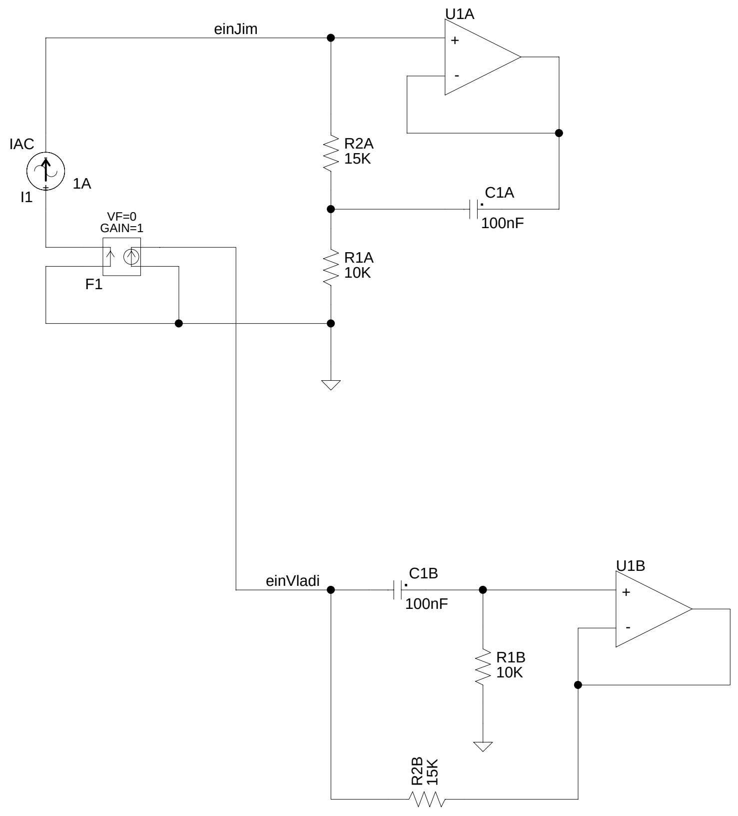


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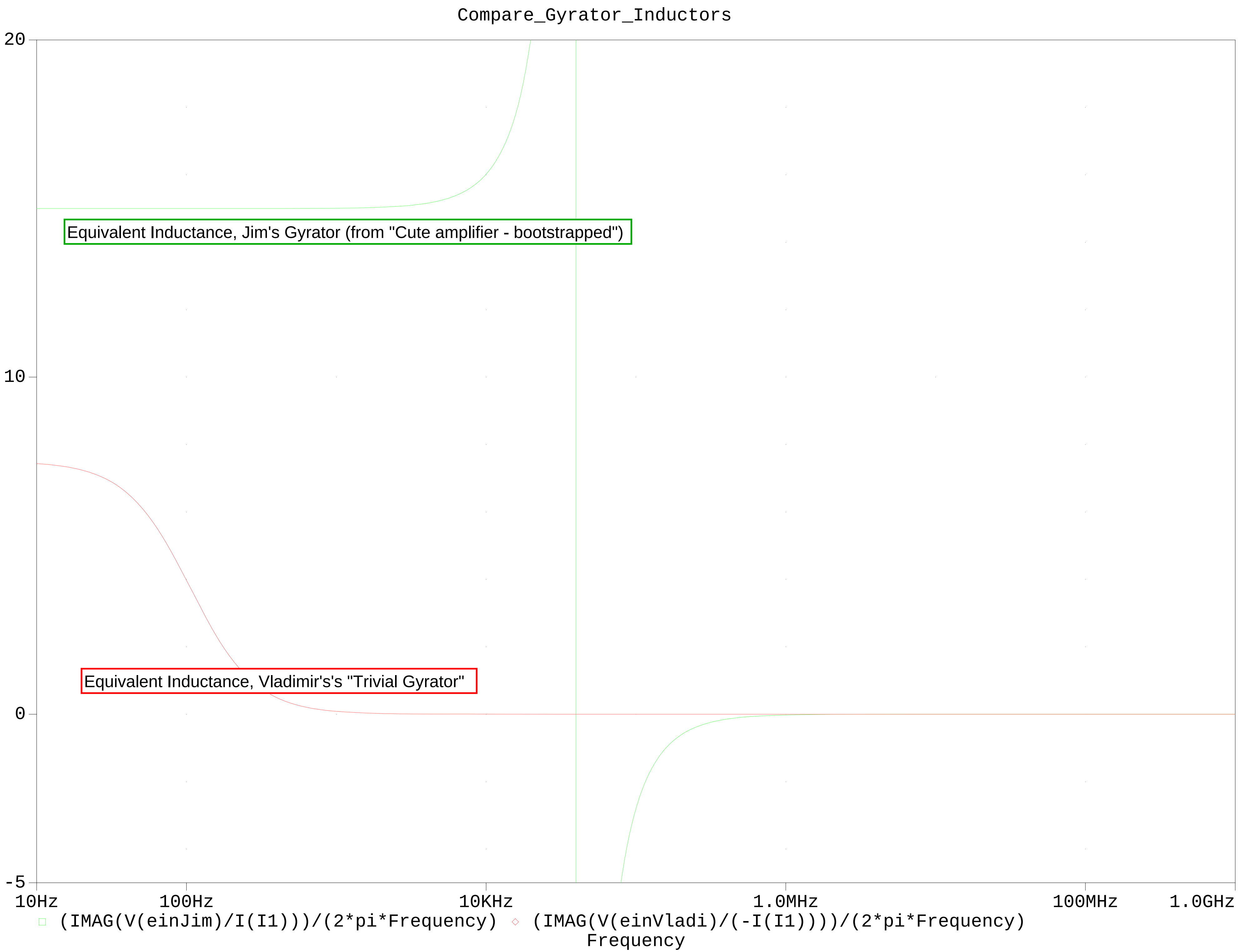
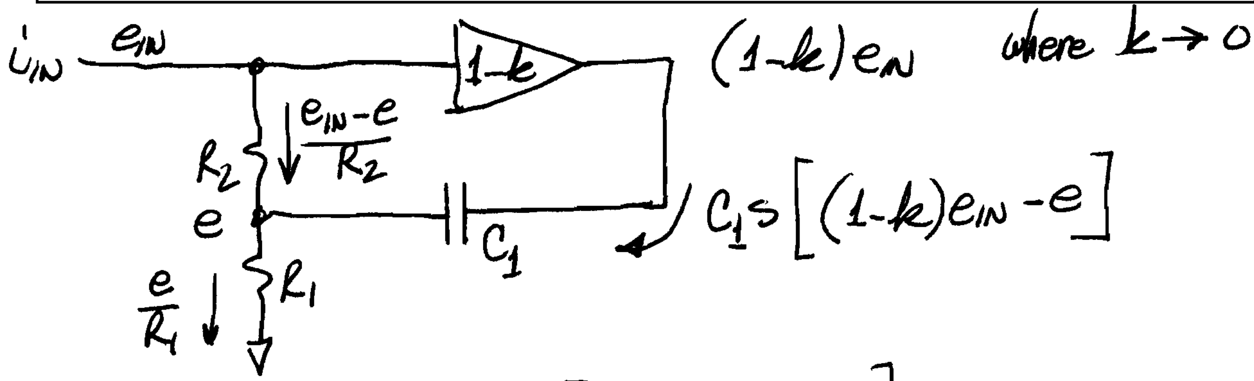
| | | |
|---|---|---|
| Title: Compare Gyrator-Based Inductors (SED) | | |
| Size A | FileName: C:\Projects\Expments\SED\Compare_Gyrator_Inductors.sch | REV A |
| January 24, 2013, 2:03 PM | Sheet 1 of 1 | |




Engineer: JT

January 24, 2013

Equivalent Inductance, Jim's Gyrator (from "Cute amplifier - bootstrapped")




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

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

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

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

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

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

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

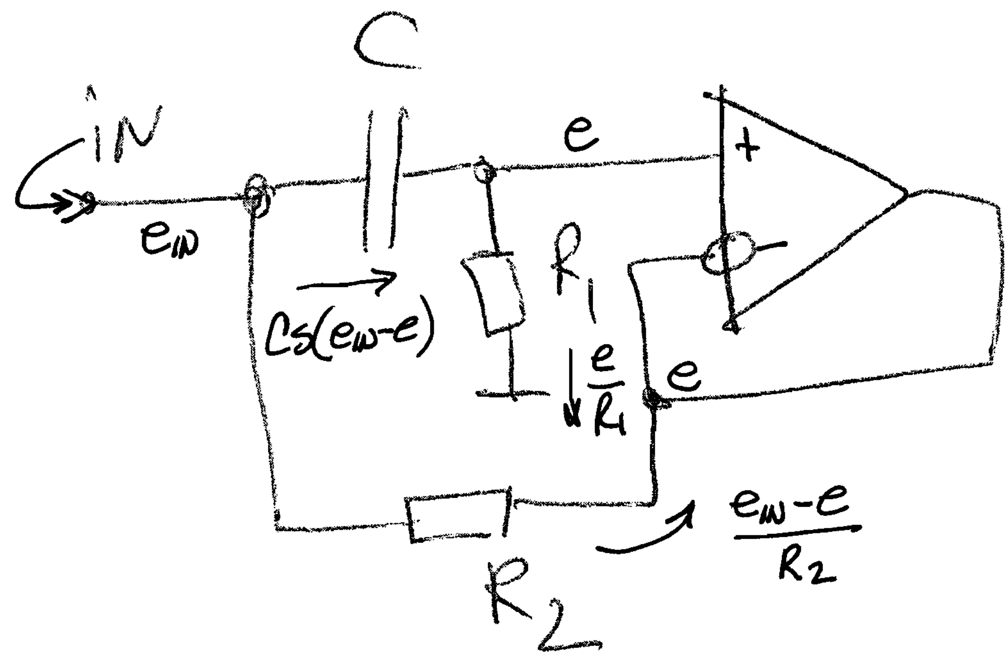
$$i_{IN} = e_{IN}\cdot\left[\frac{\frac{1}{R_1} + k C_1 s}{1 + \frac{R_2}{R_1} + R_2 C_1 s}\right] = e_{IN}\frac{1 + k R_1 C_1 s}{R_1 + R_2 + R_1 R_2 C_1 s}$$

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

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

J.E.T.
1/23/2013

# Equivalent Inductance, Vladimir's's "Trivial Gyrator"




TRIVIAL GYRATOR

$$L = R_1 R_2 C$$

$$Cs(e_{IN}-e) = \frac{e}{R_1} \rightarrow Cs\,e_{IN} = e\left(Cs + \frac{1}{R_1}\right) \rightarrow$$

$$R_1 Cs\,e_{IN} = e(R_1Cs+1) \rightarrow e = \frac{R_1Cs}{R_1Cs+1}\,e_{IN} \rightarrow$$

$$e_{IN}-e = e_{IN}\left[1 - \frac{R_1Cs}{R_1Cs+1}\right] \rightarrow e_{IN}-e = \frac{e_{IN}}{R_1Cs+1} \rightarrow$$

$$i_{IN} = \left(Cs+\frac{1}{R_2}\right)\cdot(e_{IN}-e) = \left(Cs+\frac{1}{R_2}\right)\cdot\frac{e_{IN}}{R_1Cs+1} \rightarrow$$

$$i_{IN} = \frac{R_2Cs+1}{R_1Cs+1}\cdot\frac{e_{IN}}{R_2} \rightarrow Z_{IN} = \frac{e_{IN}}{i_{IN}} \rightarrow$$

$$Z_{IN} = \frac{R_2\cdot(R_1Cs+1)}{R_2Cs+1} = \frac{R_1R_2Cs+R_2}{R_2Cs+1}$$

"INDUCTIVE", $L = R_1R_2C$, BUT SCREWS IT.

COMPARE TO: Equivalent Inductance, Jim's Gyrator (from "Cute amplifier - bootstrapped")