3.2 A boost PWM converter has the following data: $V_I = 125$–350 V, $V_O = 380$ V, $P_O = 6.8$–68 W, and $f_s =$ 50 kHz. Compute the voltage and current stresses of the transistor and the diode.

$$V_{SM} = V_{DM} = V_O = 380V$$

$$I_{Omax} = \frac{P_{Omax}}{V_O} = 68/380 = 0.179A$$

$$M_{VDC} = \frac{V_O}{V_I} = \frac{1}{1-D}$$

$$D_{min} = 1 - \frac{V_{Imax}}{V_O} = 1 - \frac{350}{380} = 0.0789$$

$$D_{max} = 1 - \frac{V_{Imin}}{V_O} = 1 - \frac{125}{380} = 0.671$$

$$R_{Lmax} = \frac{V_O^2}{P_{Omin}} = \frac{380^2}{6.8} = 21.235\,k\Omega$$

$$L_{min} = \frac{2}{27} \times \frac{R_{Lmax}}{f_s} = 31.459\,mH$$

$$\Delta i_{Lmax} = \frac{V_O}{4 f_s L} = \frac{380}{50\times10^3 \times 4 \times 32\times10^{-3}} = 0.059A$$

$$I_{SMx} = I_{DMax} = \frac{0.179}{1-0.671} + \frac{0.059}{2} = 0.574A$$

3.3 A boost PWM converter has the following data: $V_I = 8$–16 V, $V_O = 24$ V, $I_O = 0.2$–2 A, and $f_s = 200$ kHz. Calculate the minimum inductance required for the converter operation in CCM. Assume $\eta = 90\%$.

$$R_{Lmax} = \frac{V_O}{I_{min}} = \frac{24}{0.2} = 120\Omega$$

$$M_{VDC} = \frac{V_O}{V_I} = \frac{\eta}{1-D}$$

$$D_{min} = 1 - \eta \frac{V_{Imax}}{V_O} = 1 - 0.9 \times \frac{16}{24} = 0.4$$

$$D_{max} = 1 - \eta \frac{V_{Imin}}{V_O} = 1 - 0.9 \times \frac{8}{24} = 0.7$$

$$L_{min} = \frac{2}{27} \frac{R_{Lmax}}{f_s} = \frac{2}{27} \times \frac{120}{0.2 \times 10^6} = 44.44 \mu H$$

3.4 A boost PWM converter has the following data: $V_I = 8$–12 V, $V_O = 24$ V, $I_O = 0.2$–2 A, and $f_s = 200$ kHz. Calculate the minimum inductance required for the converter operation in CCM. Assume $\eta = 90\%$.

$$R_{Lmax} = \frac{V_O}{I_{Omin}} = \frac{24}{0.2} = 120 \Omega$$

$$D_{min} = 1 - \eta \frac{V_{Imax}}{V_O} = 1 - 0.9 \times \frac{12}{24} = 0.55$$

$$D_{max} = 1 - \eta \frac{V_{Imin}}{V_O} = 1 - 0.9 \times \frac{8}{24} = 0.7$$

$$L_{min} = \frac{R_{Lmax} D_{min} (1 - D_{min})^2}{2 f_s} = \frac{120 \times 0.55 \times (1 - 0.55)^2}{2 \times 0.2 \times 10^6}$$

$$= 33.41 \mu H$$

we chose $L = 47 \mu H$

3.7 A boost PWM converter employs a diode with a forward resistance $R_F = 0.02\ \Omega$. The load current is $I_O = 10$ A. Calculate the diode conduction loss due to the forward resistance R_F at $D = 0.1$, 0.2, 0.5, 0.8, and 0.9.

$D = 0.1$ $P_{RF} = \frac{R_F I_O^2}{1 - D} = \frac{0.02 \times 10^2}{1 - 0.1} = 2.222 W$

$D = 0.2$ $P_{RF} = \frac{0.02 \times 10^2}{1 - 0.2} = 2.5 W$

$D = 0.5$ $P_{RF} = 0.02 \times 10^2 / (1 - 0.5) = 4 W$

$D = 0.8$ $P_{RF} = 0.02 \times 10^{2} / (1 - 0.8) = 10\,W$

$D = 0.9$ $P_{RF} = 0.02 \times 10^{2} / 1 - 0.9 = 20\,W$

Condition loss PRF

RF increase with cycle D increase

when D will high value, it will be large.