

CURRENT AND RESISTANCE

Current $I = dQ/dt =$ charge flow per unit time Unit: C/s = ampere (A)

Some typical currents are:

| | |
|----------------------------|-------------------------------|
| Flashlight = 1A | Home Circuitry = 10-15A |
| Starter motor (car) = 200A | Computer circuits = 1pA – 1nA |

Current density $J = I/A =$ current per unit area Unit: A/m²

Random velocity of electrons = 10⁶m/s Drift velocity $v_d = 10^{-4}$ m/s

$$J = qnv_d$$

$q =$ charge of each carrier (unit: C)

$n =$ density of charge carrier (unit: m⁻³)

$v_d =$ drift velocity (m/s)

Ohm's Law: $J = \sigma E$ $\sigma =$ conductivity, $E =$ electric field
 $E = \rho J$ $\rho = 1/\sigma =$ resistivity

$V =$ potential difference across ends of a conductor

$I =$ current in a conductor $R =$ resistance of a conductor

Ohm's Law: $V = IR$ $R = \rho L/A$

$R = \rho L/A$ ($L =$ length, $A =$ area of sample)

Units: Resistance R in ohms (Ω) Resistivity ρ in $\Omega.m$