Conduction Efficiency

$$\eta = \frac{V_o I_o}{V_{in} I_{in}} \quad \text{—— (1)}$$

$$\frac{V_o}{V_{in}} = D_{no\text{-}loss}$$

$$I_{in} = D_{load} \cdot I_o$$

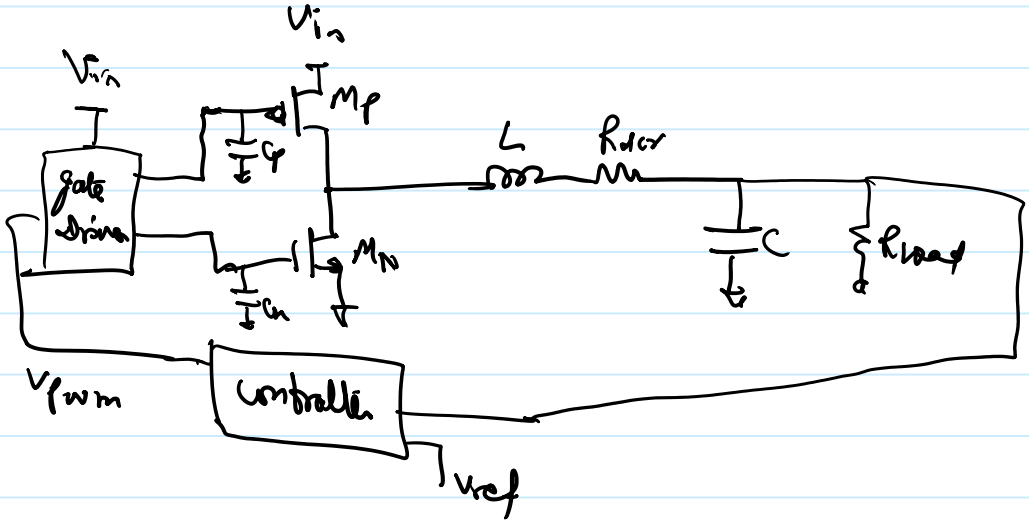
substitute in (1)

$$\eta_{cond} = \frac{D_{no\text{-}loss}}{D_{load}}$$

in CCM mode

and V_{in} at $D_{no\text{-}loss}$ = V_{in} at D_{load}

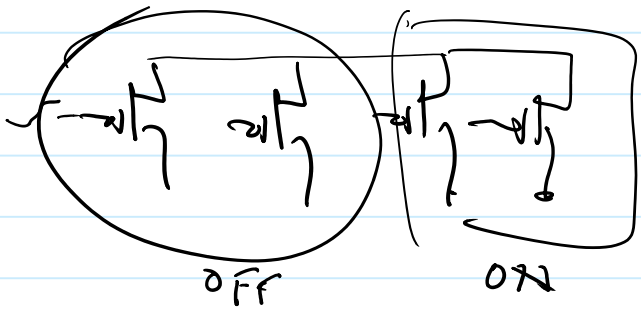
Switching Losses - Gate Drive Loss



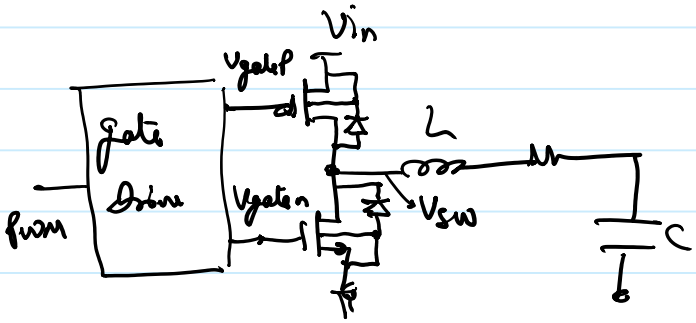
$$P_{sw\text{-}gate} = C_P V_{in}^2 F_{sw} + C_N V_{in}^2 F_{sw}$$

$$C_P + C_N = C_{gate}$$

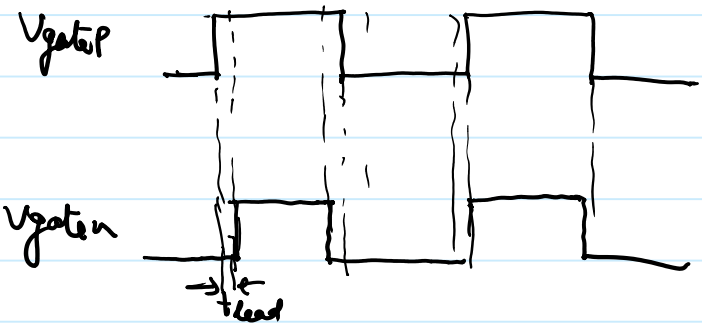
$$\boxed{P_{sw\text{-}gate} = C_{gate} V_{in}^2 \cdot F_{sw}}$$



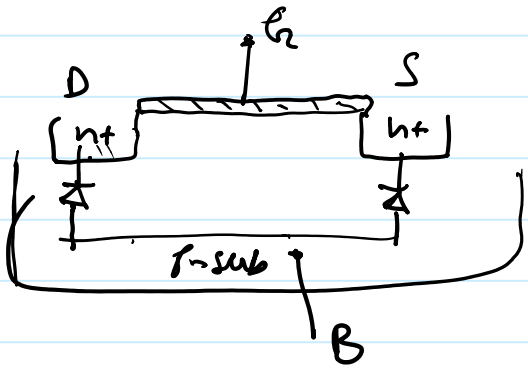
Switching Losses - Dead Time Loss



non-overlap gate Drive
(Break before Make)

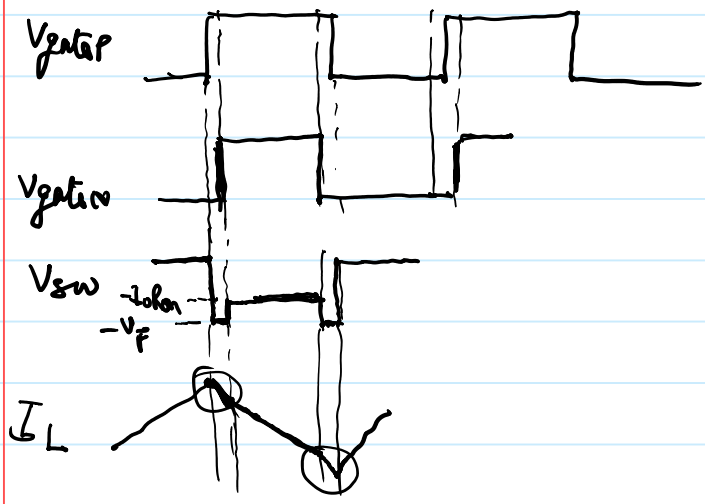


tdead → non-overlap time



during tdead current conducts through body diode of NFET.

Switching Losses - Dead Time Loss



Dead time loss

$$P_{dead} = V_F \times I_0 \times \frac{t_{dead}}{T_{sw}} \times 2$$

$$\boxed{P_{dead} = 2\, V_F \cdot I_0\, t_{dead} \times F_{sw}}$$

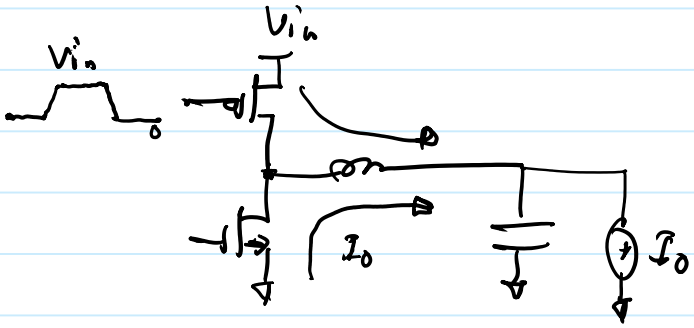
$\frac{t_{dead}}{T_{sw}}$ should be very small for higher eff.

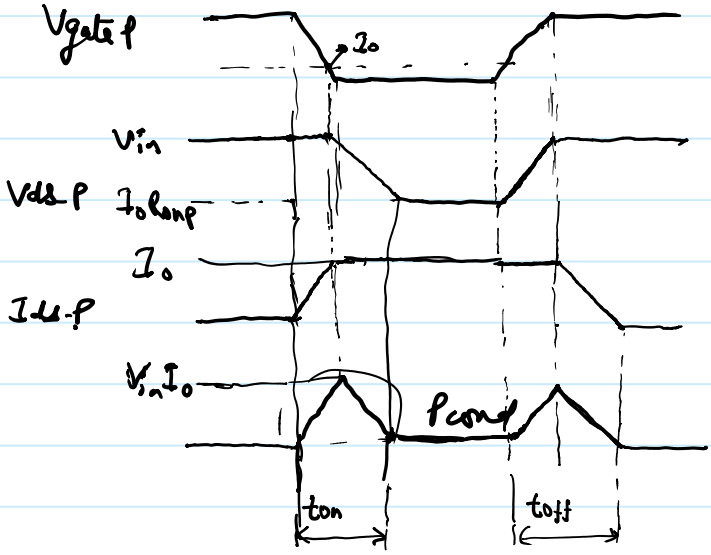
$t_{dead} = 10ns$, $T_{sw} = 1\mu s$

$V_F = 0.7$ & $I_0 = 1A$

$$\frac{10n}{1\mu} \times 0.7 \times 1 \times 2 = \frac{1.4}{100} = \boxed{14mW}$$

Power FETs Switching Loss





$$P_{sw\_loss} = \frac{1}{2} V_{in} \cdot I_0 (t_{on} + t_{off}) F_{sw}$$