

RMS value of a sinusoidal waveform

For a periodic function $f(t)$ with period T ,

$$F_{rms} = \sqrt{\frac{1}{T} \int_0^T f^2(t) \cdot dt}$$

For sinusoidal current signal,

$$\begin{aligned} I_{rms}^2 &= \frac{1}{T} \int_0^T I_m^2 \sin^2 \omega t \cdot dt \\ &= \frac{I_m^2}{T} \int_0^T \frac{1 - \cos 2\omega t}{2} \cdot dt \\ &= \frac{I_m^2}{2T} \left[t \Big|_0^T - \frac{\sin 2\omega t}{2\omega} \Big|_0^T \right] \end{aligned}$$

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

$$\Rightarrow I_{rms}^2 = \frac{I_m^2}{2T} \left[T - \frac{\sin 4\pi}{2\omega} \right]$$

$$\Rightarrow \boxed{I_{rms} = \frac{I_m}{\sqrt{2}}}$$