

מעגלי זרם חילופין

$$x(t) = x_{\max} \sin(\omega t)$$

$x(t)$ - ערך רגעי (יכול לייצג מתח או זרם)

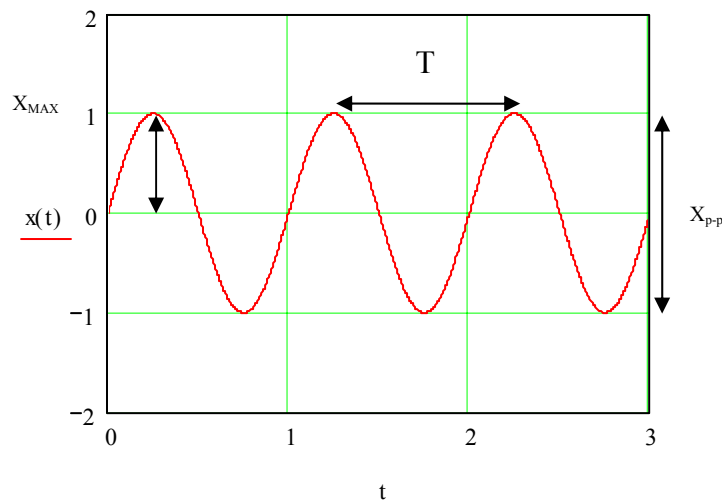
x_{\max} - משרעת מכסימלית

ω - מהירות (תדירות) זוויתית - $\frac{rad}{sec}$

$$\omega = 2\pi f = \frac{2\pi}{T} \quad f = \frac{1}{T}$$

f - תדירות (Hz)

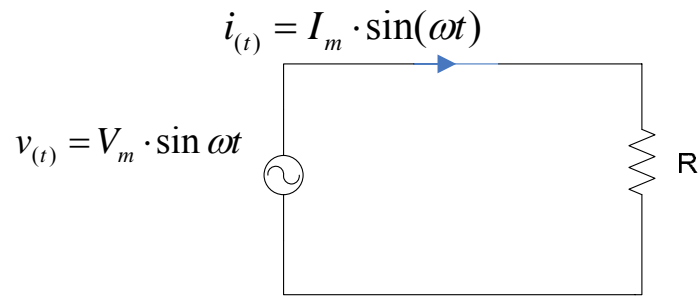
T - זמן מחזור (sec)



$$x_{p-p} = 2x_{\max} \quad x_{eff} = \frac{x_{\max}}{\sqrt{2}}$$

x_{eff} - ערך אפקטיבי (יעיל)

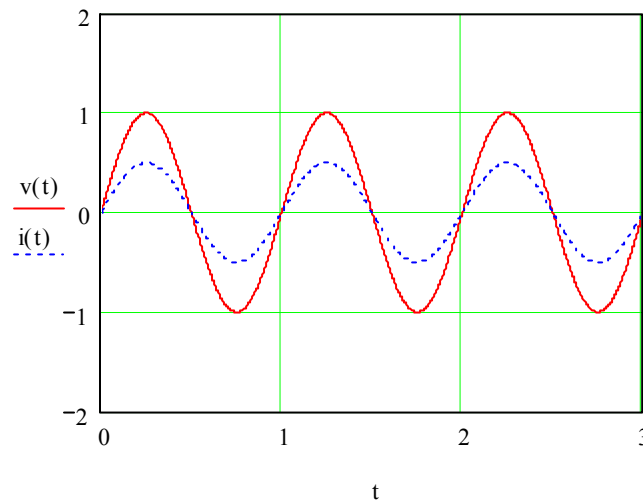
x_{p-p} - ערך שיא לשיא

נגד במעגל זרם חילופין

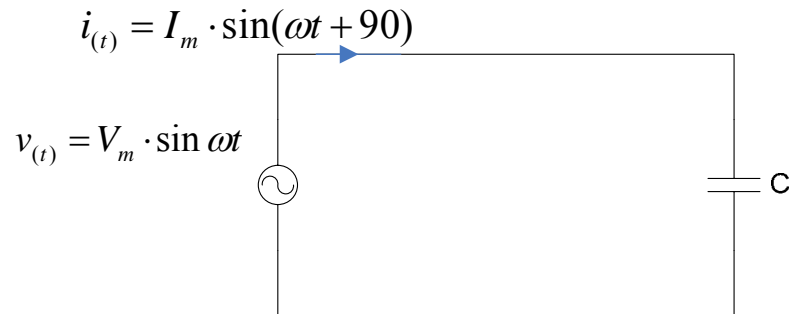
$$v_{(t)} = V_m \cdot \sin \omega t$$

$$i_{(t)} = I_m \cdot \sin(\omega t)$$

הפרש המופע בין המתח לזרם הוא 0 מעלות.



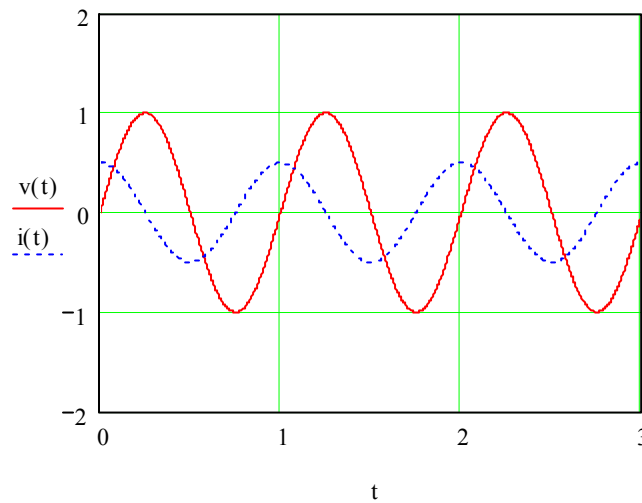
$$P = \frac{V_{eff}^2}{R} = \frac{V_{max}^2}{2R} \quad \text{הספק הנגד -}$$

קבל במעגל זרם חילופין

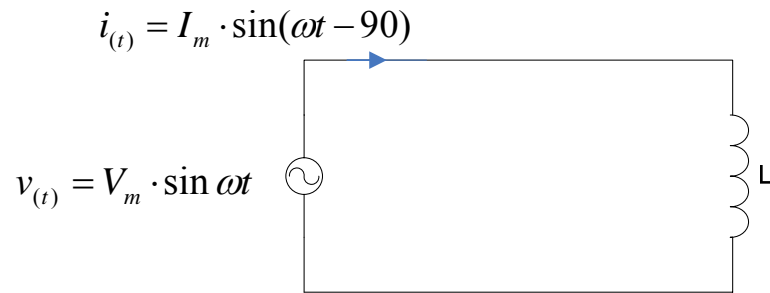
$$v_{(t)} = V_m \cdot \sin \omega t$$

$$i_{(t)} = I_m \cdot \sin(\omega t + 90^\circ)$$

המתח מפגר אחרי הזרם ב- 90 מעלות.



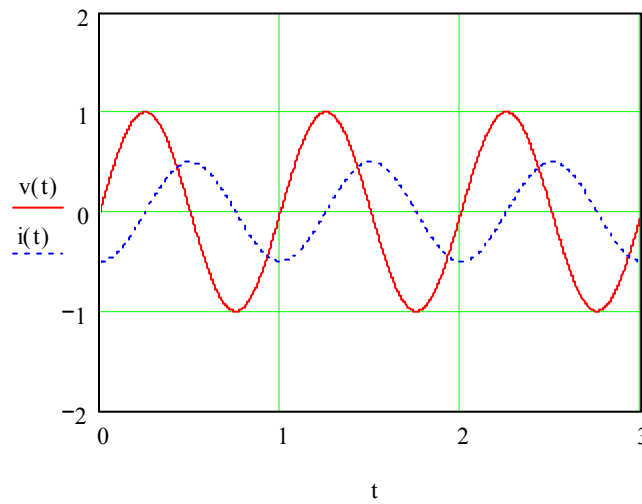
$$Q_C = \frac{V_{eff}^2}{X_C} \quad \text{הספק הקבל -}$$

סליל במעגל זרם חילופין

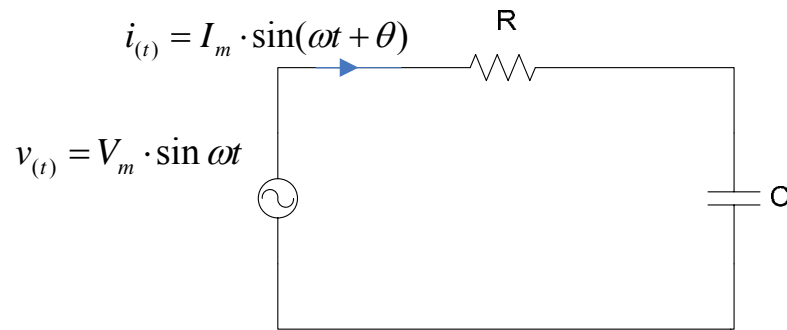
$$v_{(t)} = V_m \cdot \sin \omega t$$

$$i_{(t)} = I_m \cdot \sin(\omega t - 90^\circ)$$

המתח מקדים את הזרם ב- 90 מעלות.



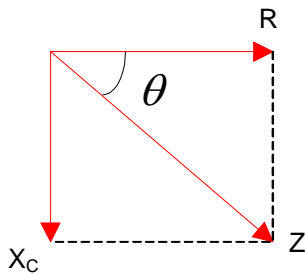
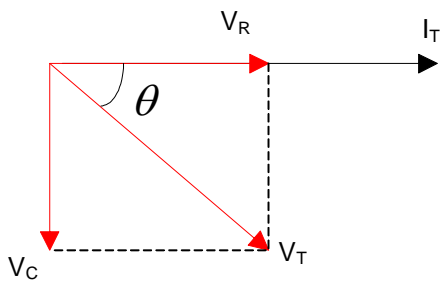
$$Q_C = \frac{V_{eff}^2}{X_L} \quad \text{הספק הסליל -}$$



$$Z = R + \frac{1}{j\omega C} = R - j \frac{1}{\omega C} = R - jX_C$$

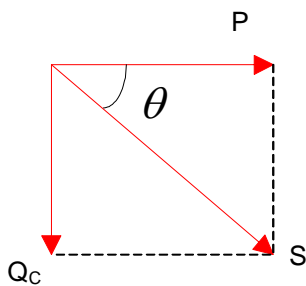
$$|Z| = \sqrt{R^2 + \frac{1}{(\omega C)^2}} = \sqrt{R^2 + X_C^2}$$

$$\theta = \tan^{-1}\left(-\frac{1}{\omega CR}\right) = \tan^{-1}\left(-\frac{X_C}{R}\right)$$

מתחים

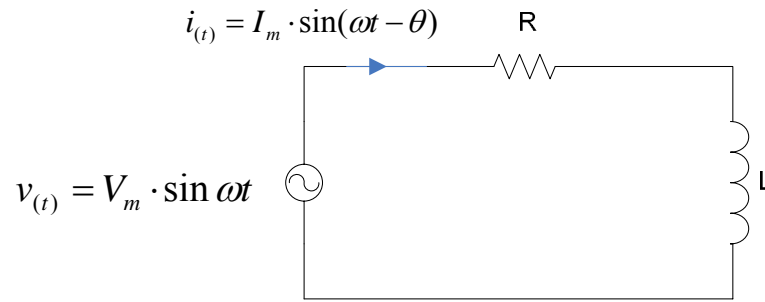
$$V_T = \sqrt{V_R^2 + V_C^2}$$

$$\theta = \tan^{-1}\left(-\frac{V_C}{V_R}\right)$$

הספקים

$$S = \sqrt{P^2 + Q_C^2}$$

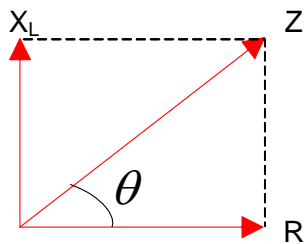
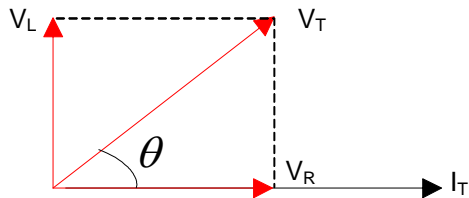
$$\theta = \tan^{-1}\left(-\frac{Q_C}{P}\right)$$

מעגל RL טורי

$$Z = R + j\omega L = R + jX_L$$

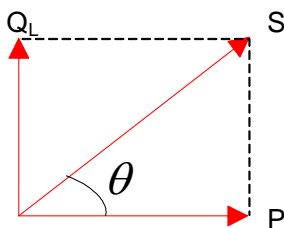
$$|Z| = \sqrt{R^2 + (\omega L)^2} = \sqrt{R^2 + X_L^2}$$

$$\theta = \tan^{-1}\left(\frac{\omega L}{R}\right) = \tan^{-1}\left(\frac{X_L}{R}\right)$$

מתחים

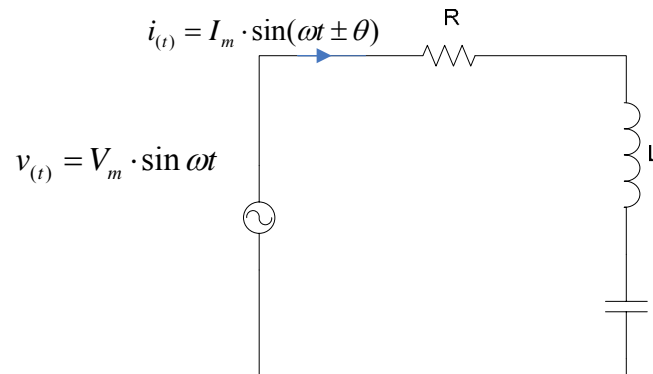
$$V_T = \sqrt{V_R^2 + V_L^2}$$

$$\theta = \tan^{-1}\left(\frac{V_L}{V_R}\right)$$

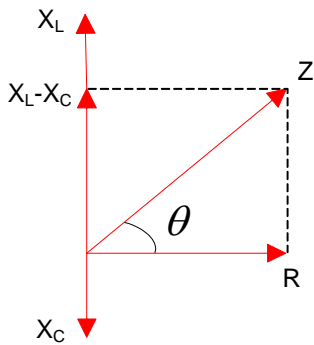
הספקים

$$S = \sqrt{P^2 + Q_L^2}$$

$$\theta = \tan^{-1}\left(\frac{Q_L}{P}\right)$$

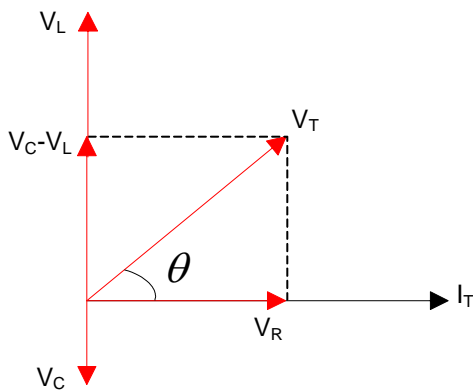
מעגל RLC טורי

$$Z = R + j\omega L + \frac{1}{j\omega C} = R + j\omega L - j\frac{1}{\omega C} = R + j(X_L - X_C)$$



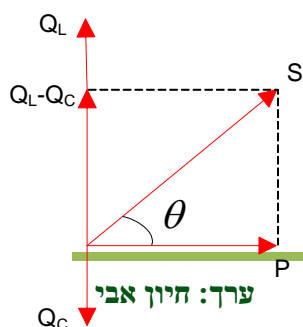
$$|Z| = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2} = \sqrt{R^2 + (X_L - X_C)^2}$$

$$\theta = \tan^{-1} \left(\frac{\omega L - \frac{1}{\omega C}}{R} \right) = \tan^{-1} \left(\frac{X_L - X_C}{R} \right)$$

מתחים

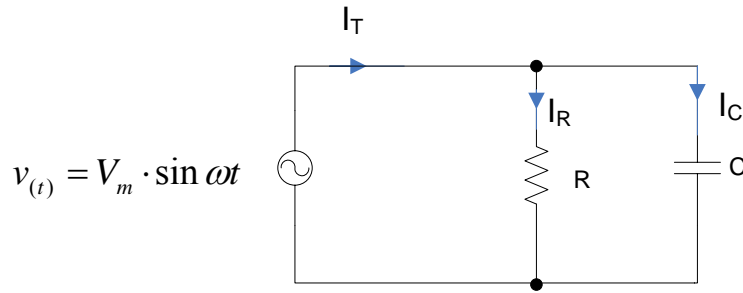
$$V_T = \sqrt{V_R^2 + (V_L - V_C)^2}$$

$$\theta = \tan^{-1} \left(\frac{V_L - V_C}{V_R} \right)$$

הספקים

$$S = \sqrt{P^2 + (Q_L - Q_C)^2}$$

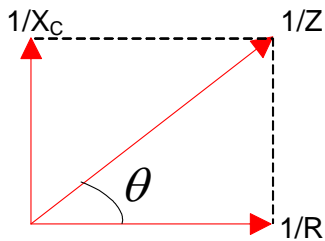
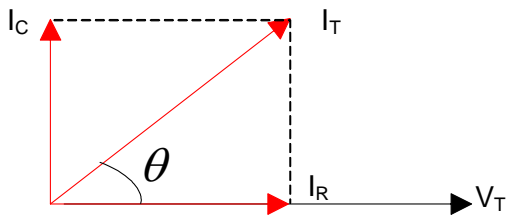
$$\theta = \tan^{-1} \left(\frac{Q_L - Q_C}{P} \right)$$

מעגל RC מקבילי

$$Y = \frac{1}{Z} = \frac{1}{R} + j\omega C = \frac{1}{R} + j\frac{1}{X_C}$$

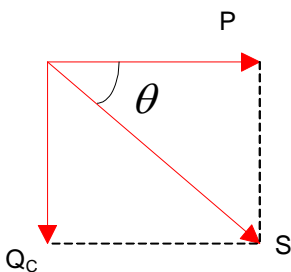
$$|Y| = \sqrt{\frac{1}{R^2} + (\omega C)^2} = \sqrt{\frac{1}{R^2} + \frac{1}{X_C^2}}$$

$$\theta = \tan^{-1}(-\omega CR) = \tan^{-1}\left(-\frac{R}{X_C}\right)$$

זרמים

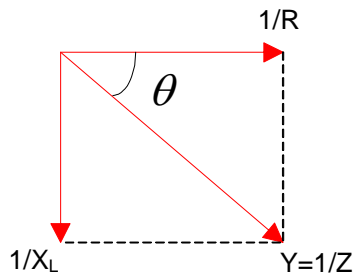
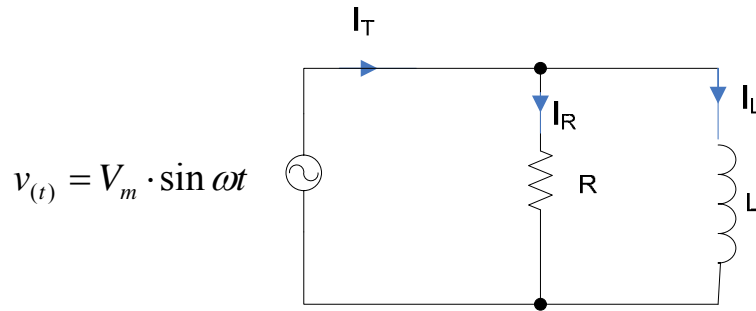
$$I_T = \sqrt{I_R^2 + I_C^2}$$

$$\theta = \tan^{-1}\left(-\frac{I_C}{I_R}\right)$$

הספקים

$$S = \sqrt{P^2 + Q_C^2}$$

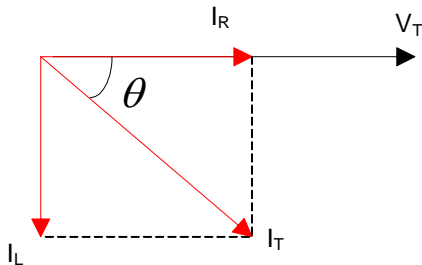
$$\theta = \tan^{-1}\left(-\frac{Q_C}{P}\right)$$

מעגל RL מקבילי

$$Y = \frac{1}{Z} = \frac{1}{R} + \frac{1}{j\omega L} = \frac{1}{R} - j \frac{1}{X_L}$$

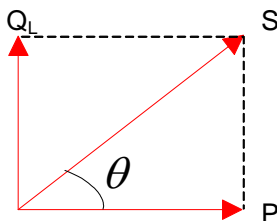
$$|Y| = \sqrt{\frac{1}{R^2} + \frac{1}{(\omega L)^2}} = \sqrt{\frac{1}{R^2} + \frac{1}{X_L^2}}$$

$$\theta = \tan^{-1}\left(\frac{R}{\omega L}\right) = \tan^{-1}\left(\frac{R}{X_L}\right)$$

זרמים

$$I_T = \sqrt{I_R^2 + I_L^2}$$

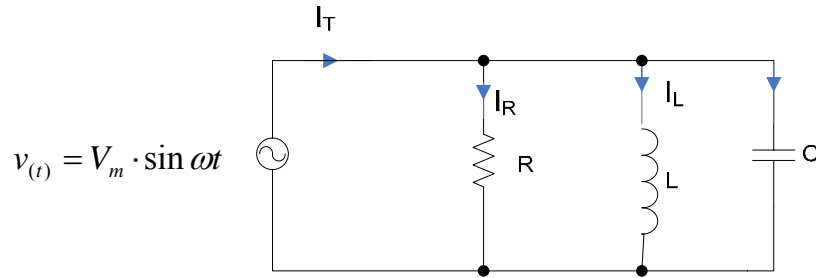
$$\theta = \tan^{-1}\left(\frac{I_L}{I_R}\right)$$

הספקים

$$S = \sqrt{P^2 + Q_L^2}$$

$$\theta = \tan^{-1}\left(\frac{Q_L}{P}\right)$$

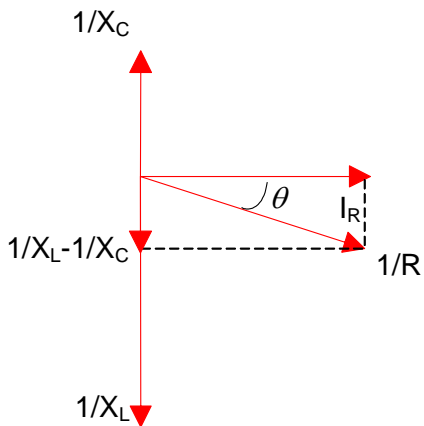
מעגל RLC מקבילי



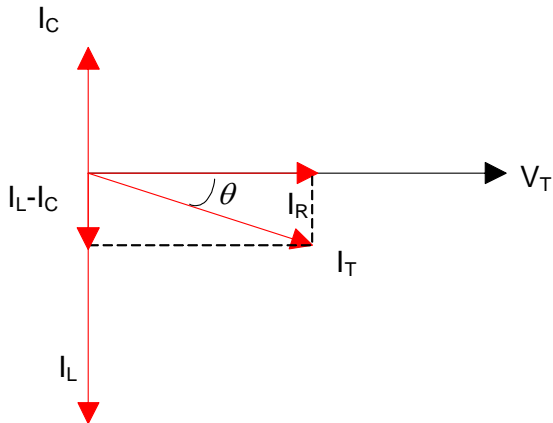
$$Y = \frac{1}{Z} = \frac{1}{R} + \frac{1}{j\omega L} + j\omega C = \frac{1}{R} - j\frac{1}{X_L} + j\frac{1}{X_C}$$

$$|Y| = \sqrt{\frac{1}{R^2} + \left(\omega C - \frac{1}{\omega L}\right)^2} = \sqrt{\frac{1}{R^2} + \left(\frac{1}{X_C} - \frac{1}{X_L}\right)^2}$$

$$\theta = \tan^{-1}\left(R \cdot \left(\omega C - \frac{1}{\omega L}\right)\right) = \tan^{-1}\left(R \cdot \left(\frac{1}{X_C} - \frac{1}{X_L}\right)\right)$$



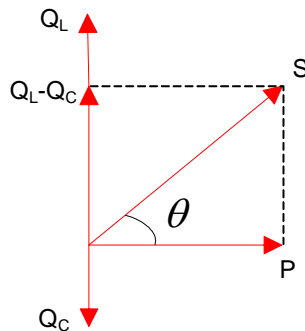
זרמים



$$I_T = \sqrt{I_R^2 + (I_L - I_C)^2}$$

$$\theta = \tan^{-1}\left(\frac{I_L - I_C}{I_R}\right)$$

הספקים



$$S = \sqrt{P^2 + (Q_L - Q_C)^2}$$

$$\theta = \tan^{-1}\left(\frac{Q_L - Q_C}{P}\right)$$