Homework #7

Digital Electronics — Dr. Pogo

Assignment is due on Thursday, May 1, 2008 — Assigned April 24, 2008

For all problems, assume that the digital circuit can provide a maximum current of 0.4 mA.

1. See Figure 1. The transistor has b = 75, and the diode between the base and the emitter has a forward voltage of 0.6V. What is the minimum resistance R needed in this circuit? With this resistance, what is the minimum resistance motor that this circuit can operate? If the resistor is actually 20 kΩ instead, what is the minimum resistance motor that this circuit can operate?

2. See Figure 1. The transistor has b = 150, and V_{BE} = 0.6V. The resistor is 15 kΩ. The motor has R_{motor} = 40 Ω. When the digital circuit is high, what is the voltage difference across the motor? Hint: it is not enough!

3. See Figure 2. The transistors are b_1 = 80, V_{BE1} = 0.6V, and b_2 = 90, V_{BE2} = 0.7V. What is the minimum required resistance R? With this resistance, what is the minimum R_{motor}? If the resistor is actually 20 kΩ instead, what is the minimum R_{motor}?

4. An analog signal having a voltage ranging from 2V to 5V is processed by an ADC. The input is sampled at 2 kHz, and the output is a 12 bit digital signal
   a. What is the output (expressed in base 10) if the input is 2.5V?
   b. What is the output (expressed in base 10) if the input is 3.5V?
   c. What is the maximum input frequency if aliasing is to be prevented?
   d. What is the output frequency if the input frequency is 2.4 kHz?

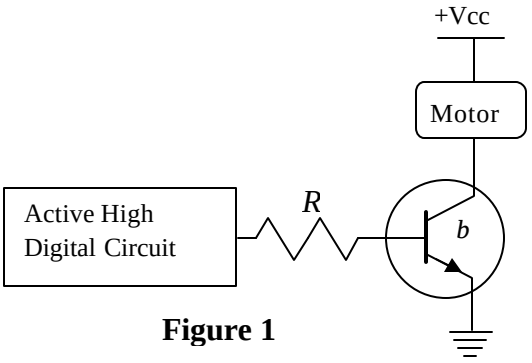

Figure 1

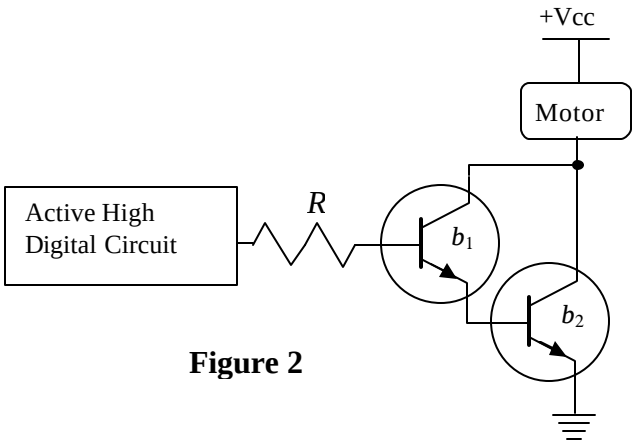

Figure 2