

Q:

- 1) The peak voltage of an AC supply is 300 V. What is the rms voltage?
- 2) The rms value of current in an AC circuit is 10 A. What is the peak current?

**Solution:**

parameter	value	description
$V(t)$	$V_0 \cdot \sin(2\pi ft + \phi)$	voltage in terms of time
$I(t)$	$I_0 \cdot \sin(2\pi ft + \phi)$	current in terms of time
$V_0$	300 V	peak voltage
$V_{\text{rms}}$	$\sqrt{\frac{1}{T} \int_0^T [V(t)]^2 dt}$	rms value of Voltage
$I_{\text{rms}}$	10 A	rms value of current
$I_0$	$\sqrt{2} \times I_{\text{rms}}$	peak current
$f$	50 Hz	frequency of the sinusoidal wave.
$T$	0.02 s	time period of sinusoidal wave.

TABLE I  
INPUT PARAMETER TABLE

1)

$$V_{\text{rms}}^2 = \frac{1}{T} \int_0^T [V(t)]^2 dt \quad (1)$$

$$= f \int_0^{\frac{1}{f}} V_0^2 \cdot \sin^2(2\pi ft + \phi) dt \quad (2)$$

$$= \frac{1}{2} V_0^2 \left( 1 - \frac{1}{f} \int_0^{\frac{1}{f}} \cos(4\pi ft + 2\phi) dt \right) \quad (3)$$

$$= \frac{1}{2} V_0^2 \left( 1 - \frac{1}{f} \left[ \frac{\sin(4\pi ft + 2\phi)}{4\pi f} \right]_0^{\frac{1}{f}} \right) \quad (4)$$

$$= \frac{1}{2} V_0^2 \left( 1 - \frac{1}{f} \cdot \frac{\sin(4\pi + 2\phi) - \sin(0 + 2\phi)}{4\pi f} \right) \quad (5)$$

$$V_{\text{rms}} = \frac{V_0}{\sqrt{2}} \quad (6)$$

To find the RMS voltage ( $V_{\text{rms}}$ ) when the peak voltage ( $V_0$ ) is 300V, you can use equation (6)

$$V_{\text{rms}} = \frac{300V}{\sqrt{2}} \approx 212.13V \quad (7)$$

2)

$$I_{\text{rms}}^2 = \frac{1}{T} \int_0^T [I(t)]^2 dt \quad (8)$$

$$= f \int_0^{\frac{1}{f}} I_0^2 \cdot \sin^2(2\pi ft + \phi) dt \quad (9)$$

$$= \frac{1}{2} I_0^2 \left( 1 - \frac{1}{f} \left[ \frac{\sin(4\pi ft + 2\phi)}{4\pi f} \right]_0^{\frac{1}{f}} \right) \quad (10)$$

$$= \frac{1}{2} I_0^2 \left( 1 - \frac{1}{f} \cdot \frac{\sin(4\pi + 2\phi) - \sin(0 + 2\phi)}{4\pi f} \right) \quad (11)$$

$$I_{\text{rms}} = \frac{I_0}{\sqrt{2}} \quad (12)$$

To find the peak current ( $I_0$ ) when the RMS current ( $I_{\text{rms}}$ ) is given, you can use equation (12)

$$I_0 \approx 10 \text{ A} \times 1.414 \approx 14.14 \text{ A} \quad (13)$$

