$$\frac{V_{out}(s)}{V_{in}(s)} = -\frac{V_{out}}{V_{in}} \frac{\left(1 + \frac{s}{\omega_{z1}}\right)}{1 + \frac{s}{Q\omega_0} + \left(\frac{s}{\omega_0}\right)^2} \tag{2A-19}$$

$$\omega_{z1} = \frac{1}{r_{Cf}C}$$

$$\omega_{z2} = \frac{D'^2R}{DL} \quad \text{(RHPZ)}$$

$$\omega_0 = \frac{D'}{\sqrt{LC}}$$

$$Q = D'R\sqrt{\frac{C}{L}}$$

Voltage-mode, DCM

Reference 1 equations:

$$\frac{V_{out}(s)}{V_{err}(s)} = \frac{V_{in}}{V_{peak}} \frac{K_1\left(1 + \frac{s}{\omega_{z1}}\right)}{\left(1 + \frac{s}{\omega_{p1}}\right)} \tag{2A-20}$$

$$\frac{V_{out}(s)}{V_{in}(s)} = \frac{V_{out}}{V_{in}} \frac{\left(1 + \frac{s}{\omega_{z1}}\right)}{\left(1 + \frac{s}{\omega_{p1}}\right)} \tag{2A-21}$$

$$K_1 = -\frac{1}{\sqrt{K}} \quad \text{with } K = \frac{2L}{RT_{sw}}$$

$$\omega_{z1} = \frac{1}{r_{Cf}C}$$

$$\omega_{p1} = \frac{2}{RC}$$

Current-mode, CCM:

Reference 1 equations:

$$\frac{V_{out}(s)}{V_{err}(s)} = \frac{R}{R_i} \frac{V_{in}}{(V_{in} - 2V_{out})} \frac{\left(1 + \frac{s}{\omega_{z1}}\right)}{\left(1 + \frac{s}{\omega_{p1}}\right)} \frac{\left(1 - \frac{s}{\omega_{z2}}\right)}{1 + \frac{s\left[\left(1 + \frac{S_a}{S_1}\right)D' - 0.5\right]}{F_{sw}} + \frac{s^2}{(\pi F_{sw})^2}} \tag{2A-22}$$

$$\frac{V_{out}(s)}{V_{in}(s)} = \frac{V_{out}^2}{V_{in}^2 - 2V_{in}V_{out}} \frac{\left(1 + \frac{s}{\omega_{z1}}\right)}{\left(1 + \frac{s}{\omega_{p1}}\right)} \tag{2A-23}$$