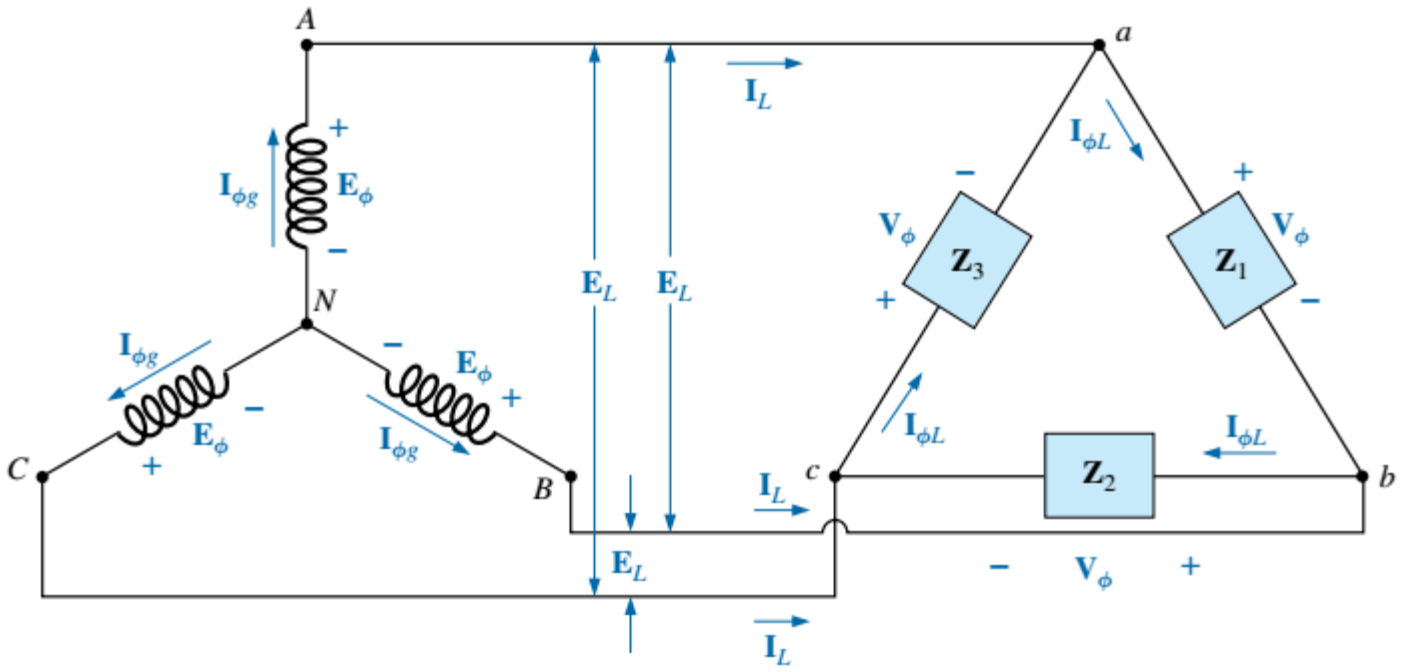
Y Connected Generator with Delta Load

- Configuration
  - Voltage and current relationships
- Example Problem
  - Balanced load, ABC phase sequence
  - Finding the currents and voltages
  - Checking our results
  - Simulation verification
    - Voltage and current measurements

Y Connected Generator with Delta Connected Load



Notes:

$\mathbf{V_\phi = E_L}$

That is to say:

Vca = **ECA**

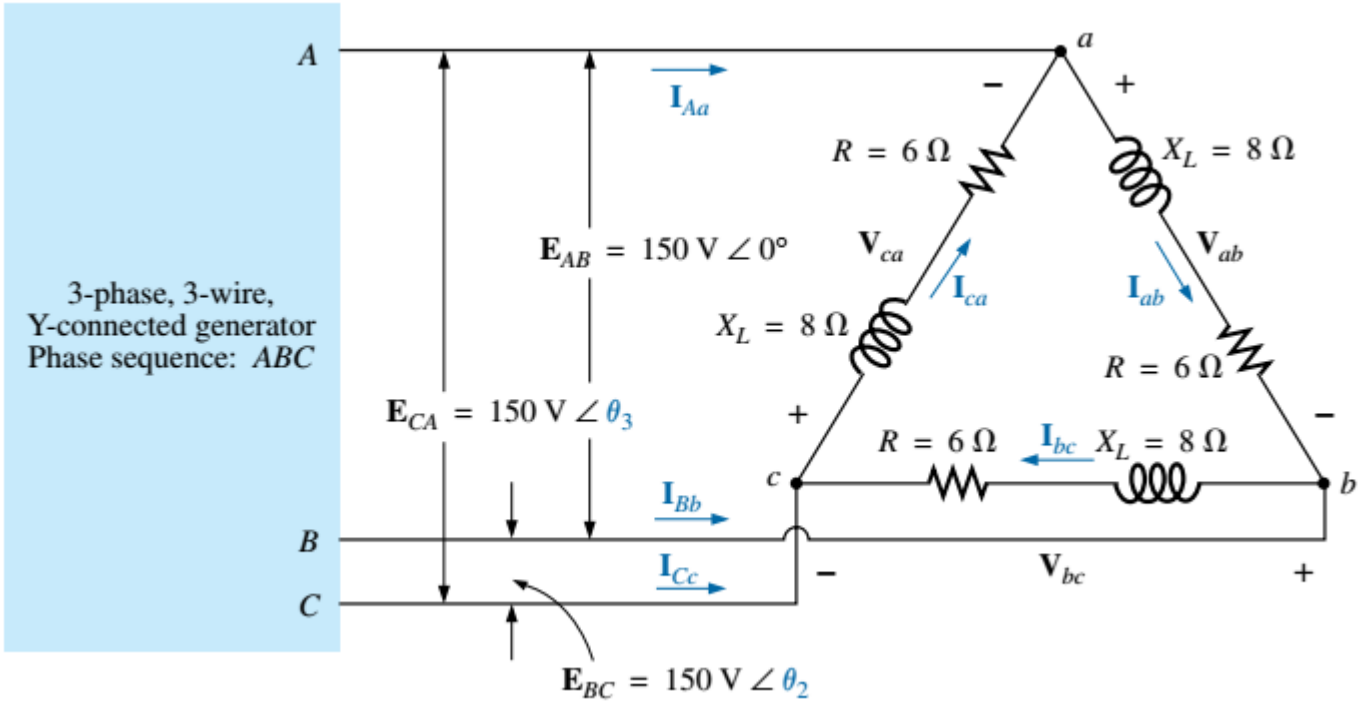
Vab = **EAB**

Vbc = **EBC**

$I_L = \sqrt{3} I_\phi$

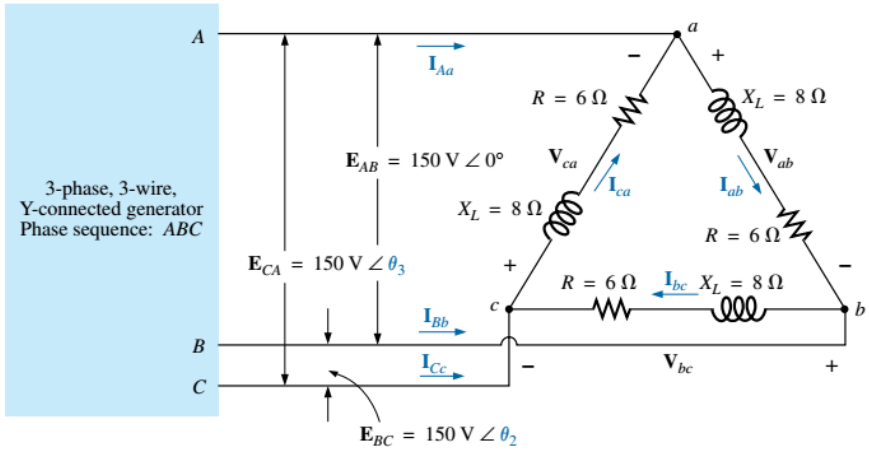
We'll use KCL to check this shortly…

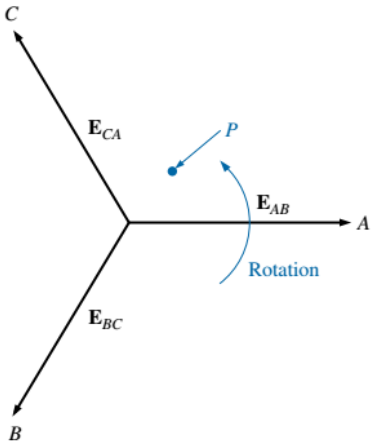
Y Connected Generator with Delta Connected Load - Example



a. Find the phase angles θ_2 and θ_3.
b. Find the current in each phase of the load.
c. Find the magnitude of the line currents.

Y Connected Generator with Delta Connected Load - Example





ABC phase sequence described by the line voltages

a. For an *ABC* sequence,

$$\theta_2 = -120° \quad \text{and} \quad \theta_3 = +120°$$

$\mathbf{V}_\phi = \mathbf{E}_L$. Therefore,

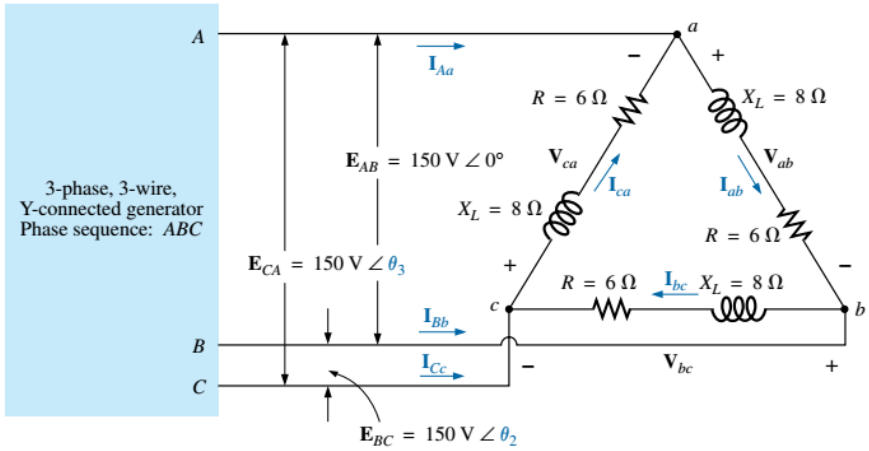
$$\mathbf{V}_{ab} = \mathbf{E}_{AB} \qquad \mathbf{V}_{ca} = \mathbf{E}_{CA} \qquad \mathbf{V}_{bc} = \mathbf{E}_{BC}$$

The phase currents are

$$\mathbf{I}_{ab} = \frac{\mathbf{V}_{ab}}{\mathbf{Z}_{ab}} = \frac{150\ \text{V} \angle 0°}{6\ \Omega + j\,8\ \Omega} = \frac{150\ \text{V} \angle 0°}{10\ \Omega \angle 53.13°}$$

$$= \mathbf{15\ A \angle -53.13°}$$

Y Connected Generator with Delta Connected Load - Example



$$\mathbf{I}_{bc} = \frac{\mathbf{V}_{bc}}{\mathbf{Z}_{bc}} = \frac{150\ \text{V} \angle -120°}{10\ \Omega \angle 53.13°} = \mathbf{15\ A \angle -173.13°}$$

$$\mathbf{I}_{ca} = \frac{\mathbf{V}_{ca}}{\mathbf{Z}_{ca}} = \frac{150\ \text{V} \angle +120°}{10\ \Omega \angle 53.13°} = \mathbf{15\ A \angle 66.87°}$$

c. $I_L = \sqrt{3} I_\phi = (1.73)(15\ \text{A}) = 25.95\ \text{A}$. Therefore,

$$I_{Aa} = I_{Bb} = I_{Cc} = \mathbf{25.95\ A}$$

As a check, solving for line current **IAa**:

KCL at node a:

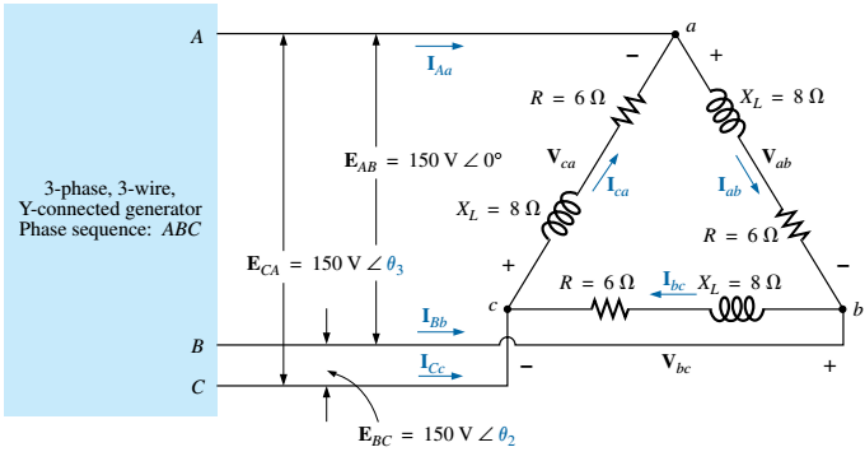
IAa + **Ica** = **Iab**

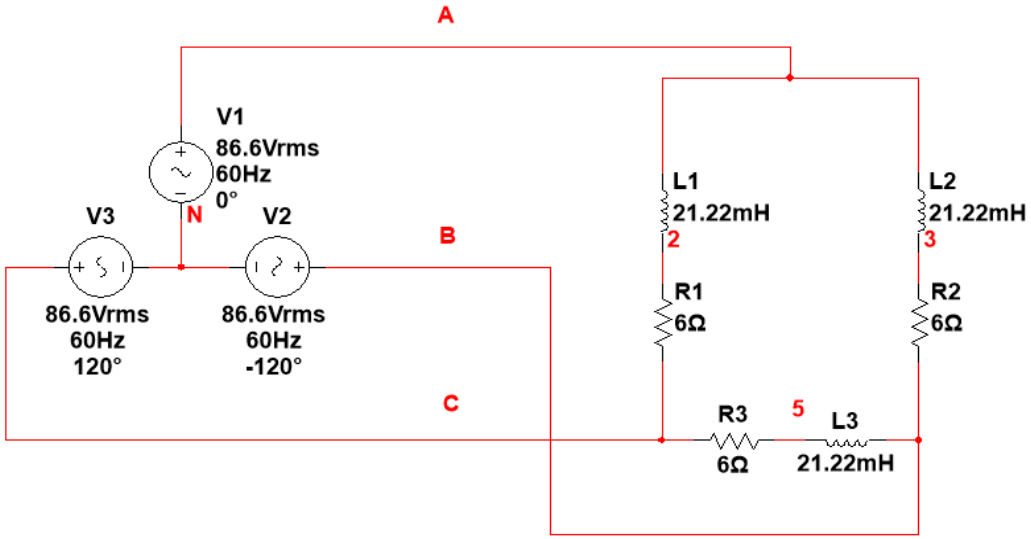
Therefore, **IAa** = **Iab** - **Ica**

IAa = 15 A<-53.13° - 15 A <66.87°

IAa = 25.98 A < -83.13°

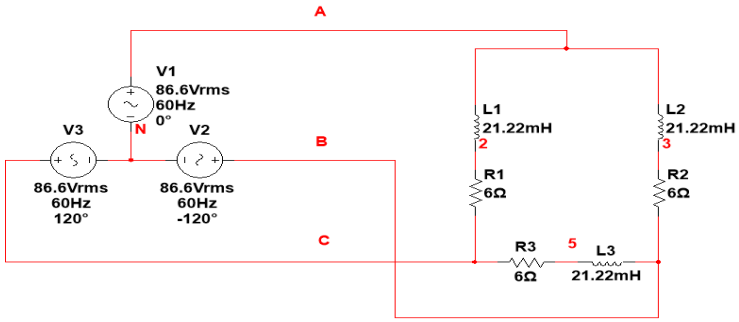
Y Connected Generator with Delta Connected Load - Simulation

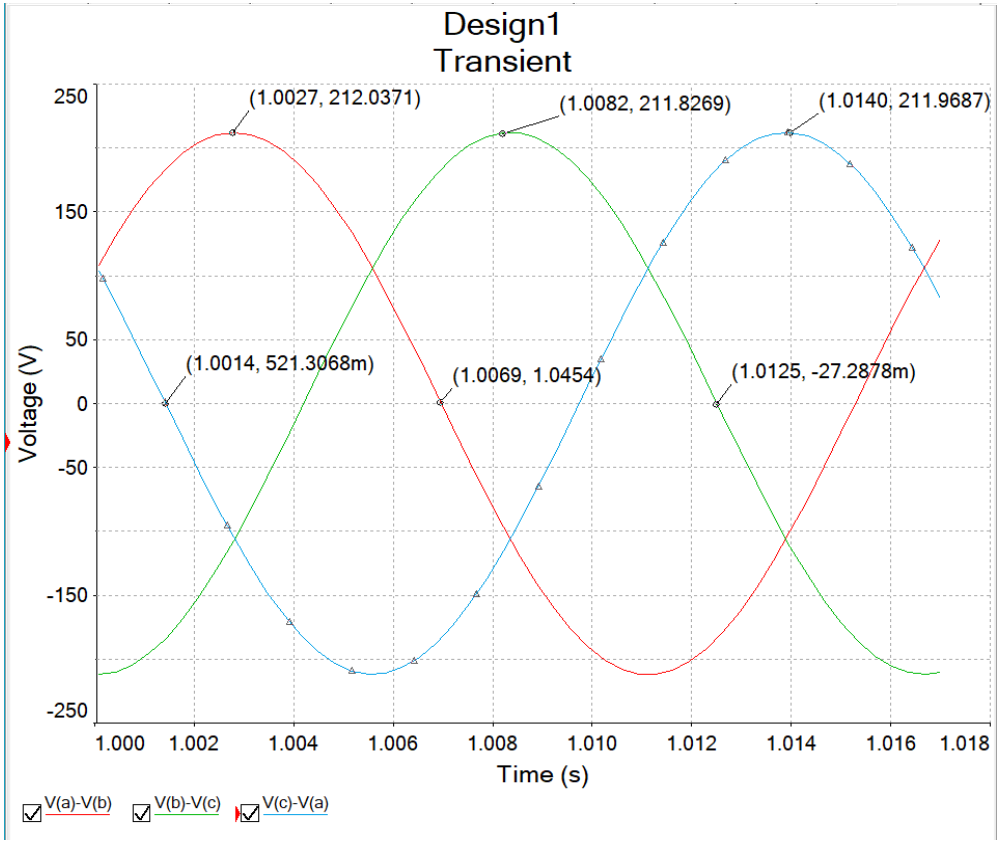




- Phase voltages in the Y are equal to (line voltages)/SQRT(3)
- L = 21.22mH for j8 Ohms (@ 60 Hz)

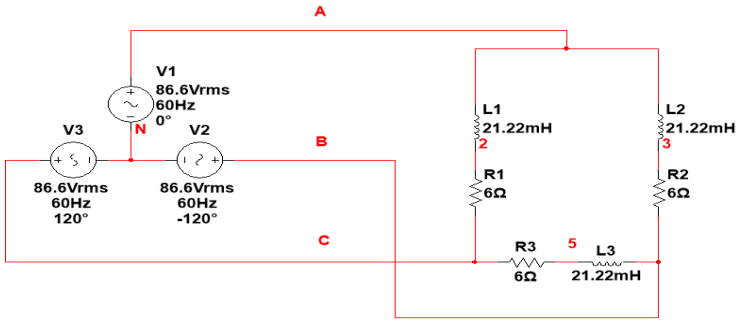
Y Connected Generator with Delta Connected Load - Simulation

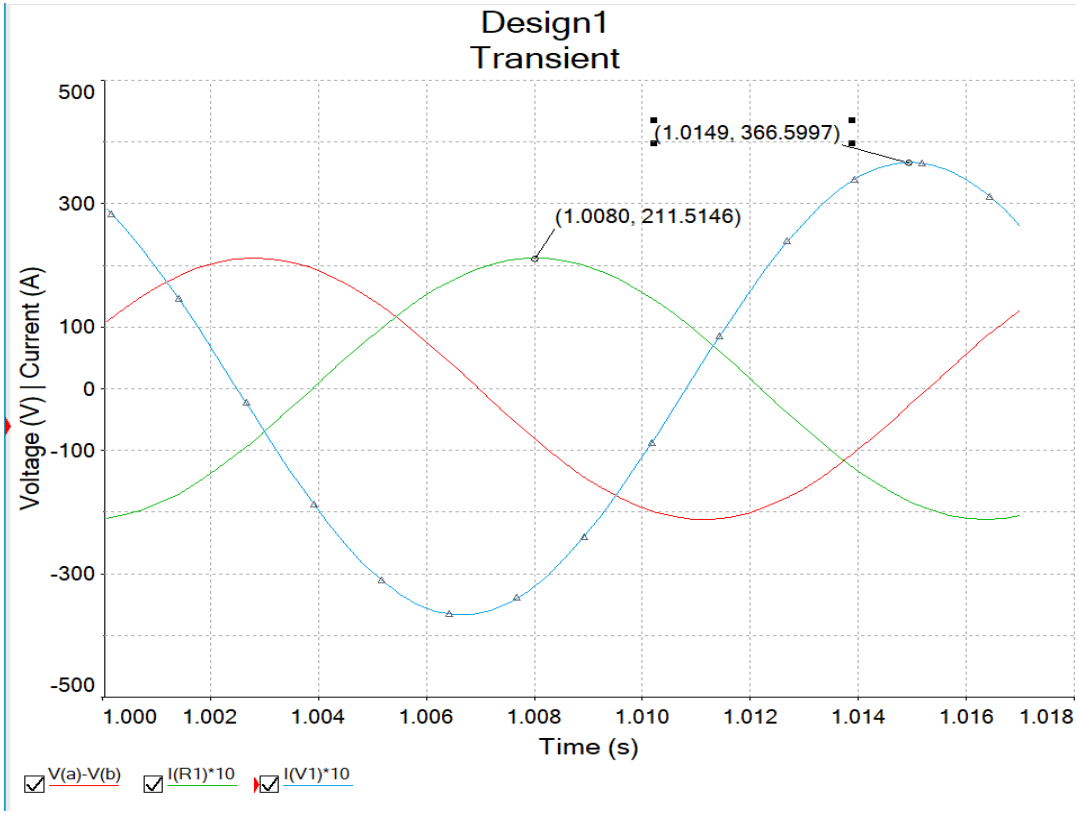




- 212Vpk = 150Vrms
- **Vab** = 150Vrms < 0 Deg, reference
- 5.5msec -> 119 Deg ~ 120 Deg
- **Vca** leads by 120 Deg
- **Vbc** lags by 120 Deg

Y Connected Generator with Delta Connected Load - Simulation





- |**Ica**| = 211.5/10 = 21.15Apk ~ 15 Arms
- |**IAa**| = 366.6/10 = 36.66Apk ~ 25.95 Arms