

ESR/LOW OHMS METER **Owner's Manual**

EVB congratulates and thanks you for choosing this ESR/LOW OHMS meter. It has been designed to save busy repair technicians valuable time by rapidly identifying defective electrolytic capacitors in circuit. Many owners find that it will pay for itself within a week, sometimes even in one difficult job.

It is constructed from top quality components for a long and trouble-free life in your workshop and toolbox. We sincerely wish you every success in your business of electronic servicing which is becoming increasingly difficult and competitive.

<http://clientes.netvisao.pt/greenpal/evb@netvisao.pt>



ESR Value Display

Chart of Approximate ESR Figures

Test Lead Jacks

Control Button

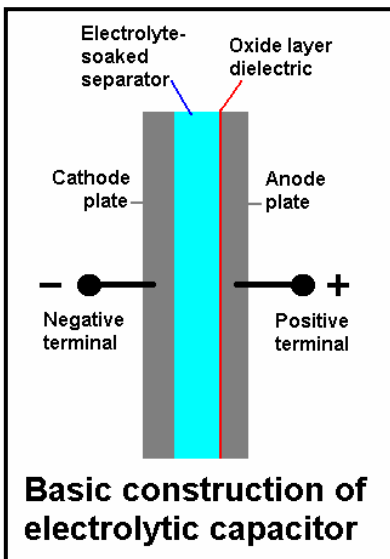
FEATURES

- Tests electrolytic capacitors in circuit.
- Single push button control of all functions.
- Test leads are non-polarized.
- Test lead resistance zeroing.
- Automatic power switch-off after 3 minutes of inactivity.
- Low battery voltage warning (“b” flashes on the right-hand digit).
- Large 13mm high-brightness LED displays.
- Measures 0,01 - 99Ω, auto-ranging.

BASIC OPERATION

1. Insert some regular test leads into their jacks.
2. Press the control button so the “-” symbol appears on the display.
3. Hold the test probes tightly together- the test lead resistance is displayed.
4. With the probes still together, press the button again to give a zeroed reading of “.00”.
5. Measure ESR of capacitors. “-” **indicates a reading greater than 99Ω.**
6. Press the control button with the probes separated. Meter flashes “??” then switches off.
7. If the battery is low, “b” flashes once per second, and the display dims to conserve remaining power.

What exactly is “ESR”?

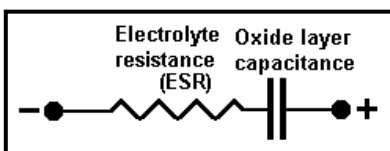


Electrolytic capacitors differ from other types.

They have two aluminium foil plates rolled into a cylinder, but the dielectric consists of a very thin layer of aluminium oxide formed on the anode plate.

One plate in contact with this oxide layer is of course the anode plate it is formed

on. The other “plate” actually consists of a layer of porous material moistened with a solvent-based liquid (the “electrolyte”) which is highly electrically conductive when the capacitor is new. It completes the electrical circuit between the metal negative plate and the oxide dielectric.



As you can see, the electrical resistance of the electrolyte is in series with the

capacitance of the dielectric, so it is known as the **Equivalent Series Resistance**, abbreviated to “**ESR**”.

Why increased ESR is a problem.

Electrolytic capacitors have the job of blocking the flow of DC current in a circuit while presenting a low impedance to AC, also known as “Ripple Current”.

Especially when an electrolytic capacitor is exposed to high temperatures because it is close to heat-generating components or has a large ripple current flowing through it, the electrolyte can dry out or be chemically altered, making its electrical resistance, the **ESR**, increase.

This has exactly the same effect as putting an external resistor in series with a good capacitor: AC current flowing through the capacitor will cause a higher than normal AC ripple voltage to appear across the capacitor. This will eventually lead to abnormal operation of the circuit the capacitor is in.

Faults caused by increased electrolytic capacitor ESR are often quite strange. ESR increases rapidly as the temperature drops, and this type of problem often shows up in winter and before the equipment has reached normal operating temperature.

Attempts to identify defective electrolytic capacitors by using a capacitance meter are usually unsuccessful.

These meters are designed to ignore the ESR which is causing the fault, to measure *only the capacitance* which hasn’t really changed. They will produce a low reading only if the capacitor is open circuit or close to it. Also, they usually can’t measure a capacitor while it’s in circuit.

This meter has been designed to measure the ESR of capacitors in circuit, made possible by keeping the test signal voltage low enough (<100mV P-P) not to cause any semiconductors in the circuit to conduct.

As well as saving time, the capacitors won’t be heated by unsoldering them, causing the ESR to fall and possibly hiding their real condition.

What are typical ESR readings?

Unlike other electrical characteristics, *there is no such thing as a “normal” ESR value* for an electrolytic capacitor of a given capacitance and operating voltage. The ESR to some extent depends on the physical size of the capacitor. It also varies between manufacturers, and whether it a low-ESR or high temperature-rated type.

The chart on the front of the meter contains sample ESR values for a range of common electrolytic capacitor values and voltage ratings. These have been taken from a capacitor manufacturer’s data sheets and a collection of actual capacitors.

It is provided only as a rough guide for new users, to give an idea of what readings to expect until they become familiar with using the ESR meter in actual repair situations.

Defective capacitors stand out clearly!

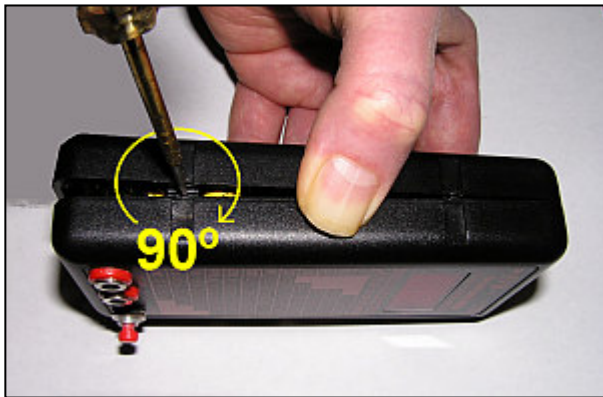
Years of experience have shown that **in almost every case, a capacitor’s ESR needs to rise to at least 10 times its normal value to cause a circuit malfunction**. Very often it will be found to have risen to **>30 times**, or even so high that the meter will not give a reading (**>99 Ω**).

It is for this reason that the front panel figures don’t need to be extremely accurate or complete.

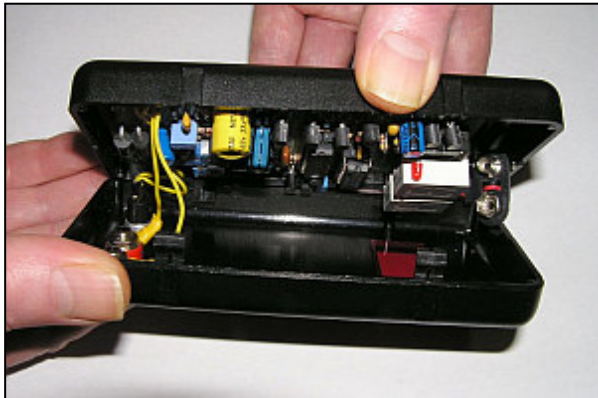
When you encounter a capacitor whose value or voltage is missing from the chart, it’s sufficient to assume that its ESR should be similar to that of a capacitor adjacent to it on the chart.

If you have any doubts, it’s best to compare the meter’s reading on a suspect capacitor with that of a new capacitor of the same value and voltage rating.

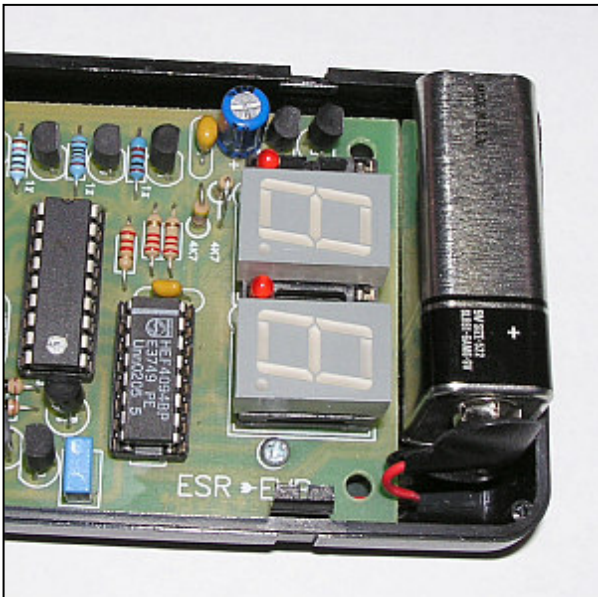
Getting started: First install a battery



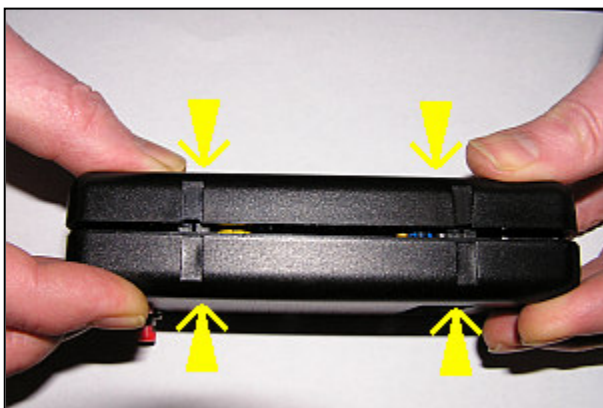
Holding the meter as shown, insert a screwdriver with a 3-5mm blade into the top and bottom slots on the left-hand side. Gently rotate it until the plastic clips release. *Important: Do not do this on the right-hand side of the case which has no slots!*



Separate the two halves of the case like a book, making sure not to strain the wires connecting the circuit board to the jacks and push button on the front panel.



Clip a 9V **alkaline** battery such as an Energizer 522 to the battery connector, observing the correct polarity. Place it in its recess as shown here. Be careful that the wires are not caught under the battery, or it will be impossible to close the case again.



Carefully align the right-hand side plastic clips. Then like closing a book, gently but firmly squeeze the left-hand side of the case back together until the plastic clips snap into place. *Be very careful not to put any pressure on the display window!*

Using your ESR/LOW OHMS meter

Precautions.

The very first thing to do is **be certain that the equipment you'll be using the meter on is disconnected from all power.**

Most electrolytic capacitors will be discharged by the circuitry around them within a few seconds of turning the power off. However, filter capacitors in power supplies can remain dangerously charged, especially if there is a fault.

Before using the meter, make sure that all power supply capacitors are fully discharged, using one 100Ω 5W power resistor if necessary. Allow several seconds for complete discharge.

Apart from the risk of serious injury to you, large charged capacitors can damage the meter (not covered by warranty), and its protection diodes can cause damage to circuitry if there is residual voltage present.

On your bench, be very careful not to confuse this meter's test leads with those of your multimeter!

The meter can produce unsteady indications if its test leads pick up strong horizontal deflection signal voltages, so use it away from operating TVs and monitors.

Don't use self-retracting "curly" test leads with your meter. Their inductance can cause measurement errors.

Switch the meter on and zero it.

After installing a battery and connecting the test leads, press the button to turn the power on. This will produce the **"- "** symbol which indicates a reading above 99Ω.

Hold the test lead probes tightly together and the meter will display the lead resistance. While still holding them together, press the button again. This will give a reading of **".00"** as the meter from this point subtracts the test lead resistance from all measurements. You can repeat this zeroing procedure at any time.

Start measuring.

Now start checking electrolytic capacitors in the area of the circuit where the fault is. Often the electrolytic capacitors which fail are the ones close to heat-generating components such as power semiconductors and resistors, so check them first.

It will save time if you mark each good capacitor with a felt-tipped pen so you know which ones still need to be checked.

An electrolytic capacitor which is causing a fault is almost certain have an ESR which is many times higher than the chart value for it.

Experience has shown that replacing all electrolytic capacitors whose ESR is more than about 50% above the figures on the chart will ensure that they can't cause a fault in the next year or two (probably in winter).

Low Battery Warning and switching off.

A **"b"** flashing on the right-hand digit once per second with the test leads unconnected indicates that the battery voltage is low.

The meter dims the display to reduce the load on the battery and give you some more operating time, but replace it as soon as you can to maintain the meter's accuracy.

When you have finished using the meter, separate the test leads and push the button to switch it off. **"??"** will flash on the display. If you forget, the meter will automatically switch off after 3 minutes of inactivity.

Some traps to avoid.

All test equipment can produce misleading indications under some conditions, and this meter is no different.

Being in reality a high frequency AC ohm-meter, it cannot discriminate between a capacitor with a very low ESR, and one which is short-circuited or very leaky.

In general, capacitors with high ESR will cause faults such as high frequency noise getting into signal circuits and distortion of scanning waveforms in monitors and TVs.

Conversely, a leaky or shorted capacitor is likely to disturb the DC conditions in its circuit, and tests with a multimeter should find it.

If you find an electrolytic capacitor with an ESR which seems too good (low) to be true, disconnect it from the circuit and measure its resistance with an ohm-meter.

In some circuits such as in computer motherboards, switching power supplies and TV/monitor deflection stages, electrolytic capacitors are connected directly in parallel. A good capacitor can make the ESR of a bad one appear to be much lower than it really is. You need to be aware of the circuit your suspect capacitor is in.

There is one more failure mode of electrolytic capacitors which is quite rare and causes a lot of confusion- when **the ESR remains perfectly OK**

but the capacitance has dropped by a large amount.

If your ESR meter is showing that all the electrolytic capacitors seem OK but some strange fault is still present and nothing seems to make sense, it would be wise to start disconnecting capacitors and measuring them with a capacitance meter. Or you could try temporarily putting new capacitors in parallel with them.

Connection to charged capacitors.

Your ESR/LOW OHMS meter contains a pair of high-current diodes connected in parallel with the test leads. If you connect it to a large charged capacitor, you will get a big spark from the probes which can damage their tips.

In addition, the high discharge current can damage the capacitor itself. After properly discharging it with one 100Ω 5W resistor, make sure that its ESR is not above normal.

If the capacitor was large and charged to a high voltage, the meter could be damaged. If it stops functioning normally after such an accident, please consult EVB about what action to take.

Resistance Measurement.

This instrument is really an AC ohm-meter with an equivalent test frequency of about 100kHz, capable of measuring *non-inductive* resistances from 0,01 to 99Ω.

It can be useful for locating short circuits on printed circuit boards by showing the resistance of a copper track decreasing or increasing as you approach or move away from the short. For example, this is useful when trying to identify which one in a paralleled set of power transistors is shorted.

You can also make your own very low value resistors by measuring out a length of nichrome or similar resistance wire to give the required resistance, and check the contact resistance of switches, connectors and relays.

Just remember that any significant amount of inductance will cause a measurement error. You cannot measure the DC resistance of a choke, transformer winding, video head or a roll of electrical cable, for example.

Other uses.

The meter's test signal is a 500mV P-P (open circuit) burst of 8μs pulses at a 2kHz rate, repeated several times per second. It can be used as a signal source to basically check amplifiers, loudspeakers and other audio components.

Meter Care and Maintenance.

Keep your meter away from grease, oil and other contamination. If it becomes dusty or dirty, wipe it with a damp cloth, avoiding harsh cleaning chemicals which can damage the case and printing. Avoid exposure to extreme high or low temperatures and direct sunlight.

The meter is not shock resistant. Do not put pressure on the plastic case and especially not on the red display window.

If you will be not be using it for a long period, please remove the battery to avoid damage from leakage.

The meter's readings might become unsteady after a lot of use, due to oxidation or loosening of the test lead jacks. Heavily spray the test lead plugs with contact cleaner of the kind which evaporates completely (e.g. **CRC "CO" Contact Cleaner**), then repeatedly insert and withdraw them from their jacks before it dries.

If the test lead jacks have become loose, gently retighten them with long-nose pliers.

General Workshop Safety

The EVB ESR/LOW OHMS meter has been designed for use by professional technicians experienced in the theory and practice of electronic repairs.

Remember that your workplace should, as much as possible, be well organized, clean and well-lit with good ventilation. Earth-leakage protection devices should always be used for your safety.

Safe and pleasant conditions will help you to concentrate better on your fault-finding.

Specifications

Measurement principle: Pulsed constant-current/voltage drop sampling.

Test signal amplitude: 500mV P-P open-circuit, <100mV P-P at full scale.

Test lead polarity: Non-polarized.

Measurement ranges: 0,01 - 99Ω in 3 automatically-selected ranges.

Resolution: 0,01Ω on 0,99Ω range, 0,1Ω on 9,9Ω range, 1Ω on 99Ω range.

Accuracy: Better than ±5%.

Reading/display rate: 4 per second.

Over-range (>99Ω) indication: “-” symbol on left display.

Low battery warning: Flashing “b” on right display.

Controls: Single push button for power on/off and zeroing.

Automatic power switch-off: After 3 minutes of inactivity.

Power source: 9 volt *alkaline* battery type IEC 6LR61, NEDA1604 or 6LF22 (not supplied).

Power consumption: 120mW – 360mW typical, depending on displayed characters.

Display: 2x high efficiency Super-Red GaAIAs Kingbright SC56-11SWRA 7 segment LED displays.

Microcontroller: ZiLOG Z86E0412PSC 1866 running custom firmware.

Dimensions: 131mm x 65mm x 30mm.

Weight: 97g without battery.