Notes: Introduction to ARM Cortex ™-M Microcontrollers

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Contents

1 Introduction to Computer Electronics

1.1 Review of Electronics

$$V = \text{Voltage (Volts)}, I = \text{Current (Amperes)}, R = \text{Resistance (Ohms/}\Omega\text{)}$$
$$V = IR,\ I = \frac{V}{R},\ R = \frac{V}{I}$$

- Voltage
  - potential to cause current to flow, measured between two places
  - has polarity
- Current
  - has direction
- If the electron flow has stopped resistance is infinite, no electrons flow
- If electrons flow freely, resistance is not zero, but some finite amount
- As resistance varies so does current
- potential is defined as the voltage difference between two places
- current/Flow has direction
  - Low resistance, High current
  - High resistance, Low current
  - Example: Temperature Movement
    - Flow $= \frac{T_1 - T_2}{\text{Resistance}}$
    - T = Temperature
- R-Value
  - used in insulation put in walls and ceiling of a house
  - given in units per square area, e.g. $m^2 \cdot^\circ C/w$
  - amount of heat flow across a wall:
    - Flow $= \frac{\text{Area} \cdot (T_1 - T_2)}{\text{R-Value}}$
    - T = Temperature
- Power
  - P in watts
  - does not have power or direction

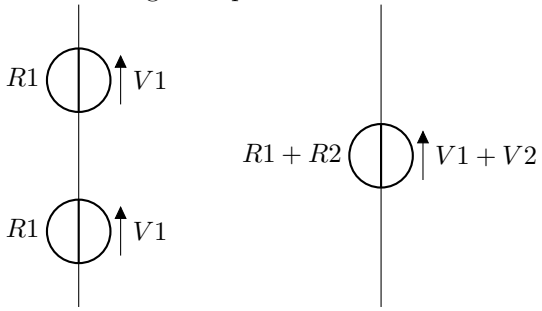
$$P\text{=Power(watts)}, V\text{=Voltage(Volts)}, I\text{=Current(Amperes)}$$
$$P = VI,\ P = \frac{V^2}{R},\ P = I^2 \cdot R$$

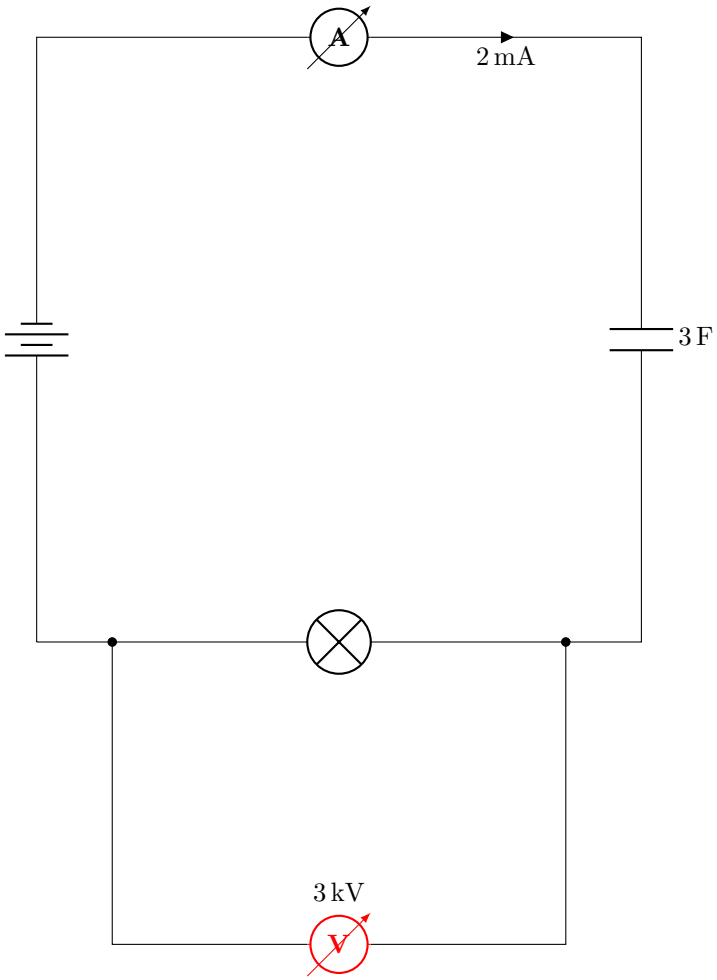
- Energy
  - E in joules
  - stored in a battery

- has neither polarity or direction

$$E = \text{Energy(Joules)},\ V = \text{Voltage(Voltage)},\ I = \text{Current(Amperes)},\ t = \text{time(seconds)}$$
$$E = VIt,\ E = Pt$$

- Switch
  - used to modify the behavior of a circuit
  - ON
    - closed, resistance is 0, current flows
    - resistance of a switch is less than 0.1Ω, assume 0 in most cases
  - OFF
    - open, resistance is ∞, no current will flow
    - resistance if greater than $100\text{M}\Omega$, close to ∞ therefore assume ∞
- Rules for solving voltages and currents in a circuit compromised with batteries, switches, and resistors
  - **Current always flows in a loop**
    - When there is no loop, no current can flow
  - **Kirchoff's Voltage Law (KVL)**
    - The sum of the voltages around the loop is zero
  - **Kirchoff's Current Law (KCL)**
    - The sum of the currents into a node equal the sum of the currents leaving a node
  - **Observation:** If at all possible, draw the circuit so curruent flows down across the resistors and switches. As a secondary rule have currents go left to right across resistors and switches.
  - **Series Resistance**
    - If resistor $R1$ is in series with resistor $R2$, this combination behaves like one resistor with a value equal to $R1 + R2$
    - V equals $V1 + V2$
    - By KCL currents through the two resistors are the same
  - **Voltage Divider Rule**
    -
$$\begin{aligned} V2 &= I \cdot R2 \\ &= (V/R) \cdot R2 \\ &= V * R2/(R1 + R2) \end{aligned}$$
    - The following are equivalent:




A
2 mA
3 F
3 kV
V