

Superposition Theorem

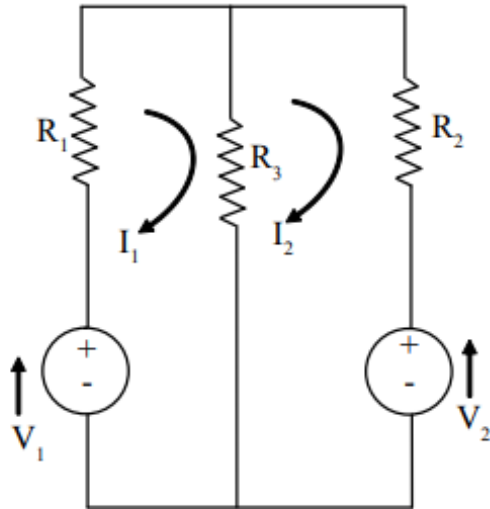


Fig.1

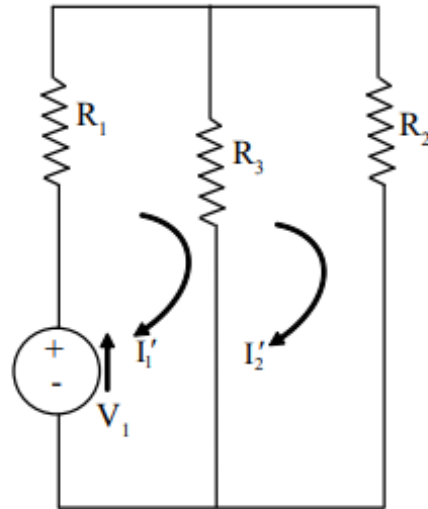


Fig.2

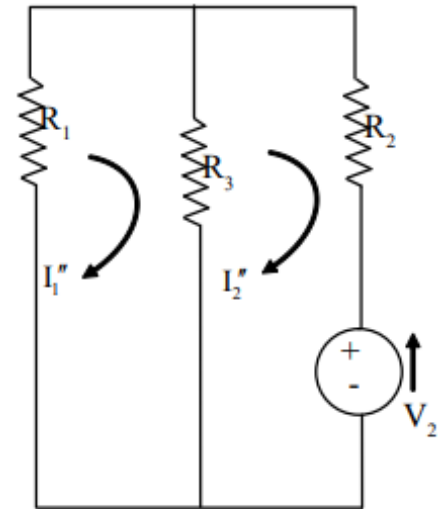


Fig.3

Statement :

“In a linear, bilateral network containing more than one source, the current through any branch is the algebraic sum of currents which would flow in that branch by considering one source at a time while the other source is reduced to zero.

$$I_1 = I_1' + I_1''$$

$$I_2 = I_2' + I_2''$$

Proof :

Applying KVL by inspection in fig. (1), we get

$$\begin{bmatrix} R_1 + R_3 & -R_3 \\ -R_3 & R_2 + R_3 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} V_1 \\ -V_2 \end{bmatrix}$$

$$(R_1 + R_3) I_1 - R_3 I_2 = V_1$$

$$-R_3 I_1 + (R_2 + R_3) I_2 = -V_2$$

Applying KVL by inspection in fig. (2), we get

$$\begin{bmatrix} R_1 + R_3 & -R_3 \\ -R_3 & R_2 + R_3 \end{bmatrix} \begin{bmatrix} I'_1 \\ I'_2 \end{bmatrix} = \begin{bmatrix} V_1 \\ 0 \end{bmatrix}$$

$$(R_1 + R_3) I'_1 - R_3 I'_2 = V_1$$

$$-R_3 I'_1 + (R_2 + R_3) I'_2 = 0$$

Applying KVL by inspection in fig (3). we get

$$\begin{bmatrix} R_1 + R_3 & -R_3 \\ -R_3 & R_2 + R_3 \end{bmatrix} \begin{bmatrix} I_1'' \\ I_2'' \end{bmatrix} = \begin{bmatrix} 0 \\ -V_2 \end{bmatrix}$$

$$(R_1 + R_3) I_1'' - R_3 I_2'' = 0$$

$$-R_3 I_1'' + (R_2 + R_3) I_2'' = -V_2$$

$$I_2 = I_2' + I_2''$$