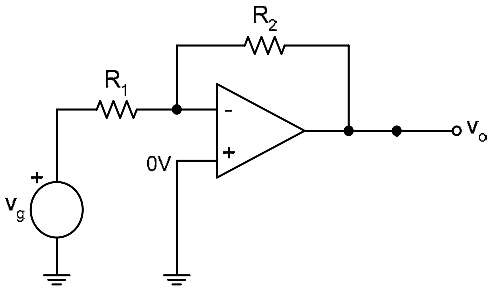
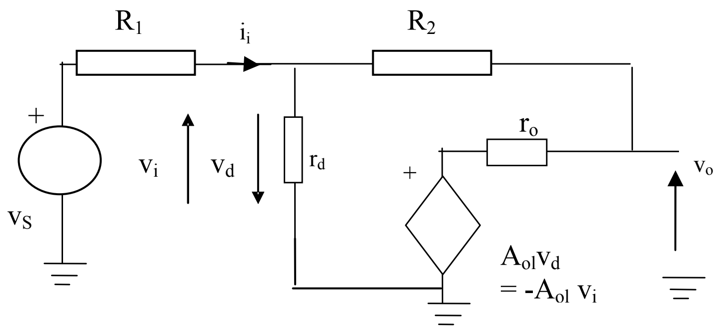
Example: What is the input resistance of the inverting amplifier

1) looking into the negative terminal (R_{in}')
2) looking from the source, v_g



Solution: The equivalent circuit for the amplifier is shown below.



1) Now $R_i' \equiv \frac{v_i}{i_i} = -\frac{v_d}{i_i}$ also, $i_i = i_{rd} + i_{R2}$

That is, $i_i = \frac{v_i}{r_d} + \frac{v_i - (-A_{ol} v_i)}{R_2 + r_o}$ and $i_i = \frac{v_i}{r_d} + \frac{v_i(1 + A_{ol})}{R_2 + r_o}$

Which we can write as: $\frac{i_i}{v_i} = \frac{1}{r_d} + \frac{1 + A_{ol}}{R_2 + r_o}$ which can be expressed as: $R_i' \equiv \frac{v_i}{i_i} = r_d \,//\, \frac{R_2 + r_o}{1 + A_{ol}}$

Take representative values: $R_2 = 10k$, $R_1 = 1k$ (gain of 10); $r_o \sim 50R$, $A_{ol} = 10^5$, $r_d = 1M\Omega$

Then $R_i' \sim \frac{R_2}{A_{ol}} = \frac{10k}{10^5}$ **R_i = 0.1Ω which is small - as expected!**

2) looking from the source, we see $R_1 + R_i' \sim$ **R_1 = 1k**
that is, the input resistance of this **trans-resistance** amplifier is set by R_1!