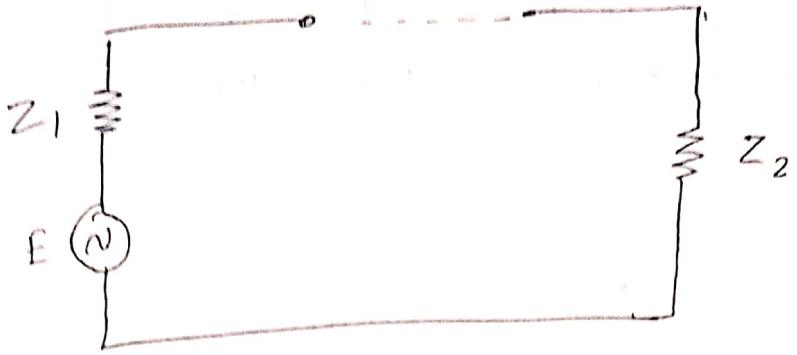
REFLECTION FACTOR & REFLECTION LOSS



(Fig) Generator of impedance Z_1 connected to load Z_2

* If $Z_2 \neq Z_1$ in the above transmission line, the impedance mismatch causes a change in the ratio of voltage to current (or) of energy transmitted by the electric field to that transmitted by the magnetic field.

* So that a portion of the energy is reflected by the load.

* The energy delivered to the load is less than the energy delivered to the load under the impedances were matched. This is known as reflection loss.

The magnitude of Reflection (reflection factor)

$$|K| = \left|\frac{I_2}{I_2'}\right| = \frac{\text{The current actually flowing in the load under mismatched condition } (I_2)}{\text{The current which would flow if the impedances were matched } (I_2')}$$

Image matching

* In order to match the generator & load impedances we use the method known as image matching.

* Image matching between a given generator and load is obtained by insertion of an ideal transformer and a lossless phase shifter between source and load.

According to the theory of ideal transformer

$$\frac{I_1}{I_2} = \sqrt{\frac{Z_2}{Z_1}} \longrightarrow (1)$$

* For image matching the magnitude of Z_2 is adjusted to that of Z_1 by choosing proper transformer ratio 'a'

The angle of Z_2 is adjusted to that of Z_1 by operation of phase shifter.

* Under these theoretical conditions Z_2 is image matched to Z_1, and the current which would flow through the generator would be

$$I_1 = \frac{E}{2Z_1} \longrightarrow (2)$$

* The current I_2' through load under matched conditions is

$$I_2' = \frac{E}{2Z_1}\sqrt{\frac{Z_1}{Z_2}} = \frac{E}{2\sqrt{Z_1 Z_2}} \longrightarrow (3)$$

* Whereas without image matching, this current is

$$I_2 = \frac{|E|}{|Z_1 + Z_2|} \rightarrow (4)$$

* Hence the ratio of the current actually flowing in the load to that which would flow under image matched conditions is

$$\left|\frac{I_2}{I_2'}\right| = \frac{\frac{|E|}{|Z_1+Z_2|}}{\frac{|E|}{|2\sqrt{Z_1 Z_2}|}} = \left|\frac{2\sqrt{Z_1 Z_2}}{Z_1 + Z_2}\right| = K \rightarrow (5)$$

* This ratio indicates the change in current in the load due to reflection at the mismatched junction and is called the reflection factor k.

Reflection Loss

It is defined as the number of nepers or decibels by which the current in the load under image matched conditions would exceed the current actually flowing in the load.

The reflection loss is reciprocal of k.

$$\text{Reflection loss, nepers} = \ln\left|\frac{Z_1 + Z_2}{2\sqrt{Z_1 Z_2}}\right|$$

$$\text{Reflection loss, decibels} = 20 \log\left|\frac{Z_1 + Z_2}{2\sqrt{Z_1 Z_2}}\right|$$