Announcements

- Presentation from General Motors (electrification and controls)
  - Thursday (tomorrow) at 3:40 in MK 524

a) Buck-Boost: $\frac{V}{V_g} = \frac{D}{D'} = \frac{1}{2} \rightarrow \boxed{D = \frac{1}{3}}$

b) To get $P_{out} = \frac{V^2}{R} = 1000W$,

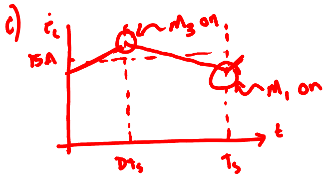
$\rightarrow I_L = \boxed{\frac{I_{out}}{D'} = \frac{3}{2}\frac{1000W}{200V}} =$ ~~15A~~

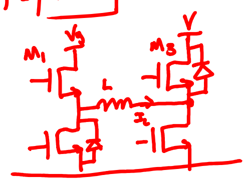
7.5 A – Note: values for the remainder of the problem are affected

Assume $R_{ds} = 100m\Omega$ still applies at 15A current at any time, I_L flows through two devices, so

$P_{cond} = I_L^2(R_{ds} \cdot 2) = \boxed{45W}$

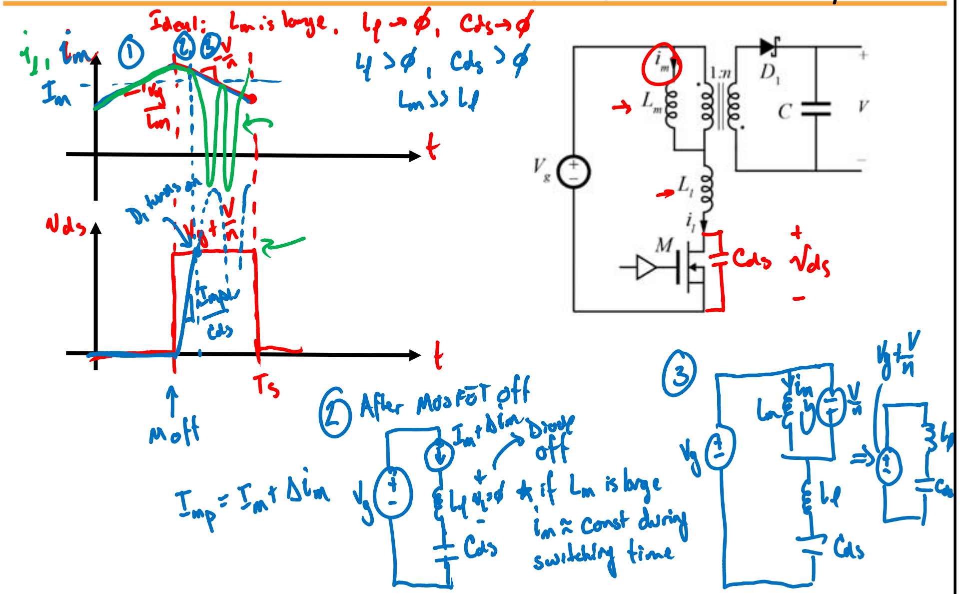
c)



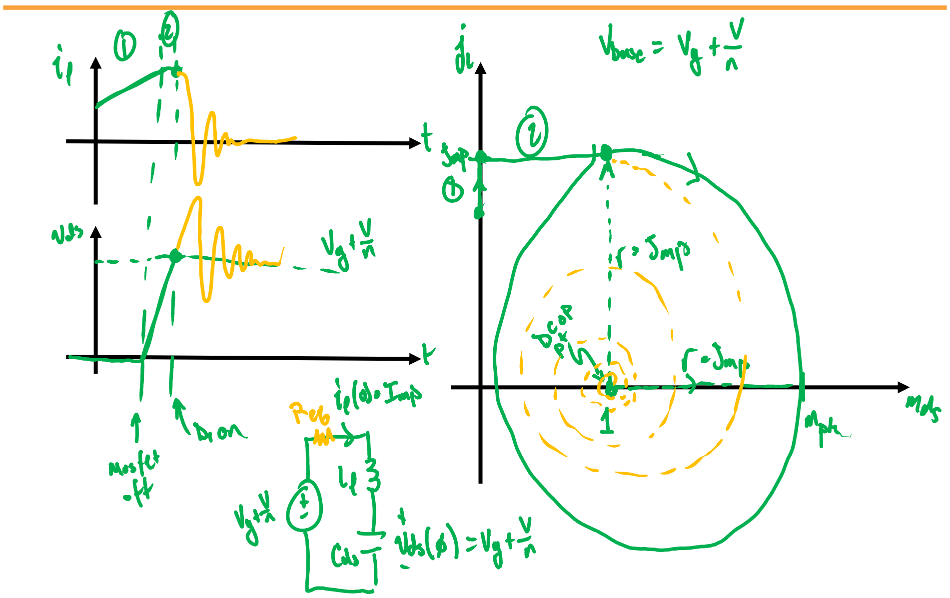


w/ constant I_g, V_{gs} tracks Q_g waveform under hard-switched conditions. When soft-switched, the "miller plateau" will dissapear. Because of direction of I_L & adequate tdt, D_2 & D_3 are conducting during all turn-on transitions

CCM Flyback: Ringing Due to L_l



MOSFET turn off



Leakage Voltage Stress

$m_{pk} = 1 + J_{mp}$

$$V_{pk} = V_{base}\, m_{pk} = \left(V_g + \frac{V}{n}\right)\left(1 + (I_m + \Delta i_m)\frac{R_o}{V_g + \frac{V}{n}}\right)$$

$$= V_g + \frac{V}{n} + R_o(I_m + \Delta i_m)$$

$I_m = \frac{I_{out} n}{D'}$

$2\Delta i_m = \frac{V_g}{L_m} D T_s$

} $I_m + \Delta i_m = I_{mp} = 550$ mA

ex

Similar to HW6

$V_g = 400V$

$V = 10V$

$P = 100W$

$f_s = 1MHz$

$D = 0.5$

$n = \frac{1}{40}$

$C_{ds} = 100pF$

$L_m = 1.8mH$

$L_\ell = 35\mu H$ (2% of L_m)

$R_o = \sqrt{\frac{L_\ell}{C_{ds}}} \approx 600\Omega$

$V_{base} = V_g + \frac{V}{n} = 800V$ Voltage stress in ideal case

$V_{pk} = 800V + 600\Omega(550mA)$

$V_{pk} \approx 1150V$!

Risk of destruction or higher rating necessary

Leakage Switching Loss

$E_{start} = \frac{1}{2} C_{ds}\left(V_g + \frac{V}{n}\right)^2 + \frac{1}{2} L_\ell I_{mp}^2$

$E_{end} = \frac{1}{2} C_{ds}\left(V_g + \frac{V}{n}\right)^2$

$E_{loss} = \frac{1}{2} L_\ell I_{mp}^2$

$= \frac{1}{2}(35\mu H)(550mA)^2$

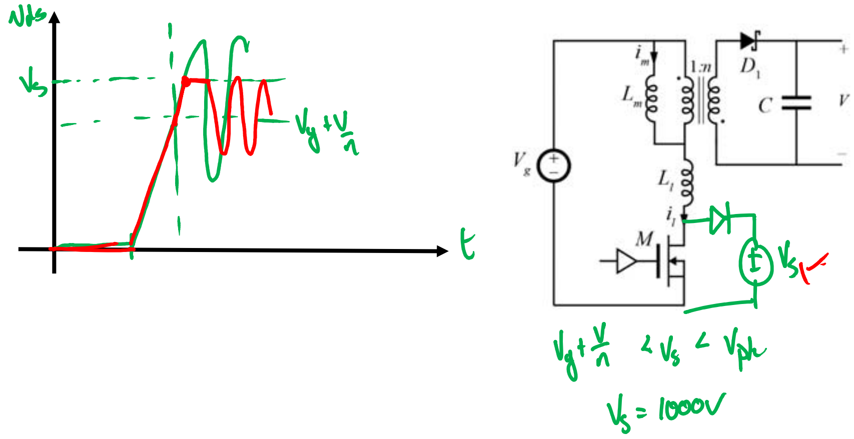
$\approx 5.29\mu J$

@ $1MHz = f_s$

$P_{loss} = 5.29W$

* Assuming ringing dies out before the end of the switching period.

CCM Flyback: Clamping Circuit



Clamped State Plane