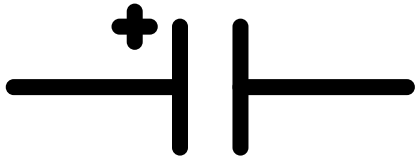
Electronic Components, Basic Circuits

An Introduction to Circuits

- Basic Electronic Components
  - Capacitors
  - Resistors
  - Diodes
  - Switches
  - Power supplies

Capacitors



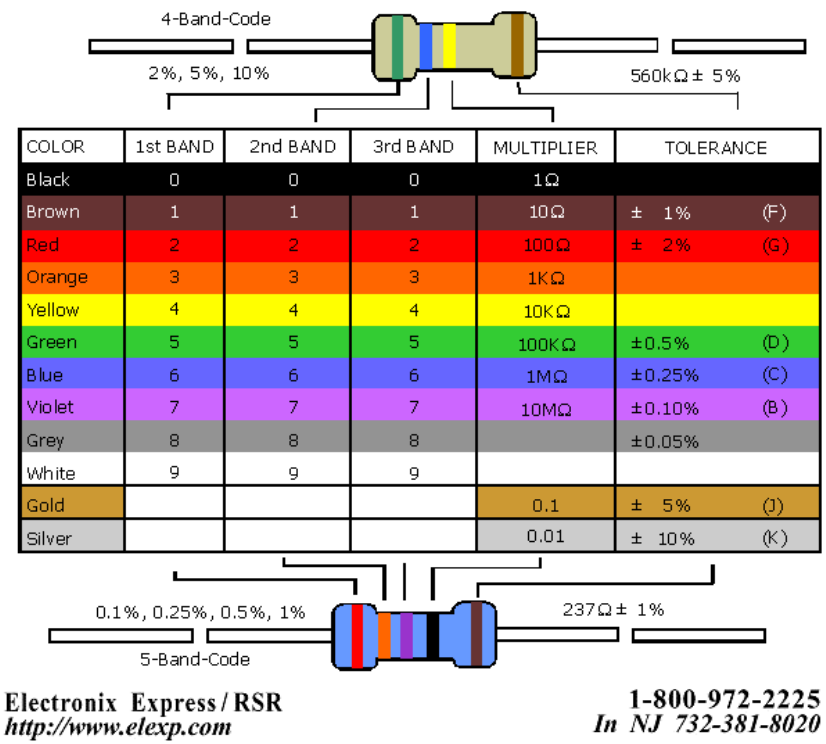
- What are They?
  - Parallel conductive plates separated by an insulator
- Uses in Circuits
  - Store and disperse charge (denouncing circuits)
- Types of Capacitors
  - Fixed-capacitance
  - Variable capacitance
- Connections
  - Dedicated + and – terminals (2 leads)

Resistors

- What are They?
  - High-resistive metal alloy surrounded by a carbon casing
- Uses in Circuits
  - Limit voltage and current
- Types of Resistors
  - Fixed-resistance
  - Rheostat
  - Potentiometer
- Connections
  - 2 terminals (voltage independent), 3 terminals (+, –, and signal)

Resistors (cont.)

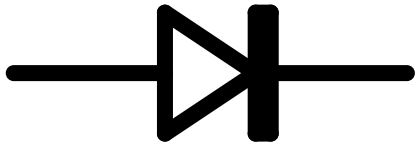
- Reading Resistor Color Codes
  - 4 and 5 color band resistors
  - Resistance measured in ohms (Ω)
  - Last band measures tolerance (%)



COLOR	1st BAND	2nd BAND	3rd BAND	MULTIPLIER	TOLERANCE	
Black	0	0	0	1Ω		
Brown	1	1	1	10Ω	± 1%	(F)
Red	2	2	2	100Ω	± 2%	(G)
Orange	3	3	3	1KΩ		
Yellow	4	4	4	10KΩ		
Green	5	5	5	100KΩ	±0.5%	(D)
Blue	6	6	6	1MΩ	±0.25%	(C)
Violet	7	7	7	10MΩ	±0.10%	(B)
Grey	8	8	8		±0.05%	
White	9	9	9			
Gold				0.1	± 5%	(J)
Silver				0.01	± 10%	(K)

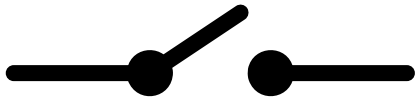
Electronix Express / RSR
http://www.elexp.com
1-800-972-2225
In NJ 732-381-8020

Diodes



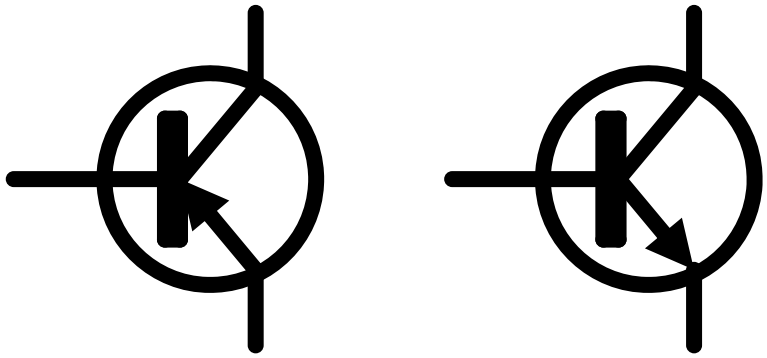
- What are They?
  - Insulated p-type and n-type silicon plates
- Uses in Circuits
  - Allow the flow of current only in one direction
- Types of Diodes
  - LEDs (Light Emitting Diodes)
  - Zener/Schottky diodes (voltage regulation)
- Connections
  - Dedicated + and – terminals (2 or 3 leads)

Switches

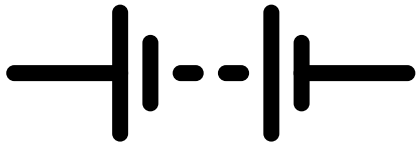


- What are They?
  - Breakable connections within a circuit
- Uses in Circuits
  - Opens or closes a circuit, switches connections
- Types of Switches
  - ON/OFF
  - ON/OFF/ON
- Connections
  - Varies (usually 2 or 3 terminals, no dedicated leads)

Transistors



- What are They?
  - Solid-state silicon switch
- Uses in Circuits
  - Switches or amplifies electronic signals
- Types of Transistors
  - PNP
  - NPN
- Connections
  - Dedicated terminals for base, collector, and emitter pins (BCE)

Power Supplies 

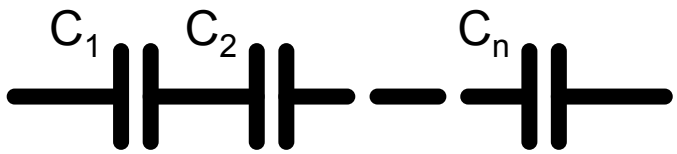
- What are They?
  - Power cells or batteries
- Uses in Circuits
  - Create voltage to drive circuits
- Types of Power Supplies
  - Single power cell
  - Battery
- Connections
  - Dedicated terminals for + and – leads

An Introduction to Circuits

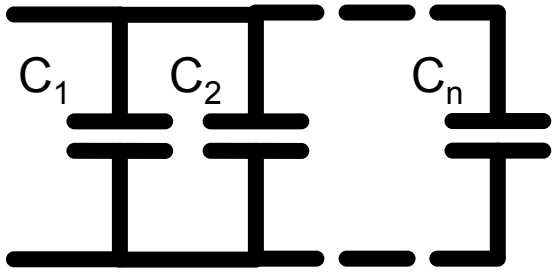
- Network Capacitors and Resistors
  - Capacitors in series and parallel configuration
  - Resistors in series and parallel configuration

Capacitors in Series and Parallel

- Series Configuration
  - Current remains constant; voltage does not
  - Net capacitance: $1/C_1 + 1/C_2 + \ldots + 1/C_n = 1/C_c$
- Parallel Configuration
  - Voltage remains constant; current does not
  - Net capacitance: $C_1 + C_2 + \ldots + C_n = C_c$



Series configuration

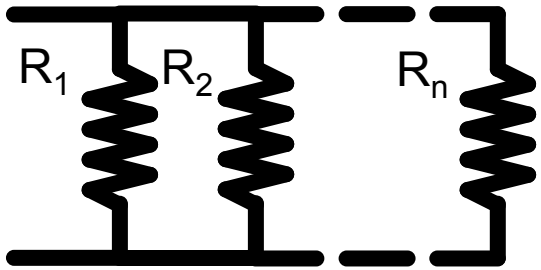


Parallel configuration

Resistors in Series and Parallel

- Series Configuration
  - Current remains constant; voltage does not
  - Net resistance: $R_1 + R_2 + \ldots + R_n = R_r$
- Parallel Configuration
  - Voltage remains constant; current does not
  - Net resistance: $1/R_1 + 1/R_2 + \ldots + 1/R_n = 1/R_r$

Series configuration



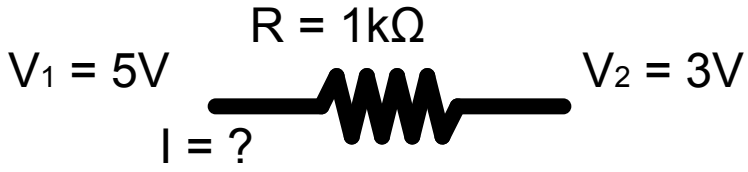
Parallel configuration

An Introduction to Circuits

- Laws of Circuits
  - Ohm's Law
  - Watt's Law
  - Kirchhoff's Law

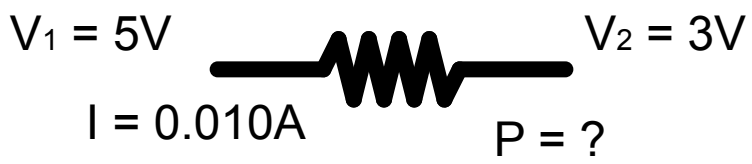
Ohm's Law

- Description
  - Relates the difference in potential (voltage) of a circuit as a function of the current and the resistance of the circuit
- Formula
  - $V = I \cdot R$
- Example
  - $(V_1 - V_2) = I \cdot R$
  - $(5V - 3V) = I \cdot (1000\Omega)$
  - $I = 2V/1000\Omega = 0.002A$



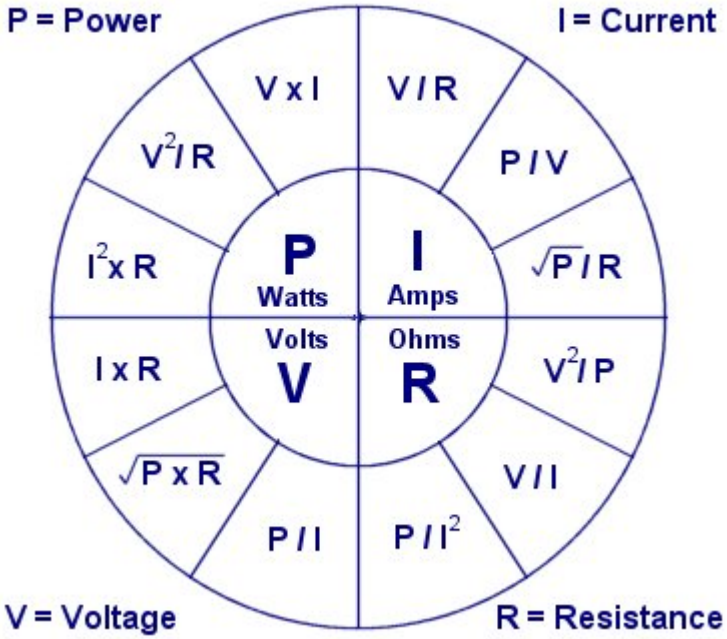
Watt's Law

- Description
  - Relates the power of a circuit as a function of the voltage and current of the circuit
- Formula
  - $P = V \cdot I = I^2R$
- Example
  - $P = (V_1 - V_2) \cdot I$
  - $P = (5V - 3V) \cdot (0.010A)$
  - $P = 0.02W$



Watt's Law (cont.)

- Relationship of Voltage, Current, and Resistance

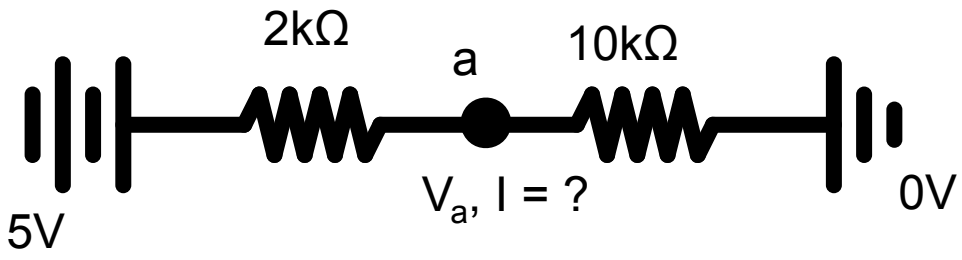


Kirchhoff's Law

- Descriptions
  - Indicates that the sum of the potential differences through the circuit must be zero (Voltage Law)
  - Indicates that the sum of the currents from a wire branch must be equal to the input current (Current Law)
- Formulas
  - $\Sigma V = 0$
  - $I_s = I_1 + I_2 + \ldots + I_n$

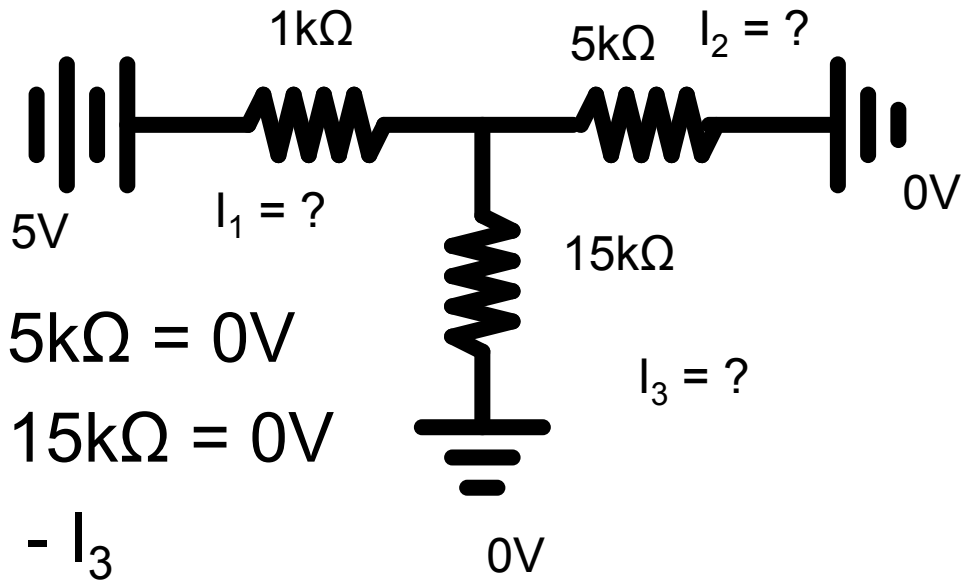
Kirchhoff's Law (cont.)

- Examples
  - $I = V/R$
  - $R_r = R_1 + R_2$
  - $R_r = 12k\Omega$
  - $I = (5V - 0V)/12k\Omega = 4.167 \cdot 10^{-4}A$
  - $V_a = 5V - I \cdot R_1$
  - $V_a = 5V - (4.167 \cdot 10^{-4}A) \cdot 2k\Omega = 4.167V$



Kirchhoff's Law (cont.)

- Examples
  - $\Sigma V = 0$
  - $5V - I_1 \cdot 1k\Omega - I_2 \cdot 5k\Omega = 0V$
  - $5V - I_1 \cdot 1k\Omega - I_3 \cdot 15k\Omega = 0V$
  - $I_1 = I_2 + I_3$, $I_2 = I_1 - I_3$
  - 3 linear equations, 3 variables
  - $I_1 = 1.053$ mA
  - $I_2 = 0.789$ mA
  - $I_3 = 0.264$ mA



Additional Resources

- Wikipedia
  - http://www.wikipedia.org/
- Circuit Info
  - http://www.kpsec.freeuk.com/index.htm