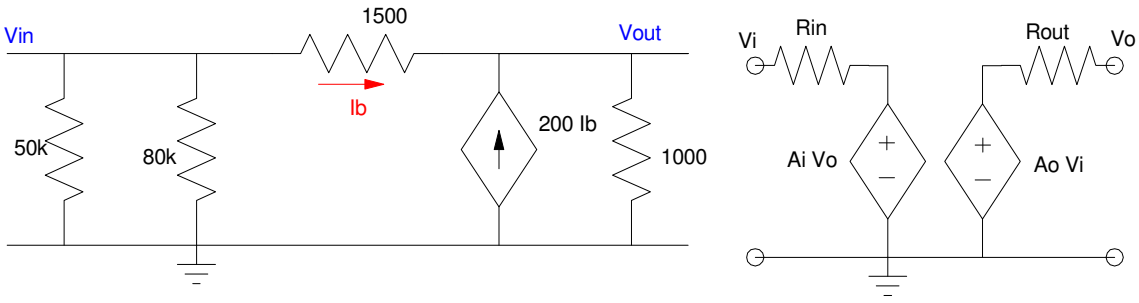
ECE 321: Handout #13

2-Port Models

1) Find the 2-port model for the following circuit



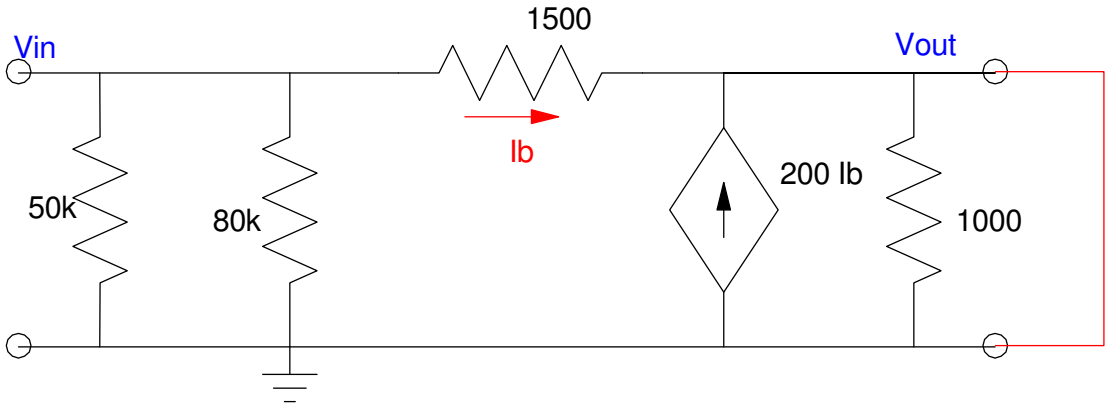
Solution

Rin:

- Set Vo = 0V
- Measure the resistance looking in.

$$R_{in} = 50k||80k||1500$$

$$R_{in} = 1430\Omega$$

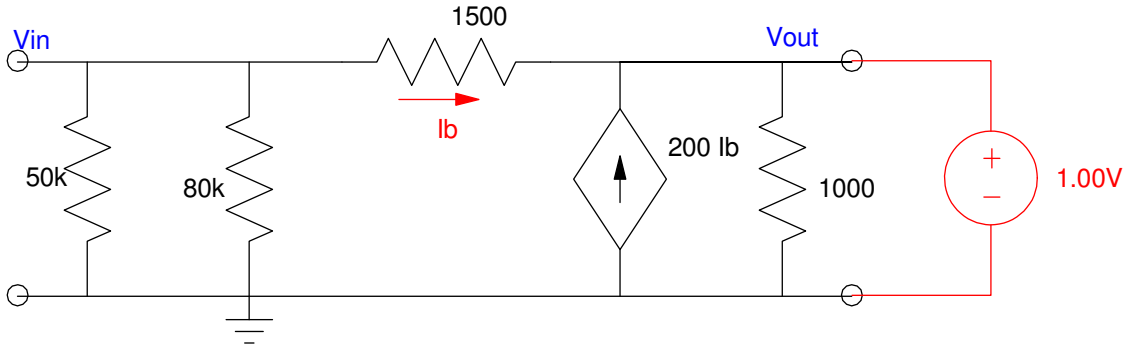


Ai:

- Sev Vo = 1V
- Measure the voltage at Vin

$$V_{in} = \left(\frac{50k||80k}{50k||80k+1500}\right) \cdot 1V$$

$$V_{in} = 0.9535V$$



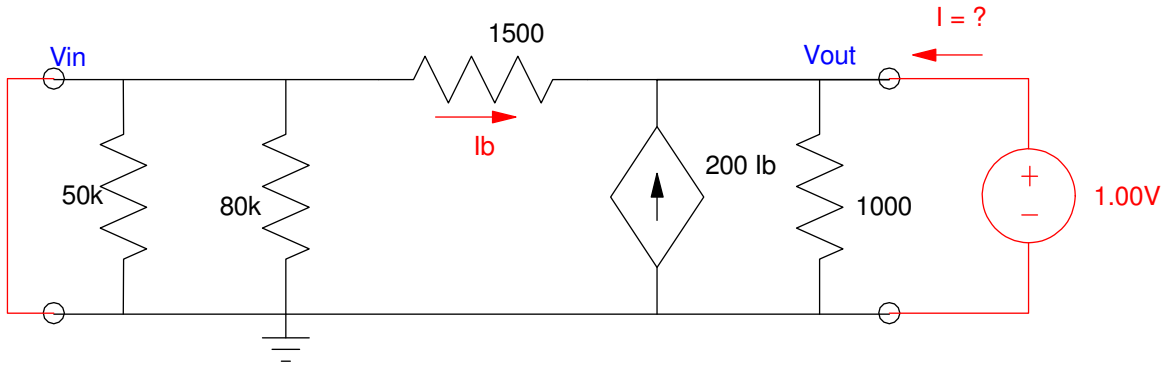
Rout:

- Short Vin
- Measure the resistance at Vout. If this isn't obvious,
- Apply +1V to Vout and compute the current

$$I = \left(\frac{1V-0V}{1500}\right) + \left(\frac{1V}{1000}\right) - 200\left(\frac{0V-1V}{1500}\right)$$

$$I = \left(\frac{1V-0V}{1500}\right) + \left(\frac{1V}{1000}\right) + 200\left(\frac{1V-0V}{1500}\right) = 135.0mA$$

$$R_{out} = \frac{1V}{135mA} = 7.407\Omega$$

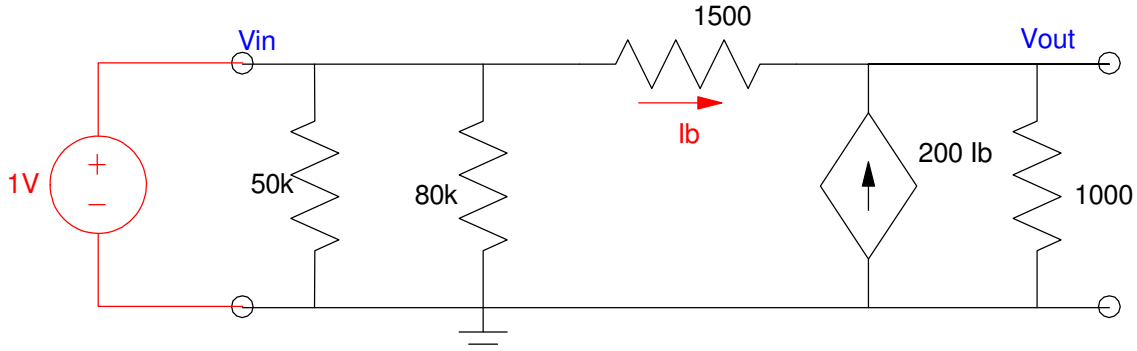


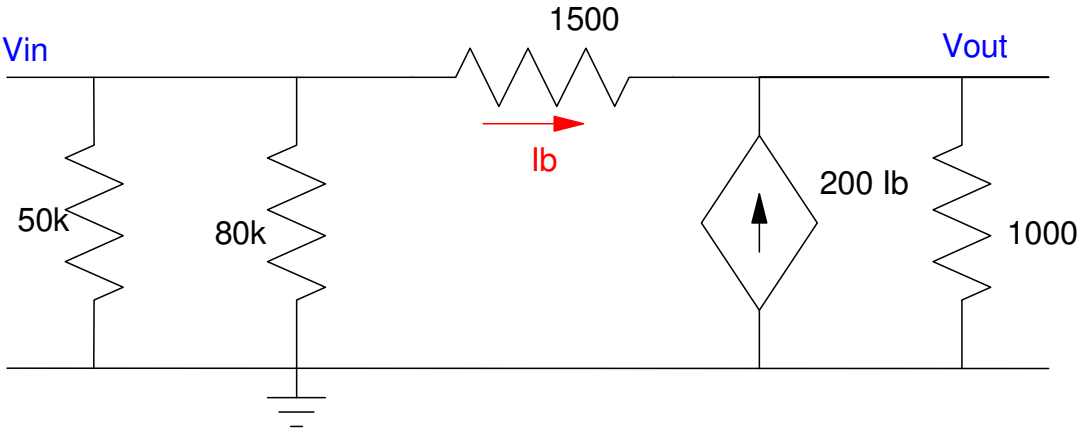
Aout: Apply 1V at the input, measure Vout

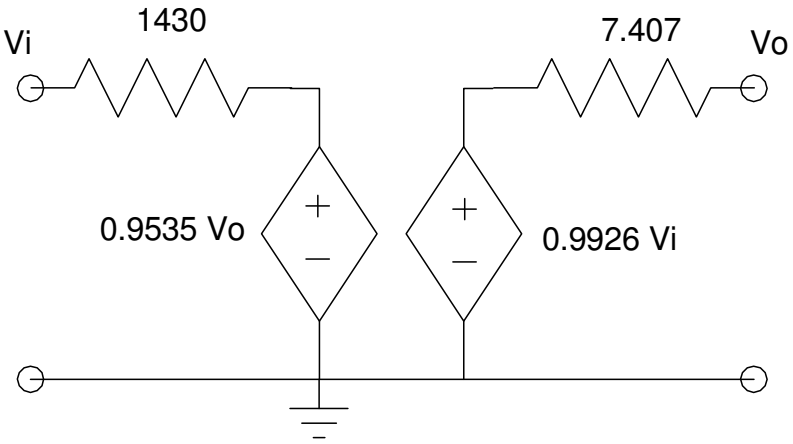
Writing the votlage node equation at Vout

$$\left(\frac{V_o-1}{1500}\right) + \left(\frac{V_o}{1000}\right) - 200\left(\frac{1-V_o}{1500}\right) = 0$$

$$V_o = 0.9926V$$




Vin
1500
Vout
Ib
200 Ib
50k
80k
1000


Vi
1430
7.407
Vo
0.9535 Vo
0.9926 Vi