I. **Power Converters**

A. Basic Purpose for Information Electronics

![Data Processor Diagram](image)

- **Input Data** (Volt/Format/Clock)
- **Output Data** (Volt/Format/Clock)
- **Power**
- **Control Input**

B. Basic Purpose for Power Electronics

![Power Processor Diagram](image)

- **Input Power** (Volt/Current/Freq)
- **Output Power** (Volt/Current/Freq)
- **Power**
- **Control Input**

C. Complete Power Converter versus Power Electronic Circuit

1. The power electronic circuit consists of the switching devices and passive elements (generally inductors and capacitors)
2. The power converter is a system that includes controls for:
   - A. Gate pulse shaping
   - B. Synchronization
   - C. Inner control
   - D. Outer control loop
**Fundamental Rules of Power Electronics**

1. KCL and KVL still apply

2. Energy is conserved

3. The average voltage across an inductor is 0

   \[ v = L \cdot \frac{di}{dt} \] before taking the limit as \( t \) goes to 0:

   \[ \Delta v = L \cdot \frac{\Delta i}{\Delta t} \]

   \[ \Delta v \cdot \Delta t = L \cdot \Delta i \]

   **volt-second balance**

   • Useful for circuit analysis

4. The average current through a capacitor is 0

   \[ i = C \cdot \frac{dv}{dt} \] before taking the limit as \( t \) goes to 0:

   \[ \Delta i = C \cdot \frac{\Delta v}{\Delta t} \]

   \[ \Delta i \cdot \Delta t = C \cdot \Delta v \]

   **charge balance**

   • Also useful for circuit analysis

**Two useful corollaries**

1. You can't change the current through an inductor instantaneously

   A. An inductor can be viewed as a current source when viewed on a short time scale
   
   B. Switching behavior must account for this:

   (1) Don't switch to connect two current source in series
   
   (2) Either switch at current zeros or provide path for the current and deal with energy
2. You can't change the voltage across a capacitor instantaneously
   A. A capacitor can be viewed as a voltage source when viewed on
      a short time scale
   B. Switching behavior must account for this:
      (1) Don't switch to connect two voltage sources in parallel
      (2) Provide path for the charge and deal with energy