ESR Meter / Low Resistance Meter

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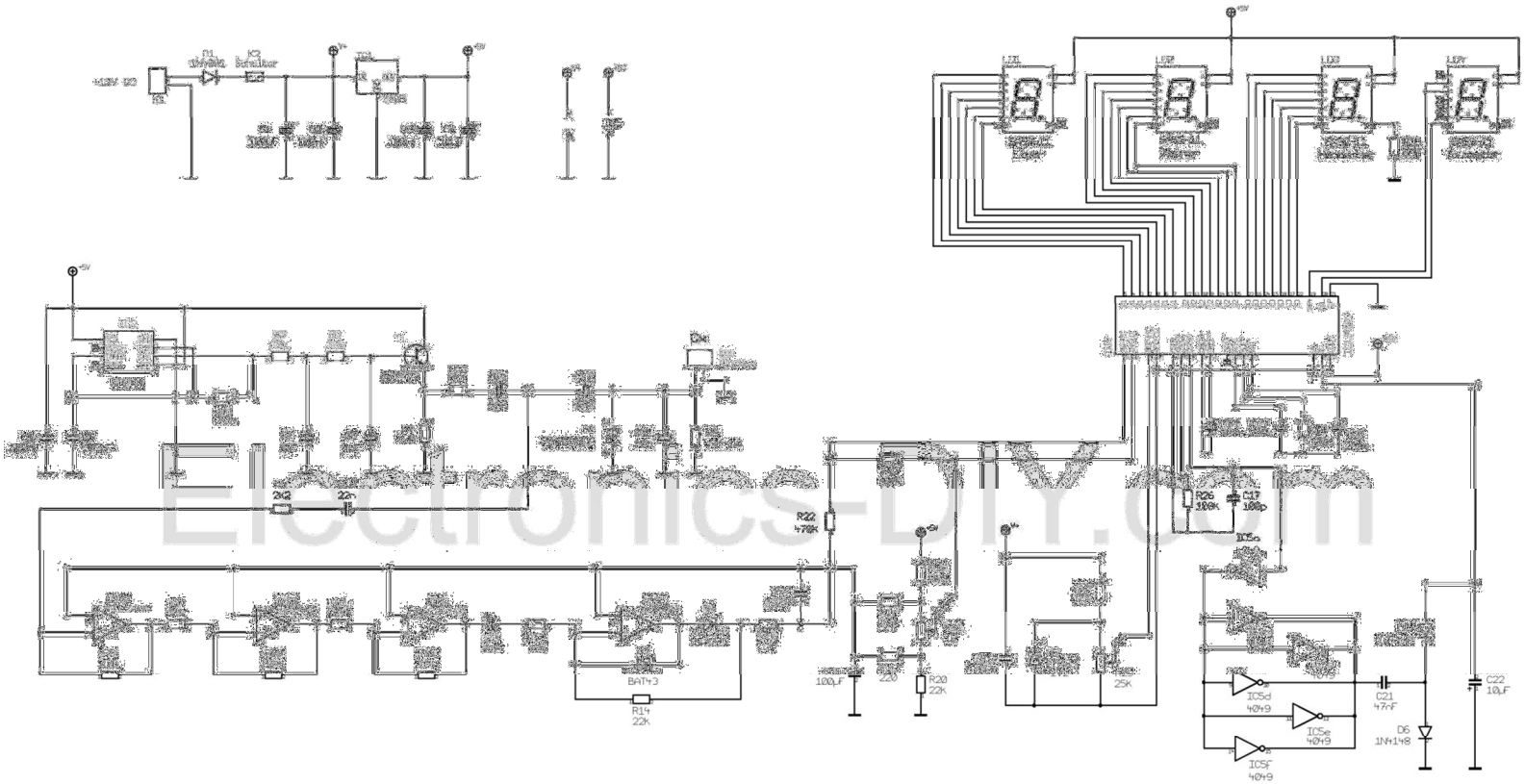
This ESR Meter is perfect for any electronics repair technicians, engineers or hobbyist. This handy ESR meter measures electrolytic capacitor equivalent series resistance (ESR) in the circuit. ESR is a very important characteristic of capacitors greater than 1 microfarad. This meter makes measurements which are often impossible to check with standard digital capacitance meters. This ESR meter is based around ICL7107, 4049, NE555 and TLC274 operational amplifier and can measure resistance from 0.01 Ohm up to 19.99 Ohm. ESR value is displayed in Ohm on four digit LED display . The power consumption is only 8mA using 12V battery. ESR Meter offers very simple design and is easy to assemble.



With the presented device can measure the equivalent series resistance of electrolytic capacitors and accumulators. The unit is original legally from the ELVjournal, Issue 4 / 2002, but - as the 18V battery charger - partially rebuilt, it has in this release, a Seven-segment LED display and is hospitalized by a network device 9 to 12 volts, whereby the auto power-off circuit of the original device is eliminated.

Each capacitor has three basic parasitic components: a series inductance Ls, due to the connecting wires, a parallel resistance Rp due to leakage currents, and a series resistance Rs

The lower the replacement series resistance (ESR Data Sheet, equivalent series resistance) is the better of the capacitor. The ESR increases with age and with high temperatures and a high ESR can lead to failures of the device (keyword: switching power supplies!).

With the presented device, the ESR of a capacitor approximately determined and so the condition can be determined. Also, batteries can be measured and assessed in this way, and moreover it is also still use a ohm meter in the range 0 to 20 ohms. It measures - in contrast to conventional ohmmeter - an AC voltage with a frequency of 60 kHz, so the (ideal) capacitor acts almost as a short circuit and only the ESR is measured.

The circuit

Here there is the circuit diagram of the ESR meter (PDF file).

Top left of the diagram of the power supply is shown. The unit requires a DC voltage in the range of about 9 to 12 volts, which is used once directly and is additionally stabilized with IC1 to 5V. The diode D1 serves as a reverse polarity, C1 to C4 stabilize the voltages.

Including the oscillator part is visible, which is a type of IC NE555 established. (In the original circuit, a power-saving ICM7555 was used, but this here, thanks to power supply is not necessary.) At the output, pin 3, a square wave kHz with a frequency of about 60, about the two low passes R2/C7 and R3/C8 is sent and then roughly sinusoidal shape. T1 through the driver transistor is DC-coupled, where the measured input to the capacitor to be measured is connected. The voltage drop across the capacitor is removed, the OP-chain IC3A increased to C and the same direction as IC3D.

Subsequently, this ICL7107 voltage to the input of IC4, a display driver of the type given. This is wired up by default to data and includes all necessary components, the A / D converter to the display driver. The result is then added directly to four seven-segment displays (models with a common anode).

Reconstruction and reconciliation

When reproduction is for the high frequencies on a clean trace leadership ensured. The measuring cables should be connected securely or tightly seated in their sockets, as well as the wires should be kept close together (ideally every 10cm with tape and tie or the like).

The adjustment is relatively simple. After switching on the device, the test leads are held together. The trimmer R21 is now set so that the display reads zero. Then, a resistance 10 to 18 ohms, the value of her should be known as accurately as possible, connected and calibrated the display with R25 to that value.

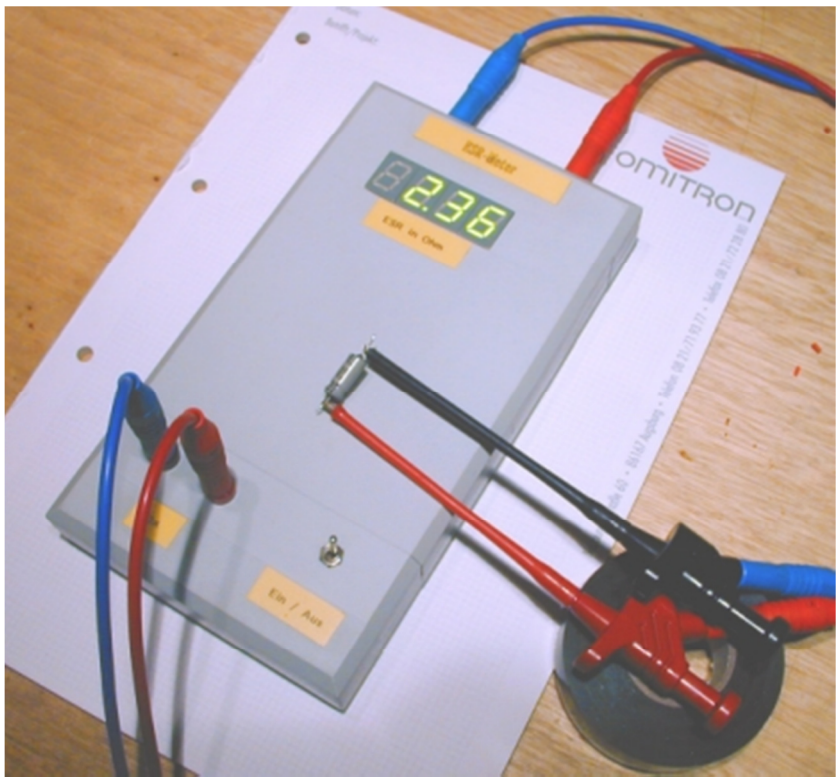
Thus, the adjustment is already finished. Now a word about the measurement practice. Capacitors with low-capacity naturally have a higher ESR than larger capacity. However, if a value of 10 ohms measured, the capacitor can be safely classified as unusable. In the range below a value of 30µF can sometimes occur at the 3-5 ohm, which is not necessarily bad. Capacitors of 100uF, however, should be well below 2 ohms. Here a little experience is needed with the values.

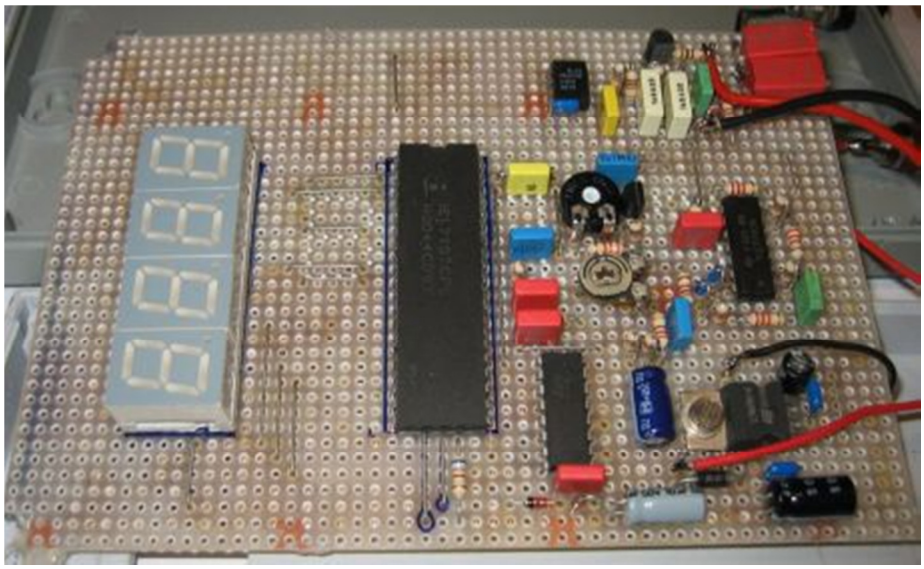
Incidentally, capacitors due to the low measuring voltage directly measured in the circuit and need not be previously developed.

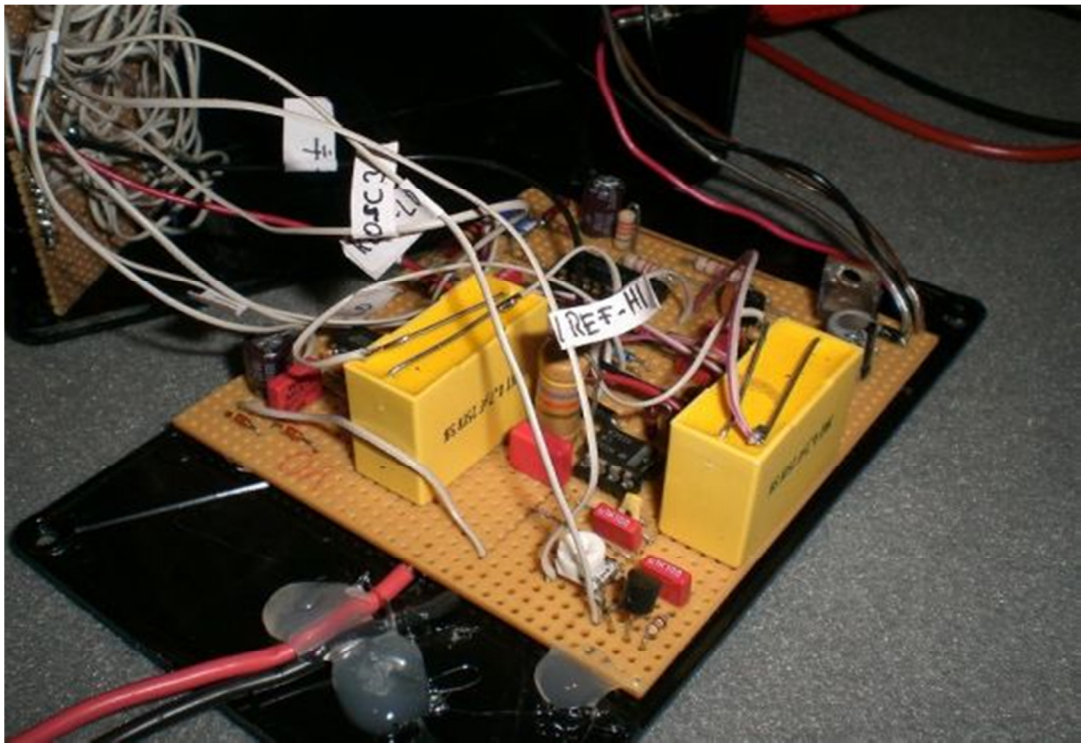
The picture shows my finished device, installed in a pretty case of Bopla. In addition to the on / off switch, the two sockets to which the capacitor is connected. At the front jacks for power supply. At the entrance is just a capacitor with 47uF / 10V, which here because of the high value to no longer be considered fresh.

My own ESR meter is built on a strip-board (see photos above). Due to various demand is now created for a layout that can be downloaded here. In the replicas (see below), there are photos of some boards based on these devices.

Note: The layout is the one with the copper surface, the solder side.







Project documentation :

ESR Meter / Low Resistance Meter - Link

PARTS :

R1-R3,R8,R10,R12,R24 – 10K (7)
R4-470
R5-100
R6-47K 1W
R7,R9,R11-2.2K (3)
R13,R14,R18,R20-22K (4)
R15-1K
R16-680
R17,R19-220 (2)
R21-1K POT
R22-470K
R23-330K
R25-25K POT
R26-100K
R27-180K

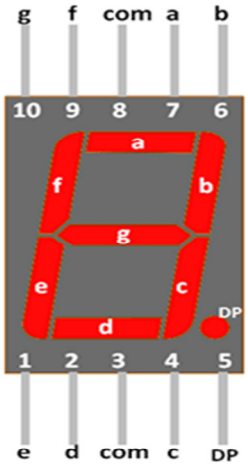
C1-10Ouf
C2,C3,C6,C14,C16,C18-100n (6)
C4,C22-10uf (2)
C5-560pf
C7,C8-1n (2)
C9,C10-4.7uf (2)
C11-10n
C12,C13-22n (2)
C15-100uf
C17-100p
C19,C20-220n (2)
C21-47n

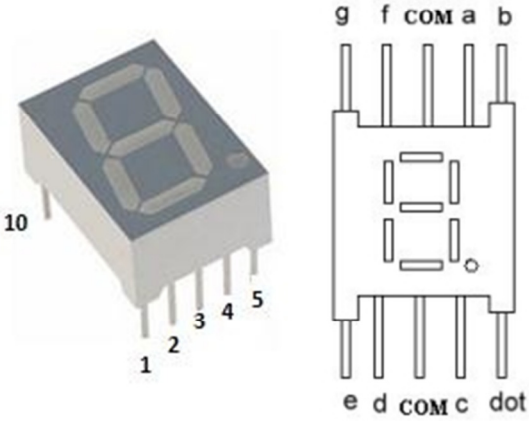
D1-IN4001
D2-P6KE6V8CA diode
D3,D4-BAT43 diode (2)
D5-LM385 1.2V diode
D6,D7-IN4148 (2)

BC548C
IC7805
IC555
ICL7107
IC4049
TLC274CN
LD1=SA52-11 Einer (all common anode)
LD2=SA52-11 Zehner
LD3=SA52-11 Hunderter
LD4=SA52-11 Tousender

10K – 7y
470 – 1y
100 – 1y
47K 1W – 1y
2.2K – 3y
22K – 4y
1K – 1y
680 – 1y
220 – 2y
1K POT – 1y
470K – 1y
330K – 1y
25K POT – 1y
100K – 1y
180K - 1
---27 resistors
100uf – 2y
100n (0.1uf) – 6y
10uf – 2y
560pf – 1y
1n (0.001uf) – 2y
4.7uf – 2y
10n (0.01uf)- 1y
22n (0.022uf) – 2y
100p (0.0001uf) – 1y
220n (0.22uf) – 2y
47n (0.047uf) – 1y
---- 22 capacitors
IN4001 – 1y
P6KE6V8CA diode – 1y
BAT43 diode – 2y
LM385 1.2V diode – 1y
IN4148 – 2y

IC7805 – 1y
IC555 – 1y
ICL7107 – 1y
IC4049 – 1y
TLC274CN – 1y
7 seg display SA52-11 (all common anode) – 4y





1. Now take multi-meter (Assumption followed red lead for positive and black lead for negative). Set the multi-meter in continuity range.
2. Check for sound test (touch both the leads together sound will produce). Sometimes it may possible, battery of your multi-meter become weak and we will be not being able to get the display.
3. Put the Black lead of multi-meter on pin 3 or 8 both are common pin as they are internally connected.
4. Now put Red lead of multi-meter on any other pin may be 1, 5.
5. If any of the segment glows then your display is common CATHODE.
6. If none of the segment glows than interchange the leads of multi-meter.
7. Connect the Red lead of multi-meter on pin 3 or pin 8 as both are common pin and internally connected to each other.
8. Now put the black lead of the multi-meter on other remaining pin. If any of the segment glow than your display is common ANODE, as in common anode positive pin is common and rest are supplied with negative supply.
9. Check all segments of both common cathode and anode to ensure your display is working properly.
10. If none of the segment glows means your 7 segment is faulty.

Hope this will save your time and energy for identification and let you know **how to test seven segment display**.