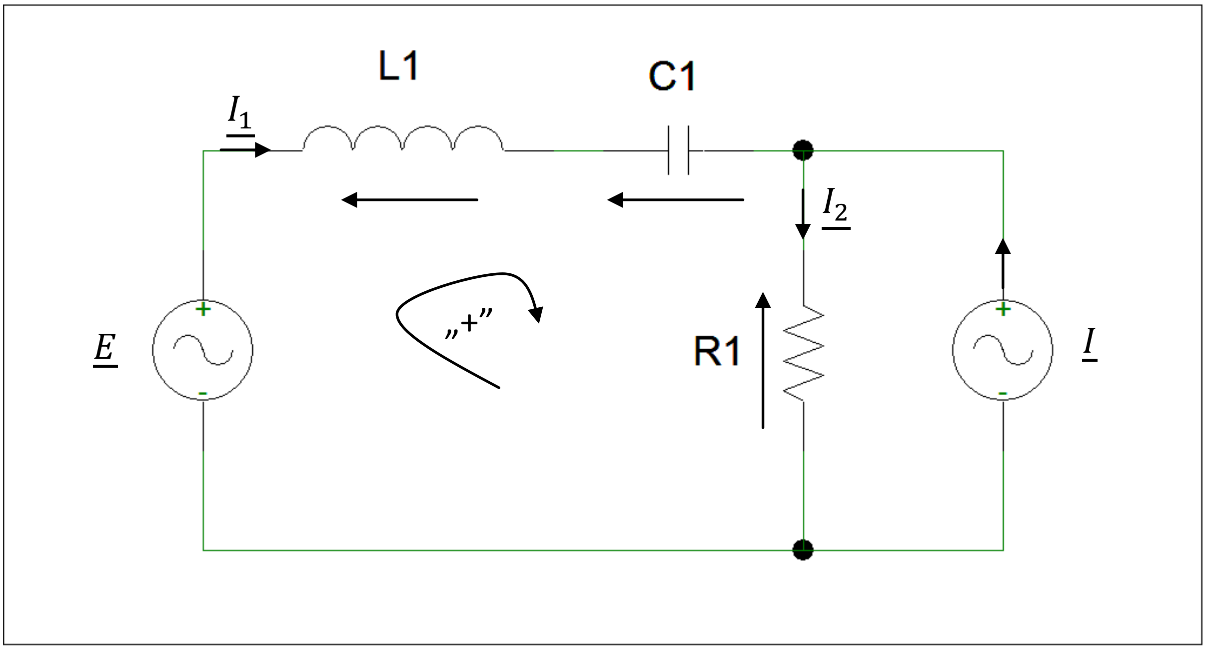
Application of branch current method to AC circuit.

In this example we will consider electric AC circuit. Branch current method will be applied for calculation of currents in circuit.

$\underline{E} = 10[V] = 10 \cdot e^{j \cdot 0}[V]$

$\underline{I} = 1 - j \cdot 1[A] = \sqrt{1^2 + 1^2} \cdot e^{-j \cdot \frac{\pi}{4}}[A] = \sqrt{2} \cdot e^{-j \cdot \frac{\pi}{4}}[A]$

$|\underline{Z_{L1}}| = 1[\Omega] \rightarrow \underline{Z_{L1}} = j[\Omega]$
$|\underline{Z_{C1}}| = 2[\Omega] \rightarrow \underline{Z_{C1}} = -j \cdot 2[\Omega]$
$|\underline{Z_{R1}}| = 3[\Omega] \rightarrow \underline{Z_{R1}} = 3[\Omega]$



Drawing 1. Electrical AC circuit.

Kirchhoff's current law equation (KCL)

$$\underline{I_1} + \underline{I} - \underline{I_2} = 0$$

Kirchhoff's voltage law equation (KVL)

$$\underline{E} - \underline{I_1} \cdot \underline{Z_{L1}} - \underline{I_1} \cdot \underline{Z_{C1}} - \underline{I_2} \cdot \underline{Z_{R1}} = 0$$

$$\underline{I_2} = \underline{I_1} + \underline{I}$$

$$\underline{E} - \underline{I_1} \cdot \underline{Z_{L1}} - \underline{I_1} \cdot \underline{Z_{C1}} - \left(\underline{I_1} + \underline{I}\right) \cdot \underline{Z_{R1}} = 0$$

$$\underline{E} - \underline{I_1} \cdot \underline{Z_{L1}} - \underline{I_1} \cdot \underline{Z_{C1}} - \underline{I_1} \cdot \underline{Z_{R1}} - \underline{I} \cdot \underline{Z_{R1}} = 0$$

$$\underline{E} - \underline{I_1} \cdot \left(\underline{Z_{L1}} + \underline{Z_{C1}} + \underline{Z_{R1}}\right) - \underline{I} \cdot \underline{Z_{R1}} = 0$$

$$\underline{I_1} = \frac{\underline{E} - \underline{I} \cdot \underline{Z_{R1}}}{\underline{Z_{L1}} + \underline{Z_{C1}} + \underline{Z_{R1}}}$$

$$\underline{I_1} = \frac{10 - \sqrt{2} \cdot e^{-j \cdot \frac{\pi}{4}} \cdot 3}{j - j \cdot 2 + 3}$$

$$\underline{I_1} = \frac{10 - \sqrt{2} \cdot e^{-j \cdot \frac{\pi}{4}} \cdot 3}{3 - j}$$

$$\underline{I_1} = \frac{10 - \sqrt{2} \cdot e^{-j \cdot \frac{\pi}{4}} \cdot 3}{3 - j} \cdot \frac{3 + j}{3 + j} = \frac{10 - 3 \cdot (1 - j)}{3 - j} \cdot \frac{3 + j}{3 + j}; where\ j^2 = -1$$

$$\underline{I_1} = \frac{10 - 3 - j \cdot 3}{3 - j} \cdot \frac{3 + j}{3 + j} = \frac{7 - j \cdot 3}{3 - j} \cdot \frac{3 + j}{3 + j}$$

$$\underline{I_1} = \frac{21 + j \cdot 7 - j \cdot 9 - 3 \cdot (-1)}{9 + j \cdot 3 - j \cdot 3 + 1} = \frac{21 - j \cdot 2 + 3}{10}$$

$$\underline{I_1} = \frac{24}{10} - j \cdot \frac{2}{10} [A]$$

$$I_1 = \sqrt{\left(\frac{24}{10}\right)^2 + \left(\frac{2}{10}\right)^2} = 2{,}40 [A]$$

$$\underline{I_2} = \underline{I_1} + \underline{I}$$

$$\underline{I_2} = \frac{24}{10} - j \cdot \frac{2}{10} + 1 - j$$

$$\underline{I_2} = \frac{34}{10} - j \cdot \frac{12}{10}$$

$$I_2 = \sqrt{\left(\frac{34}{10}\right)^2 + \left(\frac{12}{10}\right)^2} = 3{,}61 [A]$$