

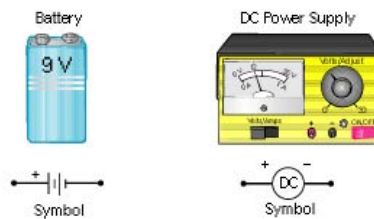
# 교류 Alternating Current

Jee-Hwan Ryu

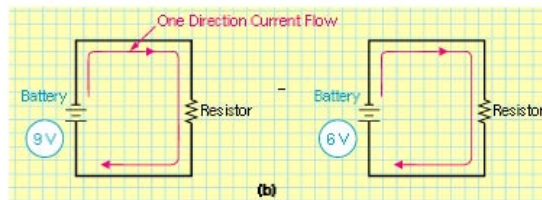
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## 직류 (Direct Current)

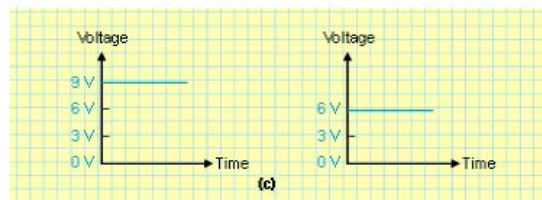
- 오직 한 방향으로 흐르는 전자의 흐름



(a)



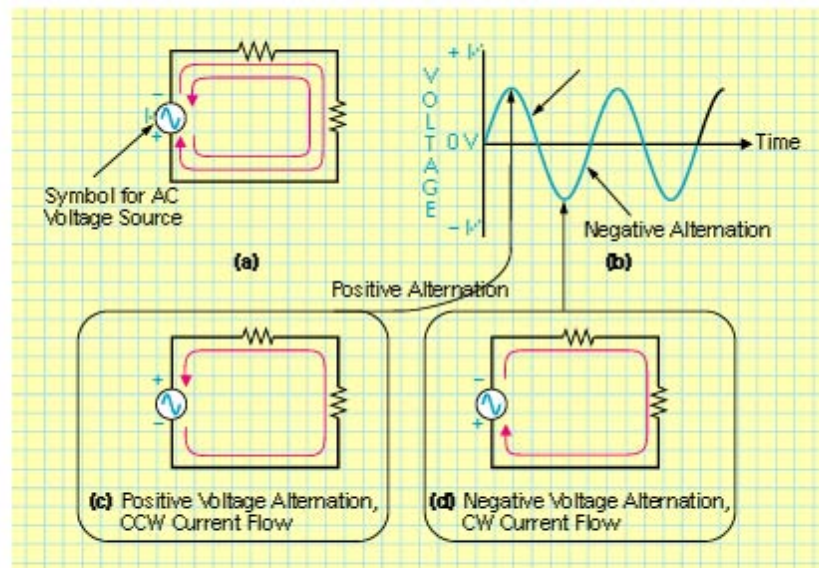
(b)



(c)

시 불변

# 교류 (Alternating Current)



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## Why AC ?

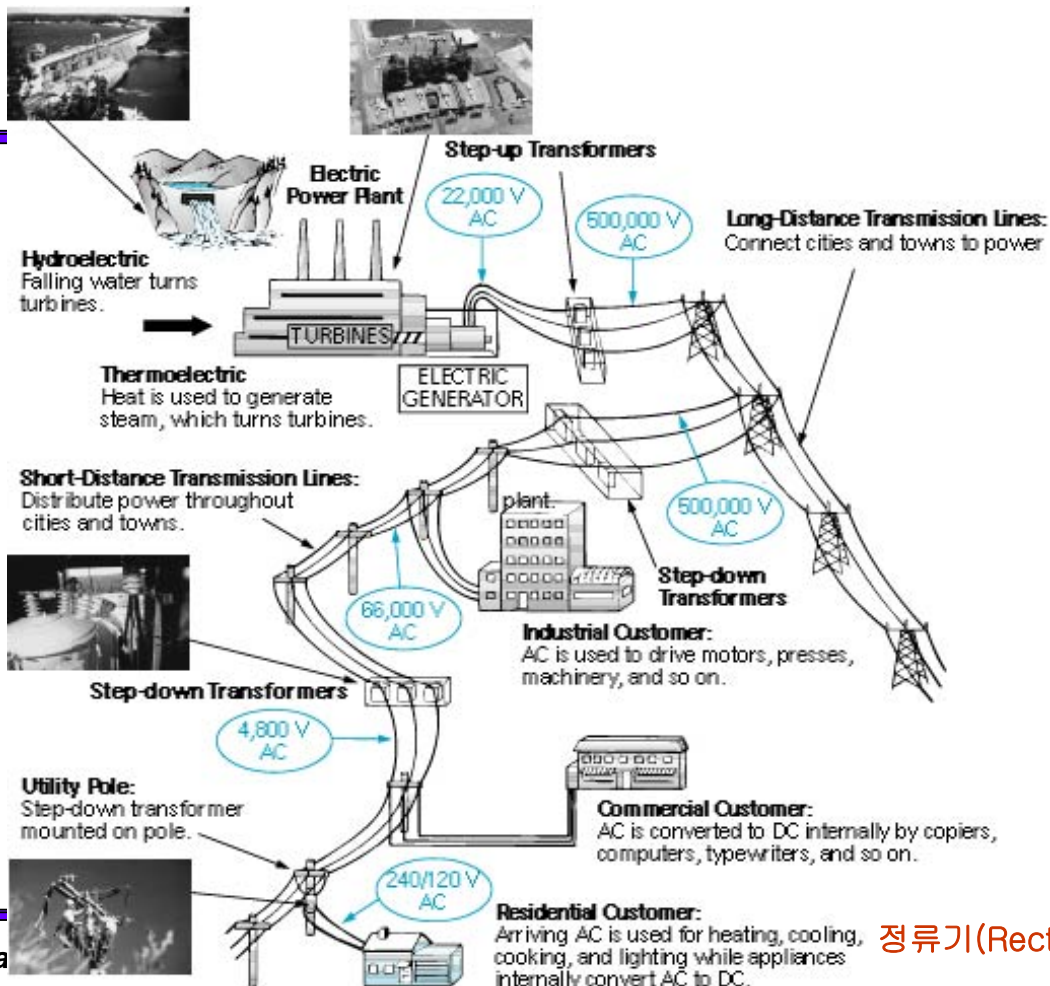
- 전력 전달
  - 가정과 산업현장에서의 점등, 가열, 냉각, 설비 및 기계장치를 위한 전기적인 제공
- 정보의 전달
  - 두 지점간에 라디오 음악과 텔레비전 화면 등의 정보를 전달하거나 통신을 제공

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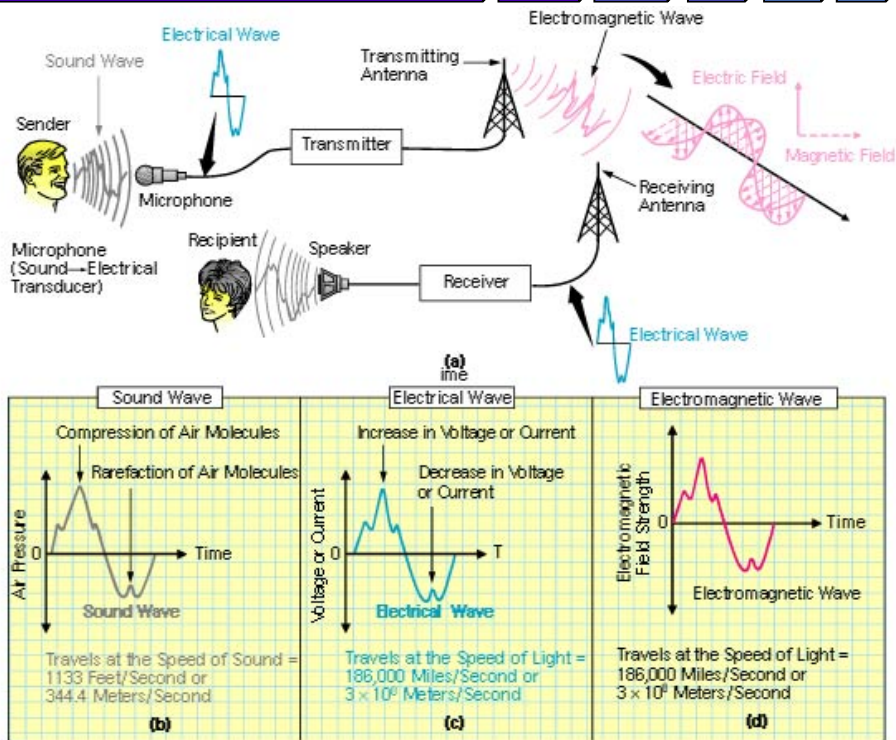
# 전력 전달

- 대부분의 산업용장비는 **큰 전류** 원을 요함
- **발전기** (기계적인 에너지 입력을 전기적인 에너지 출력으로 변환하는 장치) 사용하여 큰 값의 전류 발생
- **교류 발전기가** 용량이 크고 내부적으로 덜 복잡하며 동작에 드는 비용이 저렴
- 장거리 전력전달의 관점
  - 전선에서의 에너지 손실:  $P=I^2R$
  - 전압을 높이고 (20만 ~ 60만 V) 전류를 낮추어 같은 양의 전력을 낮은 전류로 공급 ( $P=VI$ )
- 교류전압은 변압기를 이용하게 쉽게 고 전압 저 전압으로 변환가능
- 가정, 산업현장 도착 후 교류-> 직류: 간단
- 직류를 교류로 변환하는 과정은 복잡하고 비효율적임

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# 정보 전달



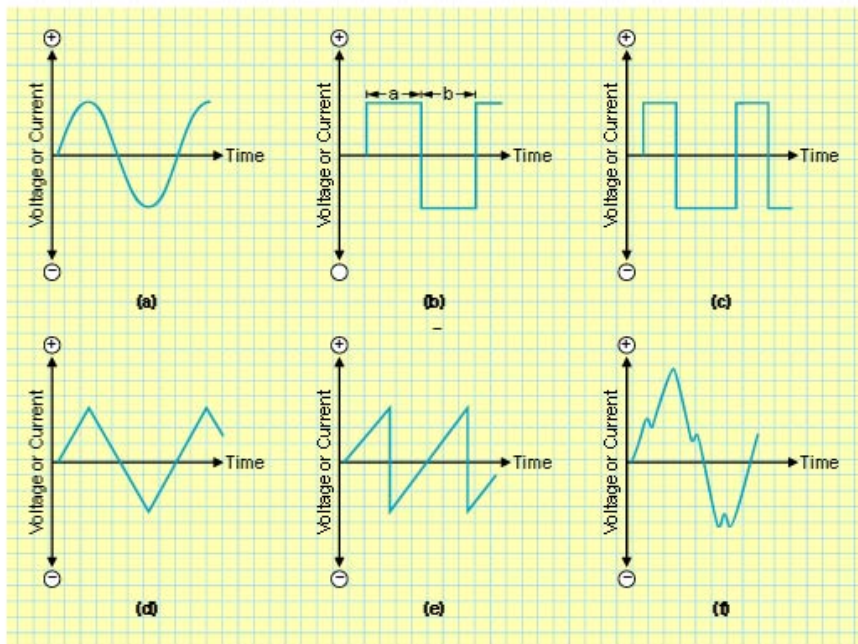
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## 전기장치 또는 전자장치

- 전기장치
  - 전력 (큰 값의 V 와 I) 를 다룸
- 전자장치
  - 정보 (작은 값의 V 와 I) 를 다룸

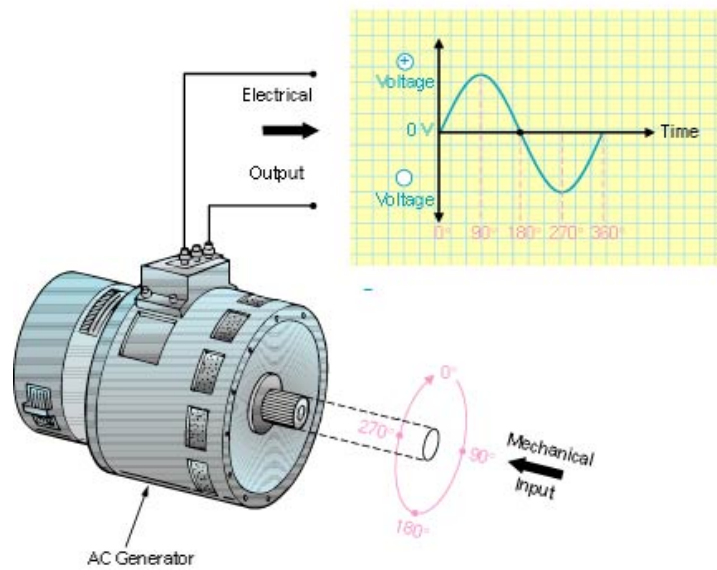
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# 교류 파형



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# 정현파



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# 진폭 (Amplitude)

$$x(t) = A \cos(\omega t + \phi)$$

$A$  : Amplitude

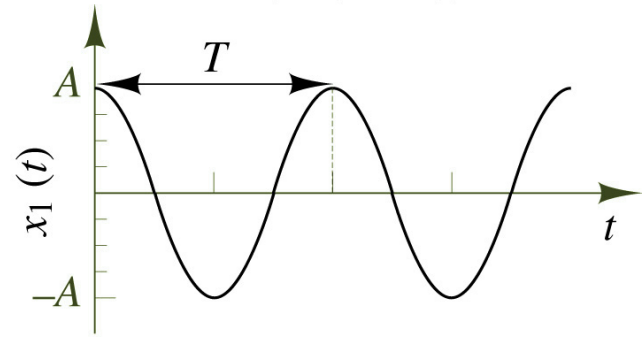
$f$  : natural frequency,  $\frac{1}{T}$ , cycle/s or Hz

$\omega$  : Radian frequency,  $2\pi f$ , rad/s

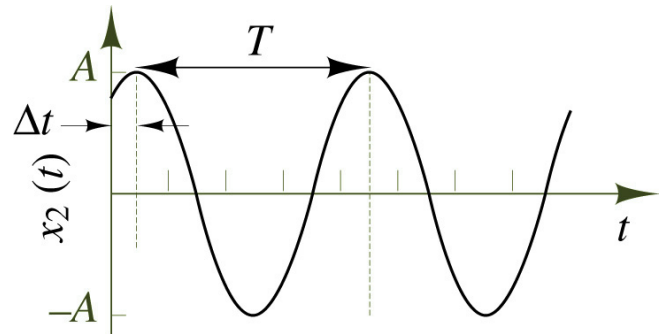
$\phi$  : phase,  $2\pi \frac{\Delta t}{T}$

$$\omega = 2\pi f$$

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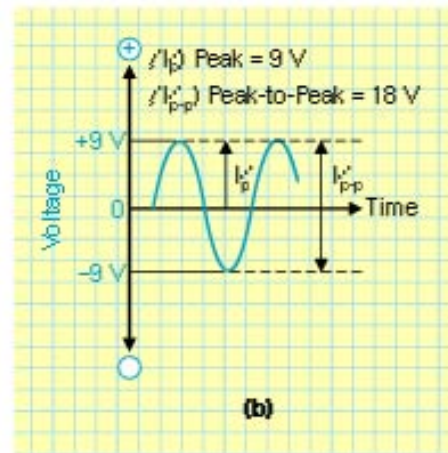
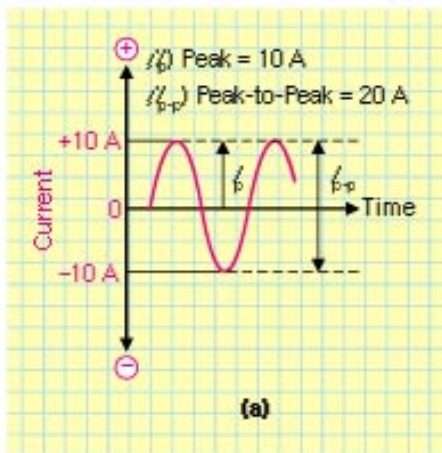
Reference cosine



Arbitrary sinusoid

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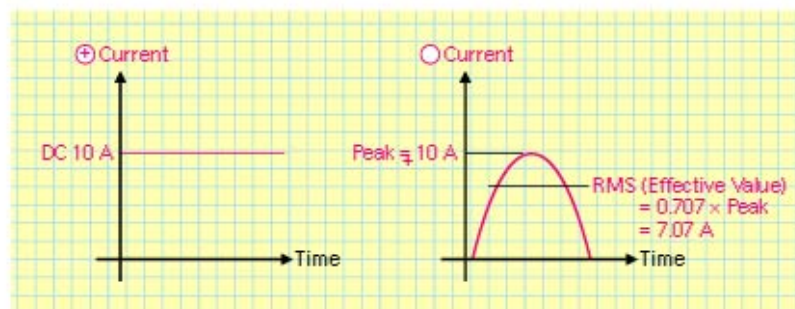
# Peak value and Peak-to-Peak value



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# RMS 또는 실효 값

- 같은 양의 전력을 공급할 수 있는 직류 값



$$W = \frac{1}{T} \int_0^T R i_{ac}^2(t) dt = I_{eff}^2 R$$

$$I_{eff} = \sqrt{\frac{1}{T} \int_0^T i_{ac}^2(t) dt}$$

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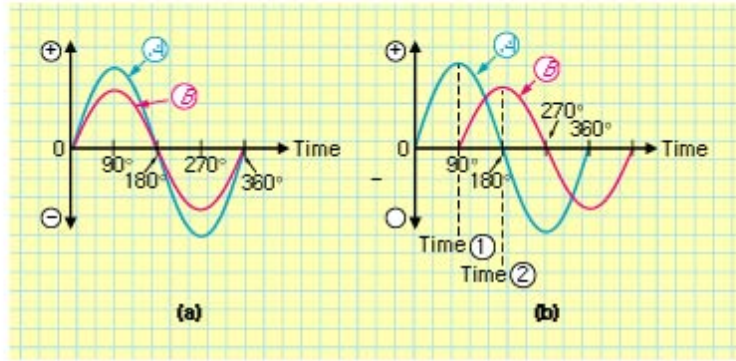
## Example

$$i(t) = I \cos(\omega t)$$

$$\begin{aligned} i_{rms} &= \sqrt{\frac{1}{T} \int_0^T i^2(t) dt} = \sqrt{\frac{\omega}{2\pi} \int_0^{2\pi/\omega} I^2 \left[ \frac{1}{2} + \frac{1}{2} \cos(2\omega t) \right] dt} \\ &= \frac{I}{\sqrt{2}} = 0.707I \end{aligned}$$

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# 위상 (Phase)



In-phase

Out-of-phase

Lead, lag

# 구형파 (Square Wave)

$$\text{Duty cycle(\%)} = \frac{\text{펄스폭}}{\text{주기}} \times 100\%$$

$$\text{평균} = \text{기준선} + \text{Duty cycle} \times P - P$$

$$= -10 + 0.5 \times 20 = 0$$

