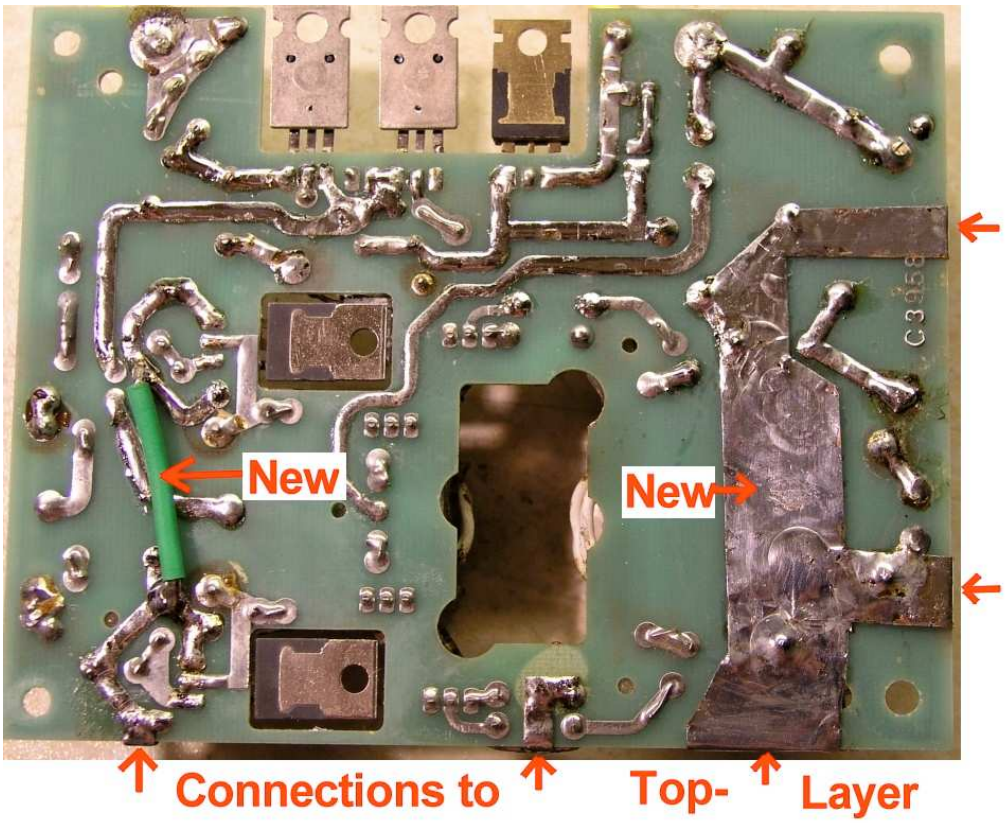
Drake TR-7 - Full Output Power on 10m

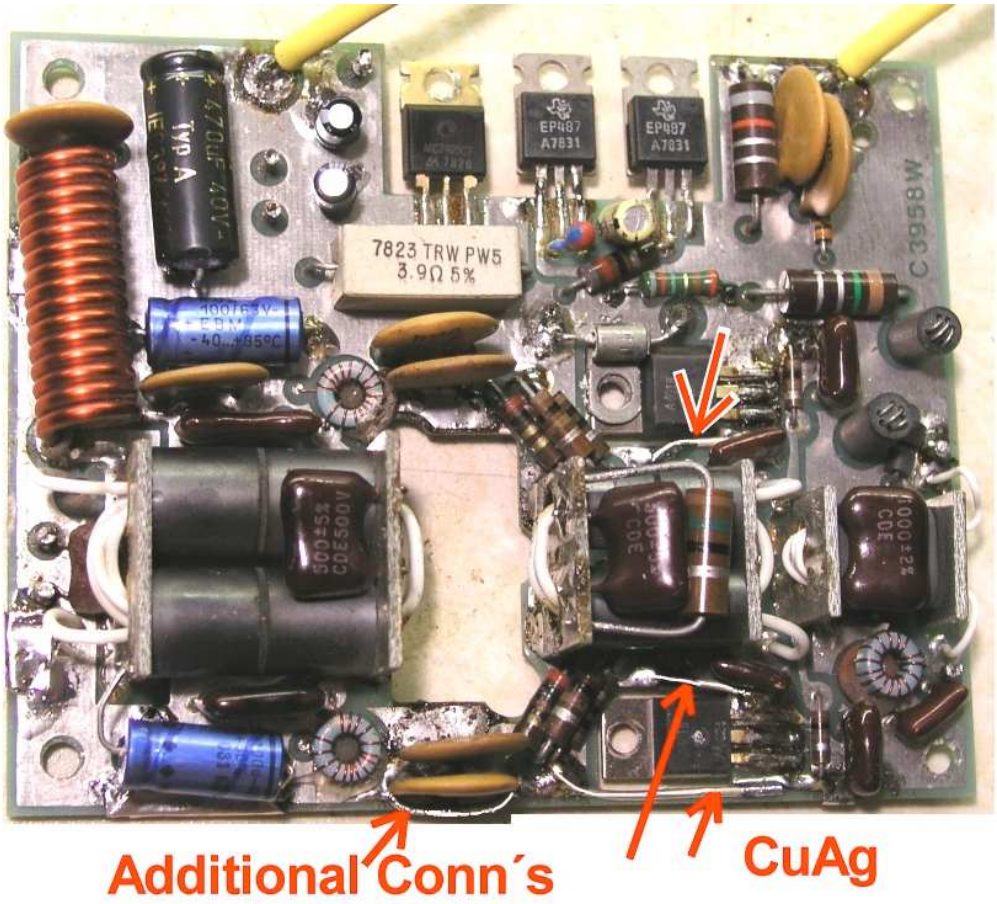
My TR-7 (rather old unit; s-nr.: 1933) had only about 35W output on 10m, the other bands provided full output, i.e. more than 100W. A complete new alignment didn´t improve the situation. Here are my proposals to improve the situation:
Note: All these modifications and results depend upon the version of your TR-7. Measurements were made with the PS-7 in use (13,8VDC).

1. Step A

I took the PA-module including the predriver (my predriver has 3 transistors) – the so called „brick“ - out of the TR-7 and checked it with a HP8640B signalgenerator, a 200W-attenuator and a wideband-scope. Even with very high input at the predriver (>> 0,4Vpp), the output of the PA wasn´t higher than 40W on 10m. In my TR-7 the driverstage in the PA uses two 2SC1969 and the finalstage uses two SRF2337.
The Solution:
The ground-planes of the PA-module were very poor. So i added additional connections between top- and bottom-layer. Additional wires and copper-strips helped to increase the conductivity for HF in the groundplane – see **pictures 1 and 2**.
After this modification, it was possible to get more than 100W out on 10m, when the PA-module was tested outside the TR-7 with predriver-inputlevels of less than 0,4Vpp!



Picture 1: New groundplanes and connections to top-layer (PA)



Picture 2: Additional connections in the groundplane (PA)

BUT: When the PA was back in the TR-7, the output was a little bit higher than before but still only 45W on 10m!! I checked the attenuation of the high- and lowpassfilters – but without results.

Additionally i resoldered all groundconnections in the PA-unit as shown in Step D (**picture 7**).

2. Step B

After many measurements, i found the most relevant reason for the low power on 10m: There is a mismatch between the output-impedance of the highpass (HP) and the input-impedance of the predriver. The output-voltage of the HP was loaded too much by the predriver-input. By testing the input-impedance of the predriver with serialresistors, i got a value of only about 26 Ohms(!) at 30MHz.

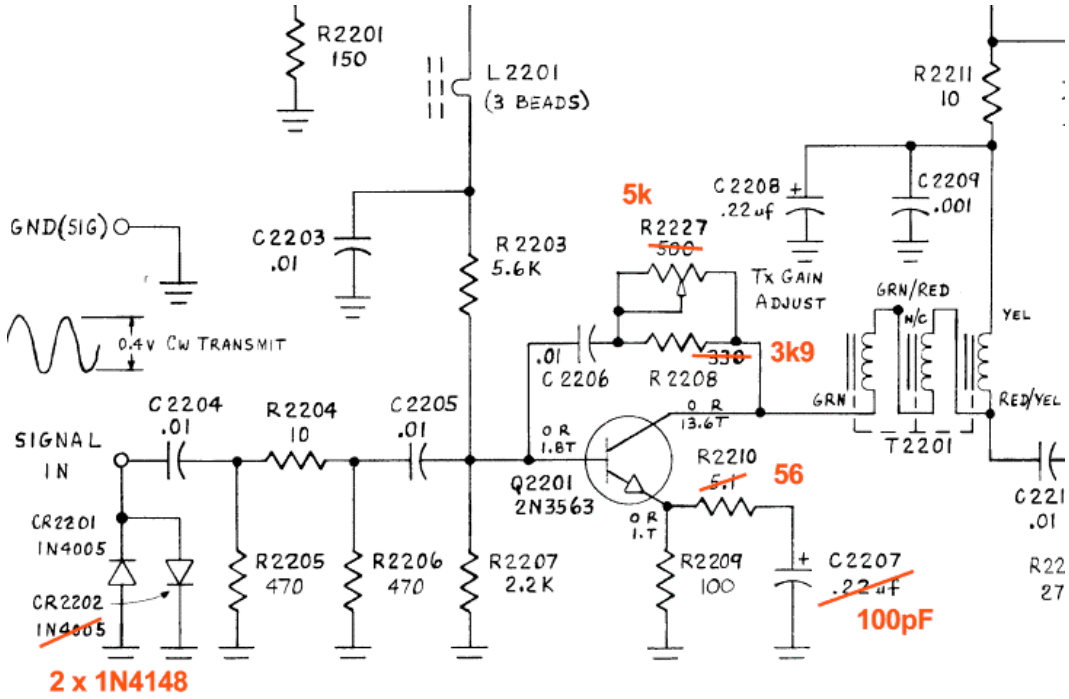
THAT WAS/IS THE PROBLEM!

Looking at the schematic (**picture 3**), the reasons can be seen easily:

A. The emitter of Q2201 is connected low-ohmic to ground via 5.1 Ohms (R2210).
B. The feedback via R2227//R2208 has a low impedance; the effective value of these resistors related to the input is divided by the voltage-gain of Q2201 because of the negative feedback.

Following modifications helped me to solve the problem:

A. Increase R2210 to 56 Ohms
B. Replace C2207 by 100pF (ceramic)
C. Increase trimpot R2227 to 5k
D. Increase R2208 to 3k9
E. Replace CR2201 and CR2202 by 1N4148 to reduce the capacitive load in the input



Picture 3: Increasing the predriver´s inputimpedance (old version with 3 transistors)

These modifications don´t reduce the gain of Q2201 but increase the input-impedance of the predriver from 26 Ohms up to 150 Ohms(!) especially at 30MHz. At lower bands the gain is reduced a little bit due to increasing reactance of C2207 – but this isn´t essential or even welcome for flatter frequency-response over all bands.

The result: More than 100Watts on all bands – even on 28 to 30MHz !!!!

Note for the new predriver version:
I have no idea, whether this modification also applies to the new version (2 Transistors) of the predriver. The circuit is different, so this mod can´t be used directly.

More Improvements

Some additional improvements, which are a little bit optic and a little bit effective, but may avoid problems in the future are described in the following:

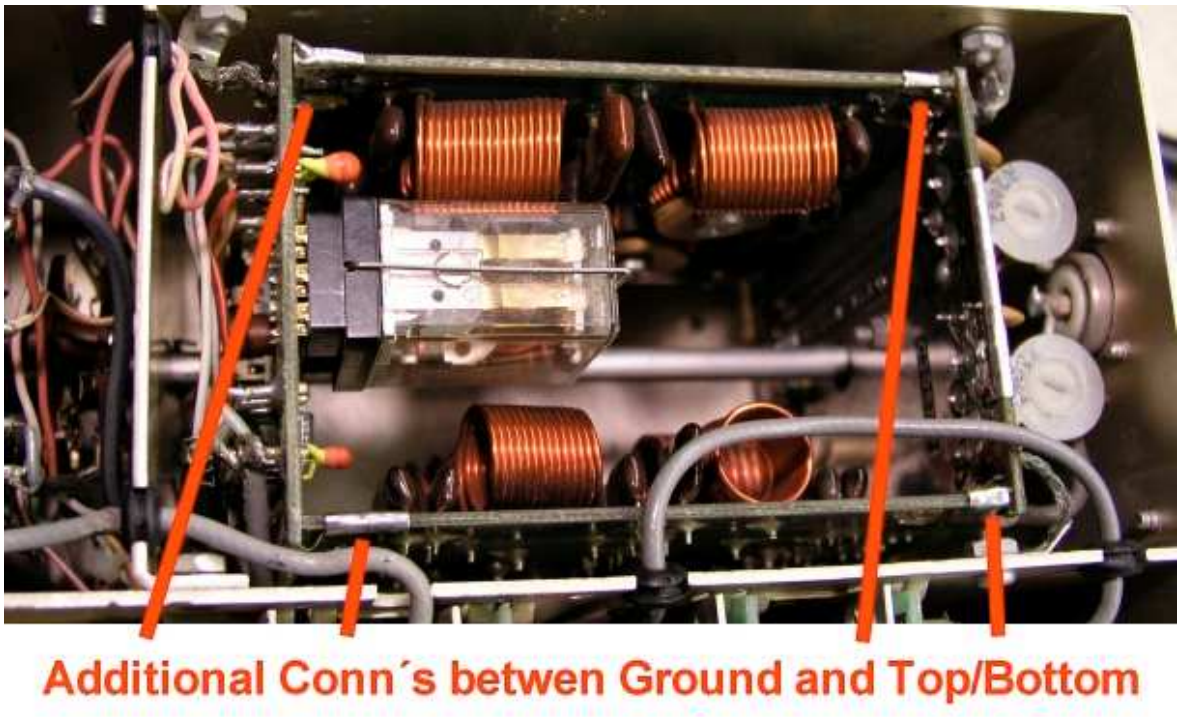
3. Step C

The HP- and LP-modules have rather few connections in the groundplane – especially the connections between the pcb´s could be improved. There are only few pins in the ground-path, so i added additional copperstrips to improve the groundplane – see **pictures 4, 5 and 6**.

A lot of work, but the result was not very effective: The output rose only by some watts.

Picture 4: Additional groundconnections in the highpassmodule

Picture 5: Additional groundconnections in the lowpassmodule



Picture 6: Additional groundconnections in the lowpassmodule

4. Step D

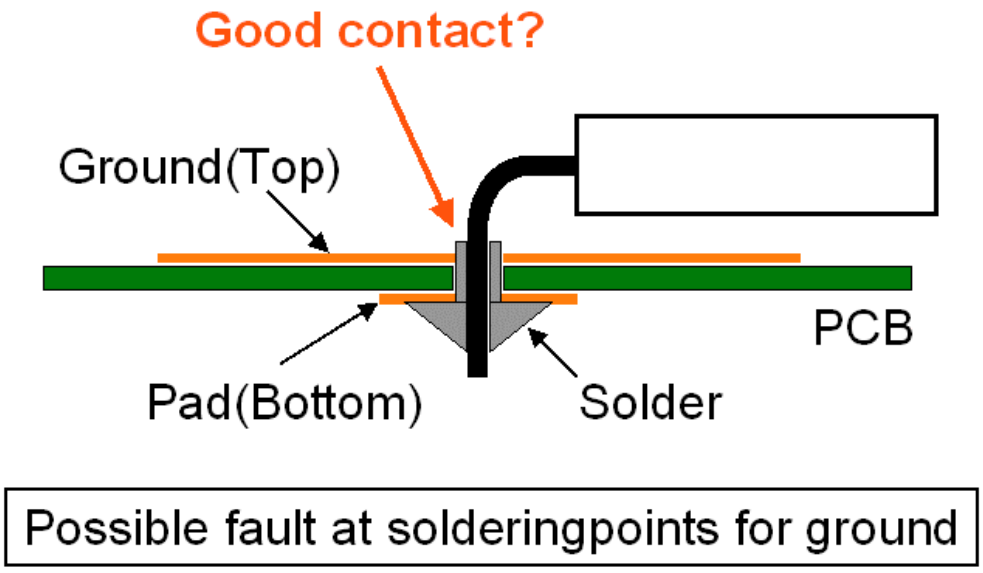
The measurement of all HF-levels inside the TR-7 and the comparison with the nominal values in the servicemanual showed, that some HF-levels were too low (70% and less).

Again i checked the pcb´s of all units and found some problems – see **picture 7** for discussion.

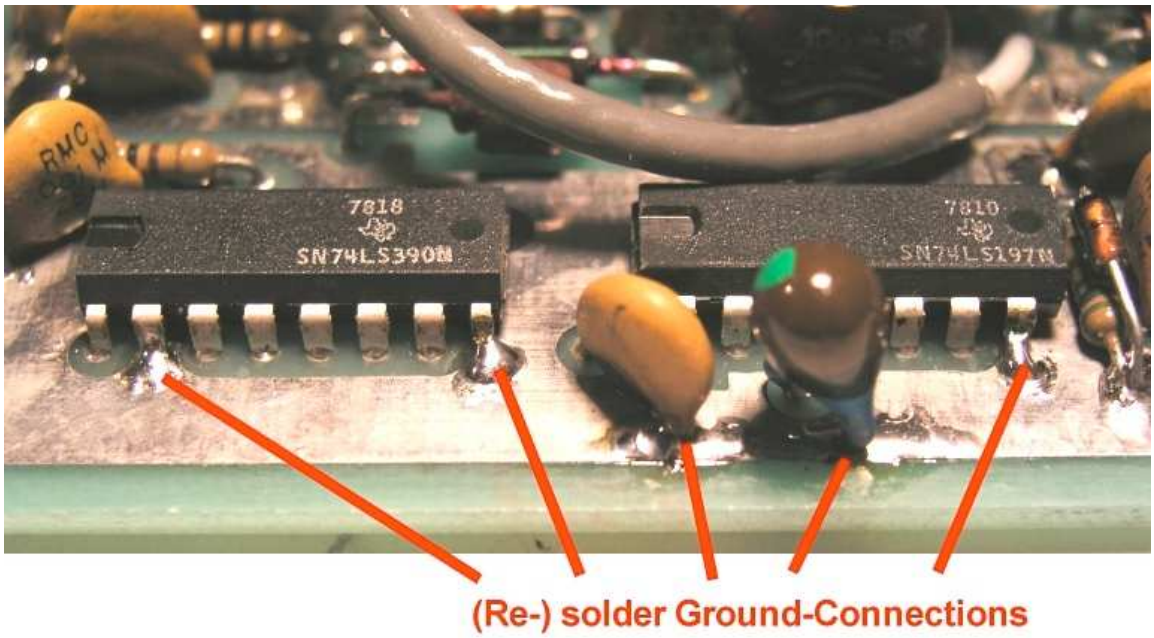
In my TR-7 many groundpads had been soldered only from the bottomside of the pcb, but the contact on the topside – were the groundplane is – was doubtful. So the groundconnection may be faulty in some cases. The contact is sometimes given only by the mechanical pressure but not by the solder and may become worse due to aging.

I resoldered all critical groundconnections of all components on the pcb´s including the connectors. This required sometimes the unsoldering of other parts who hindered the access to the solderimg points. Also additional copperstrips have been used for connections between top- and bottomlayer of the pcb´s where necessary.
Some examples are shown in the **pictures 8 to 11**.

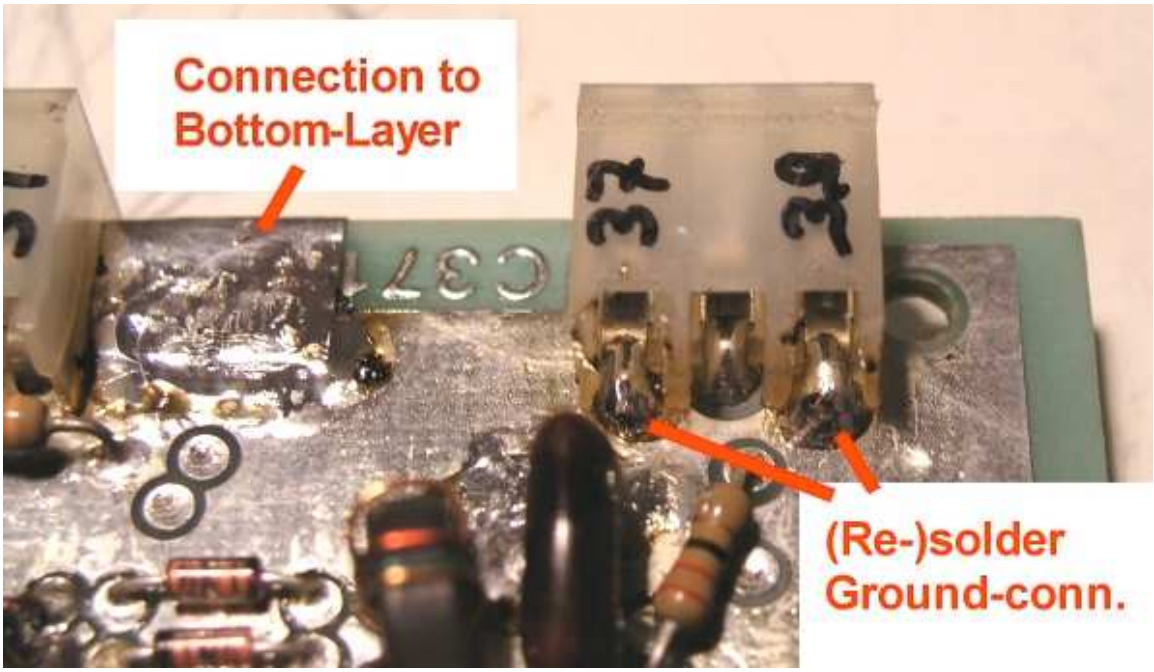
Result: The HF-levels in the TR-7 increased to the nominal values.



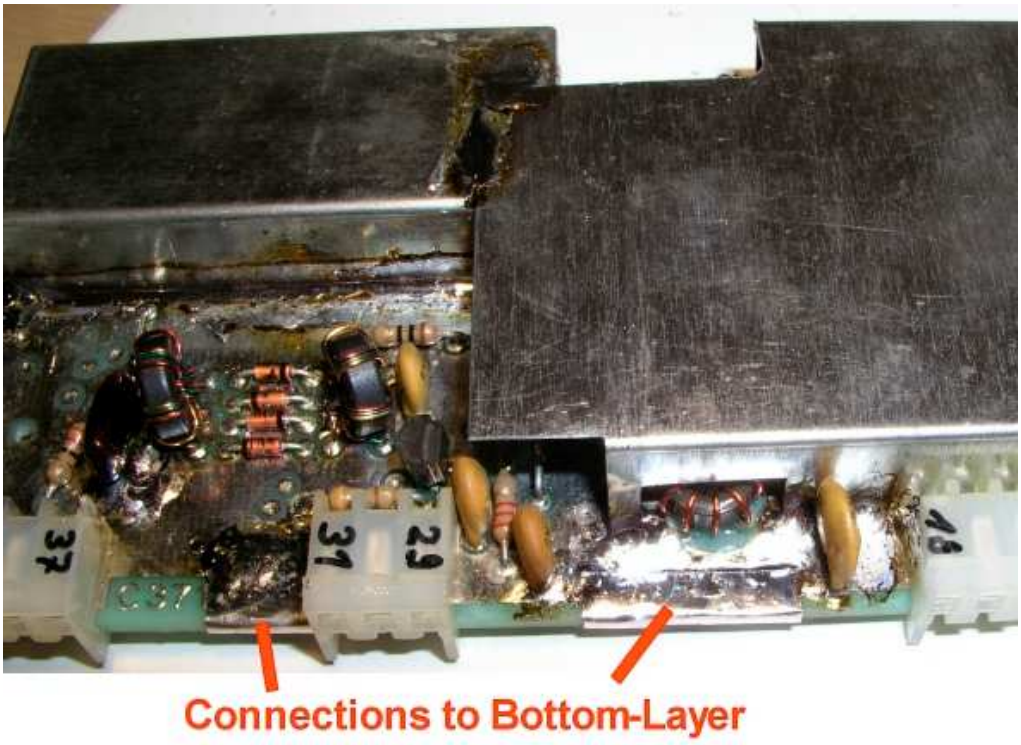
Picture 7: Problem with the groundpads



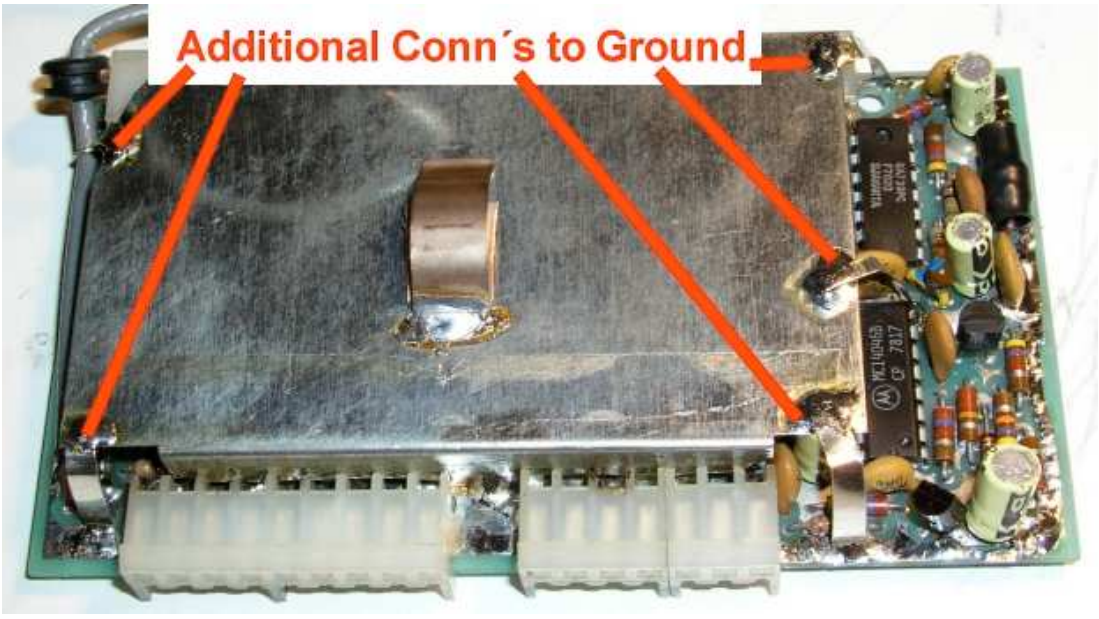
Picture 8: Resoldered groundconnections



Picture 9: Resoldered connectors and connections top- / bottomlayer



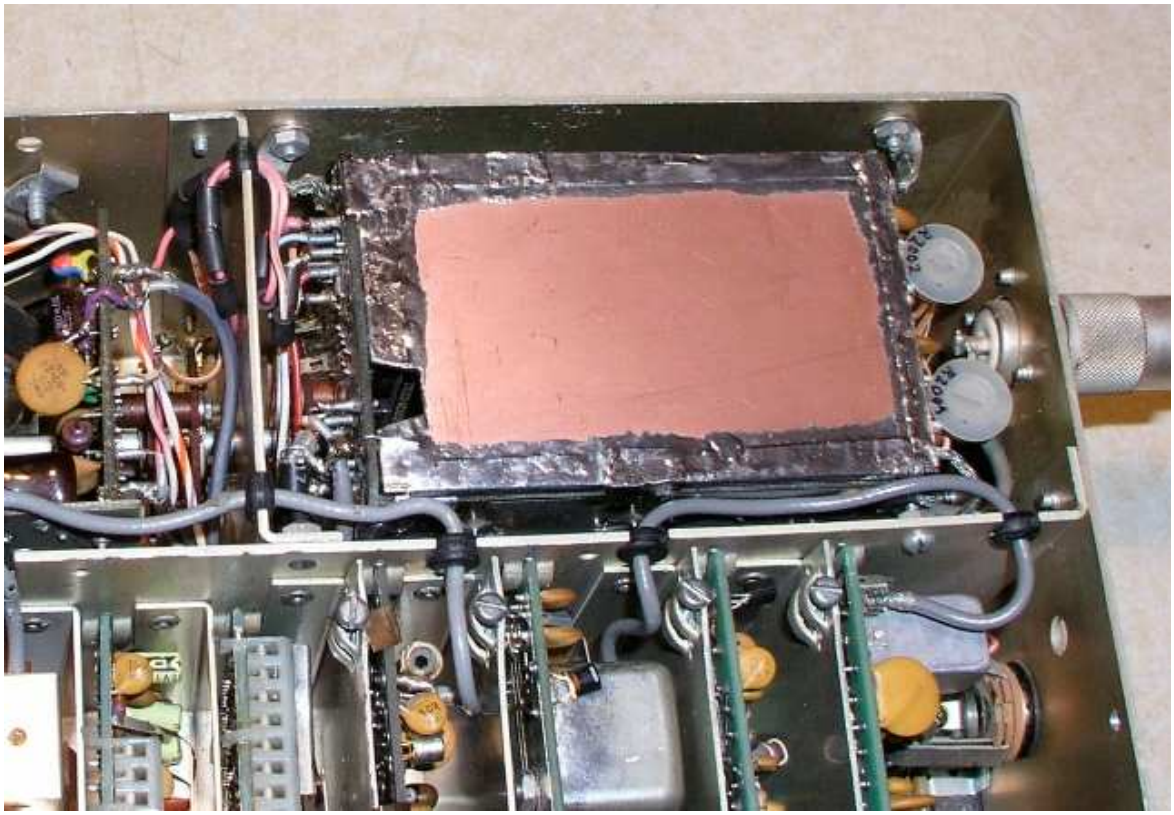
Picture 10: Connections between top- / bottomlayer



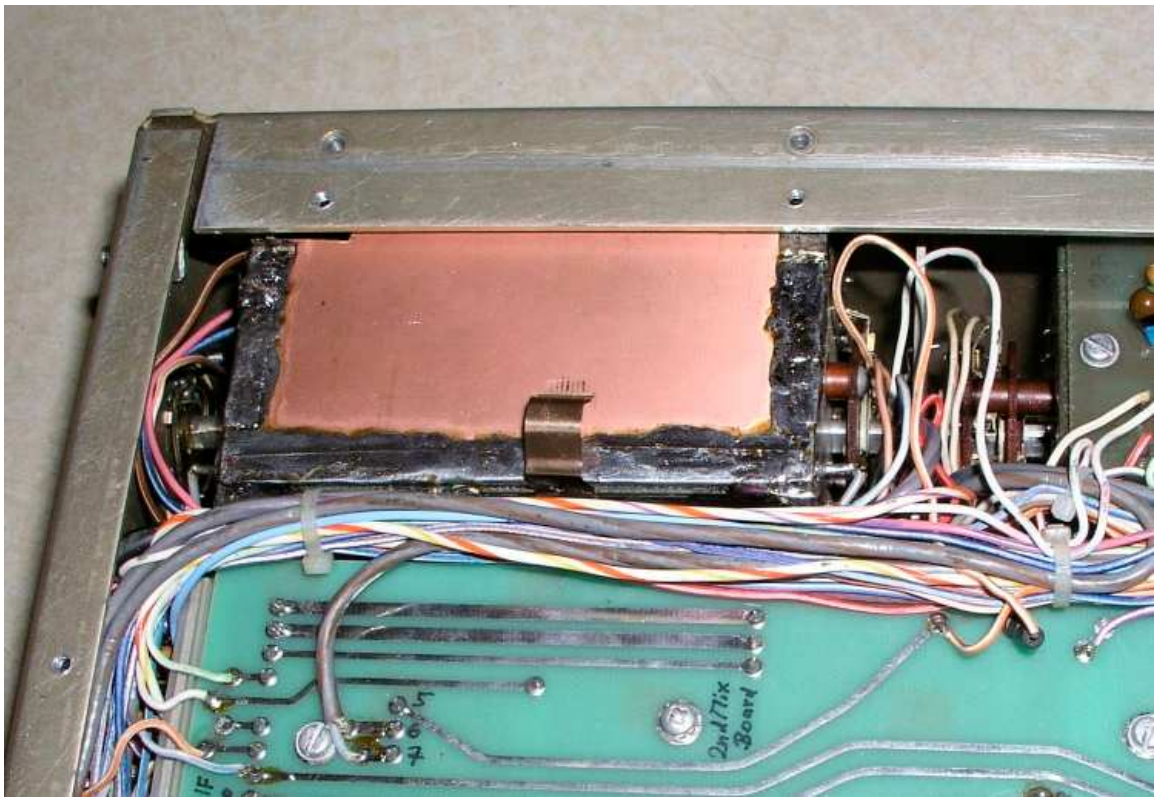
Picture 11: Shielding used as additional ground-layer

5. STEP E

The lowpassmodule is not shielded properly, when the TR-7-chassis is out of the cabinet. When transmitting with full power, some coupling may occur to other circuits which reduces the output a little bit. Before soldering these shieldings, i made some experiments with metalplates, which i pushed over the LP-module to see whether there are any effects. There were some small positive effects, so i added two additional shieldings – made from doublesided pcb-material on the upper- and lower side of the LP-module (**picture 12 and 13**). These shieldungs are soldered at these points to the lowpassmodule, where the connections between top- and bottomlayer have been made – see **pictures 5 and 6**.



Picture 12: Shield for the lowpassmodule – upper side



Picture 13: Shield for the lowpassmodule – lower side

On the lower side of the LP-module, there is also a springcontact, which makes a good contact to the cabinet (**picture 13**) and improves the shielding when closed.
I believe, the developer/s of the TR-7 have made similar observations and found the same obvious solution.

I hope you find some of these modifications helpful and let me know your experiencies. (please don´t shoot at the pianoman).

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