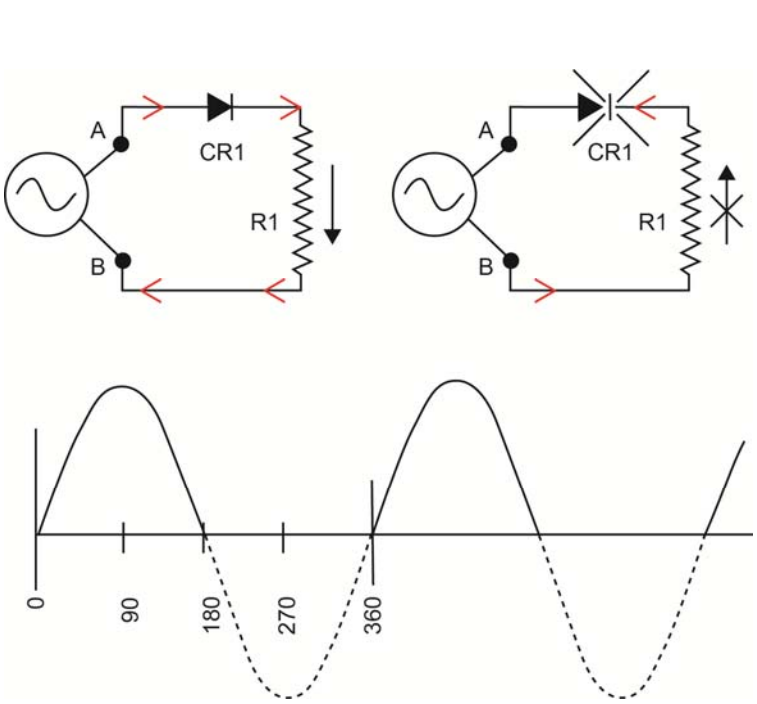
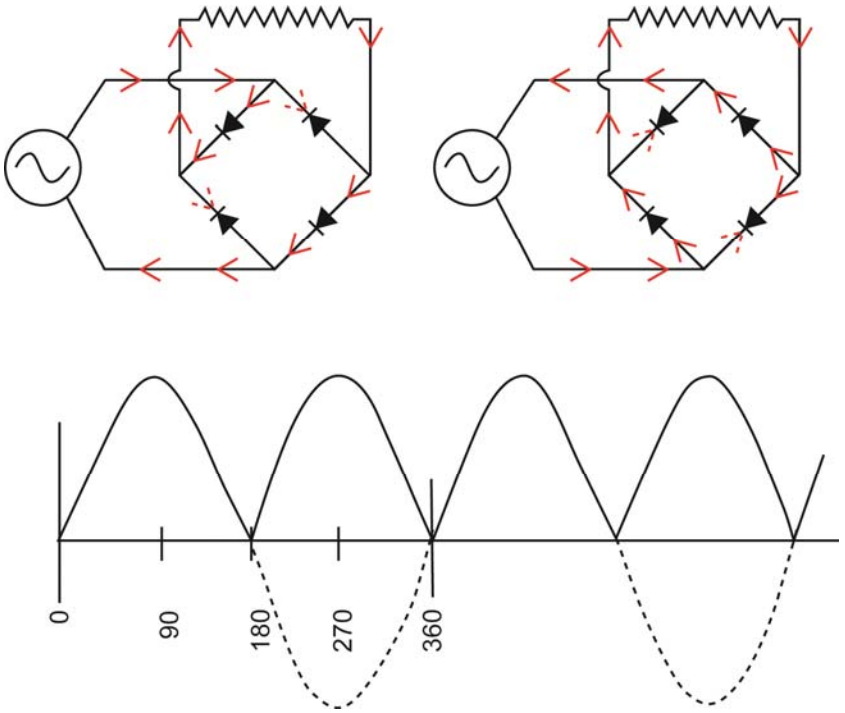
Electricity Fundamentals

Rectification (AC to DC)

- Rectifiers or diodes are used to convert AC to DC.



Half-wave rectification



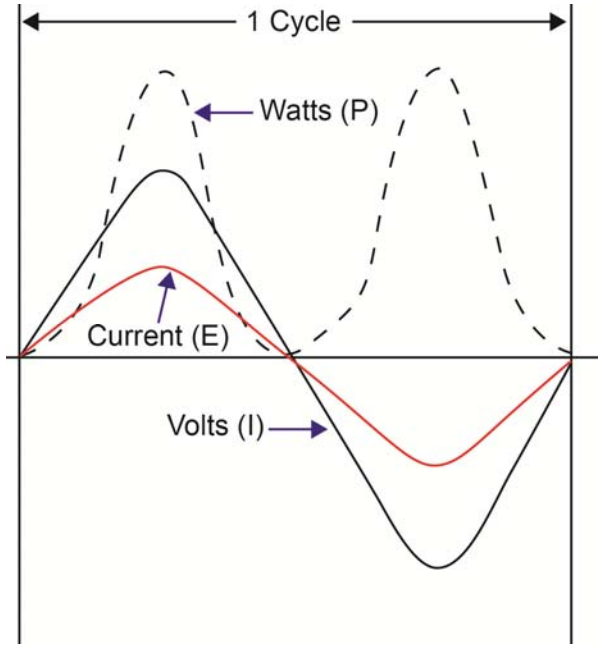
Full-wave rectification

Power

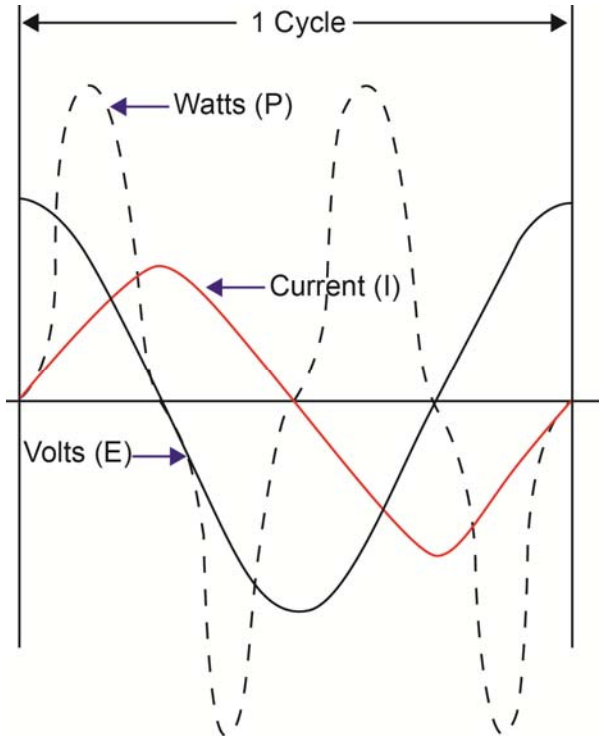
- Is the rate of doing work.
- In a DC circuit:
  - = voltage × current (EI)
  - or, since E = IR, also = I^2R.
- In an alternating current circuit, there may be inductive and capacitive elements.
  - Result in the current leading or lagging the voltage.
  - Affects power.

Power (cont.)

- Purely resistive:
  - Voltage always aligned with current
  - Power will be zero or more.
- Purely reactive (inductive or capacitive):
  - Points where voltage is positive and current is negative and vice-versa.
  - No work is done. All power is returned to the source.



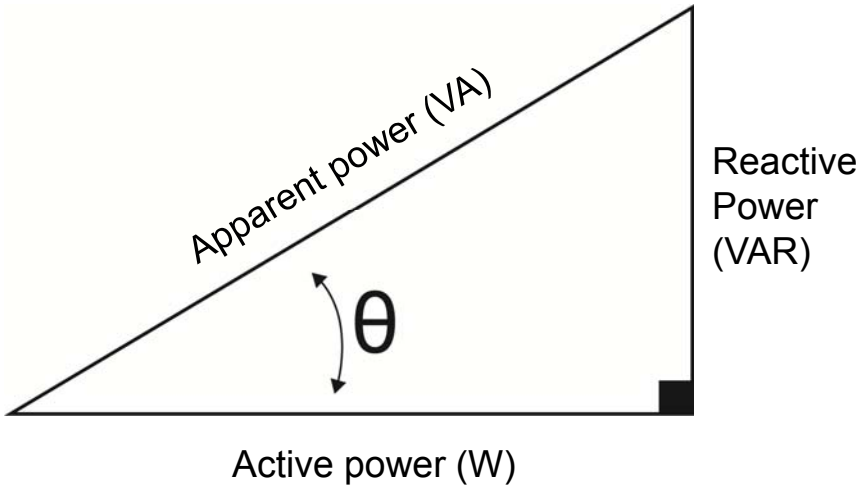
Purely resistive load



Purely inductive load (purely capacitive is similar)

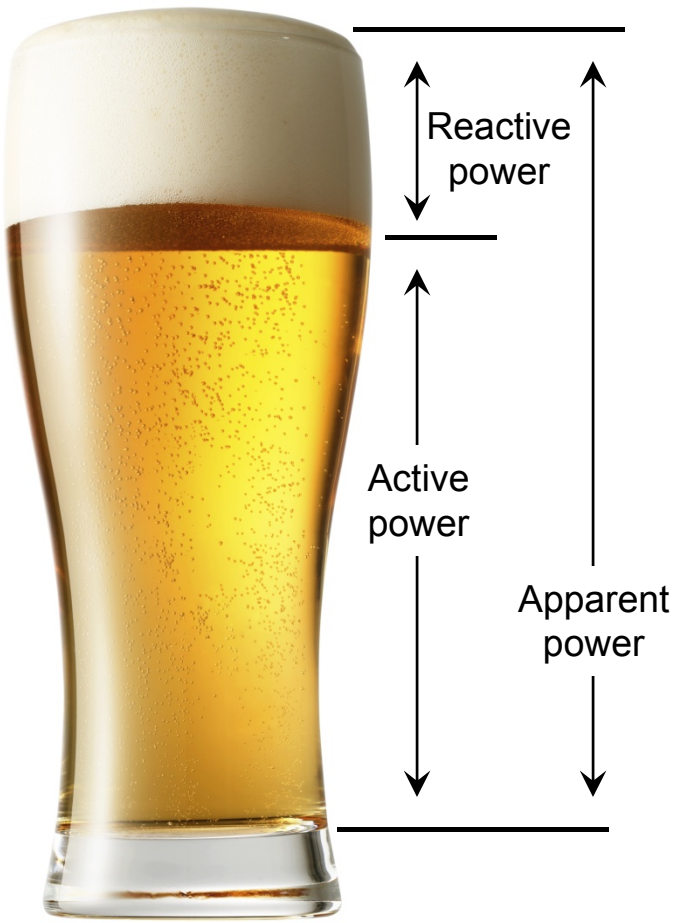
Power (cont.)

- Active (real) power (W) -. Eventually produces a tangible result like heat or light (= I^2R).
- Reactive power (VAR) - Surges back and forth between the source and load. This power produces alternating magnetic fields in devices (= I^2X).
- Apparent power (VA) - Is the vector sum of active and reactive, the total needed (= I^2Z).



A Power Analogy

- When you drink, the froth hits your mouth first and delays the beer. Reactive power is related to the delay that occurs due to setting up alternating magnetic fields.
- Beer that then flows into your mouth and quenches your thirst is like active power flowing to the equipment being powered.
- The total amount of beer and froth in the glass represents the apparent power, which is the sum of active and reactive power.



Power: Example

What are the values of the active, reactive and apparent power in our circuit?

60 A
R = 60 Ω
X = 80 Ω
Z = 100 Ω

Active power = 5 A^2 × 60 Ω = 1500 W

Reactive power = 5 A^2 × 80 Ω = 2000 var

Apparent power = 5 A^2 × 100 Ω = 2500 VA

Power Factor

- Is active power/apparent power (a ratio): Example: 1000 kW / 1250 kVA = 0.8 PF.
- Describes how much of the power produced is being used to perform work.
- Depends on the load. The generator is rated for a specific power factor.
  - 0.8 is typical.
  - 1 is called unity.
- The lower the power factor:
  - More apparent power is needed to get the job done.
  - Larger equipment is required.
  - Energy costs are higher due to increased losses in the circuit.

Power Factor: Example

What is the power factor in our circuit?

1500 W
2500 VA

1500 W / 2500 VA = 0.6 PF