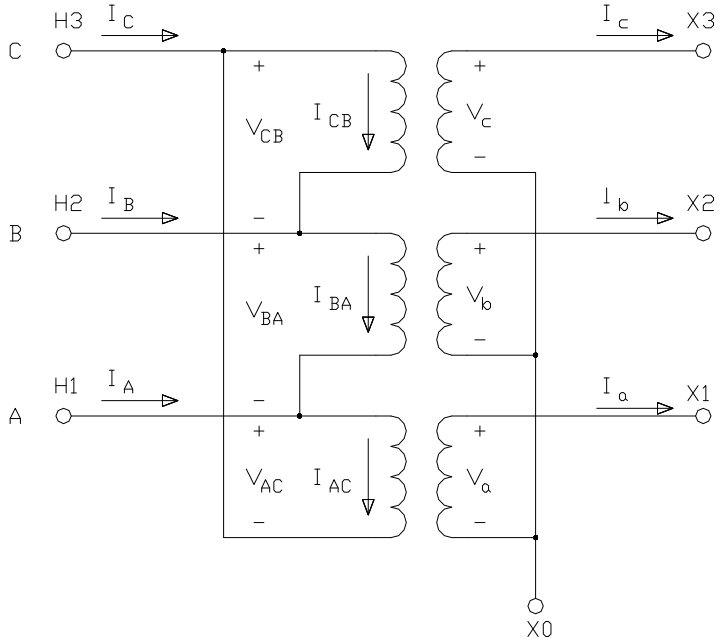
VOLTAGE AND CURRENT SHIFTS IN DELTA-WYE TRANSFORMER



Define: $kV \equiv 1000 \cdot volt \quad a := e^{j \cdot 120 \cdot deg} \quad MVA := volt \cdot amp \cdot 10^6 \quad kVA \equiv kV \cdot A$

$$\mathbf{A} := \begin{pmatrix} 1 & 1 & 1 \\ 1 & a^2 & a \\ 1 & a & a^2 \end{pmatrix}$$

Voltage ratio $N := \frac{22500}{480}$ Turns ratio $n := N \cdot \sqrt{3}$

Base power $P_B := 100kVA$

	Primary		Secondary	
Base voltage	$E_{Bp} := 22500V$		$E_{Bs} := \frac{E_{Bp}}{N}$	$E_{Bs} = 480 \cdot V$
Base current	$I_{Bp} := \frac{P_B}{\sqrt{3} \cdot E_{Bp}}$	$I_{Bp} = 2.566 \cdot amp$	$I_{Bs} := \frac{P_B}{\sqrt{3} \cdot E_{Bs}}$	$I_{Bs} = 120.3 \cdot amp$

Primary Voltages

$$V_A := \frac{22500}{\sqrt{3}} \cdot \left(e^{-j \cdot 30 \cdot deg} \cdot V\right) \quad V_B := 0 \cdot V \quad V_C := \frac{22500}{\sqrt{3}} \cdot e^{j \cdot 90 \cdot deg} \cdot V$$

$$VP := \left(V_A \ V_B \ V_C\right)^T \quad VPS := \mathbf{A}^{-1} \cdot VP \quad V_{A0} := VPS_0 \quad V_{A1} := VPS_1 \quad V_{A2} := VPS_2$$

$V_{A0} = (3750 + 2165.1i) \cdot volt \quad V_{A1} = (7500 - 4330.1i) \cdot volt \quad V_{A2} = -4330.1i \cdot volt$

$$V_{AC} := V_A - V_C \quad V_{BA} := V_B - V_A \quad V_{CB} := V_C - V_B$$

$$VWP := \left(V_{AC} \ V_{BA} \ V_{CB}\right)^T$$

Secondary Voltages

$VS := \frac{1}{n} \cdot VWP$ $V_a := VS_0$ $V_b := VS_1$ $V_c := VS_2$

$V_a = (138.6 - 240i) \cdot volt$ $V_b = (-138.6 + 80i) \cdot volt$ $V_c = 160i \cdot volt$

$|V_a| = 277.1 \cdot volt$ $|V_b| = 160 \cdot volt$ $|V_c| = 160 \cdot volt$

$\arg(V_a) = -60 \cdot deg$ $\arg(V_b) = 150 \cdot deg$ $\arg(V_c) = 90 \cdot deg$

Secondary Currents (Ø-N fault Irms = 1245 A)

$I_a := 100 \cdot e^{-j \cdot 60 \cdot deg} \cdot amp$ $I_b := 100 \cdot e^{j \cdot 150 \cdot deg} \cdot amp$ $I_c := 100 \cdot e^{j \cdot 90 \cdot deg} \cdot amp$

$IS := \begin{pmatrix} I_a & I_b & I_c \end{pmatrix}^T$ $ISS := \mathbf{A}^{-1} \cdot IS$ $I_{a0} := ISS_0$ $I_{a1} := ISS_1$ $I_{a2} := ISS_2$

$I_{a0} = (-12.2 + 21.1i) \cdot amp$ $I_{a1} = (45.5 - 78.9i) \cdot amp$ $I_{a2} = (16.7 - 28.9i) \cdot amp$

$|I_{a0}| = 24.4 \cdot amp$ $|I_{a1}| = 91.1 \cdot amp$ $|I_{a2}| = 33.3 \cdot amp$

$\arg(I_{a0}) = 120 \cdot deg$ $\arg(I_{a1}) = -60 \cdot deg$ $\arg(I_{a2}) = -60 \cdot deg$

Primary Currents

$IWP := \frac{1}{n} \cdot IS$ $I_{AC} := IWP_0$ $I_{BA} := IWP_1$ $I_{CB} := IWP_2$

$I_{AC} = (0.6 - 1.1i) \cdot amp$ $I_{BA} = (-1.1 + 0.6i) \cdot amp$ $I_{CB} = 1.2i \cdot amp$

$|I_{AC}| = 1.2 \cdot amp$ $|I_{BA}| = 1.2 \cdot amp$ $|I_{CB}| = 1.2 \cdot amp$

$\arg(I_{AC}) = -60 \cdot deg$ $\arg(I_{BA}) = 150 \cdot deg$ $\arg(I_{CB}) = 90 \cdot deg$

$I_A := I_{AC} - I_{BA}$ $I_B := I_{BA} - I_{CB}$ $I_C := I_{CB} - I_{AC}$

$I_A = (1.7 - 1.7i) \cdot amp$ $I_B = (-1.1 - 0.6i) \cdot amp$ $I_C = (-0.6 + 2.3i) \cdot amp$

$|I_A| = 2.38 \cdot amp$ $|I_B| = 1.23 \cdot amp$ $|I_C| = 2.38 \cdot amp$

$\arg(I_A) = -45 \cdot deg$ $\arg(I_B) = -150 \cdot deg$ $\arg(I_C) = 105 \cdot deg$

$IP := \begin{pmatrix} I_A & I_B & I_C \end{pmatrix}^T$ $IPS := \mathbf{A}^{-1} \cdot IP$ $I_{A0} := IPS_0$ $I_{A1} := IPS_1$ $I_{A2} := IPS_2$

$I_{A0} = 0 \cdot amp$ $I_{A1} = (1.7 - i) \cdot amp$ $I_{A2} = -0.7i \cdot amp$

$|I_{A0}| = 0 \cdot amp$ $|I_{A1}| = 1.94 \cdot amp$ $|I_{A2}| = 0.71 \cdot amp$

$\arg(I_{A0}) = -86.576 \cdot deg$ $\arg(I_{A1}) = -30 \cdot deg$ $\arg(I_{A2}) = -90 \cdot deg$

$k := 0 .. 5$

$VSr_k :=$

$0 \cdot volt$
$Re(V_a)$
$0 \cdot volt$
$Re(V_b)$
$0 \cdot volt$
$Re(V_c)$

$VSx_k :=$

$0 \cdot volt$
$Im(V_a)$
$0 \cdot volt$
$Im(V_b)$
$0 \cdot volt$
$Im(V_c)$

$VPr_k :=$

$0 \cdot volt$
$Re(V_A)$
$0 \cdot volt$
$Re(V_B)$
$0 \cdot volt$
$Re(V_C)$

$VPx_k :=$

$0 \cdot volt$
$Im(V_A)$
$0 \cdot volt$
$Im(V_B)$
$0 \cdot volt$
$Im(V_C)$

$|I_c| = 100 \cdot amp$

$ISr_k :=$

$0 \cdot amp$
$Re(I_a)$
$0 \cdot amp$
$Re(I_b)$
$0 \cdot amp$
$Re(I_c)$

$ISx_k :=$

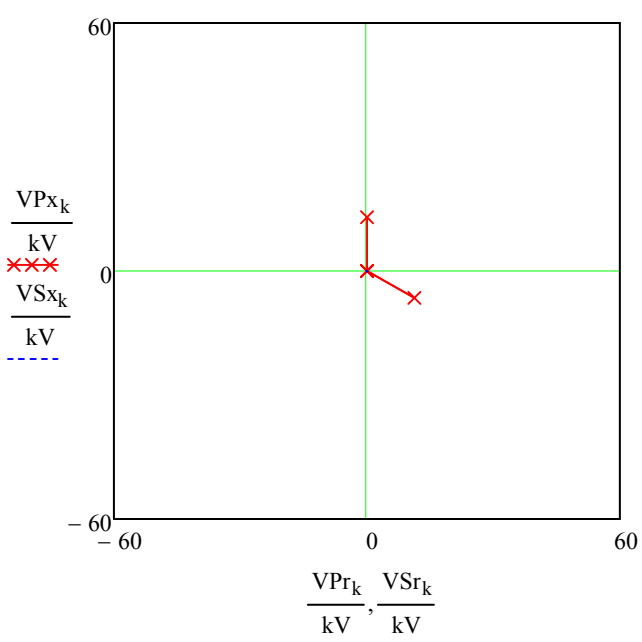
$0 \cdot amp$
$Im(I_a)$
$0 \cdot amp$
$Im(I_b)$
$0 \cdot amp$
$Im(I_c)$

$IPr_k :=$

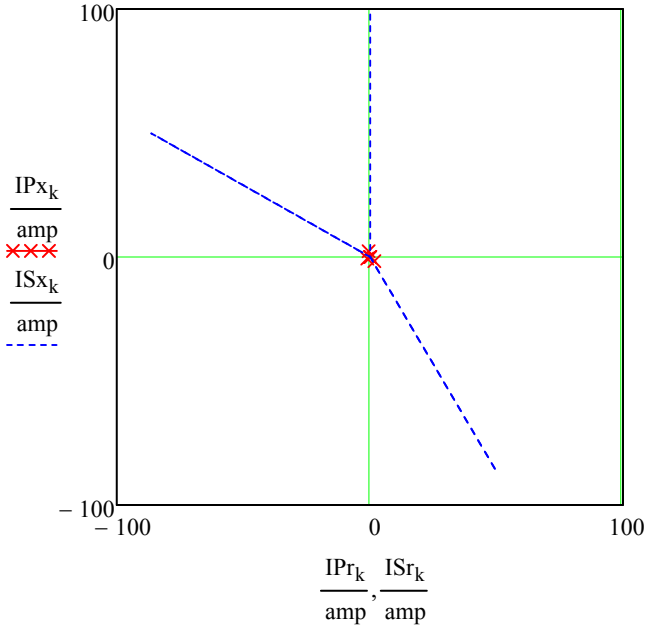
$0 \cdot amp$
$Re(I_A)$
$0 \cdot amp$
$Re(I_B)$
$0 \cdot amp$
$Re(I_C)$

$IPx_k :=$

$0 \cdot amp$
$Im(I_A)$
$0 \cdot amp$
$Im(I_B)$
$0 \cdot amp$
$Im(I_C)$



Voltages



Currents

xfmr ≡ "c:\dosdocs\xfmr3lin.mcs"