**Transconductor**

\[ i_0 = Gm \cdot V_i \]

**Single-Ended**

\[ i_0 = Gm \cdot V_i \]

**Fully Differential**

**Resistor Equivalence**

\[ i_o = -i_x \]

\[ i_o = Gm \cdot (-V_x) \]

\[ -i_x = -Gm \cdot V_x \]

\[ Z_{in} = \frac{V_x}{i_x} = \frac{1}{Gm} \]
Fully Diff.

Impedance Inverter (Gyrator)

\[ Z_L = \frac{v_2}{i_2} \]

\[ Z_{in} = \frac{v_x}{i_x} \]

1. \[ v_2 = v_{o1} = G_{m1} v_x \]
2. \[ i_x = -v_{o2} = -G_{m2} (v_2) \]
3. \[ i_x = G_{m2} v_2 \]
4. \[ \frac{G_{m1} v_x}{i_x} = \frac{i_2}{G_{m2} v_2} \]

\[ Z_{in} = \frac{v_x}{i_x} = \frac{1}{G_{m1} G_{m2} \left( \frac{v_2}{i_2} \right)} = \frac{1}{G_{m1} G_{m2} Z_L} \]
\[ Z_{in} = \frac{1}{G_{m1} G_{m2} Z_L} \]

**LET** \( Z_L = \frac{1}{SC} \) (A CAPACITOR)

\[ Z_{in} = \frac{SC}{G_{m1} G_{m2}} = S\ LEQ \]

\[ LEQ = \frac{C}{G_{m1} G_{m2}} \] SO EQUIVALENT TO AN INDUCTOR OF SIZE \( LEQ \)

\[ Z_{in} = \frac{SC}{G_{m1} G_{m2}} = S\ LEQ \]

\[ LEQ = \frac{C}{G_{m1} G_{m2}} \]
Fully Diff

\[
\begin{align*}
\text{Zin} &= \frac{5}{Gm_1 Gm_2} = 5 \text{ L}_{EQ}
\end{align*}
\]

2nd Order Bandpass Filter

\[
\begin{align*}
\frac{\text{V}_i}{\text{R}} &\quad \text{R} \\
\frac{1}{\text{C}_1} &\quad \frac{3}{\text{L}} \\
\end{align*}
\]
\[ G_{m1} = G_{m2} = \frac{1}{R} \quad L = \frac{C_2}{G_{m3} G_{m4}} \]