microcontrollers

Chapter 1

intro

microcontrollers are small computers in a single integrated circuit.a single **integrated circuit** is a chip

Chapter 2

basic electronic

2.1 AC/DC

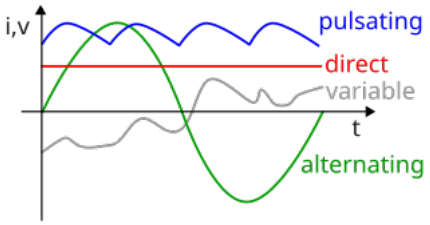


Figure 2.1: types of current

def AC → alternating current is an electric current that periodically reverses direction and changes its magnitude continuosly with time.

example → used to transmit electricity in long distances. less power loss of dc in this scenario.

def DC → direct current is one-directional flow of electric charge.

example → battery

inverter → turns DC in AC.

rectifier → turns AC in DC. (in italiano raddrizzatore)

2.2 electric laws

2.2.1 basics

- amperes → how many electrons (1 couloumb that is 6.24150910^{18} electrons) are passing through a point in a second

- volts → the electric potential between two points. many electrons in negative side, few electrons on positive side of battery. when the battery is exhausted there are equal number of electrons in each side.
- watt → the power. $W = V \cdot A$
- resistance → how difficult is it to pass for the electrons through a specific material

OHMS LAW

def → electric current is proportional to voltage and inversely proportional to resistance.

$$V = I \cdot R$$
$$R = \frac{V}{I}$$
$$I = \frac{V}{R}$$

- V is the voltage (in volts V)
- I is the current (in amperes A)
- R is the resistance (in ohms Ω)

Chapter 3

components and circuits

3.1 categories

passive → incapable of power gain. example capacitor, resistance

active → capable of power gain. example transistor

electromechanical → can carry out electrical operations by using moving parts or by using electrical connections. example relay, solenoids

note → diodes can be both active and passive.

active diodes → zener diode, led

passive diodes → normal diodes

3.2 impedances - impedenze

def → L'impedenza, in elettrotecnica e elettrologia, è una grandezza fisica che rappresenta la resistenza di opposizione al passaggio della corrente elettrica alternata o corrente variabile, in un circuito. Il concetto di impedenza generalizza la legge di Ohm estendendola ai circuiti funzionanti in regime sinusoidale (comunemente detta corrente alternata): in regime di corrente continua rappresenta infatti la resistenza elettrica.

3.3 voltage divider - partitore di tensione

def → passive linear circuit that produces an output voltage that is a fraction of its input voltage.

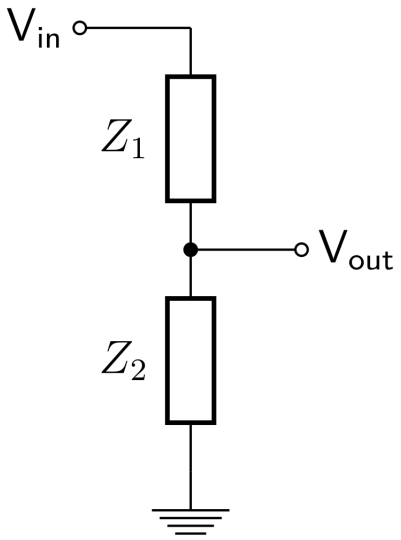


Figure 3.1: Z_1 and Z_2 are impedances

formulas $\rightarrow$ $V_{out} = \frac{Z_2}{Z_1+Z_2} \cdot V_{in}$

3.4 resistori

def $\rightarrow$ informalmente chiamati ~~resistenza~~ (in realta essa e la grandezza fisica che quantifica il valore ohmico). Basically, a resistor limits the flow of charge in a circuit and is an ohmic device where V=IR.

caratteristiche

- resistenza $\rightarrow$ in Ω. $R = \rho\frac{l}{S}$
  - ρ $\rightarrow$ resistivita del materiale. dipenede dalla temperatura T
  - l $\rightarrow$ lunghezza del materiale
  - S $\rightarrow$ sezione del materiale
- massima potenza $\rightarrow$ in W. threshold che se superata distrugge/deteriora il resistore

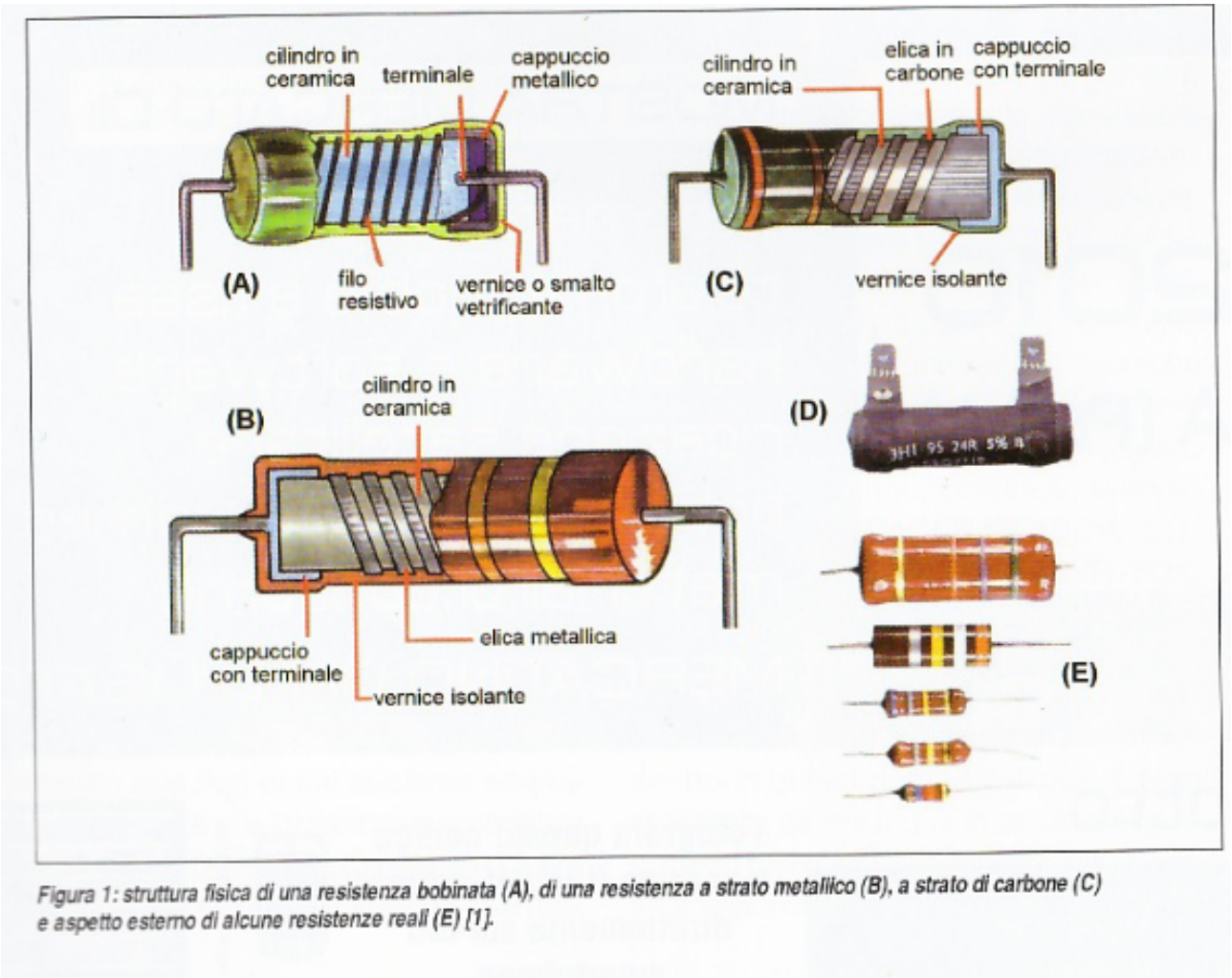
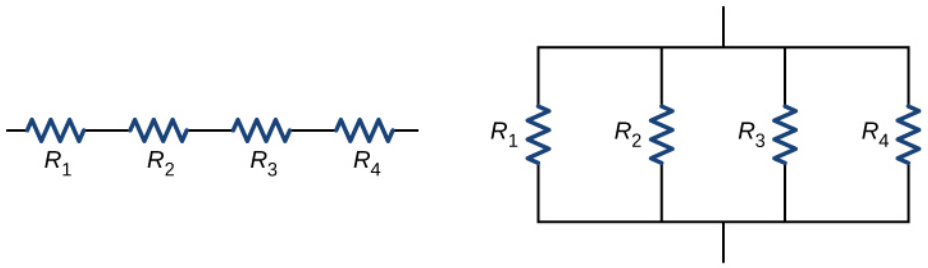


Figura 1: struttura fisica di una resistenza bobinata (A), di una resistenza a strato metallico (B), a strato di carbone (C) e aspetto esterno di alcune resistenze reali (E) [1].

3.4.1 series and parallel



(a) Resistors connected in series (b) Resistors connected in parallel

Figure 3.2: (a) For a series connection of resistors, the current is the same in each resistor. (b) For a parallel connection of resistors, the voltage is the same across each resistor.

series

resistors are in series when the current flow through them sequentially.

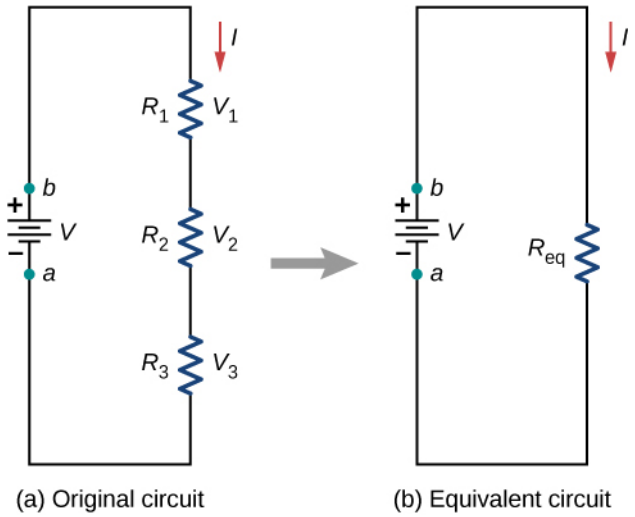


Figure 3.3: (a) Three resistors connected in series to a voltage source. (b) The original circuit is reduced to an equivalent resistance and a voltage source.

formulas $\rightarrow \quad R_{eq} = R_1 + R_2 + R_3 = \sum_{i=1}^{n} R_i$

parallel

Resistors are in parallel when one end of all the resistors are connected by a continuous wire of negligible resistance and the other end of all the resistors are also connected to one another through a continuous wire of negligible resistance. The potential drop across each resistor is the same. Current through each resistor can be found using Ohm's law I=V/R, where the voltage is constant across each resistor.

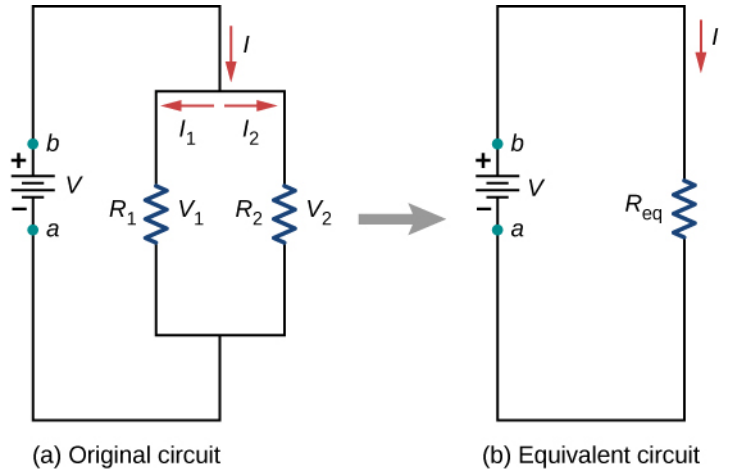


Figure 3.4: (a) Two resistors connected in parallel to a voltage source. (b) The original circuit is reduced to an equivalent resistance and a voltage source.

formulas $\rightarrow \quad R_{eq} = \left(\frac{1}{R_1} + \frac{1}{R_2}\right)^{-1} = \left(\sum_{i=1}^{n} \frac{1}{R_i}\right)^{-1}$

3.5 condensatore - capacitor

def $\rightarrow$ device that stores electrical energy by accumulating electric charges on two closely spaces surfaces that are insulated from each other. it is the equivalent of a dam (diga) in the hydraulic analogy. ha una threshold di tensione massima in volt. la capacita e l abilita di un oggetto di immagazinare carica elettrica.

3.5.1 series and parallel

series

$$C_{eq} = \left(\sum_{i=1}^{n} \frac{1}{C_i}\right)^{-1}$$

parallel

$$C_{eq} = \sum_{i=1}^{n} C_i$$

NOTE THAT IS THE OPPOSITE OF RESISTORS

3.6 circuito rc

def $\rightarrow$ un circuito rc e un circuito elettrico del primo ordine basato su un resistore e su un condensatore.
$\tau \rightarrow$ time required for the voltage to fall to $\frac{V_0}{e}$.

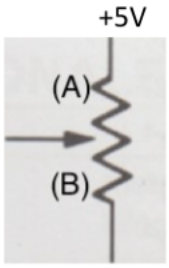
$$\tau = R \cdot C$$

PAY ATTENTION TO TIME UNITS. TIP USE 10^X NOTATION WHEN DOING MULTIPLICATION

3.7 potentiometer

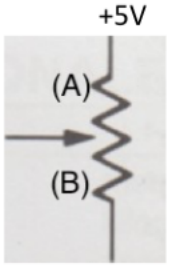
def $\rightarrow$ three terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider.

21. Un potenziometro è collegato a +5V :



Calcolare la tensione presente sul cursore rispetto a GND quando il cursore è posizionato a in (A) e in (B), dove (A) è a ¼ del potenziometro e (B) è a ¾ .

22. Un potenziometro è collegato a +5V :



Si vuole ottenere una tensione di 4 V tra il cursore e massa (GND). Il potenziometro andrà messo in (A) o in (B) ?

Figure 3.5: es

$$C = \text{Cursor position ratio}$$
$$V_{out} = V_{in} \cdot C$$

Chapter 4

protocols

- 1 WIRE PROTOCOL:
  def → wired half-duplex serial bus designed by Dallas Semiconductor that provides low-speed (16.3 kbit/s) data communication and supply voltage over a single conductor.
  - wired → on a physical cable
  - half-uplex → only a device at a time can send data
  - serial → data is transmitted one bit a time
  - bus → communication system that encompasses both hardware (wires) and software (communication protocol)
- components
  - bus master with controlling software (a "server")
  - wiring
  - devices

Chapter 5

sources

- https://phys.libretexts.org/Bookshelves/University_Physics/University_Physics_(OpenStax)/University_Physics_II_-_Thermodynamics_Electricity_and_Magnetism_(OpenStax)/10%3A_Direct-Current_Circuits/10.03%3A_Resistors_in_Series_and_Parallel