Last time: we treated $C_1$ as extra element.

To find line-to-output transfer function:

$$G_{vg}(s) = \left. \frac{v_{c2}}{v_g} \right|_{d=0} = G_{vg-old}(s) \cdot \frac{1 + \frac{sC_2}{2}}{1 + \frac{sD}{2}}$$

where $G_{vg-old}(s) = G_{vg}(s)$ with $C_1 \rightarrow$ open circuit.

$Z(s) = \frac{1}{sC_1}$

$G_{vg-old}(s)$ was found to be identical to the $G_{vg}(s)$ of an effective buck-boost converter, with poles $\omega_0$ having $Q_0$.

$Z_0(s)$ was found to be $sL_2/D$.

$Z_{in}(s) = \frac{1}{sL_2}$

we'll come back to working out the composite $G_{vg}(s)$ in a minute.
\[
\frac{g_{ud}(s)}{v_{c2}} = \left| \begin{array}{c}
\frac{v_{c2}}{s} \\
\end{array} \right|_{s \to 0} = \frac{1 + \frac{2\pi d}{\varepsilon}}{1 + \frac{2\pi d}{\varepsilon}}
\]

\[
g_{ud}(s) = g_{ud-old} \left. \frac{\frac{v_{c2}}{s}}{s} \right|_{s \to 0} = \frac{1 + \frac{2\pi d}{\varepsilon}}{1 + \frac{2\pi d}{\varepsilon}}
\]

\[c_1 \to \text{open circuit} \]

\[\text{short} \]

\[\frac{V_1}{\Delta D} \]

\[\frac{I_2}{\Delta D} \]

\[\frac{V_2}{\Delta D} \]

\[\frac{\mathbf{R}}{\Delta D} \]

\[\frac{V_{C2}}{\Delta D} \]
\[ G_{vd\text{-old}}(s) = \frac{D}{D'} \left( \frac{V_1}{D D'} - \frac{s L_1 I_2}{D' L_1} \right) \]
\[
\frac{1 + s \left( l_2 \frac{D'}{D} \frac{2}{l_1} \right) \frac{L_1}{R} + s^2 C_2 \left( l_2 + \left( \frac{D'}{D} \right)^2 L_1 \right)}{1 + s \left( \frac{L_2}{D} \frac{2}{L_1} \right) \frac{L_1}{R} + s^2 C_2 \left( l_2 + \left( \frac{D'}{D} \right)^2 L_1 \right)}
\]

\[ = G_{d0} \frac{(1 - \frac{s}{\omega_1})}{1 + \frac{s}{Q_0 \omega_0} + \left( \frac{s}{\omega_0} \right)^2} \]

- Same poles \( \omega_0, Q_0 \) as \( G_{dg\text{-old}} \)
- RHP zero at \( \omega_1 = \frac{R}{L_1} \left( \frac{D'}{D} \right)^2 \)
- \( G_{d0} = \frac{V_0}{D' L_1} \)

"Equivalent buck-boost"
Now add $C_1$.

$$G_{vd}(s) = G_{vd-old} \cdot \frac{\frac{2\pi}{s}}{1 + \frac{2\pi}{s}}$$

$$2\pi = \frac{v_n}{i} \left. \frac{v_{c2} \to 0}{v_g \to 0} \right.$$  

in presence of input $d$, adjust $i^*$ to null $v_{c2}$.

$$\hat{v} = sL_2 \hat{i} + \frac{D'}{D} sL_2 \hat{i} - \frac{V_i}{DD'} \hat{d} = \frac{sL_2 \hat{i}}{D} - \frac{V_i}{DD'} \hat{d}$$

Need to eliminate $\hat{d}$ and solve for $2\pi = \frac{v}{\pi}$.

we can write:

$$\hat{i} = \frac{I_2}{D^{\frac{1}{2}}} \hat{d} + \frac{1}{sL_1} \left( \frac{\frac{D'}{D} sL_2 \hat{i} - \frac{V_i}{DD'} \hat{d}}{\hat{v}_{L_1}} \right)$$
Solve for $\hat{d}$:

$$\hat{d} = i \frac{D'^2}{I_2} \frac{(1 - \frac{D' L_2}{D L_1})}{(1 - \frac{V_1 D'}{I_2 D L_1})}$$

Plug into $\hat{v}$ equation:

$$\hat{v} = \frac{S k_2}{D} i - \frac{V_1}{D D'} i \frac{D'^2}{I_2} \frac{(1 - \frac{D' L_2}{D L_1})}{(1 - \frac{V_1 D'}{s D L_1 I_2})}$$

Solve for $2_{nd} = \frac{\hat{v}}{i}$ and simplify using $\frac{V_1}{I_2} = \frac{D'}{D} R$

Result:

$$2_{nd}(s) = S \left( \frac{L_1 + L_2}{R} \right) \frac{\frac{L_1 L_2 D}{D'^2}}{(1 - s \frac{D'^2 L_1}{D'^2 R})}$$

Same low frequency asymptote as $12\pi n l$ of Fig. high frequency asymptote is $wl_2$
\[ G_{do} \quad \text{same as for Gug} \]

\[
\frac{1 + \frac{2\pi d}{\lambda}}{1 + \frac{3\pi d}{\lambda}}
\]

"Glitch" from correction factor \( \approx \)

\[
\omega \left( \frac{L_2}{D^2} \right) \frac{1}{D^2}
\]

\[
(1.2) = \frac{1}{\omega C_1}
\]