Multi-Meter Guide

How to Use a Multimeter
Source: https://learn.sparkfun.com/tutorials/how-to-use-a-multimeter
Additional reference: http://www.sciencebuddies.org/science-fair-projects/multimeters-tutorial.shtml#usingamultimeter

A digital multi-meter is a very useful tool for checking electronics circuits and parts, and testing batteries. A multi-meter is used to measure Voltage, Current, and Resistance. Another use is to measure Continuity – or whether a conductor is actually conducting.

Parts of a Multimeter:

- Display
- Selection Knob
- Ports

The **display** usually has four digits and the ability to display a negative sign. It also has small text areas that indicate units.

The **selection knob** allows the user to set the multi-meter to read different things such as milliamps (mA) of current, voltage (V), and resistance (Ω).

Two probes are plugged into two of the **ports** on the front of the unit. **COM** stands for *common* and is almost always connected to ground or (–) of a circuit. The black probe is used for COM. The red probe is inserted into 1 of the other ports, depending on what is being measured. Use the **mAVΩ** port on the right for Voltage (V), Resistance (Ω), Continuity, and small Currents (up to 200 mA). Use the **10A** port on the left to measure large or unknown currents (A). Large currents in the right port will often blow the fuse, which is only a problem is there aren't any handy to replace it.

Measuring Voltage of a battery

Multi-meters are useful for checking for dead batteries, a common source of problems in electronics.

To measure the voltage on a battery: Plug the black probe into **COM** and the red probe into **mAVΩ**. Set the multi-meter to **2 V** (or 20 V depending on the battery being checked) in the DC (direct-current) range. The DC voltage range has a V with a straight line next to it. Connect the black probe to the battery (-) and the red probe to (+). Read the voltage on the display. A negative number means the probes are probably reversed.

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Checking Batteries: AAA, AA, C, and D batteries are nominally 1.5 V. Fresh batteries are about 1.6 V, and they lose voltage as they get used. Batteries with less than 1.4 volts are dead. 9 V batteries are made of six 1.5 Volt batteries in series, and a fresh 9V battery will show over 9 volts. Less than 8 volts can be considered dead.

Measuring voltage on any other device is similar. Set the dial to greater than the expected voltage, place the red and black probes on the device, and read off the voltage on the display. Be sure to notice the units.

Continuity

Use the Continuity Check function to checking if alligator clips, wires, solder joints, or switches are making good electrical connections when they should be. It also helps in finding short circuits: when electrical contact is made where it is not wanted.

Continuity checkers test the resistance between two points. If there is very low resistance (less than a few ohms), the two points are connected electrically and a tone is emitted. If there is more than a few ohms of resistance, then the circuit is open and no tone is emitted.

Set the multi-meter to continuity mode. The icon varies, but generally looks like a diode symbol with propagation waves around it (like sound coming from a speaker). When the probes are touched together the multi-meter emit a tone. This shows that a very small amount of current is allowed to flow without resistance (or at least a very, very small resistance) between the probes. It is a good idea to check that the probes themselves show continuity before checking circuit components and wiring.

Measuring Resistance

Resistors often have color codes on them. If you don't know what they mean use an online calculators or smartphone apps to decode the colors. Multi-meters are useful in measuring resistance very precisely.

Set the multi-meter to a resistor setting – something with **Ω**. Hold the probes against the resistor legs and read the display. Rotate the dial until it is within range of the resistor. Note the units.

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Measuring Current

Reading current is tricky because you have to measure current in series. Where voltage is measured by poking at VCC and GND (in parallel), to measure current you have to physically interrupt the flow of current and put the meter in line. An easy way to do this is to remove the battery (+) wire and connect it to the red probe. Connect the black probe to the place the (+) wire had gone before. It is best to move the red probe to the left port that can handle 10 A before measuring current. If the reading is very low, then move the red probe to the right port.

Changing the Fuse

One of the most common mistakes with a multi-meter is to measure current on a battery from (+) to (-). This will immediately short power to ground through the multi-meter, the internal fuse will heat up and then burn out as more than 200 mA flows through it. It will happen in a split second and without any real audible or physical indication that something is wrong. However, the meter will not function as expected for future readings. To confirm that the fuse is blown, do a continuity check with the probes. If it emits a tone before the probes are touched together, then the fuse is blown. The meter will most likely be fine when the fuse is replaced, as the purpose of the fuse is to protect the meter.

Remove the screws on the back of the multi-meter and locate the fuse(s) on the inside. Here should be a spare fuse in the meter. (It's a good idea to replace this if it used).

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Lift gently up on the fuse and it will pop out. Make sure to replace the correct fuse with the correct type. Replace the 200 mA fuse with a 200 mA fuse. Do not put a 10 A fuse where a 200 mA fuse should go. Find the correct fuse.

The meter is ready for use.