The input and output resistances R_{in} and R_{out}, as well as the voltage gain A_{oc} of a two-port network can be obtained experimentally. First, connect an ideal voltage source v_s (a new battary with very low internal resistance) in series with a resistor R_s, and then connect load R_L of two different resistances to the output port. Now the three parameters can be derived from the known values of v_s, R_s and the two measurements of the load voltage v_{out}, corresponding to the two resistance values used.

Assume $v_s = 1.5V$, $R_s = 5k\Omega$, and the input voltage is measured to be $v_{in} = 1.25V$; also, assume the two different load resistors used are $R_1 = 150\Omega$ and $R_2 = 200\Omega$ respectively, with the two corresponding output voltage $v_1 = 18.75V$ and $v_2 = 20$. Find R_{in}, R_{out} and A_{oc}.

Solution:

First consider the voltage v_{in} of the input port:

$$v_{in} = v_s \frac{R_{in}}{R_s + R_{in}} = 1.5 \frac{R_{in}}{5k\Omega + R_{in}} = 1.25V$$

Solving this equation for R_{in}, we get $R_{in} = 25k\Omega$

Next consider the voltage of the output port:

$$v_{out} = Av_{in} \frac{R_L}{R_L + R_{out}}$$

i.e.,

$$R_L A v_{in} - v_{out} R_{out} = v_{out} R_L$$

Using the values of R_L and V_L of the two experiments, we get

$$\left\{ \begin{array}{l} 150Av_{in} - 18.75R_{out} = 2812.5 \\ 200Av_{in} - 20.00R_{out} = 4000 \end{array} \right.$$

Solving these two equations we get

$$\left\{ \begin{array}{l} R_{out} = 50\Omega \\ Av_{in} = 25V \end{array} \right.$$

But we know $v_{in} = 1.25V$, we get $A = 20$.

- About this document ...

Next Up Previous

Next: About this document ...

Ruye Wang 2016-02-13