Birzeit University
Physics 112

Experiment #2

Source Internal Resistance, Loading Problems
And
Circuit Impedance Matching

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Abstract:

- **The aim:** to find the value of the load resistance RL that satisfies the condition of the maximum power transfer which is RL=R+Rin

- **The method:** by reading different measurements of the current passing through the circuit in different values of the RL

- **The main result:**

 # ε = 9.7 v
y-intercept = 0.1716
(R + r in) = 936.9
RL =990 ohms

Introduction:

A voltage source is characterized by its electromotive force and the maximum value of the current it can deliver to a short circuit.

An ideal voltage source is the one in which the internal resistance is zero (R~0), so when it is connected to a short circuit it should to be able to provide an almost infinite current.

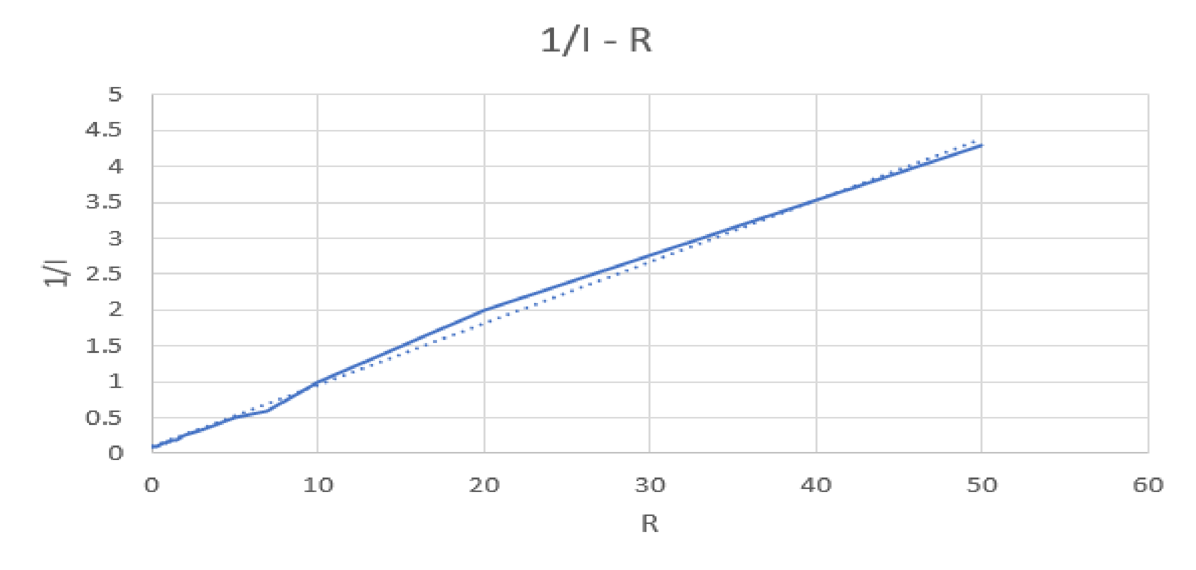
As in the internal resistance of voltage sources is usually small (a few Ohms), in practical circuits an additional resistor is connected in series with the source in order to produce the maximum power transfer condition for large values of (RL). While this additional resistance appears to (RL) as an additional internal resistance, it is seen by the source as an additional load resistance. Consequently, this resistance helps in avoiding loading problems and fulfilling the condition of impedance matching for large load values. The only disadvantage is that this additional resistance consumes part of the power delivered to the circuit by the source.

if we apply conservation of energy to the circuit and rearranging, we get:

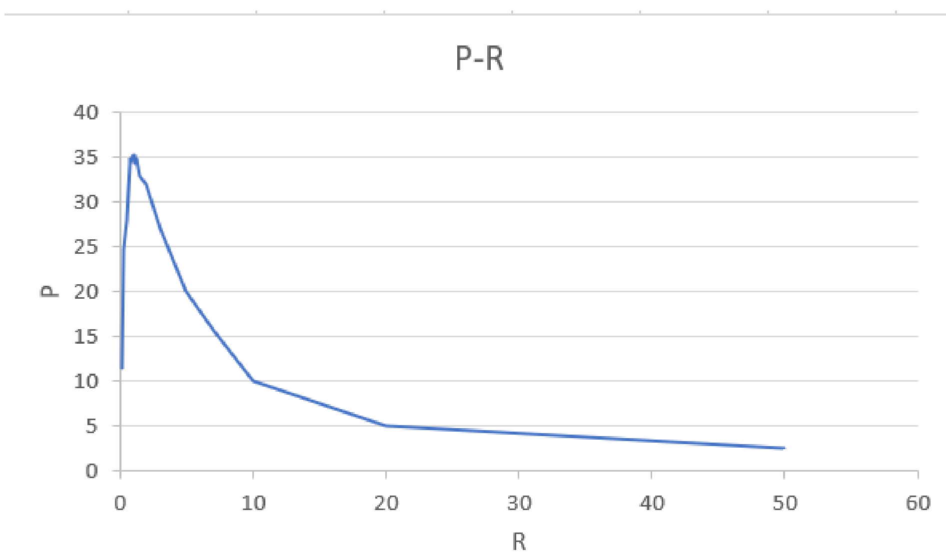
$$\frac{1}{I} = R_L \frac{1}{\varepsilon} + \frac{r_{in} + R}{\varepsilon}$$

the power consumed in the load resistor is given by:

$$P = \frac{\varepsilon^2 R_L}{(R_L + r_{in})^2}$$



slope is **0.1032**, y-intercept is **0.1716**



max value is **34.85**

Calculations:

From figure.1

ε ➞ 1/slope ➞ 1/0.1032 ➞ 9.7 v

y-intercept ➞ 0.1716

From figure.2

P ➞ max when R = 0.85 ohms

R = 990 ohms

Results & Conclusion:

- There should be an internal resistance in every circuit.
- To reach the maximum value of the power transferring the load resistance should be equal to the sum of the additional resistance and the internal resistance.
- There were some percentages of error in finding the load resistance that satisfies the condition of maximum power transfer due to systemic errors and random errors.