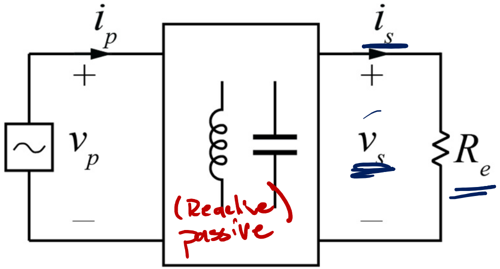
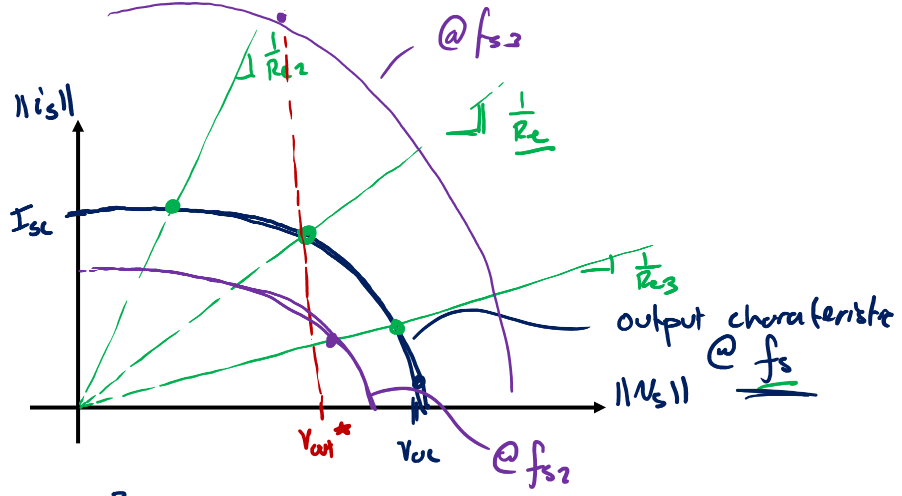
Announcements

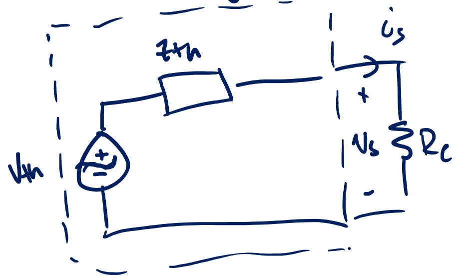
- TBC PCB and components ordering
  - Once approved e-mail to **eecs-orders@utk.edu**
  - Include description (for course design competition)
  - Actionable orders
  - cc Daniel.Costinett@utk.edu

Output Characteristic





Thevenin Equivalent



$V_{th} = V_{oc}$

$Z_{th} = \frac{V_{oc}}{I_{sc}}$ ←

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

if Z_{th} is dominantly reactive

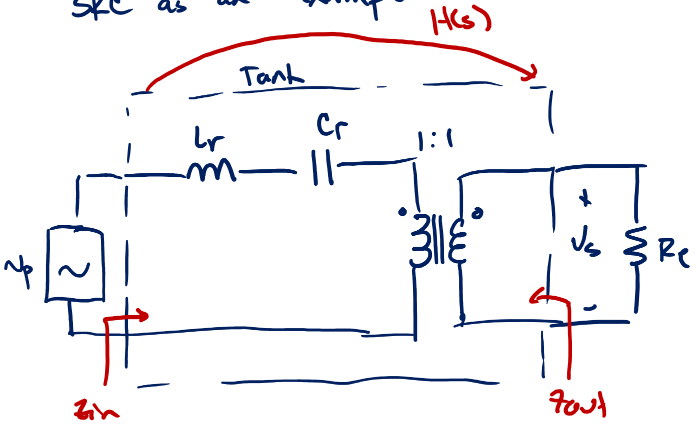
$$\|V_s\|^2 = V_{oc}^2 \frac{R_e^2}{R_e^2 + \|Z_{th}\|^2}$$

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

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

Construction of Tank Transfer Function

SRC as an example



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

$$Z_{out} \quad sL_r + \frac{1}{sC_r}$$

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

$$H(s) = \frac{sR_eC_r}{s^2L_rC_r + sC_rR_e + 1}$$

in standard form

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

$$\omega_0 = \frac{1}{\sqrt{L_rC_r}}$$

$$R_0 = \sqrt{\frac{L_r}{C_r}}$$

$$Q_e = \frac{R_0}{R_e}$$

Q_e = "effective" or loaded quality factor

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

Tank Input Impedance

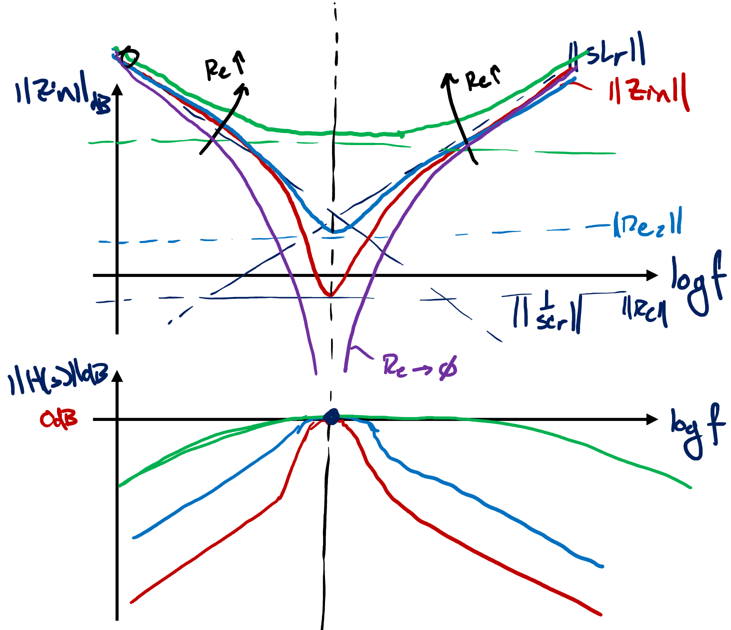
SRC example

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

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

@ f_o : $\|H(s)\|_{dB} = 0\,dB$ for all R_e

- as $R_e \to \emptyset$ $Z_{in} \to \emptyset$
  - cannot tolerate output short circuit
- Z_{in} is Resistive



Z_{in} is capacitive ←
ZVS not possible
ZCS may be possible

$f_o = \frac{1}{2\pi\sqrt{L_rC_r}}$

→ Z_{in} = Inverter load is inductive
ZVS may be possible
ZCS not possible

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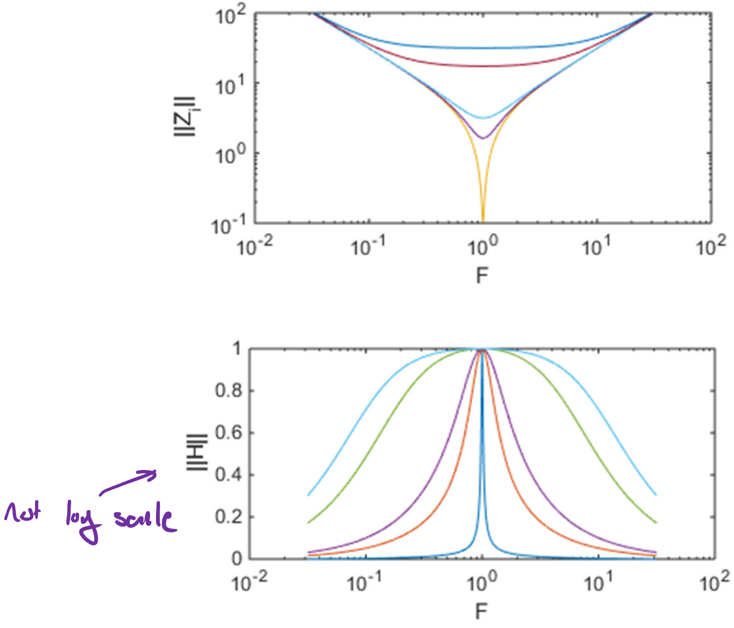
as $R_e \uparrow$, $Z_{in} \uparrow$ → $P_{cond} \downarrow$
$P_{out} \downarrow$ → Conduction losses decrease at light load

Series Resonant Tank



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Parallel Resonant Converter