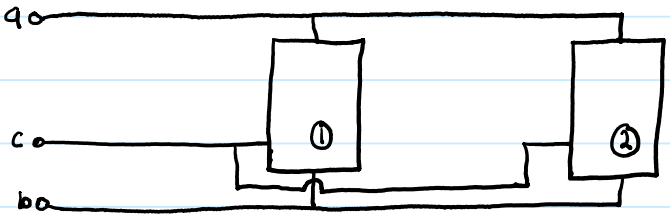
Ex| Problem 2.22



$S_1 = 15$ kVA $\quad PF_1 = 0.8$ leading

$P_2 = 72$ kW $\quad PF_2 = 0.8$ lagging

$V_L = 2000$ V

Find: a) I_L and PF_{TOT}

b) Q_C for $PF = 1$

Solution: a) $\overline{S_{TOT}} = \overline{S_1} + \overline{S_2}$

$$S_2 = \frac{P_2}{PF} = 90 \text{ kVA}$$

$$\overline{S_{TOT}} = (12 - j9) + (72 + j54)$$

$$\overline{S_{TOT}} = 84 + j45 \text{ kVA}$$

$$= 95.3 \angle 28.18^\circ \text{ kVA}$$

$$S_{3\phi} = \sqrt{3} V_L I_L$$

$$I_L = \frac{S_{3\phi}}{\sqrt{3} V_L} \Rightarrow \boxed{I_L = 27.51 \text{ A}}$$

$$\boxed{PF_{TOT} = 0.881 \text{ lag}}$$

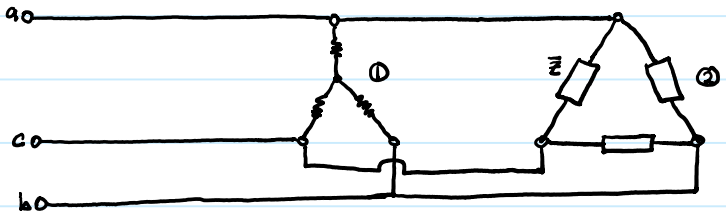
b) $Q_{3\phi} = 45$ kVAR

$$\boxed{Q_C = -45 \text{ kVAR}}$$

Ex| Problem 2.23

Given: $S_{TOT} = 1000$ kVA PF=0.8 lag

$V_L = 4160$ V



$P_1 = 200$ kW

Find: a) $\bar{S}_2$

b) $\bar{Z}$

Solution: a) $\bar{S}_{TOT} = \bar{S}_1 + \bar{S}_2$

$\bar{S}_{TOT} = 1000\angle 36.87°$ kVA

$= 800 + j600$ kVA

$\bar{S}_2 = \bar{S}_{TOT} - \bar{S}_1$

$\bar{S}_2 = 800 + j600 - (200 + j0)$

$\bar{S}_2 = 600 + j600$ kVA

$\boxed{\bar{S}_2 = 600\sqrt{2}\angle 45°\ \text{kVA}}$

b) $S_2 = \sqrt{3} V_L I_L$

$S_2 = 3 V_L I_\phi$

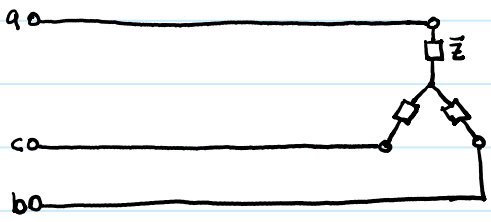
$I_\phi = \frac{S_2}{3V_L} \Rightarrow I_\phi = 67.99$ A

$I_\phi = \frac{V_L}{Z} \Rightarrow Z = \frac{V_L}{I_L} \Rightarrow Z = 61.19\ \Omega$

$\theta = 45°$

$\boxed{\bar{Z} = 61.19\angle 45°\ \Omega}$

Ex Problem 2.24



$V_\phi = 1000\ V$

$\bar{Z} = 50 + j37.7\ \Omega$

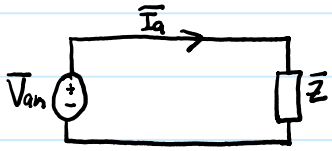
Find: a) $\bar{I}_a, \bar{I}_b, \bar{I}_c$

b) $\bar{V}_{ab}, \bar{V}_{bc}, \bar{V}_{ca}$

c) $\bar{S}_{TOT}$

Solution: a) $\bar{V}_{an} = 1000\angle 0$

$\bar{Z} = 62.62\angle 37.02°$



$$\bar{I}_a = \frac{\bar{V}_{an}}{\bar{Z}} = \frac{1000\angle 0}{62.62\angle 37.02°}$$

$\bar{I}_a = 15.97\angle -37.02°\ A$

$\bar{I}_b = 15.97\angle -157.02°\ A$

$\bar{I}_c = 15.97\angle 82.98°\ A$

b) $\bar{V}_{an} = 1000\angle 0°$ $\bar{V}_{bn} = 1000\angle -120°$

$\bar{V}_{ab} = \sqrt{3}\,1000\angle 30°\ V$

$\bar{V}_{bc} = \sqrt{3}\,1000\angle -90°\ V$

$\bar{V}_{ca} = \sqrt{3}\,1000\angle 150°\ V$

c) $\bar{S}_{TOT} = 3\bar{V}_\phi \bar{I}_a^* = 3(1000\angle 0)(15.97\angle 37.02) \Rightarrow$

$\bar{S}_{TOT} = 47{,}910\angle 37.02\ VA$

$= 38{,}253 + j28{,}846\ VA$

Ex| Problem 2.25

$P_{3\phi} = 300$ kW PF = 0.6 lag

Find: Q_c for PF = 0.9 lag

Solution: $S_{3\phi} = \frac{P_{3\phi}}{PF} \Rightarrow S_{3\phi} = 500$ kVA

$Q_{3\phi} = S_{3\phi}\sin(\theta) \Rightarrow Q_{3\phi} = S_{3\phi}(0.8) \Rightarrow Q_{3\phi} = 400$ kVAR

$P = S_{3\phi_2}(PF_2)$

$S_{3\phi_2} = \frac{P}{PF_2} \Rightarrow S_{3\phi_2} = 333.33$ kVA

$\theta_2 = \cos^{-1}(0.9) \Rightarrow \theta_2 = 25.842°$

$Q_2 = S_{3\phi_2}\sin(\theta_2)$

$Q_2 = 145.30$ kVAR

$Q_2 = Q_1 + Q_c$

$Q_c = Q_2 - Q_1$

$\boxed{Q_c = -254.7 \text{ kVAR}}$