POWER ELECTRONICS REFERENCE

Created by Katherine A. Kim

June 2010

Contents

1. Buck Converter 2
2. Boost Converter 3
3. Buck-Boost Converter 4

Page numbers reference *Elements of Power Electronics* by Philip T. Krein.

1. Buck Converter

Continuous Conduction Mode [p.123]

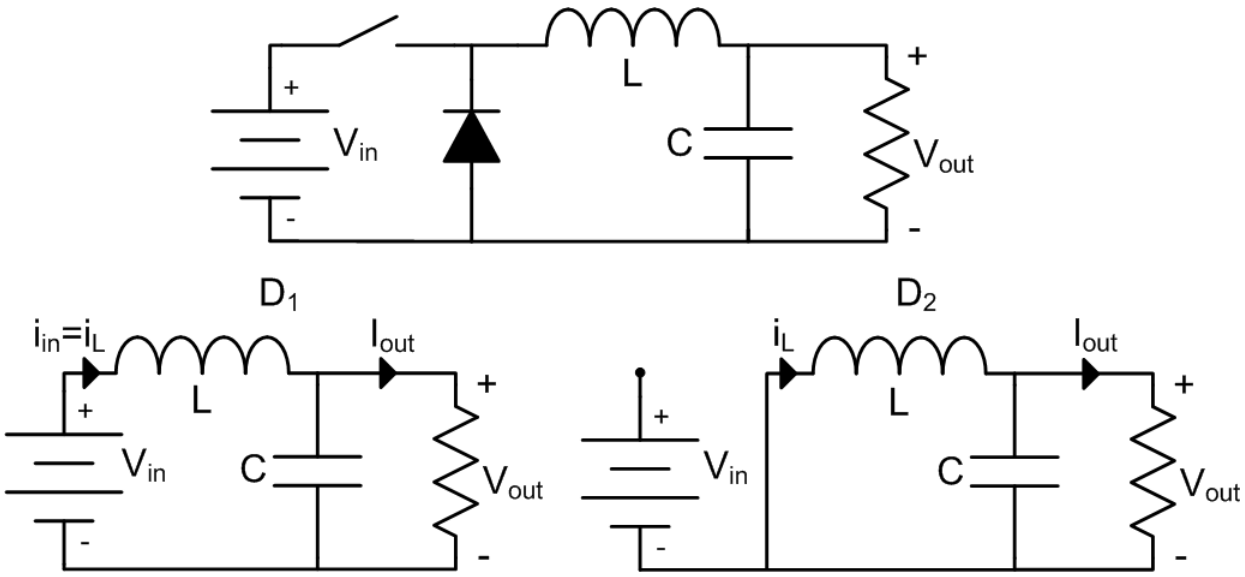
$$D_1 + D_2 = 1 \qquad D_1 = \frac{V_{out}}{V_{in}}$$
$$V_{out} = D_1 V_{in} \qquad I_{in} = D_1 I_{out}$$
$$I_{in} = D_1 I_L \qquad I_{out} = I_L$$

Critical Conduction Mode

$$\Delta i_L = 2I_{out} \qquad \Delta v_C = 2V_{out}$$
$$L_{crit} = \frac{(V_{in} - V_{out})D_1 T}{2I_{out}} \qquad C_{crit} = \frac{I_{ripple} T}{16 V_{out}}$$

Discontinuous Conduction Mode [p.330]

$$D_1 + D_2 + D_0 = 1 \qquad D_1 V_{in} = (D_1 + D_2) V_{out}$$
$$V_{out} = \frac{-D_1^2 V_{in} RT}{4L} + D_1 V_{in} \sqrt{\frac{RT}{2L} + \frac{R^2 T^2 D_1^2}{16 L^2}} \qquad I_{in} = (V_{in} - V_{out}) \frac{D_1^2 T}{2L}$$



2. Boost Converter

Continuous Conduction Mode [p.129]

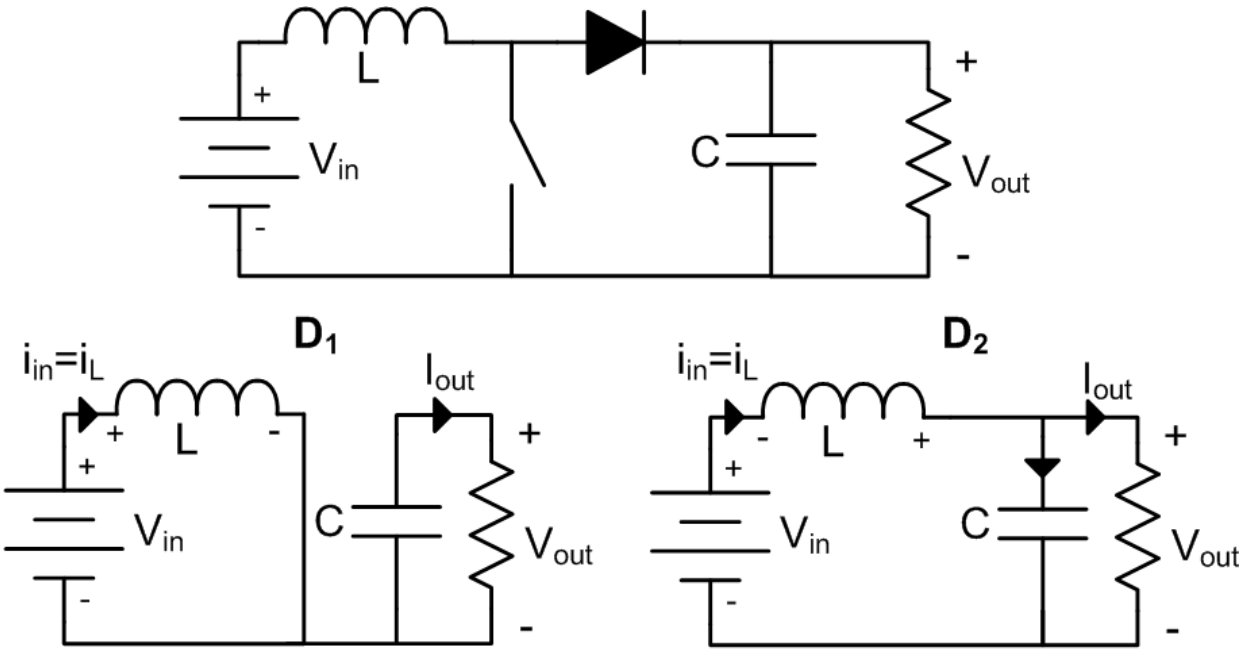
$$D_1 + D_2 = 1 \qquad D_1 = \frac{V_{out} - V_{in}}{V_{out}}$$
$$V_{out} = \frac{1}{1 - D_1} V_{in} \qquad I_{in} = \frac{1}{1 - D_1} I_{out}$$
$$I_{in} = I_L \qquad I_{out} = I_L D_2$$

Critical Conduction Mode

$$\Delta i_L = 2 I_{in} \qquad \Delta v_C = 2 V_{out}$$
$$L_{crit} = \frac{V_{in} D_1 T}{2 I_{in}} \qquad C_{crit} = \frac{I_{out} D_1 T}{2 V_{out}}$$

Discontinuous Conduction Mode [p.330]

$$D_1 + D_2 + D_0 = 1 \qquad (D_1 + D_2) V_{in} = D_2 V_{out}$$
$$V_{out} = \frac{V_{in}}{2} + \frac{V_{in}}{2} \sqrt{1 + \frac{2 D_1^2 R T}{L}} \qquad I_{in} = (D_1 + D_2) \frac{V_{in} D_1 T}{2L}$$



3. Buck-Boost Converter

(Polarity Reversal)

Continuous Conduction Mode [p.132]

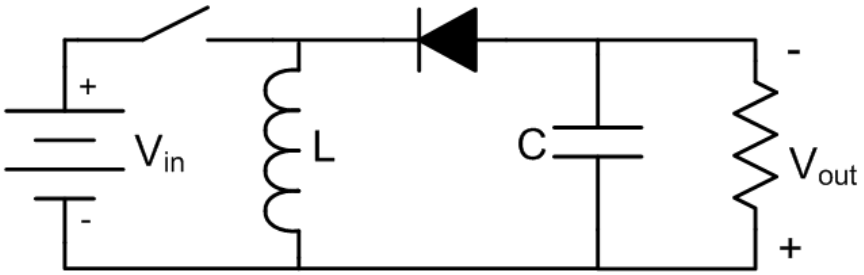
$$D_1 + D_2 = 1 \qquad D_1 = \frac{V_{out}}{V_{in} + V_{out}}$$
$$V_{out} = \frac{D_1}{1 - D_1} V_{in} \qquad I_{in} = \frac{D_1}{1 - D_1} I_{out}$$
$$I_{in} = D_1 I_L \qquad I_{out} = D_2 I_L$$
$$I_{in} + I_{out} = I_L \qquad D_1 I_{out} = D_2 I_{in}$$

Critical Conduction Mode

$$\Delta i_L = 2I_{out} \qquad \Delta v_C = 2V_{out}$$
$$L_{crit} = \frac{V_{in} D_1 T}{2I_{out}} \qquad C_{crit} = \frac{I_{out} D_1 T}{2V_{out}}$$

Discontinuous Conduction Mode [p.330]

$$D_1 + D_2 + D_0 = 1 \qquad (D_1 + D_2) V_{in} = D_2 V_{out}$$
$$V_{out} = \frac{V_{in}}{2} + \frac{V_{in}}{2}\sqrt{1 + \frac{2D_1^2 RT}{L}} \qquad I_{in} = (D_1 + D_2)\frac{V_{in} D_1 T}{2L}$$



D1 **D2**