

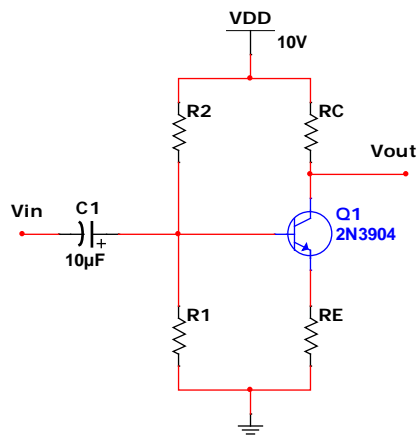
BEE 332 Lab 2  
Single-stage BJT amplifiers  
Spring 2017

Nicole Hamilton

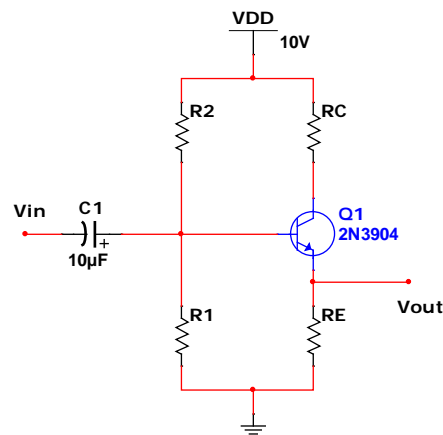
<https://faculty.washington.edu/kd1uj>

# Objective

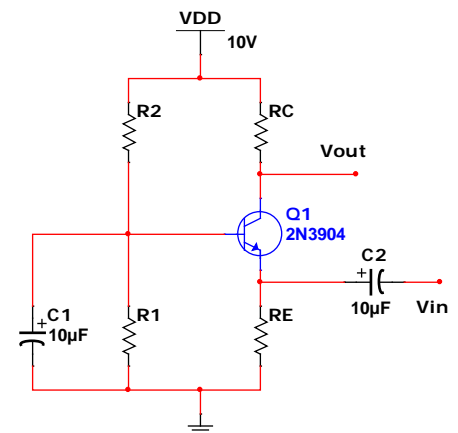
Observe the operating characteristics of the three fundamental single-stage BJT amplifier circuits.



Common emitter



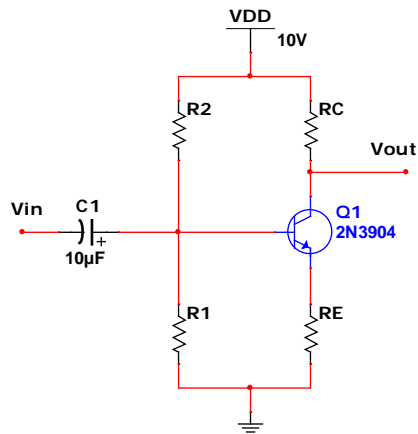
Common collector



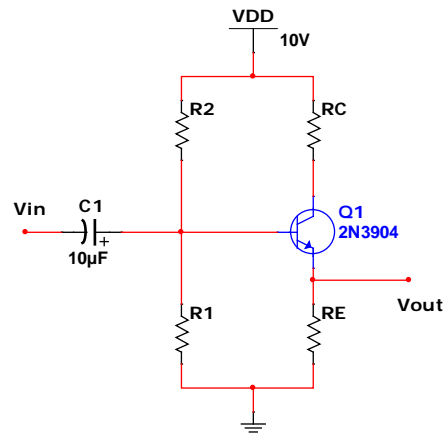
Common base

The BJT is a 3-terminal device. Thus, all amplifiers built using BJTs must use one terminal as input, another as output and the remaining one as common.

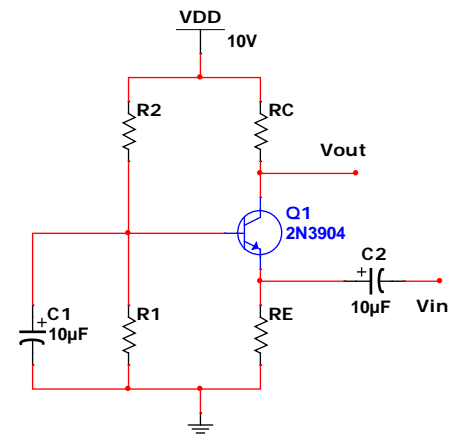
1. The base can never be the output.
2. The collector can never be the input.



Common emitter



Common collector

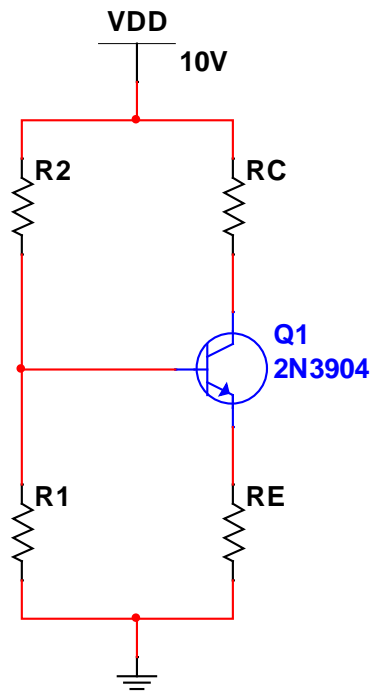


Common base

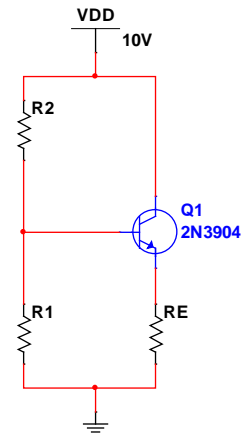
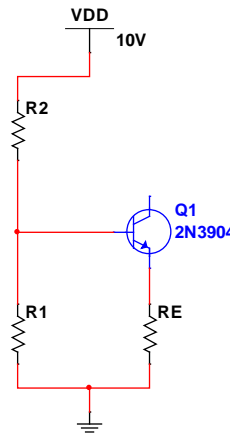
# Procedures

1. Bias a transistor in forward active mode.
2. Simulate and build and then measure gain, clipping and cutoff points for several basic single-transistor amplifiers.

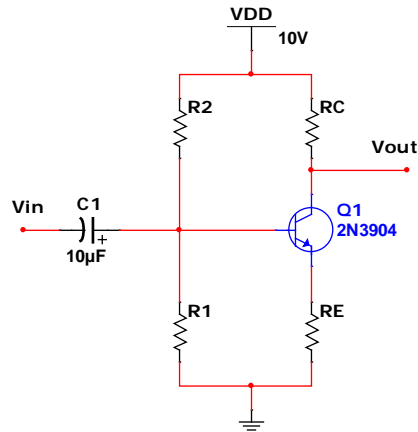
# Biassing the Q-point



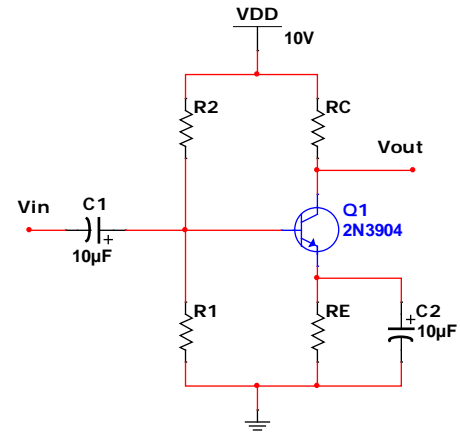
1. Pick R1, R2, RE and RC to give  $V_B \approx 1.5\text{ V}$  and  $\sim 150\ \mu\text{A}$  through the divider.
2. Measure  $V_B$ ,  $V_E$  and  $V_C$  with RC in place and with it replaced by an open or a short.



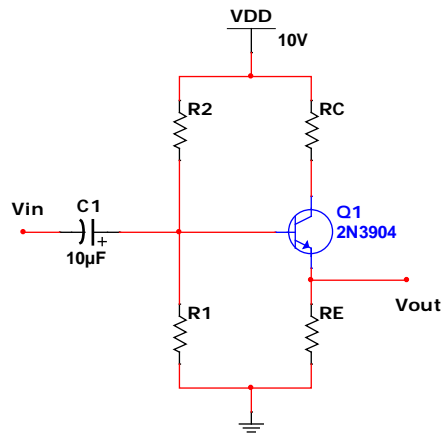
# The amplifiers you'll build



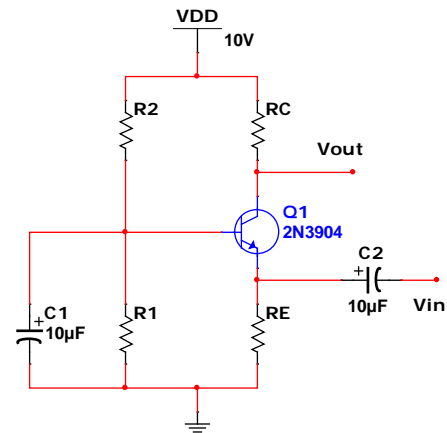
Common emitter



Common emitter with bypass



Common collector

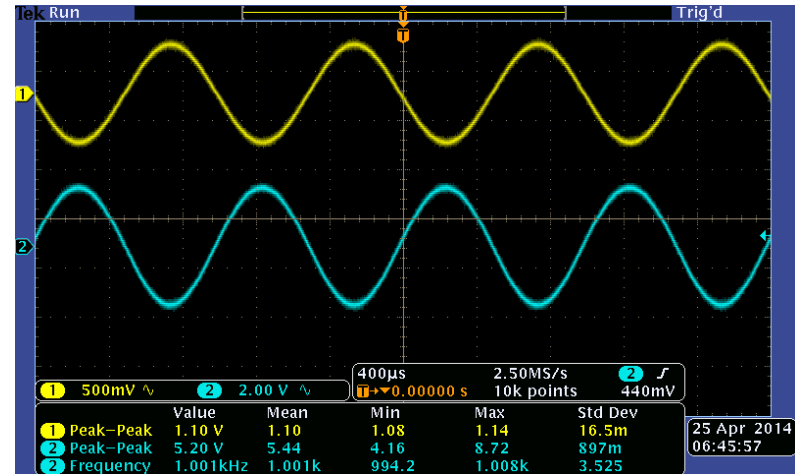
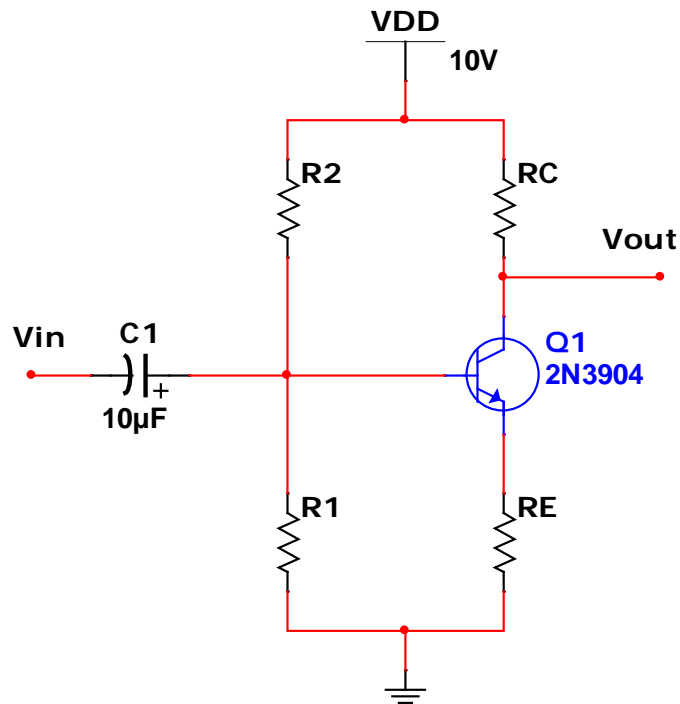


Common base

# For each circuit

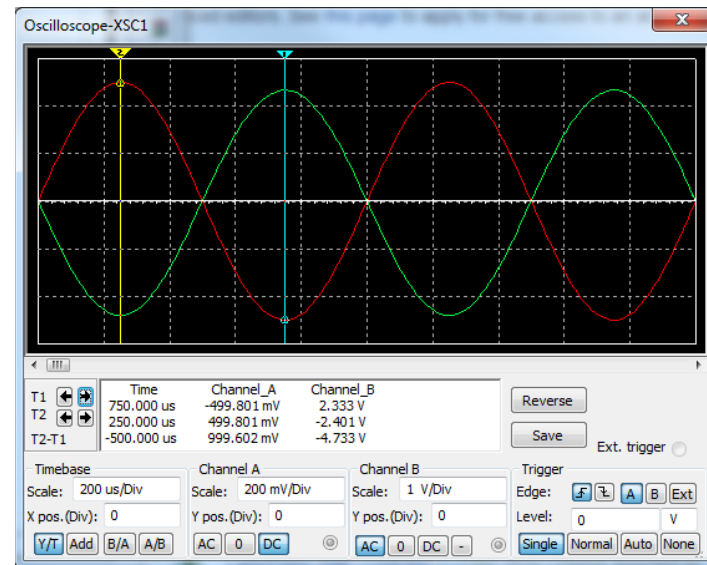
1. Simulate and build the circuit.
2. Capture screenshots from both your simulation and from actual measurements:
  - a.  $A_v$  with  $V_{in} = 1$  Vpp sine wave at 1 KHz  
( $V_{in} = 50$  mVpp for common emitter with bypass only)
  - b. Onset of clipping on top or bottom.
  - c. Clipping on both top and bottom.
  - d. 3 dB cutoff frequency.
3. Compare simulated versus measured results.
4. Answer some questions.
5. The schematics you provide should be copied from *your simulation*, not from the assignment or my slides.

# Example: Common emitter



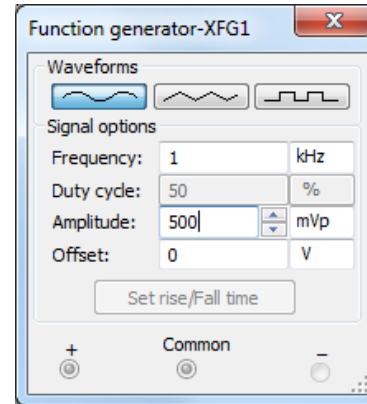
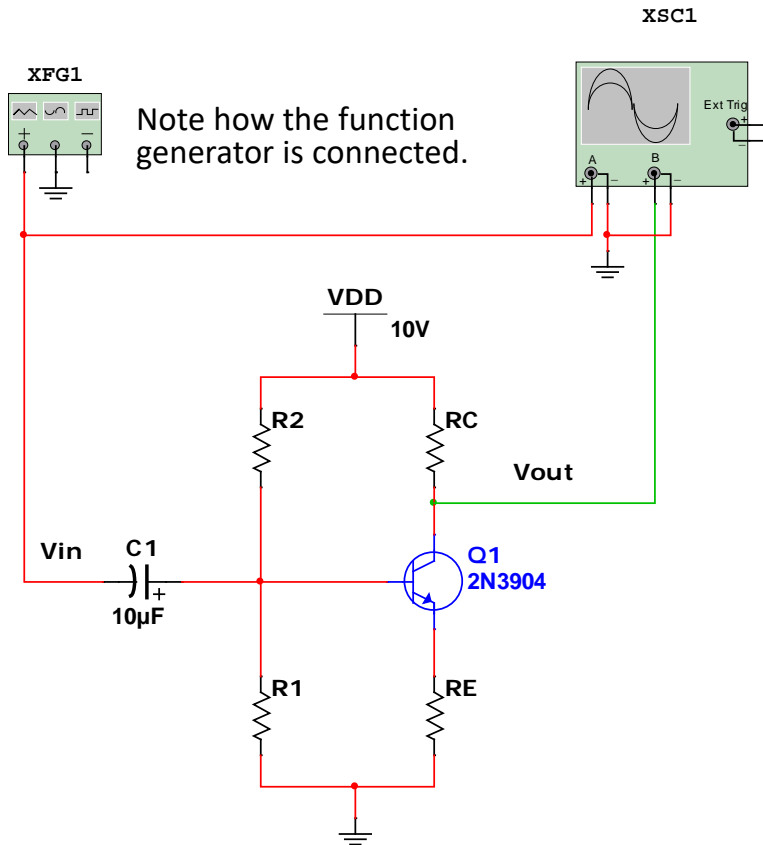
Measure  $A_v$  at 1 KHz with  $V_{in} = 1.0$  Vpp sine wave.

What's wrong with the screenshot?

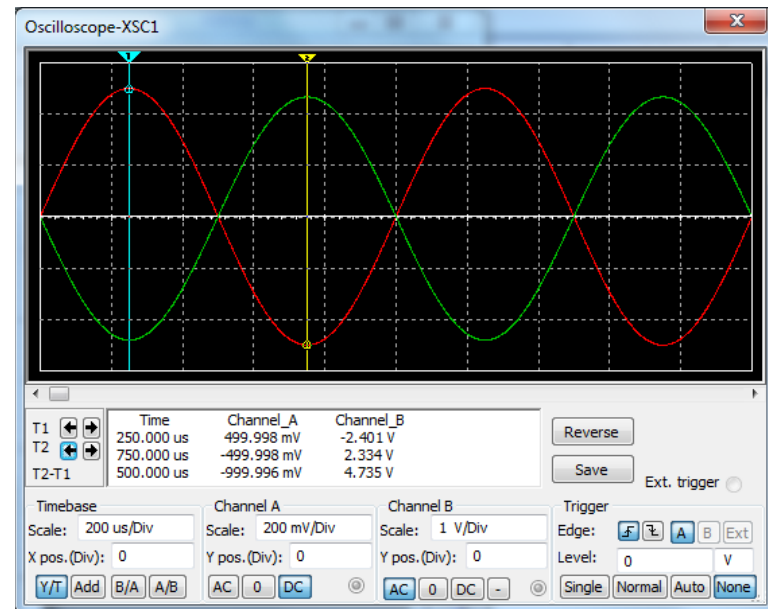




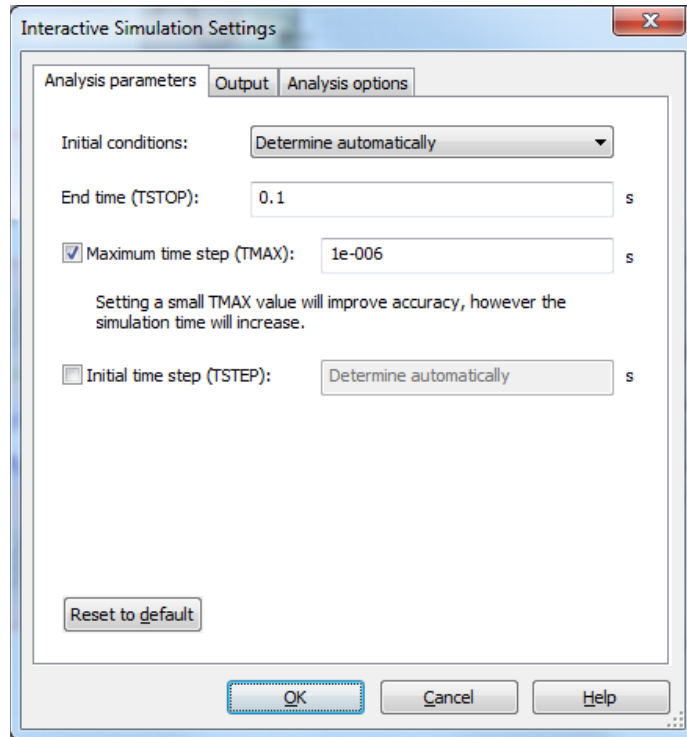
# Simulation



1 Vpp = 500 mVp



# Simulation limits



Useful to set the simulation End time to something reasonable.

Accessed via *Simulate* → *Interactive simulation settings*.

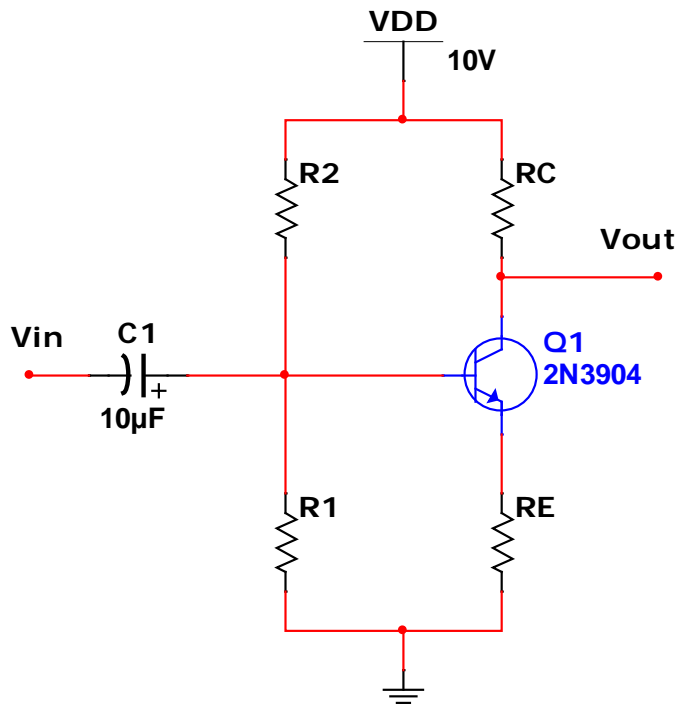
The default is  $1\text{e}+030\text{ s} = 3.17\text{e}+022\text{ years}$ .

But the universe is only  $13.8\text{e}+09\text{ years}$  old.

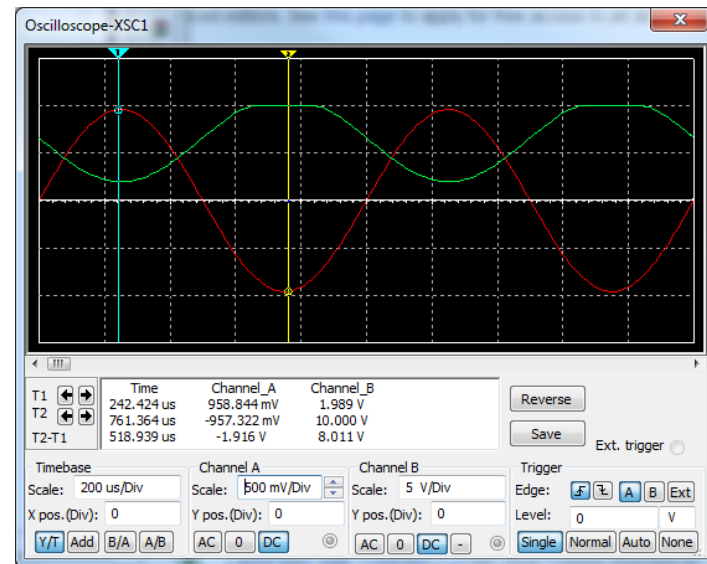
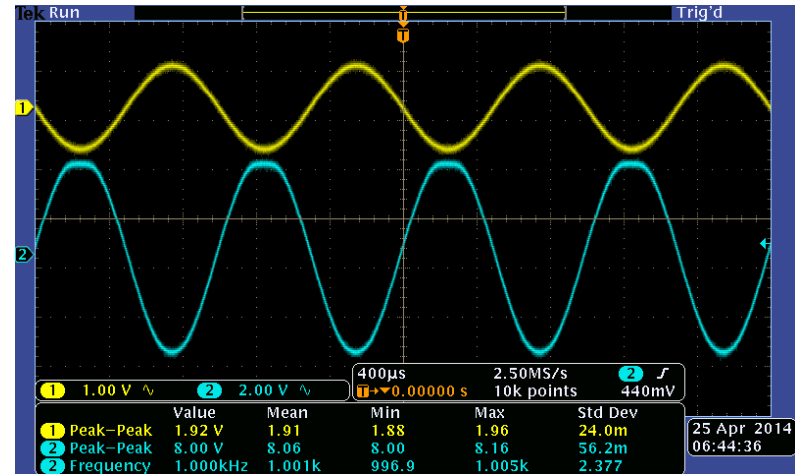
The default =  $2.30\text{e}+012\text{ age of the universe}$ .

This is why the simulation never stops.

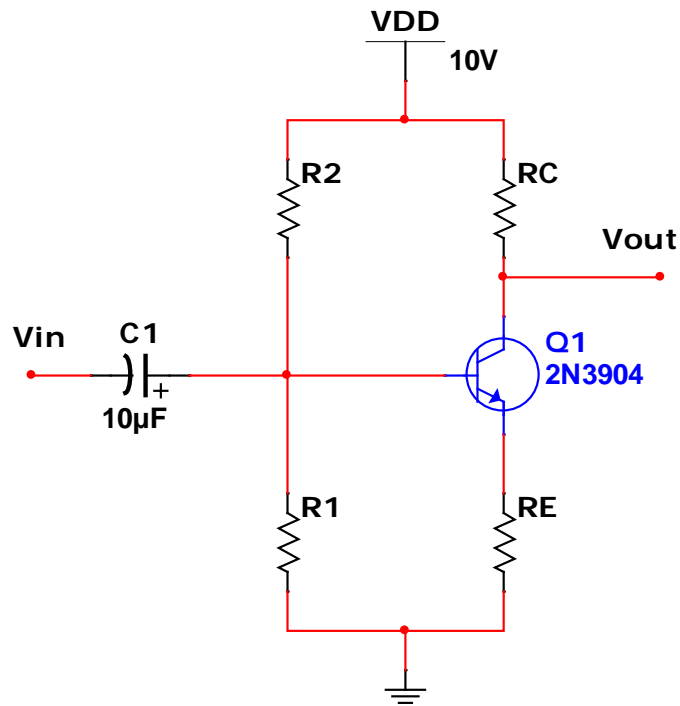
# Common emitter clipping one peak



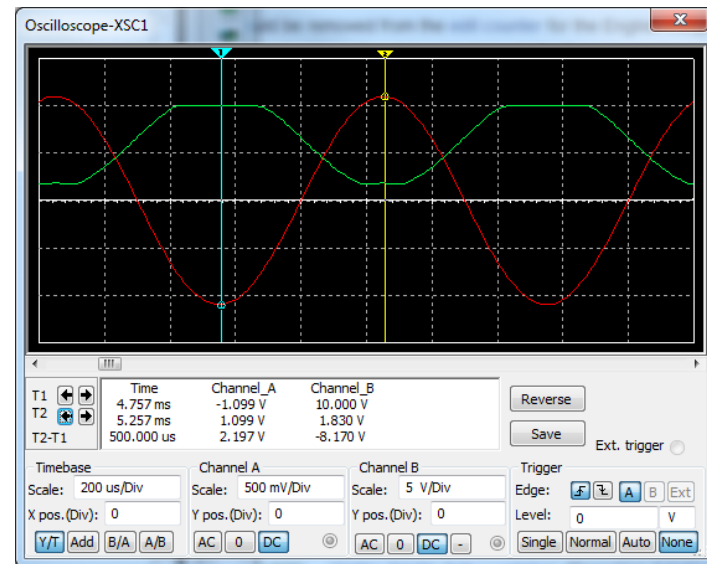
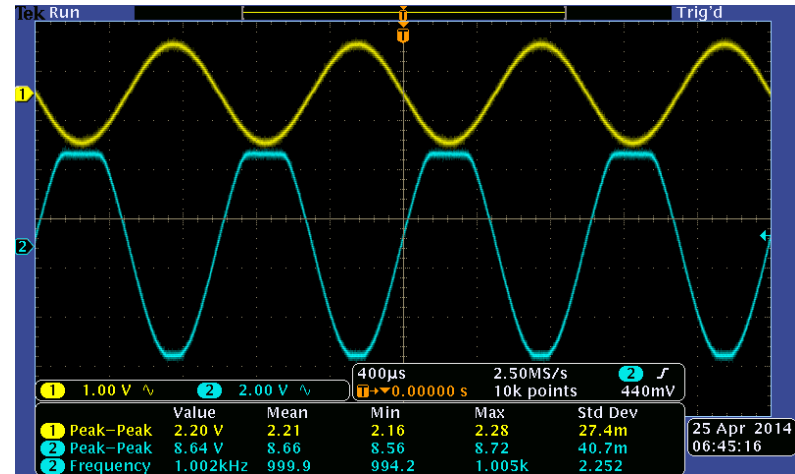
Increase  $V_{in}$  until  $V_{out}$  begins clipping on one peak.



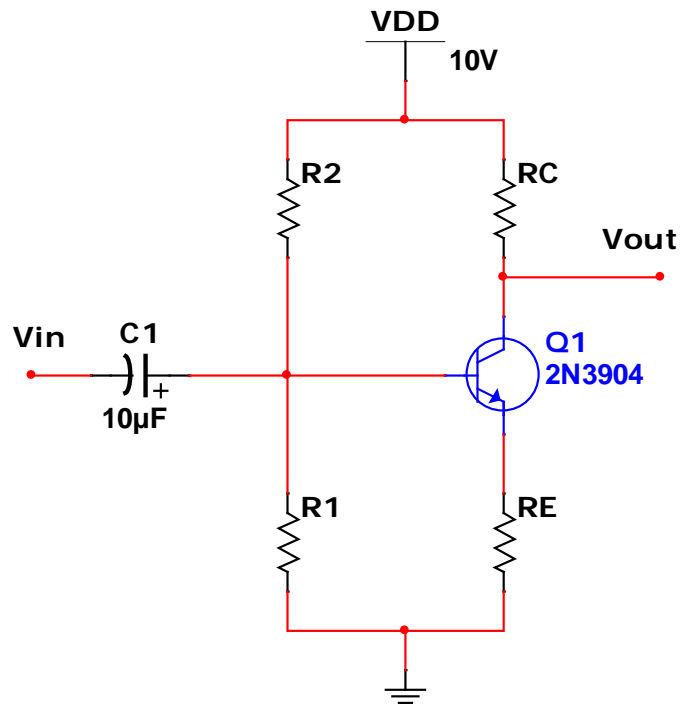
# Common emitter clipping both peaks



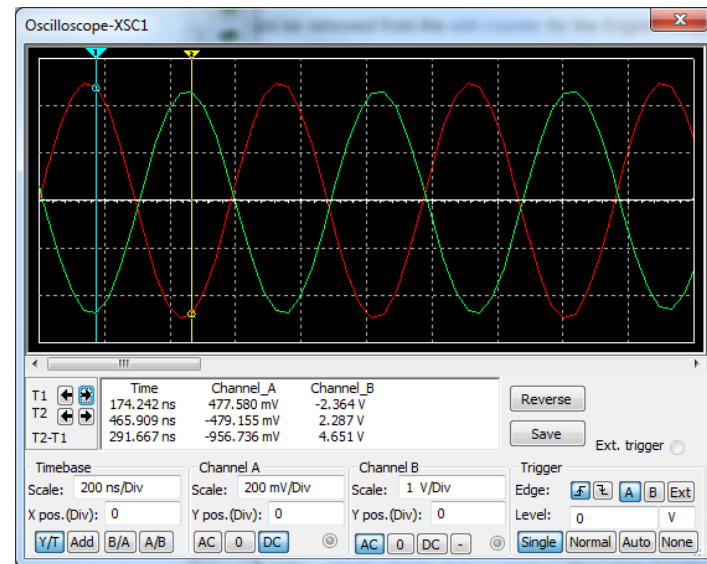
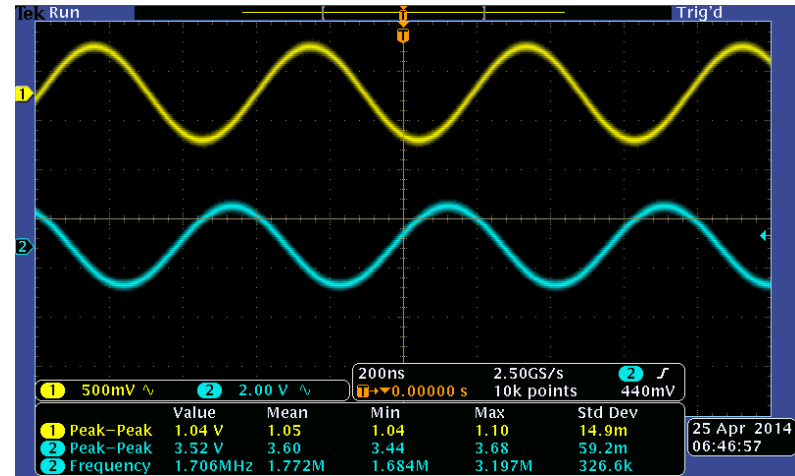
Increase  $V_{in}$  until  $V_{out}$  begins clipping on both peaks.



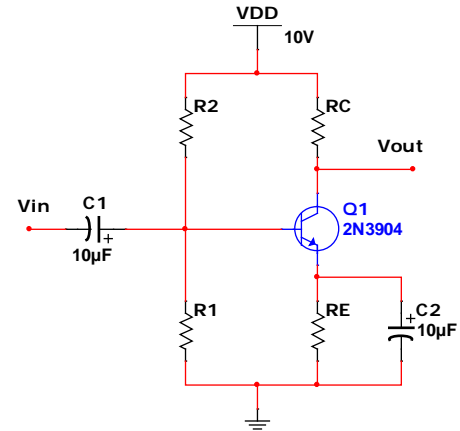
# Common emitter cutoff frequency



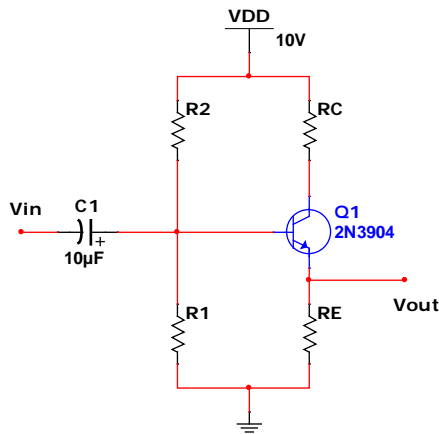
Increase frequency until  $A_v$  drops by 3 dB, compare with simulation.



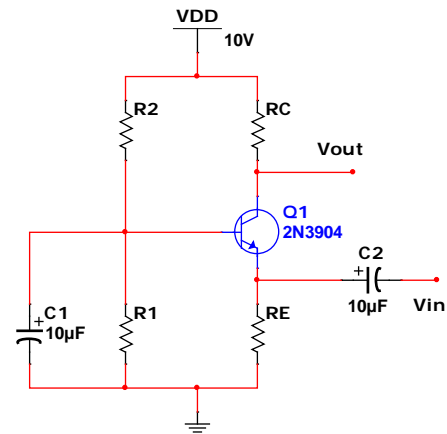
# Repeat for the rest of the circuits



Common emitter with bypass



Common collector



Common base