

the source keeps flipping, and every element answers it differently

AC source

$$e = e_0 \sin \omega t$$

emf reverses direction every half cycle

→ measured by

Instantaneous current

$$i = i_0 \sin(\omega t \pm \phi)$$

generally out of step with e by phase ϕ

→ measured by

RMS value

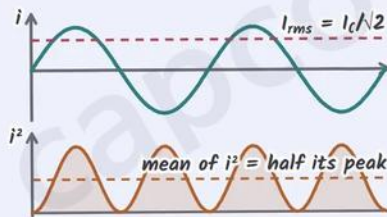
$$i_{rms} = \frac{i_0}{\sqrt{2}}$$

the steady DC that delivers the same average heating

$\phi = 0$ for a pure resistor, and also at resonance once L and C cancel each other out: everywhere else, L and C shift current out of step with the emf

Average and RMS value, said precisely *

- average of $\sin \omega t$ over a full cycle is zero, halves cancel exactly
- mean AC is instead defined over half a cycle
- average over half a cycle: $i_{av} = 0.637 i_0 = \frac{2}{\pi} i_0$, likewise $e_{av} = 0.637 e_0$
- RMS squares first, always positive, averages that, then square-roots
- $i_{rms} = \frac{i_0}{\sqrt{2}} = 0.707 i_0$, $e_{rms} = \frac{e_0}{\sqrt{2}}$
- power, heating and moving-coil readings always use RMS values, never peak



i^2 averages to half its peak: the steady current with the same heat is $I_0 / \sqrt{2}$

Phasors

- a phasor is a rotating vector, length e_0 or i_0 , spinning anticlockwise at speed ω
- its vertical projection at any instant gives the instantaneous value, $i_0 \sin \omega t$
- two phasors with angle ϕ between them carry that same phase difference
- phase and amplitude questions then become ordinary vector addition of phasors