A stress \( V_{DS \text{ (off)}} \): Flyback diode on

\[ V_p = \frac{(V_o)}{n_2} n_1 + \text{polarity} \]

\[ V_g - V_o - \frac{V_o n_1}{n_2} - \frac{V(\text{low}) n_1}{n_2} \]

\[ V_{DS}(t) \]

Soon CH 19 
Le can cause ringing with \( C_{as \text{ (off)}} \) on no sec \( V_{In} \)
Intro to Pbm 6.4

$V_{ds(\text{off})}$ stress is worst case (w.o. $L_e$) = $V_g + \frac{V}{n}$

$L_e$ (leakage) exists:

Next level

$V_{ds(\text{off})} = V_g + \frac{V}{n} + V_L$

$V_{ds(\text{off})}$ is Correct?
Next next level

Series resonance

$V_{as} \rightarrow \text{No Ch19} \Rightarrow \text{changes to}$

$V_{as(peak)}$ kills FET

Ring causes EMC noise! cannot pass compliance
Figure 1b: Flyback converter drain voltage with no snubber

How to reduce ringing?
What about \( L \) (leakage) in series, it stores \( \frac{1}{2} I^2 L \) when FET is on.

FET goes off, this energy "tugs" via \( C_{ds} \) (off).

\[ L \approx 563 \]
Transistor stress in flyback converter

V_{ds}pk it happens when Q turns OFF

D turns on only on interval 3 and remains reversed biased as long as:

\[(V_{g}-V_{ds})(N2/N1) > V\]

The average power loss \(P_s\) for parasitic elements \(L_L\) and \(C_{ds}\) is:

\[P_s = \frac{1}{2} L_L I_m^2 f_s\]

Transistor voltage peak \(V_{ds pk}\) is:

\[V_{ds pk} = V_{g} + (N1/N2)(V + V_d) + (D/D_s^2)(R_o/R)V_g\]

\(R_o = (L_L/C_{ds})^{1/2}\)

The oscillation frequency for the over-voltage is determined by \(L_L\) and \(C_{ds}\)
Choices

FET with C3s
Trf with L_e

Consequences

One fix is use two Q in series driven the same

\( V_{gs} \) (off) effects \( \div 2 \)

Second fix Clamp primary

\( + V_g \)

\( V_g \) (ground)

Never more than \( Q \)

Never more than \( V_g \)