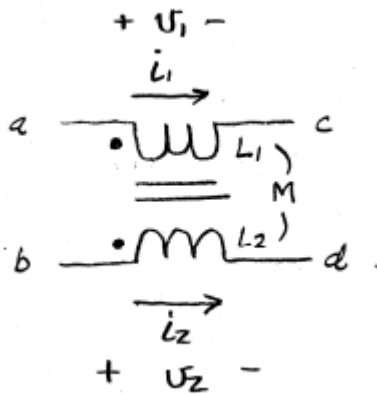


Common Mode Choke Analysis

G. Barrere – Exality Corporation



Common mode choke with mutual inductance $M = k\sqrt{L_1 L_2}$.

If $L_1 = L_2 = L$, M is between 0 and L . Assume this is true, i.e. turns ratio $N = 1$.

For any inductor $v_L = i_L X_L = i_L s L$ so $L = \frac{v_L}{s i_L}$ (where $s = j\omega$)

The effective inductance between 'a' and 'c' is then:

$$\begin{aligned} L_{eff} &= \frac{v_1}{s i_1} \\ &= \frac{s L_1 i_1 + s M i_2}{s i_1} \text{ from transformer terminal equations} \\ &= L_1 + M \frac{i_2}{i_1} \end{aligned}$$

For common mode signals $i_2 = i_1$ so

$$L_{eff(CM)} = L_1 + M$$

Note that $L_{eff(CM)} = 2L$ when coupling $k = 1$. For differential mode signals $i_2 = -i_1$ so

$$L_{eff(diff)} = L_1 - M$$

Note that $L_{eff(diff)} = 0$ when coupling $k = 1$. This means that the common mode choke presents no inductance (and therefore no impedance) to differential mode signals.