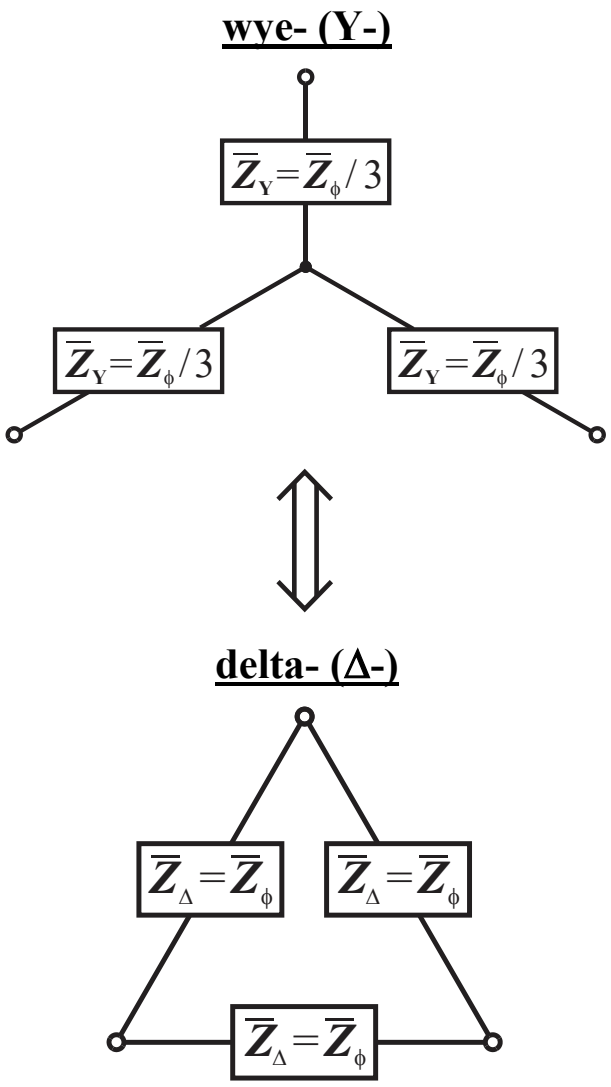
Three-Phase (3ϕ) wye- (Y-) ⇔ delta- (Δ-) Conversions

- 3ϕ sources and loads can be configured and connected in many permutations, e.g., we can have Y - Y, Δ - Y, Y – Δ, or Δ - Δ.
- For balanced sources and loads, we might prefer the Y - Y case (easiest for dealing with transmission line and generator impedances), or
- we might prefer the Δ - Δ case (easiest for dealing with parallel loads).

Load Conversions (valid for *balanced* loads)

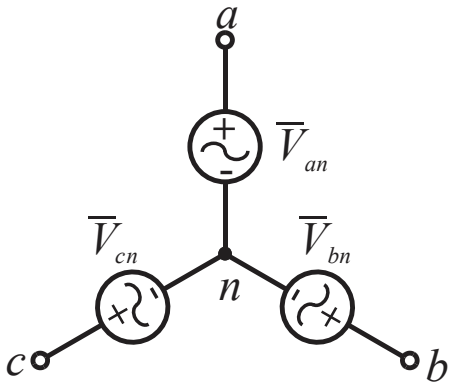


Key conversion relationship- $\boxed{\overline{Z}_Y = \frac{\overline{Z}_\Delta}{3} \text{ or } \overline{Z}_\Delta = 3\overline{Z}_Y}$.

$\mathbf{Y \rightarrow \Delta}$ Source Conversion (valid for *balanced* sources)

- This was covered in section 2.2 when we looked at line and phase voltages.
- Reality- Δ-sources are not used much in practice (i.e., generators) as it is undesirable to have currents circulating w/in or around the source which could happen could be an issue if phase voltages are slightly off.

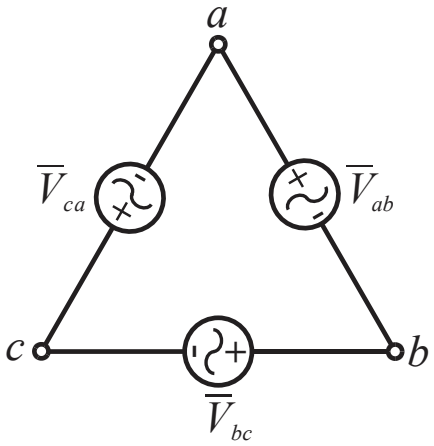
wye- (Y-)



where $\boxed{\overline{V}_{an} = V_\phi \angle 0°, \quad \overline{V}_{bn} = V_\phi \angle -120°, \quad \text{and} \quad \overline{V}_{cn} = V_\phi \angle -240°}$.

$\Downarrow$

delta- (Δ-)



where

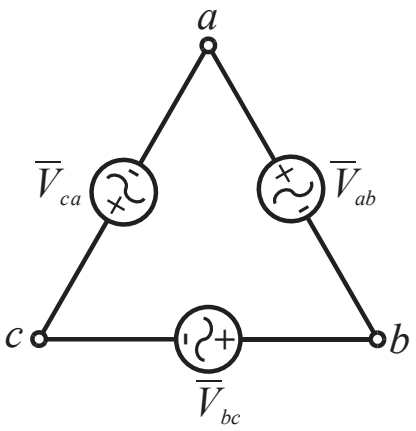
$$\boxed{\overline{V}_{ab} = \sqrt{3}\, V_\phi \angle 30°, \quad \overline{V}_{bc} = \sqrt{3}\, V_\phi \angle -90°, \quad \& \quad \overline{V}_{ca} = \sqrt{3}\, V_\phi \angle -210° = \sqrt{3}\, V_\phi \angle 150°}.$$

Note that we used $\boxed{V_{LL} = \sqrt{3}\, V_\phi}$.

$\Delta \rightarrow$ Y Source Conversion (valid for *balanced* sources)

- This was covered in section 2.2 when we looked at line and phase voltages.

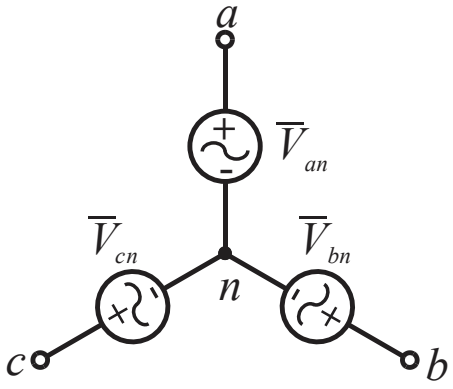
delta- (Δ-)



where $\boxed{\overline{V}_{ab} = V_\phi \angle 0°, \quad \overline{V}_{bc} = V_\phi \angle -120°, \quad \& \quad \overline{V}_{ca} = V_\phi \angle -240°}$.

$\Downarrow$

wye- (Y-)



where $\boxed{\overline{V}_{an} = \frac{V_\phi}{\sqrt{3}} \angle -30°, \quad \overline{V}_{bn} = \frac{V_\phi}{\sqrt{3}} \angle -150°, \quad \& \quad \overline{V}_{cn} = \frac{V_\phi}{\sqrt{3}} \angle -270°}$.