

The Multimeter

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A multimeter can measure several different things.

(Hence the prefix *multi*.)

- ▶ Voltage that stays constant (DC voltage)
- ▶ Voltage that oscillates with time (AC voltage)
- ▶ Resistance
- ▶ Electric current that stays steady (DC current)
- ▶ Electric current that oscillates with time (AC current)

Some definitions

- ▶ *Electric potential* is a form of electric potential energy per unit charge. Electric potential is measured in volts (V). We talk about the electric potential at a particular place or point in space.
- ▶ *Voltage* is difference in electric potential between two places. This is why we need two wires (leads) to measure voltage. Voltage is also measured in volts.
- ▶ When we studied gravitational potential energy, we learned $PE = mgh$, where h is the height above some reference place. We can put the reference place anywhere near the surface of the Earth; it does not need to be at, for example, sea level. Similarly, we can choose one place to be a reference of 0 V for electric potential. This is where we will put the black lead.

How to measure DC voltage

1. Turn the dial to one of the DC voltage settings (probably marked “DCV”). Start at the highest setting, or a setting that you know is larger than the voltage you want to measure.
2. Put the black lead (wire) into the spot marked “COM” .
3. Put the red lead into the appropriate place for measuring DC voltage.
4. Using the red and black leads (the ends that you didn't plug into the meter), place the red lead against one spot you are interested in, and the black lead against a spot we will use for reference. (If these two spots are the same spot, you should get a reading of 0 V.)
5. If the voltage readout is small enough, turn the dial to a lower setting.
6. Read the voltage on the display. If the voltage is negative, you can switch the locations of the red and black leads to get a positive voltage.

Properties of metals and other good conductors

- ▶ Two spots connected by a metal wire have the same electric potential.
- ▶ The voltage across a wire is zero.
- ▶ I can put my red lead anywhere on a wire (including either end) and I will get the same reading on the meter.

How to measure AC voltage

1. Turn the dial to one of the AC voltage settings (probably marked "ACV"). Start at the highest setting, or a setting that you know is larger than the voltage you want to measure.
2. Put the black lead (wire) into the spot marked "COM".
3. Put the red lead into the appropriate place for measuring AC voltage.
4. Using the red and black leads (the ends that you didn't plug into the meter), place the red lead against one spot you are interested in, and the black lead against a spot we will use for reference. (If these two spots are the same spot, you should get a reading of 0 V.)
5. If the voltage readout is small enough, turn the dial to a lower setting.
6. Read the voltage on the display.

How to measure resistance

1. Turn the dial to one of the resistance settings (probably marked " Ω "). Start at the highest setting, or a setting that you know is larger than the resistance you want to measure.
2. Put the black lead (wire) into the spot marked "COM".
3. Put the red lead into the appropriate place for measuring resistance.
4. Using the red and black leads (the ends that you didn't plug into the meter), place the red lead against one end of the resistor, and the black lead against the other side.
5. If the readout is small enough, turn the dial to a lower setting.
6. Read the resistance on the display. Resistance is measured in ohms (Ω).

How to measure DC current

1. Turn the dial to one of the DC current settings (probably marked “DCA”). Start at the highest setting, or a setting that you know is larger than the current you want to measure.
2. Put the black lead (wire) into the spot marked “COM” .
3. Put the red lead into the appropriate place for measuring DC current. This is different than the place for DC voltage.
4. Find a wire that is carrying the current you want to measure. Remove this wire from your circuit and *replace* this wire with the meter.
5. If the current readout is small enough, turn the dial to a lower setting.
6. Read the current on the display. Current is measured in amps (A).