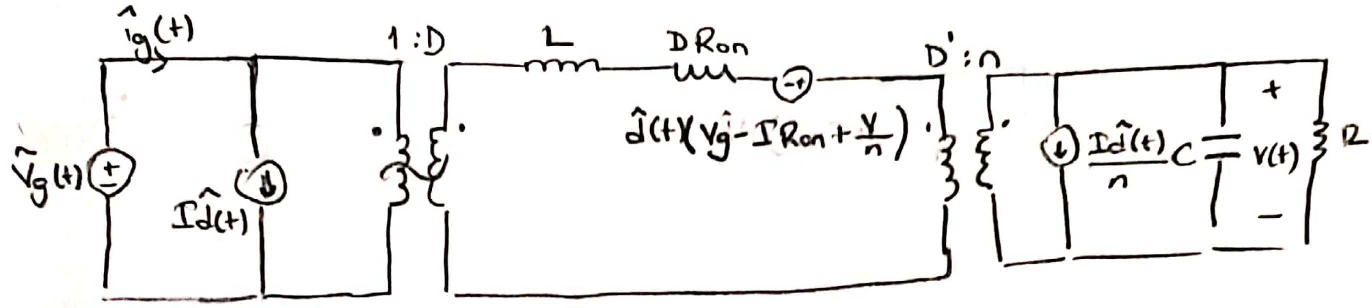
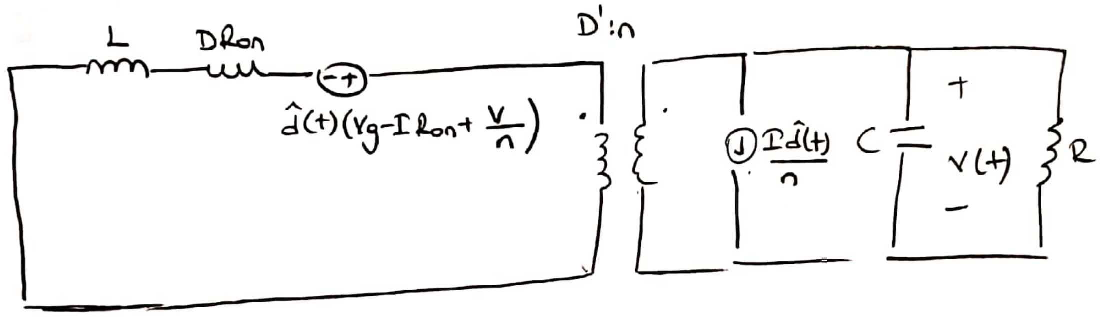
CCM Flyback Control-to-Output Transfer Function Derivation

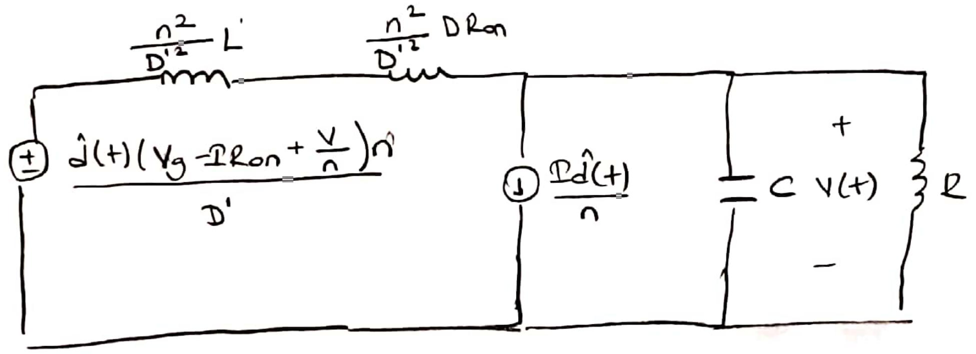


↳ Erikson'un kitabından small signal model

$\hat{V}_g(t) = 0$ for control to output tf. Therefore, circuit becomes

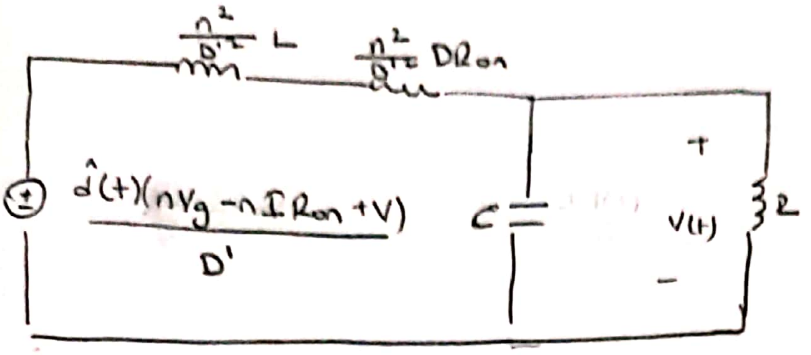


Referring everything to secondary side



Superposition :

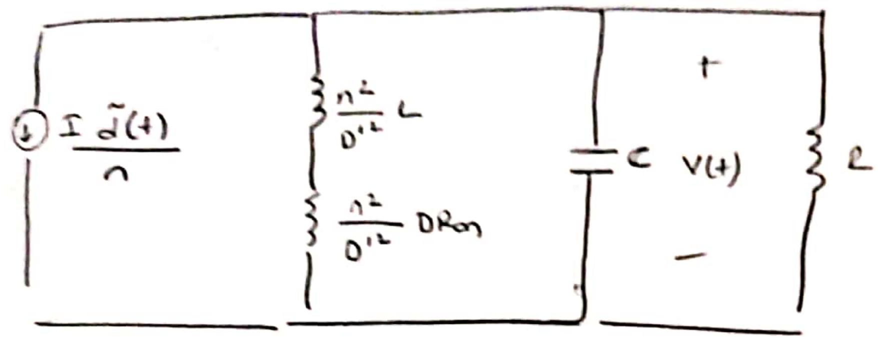
Killing Current Source:



$$\frac{\tilde{v}}{\tilde{d}} = \frac{(nV_g - nIR_{on} + V)}{D'} \times \frac{\left(R \parallel \frac{1}{sC}\right)}{(sL + DR_{on})\frac{n^2}{D'^2} + \left(R \parallel \frac{1}{sC}\right)}$$

$$\frac{\tilde{v}}{\tilde{d}} = \frac{(nV_g - nIR_{on} + V)\, D'R}{n^2(sL + DR_{on})(sCR + 1) + D'^2 R}$$

Killing Voltage Source



$$\frac{V}{d} = \frac{-I}{n} \times \left(\frac{1}{sC} \,//\, R \,//\, (sL + DRon)\frac{n^2}{D'^2} \right)$$

$$\frac{R}{sCR+1} \,//\, (sL+DRon)\frac{n^2}{D'^2}$$

$$\frac{V}{d} = \frac{-I}{\cancel{n}} \times \frac{(sL+DRon)n^{\cancel{2}}R}{RD'^2 + (sL+DRon)n^2(sCR+1)}$$

$$\frac{V_{out}}{V_{in}} =$$

$$\frac{V}{d} = \frac{-V(sL+DRon)n}{RD'^2+(sL+DRon)n^2(sCR+1)} + \frac{D'Rn\,Vg - nVRonD' + VD'R}{n^2(sL+DRon)(sCR+1)+RD'^2}$$

$$\frac{V}{d} = \frac{-nVLs - DRon\,nV - D'Ron\,nV + D'Rn\,Vg + VD'R}{n^2(sCR+1)(sL+DRon) + RD'^2}$$

$$\frac{V}{d} = \frac{-n\frac{VgD}{D'n}Ls - Ron\,n\frac{VgD}{D'n} + D'Rn\,Vg + \frac{VgD}{D'n}D'R}{n^2(sCR+1)(sL+DRon) + RD'^2}$$

$$\frac{\hat{v}}{\hat{d}} = \frac{(-V_g D L s - R_{on} V_g D + D'^2 R n V_g)n + V_g D D' R}{D' n [n^2 (sCR+1)(sL+DR_{on}) + R D'^2}$$

$$= \frac{-V_g (D L n s + R_{on} D n - D'^2 R n^2 - D D' R)}{D' n \left[n^2 (sCR+1)(sL+DR_{on}) + R D'^2 \right]}$$

where $D' = 1 - D$