

ELECTRONICS I

Lab 6 Bipolar Junction Transistor (BJT) II

TRADITIONAL LAB**Design Project****Experiment 6: Bipolar Junction Transistor (BJT) II**

In the linear characteristics region, the BJT operates as an amplifier. The classes of the BJT amplifier are:

- (i) Common-Emitter (CE) amplifier
- (ii) Common-Base (CB) amplifier
- (iii) Common-Collector (CC) amplifier

Each amplifier has its own applications. Fig. 6.1 shows basic BJT amplifier configurations.

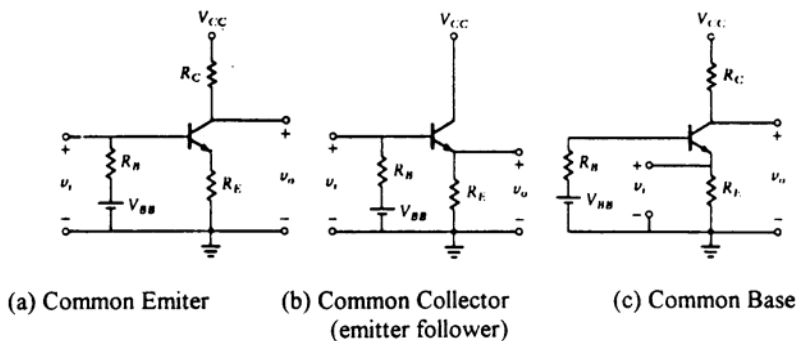


Fig. 6.1 BJT Amplifier Configurations.

The CE amplifier is the most widely used BJT amplifier because it has high voltage gain, high current gain, reasonable input resistance and reasonable output resistance. It is mostly used for voltage amplification.

The CC (commonly known as an emitter follower, EF) amplifier has high current gain, almost unity voltage gain, high input resistance and low output resistance. It is used as a buffer or as a final stage of a multistage amplifier.

The CB amplifier has low input and high output resistances. These are undesirable properties for amplification.

Common Emitter (CE) Amplifier Design

Design a common emitter (CE) amplifier with the following specifications:

1. Use BJT from experiment 5 ($\beta =$)
2. Midband gain = - 10
3. Load resistance = 8 K-ohm
4. Maximum swing
5. Low corner frequency = 100 Hz
6. Upper corner frequency = 22 KHz

Determine all parameters values and maximum peak-peak output voltage swing without distortion.

Check your D.C. analysis using say Electronicswork Bench/PSPICE.

You need r_i source function generator internal resistance from expt 4.

Obtain the frequency response for your design using Electronics Workbench program/PSPICE.

Obtain frequency response experimentally and compare results with theoretical results.

MOBILE STUDIO LAB

Before We Start

As the title of this lab says, this lab is about designing a Common-Emitter Amplifier, and this in this stage of the lab course is premature, in my opinion, of course. How can one design a BJT amplifier only after one simple characteristic experiment? Maybe students are all brilliant or this subject is already covered in a class, extensively. Even with that assumption, experiment with a BJT amplifier should come before asking for designing such circuit. Even before that, a much simpler circuit investigation would be more beneficial to understand the Common-Emitter Amplifier. If time is not allowed, or this subject is too rudimentary, skip this and move on to the design thing.

Unlike the suggested lab manual in the Traditional Lab, the Mobile Studio Lab has 3 components:

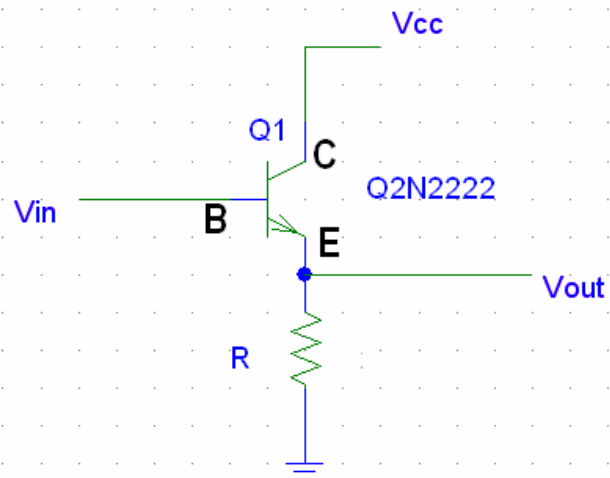
- A. Emitter-Follower Experiment
- B. Common-Emitter Amplifier Experiment
- C. Common-Emitter Amplifier Design (this is the Lab 6 of the manual)

A. Emitter-Follower Experiment

The figure right shows an example of Emitter-Follower. As the name implies, the output voltage at the Emitter follows (or is the same as) the input voltage at the Base.

Actually, the output voltage is lower than the input voltage by the amount of a diode drop, i.e., 0.6 or 0.7 [V]. From $V_{out}=V_E$, $V_{in}=V_B$, and $V_{BE}=0.6$, we get $V_{out}=V_{in}-0.6[V]$.

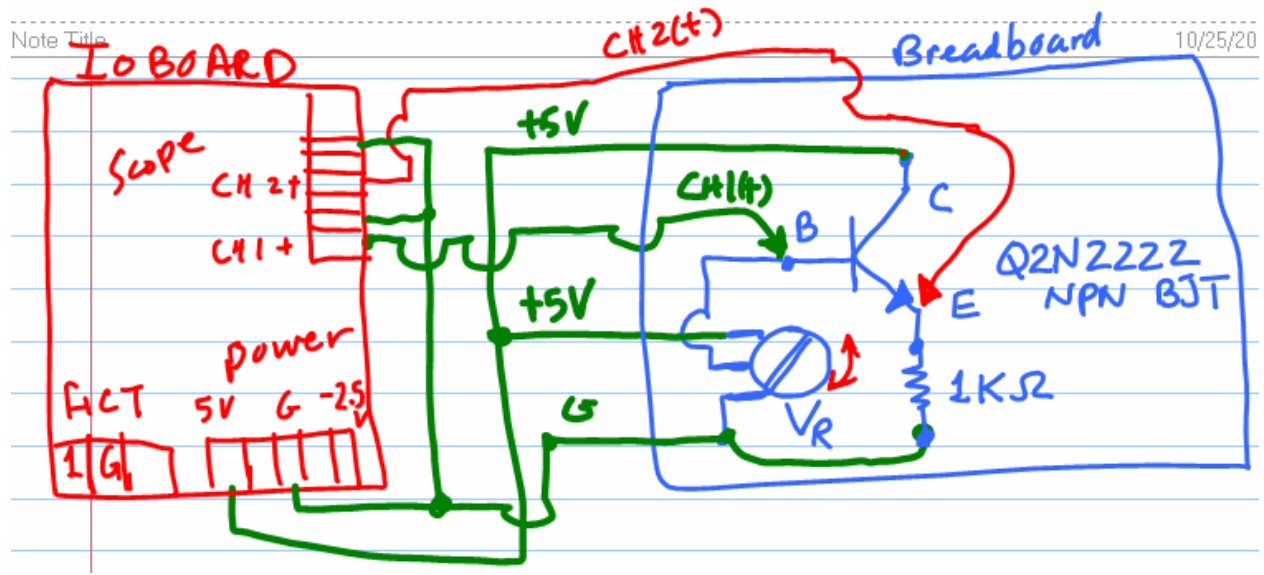
By connecting the Emitter resistor, R, to a negative supply voltage, we can get negative voltage swing too.



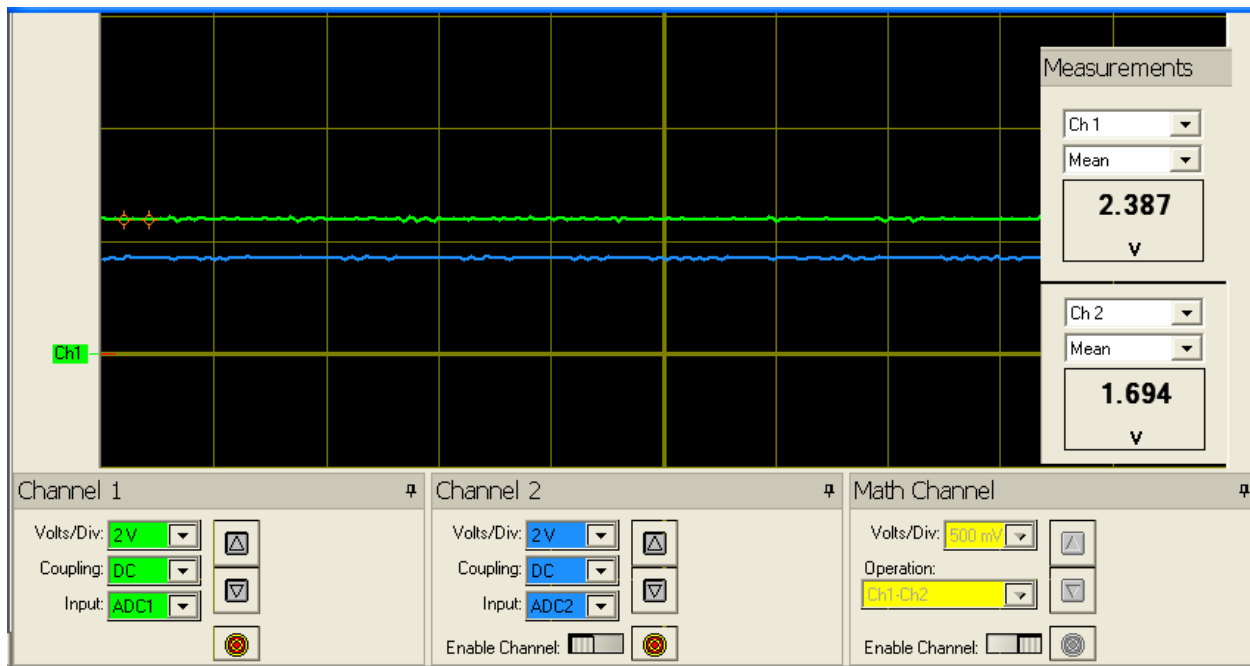
A.1. DC input with Emitter resistor to GND

- (a) Implement the Emitter-Follower circuit on the breadboard. Pick the value of R as 1k Ω .
- (b) Connect +5V source of IOBoard to Vcc
- (c) Connect the same +5V source of IOBoard to a variable resistor so that it in turn supplies variable DC voltage to Vin.
- (d) Measure Vin and Vout using scopes 1 and 2, respectively.

The experiment for Mobile Studio Lab is sketched as below:



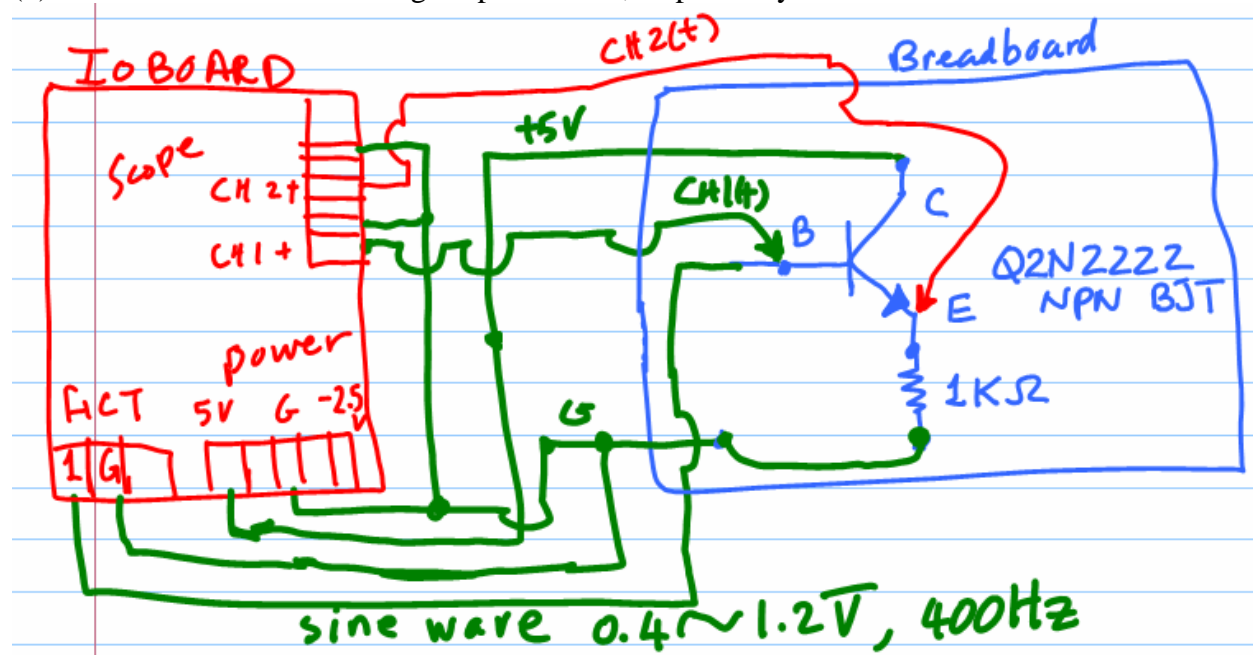
The following screen shot shows an example measurement of V_{in} and V_{out} .



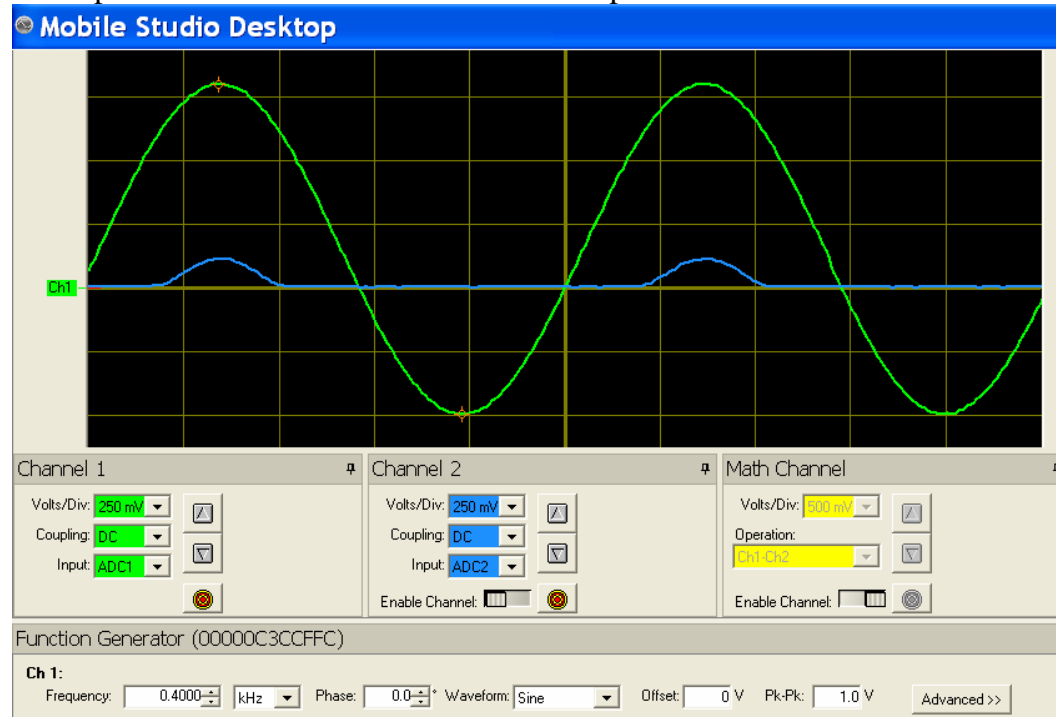
- (e) Change the input voltage at Base and observe the output voltage at Emitter. What conclusion can you draw from the observation?

A.2. Sinusoidal Input with Emitter resistor to GND

- Now, let's apply a sinusoidal input to the input of the circuit.
- We keep +5V to the Collector all the time.
- Connect the output of FCT 1 of IOBoard as input source directly to Base.
- Measure V_{in} and V_{out} using scopes 1 and 2, respectively.



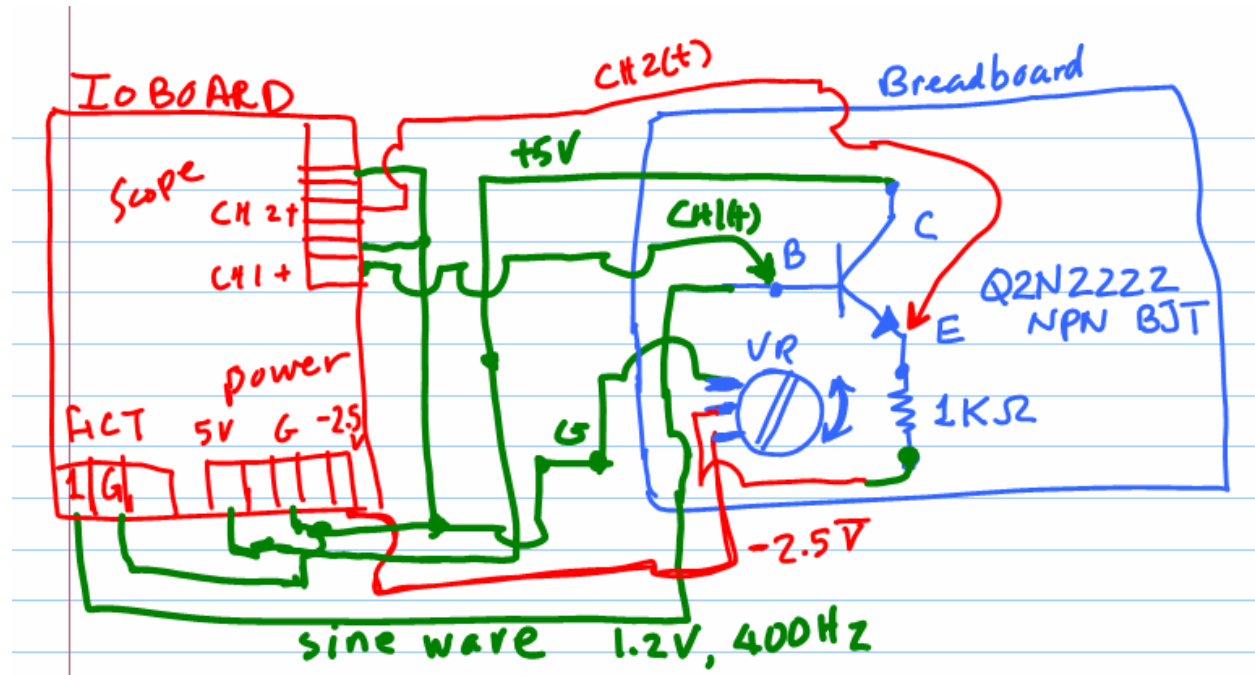
A sample screen shot of Mobile Studio Desktop is as follows:



- Change the peak-to-peak voltage of the sine wave from 0.4 to 1.2 and see how the output behaves under different conditions. So, what conclusion can you draw from this part of the lab?

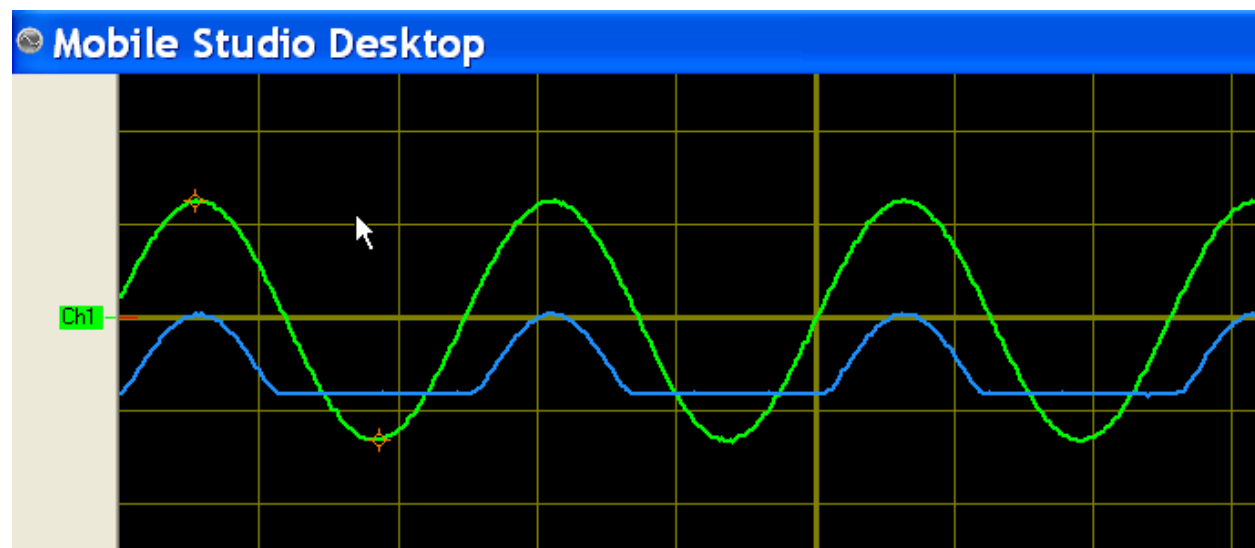
A.3. Sinusoidal Input with Emitter resistor Negative Supply

- (a) Keep everything done before intact except the end of 1k resistor: We will supply negative voltage there via a variable resistor.
- (b) Connect -2.5V source from IOBoard at one of the variable resistor, and GND to the other end of the variable resistor. Then, connect the wiper of the variable resistor (middle pin) to the bottom end of the 1k resistor.



- (c) While keeping the sine wave at 1.2 peak-to-peak and 400Hz, change the wiper position of the variable resistor, and observe the output at the Emitter.

An example screen shot of Mobile Studio Desktop:



- (d) What conclusion can you draw from this part of the lab?