MIC&MOD

DIY Vintage Microphones

Mic & Mod U47 microphone.

The U 47 is a large-diaphragm condenser microphone. It is one of the most famous studio microphones and was Neumann's first microphone after the Second World War. The original series, manufactured by Georg Neumann GmbH between 1949 and 1965, employed a tube design; early U 47s used the M 7 capsule, then replaced by the K 47 from 1958. Since Telefunken ceased production of VF 14 tubes in 1957, the U 47 was discontinued in 1965.
The U 47 is regarded as one of several all-time preferred tube recording microphones. Its desirability is based primarily on the synergy of its three sound-shaping components: capsule, tube, transformer. The U47 was especially popular in US studios. Frank Sinatra owned his own U 47.
It's hard to find an album recorded in the 1950s or 1960s that didn't have a U47 on it; the Beatles used the mike for almost every track they sang from 1962 through 1970.

This is the list of materials you should have to build a U47 microphone:

Parts list

Resistors		
1	**1000 ohm**	**Brown/Black/Black/Black (Brown)**
1	**10 K.ohm**	**Brown/Black/Black/Red (Brown)**
1	**100 K.ohm**	**Brown/Black/Black/Orange (Brown)**
2	**2.2 M.ohm**	**Red/Red/Black/Yellow (Brown)**
2	**100 M.ohm**	**Brown/Black/Violet (Gold)**
2	**1 G.ohm**	**Brown/Balck/Gray (Silver)**

Capacitors		
1	**1000 pF Styroflex**	**Silver, axial**
2	**10 nF/630 V**	**0.01 µF Red or Blue**
2	**1µF/250 V**	**Green, 1 µF, axial**
1	**47µF/16 V or higher**	**Black, radial**

Miscellaneous		
1	**EF806S tube, selected**	**Noval penthode tube**
1	**Amplifier PCB**	**Main printed circuit board**

1	**Tube PCB**	**Small printed circuit board for tube socket**
1	**Tube socket, Noval**	**PCB mounted tube socket**
1	**Transformer BV8**	**6.5 : 1 output transformer**
4	**Screw, M2 x 4**	**To mount the main PCB**
2	**Screw, M1.6 x 6**	**To mount K47 capsule**
2	**Washer 1.7 mm.**	**Washers for capsule screws**
1	**1 mm tinned copper wire**	**Wire for mounting the output transformer**

* Depending on the manufacturer, colors may be different.

First a word of warning:

Do not touch anything inside the microphone when the power supply is connected. The microphone works with high voltages, that in some situations can be lethal. When you work on the microphone, ALWAYS disconnect the power supply. Even when the power supply is switched off, the capacitors inside the power supply will keep a high voltage for a long time.

The building process of the U47 will be described step by step, if necessary further explained with pictures.

1. Unscrew the bottom of the microphone housing by holding the microphone body and unscrewing the bottom ring. Now the metal body tube can be removed too.

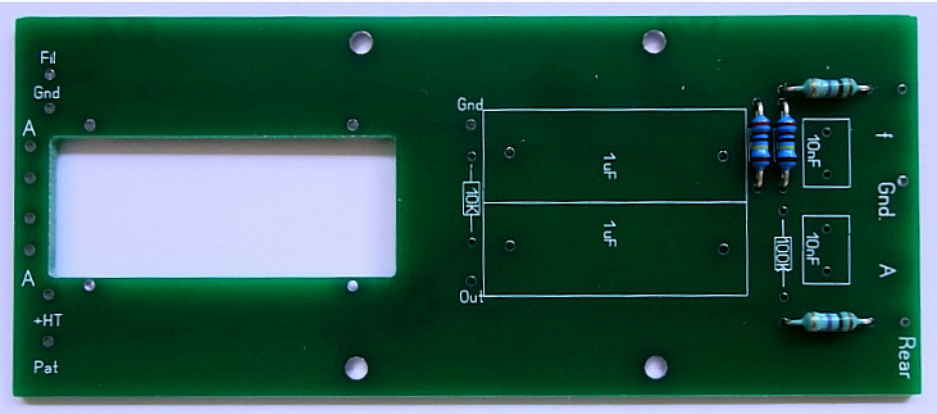
2: Remove the two screws that hold the headbasket. Store the screws carefully. Now remove the headbasket.

3. Remove the capsule holder (if present), by removing the two crosshead screws that hold it. We will install another new capsule holder later.

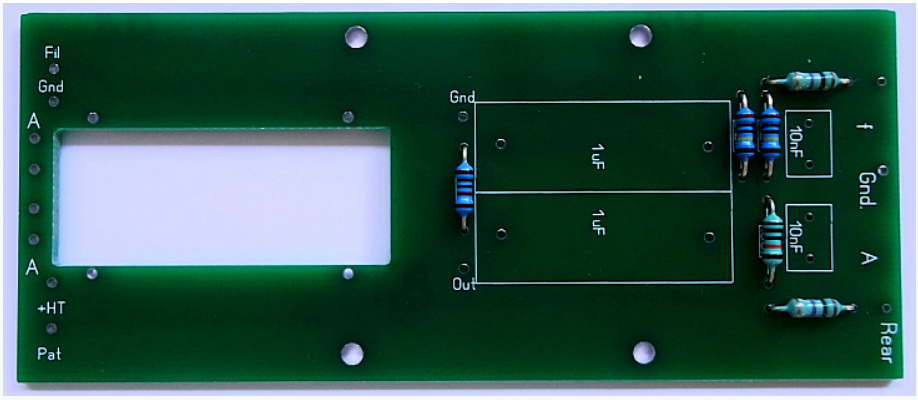
4. Remove the two screws that connect the metal top plate to the two ‘rails’.

5. Now the microphone body is prepared, we assemble the audio PBC first.

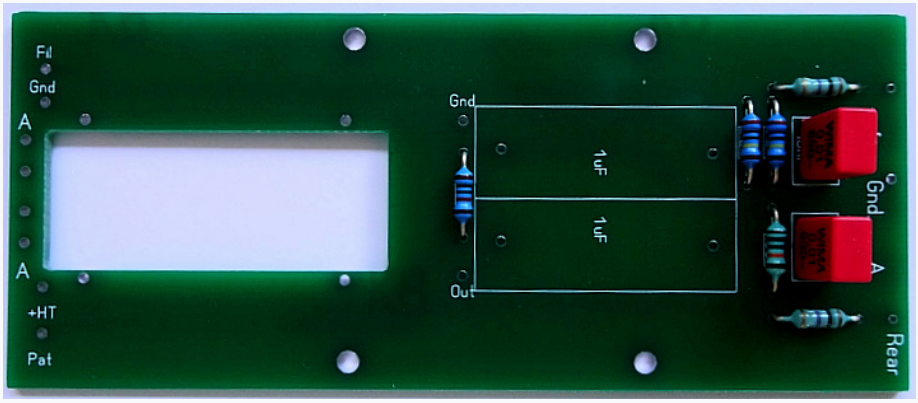
6. First step is to mount and solder the two **2.2 M.ohm** resistors and the two **100 M.ohm** resistors



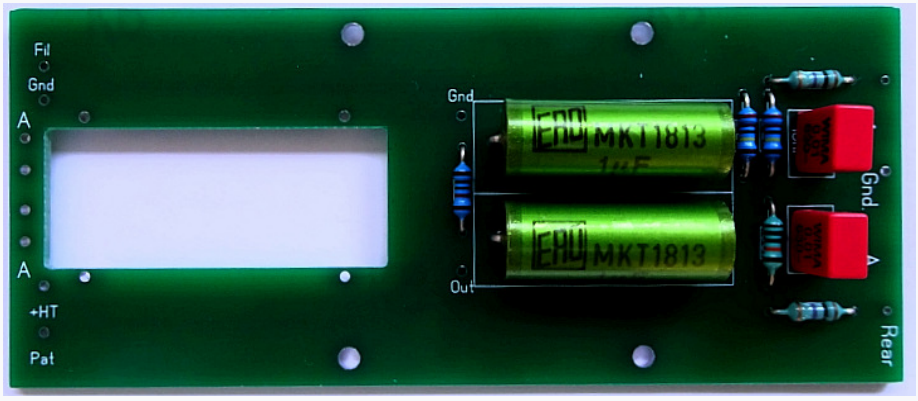
7. Next place and solder the **100 K.ohm** resistor and the **10 K.ohm** resistor. They look *almost* the same, so don’t mix them up!
(The 100 K.ohm has an **orange** band, the 10 K.ohm has a **red** band.)



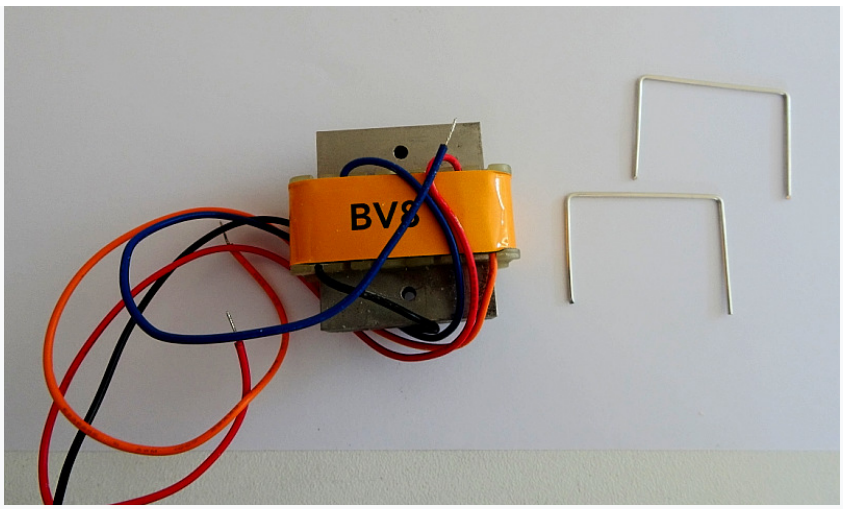
8. Place and solder the two **10 nF** capacitors.



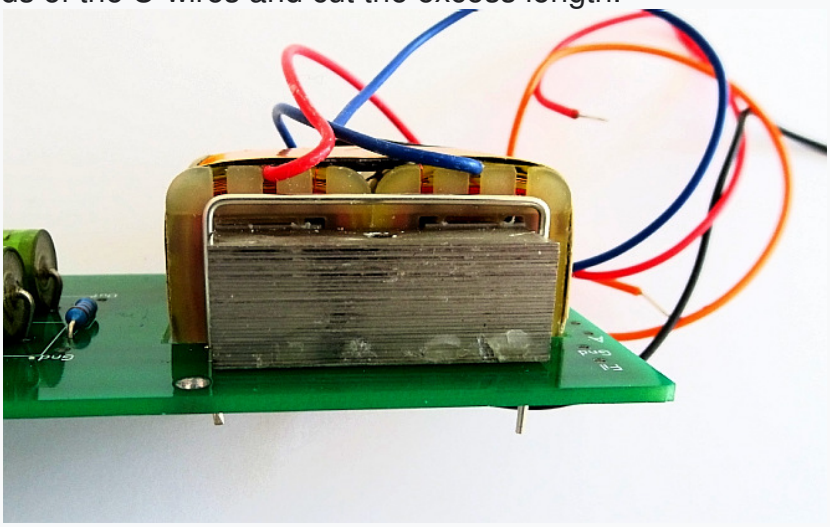
9. Place and solder the two **1 µF** capacitors. You will have to bend the wires close to the body of the capacitor.



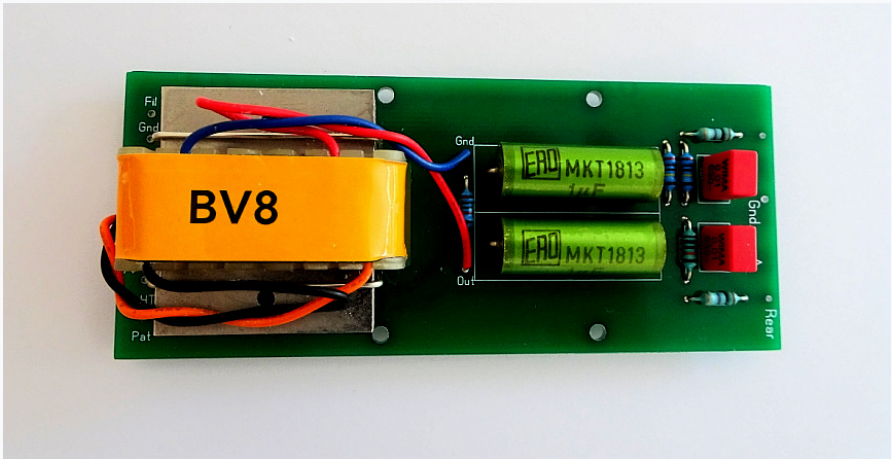
10. Now we install the **transformer**. Take the piece of 1 mm thick tinned copper wire, stretch it and cut it in two pieces. Fold the pieces of wire in a ‘U’ shape, in such a way that the core of the transformer just fits between the ‘legs’ of the U.



11. Insert the transformer in the rectangular hole in the PCB and insert the U-wires we just made in the holes of the PCB. Push the transformer down so that it is flat on the PCB and push the U-wires down, so that they will keep the transformer in place. Solder the ends of the U-wires and cut the excess length.

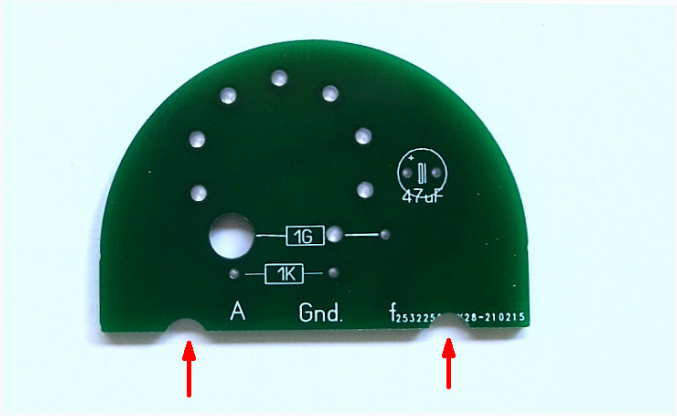


12. Solder the **red** transformer wire to '**Out**' and the **blue** transformer wire to '**Gnd**'. You will need to shorten the transformer wires a bit. **NEVER** pull on the transformer wires while stripping them!
Solder the **black** and **orange** wire to the two solder spots that are close together between the points marked 'A'. (The most centered ones.)

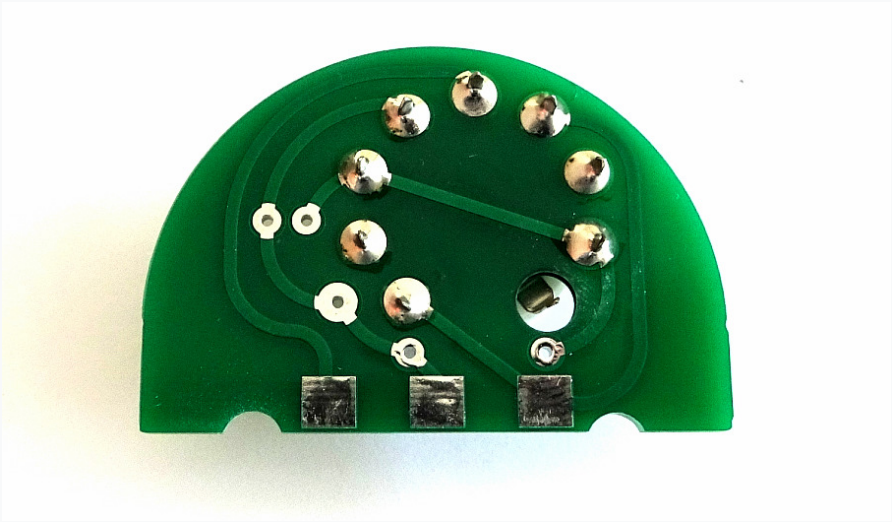


13. Mount the competed PCB on the microphone frame, using four M2 x 4 screws. (Connection points ‘Fil’, ‘Gnd.’, ‘+HT’ etc. down, close to the XLR connector.)

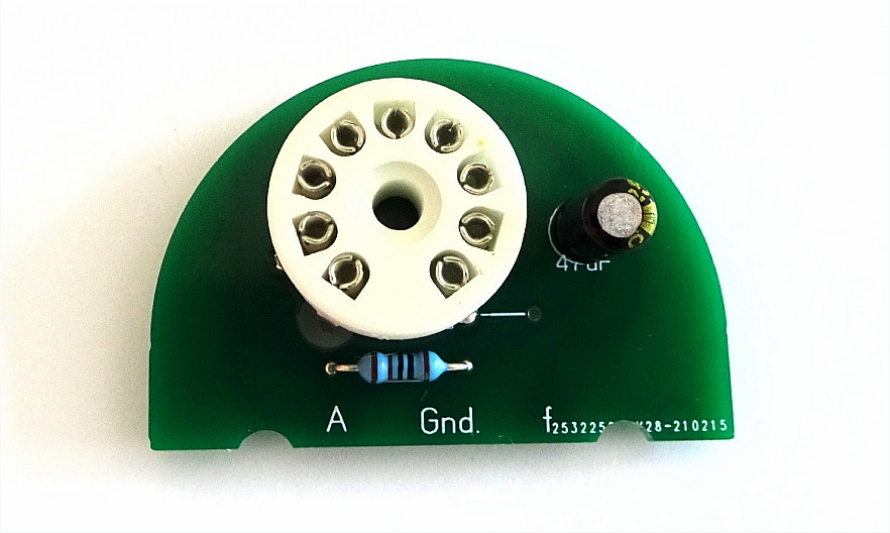
14. Now insert the small tube PCB in the slots of the frame, close to the top of the microphone. If the solder connections on the bigger PCB prevent the small tube PCB to touch the the surface of the PCB, you can use a file to remove some PCB material.



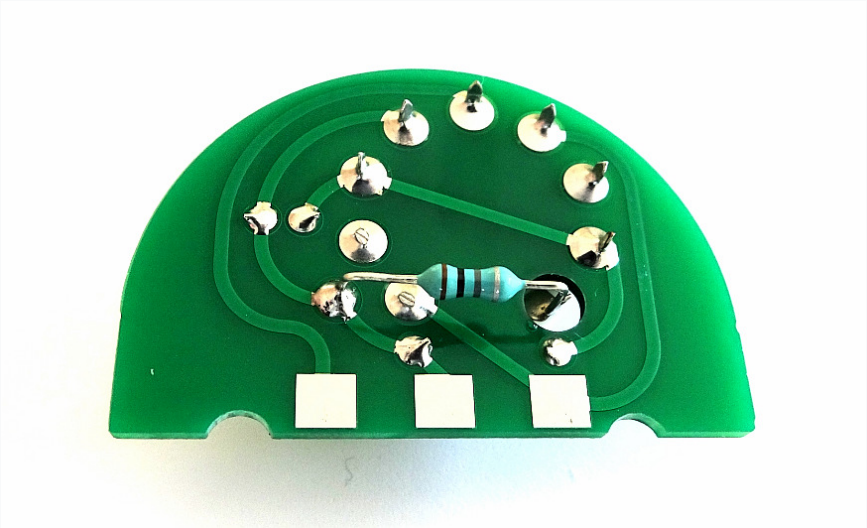
15. If everything fits, take out the small tube PCB and solder the tube socket on the PCB.



16. Place and solder the 1 K.ohm resistor and the 47 µF capacitor.
Take care of the polarity, the ‘-‘ side should be near the edge of the PCB, the ‘+’ side should be near the tube socket. The ‘-‘ side of the capacitor is indicated by a colored stripe. The ‘+’ side of the capacitor is the longest wire.

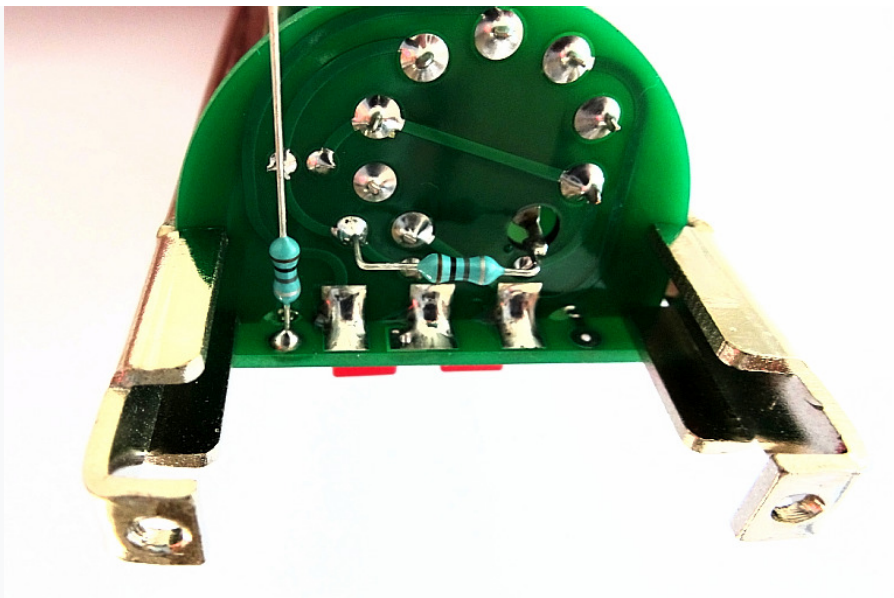


17. Solder a 1 G.ohm resistor between the pin of the tube socket protruding through the bigger hole and the PCB, like below:

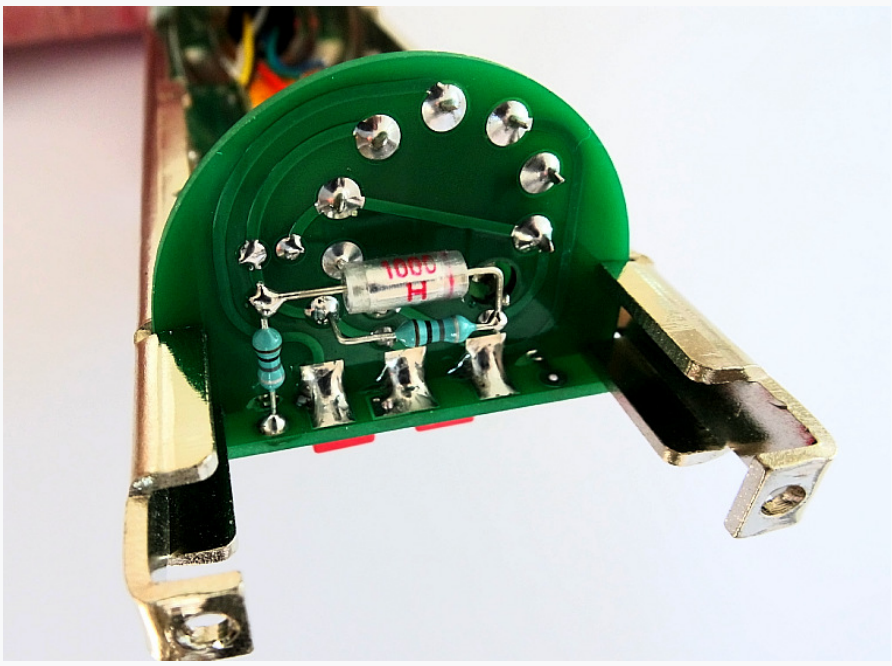


Cut the excess length of the resistor wire at the other end of the PCB.

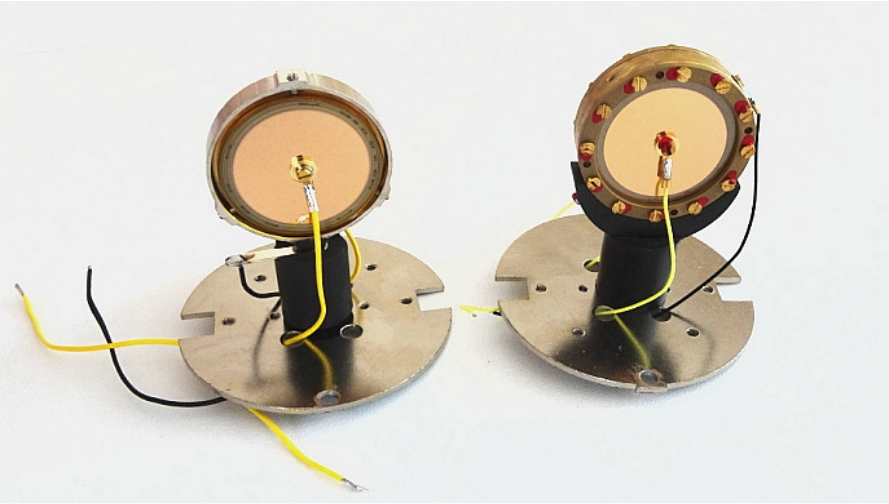
18. Put back the tube PCB in the microphone frame and solder three points together. Use a good bit of solder, but solder quick(!), in order not to damage the traces on the PCB(s).
Solder the second 1 G.ohm resistor with **one** wire to the PCB, like below, and trim the excess length on the other side of the PCB.



19. Solder the 1000 pF styroflex capacitor between the resistor that is already connected to the tube pin and the other end of the resistor that we just placed. Trim the wires to length like in the picture below.



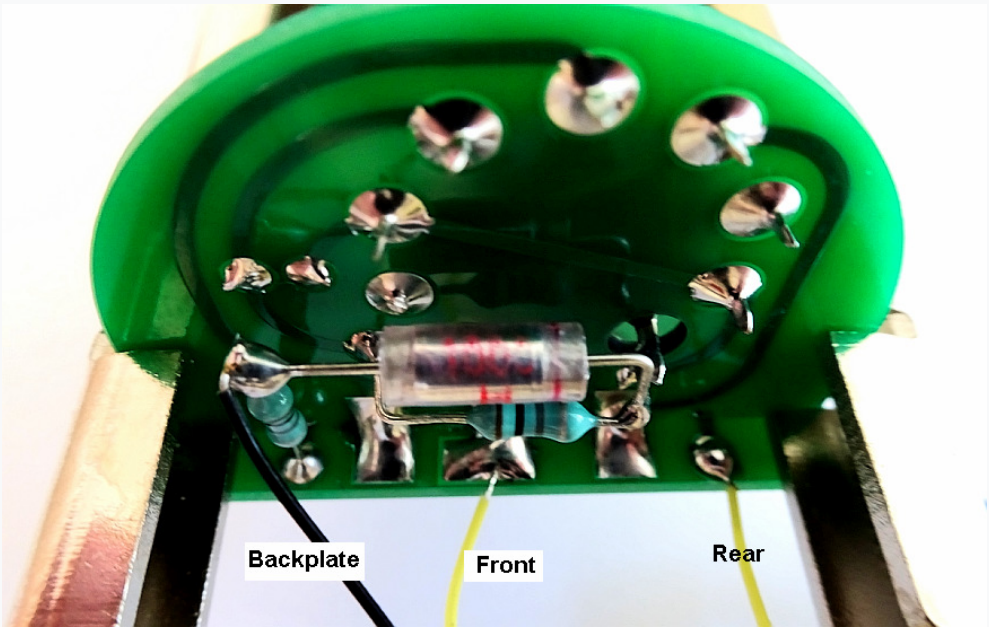
20. The time has come to mount the microphone capsule.
If you use a M7 capsule, the capsule mount and the capsule are one single piece.



M7 capsule (left) and K47 capsule (right)

For the M7 the only thing you have to do, is to solder the (black) backplate wire to the solder lug at one side. Be careful not to splash solder flux on the membrane(s)!
It might be a good idea to cover the membranes with a small plastig bag while soldering. **Never** touch the membranes with your fingers!
If you use a K47 capsule, you first have to screw the capsule in the capsule mount (or 'saddle'), with the two M1.6 x 6 screws. Use the M1.7 washers if needed.
In both cases the capsule mount is fastened to the metal top plate with a single screw + washer. You can rotate the capsule mount freely. Adjust it in such a way that the sides of the capsule are near the screw holes for the 'rails'.
Use different holes to lead the wire from the front- and the rear membrane through. (Eventually put a mark on the bottom, so you know which wire is the front and which wire is the back. The backplate wire has a different color.)
Note that the capsule itself has no 'front' or 'back' side. Both sides are the same, it is just how you connect the wires.

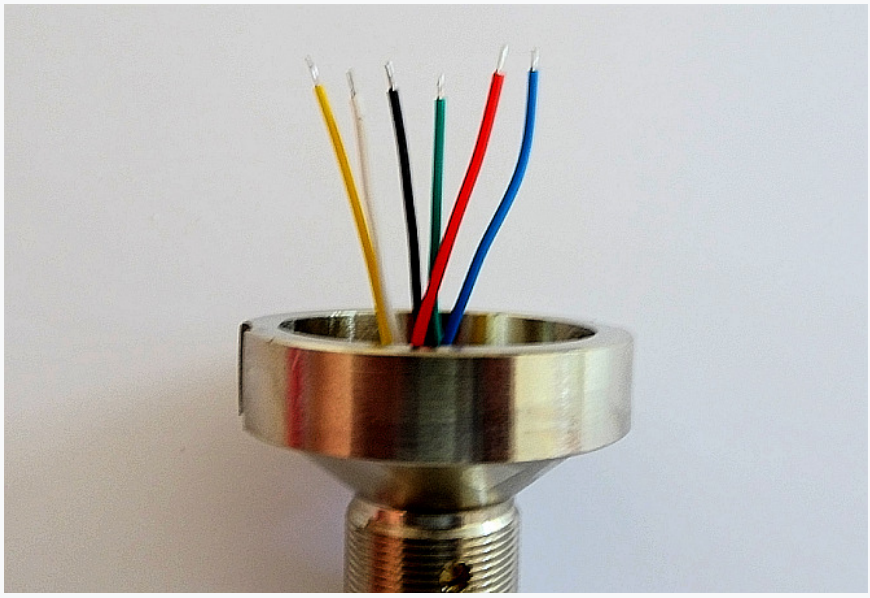
21. It is easier to solder the capsule wires while the metal top plate is not back in place. Solder the backplate wire to the connection **1000 pF/1G.ohm** (see picture), the front membrane wire goes to the **center connection** where the two PCBs are soldered together and the wire from the rear membrane is soldered to the point marked '**Rear**'. (on the back of the PCB.)



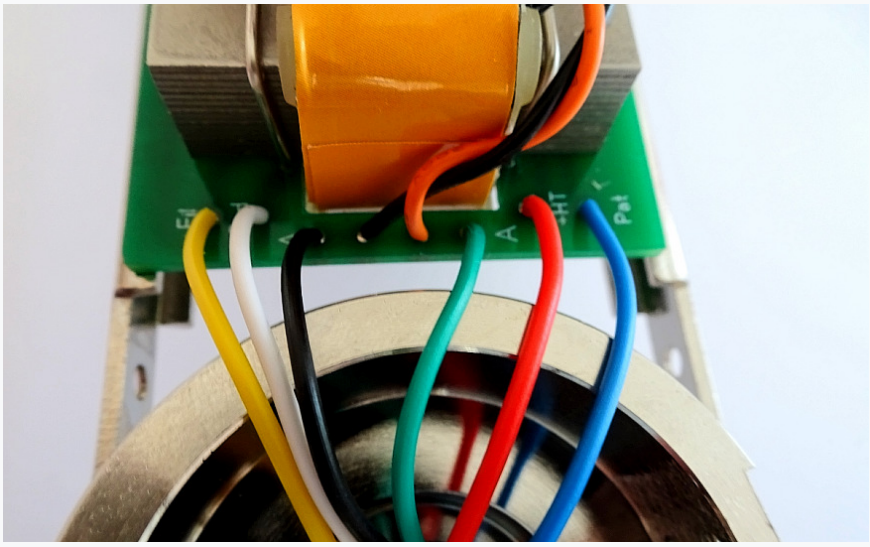
22. To put the metal top plate back, you need to remove one of the ‘rails’ first. Remove two screws on the long side of the main PCB and also remove two countersunk screws in the metal base where the XLR insert is.

23. Fasten the metal top plate with the microphone capsule to the ‘rails’, place the screws back that hold the PCB and put the headbasket back in place with the screws you took out in **2**.

24. Take out the metal bottom piece with the XLR connector and shorten the wires to about 4 cm (1.6”). Strip the ends of the wires, twist the strands and tin the ends.



Solder the wires to the main PCB:



Yellow connects to ‘Fil’ (=Filament)
White connects to ‘Gnd. (=Ground)
Black connects to the spot with the black wire from the transformer
Green connects to the spot with the orange wire from the transformer
Red connects to +HT (= +120 V.)
Blue connects to ‘Pat’ (= Pattern)

25. Put back the metal bottom piece and fasten it with the four countersunk screws that you took out before.

26. Carefully insert the EF806 into the tube socket.
To make it easier to insert the tube, you could push the end of a paperclip or a leftover short piece of 1 mm. wire into each tube socket contact.
This will slightly reduce the force of the spring contacts, making it easier to insert the tube. The easiest way is to ‘wiggle’ the tube into the socket.

27. Place the body tube back and screw the bottom ring back in place.
Now connect the microphone to the power supply and test the microphone...

Schematic: