

Multimeters

A multimeter is an instrument used to measure voltage, current, and resistance. Many of today's meters have a digital display and are called digital multimeters (DMM's).

Become familiar with your multimeter by observing the pushbuttons, knobs (if any), and labels. A user's manual is available in the lab for your reference. Usually, some sort of switch (rotary or a bank of pushbuttons) is available to allow the user to select the operation desired, viz., to measure voltage, current, or resistance. The leads need to be connected to the correct terminals of the meter. Usually the red lead is connected to the appropriate red terminal of the meter and the black lead to the black terminal of the meter. For measurements involving polarity (voltage, current), the red lead is the positive polarity and the black lead is the negative polarity.

Guidelines for measurements:

Voltage: Voltage is a *potential difference*; therefore, it is measured between (across) two points. For instance, to measure the voltage across a resistor you put the multimeter *in parallel* with the resistor (i.e., you place one multimeter lead on each side of the resistor). To measure the voltage at a node with respect to ground (or other reference point), one multimeter lead is placed on the node of interest and the other lead on ground.

Current: To measure the current flowing through an element (such as a resistor), the multimeter must be placed *in series* with the element. For safety, be sure to have the power off in the circuit in which you wish to make the measurement when breaking and making the following connections. First, disconnect one of the element's leads, and then connect one multimeter lead to the element and the other multimeter lead to the node the element's lead was originally connected to. Then the current through the multimeter will be the same as the current through the element.

CAUTION: **You can damage the multimeter if you try to measure a current by placing the meter across (in parallel with) a circuit element.** Also, to protect the multimeter when measuring a current, you should always start the measurement by placing the multimeter in the "A" range rather than the "mA/uA" range. In case the value being measured by the multimeter is too small to be read in the "A" range, you can then switch the meter to the "mA/uA" range.

Resistance: To measure the resistance of a passive circuit element, **disconnect** it from the circuit. Then connect one multimeter lead to one lead of the element and the other multimeter lead to the other lead of the element. To measure the resistance between two nodes (equivalent resistance), make certain that the circuit is dead (not energized) and then place one multimeter lead on each node. *Never hold the element with your fingers when measuring it!* (If you do this, you are measuring the resistance of element in parallel with your body's electrical resistance, which gives you a reading lower than the resistance of the element.)