EQUIPMENT

DIGITAL MULTI-METER

A Digital Multi-Meter, DMM, will measure several different quantities. You must determine which function the DMM will perform by selecting the following four items:

- **POWER SOURCE:** Set the switch to DC (Direct Current) or AC (Alternating Current). We use DC for all experiments except Exp. 15, The Oscilloscope.

- **LEADS:** The black lead should always plug into the "COM" jack. Although the color of the wire covering is irrelevant, it is standard to define the black wire as the common (ground). The red lead will be plugged into the "VΩ" jack when measuring voltage or resistance. Plug the red lead into the "mA" jack when measuring current (the "10A" jack is used only for Exp. 22 and Exp. 23).

- **DIAL:** You must select the function the DMM will perform by turning the dial to the appropriate setting, as well as the appropriate scale. Select the lowest value that will accommodate your circuit, e.g., the '20V' setting will measure voltage up to 20 volts.

- **CONNECTION:** You must connect the leads to your circuit properly, or the DMM could be damaged.

  A voltmeter is always connected in parallel; the leads connect to each end of the same element.

  An ammeter is always connected in series; a jumper must be removed from the circuit in order to place the ammeter into the circuit.
EQUIPMENT

Fig. 4-A: Digital Multi-Meter (DMM)

Note the multipliers $\mu$, $m$, $K$, and $M$ on the different scales. This means you would multiply the digital reading of the DMM by the appropriate multiplier. For example, the $200K$ scale for the ohmmeter means you should multiply the digital readout by $10^3$. Note also that the DMM will only read values up to the scale value. For example, the $20m$ scale for the ammeter means the DMM will measure current up to $20mA$ if using the $mA$ jack, but will measure up to $10A$ if using the $10A$ jack.
To use the DMM as a voltmeter, make these selections:

- **POWER**: Select DC or AC.
- **LEADS**: Plug the black lead into "COM" and the red lead into "VΩ".
- **DIAL**: Turn to the appropriate scale on "V".
- **CONNECTION**: Place leads on each end of the same element.
Fig. 6-A: **Ohmmeter**  (See also Fig. 9-A and 10-A.)

Ohmmeter Reading: $0.501 \times 10^3 \, \Omega = 501 \, \Omega$.

To use the DMM as an ohmmeter, make these selections:

- **POWER**: Select DC or AC.
- **LEADS**: Plug the black lead into "COM" and the red lead into "VΩ".
- **DIAL**: Turn to the appropriate scale on "Ω".
- **CONNECTION**: Place leads on each end of the same element.
Fig. 7-A: **Ammeter**  (See also Fig. 11-A.)  Ammeter Reading: \( 10.2 \times 10^{-3} \text{ A} = 0.0102 \text{ A} \).

To use the DMM as an ammeter, make these selections:

- **POWER:** Select DC or AC.
- **LEADS:** Plug the black lead into "COM" and the red lead into "mA".
- **DIAL:** Turn to the appropriate scale on "A".
- **CONNECTION:** Remove a jumper, place leads into circuit (current travels from one element, through the ammeter, into a different element).
**Fig. 8-A: Voltmeter and Circuit**  Voltmeter Reading: 5.01 V.

Note that the circuit is complete, power supply plugged in and set to desired voltage. The voltmeter is connected in parallel, as it measures voltage across an element in a circuit.
Fig. 9-A: Ohmmeter and Circuit  Ohmmeter Reading: 0.501 kΩ=501 Ω.
Note that the power supply has been disconnected in order to measure the resistance, $R_{eq}$, of the circuit.

Fig. 10-A: Ohmmeter and Resistor  Ohmmeter Reading: 0.200 kΩ=200 Ω.
Connect ohmmeter to resistor for resistance measurement of an individual element.
Fig. 11-A: **Ammeter and Circuit**  
Ammeter Reading: 9.9 mA = 0.0099 A.
Note that the ammeter is connected in series. A jumper has been removed from the circuit so that the ammeter can be inserted, in series, to measure the current. Power supply is connected and active.