How to Measure a Voltage Using a Digital Multimeter

What is a Digital Multimeter?

A digital multimeter is a testing tool that measures <u>voltage</u>, <u>current</u>, and <u>resistance</u> values. It is an indispensable diagnostic tool for electrical technicians. When a problem occurs in the circuit, the first thing that the technicians would do is to use digital multimeters to check whether the components are properly supplied with a voltage.

This instruction set is geared toward students who understand basic circuit theories, but do not have any previous experience in using either a digital multimeter or other lab equipment.

Measuring a voltage of one component in a circuit using a digital multimeter takes approximately 2 minutes.

List of Supplies

- A digital multimeter
  - All digital multimeter are essentially the same for measuring a voltage.

- A circuit
  - A circuit needs to be powered in order to measure a voltage of any component in the circuit.

Parts of a Digital Multimeter

Figure 1: Parts of a Digital Multimeter
(Image Source: https://www.sparkfun.com/products/12966)

- Display
  - A measurement value is shown on this display.

- Selection Knob
  - The selection knob is used for selecting the measurement range.
  - The selection knob functions as a power switch for the digital multimeter.
    - Turning the knob to any position other than OFF turns on the digital multimeter.
    - Turning the knob to OFF turns off the digital multimeter.

- Ports (10A, COM, and mAVΩ)
 - The ports are where the voltage, current, or resistance of a circuit are inputted using the probes.

- The COM port is connected to a negative of a circuit.
- The mAVΩ port is connected to a positive of a circuit.
- The 10A port is only used when measuring high currents, which are higher than 200mA.

- Probes
  - The probes are the physical parts that connect between a digital multimeter and a circuit.
    - The black probe is used for the COM port.
    - The red probe is used for the mAVΩ port.

WARNING

- *Use caution when measuring high voltage circuits to avoid electrical shock.*

- *Do NOT measure any voltage exceeding the voltage measurement limit.*
  - *The voltage measurement limit is 600V for this device.*
  - *The voltage measurement limit is written in between the COM port and the mAVΩ port on the digital multimeter.*

- *Do NOT insert any probe to the 10A port to measure the voltage.*
  - *Using the 10A port for measuring the voltage can cause a short circuit.*

Steps to Measure a Voltage

1. Insert the black probe to the COM port.

2. Insert the red probe to the mAVΩ port.

3. Turn on the digital multimeter by turning the selection knob.

4. Set the voltage range setting by turning the selection knob.
    -   Read 4.1 to measure <u>DC voltage</u> and 4.2 to measure <u>AC voltage</u>.

    4.1. Turn the selection knob to V- to measure DC voltage.

        4.1.1. Turn the selection knob to 200mV to measure DC voltage less than 200mV.
        4.1.2. Turn the selection knob to 2V to measure DC voltage between 200mV and 2V.
        4.1.3. Same applies for selecting higher voltage range.
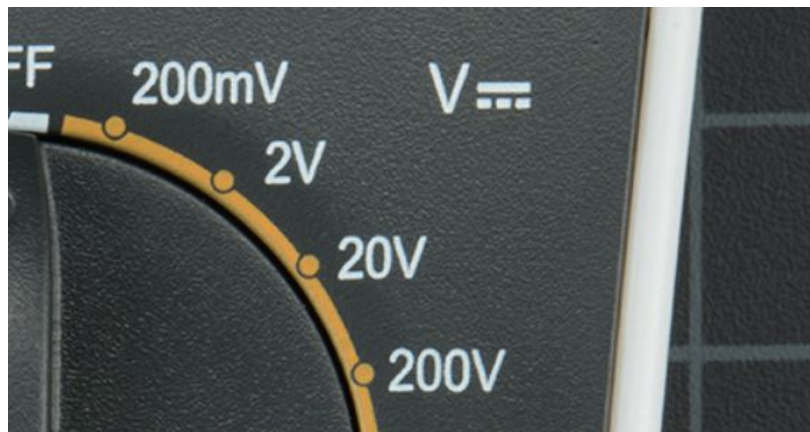
Figure 2: DC voltage measurement on the selection knob
(Image Source: https://learn.sparkfun.com/tutorials/how-to-use-a-multimeter/measuring-voltage)

    4.2. Turn the selection knob to V~ to measure AC voltage

        4.2.1. Turn the selection knob to 200V to measure AC voltage less than 200V.

        4.2.2. Turn the selection knob to 600V to measure AC voltage between 200V to 600V.

Figure 3: AC voltage measurement on the selection knob
(Image Source: https://learn.sparkfun.com/tutorials/how-to-use-a-multimeter/measuring-voltage)

5.   Connect the black probe to one end of the component that you want to measure.
    - *A way to connect the probes to the component is shown in Figure 4.*

6.   Connect the red probe to the other end of the component.

7.   Read the measurement on the display.
    - *If a negative value is shown on the display, see **Troubleshooting Tip 1***
    - *If '1' is shown on the display, see **Troubleshooting Tip 2***

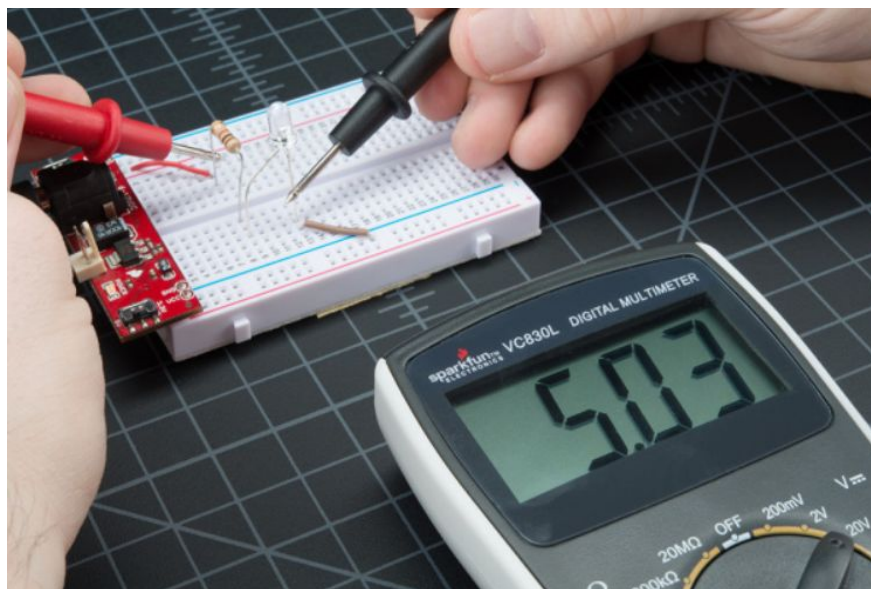8.   The task is now completed and Repeat step 4 to 7 to measure the voltages of other components.

Figure 4: Demonstration of Measuring Voltage
(Image Source: https://learn.sparkfun.com/tutorials/how-to-use-a-multimeter/measuring-voltage)

Steps to Disconnect the Digital Multimeter

1. Disconnect the red probe from the component.

2. Disconnect the black probe from the component.

3. Turn off the digital multimeter by turning the selection knob to OFF.

4. Remove both probes from the ports.

5. The digital multimeter is now safely disconnected from the circuit.

Troubleshooting Tips

1. If a negative value is shown on the display,
   switch the connection between the probes by following the steps below:

   1.1. Remove the red probe
   1.2. Remove the black probe
   1.3. Connect the black probe to one end of the component where the black probe was connected
   1.4. Connect the red probe to the other end of the component where the red probe was connected

2. If '1' is shown on the display,
   reselect the voltage range setting by following the steps below:

   2.1. Go back to Step 4.
   2.2. Select the next higher voltage range setting
   - e.g. If the voltage range setting was 200mV, turn the selection knob to 2V.

Glossary

Voltage: A Voltage is an electric potential between two points.

Current: A Current is a flow of electrical charge carriers.

Resistance: A Resistance is an opposition to the flow of current.

DC voltage: A voltage produced due to a direct current, which always flows in the same direction. Therefore, the DC voltage is either always positive or always negative.

AC voltage: A voltage produced due to an alternating current, which continually reverses the direction of flow. Therefore, the AC voltage continually changes between positive and negative.

Short Circuit: A circuit is called a short circuit when an abnormal connection in the circuit causes a current to flow in an unintended path by bypassing resistances. It is dangerous because a short circuit can cause overheating to the circuit which may result in fire.