Inbyggd Elektronik 2018-03-21 #2

Electric Power is the amount of electrical energy converted into another energy form per unit time.

- When a charge Q moves through a potential difference V the potential energy is changed $E_{pot} = QV$

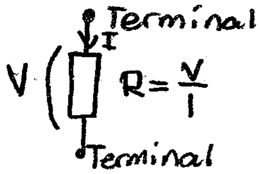
This energy is converted into another energy form, for example heat or light.

$$P = \frac{\text{Energy transformed}}{\text{time}} = \frac{QV}{t} = IV \qquad \boxed{P = IV}$$

Lumped Circuit Abstraction

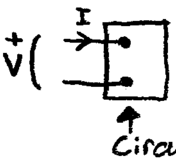
We model components as "black boxes" where the behaviour of the terminals is more important than what is happening inside the component.

Example



Connections between circuit elements is assumed to $R = 0\,\Omega$, hence the potential is constant along a wire.

Passive sign convention



if $P = VI > 0$ power is consumed by the element.
if $P = VI < 0$ power is delivered from the element to the circuit it is connected to.

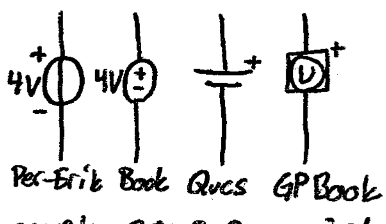
Power is ALWAYS balanced in a circuit

$$\boxed{P_{delivered} = P_{consumed}}$$

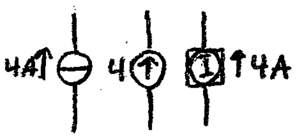
DC sources

- An ideal voltage source maintains a constant voltage across its terminals regardless of the current flowing through it.

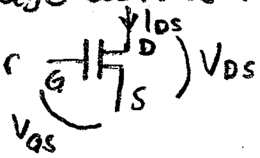
Ex symbols

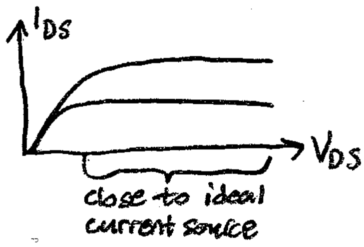


- An ideal current source maintains a constant current across its terminals regardless of the voltage across its terminals.



Transistor

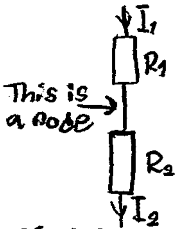




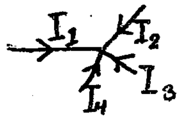
Key Concept: I through

Key Concept: I through ideal voltage source is determined by the circuit connected to it.
V through ideal current source is determined by the circuit connected to it.

Kirchoff's current law (KCL): The sum of all currents entering/leaving a node is zero.

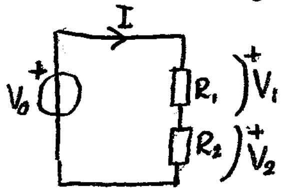


$I_1 = I_2$



$I_1 + I_2 + I_3 + I_4 = 0$

Kirchoff's Voltage law (KVL): The sum of all voltages across the circuit elements in a closed path is zero.



$V_2 + V_1 - V_0 = 0$ Voltage divider.

$I_1 = I_2$ $R_1 = 1k\Omega$ $R_2 = 10k\Omega$

$$\Rightarrow \frac{V_1}{R_1} - \frac{V_2}{R_2} = 0 \Rightarrow V_1 = \frac{R_1}{R_2} V_2 .$$

$$V_0 = V_2 + \frac{R_1}{R_2} V_2 = V_2\left(1 + \frac{R_1}{R_2}\right) \Rightarrow V_2 = \frac{R_2}{R_1 + R_2} V_0$$

$V_0 = 5V$

$$V_2 = \frac{10}{1+10} 5 = 4{,}55V$$

$$I = \frac{V_2}{R_2} = \frac{4{,}55}{10k} = 0{,}45mA$$