Switch Conversion Ratio

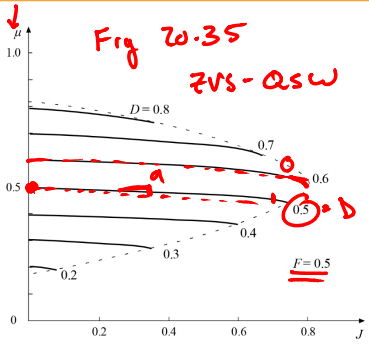


Fig 20.35

ZVS-QSW

PWM Boost

$\frac{V}{V_g} = M = \frac{1}{1-d}$

ZVS-QSW:

$\frac{V}{V_g} = \frac{1}{1-M} \rightarrow M = 0.5$

$M \approx D$ for J small

Approx knee $a = 0.05$

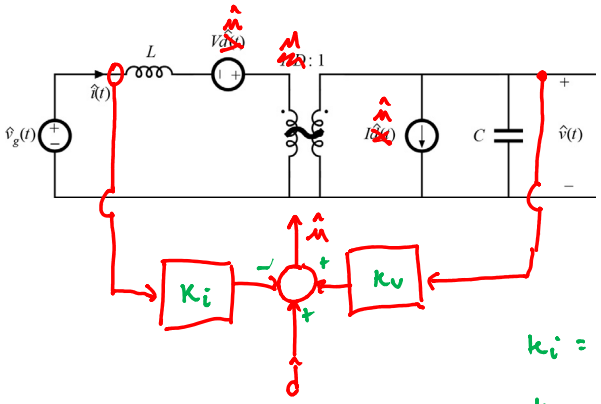
$M \approx d - aJ$

$J = \frac{i_{out}}{V_g} R_e$

$\hat{m} = \hat{d} - \frac{a}{V_g} R_e \hat{i}_{out} + \frac{a I_{out}}{V_g^2} \hat{v}_g = \hat{d} - \frac{a R_e}{V} \hat{i}_c + \frac{a I_c}{V^2} \hat{v}$

K_i K_v

Boost SSM



$k_i = \frac{a R_e}{V}$

$k_v = \frac{a R_e I_c}{V^2}$

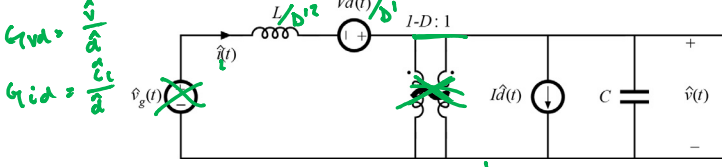
PWM Converter Transfer Functions

for trad. PWM Boost

$L_{eq} = \frac{L}{D'^2}$

$G_{vd} = \frac{\hat{v}}{\hat{d}}$

$G_{id} = \frac{\hat{i}_L}{\hat{d}}$

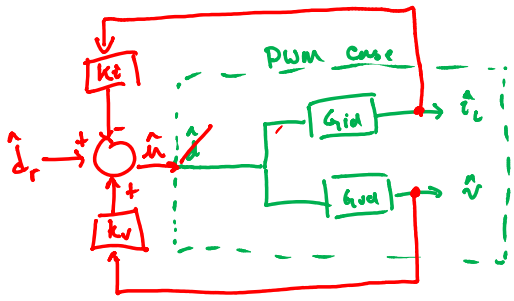


$$G_{vd} = \frac{\hat{v}}{\hat{d}} = \frac{V}{D'} \frac{\frac{1}{sC}}{sL_{eq} + \frac{1}{sC}} + -I \frac{\frac{1}{sC} \cdot sL_{eq}}{\frac{1}{sC} + sL_{eq}} = G_{do} \frac{1 - \frac{s}{\omega_z}}{1 + \left(\frac{s}{\omega_0}\right)^2}$$

$$G_{do} = \frac{V}{D'} \qquad \omega_z = \frac{D'^2 V}{L I_0} \qquad \omega_0 = \frac{D'}{\sqrt{LC}}$$

$$G_{id} = \frac{\hat{i}_L}{\hat{d}} = \frac{V}{D'} \frac{1}{sL_{eq} + \frac{1}{sC}} + I \frac{\frac{1}{sC}}{sL_{eq} + \frac{1}{sC}} = G_{io} \frac{1 + \frac{s}{\omega_{zi}}}{1 + \left(\frac{s}{\omega_0}\right)^2}$$

$$G_{io} = \frac{I_0}{D'^2} \qquad \omega_{zi} = \frac{I_0}{VC}$$



$\hat{v} = G_{vd}\hat{m}$

$\hat{m} = \hat{d}_r - \hat{m} G_{id} k_i + \hat{m} G_{vd} k_v$

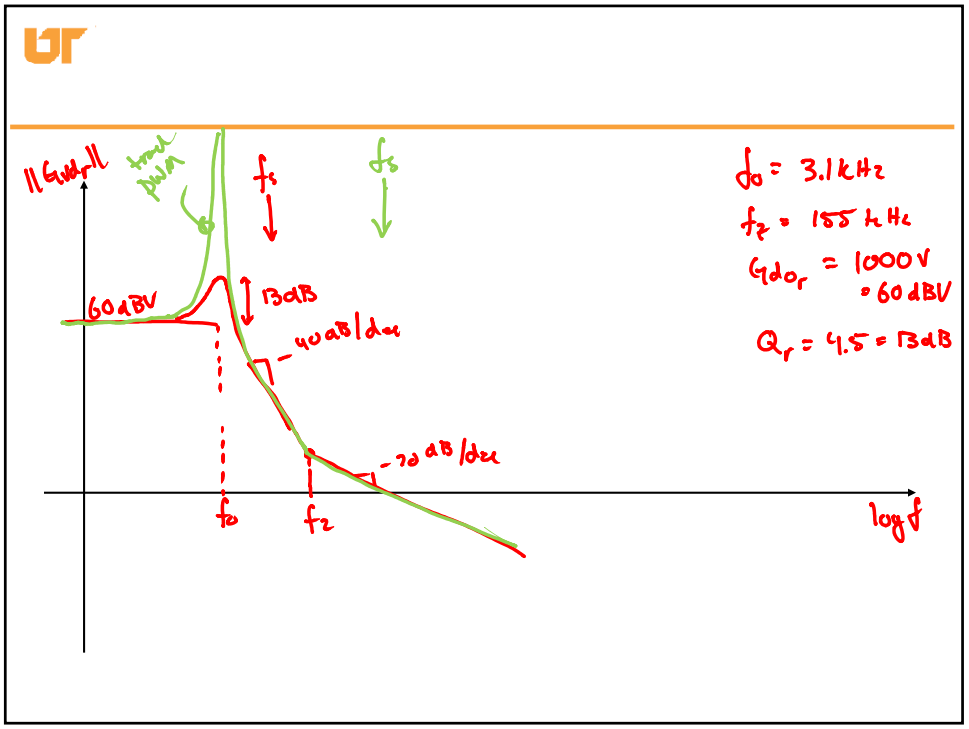
$\hat{m} = \frac{\hat{d}_r}{1 + G_{id} k_i - G_{vd} k_v}$

$\frac{\hat{v}}{\hat{d}_r} = \frac{G_{vd}}{1 + G_{id} k_i - G_{vd} k_v}$ → $U = 1 + G_{io} k_i - G_{do} k_v$

$$G_{vd_r} = \frac{G_{do}}{U} \frac{1 - s/\omega_z}{1 + \frac{k_i G_{io}}{\omega_{zi}} + \frac{k_v G_{do}}{\omega_z} + \frac{s^2}{\omega_0^2 U}}$$

@ DC

$U = 1 + \frac{I_0}{D'^2} \frac{aR_0}{V} - \frac{V}{D'} a \frac{R_0 I_L}{V^2} = 1$ (Q ↑ ∞)


$\|G_{vd_f}\|$
true plot
f_1
f_3
60 dBV
3dB
-40 dB/dec
-20 dB/dec
f_0
f_2
log f
$f_0 = 3.1\,kHz$
$f_2 = 155\,kHz$
$G_{do_f} = 1000\,V/V = 60\,dBV$
$Q_f = 4.5 = 13\,dB$