

DCM Buck State Plane

in ③

$$V_{base} = V_g, \quad I_{base} = \frac{V_g}{R_o}$$

$$\text{DC: } v_{sw} = V \rightarrow m_{sw} = \frac{V}{V_g} = M$$

$$i_L = 0 \rightarrow \dot{i}_L = 0$$

→ center @ (M, 0)

$$\text{IC: } v_{sw} = 0 \rightarrow m_{sw} = 0$$

$$i_L = 0 \rightarrow \dot{i}_L = 0$$

Diodes:

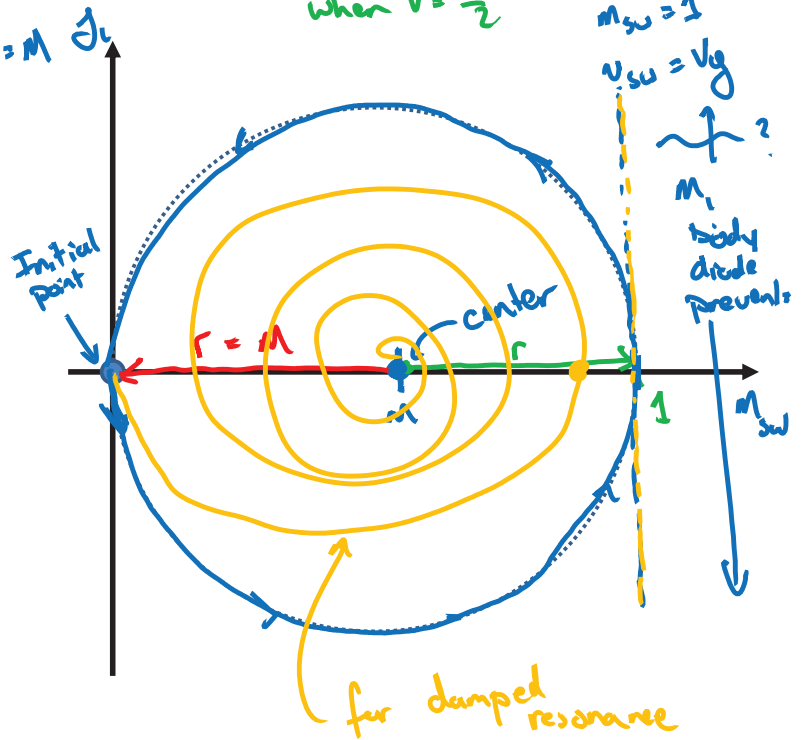
diode-limited

$$0 \leq v_{sw} \leq V_g$$

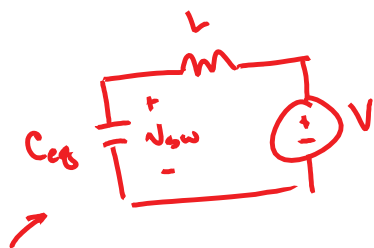
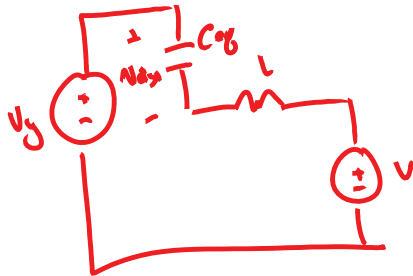
$$0 \leq m_{sw} \leq 1$$

$$M = \frac{1}{2}$$

when $V = \frac{V_g}{2}$



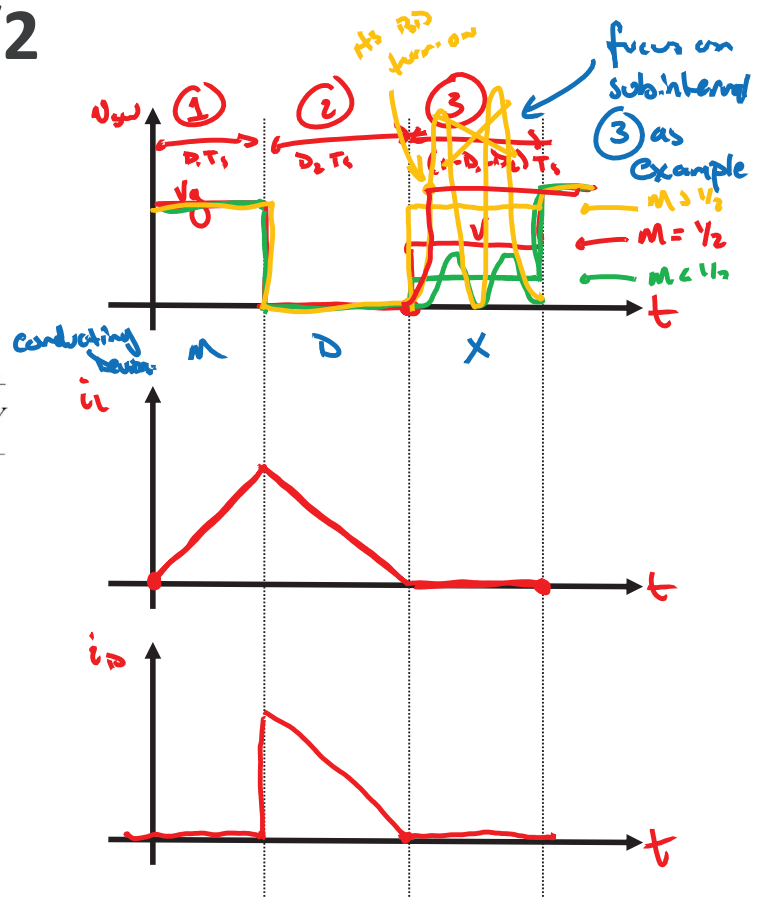
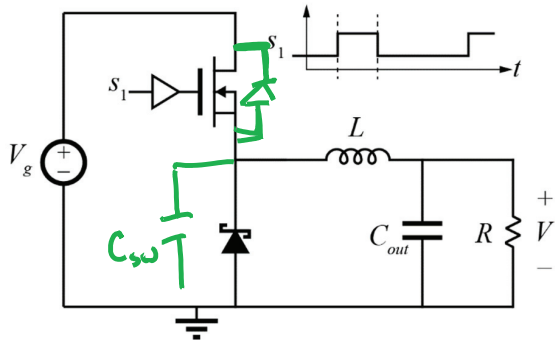
Choosing Equivalent Circuit



All fine, but state plane voltages will vary

$$C_{cg} \equiv C_{sw}$$

DCM Buck $M \neq 1/2$



DCM Buck State Plane ($M \neq 0.5$)

ZVS condition:

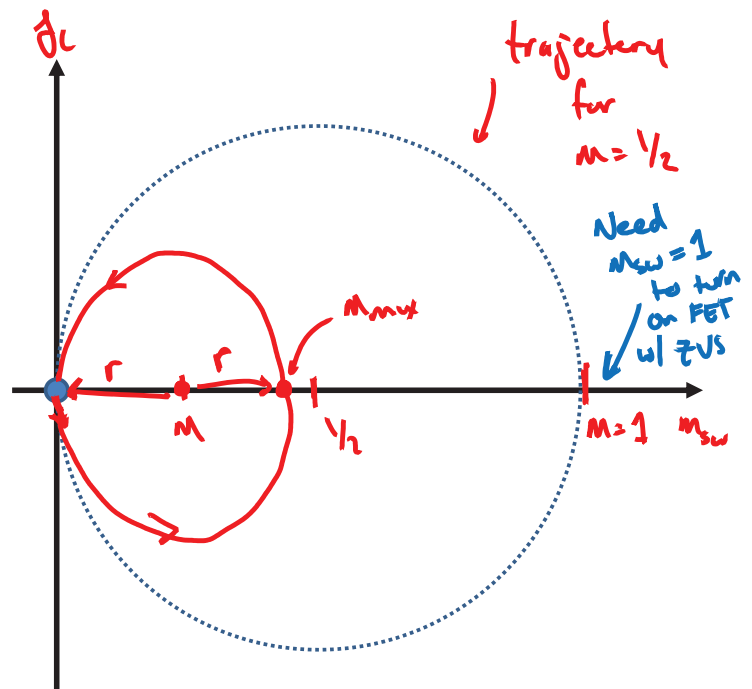
Need $M_{max} \geq 1$

$$M_{max} = M + r$$

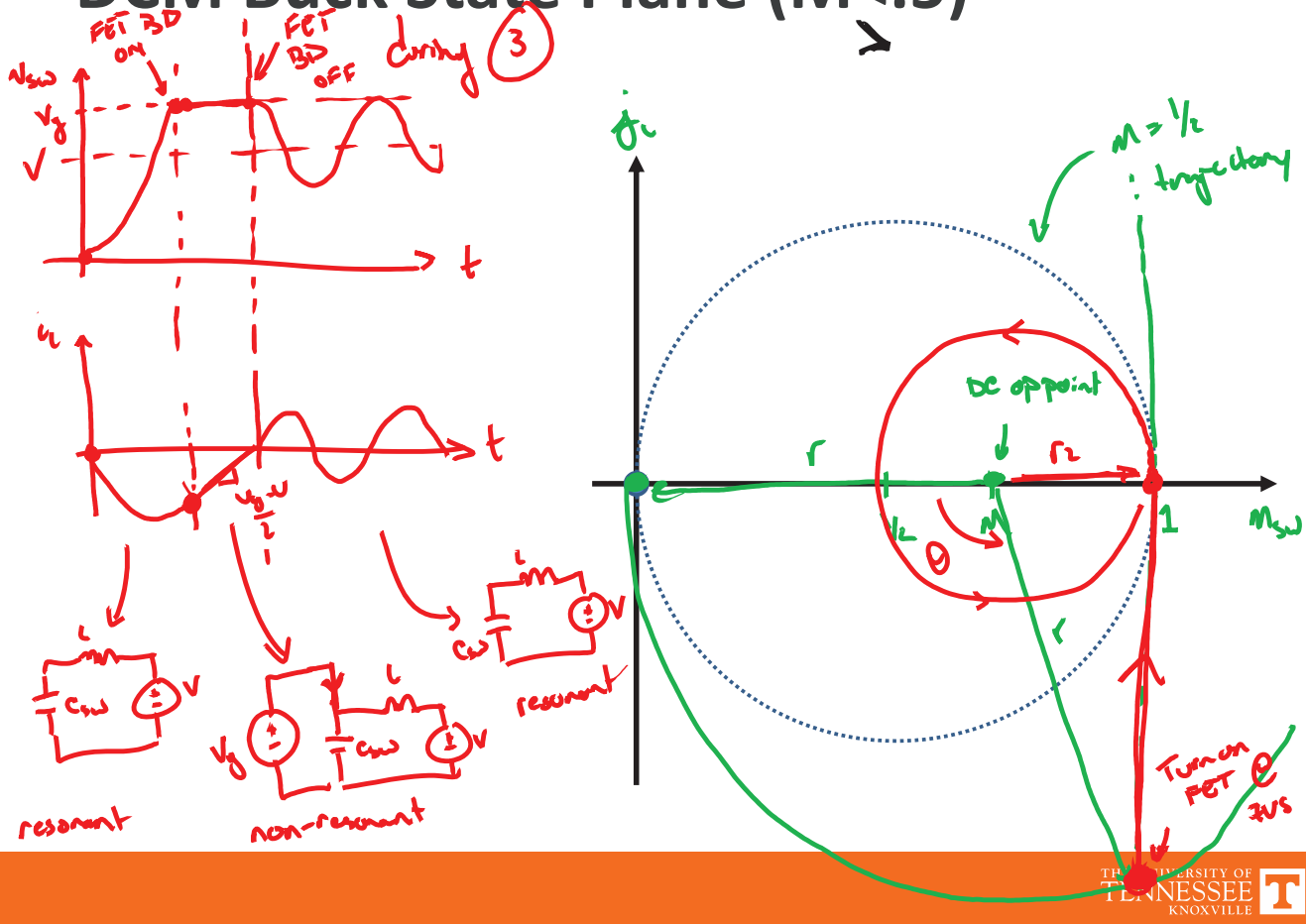
$$r = M$$

$$M_{max} = 2M$$

$$2M \geq 1$$



DCM Buck State Plane ($M=0.5$)



Synchronous Buck Converter

CRM BCM TCM
critical boundary Triangular

