ECE 331: Electronics Principles I
Fall 2013

Lab #2: Bipolar Transistor (BJT) Characterization and its Applications

Report due on Tues, Oct. 8 to Fri, Oct. 11, at the beginning of your registered lab session

Week 1

1: BJT characterization

g_m: Transconductance, defined as

You need to measure the ratio of the incremental changes in collector current and base-emitter voltage by slightly varying the base current around the operating point. You will need to vary V1 to make sure that V_{CE} is kept constant in the measurement.

β_0: AC current gain, defined as

You need to measure the ratio of the incremental changes in collector current and base current by slightly varying the base current around the operating point. You will also need to vary V1 to make sure that V_{CE} is constant in the measurement.

r_π: Input resistance, or base-emitter resistance, defined as

You need to measure the ratio of the incremental changes in base-emitter voltage and base current by slightly varying the base current from the operating point. You will also need to vary V1 to make sure that V_{CE} is constant in the measurement.

r_o: Output resistance, or collector-emitter resistance, defined as

You need to measure the ratio of the incremental changes in the collector-emitter voltage and collector current by slightly varying V1. How would you make sure V_{BE} is constant in this measurement?

$V_{CE,SAT}$: Saturation voltage is the minimum voltage you will see across the collector-emitter junction. To measure this value you can increase the base current until you see no significant decrement in the collector-emitter voltage

2: BJT Common Emitter amplifier

Measure the I-V characteristic of the BJT and draw the load line of the CE amplifier in Fig. 4-2 on top of the I-V characteristic. Use the program tranchar.vi to obtain the transfer function of the amplifier. Use the information from the above steps to find the DC voltage of the input needed to place the BJT operating point in the middle of the linear region of the transfer function. This should yield a V_{CE} not too far from VCC/2.

Use the function generator as the input source and generate the signal as follows

- Amplitude: 0.1V
- Frequency: 1 KHz
- Waveform: sinusoidal
- DC Offset: the DC bias voltage you found

Use the oscilloscope to view the input and output waveforms. Record the small-signal (AC) voltage gain and the DC values of the collector voltage and the collector current. Increase the amplitude of the function generator until you see the output clipped at the

top and bottom of the sine wave. Then use the XY display mode of the oscilloscope, and set the input signal to Channel 1 and the output signal to Channel 2. What you will see here is the transfer function of the CE amplifier. Use the cursors to measure the maximum as well as the minimum output voltages.