Current Transformers

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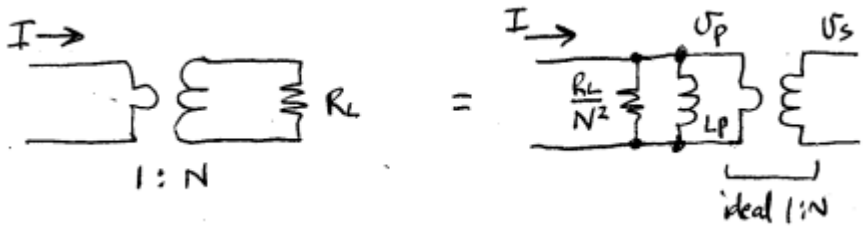
Measuring AC current I as a voltage across known resistance R_L.



The normal transformer model pertains, but primary inductance L_p is very small. R_L may be reflected to the primary as shown above, so v_p has a highpass characteristic with cutoff frequency of

$$f_1 = \frac{R_L}{2 \cdot \pi \cdot L_p \cdot N^2}$$

Above f_1, $v_p = \frac{I \cdot R_L}{N^2}$ and $v_s = v_p \cdot N = \frac{I \cdot R_L}{N}$, assuming no losses and perfect coupling.

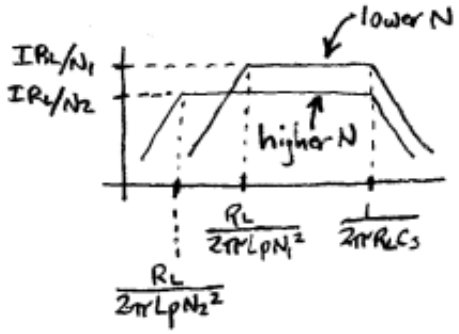
High frequency cutoff

If R_L is replaced by $Z_L = R_L \| C_S$ a lowpass pole is created by R_L and C_S with cutoff frequency

$$f_2 = \frac{1}{2 \cdot \pi \cdot R_L \cdot C_S}$$

C_S may be due to secondary winding or load capacitance. Reflected to the primary this load is $\frac{Z_L}{N^2}$ which does not change cutoff frequency with N. As N increases C_S will also increase somewhat because of increased winding capacitance, but this increased C_S is the only thing which affects f_2.

Trends with N variation



Here is the variation in transformer output voltage with changing N. As N goes up the insertion impedance, output voltage, and highpass cutoff frequency f_1 all go down.