EE 442-642
Switching DC Power Supplies
Linear Power Supplies

Very poor efficiency and large weight and size
Switching DC Power Supply: Block Diagram

High efficiency and small weight and size
Switching DC Power Supply: Multiple Outputs

In many applications, several dc voltages are required, electrically isolated from each other.
Transformer Analysis

(a) B-H Curve

(b) Transformer Diagram

(c) Equivalent Circuit
Flyback Converter

Derived from buck-boost; small power levels (< 50 W)
Flyback Converter

\[
\frac{V_o}{V_d} = \frac{N_2}{N_1} \frac{D}{1 - D}
\]
Flyback Converter

Switching waveforms (assuming incomplete core demagnetization, i.e., continuous conduction mode)
Forward Converter: ideal case

Derived from Buck; assuming that the transformer is ideal (not possible in practice)

\[ \frac{V_o}{V_d} = \frac{N_2}{N_1} D \]
The transformer magnetization curve must be taken into account. On approach is to use a third (demagnetizing) winding whose purpose is to recover the energy stored in the magnetic field and feed it back to the input supply as shown above.

\[
D_{\text{max}} = \frac{1}{1 + \left( \frac{N_3}{N_1} \right)}
\]
PWM to Regulate Output
Push-Pull Converter

\[
\frac{V_o}{V_d} = 2 \frac{N_2}{N_1} D
\]

\(0 < D < 0.5\)
Half-Bridge Converter

\[ \frac{V_o}{V_d} = \frac{N_2}{N_1} D \]

\[ 0 < D < 0.5 \]
Full-Bridge Converter

\[
\frac{V_o}{V_d} = 2 \frac{N_2}{N_1} D
\]

\[0 < D < 0.5\]