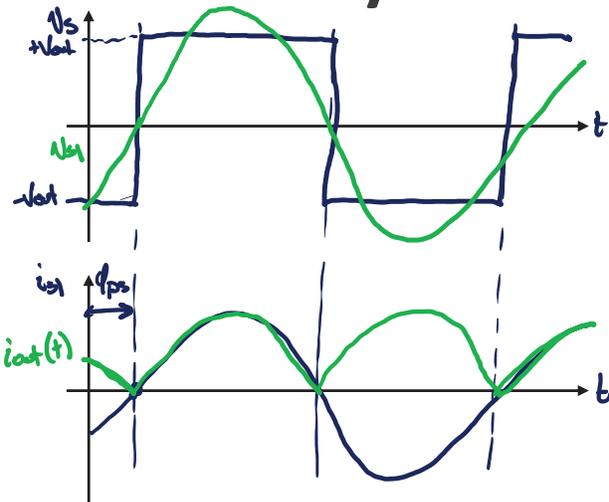
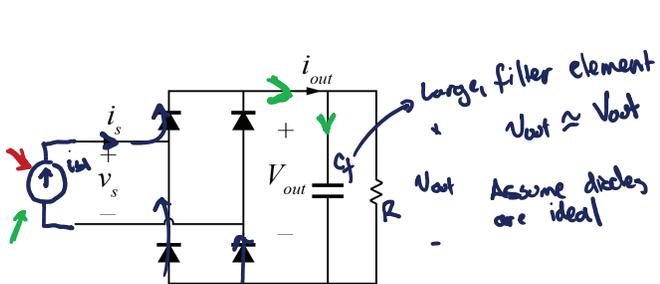


Diode Rectifier Sinusoidal Analysis



$$V_{s1}(t) = \frac{4}{\pi} V_{out} \sin(2\pi f_s t - \phi_{ps})$$

(same derivation as inverter)

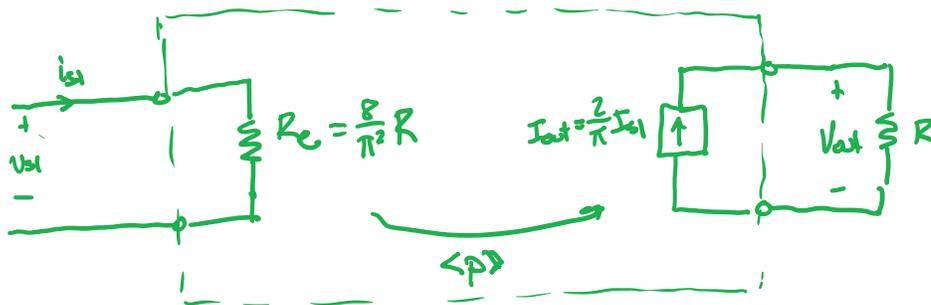
$$\langle i_{out} \rangle_{T_s} = \frac{1}{T_s} \int_0^{T_s} i_{out}(t) dt = \frac{1}{T_s} \int_0^{T_s} |i_{s1}| dt$$

$$I_{out} = \frac{2}{\pi} I_{s1}$$

$$V_{out} = I_{out} R = \frac{2}{\pi} I_{s1} R \quad (\text{by cap-Q balance on } C_f)$$

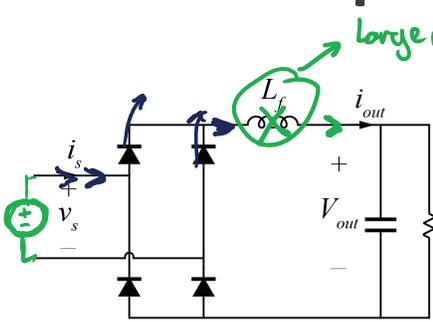
$$i_{s1} = I_{s1} \sin(2\pi f_s t - \phi_{ps})$$

Diode Rectifier Equivalent Circuit

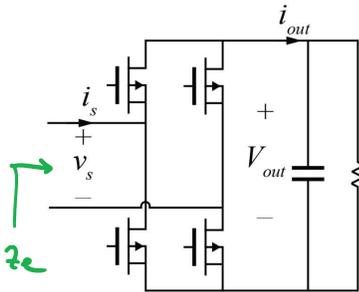


$$\frac{V_{s1}}{i_{s1}} = \frac{\frac{4}{\pi} V_{out} \sin(\omega_s t - \phi_{ps})}{I_{s1} \sin(\omega_s t - \phi_{ps})} = \frac{\frac{4}{\pi} V_{out}}{V_{out} \frac{2}{\pi} \frac{1}{R}} = \frac{8}{\pi^2} R = R_e$$

Other Implementations

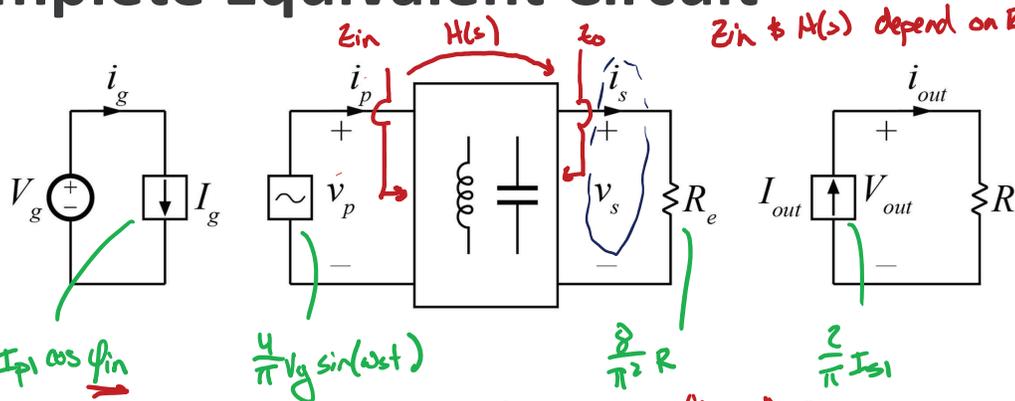


No hf & low Z_o of tank → no diodes on for some amount of time



Control freedoms in D_{rec} & I_{ps} ←
 $z_e = R_e + jX_e$, controlled SW

Complete Equivalent Circuit



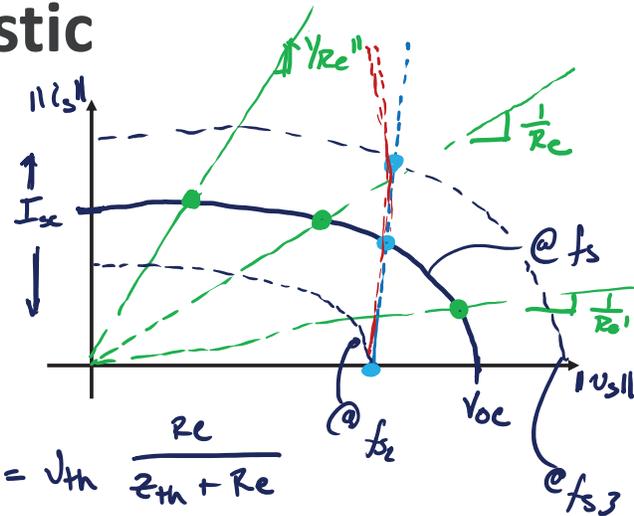
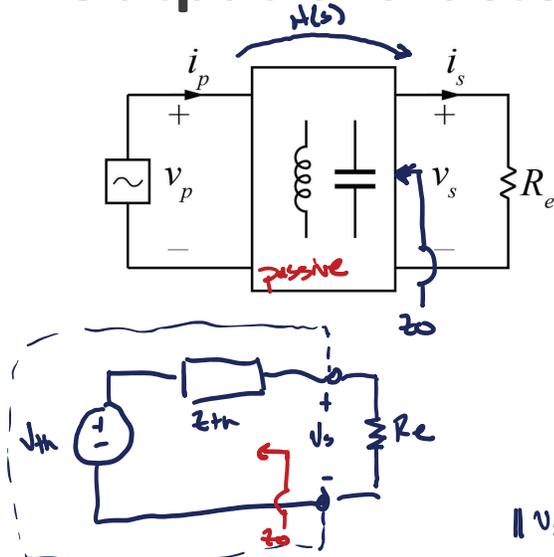
Results for FB inverter, FB diode rectifier, & "large" Z_o

$$M = \frac{V_{out}}{V_g} = \frac{V_{out}}{I_{out}} \cdot \frac{I_{out}}{I_s} \cdot \frac{I_s}{V_s} \cdot \frac{V_s}{V_p} \cdot \frac{V_p}{V_g}$$

$$= \cancel{R} \cdot \cancel{\frac{2}{\pi}} \cdot \frac{1}{\cancel{\frac{2}{\pi} R}} \cdot \|H(j\omega_s)\| \cdot \cancel{\frac{4}{\pi}}$$

$$M = \|H(j\omega_s)\| = \frac{V_{out}}{V_g}$$

Output Characteristic



$$\|V_{th}\| = \|V_{oc}\| = V_{oc}$$

$$Z_{th} = \frac{V_{oc}}{I_{sc}} = Z_0$$

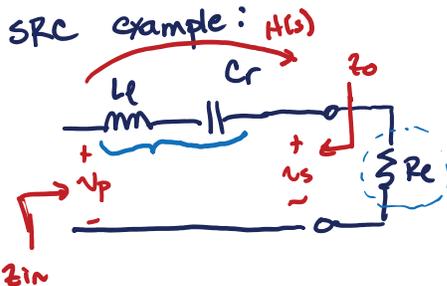
$$V_s = V_{th} \frac{R_e}{Z_{th} + R_e}$$

$$\|V_s\|^2 = V_{oc}^2 \frac{R_e^2}{R_e^2 + \|Z_0\|^2}$$

$$\frac{\|V_s\|^2 R_e^2}{V_{oc}^2 R_e^2} + \frac{\|V_s\|^2 \|Z_0\|^2}{R_e^2 V_{oc}^2} = 1$$

$$\frac{\|V_s\|^2}{V_{oc}^2} + \frac{\|i_s\|^2}{I_{sc}^2} = 1$$

Construction of Tank Transfer Function



$$Z_{in} = sL_e + \frac{1}{sC_r} + R_e$$

$$H(s) = \frac{v_s}{v_p} = \frac{R_e}{Z_{in}}$$

$$H(s) = \frac{sC_r R_e}{s^2 L_e C_r + sC_r R_e + 1}$$

in standard form:

$$H(s) = \frac{s/Q_e \omega_0}{(\frac{s}{\omega_0})^2 + \frac{s}{Q_e \omega_0} + 1}$$

$$\omega_0 = \frac{1}{\sqrt{L_e C_r}}$$

$$Q_e = \frac{\sqrt{L_e}}{C_r R_e}$$

$$Q_e = \frac{R_e}{Z_0}$$

Q_e = "effective quality factor considering R_e loading"

$$M = \|H(j\omega_s)\| = \frac{1}{\sqrt{1 + Q_e^2 \left(\frac{1}{F} - F\right)^2}}$$