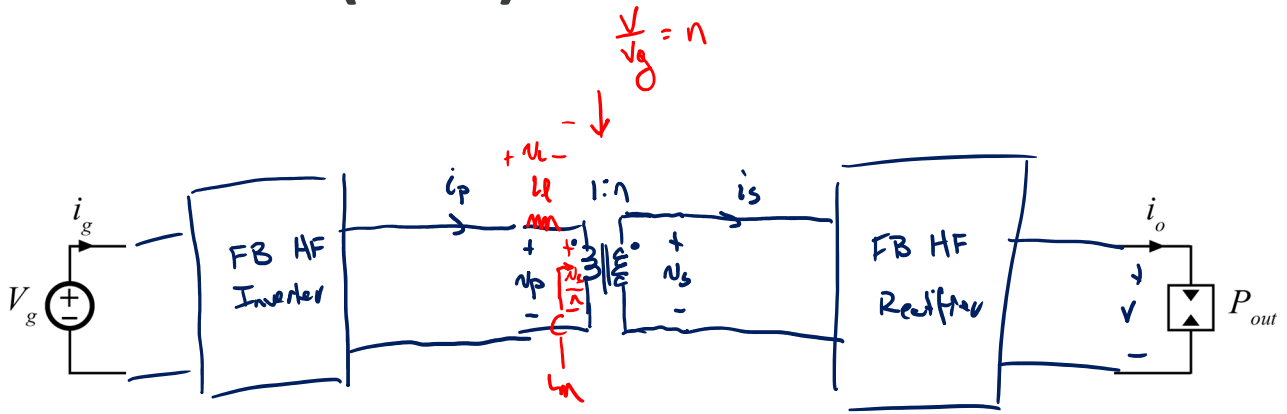
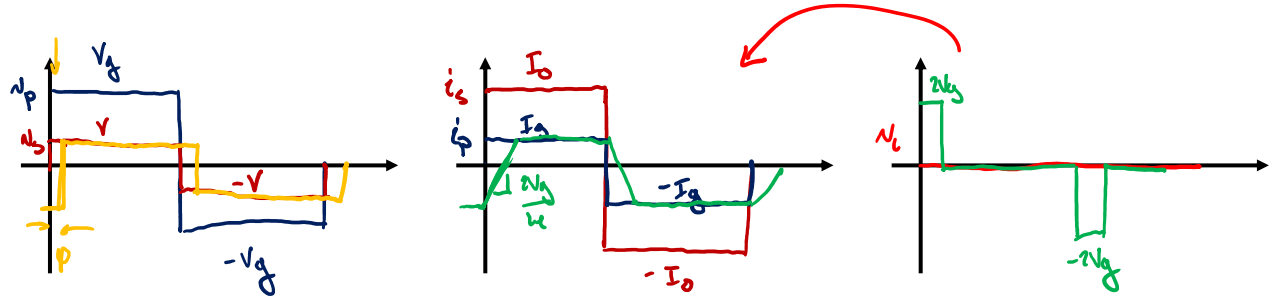
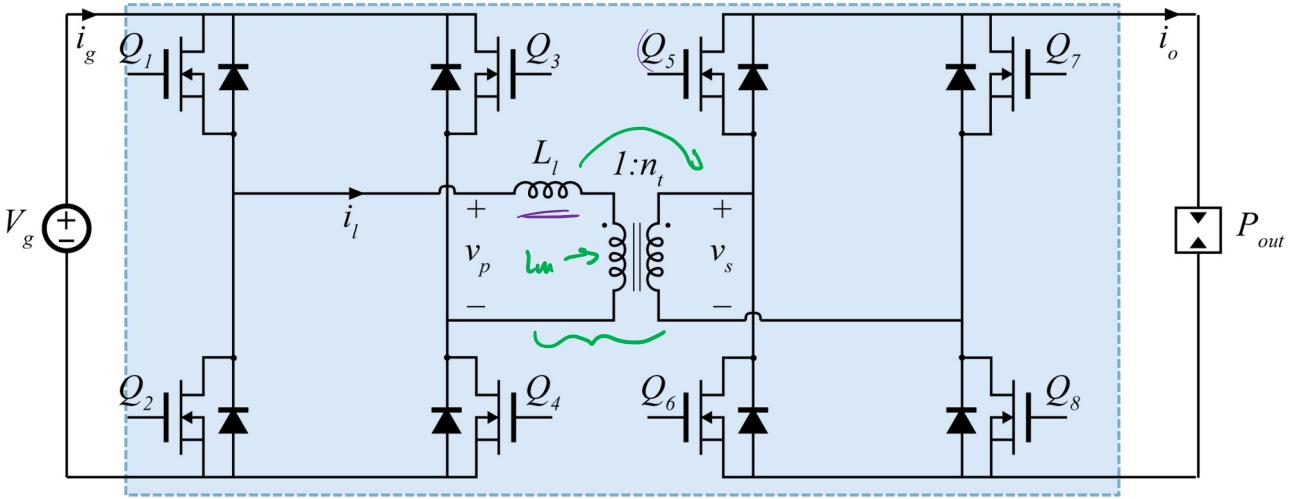
DC-Transformer (DCX)

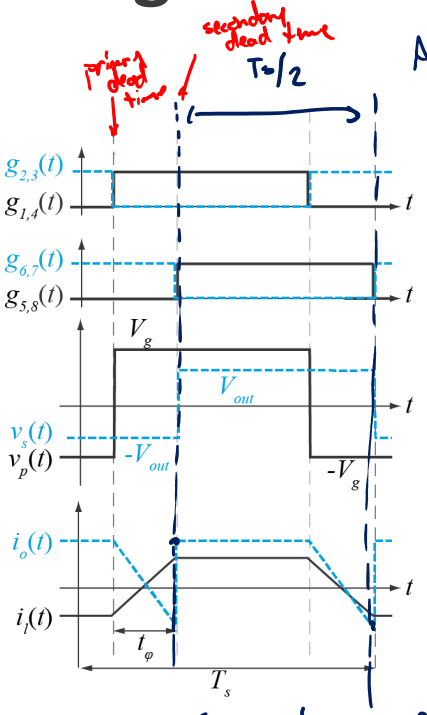




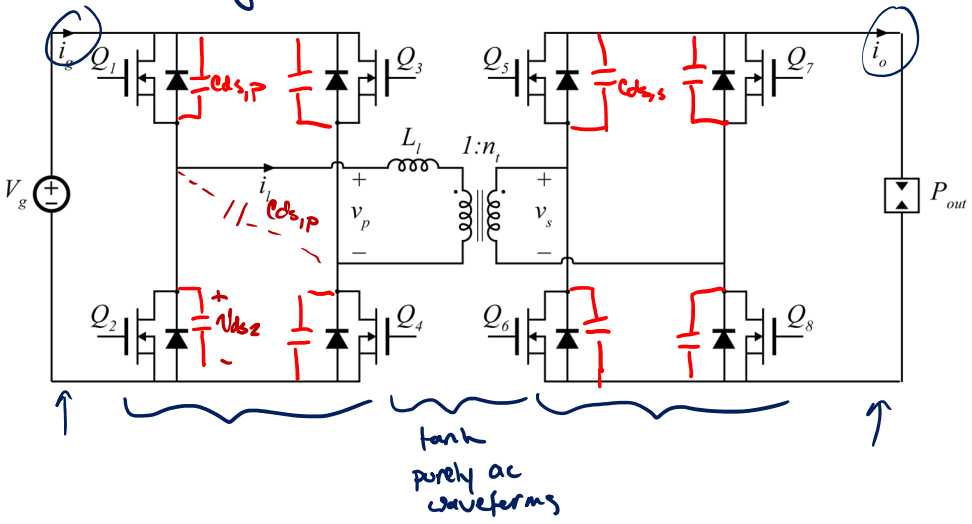
Dual Active Bridge



Switching Behavior (PSM)

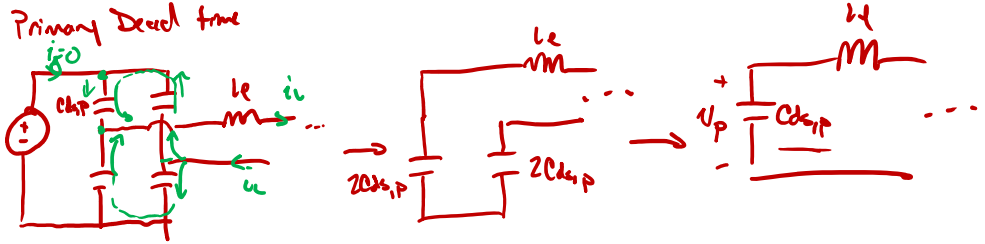


Assume: ① Phase shift Modulation ② $\frac{V}{V_g} = n_t$

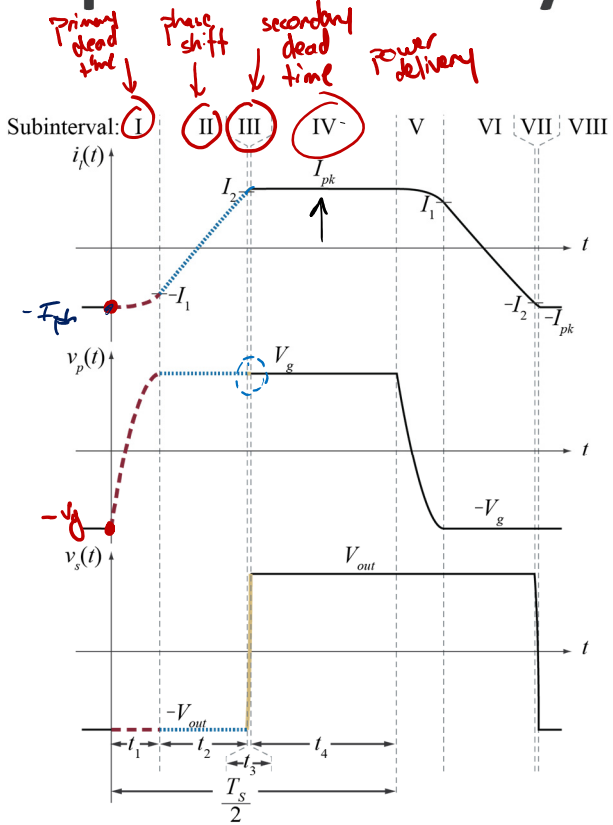


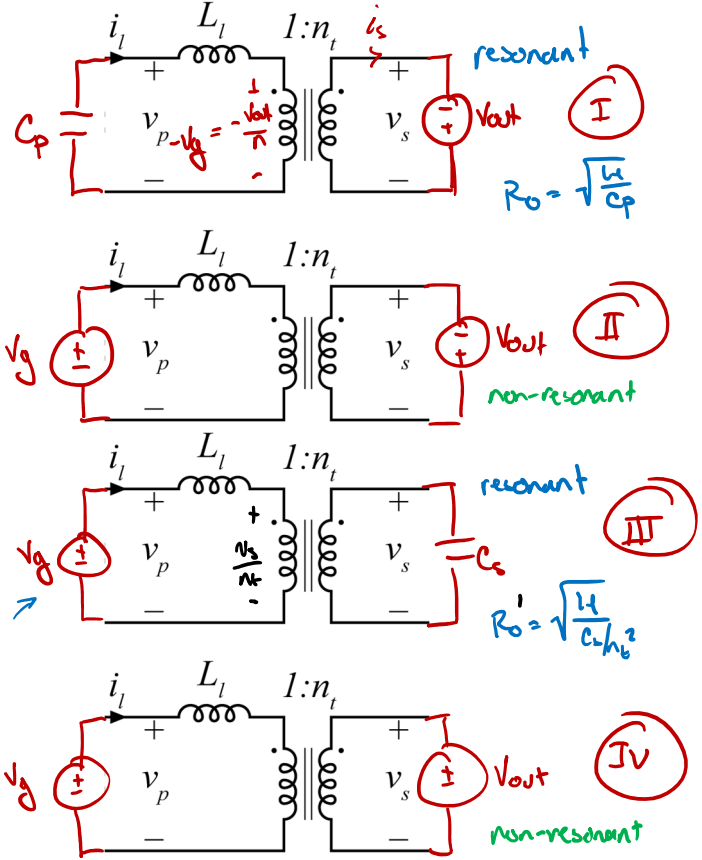
ac waveforms are half-period anti-symmetric

dc waveforms are half-period symmetric

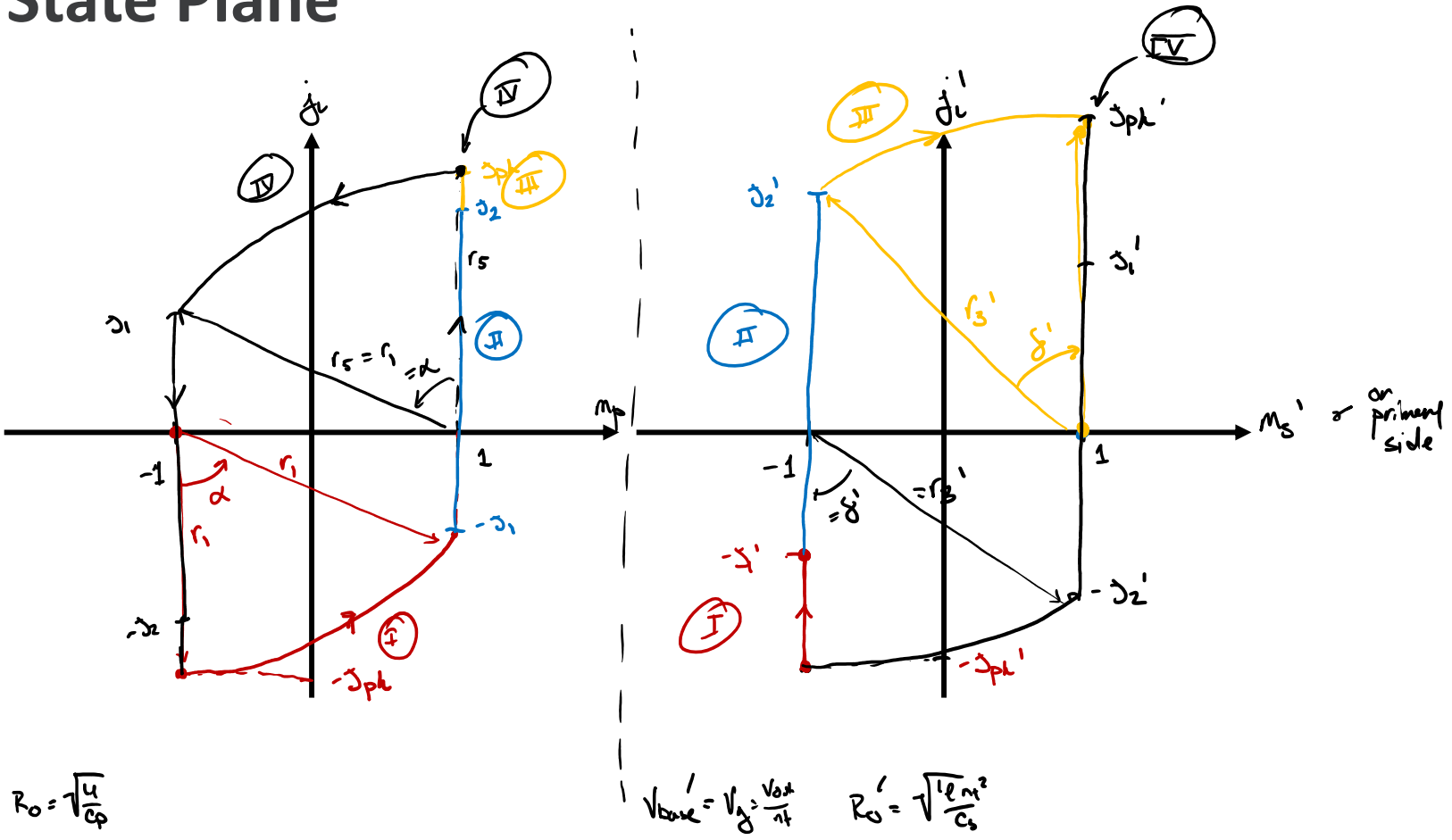


DAB Operation Analysis





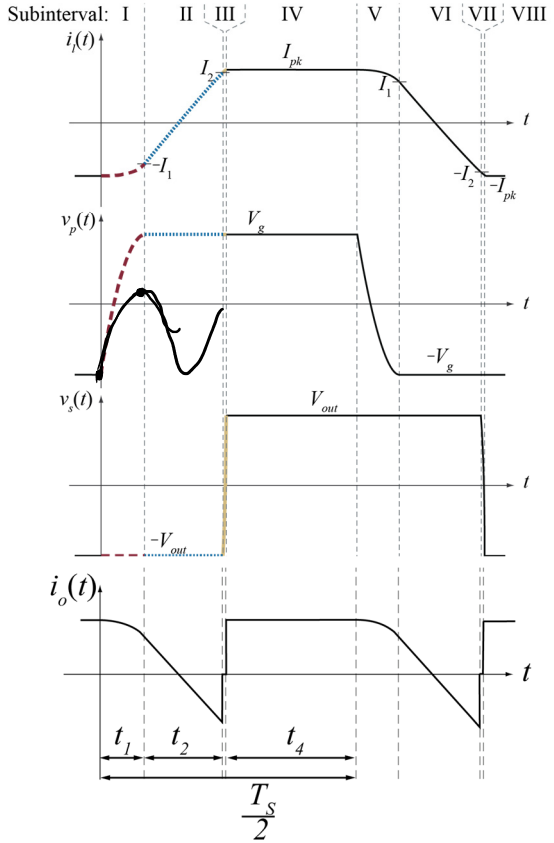
DAB State Plane



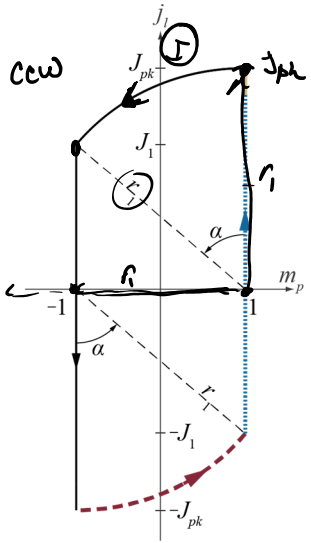
$V_{bank} = V_g$ $\quad R_0 = \sqrt{\frac{L}{C_p}}$

$V_{bank}' = V_g \frac{V_{out}}{n}$ $\quad R_0' = \sqrt{\frac{L_p n^2}{C_s}}$

State Plane Analysis of DAB Converter

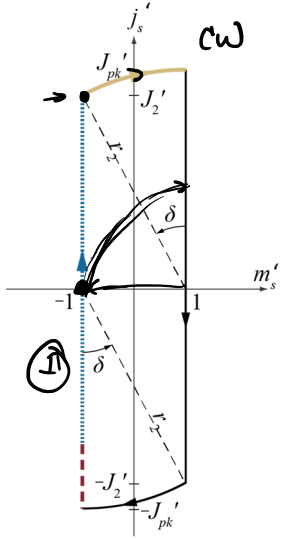


Primary



$$I_{base} = V_g \sqrt{\frac{C_p}{L_l}}$$

Secondary



$$I_{base} = V_g \sqrt{\frac{C_s}{n_t^2 L_l}}$$

ZVS Condition

Primary

$r_1 > 2$

$\boxed{j_{pk} > 2}$

$I_{pk} > 2 I_{base} \Rightarrow I_{pk} > 2 V_g \sqrt{\frac{C_p}{L_1}}$

$\frac{1}{2} L_1 I_{pk}^2 > \frac{1}{2} (2V_g)^2 C_p$

Initial energy in L_1 > Energy supplied to C_p

Secondary:

No constraint for this mode of operation