of each bar, extending from the slots.

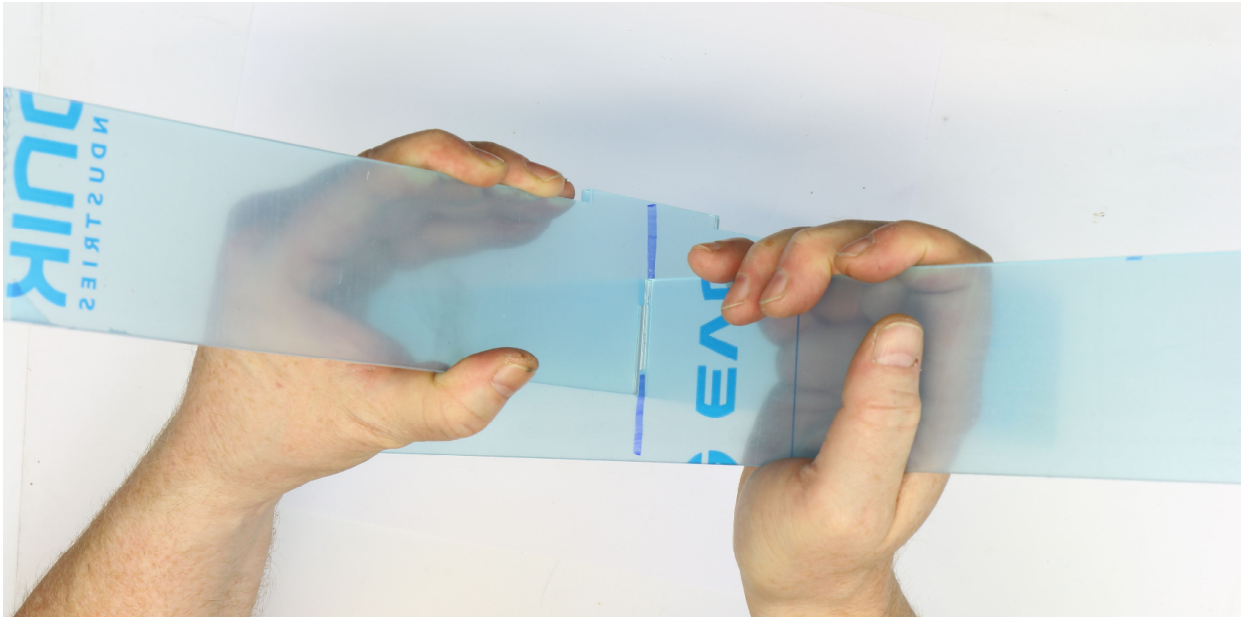
It is advisable to place the two bars clamped between two bottles or similar objects in an upright position after removing the protective film.

This is helpful so that after applying the adhesive to the first bar, it can be briefly "parked" upright without the moist adhesive accidentally touching any parts.

It is best to practice this procedure with the protective film before actually applying the adhesive.

16.) After applying the adhesive to both supports, insert the two bars together in a way that both slots face each other.

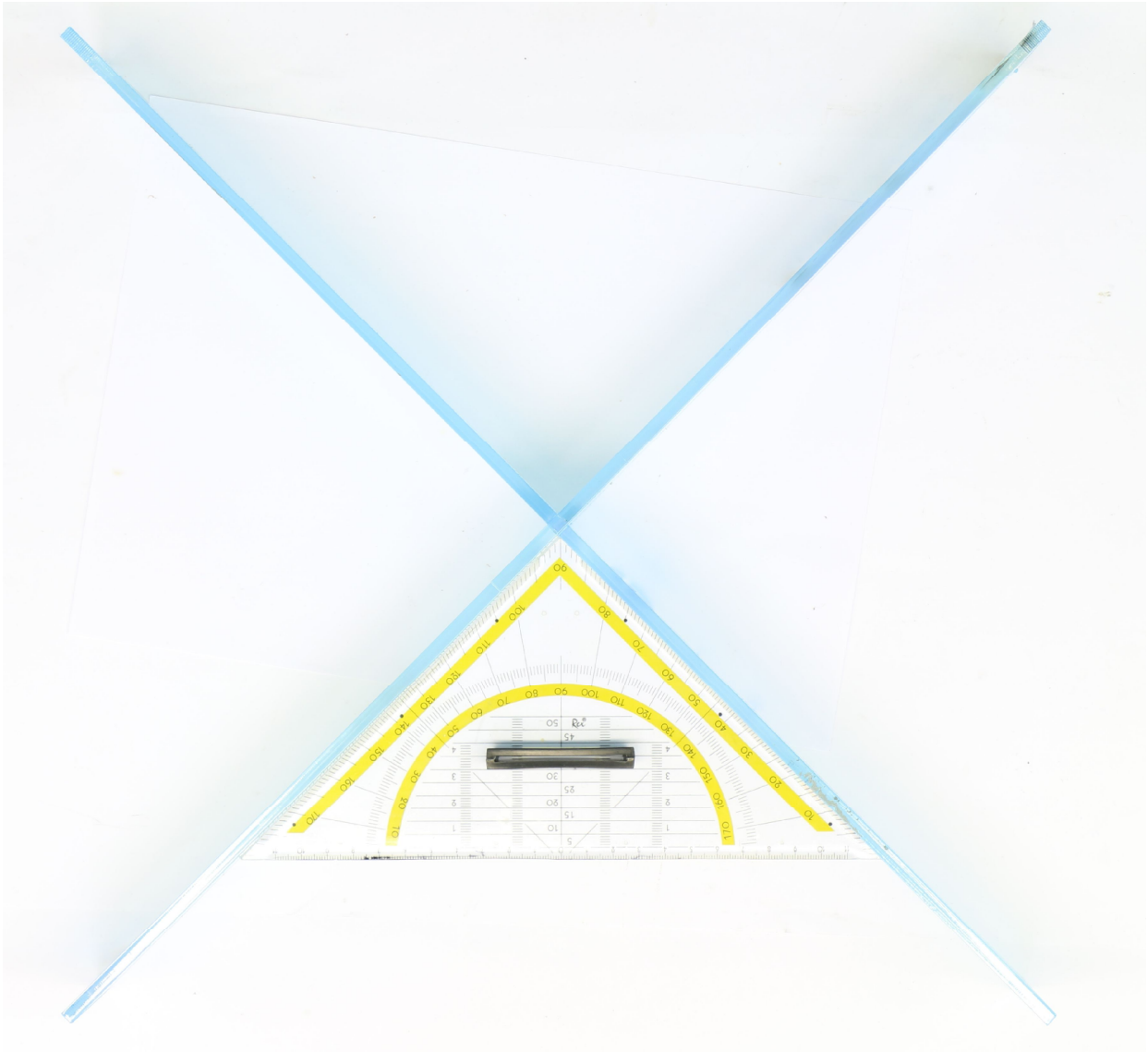
Here is another picture for the "dry run," still with the protective film.



17.) Place the assembled frame cross on a smooth surface in such a way that the bar with the central pin points upward.

This ensures that the cross rests flat and evenly on the surface.

Since the slots have some play, use a triangle or similar tool to align the two bars exactly at right angles.



<u>Allow the glued frame cross to dry overnight once again.</u>

18.) Now place the base plate with the stand plate flat on a table.

You may want to use a spacer (e.g., a flat battery) to support the stand plate at the rear end, so that the slot for the frame cross is free-floating and the adhesive on the tab of the frame support to be glued later does not come into contact with the surface.

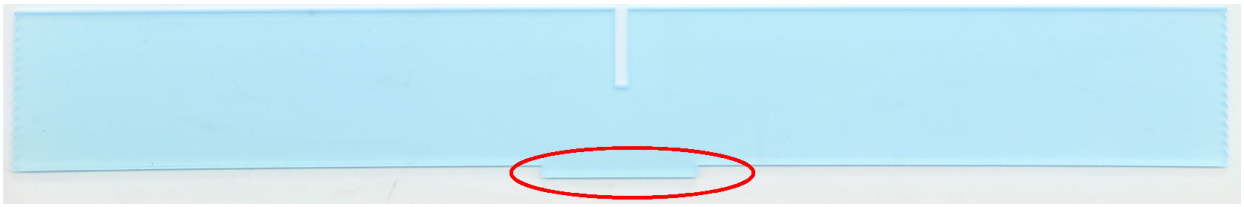
19.) Now, place the frame cross with the tab into the corresponding slot of the stand plate as a trial fit. The fit is quite tight and without much play, as later the frame cross will exert a significant force on the slot of the stand plate. Therefore, the fit must be quite precise to ensure that the adhesive can bond the tab with the slot as fully as possible. If the tab is slightly too large for the slot in the stand plate, you can carefully file down the sides of the tab with a fine flat file.

20.) Carefully remove the cross frame from the slot. Proceed very cautiously (possibly with a slight, vertical wiggling motion) as the glued cross frame is now very fragile and prone to breakage.

It is best to have an assistant hold the base plate while you vertically lift the cross frame out.

Next, apply the special adhesive to all four sides of the tab of one frame support.

The first image shows the tab to be glued, circled in red.



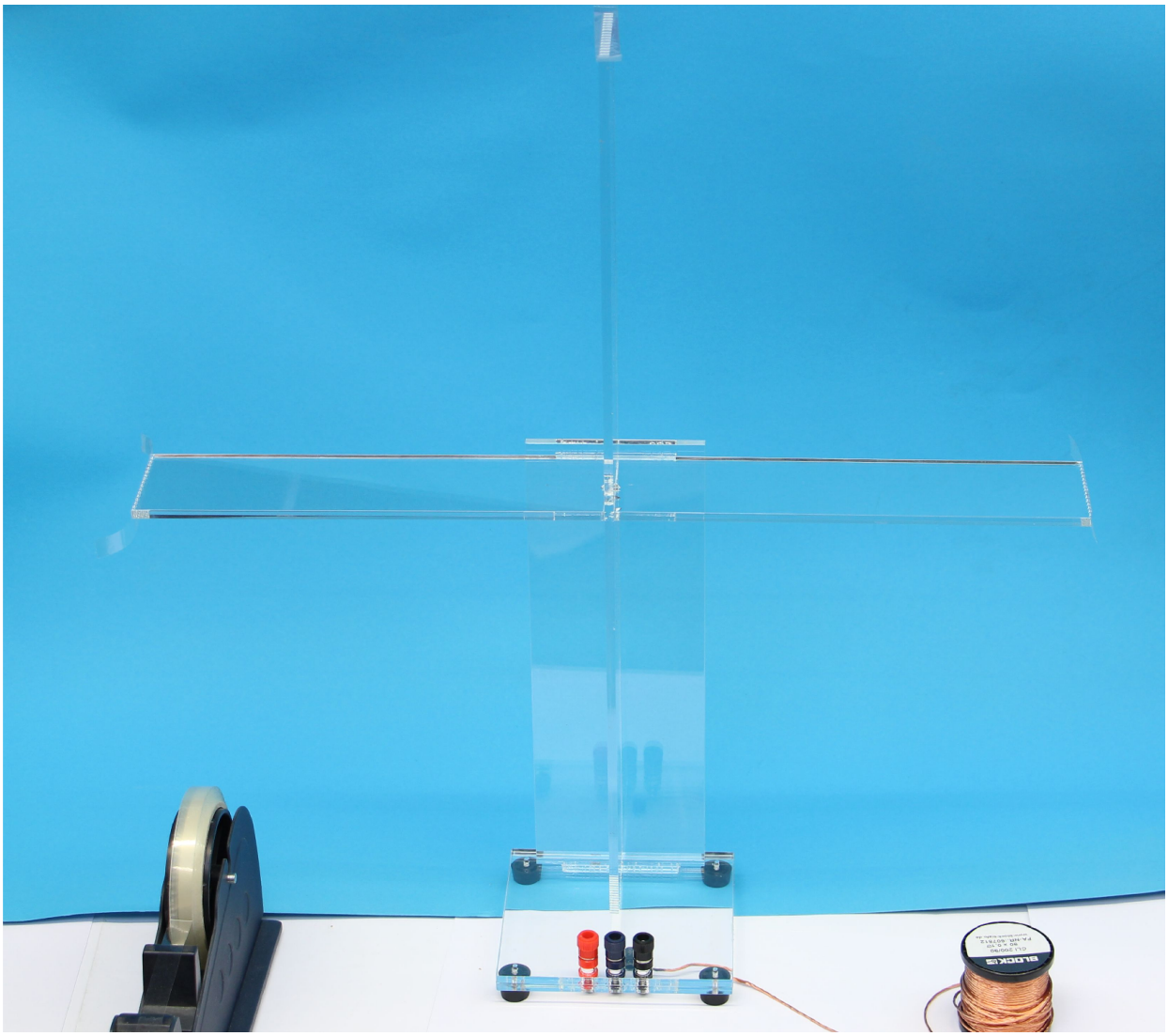
The second image shows the tab being coated with the special adhesive.

Then, center the frame cross over the slot and press it down.

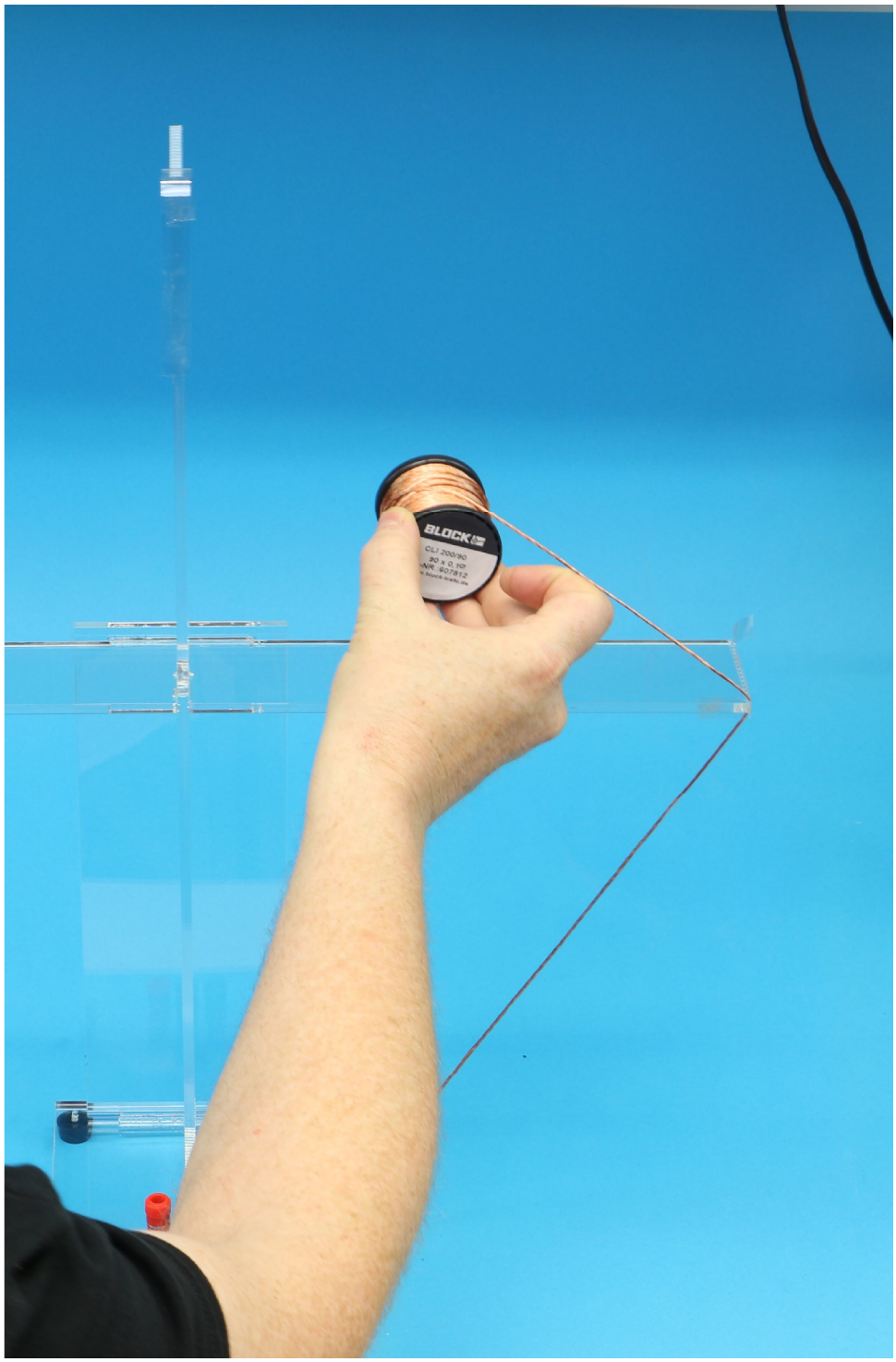
<u>Let the glued frame structure dry overnight once again.</u>

3. Applying the winding

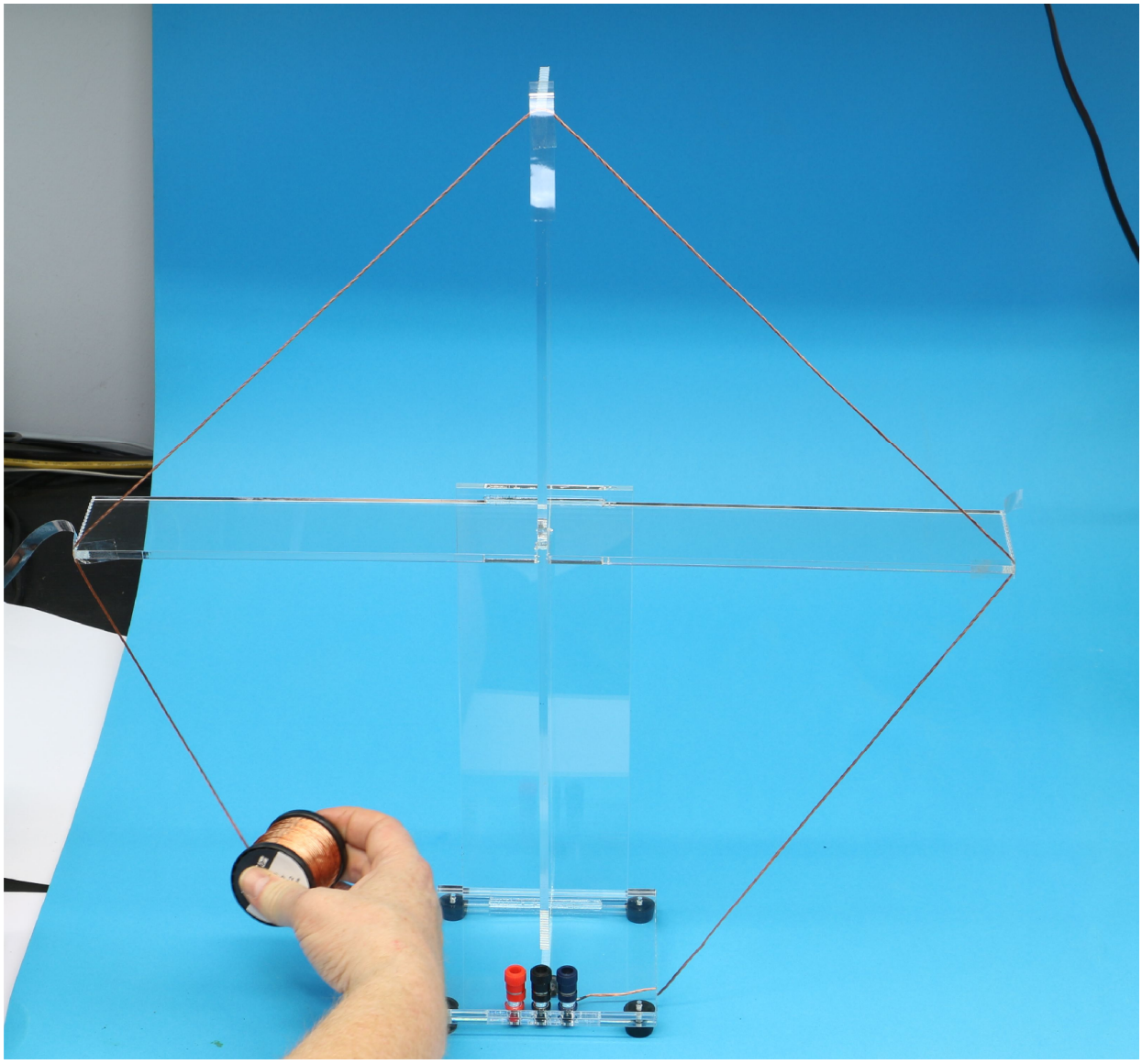
21.) After drying, position the frame upright. It can be helpful to secure each turn with a strip of Tesa tape to the two outer and upper ends of the frame cross. Having a second person to assist is also useful, but not necessarily required. (The author has also worked alone)



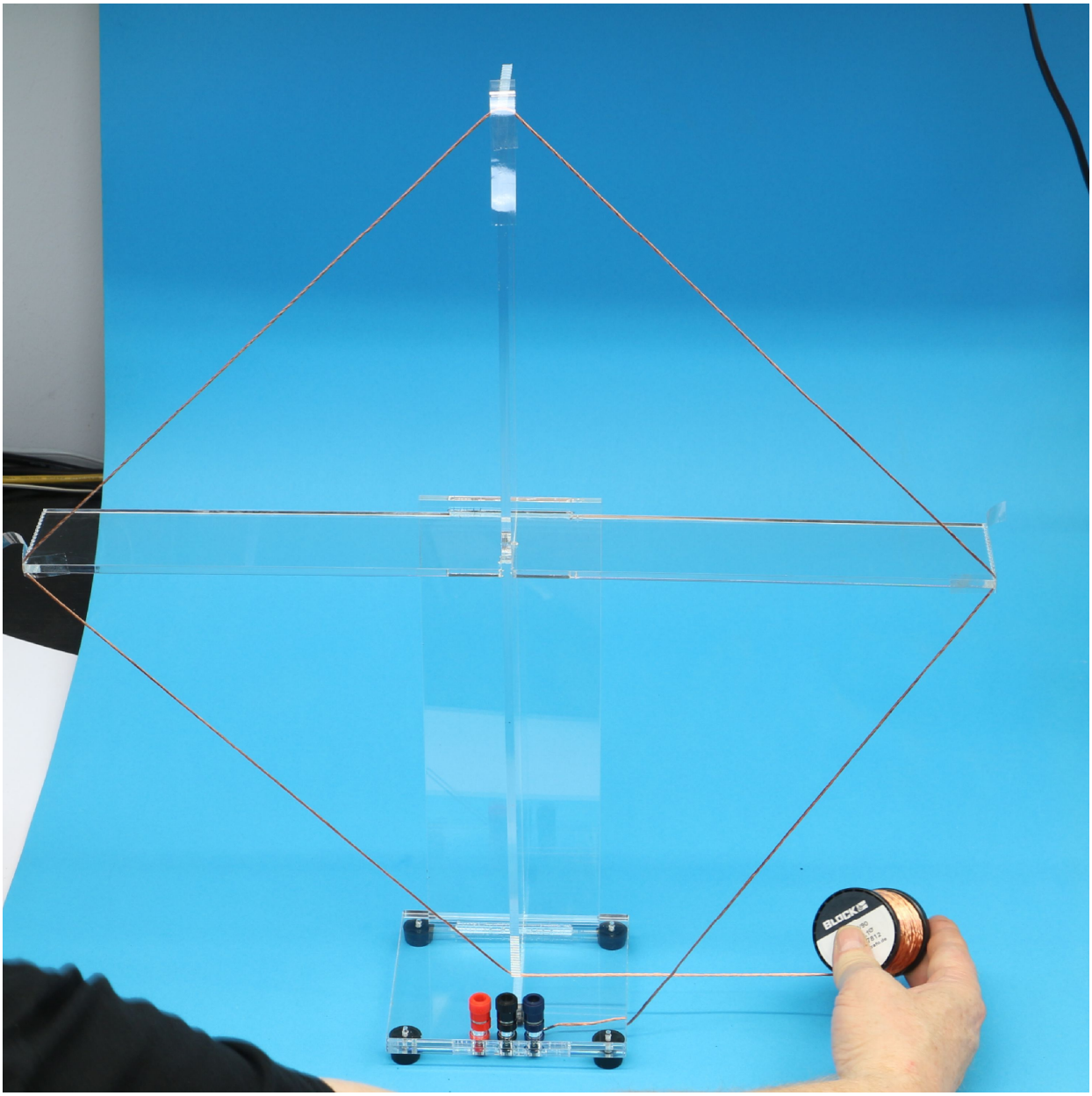
22.) Now, begin the winding process by unrolling the HF wire from the front notch on the right support.
Always maintain a **slight tension or pull** on the coil.
The HF wire or CuL wire must be **unrolled** throughout the entire winding process.
This means that the coil always faces the user (in this case, the type label always faces the user).
Otherwise, the wire will twist and have a consistent "twist" towards one side, which significantly complicates the winding process.
The two frame supports have small notches at their ends for guidance.
This ensures that each winding (even without Tesa tape) remains precisely in the right position and at the correct distance from each other.



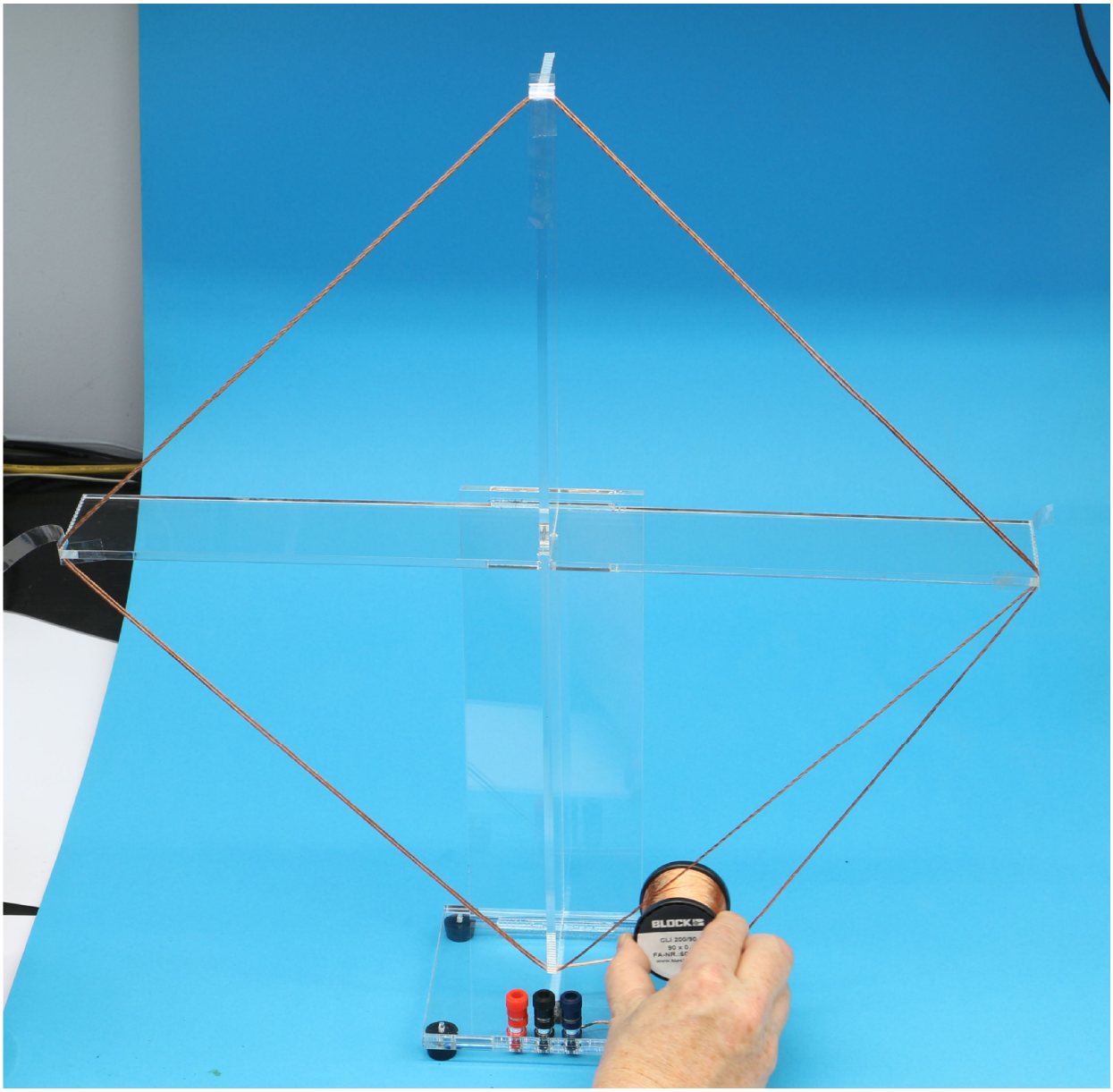
23.) Once the HF wire or CuL wire is threaded through one end of the frame cross, it should be secured again with the strip of Tesa tape. Continue the winding, **maintaining a gentle tension**, corner by corner.



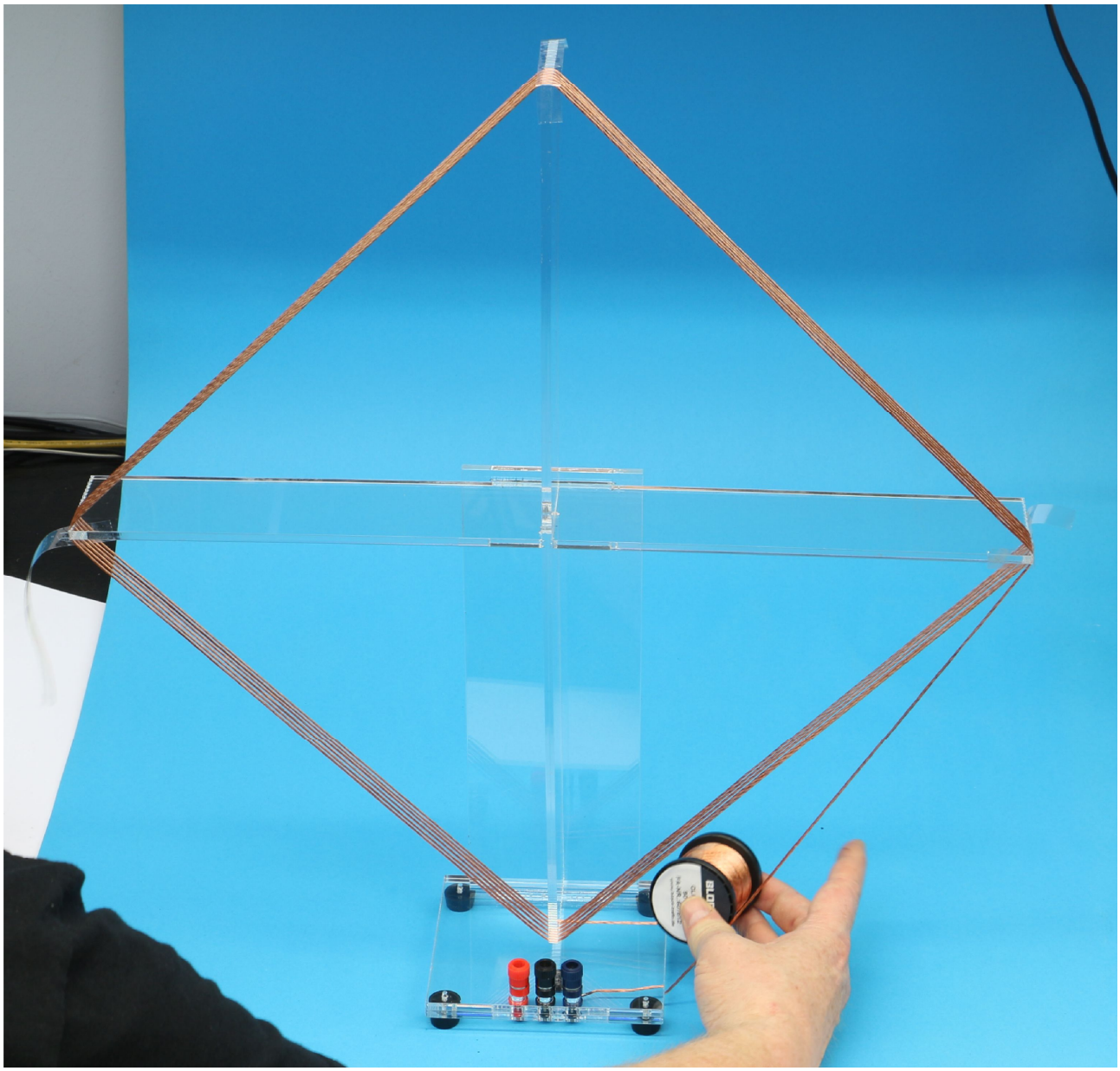
24.) When reaching the lower edge of each carrier, the coil must always be threaded behind the starting point of the winding. The following pictures show the progress of the winding and the "threading" at the bottom end.



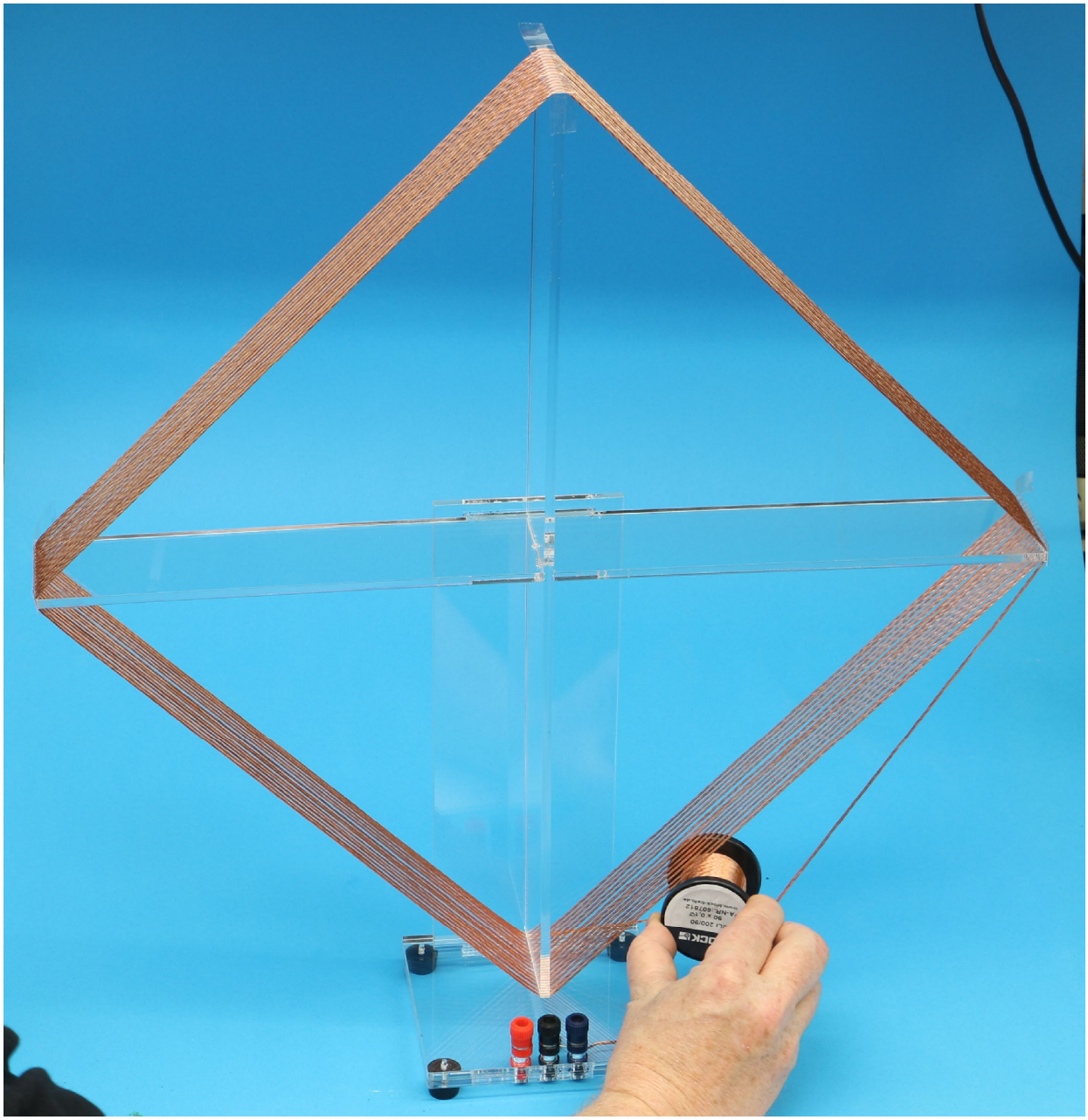
25.)



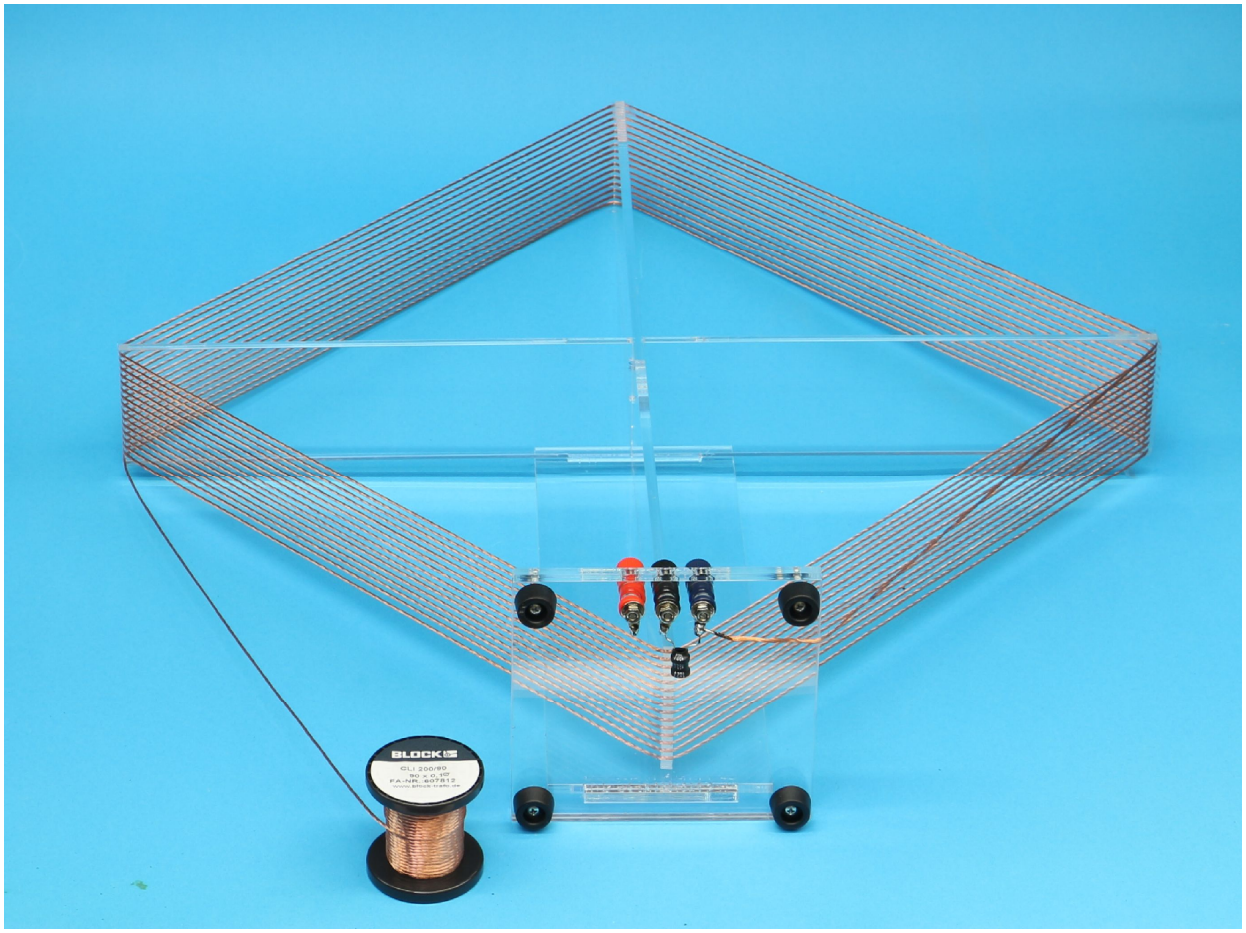
26.)



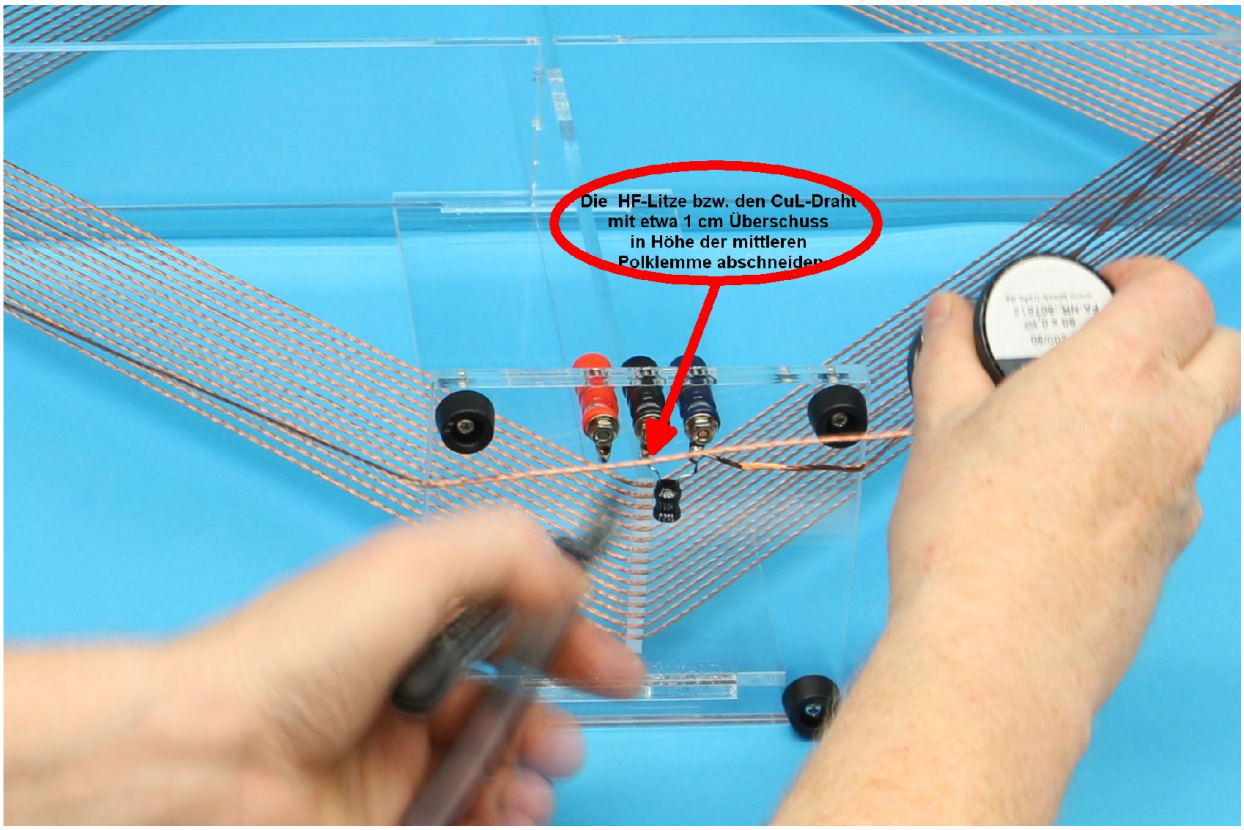
27.)



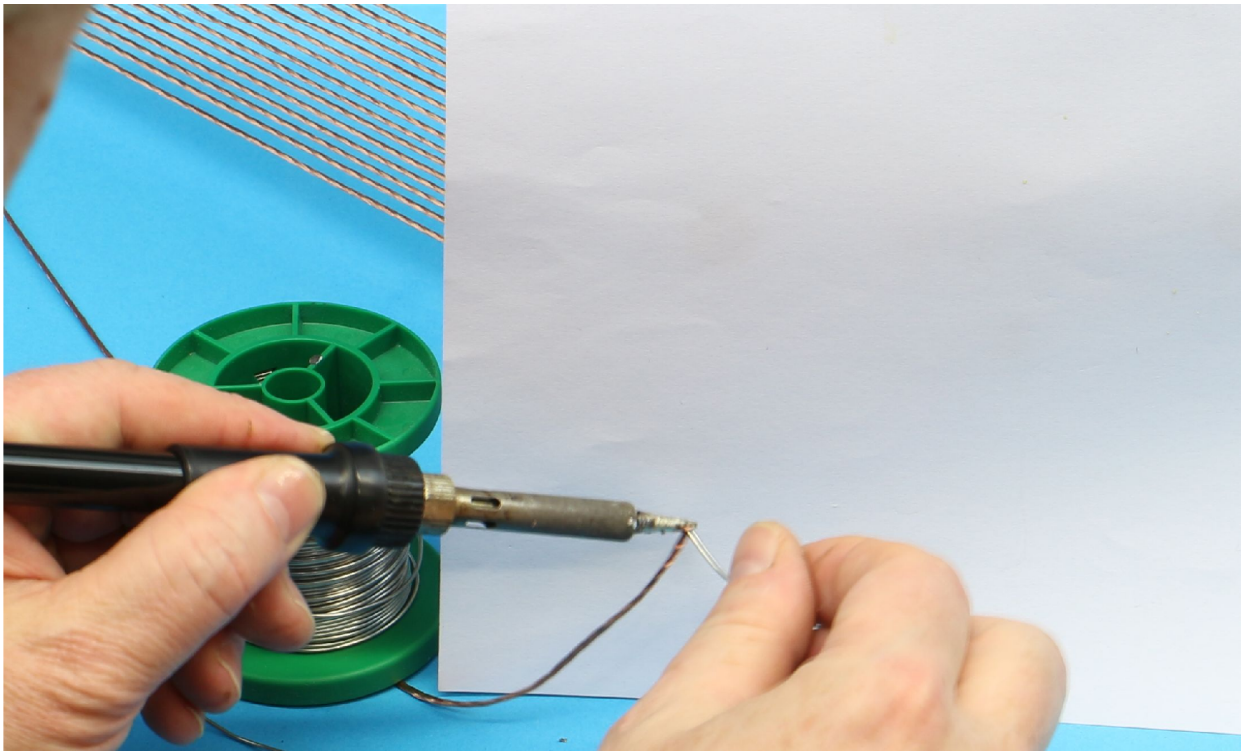
28.) Once the last turn has been applied to the left carrier, carefully lay the frame flat on its back. The base plate should be at the bottom and the 3 terminal clamps facing upward. It is particularly important at this point to secure the winding at the left carrier end with a strip of adhesive tape.



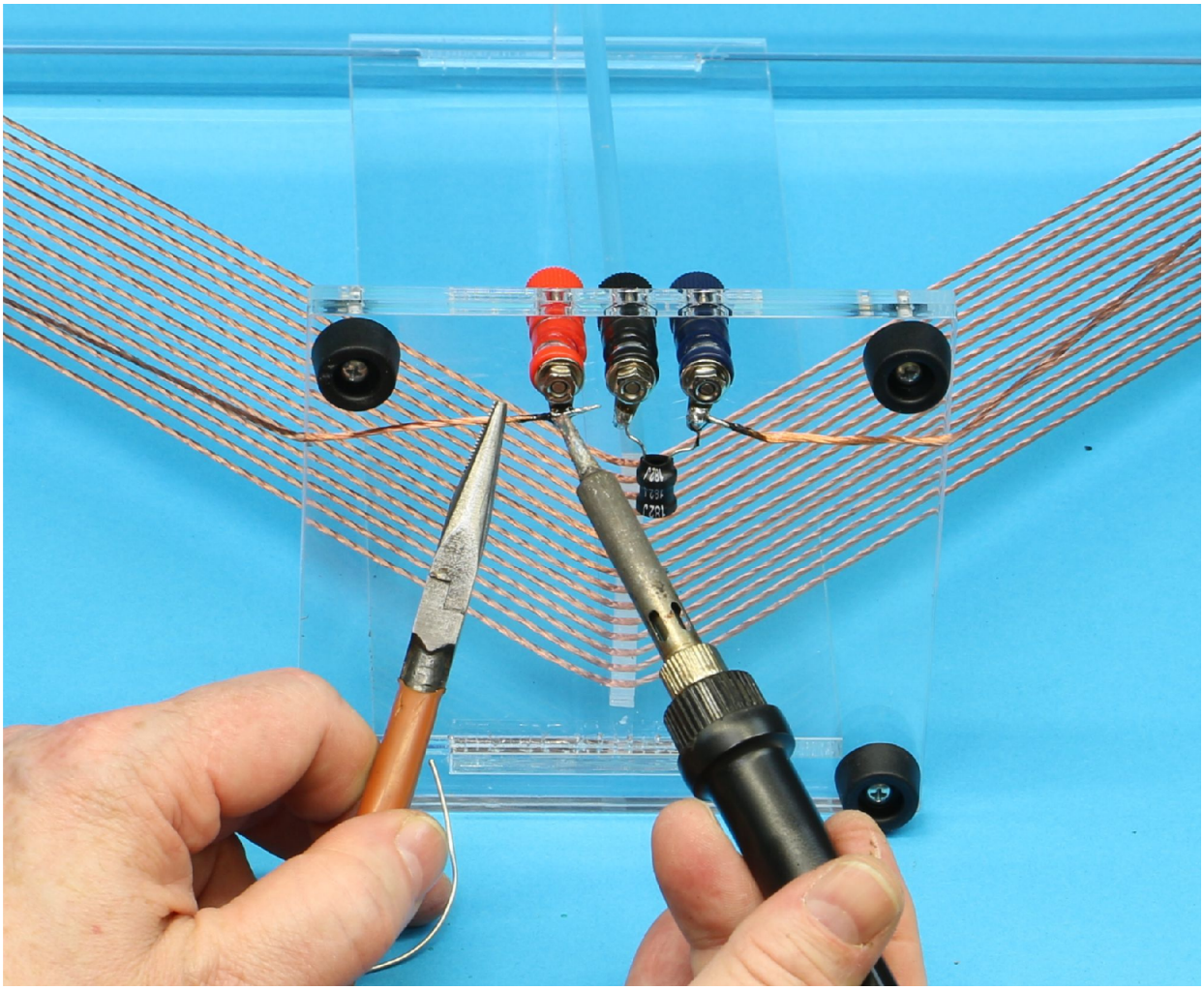
29.) Now, **guide the HF wire or CuL wire over the edge of the base plate** as shown in the image, and cut it with approximately 1cm wire excess at the level of the middle terminal clamp.



30.) Cover the base plate with a sheet of paper to protect it from solder splatters. Then, secure the end of the wire or stranded wire with a weight (e.g., solder spool) and tin it to a length of approximately 1...2 cm.



31.) Hold the tinned end under slight tension with a pair of flat-nose pliers and solder it securely to the remaining free solder lug of the left terminal. Then, cut off the excess piece at the end of the wire with a wire cutter. The frame antenna is now complete and ready for use.



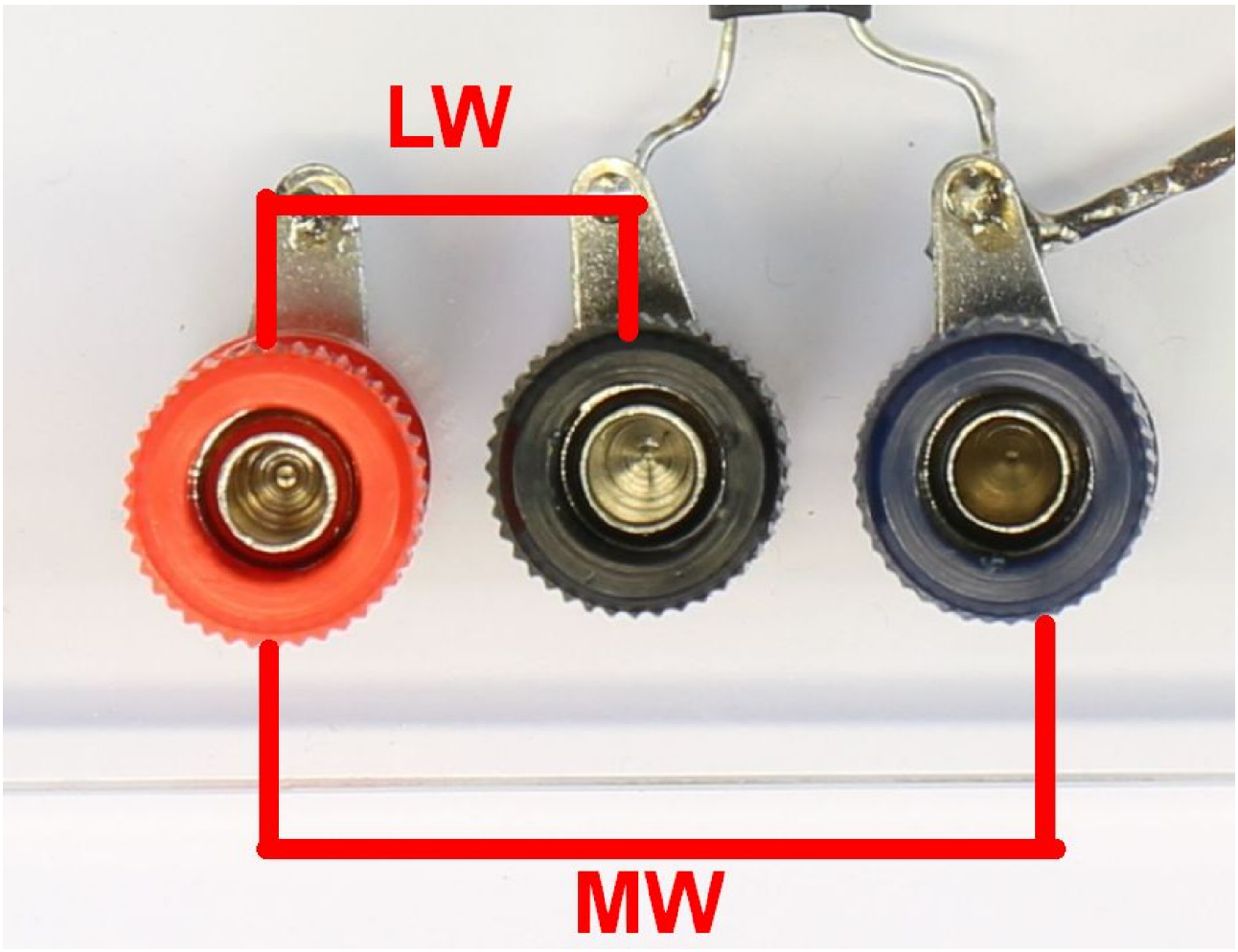
Finally, you can gently wipe off any marks or fingerprints with a dry microfiber cloth.

Be careful not to apply pressure on the supports, as they can easily break.

It's better to wipe both sides of the support with the cloth.

It is helpful to have someone hold the frame antenna firmly on the base plate during cleaning to prevent it from shifting.

For medium wave (inductance approximately 180 µH), the two outer terminals are used.
For long wave (inductance approximately 2 mH), the middle and left terminals are used.
(That is the terminal where the 1.8 mH inductance is not soldered)



The quality factor (Q) for LW and MW should be greater than 200 if the HF wire soldering was done correctly. You can perform a rough test for faulty wire soldering using a high-quality multimeter with an ohm measurement range resolution of at least 0.01 Ω.

To do this, insert two high-quality laboratory cables (preferably with banana or spade connectors) into the resistance measurement sockets of the multimeter and connect them together at the free ends (short circuit). Rotate the connectors in the sockets several times to minimize any transitional resistance due to oxide layers.

Note down the displayed resistance value (cable resistance + transitional resistance) or press the **"REL"** button for relative measurements. Then insert the ends of the laboratory cables into the two outer terminals and again rotate them several times to minimize contact resistance caused by oxide layers.

The displayed resistance (after subtracting the noted cable resistance) should be approximately 0.57...0.59 Ω. If it is significantly higher (e.g., 0.62 Ω), some wire strands are not soldered. This can be corrected by desoldering the ends of the coil from the terminals and resoldering them.

If you have a high-quality LCR meter available and connect it to the two outer terminals, you should see the following approximate values depending on the measurement frequency:

L_p ca. 180 µH

Measurement frequency:	**Q (quality factor):**
100 Hz	approx. 0.2
1 kHz	approx. 2.0
10 kHz	approx. 20
100 kHz	approx. 150...200
1 MHz	200...500

We wish you a lot of fun with long-distance or detector reception using this powerful loop antenna!