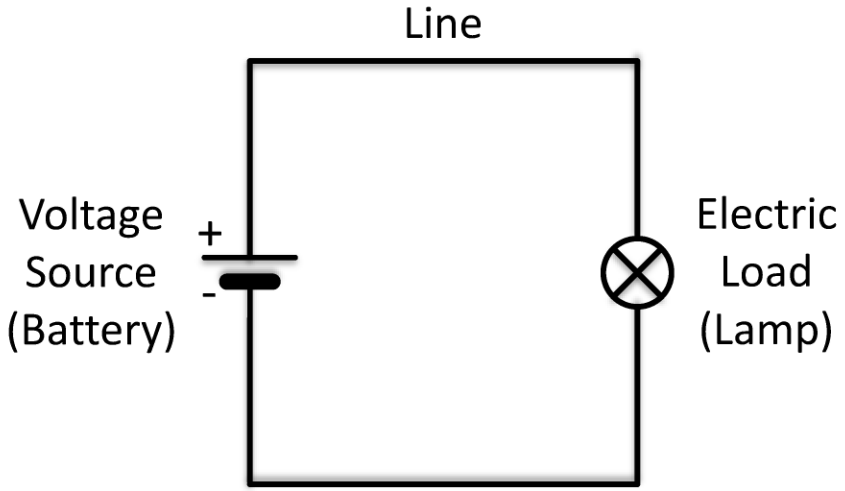
Electric Circuits

Electrical Engineering

Wolfgang Neff

Electric Circuit (1)

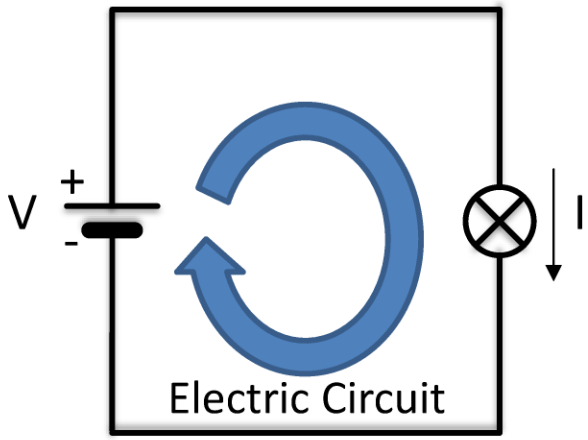
- Structure
  - Voltage source
    - Battery
  - Electric Load
    - Lamp
  - Electrical wiring
    - Line
    - Cable



Electric Circuit (2)

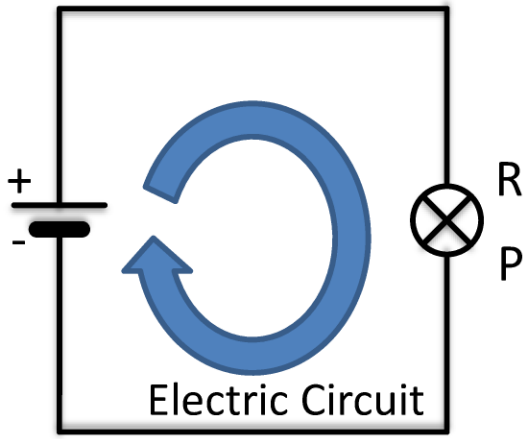
- Basics
  - Voltage source
    - A voltage is applied
    - Voltage V, [V] (Volt)
  - Electric Load
    - A current flows through
    - Electric current I, [A] (Ampere)
  - Conventional direction of current
    - The current flows from plus (+) to minus (-)

Unit



Electric Circuit (3)

- Electric Circuit
  - Resistor
    - A load hinders the current
    - Resistance R, [Ω] (Ohm)
  - Power
    - A load consumes power
    - Power P, [W] (Watt)
  - Formulas
    - $R = \frac{V}{I}, \quad P = V \cdot I$



Electric Circuit (4)

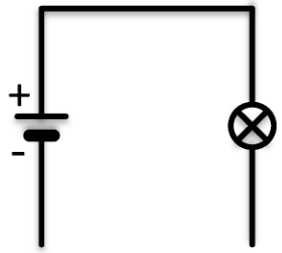
- Exercise
  - If a voltage of 5 V is applied to a lamp and a current of 20 mA flows through it
  - What is the resistance of the lamp?
    - $R = \frac{V}{I} = \frac{5\,V}{20\,mA} = \frac{5\,V}{0.02\,A} = 250\,\Omega$
  - What power is consumed?
    - $P = V \cdot I = 5\,V \cdot 20\,mA = 5V \cdot 0.02\,A = 0.1\,W$
    - $P = 0.1\,W = 100\,mW$

Electric Circuit (5)

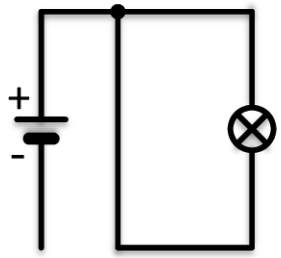
- Rules of Thumb
  - The current flows from plus (+) to minus (-)
  - Current is measured at a point
    - It flows through this point
    - It flows for example through a load
  - Voltage is measured between two points
    - It is applied at these points
    - Often one of these points is ground
      - Ground, GND → 0 V

Electric Circuit (6)

- Rules of Thumb
  - Electric Current can flow only if …
    - … the electric circuit is closed

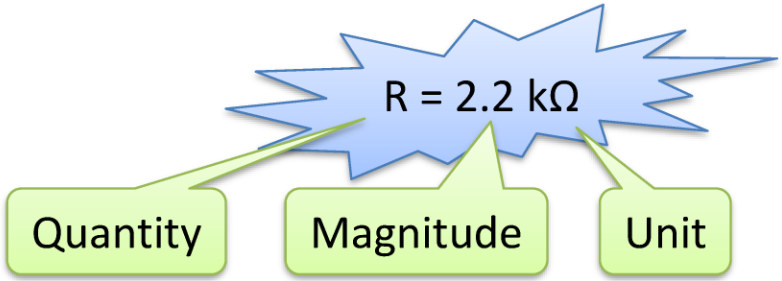


    - … there is a voltage difference



Unit Prefixes (1)

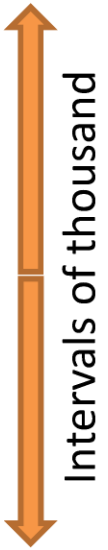
- Physical quantities
  - Have a magnitude
    - Should not have more than three digits
    - Should not have a decimal point
      - Exception: Circuit Diagrams (e. g. 2k2)
  - Have a unit
    - Prefixes are used to respect these rules



Unit Prefixes (2)

- Decimal unit prefixes (SI)
  - In technical applications powers of three are used
    - Centi and deci are usually not used

Text	Symbol	Value	Factor	Power
Giga	G	Billion	1 000 000 000	10^{9}
Mega	M	Million	1 000 000	10^{6}
Kilo	k	Thousand	1 000	10^{3}
-	-	One	1	10^{0}
Milli	m	Thousandth	0.001	10^{-3}
Micro	µ	Millionth	0.000 001	10^{-6}
Nano	n	Billionth	0.000 000 001	10^{-9}



Unit Prefixes (3)

- Binary unit prefixes (IEC)
  - One uses powers of 1024
    - $2^{10} = 1024 \rightarrow$ Quite close to 1000
  - There are texts and symbols of it's own
    - But they are seldom used

Text	Symbol	Factor	Power	Power
Gibi	Gi	1 073 741 824	1024^3	2^{30}
Mebi	Mi	1 048 576	1024^2	2^{20}
Kibi	Ki	1 024	1024^1	2^{10}
-	-	1	1024^0	2^0