

## ALTERNATING CURRENT

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References: Griffiths, David J. (2007), Introduction to Electrodynamics, 3rd Edition; Pearson Education - Problem 7.10.

The alternating current common in households can be generated by rotating a loop of wire in a constant magnetic field. Suppose we have a square loop of side length  $a$  rotating at a constant angular velocity  $\omega$  within a constant magnetic field  $\mathbf{B}$  which is perpendicular to  $\omega$ . Then the magnetic flux is given by

$$\Phi(t) = \int \mathbf{B} \cdot d\mathbf{a} = Ba^2 \cos \omega t$$

The emf is then

$$\mathcal{E} = -\frac{d\Phi}{dt} = \omega Ba^2 \sin \omega t$$

The emf thus alternates between positive and negative with period  $2\pi/\omega$ . A power station uses some external force to rotate the wire and provides the magnetic field, with the result that electricity is generated.