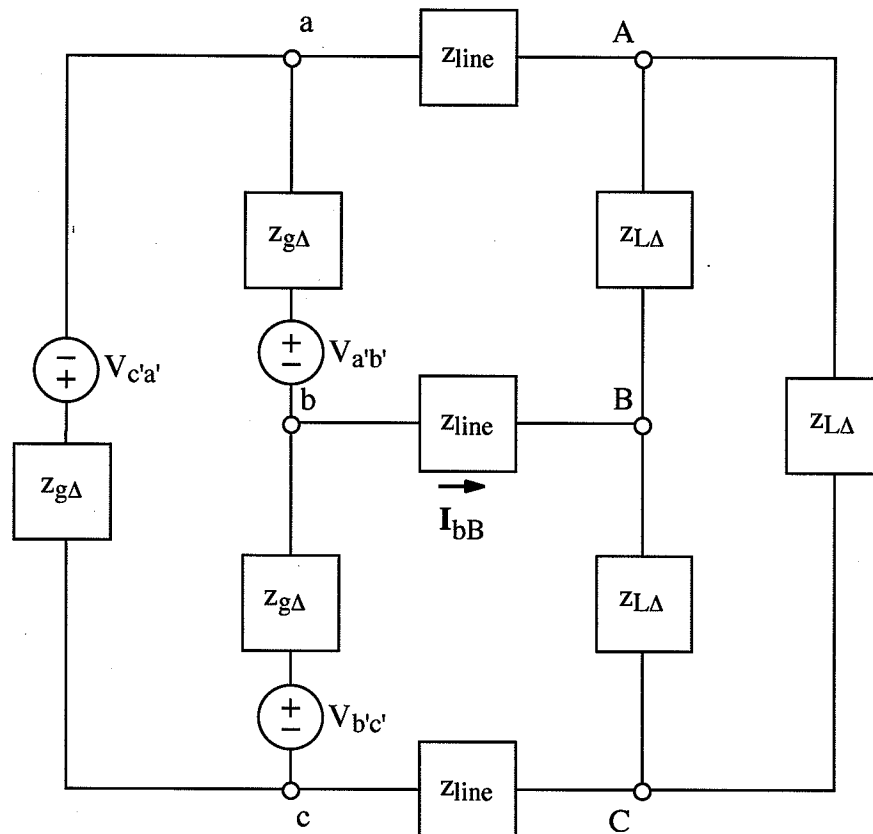


Ex:



$$V_{a'b'} = 142\angle 0^\circ \text{ V} \quad z_{g\Delta} = 24 + j33 \, \Omega$$

$$V_{b'c'} = 142\angle -120^\circ \text{ V} \quad z_{line} = j28 \, \Omega$$

$$V_{c'a'} = 142\angle 120^\circ \text{ V} \quad z_{L\Delta} = 3 + j3 \, \Omega$$

Find the numerical value of the current, I_{bB} .

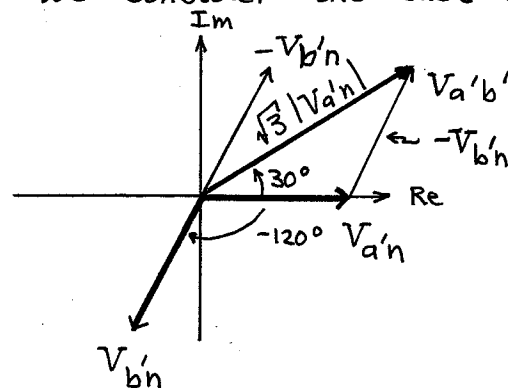
sol'n: We find I_{bB} by converting the Δ - Δ circuit to a Y - Y configuration, finding the current I_{aA} , and shifting the phase by -120° .

To convert from z_{Δ} to z_Y , (both for the generator and load), we divide z by 3:

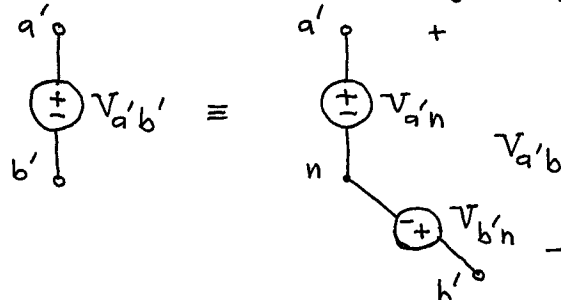
$$z_{gY} = \frac{z_{g\Delta}}{3} = \frac{24 + j33 \Omega}{3} = 8 + j11 \Omega$$

$$z_{LY} = \frac{z_{L\Delta}}{3} = \frac{3 + j3 \Omega}{3} = 1 + j \Omega$$

To find the Y-equivalent voltage source value, we consider the case of $z's = 0$.



Note: The diagram follows from $V_{a'b'} = V_{a'n} - V_{b'n}$:



From the phasor diagram, we have the following relationship between $V_{a'b'}$ and $V_{a'n}$ and $V_{b'n}$:

$$V_{a'b'} = V_{a'n} - V_{b'n}$$

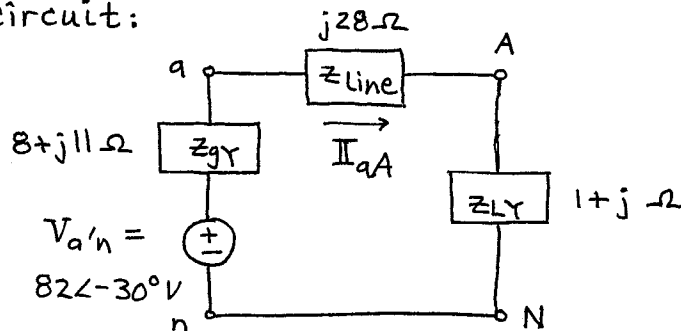
$$V_{a'b'} = V_{a'n} \cdot \sqrt{3} \angle 30^\circ$$

Inverting the eqn for $V_{a'b'}$ yields an expression for $V_{a'n}$:

$$\begin{aligned} V_{a'n} &= V_{a'b'} \frac{1}{\sqrt{3}} \angle -30^\circ \\ &= 142 \angle 0^\circ \text{ V} \cdot \frac{1}{\sqrt{3}} \angle -30^\circ \end{aligned}$$

$$V_{a'n} = 82 \angle -30^\circ \text{ V}$$

We now draw the single-phase equivalent circuit:



Line current I_{aA} is the same in the original circuit and the single-phase equivalent since it is outside the generator and load.

We now calculate I_{aA} :

$$\begin{aligned} I_{aA} &= \frac{V_{a'n}}{z_{gY} + z_{Line} + z_{LY}} \\ &= \frac{82 \angle -30^\circ \text{ V}}{8 + j11 \Omega + j28 \Omega + 1 + j \Omega} \\ &= \frac{82 \angle -30^\circ \text{ V}}{9 + j40} \end{aligned}$$

$$I_{aA} = \frac{82 \angle -30^\circ \text{ V}}{41 \angle 77.3^\circ \Omega} = 2 \angle -107.3^\circ \text{ A}$$

Since $V_{b'c'}$ is phase-shifted by -120° from $V_{a'b'}$, we phase-shift I_{aA} by -120° to obtain I_{bB} :

$$\begin{aligned} I_{bB} &= I_{aA} \cdot 1 \angle -120^\circ \\ &= 2 \angle -107.3^\circ \text{ A} \cdot 1 \angle -120^\circ \end{aligned}$$

$$I_{bB} = 2 \angle -227.3^\circ \text{ A}$$

$$\text{or } I_{bB} = 2 \angle 132.7^\circ \text{ A}$$

$$\text{or } I_{bB} = -1.36 + j1.47 \text{ A}$$