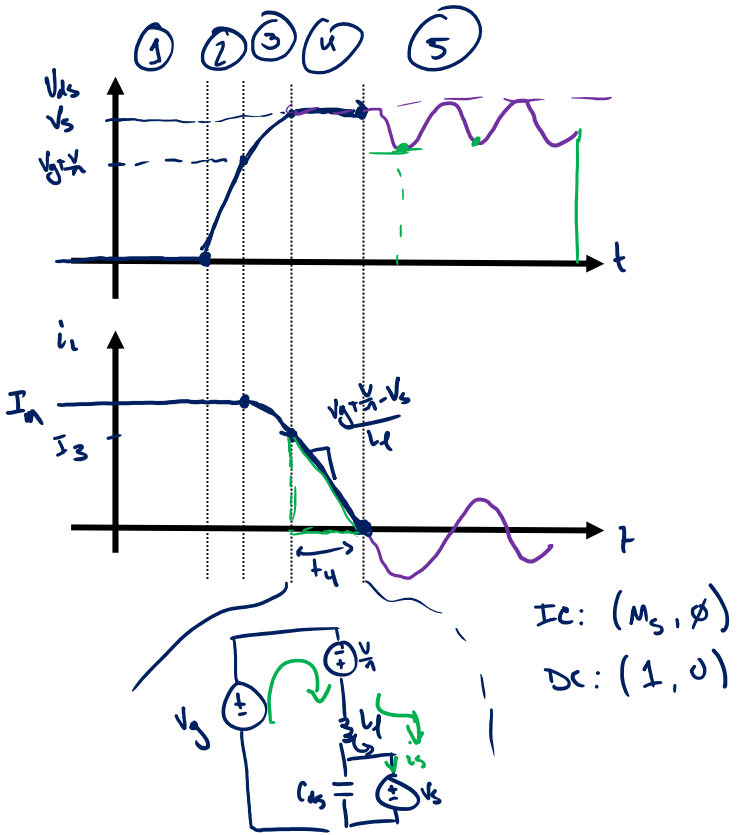
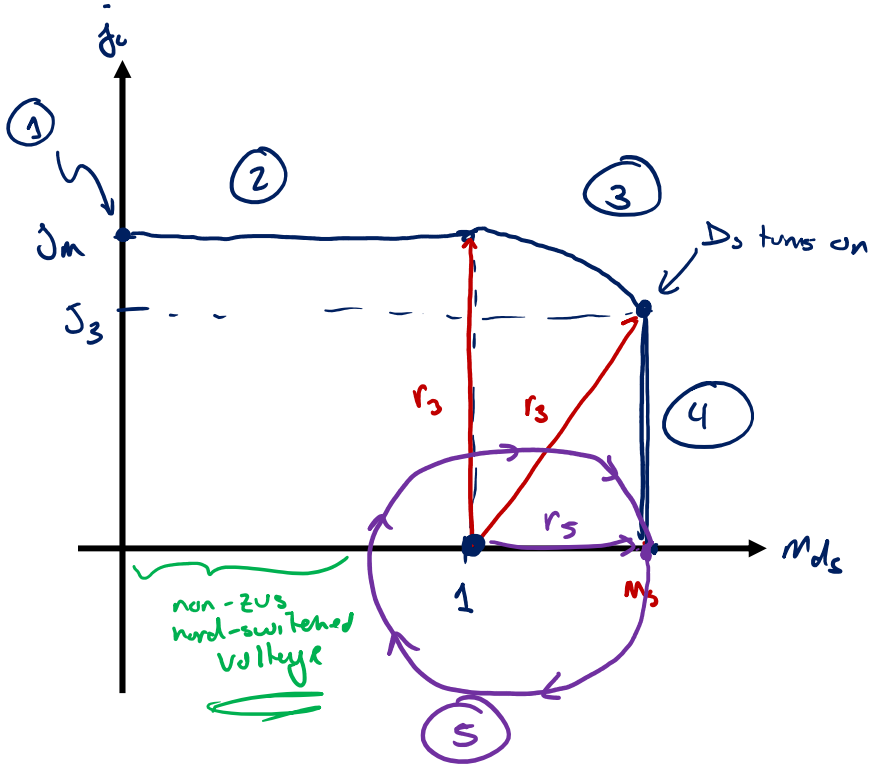
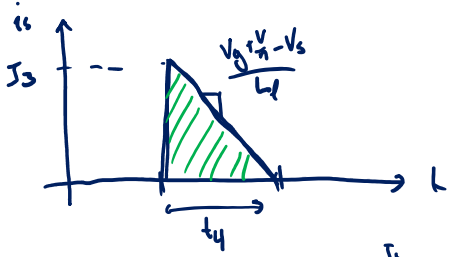
Clamped State Plane





Loss Comparison

$$J_3 = \sqrt{J_m^2 - (m_a - 1)^2}$$



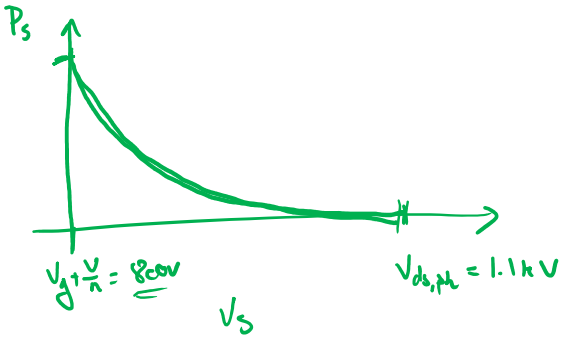
$$P_s = E_s f_s = f_s \int_0^{T_s} V_s \cdot i_s \, dt = f_s V_s \int_{t_4} i_s \, dt$$

$$= f_s V_s \frac{1}{2} t_4 I_3 = f_s V_s \frac{1}{2} I_3 \left[\frac{I_3 L_f}{V_g + \frac{V}{n} - V_s} \right]$$

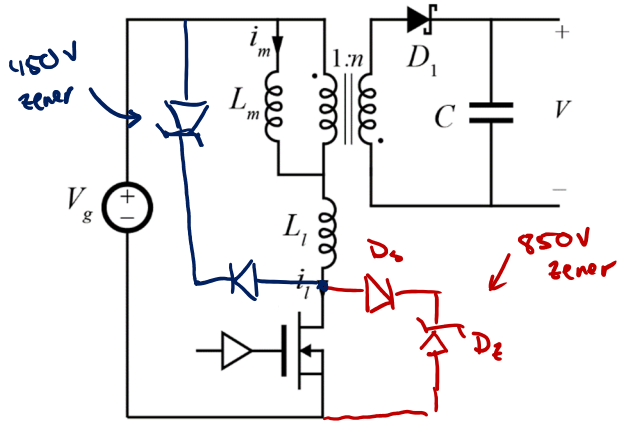
Plug in from previous design with $V_s = 850V$

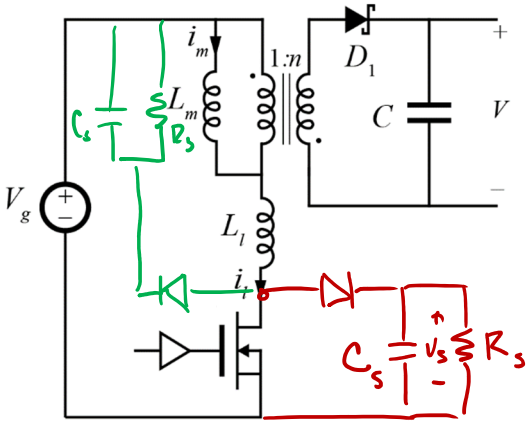
$E_s = 72\mu J$

$P_s = 72W$ → Huge!



Snubber Implementations

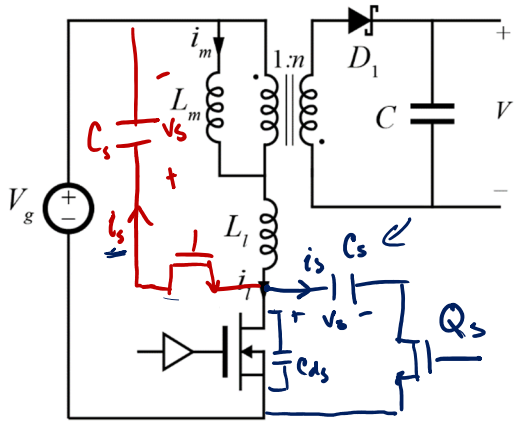




C_s → large, filter element

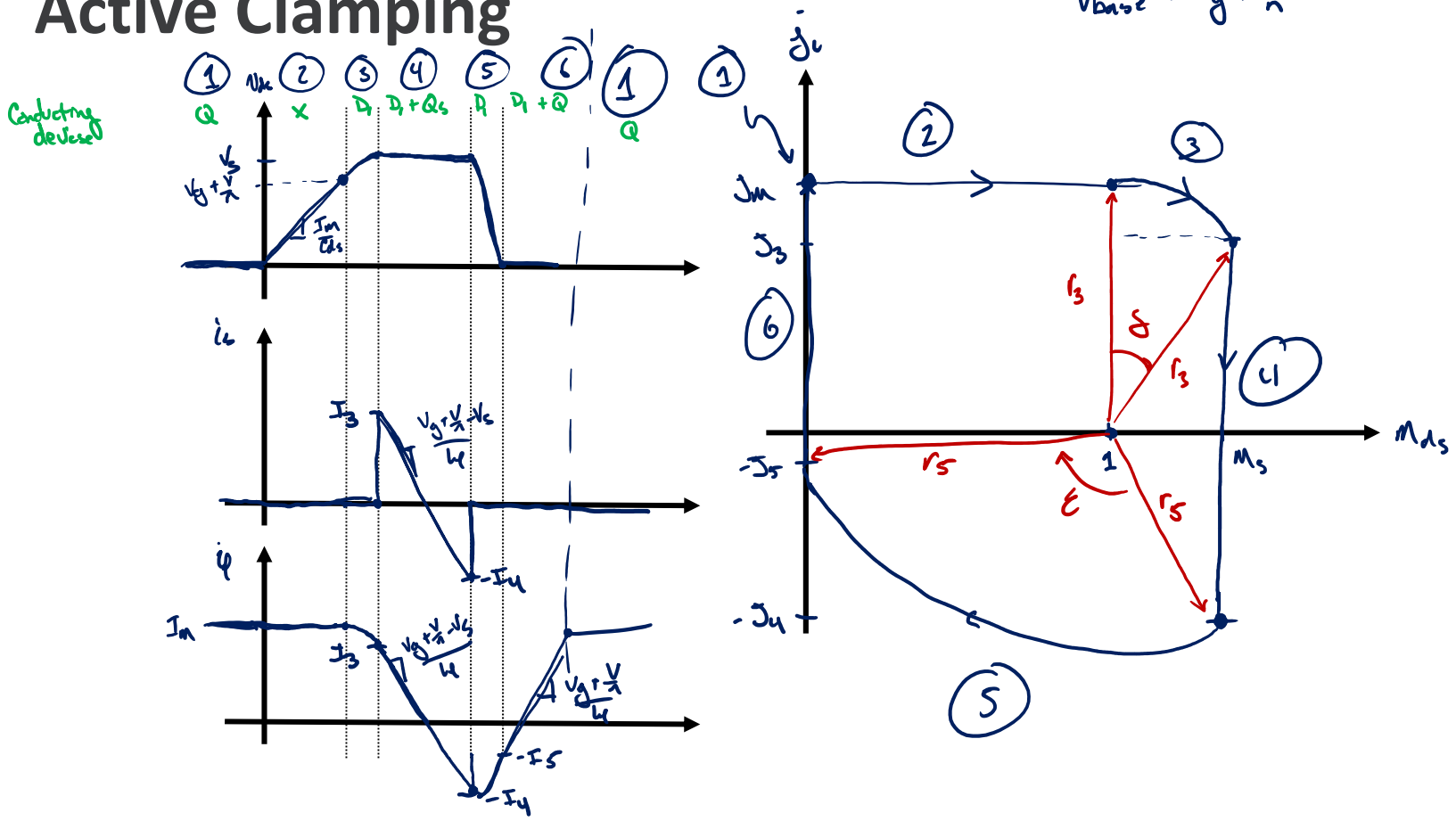
$P_s = \frac{V_s^2}{R_s}$

Active Clamping

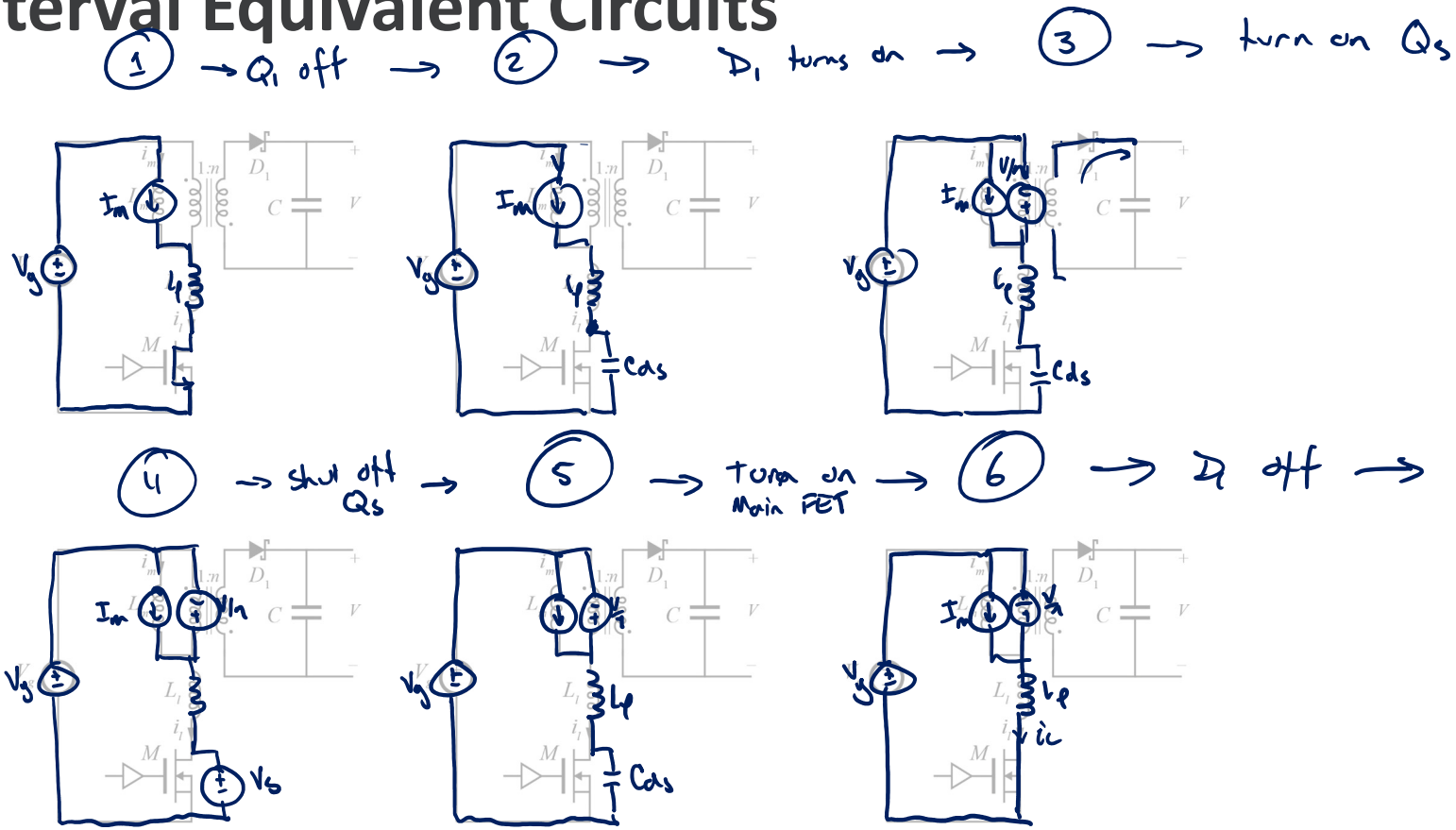


C_s ($\ll L_m$ & C) → large filter elements

Active Clamping



Subinterval Equivalent Circuits



ZVS Conditions

(3) $r_3 \geq m_s - 1$

$$J_m \geq m_s - 1$$

→ Only violated $V_{dc,pk} < V_s$ → No need for clamping

(5) ZVS of Q

$r_5 \geq 1$

$$\sqrt{J_y^2 + (1-m_s)^2} \geq 1$$

Analysis: Intervals 1-3

1. No equation from state plane or time domain

$$T_s = t_1 + t_2 + \cdots t_6$$

$$\frac{2\pi}{F} = \theta_1 + \theta_2 + \delta + \theta_4 + \varepsilon + \theta_6$$

2. $\left(\frac{1}{I_{base}}\right)\frac{I_m}{C_{ds}} t_2 = V_y + \frac{V}{n}\left(\frac{1}{I_{base}}\right)$

$$J_m \frac{t_2}{C_{ds}} = 1 \cdot R_0$$

$$J_m t_2 \frac{1}{C_{ds} R_0} = 1 \rightarrow \boxed{J_m \theta_2 = 1}$$

$$\frac{1}{C_{ds} R_0} = \frac{1}{C_{ds}\sqrt{L_4/C_{ds}}} = \frac{1}{\sqrt{L_4 C_{ds}}} = \omega_0$$

3. $r_3^2 = \boxed{J_m^2 = (M_s - 1)^2 + J_3^2}$

$$\boxed{\gamma = \tan^{-1}\left(\frac{M_s - 1}{J_3}\right)}$$