Ηλεκτρονική

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19/10/2020

Τμήμα Μηχανικών Πληροφορικής και Υπολογιστών

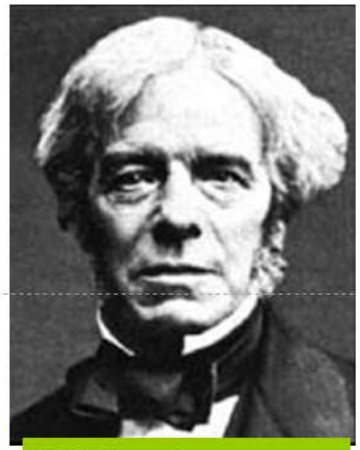
2020-2021

Ιστορικές Μορφές

Alessandro Antonia Volta 1796 – invented the battery

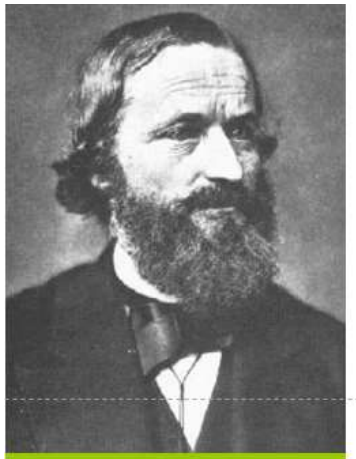
Andre-Marie Ampere 1820s – defined electric current and developed a way to measure it

George Simon Ohm 1826–discovered the most basic law relating voltage and current for a resistor



Michael Faraday 1831 – discovered electromagnetic induction providing a way to generate electricity

Ιστορικές Μορφές



Gustav Robert Kirchhoff
1847 –
stated the basic laws governing the relationship between currents and voltages in an electrical circuit

Joseph Henry
Late 1830's –
discovered inductance and constructed an electric motor

Heinrich Rudorf Hertz
1887 –
discovered electromagnetic waves and behaved the same as visible light

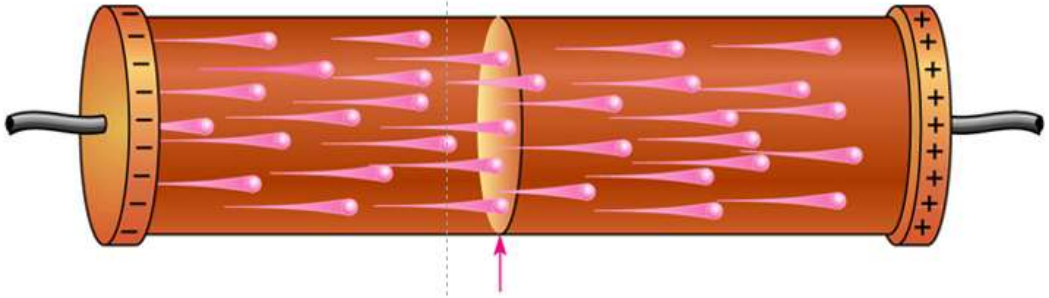
Charles Proteus Steinmetz
1890s –
introduced the phasor method, started IEEE, and developed ac circuit analyis

Εξίσωση του Maxwell

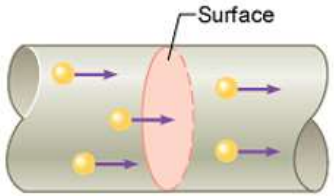
- Electricity and magnetism were originally thought to be unrelated
- in 1865, James Clerk Maxwell provided a mathematical theory that showed a close relationship between all electric and magnetic phenomena

Εννοια του ρεύματος (Ampere)

One ampere is the amount of current that exists when a number of electrons having a total charge of one coulomb move through a given cross-sectional area in one second.



When a number of electrons having 1 coulomb of charge pass through this cross-sectional area in 1 second, there is 1 ampere of current.

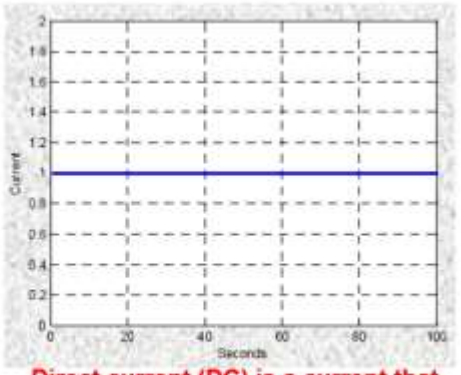


Έννοια του φορτίου και του ρεύματος

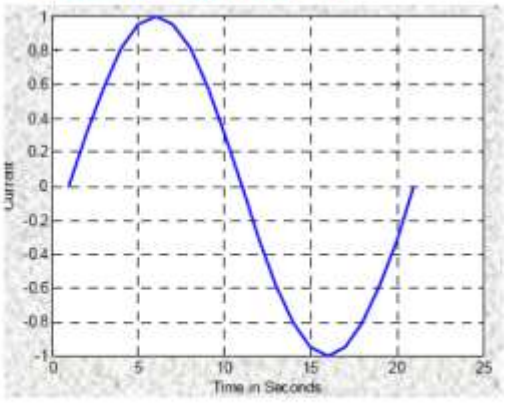
- The charge transferred from one location to another location occurs in some finite amount of time
- Δt ("delta t") = t – t0, which is the time from some time origin
- The charge transferred during time Δt:

$$q = \int_{t_0}^{t} i dt$$

Current is not necessarily a constant, generally it is a function of time i = i (t)



Direct current (DC) is a current that remains constant with time



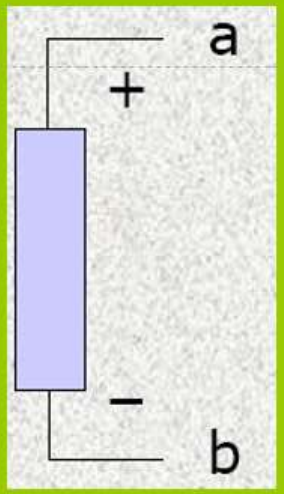
Alternating current (AC) is a current that varies as a sinusoidal with time

- 1 Cb = 6.24x10 ^18 ηλεκτρόνια

Τάση

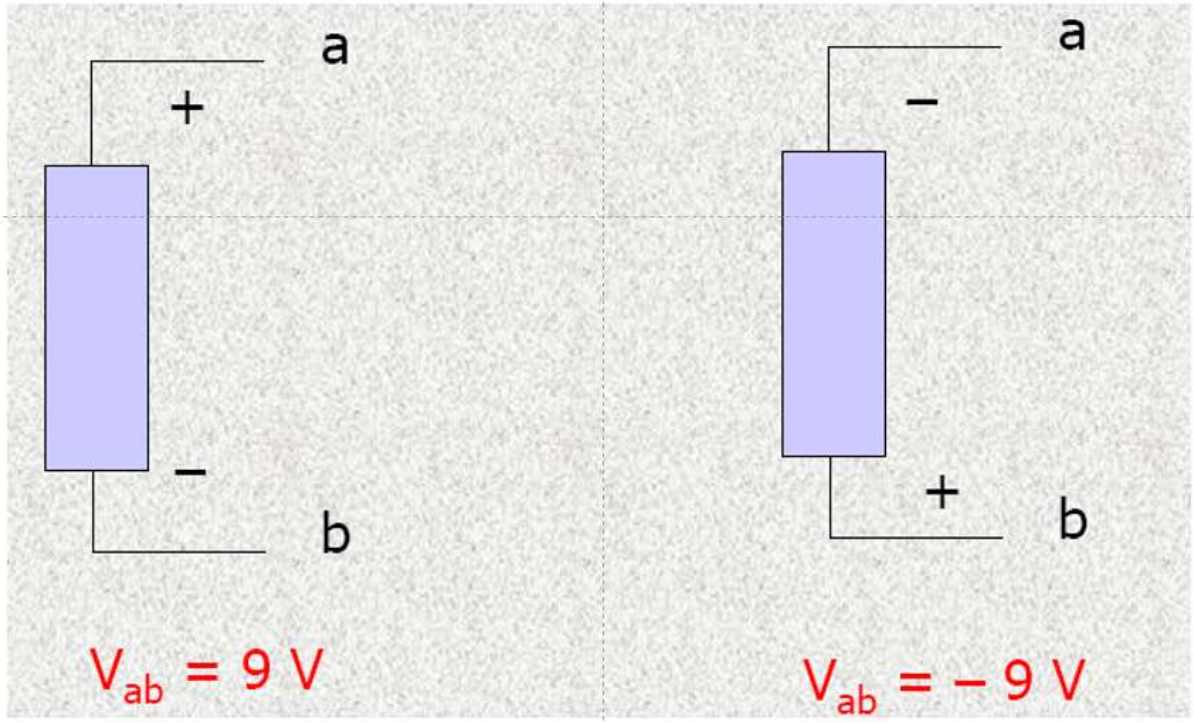
- It takes work or energy to move a charge from one location to another
- Work is performed via an external electromotive force (emf)
- The emf is also called the voltage or potential difference
- Voltage (or potential difference) is the energy required to move a unit charge from one location to another
- Mathematically, the voltage between two locations, a and b, is the relationship between v_{ab} the potential at point a with respect to b, w the work or energy in joules, and q is charge in coulombs:

$$v_{ab} = \frac{dw}{dq}$$



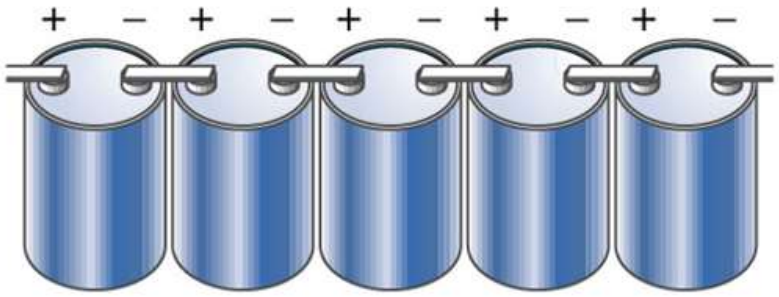
- $v_{ab} = -v_{ba}$: + and – sign are used to reference direction or polarity of the voltage

• What is the V_{ab} if there is a 9 volts difference between a and b?

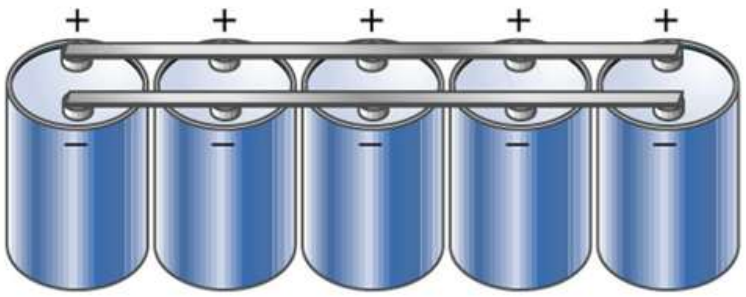


Μπαταρίες

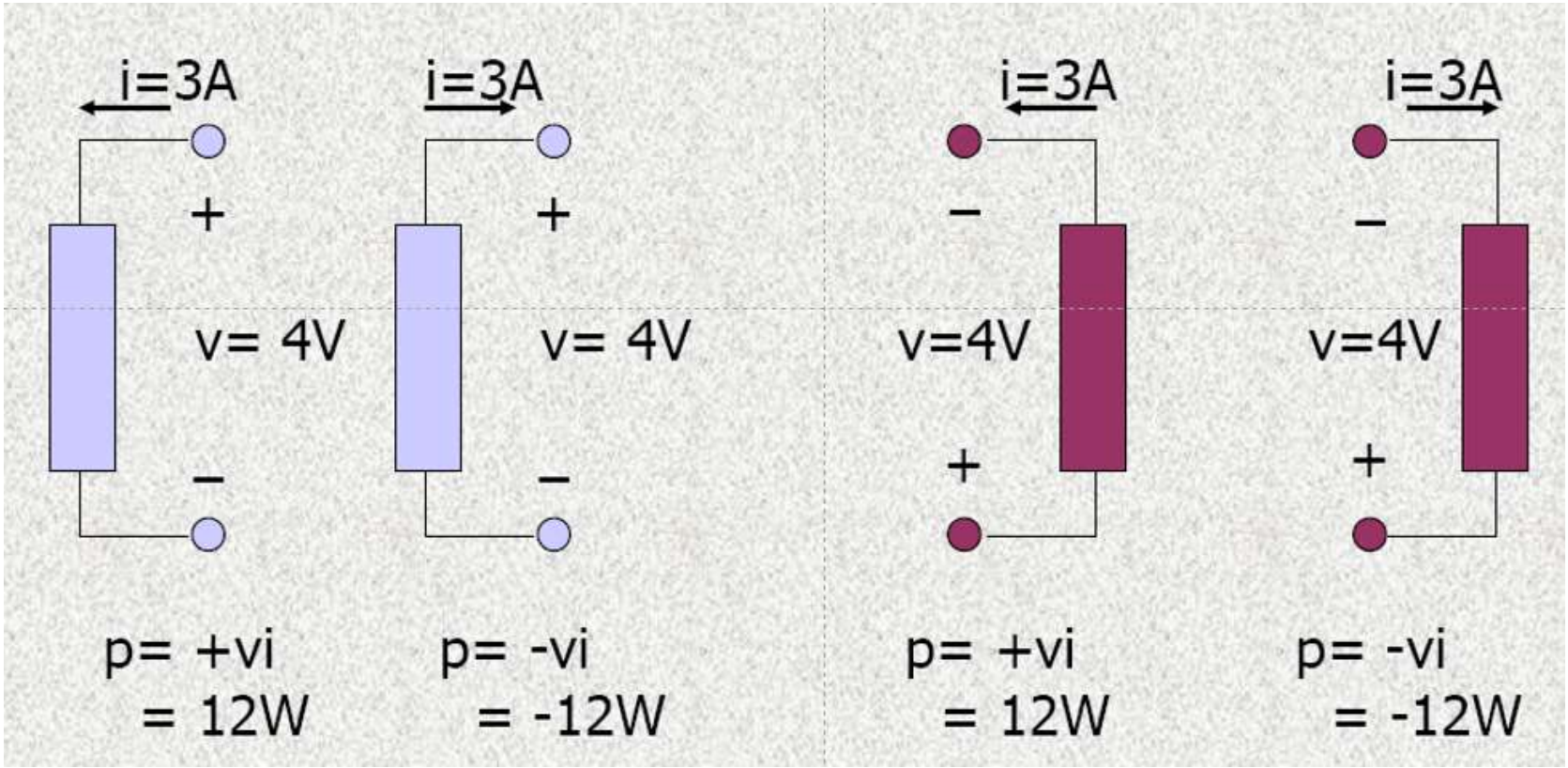
- A battery is a type of voltage source that converts chemical energy into electrical energy.
- The way cells are connected, and the type of cells, determines the voltage and capacity of a battery.



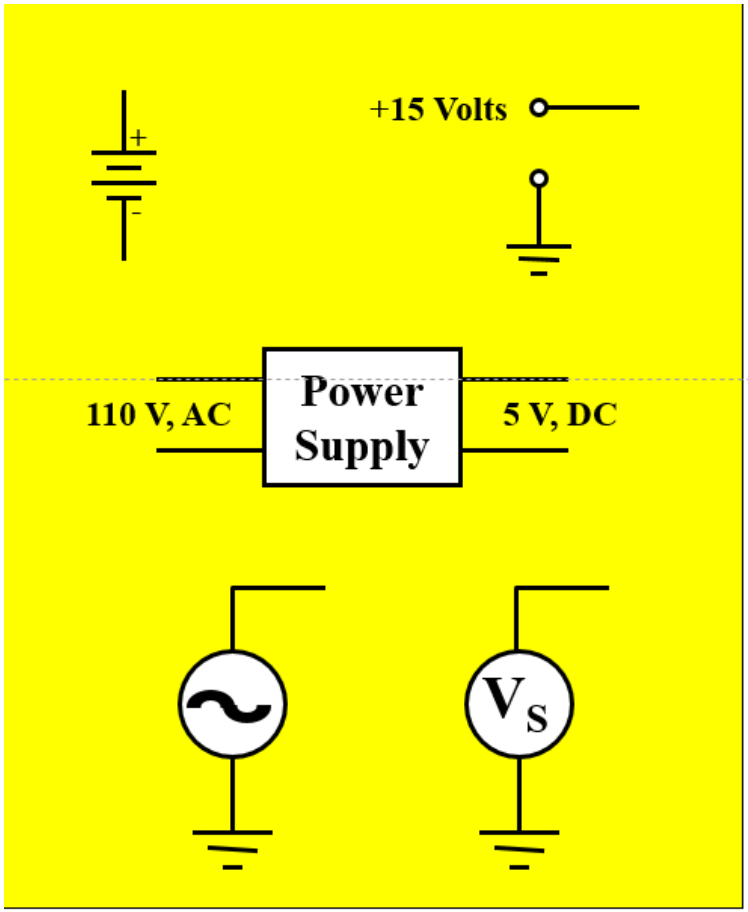
(a) Series-connected battery



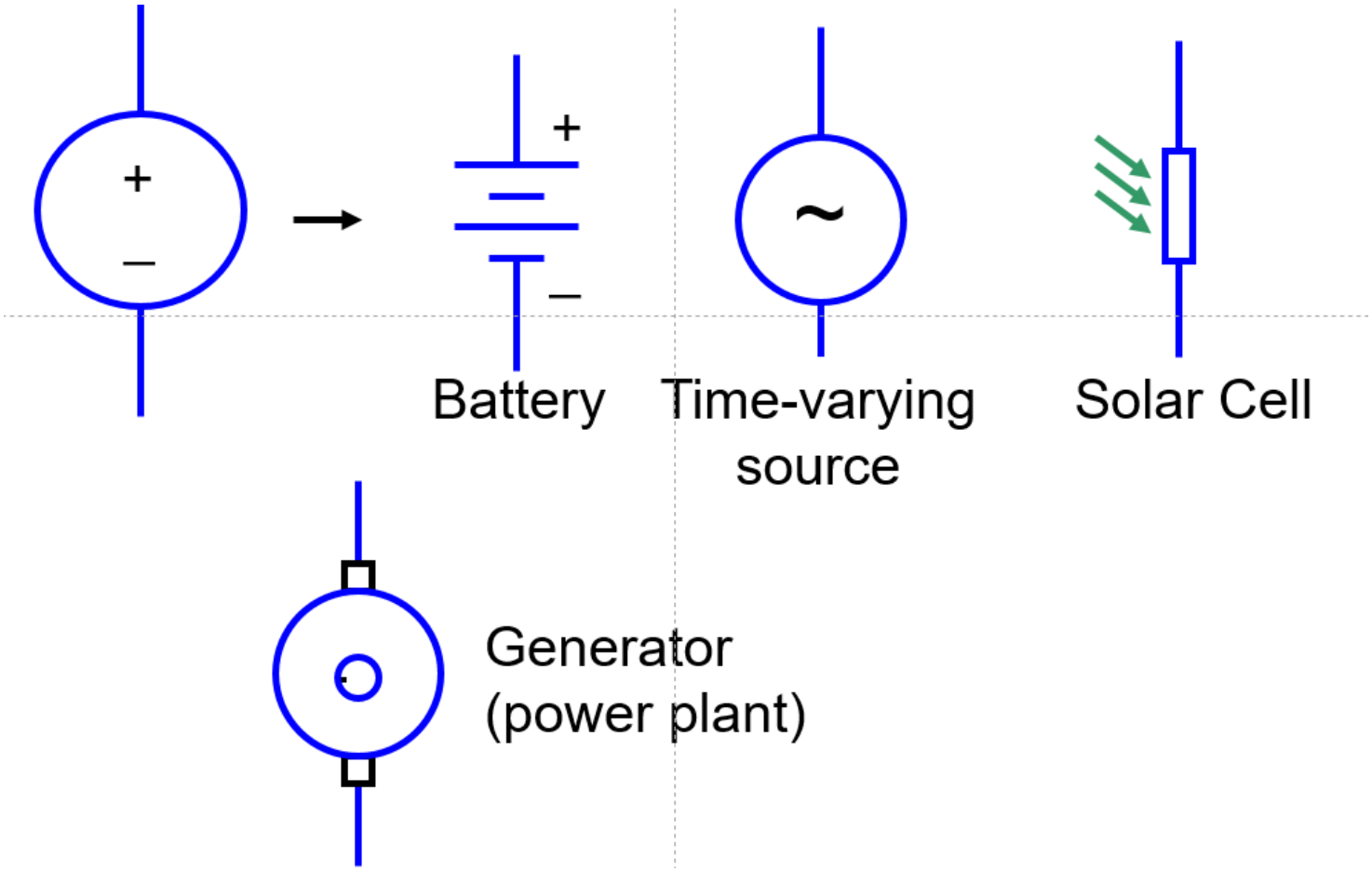
(b) Parallel-connected battery


i=3A
+
v= 4V
–
p= +vi
= 12W
i=3A
+
v= 4V
–
p= -vi
= -12W
i=3A
–
v=4V
+
p= +vi
= 12W
i=3A
–
v=4V
+
p= -vi
= -12W

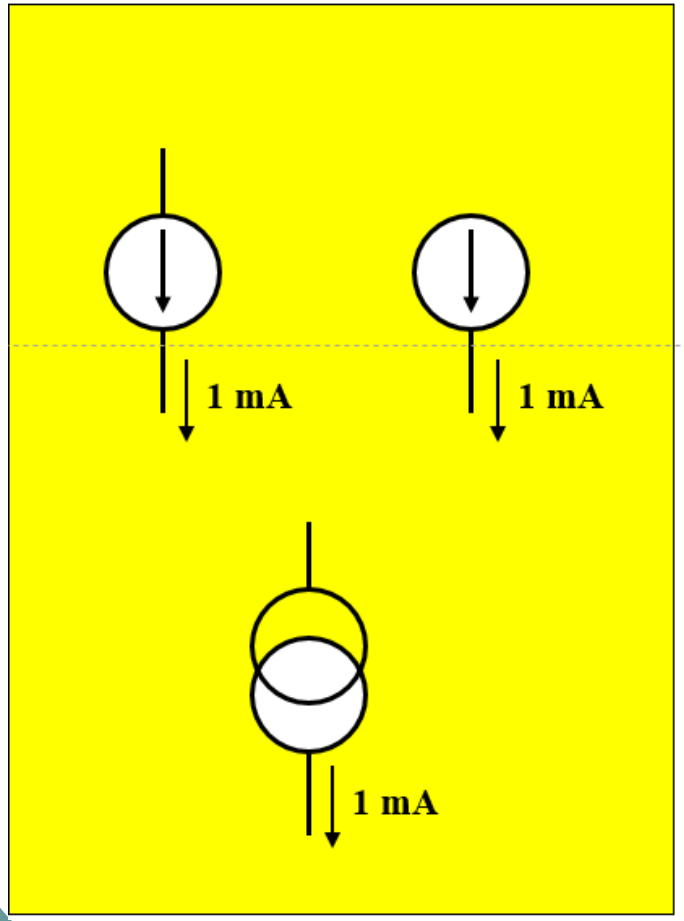
Πηγές τάσης



A *perfect voltage source* is a two-terminal black box that maintains a *fixed voltage drop* across its terminals, regardless of load resistance.


+
–
+
–
Battery
~
Time-varying source
Solar Cell
Generator (power plant)

Πηγές ρεύματος

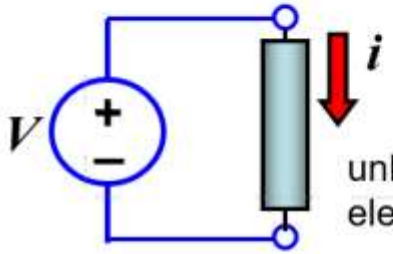


A *perfect current source* is a two-terminal black box that maintains a *constant current* through the external circuit, regardless of load resistance of applied voltage.

Ohm's Law

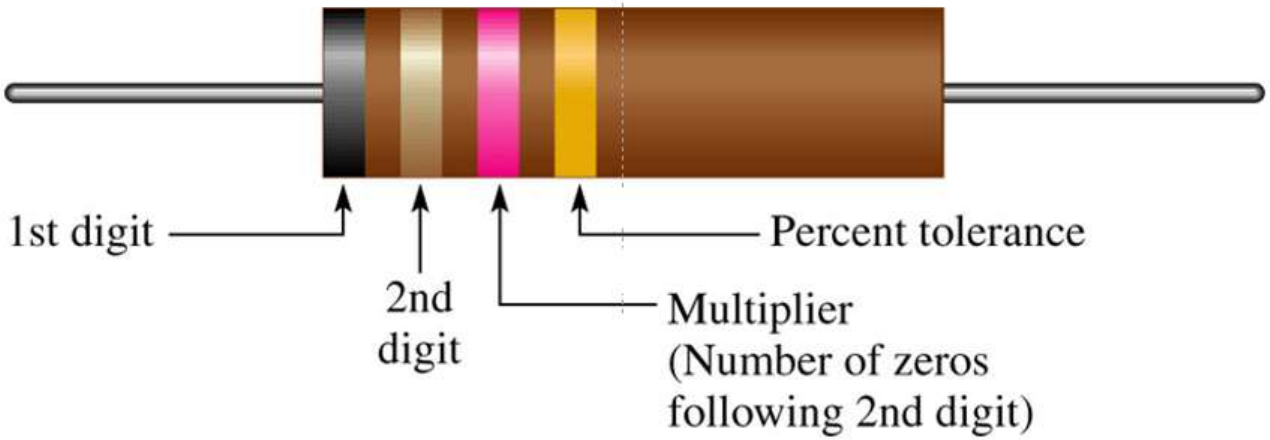
Let us remind the Ohm's Law

Georg Ohm



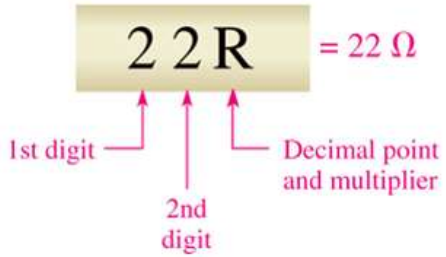
- Assume that the wires are "perfect conductors"
- The unknown circuit element limits the flow of current.
- The resistive element has ***conductance G***

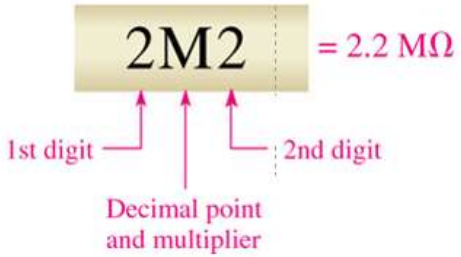
- 1st band is the first digit of the resistance value.
- 2nd band is the second digit of the resistance value.
- 3rd band is the multiplier (number of zeros).
- 4th band indicates the tolerance.

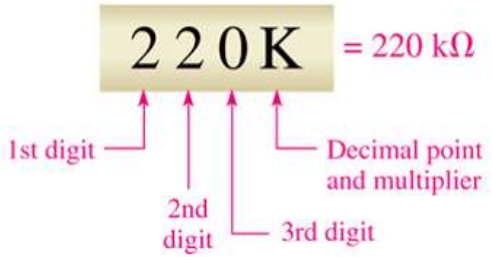


Αλφαριθμητικός κώδικας

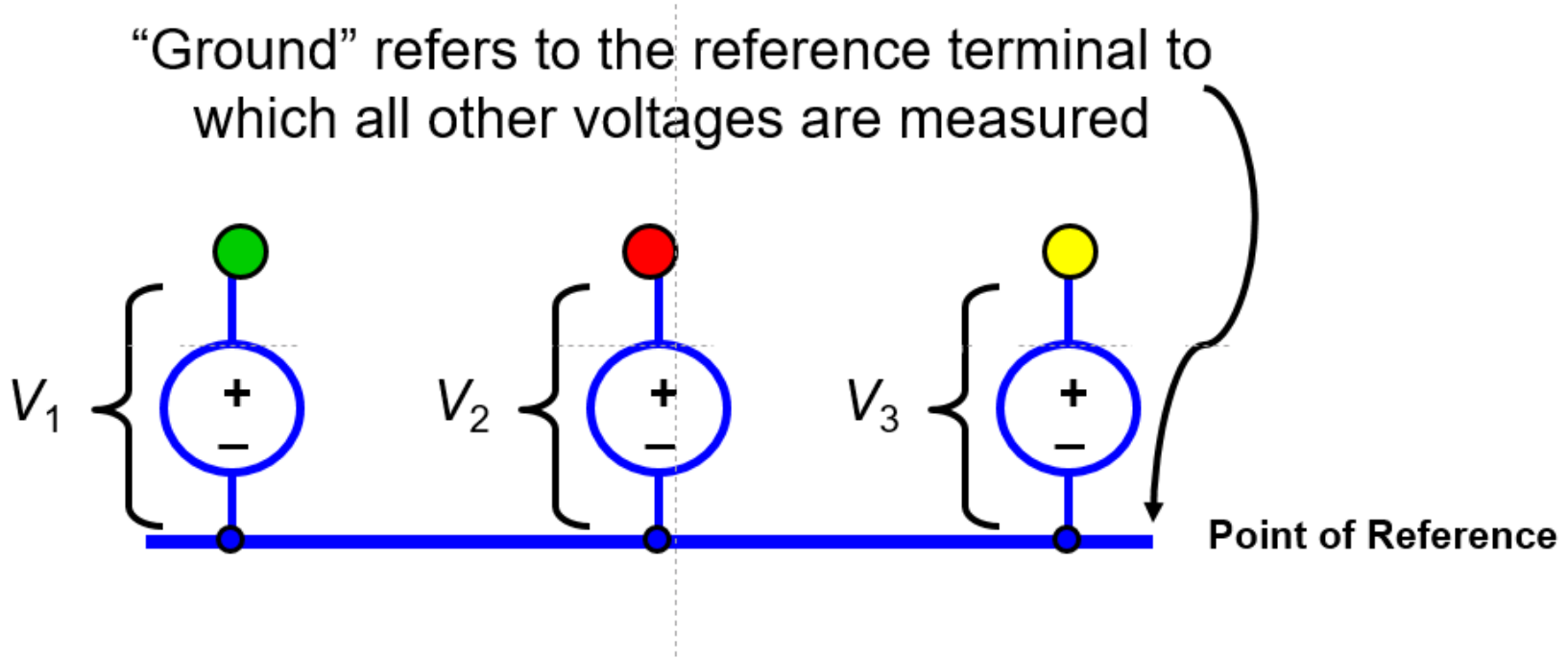
- Two or three digits, and one of the letters R, K, or M are used to identify a resistance value.
- The letter is used to indicate the multiplier, and its position is used to indicate decimal point position.



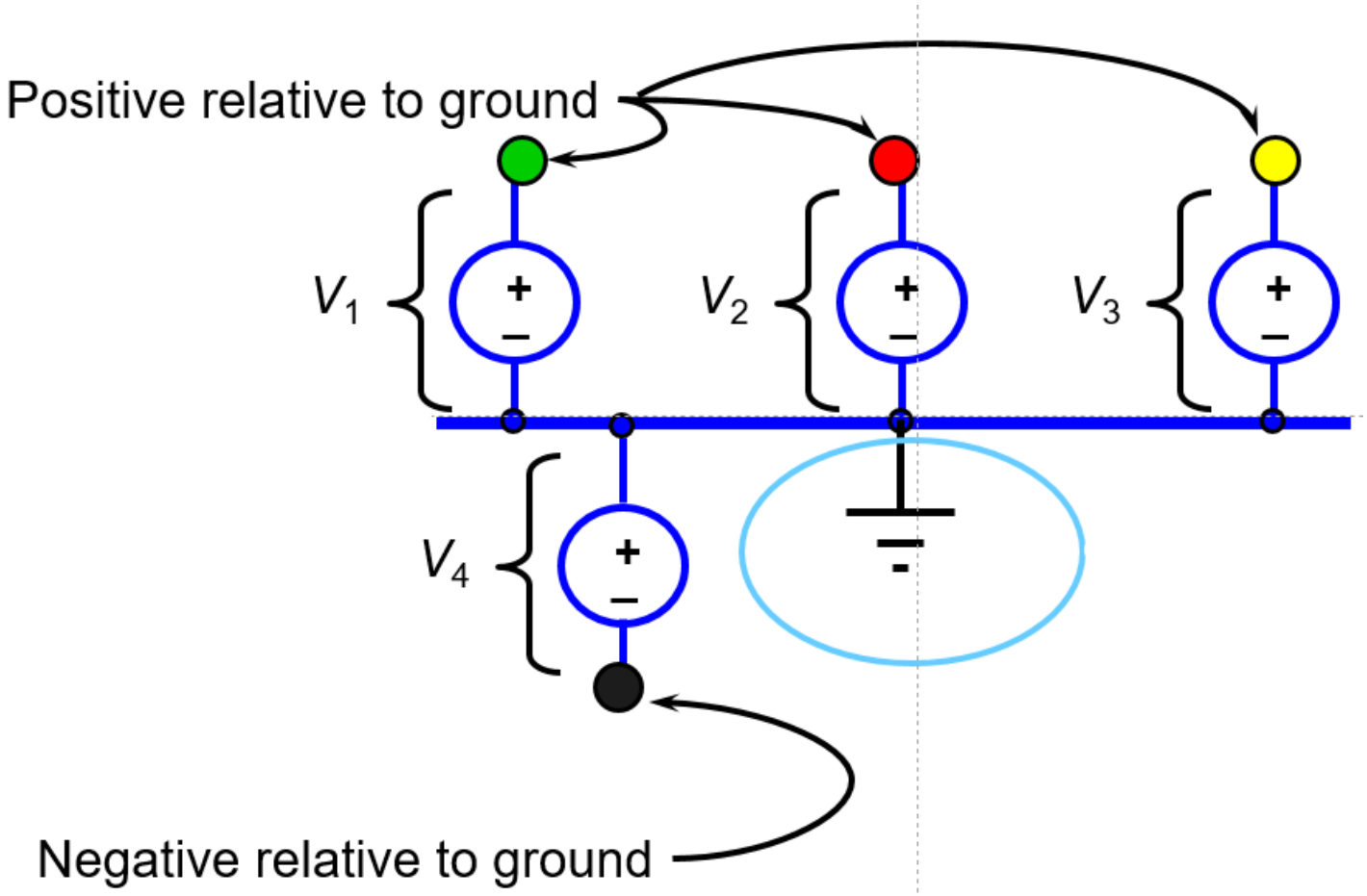




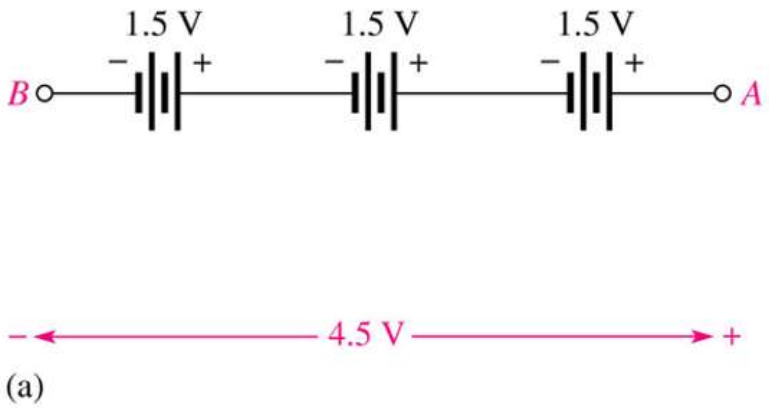
Γείωση

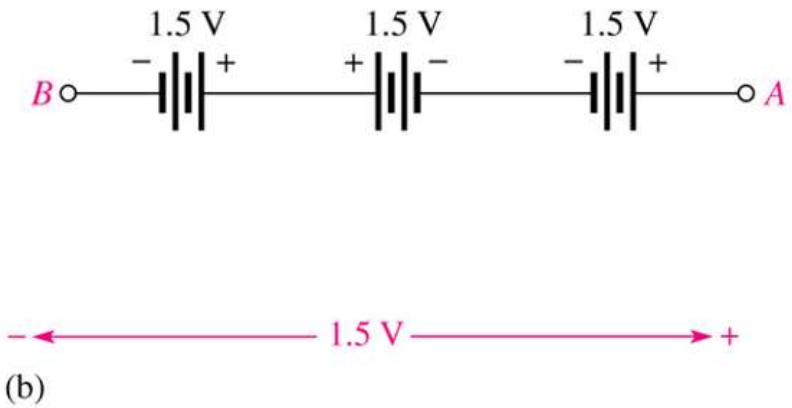

"Ground" refers to the reference terminal to which all other voltages are measured
V_1
V_2
V_3
+
–
Point of Reference

Γείωση

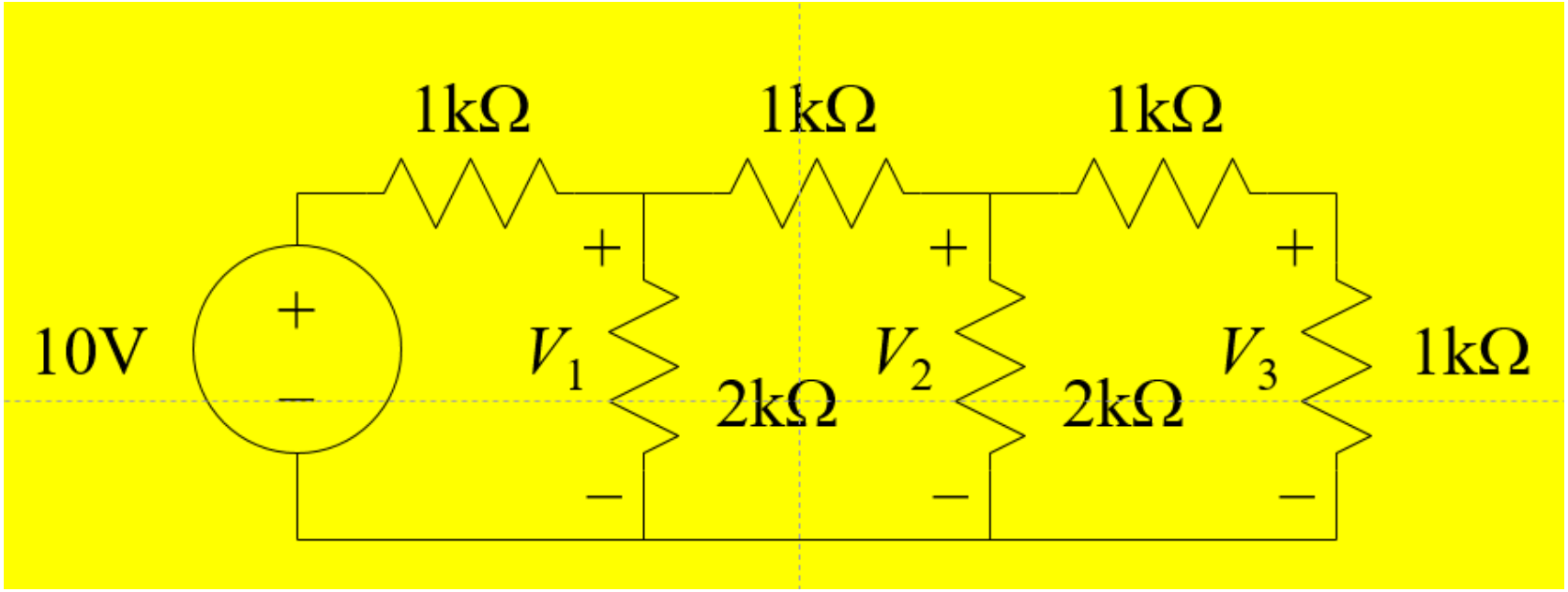

Positive relative to ground
V_1
V_2
V_3
V_4
Negative relative to ground

Πηγές σε σειρά και παράλληλα

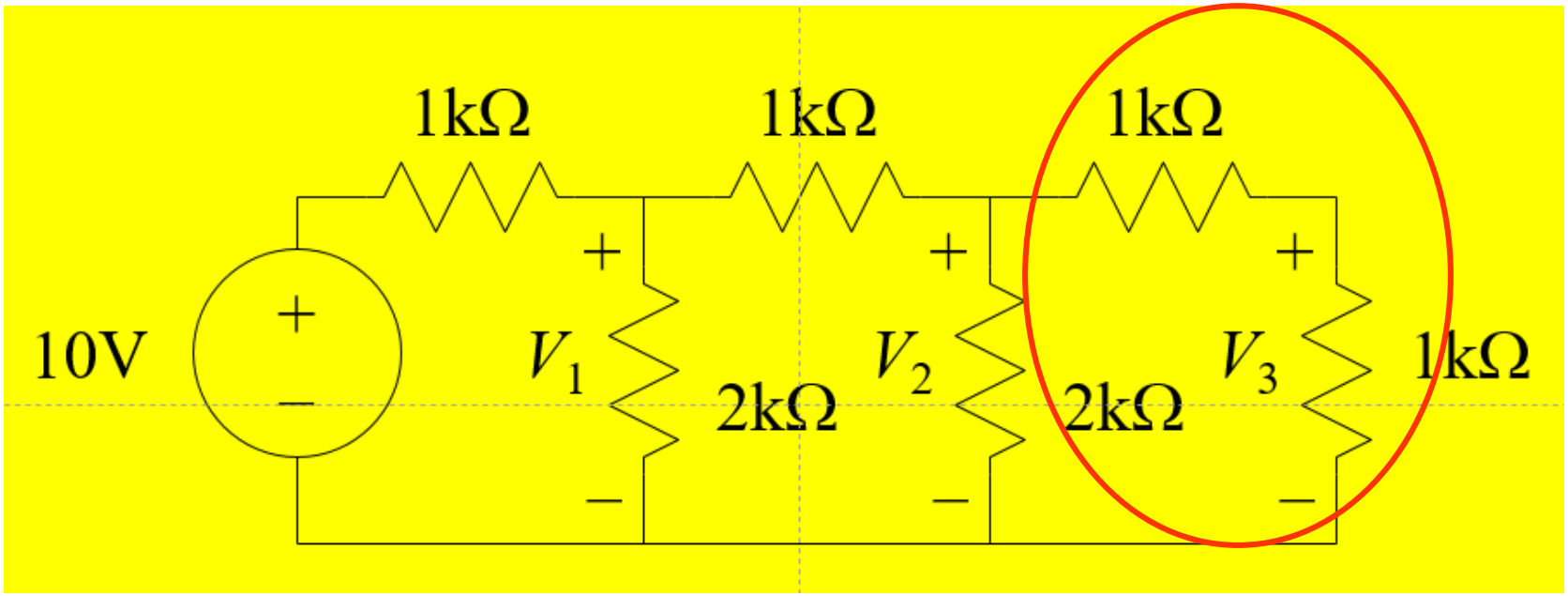




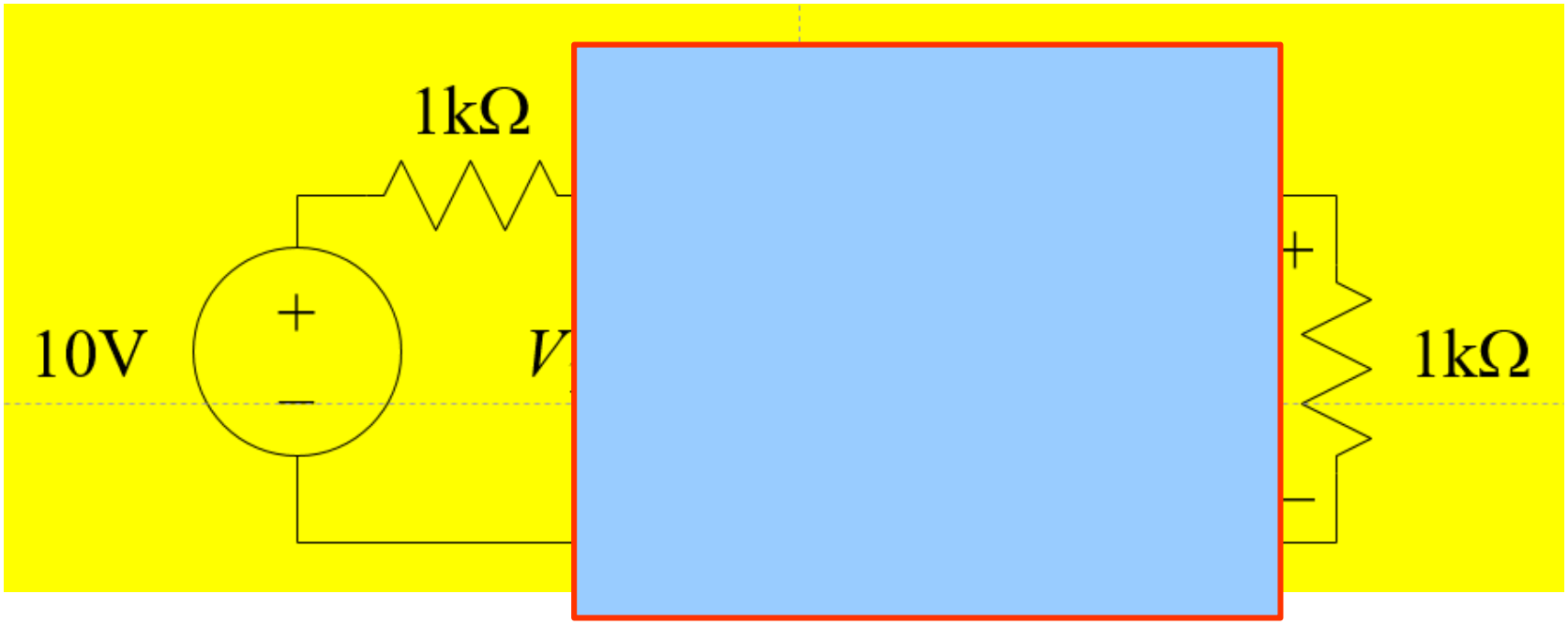
Κλίμακα αντιστάσεων (Ladder)



Ισοδύναμο κύκλωμα



Ισοδύναμο κύκλωμα



- Η πρώτη τάση θα είναι 5 V η δεύτερη 2,5 V και η τρίτη 1,25 V

Συνδεσμολογία σε σειρά

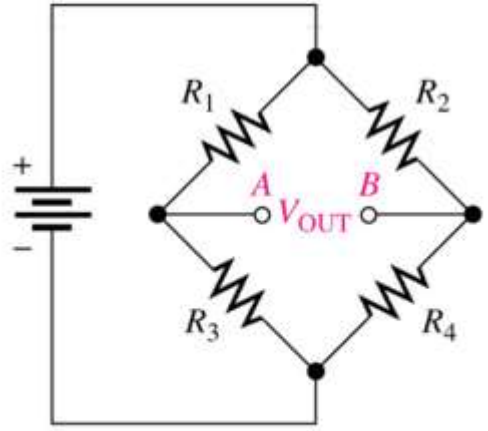
- Η πρώτη τάση θα είναι 5 V η δεύτερη 2,5 V και η τρίτη 1,25 V

- 5+2,5+1,25 = 8,75 V

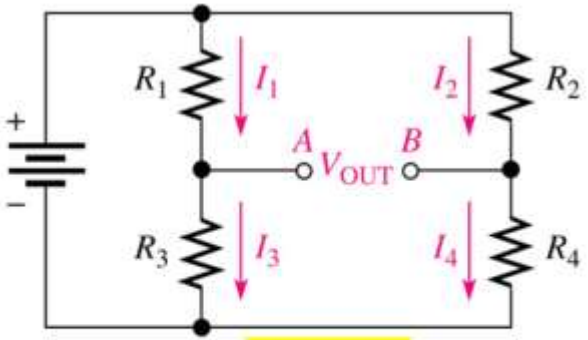
Γέφυρα Wheatsone

Balanced Wheatstone Bridge

The Wheatstone bridge is in the balanced bridge condition when the output voltage between terminals A and B is equal to zero.



(a)

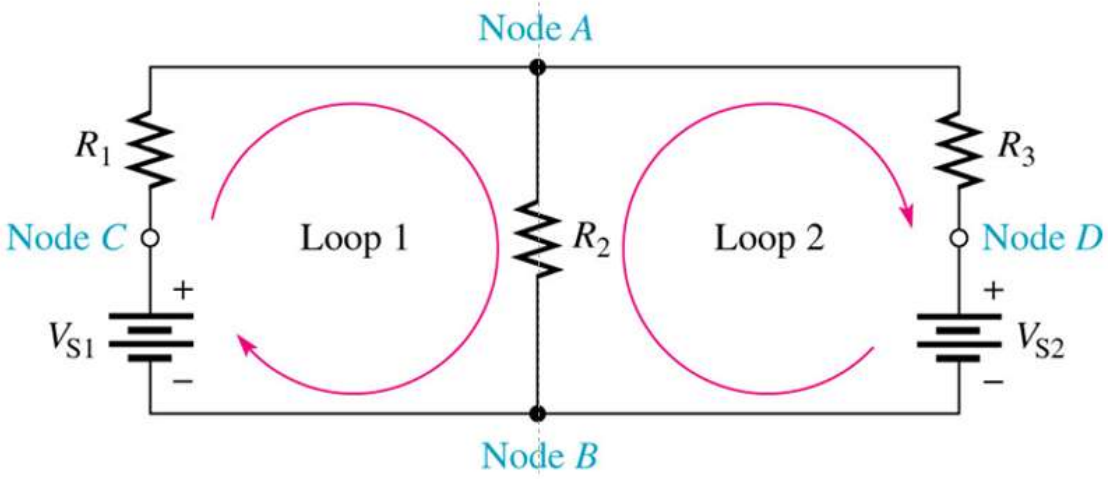


(b)

$$\frac{R_1}{R_3} = \frac{R_2}{R_4}$$

Βρόχοι

- A loop is a complete current path within a circuit.
- A node is a point where two or more components are connected.
- A branch is a path that connects two nodes.



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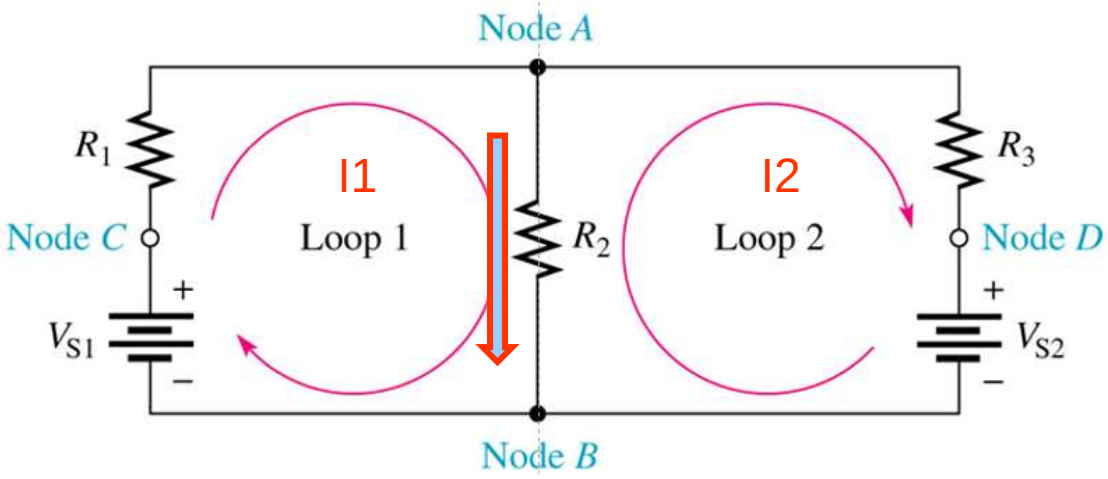
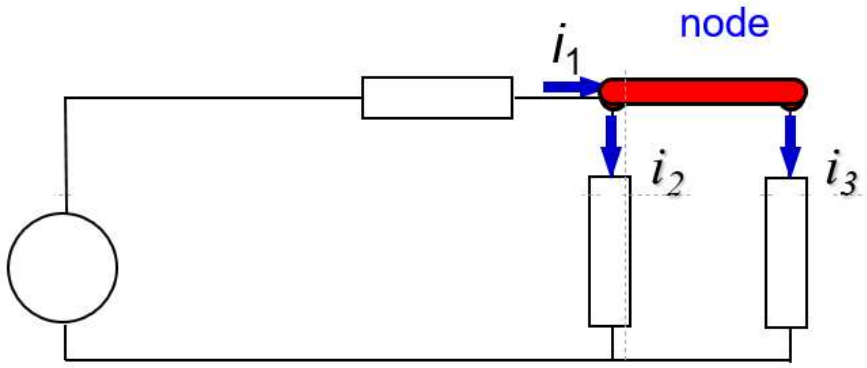


The sum of currents flowing **into** a node must be balanced by the sum of currents flowing **out** of the node.



Gustav Kirchoff was an 18th century German mathematician

i_1 flows **into** the node

i_2 flows **out** of the node

i_3 flows **out** of the node

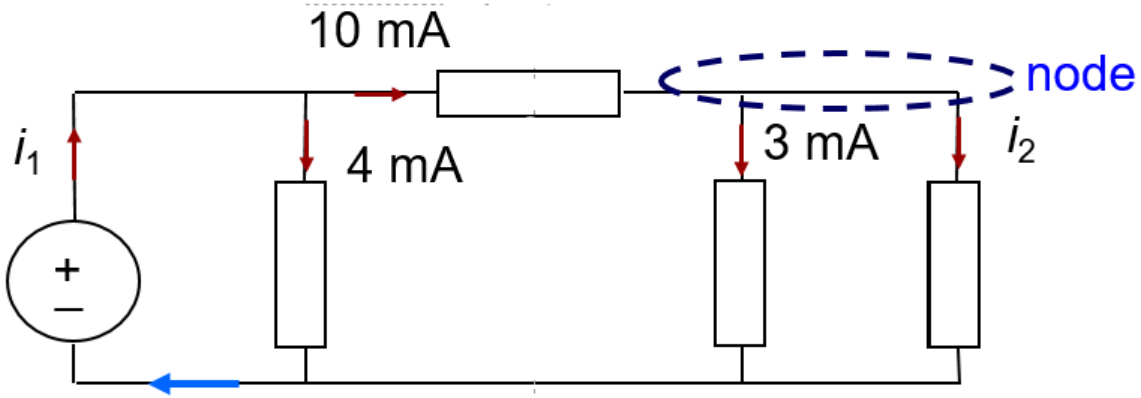
$$i_1 = i_2 + i_3$$

$$\sum i = 0$$

Q: How much are the currents i_1 and i_2 ?

A: $i_2 = 10\ \text{mA} - 3\ \text{mA} = 7\ \text{mA}$

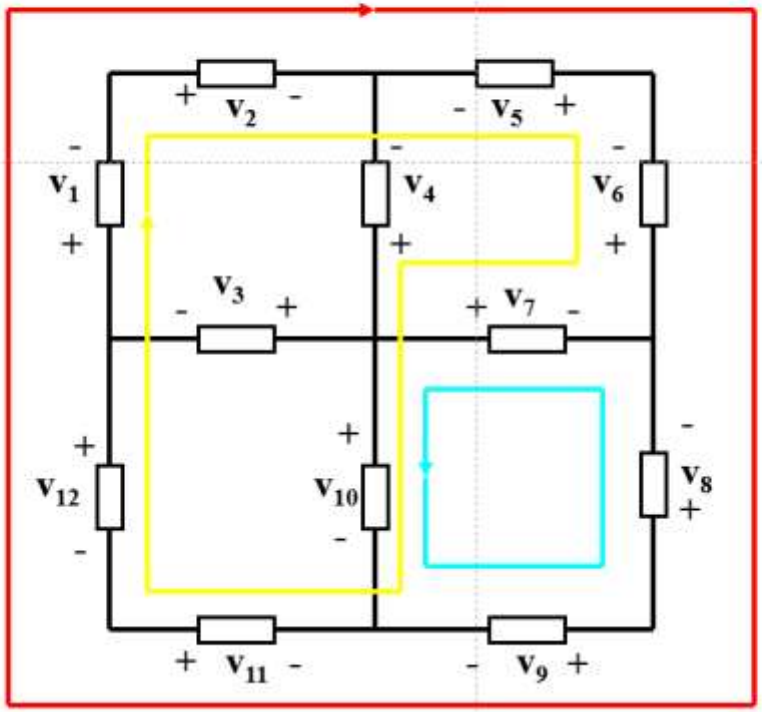
$i_1 = 10\ \text{mA} + 4\ \text{mA} = 14\ \text{mA}$

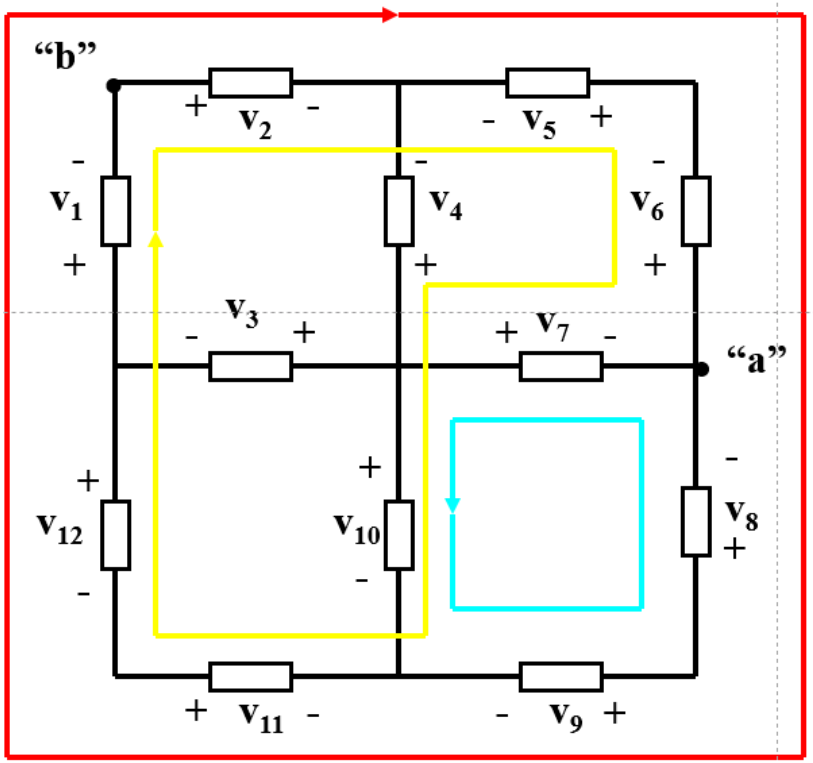


4 mA + 3 mA + 7 mA = 14 mA

Loops can be chosen arbitrarily. For example, the circuit below contains a number of closed paths. Three have been selected for discussion.

Suppose that for each element, respective current flows from + to - signs.





Using sum of the drops = 0

Blue path, starting at "a"

$$- v_7 + v_{10} - v_9 + v_8 = 0$$

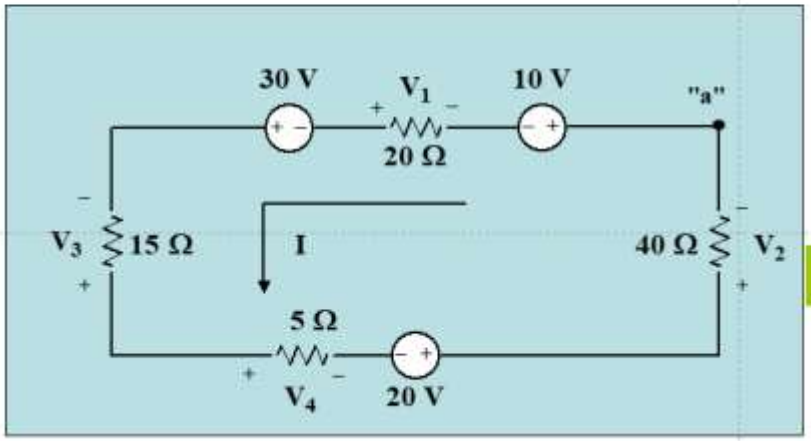
Red path, starting at "b"

$$+v_2 - v_5 - v_6 - v_8 + v_9 - v_{11} - v_{12} + v_1 = 0$$

Yellow path, starting at "b"

$$+ v_2 - v_5 - v_6 - v_7 + v_{10} - v_{11} - v_{12} + v_1 = 0$$

Example: For the circuit below find I, V_1, V_2, V_3, V_4 and the power supplied by the 10 volt source.



1. For convenience, we start at point "a" and sum voltage drops =0 in the direction of the current I.

$$+10 - V_1 - 30 - V_3 + V_4 - 20 + V_2 = 0 \quad (1)$$

2. We note that: $V_1 = -20I$, $V_2 = 40I$, $V_3 = -15I$, $V_4 = 5I$ (2)

3. We substitute the above into Eq. 1 to obtain Eq. 3 below.

$$10 + 20I - 30 + 15I + 5I - 20 + 40I = 0 \quad (3)$$

Solving this equation gives, $I = 0.5$ A.

Βασικές ενότητες του μαθήματος

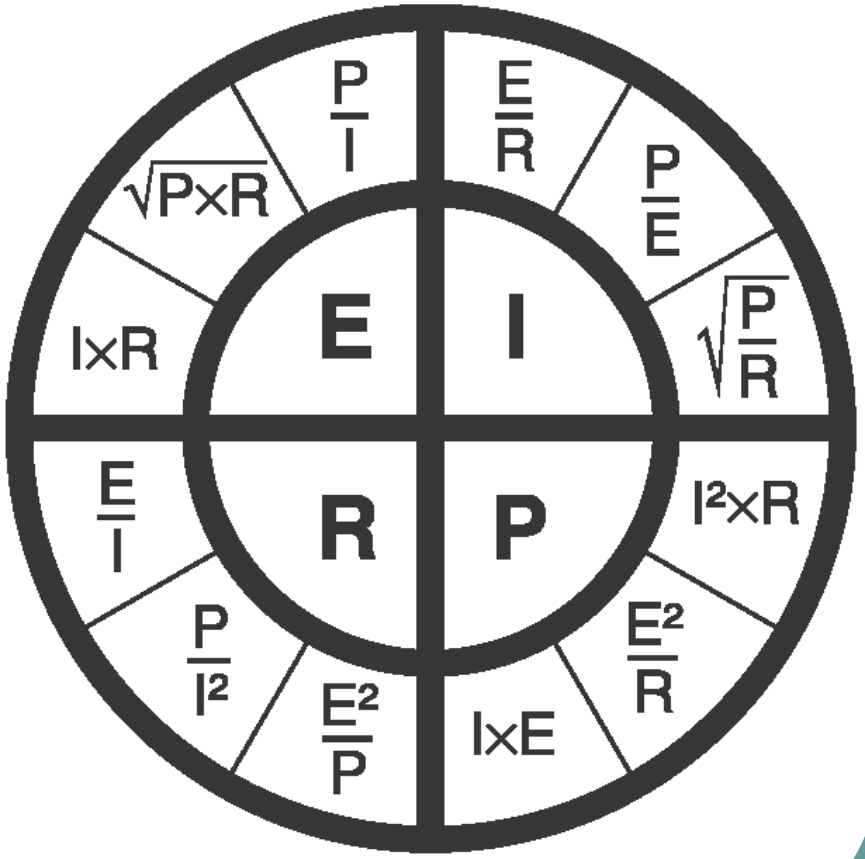
- Εισαγωγή στην ηλεκτρονική
- Τελεστικοί ενισχυτές
- Δίοδοι
- Διπολικά τρανζίστορ ένωσης (BJT)
- Τρανζίστορ επίδρασης πεδίου
- Διαφορικοί ενισχυτές και ενισχυτές πολλών σταδίων
- Απόκριση συχνότητας

Δομή παρουσίασης

- Βασικά ηλεκτρονικά
- Σήματα
- Το φάσμα συχνοτήτων των σημάτων
- Αναλογικά και ψηφιακά σήματα
- Ενισχυτές
- Κυκλωματικά μοντέλα για ενισχυτές
- Απόκριση συχνότητας των ενισχυτών

Βασικά ηλεκτρονικά

- Ορολογία:
  - Τάση *(E)*
  - Ρεύμα *(I)*
  - Αντίσταση *(R)*
  - Ισχύ *(P)*
  - Σύνθετη αντίσταση
  - Επαγωγή
  - Χωρητικότητα



Βασικά ηλεκτρονικά

- Αντίσταση είναι η αντίσταση στην συνεχή φορά ηλεκτρικών φορτίων και μετράται σε Ohms
- Σύνθετη αντίσταση είναι η αντίσταση στην εναλλασσόμενη φορά ηλεκτρικών φορτίων και μετράται σε Ohms
  - Διαφέρει με την συχνότητα και την χωρητικότητα ή την επαγωγή του κυκλώματος

Βασικά ηλεκτρονικά

- Επαγωγή είναι η ιδιότητα ενός ηλεκτρικού κυκλώματος να δημιουργεί υψηλή αντίσταση στην ροή του ρεύματος σε υψηλές συχνότητες
  - Επαγωγός (πηνίο) είναι σύρμα με ειδική μόνωση τυλιγμένο σε μορφή σπειρών και δημιουργεί υψηλή αντίσταση στην ροή του ρεύματος σε υψηλές συχνότητες και χαμηλή στις χαμηλές

Βασικά ηλεκτρονικά

- Χωρητικότητα είναι η ιδιότητα ενός ηλεκτρικού κυκλώματος να δημιουργεί υψηλή αντίσταση στην ροή του ρεύματος σε χαμηλές συχνότητες
  - Ο πυκνωτής αποτελείται από δύο πλάκες που διαχωρίζονται με ένα διηλεκτρικό
  - Ο πυκνωτής δημιουργεί υψηλή αντίσταση στις χαμηλές συχνότητες και χαμηλή στις υψηλές

Βασικά ηλεκτρονικά

- Η ισχύς σε watts ισούται το δυναμικό στο τετράγωνο διαιρεμένο διά την αντίσταση του φορτίου
- Η ισχύς ισούται με το γινόμενο του ρεύματος επί το δυναμικό