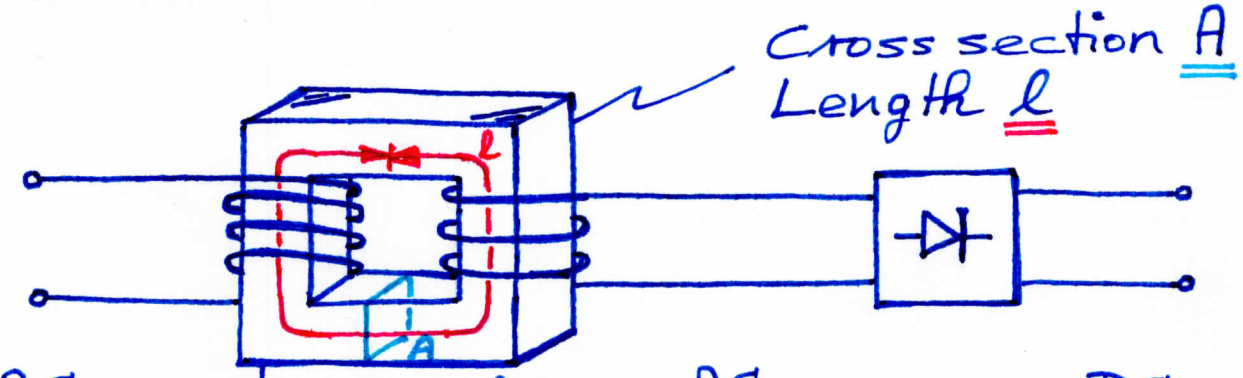
Standard power supply



AC HV → High Voltage

→ Transformer core ⇒ Ferromagnetic core

AC LV → Low voltage

DC LV

Magnetic field generated in magnetic core

$$\Phi_M = B\,A = L\,I$$

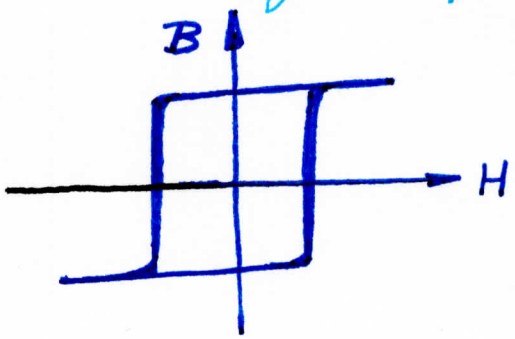
- Φ_M → Magnetic flux
- B → Magnetic flux density
- A → Cross-section area of core
- L → Inductance
- I → current

Magnetic field energy stored in core

$$E = \frac{1}{2}\mu H^2\,Al = \frac{1}{2}HB\,Al$$

- H → Magnetic field
- Al → Volume of core

Recall



Hysteresis ⇒ B saturates

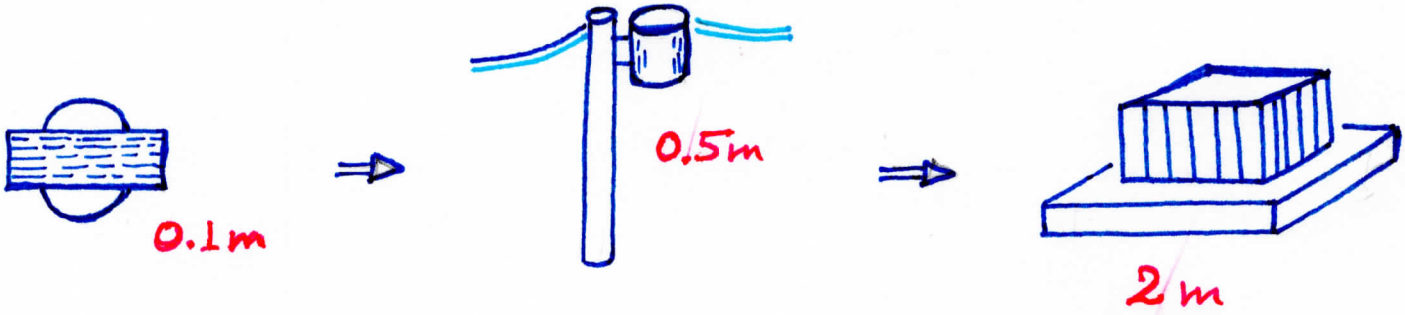
Power transmitted by transformer

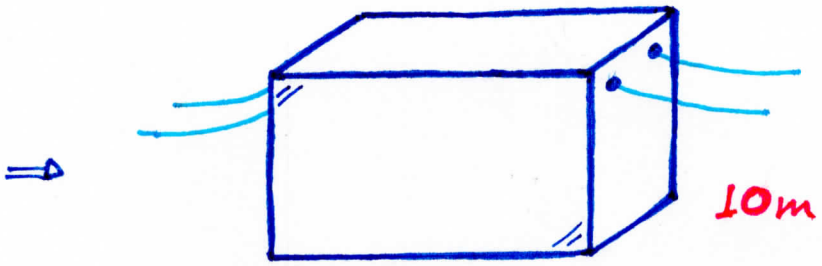
$$P = \frac{E}{T} = Ef = \underbrace{\frac{1}{2} HB}_{\text{Saturates}} A\ell f$$

f: 60 Hz; f: 60 Hz

How to transmit greater powers ?

Increase $A\ell$ ⇒ Bigger core !





We do not like big transformers

What should we do ?

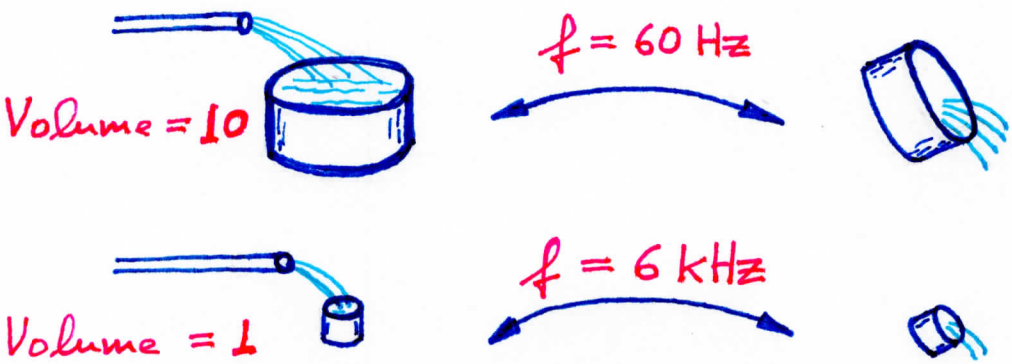
Recall $P = \frac{1}{2} HB\ A\ell f$

Switched mode power supply (SMPS) ③

Recall: $P = \frac{1}{2} HB \; Al \; f$

Visualization of the equation

Bucket of water



Which bucket transports more water?

⇒ Increase energy transfer by increasing f

⇒ Let us increase f

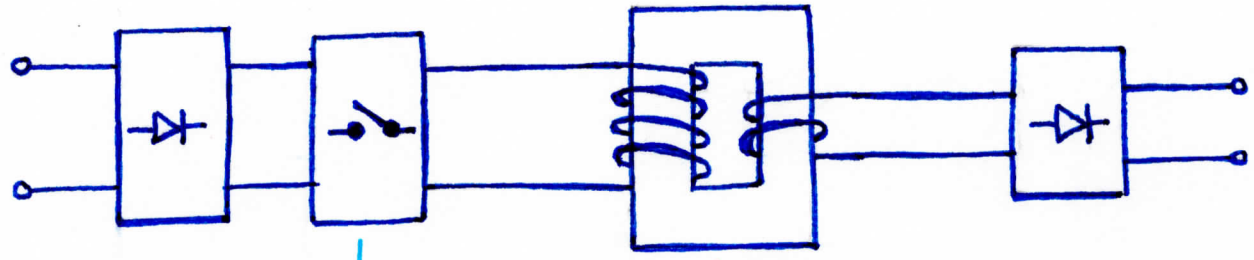
⇒ f = 60 Hz ⇒ 6 kHz

⇒ Decrease Al by a factor of 100

⇒ Smaller transformer

⇒ Switched mode power supply (SMPS)

Block diagram



HV AC 60Hz

HV DC

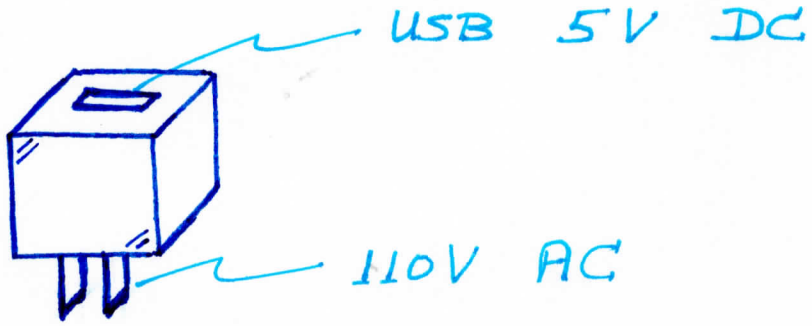
HV AC 6kHz → ON/OFF switch ⇒ FET

LV AC 6kHz → Volume reduced by a factor of 100

LV DC

SMPS ⇒ Smaller volume of transformer ⇒ Lighter weight ⇒ Great

Example : Power adapter of smartphone



The switch of the SMPS is an FET

Q: Which properties of the FET matter most when used as a switching transistor ?

⇒ R_{ON} and R_{OFF}

↳ Ideally = 0 ↳ Ideally = ∞

Q: Do you have a broken phone charger ? Take it apart and look for tiny transformer ?