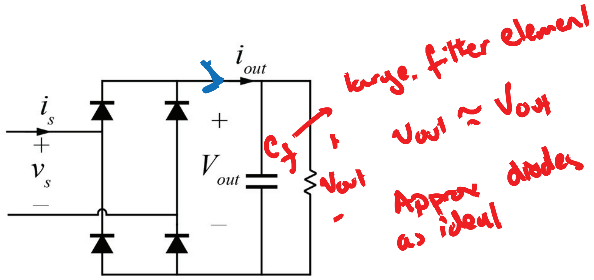
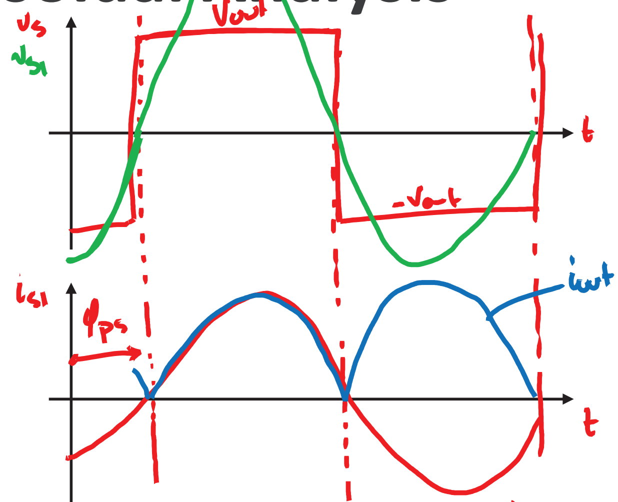
Diode Rectifier Sinusoidal Analysis





$$i_{s1} = I_{s1} \sin(\omega_s t - \varphi_{in})$$

$$v_{s1} = \frac{4}{\pi} V_{out} \sin(\omega_s t - \varphi_{ps})$$

(same derivation as inverter)

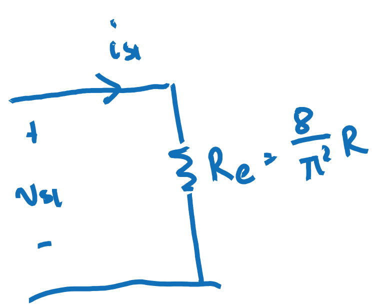
$$\langle i_{out} \rangle = I_{out} = \frac{1}{T_s}\int_0^{T_s} i_{out}\, dt$$

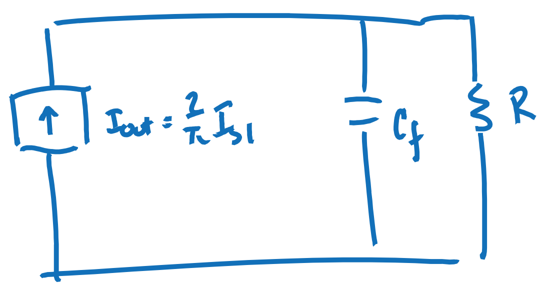
$$I_{out} = \frac{2}{\pi} I_{s1}$$

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

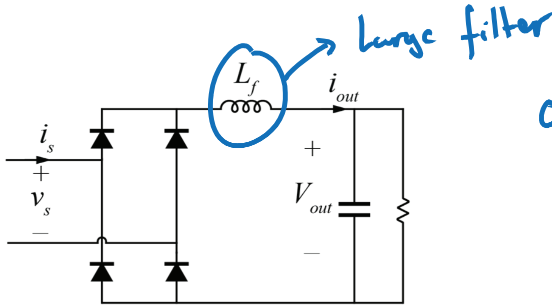
Diode Rectifier Equivalent Circuit

$$\frac{v_{s1}}{i_{s1}} = \frac{\frac{4}{\pi} V_{out} \sin(\omega_s t - \varphi_{ps})}{I_{s1} \sin(\omega_s t - \varphi_{ps})} = \frac{\frac{4}{\pi}\left(\frac{2}{\pi} I_{s1} R\right)}{I_{s1}} = \boxed{\frac{8}{\pi^2} R = R_e}$$

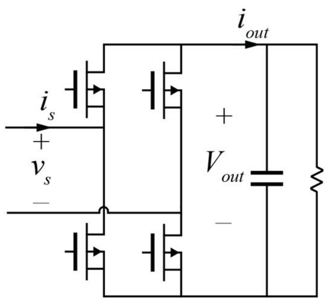




Other Implementations

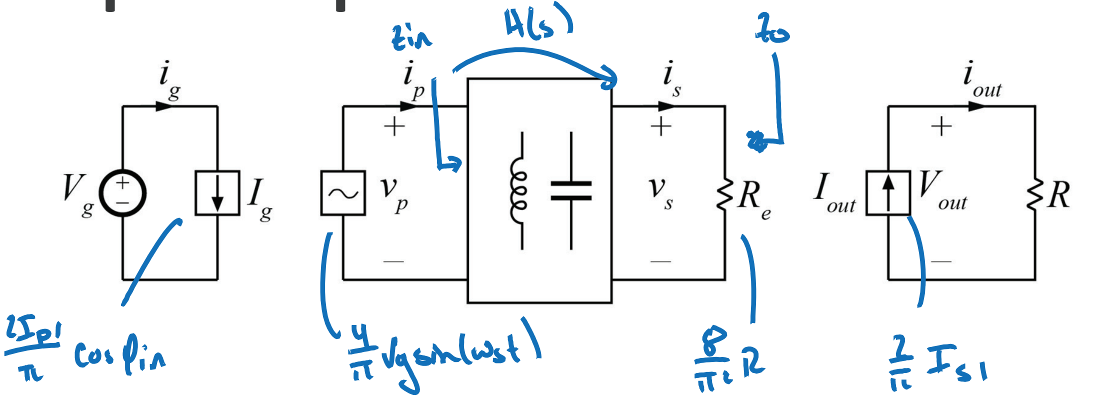


current i_s is a squarewave $\pm I_{Lf}$



Z_e load → can have reactive loading @ f_s

Complete Equivalent Circuit



φ_{in}, I_{p1}, I_{s1} determined by complete circuit

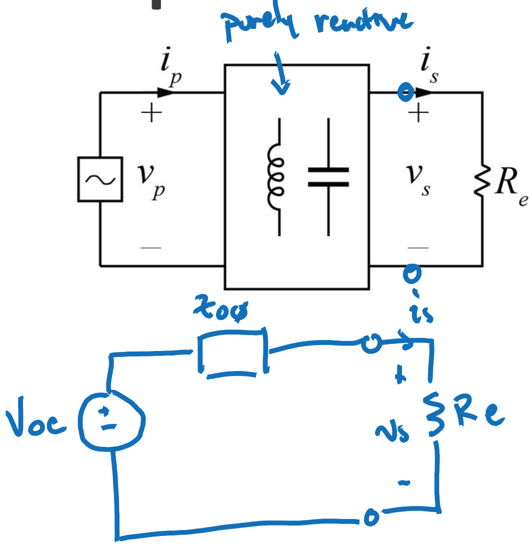
$$M = \frac{V_{out}}{V_g} = \frac{V_{out}}{I_{out}} \cdot \frac{I_{out}}{I_{s1}} \cdot \frac{I_{s1}}{V_{s1}} \cdot \frac{V_{s1}}{V_{p1}} \cdot \frac{V_{p1}}{V_g}$$

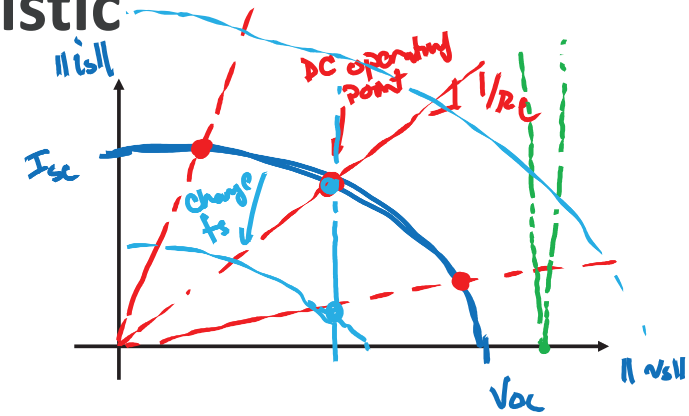
$$M = R \cdot \frac{2}{\pi} \cdot \frac{1}{\frac{8}{\pi^2}R} \cdot \|H(j\omega_s)\| \cdot \frac{4}{\pi}$$

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

keep in mind Z_{in}, $H(s)$, Z_o depend on R_e

Output Characteristic





$$v_s = V_{oc}\,\frac{R_e}{R_e + Z_{00}}$$

$$\|v_s\|^2 = \|V_{oc}\|^2 \cdot \left\|\frac{R_e}{R_e + Z_{00}}\right\|^2$$

$$\|v_s\|^2 = V_{oc}^2 \cdot \frac{R_e^2}{R_e^2 + \|Z_{00}\|^2}$$

$$\|v_s\|^2 R_e^2 + \|v_s\|^2 \|Z_{00}\|^2 = V_{oc}^2 R_e^2$$

$$\frac{\|v_s\|^2}{V_{oc}^2} + \frac{\|v_s\|^2 \|Z_{00}\|^2}{V_{oc}^2 R_e^2} = 1$$

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