
LAB 24A. MULTIMETER

Purpose

Properly use an electric multimeter to measure voltage and current in an electric circuit.

Materials

Multimeter, wire leads, voltage source, resistors, breadboards, battery, light bulbs, light bulb holders, alligator clip wires

Using the Multimeter

Voltage

Measuring voltage is a critical part of building and analyzing circuits. It is easy to do, as long as you keep a few things in mind.

- Voltage is the electric potential difference between different locations. It is not a property of a particular location, but of two different locations.
- Voltage has polarity, or sign. Voltage measured between two points in one direction is the opposite (negative) of voltage measured in the other direction. Some voltmeters can measure both positive and negative voltage, while others can measure only positive voltage.
- The voltage between any two points on the same conductor is zero.

Current

Current is the flow of electrical charge *through* a wire or electrical component at a certain point in a circuit. **To measure current, break the circuit before or after the component and bridge the break with the ammeter, i.e., in series.** See Figure 3. One probe of the ammeter connects to one end of the break and the other probe connects to the other end of the break.

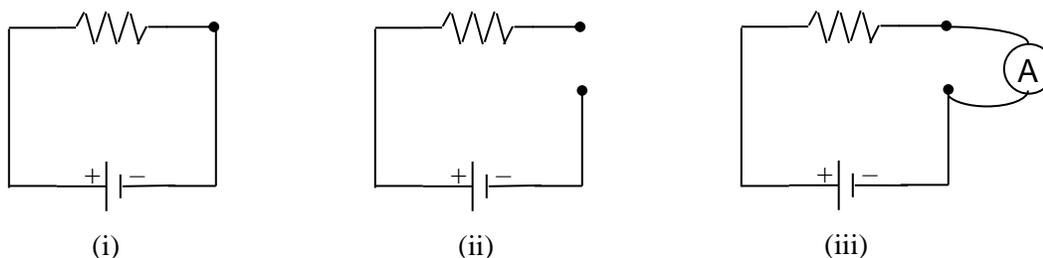


Figure 3. To measure the current through the resistor and circuit: (i) choose a point at which to measure the current; (ii) break the circuit at that point; then (iii) insert the ammeter, taking care to use the proper polarity.

When using an ammeter, observe the following precautions:

- (1) *Never connect an ammeter between two points in a circuit that are at two different potentials.* If you do, you will blow a fuse. The two ends of the break in the circuit of Figure 3 are at the same potential. If in doubt, check the break with a voltmeter before you switch to ammeter mode. It should read 0 V.
- (2) *Do not exceed the range of the ammeter.* Start with the largest range and then choose smaller ranges to obtain more precise measurements.
- (3) Double-check that the circuit is set up correctly before inserting the ammeter. It is very easy to blow the fuse in the ammeter; please avoid doing so!

If the ammeter always reads zero current when you expect it to be measuring something, consult your instructor. The fuse may be blown (by someone not following the precautions above).

Resistance

The best way to measure the resistance of an electrical component is to remove the component from the circuit. If this is not feasible, make sure that all power sources in the circuit are disconnected, and that nothing is wired in parallel to it. Before you use the meter, select the correct function (Ω). Turn the ohmmeter on, then touch both ends of the probes together. You should get a zero reading.

To measure the resistance of a component, touch the two ends of the component with the probes. See Figure 1.

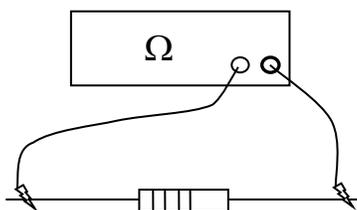


Figure 1. Measuring the resistance of a resistor.

First select the highest range, then reduce the range to get the most precise reading. If the reading is “1.”, that means you are off the scale and should change to a higher range.

Never measure the resistance between two points that are at two different voltages, such as the terminals of a battery. If you do, the ohmmeter will be overloaded. (This is why you should take the component out of the circuit first.) Finally, do not keep your multimeter in the ohmmeter mode when not in use. The small internal current is powered by a battery that can lose its charge if kept on for a long time.

Activity

Measure the resistance of an isolated resistor. Place it in a circuit with a voltage source and measure the voltage across it. Call over your instructor, break the circuit, and, with your instructor present, measure the current through the gap in the circuit.