Lab 1.5.5 Electrical Safety

Estimated Time: 10 minutes

Number of Team Members: Up to six

Objectives:
- Identify the parts of an AC outlet.
- Understand how current flows.
- Use a multimeter safely.

Overview:
This lab will explain the functions of each wire and the voltages present within an AC outlet.

![AC Outlet Diagram]

AC outlets are typically connected to three wires: the ungrounded, the grounded, and the grounding conductor.

The black or red wire is the ungrounded, or hot, conductor. It is the conductor that feeds power to an appliance.

The white wire is the grounded, or neutral, conductor. It is the electricity path back to ground, which completes the circuit.

The green, or bare copper, wire is the grounding conductor. It is an extra safety wire that provides an additional path to ground which is normally connected to an appliance housing.

Current normally flows between the ungrounded conductor, or hot, and the
grounded conductor, or neutral. Current flows through the grounding conductor in the event of a fault.

A multimeter is an electrical testing tool capable of detecting voltage levels, resistance levels, and open or closed circuits. It can measure both Alternating Current (AC) and Direct Current (DC) voltages. Opens and shorts are shown by the amount of resistance for each circuit type. Opens are very high resistance and shorts are very low resistance. This resistance is measured in ohms.

Direct Current is a voltage at a certain level that stays at that level flowing in one direction. A battery produces DC voltage. One battery terminal is positive and one is negative. When a load such as the light bulb in a flashlight is connected between the terminals, electricity flows through the filament in the bulb causing it to glow.

Alternating Current is a voltage that rapidly changes between positive and negative. An example of AC is the common wall outlet. In most countries, this outlet provides either 120V or 220-240V AC. In the United States, this outlet provides 120V AC. Some appliances in the United States like ovens or clothes dryers need a higher voltage of 220V. Special AC outlets are provided to accommodate these appliances.

**Warning:** All electrical outlets and wires should be treated as if they are hot, whether they have been turned off or not.

**Preparation:**
Find a working outlet in the lab room.

**Tools and Resources:**
- Multimeter

**Additional Materials:**
- Outlet drawing
- Instructions provided with the multimeter

**URLs:**
http://www.fluke.com
http://www.multimeterwarehouse.com/usingamultimeter.htm
Step 1 Using a Multimeter

Set the multimeter to read AC volts. It is very important to set the meter to the correct setting for the application. Some meters can be damaged if they are not set correctly.

Insert the probes of the meter into the slots of an AC outlet. The red probe should be inserted into the shorter slot, which is hot. The black probe should be inserted into the longer slot, which is neutral.

**Warning:** Do not touch the bare metal parts of the probe.

- HOLD – This button is pressed to freeze the present reading on the display.
- MIN MAX – This button stores minimum, maximum, and average input values.
- RANGE – This button exits auto ranging and locks on the present range.
- Hz – This button is pressed to measure the frequency of a voltage or current signal.

Set the meter to AC Volts and insert the probes. The red probe goes into the shorter slot, and the black probe into the longer slot.

What is the reading on the meter?

___________________________________________________________

___________________________________________________________
Step 2 Turn the Probes Around
Remove the probes from the outlet. Insert the probes, this time with the red probe in the longer slot and the black probe in the shorter slot. What is the reading on the meter?

_____________________________________________________________________

_____  Is there a difference in the readings?
_____________________________________________________________________

_____  If there is a difference, what could account for it?
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Step 3 Checking for Ground
Leaving the black probe in the shorter slot, remove the red probe and insert it into the round hole in the outlet. This is the grounding connection, or safety ground.

What is the reading on the meter?

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_____  Replace the red lead into the longer slot. Remove the black lead and insert it into the round hole, the grounding connection.

What is the reading on the meter?

_____________________________________________________________________

_____  If a person were to touch the ungrounded conductor and a grounded portion of the building, would that person receive an electrical shock?
_____________________________________________________________________

_____  If a person were to touch the grounded conductor and a grounded portion of the building, would that person receive an electrical shock?
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