EE 105

Microelectronic Devices and Circuits

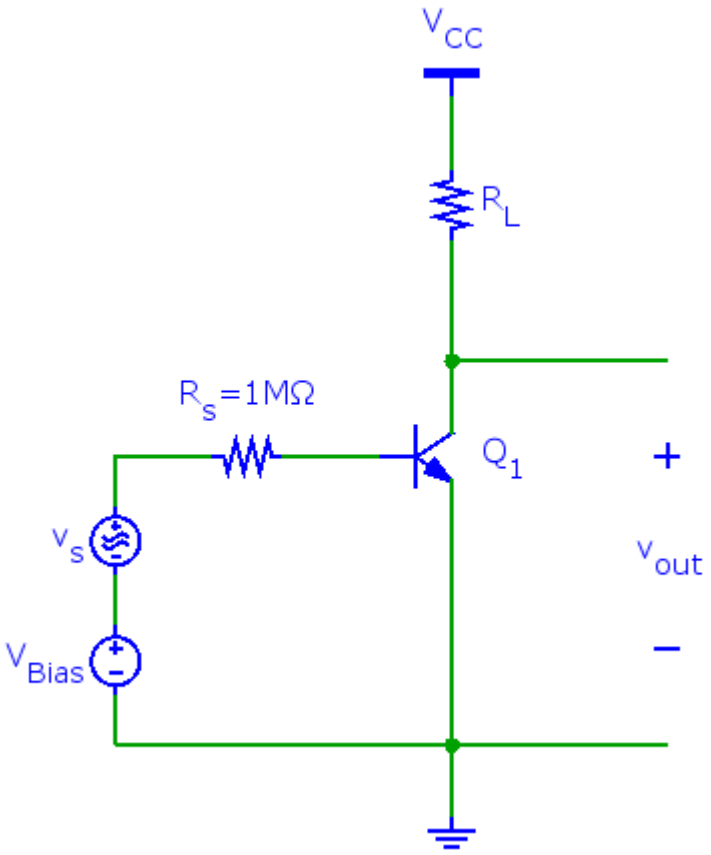
Bernhard E. Boser
University of California, Berkeley
boser@eecs.berkeley.edu

Outline

- BJT Small-signal model – “second-order effects”
  - Finite Early Voltage, V_A
  - Finite current gain, β
  - Other … finite r_b, r_e, …, device capacitance (later)

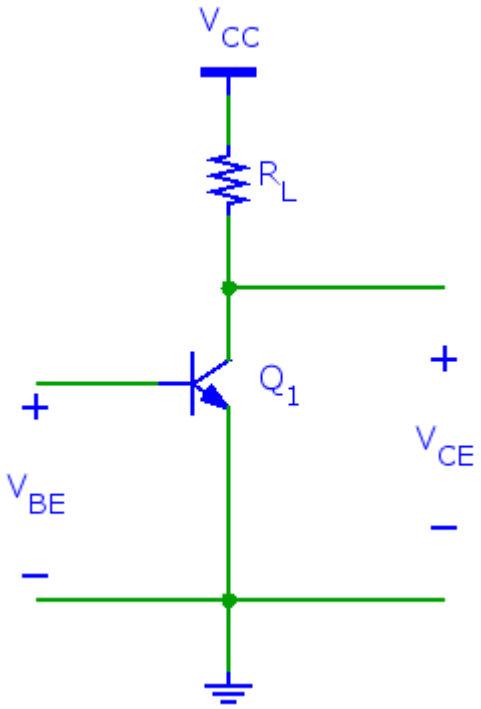
- Biasing
  - Why constant voltage bias won’t work
  - Biasing with feedback
  - Biasing with resistors
  - Replica bias circuit
  - Emitter degeneration

μPhone Amplifier

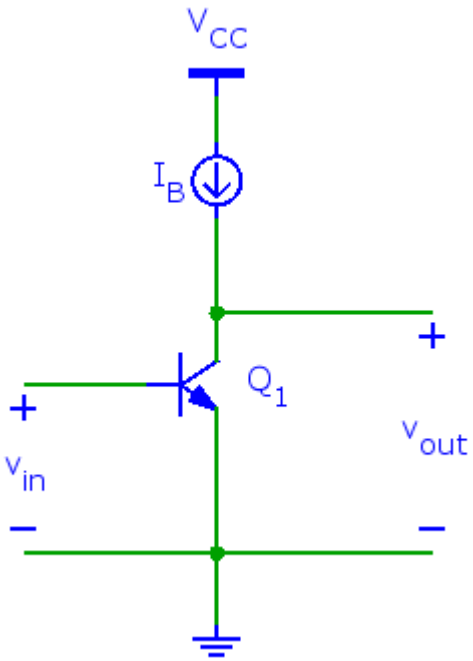


Finite Current Gain β

Maximum Gain



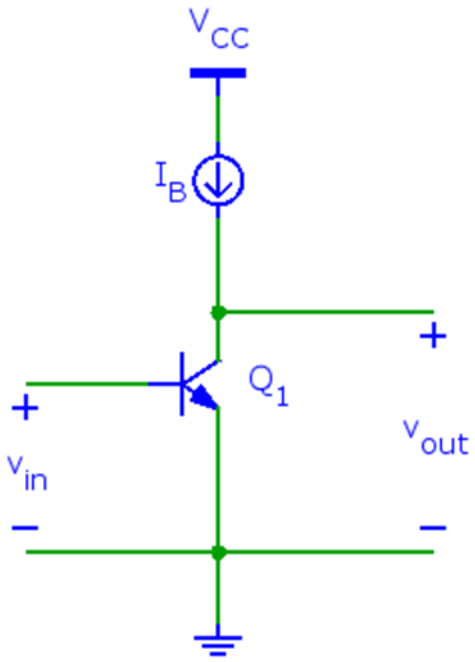
Current Source “Load”



Early Voltage

"Enhanced" (?!) BJT Small-Signal Model

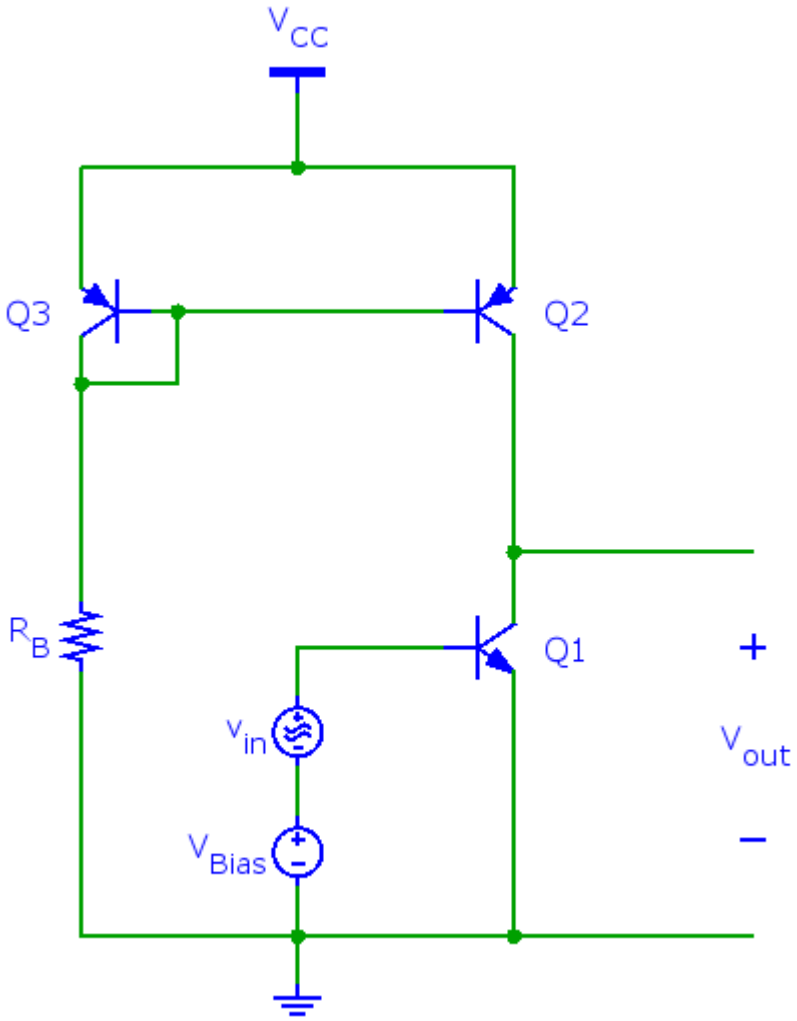
Common Emitter with Current Source Load



Transistor Current Source

Active Current Source Bias Options

High-Gain Common-Emitter Amplifier

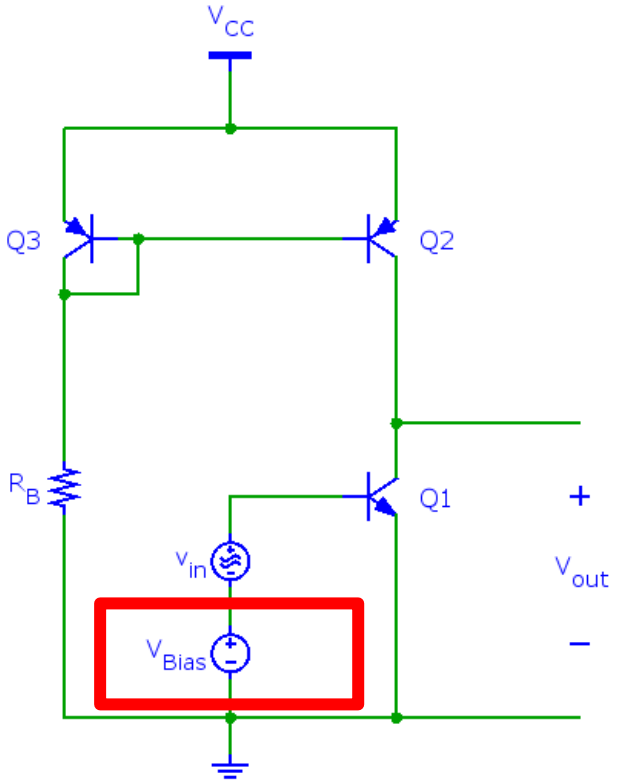


Small-Signal Summary

- Small-signal model
- Linearized about “bias point”
- Parameters are derivative of large signal model
- BJT small-signal model:

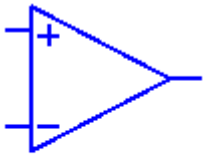
Biasing

- ~~Constant Voltage~~
- Feedback
- Resistor Bias
- Emitter Degeneration
- Replica Bias



Bias with Feedback

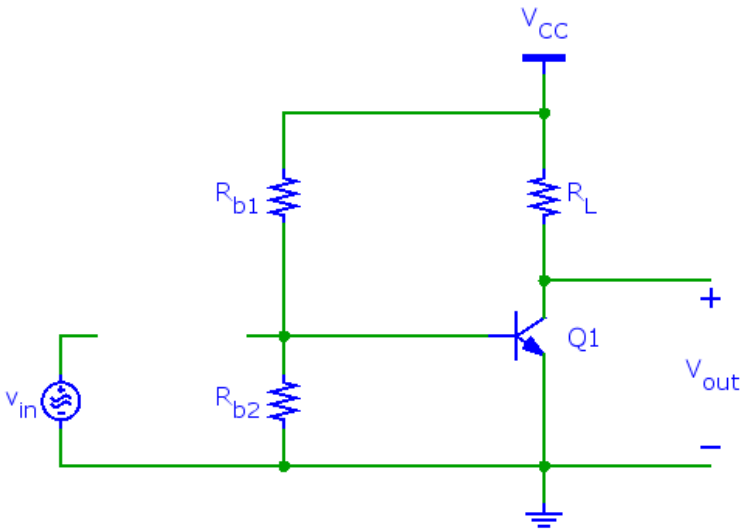
A familiar problem …



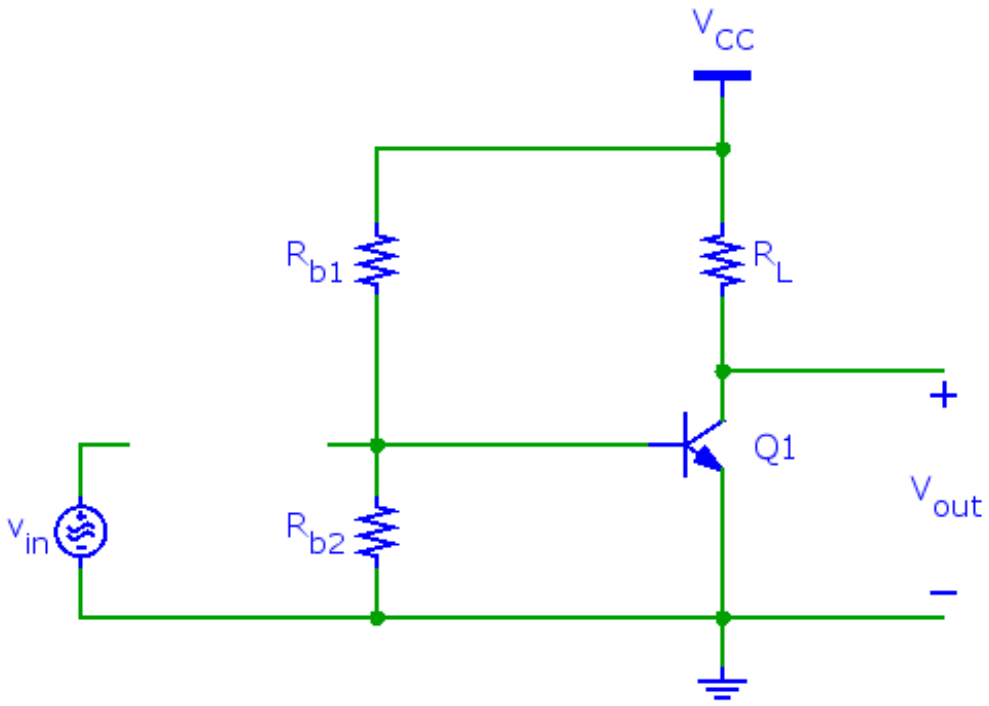
a_v --> large

EE 140 covers feedback in analog circuits in detail

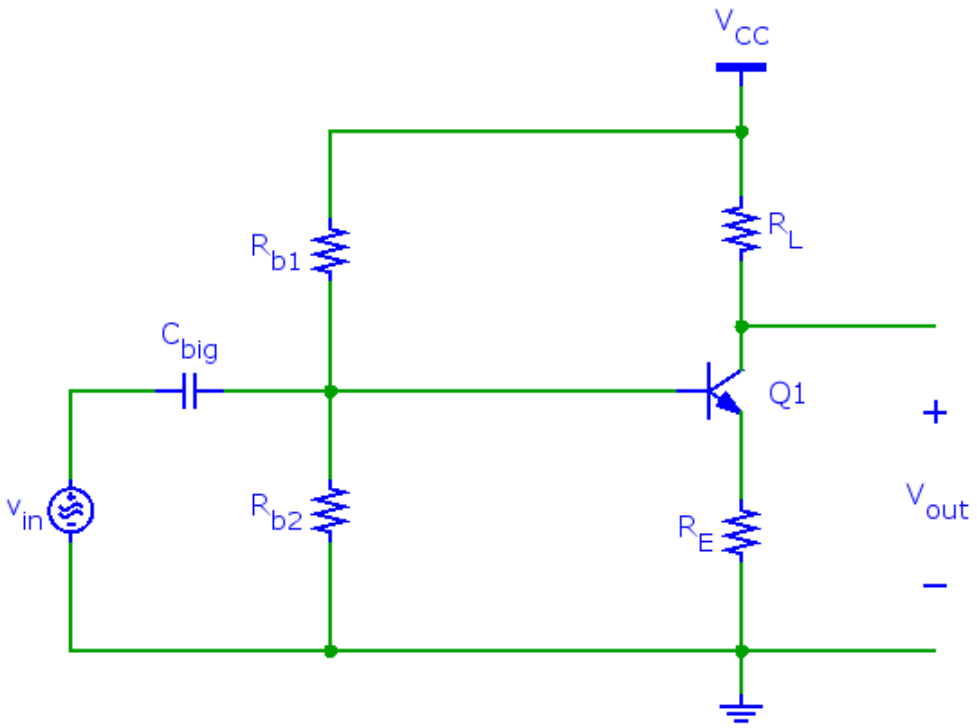
Resistor Biasing



Resistor Biasing



Emitter Degeneration



Outline

- BJT Small-signal model – “second-order effects”
  - Finite Early Voltage, V_A
  - Finite current gain, β
  - Other … finite r_b, r_e, …, device capacitance (later)
- Biasing
  - Why constant voltage bias won’t work
  - Biasing with feedback
  - Biasing with resistors
  - Replica bias circuit
  - Emitter degeneration
- Practice!