## IMPEDANCE MATCHING CIRCUIT

The term “impedance matching” is rather straight forward. Its simply defined as the process of making one impedance look like another. Frequently, it becomes necessary to match a load impedance to the source or internal impedance of a driving source. A wide variety of components and circuits can be used for impedance matching. This series summarizes the most common impedance-matching techniques.

**Rationale and concept:**

The maximum power transfer theorem says that to transfer theorem the maximum amount of power from a source to a load, the load impedance should match the source impedance. In the basic circuit, a source may be dc or ac, and its internal resistance ($R_i$) or generator output impedance ($Z_g$) drives a load resistance ($R_L$) or impedance ($Z_L$).

$$R_L=R_i \text{ or } Z_L=Z_g$$

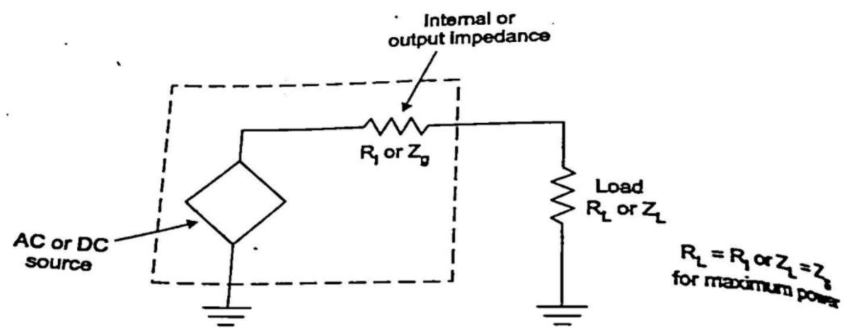


**Fig: Equivalent circuit of Thevenin theorem**

The figure shows the maximum power is transferred from a source to a load when the load resistance equals the internal resistance of the source. A plot of load power versus load resistance reveals that matching load and some impedances will achieve maximum power.

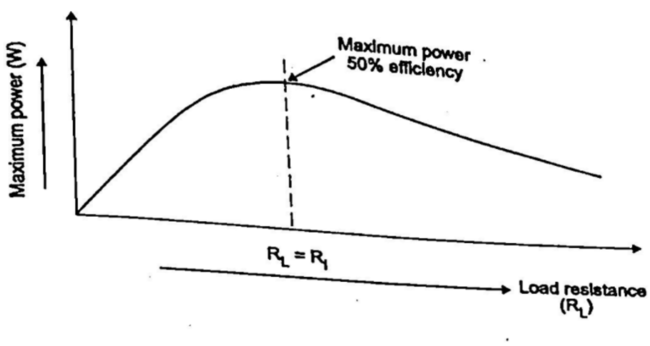


**Fig: Performance curve**

The figure shows varying the load resistance on a source show that maximum power to the load is achieved by matching load and source impedances. At this time, efficiency is 50%. A key factor of this theorem is that when the load matches the source, the amount of power delivered to the load is the same as the power dissipated in the source. Therefore, transfer of maximum power is only 50% efficient. The source must be able to dissipate the power. To deliver maximum power to the load, the generator has to develop twice the desired output power.

**Types of Impedance matching circuits:**

1. Transform matching:

RF transformers can be used to produce very wideband impedance matching. The main limitations are the restricted range of available impedances and the frequency limitations on transformers.

2. LC matching:

LC matching where inductors and capacitors are used to affect the impedance transformation. LC matching results in a relatively narrow bandwidth match. LC matching is very practical at frequencies from 30mHz to 300Mhz. LC matching permits easy tuning of the match to allow for device variations.

3. Transmission line matching:

By using a transmission line of a required length and characteristic impedance, the required composite match can be obtained. Such a match tends to be of a broader frequency range than LC matching and can be applied at frequencies above about 150MHz. It is difficult to tune the length and characteristic impedance of a transmission line once constructed.

**Capacitive Impedance Transformer:**

The network is thus used to match the output impedance of one transistor to the input impedance of another transistor. The circuit is related to the Lowpass $P_i$ network, except the ground and the input port are changed. For this network the output impedance at port 2 is always larger that a port 1.

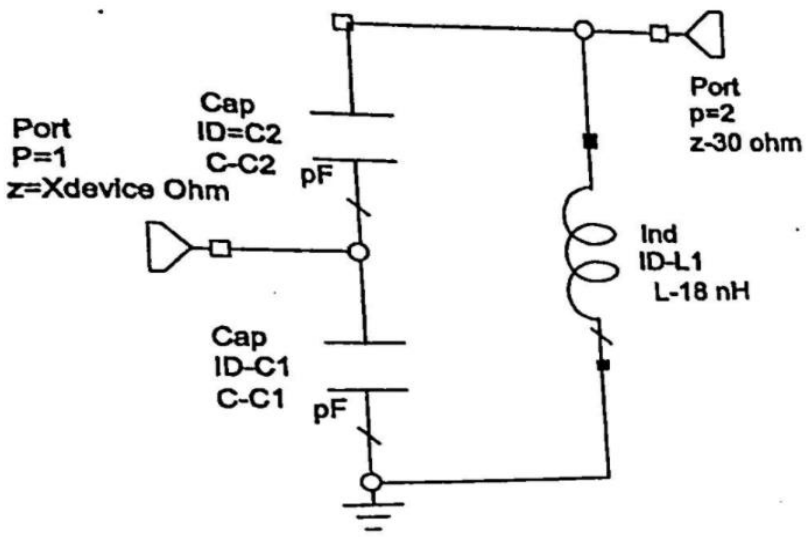


**Fig: Capacitive impedance transformer matching network**

For a non-reactive device, the equations for the component values are the same as those for the $P_i$ network, with the input impedance being the same at port 1, but the reference impedance 50Ω now being the same as ($R_i$-$R_{device}$) used in the $P_i$ network.