

# Experiment 1 : Basic Electronic Circuits I

(tbc 12/26/2006, 1/13/09)

**Objective:** To get familiar with the basic concepts of voltage and current in electronic circuits by verification of Kirchoff's law and Ohm's law in resistor circuits.

## A. Theory

### I. Voltage and Current

#### A. Definitions and Units

Current ( $I$ ) = amount of electrical charge flowing per unit time

Units: 1 ampere (A) = 1 coulomb/second

Voltage ( $V$ ): potential energy per unit charge (also known as electromotive force, emf)

Units: 1 volt (V) = 1 joule/coulomb

#### B. Conventions

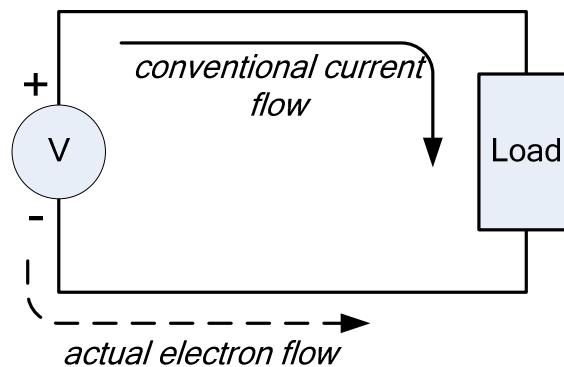


Figure 1. Electrical Loop

### II. Resistors and Ohm's Law:

$$\text{Resistance (R)} = \frac{V}{I}$$

Units: 1 ohm ( $\Omega$ ) = 1 volt/ampere

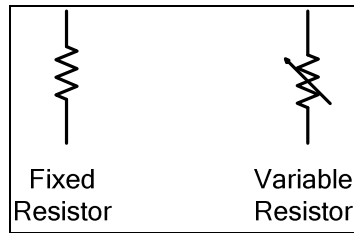


Figure 1. Symbols for Resistors.

**Main application of resistors:** to set the current flow in a wire for a given voltage.

### III. Kirchoff's Laws

- a) Sum of voltage around a closed loop is zero
- b) Sum of current at a junction is zero.

$$\text{Loop A: } V_{ga} + V_{ab} + V_{bd} + V_{de} + V_{ef} + V_{fg} = 0$$

$$\text{Loop B: } V_{db} + V_{bc} + V_{ce} + V_{ed} = 0$$

$$\text{Junction } b: I_{ab} + I_{db} + I_{cb} = 0$$

$$\text{Junction } e: I_{de} + I_{ce} + I_{fe} = 0$$

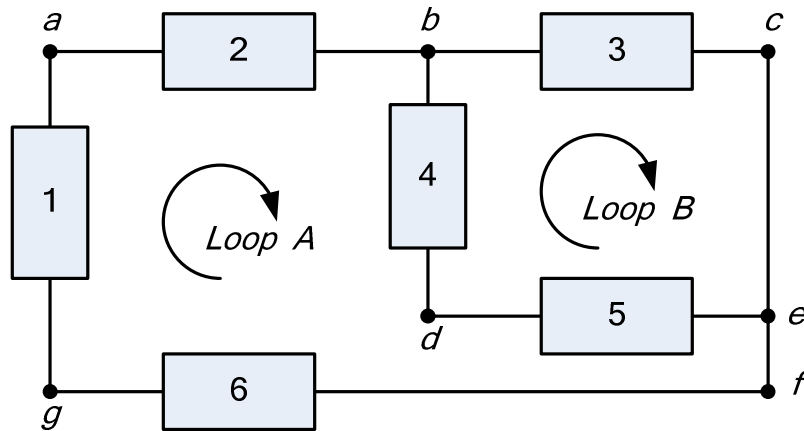


Figure 2.

#### Consequence of Kirchoff's law:

- a) Series

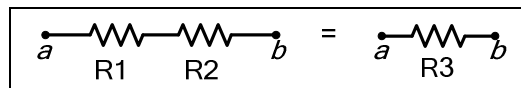


Figure 2.

$$R3 = R1 + R2$$

b) Parallel

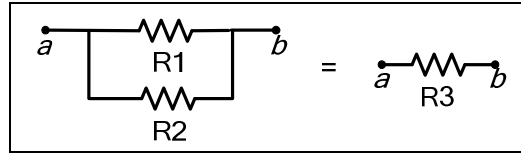


Figure 3.

$$\frac{1}{R3} = \frac{1}{R1} + \frac{1}{R2}$$

## B. Experimental setups ( Note: See Appendix A for breadboard connections)

**Instruction:** Obtain setups 1 to 4 and fill the observations in Table 1. (Hint: To avoid overheating of resistors, turn on the power only when measuring.)

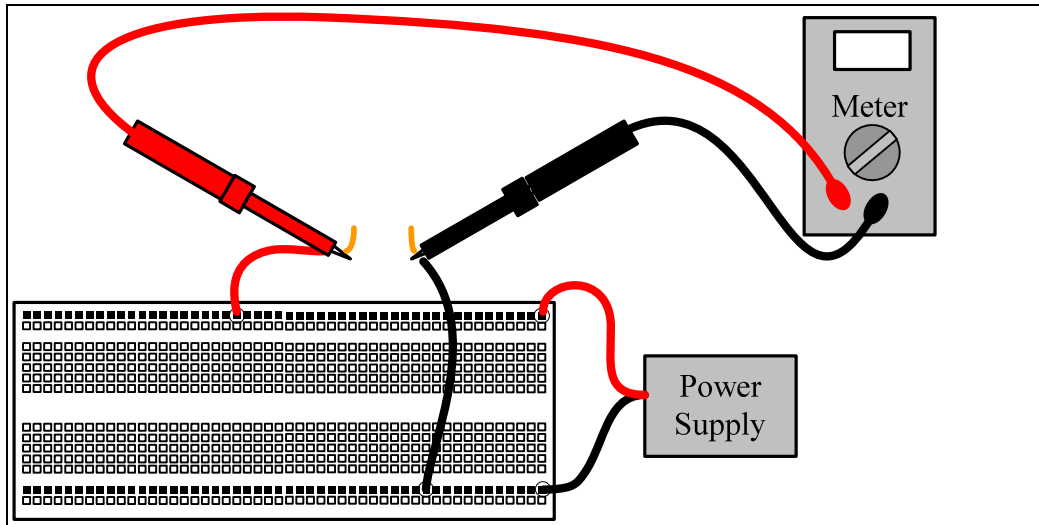
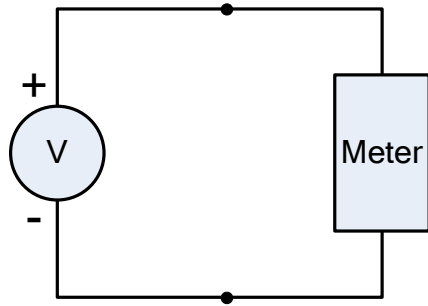
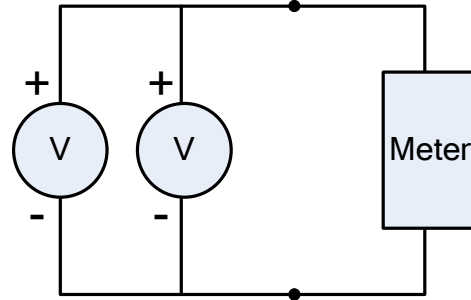


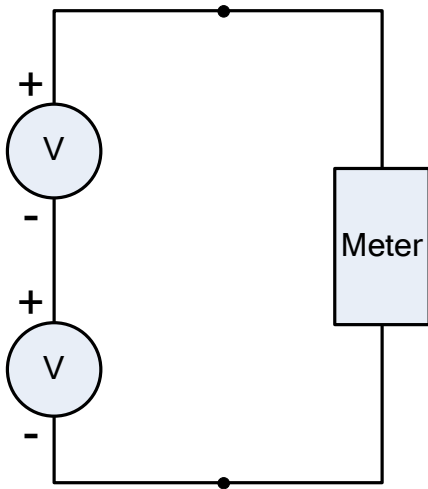
Figure 2. Suggested wiring for setup 1.



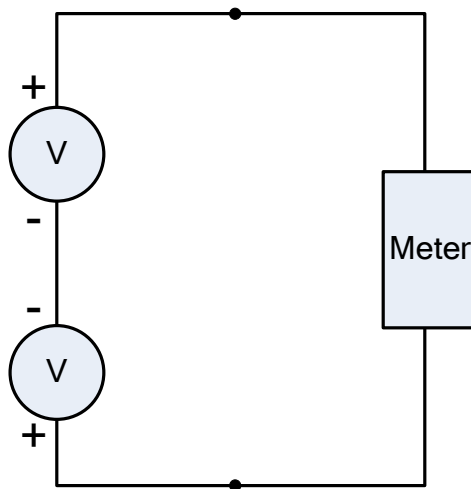
Setup 1



Setup 2



Setup 3



Setup 4

Figure 3. Setups for voltage measurement experiment.

Table 1. Result from meter readings.

	Power I	Power 2	Voltage reading
Setup 1	3 V	-	
	6 V	-	
	12 V	-	
Setup 2	3 V	3 V	
	3 V	6 V	
	6 V	3 V	
Setup 3	3 V	3 V	
	3 V	6 V	
	6 V	3 V	
Setup 4	3 V	3 V	
	3 V	6 V	
	6 V	3 V	

**Observations:**

Setup 1:

Setup 2:

Setup 3:

Setup 4:

**Resistor setups:** ( see Appendix B for resistor codes )

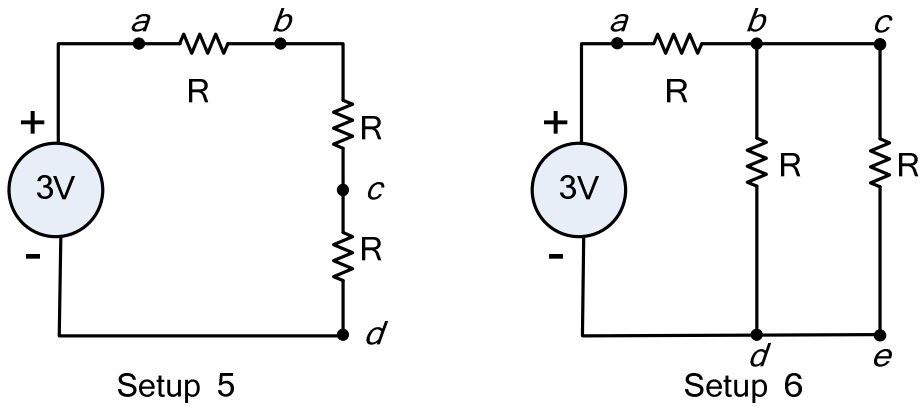


Figure 4. Use  $R=100\ \Omega$

**Instruction:** Obtain setups 5 and 6, then fill in Table 2.

Table 2.

Setup 5	$V_{ab}$	
	$V_{bc}$	
	$V_{ac}$	
Setup 6	$V_{ab}$	
	$V_{ad}$	
	$V_{bd}$	
	$V_{ce}$	

**Observations:**

Setup 5:

Setup 6:

**Problem:**

1. Given a power supply of 3 volts and a  $100\ \Omega$  resistor as shown in Figure 5, use an additional two or three  $100\ \Omega$  resistors and obtain a circuit such the voltage across junction  $a$  and  $b$  is about 0.6 to 0.65 volts.

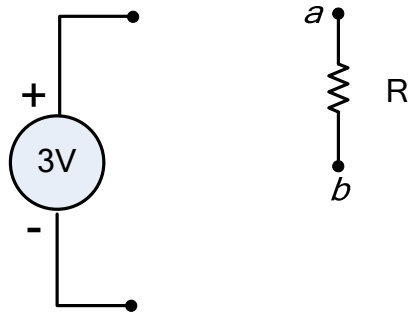
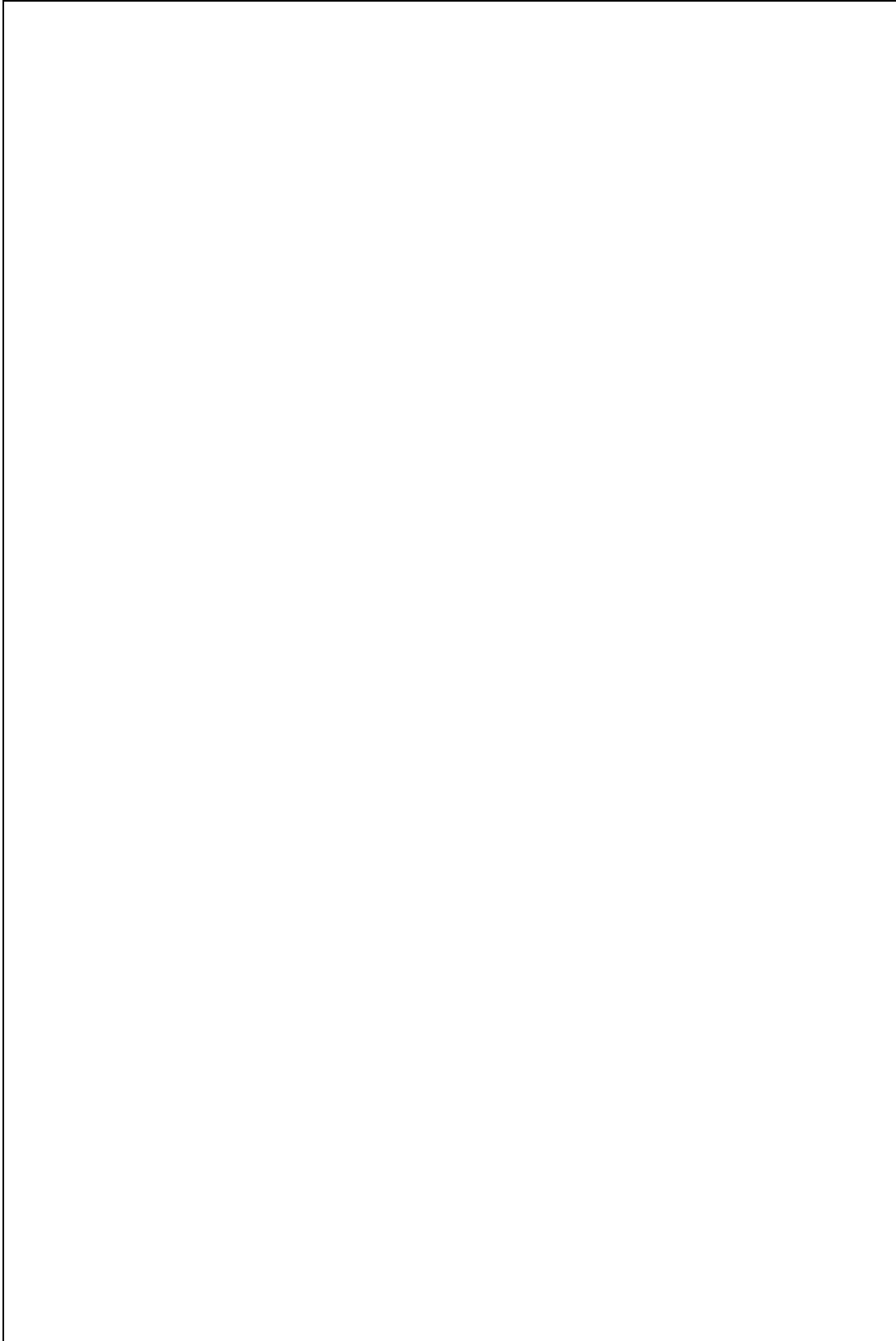
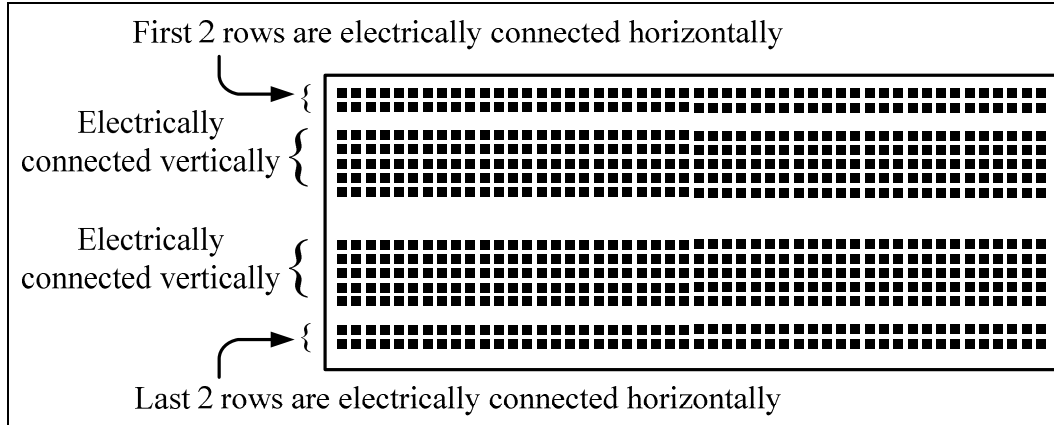


Figure 5.  $R=100\ \Omega$

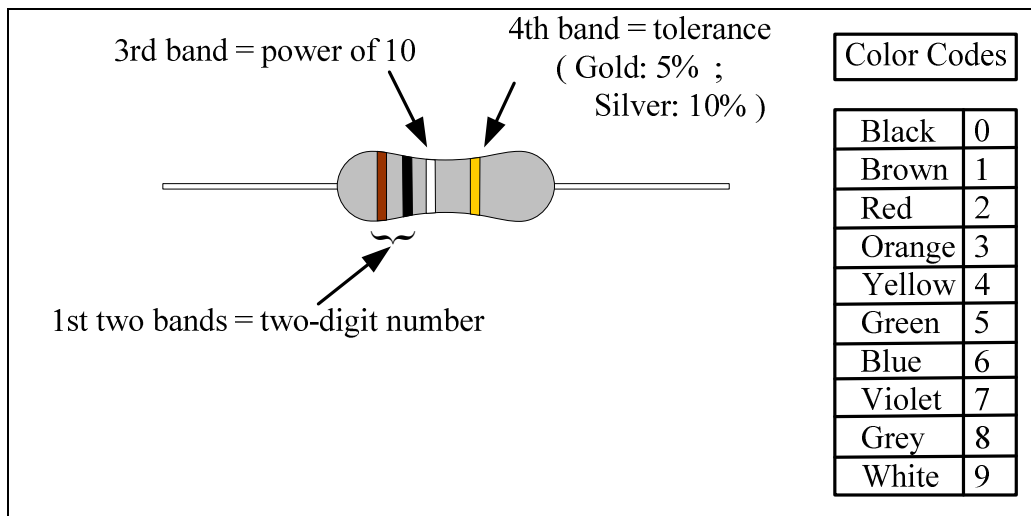
**Solution to Problem:**



## Appendix A. Breadboard Connections



## Appendix B. Code Convention for Resistors



**Example:** Brown-Black-Red-Gold  $\rightarrow$  1 k $\Omega$  with 5% tolerance