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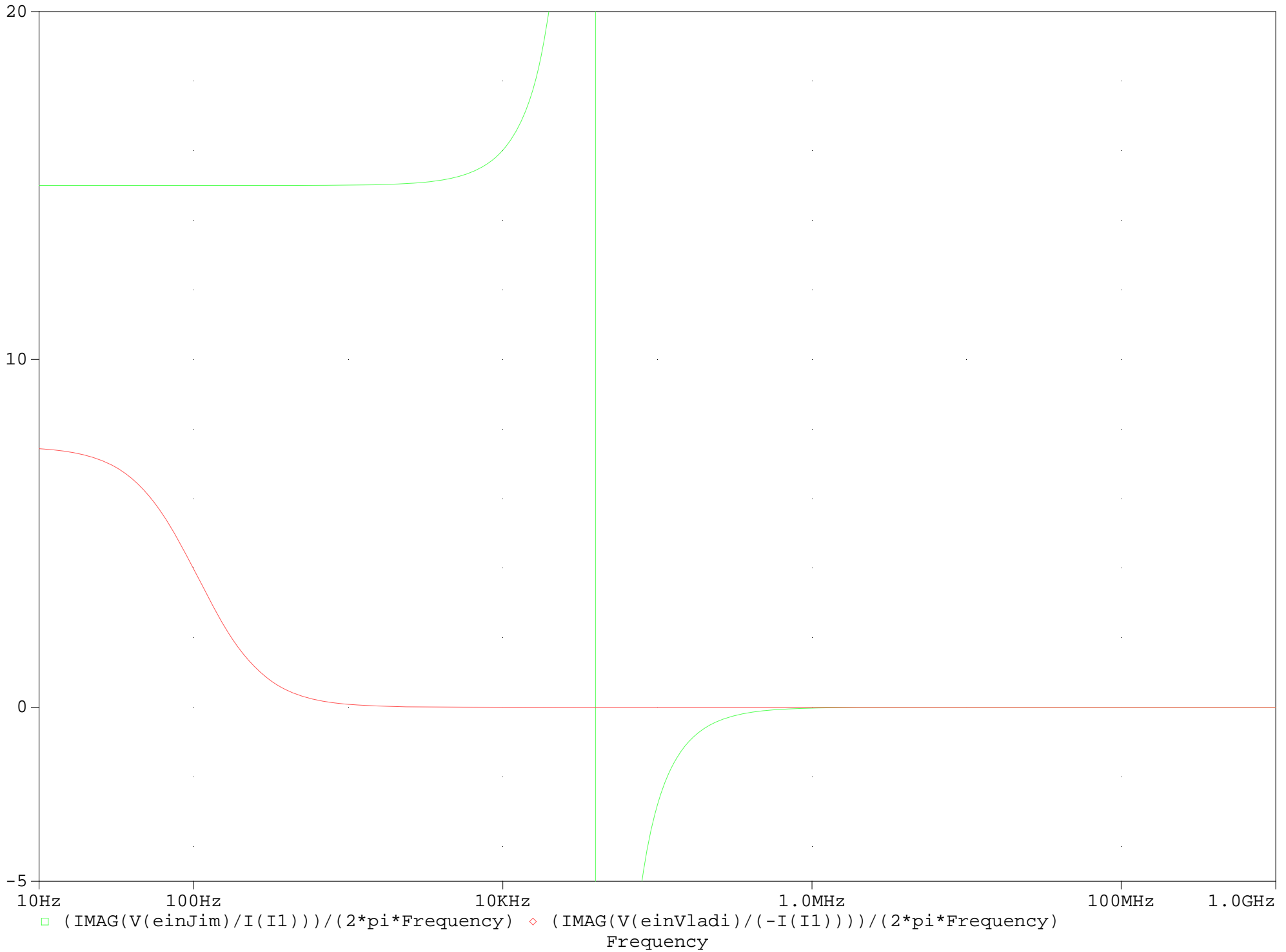
Title:  
 Compare Gyrator-Based Inductors (SED)

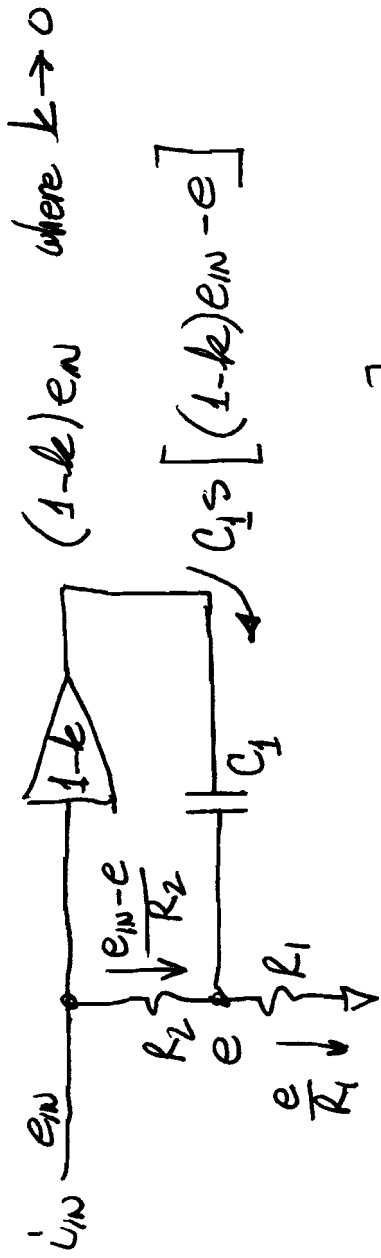
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January 24, 2013, 2:03 PM

Sheet 1 of 1

# Compare\_Gyrator\_Inductors





$$\frac{e}{R_1} = \frac{e_{IN} - e}{R_2} + C_1 s [(1-k)e_{IN} - e]$$

$$e \left[ \frac{1}{R_1} + \frac{1}{R_2} + C_1 s \right] = e_{IN} \left[ \frac{1}{R_2} + (1-k)C_1 s \right]$$

$$e = \frac{\frac{1}{R_2} + (1-k)C_1 s}{\frac{1}{R_1} + \frac{1}{R_2} + C_1 s} e_{IN}$$

$$e = \frac{R_2 + R_1 R_2 C_1 s}{1 + (1-k)R_2 C_1 s} e_{IN}$$

$$i_{IN} = \frac{e_{IN} - e}{R_2} = \frac{e_{IN}}{R_2} \left[ 1 - \frac{R_2 + R_1 R_2 C_1 s}{1 + (1-k)R_2 C_1 s} \right]$$

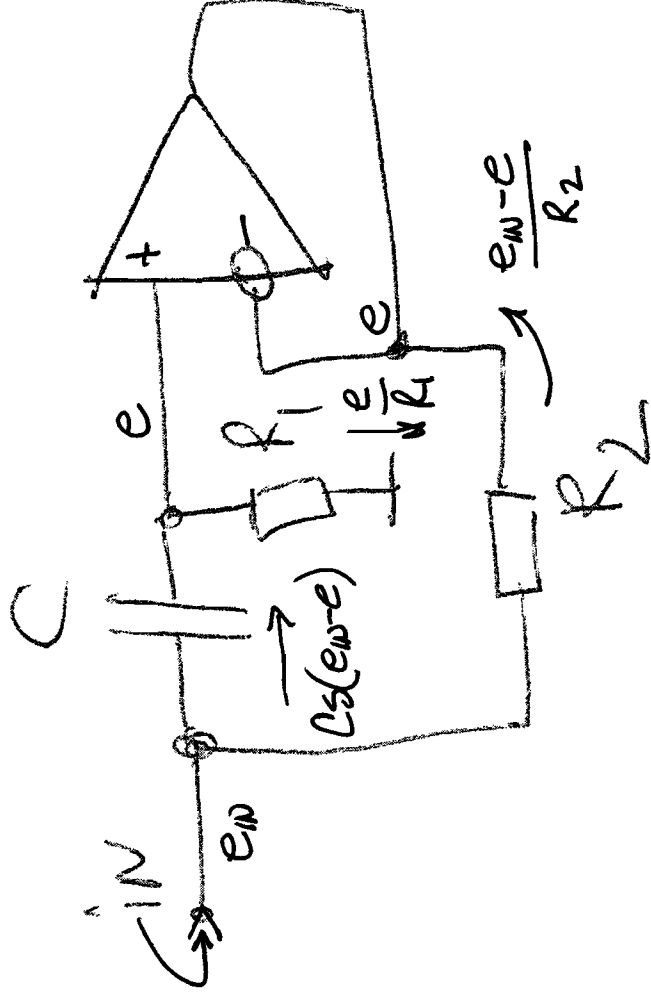
$$i_{IN} = \frac{e_{IN}}{R_2} \left[ \frac{1 + \frac{R_2}{R_1} + R_2 C_1 s - 1 - (1-k)R_2 C_1 s}{1 + \frac{R_2}{R_1} + R_2 C_1 s} \right]$$

$$i_{IN} = \frac{e_{IN}}{R_2} \left[ \frac{\frac{R_2}{R_1} + k R_2 C_1 s}{1 + \frac{R_2}{R_1} + R_2 C_1 s} \right]$$

$$i_{IN} = e_{IN} \cdot \left[ \frac{\frac{R_2}{R_1} + k C_1 s}{1 + \frac{R_2}{R_1} + R_2 C_1 s} \right] = e_{IN} \frac{1 + k R_1 C_1 s}{R_1 + R_2 + R_1 R_2 C_1 s}$$

$$Z_{IN} = \frac{e_{IN}}{i_{IN}} = \underbrace{\left( \frac{R_1 + R_2 + R_1 R_2 C_1 s}{1 + k R_1 C_1 s} \right)}$$

THIS IS AN INDUCTOR OF VALUE  $R_1 R_2 C$   
 IN SERIES WITH RESISTANCE  $R_1 + R_2$ .  
 THIS IS CALLED A "POOR MAN'S GYRATOR"  
 IT DOESN'T LOSE INDUCTIVE EFFECT  
 UNTIL  $\omega \geq \frac{1}{k R_1 C_1}$  (REMEMBER THAT  $k \rightarrow 0$ )



## TRIVIAL GYRATOR

$$L = R_1 R_2 C$$

$$C s(e_W - e) = \frac{e}{R_1} \rightarrow C s e_W = e \left( C s + \frac{1}{R_1} \right) \rightarrow$$

$$R_1 C s e_W = e (R_1 C s + 1) \rightarrow e = \frac{R_1 C s}{R_1 C s + 1} e_W \rightarrow$$

$$e_W - e = e_W \left[ 1 - \frac{R_1 C s}{R_1 C s + 1} \right] \rightarrow e_W - e = \frac{e_W}{R_1 C s + 1} \rightarrow$$

$$i_{IN} = \left( C s + \frac{1}{R_2} \right) (e_W - e) = \left( C s + \frac{1}{R_2} \right) \cdot \frac{e_W}{R_1 C s + 1} \rightarrow$$

$$i_{IN} = \frac{R_2 C s + 1}{R_1 C s + 1} \cdot \frac{e_W}{R_2} \rightarrow Z_{IN} = \frac{e_W}{i_{IN}} \rightarrow$$

$$Z_{IN} = \frac{R_2 \cdot (R_1 C s + 1)}{R_2 C s + 1} = R_1 R_2 C s + R_2$$

"INDUCTIVE",  $L = R_1 R_2 C$ , BUT SCREWS IT.

COMPARE TO: