



$$\text{result_I2_I3} := \begin{bmatrix} I_3 \cdot (R_3 + n_3^2 \cdot R_4 + n_3^2 \cdot Z_{L2} + n_3^2 \cdot Z_{C2} + Z_{C1}) + I_2 \cdot Z_{C1} + V_{i2} = 0 \\ I_2 \cdot (R_2 + n_2^2 \cdot R_1 + n_2^2 \cdot Z_{L1} + Z_{C1}) + I_3 \cdot Z_{C1} + V_{i2} - n_2 \cdot V_{i1} = 0 \end{bmatrix} \xrightarrow{\text{simplify}} \left[\frac{\text{solve } I_2, I_3}{((Z_{L1} + R_1) \cdot (Z_{C1} + R_2) + R_1 \cdot Z_{C2} + R_1 \cdot R_4) + Z_{L1} \cdot (Z_{C2} + R_4) + Z_{L2} \cdot (Z_{L1} + R_1) + Z_{C1} \cdot (Z_{C2} + R_4) + R_1 \cdot Z_{C2} + R_1 \cdot R_4)} \right]$$

$$I_2 = \text{result_I2_I3}_{0,0} \rightarrow I_2 = \frac{n_3^2 \cdot (n_2 \cdot (V_{i1} \cdot Z_{L2} + V_{i1} \cdot Z_{C2} + R_4 \cdot V_{i1}) - (V_{i2} \cdot Z_{L1} + V_{i2} \cdot Z_{C1}))}{n_3^2 \cdot (n_2^2 \cdot (Z_{L2} \cdot (Z_{L1} + R_1) + Z_{L1} \cdot (Z_{C2} + R_4) + R_1 \cdot Z_{C2} + R_1 \cdot R_4) + (Z_{C1} + R_2) \cdot (Z_{L1} + R_1) + Z_{C1} \cdot (Z_{C2} + R_4) + R_1 \cdot Z_{C2} + R_1 \cdot R_4)}$$

$$I_3 = \text{result_I2_I3}_{0,1} \rightarrow I_3 = \frac{n_2^2 \cdot (-(V_{i2} \cdot Z_{L1}) + (V_{i1} \cdot Z_{L2} + V_{i1} \cdot Z_{C2} + R_4 \cdot V_{i1}))}{n_3^2 \cdot (n_2^2 \cdot (Z_{L2} \cdot (Z_{L1} + R_1) + Z_{L1} \cdot (Z_{C2} + R_4) + R_1 \cdot Z_{C2} + R_1 \cdot R_4) + (Z_{C1} + R_2) \cdot (Z_{L1} + R_1) + Z_{C1} \cdot (Z_{C2} + R_4) + R_1 \cdot Z_{C2} + R_1 \cdot R_4)}$$

$$I_1 = n_2 \cdot \text{result_I2_I3}_{0,0} \rightarrow I_1 = \frac{n_2 \cdot (n_3^2 \cdot (n_2 \cdot (V_{i1} \cdot Z_{L2} + V_{i1} \cdot Z_{C2} + R_4 \cdot V_{i1}) - (V_{i2} \cdot Z_{L1} + V_{i2} \cdot Z_{C1})))}{n_3^2 \cdot (n_2^2 \cdot (Z_{L2} \cdot (Z_{L1} + R_1) + Z_{L1} \cdot (Z_{C2} + R_4) + R_1 \cdot Z_{C2} + R_1 \cdot R_4) + (Z_{C1} + R_2) \cdot (Z_{L1} + R_1) + Z_{C1} \cdot (Z_{C2} + R_4) + R_1 \cdot Z_{C2} + R_1 \cdot R_4)}$$

$$I4 := -n_3 \cdot \text{result_I2_I3}_{0,1} \rightarrow I4 = \frac{n_3 \cdot (n_2^2 \cdot (V_{i2} \cdot Z_{L1} + R_1 \cdot V_{i2}) + V_{i1} \cdot Z_{C1} + I3 \cdot R_3 + (I2 + I3) \cdot Z_{C1} + V_{i2})}{n_3^2 \cdot (n_2^2 \cdot (Z_{L2} \cdot (Z_{L1} + R_1) + Z_{L1} \cdot (Z_{C2} + R_4) + R_1 \cdot Z_{C2} + R_1 \cdot R_4) + (Z_{C1} + R_2) \cdot (Z_{L2} + Z_{C2}) + R_4 \cdot Z_{C1} + I3 \cdot R_3 + (I2 + I3) \cdot Z_{C1} + V_{i2})}$$

$$R_1 := 7 \cdot \Omega$$

$$R_2 := 4 \cdot \Omega$$

$$R_3 := 3 \cdot \Omega$$

$$R_4 := 2 \cdot \Omega$$

$$L_1 := 4 \cdot H$$

$$L_2 := 3 \cdot H$$

$$C_1 := 2 \cdot F$$

$$C_2 := 1 \cdot F$$

$$\omega := \frac{1}{2} \cdot \frac{\text{rad}}{\text{s}}$$

$$Z_{L1} := 1j \cdot \omega \cdot L_1$$

$$Z_{L2} := 1j \cdot \omega \cdot L_2$$

$$Z_{C1} := \frac{1}{1j \cdot \omega \cdot C_1}$$

$$Z_{C2} := \frac{1}{1j \cdot \omega \cdot C_2}$$

$$V_{i1} := 24 \cdot e^{1j \cdot 0} \cdot V$$

$$V_{i2} := 5 \cdot e^{1j \cdot 0} \cdot V$$

$$n_1 := 1$$

$$n_2 := 3$$

$$n_3 := 1$$

$$n_4 := 2$$

$$I2 := \frac{n_3^2 \cdot (n_2 \cdot (V_{i1} \cdot Z_{L2} + V_{i1} \cdot Z_{C2} + R_4 \cdot V_{i1}) - (V_{i2} \cdot Z_{L2} + V_{i2} \cdot Z_{C2} + R_4 \cdot V_{i2}))}{n_3^2 \cdot (n_2^2 \cdot (Z_{L2} \cdot (Z_{L1} + R_1) + Z_{L1} \cdot (Z_{C2} + R_4) + R_1 \cdot Z_{C2} + R_1 \cdot R_4) + (Z_{C1} + R_2) \cdot (Z_{L2} + Z_{C2}) + R_4 \cdot Z_{C1} + I3 \cdot R_3 + (I2 + I3) \cdot Z_{C1} + V_{i2})}$$

$$I3 := \frac{n_2^2 \cdot ((-V_{i2} \cdot Z_{L1}) - R_1 \cdot V_{i2}) - (V_{i1} \cdot Z_{C1} + I3 \cdot R_3 + (I2 + I3) \cdot Z_{C1} + V_{i2})}{n_3^2 \cdot (n_2^2 \cdot (Z_{L2} \cdot (Z_{L1} + R_1) + Z_{L1} \cdot (Z_{C2} + R_4) + R_1 \cdot Z_{C2} + R_1 \cdot R_4) + (Z_{C1} + R_2) \cdot (Z_{L2} + Z_{C2}) + R_4 \cdot Z_{C1} + I3 \cdot R_3 + (I2 + I3) \cdot Z_{C1} + V_{i2})}$$

$$I1 := \frac{n_2 \cdot (n_3^2 \cdot (n_2 \cdot (V_{i1} \cdot Z_{L2} + V_{i1} \cdot Z_{C2} + R_4 \cdot V_{i1}) - (V_{i2} \cdot Z_{L2} + V_{i2} \cdot Z_{C2} + R_4 \cdot V_{i2}))}{n_3^2 \cdot (n_2^2 \cdot (Z_{L2} \cdot (Z_{L1} + R_1) + Z_{L1} \cdot (Z_{C2} + R_4) + R_1 \cdot Z_{C2} + R_1 \cdot R_4) + (Z_{C1} + R_2) \cdot (Z_{L2} + Z_{C2}) + R_4 \cdot Z_{C1} + I3 \cdot R_3 + (I2 + I3) \cdot Z_{C1} + V_{i2})}$$

$$I4 := \frac{n_3 \cdot (n_2^2 \cdot (V_{i2} \cdot Z_{L1} + R_1 \cdot V_{i2}) + V_{i1} \cdot Z_{C1} + I3 \cdot R_3 + (I2 + I3) \cdot Z_{C1} + V_{i2})}{n_3^2 \cdot (n_2^2 \cdot (Z_{L2} \cdot (Z_{L1} + R_1) + Z_{L1} \cdot (Z_{C2} + R_4) + R_1 \cdot Z_{C2} + R_1 \cdot R_4) + (Z_{C1} + R_2) \cdot (Z_{L2} + Z_{C2}) + R_4 \cdot Z_{C1} + I3 \cdot R_3 + (I2 + I3) \cdot Z_{C1} + V_{i2})}$$

$$V3 := -(I3 \cdot R_3 + (I2 + I3) \cdot Z_{C1} + V_{i2}) = (-3.453 + 0.605i) \text{ V}$$

$$I3 = (-0.424 - 0.03i) \text{ A}$$

$$V4 := \frac{V3}{n_3} = (-1.727 + 0.303i) \text{ V}$$

$$I4 = (0.848 + 0.061i) \text{ A}$$

$$V2 := I2 \cdot R_2 + (I2 + I3) \cdot Z_{C1} + V_{i2} = (8.479 - 1.492i) \text{ V}$$

$$I2 = (0.938 - 0.244i) \text{ A}$$

$$V1 := \frac{V2}{n_2} = (2.826 - 0.497i) \text{ V}$$

$$I1 = (2.815 - 0.733i) \text{ A}$$

Total Power from Voltage sources.

$$24 \text{ V} \cdot (-I1) + 5 \text{ V} \cdot (I3 + I2) = (-64.995 + 16.226i) \text{ W}$$

Total power loss by resistors.

$$I1 \cdot I1 \cdot 7 \Omega + I2 \cdot I2 \cdot 4 \Omega + I3 \cdot I3 \cdot 3 \Omega + I4 \cdot I4 \cdot 2 \Omega = 64.995 \text{ W}$$

$$20 \log(x) = 7.4154759 \xrightarrow{\text{solve, } x} 2.3484093185446876314 = 2.34841$$

$$2.86975 \angle -9.9798016 \text{ deg} = 2.826 - 0.497i$$

$$|V2|^2 + |V1|^2$$

$$20 \log(x) = 36.517616 \xrightarrow{\text{solve, } x} 66.970077266151918361 = 66.97008$$

$$66.97008 \angle 165.89698 \text{ deg} = -64.952 + 16.318i$$

$$L2 := 10^5 \text{ H}$$

$$L3 := 10^5 \text{ H}$$

$$L1 := L2 \cdot \left(\frac{n_1}{n_2}\right)^2 = 111111.111 \text{ H}$$

$$L4 := L3 \cdot \left(\frac{n_4}{n_3}\right)^2 = 25000 \text{ H}$$