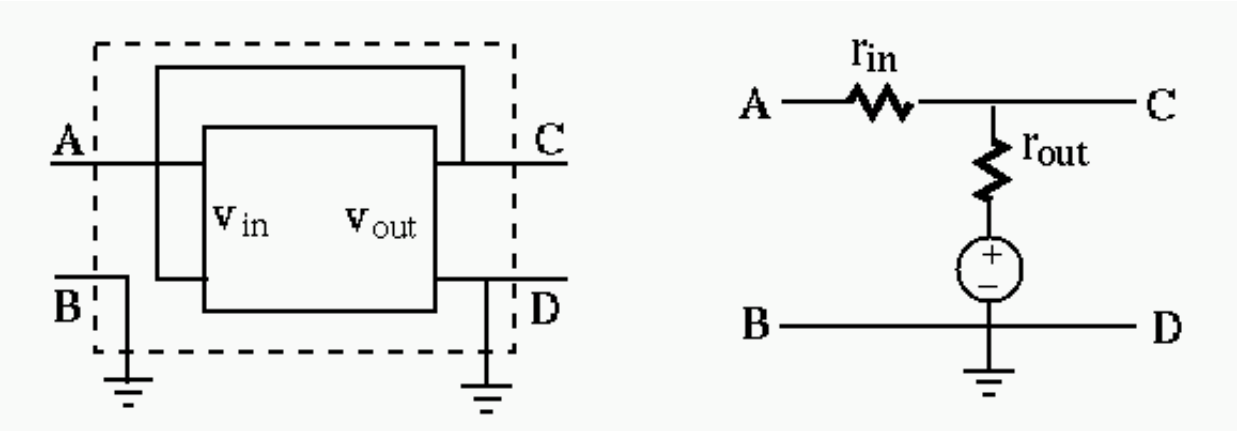
Next Up Previous

Next: About this document ...



- **Voltage gain:** Assume an ideal voltage source v_s is applied to the input port AB. Apply KVL to the loop to get:

$$v_s = i_{in} r_{in} + i_{in} r_{out} + A r_{in} i_{in} = i_{in}[r_{out} + (A+1) r_{in}]$$

i.e.,

$$i_{in} = \frac{v_s}{r_{out} + (A+1) r_{in}}$$

The voltage across the output port CD is:

$$v_{out} = A r_{in} i_{in} + r_{out} i_{in} = v_s \frac{A r_{in} + r_{out}}{r_{out} + (A+1) r_{in}}$$

i.e.,

$$A_{oc} = \frac{A r_{in} + r_{out}}{r_{out} + (A+1) r_{in}} \approx 1$$

- **Input resistance:** Assume a load R_L is connnected to the output port CD. Apply KVL to the two loops and get:

$$v_s = (r_{in} + r_{out} + Ar_{in})i_{in} - r_{out}i_{out}$$

$$Ar_{in}i_{in} = (r_{out} + R_L)i_{out} - r_{out}i_{in}$$

Solving the second equation we get

$$i_{out} = \frac{Ar_{in} + r_{out}}{r_{out} + R_L} i_{in}$$

Plugging that into the first equation we get

$$v_s = i_{in}[(r_{in} + r_{out} + Ar_{in}) - r_{out}\frac{Ar_{in} + r_{out}}{r_{out} + R_L}]$$

i.e.,

$$R_{in} = \frac{v_s}{i_{in}} = r_{in}(1 + \frac{AR_L}{r_{out} + R_L}) \approx Ar_{in}$$

- **Output resistance:** Apply a source voltage v_s with an internal resistance R_s to the input port AB, and get

$$v_s = i_{in}[R_s + r_{in} + r_{out} + Ar_{in}]$$

i.e.,

$$i_{in} = \frac{v_s}{R_s + (A+1)r_{in} + r_{out}}$$

The open-circuit output voltage is:

$$v_{oc} = (r_{out} + Ar_{in})i_{in} = (r_{out} + Ar_{in})\frac{v_s}{R_s + (A+1)r_{in} + r_{out}}$$

Next, we find short-circuit output current. Due to superposition (two voltage sources v_s and $Ar_{in}i_{in}$) we have:

$$i_{sc} = \frac{v_s}{R_s + r_{in}} + Ar_{in}\frac{v_s}{(R_s + r_{in})r_{out}} = v_s\frac{Ar_{in} + r_{out}}{(R_s + r_{in})r_{out}}$$

Now we get:

$$R_{out} = \frac{v_{oc}}{i_{sc}} = \frac{(R_s + r_{in})r_{out}}{R_s + (A+1)r_{in} + r_{out}} \approx \frac{r_{out}}{A}$$

The approximation is due to the assumption that $A >> 1$ and both R_s and r_{out} are very small.

- About this document ...

Next Up Previous

Next: About this document ...

rwang 2008-03-03