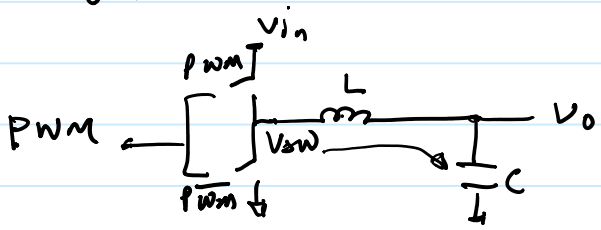
# Boost Converter

$V_o > V_{in}$

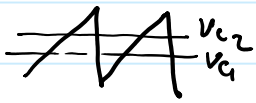


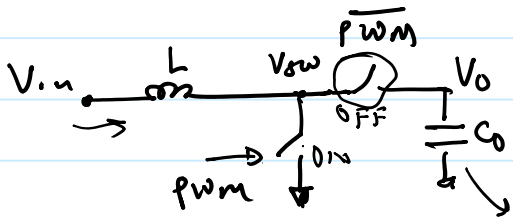

Buck

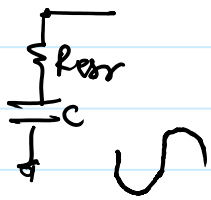
$$V_o = D \cdot V_{in}$$

$$V_o = \frac{V_{in}}{D \rightarrow 1-D}$$

$$V_o = \frac{V_{in}}{1-D}$$




$V_L$ during $T_{ON}$

$$V_L = V_{in}$$

$V_L$ during $T_{OFF}$

$$V_L = V_{in} - V_o$$

Volt-second balance:

$$V_{in} \cdot D \cdot T_{sw} + (V_{in} - V_o)(1-D) T_{sw} = 0$$

$$D \cdot V_{in} + V_{in} - D V_{in} - V_o (1-D) = 0$$

$$\boxed{V_o = \frac{V_{in}}{1-D}}$$

# Buck-Boost Converter

$$V_o = \frac{V_{in}}{1-D}$$

$P_{in} = P_{out}$

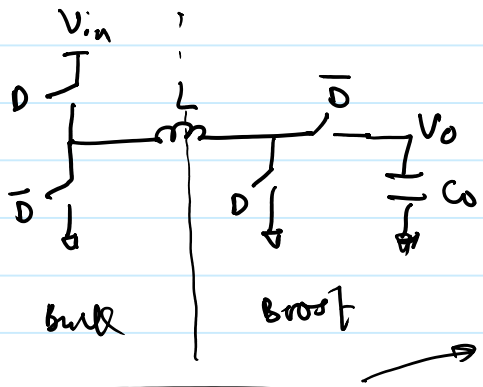
$V_{in} \cdot I_{in} = V_o \cdot I_o$

$V_{in} \cdot I_{in} = \frac{V_{in}}{1-D} I_o$

$$I_{in} = \frac{I_o}{1-D} = I_L$$

Buck - Boost

= Buck + Boost




$$I_o = \frac{1}{1-D} I_{in}$$

$$V_o = \frac{D}{1-D} V_{in}$$

$D = 0.5$

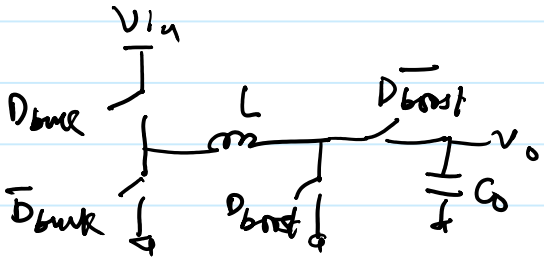
$V_o = V_{in}$

Buck → $V_o < V_{in}$ $D < 0.5$

Buck - Boost → $V_o \simeq V_{in}$ $D \simeq 0.5$

Boost → $V_o > V_{in}$ $D > 0.5$

# Buck-Boost Converter




$$V_o = \frac{D_{buck}}{1 - D_{boost}} V_{in}$$

$D_{buck} = 0.9 \qquad D_{boost} = 0.1$

$V_o = V_{in} \qquad I_{in} = \frac{I_o}{1 - D_{boost}}$