

Single Phasing (34:03)

Identify reasons why a 3 phase AC system may become imbalanced.

Define the term "single phasing". Identify what events might cause single phasing.

Describe the mechanical and electrical consequences of a 3 phase AC motor single phased at stand still.

Describe the mechanical and electrical consequences of an unloaded 3 phase AC motor single phased while in the act of rotating.

Describe the mechanical and electrical consequences of a loaded 3 phase AC motor single phased while in the act of rotating.

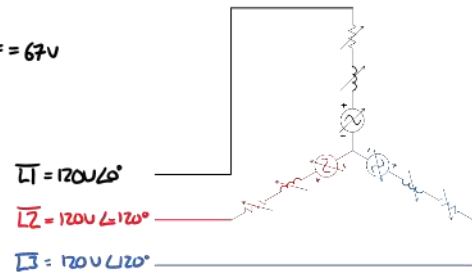
Given this data and model of a 3 wire Y configured motor in the balanced condition explain why it experiences less CEMF and more current in the loaded condition.

UNLOADED $n = 1780 \text{ rpm}$ $\text{CEMF} = 70 \text{ V}$

$$\begin{aligned} \vec{V}_1 &= 120 \text{ V} \angle 0^\circ \\ \vec{I}_1 &= 715 \text{ mA} \angle 70^\circ \\ \vec{V}_2 &= 120 \text{ V} \angle 120^\circ \\ \vec{I}_2 &= 715 \text{ mA} \angle 170^\circ \\ \vec{V}_3 &= 120 \text{ V} \angle 240^\circ \\ \vec{I}_3 &= 715 \text{ mA} \angle 50^\circ \end{aligned}$$

LOADED $n = 1710 \text{ rpm}$ $\text{CEMF} = 67 \text{ V}$

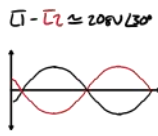
$$\begin{aligned} \vec{V}_1 &= 120 \text{ V} \angle 0^\circ \\ \vec{I}_1 &= 1 \text{ A} \angle -45^\circ \\ \vec{V}_2 &= 120 \text{ V} \angle 120^\circ \\ \vec{I}_2 &= 1 \text{ A} \angle -15^\circ \\ \vec{V}_3 &= 120 \text{ V} \angle 240^\circ \\ \vec{I}_3 &= 1 \text{ A} \angle 75^\circ \end{aligned}$$



Given this data and model of a 3 wire Y configured motor while being single phased in the running and standstill condition explain how current flows through this system. Explain how voltage is apportioned in this system. Predict which winding(s) might be damaged.

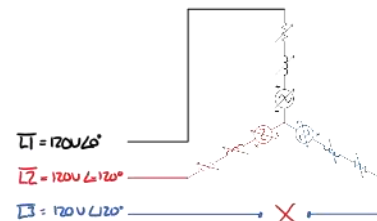
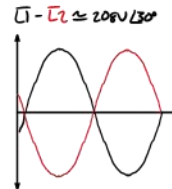
UNLOADED $n = 1750 \text{ rpm}$ $\text{CEMF} = 69 \text{ V}$

$$\begin{aligned} \vec{V}_1 &= 107 \text{ V} \angle 0^\circ \\ \vec{I}_1 &= 1.1 \text{ A} \angle -30^\circ \\ \vec{V}_2 &= 114 \text{ V} \angle -130^\circ \\ \vec{I}_2 &= 1.1 \text{ A} \angle 50^\circ \\ \vec{I}_3 &= 0 \text{ A} \end{aligned}$$

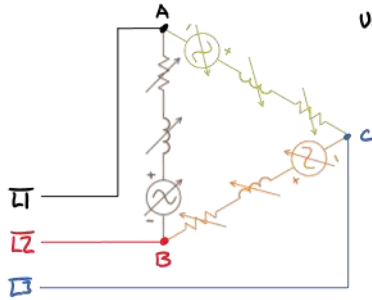


STANDSTILL $n = 0 \text{ rpm}$ $\text{CEMF} = 0 \text{ V}$

$$\begin{aligned} \vec{V}_1 &= 104 \text{ V} \angle 30^\circ \\ \vec{I}_1 &= 6 \text{ A} \angle 15^\circ \\ \vec{V}_2 &= 104 \text{ V} \angle 150^\circ \\ \vec{I}_2 &= 6 \text{ A} \angle 165^\circ \\ \vec{I}_3 &= 0 \text{ A} \end{aligned}$$



Given this data and model of a delta configured motor in the balanced condition explain why it experiences less CEMF and more current in the loaded condition.



$$\begin{aligned} \bar{U}_1 - \bar{U}_2 &= 208\text{V} \angle 0^\circ \\ \bar{U}_2 - \bar{U}_3 &= 208\text{V} \angle 120^\circ \\ \bar{U}_3 - \bar{U}_1 &= 208\text{V} \angle 240^\circ \end{aligned}$$

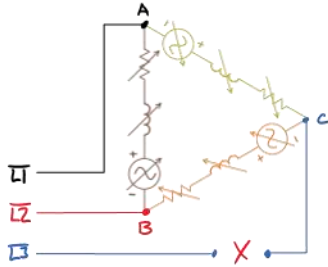
UNLOADED $n = 1770\text{rpm}$ CEMF = 70V

$$\begin{aligned} \bar{V}_{AB} &= 208\text{V} \angle 0^\circ \\ \bar{I}_{AB} &= 406\text{mA} \angle -70^\circ \\ \bar{V}_{BC} &= 208\text{V} \angle 120^\circ \\ \bar{I}_{BC} &= 406\text{mA} \angle 170^\circ \\ \bar{V}_{CA} &= 208\text{V} \angle 240^\circ \\ \bar{I}_{CA} &= 406\text{mA} \angle 50^\circ \\ \bar{I}_1 &= \bar{I}_{AB} - \bar{I}_{CA} = 707\text{mA} \angle -100^\circ \\ \bar{I}_2 &= \bar{I}_{BC} - \bar{I}_{AB} = 707\text{mA} \angle 140^\circ \\ \bar{I}_3 &= \bar{I}_{CA} - \bar{I}_{BC} = 707\text{mA} \angle 20^\circ \end{aligned}$$

LOADED $n = 1710\text{rpm}$ CEMF = 67V

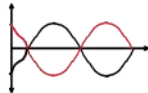
$$\begin{aligned} \bar{V}_{AB} &= 208\text{V} \angle 0^\circ \\ \bar{I}_{AB} &= 587.5\text{mA} \angle -45^\circ \\ \bar{V}_{BC} &= 208\text{V} \angle 120^\circ \\ \bar{I}_{BC} &= 587.5\text{mA} \angle -145^\circ \\ \bar{V}_{CA} &= 208\text{V} \angle 240^\circ \\ \bar{I}_{CA} &= 587.5\text{mA} \angle 75^\circ \\ \bar{I}_1 &= \bar{I}_{AB} - \bar{I}_{CA} = 1\text{A} \angle 75^\circ \\ \bar{I}_2 &= \bar{I}_{BC} - \bar{I}_{AB} = 1\text{A} \angle 175^\circ \\ \bar{I}_3 &= \bar{I}_{CA} - \bar{I}_{BC} = 1\text{A} \angle 45^\circ \end{aligned}$$

Given this data and model of a delta configured motor while being single phased in the running and standstill condition explain how current flows through this system. Explain how voltage is apportioned in this system. Predict which winding(s) might be damaged.



UNLOADED $n = 1750\text{rpm}$ CEMF = 69V

$$\begin{aligned} \bar{V}_{AB} &= 208\text{V} \angle 0^\circ \\ \bar{I}_{AB} &= 175\text{mA} \angle -70^\circ \\ \bar{V}_{BC} &= 150\text{V} \angle -125^\circ \\ \bar{I}_{BC} &= 507\text{mA} \angle 103^\circ \\ \bar{V}_{CA} &= 170\text{V} \angle 135^\circ \\ \bar{I}_{CA} &= 507\text{mA} \angle 103^\circ \\ \bar{I}_{TCA} &= 507\text{mA} \angle 108^\circ \\ \bar{I}_1 &= \bar{I}_{AB} - \bar{I}_{TCA} = 1.5\text{A} \angle -70.7^\circ \\ \bar{I}_2 &= \bar{I}_{TCA} - \bar{I}_{AB} = 1.5\text{A} \angle 109.3^\circ \end{aligned}$$



STANDSTILL $n = 0\text{rpm}$ CEMF = 0V!

$$\begin{aligned} \bar{V}_{AB} &= 208\text{V} \angle 0^\circ \\ \bar{I}_{AB} &= 6.9\text{A} \angle -40^\circ \\ \bar{V}_{BC} &= 104\text{V} \angle 190^\circ \\ \bar{I}_{BC} &= 3.5\text{A} \angle 140^\circ \\ \bar{V}_{CA} &= 104\text{V} \angle 180^\circ \\ \bar{I}_{CA} &= 3.5\text{A} \angle 110^\circ \\ \bar{I}_{TCA} &= 3.5\text{A} \angle 110^\circ \\ \bar{I}_1 &= \bar{I}_{AB} - \bar{I}_{TCA} = 10.4\text{A} \angle 40^\circ \\ \bar{I}_2 &= \bar{I}_{TCA} - \bar{I}_{AB} = 10.4\text{A} \angle 140^\circ \end{aligned}$$

