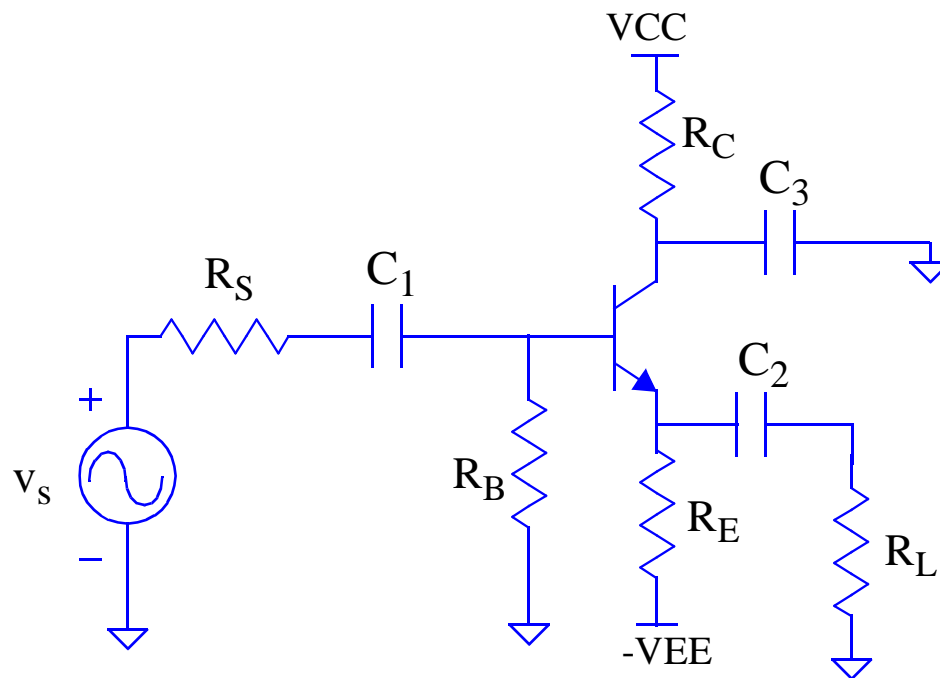


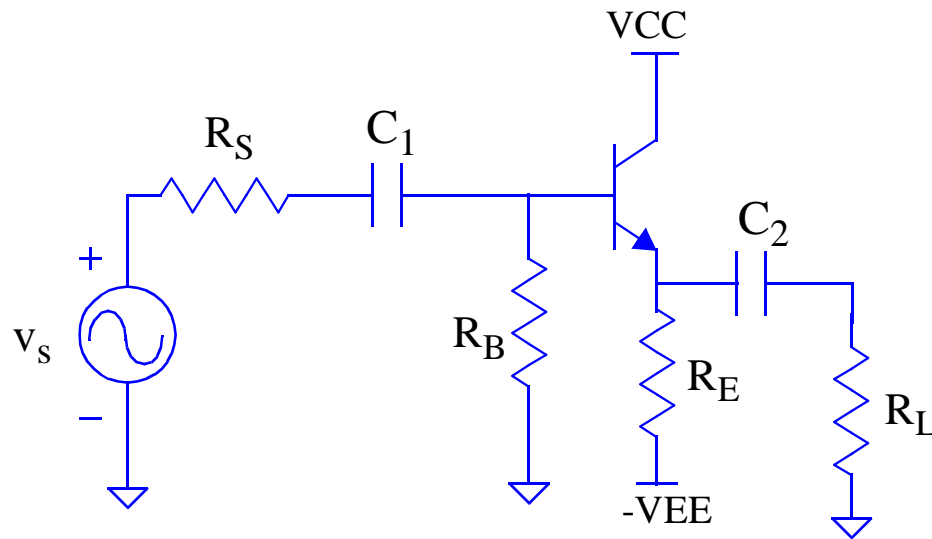
Common Collector (Emitter Follower) Amplifier

- Gain is never better than unity, however, has some desirable input and output impedance characteristics --- acts as a **buffer**



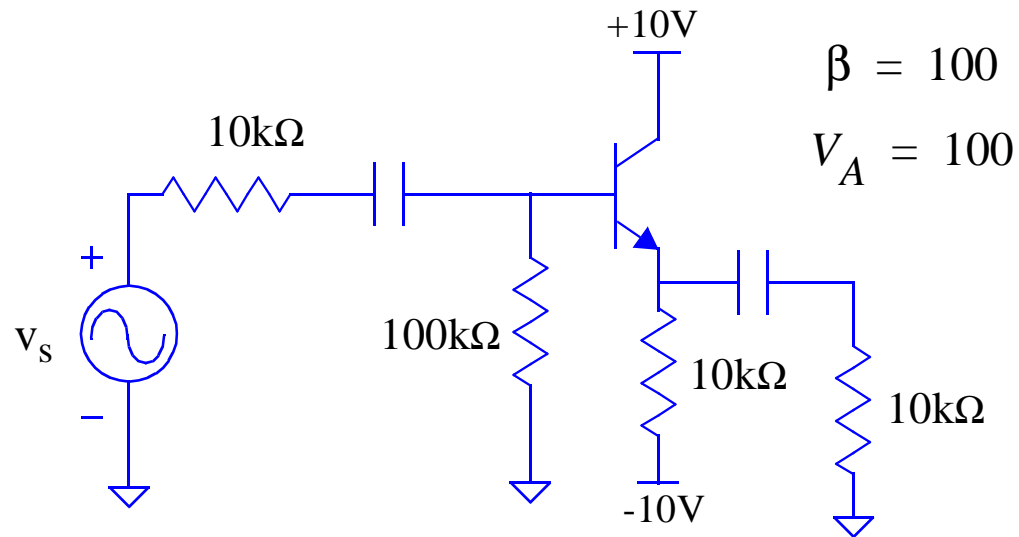
Common Collector (Emitter Follower) Amplifier

- Without R_C there is no need for C_3



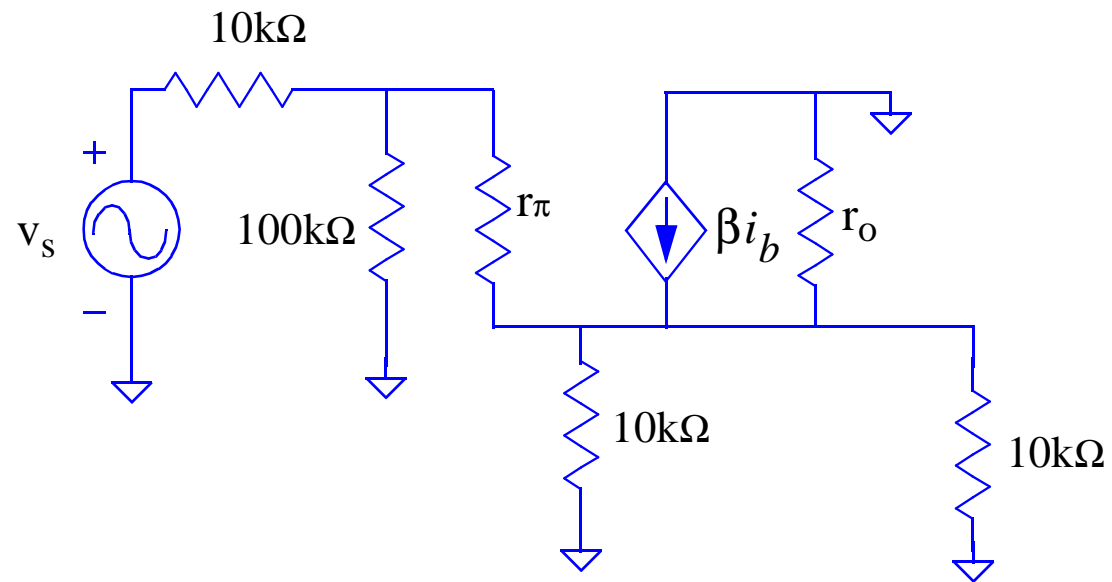
Emitter Follower Example

- Calculate the voltage gain, current gain, input resistance and output resistance
- Assume capacitors are infinite
- 1) Calculate dc operating point



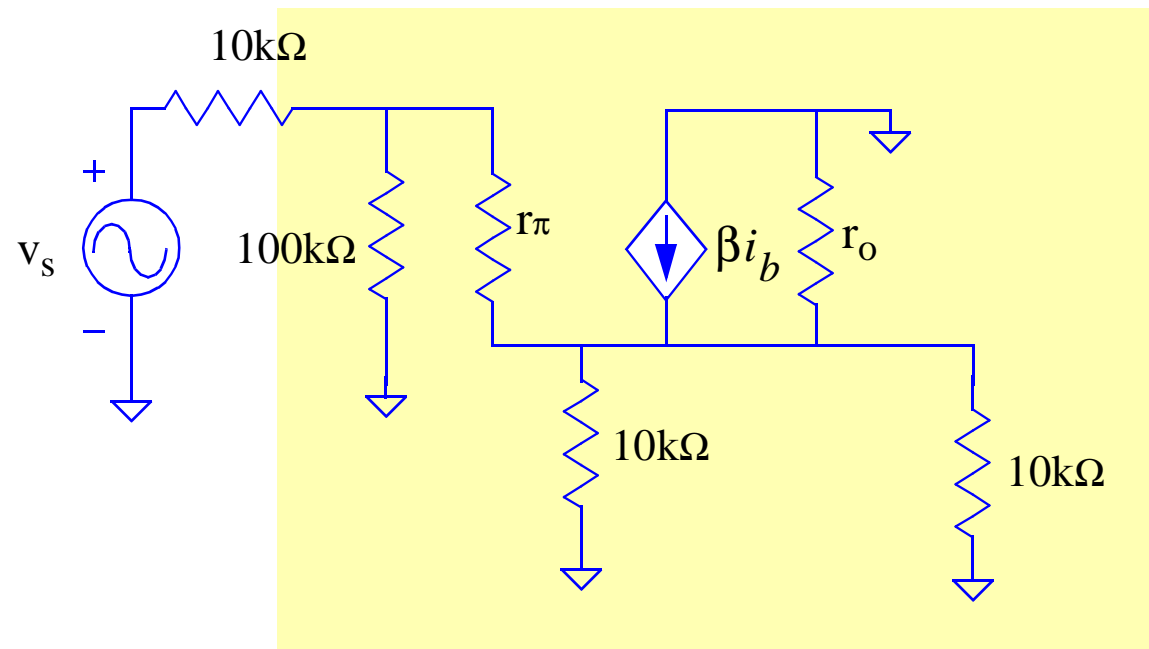
Emitter Follower Example

- 2) Establish small signal model



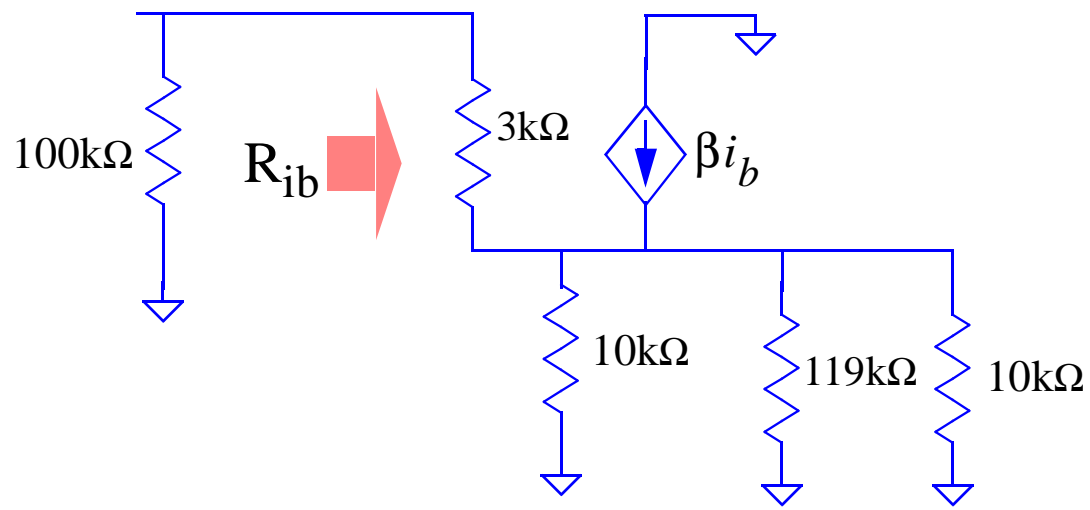
Amplifier Input Resistance, R_{ib}

- 3) Calculate input resistance



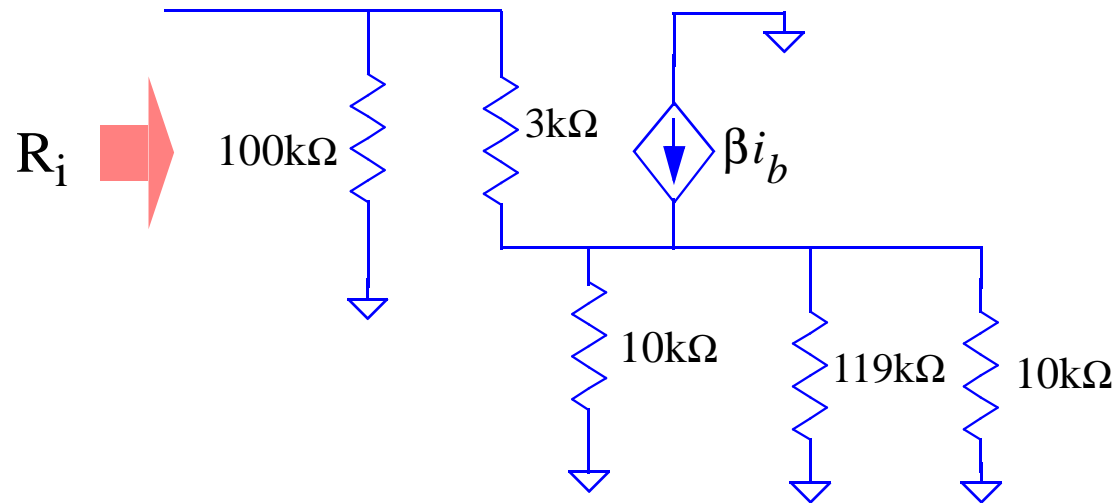
Transistor's Input Resistance, R_{ib}

- “*Reflect*” impedances into base from emitter for simplified input resistance calculation



Amplifier Input Resistance, R_i

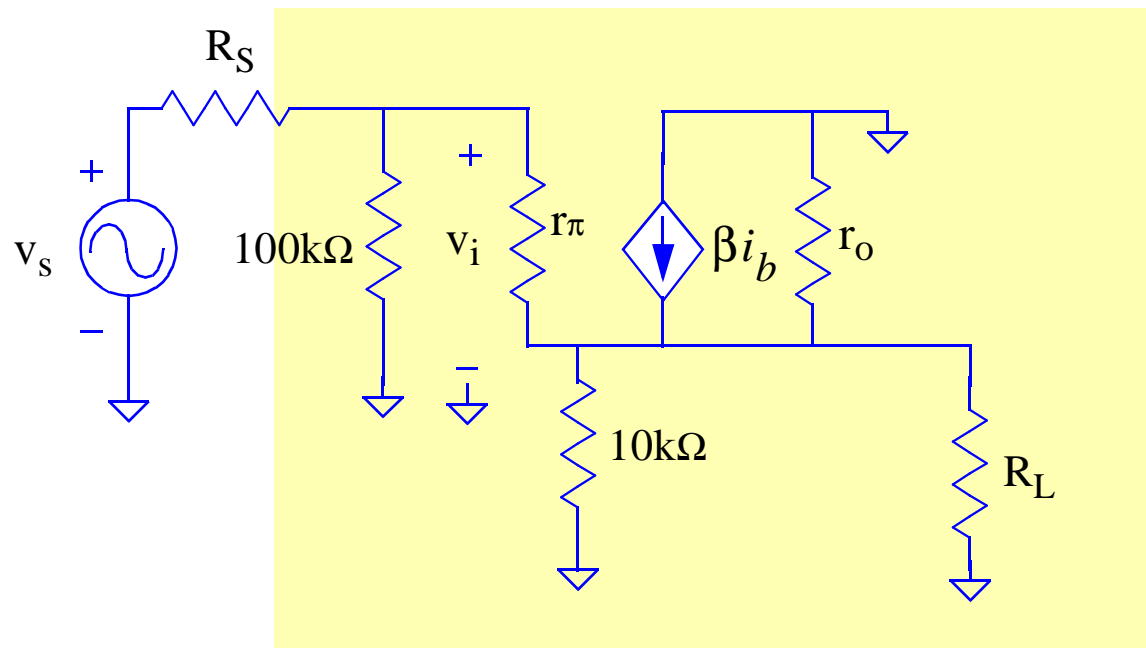
- R_B is part of the amplifier circuit, and adds to the input resistance to the transistor



- Amplifier input resistance is limited by R_B in this circuit. Why not make it bigger?

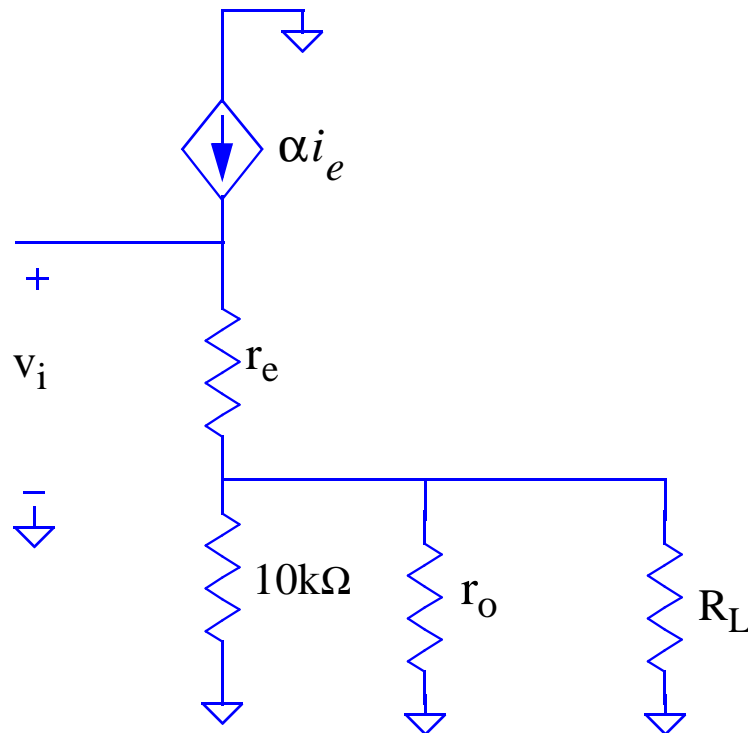
Emitter Follower --- Buffer

- Even though the load resistance is $10\text{k}\Omega$, the input resistance is much higher
- This is a desirable feature of a buffer amplifier, especially if R_S is large, or R_L is small
- Is R_{in} big enough for our example? What is v_i ?



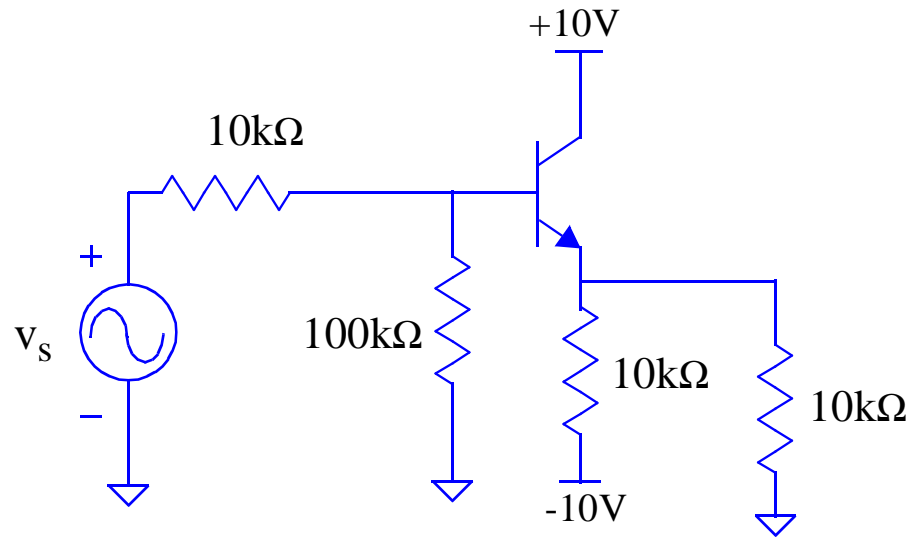
Emitter Follower --- Buffer

- Further voltage division for the amplifier stage
- Most easily seen using other small signal model



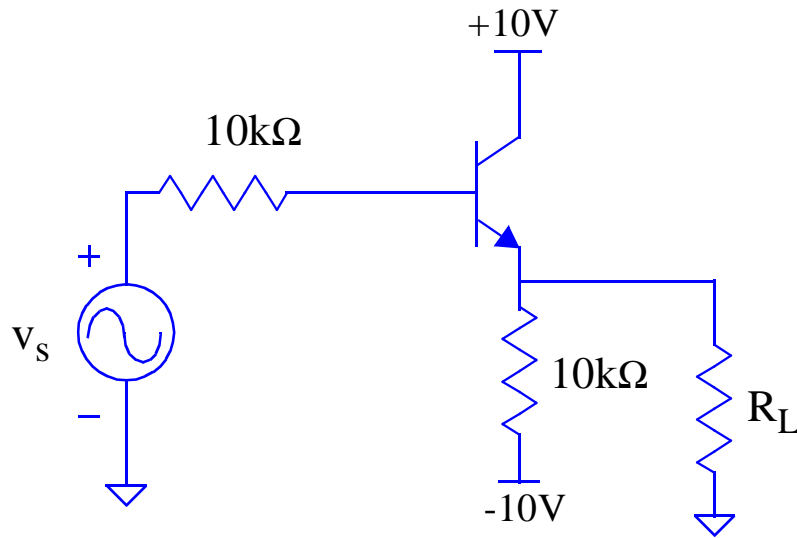
Analysis by Inspection

- Experienced analog designers just analyze the circuit directly by inspection



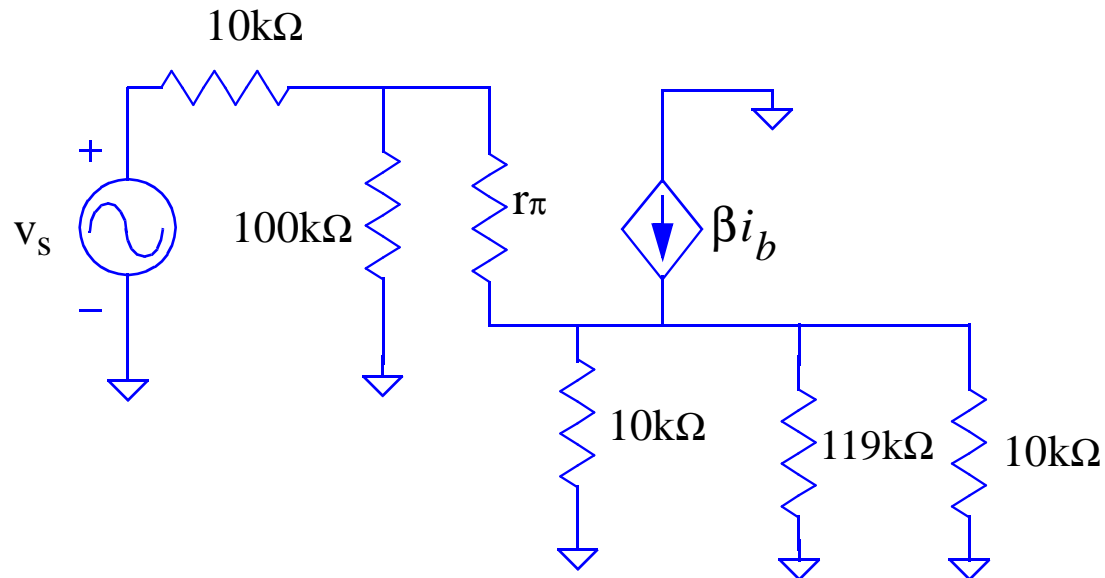
Analysis by Inspection

- What if R_L is much less than R_E ?

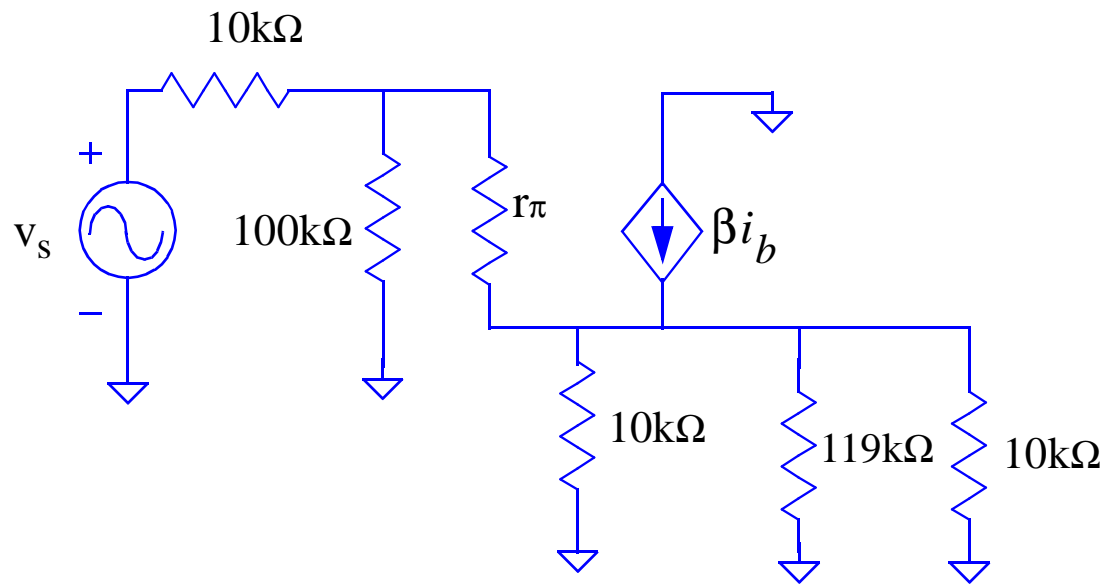


Emitter Follower Current Gain

- No voltage gain, but acts as a buffer to drive small impedance loads
- Provides good current amplification

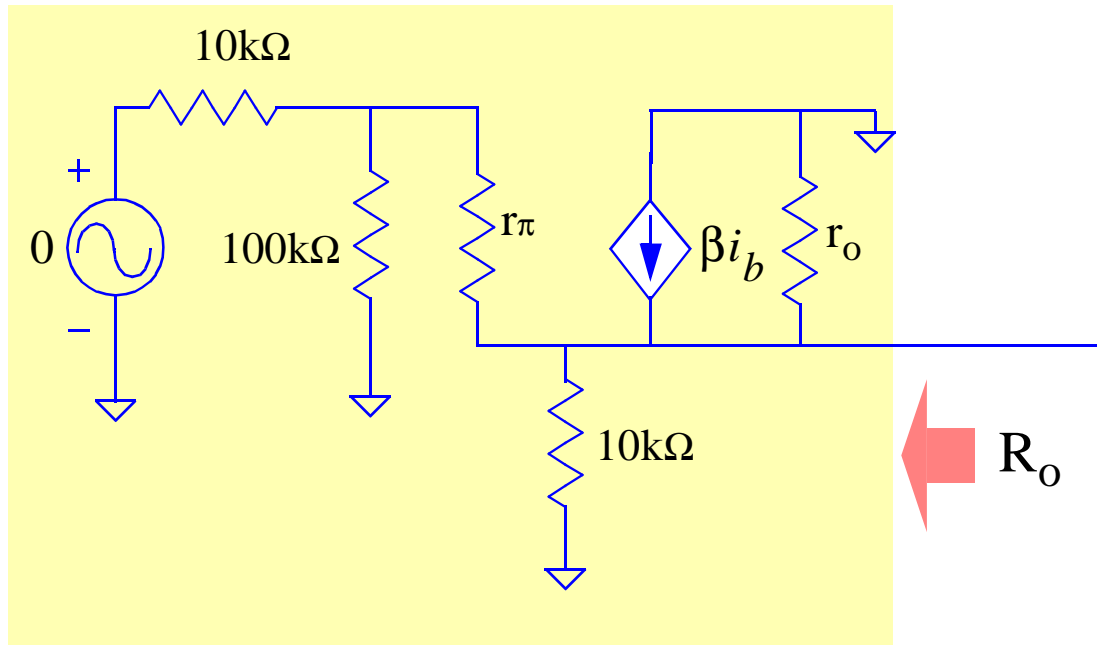


Current Gain



Output Resistance, R_o

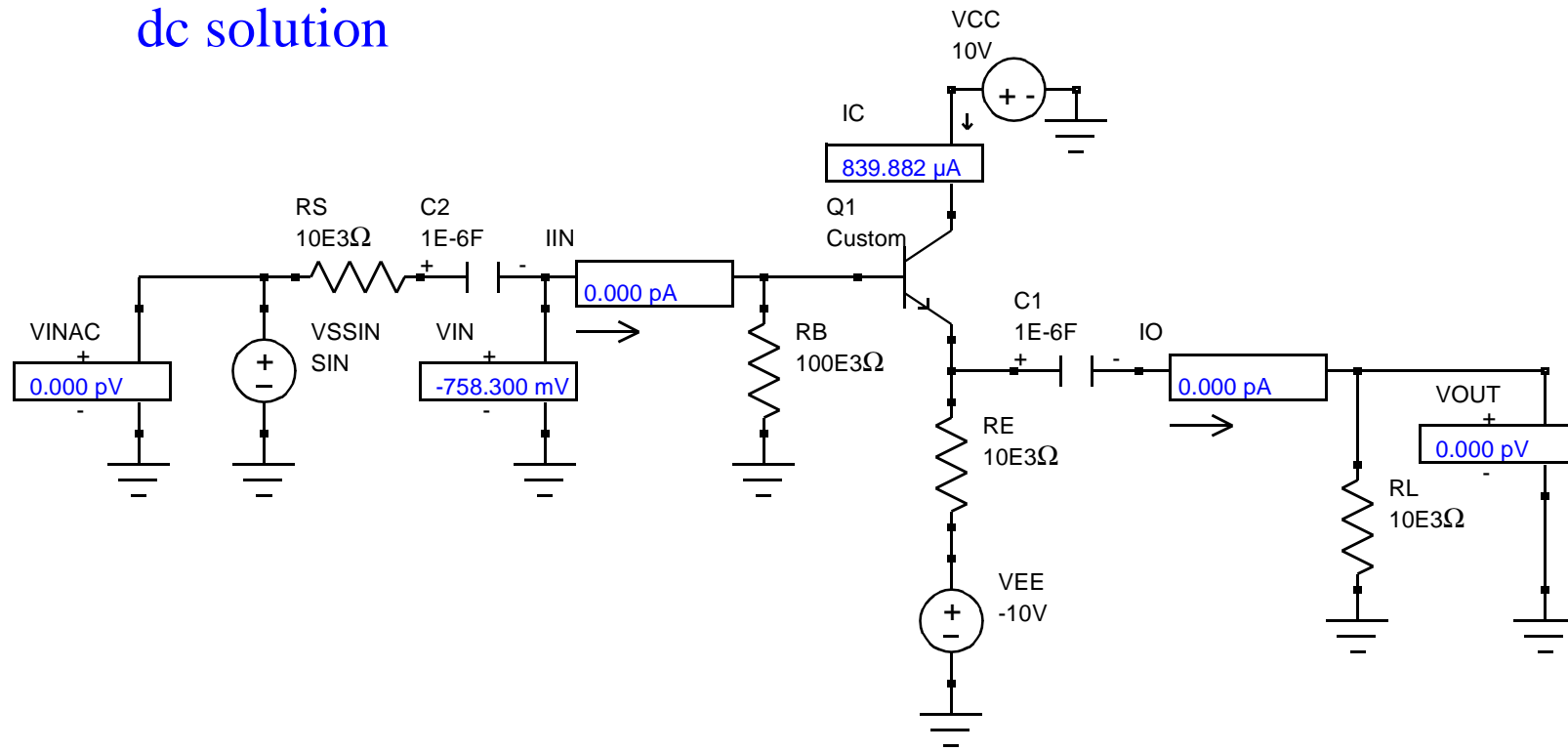
- 4) Calculate output resistance



Output Resistance, R_o

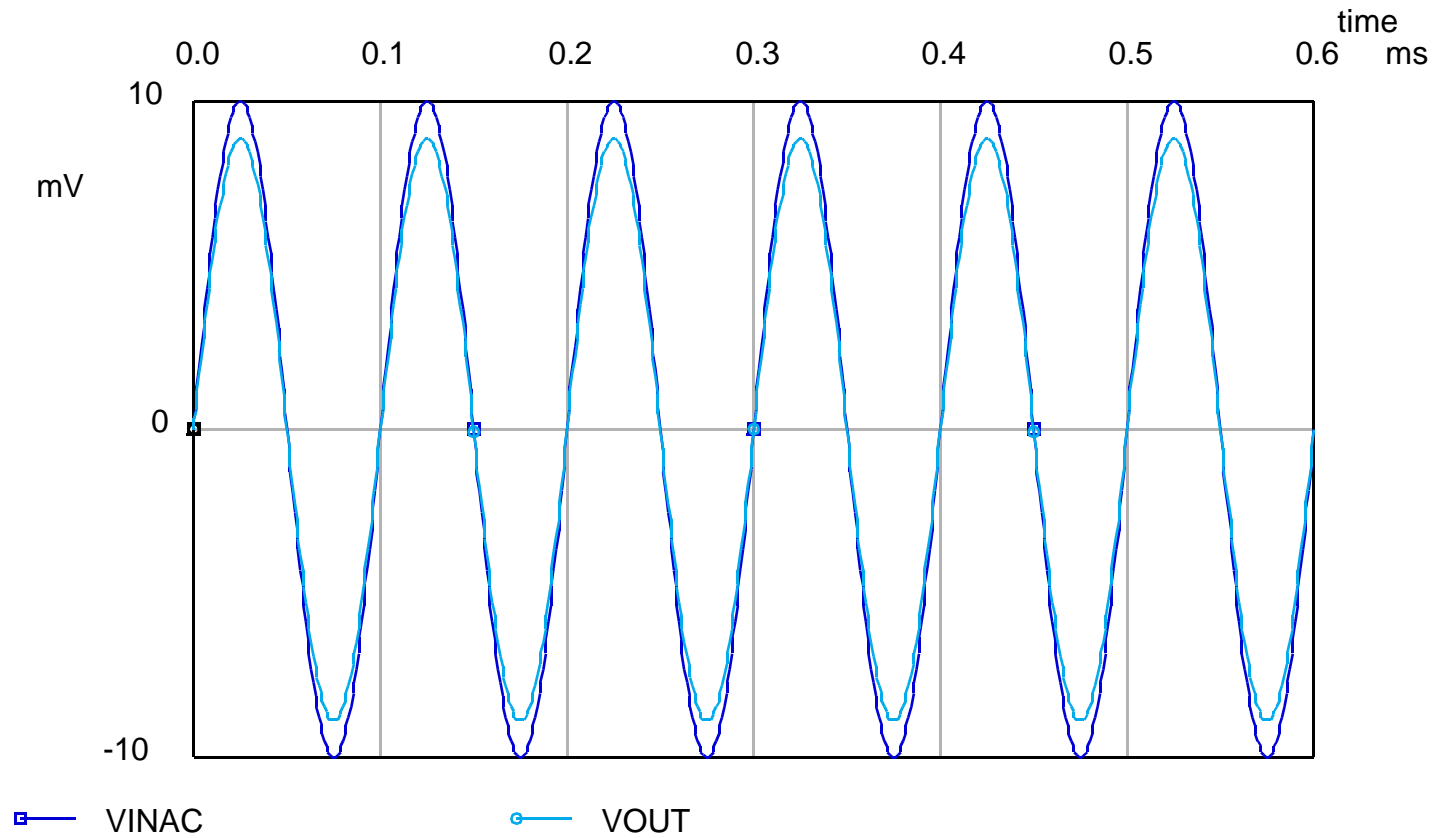
SPICE Results

dc solution



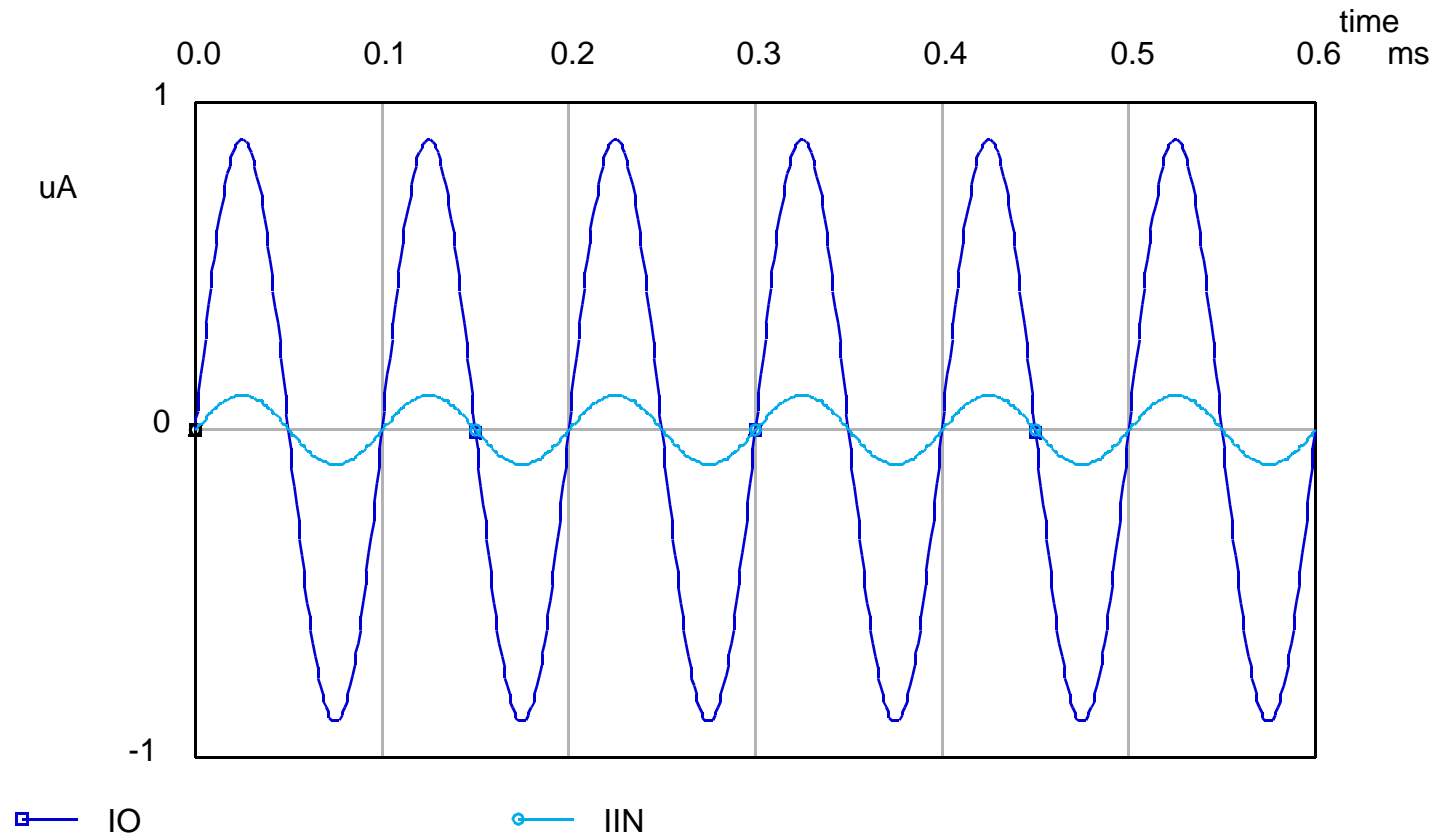
SPICE Results

voltage gain



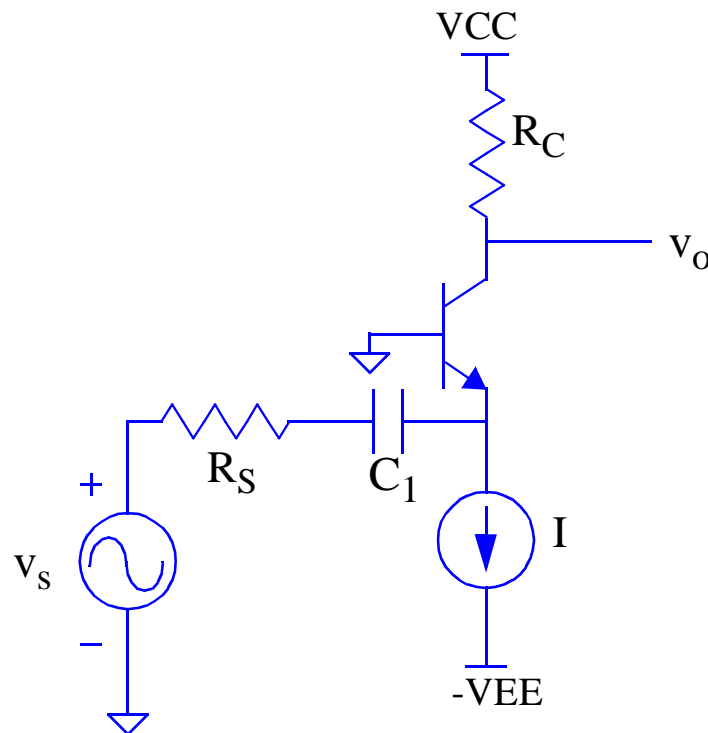
SPICE Results

current gain



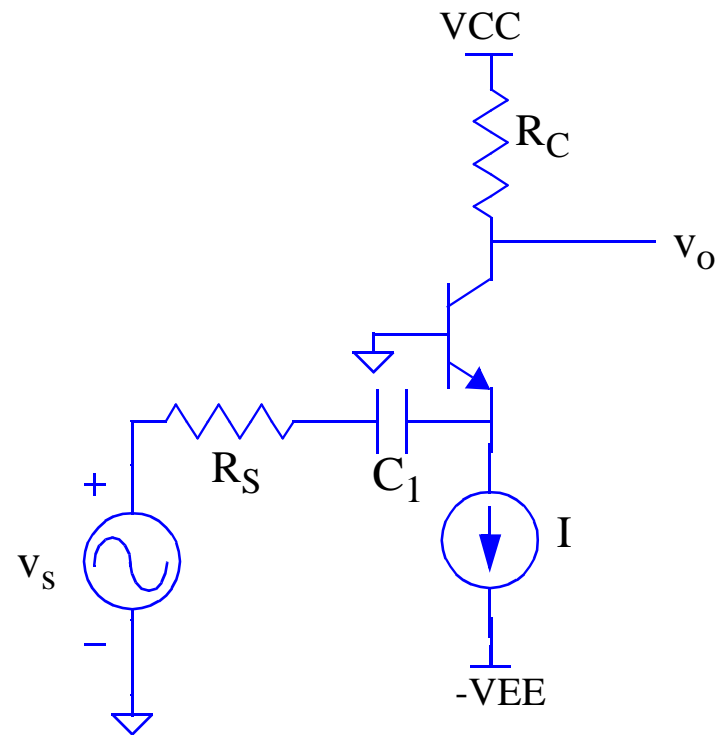
Common Base Amplifier

- Gain is close to unity
- Very low input impedance --- great for impedance matching (e.g. 50 ohms)
- Large output impedance -- approximately R_C
- Great high frequency behavior -- more on this later...



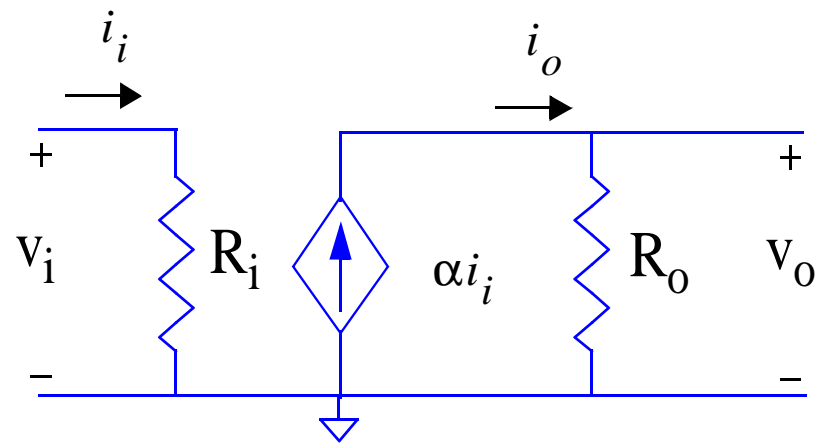
Current Source Biasing

- Instead of resistors, a current source is used to bias the transistor in this example
- Current sources can be used to bias other amplifier types too
- Building a current source is less expensive than building a resistor on an IC --- we'll be addressing IC issues such as this much more extensively beginning with the next lecture



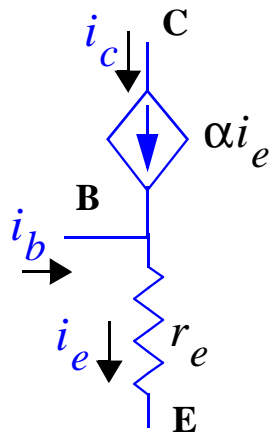
Current Buffer

- Can be used as a current buffer
- Macromodel:



Small Signal Equivalent Circuit

- Since the base is grounded, we would probably select the T-model from Lecture 13



- What parameters are being ignored in this simplified T-model? And what is the potential impact?

Common Base Small Signal Analysis

Common Base Small Signal Analysis