Lab 2: BJTs - DC operating point

Introduction

"If you measure something "funny", record the amount of "funny".
-Bob Pease

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Rapid Prototyping Using *Ugly Construction*

We will build our circuits using a method called *ugly construction* or sometimes *dead-bug* construction. In this method, circuits are built directly on the top of an unetched copper clad board (also called a "PCB"). The copper surface serves as both circuit ground and mechanical mounting point for the components. Parts without ground connections are supported by other parts that do.

There are many advantages to building circuits this way. More importantly, for our experiments the solid copper ground-plane provides a nearly perfect low-impedance ground. The copper plane has so little resistance or inductance that circuits built with care will work to 1 Ghz and beyond. Commonly, ugly prototype circuits outperform those on a finished printed circuit board due to the lack of parasitic capacitance effected by three-dimensional wiring.

If you doubt the usefulness of this technique, refer to the excellent application note AN-47 written by the late Jim Williams of Linear Technology. Appendix F of that application note gives many excellent examples of prototyping high speed analog circuits. This is probably one of the finest application notes ever written about building high-speed analog/digital prototypes.

Lab procedure

1. Draw the schematic of a sample BJT common emitter amplifier shown below in your lab notebook.

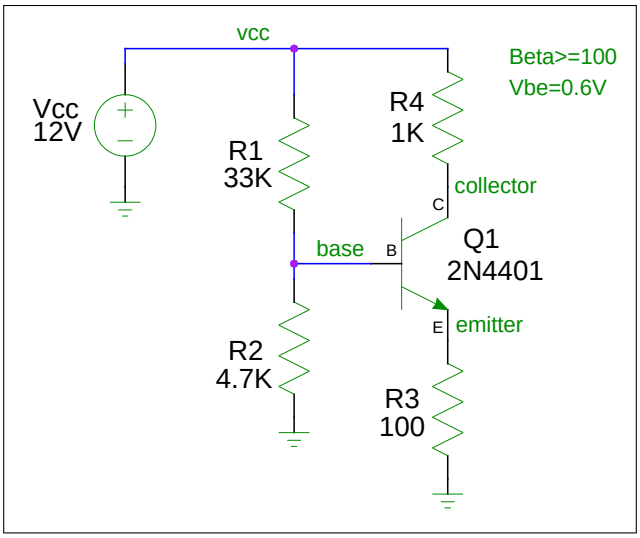

Figure 1: Schematic Diagram for Lab 2

2. Analyze the circuit using the techniques and assumptions we talked about in class. Show all your calculations in your lab notebook. Record what you found for Vc, Ve, Vb, Ic, and Ie. In addition, what is the power dissipation of Q1?

3. Download the spice model file: 2n4401.mod to a working area for lab2. Then create the spice file to simulate the circuit of Fig 1 and record it in your lab notebook. Refer to earlier ngspice files as how to proceed. Run the simulation and comment on how your hand-calculated values differ from ngspice.

4. Build Figure 1's BJT amplifier "dead-bug" style using the techniques shown in class and lab. Measure the voltages and currents in the circuit and record in your lab notebook.

5. Make a statement in your notebook summarizing how the different implementations of the circuit differed with respect to voltage and current measurements.

Your lab notebook should have the following:

- A complete schematic of the amplifier design including node names used for spice
- The analysis of the circuit given. This must be neat, orderly and easy to follow
- The spice file that you used to simulate the circuit
- Voltages at base, emitter, and collector and Ic, Ie and power dissipation of Q1
- Voltages at base, emitter, and collector as well as Ic and Ie as seen on the hand-built prototype
- A statement of how the different implementations differed in measured voltages and currents