Alternating Current Generator

Coil of $N$ turns and cross-sectional area $A$ rotating with angular frequency $\omega$ in uniform magnetic field $\vec{B}$.

- Angle between area vector and magnetic field vector: $\theta = \omega t$.
- Flux through coil: $\Phi_B = NBA \cos(\omega t)$.
- Induced EMF: $E = -\frac{d\Phi_B}{dt} = E_{max} \sin(\omega t)$ with amplitude $E_{max} = NBA\omega$.
- U.S. household outlet values:
  - $E_{max} = 120V\sqrt{2} \approx 170V$
  - $f = 60Hz, \quad \omega = 2\pi f \approx 377rad/s$. 