Common Mode Choke Analysis

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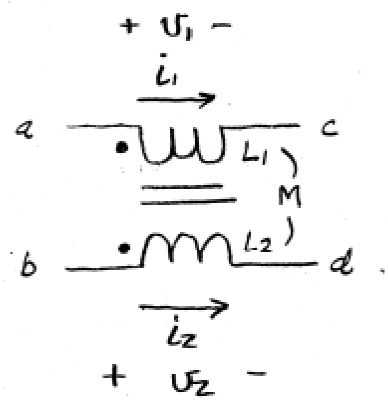

Common mode choke with mutual inductance $M = k\sqrt{L_1 L_2}$.

If L1 = L2 = 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:

$$L_{eff} = \frac{v_1}{s\, i_1}$$

$$= \frac{s L_1 i_1 + s M i_2}{s i_1} \quad \text{from transformer terminal equations}$$

$$= L_1 + M \frac{i_2}{i_1}$$

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.