

$$V_i := 220 \text{ V} \quad f_i := 60 \text{ Hz} \quad R_0 := 18 \text{ } \Omega \quad C_0 := 220 \text{ } \mu\text{F}$$

$$v_{on} := 700 \text{ mV} \quad r_{on} := 12 \text{ m}\Omega$$

$$V_{ipk} := V_i \cdot \sqrt{2} = 311,127 \text{ V}$$

$$\omega_0 := 2 \cdot \pi \cdot f_i = 376,9911 \text{ Hz}$$

$$\tau_0 := R_0 \cdot C_0 = 0,004 \text{ s}$$

Ângulo de bloqueio do diodo

$$\theta_b := \pi + \text{atan}(-\omega_0 \cdot \tau_0) = 2,161$$

$$\theta_b \cdot \frac{180}{\pi} = 123,8159$$

$$\Delta t_b := \frac{\theta_b}{2 \cdot \pi \cdot f_i} = 5,7322 \text{ ms}$$

Tensão na fonte:

$$v_{in}(\omega t) := V_{ipk} \cdot \sin(\omega t)$$

$$v_{exp}(\omega t) := V_{ipk} \cdot \sin(\theta_b) \cdot e^{\frac{\theta_b - \omega t}{\omega_0 \cdot \tau_0}}$$

$$f(\gamma) := |\sin(\gamma)| - \sin(\theta_b) \cdot e^{\frac{\theta_b - \gamma}{\omega_0 \cdot \tau_0}}$$

$$\theta_c := \text{solve}\left(f(\gamma); \gamma; \pi; \frac{3 \cdot \pi}{2}\right) = 3,4897$$

$$\theta_c \cdot \frac{180}{\pi} = 199,9479$$

$$\Delta t_c := \frac{\theta_c}{2 \cdot \pi \cdot f_i} = 9,2568 \text{ ms}$$

Ângulo inicial de entrada em condução do diodo;

$$\theta_{c0} := \theta_c - \pi = 0,3482$$

$$\theta_{c0} \cdot \frac{180}{\pi} = 19,9479$$

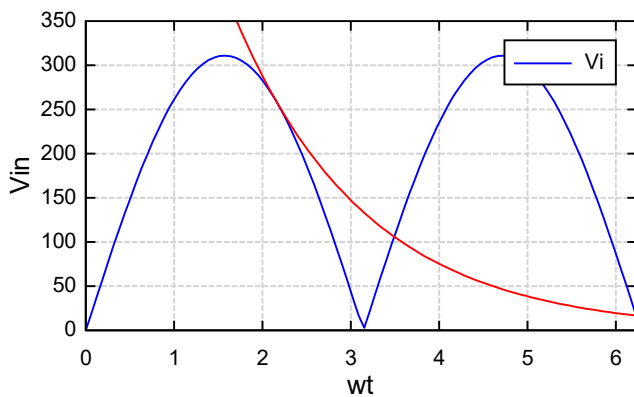
$$\Delta t_{c0} := \frac{\theta_{c0}}{2 \cdot \pi \cdot f_i} = 0,9235 \text{ ms}$$

$$\gamma := \theta_b - \theta_{c0} = 1,8128$$

$$\gamma \cdot \frac{180}{\pi} = 103,868$$

Ângulo de condução do diodo;

$$\Delta t_\gamma := \frac{\gamma}{2 \cdot \pi \cdot f_i} = 4,8087 \text{ ms}$$



$$\begin{cases} |v_{in}(\omega t)| \\ v_{exp}(\omega t) \end{cases} \quad 4 \cdot \pi = 12,5664$$

Qual o valor médio da tensão na carga?

Considerando diodo ideal

$$V_0 := \frac{1}{\pi} \cdot \left[\int_{\theta_{c0}}^{\theta_b} V_{ipk} \cdot \sin(\omega t) d\omega t + \int_{\theta_b}^{\theta_c} v_{exp}(\omega t) d\omega t \right] = 220,6042 \text{ V}$$

$$\Delta V := V_{ipk} \cdot (1 - \sin(\theta_{c0})) = 204,9812 \text{ V}$$

Ondulação de tensão na carga

Qual o valor médio da corrente na carga?

$$I_0 := \frac{V_0}{R_0} = 12,2558 \text{ A}$$

Qual o valor eficaz da tensão na carga?

$$V_{ORMS} := \sqrt{\frac{1}{\pi} \cdot \left[\int_{\theta_{c0}}^{\theta_b} (V_{ipk} \cdot \sin(\omega t))^2 d\omega t + \int_{\theta_b}^{\theta_c} (v_{exp}(\omega t))^2 d\omega t \right]} = 230,6346 \text{ V}$$

Qual o valor eficaz da corrente no capacitor?

$$I_{CORMS} := \sqrt{\frac{1}{\pi} \cdot \left[\int_{\theta_{c0}}^{\theta_b} (\omega_0 \cdot C_0 \cdot V_{ipk} \cdot \cos(\omega t))^2 d\omega t + \int_{\theta_b}^{\theta_c} \left(\frac{v_{exp}(\omega t)}{R_0} \right)^2 d\omega t \right]} = 12,242 \text{ A}$$

Qual o valor eficaz da corrente no resistor?

$$I_{ORMS} := \sqrt{\frac{1}{\pi} \cdot \left[\int_{\theta_{c0}}^{\theta_b} \left(\frac{V_{ipk} \cdot \sin(\omega t)}{R_0} \right)^2 d\omega t + \int_{\theta_b}^{\theta_c} \left(\frac{v_{exp}(\omega t)}{R_0} \right)^2 d\omega t \right]} = 12,813 \text{ A}$$

Qual o valor eficaz da corrente na fonte e ou diodo?

$$I_{RMS} := \sqrt{\frac{1}{\pi} \cdot \left[\int_{\theta_{c0}}^{\theta_b} \left(\omega_0 \cdot C_0 \cdot V_{ipk} \cdot \cos(\omega t) + \frac{V_{ipk} \cdot \sin(\omega t)}{R_0} \right)^2 d\omega t \right]} = 17,7212 \text{ A}$$

Qual a potência ativa na carga?

$$P_0 := \frac{1}{\pi} \cdot \left[\int_{\theta_{c0}}^{\theta_b} \frac{(V_{ipk} \cdot \sin(\omega t))^2}{R_0} d\omega t + \int_{\theta_b}^{\theta_c} \frac{v_{exp}(\omega t)^2}{R_0} d\omega t \right] = 2955,1296 \text{ W}$$

$$\frac{1}{\pi} \cdot \left[\int_{\theta_{c0}}^{\theta_b} \left(\omega_0 \cdot C_0 \cdot V_{ipk} \cdot \cos(\omega t) + \frac{V_{ipk} \cdot \sin(\omega t)}{R_0} \right) \cdot V_{ipk} \cdot \sin(\omega t) d\omega t \right] = 2955,1296 \text{ W}$$

Qual a potência aparente na fonte?

$$V_{RMS} := \frac{V_{ipk}}{\sqrt{2}} = 220 \text{ V}$$

$$S_{in} := V_{RMS} \cdot I_{RMS} = 3898,6652 \text{ W}$$

Qual o fator de potência?

$$P_{in} := P_0 = 2955,1296 \text{ W}$$

$$FP := \frac{P_{in}}{S_{in}} = 0,758$$

Qual a potência dissipada no diodo?

$$P_D := r_{on} \cdot I_{RMS}^2 + v_{on} \cdot I_0 = 12,3475 \text{ W}$$

Análise harmônica da corrente na fonte

$$i_{in}(\omega t) := \omega_0 \cdot C_0 \cdot V_{ipk} \cdot \cos(\omega t) + \frac{V_{ipk} \cdot \sin(\omega t)}{R_0}$$

$$a(n) := \frac{1}{\pi} \cdot \left[\int_{\theta_{c0} - \pi}^{\theta_b - \pi} i_{in}(\omega t) \cdot \cos(n \cdot \omega t) d\omega t + \int_{\theta_{c0}}^{\theta_b} i_{in}(\omega t) \cdot \cos(n \cdot \omega t) d\omega t \right]$$

$$b(n) := \frac{1}{\pi} \cdot \left[\int_{\theta_{c0} - \pi}^{\theta_b - \pi} i_{in}(\omega t) \cdot \sin(n \cdot \omega t) d\omega t + \int_{\theta_{c0}}^{\theta_b} i_{in}(\omega t) \cdot \sin(n \cdot \omega t) d\omega t \right]$$

$$c(n) := \sqrt{a(n)^2 + b(n)^2}$$

$$\delta(n) := \text{atan}\left(-\frac{b(n)}{a(n)}\right)$$

$$I_h(n) := \frac{c(n)}{\sqrt{2}}$$

Qual o valor eficaz da componente fundamental da corrente na fonte?

$$\frac{c(0)}{2} = 7,6688 \cdot 10^{-15} \text{ A}$$

$$I_1 := I_h(1) = 15,7446 \text{ A}$$

$$c(1) = 22,2662 \text{ A}$$

Qual o valor eficaz dos harmônicos de corrente?

$$I_H := \sqrt{I_{RMS}^2 - I_1^2} = 8,1332 \text{ A}$$

Qual a taxa de distorção harmônica da corrente?

$$THD_i := \sqrt{\left(\frac{I_{RMS}}{I_1}\right)^2 - 1} = 0,5166$$

$$\frac{I_H}{I_1} = 0,5166$$