ESR Project *by WD9GNX*

Several years ago this author became familiar with the ESR meter while repairing audio equipment at Fast Service in DeKalb. This device measures the Equivalent Series Resistance of electrolytic capacitors. It can be used to check electrolytic capacitors in or out of a circuit but not when the circuit is live or the capacitor is still fully charged. An ESR of less then 3 ohms means the capacitor is good, 3 to 10 ohms is between good and bad or leaky. Above 10, the capacitor needs to be replaced. As a point of information; electrolytic capacitors age in several ways: They can become electrically leaky; causing a DC current through them that can make them blow up. They can shift in capacitance value. But the most common way they degrade, by far, is by unduly increasing their Equivalent Series Resistance, which is the undesired internal resistance that appears in series with the wanted capacitance at a given frequency.

We only had 1 ESR meter in the shop and it had a habit of being lost when it was most needed. It occurred to me that such a device could be useful in my shack and it would be nice to keep one in my tool box so it was available for use when I needed it. Unfortunately the cost of a commercial unit runs $100 to $150. For as little use that it might see in my shack I decided to build my own. After finding several articles on this subject I settled on the XQ2FOD version.

This unit required a transformer made with 400 turns of #30 wire and 20 turns of #26 wire with an E shape ferrite core. Winding that transformer was a bit of a chore. In the following years I built 2 more and sold them to Bob the owner of Fast Service.

In the April 2014 issue of QST, KG4BZW described a newer version of an ESR the didn't require a transformer. It looked simple enough so I decided to give it a go.

What follows is my method of attacking a project and the procedures used. This article is intended to help others that wish to build projects.

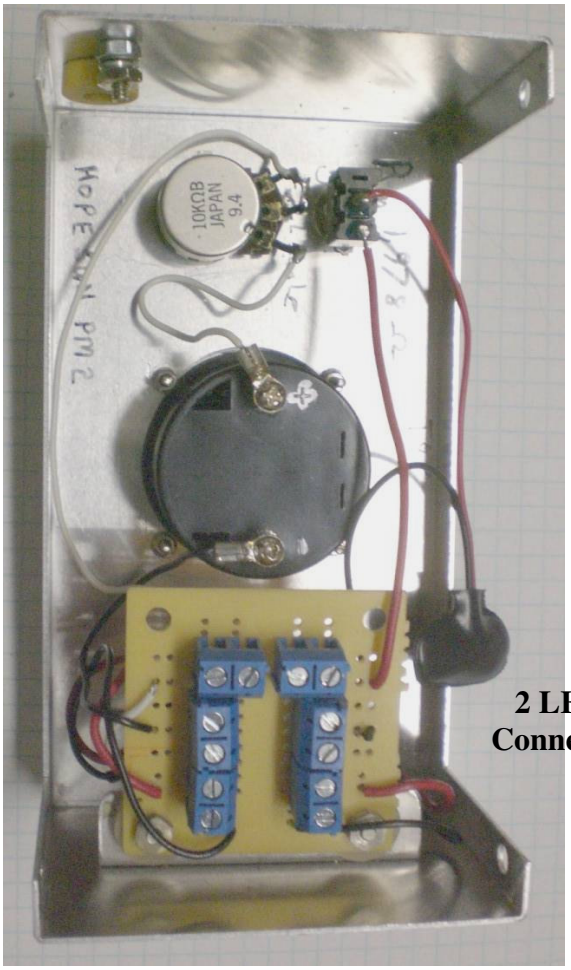
After carefully reading the QST article and studying the block diagram and schematic I decided to breadboard the circuit first. I have built other projects from the internet and wasted a lot of time because they did not work as described or at all. So breadboarding first can actually save time. Layout of the components on the breadboard is not very easy with the schematic that was provided so my first task was to create a new schematic that showed the ICs with their pins and the components connected to them. This makes it a lot easier to lay out the breadboard and ultimately mounting the components on a proto-board. See QST_ESR_Schematic.pdf and ESR_Schematic_052514.PDF.

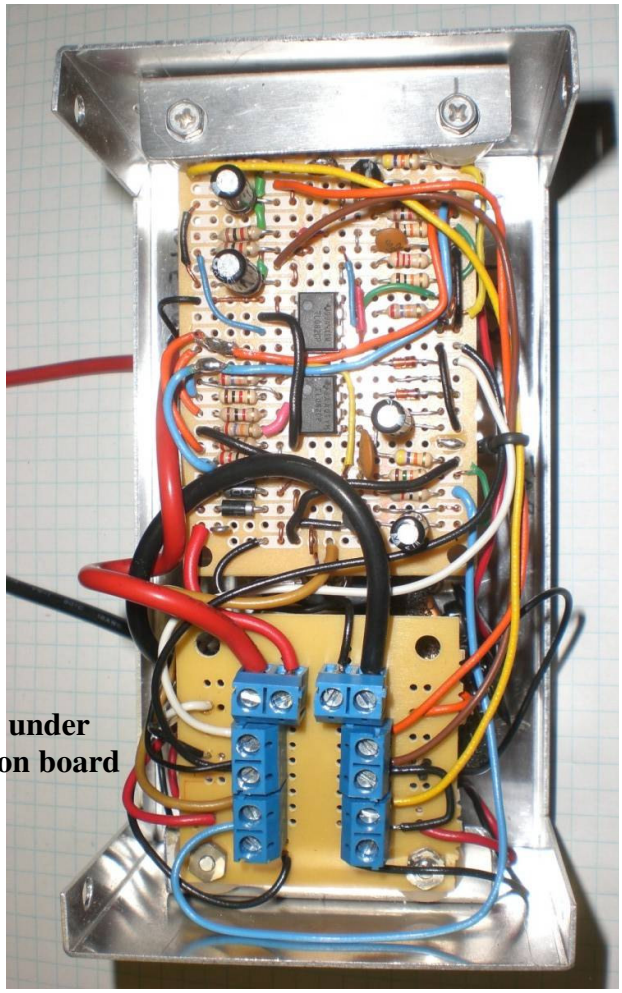
During the breadboard test it was found that a 2.2 K ohm resistor produced 96.3 KHz signal. The 2.4 K (original schematic) produced near 84 KHz. Also there was no 100 uA meter in my junk box so I used a 50 uA meter which require a 10 K pot, not 5 K as specified.

Once I was convinced that the meter works as outlined in the QST article the next step was to lay out the parts placement on the proto-board. A template was made and after hand drawing the parts on the template a printable version was produced, see BoardLayout_02.PDF.

To make it easier to service the unit a connection board was fabricated to go inside the meter box and allow connecting all the external wiring from the proto-board to the various parts inside the meter box. After connecting all the proto-board leads to the connection board a few more tests were performed and when it was found to be working as planned the new meter face needed to be made and pasted on the old meter face. Final Testing and wa-la a better designed ESR meter.

There were a lot of interruptions while building this project so it took over a month to complete but it was, as always, a fun project.





2 LEDs under Connection board

Final Tests

Zero Meter, note that Short LED is On

Good Capacitor

2.8 ohm resistor, DC short