



# ESR & Low Resistance Meter

## Introduction

As electrolytic capacitors age, their internal resistance - Equivalent Series Resistance (ESR) - increases & eventually causes faulty operation of the circuit. This device can measure the ESR & can be also used to measure small resistances..

## Circuit Description

IC1a is configured as an oscillator. IC2a divides this signal by 2 to ensure a 50/50 mark/space ratio.

IC3a switches between +5 Volt and -5 Volt and thus applies an AC square wave current of about 2 mA to the capacitor under test Cx. IC3b/1,2 directs the positive half cycles to C9 and IC3b/3,4 directs the negative ones to C10. R4, C9 & C10 act as low pass filters to attenuate the 100 kHz AC component of the voltage across Cx. C9 & C10 charge to the DC component which is proportional to the ESR. C9 holds the positive voltage during negative half cycles and C10 holds the negative voltage during positive half cycles.

IC4 amplifies the differential DC signal so it can be displayed on a Digital Multimeter (on the 200mV scale). 10 Ohm will be represented by 100 mV, 1 Ohm by 10 mV, etc.

## Calibration

Adjust P1 to obtain 100 kHz at TP3.

Connect the probes together and adjust P4 for 0mV at IC4/6.

Separate the probes. Set P2 to balance the positive & negative currents through R2 as follows. Apply -5V to TP2. Connect a multimeter between TP4 and B and note the current (about 2 mA). Transfer the -5V from TP2 to TP1 and adjust P2 until the same current (magnitude, ignore sign) is obtained. Remove the -5V from TP1.

Connect the Multimeter between A & B. Apply the probes to a 10 Ohm resistor and adjust P3 until the Multimeter reads 100 mV.

## Protection against charged capacitors.

Always ensure that the capacitor under test is discharged before measuring its ESR. However, accidents will happen, so R3, D1 & D2 protect against capacitors charged to at least 20 Volt. R4, D3 & D4 to at least 32 Volt. If the voltage is greater than these, survival of these components will depend upon the energy stored in the capacitor which is dependant upon the voltage and capacitance.

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