

Modifications of Vacuum Tube Voltmeter VT-650

Introduction

In the early 70's as a young boy, I've got a VT650 and was very proud about it – my FIRST usable Voltmeter! During the years, my equipment got more and more, my workbench is overloaded now and this VT650 was never used for many years; so it was one of the candidates to go to the scrapyard. But this VTVM has a very big analog scale, is electrically very robust and I decided to hold it for reasons of some reminiscences.....

Problems

But there some risks and disadvantages (picture 1):

1. The case is not grounded solidly – it is isolated from the (not existing) ground connector and always on the potential of measurement.
2. There is no internal fuse on the line connection.
3. DC-Alignment is not perfect, because there is only one pot for alignment of DC; it is assumed that for DC+ and DC- one alignment is sufficient – but it isn't!
Due to some nonlinearities it is better, to have an alignment separated for DC+ and DC-.
4. Input impedance for DC is 11MOhm, which was standard for VTVMs in those days. But when we want to use HV-Probes and other accessories designed for new meters, we would require 10MOhm impedance for DC.

Solutions

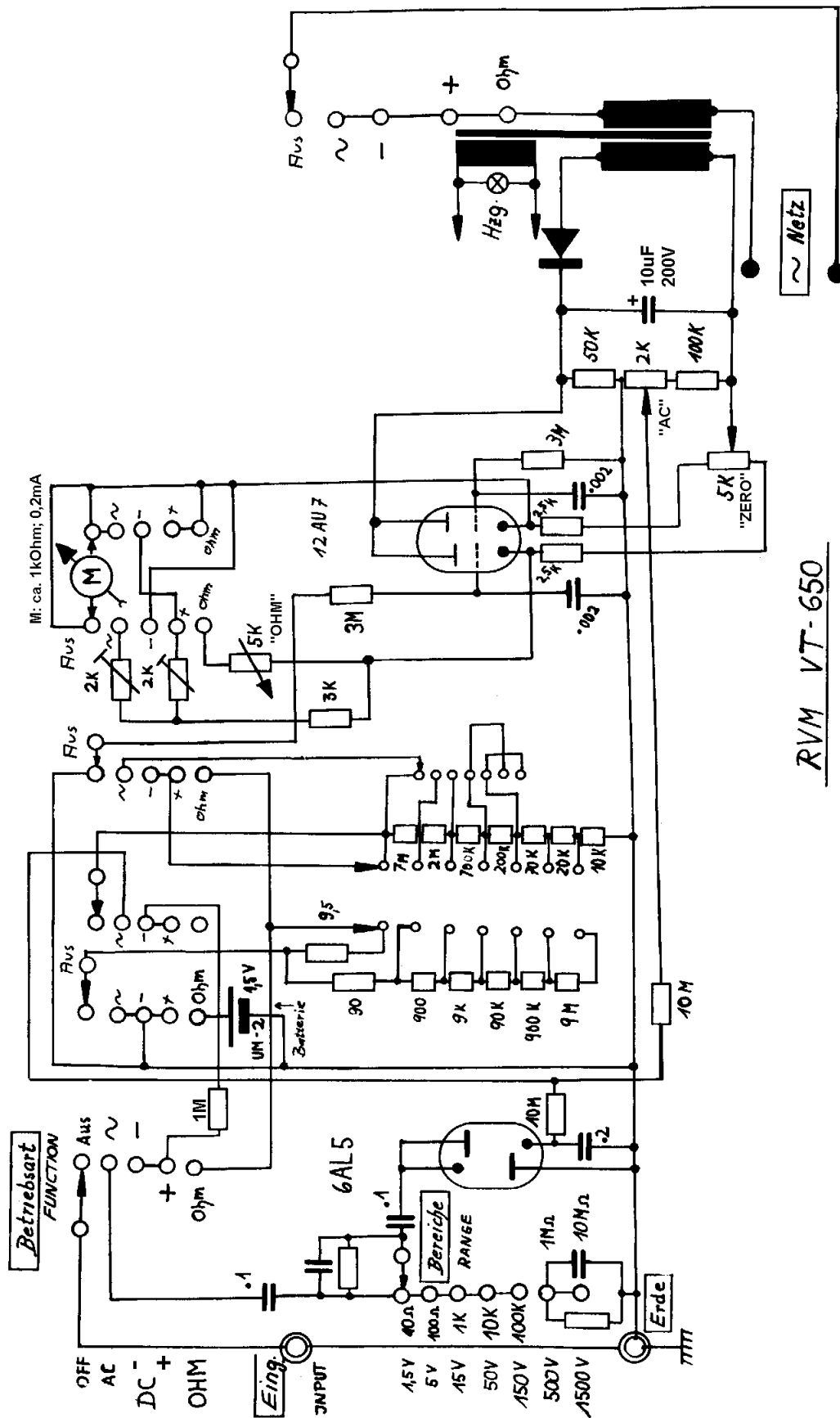
For all these mods refer to modified schematic in picture 2!

NOTE:

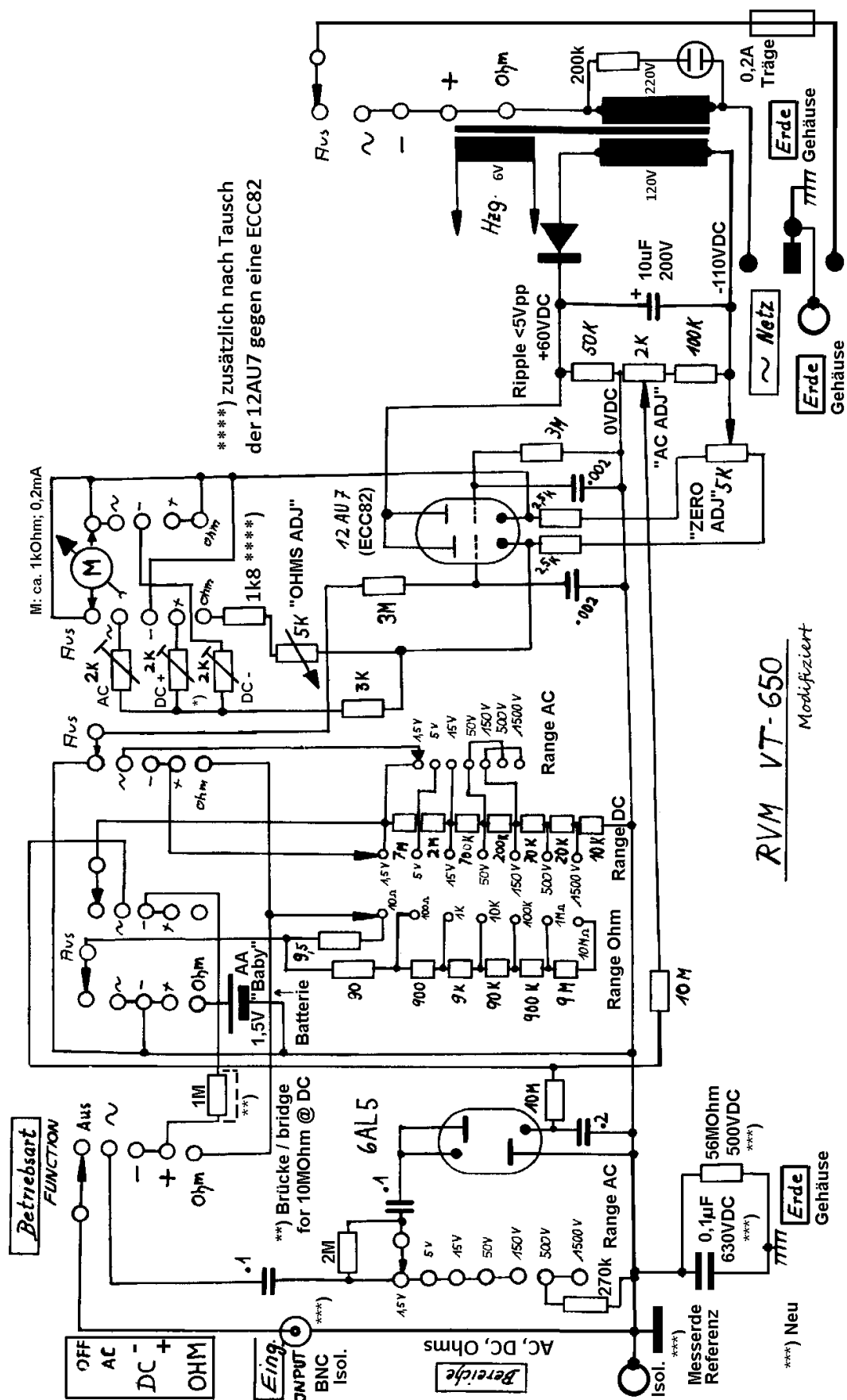
The internal voltages MAY BE LETHAL !

1. Isolation of measurement reference (pictures 3 to 6):
 - install isolated BNC-jack
 - isolate circuits; rewire traces away from grounded screws (don't forget batt. minus)
 - install capacitor 0,1uF/630VDC and resistor 56MOhm/500VDC between ground and reference
 - install additional jacks for case (=ground) and reference (=isolated)
2. New AC-fuse and cable infeed, it requires some mechanical work. (pictures 7 to 10).
3. Additional trim pot for DC+ and DC-; new holes in the case for better alignment from outside. (pictures 11 and 12).
4. Bypass the 1Mohm resistor for 10Mohm input impedance (picture 13 and 14)
5. Install battery eliminator for the 1,5V battery for Ω measurements (picture 15 and 16)
Connect batt. minus to the reference – NOT to the chassis!

PS: Does anyone know the manufacturer of this VTVM?



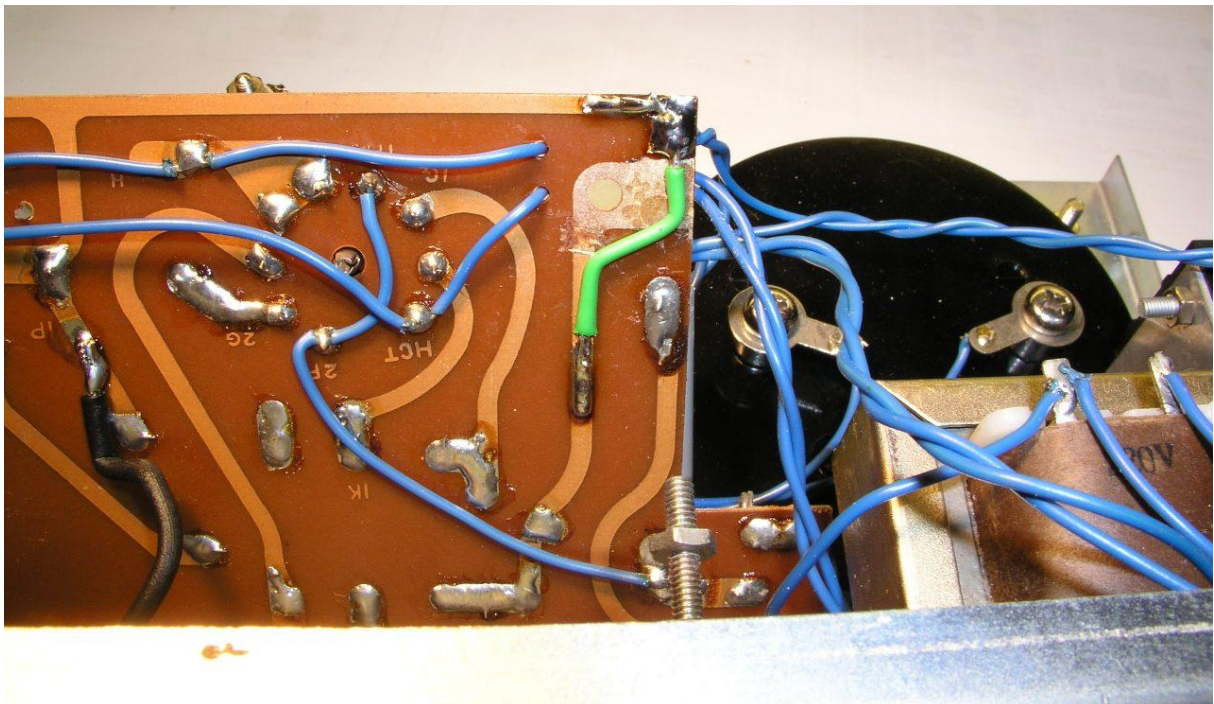
Picture 1: Original schematic



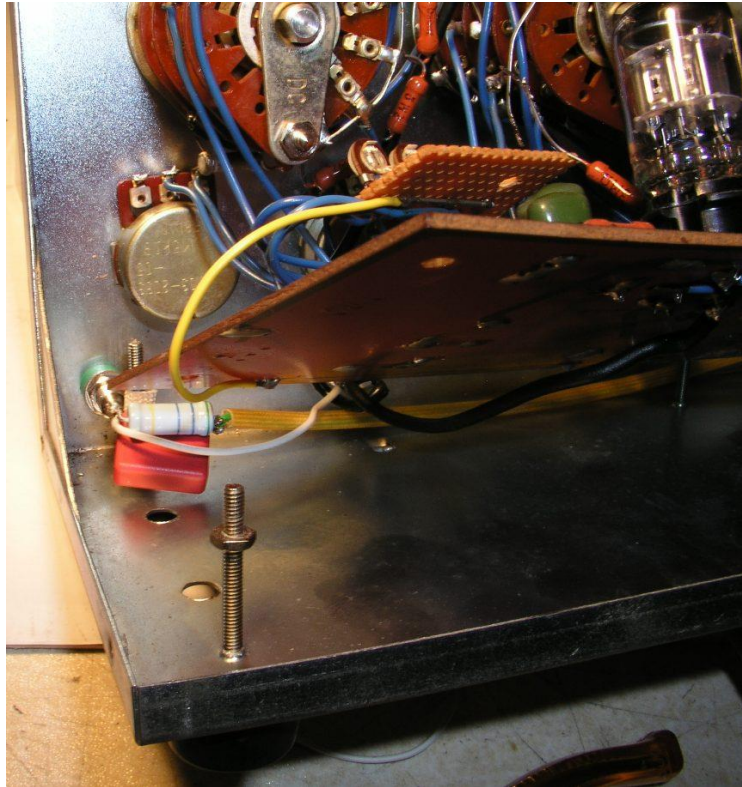
Picture 2: Modified schematic



Picture 3: Isolated BNC-jack



Picture 4: Rewire trace from grounded screw (green)



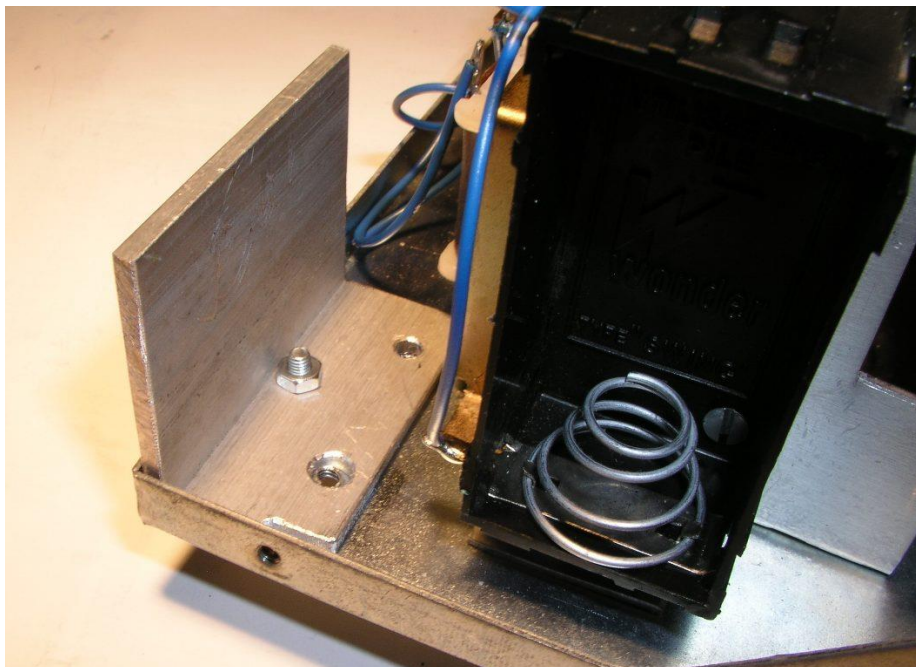
Picture 5: New capacitor, resistor and isolated reference connector



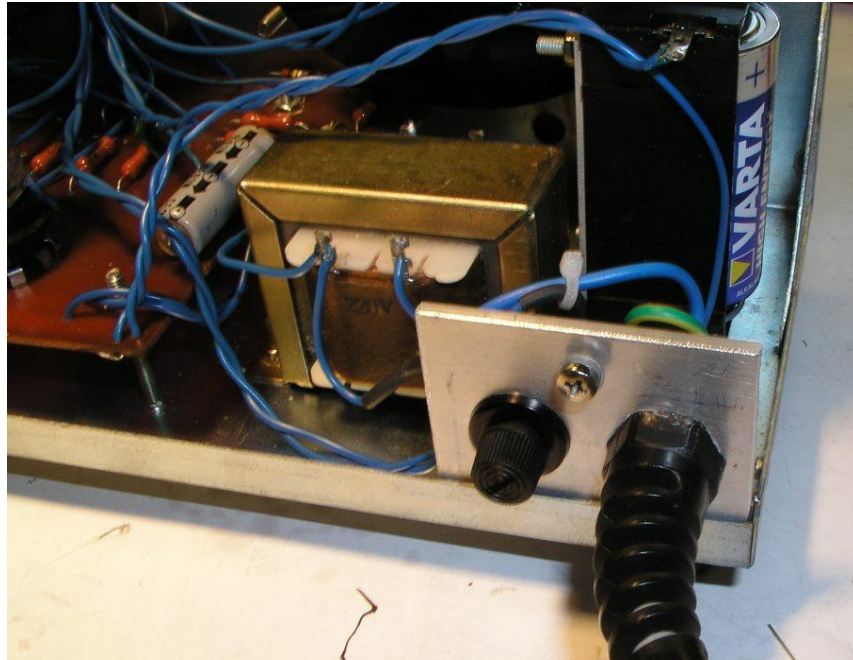
Picture 6: New case connector (right with green wire)



Picture 7: Drilling, sawing and bending – the unavoidable dirty work



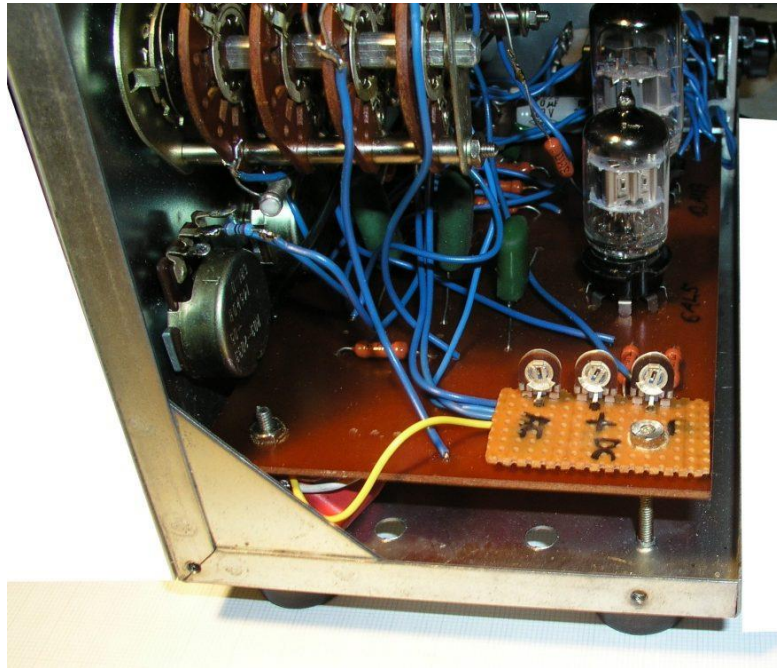
Picture 8: New aluminum profile (and new battery holder)



Picture 9: Installed fuse holder and cable infeed
Use a three wire line cable with ground connection!



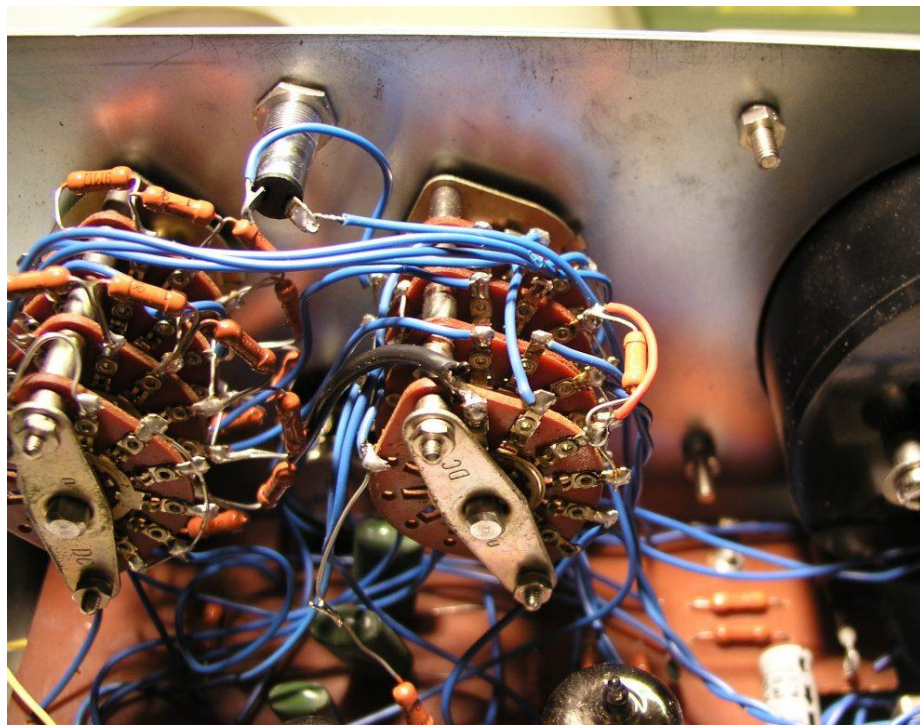
Picture 10: New line cord; 3-wire with protective ground



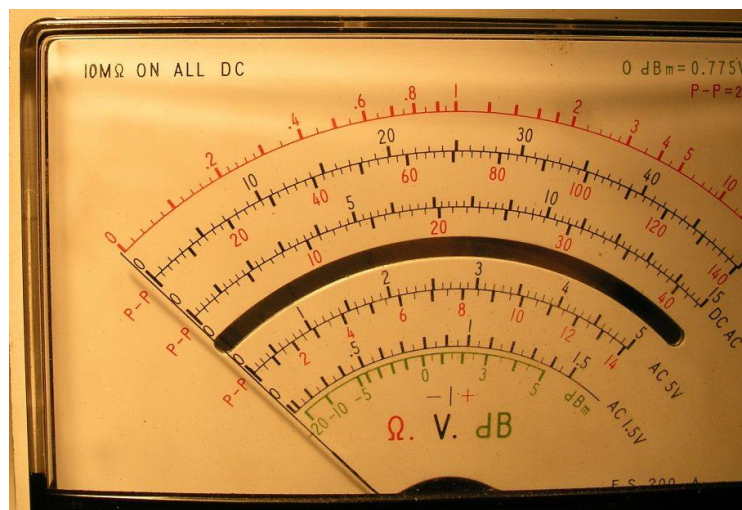
Picture 11: Trimpots for AC, DC+ and DC-



Picture 12: Holes for alignment and labels



Picture 13: Bypassed 1M Ω resistor (red wire)

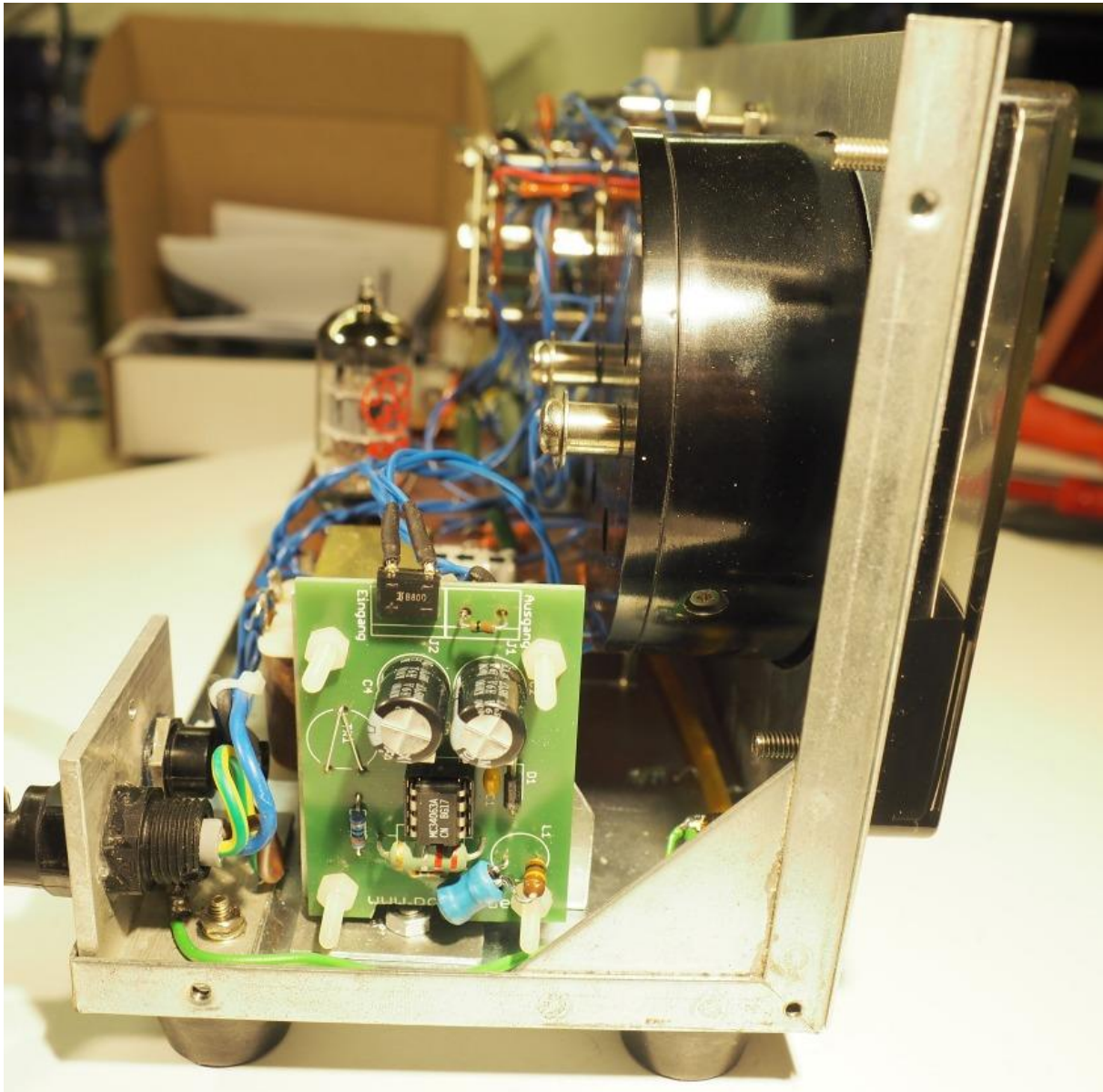


Picture 14: If you want to be perfect.... write 10M Ω instead of 11M Ω onto the scale

To eliminate the battery for Ohm Measurements is due to the availability of cheap DC/DC-converters very easy. I used a step down converter to generate the 1,55VDC. The power source for this converter is the heater voltage with 6VAC.

IMPORTANT

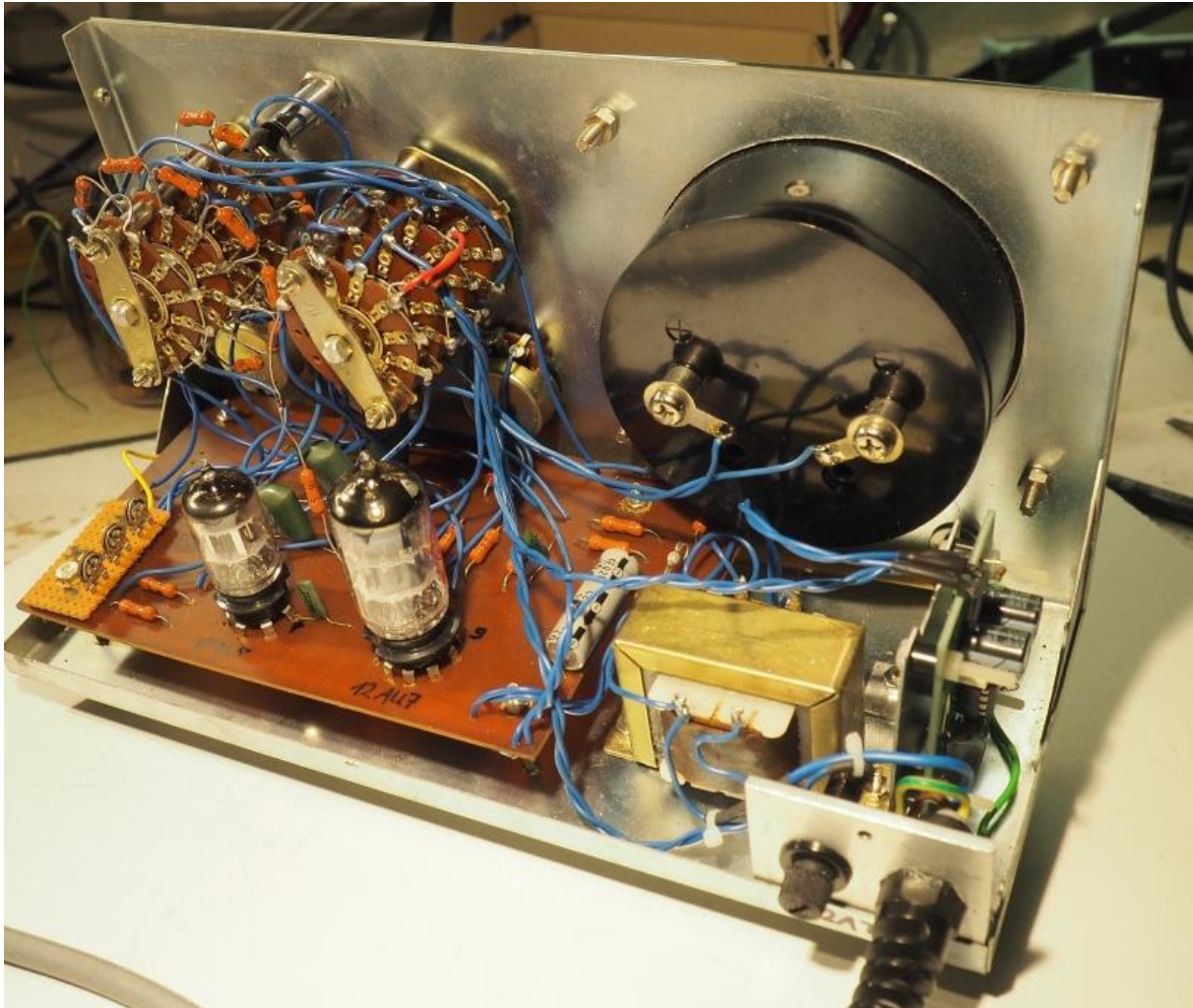
Make sure, that this filament voltage is isolated with respect to ground. This types of step-down converter don't provide a potential free output! With this converter, the filament heater is now connected to ground



Picture 15 New Step-Down-converter

It was a kit with DC-input, so an additional rectifier is necessary (picture 15). The small rectifier, which is connected to the 6VAC, is visible on top of the pcb. the 1,55VDC output is fixed by replacing the trimpot with a fixed selected resistor. Additionally I added a minimum load of 1kOhm to the converter to stabilize the output voltage.

Due to copyright reasons I didn't add a copy of the schematic but the IC is a MC34063 – the rest is searching in the net. Any step-down converter which can be adjusted down to 1,55VDC is OK, the needed current on 1,55VDC is app. 160mA in the x10 Ohm range and less in the higher Ohm ranges.



Picture 16 Another view on the new Step-Down-converter



Ready for the next 50 years!

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