Foundations of Electrical and Computer Engineering

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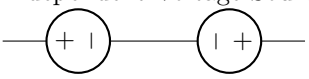
January 24, 2017

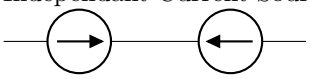
Elements

1. Independent Voltage Source



   Provides a fixed voltage independent of what is already attached to the circuit.

2. Independant Current Source



   Provides a fixed current independent of what is already attached to the circuit as long as there is a closed path.

Analog Circuit Fundementals

1. Current $\equiv$ the flow of charge around a closed path in a circuit.
   Symbol $\equiv i(t)$ or i
   Unit $\equiv$ Amperes, Amps or (A)
   Current is a vector of Amperes and direction. It may be defined at any one point along a circuit with either positive or negative values. A negative value current is equivalent to a positive value but opposite direction current.

2. Voltage $\equiv$ the measure of potential difference between two points in a circuit.
   Symbol $\equiv v(t)$ or v
   Unit $\equiv$ Volts or (V)
   Voltage is a vector of of voltage and polarity. The point with postive polarity is the point where the potential difference is greatest. Voltage may also be either positive or negative, and a negative voltage is equivalent to a positive voltage with reversed polarity.

3. Power $\equiv$ a measure of useful output of a circuit.
   Symbol $\equiv p(t)$ or p
   Unit $\equiv$ Watts or (W)
   Relationship $\equiv p(t) = v(t) * i(t)$ or $p = vi$
   Conservation of Power $\equiv$ in a valid circuit, the total power supplied is equivalent to the total power absorbed. Power can be absorbed or supplied by a given element. Circuit validity, as used in the of Conservation of Power is true as a consequence of the law. That is to say, a circuit that does not satisfy the Conservation of Power is not a valid circuit.

To determine if an element absorbs or supplies power:

1. Take measurements of current and voltage before and after the element, in terms of positive values.

2. If current flows into the positive side $\rightarrow$ the element absorbs power.
   If current flows into the negative side $\rightarrow$ the element supplies power.

Kirchhoff's Laws

1. Node $\equiv$ a node is a point in a circuit where two or more elements are connected. All points along a wire are the same node.

2. Loop $\equiv$ a loop in a circuit is a closed path that begins and ends at the same node and goes through at least one element.

Kirchhoff's Current Law (KCL)

The total current into a node is equal to the total current out of the node.

Kirchhoff's Voltage Law (KCL)

The sum of the voltages around a loop in the circuit is zero.

When tracing the loop, if voltage goes from negative to positive through an element, the voltage is positive. If voltage goes from positive to negative, the voltage is negative.

Both laws must be true in order to have a valid circuit.

Example of a Valid Circuit