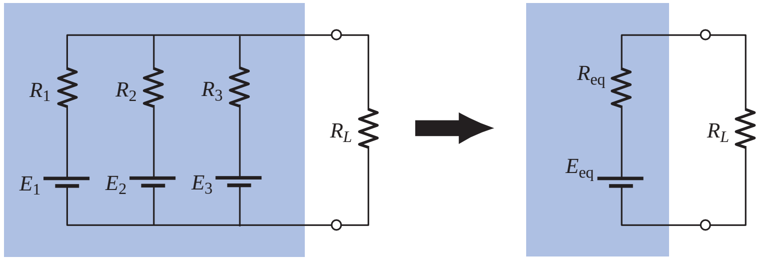
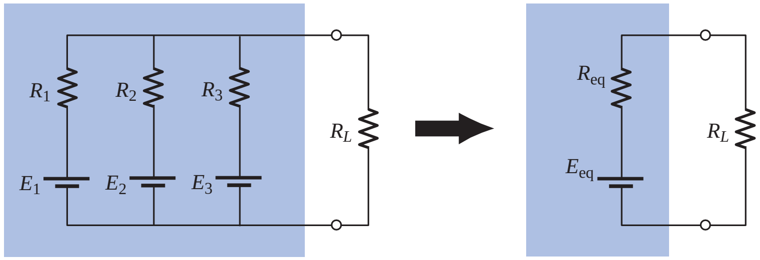
MILLMAN'S THEOREM

- Through the application of Millman's theorem, any number of parallel voltage sources can be reduced to one.
- Showing in Fig, for example, the three voltage sources can be reduced to one. This would permit finding the current through or voltage across RL without having to apply a method such as mesh analysis, nodal analysis, superposition, and so on.



Basically, three steps are included in its application

- Convert all voltage sources to current sources
- Combine parallel current sources
- Convert the resulting current source to a voltage source, and the desired single-source network is obtained



$$E_{eq} = \frac{\frac{E_1}{R_1} + \frac{E_2}{R_2} + \cdots + \frac{E_n}{R_n}}{\frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_n}}$$

$$R_{eq} = \frac{1}{\frac{1}{R_1 + R_2 + R_3 + \cdots + R_n}}$$

MILLMAN’S THEOREM FOR NETWORKS

For AC networks Millman’s theorem states that “ if ‘n’ number of voltage sources V_1, V_2, V_3,........,V_n having internal impedances Z_1, Z_2, Z_3,......., Z_n are connected in parallel across the load Z_L than this arrangement may be replaced by a single voltage source V_{eq} in series with equivalent impedance Z_{eq}. Millman’s equivalent circuit is shown in fig.1.

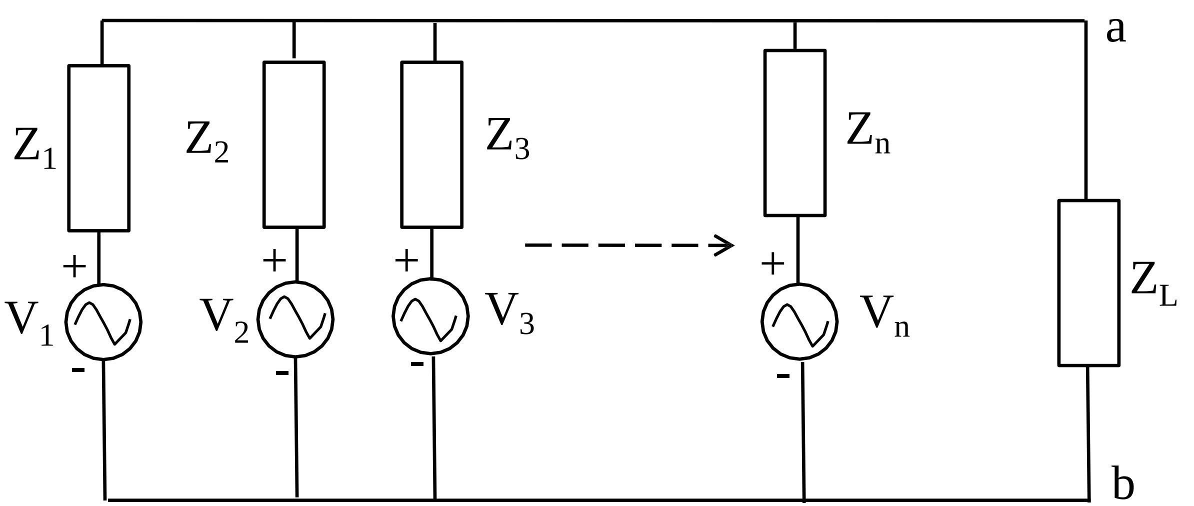


Fig. 1a

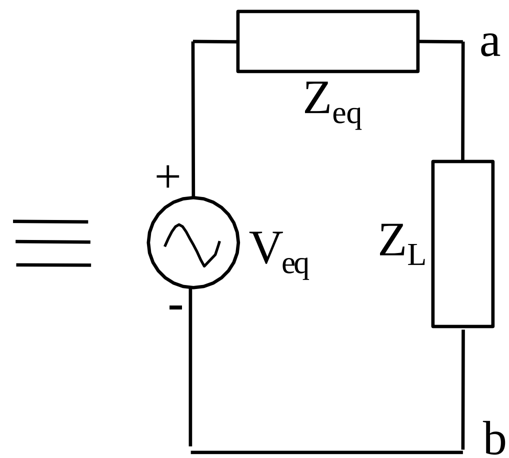


Fig. 1b

MILLMAN'S THEOREM FOR AC NETWORKS

$$V_{eq} = \frac{V_1Y_1 + V_2Y_2 + V_3Y_3 - - - - - - + V_nY_n}{Y_1 + Y_2 + Y_3 - - - - - - - - - - + Y_n} - - - - - - - (1)$$

$$Z_{eq} = \frac{1}{Y_1 + Y_2 + Y_3 - - - - - - - - - - + Y_n} - - - - - - - - (2)$$

Where $Z_1, Z_2, Z_3 ....Z_n$ are theimpedances and $Y_1, Y_2, Y_3, ...Y_n$ are theadmitatances.

$$Y = \frac{1}{Z}$$

This theorem is applicable only to solve the parallel branch with one impedance or *resistance connected to voltage or current source. The voltage sources can be converted into current sources by transformation of sources.*

MILLMAN'S THEOREM FOR AC NETWORKS

EXAMPLE: Using Millman's theorem, find the current through 'ab'

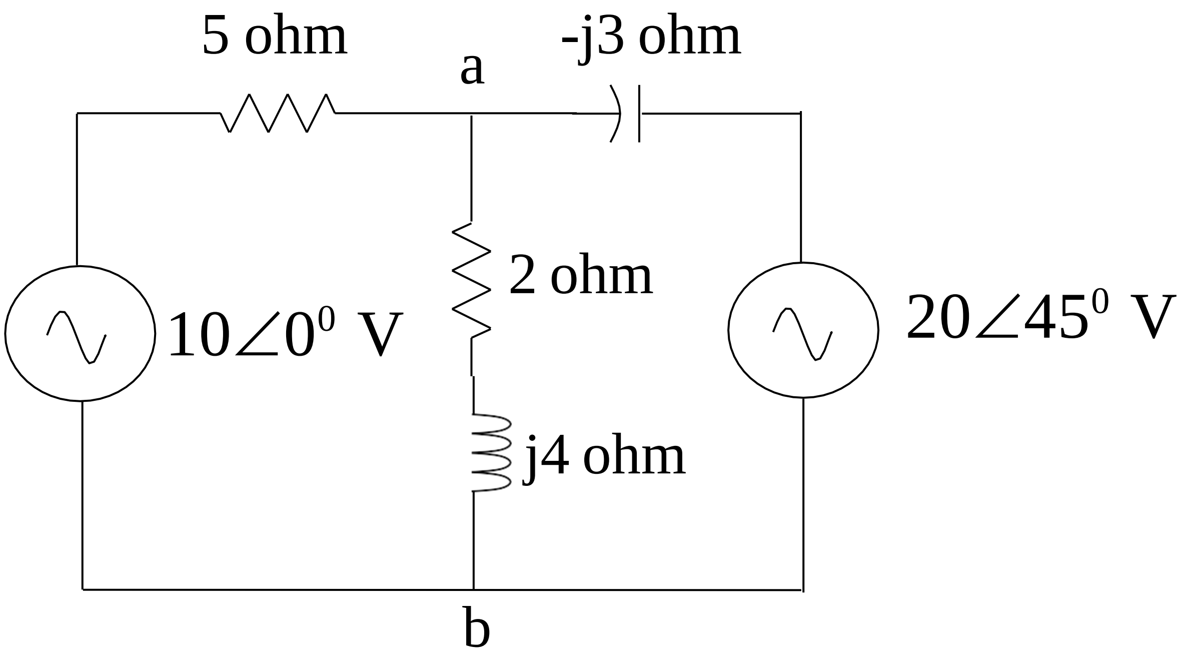


Fig.2

MILLMAN'S THEOREM FOR AC NETWORKS

SOLUTION:

$$V_1 = 10\angle 0^0\,\mathrm{V}$$

$$V_2 = 20\angle 45^0\,\mathrm{V}$$

$$Y_1 = \frac{1}{Z_1} = \frac{1}{5} = 0.2\,\mathrm{S}$$

$$Y_1 = \frac{1}{Z_2} = \frac{1}{-j3} = 0.33\angle 90^0\,\mathrm{S}$$

$$V_{eq} = \frac{V_1 Y_1 + V_2 Y_2}{Y_1 + Y_2}$$

$$V_{eq} = \frac{(10\angle 0^0)(0.2) + (20\angle 45^0)(0.33\angle 90^0}{0.2 + 0.33\angle 90^0}$$

$$V_{eq} = 13.94\angle 60.97^0\,\mathrm{V}$$

$$Z_{eq} = \frac{1}{Y_{eq}} = \frac{1}{0.2 + 0.33\angle 90^0} = 2.59\angle -58.78^0\,\Omega$$

MILLMAN'S THEOREM FOR AC NETWORKS

Millman's Equivalent Circuit:

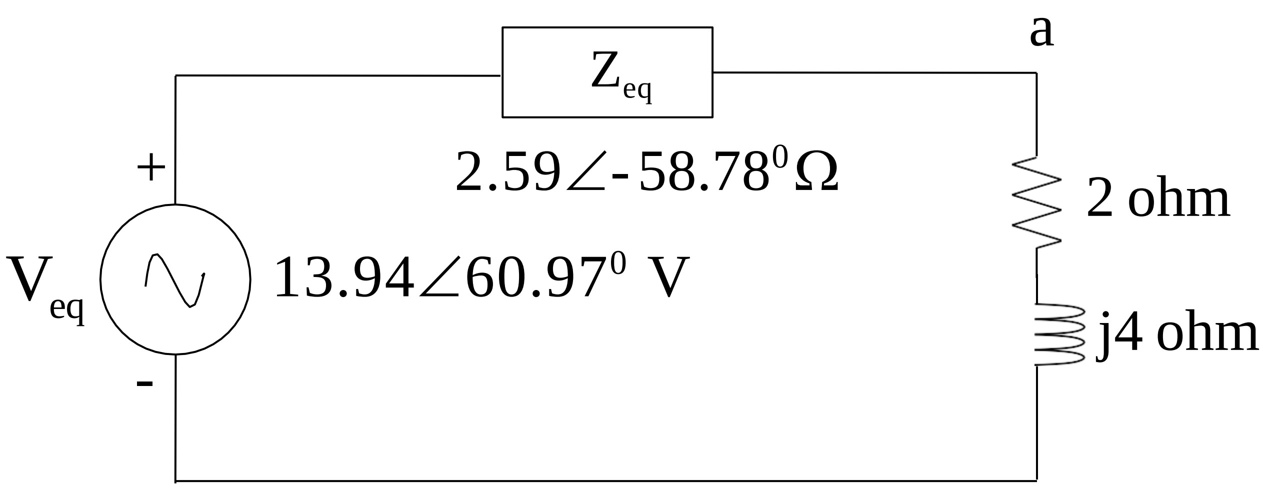


Fig. 3

$$I_{ab} = \frac{V_{eq}}{Z_{eq} + (2 + j4)} = \frac{13.94\angle 60.97^0}{(2.59\angle -58.78) + (2 + j4)}$$

$$I_{ab} = 3.68\angle 32.79_0\,A$$

Current through branch ab $= 3.68\angle 32.79^0$ A


Thank You!